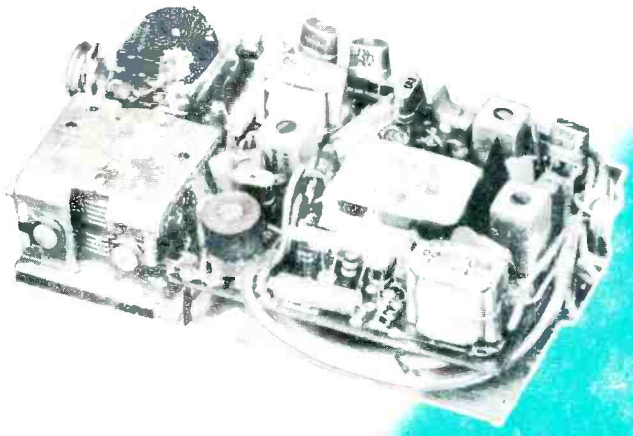
MARCH · 1957
25 CENTS

PF REPORTER

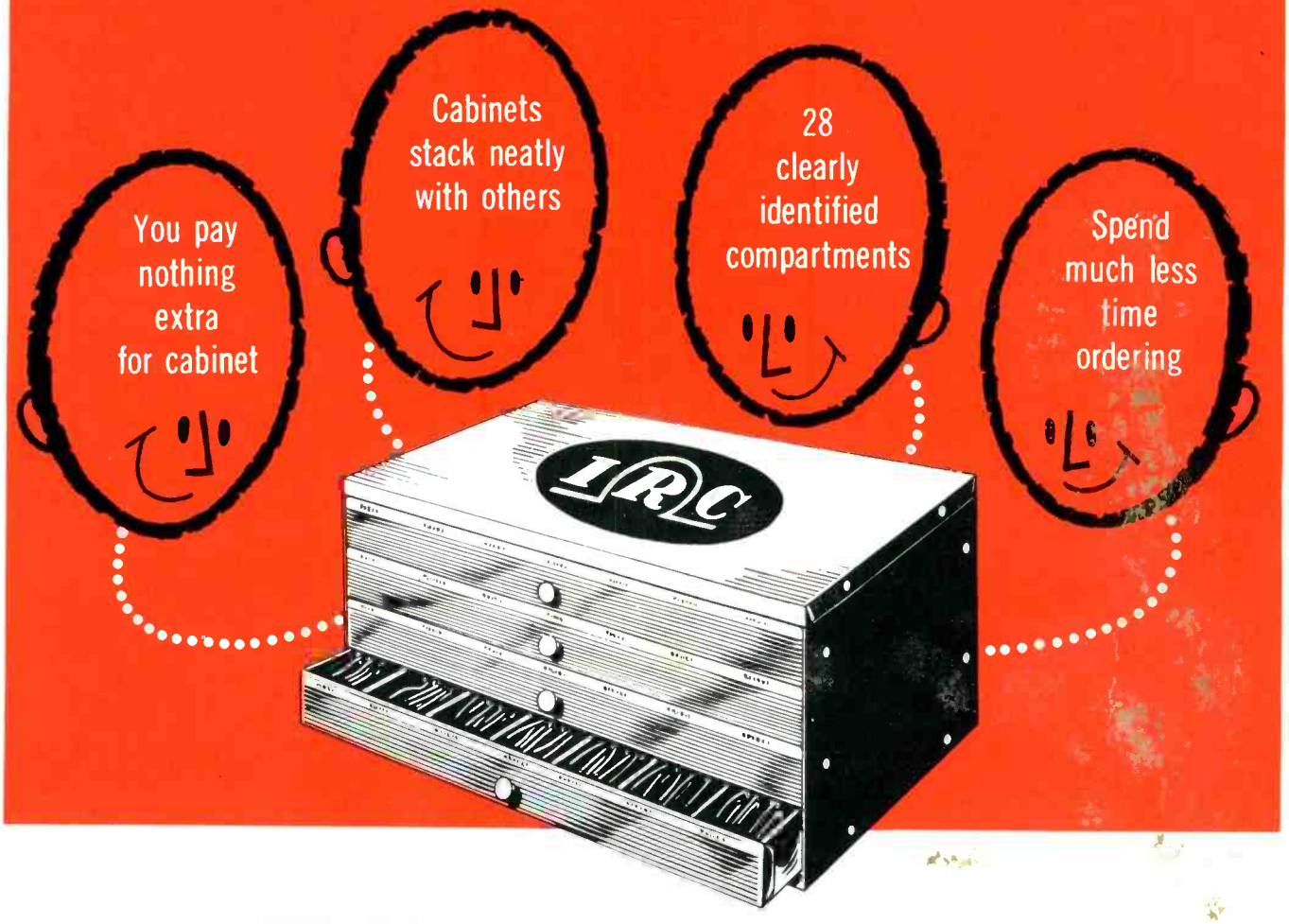
PHOTOFACT

FOR THE ELECTRONIC SERVICE INDUSTRY



This Month's Highlights

SAVE MANY WAYS



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Four "Savingest" Assortments

IRC Resist-O-Cabinets come complete with a colorful all-metal cabinet and any one of four resistor assortments. All resistors are guaranteed fresh and packed in the cabinet at the factory. Cabinets are yours at no extra charge. They have 4 "non-spill" drawers with 28 clearly identified compartments. Design permits neat stacking.

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Wherever the Circuit Says — IRC

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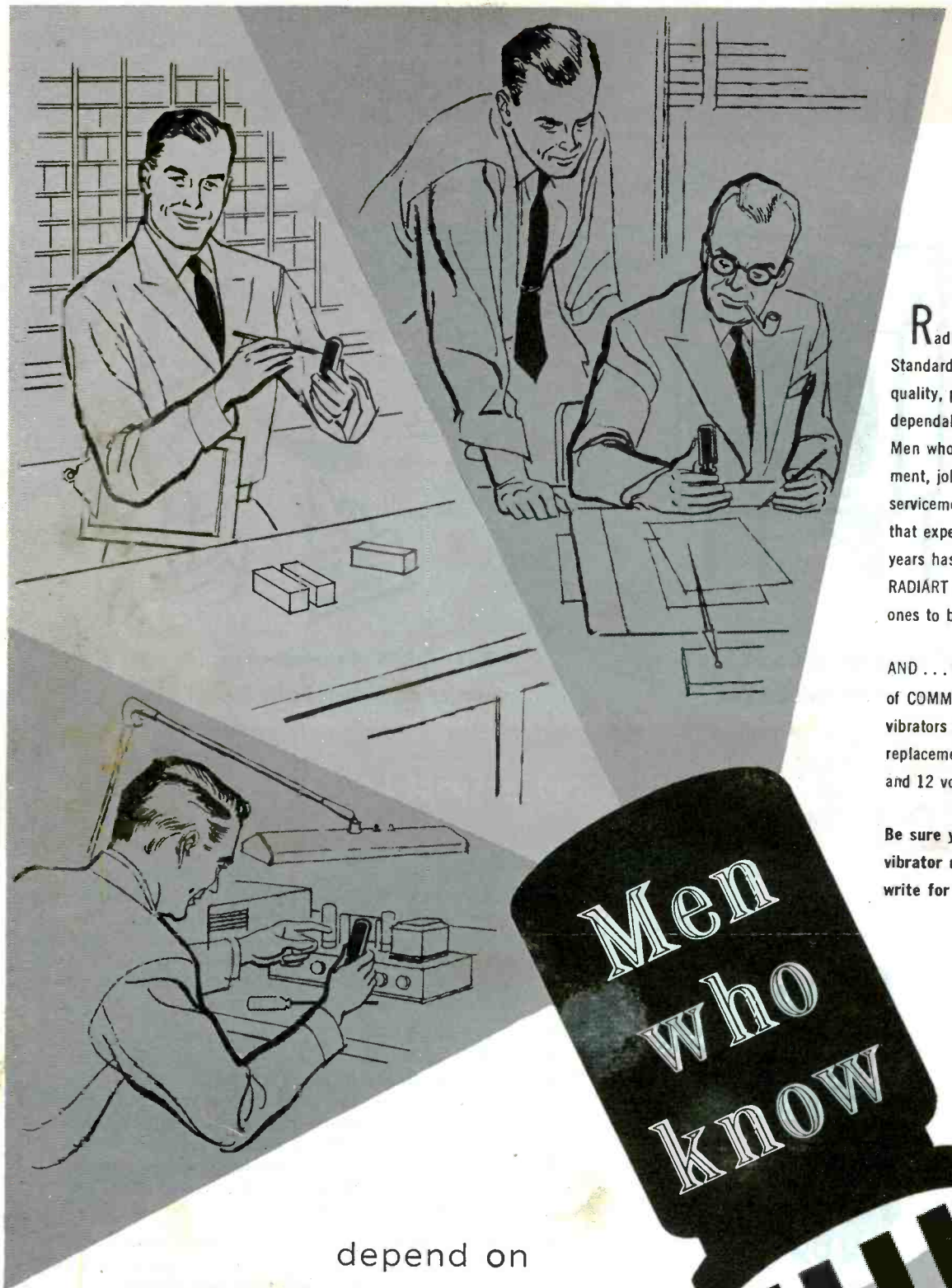

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NEXT MONTH

CURING TURNTABLE RUMBLE

A practical servicing article giving most of the probable causes and the best cures for this common source of customer dissatisfaction.

KNOW YOUR VTVM

Facts you should know about your vacuum-tube voltmeter — its operation, capabilities, and limitations.

WAFER-SWITCH CIRCUITS

Helpful advice for those who are sometimes puzzled by the complex switch circuits found in many test instruments, communications receivers and TV sets.

HERE'S A NEW COLOR RECEIVER

A description of the Westinghouse 22" 1957 color set with its new design, rectangular color picture tube and other distinctive features.

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PF REPORTER

FOR THE ELECTRONIC SERVICE INDUSTRY

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SUBJECT INDEX

USE HANDY CARD AT BACK TO ENTER YOUR SUBSCRIPTION

Here's your first line of defense against one of TV's biggest service problems

Sylvania Deflection Tubes

—upgraded and triple-tested for dependable performance in TV's hardest working deflection systems

Notice how much more rugged the Sylvania wafer stem mount looks (left). That's because the wafer stem results in shorter construction with more points of support and heavier, sturdier leads.

If you haven't yet tried these new Sylvania deflection tubes—you're in for a pleasant and profitable surprise.

They've been carefully redesigned and thoroughly tested to meet the challenge of hard-working deflection systems, tightly engineered circuits and the "runaway" conditions which often result when components age and change in value.

Sylvania's wafer stem construction minimizes the effects of electrolysis resulting from gases driven off by high tube operating conditions. The wafer stem provides wider spacing between leads and permits the use of heavier lead wires.

The wafer stem adds mechanical ruggedness to these tubes by providing three-point support and reduces internal arcing by increasing the spacing between the plate pigtail lead and the tube mount.

These improvements were made as the result of thorough testing and experimentation to determine points of breakdown in earlier types. Now, these tests serve as important quality control measures for the production of these new deflection types.

SYLVANIA

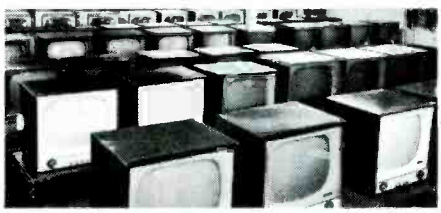
SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
Shell Tower Building, Montreal

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

Test No. 1—Static Life Test

The static life test operates the tube under dc circuit conditions near maximum plate and screen dissipations and dc cathode current. Characteristics are controlled for maximum and minimum values and is considered at the end of its life when characteristics drop below or rise above specified limits.

Test No. 2—TV Life Test



Sylvania deflection tubes are testing in stock models of representative TV manufacturers. Tests are conducted at accelerated line voltages so that tubes are operated at a considerably high level. These accelerated conditions of 130-volt line increase failure rate 2.37 times to provide important design and production information which results in better quality and dependability for you.

Test No. 3—Dynamic Life Test

These dynamic life test racks enable Sylvania to approximate TV set operating conditions which can be controlled. Thus, an operating standard is established against which all deflection tubes can be tested.

Look for and specify Sylvania's new deflection tubes in the new carton.

OPEN LETTER TO THE SERVICING INDUSTRY

Statement of RCA Policy

January 2, 1957

The radio-television-electronics industry has just completed its greatest year in history.

In 1956, the industry contributed more than $11 billion to the national economy and now, after only ten short years, it has achieved fifth place in American manufacturing.

Servicing, a primary factor in customer satisfaction, has been one of the major elements in this phenomenal growth. In fact, the electronics industry has reached its present high level largely because of the outstanding performance of the servicing profession. Reflecting the importance of its contribution, the servicing profession last year achieved a $2.8 billion volume—one quarter of the entire electronics industry's gross income.

The rapid expansion of the electronics industry has been characterized, like other fast-growing industries, by many new developments and changing conditions. Some of these activities have created a feeling of uncertainty and confusion in some segments of the servicing profession.

As a timely contribution toward clearing up this uncertainty and confusion, RCA's fundamental policies with regard to servicing are herewith reaffirmed and amplified:

1. RCA believes that full customer satisfaction depends on a vigorous and healthy independent service industry and, therefore, RCA will continue to make available to the servicing profession the information and knowledge it acquires in its own operations.

2. RCA believes in the free competitive system in the operation of its factory service business. In this, independent service organizations must have equal opportunity to compete with RCA factory service for consumer service arrangements on RCA Victor television sets. It is our further belief that in any plan under which the original price of the television receiver includes service through the warranty period, dealers must have full freedom to provide their own service or provide the service through independent service organizations or RCA factory service. In the exercise of this choice the dealer must not be restricted to "captive service."

3. RCA believes in, and plans to continue, its service organization's program for procuring replacement parts and other material on a basis that is fair and competitive with the independent service dealers.

4. RCA believes that good customer service requires broad distribution of replacement parts. It will continue its long established policy of making all repair and replacement parts available to the service industry through all of its distributors.

5. RCA believes in supporting every forward-looking industry-wide program aimed at increasing the respect of the consuming public for this vital arm of the American distribution system. RCA will continue to recognize the independent service industry in its advertising program and printed literature.

Historically, RCA has operated on a basis of cooperation with the independent service profession. When we pioneered television immediately after World War II, we not only developed our own servicing facilities, but also encouraged the growth of the entire servicing profession by inaugurating a program of education and training for independents.

Virtually everything that we learned, and our technical "know how," were made available to servicemen throughout the country. This information was given without charge to 175,000 servicemen through 3,500 seminars and training sessions in 247 cities. Since the introduction of color television, RCA has conducted 2,000 color clinics in more than 150 cities for more than 100,000 service technicians. In addition, our knowledge and experience on color television servicing have been made available to thousands of other servicemen through seminars, lectures, demonstrations and printed material.

This program of cooperation has contributed immeasurably to the tremendous growth of the entire servicing profession.

Today, independent servicemen handle the great bulk of the electronics industry's servicing requirements. For example, more than 90 per cent of all RCA Victor television sets are maintained by independent service technicians, with less than 10 per cent being handled by the RCA Service Company.

We believe that the importance of the RCA Service policy lies in the contributions it makes to the entire servicing industry. It has helped sell the public on the need to buy good service. It has helped raise standards throughout the industry to their present high level.

Cooperation and mutual understanding of the problems common to the manufacturer, distributor, dealer and serviceman are essential. This is the basis upon which we all can continue to win and merit the public acceptance that is so vital to our success.

Frank M. Folsom, *President*

RADIO CORPORATION OF AMERICA

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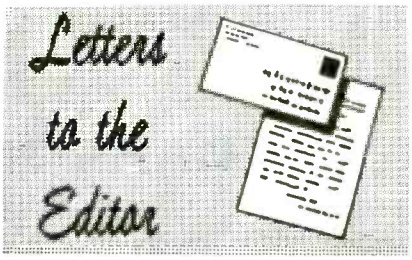


Dear Editor:

Just a note to tell you I enjoyed the article on silicon rectifiers in the January issue. I hope this will be followed soon by an article giving specific data on other units that will undoubtedly be put on the market by other manufacturers.

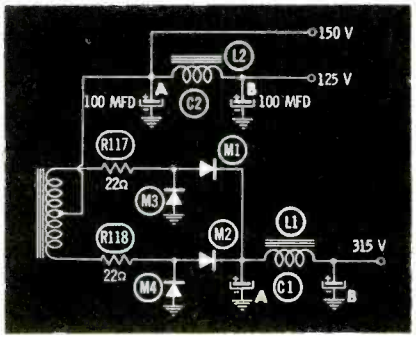
Can you tell me what determines the voltage rating of the silicon rectifier? In my Radio Craftsmen set, I must use rectifiers rated at 160-180 volts. In a selenium rectifier, this additional rating could be obtained by adding a couple or more plates to the stack. Would one of the Sarkes Tarzian units work in this service? I understand that the size of the heat sink determines to a great degree the current rating, but I wonder what determines the voltage rating.

JOHN T. FRYE

Logansport, Indiana

The voltage ratings (both input and inverse) of a silicon rectifier are determined largely by the resistivity of the silicon—an intrinsic property established during the formation of the ingot. Physical characteristics of the junction also affect the ratings.

For Reader Frye's Radio Craftsmen receiver, which uses the full-wave bridge circuit shown below, the input



voltage from either side of the secondary is in the neighborhood of 160v RMS. Since the ratings of the Sarkes Tarzian M500 units are 130v input and 400v inverse (particularly adaptable for 100-120v line operation), two such units in series would be required in place of each selenium stack. This is comparable to using more plates in a selenium stack.

The "M" type series of silicon rectifiers also includes three other units, which are lower-rated and adaptable to circuits requiring less power.—Editor

Dear Editor:

I have been reading with interest recent comments on TV service charges.

I operate a furniture and appliance store and charge $6.00 plus parts for house calls, but dozens in this area only charge $3.00 or $4.00. Of course, they must do sloppy work or put in unnecessary parts to make up the difference.

Our biggest problem is competition from other dealers' employees doing repair work on their own time. Not only are they cutting their own employers' throats, but ours as well. Our TV man must sign an agreement not to do any repair work except for us.

We pay our man well and keep him supplied with plenty of work. We feel other employers should follow suit and insist on employees not doing outside work.

A. C. PFEIL
Lake City Furniture & Appliances
Lake City, Pa.

Dear Editor:

I suggest you start an up-to-date directory of TV and radio companies which have sold out, changed hands, etc.

BJORKQUIST RADIO & TV SERVICE
Des Plaines, Ill.

Here is a list of manufacturers who have recently suspended TV production:

Arvin	*Crosley*
Bendix	*Raytheon*
Capehart	*Stewart-Warner*
CBS-Columbia	*Stromberg-Carlson*

These firms, however, are still in business and are manufacturing other types of electronic equipment. In addition to the list, Sentinel and Sparton sets are no longer made by the original manufacturers. The TV factories of these two companies have been bought by Magnavox.—Editor

CORRECTION NOTE

On page 28 of the January issue, the waveform in Fig. 2 of the article "Color Killer Circuit" was printed upside-down. The correct illustration is shown below.

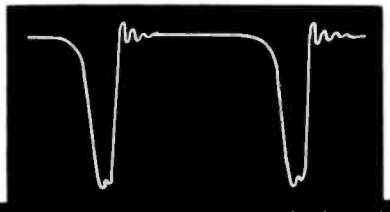


Fig. 2. Negative pulse applied to the grid of the color killer.

Is a Degree Essential for an Electronic Engineering Career?

"Student" Fred Gunther in the IBM school

Fred Gunther has no degree. Yet, today, at IBM, Fred is a Computer Systems Engineer on America's biggest electronics project. His story is significant to every technician who feels that lack of formal training is blocking his road to the top.

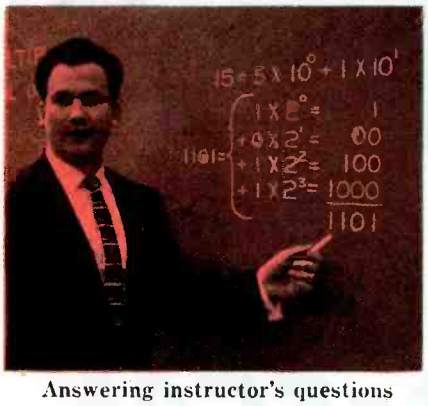
Let's go back to 1950 and watch Fred Gunther, at 18, as he goes about the business of determining his life's work. Fred spent almost a year interviewing with prospective employers. Then, perhaps due to the fact that his high school background didn't prepare him for work in an area of his interest, he entered the Navy for a four-year hitch.

Fred learned something very valuable in the Service, as have many other men who eventually discover the electronics field. His aptitude tests revealed him as an excellent electronics prospect, and he received ten months' training in electronics fundamentals and radar. Upon his discharge in 1955, he was an Electronics Technician, First Class.

Something even more important to Fred's career occurred during his Service hitch. He began to hear such terms as "automation" . . . "data processing" . . . "electronic computer." "Then, one evening, while glancing through the paper," he recalls, "I spotted a story about *Project SAGE.*"

What is Project SAGE?

SAGE means Semi-Automatic Ground Environment. It is America's giant radar system—a chain of defense that will ultimately ring our country's entire perimeter. Heart of this system is the electronic computer, which digests data filtered in from Texas towers, picket ships, reconnaissance planes, ground observers. The computers analyze this information for action by the Strategic Air Command and other defense units. These computers are the largest in the world. Each contains perhaps a million parts—occupies an entire city block. They are built for the Project by IBM.



Answering instructor's questions


at the operating console of the computer

Home to the family, Pemberton, N. J.

Fred joins IBM

SAGE fascinated Fred, for it embodies the most advanced electronic concepts. And when he learned that IBM would train him for six months, at full salary, plus a living allowance, to become a Computer *Units* Field Engineer, he seized the opportunity. Fred started his new electronics career in the IBM school, with twenty other technicians. He attended classes 8 hours a day. Courses consisted of some 20 subjects—computer circuitry and units, maintenance techniques — everything he would need to become a full-fledged Computer *Units* Field Engineer.

Assigned to McGuire AFB

His six months' training completed, Fred was assigned in May, 1956, to McGuire Field, where the first of the giant SAGE computers is located. Here he assisted in the cable installation for this vastly complicated electronic giant. He helped to set up the computer, interconnect its many sections, check it out and make it ready for operation. Fred spent five months at McGuire, but his education was not yet completed.

Becoming a Computer *Systems* Engineer

"I like to think it was due to my interest and grade of work," Fred says, "but at any rate, last November I was invited to return to Kingston for further training—to become, in fact, a Computer *Systems* Engineer. Naturally, I was proud and pleased, for this training would give me a much greater range of understanding . . . make me more valuable to the company and myself . . . and give me a chance to assume actual engineering responsibility." Fred is once more putting in a full 8-hour training day—both classroom and lab. By the time you read this message, he will have completed his new education and be ready for assignment as a Computer *Systems* Engineer to an area of his choice.

What does the future hold?

"First off, I'll probably go back to McGuire," Fred says. "My home is nearby and there's still a vast amount of work to be done at this computer site. The future? It's hard to even set a goal in a field as rapidly moving as this, but with my IBM training back of me, the future sure looks good. I've advanced from radar technician to Computer *Systems* Engineer *in sixteen months*—and received a valuable electronics education besides!"

How about YOU?

Since Fred Gunther joined IBM Military Products and the Project SAGE program, opportunities are more promising than ever. This long-range program is destined for increasing national importance, and IBM will invest thousands of dollars in the right men to insure its success.

If you have 2 years' technical schooling — or equivalent experience—IBM will train you for 6 months as a *Computer Units Field Engineer.*

If IBM considers your experience equivalent to an E.E., M.E., or Physics degree, you'll receive 8 months' training as a *Computer Systems Engineer.*

After training, you will be assigned to an area of your choice within the United States. You receive *salary,* not wages, plus overtime pay. In addition, every channel of advancement in the entire company is open, and IBM is a leader in a field that is sky-rocketing in growth. And, of course, you receive the famous IBM company-paid benefits that set standards for industry.

WHY NOT WRITE — today — to Nelson O. Heyer, Room 9603 IBM Corp., Kingston, N. Y.? You'll receive a prompt reply. Personal interviews arranged in all areas of the United States if your resume of experience and education indicates you have the qualifications.

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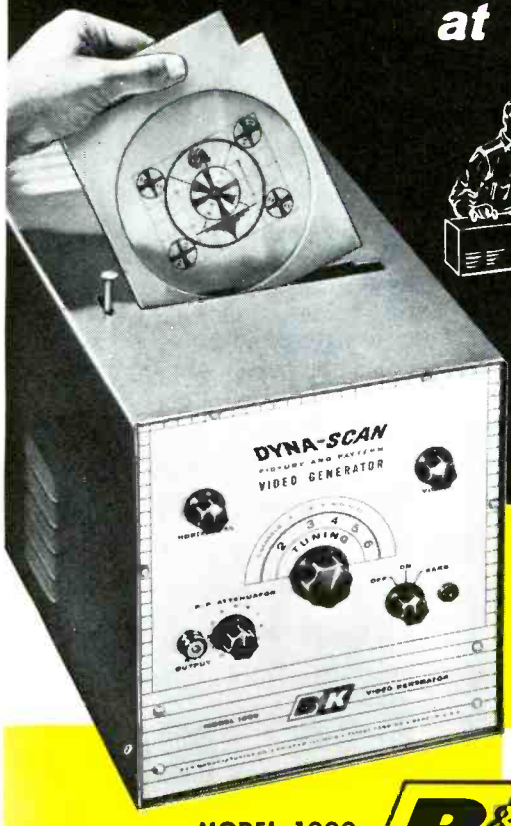

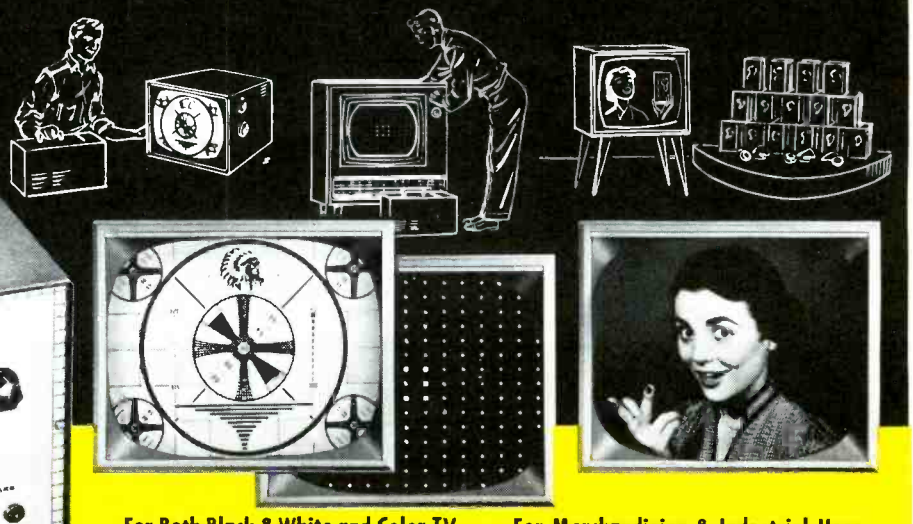

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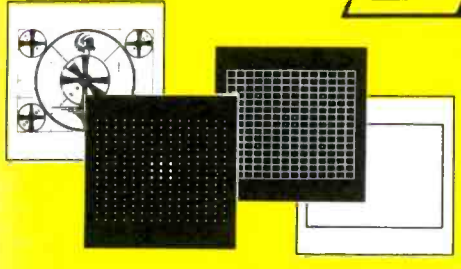

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Make the most of this *Complete Flying Spot Scanner.* It produces a composite video and sync signal that operates any standard black & white or color TV receiver. Can be used with one or more TV sets or fed into a master antenna system or community antenna system. Maximum resolution capability is well in excess of 450 lines; band width in excess of 5 mc. Projects and reproduces pattern or picture with high definition from any slide transparency. Transmits messages typed or written on clear acetate. Makes convenient stand-by and break-in for community distribution operation. Rugged, compact, portable, and ready to operate. **NET $199.95**

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Shop Talk

MILTON S. KIVER

Author of . . .
How to Understand and Use TV Test Instruments
and Analyzing and Tracing TV Circuits

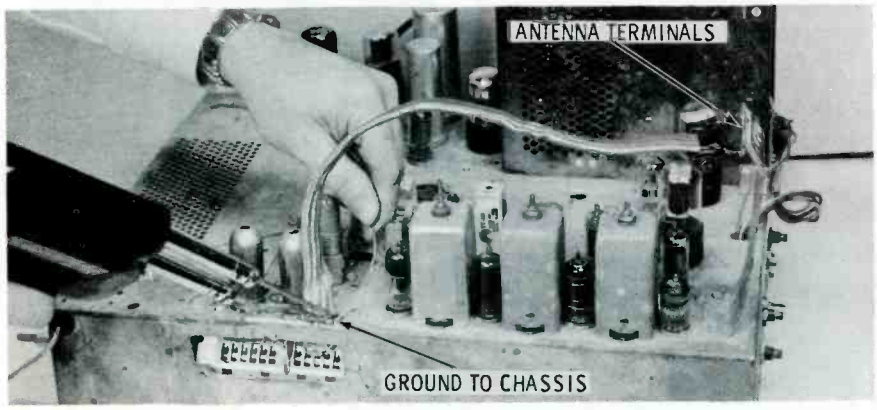


Fig. 1. Shielding the 300-ohm line from antenna terminals to tuner input.

Servicing Master Antenna Systems

The servicing of master antenna systems after they have been installed and have functioned satisfactorily for a period of time can logically be divided into two sections. Part of the servicing is performed at the building where the system is installed; the rest is usually best carried out in the service shop.

When trouble develops in a system, the first job for the serviceman is to pin-point its location. The next step is either to perform the repair right there, if this is possible or feasible, or to replace the defective section with a similar unit. The defective section is then brought back to the shop where the necessary repair can be effected.

Test Equipment

It was stated in previous columns that the two major service instruments for master antenna systems are a field strength meter and a VTVM. The VTVM need not be special in any respect although it will frequently be more convenient to use a battery-powered unit than one that requires external AC power. However, either one is suitable since master systems are themselves AC powered and outlets are usually readily available.

The field strength meter, on the other hand, is a precision instrument which should be capable of indicating signal strength in actual (not relative) microvolts because you must know exactly what the signal value is at each point. The field strength meter should also contain a phone output jack and a video output jack. The phone jack is useful in identifying various signals as possible sources of interference, such as FM or AM stations, aeronautical or amateur signals or industrial electronic equipment. The video jack permits the connection of an oscilloscope for the observation of the composite video signal. This is useful in determining if the sync pulses are being distorted due to improper bandpass characteristics in the master amplifier or in any of the other electronic equipment in the distribution system.

Tracing a Trouble

Trouble in a system can occur almost anywhere; it need not be confined only to the electronic amplifiers and distribution networks. For example, a loose wire at any of the antennas (if there is more than one) will cause flashing on one or more channels. This will be true of all the receivers in the system. By the same token, a loose connection at any coaxial tie-in point will also produce the same effect, although perhaps not throughout the entire system.

As an illustration, suppose a set owner complains that his picture is flashing. Your first task, on arriving at his set, is to verify the complaint. Next, note whether this is occurring on all channels or only on one. If only one station is affected, it is unlikely that the riser from the distribution point is at fault (from a loose, poor or dirty connection) because then all channels would be affected.

The next suggested step would be to go to the master amplifier and check the input and output of the strip concerned with the affected channel. If the input signal is steady but the output signal fluctuates in intensity, then the defect lies in the strip. Either tube substitution or strip replacement would be a step toward a solution in this case. On the other hand, if the input signal shows the same signal variations, follow the transmission line to the antenna.

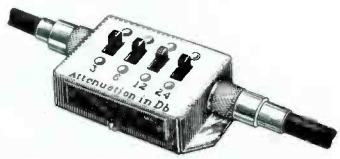


Fig. 2. Attenuator pad capable of providing uniform signal loss from 0-45 db in 3-db steps.

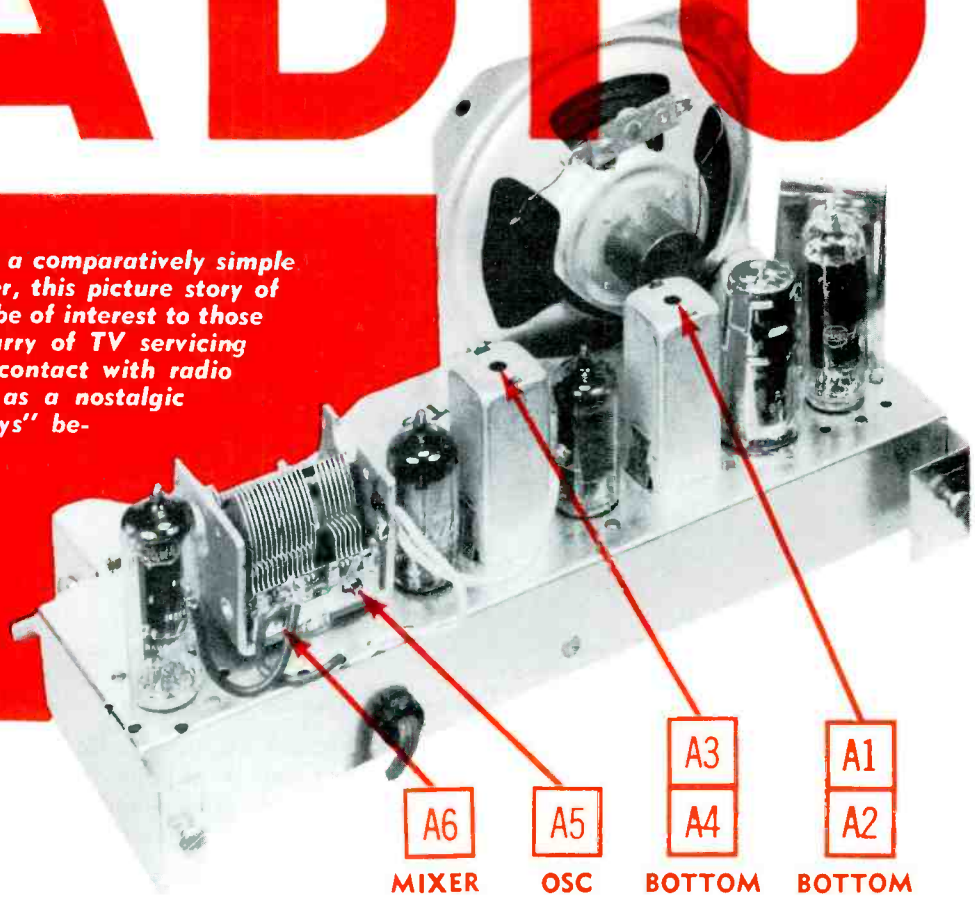
Note that the narrowing down of the defect location follows a straight, logical path that leads from the receiver to the point where the trouble originates.

Consider the same situation of picture flashing, only assume that all channels are affected at the receiver. Your first step would *not* be to go to the central distribution point but to follow the coaxial lead-in from the receiver. To start, disconnect any receivers which may be operating from the same riser, but below it. This is

Please turn to page 64

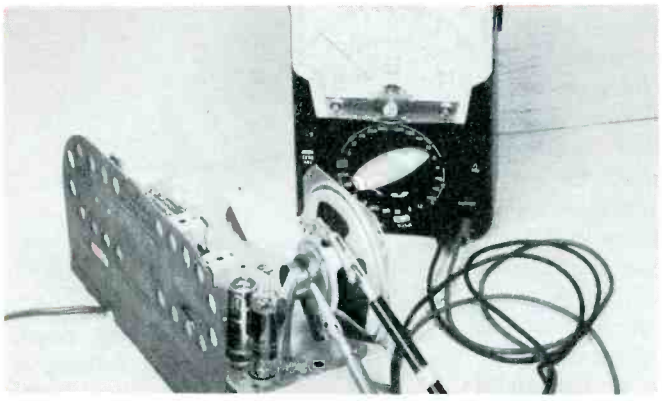
RADIO FOR THE TV MAN

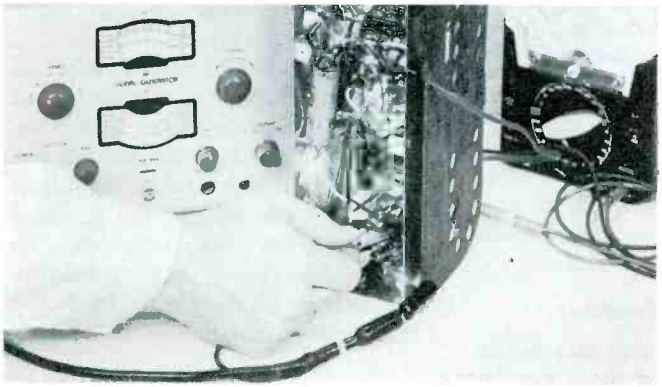
Even though an AM radio is a comparatively simple unit compared to a TV receiver, this picture story of a typical radio alignment may be of interest to those of our readers who, in the flurry of TV servicing these recent years, have lost contact with radio work. To many, it will serve as a nostalgic reminder of "the good old days" before TV, and to our younger readers it should provide much basic, useful information—particularly in view of the increasing numbers of radios being purchased by consumers.



ALIGNMENT POINTS

On this chassis photograph of a five-tube AC-DC superheterodyne radio, the alignment points are numbered in the order in which they should be adjusted for best results.





METER CONNECTION

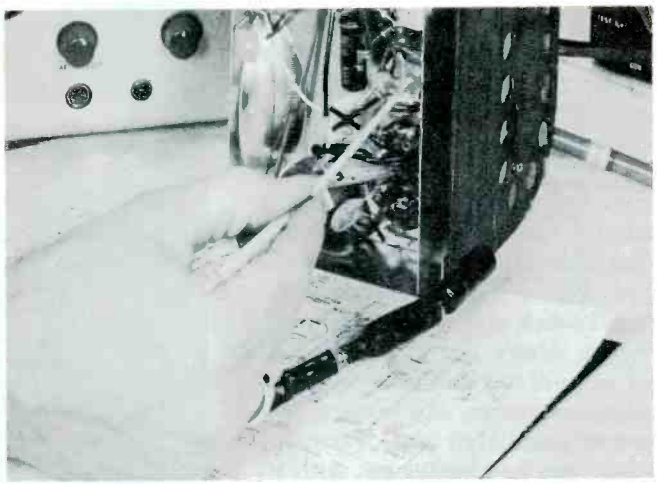
Disconnect one side of the secondary of the output transformer from the voice coil, and connect the leads of the meter (low range AC) across the secondary of the output transformer. The meter will act as a sensitive indicator, and at the same time disturbing sound from the speaker will be eliminated.

SIGNAL GENERATOR CONNECTION

Couple a 455-kc signal to the external connection on the loop antenna, using a .05-mfd capacitor in series with the signal-generator lead, and connect the ground lead of the generator to B—. (If no external connection is provided, connect the signal to the grid, generally pin 7, of the converter tube.) Plug the radio into an isolation transformer—for safety—and turn it on.

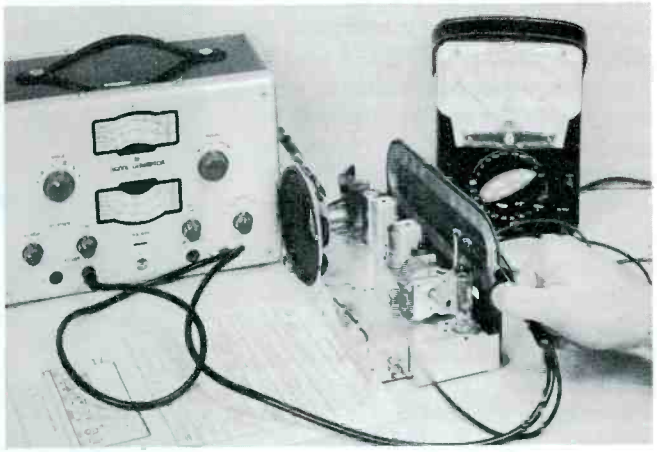
IF ADJUSTMENTS

After the receiver has warmed up for about 10 minutes, adjust the two IF transformers (four slugs). Start with A1 and proceed in order through A4, adjusting each to produce the highest reading on the meter. Maintain the generator output at the lowest possible level which still provides an indication on the meter.



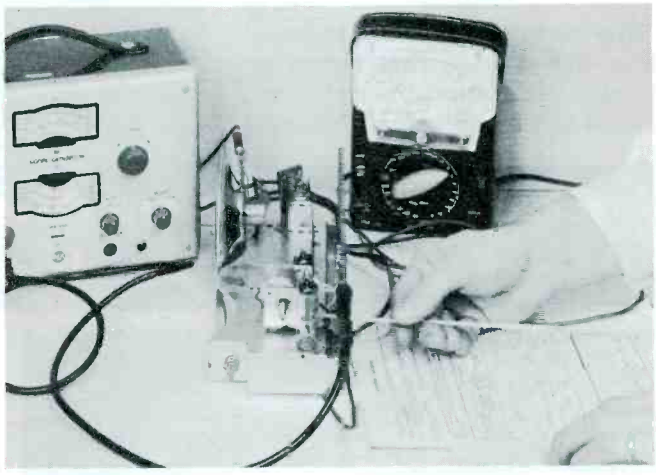
SIGNAL COUPLING

Loosely couple a 1640-kc signal to the loop antenna by clipping the signal lead to the loop and the ground lead to B—. If a direct connection is impossible or undesired, the signal may be coupled to the antenna by fashioning a coil about 6" in diameter consisting of 3 or 4 turns of wire. Connecting the signal generator to the ends of the coil will produce radiations which will be picked up by the loop of the receiver.



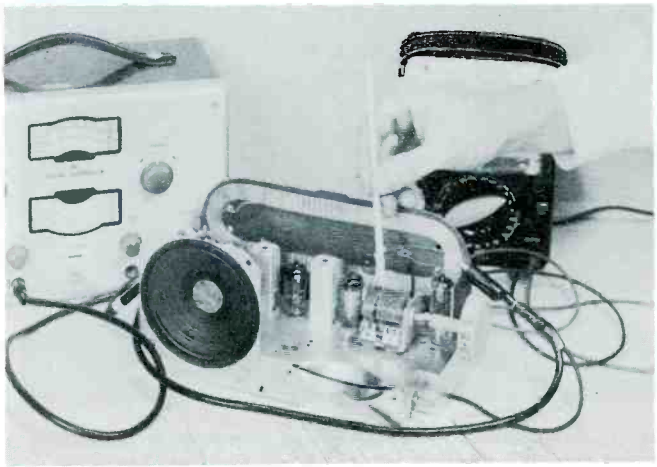
RF ADJUSTMENTS

With the tuning gang fully open, adjust the oscillator trimmer (A5) to produce a maximum reading on the meter. Turn the tuning gang and the signal generator to 1400 kc and adjust the mixer trimmer (A6) to produce a maximum reading on the meter.

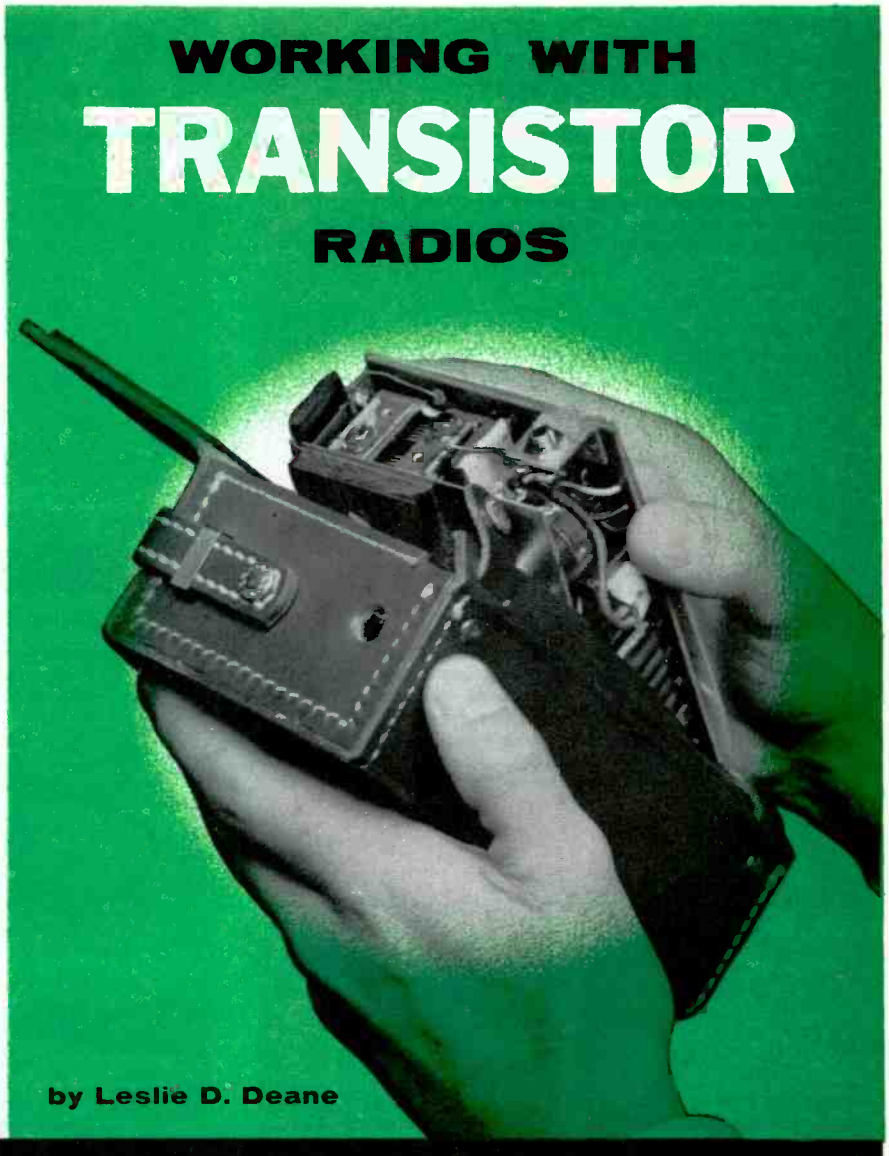


TRACKING ADJUSTMENTS

With the tuning gang fully closed, tune the signal generator through 550 kc to produce the highest reading on the meter. If the generator dial reads higher than 550 kc, bend the slotted plate on the oscillator section (smallest one) slightly inward to increase capacity and lower the oscillator frequency. Bend the tab on the end of the plate which meshes with the stator (stationary) plates last. If the dial reads lower than 550 kc, do just the opposite—bend the plate outward to reduce the capacity and increase the frequency. Some receivers employ a tunable oscillator transformer which can be used for low-end tracking. Adjust the oscillator transformer at 550 kc and the trimmer at 1640 kc in this case.



WORKING WITH TRANSISTOR RADIOS



by Leslie D. Deane

Equipment Needed and Preliminary Service Instruction

The average service shop is usually well equipped to handle any and all repairs involving conventional radio and television receivers. These same shops, however, may soon find themselves somewhat unprepared when a customer comes walking in with a portable transistor radio in his hand. When he claims the radio doesn't work and wants you to fix it—just where do you begin? If you are not yet familiar with the design, operation, and service procedures associated with transistor radios, you had better get with it!

In the first place, portable transistor radios are very compact in design, as shown in Figs. 1 and 2. This feature alone is liable to give many technicians a headache. The moment the miniature chassis is removed from its case, care must be taken not to damage any of the small parts or delicate wires. You may eventually find yourself working somewhat like a watchmaker, using small tools and exercising great care when testing, probing, and replacing circuit components.

Batteries

The battery pack of a transistor radio differs from that normally found in conventional portable receivers in that only one source of

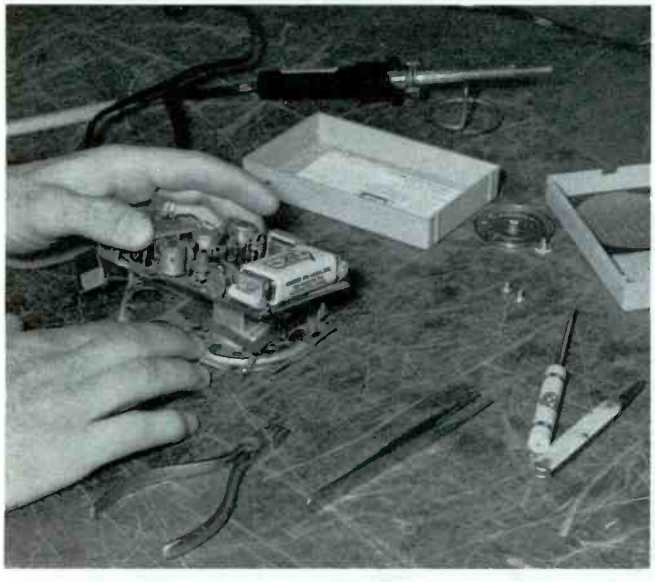


Fig. 1. Compactness of transistorized portables is illustrated by this view of a Regency Model TR-1-G with case removed.

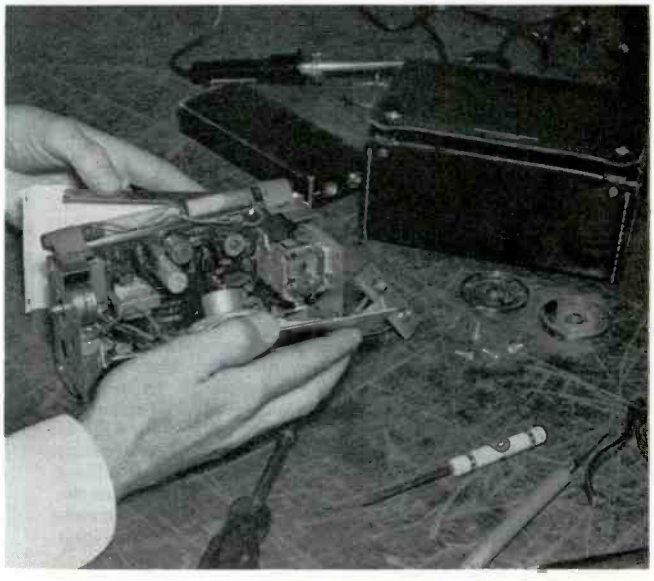


Fig. 2. Accessibility to test points on this Regency Model TR-6 is achieved by removing speaker panel and protective shield.

voltage is usually required in a transistorized unit, whereas the tube-type portable requires both an "A" and a "B" battery. The reason for this, naturally, is that transistors have no need of filament or heater voltage and the "A" supply can be eliminated. The lower operating potentials required by transistor circuits also call for a reduction in the "B" battery voltage. Instead of "B" voltage in the neighborhood of from 40 to 90 volts, the new transistor power packs range from only 6 to 22½ volts. The most popular battery used in transistor portables today seems to be the 9-volt variety.

Another difference between transistorized and conventional portable radios is that the "B" supply voltage in a transistor unit may be negative in polarity. This design feature stems from the fact that some transistors (p-n-p types) require a negative operating potential. The n-p-n units, however, require an operating voltage which is positive in polarity.

If the battery in a transistor set has its positive terminal connected to chassis ground and its negative terminal to the "B" supply line, then the set is probably using p-n-p type transistors. Although both types may be found in the same chassis, the polarity of the battery will naturally govern all meter connections when voltage measurements are taken.

Worn out batteries will unundoubtedly be the most frequent cause of trouble in transistor radios, although battery life should be considerably longer than in tube-type portables because of the lower current drain through transistors. Most of you are familiar with the zinc-carbon batteries which have long been used as a source for DC voltages; however, many of the transistor portables are using mercury units. As far as practical servicing goes, the technician need not, however, be too concerned with this factor. To make a conclusive check of a battery's condition, it will pay to try a new battery or to power the set with a battery eliminator to see if receiver performance is improved. Should a battery be completely dead, always check for a short circuit to prevent damage to the equipment. When a customer's set has several batteries connected in series or in parallel, they should all be replaced at one time.

Fig. 3. Commercial-type DC supplies for operating transistor portables.

Disassembly and Tools

The compact design of these miniature radios plays an important part in determining the proper trouble-shooting approach to use. The technician may find it necessary to disassemble certain panels and shields before performing various tests on the small chassis. For the set pictured in Fig. 1, it was necessary to remove the speaker assembly before certain test points were accessible. In another example, shown in Fig. 2, it was necessary to remove both the speaker mounting panel and the metalized shield covering the printed-wiring side of the chassis. Only by removing these items was it possible to make voltage and resistance measurements and follow a logical trouble-shooting procedure.

Until you become completely familiar with transistor radio circuits, it is suggested that a schematic diagram be used when trouble shooting. Even though the technician may be capable of distinguishing the various stages without a schematic, it is imperative that he be absolutely sure of all test points so as not to damage the delicate components involved.

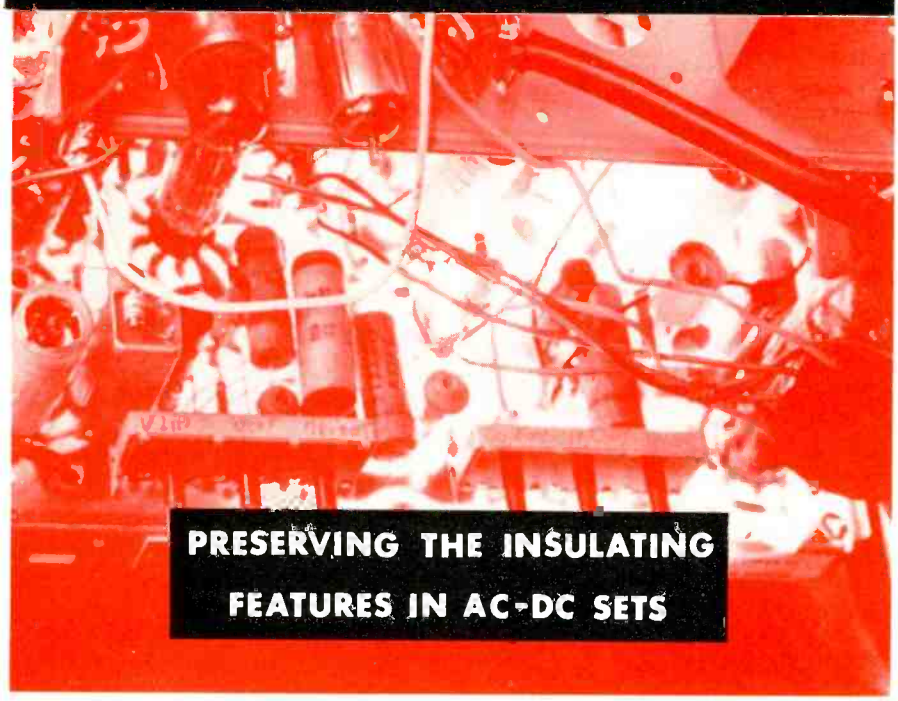
As the technician continues to service transistor radios, he will certainly find it advantageous to have the proper tools available. A low-wattage soldering iron with a small tip is one item which should definitely be on the transistor service bench. An iron of approximately 25 watts is ideal for this application and will be less likely to cause damage to circuit components. Small diagonal side-cuts, needle-nose pliers, a pair of tweezers, and a conventional soldering aid will also come in handy when servicing these miniaturized assemblies.

Bench Power Supplies

It would be costly for the service shop to stock a complete line of portable batteries suitable for testing different transistor sets; therefore, it is suggested that a variable DC power supply be used. Such an apparatus can either be built by the technician or obtained from a commercial source. A battery eliminator designed for auto-radio servicing can be used to power transistor radios if its ripple content is low enough. The instrument shown in Fig. 3A will supply adequate test voltages but, at the same time will introduce a certain amount of AC hum in the receiver. The hum or buzz, however, will not be too noticeable on strong signals. The DC power supply pictured in Fig. 3B has greater control over AC ripple than the conventional battery eliminator. Designed especially for transistor auto radios, this particular unit provides two variable DC ranges —one from 0-8 volts and the other from 0-16 volts.

A suitable power supply will enable the technician to: (1) check operation of the set without its battery, (2) test a battery by using the supply voltage as a substitute, (3) perform long operational tests without using up the life of a good battery and (4) check sensitivity and output at supply voltage levels ranging from low to normal. When applying power to the battery contacts, double-check the terminal polarities and make sure the variable supply is set for minimum output. In addition, never insert or remove circuit components while voltage is applied to the set. Surge currents may result in permanent damage to the transistors. ▲

hot chassis safeguards



PRESERVING THE INSULATING FEATURES IN AC-DC SETS

by Thomas A. Lesh

Manufacturers take various precautions to protect the customer and the service technician from being "bit" by line voltage in TV sets which have one side of the AC line connected to the chassis. Anti-shock features are provided by isolating the main chassis from exposed metal parts on the outside of the cabinet. It is up to the technician to ensure that these safeguards are not made ineffective as a result of receiver servicing.

Several methods of insulating "hot" chassis are demonstrated in the accompanying photographs. Ingenious white plastic grommets serve as anchors for the brackets or screws used to fasten the chassis to the cabinet in the majority of new AC-DC television sets. Fig. 1 includes a side view of one of these grommets. Notice that it is composed of a ring of plastic having a narrow neck which is split into two parts. In mounting the grommet, the halves of the neck are pressed together so that it can be pushed through a hole in the chassis. When released, both parts of the neck spring apart and hold the grommet loosely in place. When a screw is driven through the hole in the center of the grommet, it exerts pressure and spreads the plastic neck pieces so they fit tightly against the chassis. The cabinet or other part to be insulated rests against the plastic ring, spaced at a safe distance from the "hot" chassis. The screw is also insulated; thus, there is no risk of getting a jolt from exposed screw heads or metal trim.

The shafts of the operating controls on many AC-DC sets are not insulated because they are intended to be covered with knobs during normal operation. Although the serviceman will often handle these controls with the knobs removed, particularly when working on the bench, he is expected to use an isolation transformer under those conditions—not only to keep the chassis separate from the power line, but also to simplify the interconnection of test equipment. Controls such as those used to adjust height and vertical linearity present a different situation, however. Since these controls often must be adjusted on home service calls when it is inconvenient to use an isolation transformer, they are usually insulated from a "hot" chassis in some fashion.

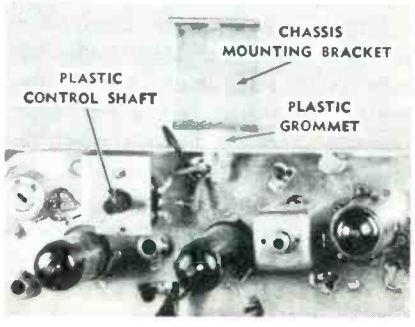


Fig. 1. Plastic grommet and control shaft in Crosley Model AT10B.

Plastic shafts are used on the service controls in many AC-DC sets. (See Fig. 1.) If a control of this type becomes defective, it should be replaced with a similar unit for the protection of technicians who might work on the set in the future. Several manufacturers of replacement controls have marketed products with insulating plastic shafts. The Centralab Type AK-19 nylon shaft is made to fit the Type AB Adashaft controls made by that company. Clarostat makes an RN-3 plastic shaft for use with Type A47 Pick-A-Shaft controls. International Resistance Co. offers a plastic shaft designated TQ which is a companion to IRC Type Q controls. P. R. Mallory has two kinds of replacement controls with fixed phenolic shafts—the Type SU (bushing-mounted) and the Type PTA (tab-mounted).

Plastic shafts are required for insulation only if the body of the control is mounted directly to a "hot" chassis. There are several ways to mount ordinary metal-shaft controls in order to isolate them from the power line. For example, they may be placed on a chassis section that is separated from the main chassis by some insulating material. One such arrangement, shown in Fig. 2, is the "cold" control panel of an Admiral portable receiver, which is fastened to the rest of the chassis by means of plastic grommets.

Another partially insulated chassis (see Fig. 3) is used in a new Westinghouse receiver. Printed wiring boards and sections of "hot" chassis are sup-

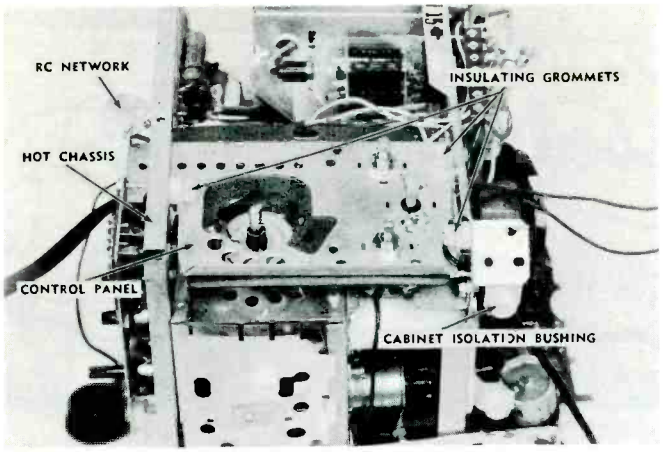


Fig. 2. Isolated metal control panel in Admiral Model TS104.

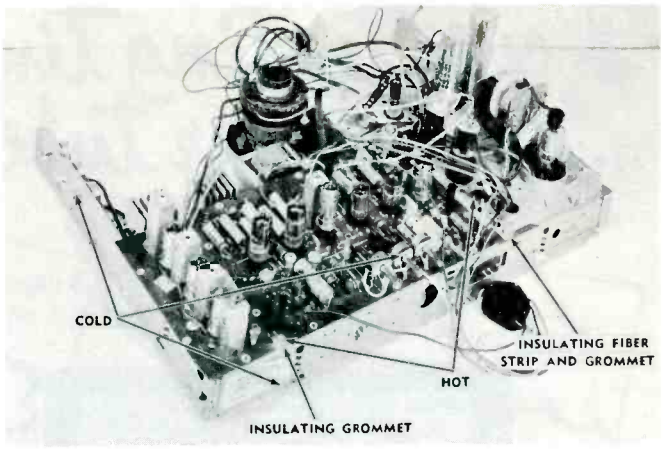


Fig. 3. Isolated control panels in Westinghouse Model H21T107.

ported on a U-shaped frame which is "cold" because all the points of support are insulated. Cabinet bolts are fastened to this "cold" section. Some of the service controls are attached to the frame, and others are mounted on the printed wiring board which also serves as insulation from the AC line.

The insulated metal sections which have just been described do not "float" electrically; instead, they are connected to the main portion of the chassis through a resistor of a few hundred thousand ohms paralleled with a capacitor. This RC network (visible in Fig. 2) maintains a safe degree of insulation while preventing the buildup of an electrostatic charge between the "hot" and isolated sections of the chassis.

Insulated control panels of another type are shown in Fig. 4. The main purpose of this type of construction is to make possible the mounting of controls in the upper front corners of the cabinet, some distance from the main chassis. Electrical insulation of the controls is actually a secondary benefit. Remote-subchassis arrangements are also used in some transformer-powered sets.

These isolated metal panels should never be used to ground the common leads of test instruments or to discharge the high-voltage supply. When high voltage is arced to an isolated subchassis instead of B—, the subchassis may become charged. Dissipation of this charge can take place only by high-resistance leakage, by breakdown of insulation, or by accidental contact between the isolated chassis and B—.

Another type of insulator used to keep line voltage away from control shafts is made of a fiber material. The shafts of tuners often contain fiber sections so that the outer tips will be insulated even though the tuner body itself is mounted to the main chassis and thus connected directly to one side of the AC line. There are

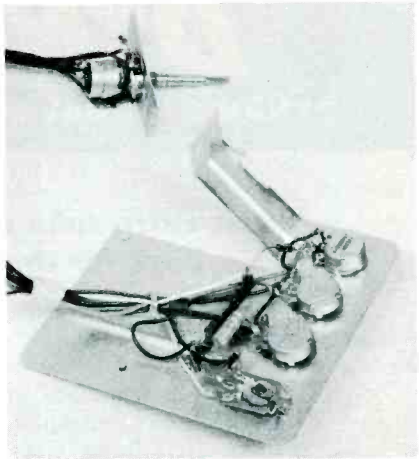
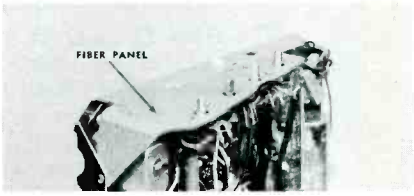
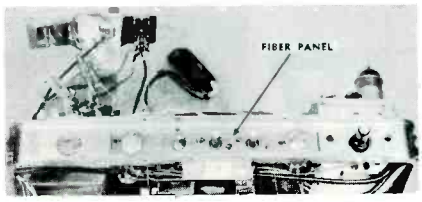


Fig. 4. Separate control subchassis in Crosley Model AT10B.



(A) In Hotpoint Model 14S201;



(B) In Magnavox Model V19-02AA.

Fig. 5. Control-mounting panels made of fiber material.

some sets in which adjacent sections of the chassis are insulated by a fiber "sandwich." Special grommets are then used to insulate the rivets or screws that hold the two sections together. This type of construction was utilized in the chassis shown in Fig. 3. Small fiber sections may also be riveted to a metal chassis to serve as control-mounting panels. Two examples of these are shown in Fig. 5. Some panels such as the one in Fig. 5A are mounted so that the insulating material can be easily recognized as such, while others (Fig. 5B) are small chassis inserts which are harder to spot at first glance.

Summary

Most AC-DC television sets use shock protection for exposed parts, but the technician who is servicing an unfamiliar receiver of this type should not take for granted that protection has been provided. After a job is done, he should be sure that insulation remains effective so that the set will not be a booby trap for an unwary customer or the next technician to service the unit. Resistance measurements between insulated sections or voltage readings between exposed metal parts and absolute ground provide effective safety checks.

Avoid replacing plastic control-shaft units with ones having uninsulated metal shafts, and check to be sure that loose items such as blobs of solder or small washers are not lodged between chassis sections where they can bridge across insulation. Customers and technicians will both live longer that way! ▲

"I cut testing time in half" ..."doubled our tube sales" *

"Adds to my income and saves me unprofitable call-backs."

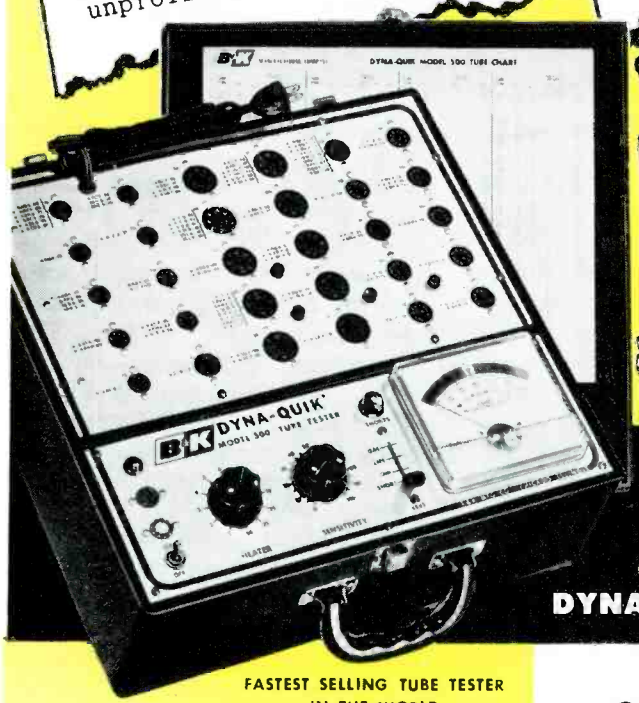
"We have two...one for the shop and one for house calls."

"Paid for itself several times. Really indispensable."

"Best tube tester I've ever owned. Simple to operate. Saves time."

"Makes lots of money for us. Wonderful instrument."

"Serves my purpose best for speed and dependability."



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REMOTE TUNING WITHOUT WIRES

A Close Look at Motorola and Zenith Remote Controls

by Thomas A. Lesh

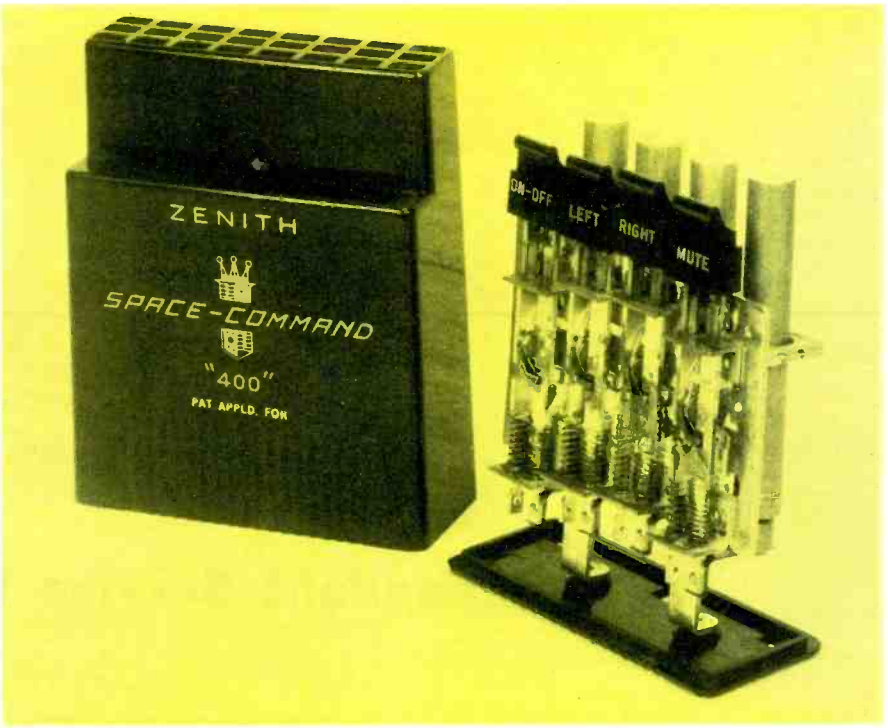

Fig. 1. Zenith "Space-Command 400" transmitter removed from its case. Keys operate hammers which strike tuning rods.

"Relax in your easy chair and tune the TV set by remote control" is potent sales talk, and set manufacturers have been devoting considerable energy lately to the development of remote tuning devices. The majority of these units are connected to the TV receiver by a cable. Such systems have the advantage of being extremely simple electrically, but the long cable run may be awkward. In addition, remote operation is for the most part restricted to one general area. These drawbacks have been overcome in at least two different types of wireless remote control systems that have been produced this year. One (Zenith) uses supersonic waves as a control medium, and another (Motorola) employs low-power RF radiation. Both are relatively complex in construction but highly convenient to use.

Zenith "Space-Command"

Some 1957 Zenith sets are equipped with an acoustically operated device called "Space-Command." The essential parts of this system are as follows:

1. A small, hand-held transmitter (Fig. 1) equipped with tuning rods which, when struck, will vibrate at supersonic frequencies near 40 kc.
2. A capacitor-type microphone on the front of the TV set to pick up the supersonic vibrations and convert them to RF energy.
3. A control receiver inside the TV set to amplify and detect the RF signals.
4. Relays to make or break switch contacts and perform the desired tuning functions.

There are two versions of the "Space-Command" system. A deluxe "400" model features a 4-rod transmitter with which the user can turn the set on and off, mute the sound, and rotate the channel selector either clockwise or counterclockwise. The control receiver in the TV set used with this model contains 8 tubes. A simpler two-rod system called the "200" performs only the functions of muting the sound and turning the channel selector in a clockwise direction. A narrow-bandpass, 5-tube control receiver is included in the "200" system.

Details of construction in the "400" transmitter can be seen in Fig. 1. The rods are supported at the center by spring-wire clamps. Each tuning key is linked to a small hammer in such a way that pressure on the key causes the hammer to be cocked. As soon as the key is fully depressed, a retaining spring is released and the hammer strikes the bottom end of a rod. This causes supersonic vibration of the rod, accompanied by a slightly audible "ping." The rods all have different resonant frequencies, given in Table I. The "200" transmitter is similar to the "400" in all respects except that it

· Please turn to page 74

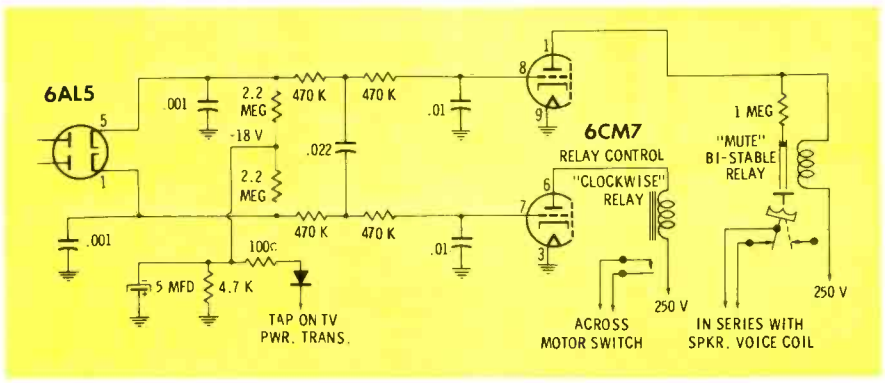

Fig. 2. Discriminator and relay-control circuits of Zenith "Space-Command 200" control receiver. Output of 6AL5 is positive and drives 6CM7 into conduction.

NOTES ON TEST EQUIPMENT

Latest Information on Application, Maintenance and Adaptability of Service Instruments

by Leslie D. Deane

Fig. 1. Win-Tronix Model 825 Dynamic AGC Circuit Analyzer. The unit cuts time in servicing AGC systems.

AGC Trouble Shooting

Pictured in Fig. 1 is the Win-Tronix Model 825 Dynamic AGC Circuit Analyzer, manufactured by Winston Electronics, Inc. and especially designed for trouble-shooting television AGC systems. The instrument actually combines a signal generator, VTVM and variable bias supply into one portable unit.

Specification features are:

1. *AGC Test Signal — RF signal with 15 kc sync-pulse modulation, variable output from zero to 500,000 microvolts, preset for channel 2 and adjustable for channels 2 through 4.*
2. *Vacuum Tube Voltmeter and Ohmmeter — available scales are 15-0-10 volts DC, center zero; 300-0-300 volts DC, center zero; 0-800 volts peak-to-peak; 0-250 volts AC (RMS); and 0-10 megohms.*
3. *AGC Bias Supply — variable DC output from +1 to −15 volts.*

I recently had the opportunity to examine a Model 825 AGC Analyzer in our lab. Since the checks I made were under typical service shop conditions and on conventional TV receivers, I thought you, the reader, might like to follow me through on some of the tests I performed with this particular instrument.

Naturally, my first step was to read over the operating instructions completely. In doing so, I found the instrument was designed for testing AGC systems in several different ways. By using the proper test leads and placing the function switch in the correct position, one can monitor the AGC voltage at various test points, check the gating pulse at the AGC keyer tube, substitute a variable DC bias for the AGC voltage, or check AGC action by using the RF signal generated within the unit.

Fig. 2. Pattern produced on the screen of a late model TV by the RF signal from the Win-Tronix analyzer.

I decided to fire up one of the older TV test chassis and check its AGC action both on local stations and on our own closed-circuit signal. After turning the analyzer on, I placed the function switch in the 15-0-10 VDC position and zeroed the meter with test leads open.

I connected the meter cables to the AGC line and chassis ground and monitored the AGC voltage under both strong and weak signal input conditions. I could detect no trouble symptoms in the picture and the action of the AGC voltage appeared normal.

In order to simulate a trouble, I disconnected the AGC line from the IF and tuner sections of the receiver. Selecting a signal from a local station, I found the picture would pull horizontally and overload almost to the point of negative phase. I then connected

· *Please turn to page 79*

RESONANT CIRCUITS

part 2

RESONANT FREQUENCY and Q

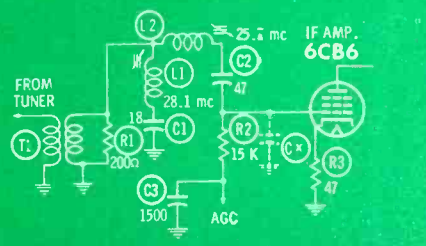

Fig. 1. Input circuit of IF amplifier.

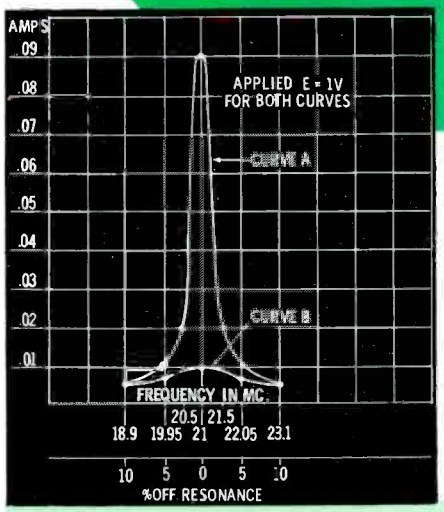

Fig. 2. Frequency response curves for series resonant circuits. Curve A represents a high-Q and curve B, a low-Q.

by Calvin C. Young, Jr.

CHART I—Data for Fig. 2

	Curve A			Curve B		
Resonant Frequency	21 mc			21 mc		
Inductance	7.5 μh			7.5 μh		
Capacitance	7.7 mmf.			7.7 mmf.		
Resistance IF Coil	10 Ω			100 Ω		
Q	99			9.9		
	X_L	X_C	Z	X_L	X_C	Z
18.9 mc	890 Ω	1085 Ω	200 Ω	890 Ω	1085 Ω	223 Ω
19.95 mc	935 Ω	1035 Ω	100 Ω	935 Ω	1035 Ω	141 Ω
20.5 mc	960 Ω	1010 Ω	51 Ω	960 Ω	1010 Ω	112 Ω
21 mc	990 Ω	990 Ω	10 Ω	990 Ω	990 Ω	100 Ω
21.5 mc	1010 Ω	960 Ω	51 Ω	1010 Ω	960 Ω	112 Ω
22.05 mc	1035 Ω	935 Ω	100 Ω	1035 Ω	935 Ω	141 Ω
23.1 mc	1085 Ω	890 Ω	200 Ω	1085 Ω	890 Ω	223 Ω

The resonant frequency of a series tuned circuit, the figure of merit or Q of a coil, and the Q of a circuit are each bits of information with which the practicing service technician should be familiar. The best reason that can be given for this statement is that a basic knowledge of these electrical properties is a big help toward the intelligent servicing of circuits such as traps, peaking networks, coupling circuits, etc. So here are the facts in concise and easily digestible form.

Series Resonance

The resonant frequency of a series tuned circuit may be calculated using the formula:

$$f_R = \frac{159}{\sqrt{LC}} \qquad (4)$$

where f_R = resonant frequency in kilocycles,
L = inductance in microhenries,
C = capacitance in microfarads.

The value of the capacitor is always easy to obtain (color code or value on schematic diagram) but the inductance of a coil may or may not be given; therefore, if the above formula is to be used to determine the resonant frequency of a circuit, the value of inductance may have to be obtained by measurement with a Q meter or impedance bridge, both of which are laboratory type test instruments. Series resonant circuits are generally used in a television receiver as traps, and the proper resonant frequencies of these networks may usually be found by consulting the alignment instructions.

If the resonant frequency and the value of capacity in a series resonant circuit are known, the value of inductance may be calculated using the formula:

$$L = \frac{25{,}300}{f_R^2 C} \qquad (5)$$

where L = inductance in microhenries,
f_R = resonant frequency in kilocycles,
C = capacitance in microfarads.

· *Please turn to page 70*

FROM DELCO RADIO come the speakers with highest performance. You trust them... so do your customers!

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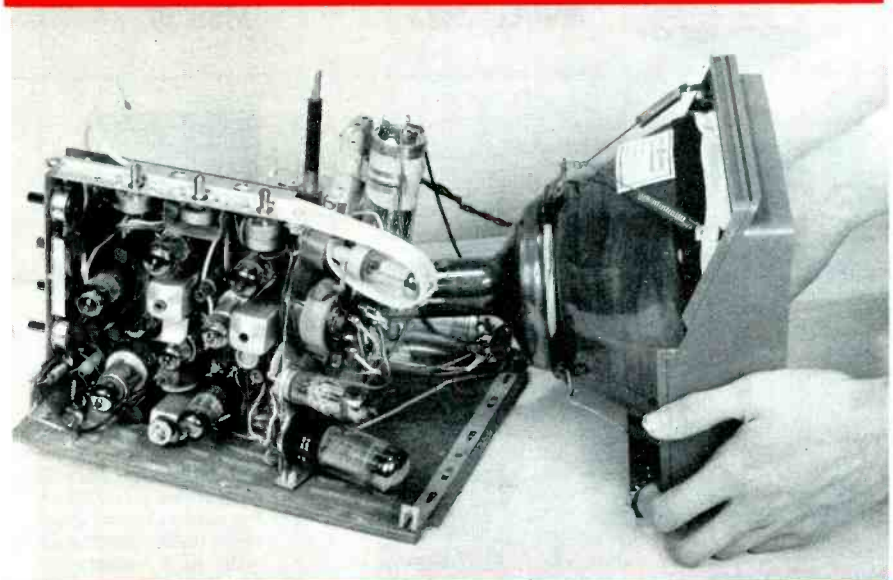


To Keep You Up to Date, Here's Important Data on Some Unusual Tubes in a 9" Portable TV Set

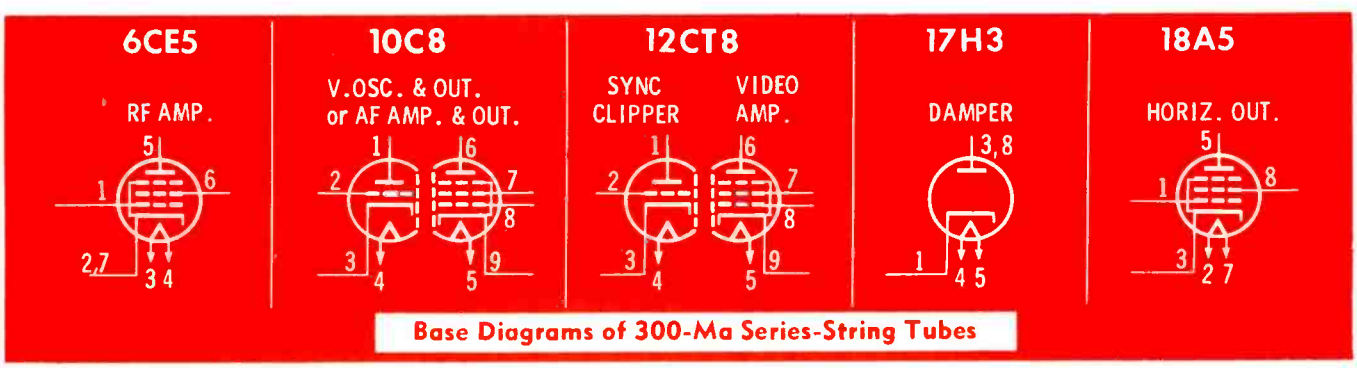
Typical of the many new developments constantly being made in picture-tube and receiving-tube design are the new tubes which appear in the General Electric Model 9T001 portable TV set. The surprisingly light weight of the 9QP4 picture tube—only about 2 pounds—is made possible by a new construction technique. Instead of having a separate cone and faceplate, this tube has a one-piece bell which is made by the same process used to manufacture bottles. A separately made neck is sealed to the bell, and the anode lead is brought out to the tube base. Anode operating voltage is approximately 5.5 kv. The 9QP4 has 40 sq. in. of viewing area, 70° deflection, and electrostatic focusing.

The G-E 9" portable receiver utilizes 8 special new tube types which were designed for series-string operation with only 300-ma heater current. Two older types are also used—a 1V2 high-voltage rectifier, and a 7AU7 with both halves of the heater wired in series to permit 300-ma operation. The advantages of the relatively low heater current lie not only in reduced power consumption but also in lower heat dissipation. The 300-ma tubes help the manufacturer to design an extremely compact portable receiver that will not tend to overheat.

Three of the new tube types (9U8, 6CB6A, and 6AU6A) are redesigned versions of old types, with heater voltage or warm-up time changed to conform to new standards. The other five 300-ma types are completely new. Their base diagrams are presented at the bottom of this page.

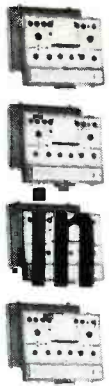
The tuner contains a 6CE5 RF amplifier and a 9U8 converter. The two IF amplifiers are 6CB6A tubes. A 12CT8 is used as a video amplifier (pentode section) and sync clipper (triode section). The sound section consists of a 6AU6A IF stage, a pair of crystal diodes connected as a ratio detector, and a 10C8 which serves as an audio amplifier and output tube. Another 10C8 is the vertical oscillator and output tube. A 7AU7 horizontal multivibrator drives an 18A5 horizontal output tube, and the damper is a 17H3. The set has a total complement of 12 receiving tubes.

The cabinet of the Model 9T001 is divided into three parts. Two of these are shown in the illustration—the front panel attached to the picture tube, and the bottom board upon which all other components are mounted. These sections are fastened together by snaps which are locked in place by a sliding bar. The third section of the cabinet is a cover, fastened in place by 8 screws. It is removable to provide access to tubes and other components for servicing. ▲



Base Diagrams of 300-Ma Series-String Tubes

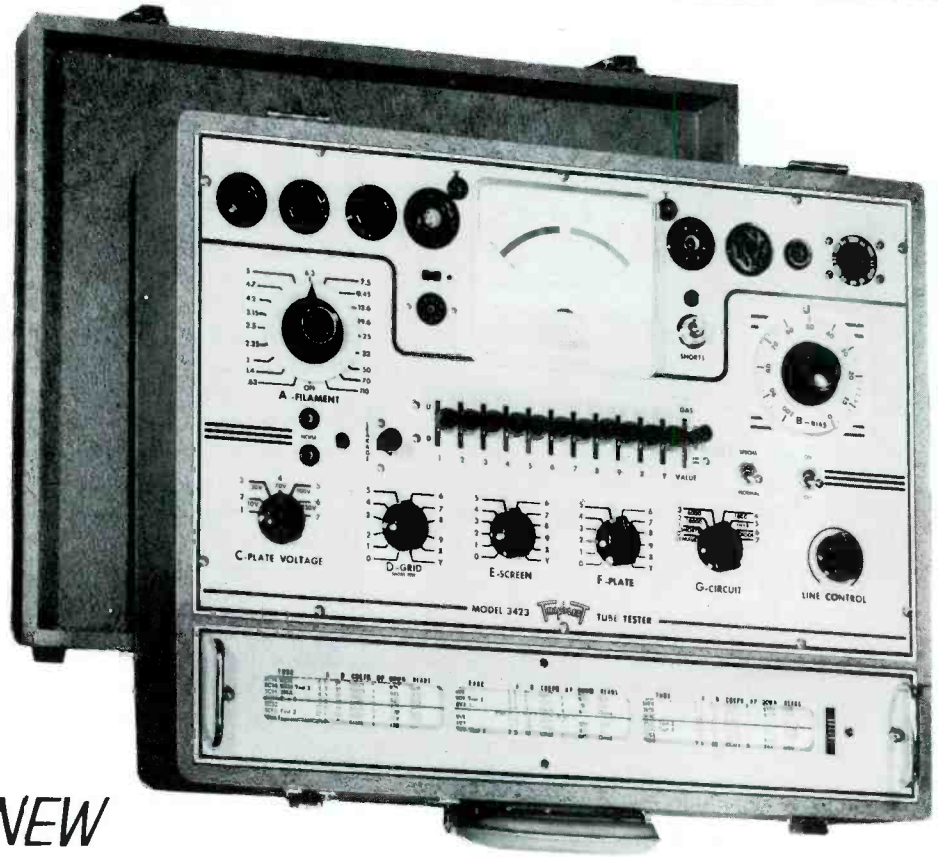
4 in 1



TRIPLETT

- *mutual conductance tube tester*
- *transistor checker*
- *germanium diode tester*
- *selenium rectifier tester*

MODEL 3423 **$199.50**

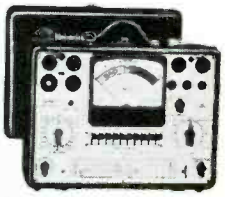


NEW

Triplett Tube Tolerance Computer—permits model 3423 users to check tubes for critical circuits closer than the approximately 35% below tube manual value as shown on the roll chart.

Simple use quickly determines micrombo reading required for selecting applicable tubes for such as oscillator circuits that call for tubes within 10% of the manual value.

Available to all present and future users.



MODEL 3413-B . . . $79.50

The first low priced tube tester to provide

- ***dual sensitivity for short test***

Triplett model 3413-B combines provision for conventional short test (0.25 megohms) with high sensitivity leakage test (2.0 megohms)—will test series string tubes without adapter.

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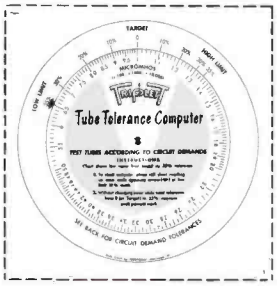
Burton browne advertising

Here is the ultimate in a tube tester for today and tomorrow. A 4 in 1 value that checks for accuracy as the circuit demands depending on the tolerance of the circuit.

Model 3423 will give you no false readings to waste time. The patented circuit for the tube testing employs actual



signal (4KC) for grid and DC bias voltage making it independent of line voltage hum. It also has a complete coverage of all tube types—six plate voltages (including 0-10 variable). Micromhos scales read 0-1800, 0-6,000, 0-18,000 and 0-36,000. Leakage measured directly on meter 0-10 megohms.

Quick development of new types of tubes can obsolete any tester tomorrow that does not have the multiple switching arrangement of Model 3423 which allows making any combination of tube connections. Ask your parts distributor to demonstrate the many other extra features of this foremost tube tester. . . . Triplett automatically furnishes revised, up-to-date roll charts regularly if you promptly return registration card. (Included with tester.)

TRIPLETT ELECTRICAL INSTRUMENT COMPANY • BLUFFTON, OHIO

A STOCK GUIDE FOR TV TUBES

The following chart is presented as a guide for the maintenance of an up-to-date stock of television receiving tubes. The figures in the chart are expressed as proportions based on a total of 1,000 tubes. For example, if the figure 6 is given for a particular type of tube, this means that six out of every 1,000 tubes in television receivers now in service are of that type. The minimum entry is 0.5 per 1,000, rounded off to 1.

A cumulative record is kept of the tubes used in new models of receivers. The resulting figures are adjusted to take into account the quantities of production of different models and the retirement of old sets at an estimated average age of six years.

In most cases, combined listings are given for redesigned "A" and "B" tube types and their prototypes. Some of the most recent designs should be kept in stock, and it is usually practical to stock the latest version exclusively.

The listing of a large figure for a particular type of tube is not necessarily a recommendation for stocking that number of tubes. (Some consideration should be given to the frequency of failure of the tube.) A large figure does indicate that the tube is used in many circuits and emphasizes the necessity for maintaining a sufficient stock to fill requirements between regular tube orders.

NOTE: The 0.5-per-1,000 minimum figure is somewhat lower than that which has been used in the past. This reduction was made so that the chart will more quickly reflect the relative popularity of the enormous number of new tube types being placed on the market. The previously-used separate listings for pre-freeze and post-freeze areas have lost much of their former significance, and they have been merged for simplicity's sake. UHF tuner tubes are no longer being listed, due to their limited application; but color receiver tubes will continue to be listed as they reach the 0.5-per-1,000 percentage-of-use figure.

TUBE TYPE	NO. OF UNITS	TUBE TYPE	NO. OF UNITS	TUBE TYPE	NO. OF UNITS
1B3GT	45	6AU5GT	3	6DQ6/-A	1
1X2A/-B	8	6AU6	101	6J5	3
3AL5	2	6AU8	2	6J6	24
3AU6	2	6AV5GA	3	6K6GT	8
3BC5	1	6AV6	17	6S4/-A	1
3BN6—	2	6AW8	4	6SL7GT	2
3BZ6	1	6AX4GT	14	6SN7GT/-A	68
3CB6	7	6AX5GT	2	6SN7GTB	5
3CF6	1	6BA6	8	6SQ7	3
3CS6	1	6BC5	6	6T8	13
4BQ7A	1	6BC8	1	6U8	18
5AM8	1	6BE6	7	6V3A	2
5AN8	1	6BF5	1	6V6GT	15
5AQ5	2	6BG6G	4	6W4GT	21
5AT8	1	6BH8	1	6W6GT	11
5J6	1	6BK5	3	6X8	8
5T8	1	6BK7A	7	6Y6G	1
5U4GA/-B	47	6BL7GT	6	7AU7	2
5U8	3	6BN6	7	7N7	1
5Y3GT	2	6BQ6G/-A	2	12AT7	11
6AB4	2	6BQ6GTA/-B	21	12AU7/-A	33
6AC7	5	6BQ7A	17	12AV7	2
6AG5	6	6BX7GT	1	12AX4GT/-A	6
6AG7	2	6BY6	2	12AX7	5
6AH4GT	3	6BZ6	3	12AZ7	1
6AH6	6	6BZ7	4	12B4A	2
6AK5	2	6C4	8	12BH7/-A	14
6AL5	67	6CB6	133	12BQ6GTA/-B	1
6AM8	3	6CD6G/-A	2	12BY7/-A	11
6AN8	7	6CF6	2	12CU6	1
6AQ5	15	6CG7	3	12DQ6/-A	1
6AQ7GT	2	6CL6	3	12L6GT	2
6AR5	1	6CM7	1	12SN7GT/-A	4
6AS5	3	6CN7	1	25AX4GT	1
6AS6	1	6CS6	3	25BK5	1
6AS8	1	6CU6	3	25BQ6GTA/-B	4
6AT6	2	6DC6	1	25L6GT	5
6AT8	1	6DE6	2	25W4GT	1
6AU4GT/-A	3	6DG6GT	1		

TWO WHOLE LINES OF NEW TUBES INTRODUCED DURING 1956

1. FOR HYBRID AUTO RADIOS

An entire family of new tubes was produced to make possible the development of hybrid tube-transistor radios for automobiles. All these new tube types are capable of operating at a plate potential of approximately 12 v.

TUBE	USE
12AC6	RF-IF pentode
12AD6	Pentagrid converter
12AE6	Dual diode/triode
12AF6	RF-IF pentode
12AG6	Pentagrid converter
12AL8	Triode/tetrode
12BL6	RF-IF pentode
12CN5	IF pentode
12CY6	RF pentode
12DK5	IF pentode
12F8	Dual diode/pentode
12G8	Dissimilar dual triode
12J8	Dual diode/tetrode
12K5	Power tetrode
12U7	Dual triode

2. FOR 450-MA SERIES STRINGS

At least five manufacturers are making tubes with 450-ma heaters having controlled warm-up time. It is possibly premature to keep these tubes as yet, since they have not appeared on the market in substantial numbers. Nevertheless, the length of the list of 450-ma tubes is a forecast of an important design trend. You can expect to see many of the smaller TV sets appearing with tubes of this kind in the near future.

Note that some of the new types have 6-volt heaters. These can be used as replacements for their prototypes, but not vice versa. Other types will be non-interchangeable because of the differences in filament voltages. In the list given below, some of the prototypes themselves will be unfamiliar because they have been on the market for less than a year. Several of the very latest tubes to be introduced are made in three versions, with a choice of 6-volt, 600-ma, or 450-ma heaters.

TYPE	PROTOTYPE	KIND OF TUBE
3AF4A	6AF4A	UHF triode
3BN4	6BN4	RF triode
4AU6	6AU6	Pentode
4BA6	6BA6	Pentode
4BC5	6BC5	Pentode
4BE6	6BE6	Pentagrid
4BN6	6BN6	Gated-beam
4BU8	6BU8	Dual Pentode
4CB6	6CB6	Pentode
4CE5	6CE5	Pentode
4DK6	new	Pentode
4DT6	6DT6	Pentode
5BQ7A	6BQ7A	Dual triode
5BS8	6BS8	Dual triode
5BZ7	6BZ7	Dual triode
6AM8A	6AM8	Diode/pentode
6AN8A	6AN8	Triode/pentode
6AQ5A	6AQ5	Beam pentode
6AT8A	6AT8	Triode/pentode
6BE8A	6BE8	Triode/pentode
6BK7B	6BK7A	Dual triode
6BR8A	6BR8	Triode/pentode
6CG8A	6CG8	Triode/pentode
6CL8	new	Triode/tetrode
6CM8	new	Triode/pentode
6CR8	new	Triode/pentode
6CS8	new	Triode/pentode
6CZ5	new	Beam pentode
6J6A	6J6	Dual triode
6T8A	6T8	Triple diode/triode
6U8A	6U8	Triode/pentode
6V6GTA	6V6GT	Beam pentode
6X8A	6X8	Triode/pentode
8AU8	6AU8	Triode/pentode
8AW8A	6AW8A	Triode/pentode
8BA8A	6BA8A	Triode/pentode
8BH8	6BH8	Triode/pentode
8BN8	6BN8	Triode/dual diode
8CG7	6CG7	Dual triode
8CM7	6CM7	Dissimilar dual triode
8CN7	6CN7	Dual diode/triode
8CS7	6CS7	Dual triode
8SN7GTB	6SN7GTB	Dual triode
9AU7	12AU7	Dual triode
11C5	35C5	Beam pentode
13DE7	new	Dual triode
17AV5GA	6AV5GA	Beam pentode
17AX4GT	6AX4GT	Damper diode
17BQ6GTB	6BQ6GTB	Beam pentode
17C5	25C5	Beam pentode
17CA5	6CA5	Beam pentode
17CU5	6CU5	Beam pentode
17D4	new	Diode (damper)
17DQ6/A	6DQ6/A	Beam pentode
17L6GT	6L6GT	Beam pentode
17R5	12R5	Beam pentode
35CD6GA	6CD6GA	Beam pentode

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CALL YOUR INDEPENDENT SERVICE-DEALER FOR HIS SPECIAL "PICTURE TUBE CLEAN-UP."

He is *your* neighbor. He pays taxes in *your* community. His children go to the same schools and churches as *yours*. And he knows his standing and reputation depend upon the care and thoroughness with which he services your community's radio and television sets. What is more, he is trained to service any make of set. So patronize your neighborhood independent radio and television service-dealer.

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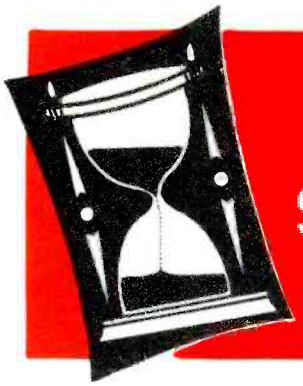

QUICKER SERVICING

by Calvin C. Young, Jr.

We have in past issues tried to present ideas in this column which would help the service technician locate and eliminate troubles faster and easier. We hope, however, that the emphasis on speed has not given the impression that quality is not of equal importance. In service work, poor quality will alienate customers more than will high charges. Besides, a repair that doesn't last isn't a complete repair, since it will result in another call to correct the trouble.

The fast, haphazard jobs that take only 20 minutes each can bring in a few fast dollars; however, they can also cause several lost customers. So instead of earning money, a haphazard repair has a better chance of losing it. On the other hand, a thorough repair job takes longer, but it earns a profit—and just as important, it is appreciated by the customer. The thorough repair can earn new customers as well as dollars and should be "the order of the day" in all service shops.

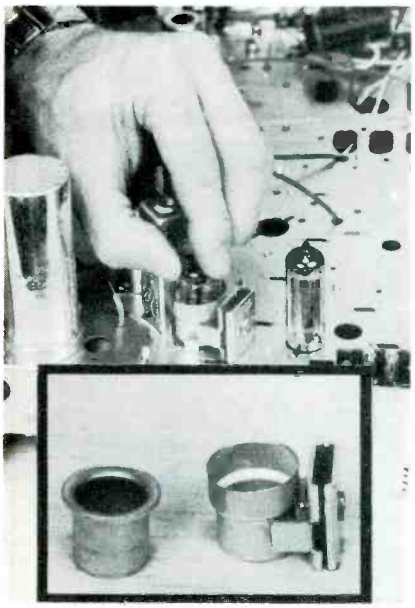

Fig. 1. Using the magnetic tube guide to aid in seating a tube in its socket.

Now that the sermon is over, let us examine some new devices which can help to smooth out some very thorny problems for the serviceman.

Magnetic Tube Guide

The replacement of seven- and nine-pin miniature tubes in sockets which can't be seen is a problem that the TV technician encounters daily. It isn't hard to remove the old tube, but trying to get the new one into its socket is almost like looking for the proverbial "hen's teeth."

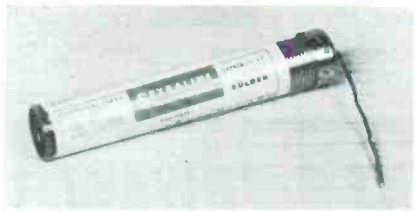

Fig. 2. "Spyraline" solder dispenser.

The magnetic tube guide in Fig. 1 is made by Altron Products Co. of Long Beach, Calif. and can make replacement of tubes in hidden locations much easier. The guide is placed over the tube before the old tube is removed. A ceramic magnet holds the unit in place on the chassis so that the new tube can simply be inserted into the tube guide and slowly turned until the pins line up and drop into the holes of the socket.

Handy Solder Dispenser

An easy-to-use solder dispenser (Fig. 2) has been marketed by Rayline Inc. of Mineola, N. Y. This dispenser is sold under the name "Spyraline" and contains approximately eleven feet of 60/40 rosin-core solder, which may be used for all radio and TV work including printed wiring boards because it has a low melting temperature (approximately 370°F).

The "Spyraline" is small, 4½" long by ¾" in diameter, and should be of valuable use both in the home service kit and in the shop.

Aid in Locating Intermittents

The radio and TV trouble that develops only when the receiver is hot, or goes away after the receiver warms up, or comes and goes with heat changes, has long been a thorn in the technician's side. A liquid refrigerant called "Jiffy Zero," when used as directed, is a valuable aid to the technician in locating troubles which come and go with temperature changes. The receiver is turned on and allowed to operate until the trouble appears or disappears as the case may be. The components in the suspected circuit are then sprayed singly with "Jiffy Zero" as shown in Fig. 3. When the faulty component is subjected to the sudden temperature drop produced by the spray, it will very often reveal its condition by a marked change in the operation of the set.

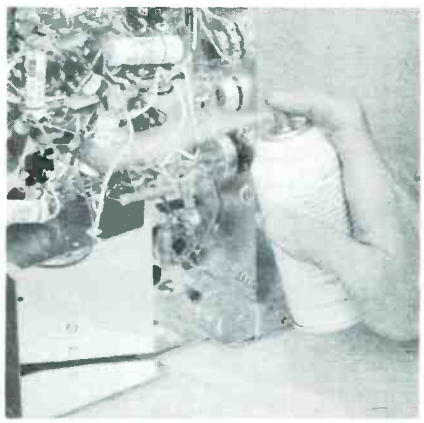

Fig. 3. "Jiffy Zero," a liquid refrigerant for locating components which intermittently fail due to temperature changes.

Testing Hi-Fi Phonographs

The service technician is being asked to test hi-fi phonographs more often these days; therefore, he should prepare himself to make a thorough and business-like check of these units. To aid in this type of test, he should have some type of test record, especially made for testing or demonstrating hi-fi systems and containing a wide variety of sounds. Such a record provides a better quality check than customers' records

which are often worn. To protect the test record, the customer's stylus should be examined with a stylus microscope before playing. A worn or broken stylus can damage a record and make it useless for test purposes.

Sell that Picture Tube

Between two and one-half and three million pictures tubes will be sold in 1957 for replacement purposes. Since there are about 40 million TV sets in use, this means that almost 7.5% of these sets will require a new picture tube this year.

The service technician can, by careful planning, insure that each defective or slowly dying picture tube encountered on service calls will mean an eventual replacement job for him. The trick is to give the customer a break. If you encounter a tube with an intermittent condition and you can see that the customer isn't amenable to having the tube replaced at once, try to get it going by tapping it lightly to loosen shorts or try resoldering the base pins. If this procedure should get the set back into operation, make the usual service charge with the stipulation in writing that in the next 30 days you will credit the cost of the call against the standard picture tube replacement charge. (Be sure to quote the charge for the picture tube plus the installation charges.)

If the picture tube is weak or is slow in heating you could install a filament booster and state in writing that during the next 90 days, full credit for booster cost will be applied against the picture tube replacement.

This gives the customer a break and at the same time a good reason to call you to install the new picture tube when the original one fails completely. ▲

REMOVING SAFETY GLASS

In the November 1956 issue, the "Quicker Servicing" column included a hint which recommended the "plumber's friend" as an aid in the removal of safety glass. For those who might prefer to carry a less bulky tool for this purpose, here is an easily constructed gadget that will do the job. A pair of suction cups 2" in diameter and a screen door handle can be bought for less than 50c. As shown in the picture, the handle is combined with the suction cups and applied to the glass, without fear of slipping.

—*A. C. Indovino*

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I understand I may select and order a library of PHOTOFACT Sets as long as I order a *minimum of fifty* (50). I may also order as a part of this agreement, up to two (2) File Cabinets or as many PHOTOFACT Binders as I may require. I also understand there will be no interest or carrying charges added to this agreement. I agree to the terms as outlined and enclose my down payment.

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1	31	61	91	121	151	181	211	241	271	301	331
2	32	62	92	122	152	182	212	242	272	302	332
3	33	63	93	123	153	183	213	243	273	303	333
4	34	64	94	124	154	184	214	244	274	304	334
5	35	65	95	125	155	185	215	245	275	305	335
6	36	66	96	126	156	186	216	246	276	306	336
7	37	67	97	127	157	187	217	247	277	307	337
8	38	68	98	128	158	188	218	248	278	308	338
9	39	69	99	129	159	189	219	249	279	309	339
10	40	70	100	130	160	190	220	250	280	310	340
11	41	71	101	131	161	191	221	251	281	311	341
12	42	72	102	132	162	192	222	252	282	312	342
13	43	73	103	133	163	193	223	253	283	313	343
14	44	74	104	134	164	194	224	254	284	314	344
15	45	75	105	135	165	195	225	255	285	315	345
16	46	76	106	136	166	196	226	256	286	316	346
17	47	77	107	137	167	197	227	257	287	317	347
18	48	78	108	138	168	198	228	258	288	318	348
19	49	79	109	139	169	199	229	259	289	319	349
20	50	80	110	140	170	200	230	260	290	320	350
21	51	81	111	141	171	201	231	261	291	321	351
22	52	82	112	142	172	202	232	262	292	322	352
23	53	83	113	143	173	203	233	263	293	323	353
24	54	84	114	144	174	204	234	264	294	324	354
25	55	85	115	145	175	205	235	265	295	325	355
26	56	86	116	146	176	206	236	266	296	326	
27	57	87	117	147	177	207	237	267	297	327	
28	58	88	118	148	178	208	238	268	298	328	
29	59	89	119	149	179	209	239	269	299	329	
30	60	90	120	150	180	210	240	270	300	330	

PHOTOFACT File Cabinets	OR	PHOTOFACT Binders
$32.95 ea. Net		$3.50 ea. Net
Specify Quantity Here		Specify Quantity Here

*Value of Cabinets (if ordered) ..... $

Value of Binders (if ordered) ..... $

Value of Sets—$1.95 each ..... $

TOTAL COST ..... $

LESS DOWN PAYMENT ..... $

$ 87.50 to $200.00—$10.00 Down
$201.00 to $300.00—$20.00 Down
Over $300.00— $30.00 Down

BALANCE ..... $

State Tax, if any, must be paid along with Down Payment. ..... $

*If File Cabinets are ordered, they will be shipped transportation charges COLLECT from Aurora, Ill.

All other merchandise on this order will be shipped transportation charges PREPAID from Indianapolis, Indiana.

I agree to pay the balance of $_____ in _____ monthly payments (if balance is $400.00 or under you have up to 18 months, over $400.00 up to 24 months), _____ payments of ($10.00 **minimum** monthly payments) $_____, and a final payment of $_____ due the _____ day of each month. My first payment is due the _____ day of _____, 195____.

Until full payment is made, I agree that title to and right of possession of the merchandise shall remain in you, that I will not sell, remove, or encumber the same without your written consent, that I assume and shall be responsible for all loss or damage to said goods, and that upon default of any payment or payments, you may, at your option, take back the merchandise or affirm the sale and hold me liable for the full unpaid balance.

Your Signature Here—WRITE—do not print X _____ (Purchaser)

NOTE: If you wish, we will gladly figure the payments for you. Just indicate the sets you want, sign your name above and enclose your down payment, we'll do the rest. NO INTEREST—NO CARRYING CHARGES.

YOUR DISTRIBUTOR'S NAME AND ADDRESS
(PLEASE PRINT)

Name _____

Address _____

City _____ Zone _____

State _____

YOUR NAME AND ADDRESS
(PLEASE PRINT)

Name _____

Address _____
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City _____ Zone _____

State _____

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BY JOHN MARKUS

Editor-in-Chief, McGraw-Hill Radio Servicing Library

Per-Call Charges. A recent survey of 73 servicing dealers on Long Island by Morris Scheffler revealed that 30 of them used a minimum charge of $3.00 per call, 15 charged $3.50, 26 charged $4.00 and 2 charged $5.00.

Interestingly, all are below the actual cost of making a home call in this area if overhead expenses are properly allocated. This situation is partly the result of competition and partly the result of consumer reaction to a higher charge for what may involve only five minutes' work in the home. If a shop is to stay in business, the deficiency must be made up in some way. Replacing weak tubes, as a form of preventive maintenance to reduce the number of future service calls, is one common way of breaking even on the simple home calls. There are many other legitimate ways, varying with locality and the individual.

The goal to keep in mind is that a serviceman is entitled to the prevailing fair income for the work he does with the knowledge and skill that he possesses. If the problem is approached from this basis, there can be no question of padded charges or dishonesty in servicing.

$ & ¢

Rat's Nest. An old TV chassis standing on end up near the front of your shop can be a real help in selling estimates to people and collecting repair bills. More and more people are becoming aware of the relatively low cost of many components to the manufacturer, so they naturally object to a $15 or $25 service charge that involves replacing only one part. When you encounter one of these complaints, take the customer over to this junked chassis and point out one by one the number of components of that type in the set. Give him some idea of what you had to do to find out which one was bad. Point out also that it could have been just as well some other type of component at fault, so that initially there were dozens or even hundreds of parts on your suspect list. The chances are that long before you get a chance to complete your story, he'll interrupt and say, "If that's what you have to do to earn a living, you can have it," then pay your charge with a sigh of relief that it wasn't bigger.

$ & ¢

Settling Down. When people buy a new car today, they expect a few annoying troubles during the first few months of operation. The car manufacturer's guarantee covers the actual cost of repairing these early troubles in most cases, but does not begin to compensate for the inconvenience and discomfort of stalling on the road in the middle of the night or in a blinding snowstorm just because a loose ignition wire fell off or all the oil leaked out. Remind your customers of this, the next time they complain about service charges on a brand new set.

Television receivers at today's low prices are possible only because of mass-production conveyor-line techniques like those used to make automobiles. TV sets are therefore subject to the human errors that occur when a person does the same task over and over again, as often as three times per minute, on sets as they move past. The same holds true for the individual components that are put into sets; they too can fail prematurely for a variety of reasons.

Fortunately the manufacturing

defects in components and in complete sets will generally show up within the first three months of operation of a television set. Most of the remaining defects will have made their appearance during the remainder of the first year. After that a good television set will settle down and require only occasional attention for the remainder of its normal life. Offering this hope for the future to your customers and explaining the problem of manufacture in comparison with that of automobiles will help customers understand why a new set may run up a few service charges.

$ & ¢

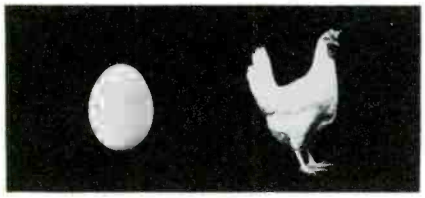
Collecting. "I'm a little short of money today, but I'll pay you Saturday" is an all-too-familiar plea heard by servicemen at bill-paying time on a home call. Too often that Saturday never comes, despite repeated bills, phone calls or costly personal collection follow-ups.

A firm C. O. D. policy is not always a practical answer. There are many cases where such an explanation is true and the customer will definitely pay when promised. Rigid C. O. D. enforcement here will mean losing the customer. Furthermore, what can you do if there is no money in the house and no checking account—take out the repairs?

One solution that has worked well for a number of shops is to make an extra charge for bookkeeping when payment is deferred. This provides a cash incentive for paying immediately, even if it means shaking out the piggy bank. A 10% charge for bookkeeping is fully justified, and is usually enough to encourage immediate payment even if inconvenient to the customer.

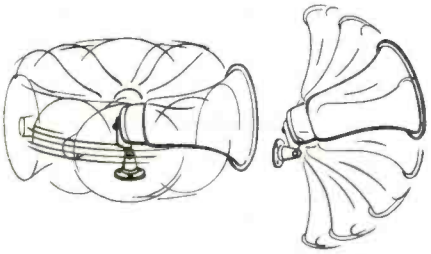
A more tolerable collection penalty, for localities where there are few credit risks, would be a 10% bookkeeping charge effective after 10 days or after the first of the following month. The important thing is to have a penalty charge, let all your customers know about it, and enforce it. The delayed penalty permits a friendly leavetaking with a comment like this: "I'm supposed to collect right away on all home-service calls, but in your case it will be all right if you send it in by the end of the week. Then you won't have to pay the 10% bookkeeping charge that we make after 10 days."

WHAT HAS THIS SPEAKER SWIVEL MOUNT TO DO WITH . . .



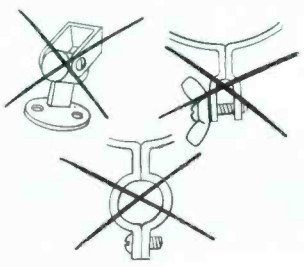
Another great University first

As we've been saying . . . University "firsts" are worth having, worth working toward, worth waiting for. Not the *first* "Universal" joint to be incorporated into a bracket design, the new University omni-swivel bracket *is* the first that really works. It is also the only bracket that can fit directly on ½ inch pipe. Its *positive-lock* design, precision die-cast construction and versatility of application set new standards by which others will be judged.



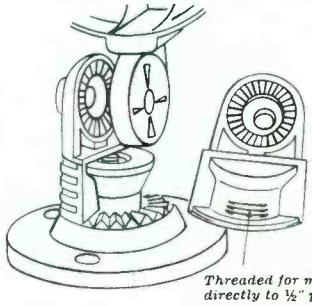
Progress that makes waste

As we've been saying . . . *being* the first is not as important to University as being first with a new design of *proven* quality . . . even if it means discarding achievements that no longer meet *our own* high standards. The serrated, die-cast swivel bracket being replaced by the new omni-swivel, is still superior to any other on the market today . . . yet we willingly discard it for the sake of true progress, the most important commodity University has to offer.



Engineering that makes the difference

As we've been saying . . . the integrity and quality of good engineering is often where you can't see it, or touch it. Yet, these are what make the *difference* in brands . . . differences that spell success or failure of operation, really great value or a poor purchase. The drawing of the new University omni-swivel bracket unveils the ingenuity, meticulous detail and farsighted design that are the ingredients of *every* University product.



Threaded for mounting directly to ½" pipe

The University Positive-Lock OMNI-SWIVEL *base is standard equipment on the Models IB and MIL series paging and talk-back speakers, and Models CMIL and CIB series wide-angle paging speakers. Additional models will be so equipped in the near future.*

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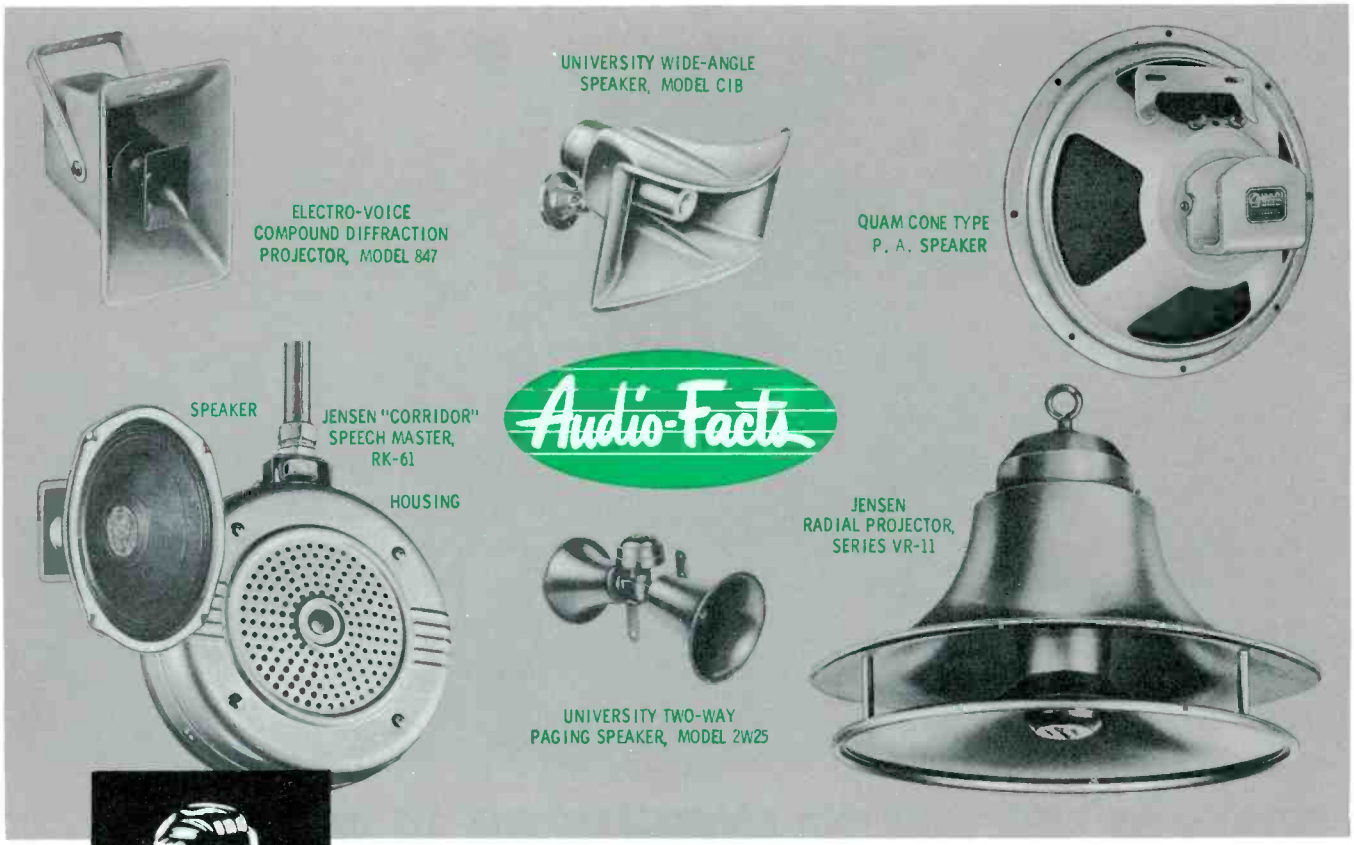

Fig. 1. Samples of various types of PA sound reproducers.

by Calvin C. Young, Jr.

PUBLIC ADDRESS SPEAKERS AND THEIR APPLICATION

With the construction of new commercial buildings at an all-time high and the remodeling of old buildings on the increase, the installation of audio systems of all types is becoming a large business. This field offers the service technician or shop owner who is prepared to take advantage of the opportunities, a chance to greatly increase his income.

There are problems associated with the installation and maintenance of commercial sound systems, but they can be solved with a little study and foresight. The scope of this article will be limited to the problems associated with choosing speaker types and the location of speakers. The many other considerations for audio installations and service will be presented in a series of future articles.

Speaker Types

In the general field of commercial sound systems, a large number of different types of sound reproducers, each having different applications, will be encountered. Examples of the types very often used are illustrated in Fig. 1. These units, as the call-outs on the photographs indicate, range from the familiar cone-type

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Fig. 2. Bi-directional speaker for paging service in long hallway.

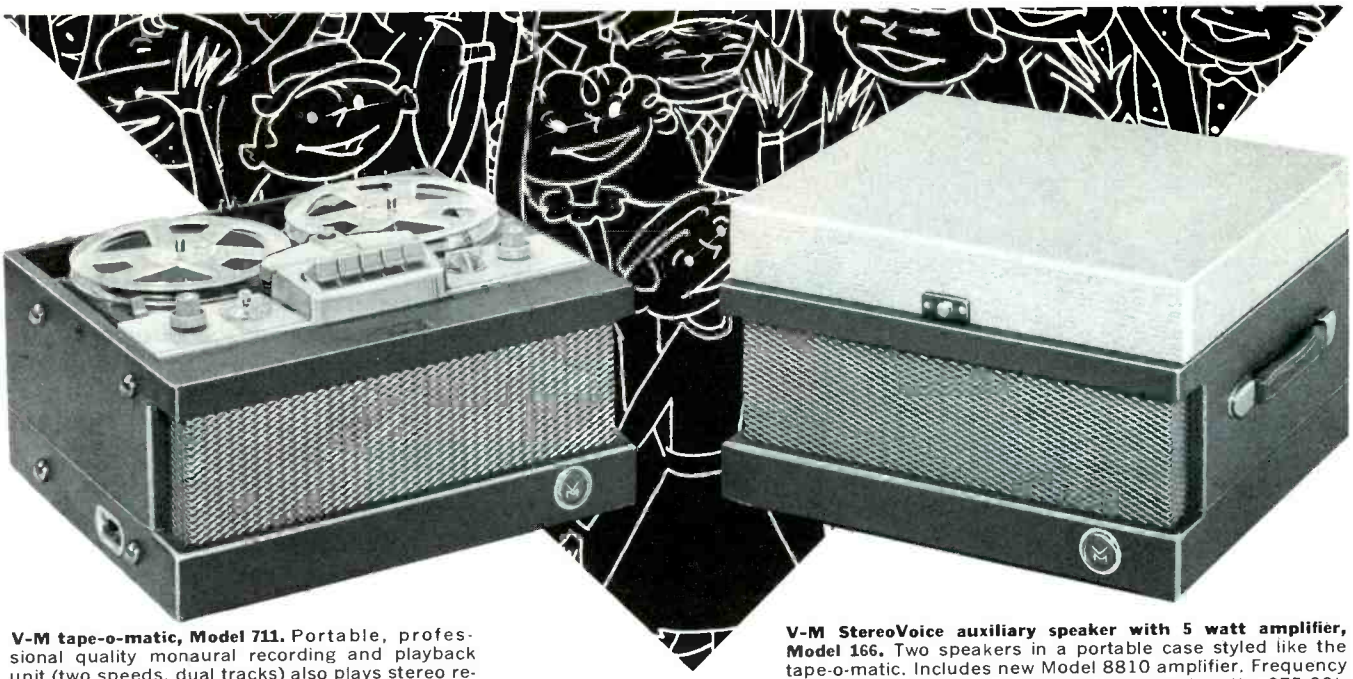
speaker to the large re-entrant trumpet. So many types are required because of the different demands placed upon them—e. g., the cone type loudspeaker is used for low-level coverage where background noise level is low or where a broad frequency response for music at low-power levels is desired, and the large re-entrant trumpet is used for paging in factories where the noise level is high and sizable areas have to be covered. In the discussion which follows, the uses of the various types of speakers are clearly illustrated.

Hallways

It is often necessary to install paging systems in hallways, factory aisles, or similar places in which bi-directional coverage is required. If the system is in an office building, hospital, school or other quiet location, a cone type loudspeaker mounted in a baffle that is open on both sides (such as the Jensen "Corridor" Speech Master illustrated in Fig. 1) can be used. Fig. 2 shows this type of unit mounted as high as practical to insure proper coverage of the hall area.

When the installation is in a large building having a long or complex hall system, a speaker should be mounted at least every 50 feet or, if there are turns in the hall, in each section of the hall. This will permit complete coverage with reasonably uniform sound levels at all points.

In this type of installation, as in



V-M tape-o-matic, Model 711. Portable, professional quality monaural recording and playback unit (two speeds, dual tracks) also plays stereo recorded tapes. Two-tone gray leatherette, $209.95*.

V-M StereoVoice auxiliary speaker with 5 watt amplifier, Model 166. Two speakers in a portable case styled like the tape-o-matic. Includes new Model 8810 amplifier. Frequency response 30-20,000 cps. Two-tone gray leatherette, $75.00*.

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*Slightly higher in the West.

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NEW From V-M:

StereoVoice Amplifier-Speaker To Match the tape-o-matic Tape Recorder!

Now stereo costs less than ever, sells even better than ever! NEW Model 166 portable amplifier-speaker is the perfect sound-mate and style-mate to team with the tape-o-matic for stereo playback. It's an amplified auxiliary speaker for ANY hi-fi setup!

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other multiple speaker installations, speaker phasing is very important. The speakers should all be connected so that the sound from one aids or reinforces the sound from all the rest.

Offices or Schoolrooms

Music distribution as well as paging facilities are desired in many office or schoolroom installations; therefore, it is the usual practice to use cone-type loudspeakers mounted in suitable baffles.

There are several places that the speakers can be mounted and several types of baffles that can be employed. The location of the

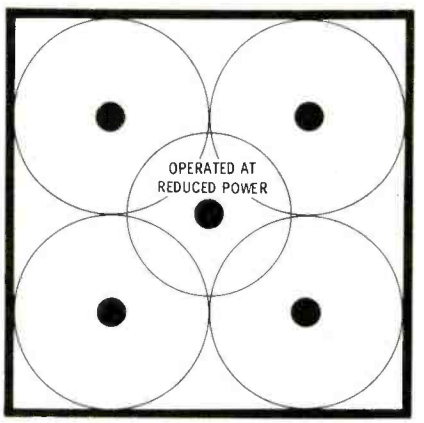

Fig. 3. Sound coverage provided by ceiling mounted speakers.

speaker and the type of baffle used will be dependent on the type of coverage desired, the area to be covered and the construction of the room.

If the installation is being made while the building is under construction and if the type of conconstruction permits, a ceiling installation using one of the specially designed mounting boxes and decorative grill assemblies is probably the most satisfactory. Better distribution of sound over a larger area and with fewer speakers can usually be obtained in a ceiling installation since the speakers are closer to the center of the coverage area. This is illustrated in Fig. 3. Notice how the coverage areas of the individual speakers overlap and thus insure complete sound dispersion. If the speakers are mounted on the walls around the room, however, either more speakers must be used or higher power must be fed to each speaker in order to obtain satis-

factory dispersion over the entire area. This is especially true in large rooms.

Sometimes it is necessary to install wall-mounted baffles because of the construction of the building or for other reasons. In these cases, the corner type of baffle mounted at ceiling level is most effective since the walls act as a horn for the speaker and give better distribution of the sound. The baffles are tapered so that when properly installed the sound will be beamed at a downward angle. This minimizes echos which would result in distortion. If the speaker installation is for a small room which can be adequately covered with one or two speakers, wall-mounted baffles are generally very satisfactory and the installation cost is relatively low.

Factories

When planning a speaker installation for a factory or other noisy inside location, the installer must consider the noise levels in the various sections of the coverage area. As the noise level rises so does the power required to cover the area; for example, a re-entrant horn with a 30-watt driver and 12 watts of input power can overcome a 75-db noise level within a space of 100,000 cubic feet. At an 80-db noise level, it would require four re-entrant horns and 30 watts of power to each horn in order to provide the same coverage. The above data was taken from an acoustic design chart offered by University Loudspeakers, Inc.

It may be seen from the foregoing discussion that it is most valuable to know the sound levels in the various sections of any area in which you are installing a speaker system. If the noise levels are not carefully considered, the system could end up with excessive audio power in some areas and not enough in others. Noise levels can be determined with a noise meter if one is available. In fact, such an instrument is a necessity for any company installing speaker and audio systems on a large scale.

Here again, the type of speaker to be used in each area will be determined by the type of coverage desired; e. g., a re-entrant

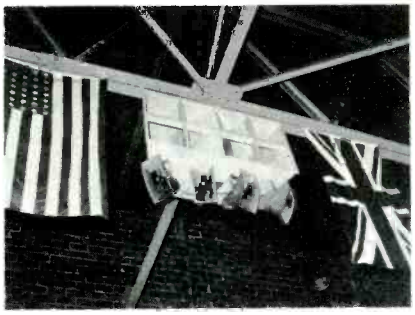

Photo courtesy Electro-Voice, Inc.

Fig. 4. Reproducers in PA system for large indoor arena. This installation was made by John P. LeBlanc of Sault Sainte Marie, Mich., for the Pullar Community Building in that city.

horn may be used for directional paging, and a radial projector for wide-area coverage. It is also possible that you might prefer to use the sound reproducer unit manufactured by a particular company, in which case the arrangement of these units would be determined by their radiation or coverage patterns and the type of coverage desired. There are so many possible combinations which could be employed that we will not try to cover them in this article. As a rule, each manufacturer of sound reproducers has literature which explains in detail how their particular units should be installed.

Auditoriums and Theatres

Adequate and proper coverage of auditoriums, theatres, meeting halls, music halls, gymnasiums, dance studios, sports arenas and other similar places can present a number of different problems. The acoustic properties of these areas will vary but they are nevertheless controlling factors in the types, locations, and number of speakers which must be employed to give satisfactory coverage. The speakers must be located and the power input to each speaker adjusted so that reverberation or echo is avoided. Unless the speakers are correctly positioned, the echo could be so bad that music or speech would be completely garbled.

An installation of sound reproducers in an indoor arena is shown in Fig. 4. Notice how the speakers are located in a single group and are turned to provide coverage of a wide area. The large unit to which the four smaller units are fastened is a low-frequency horn which provides

the bass response and is sometimes known as a bin type "woofer." Two Electro-Voice Model 15W low-frequency speakers are used in this "woofer," and the four other speakers are Electro-Voice Model 848 Compound Diffraction Projectors. These speakers are mounted above the stage end of the arena as indicated by the presence of the flags.

Another type of installation in a music theatre is shown in Fig. 5. Here, several speakers are located around the central stage. The speakers were installed in this manner instead of in a single group because of the low ceiling in the tent. Spaced as they are at relatively low positions, the speakers provide proper coverage of the entire area. They are beamed back toward the rear seating area since the seats in the front are covered by the primary sound from the stage.

Outdoor Areas

Outdoor installations require not only the proper dispersion of sound but also protection against damage to the components and wiring by weather. The speakers, matching transformers, wiring and connections must be weatherproof if trouble-free operation is to be maintained. Speakers and matching transformers for outdoor use are available from most manufacturers of commercial sound systems, but the wiring and connections are made weatherproof by the installer. The most common method of doing this is to run the wiring through conduit with the use of weatherproof connectors and junction boxes.

Some of the places which will normally have outdoor speaker installations are race tracks, baseball parks, football stadiums, outdoor theatres, factories, railroad stations, drive-in restaurants, and amusement parks. Some modern homes are even installing an outdoor speaker to provide music coverage of the patio or barbecue area. A Jensen Model HF-100 hi-fidelity outdoor projector is shown installed for coverage of a patio in Fig. 6. You will notice that the speaker is mounted on a stand and can be directed as desired.

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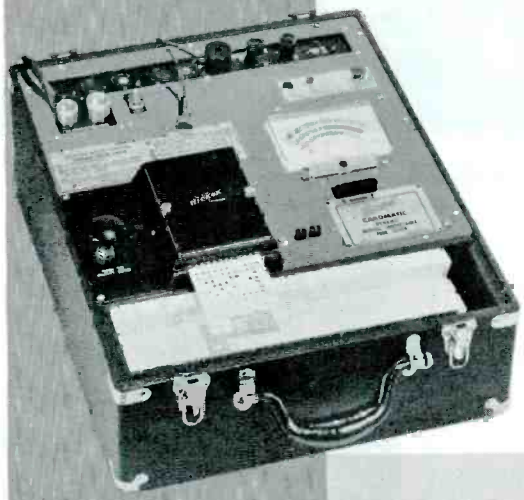

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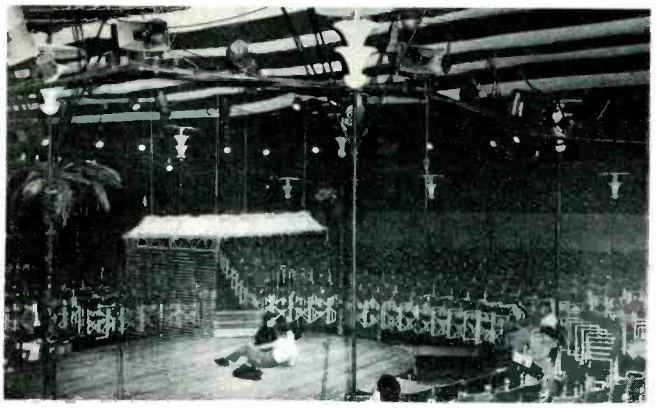

Photo courtesy Electro-Voice, Inc.

Fig. 5. PA installation in music theater with central stage by Robert Oakes Jordan and Assoc., Highland Park, Ill.

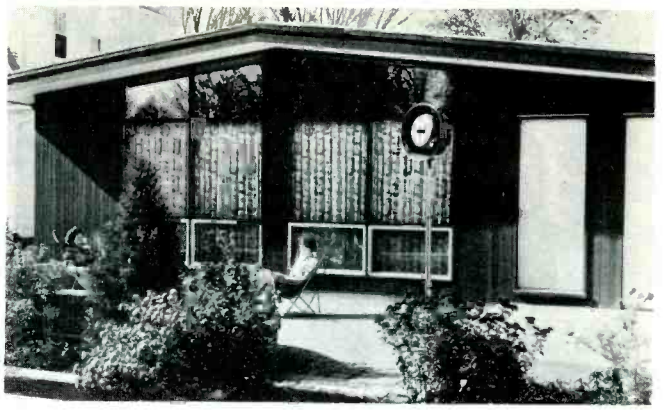

Photo courtesy Jensen Mfg. Co.

Fig. 6. Hi-Fi speaker providing music entertainment on patio of home.

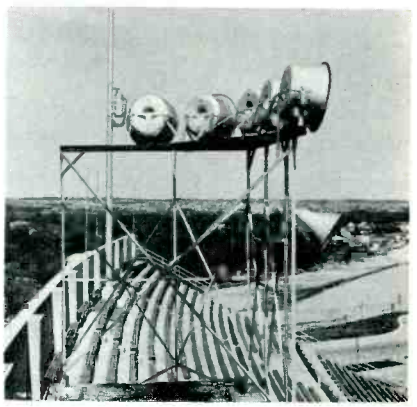

Photo courtesy of University Loudspeakers, Inc.

Fig. 7. A group of weatherproof speakers in PA system for football stadium.

The speaker installation in a football stadium in Fort Worth, Texas is pictured in Fig. 7. The speakers shown are only one-half of the entire installation—an identical number of speakers are mounted on the other end of the press box and are grouped in a similar manner. Speakers located above the crowd in this manner provide very efficient coverage, and the sound originates from the same source for all of the listeners. Placing speakers in too many different locations can result in an echo effect caused by the time delay due to the variations in distances from the different speakers to the listener. In smaller areas this effect is not too much of a problem, but in large outdoor installations where the distance from one sound reproducer to the listener can be several hundred feet, it must be considered.

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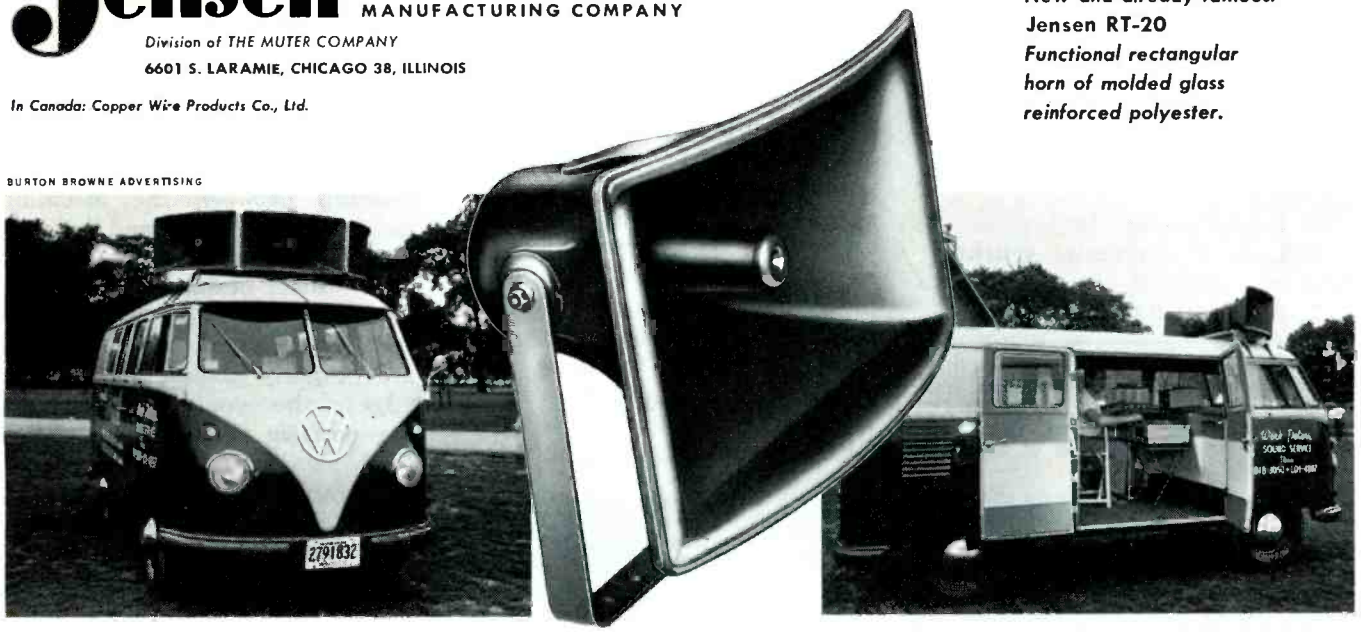

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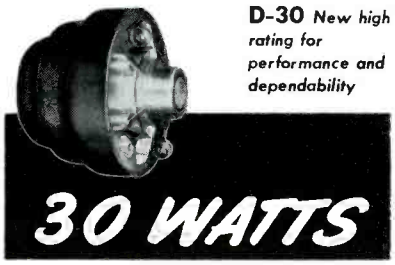

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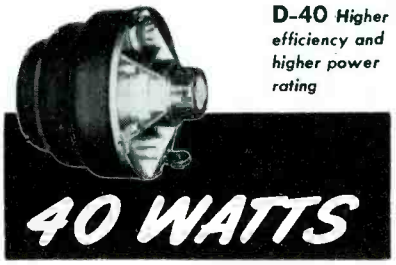

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Horizontal AFC and Oscillator Troubles

BY LESLIE D. DEANE *and* CALVIN C. YOUNG, JR.

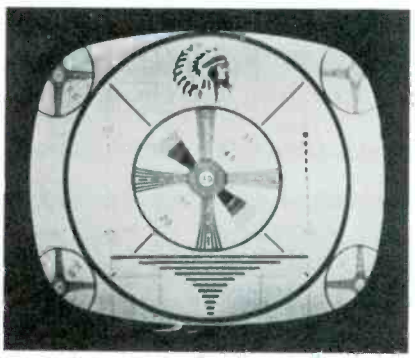

Fig. 1. Normal test pattern.

The next time a TV set with horizontal sweep trouble blocks your path suddenly after you've been coasting through some routine jobs, try this article as a guide. Perhaps it will help you over the hurdle.

Several common trouble symptoms resulting from failure in the horizontal AFC or oscillator circuits are:

1. Loss of raster.
2. Loss of horizontal synchronization.
3. Improper horizontal phasing.
4. Horizontal pulling.
5. Insufficient width or foldover.
6. Pie-crust effect.

The technician should be aware of the fact that the trouble symptoms listed are not necessarily caused by faults occurring in the horizontal AFC or oscillator circuits alone. Defective tubes or components in other sections of the receiver are also capable of producing some of these troubles. A normal test pattern is shown in Fig. 1 for reference purposes.

EDITOR'S NOTE: The material in this article is based on a chapter from the book *TV Servicing Guide*, by Leslie D. Deane and Calvin C. Young, Jr., a recent publication of Howard W. Sams & Co., Inc.

General Discussion

The schematic diagram shown in Fig. 2 illustrates a typical Synchroguide circuit employing the two triode sections of a 6SN7GT tube. This system operates on a pulse-width method of automatically controlling the bias applied to a horizontal blocking oscillator. The horizontal AFC triode is biased below cutoff, i.e., the grid is held negative with respect to the cathode. A signal, consisting of the incoming sync pulses and a sawtooth voltage which is fed back from the oscillator, is applied to the grid of this

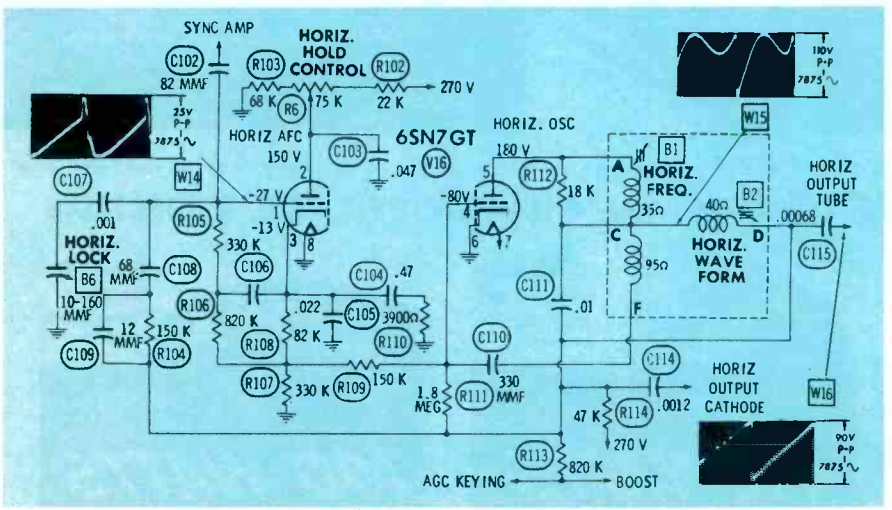

Fig. 2. Typical Synchroguide circuit.

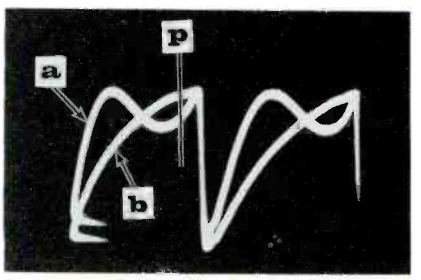

Fig. 3. Oscillator waveforms with and without superimposed sine wave.

stage. The most positive peak of this composite waveform will overcome the negative grid bias and will cause the AFC triode to conduct. When the tube conducts, a positive voltage is developed in the cathode circuit at the junction of resistors R107 and R108. This voltage changes the negative voltage at the oscillator grid and biases the oscillator accordingly.

The frequency or phase relationship between the incoming horizontal sync pulse and the sawtooth signal determines the width of the most positive peak of the composite signal applied to the AFC grid. When the two signals are properly phased, the leading edge of the sync pulse occurs on the positive portion of the sawtooth signal. The trailing half of the sync pulse occurs during the negative slope of the sawtooth signal or immediately after the oscillator tube has been driven into conduction. If the sawtooth signal is slightly out of phase with the horizontal sync pulse, the width of the composite pulse will increase or decrease depending on whether the oscillator is running slow or fast. The width of the positive pulse will govern the length of time the AFC tube conducts; in turn this regulates the amount of voltage developed in the cathode circuit of the AFC tube.

The waveform adjustment B2 stabilizes the oscillator by superimposing a sine wave on the oscil-

Pinpointing Defects in a Synchroguide Circuit

lator grid signal. The sine wave increases the steepness of the positive-going slope of the grid signal and causes the oscillator to be less sensitive to positive noise pulses as the point of conduction is approached. The effect of this sine-wave injection may be more clearly visualized from the oscilloscope waveforms shown in Fig. 3. These waveforms are actual photographs superimposed to illustrate better the relationship between the two. Waveform *b* represents the horizontal oscillator signal without the sine-wave modulation, and waveform *a* illustrates the normal composite signal. Note the difference in the slopes of the waveforms at point *p*. It is suggested that the technician learn to recognize the waveforms given in Fig. 2 in order that he may know what types of signals should be present at the various test points.

General Trouble-Shooting Procedure

If all the tubes employed in the horizontal sweep section have been replaced with tubes of known good quality, a voltmeter or an oscilloscope may be used to isolate the faulty stage. When a voltmeter is used, a check of all the major voltage points should be made. Voltage readings obtained should be compared with those found in reliable sources of service data. If a voltage reading deviates more than 20% from that listed for normal operation, the components making up the suspected circuit should be checked individually. The DC voltages present in the different horizontal stages are somewhat more critical than those in the vertical section. For this reason, it may be more advantageous to make resistance measurements rather than voltage

Fig. 4. Diagonal bars indicating loss of horizontal synchronization.

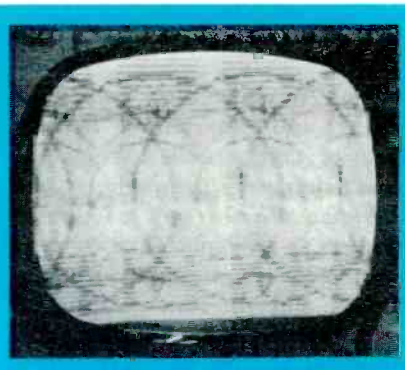

Fig. 5. Overlapping pictures produced by severe loss of horizontal synchronization.

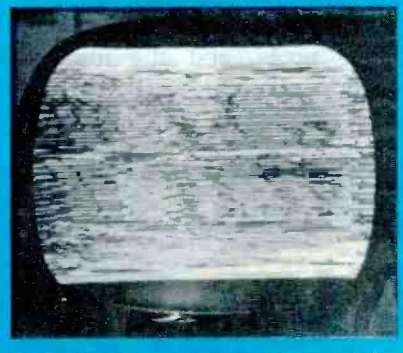

Fig. 6. "Christmas-tree" effect produced by oscillator running wild.

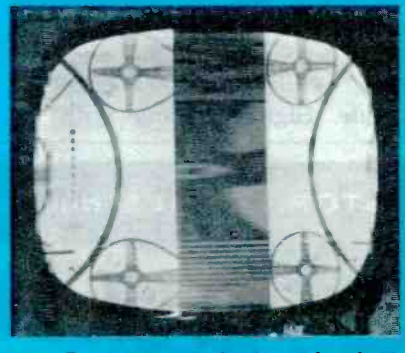

Fig. 7. Improper horizontal phasing causes dark vertical bar.

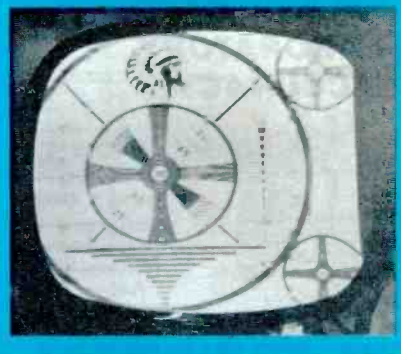

Fig. 8. Phasing ghost accompanied by slight picture shift.

Fig. 9. Horizontal pulling or bending at top of picture.

Fig. 10. Horizontal pulling near center of picture.

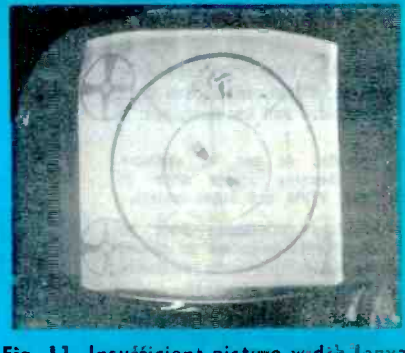

Fig. 11. Insufficient picture width leaves dark margins on screen.

Fig. 12. Horizontal foldover near center of picture

Fig. 13. "Pie-crust" effect in which "waves" move through picture.

checks. An incorrect resistance reading will warrant a further check of components. When replacing defective components, the technician should pay particular attention to any special characteristics such as temperature coefficient and tolerance rating of the part removed. An exact replacement should be used whenever possible, and the lead length and dress should approximate those of the original part.

The use of an oscilloscope will prove helpful in most cases of trouble. Signal tracing with an oscilloscope can usually localize the trouble to one section of the receiver and often to the particular stage at fault. In some cases, however, trouble shooting the AFC circuit with an oscilloscope may prove misleading. In a few receivers, the interaction between the horizontal oscillator and AFC system may cause improper waveforms in all stages instead of in the defective one only.

The capacitance of the oscilloscope probe and the input impedance of the oscilloscope can also upset the operation of the AFC circuit under test. In order that these adverse effects may be minimized, the oscilloscope may be isolated from the circuit being tested if a resistor of large value is inserted in series with the probe. It should be remembered, when this type of isolation is being used, that the amplitude and shape of the waveform may be altered somewhat. It is usually more desirable to employ a low-capacitance probe for such an isolation purpose. This type of probe will introduce a negligible amount of distortion in the pattern observed and is highly recommended when trouble shooting the horizontal section.

The technician is undoubtedly acquainted with the oscillator alignment procedure set forth in most of the service data now available. This procedure will not be given in detail at this time, but its importance to the proper operation of the horizontal oscillator circuit must never be overlooked. As the tubes and other components in the horizontal system age, it may be necessary to perform frequency or phase adjustments. Adjustment may cure the trouble completely, but if repeated adjustments become necessary, the defective part or parts must be located and replaced.

In order to achieve a proper alignment for the Synchroguide circuit of Fig. 2, an oscilloscope should definitely be used. This is about the only way in which to determine the correct setting of the horizontal waveform slug B2.

Common Symptoms

1. Loss of Raster

A blank screen usually indicates that the high voltage on the second anode of the picture tube is missing. When the trouble symptom of no raster but normal sound is encountered, the first logical step is usually to check for the presence of high voltage. If it is excessively low or is missing, the next step is to check for an open fuse and to substitute tubes in the horizontal and high-voltage circuits.

Many technicians are able to determine by ear whether or not the horizontal oscillator is running. If it is, the chances are that

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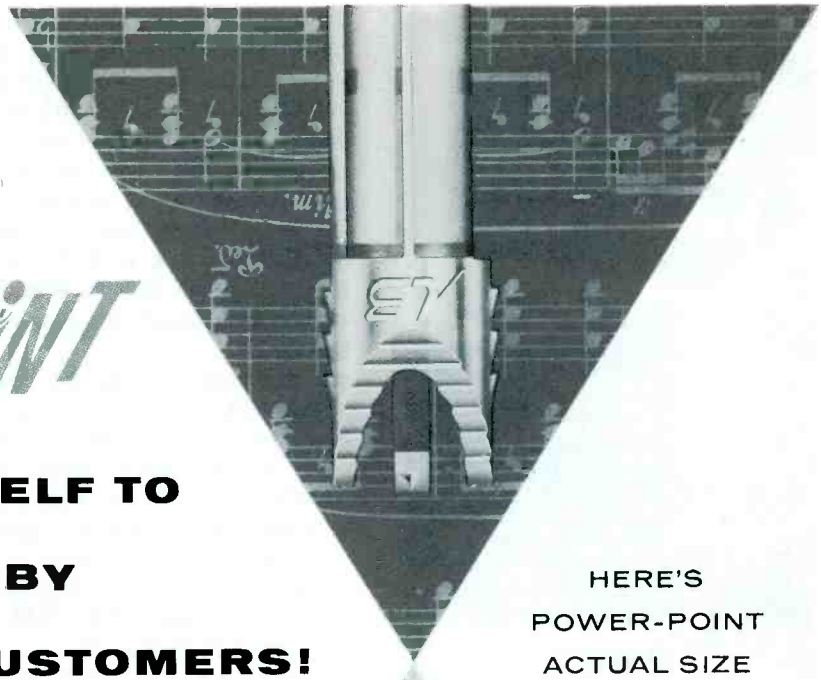

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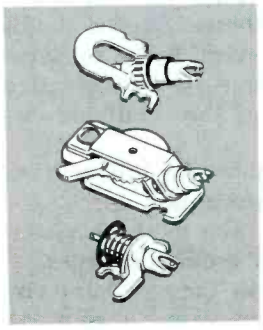

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the trouble exists in the output or high-voltage circuits. If it is suspected that the oscillator is inoperative and tube substitution does not restore the raster, the chassis should then be removed and further tests made in the shop. A meter or oscilloscope can be put to work and the trouble isolated to the defective stage.

Possible causes for loss of raster are:

a. Defective tube in the horizontal AFC or oscillator stages.
b. Plate resistor open or too high in value. (See R102, R103, R113, and R114 in Fig. 2.)
c. Defective coupling capacitor. (See C115 in Fig. 2.)
d. Shorted filter or bypass capacitor. (See C103, C105, C106 and C114 in Fig. 2)
e. Open horizontal hold control.
f. Open capacitor across horizontal waveform coil. (See C111 in Fig. 2.)
g. Defective oscillator transformer.
h. Defective tube socket and shorted or broken leads.
i. Open grid resistor. (See R109 in Fig. 2.)

The listed causes for no raster do not represent all the possible defects which could produce this symptom: rather, they represent some of the more common defects in the horizontal AFC and oscillator circuits only. The technician may find it expedient to check the waveform present on the grid of the horizontal output tube first. If there is insufficient drive at this point, the horizontal oscillator or discharge circuit may be at fault. A voltage and resistance check should then be taken in these circuits.

Troubles developing in the AFC circuit will not usually result in a total loss of raster. In some cases, however, a shorted capacitor or open resistor in this circuit may reduce the B+ voltage or throw the oscillator too far off frequency to produce a raster. It is even possible for a defective AGC stage to render the horizontal oscillator inoperative when a normal signal is being received. With the antenna disconnected or the tuner in an off-channel position, the oscillator may return to operation. This condition can result when the incoming sync pulses produce an AFC correction voltage capable of holding the oscillator tube at cutoff. When the incoming sync pulses are no longer present, the oscillator grid bias will decrease and the stage will resume oscillation.

2. *Loss of Horizontal Synchronization*

The loss of horizontal synchronization is a very common trouble symptom and is usually caused by faulty tubes or components in the horizontal AFC or oscillator stages. It is also possible for a defect in the sync or horizontal output circuits to produce this condition.

In many instances, the loss of horizontal sync can become intermittent or it may occur only during the warm-up period. A trouble of this nature is often caused by some component that changes value as the temperature of the receiver varies. The appearance of dark diagonal bars across the screen, as shown in Fig. 4, indicates that the frequency of the horizontal oscillator is slightly different from the frequency of the incoming sync pulses. The raster and picture are still present, but the picture is not distinguishable on the screen. When the raster and picture are present, this should indicate to the technician that the flyback and video sections of the receiver are operating. In the majority of sync circuit failures, the stability of the vertical sync will also be affected. If horizontal synchronization is poor but the vertical is normal, the trouble is probably in the horizontal AFC circuit.

Another degree of this trouble symptom can cause the results illustrated in the photograph of Fig. 5. In this instance, a number of overlapping pictures can be seen and this indicates that the frequency of the oscillator is much lower than the repetition rate of the picture. Such a condition can be caused by an inoperative AFC stage or by defective components in the oscillator circuit itself.

Possible causes for loss of horizontal synchronization are:

a. Defective tube in the horizontal AFC or oscillator stages.
b. Capacitor in the oscillator circuit changes value. (See C111

in Fig. 2.)

c. Improper alignment of the horizontal system.

d. Improper value of resistor in the AFC network. (See R105, R106, R107 and R108 in Fig. 2.)

e. Defective sync coupling capacitor . (See C102 in Fig. 2.)

f. Vertical sweep or power-supply frequencies entering the oscillator circuit. (Check the lead dress and all filter capacitors.)

g. Defective horizontal hold control or locking-range trimmer.

h. Defective capacitor in feedback network. (See C108 and C109 in Fig. 2.)

i. Open filter capacitor in AFC network. (See C104, C105, C106 in Fig. 2.)

j. Defective oscillator transformer. (See L43 in Fig. 2.)

Horizontal jitter or tearing in the picture is often due to interaction between stages or to external interference. Improper adjustment of the horizontal waveform slug will also produce this trouble symptom. In a few remote cases, the permeability of the slugs used to tune the horizontal frequency and waveform coils has been known to change. If any of these conditions become too extreme, they may result in what is frequently referred to as the "Christmas-tree" effect. An example of this trouble symptom is pictured in Fig. 6.

The Synchroguide system possesses an excellent noise-immunity characteristic, but at the same time, the circuit is very susceptible to microphonic conditions. Some receiver manufacturers employing this type of circuit will shock-mount the tube in order to reduce microphonic effects. Any erratic oscillations occurring in the horizontal circuit will usually upset the operation of the oscillator stage.

3. Improper Horizontal Phasing

Another trouble symptom closely related to poor horizontal synchronization is improper phasing. This trouble usually originates in the horizontal AFC system. An out-of-phase condition will often produce a split picture like that shown in Fig. 7. The right half of the picture will appear at the left of the screen, and

the left portion of the picture will appear at the right side. The dark vertical bar in the center is produced by the horizontal blanking signal. Under normal conditions, a small portion of this blanking signal is present on each side of the picture and can be seen if the picture is shifted off center and is increased in brightness. The remainder of the blanking signal occurs during horizontal retrace time.

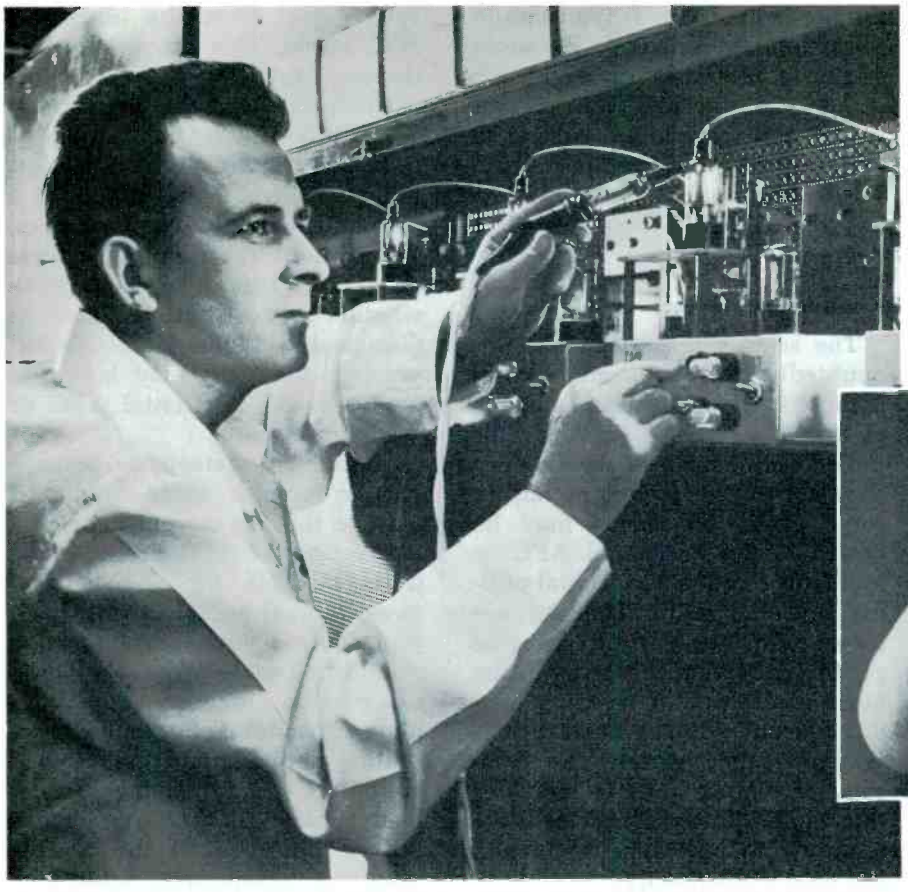
The trouble symptom of Fig. 7 indicates that sweep retrace is being initiated near the middle of each line-scanning signal. This pattern may tend to shift back and forth or intermittently lock into sync. If the phasing trouble is less extreme, a phasing ghost like the one in Fig. 8 may appear on the screen. This symptom will occur when the video signal appears on the screen during horizontal retrace time. The phasing ghost usually takes the form of a white cloud toward the left side of the picture, and it is often accompanied by picture pulling.

Possible causes for improper phasing are:

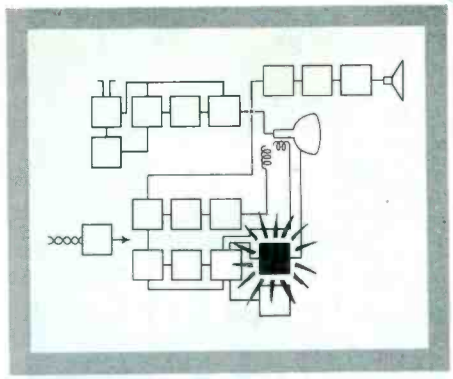
a. Defective tube in the horizontal AFC or oscillator stages.
b. Improper horizontal sweep alignment.
c. Defective capacitor in feedback network. (See C108 and C109 in Fig. 2.)
d. Open or leaky AFC fiilter capacitor. (See C104, C105, and C106 in Fig. 2.)
e. Plate resistor open or too high in value. (See R102, R103, R113, and R114 in Fig. 2.)
f. Defective resistor in feedback circuit. (See R104 and R111 in Fig. 2.)
g. Defective horizontal lock trimmer.
h. The wave-shaping component changed in value. (See C114 in Fig. 2.)
i. Incorrect value of resistor in the AFC network. (See R105, R106 ,R107, and R108 in Fig. 2.)

Many of the phasing problems can be solved by proper alignment of the horizontal system. The alignment procedure should not only include the frequency and phasing coils but also adjustment of the horizontal drive, width, and linearity.

The critical balance required in



ABOVE: A General Electric technician checks rectifier tubes during special flyback life test.



ABOVE: Tungsten "lightning rod" in G-E high-voltage rectifier tubes shields the filament from electrostatic pull of high anode voltages. Shorts, broken filaments are sharply reduced.

"Lightning rod" in G-E high-voltage rectifier tubes minimizes filament pull-out, adds hours of service!

High-voltage rectifier tubes handle high anode voltages. These create an electrostatic pull on the fragile filament, and can cause it to short or break. In General Electric's service-designed 1B3-GT and 1X2-A/B, a tungsten post shields the filament . . . cuts filament-to-plate shorts and pull-out . . . enables you to install long-life tube performance in your customers' sets.

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the horizontal AFC system should always be maintained. Resistors having a tolerance rating of 5% should be checked for correct value and capacitors having a temperature-compensation characteristic should be replaced if for any reason they are suspected of being faulty.

4. *Horizontal Pulling*

The service technician has undoubtedly heard customers complain that the vertical lines in the picture are bent, curved, or pulled out of shape. This is a very common trouble symptom, and in some cases, the cause may be traced to the horizontal AFC or oscillator circuits. Horizontal pulling and horizontal bending are terms used frequently to describe picture distortion occurring in the horizontal plane. A weaving condition usually occurs when the extent of pulling varies. The presence of picture pulling indicates that the horizontal oscillator is attempting to lose synchronization but only momentarily.

Perhaps the most common type of horizontal pulling is slight bending of the lines at the top of the picture. In most instances, the bent portion of the picture will shift back and forth or straighten when various settings of the horizontal hold or contrast controls are made. The trouble symptom pictured in Fig. 9 illustrates a slight bending near the top of the picture.

Another condition of horizontal pulling is shown in the photograph of Fig. 10. Here the center portion of the picture tends to pull to the left; however, the distortion is often more severe than that shown in this photograph.

The trouble-shooting procedure to be followed for isolating the cause of horizontal pulling should include a number of basic checks. The technician should first check for the symptom on all operating channels. By increasing the brightness and misadjusting the centering, he can determine whether the pulling is in the raster or only in the picture. Picture pulling or poor sync phasing will not affect the edges of the raster.

Another logical procedure would be to remove the incoming sync signal from the horizontal AFC stages. This may be done by disconnecting the sync coupling capacitor C102 at the input to the AFC tube. With the horizontal hold control set at mid-position, adjust the frequency coil until a momentary picture can be seen on the screen. It usually requires only a glance to determine whether or not the trouble has disappeared. If the trouble is still present, the fault may be originating in the horizontal AFC or oscillator circuits.

Should no defective components be found in these circuits, it may be that an extraneous signal is affecting the AFC circuit. Since it is possible for the vertical sweep signal to affect the horizontal circuit, the sync section should be isolated from the vertical circuit. Disconnect the coupling capacitor between the integrating network and the vertical oscillator, and adjust the vertical hold control so that the picture can be observed. If the trouble symptom disappears, additional isolation is necessary between the vertical oscillator and the horizontal sync section.

Possible causes for horizontal pulling are:

a. Defective tube in the horizontal AFC or oscillator stages.
b. Open or leaky sync coupling capacitor. (See C102 in Fig. 2.)
c. Component of incorrect value in AFC filter circuit. (See R105, R106, R107, R108, C104, C105, and C106 in Fig. 2.)
d. Improper alignment of horizontal frequency or phase slugs.
e. Poor regulation of B+ voltage supplied to horizontal section.
f. Defective capacitor in oscillator circuit. (See C110 and C111 in Fig. 2.)
g. External signals modulating the horizontal sweep frequency. (Check for an open filter capacitor, poor lead dress, improper shielding.)

5. *Insufficient Width or Foldover*

The signals that are generated in the horizontal oscillator drive the output tube, which in turn energizes the horizontal winding of the deflection yoke. If the amplitude of the output signal from the horizontal oscillator is re-

duced, the width of the picture and raster may be insufficient to fill the face of the tube. A defective tube or component in this section of the receiver may produce the trouble symptom pictured in Fig. 11. This symptom reveals itself as a narrow dim picture which is slightly out of focus. In many cases, however, this type of trouble results from a defective horizontal output circuit, from low line voltage, or from a deficiency in the B+ supply voltage.

The picture in Fig. 12 illustrates another symptom often produced by faulty components in the horizontal oscillator. It can be seen in the photograph that the center portion of the picture has a slight foldover. With the video signal removed, the raster will reveal a bright vertical line at the point of foldover. In some instances, a more noticeable reduction in picture width will accompany this type of horizontal trouble.

When insufficient width or horizontal foldover develops, it is a good idea to examine the waveform present on the grid of the horizontal output tube. If the amplitude of the pulse is lower than normal, or if it is distorted in some manner, a further check of the oscillator should be made.

Possible causes for insufficient width or foldover are:

a. Defective tube in the horizontal oscillator circuit.
b. Improper adjustment of the oscillator and AFC circuits. (Check the frequency, phase, drive, width, and linearity adjustments.)
c. Oscillator plate resistor too high in value. (See R113 and R114 in Fig. 2.)
d. Open or leaky capacitor in wave-shaping network. (See C114 in Fig. 2.)
e. Defective coupling capacitor. (See C115 in Fig. 2.)

6. *Pie-crust Effect*

The trouble symptom presented in Fig. 13 displays what is commonly referred to as "pie-crust" effect. The term is reflected in the wavy shape of the circles making up the test pattern—the circles resemble the edge of a pie crust.

The trouble is usually caused by an electrical hunting action in the horizontal AFC circuit. The amplitude and number of ripples may change with different settings of the horizontal hold control. If the effect of this condition is only slight, the symptom may appear as a pull or wiggle through the picture. An antihunting circuit is usually employed in the conventional Synchroguide system. This network provides a certain amount of correction in case the AFC circuit tends to overcontrol the oscillator. Defective components in this circuit will often produce a pie-crust effect.

In a few instances, it is possible for the horizontal circuit to pick up the vertical signal or some 60-cycle interference from the power supply and to produce this pie-crust condition.

Possible causes for pie-crust effect are:

a. Microphonic tube in the horizontal AFC or oscillator stages.
b. Defective component in the antihunting circuit. (See C104 and R110 in Fig. 2.)
c. Open capacitor in AFC circuit. (See C105 and C106 in Fig. 2.)
d. Defective oscillator transformer
e. Vertical signal picked up by the horizontal AFC circuit. (Check the lead dress, the shielding, and the isolating and filtering components.)
f. Line frequency at the receiver out of phase with the line frequency used by the transmitter.
g. Open bypass capacitor. (See C103 in Fig. 2.)
h. Flux leakage from the power transformer. (Check the shielding and lead dress of the transformer.)

When a picture has horizontal ripple caused by a 60-cycle voltage which is entering the horizontal AFC or oscillator circuits, there are a few procedures which will help you to eliminate this condition.

If changing component and lead positions fails to cure the trouble, it may be necessary to install a metal shield around the horizontal oscillator transformer or to extend the leads of some of the associated components. If a can is used to shield the coil, make sure a good ground connection exists between the metal can and the chassis. ▲

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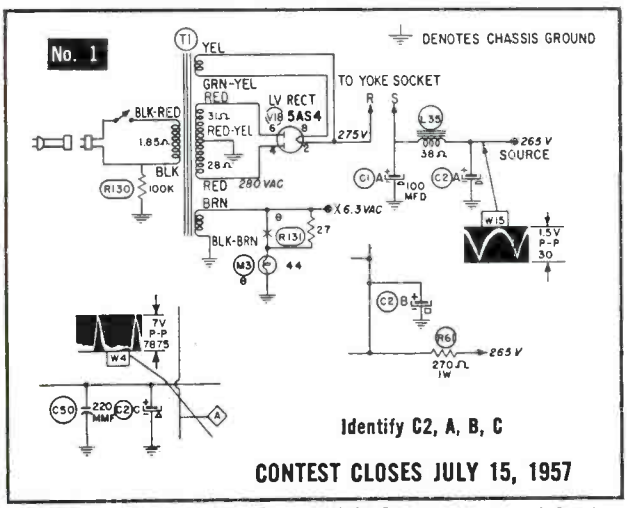

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JUDGES: M. Harvey Gernsback, editor director, Radio-Electronics
Oliver Read, Dsc, publisher, Radio & Television News
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The unidentified capacitor in each entry will be a Pyramid Twist-Mount. All schematics are of TV sets made in the U. S. by a known manufacturer within the past 2 years.

Schematics for reference may be those published by the TV set manufacturers, Howard Sam's Photofacts, or by any other accepted publisher. You may enter as often as you like but be sure to include a box top (showing stock number) of any Pyramid Twist-Mount Capacitor, with your letterhead or business card with each entry.

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Shop Talk

(Continued from page 13)

done at the point where the line is brought into the apartment. Do not disconnect the receiver you are working on from the line. Then, in place of the receivers which have been temporarily disconnected, insert a 72-ohm terminating resistor. This is available in a suitable plug which can be screwed onto the end of the coaxial line.

Check the receiver again. If the flashing persists, then you know that the trouble is located somewhere between the set and the distribution center. However, if the flashing has disappeared, then the defect is somewhere in the disconnected line. There may be a poor connection on this portion of the line which, by its action, is disturbing the rest of the line; or the normal terminating resistor at the far end of the riser may be defective.

If the path points upward, go to the nearest distribution point and check the input and output signals there. If the input is affected, with the output disconnected, then the search upward will continue, this time leading to the next signal distribution point. If the signal at the input is steady, then a defect location between this distribution point and the receiver is indicated.

In all of this, the only test instrument needed is the field strength meter. A VTVM, as we have indicated before, should be carried for auxiliary resistance and voltage checks, but the brunt of the servicing will be performed with the field strength meter. This is why so much stress has been placed on the selection of this instrument and why it is important to always keep it at the peak of adjustment.

Common Defects

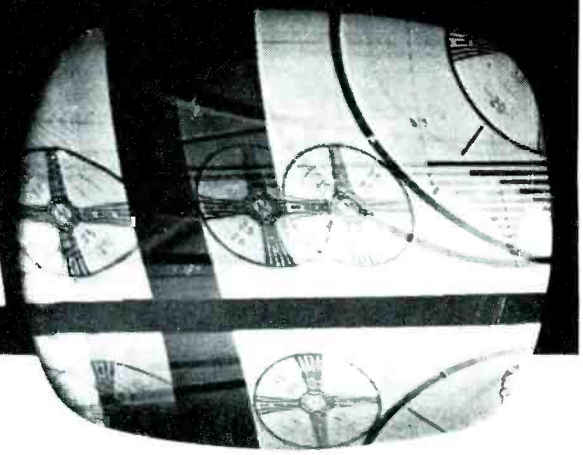
Now that we have discussed general servicing procedure, let us concentrate on certain specific defects which are generally encountered.

Direct Pickup

This situation is generally of interest only in high signal areas where it is not unusual for the chassis to pick up sufficient signal to produce a picture on the screen. Such pictures are usually quite ghosty and completely unusable by themselves. However, to over-ride them, an exceedingly strong signal is required in the system. In one downtown Chicago location, the writer has seen an installation where 25,000 micro-

how long would it take you to solve this service problem?

SYMPTOM: Loss of both vertical and horizonal synchronization.



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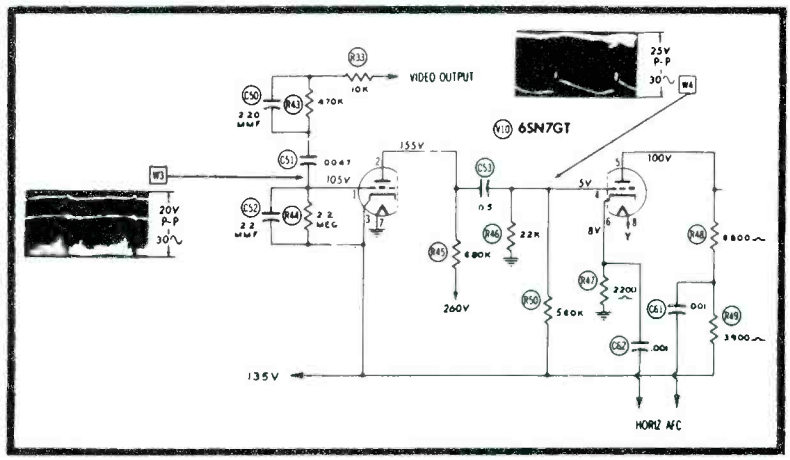
Let's take a look at this problem: The loss of both vertical and horizontal synchronization is very often a result of defective components in the sync circuits. So look for the following possible causes—

1. Defective tube in sync or noise-limiter stages
2. Video-coupling capacitor (C51) shorted, leaky, or open
3. Plate resistors (R45, R48, R49) open or too high in voltage
4. Shorted or leaky coupling capacitor (C53)
5. Sync isolation resistor (R33) open or too high in value
6. Resistance of voltage divider (R46) changed in value
7. Improper cathode bias in R47



With a PHOTOFACT Folder by your side, you trouble-shoot and solve this problem in just minutes. Here's how: Check the sync tube (V10). You locate the tube in just seconds on the Tube Placement Chart you'll always find in each PHOTOFACT TV Folder. It also shows the locating lug for use in replacement when the sockets are "hidden."

Now, if the tube isn't the culprit in this case, use a scope and check for proper waveform and amplitude of signal at pin 1 of V10. The correct waveform is shown right on the Standard Notation Schematic featured exclusively in all PHOTOFACT Folders. Waveform incorrect?—check for defective R33 or C51. Waveform okay?—then:

Check waveform at Pin 4 of V10. Something wrong?—check voltages (they're always on the schematic). Resistance check?—use the handy, easy-to-read resistance chart. In just minutes you can check for defective part R45, R46 or C53. Waveform okay?—then:

Check voltages and/or resistances at pins 5 and 6 of V10 to determine if R47, R48, or R49 is defective. The exclusive PHOTOFACT chassis photos (with call-outs keyed to schematic) help you quickly locate faulty parts. The complete parts list shows ratings and proper replacements...

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volts of antenna signal was needed to produce a satisfactory, ghost-free picture. This is a far cry from the 3,000 microvolts specified earlier in this series of articles. (The reader will recognize that we are dealing here with a special situation. For most installations, 3,000 microvolts of signal at the receiver will prove fully satisfactory.)

The application of a strong signal to the receiver, via the master antenna system, is a brute-force solution that is frequently successful. It has its disadvantages, however. For one thing, to develop this much signal for a network of receivers will usually mean a more extensive master amplifier. Second, the signal may be so high that the operational range of the receiver contrast control is reduced. Third, the receiver will overload more easily since it is operating closer to its saturation level.

There are several other remedies that do not require such a high signal level from the system. One of these consists of placing a length of shielded loom or tubing over the 300-ohm line running from the receiver input terminals to the tuner as shown in Fig. 1. Ground the shield to the chassis at the tuner end. In severe cases of direct pickup, ground the shielded tubing at the rear of the chassis as well as at the tuner.

If the tuner has provision for 75-ohm input line as well as 300-ohm line, use a 72-ohm coaxial cable between antenna terminals and tuner. Also ground the shield of the lead-in cable to the chassis. A U-shaped cable clamp can be used for this purpose and it can be fastened to any convenient hole on the chassis. An inch of vinyl jacket can be removed and the exposed braid clamped to the chassis. It is also helpful to place shields over any unshielded front-end tubes, such as an R.F. amplifier or mixer.

Direct signal pick-up by the riser cables themselves can also lead to trouble. The difference in phase between these signals and those which are fed to the riser from the master amplifier (and hence have suffered some delay through these networks) can also produce ghosts. Useful measures in combating this form of interference are:

a. Use double shielded risers.
b. Ground all equipment well.
c. Place risers in conduit. (The latter should be specified in systems designed for new construction.)

Jerrold recommends, in severe cases, that the received signal at the antenna be converted to another vacant channel. Special crystal-controlled converters are available from them for this purpose.

Excessive Signal at the Antenna

Signals that are too strong can overload the amplifiers and produce one or more of the following effects:

a. Picture breakup.
b. Poor hold-in control at the receivers.
c. Windshield wiper effect.
d. Herringbone pattern.
e. Ride-through of one channel into several others.
f. Picture distortion.
g. Single large stationary horizontal black or white bar.

Where individual channel strips are being used in the master amplifier, correction of this condition is fairly straightforward. This usually involves gain reduction or inserting appropriate attenuation pads before the signal reaches the amplifier. A unit such as that shown in Fig. 2 will provide uniform attenuation from 0-45 db in 3-db steps.

Occasionally one signal will be so much more powerful than any of the others that special traps will be needed to reduce its intensity without affecting the remaining signals. Special sharply-tuned traps are available for this purpose. High-Q traps are particularly necessary at the upper end of the VHF television band because of the difficulty in attenuating a nearby undesired signal. Remember that to maintain the same effective bandpass at the higher frequencies as at the lower frequencies, the Q of a tuned circuit must be raised by the same ratio as that of the upper frequencies to the lower frequencies. For example, to maintain the same bandpass when the operating frequency is doubled requires a tuned circuit possessing twice

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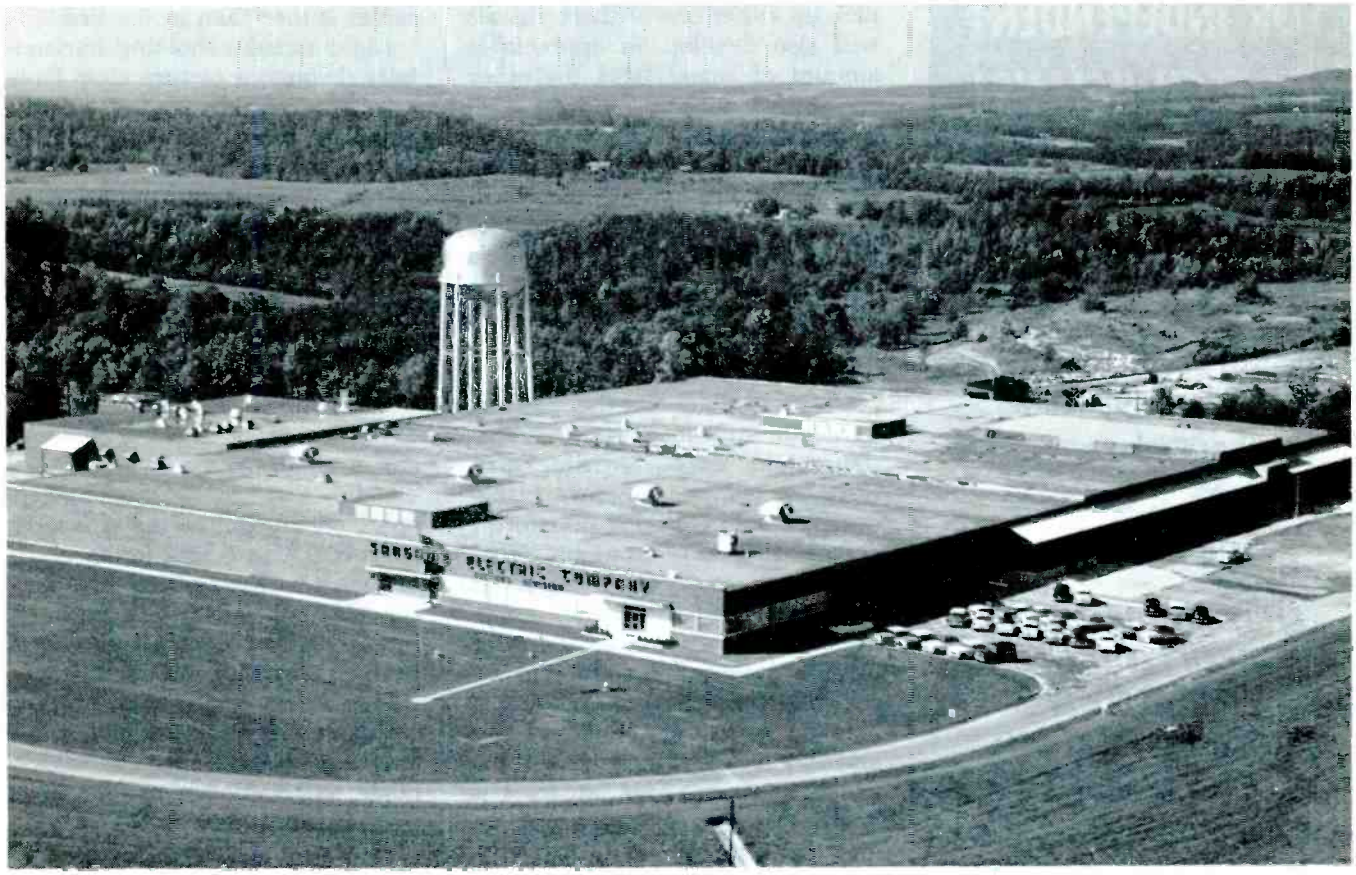

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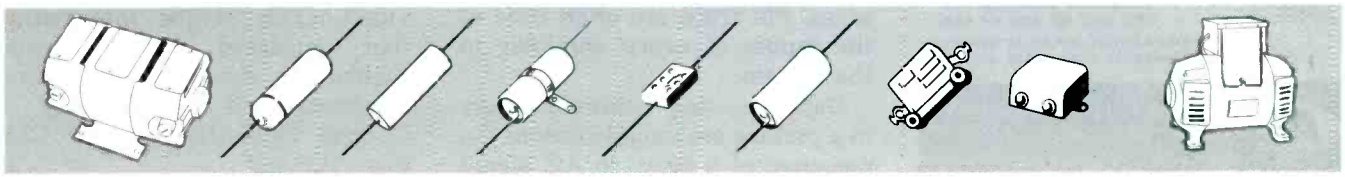

the Q.

A common situation in Chicago is the appearance of the Channel 9 signal in the Channel 11 strip even though separate antennas are being used. This is due to the fact that any antenna used to pick up either one of these signals will also develop an appreciable amount of signal from the other channel. This is true even with the most sharply tuned Yagi. To further complicate the situation, Channel 9 output from the transmitter is far higher than that of Channel 11. Only by using a high-Q trap can this condition be alleviated.

Picture Interference

Diagonal lines in the picture, light herringbone patterns, venetian blind effect, swirling patterns, or complete picture blackout—all stem from RF interfering signals from FM stations, other radio services, local oscillators in TV sets, oscillating line amplifiers or a TV station on the same or an adjacent channel. Local TV set interference can be cured only by servicing individual sets and by checking tapoffs for proper connections and for at least a 12-db tapoff loss. Increasing the amount of tapoff loss to the troublesome receiver will often eliminate the problem. Also, if an unshielded line is used between the tuner and the receiver input terminals, it may help to either shield this line or replace it with 75-ohm coax. Power-line RF filters at the receiver will also help reduce interference which might be carried by the AC lines.

Interference picked up by the antenna system can be eliminated with wave traps, provided that the frequency of the interference is not the same as that of the desired TV signal. Frequently, the worst interference is caused by transmitters operating in the FM band between 88 and 108 mc. A suitable FM trap placed at the antenna input to the first amplifier in the system will usually eliminate this difficulty. In strong FM signal areas, FM traps are often used at the inputs of every amplifier in the system.

Dark, moving horizontal bars in a picture are usually due to the presence of a 60-cycle AC signal in the picture signal. Examine line amplifiers and distribution amplifiers for defective tubes, rectifiers, DC filter condensers, or other power supply components. If AC bars appear in just one receiver, look for AC troubles in that receiver rather than in the line.

Light streaks shooting horizontally through a picture stem from interference caused by automobile ignition, neon or fluorescent lights, electric motors, high voltage power lines, and intermittent cable connections. Ground coax and amplifier units, shield equipment and install power line filters. A high-pass RF filter may be used at amplifier inputs.

Other Troubles

Weak signals on some channels and normal signals on others are usually due to a mismatched, open, or short-circuited transmission line. These line faults occur in such a way as to form a trap for the channels affected. Check all line and equipment terminations, jumper positions and connections.

Weak, snowy pictures are the result of insufficient signal, weak amplifier tubes, open or poorly made connections, or defective transmission lines.

Multiple ghosts or picture smear can be caused by an open or short circuit in the transmission line, improper line or equipment termination, an incorrect terminal connection or jumper position on one of the units, or a ghost in the received signal.

NOTE: In these days of extensive construction, it frequently happens that weak signals are caused by the rise of new buildings between the receiving antenna and the broadcast tower. Keep this in mind whenever a marked decrease in signal strength occurs.

* * *

Since this is the final article in this series, the writer would like to acknowledge his indebtedness to the manufacturers of master antenna equipment and to the service organizations who provided much of the information that appeared here. Special thanks are due also to William Grossman and Sid Reisberg of Central Television Service, Chicago, Illinois. ▲

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Resonant Circuits

(Continued from page 25)

By the same token, the value of C may be determined using the formula:

$$C = \frac{25{,}300}{f_R^2 L} \qquad (6)$$

Figure of Merit or Q

The figure of merit or Q of a coil is the ratio of the inductive reactance of the coil to the resistance of the coil and is expressed by the formula:

$$Q = \frac{X_L}{R} \qquad (7)$$

where X_L = reactance in ohms of the coil at resonance,
R = resistance in ohms.

To apply formula (7), let us use a typical 28.1-mc trap (Fig. 1). You will notice that an 18-mmf capacitor C1 is shown in series with the coil L1, which is tuned to resonate at 28.1 mc. By applying formula (5), we can determine the inductance of L1, which is necessary first if we are to determine the Q of the coil.

$$L = \frac{25{,}300}{f_R^2 C}$$

$$L = \frac{25{,}300}{(28.1\times10^3)^2\times18\times10^{-6}}$$

$$L = 1.78\ \mu h.$$

With the value of L known, we can calculate X_L by applying formula (1) which was given in Part 1 of this series of articles.

$$X_L = 2\pi fL \qquad (1)$$
$$X_L = 6.28\times28.1\times10^6\times1.78\times10^{-6}$$
$$X_L = 314 \text{ ohms.}$$

The value of resistance of L1 was given as .16 ohms in Part 1 and we will use this value in calculating Q. By applying formula (7), we find:

$$Q = \frac{X_L}{R}$$

$$Q = \frac{314}{.16}$$

$$Q = 1{,}962.$$

Thus, we see that the Q of the coil is very high. However, the effective Q of the trap circuit (L1

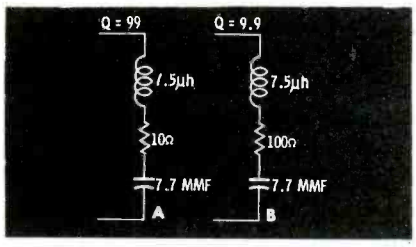


Fig. 3. Series resonant circuits, *(A)* high-Q and *(B)* low-Q.

and C1 in Fig. 1) is somewhat lower because of the loading effect caused by T1 and R1. Even with this loading, the effective Q of the trap circuit will be on the order of 100 or more. This high effective Q is necessary if good trap action is to be obtained without an adverse effect on the desired frequency response.

It is the property of a tuned circuit with a high Q to peak very sharply at resonance with the response falling off abruptly at frequencies away from resonance. To illustrate this point, let's examine the bandpass curve of a relatively high-Q circuit. Curve A in Fig. 2 illustrates the amount of current that would flow through a series tuned circuit that has a Q of 99 if 1-volt signals at frequencies at or near resonance were applied. A 21-mc series-resonant circuit consisting of 75μh, 7.7 mmf and 10 ohms (Fig. 3A) was used for the calculation of values for curve A. By plotting current against frequency, we obtained an indication of the Q and the bandpass characteristics of the circuit. Each point on curve A was obtained in the following manner. X_L and X_C were determined; Z was figured using the values of X_L, X_C, and R; and current was calculated using each new value of Z. The formula for current in a series tuned circuit is:

$$I = \frac{E}{Z} \qquad (8)$$

where I = current in amperes,
E = voltage in volts,
Z = equivalent circuit impedance.

The values of X_L, X_C, and Z for each point on curve A of Fig. 2 are given in Chart I. These values may be used to check your figures and to apply them in the appropriate formula for working out the response curve of a high-Q series tuned circuit.

So that the difference between

a low-Q circuit and a high-Q circuit will be made very clear, we also plotted the current through a 21-mc series tuned circuit with a Q of 9.9 (Fig. 3B). This was done in the same manner that was used for the high-Q circuit, and curve B in Fig. 2 was the result. The values of X_L, X_C and Z for each point on curve B are also given in Chart I. You will notice that the difference in the Z of each circuit was caused by the difference in R since X_L and X_C for each point was the same for both curve A and curve B.

Curve B has only a small change in amplitude at frequencies ranging from resonance to 15% on each side of resonance, whereas curve A has a large change in amplitude for frequencies only 2½% away from resonance. These characteristics have very definite applications in radio and television. Low-Q circuits are used in wide-band applications where it is desired to pass a wide range of frequencies. High-Q circuits are used as traps, since it is necessary to eliminate a narrow range of frequencies without seriously affecting the desired frequency range.

Q of a Circuit

It was shown that the Q of the coil alone may be very high, since a coil may be wound with low-resistance wire and have a considerably high reactance. The Q of a circuit will be lower than the Q of the coil alone because of the resistance in the wiring and the effective resistance of the capacitor. In the example using the 28.1-mc trap coil, we found a coil Q of 1,962. Now if we consider the small amount of resistance in the wiring between this series circuit and the control grid and the small effective resistance of the capacitor, the effective Q of the 28.1-mc trap may be reduced to 1,000 or less. This is still very high when compared to the Q of 9 or 10 for the entire grid circuit of the video IF amplifier. The low circuit Q is due to the low-impedance transformer coupling from the tuner and the 200-ohm shunt resistor. This circuit will be covered more completely in the discussion of parallel tuned circuits to appear in a forthcoming issue. ▲

Remote Tuning Without Wires *(Continued from page 21)*

has only two key-and-rod combinations.

The receivers used with both models of transmitters have three RF stages utilizing a 6CB6 and both sections of a 6AU8. Following the last stage is a 6BN6 limiter. Frequency tripling takes place in the plate circuit of the third RF stage in the "400" and in the limiter plate circuit in the "200". The resulting third-harmonic output frequencies are shown in Table I.

The output of the limiter in the "200" is fed to a 6AL5 discriminator tuned to 122.25 kc, whereas the "400" receiver has two discriminators, tuned to 114.75 kc and 122.25 kc respectively. These frequencies were chosen so that the third harmonics of all control frequencies would fall either above or below a discriminator center frequency by exactly 1.5 kc. The discriminator output circuit of the "200" receiver is included in the schematic in Fig. 2. Similar circuits are found in the "400" unit.

Table I—Control Frequencies for Zenith "Space-Command"

Function ("400")	Function ("200")	Freq. (kc)	3rd Harm. (kc)
ON-OFF		37.75	113.25
MUTE		38.75	116.25
LEFT	RIGHT	40.25	120.75
RIGHT	MUTE	41.25	123.75

When a "mute" signal (above center frequency) is received by the discriminator in the "200", a positive output, obtained from the upper diode, is fed through an integrator circuit to one control grid of a 6CM7 relay-control tube. The "right" control signal for the channel-selector motor is below center frequency and produces a positive output in the lower diode of the discriminator. The grid of the second section in the 6CM7 receives this signal.

A fixed bias (—18 volts in the "200" or —28 volts in the "400") keeps the relay-control tubes cut off until a signal arrives. Being positive, the control signal overrides enough of the fixed bias on one section of the 6CM7 to permit it to conduct, and the relay coil which is series-connected in the plate circuit is energized. A plate current of 8.5 to 11 ma is sufficient to operate the motor-control relays, and they remain closed as long as the current stays above this level.

The "on-off" and "mute" relays require 13 to 17 ma DC for operation and are of a bi-stable type—i. e., the switch contacts may remain in either of two resting positions (shown in Fig. 2) after the relay is de-energized. One "ping" from the transmitter opens a switch in the speaker circuit and mutes the sound, and a second "ping" is required to restore the switch to the closed position. The cores of the bi-stable relays are connected to the coils through 1-megohm resistors to place these two adjacent parts at approximately the same potential.

The "200" receiver obtains power from the TV set through an octal plug. A low AC voltage from a special tap on the main power transformer, applied to a selenium rectifier on the control chassis, de-

velops —18 volts of fixed bias for the 6CM7. The larger "400" receiver is self-powered, having its own transformer and 25Z6 rectifier. One section of the rectifier tube furnishes 235 volts B+, and the other section supplies —28 volts of fixed bias.

The motor-driven channel selector which is controlled by the "Space-Command" system is similar to the automatic tuners described in "About These Automatic Tuning Devices . . ." in the February, 1957 PF REPORTER. Closing of the relay on the control chassis causes the motor to begin a tuning cycle, and an internal switch keeps the motor circuit closed until the next channel position is reached. Desired channels are preselected by adjustment of tabs at the back of the receiver. (Directions for adjustment are printed on the back cover of the set.) In a tuner that is set up to stop at all channels, a cam moves a pawl and opens the motor switch each time a new channel position is reached. When the tab for a particular channel is adjusted for bypassing, it prevents the cam from turning the pawl when the tuner reaches the position to be skipped. As a result, the motor switch stays closed and the motor continues to run.

Operating and Servicing Hints

The "Space-Command" transmitter is effective as far as 30 feet away from the TV receiver. In an average-sized room, it can be pointed in practically any direction with good results. The transmitter and receiver do not have to be in a direct line of sight as long as the sound waves can reach the microphone. Around-the-corner performance is most successful in an acoustically "live" room.

A TV receiver equipped with the "400" unit can be turned off either by the remote transmitter or by the switch on the set. In the former case, the control receiver remains in operation as long as the TV set is plugged into the AC line and the set can be turned back on from a remote location at any time. If the main set switch is turned off, the primary circuit of the power transformer in the control receiver is broken and the set switch must be used to resume operation.

The following troubles are among those which have been observed in the field.

1. *One relay fails to operate.* Caused by an open relay coil in the control receiver. To check for this condition, see whether B+ is present on all 6CM7 plates.
2. *None of the relays operate.* Caused by a short in the primary of the discriminator transformer. This fault can usually be spotted easily because the affected coil will be discolored.
3. *Continuous operation of tuning motor.* Caused by a shorted or leaky 5-mfd capacitor in the bias line, with resulting loss of bias on the 6CM7's. The same symptom can also be caused by sticking relay contacts.
4. *Failure to operate until transmitter is brought within a few inches of set.* Caused by a bad microphone. The vibrating element can be removed after two Phillips screws are taken out. Although the TV set appears to

have two microphones, the one at the right is a dummy.

5. *Erratic operation, such as random triggering of relays.* Most frequently caused by a bad tube.
6. *Failure of transmitter to operate.* Caused by tuning rod loose in its mounting. Check this by shaking the unit and listening for a loud rattle. To disassemble the transmitter, depress the two center keys and remove the Phillips screw located between them. Then grasp the case and push down on the keys to separate the chassis from the case.
7. *Tuner goes through extra cycle.* Caused by prolonged reverberation of tuning rod. Normally, as soon as the transmitter key is released, a small wire spring touches the rod and damps its vibration. Its action can be made more effective if a piece of spaghetti is slipped over the end of the wire. It may only be necessary to instruct the customer to let go of the key promptly.

The "Space-Command" system is not generally sensitive to outside interference. We have heard of one case of spurious triggering, however. One set changed channels each time the front door of the home was opened, because an inaudible squeak in the door was of the correct supersonic frequency to activate the motor-control relay. Oiling the hinge fixed the TV!

A test point is provided on top of the "200" control chassis for measurement of the bias voltage. In addition, some "200" sets have adjustable bias to compensate for changes in the condition of the selenium rectifier or variations among relays.

The manufacturer recommends that the tuned RF circuits should not be realigned, and that they should be replaced as a unit if they develop trouble.

Several specialized items of test equipment for servicing "Space-Command" devices are available from the manufacturer. There is a power supply which will operate the 5-tube control chassis independently of the TV set. Another item is a set of special jumpers that can be attached to the TV receiver so that it can be operated with the control chassis removed. There is also a discriminator-alignment generator which is similar to the "200" 2-key transmitter except that the third harmonics of the frequencies from it exactly equal the discriminator center frequencies (114.75 and 122.25 kc).

Motorola "Transituner"

An optional accessory for some recent Motorola TV sets is the TK-74 "Transituner," a remote channel selector. Its essential components are:

1. A pocket-size transmitter consisting of a 2N112, 2N112A, or 2N135 transistor connected in a Hartley oscillator circuit and powered by a 22½-volt battery.
2. A ferrite loop antenna with an electrostatic shield, mounted in or under the TV set.
3. A 3-tube control receiver powered by the TV set.
4. A relay which acts as a motor-control switch for an automatic tuning system. (See the previously-mentioned article, "About These Automatic Tuning Devices . . . ," for a com-

plete description of the tuning motor system.)

The operating frequency of the receiver and transmitter is fixed at 2.881 mc. Two 6AU6 tubes are used as high-gain RF amplifiers, and the output of the second stage is rectified by a 1N64 detector. The load is direct-coupled to a relay tube—one section of a 12AT7.

Fig. 3 is a schematic of the detector, relay, and associated circuits of the Motorola control receiver. The detector output voltage is positive and subtracts from a fixed bias on the grid of the relay tube; therefore, an incoming signal brings the tube out of cutoff and causes current to flow through the relay coil in the plate circuit.

The fixed bias has a value of about −15 volts and is obtained from the filament supply by means of a selenium rectifier voltage doubler. The portion of the rectifier output which is required as bias is tapped off at the arm of a "threshold" potentiometer. A smaller part of the rectified filament voltage is applied across a "sensitivity" control which furnishes a variable bias for the grid of the second RF amplifier.

The second section of the 12AT7 is diode-connected and serves as a noise clamp. Since the cathode is maintained at +0.9 volt, this tube is normally non-conducting. Strong noise pulses drive the plate of the clamp tube more positive than the cathode, and the resulting conduction of this tube clips the pulses so that they do not trigger the relay control tube.

Operating and Service Hints

The voltage at a test point in the grid circuit of the relay tube is monitored with a VTVM during most adjustments on the receiver. Under no-signal conditions, the reading at this point should be from −5 to −6 volts. The voltage should shift by approximately +2 volts when the transmitter is keyed. Advancing the threshold control supplies more bias voltage to the relay tube and results in a more negative indication. Turning up the sensitivity reduces the negative VTVM reading because the detector produces more positive signal voltage.

The receiver will respond to

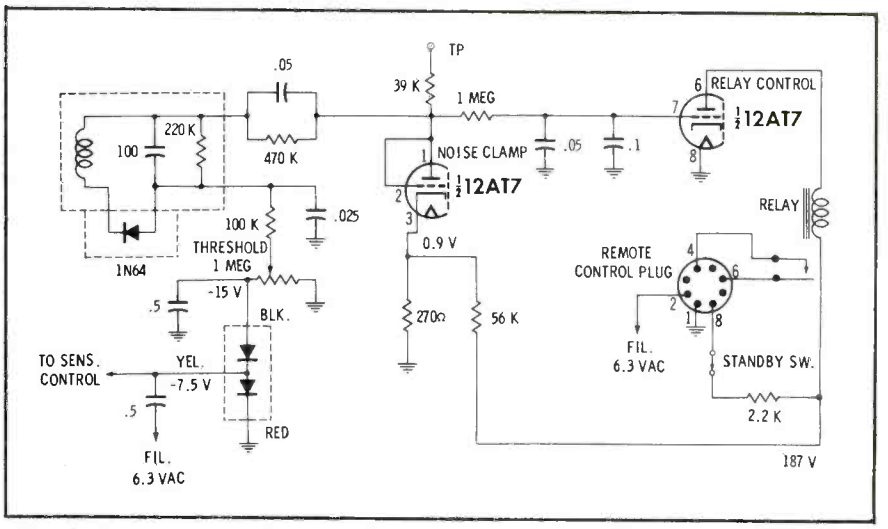


Fig. 3. Detector and relay-control circuits of Motorola "Transituner." Detector output rides on top of fixed bias derived from filament supply.

certain kinds of RF interference, and it is especially sensitive to some of the harmonic frequencies radiated by the high-voltage circuits of the TV set. The control antenna must therefore be carefully positioned for the least possible noise pickup. The "Transituner" can be made to operate in a location with a high RF noise level, but the control receiver sensitivity must be reduced under such conditions.

The antenna should be oriented with the aid of a VTVM. The procedure is as follows: Turn the threshold control for a maximum negative reading. Then turn the sensitivity control to maximum, and see if the reading becomes less negative. It should do so because more noise should be present in the detector output circuit. Rotate the antenna for the most negative reading obtainable; this corresponds to minimum noise pickup. If this reading is less negative than —6 volts, the sensitivity setting must be reduced.

Back off the threshold control until the relay tube is brought out of cutoff and the motor starts operating. Then gradually increase the bias until the motor stops. Note the VTVM reading at this point. Keep turning the threshold control until the VTVM indicates a bias 2½ volts more negative than that required to stop the tuner motor. If the control is left at this setting, the noise clamp should operate correctly during normal reception.

The technician can make a rough check of control-receiver operation by taking advantage of the unit's sensitivity to high-voltage radiation. The manufacturer suggests that if the shaft of the width control is held in one hand and the other hand is placed near the control antenna, enough signal to operate the receiver may be delivered to the antenna. Should this test fail to work on the first try, it can be attempted again at a reduced threshold setting. A precision signal generator tuned to 2.881 mc is also usable and has the added advantage of indicating whether or not the receiver is operating on frequency.

A highly probable cause of remote-control failure is a defective battery in the transmitter. Among the likeliest causes of continuous operation or random triggering are excessive noise pickup and insufficient relay-tube bias. A high noise level may be a result of poor aiming of the antenna, or it may indicate too much radiation because of some defect in the TV set. Insufficient bias is sometimes due to weak selenium rectifiers, or the trouble may be an incorrect setting of the threshold control or a defect in the noise-clamp circuit.

Summary

A wireless remote control tuning device is a simple "little black box" from the customer's viewpoint. The technician, however, sees it as a chain composed of several links—transmitter, signal-pickup device, control receiver, and relays—and these extra circuits mean more potential service business for him. ▲

Notes on Test Equipment

(Continued from page 23)

the red test lead from the DC-bias jack of the instrument to the AGC line of the receiver. By adjusting the DC-bias control of the analyzer, I was able to restore the set to normal operation, thus proving that the fault was in the AGC circuit itself.

The Model 825 also provides a means of checking for opens and shorts in the AGC system. By removing power from the receiver, placing the meter function switch in the AGC OHMS position, and connecting the meter leads between the AGC line and chassis ground, I was able to measure the circuit resistance on the AGC continuity scale. In this particular circuit I obtained a reading of approximately 60,000 ohms, which is normal. If the test had revealed a shorted or open condition, the instrument could have then been used as an ohmmeter to check individual circuit components.

For my next test I used a recently-designed vertical chassis employing a keyed AGC system. When troubleshooting this type of circuit, the technician will often find it advantageous to measure the amplitude of the gating pulse on the plate of the AGC keyer tube.

In order to perform this operation, I placed the function switch in the P-P OR RMS position, zeroed the meter with test leads open, and connected the test leads between the keyer plate and chassis ground. After tuning in one of the local stations, I noted a reading of 500 volts peak-to-peak on the meter scale. I found this to be a normal value as specified by the set manufacturer. In addition to this peak-to-peak AC measurement, I found that by placing the function switch in the 300-0-300 VDC position I could check all remaining DC voltages associated with the AGC system.

As a final step in the examination of the Model 825, I decided to check the AGC action of another late model set using the variable RF signal produced by the instrument itself. To set up the equipment, I placed the function switch in the 15-0-10 VDC

position, zeroed the meter, attached the test leads to the AGC line, and connected the RF cable from the analyzer across the antenna input terminals of the receiver. I then adjusted the set to receive channel 2 and placed the RF output control of the analyzer to approximately mid-position. The 15-kc sync-pulse modulation appeared on the test tube screen as several slanted horizontal bars. Following the instruction manual, I adjusted the horizontal frequency of the receiver until the modulation appeared as one dark area on the right side of the screen (Fig. 2).

I checked the AGC voltages produced by various settings of the RF output control and from this I was able to see exactly how the AGC system acted under a wide range of RF signal levels. The zero center feature of the VTVM in this instrument makes it of additional use in the adjustment of FM sound detectors and balanced horizontal AFC circuits. The variable bias supply could also be of help when performing RF and IF alignment.

New Scope Features Automatic Sweep

The Hycon Model 622 oscilloscope (Fig. 3) is designed for general-purpose use as well as for color TV servicing.

Electrical specifications are:

1. *Cathode Ray Tube—5ABP or 5ADP with either short, medium, or long persistence; illuminated face with both horizontal and vertical calibration lines.*
2. *Vertical System—sensitivity of .01 volts RMS/inch, response from 6 cycles to 6 mc ± 3 db, maximum input voltage of 600 volts AC or DC, input impedance (less probe) of 1 megohm shunted by 40 mmf ± 2 mmf, 8-step vertical attenuator.*
3. *Horizontal System—sensitivity of .075 volts RMS/inch, response from 1.5 cycles to 500 kc ± 3 db, maximum input voltage of 600 volts AC or DC, input impedance of 100K ohms shunted by 25 mmf, sweep expansion to 5 times normal size.*
4. *Internal Sweep System — frequency range from 10 cycles to 300 kc, preselected sweep rates*

Fig. 3. Hycon Model 622 featuring a new automatic sweep control system.

of 30 and 7,875 cycles, sinusoidal sweep at line frequency with variable phase.

5. *Z-Axis Modulation—input impedance of approximately 100K ohms, requires positive signal for blanking.*
6. *Internal Calibration — square-wave signal at line frequency with amplitude of .05 volts peak-to-peak ± 3%.*

When I examined the Hycon Model 622 oscilloscope in our lab, one particular feature stood out above the rest. It was the AUTO SWEEP switch located near the center of the control panel. In order to familarize myself with the functions of this switch, I consulted the manufacturer's instruction manual. From it I learned that the switch was part of a very interesting automatic sweep control circuit.

After turning the instrument on and letting it warm up, I obtained a clearly defined trace by following the setup procedures given in the instruction manual. Using one of the audio generators in the lab, I decided to check the operation of the automatic sweep circuit. Connecting the vertical input cable of the scope to the output jack on the generator, I positioned the sweep switch of the scope at 100 cycles and placed the range switch of the generator for a variable output of 60 to 600 cycles. I touched up the intensity and focus on the scope, adjusted the sync control and obtained a sinusoidal waveform on the screen. Varying the frequency of the generator from 60 to 600

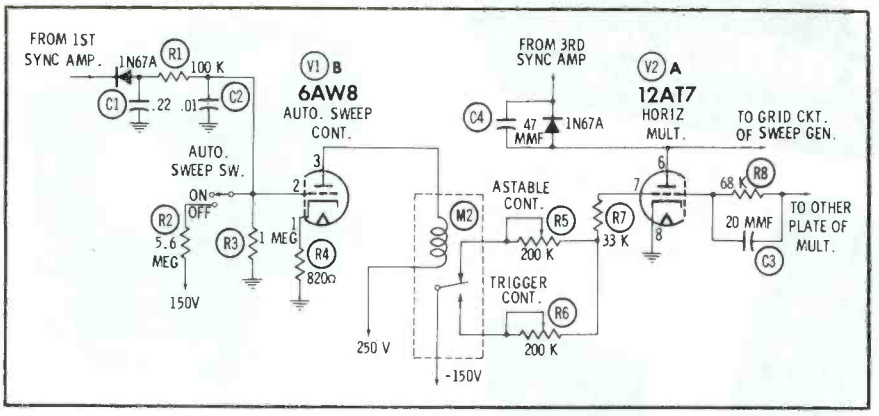


Fig. 4. Automatic sweep circuit used in the Hycon Model 622 scope.

cycles, I discovered that the pattern remained in sync without adjusting any other controls.

My next move was to increase the frequency range of the generator by placing the range switch in the 600 to 6,000 cycle position. When this was done, the pattern on the scope screen fell out of sync. To correct this condition, I merely moved the sweep switch to the 1K position and the pattern snapped back into sync. From this little experiment, I learned that whenever a suitable signal is applied to the vertical input terminals of the scope and the AUTO SWEEP switch is on, the sweep circuits will be synchronized with the input signal, provided the sync control is set at the appropriate polarity and the sweep range is anywhere close to the incoming frequency.

Let's take a quick peak at the automatic sweep control circuit (Fig. 4) and see how it works. The triode section of a 6AW8 functions as the automatic-control tube, V1B. With the AUTO SWEEP switch S1 in the ON position and no signal coming from the first sync amplifier, the conduction of V1B activates relay M2 which places a predetermined bias voltage on the grid of the sweep multivibrator V2A. The bias is established by the setting of the astable control R5. This action throws the multivibrator into a condition wherein it feeds recurring gate pulses to the sweep generator stage which develops a sweep signal for horizontal deflection.

On the other hand, when a sync signal is applied to the sync amplifier, a negative bias voltage is developed by diode M1 which in turn cuts off V1B. With V1B not conducting, the relay M2 switches to the trigger control circuit. The trigger control R6 supplies a different bias to the multi-

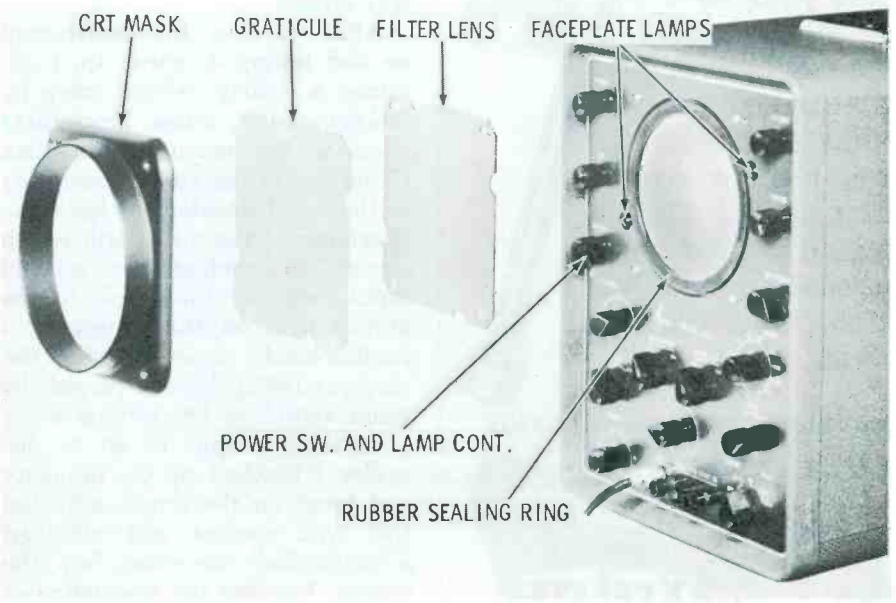


Fig. 5. Exploded view of the CRT mask assembly on the Hycon scope.

vibrator grid and throws it into a triggered or driven condition. Negative sync pulses from the third sync amplifier are then coupled to the multivibrator through diode M3. Thus the incoming sync signal triggers the multivibrator and the scope goes automatically into driven operation. In the EXT or 60-cycle sweep positions, plate voltage is removed from the multivibrator, and 60 cycle or external sweep signals are fed directly to the deflection amplifier section.

Getting back to the more physical aspects of this particular scope, I've always been a little curious to learn exactly how the calibration lines on the face of such an instrument are illuminated. To satisfy my curiosity, I completely disassembled the CRT mask and closely examined its structure. See the exploded view illustrated in Fig. 5.

Directly behind the metal CRT mask, I found what the manufacturer refers to as a 5" graticule. This clear lens is marked with calibration reference lines which are etched into the plastic-like surface. Behind this piece is a green-tinted filter which is designed to improve trace contrast. Two red dial lamps are mounted in the front panel of the instrument as pointed out in Fig. 5. These bulbs are positioned so that their light strikes the edges of the graticule and thus illuminates only the etched lines. The brightness of the bulbs can be varied by adjusting the control knob located on the power switch. With this arrangement, the reddish calibration lines are easily seen against the green filter and help the operator perform calibration measurements under poor external light conditions.

Automation Hits Tube Testing

The instrument pictured in Fig. 6 represents one of the latest ideas in tube testing devices. Manufactured by the Hickok Electrical Instrument Co. of Cleveland, Ohio, this Model 123 tester, named the "Cardmatic," can be automatically set up for any particular tube type by inserting a pre-punched index card. Operating similarly to an IBM machine, the instrument was orig-

inally designed for self-service counters and industrial applications.

The instrument will check tubes for:

1. *Leakage and shorts.*
2. *Quality (Mutual Conductance).*
3. *Gas.*

Direct results are indicated on a Good-Replace meter scale. A complete set of automation cards for all conventional radio and television tube types are supplied with the instrument.

When checking out this unit in the test-equipment lab, I found it so unusual that I was sure many of our readers would be interested in learning more about it.

In order for you to follow the operating instructions and to become more familiar with its design, I have pointed out all of the significant features of the instrument in Fig. 6. I found myself very eager to check some tubes on the "Cardmatic" so I proceeded to set the instrument into operation after reading the installation notes carefully. I decided to check a typical television tube, a 6SN7 dual-triode.

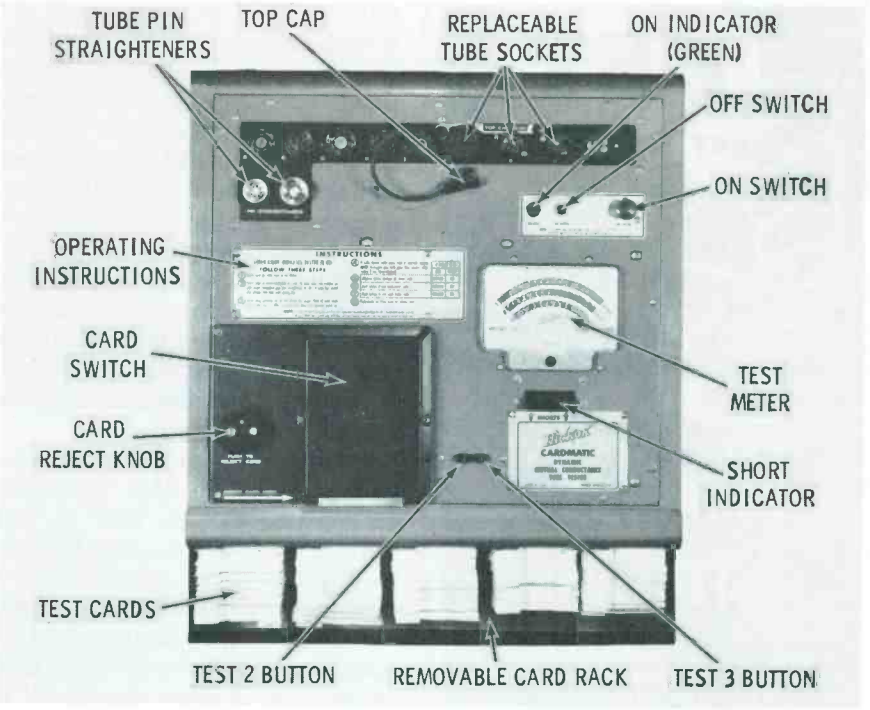


Fig. 6. Control panel of the Hickok "Cardmatic" with all features identified.

Following the operating instructions for tube testing, I thumbed through the test cards until I located two cards marked "6SN7". Next, I placed the tube in the proper test socket, which incidentally is indicated on both cards, and slipped the first card into the card switch slot. When the card is pushed all the way in, the large reject knob just left of the card switch will fly up sud-

denly. This simple operation automatically sets up the instrument for the leakage-short test. Allowing the tube to warm up for 10 or 15 seconds, I then observed the short indicator bulbs located under a small hood below the meter. If a tube is shorted, one or more of the bulbs will glow. In this particular case a short was not evident. In addition to the shorts test, any leakage within the tube will be indicated on meter scale #1.

For the next test, I depressed the small push-button marked 2. This button is located just to the right of the card switch. With the button down, I observed the meter reading on scale #2 as per instructions. For the tube I was testing the meter needle came to rest in the GOOD area, indicating that its mutual conductance was satisfactory. I released push-button 2 and depressed button 3.

This final step is the gas test, and if the tube is gassy, the meter needle will read in the REPLACE region of scale #3. In this step, the 6SN7 under test indicated no gas content. I repeated the foregoing procedure, using the second card of the 6SN7 test. This card automatically set up the instrument for testing the other triode section of the tube. You may be interested to know that I later checked some known bad tubes with the instrument and found the "Cardmatic" to be very accurate.

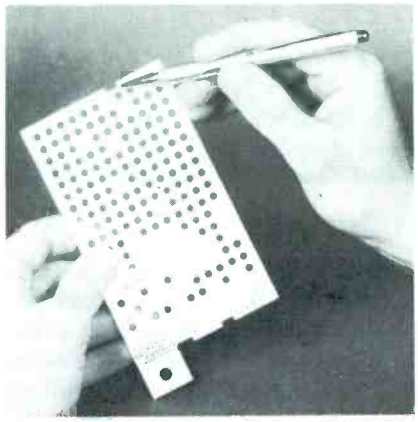
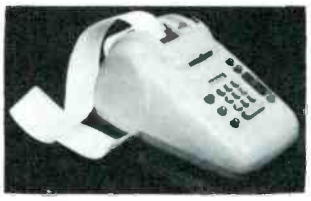


Fig. 7. A typical test card used by the "Cardmatic" tube tester. The small notch pointed out in this picture is one of the instrument's safety features.

The test cards used with this instrument are made of a white plastic-like material with various combinations of holes for the different tube types.

The small notch in the leading edge of the card (Fig. 7) prevents it from being inserted upside-down. In the correct position, the leading edge of the card closes a small contact switch mounted in the back of the card switch. If this switch is not activated, the reject knob will not come up, and power will not be applied to any of the tube sockets. All cards are printed in either gold, red, green, or blue ink. Gold printing on a card tells the operator that only one card is required to test the tube. Red printing indicates two cards are required, green, three and blue, four.

Contained in an envelope inside the back cover of the instruction manual you will find several special test cards. These cards may be used to check the operation of the instrument during installation and at periodic intervals thereafter. As an aid to the technician, operating instructions are clearly given on the front panel of the instrument, and a complete troubleshooting guide is contained within the manual. ▲



Let's Talk Business

by Verne M. Ray

Tips on Handling Customers

A periodic check of your customer files will show that certain people haven't called for service in some time. There can be several reasons for this, of course, but let's hope that none of them are your fault. The point is that it costs money to get customers, and you should be very much concerned about keeping them. It's a proven fact that it costs more to get new customers than it does to keep old ones. In addition, repeat customers often provide free advertising by making recommendations to their friends, relatives and neighbors.

Some of us neglect our regular customers because we're too concerned about getting new ones. For example, the last time you had a choice of making only one of two calls, one for an old customer or one for a person who never called before—did you take care of the new one first, hoping to make a good impression and confident that your old customer would wait a little longer? There is a certain psychology in favor of such thinking, and in many cases it pays off—but your regular customers better not hear of it, or you'll lose them for sure.

This neglect can also be applied to the personal treatment of your customers. The day has past when the public was awe-struck by the mysteries of video. Sure, most people still express some amazement at the sight of "all those wires" when first exposed to the underside of a chassis, but they expect the technician to know his business and to fix the set without too much expense on their part. Today, TV is taken for granted almost as much as the automobile, and the technician has to do more than display his skill at tube changing to keep his customers happy. Courtesy, kindness, and frank explanations in layman terminology pay off in other service businesses—and they will in TV servicing, too!

Customers are sometimes pretty shrewd people. Recently, a technician friend of mine told me about an incident which occurred in a customer's home. Not being able to restore the high-voltage supply to normal operation, he advised the woman that the chassis would have to go to the shop for further analysis. Naturally, she wanted to know how much this would cost. He explained that the trouble would have to be located with the use of special test instruments and that this was often a time-consuming, laborious operation, making it difficult to determine the precise cost in advance. Still she insisted on some sort of quotation, so my friend told her that this type of repair usually ran between $20 and $30, based on parts and labor costs.

When she finally consented, he pulled the chassis and set it on the floor, bottom-side exposed. "Oh, just look at all those wires and things under there! How do you fellows ever find a trouble in all that maze?"

This was the perfect opportunity for the technician to justify his reasons for not being able to accurately estimate the cost of the repairs. Forgetting all modesty, however, he replied, "Nothing to it when you know how," implying that he was an expert and would have little trouble setting this receiver straight.

The customer, feeling that she was being taken because of her ignorance in electronics, quickly retorted, "Then how come it's going to take so much of your valuable time to find out what the trouble is? You TV men are all alike—taking advantage of people at every turn. You just put that set back together and get out of here!"

At this point my friend was at a loss for words, so he promptly put the chassis back in the cabinet and left, red-faced and steaming under the collar. This customer was lost for good, and she would now distrust every technician in the business until an extremely personable technician proved himself honest enough to get her business.

Certainly, this was an unusual case of a "tough-dog" customer, but if this technician had been more honest with himself and the customer and had frankly admitted that "all those wires and things" at times stumped him, as well as some of the best in the business, he'd have had both the repair job and the customer.

Check your customer files periodically—every month or so if necessary. You may have a fair idea why a few of them haven't called for service recently, but what about the others? You may find names of people who haven't called in a year or more. Is it because they haven't needed service, moved away, etc.—reasons over which you have no control—or have they decided to call someone else for service (and sales)?

If you feel that you have enough customers and one more or less won't make any difference, don't take the time to finish reading this page. You might not be in business that long. On the other hand, if you are interested in finding out why certain people have never called again, here is a suggestion. Have some post cards printed with a special message. Change it occasionally to mention specific items you have to merchandise, or to offer service specials like repairing a TV and a radio for the same service rate ordinarily charged for the TV alone.

Of course, you may find that some of these customers have been lost for good because of the time interval. A good way to prevent this from happening is to send a "thank you" post card a few days after completing a job. Mention that you hope everything is satisfactory, and to call you if it isn't. Some shops use a double postcard for this purpose, having a section for the customer to fill out and return. This would be especially appropriate for new customers. Attentiveness of this type will let your customers know that you are sincere in wanting to provide them with the best service possible and also is sure to be instrumental in making your business prosper. ▲

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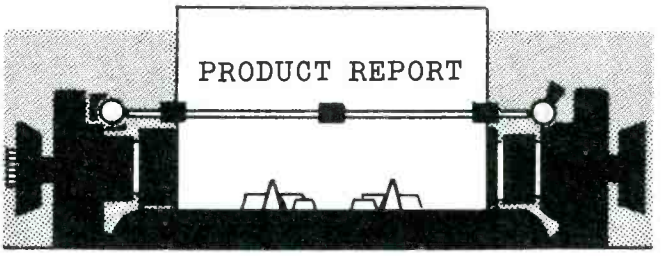
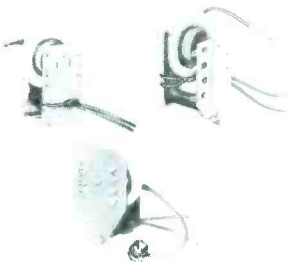


Flyback Transformers



Chicago Standard Transformer Corp., 3501 W. Addison St., Chicago, has added five new types to its line of Stancor exact replacement flybacks. A-8291 replaces Muntz part number TO-0039 in four chassis series; A-8292 is a replacement for Admiral part 79D65-1 in two chassis; A-8293 replaces Magnavox parts 360552-1/-2/-2A, 360577-1, and 360593-1/-2 in seven chassis; A-8294 replaces Magnavox part 360606/-1 in four chassis; and A-8295 replaces Magnavox part numbers 360623/-1 and 360614-1 in eleven chassis.

Combined Resistor-Capacitor

A single unit resistor-capacitor, no larger than a tubular capacitor alone, has been developed and produced by the Centralab Div. of Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee, Wis. The combination, called "TUBE-R-CAP," is a standard size CC32 tubular ceramic capacitor with a ceramic base resistor connected in parallel and on the same body. Maximum length of the unit is .900" and the approximate diameter is .280". The capacitor is rated at 470 mmfd and 1500 volts AC, and the resistor is a ½-megohm, ½-watt unit.

Buttonless Vibrators

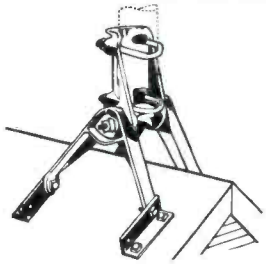
P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis, Ind., has designed a new type of vibrator in which the usual button contacts are eliminated. The vibrating reed and side arms themselves are made of a special alloy and act as the contacting elements.

Because of the larger area of the contacts, the new vibrators are said to have 50% to 100% longer life than former models. In addition, mechanical buzz is held to a very low level. The new components are designated as Series 1600 types and are available in a large variety of ratings for replacement purposes.

Capacitor Packaging

Distributor's stocks of ceramic and mica capacitors from Aerovox Corp., New Bedford, Mass., are now being packaged in transparent plastic envelopes mounted on index cards and filed in metal drawers. The smaller types of capacitors are packaged five to an envelope. If only a part of the contents are sold at one time, they can be removed from stock without damage to the envelope, which is securely closed by a folded flap. If the entire contents are sold, the envelope (including a tag which describes the contents) is detached from the index card and given to the customer for his convenience in storing.

Self-Locking Roof Mount

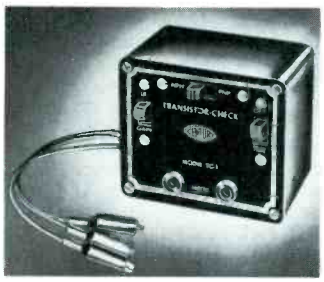


Manufactured by Rohn Mfg. Co., 116 Limestone, Bellevue, Peoria, Ill., this specially designed, cast roof mount snaps into place when upright, then securely locks in that position when hinge bolt is tightened. This feature means that masts can be installed quickly by one man.

Three-Way Switch

Anchor Products Co., 2712 W. Montrose Ave., Chicago, is marketing a rotary three-way switch, the Model S-203 "Selecto-Switch." The unit, featuring solderless connections, has many possible uses in hi-fi and antenna systems. The high-impact plastic case measures 3" × 1¾" × 1" and is equipped with two mounting ears to simplify installation. A diagram showing how to hook up two speakers to the switch for "one, the other, or both" operation is furnished with each unit.

Transistor Checker



Century Electronics Co., Inc., 111 Roosevelt Ave., Mineola, N. Y., has developed a low-cost transistor tester, the Model TC-1 "Transistor - Check." Any available volt - ohmmeter may be plugged into the unit to serve as an indicating device. The TC-1 tests transistors in or out of the receiver for current gain, leakage, open or shorts. Crystal diodes can be checked for ratio of forward to back current. The battery-powered instrument costs $6.95, complete with instruction manual.

PF REPORTER

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2C. B & K
Bulletin 1000 describes new "Dyna-Scan" picture and pattern video-generator. Bulletin 750 on new lab-type test equipment calibrator Model 750 that checks instrument accuracy. Also Bulletin 500 on "Dyna-Quick" dynamic mutual conductance tube tester and Bulletin 400 on CRT cathode rejuvenator tester. *See ads pages* 12, 20, 52.

3C. BLONDER-TONGUE
Form 6510065 on Model MCS TV amplifiers; Form MC-5-17 on crystal-controlled VHF and UHF converters. *See ad page* 66.

4C. BUSSMANN
New and very comprehensive book on fuses and fuse mountings used by the electronics industries. *See ad page* 39.

5C. CENTRALAB
New 48-page 2-color Centralab Catalog No. 30. Lists controls, switches, capacitors, packaged electronic circuits and semiconductors. *See ads pages* 70, 71.

6C. CENTURY
Free 1957 catalog describing complete line of test equipment for radio and TV servicing. *See advertisement page* 75.

7C. CLAROSTAT
Form No. 751771 describing "Pick-A-Shaft" 2-watt, 3-watt, and 4-watt wire-wound controls. *See advertisement page* 24.

8C. CLEAR BEAM
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11C. EICO
12-page catalog shows how to save 50% on electronic test instruments and high fidelity equipment in both kit and factory-wired form. *See ad page* 81.

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Pocket-size, Power-Point phono cartridge "Interchangeability Guide" indexes in easy-to-use chart form the more than 400 conventional cartridges replaced by 7 Power-Point models and 3 mounts. *See ad page* 53.

13C. ERIE
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21C. PHAOSTRON
Illustrated catalog lists complete line of custom panel meters. Includes comparison chart of Phaostron instruments vs. other brands and complete information on dimensions and features. *See advertisement page* 9.

22C. R-COLUMBIA
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23C. SIMPSON
Bulletin No. 2058 describing test equipment, and Bulletin No. 2057 covering panel meters. *See advertisement page* 55.

24C. SPRAGUE
C-611a revised catalog of stock TV and radio replacement parts. *See advertisement page* 2.

25C. TACO
Consumer advertising program for TV antenna installers.

26C. TELEMATIC
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SUPPLEMENT No. 102-B

MARCH 1957

SUPPLEMENT to SAMS MASTER INDEX No. 102

File this Supplement with your 36-page SAMS MASTER INDEX. Together, they give you complete PHOTOFACT coverage.

This Supplement is your handy index to new models covered in the latest **PHOTOFACT Sets 346 through 352.** It's your guide to the world's finest service data coverage of the current output of the new TV and Radio receivers, as well as models not previously covered in PHOTOFACT. It keeps you right up to date.

For models and chassis not listed in this Supplement, refer to SAMS MASTER INDEX No. 102. If you haven't a copy, send for it today. It's FREE . . . just write to HOWARD W. SAMS & CO., INC., 2201 East 46th Street, Indianapolis 5, Indiana.

ALWAYS USE YOUR LATEST ISSUE OF THIS SUPPLEMENT *WITH* THE SAMS MASTER INDEX . . . TOGETHER, THEY ARE YOUR COMPLETE INDEX TO OVER 30,000 MODELS.

IMPORTANT: THIS SUPPLEMENT REPLACES FEBRUARY SUPPLEMENT No. 102-A

FILE WITH YOUR SAMS MASTER INDEX No. 102, DATED FEBRUARY, 1957

Discard prior supplement, since this issue includes all previous listings *plus* latest models

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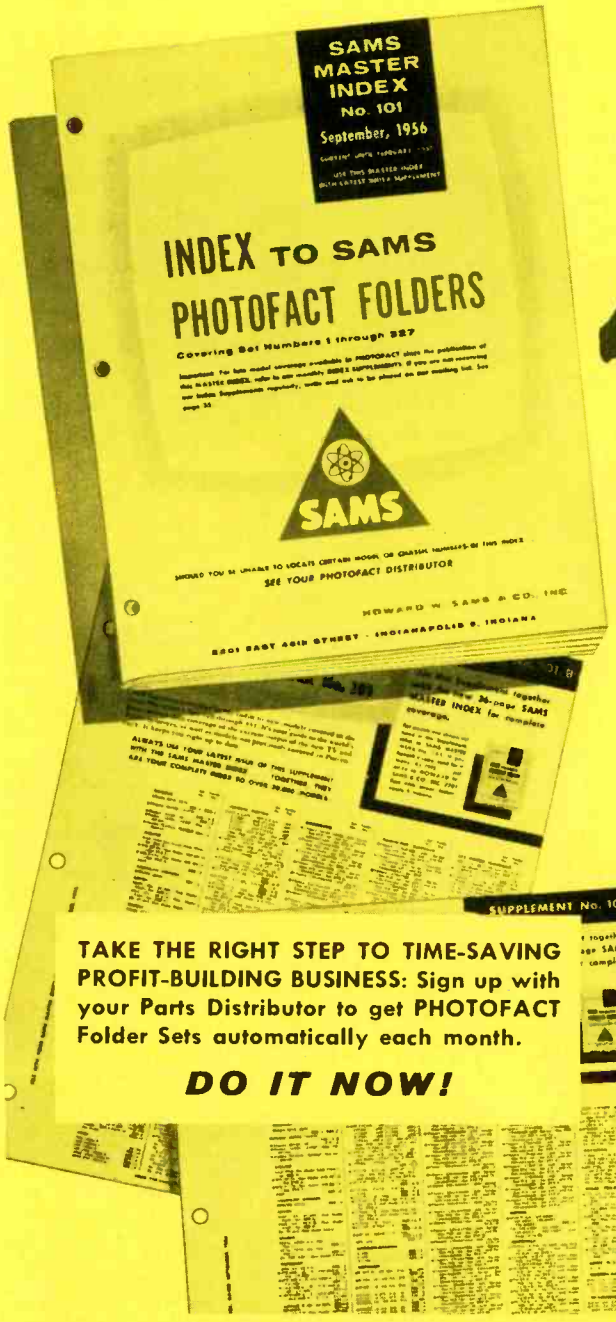

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ACTUAL SIZE

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The new Limited Current (LC) fuses are being used by more and more TV set manufacturers. The LC fuses are designed to protect the TV set manufacturer, the serviceman and the set owner by making it mechanically impossible to replace a fuse with anything but another fuse of the proper amperage range.

LC fuses demand exact replacement.

The table printed below is a quick check list to speed stock planning and replacement identification by TV set brands. The cross reference table is designed to fit the top of the LITTELFUSE fuse caddy. For additional copies see your Littelfuse jobber.

Tear on dotted line

NAME	FUSE DESCRIPTION		LF PART NO.
Admiral	*3/10 amp	Type C	332.300
Admiral	*3/4 amp	Type C	332.750
Admiral	*2 amp	Type C	332002
Airline (Montgomery Ward)	4/10 amp	Type N	333.400
Bendix	2 amp	Type N	333002
Capehart Farnsworth	1/2 amp	Type N	333.500
CBS Columbia	1-6/10 amp	Type N	33301.6
Coronado	4/10 amp	Type N	333.400
Crosley (Eldorado)	2-8/10 amp	Type N	33302.8
DuMont	3/4 amp	Type N	333.750
Emerson	6/10 amp	Type N	333.600
Emerson	1 amp	Type N	333001
Emerson	1-1/4 amp	Type N	3331.25
Firestone	4/10 amp	Type N	333.400
General Electric	1-1/4	Type N	3331.25
Motorola	2 amp	Type C	332002
Olympic	3/8 amp	Type C	332.375
Packard-Bell	2/10 amp	Type N	332.200
Packard-Bell	*3/10 amp	Type C	332.300
Packard-Bell	1/2 amp	Type N	333.500
Packard-Bell	*3/4 amp	Type C	332.750
Philco	7/10 amp	Type N	330001
Raytheon	*1/4 amp	Type N	333.250
Raytheon	*1/2 amp	Type N	333.500
RCA	3/10 amp	Type C	332.300
RCA	*3/4 amp	Type C	332.750
Setchel Carlson	2-1/2 amp	Type C	33202.5
Silvertone	*3/10 amp	Type N	333.300
Silvertone	*3-1/2 amp	Type N	33303.5
Stromberg Carlson	1/4 amp	Type N	333.250
Sylvania	2-1/2 amp	Type C	33202.5
Truetone	4/10 amp	Type N	333.400
Westinghouse	*1/2 amp	Type C	332.500
Westinghouse	*3/4 amp	Type C	332.750
Westinghouse	*7 amp	Type C	332007
Zenith	1/4 amp	Type N	333.250
Zenith	3/10 amp	Type N	333.300

*Color TV

LITTELFUSE, INC.

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Des Plaines, Ill.