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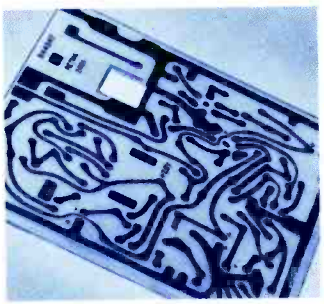
for the Electronic Service Industry

This Month's Highlights



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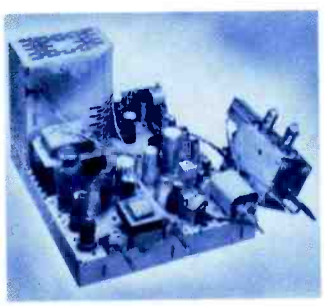

KEEP YOUR CUSTOMERS HAPPY WITH CLEAN CHASSIS

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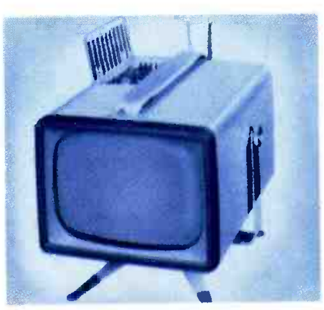

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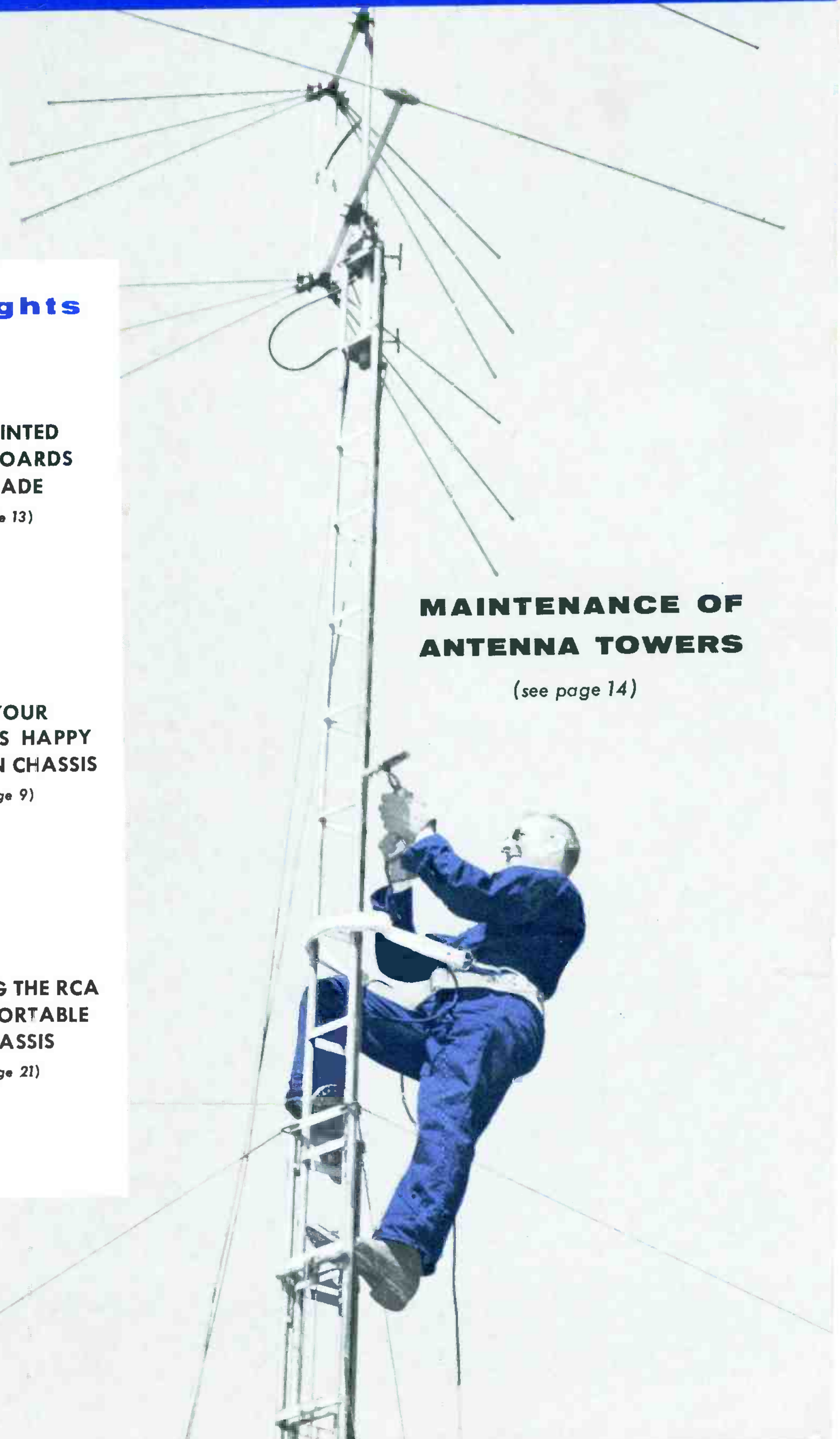

MAINTENANCE OF ANTENNA TOWERS

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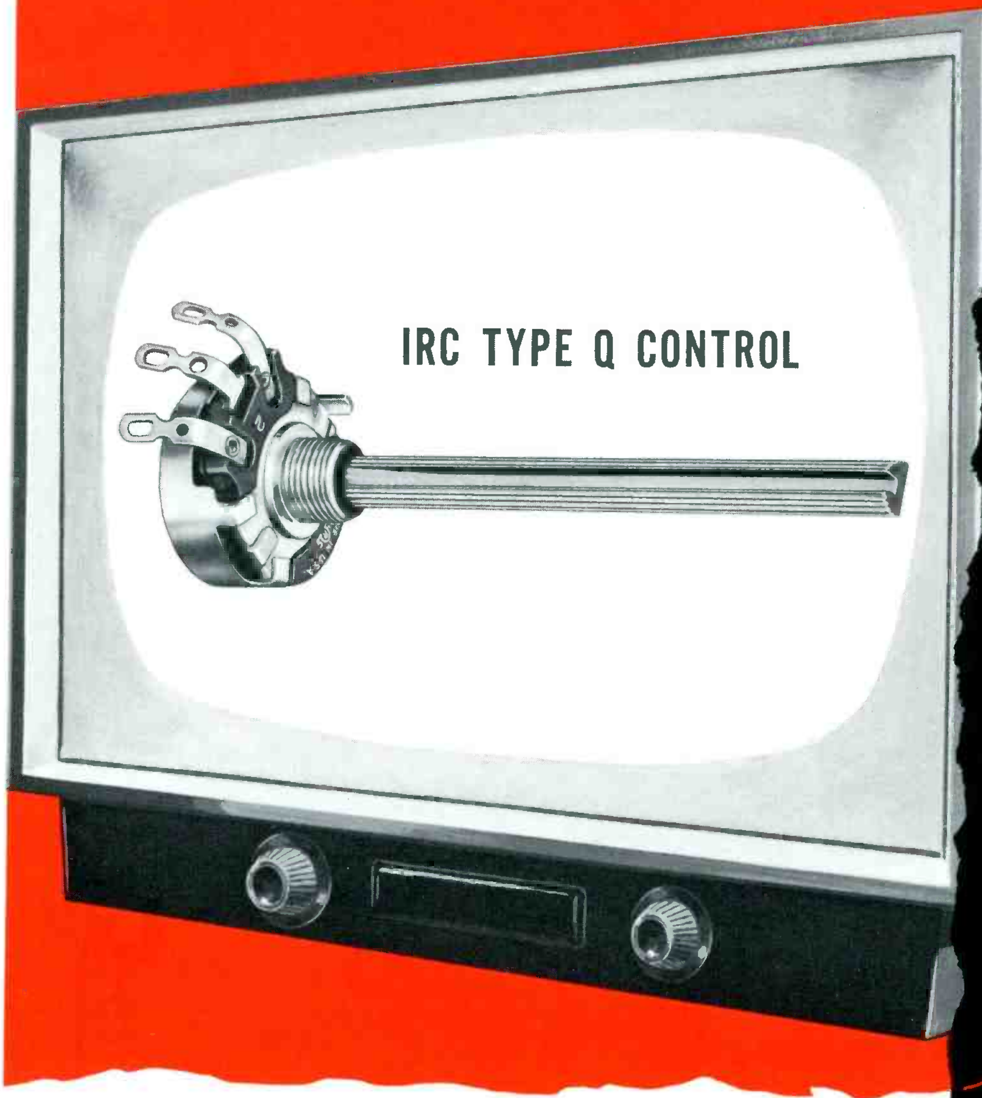

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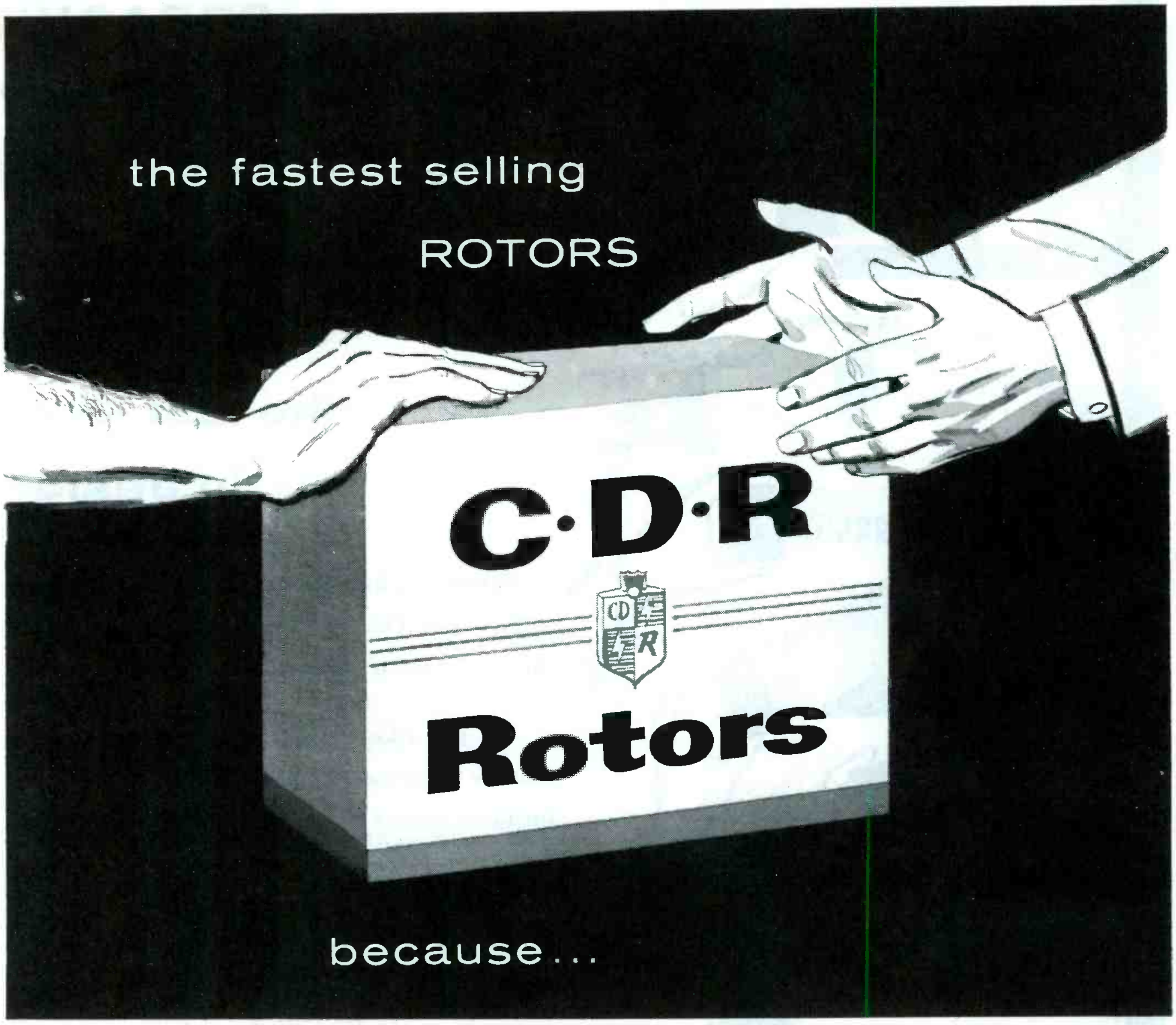

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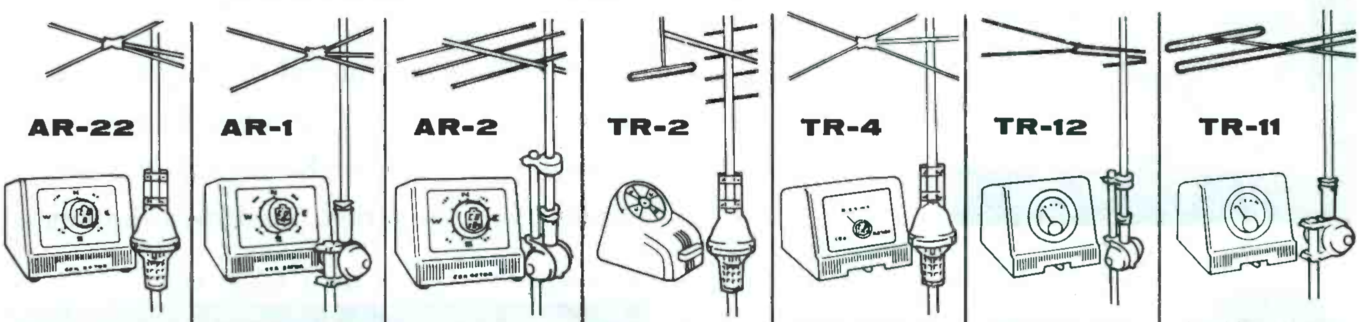

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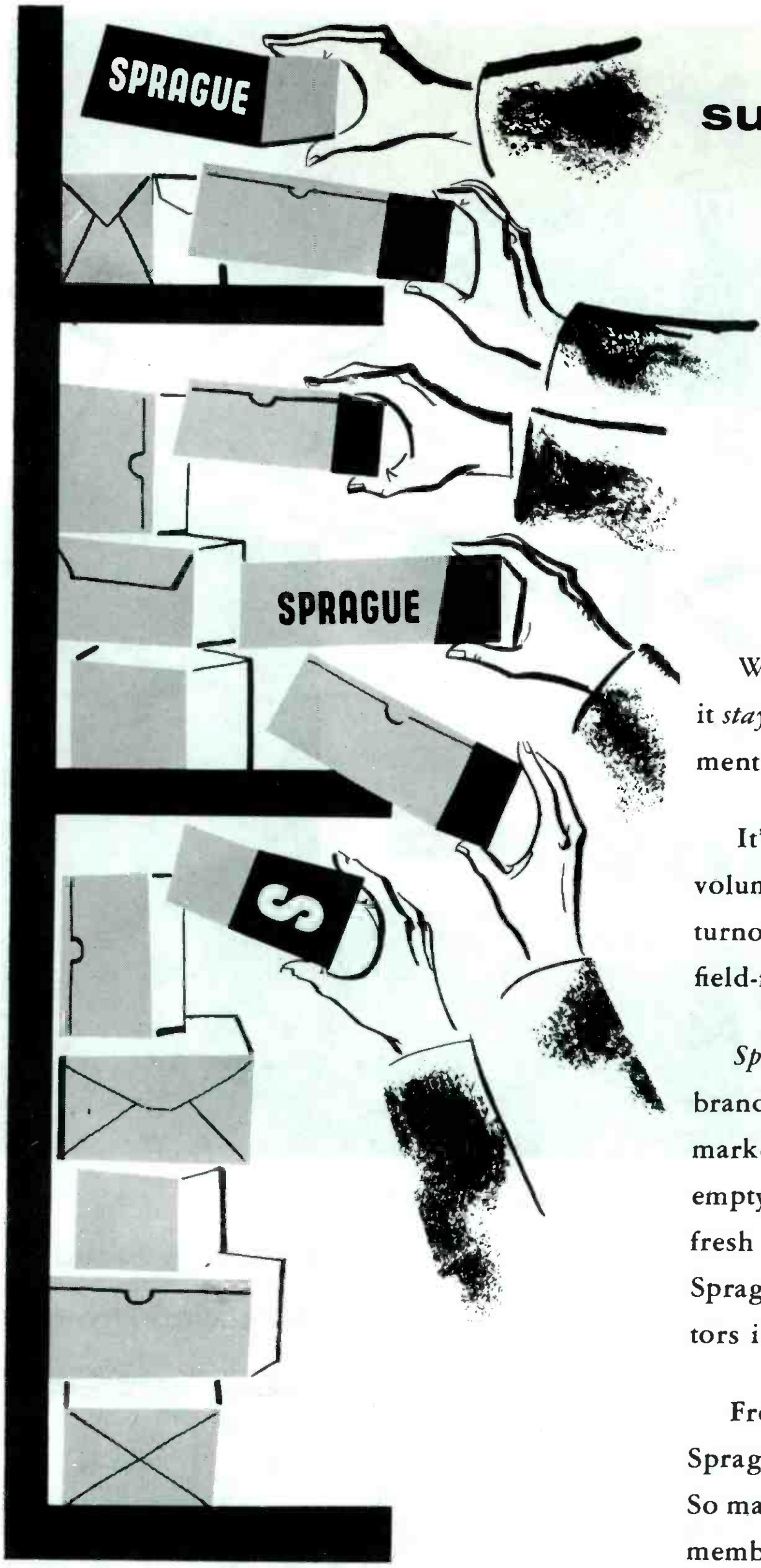

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VOL. 6 · No. 8

SAMS PF REPORTER
for the Electronic Service Industry

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ABOUT THE COVER

The man on the tower is the author of "Maintenance of Antenna Towers." This photo article on pages 14 and 15 shows equipment and methods for keeping antenna towers in good shape.

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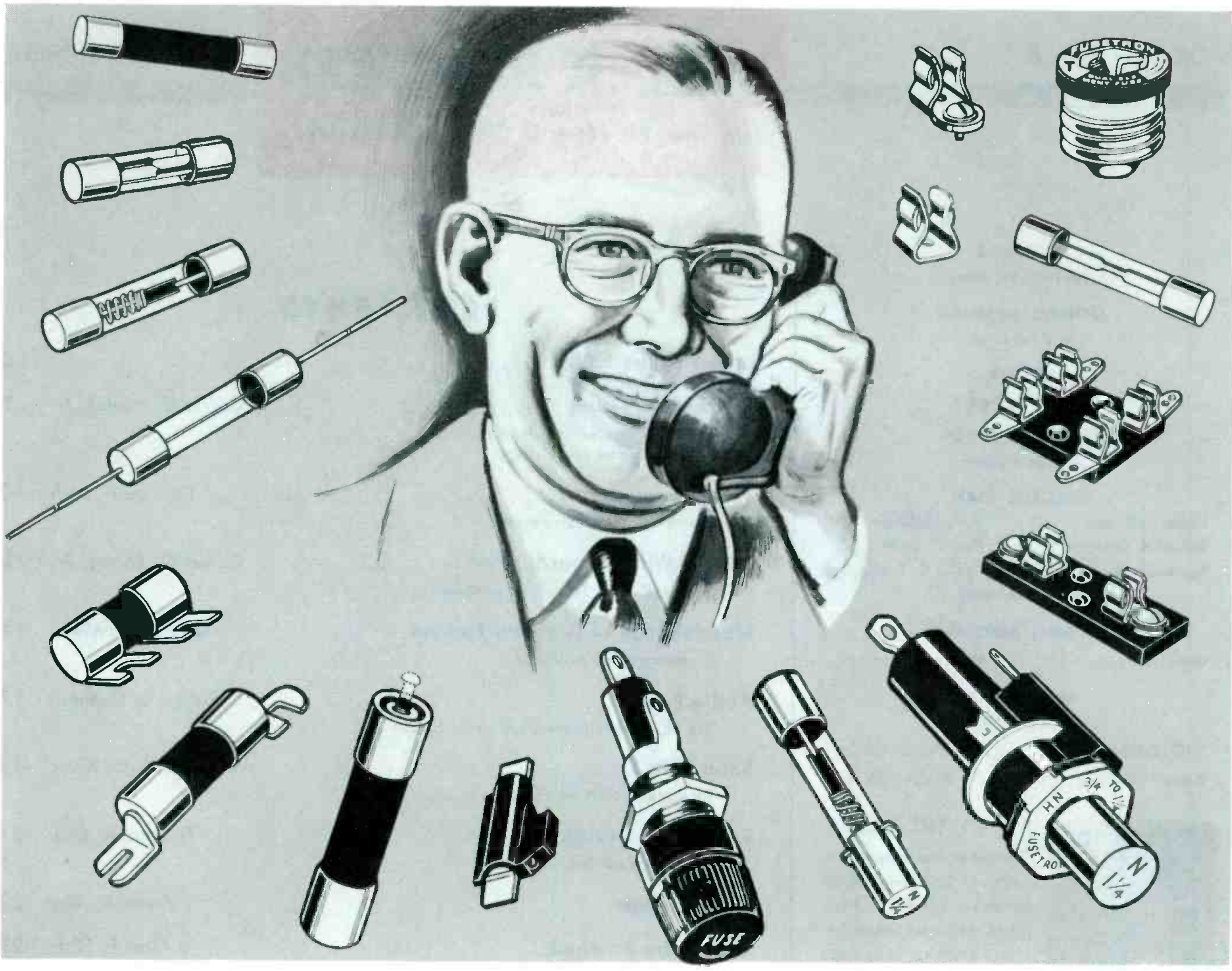

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LETTERS to the EDITOR

Dear Editor:

Concerning the article, "Changes in Tube Design," by Thomas A. Lesh, in your April 1956 issue, the statement was made that "all four of the tubes of the 6BQ7 and 6BK7 types are interchangeable, but the tuner may have to be slightly realigned to compensate for the differences between types."

This statement would lead the reader to think that the 6BQ7 and the 6BQ7A are interchangeable with the 6BK7 and the 6BK7A. According to tube manufacturers, this is not correct. RCA has advertised . . . that the improved 6BQ7A is a replacement for the original 6BQ7; and since the mu has been raised, it is a replacement for the 6BZ7 in 90 per cent of the cases. RCA has not even suggested the 6BQ7 or 6BQ7A as a replacement for the 6BK7A type.

In the March 1954 issue of *Sylvania News*, Sylvania has a chart which is a "cross comparison of duo-triode types used for cascode amplifiers."

GROUP A

(cathode bias resistor of 220 ohms)

6BQ7
6BQ7A
6BZ7

GROUP B

(cathode bias resistor of 56 ohms)

6BK7
6BK7A

The comparison chart makes it apparent that for most circuits, the tube types in Group A may be interchanged without circuit changes. The same is true for the types in Group B. To interchange a tube in Group A with one in Group B, it is mandatory to change the value of the cathode resistor. Also, a slight realignment touch-up is necessary for the best performance.

C. M. ALLMAN

Newport News, Virginia

Reader Allman is correct in stating that the interchanging of 6BQ7A and 6BK7A tubes is not recommended in manufacturers' published data. When Mr. Lesh wrote the article in question, he used informa-

tion furnished to us by a well-known tube-manufacturer who ran a series of subjective tests and found that the 6BQ7 and the 6BK7A were completely interchangeable in two major brands of cascode tuners in a near-fringe area. Although objective laboratory measurements would indicate that noise figure and gain are adversely affected by interchange, the deterioration is not severe enough to be noticeable to viewers.

Our experience supports this manufacturer's contention The interchange produces no visible deterioration of the picture. Perhaps we should have emphasized that the interchange of these two types of tubes is not a standard recommended procedure, but that it is feasible in emergencies.—Editor

Dear Editor:

I have just finished reading your very informative article, "Troubles in Vertical Sweep Systems," in the June, 1956 issue. It occurs to me that you might be able to help me in solving my current problem with an RCA Victor Model 21CT661U color TV set. The set is of the initial-run series and incorporates none of the later production changes.

I am enclosing photos *(see below)* of the screen showing vertical bars which are satisfactory and horizon-

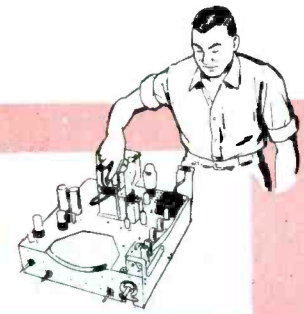
tal bars which show lack of focus—although I realize there is no chance for that. (Convergence is "off," I can see, but that is not my trouble.) I have checked the vertical circuit using my Sams Photofact folder, and I can find nothing wrong. Have you any idea what the trouble can be?

HARRY B. PIPER, JR.
Adelanto, Calif.

From the photographs which reader Piper has supplied, it would seem that the horizontal bar pattern indicates poor interlace or vertical jitter. Assuming that this is the trouble, the fact that a color set is involved should make little difference in the servicing procedure required.

Possibly one of the components in the vertical integrating network has changed in value, or there may be an abnormality in the sync amplifier or sync separator stage.—Editor

Quicker Servicing



by Calvin C. Young, Jr.

Tubes for Testing by Substitution

The difficulty of maintaining an adequate supply of tubes while making service calls is a problem that most technicians have encountered at one time or another. The limited size of a tube caddy makes it difficult to carry large numbers of each type of tube used in television receivers. Most service technicians will carry one or two each of the types which they know from experience are seldom needed and several of each of the types that are needed more frequently. Many technicians even carry extra supplies in the service truck of the most popular types such as the 5U4G, 6SN7GT, 6AU6, 6CB6, and 6BQ6GT. Even with these precautions, there will be many times toward the end of a busy day when the technician will find himself on a service call without a substitute for a tube he suspects of being defective in the customer's receiver. When such a situation develops, the technician can do one of three things. He can remove the chassis and take it into the shop, he can go to the shop and get the necessary tube, or he can substitute the suspected tube with another type which has the same physical connections and similar electrical characteristics.

If he takes the chassis into the shop, there is the possibility that he will find that a tube will correct the trouble; therefore, he has wasted a considerable amount of time and performed unnecessary work. As a result, the service shop will have lost money on that call. In addition to this, the customer will have been needlessly deprived of the use of his television receiver.

If, on the other hand, the service technician makes a trip to the shop for the correct tube and returns to the customer's house, he is apt to find that the receiver does not operate properly, even with the new tube installed. Again the service shop has wasted time and, as a result, could lose money on that call.

The alternative is to check the suspected tube by substituting a tube that has the same basing connections and similar electrical

• *Please turn to page 50*

CHART 1—Substitution Guide for TV Tubes

1. 1X2, 1X2A, 1X2B, 1AX2
2. 3AU6, 3BA6
3. 3BC5, 3CE5
4. 3BE6, 3BY6, 3CS6
5. 3CB6, 3CF6, 3BZ6
6. 4BQ7, 4BZ7, 4BS8, 4BZ8
7. 5Y3GT, 5R4GY, 5U4G, 5U4GB, 5AW4, 5AU4 (See Note A)
8. 6AC7, 6SK7, 6SJ7
9. 6AF4, 6T4, 6AN4 (See Note B)
10. 6AG5, 6AK5, 6BC5, 6CE5
11. 6AG7, 6AK7
12. 6AH6, 6AH6V, 6AK6
13. 6AU6, 6BA6, 6BD6, 6CG6
14. 6AQ5, 6BF5
15. 6AT6, 6AV6, 6BF6, 6AQ6, 6BK6, 6BT6, 6BU6
16. 6AU5GT, 6AV5GT, 6AV5GA
17. 6BC7, 6BJ7
18. 6BE6, 6BY6, 6CS6
19. 6BK7, 6BQ7, 6BZ7, 6BS8, 6BZ8, 6CG7 (See Note C)
20. 6BQ6G, 6BQ6GA, 6BQ6GT, 6BQ6GTA, 6CU6, 6DQ6
21. 6BZ6, 6BJ6, 6DC6
22. 6CB6, 6CF6, 6DE6, 6BH6
23. 6J5, 6J5GT
24. 6K6GT, 6V6GT, 6W6GT, 6Y6G (See Note D)
25. 6SH7, 6SG7
26. 6SL7GT, 6SN7GT, 6SN7GTA, 6SN7GTB, 6BL7GT
27. 6SQ7, 6SR7, 6ST7, 6SZ7
28. 6T8, 6R8
29. 6U4GT, 6W4GT, 6AX4GT, 6AU4GT (See Note E)
30. 6U8, 6AX8
31. 6X5, 6X5GT, 6AX5GT (See Note F)
32. 12AT7, 12AV7, 12AU7, 12AZ7, 12BH7
33. 12AX7, 12BZ7
34. 12BQ6GTA, 12BQ6GA, 12CU6, 12DQ6
35. 12SL7GT, 12SN7GT
36. 25BQ6GT, 25BQ6GA, 25CU6, 25DQ6
37. 25W6GT, 25L6GT
38. 25W4GT, 25AX4GT, 25U4GT

Note A. Because of the different filament-current requirements and direct-current capacities of all rectfier tubes, the technician should exercise caution in any substitution of these tubes.

Note B. These tubes are all used in UHF applications and may not operate when substituted.

Note C. With the exception of the 6CG7, these tubes are used as cascode RF amplifiers in VHF tuners and may be used for substitution purposes if carefully selected.

Note D. The DC plate current passed by these tubes varies, and the tubes are listed from left to right in ascending order of the direct current they will pass.

Note E. These tubes are listed from left to right in ascending order. No tube can be used to replace one listed to the right of it.

Note F. Because of direct-current considerations, the 6AX5GT may be used as a substitute for the 6X5 or 6X5GT tubes but not the reverse.

VIDEO AMPLIFIERS

by Thomas A. Lesh

Have These Circuits Puzzled You? Here's All the Theory You'll Need to Better Understand Them.

A video amplifier is similar to other types of amplifiers except that it has a very broad frequency response. The ideal video amplifier should be able to give equal and undistorted amplification to all signals which lie within the frequency range from 30 cycles to 4 megacycles. This flat response can be achieved in a specially designed amplifier, but such an amplifier has a relatively low gain—usually less than 25 or 30.

The video amplifier in a television receiver has the job of increasing the amplitude of the detected video signal so that this signal will be strong enough to modulate the electron beam of the picture tube. A signal which has a peak-to-peak amplitude of only a few volts must be boosted to an amplitude of 50 to 100 volts. Two stages of video amplification are often used in order to assure ample output. This is especially true of older receivers.

A satisfactory video amplifier that has only one stage can be designed if the transconductance of the tube in the circuit is very high in comparison with the total interelectrode capacitance of the tube. Several tubes which meet this requirement are available, and single-stage video amplifiers have been used in a large proportion of the receivers which have been built in the last few years. Some of the tubes which are often found in single-stage video amplifiers are the 12BY7, the 6CB6, the 6CL6, and the pentode sections of several new dual-purpose tubes such as the 6AU8 and the 6AN8.

Fig. 1 is a schematic diagram of a circuit that has many features which are typical of modern single-stage video amplifiers. A composite video signal that contains negative sync pulses is applied to the grid of this video amplifier from the video detector. The output signal of the amplifier then has positive sync pulses, and a positive swing of this signal corresponds to an increase in the blackness of the picture. This signal is applied to the cathode of the picture tube so that the most positive portion of the signal will bias the tube the most and will produce black in the picture. Use of the signal polarity which has been described is common practice.

In video amplifiers which have two stages, the signal is inverted twice. Negative sync pulses are present in the output signal of the video detector as a rule; therefore, the output of the second video amplifier also contains negative-going pulses. An output signal of this polarity must be applied to the grid of the picture tube in order that the electron beam will be modulated correctly.

Frequency Compensation

The frequency response of an ordinary amplifier is limited mainly by the effect of capacitive reactance in the circuit. Since the reactance varies according to frequency, the over-all impedance of the circuit changes with frequency. Different portions of a video signal will therefore be amplified unequally unless compensation for the reactance change is provided. An uncompensated amplifier has much less gain at low and high video frequencies than it does in the middle range of frequencies.

The equivalent load circuit of an RC-coupled amplifier at the higher video frequencies is shown in Fig. 2A. Capacitive reactance is very low at these frequencies. The large coupling capacitor has such a low reactance that its presence can be disregarded. The output capacitance C_O of the first stage, the input capacitance C_I of the next stage, and the stray capacitance C_S between wiring and chassis have a total value of only a few micromicrofarads; but these capacitances have a considerable effect upon the high frequencies in the video signal. All these effective capacitors are in shunt with the load resistor, and the total capacitive reactance may be as low as a few thousand ohms.

When a load presents less reactance than resistance to a signal of a given frequency, a large part of that signal is shunted to ground and does not appear in the input signal to the following stage. The loss of high frequencies from the video signal represents a loss of fine detail in the television picture, and the picture appears fuzzy or blurred.

The bypassing effect of the shunt capacitance can be largely overcome if the value of the load resistance is no larger than the value of the total shunt capacitive reactance at the highest frequency which appears in the video signal; consequently, the load resistor of a video amplifier is made low in value. Notice that R8 in Fig. 1 has a value of only 4.7K ohms. This load resistance is low in comparison with the internal plate resistance of the tube, and a relatively small portion of the output signal is developed across the load resistor. The gain of the amplifier therefore is low.

If the shunt capacitance is held to a minimum by careful design, the allowable maximum value of the load resistor can be increased and more gain can be obtained from the amplifier. Gain is also a function of tube transconductance as well as of load resistance, and the use of a tube with extremely high g_m helps to make up for the restrictions which are placed upon gain by the low value of load resistance.

The response curve of an uncompensated video amplifier shows a gradual decrease of gain toward the high-frequency end of the curve. This decrease of gain corresponds to the increased shunting effect that takes place as the value of shunt capacitive reactance approaches the same value as the load resistance. In practical video amplifiers, the decrease is prevented and full gain is maintained up to a desired frequency limit which is usually from 3.2 to 4 megacycles. This is done by the use of peaking coils which are placed in shunt or in series with the path of the output signal of the amplifier. The coils form resonant circuits of low Q with the shunt capacitances, and the resonant frequency of such a circuit is near the upper frequency limit of the video signal. A damping resistor is often connected across a peaking coil in order that the Q of the resonant circuit will be kept low. If the Q were too high, undesirable sharp peaking of a narrow band of frequencies would take place.

A shunt peaking coil is placed in parallel with the path of the output signal but in series with the load resistor. L5 in Fig. 1 is a coil of this type. A parallel-resonant circuit is effectively placed between the amplifier plate and ground. The voltage across this circuit rises at frequencies near resonance, and the high-frequency portions of the video signal are boosted slightly instead of being attenuated.

A series peaking coil such as L2 in Fig. 1 may be inserted directly into the path of the signal. This

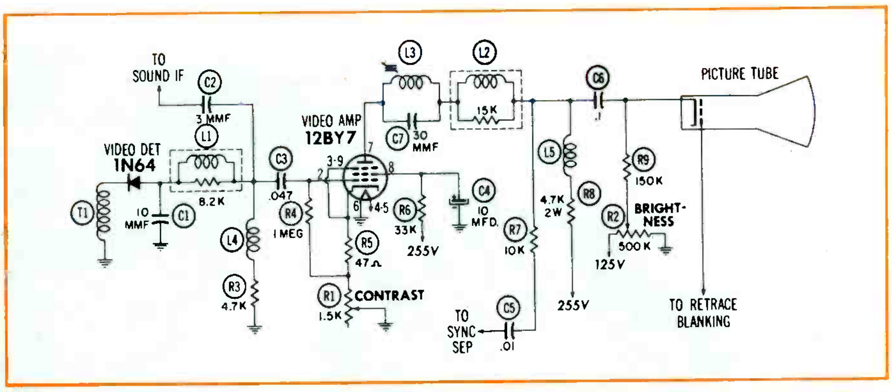


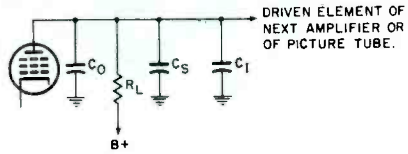
Fig. 1. Schematic of a Typical Single-Stage Video Amplifier Employing AC Coupling.

coil has the function of isolating the output capacitance C_O of the first stage from the input capacitance C_I of the following stage so that the shunting effect of C_I upon the load resistor will be eliminated. The isolation of the input circuit from the output circuit causes the total shunt capacitance across the resistor to be reduced at high frequencies, and the load resistor can therefore be made somewhat larger than the maximum value that would be permissible if series peaking were not used. A combination of shunt and series peaking is most often used because the maximum gain is obtainable in this way.

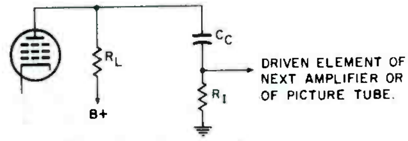
The reactance of shunt capacitors ceases to be a problem at the lowest video frequencies, and the increase in the series reactance of coupling and bypass capacitors becomes important instead. An equivalent load circuit of an RC-coupled video amplifier at low frequencies is shown in Fig. 2B. The input resistance R_I in this figure represents either the grid resistor of a second amplifier stage or a resistor in the cathode or grid circuit of the picture tube. The reactance of the coupling capacitor C_C to low frequencies is so great that this capacitor and the resistor R_I may be considered as a voltage divider. A low-frequency signal is developed across C_C and R_I in series. The portion which appears across C_C is lost, and the following stage receives as an input signal only the portion which appears across R_I.

More serious than the loss of signal amplitude is the phase shift which is produced when a low-frequency signal is passed through a coupling capacitor. A shift in phase is equivalent to a slight displacement in time. Since the precise time at which various portions of the video signal reach the picture tube determines the positioning of various elements in the picture, a phase shift of any part of the video signal will cause some objects in the picture to be moved from their proper position relative to other objects.

This phase shift is especially noticeable at low video frequencies for two reasons. The low frequencies correspond to large areas



(A) At High Frequencies.



(B) At Low Frequencies.

Fig. 2. Equivalent Load Circuits of an RC-Coupled Video Amplifier.

or objects in the picture, and a phase shift of a given number of degrees represents a greater displacement in time and distance at low frequencies than at high frequencies. The effects of phase shift appear in the picture either as smears at the borders of large areas or as white trailing edges at the right of large black areas.

The reactive effect of the coupling capacitor at low frequencies is minimized if the capacitor is large in value. The input resistor R_I should also have a large value. The greater the input resistance, the less effect a given amount of capacitive reactance will have upon the total impedance in the input circuit. There are practical

· *Please turn to page 52*

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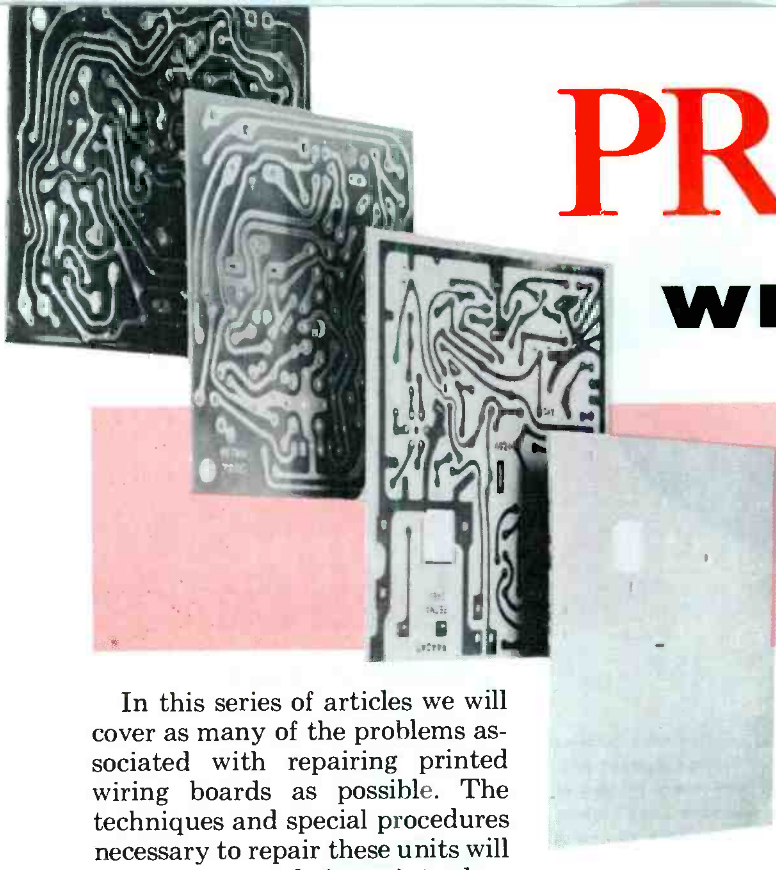


PRINTED WIRING BOARDS

PART 1 BACKGROUND and GENERAL INFORMATION

by *Calvin C. Young, Jr.*

In this series of articles we will cover as many of the problems associated with repairing printed wiring boards as possible. The techniques and special procedures necessary to repair these units will also be presented. As an introduction, we are presenting some of the necessary background information which will help the television and radio technician to understand the reasons behind the growing use of printed wiring boards.

Printed or plated wiring boards and printed components made their initial appearance in television and radio receivers only a short time ago, but they have already achieved wide acceptance. In fact, their use is so universal that almost every television and radio receiver currently produced uses either one or both of these kinds of parts.

The trend in manufacturing has been toward more compact, more easily constructed, and more inexpensively manufactured radio and TV sets because of consumer demand for lower-priced and more portable receivers.

Lower production costs through the use of printed wiring boards are made possible because of several factors:

1. Greater simplicity of wiring. Printed circuit boards require less wiring than the same circuit of a nonprinted nature.
2. Each printed board is identical. This means that there will be no wiring errors and that wiring troubles are therefore minimized.
3. Faster production. Production can be speeded up because of the elimination of hand wiring such as that required by the older methods of receiver construction.
4. One soldering operation. Complete assemblies are soldered in one dipping operation. Previously, a few individual connections were soldered by each of many employees.
5. Components installed by machinery. Production speed increases when components are installed by machinery instead of by hand.
6. Ease and adaptability in the use of printed components. Modules and printed components are readily installed on a printed board either by machinery or by hand.

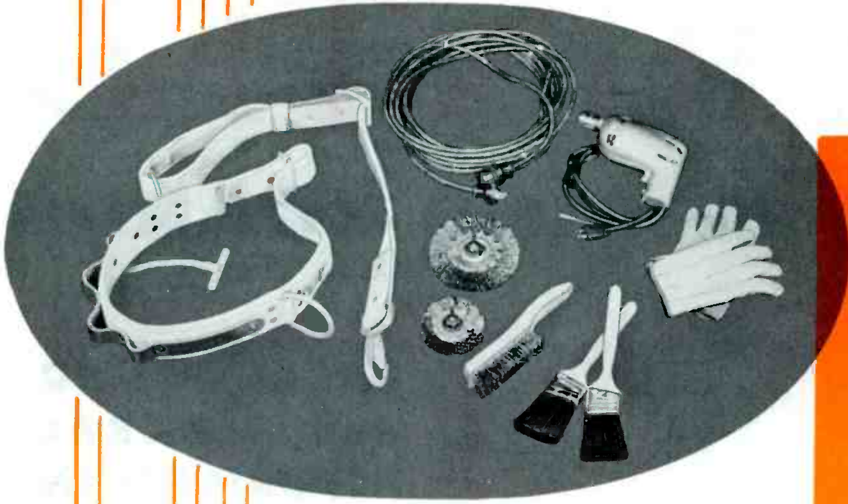
All of the foregoing features result in lower production costs and at the same time help create units which are more compact and more easily constructed. In fact, the compactness and ease of construction are automatic by-products of this type of wiring, especially if the components are installed on the boards by machines. Miniature components are constantly being developed to aid in making assemblies still more compact. It has been a combination of printed wiring and miniaturized components that has made possible the small portable radios of shirt-pocket size.

Printed wiring boards and components represent advancement for the electronics field just as more horsepower and better automatic transmissions represent advancement in the automotive field. We know that progress is not always easy to accept, but we also know that progress will benefit the maximum number of people. Some service technicians have complained about experiencing difficulty with the varied procedures and techniques required for servicing printed wiring. Automobile mechanics likewise complained of the difficulty in servicing automatic transmissions and the new engines. Just as the automobile mechanic had to become accustomed to dealing with the new, so also must the electronics technician become familiar with the new developments which mean progress in his field. The printed wiring board is here to stay; therefore, it is necessary to know how to service and maintain circuits or sections of receivers which employ these boards.

How Boards Are Made

Most of the printed wiring boards being used in television

· *Please turn to page 61*

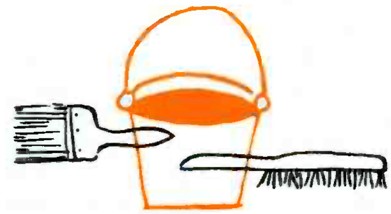


MAINTENANCE of ANTENNA TOWERS

by George B. Mann

EQUIPMENT

The equipment required for tower work is relatively inexpensive and easily obtained. This equipment should include a power drill, a heavy-duty extension cord, at least two wire-wheel brushes of different diameters, a wire brush of the standard hand variety, one or more good paint brushes, and a pair of work gloves. A safety belt should be included whenever the work is to be performed on a standing tower.



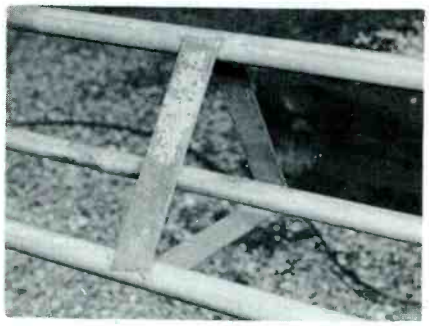
Antenna towers are a common sight in many sections of the country, particularly in the regions which lie outside of the primary service areas of television transmitters. The need for these towers resulted in the growth of profitable installation businesses, and the maintenance requirements of the towers have opened the way for additional service business.

Rust and corrosion are the worst enemies of metal structures. For the average tower, a year or two of exposure to the weather is sufficient for rust and corrosion to set in.

Antenna towers can be cleaned and refinished at a fairly reasonable cost to the customer. Whether or not the tower is taken down or left standing during the maintenance operation will depend on the type of tower and the way it was installed. Some towers are self-supporting and are usually set in a concrete base. Others are telescoping types that can be cranked up or down.

The telescoping types are often mounted so that they can be quickly tilted and lowered when service is required. On the other hand, the time involved in taking down most self-supporting types may make the cost prohibitive. Work on these types can be done while the tower is left standing.

There is plenty of need for tower maintenance in certain sections of the country, and TV shop owners looking for additional business should consider this fairly noncompetitive field. It is the purpose of this article to provide practical, useful information to those who might be interested in this source of additional income.

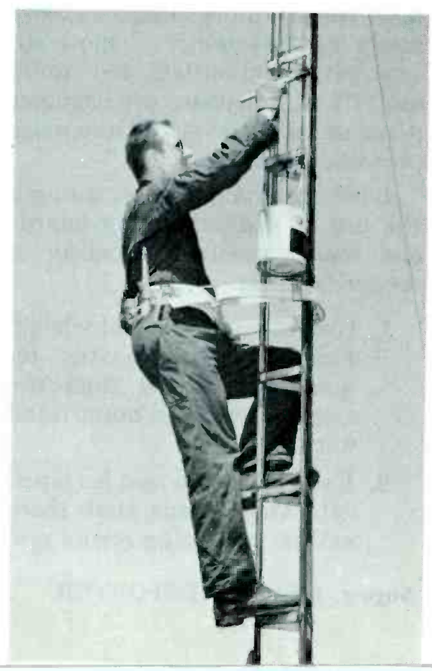


EFFECTS OF RUST AND CORROSION

This section of a tower structure shows extensive corrosion on one of the cross members. The tubing has rusted very little; but once the rust gets through the protective coating, corrosion will take place rapidly. To prevent further corrosion, the rust must be removed and a new protective coating applied.

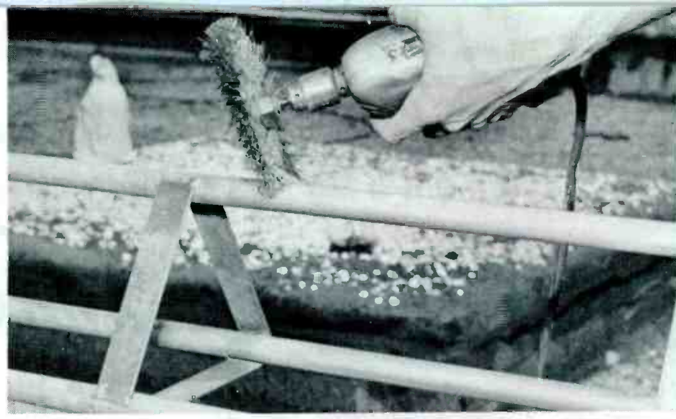
WORKING ON A STANDING TOWER

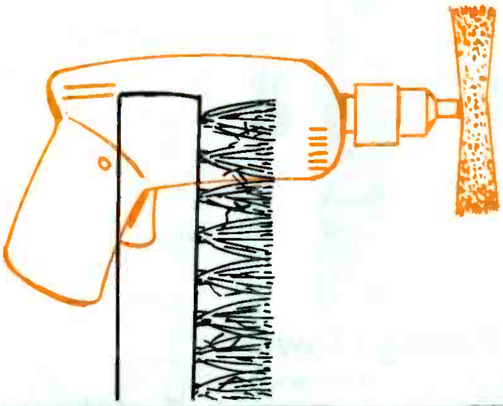
In many instances, it is advantageous to clean and repaint a tower while it is standing. In addition to permitting freedom of both hands, the use of a good safety belt provides a high degree of safety and comfort to the worker. The wearing of heavy shoes prevents discomfort to the worker's feet, and a pair of goggles protects his eyes against dislodged particles of rust.

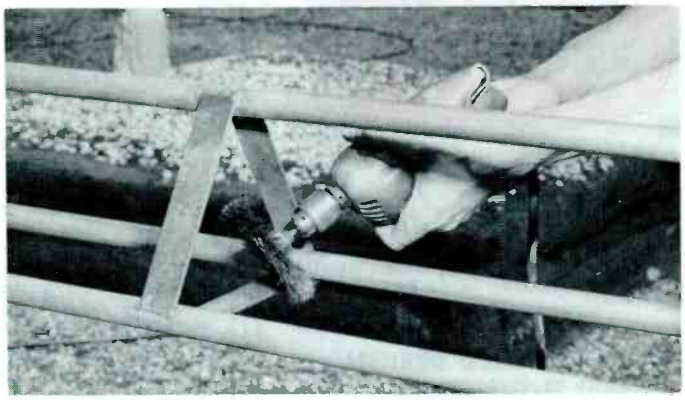


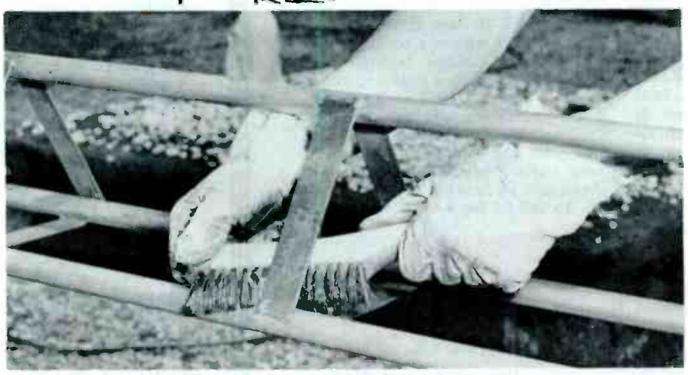
USE OF WIRE WHEELS TO REMOVE RUST

The use of a wire wheel in conjunction with a power drill is very effective in cleaning off rust. Light pressure of the wheel on the metal allows the drill to do most of the work. Outside surfaces can be cleaned with a large wheel and inside surfaces with a small wheel. To prevent wire bristles and particles of rust from flying into the face and eyes, the drill should be held so that such debris will be thrown away from the worker's face.



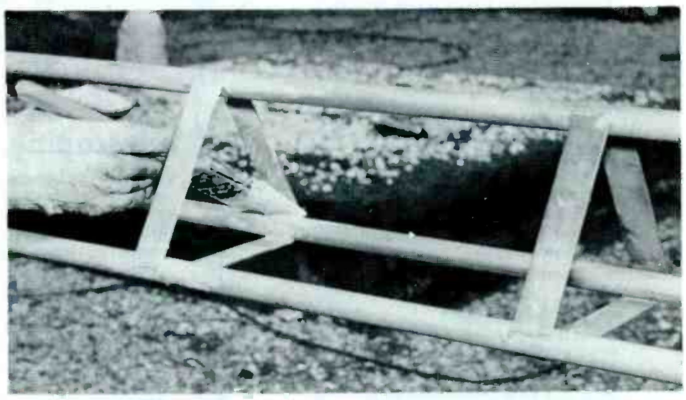


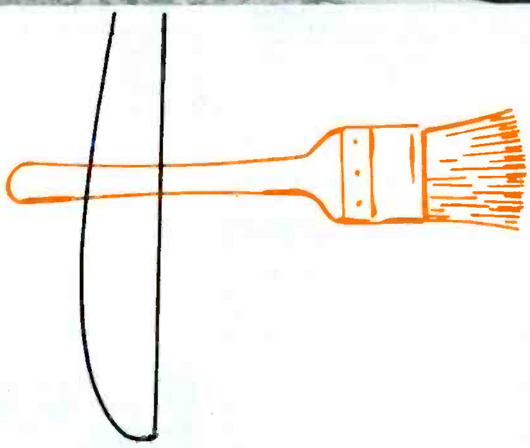




USE OF THE WIRE BRUSH

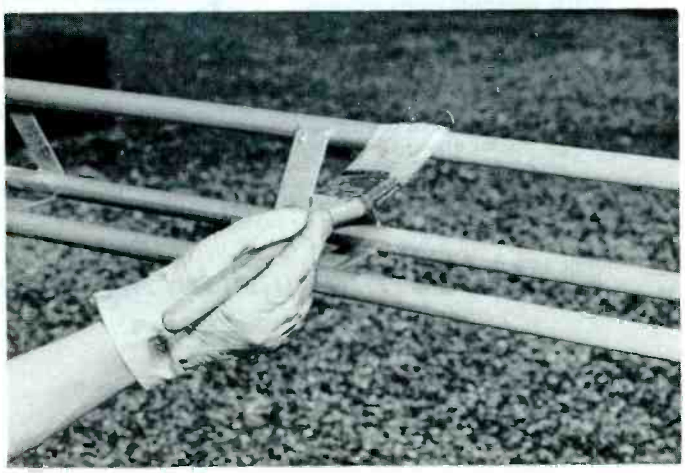
A wire brush can be used to clean portions of the tower structure which cannot be reached with the wire wheel. During the painting operation, such a brush may also be used to clean sections which may have been missed or which were not sufficiently cleaned by the wire wheel.





APPLYING PRIMER AND FINISH COATINGS

The cleaned tower should be coated with a primer which contains a rust-inhibitive pigment. Examples of such pigments are red lead, zinc chromate, lead chromate, or zinc oxide. When the primer coat has dried, the tower should be finished with a paint that is moisture resistant. Paints which contain the powder of metals such as aluminum or lead are recommended for this purpose.



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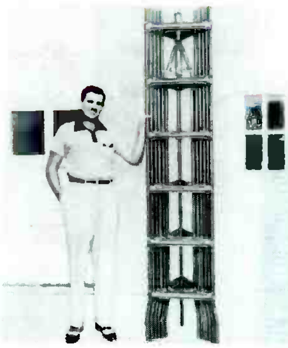

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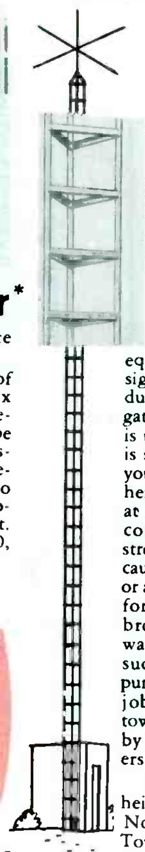

For extreme heights and communication purposes of all kinds, the Rohn No. 40 gives you strength and durability on which you can depend. The time tested and proven equilateral triangle design using extra heavy duty tubing and corrugated steel cross-bracing is utilized. The No. 40 is structurally sound so you can install it for heights up to 300′; or at lesser heights when considerably greater strength is required because of excessive wind or antenna loading. Use for radio telephone, broadcasting, microwave relay and all other such communication purposes. If a particular job calls for this type tower, save real money by using ROHN towers.

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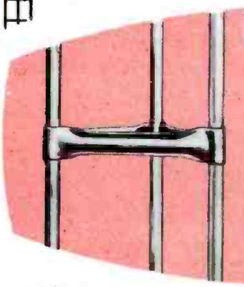

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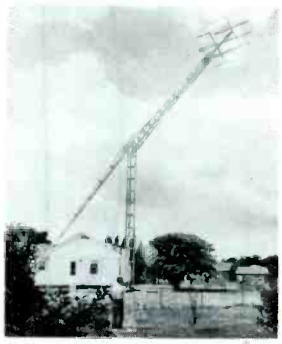

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Audio-Facts

All About the Use of Cathode Followers in High Quality Audio Circuits

by Robert B. Dunham

On several occasions when we have discussed certain pieces of audio equipment in these columns, we have mentioned that they made use of conventional circuits. The term "conventional circuits" was used because it seemed to be self-explanatory and served to point out the fact that individual sections and stages employed familiar and typical circuits.

Anyone who is at all familiar with electronic equipment is aware of the way circuits are constructed around a tube in order to produce a desired result. Standard (or conventional) circuits have been developed for specific purposes such as amplifying the signal, generating a signal, modifying the signal in some manner, or aiding in the proper handling or transmission of the signal.

When we examine the schematic diagrams of several pieces of audio equipment, we usually find that some particular circuits seem to be used very often. One circuit which appears frequently in high quality audio equipment is the cathode follower. Why it appears so often is a question worthy of some discussion.

Amplification or gain seems to have been the primary function of audio apparatus in years past when equipment was more basic; and in general, listeners were not so critical about the quality of the reproduced sound. Things have changed. The circuits of most audio equipment are now much more complicated and elaborate. Because of the high quality of reproduction expected from a modern audio system, consideration must be given to obtaining compensation, reducing distortion, and matching impedances, in addition to obtaining sufficient amplification. The characteristics of the cathode follower are found to be very useful when circuits are selected for a piece of audio equipment which must produce certain desired results.

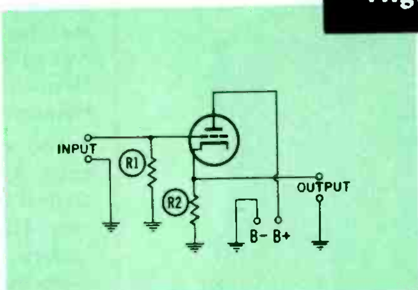

Fig. 1. Basic Cathode Follower.

A basic cathode-follower circuit is shown in Fig. 1. The most noticeable feature of this circuit arrangement and the one by which a cathode follower can be recognized is the location of the load in the cathode circuit. No plate load is used as in the conventional plate-loaded circuit; instead, the load is connected from cathode to ground. The input signal is connected to the grid and ground in the usual way.

We can list some of the more important characteristics or features of a cathode follower as follows:

- High input impedance.
- Low output impedance.
- Large amount of negative feedback.
- No gain in stage.
- Input and output signals in phase.
- Can handle large input signal.
- Input can be direct-coupled to advantage in many cases.

These are not necessarily listed in the order of their importance, which varies with application; but they do give some clues as to what to expect from a cathode follower. These characteristics will be covered in more detail when cathode-follower circuits used for specific applications are discussed.

Cathode-Follower Applications

Used As Output Stage of Preamplifier

One of the most frequent applications of the cathode follower is its use in an output stage, as shown in Fig. 2. This partial schematic shows the output stage of the Fisher Model 50-C master audio control. The low output impedance of the cathode follower makes it particularly suitable for use in the output stage of such preamplifiers and control units.

A cathode follower will operate satisfactorily into most any load impedance. It operates best through a certain range of load

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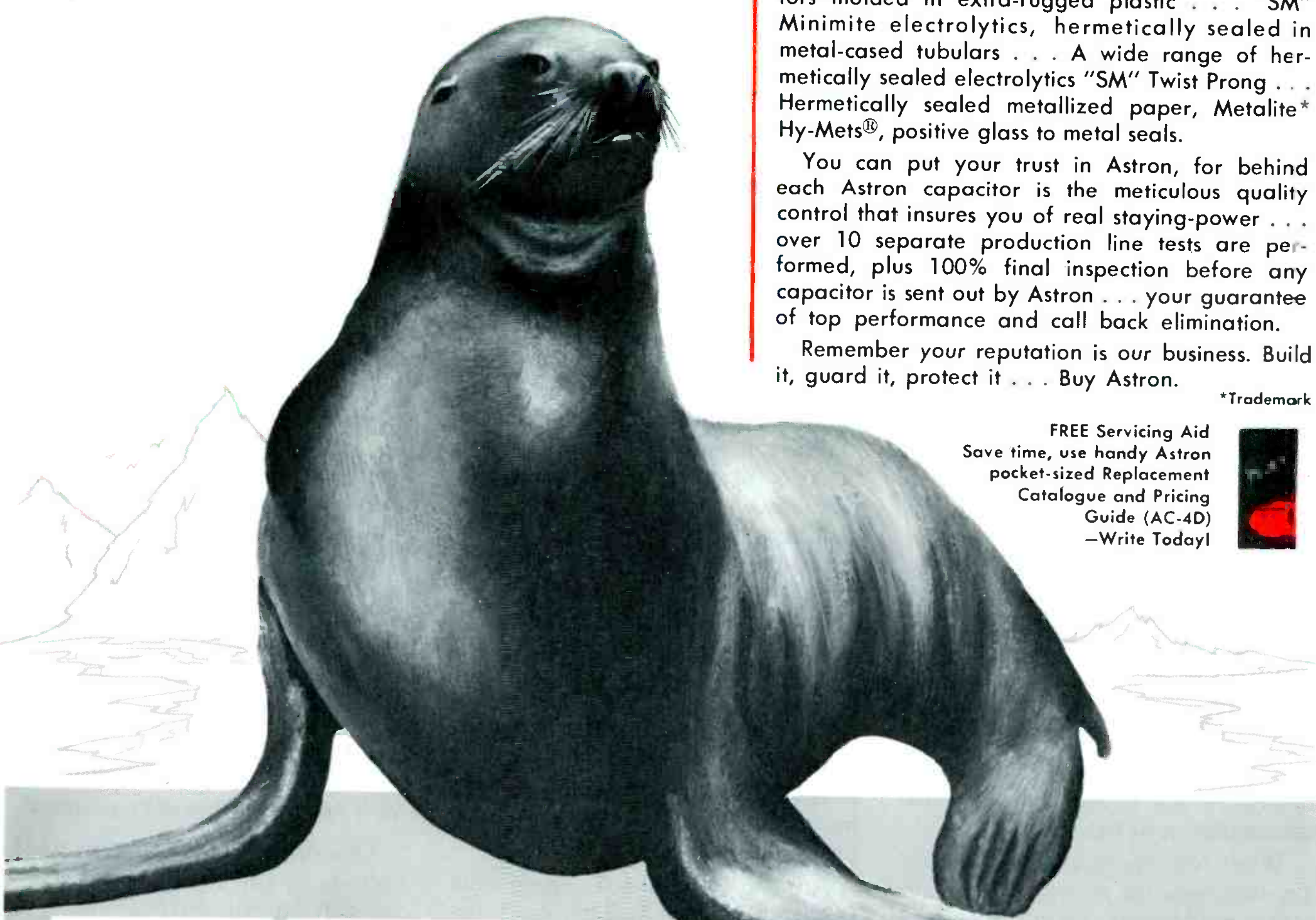

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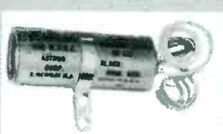

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Shop Talk

MILTON S. KIVER

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

Advance Planning Saves Service Time

As we have had occasion to observe before, every service technician is continually pitting whatever ability he possesses against time. The more successful operators are those who are getting the most amount of work done in the shortest time. The least successful are those who are accomplishing much less in the same time.

From this, the reader might assume that those who know the most are the ones who are the most successful. Oddly enough, this is not always true. Knowing a lot about servicing is certainly helpful, but there is more to the story than that. There is, for example, the way in which you organize your work before you even lay a hand on the set to be repaired. Consider the simple things. Do you have all the special tools you need, or are you always improvising? Do you have your tools within reach when you want them? How about your instruments? Do you have to lug each to the bench when you need it, perhaps at the same time removing some other unit to make way for the new one? How about your folders of service literature? Are they filed and arranged in an orderly fashion so that you can place your hands on exactly the one you want quickly?

The list could be made much longer, but the idea is apparent. The items indicated may appear to be trivial and insignificant, but if you stop and analyze the amount of time they eat up in a normal working day, you begin to appreciate how much time a well-organized work plan can save you. Figures up to 20 per cent are not unusual, and sometimes they go even higher. Think what this can mean to you—one or two more sets serviced a day, with a corresponding boost in your income.

The first step toward salvaging some of this wasted time is to examine everything you do with the question in mind, "How can this be done quicker, more efficiently?" The initial self-analysis may take several weeks, so don't try to hurry it along. In the course of this examination, you will uncover a lot concerning your own particular work pattern. You may find that you work faster in the morning because you are rested and more alert. You can take advantage of this fact by scheduling the tougher jobs for this part of the day. Or you may find that tough jobs are "cracked" faster if they are put aside for a brief time. This frequently helps because you give your mind a chance to clear. The funny thing is that your mind will continue subconsciously to work on the problem even after you have consciously forgotten about it.

The reorganization of your work can also extend beyond the shop to outside calls. Do you set aside a fixed time to make calls? Or do you rush out whenever a call is received or whenever you happen to think of it? Make your plans so that you will make house calls just often enough to get sufficient business in the shop to keep you busy the rest of the time. Try to group your house calls together, particularly with respect to the general area. Once you get on the street, stay there until all calls are completed. Do not interrupt this phase of your work any more than you would interrupt your bench work needlessly. It has been conclusively demonstrated that it takes time to start or stop any action. The more times you start or stop something, the less time you have left to do essential work.

One of the things you can do to make your outside time more fruitful is to notify the customer in advance, preferably by phone, that you will be there some time during such-and-such a day or afternoon. Not only is this a little personal courtesy, which never hurts, but it will reduce your number of incompleted calls. If the customer is not at home even after this notification and you cannot stop back after some other calls, then let the customer go until your next scheduled time for calls. There will be exceptions, of course, since nothing ever runs smoothly all of the time; but if you keep them strictly in the exception category, the number of extra trips will be much lower than if you followed a haphazard routine.

With all due respect for the customer, it may not be amiss to point out that service technicians sometimes do more than they are paid to do. The first responsibility of the technician is to find the trouble and repair the set to the point where the customer wants it repaired. If the set has lost vertical height and you discover that this is being caused by a defective vertical output tube, then your

• *Please turn to page 67*


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Examining DESIGN Features

by Thomas A. Lesh

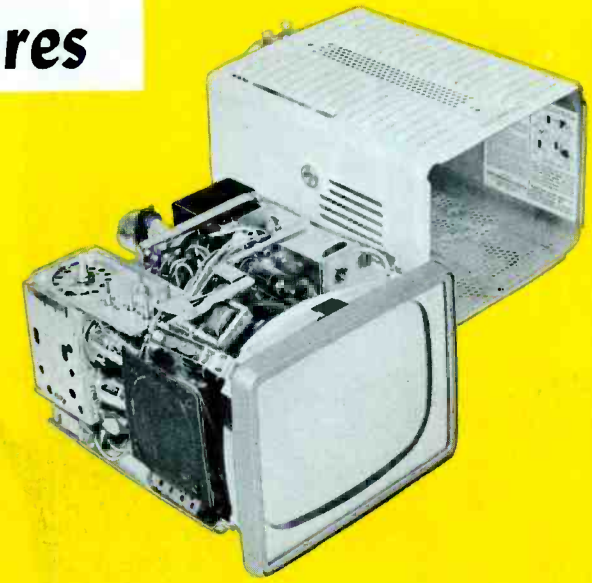

Fig. 1. RCA Victor Portable Television Receiver Chassis and Cabinet.

RCA Victor Portable TV Receiver

The new RCA Victor "Personal Television" receiver is an extremely compact unit. It weighs only 22 pounds, and its cabinet is approximately 12⅞ by 8⅝ by 6¾ inches in size. The 8DP4 picture tube that is used in this receiver has a rectangular 8-inch screen and requires 90-degree deflection, and the viewing area of the screen is 36 square inches. The receiver chassis (KCS 100B) includes 10 tubes, 4 crystal diodes, and a selenium rectifier.

The latter is used as a voltage doubler, and its output is a B+ voltage of 216 volts. The power supply also includes a transformer that has two secondary windings. One of these supplies power to the voltage-doubler circuit, and the other is a filament winding which furnishes 6.3 volts AC to all tube heaters in parallel. Since an isolation transformer is used, the chassis is electrically cold. The rated power consumption of the receiver is 90 watts.

Fig. 1 is a photograph of the RCA Victor portable TV receiver after it has been removed from its cabinet. It can be seen that many components are tightly packed into a small space. All circuits are mounted on two vertical chassis which fit around the neck of the picture tube in such a way that the wiring side of one chassis faces the wiring side of the other. Conventional rather than printed wiring is used throughout the receiver.

The two chassis are secured to each other and to the picture tube by metal rails which extend straight backward from the corners of the picture-tube mask. The top edges of these chassis are also joined together by a broad, perforated bar of metal; but this was removed before the picture in Fig. 1 was taken. The mounting rails, the two chassis, the picture tube, and the front panel of the receiver form a rigid assembly that can be pulled out of the cabinet as a unit.

Before the chassis can be taken from the cabinet, the following items must be removed: the carrying handle, one screw at the center of the bottom edge of the picture-tube mask, and the control knobs and control panel at the top of the cabinet. The control panel and its hinged cover form a box-like assembly that can be lifted out of the cabinet after the control knobs and three screws have been removed. The power and antenna connections are made through interlocks located on the rear panel of the cabinet, and these connections are automatically broken when the receiver is disassembled.

The width, height, vertical linearity, focus, and horizontal drive adjustments are located on the bottom of the front chassis. Special holes in the cabinet are provided so that these adjustments can be varied without disassembly of the receiver. The deflection circuits and the selenium rectifier are also mounted on the front chassis, and the speaker is held in place by a bracket that is attached to this chassis. The video, sound, and sync circuits; the operating controls; the tuner; and the power transformer are located on the rear chassis.

The two chassis do not have to be separated for the purpose of tube replacement. All tubes on the rear chassis, except those in the tuner, are accessible as soon as the receiver is taken out of its cabinet. Before removing the tuner tubes, the technician should loosen the setscrew which holds the speaker in its bracket. Then he can lift the speaker out of the way of the tubes. When the picture tube, a sweep oscillator or output tube, or the high-voltage rectifier is to be replaced, the picture tube must be detached from the rest of the chassis assembly. This requires the removal of four screws that join the mounting rails to the picture-tube mask. The socket and anode leads and the ion trap must then be removed from the picture tube before the latter can be freed from the chassis assembly.

The technician can gain access to nearly all components by separating the rear chassis from the rest of the receiver. This can be done when the screws which fasten the rear chassis to the mounting rails are removed. The interconnecting leads between the two chassis are long enough that the rear chassis may be moved some distance away from its normal position. See Fig. 2. The receiver

• *Please turn to page 65*

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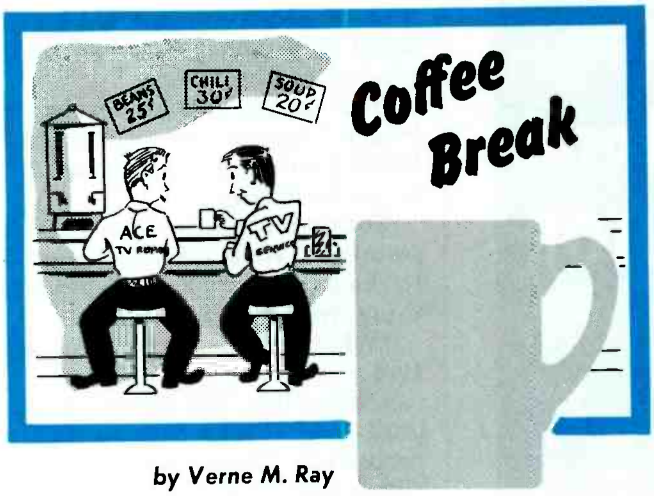

by Verne M. Ray

Tony Freeman was somewhat disgruntled. He had been trying to find the cause for a case of intermittent horizontal bending ever since he had returned from lunch. To make matters worse, it was a hot Saturday afternoon; and just because a couple of sets had to be repaired and returned that afternoon, he hadn't been able to accept an invitation to join some friends at a nearby lake. The screen door slammed, and his co-worker Bud McMahon walked in.

"Hi, Tony!" his tired voice floated through the humid air. "Boy! It's hot!"

Tony pulled a soppy handkerchief from his hip pocket and wiped the perspiration from his face. "Yeah, and this 'dog' set isn't helping matters. Let's take a break and go next door. At least, we'll get the benefit of air conditioning."

On the way out of the shop, Tony queried, "Did you make that call for Mrs. Clark?"

"Sure did," replied Bud with a slight touch of exuberance in his voice. "Replaced the AGC keyer tube. Had me stumped for a couple of minutes, though. There wasn't any raster, and I assumed that either the picture tube or the high-voltage circuit had failed. I was sure surprised when I turned the channel selector and the raster came on. It finally dawned on me that the trouble was probably in the AGC circuit."

Tony smiled to himself. He was thinking how easily Bud had been misled until he had switched to an unused channel. Bud was also smiling; however, he was enjoying the coolness of the air that greeted the pair as they walked through the door of the coffee shop. As they sat down at the counter, Bud confessed something that had been preying on his mind. "I had to bring Thompson's set back again," he admitted rather reluctantly.

"What again!" Tony almost shouted, and Bud flinched with apprehension. "How come? That set was perfect when you took it out of the shop this morning! Don't tell me it's the same trouble?"

Bud threw caution to the winds, and his voice indicated his irritation concerning the subject. "Yes, it was perfect this morning, and it was perfect last Wednesday when I took it out! But I'll be darned if it was perfect when I got it back to Thompson's place! It's doing the same darned thing—no horizontal or vertical sync!"

"I can't figure it out," said Tony. "Evidently, we're tied up with one of those intermittents that act up only in the customer's home."

"Yeah!—and those are the worst kind," Bud added, mimicking a well-known TV comedian. "But don't you think it's a little strange? I mean the way it never works in the cabinet, but it always works OK in the shop."

"We ran it for 8 or 10 hours at a time, too," Tony added, "even with a cardboard box over it to simulate heat conditions when it's in the cabinet. That chassis has been cooked almost to the point where even a normal TV would break down, and still nothing shows up in the shop."

"Well, I'll tell you one thing," Bud exclaimed. "I was quite embarassed about delivering a chassis that didn't work even after it had been serviced twice! Mr. Thompson is really disgusted."

Tony pondered the problem for a moment while he sipped the last of his iced tea. "Well," he said, "I'll check the set again Monday. If I don't find anything wrong, I'll take it back to Thompson myself. There has to be an answer somewhere. I can't go through life knowing that a little sync problem stumped me."

This was fine with Bud. "I'm glad you decided to take it back," he said. "I sure don't want to face Thompson if his set doesn't work this time. You realize, of course, that he's bound to be overly critical of the performance even when you do get it fixed."

Tony smiled and clutched Bud's shoulder as he said, "We'll see. In the meantime, let's get the rest of these sets out so we can go home. My wife has invited the neighbors over for the evening, and she'll be mighty unhappy if I come home late."

Monday morning Tony checked Thompson's set thoroughly and then delivered it. When Bud returned from making a couple of calls, he found Tony taking a late morning break in the coffee shop. "Hi, Tony! Looks like another scorcher, doesn't it?"

"Sure does," replied Tony with a grin that puzzled Bud.

"What are you grinning about?" asked Bud. "You look like the cat that swallowed the canary."

"No," drawled Tony, "nothing like that—but I did find out why Thompson's set wouldn't work."

"You did?" exclaimed Bud. "Well, don't keep me in suspense—tell me what it was!"

"Oh, I don't know if I should," teased Tony. "It might make you feel bad."

"Never mind that," Bud countered. "Just tell me what happened. Was it a tube?"

Now that Bud's curiosity was aroused, Tony could afford to let the suspense build up a little. "No," he said, "it wasn't a tube. You couldn't guess in a million years."

Bud realized that Tony would keep him dangling as long as he showed any interest. "Oh, I don't really care what was causing the trouble," he said, feigning indifference. "The important thing is that Mr. Thompson is well satisfied."

"He's satisfied all right," said Tony, "but I'll bet he'd be giving you the old horse laugh if he knew what had been causing all the trouble."

Bud couldn't hold back any longer. "Aw come on, Tony. Quit holding out. It couldn't be as bad as you're making out."

Tony's reply was somewhat reassuring. "Well, I guess it wasn't too bad, but you'd better learn one thing from this experience."

"What's that, Tony?" asked Bud.

"Never bolt the chassis down until you're sure the set works properly," Tony pointed out. "That way you'll save a lot of time and effort if the set doesn't work quite right and the chassis has to be removed again. In this case, the bolt used at the center of the chassis was too long. When it was threaded up through the mounting flange, it touched a pigtail lead to the grid of the sync separator and shorted it to ground."

Bud was astounded. "Now why in the heck didn't that trouble show up before? I used the same bolts!"

Tony had the answer. "Ordinarily, a much shorter bolt is used in the center flange of this chassis. Somehow, the shorter bolt was used in one of the corners; and one of those originally used for a corner mounting was put in at the center."

"You mean to say that all this trouble resulted from mixing up the chassis bolts?" asked Bud, not wanting to believe the truth. "Oh brother! Is my face red?"

Tony was sympathetic. "Well, I wouldn't worry about it. Most receivers nowadays are designed so that it is practically impossible for such a thing to happen. If you've learned your lesson for today, finish your coffee so we can get back to work." ▲

CORRECTION NOTE

Excuse us, please. . . . In the July issue, the two schematic diagrams on pages 57 and 58 were inadvertently interchanged. Fig. 3 should have shown the damping-factor control circuit, and Fig. 4, the phono-preamplifier circuit.

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RCA ANNOUNCES

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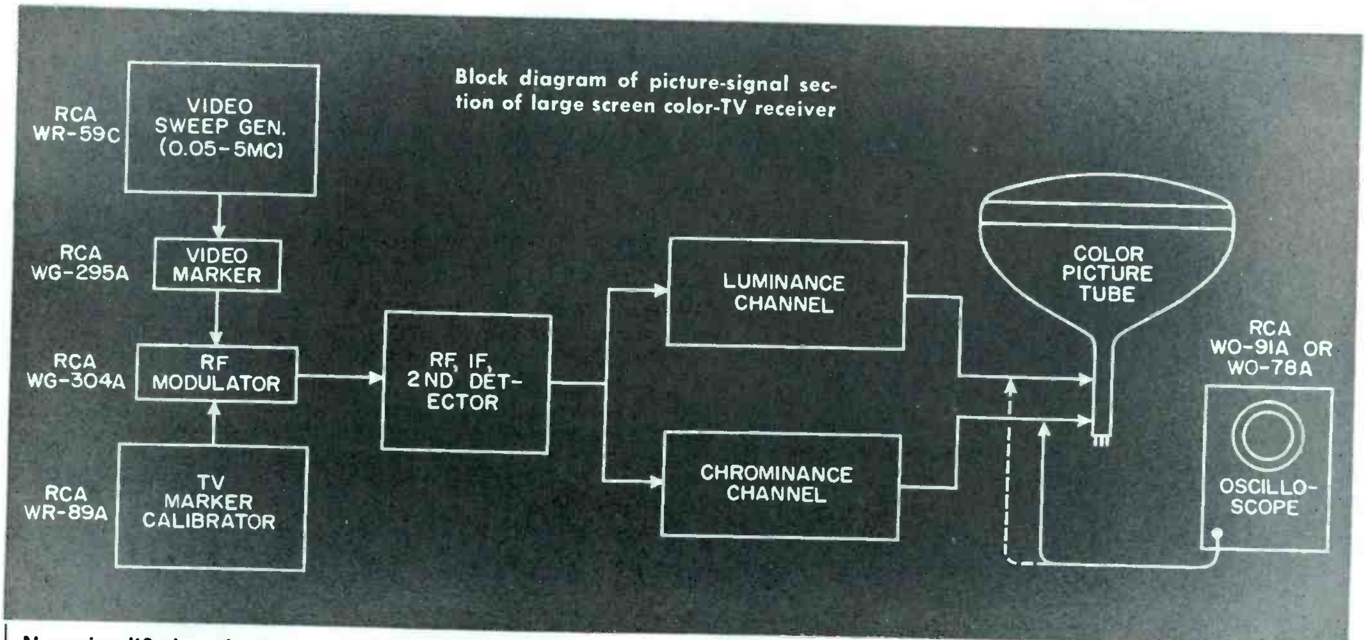

New simplified method essential for the correct alignment of chrominance circuits and for checking overall frequency response of color-TV receivers from antenna to picture tube—rapidly! accurately!

Techniques considered adequate for checking the overall frequency response of black-and-white receivers are unsatisfactory for checking color-TV receivers. The chrominance circuits and video-amplifier, for example, contain several tunable bandpass stages which must be sweep-aligned to insure good color reproduction.

The Missing Link

The familiar black-and-white two-step "overall" alignment check from tuner to second detector to picture tube fails to indicate what effects the second detector load circuits have upon overall receiver bandpass. This type of alignment check is inadequate because connection of a video-frequency sweep generator to the second-detector circuits introduces loading, and the resultant detuning alters normal bandpass characteristics. Because this so-called "overall" check does not include the second detector itself, there is a "missing link" in the otherwise complete alignment picture.

For a true indication of overall receiver bandpass and for correct alignment of the chrominance circuits, the response check must indicate the undisturbed, combined performance of the rf, if, second-detector, video-amplifier, and chrominance circuits. It is obvious that a different alignment technique must be employed for color sets than for black-and-white receivers.

The RCA Overall Response Check

When an rf sweep signal is fed into the tuner, as is conventional practice, the response curve obtained at the second detector is a rectified 60-cps waveform containing no video-frequency components. Such a sweep signal obviously cannot be used to check the video-frequency characteristics of the second detector, video amplifier, and chrominance circuits. To permit a performance check from the tuner through to the picture tube, the test signal must contain elements of the proper frequencies for *all* picture-signal sections of the receiver. Such a signal can be obtained simply by the addition of the new RCA WG-304A RF Modulator to your present RCA TV-alignment equipment. The new overall alignment technique utilizing the WG-304A provides a picture-carrier output signal *which is amplitude modulated by a video sweep signal of from 0.05 Mc to 5 Mc.*

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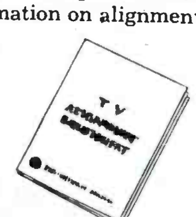

TEST EQUIPMENT

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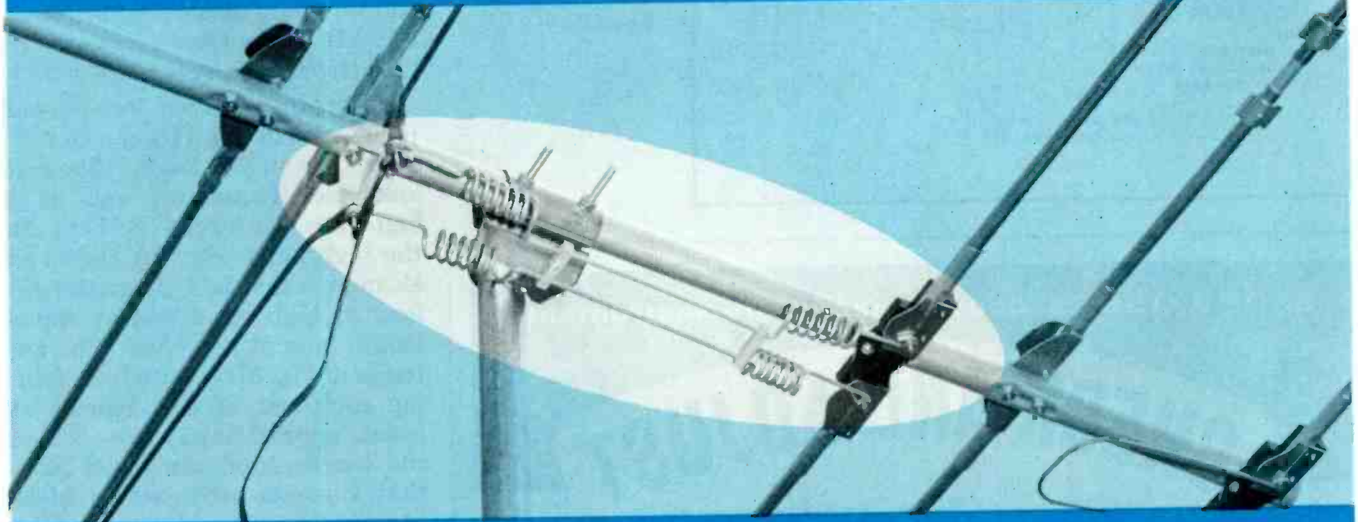
WITHIN THE ANTENNA

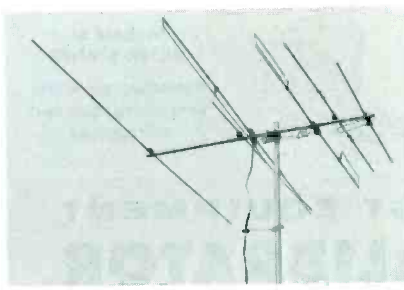


Examining a New Connecting Network for Antennas

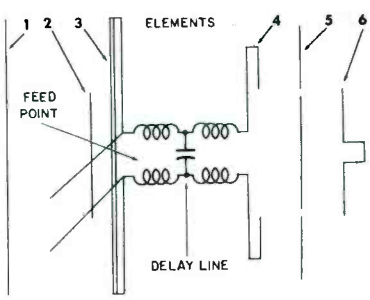
BY GLEN E. SLUTZ

A television receiver, as we all know, consists of a number of interconnected stages which perform separate functions. Learning how a television set works is simply a matter of learning the operation of each of its individual stages and then fitting these pieces of knowledge together. It is logical to apply a like thought process to the study of antennas, for each part of a TV antenna has a more or less distinct function which contributes to the over-all operation. Some antenna parts have even become standardized to a certain extent and are used over and over again with few changes in their shapes and sizes. Generally speaking, reflectors and directors can be included in this group. On the other hand, certain antenna components are being redesigned rather frequently as each manufacturer seeks to improve his products.

As an example of the results of this type of activity, we will examine one of a series of new TACO "Topliner" all-channel VHF antennas which are being marketed by Technical Appliance Corporation. This antenna is an end-fire array, as can be seen in Fig. 1. Element 1 will be recognized as a reflector and elements 5 and 6 as directors. Element 3 acts together with element 2 as a single driven component, and element 4 is another driven component.



(A) Photograph of Erected Antenna.



(B) Layout of Elements.

Fig. 1. The New TACO "Topliner."

The connecting link between the two driven components is the principal new feature of this antenna and is the one we will examine thoroughly in this article in much the same fashion and for the same purpose that we would present information on a new circuit in a television receiver.

The Delay Line

TACO has called its new connecting network a "delay line," the function of which is to couple the driven components together so that their signals will add in phase over both VHF television bands. If we trace the development of each driven component, we will be able to see the purpose of the delay line more clearly.

Figs. 2 and 3 show steps in the development of the components. Elements 2 and 3 started with an open-wire transmission line (Fig. 2A) with one wire cut shorter than the other by ½ wavelength at the mean high-band frequency. By going one step further and using two of these lines placed end to end and fed in parallel, the designers arrived at the antenna in Fig. 2B. The antenna was fed in series, as in Fig. 2C, rather than in parallel. As a result, the short bar appeared as one conductor of a two-wire transmission line which is ½ wavelength long at high-band frequencies. Thus, a delay of 90° in the phase of high-band signals is

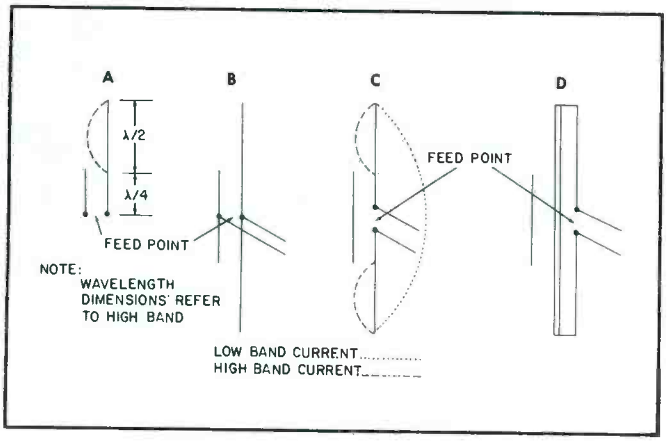


Fig. 2. Development of Elements 2 and 3.

introduced by this transmission-line portion of the antenna. The short bar is ineffective at low-band frequencies because of its short length; consequently, the antenna acts as a simple center-fed half-wave dipole at these frequencies and no phase delay is introduced. Fig. 2D shows the final design of this driven component.

The other driven component (element 4 in Fig. 1B) can be considered as an end-loaded dipole at low-band frequencies and as a half-wave center-fed element on the high band. Fig. 3A shows an element which is 3/2 wavelength long at high band and ½ wavelength long at low band. The antenna of Fig. 3B results from folding each end of the element at points approximately one-sixth of the length from the ends. Note that currents produced by high-band frequencies at the ends of the element are out of phase and cancel each other. The currents at both high- and low-band frequencies are in phase at the feed point.

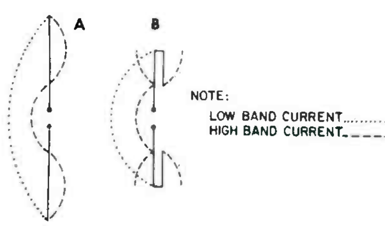
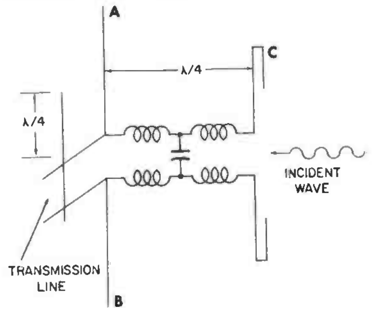


Fig. 3. Development of Element 4.

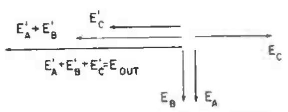
In summary, a phase shift at frequencies in the high VHF band is produced in the signal from the driven component comprised of elements 2 and 3. At frequencies in the low VHF band, however, the component acts as an ordinary center-fed, half-wave dipole; and no phase shift occurs. As a result of this difference in phase on the high and low bands, there is a problem to be overcome in adding this signal to that from the other driven component. The delay line is the solution. Let's see how it works.

The operation of the frequency-selective delay line and the way it ensures additive inphase signals are illustrated in Figs. 4 and 5. The subscripts associated with the vectors refer to the individual elements upon which the signal is induced. The vectors with the prime (′) designation refer to the individual signals as they appear at the output terminals.

Fig. 4A shows the basic elements for high-band operation, while Fig. 4B shows the vector relationship of the signals as they are induced on the elements and as they are additively combined at the output terminals. Induced signal E_C leads signals E_A and E_B by 90° (¼ wavelength) because of the space separation between the elements. Signals E_A and E_B are retarded further in phase by 90° during their travel to the output terminals because of the transmis-



(A) Basic Elements of Antenna.



(B) Vector Diagram of Signal Voltages.

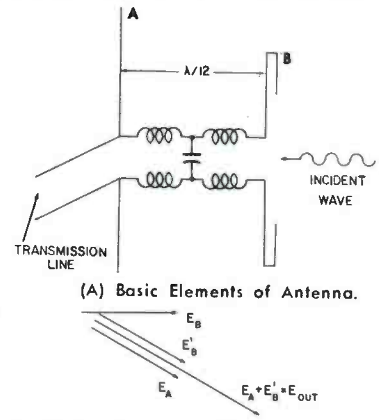
Fig. 4. Operation on High-Band.

sion-line effect of the short bar (element 2 in Fig. 1). If E_C is to be additive in phase at the output terminals, this signal must be delayed by 90° plus 90° or 180° in its travel over a transmission-line path which is ¼ wavelength long. The delay line automatically performs this job by producing the 180° phase shift over a 90° path length (¼ wavelength).

In Fig. 5, we see the basic elements and the vector relationship of the signals in low-band operation. For purposes of simplicity, the long element is shown as a simple dipole and the short transmission-line element is omitted. The constants of the delay line at low-band frequencies are such that the line does not act to delay the signals; therefore, it works as an ordinary straight transmission line which is 30° (1/12 wavelength) in electrical length. As a result, the signals at low-band frequencies add in phase, as shown in Fig. 5B.

To make this more easily understandable, we will draw an analogy for the delay line. Assume that you are at point B of Fig. 6 at 3:00 o'clock and are traveling at a rate of 2 miles per hour toward point C which is 2 miles away. You have a friend who leaves point A at 4:00 o'clock and travels toward C in a straight line at the same rate of speed. It is necessary for you to arrive at C at precisely the same time as your friend. Since you have no control over your speed in this case, it will be necessary for you to delay yourself by traveling over a 4-mile path similar to that shown by the dotted line. By doing this, you and your friend will meet at C at exactly 5:00 o'clock. The purpose of the curved 4-mile path is identical with that of the delay line developed for this antenna. For the low-band condition, the analogy is very simple. You and your friend leave the same point at the same time and travel in the same direction at equal speeds. In this case, you are both "locked in synchronism or in phase" at all points.

The delay line is essentially a balanced T-section composed of inductive elements in series and a capacitive element in shunt. As a result of this design, the transmission of signals is delayed at the high-band frequencies. At the low-



(A) Basic Elements of Antenna.

(B) Vector Diagram of Signal Voltages.

Fig. 5. Operation on Low-Band.

band frequencies, however, the reactance of the circuit is such that transmission is not retarded. Fig. 7A shows a schematic diagram of the delay line, and Fig. 7B is a sketch of the actual delay line.

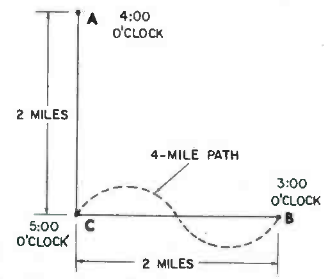
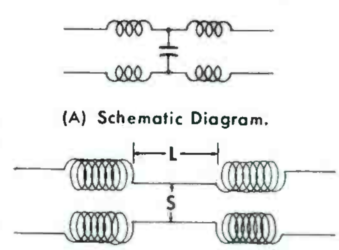


Fig. 6. Sketch of Paths Used As Analogy for Delay Line.



(A) Schematic Diagram.

(B) Sketch of Physical Design.

Fig. 7. Delay Line.

The length L, the spacing S, and the wire diameter have been chosen so that the proper amount of distributed shunt capacitance will be obtained. The entire line including the inductive elements is made from ⅛-inch aluminum wire.

The aim of TACO in developing and using this delay line has been to reduce the size, and consequently the wind resistance, of the antenna and at the same time to preserve the gain and other desirable characteristics. ▲

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OPERATION OF DAMPER CIRCUITS

by Jesse Dines

Currents Fed to the Yoke

The damper circuit serves to prevent the transient oscillations, which occur in the horizontal deflection circuit after the driver tube is cut off, from appearing in the deflection coils and causing a distorted raster. In conjunction with other components in the sweep circuit, the damper tube provides about a third of the trace portion of the sawtooth current. It is during this portion of the trace that the oscillations occur.

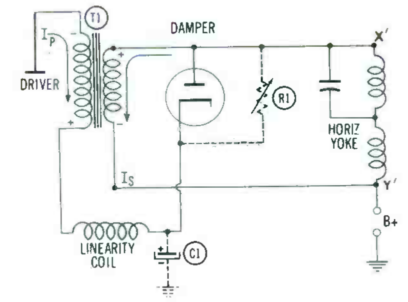
A basic horizontal deflection circuit is shown in Fig. 1A. Capacitor C1 is shown in dotted lines because the explanation of its operation will not be given now but will be discussed in connection with the boost circuit. The damper plate connects to the high side of the deflection coils, and the cathode connects to the low side of the flyback primary through the linearity coil.

Capacitor C1 has a high value of capacitance and therefore provides a relatively low impedance at 15,750 cycles per second. As far as AC is concerned, the damper tube and the horizontal windings of the deflection yoke are effectively connected in parallel across the secondary winding of the transformer. One leg of the parallel connection consists of the damper tube, capacitor C1, and the B+ filters, while the other leg consists of the deflection coils.

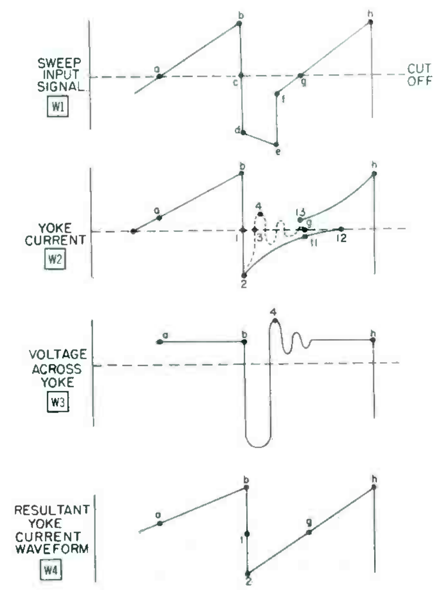
A variable resistor R1 is shown connected across the damper tube in dotted lines. This resistor does not actually exist but is indicated for the sake of explanation. It represents the resistance which exists between the cathode and plate of the damper, and it is shown to be variable because the resistance value at any instant is dependent upon the amount of current through the damper tube.

When power is first applied to the circuit, B+ voltage appears at the plate of the damper tube and the tube conducts. Current flows from the top side of capacitor C1 through the damper tube, through the parallel circuit (which is formed by the deflection coils and the secondary of the transformer), then through the power supply and back to the low side of C1 and charges this component with the polarity shown. Since the top side of C1 is connected to the cathode of the damper tube, the voltage at this cathode increases as the capacitor charges and the potential between the cathode and plate decreases until very little current flows through the tube.

The charge across capacitor C1 also appears at the plate of the driver tube. The driver tube will conduct when the signal voltage at the grid of this tube rises above the cutoff level, as shown by waveform W1 in Fig. 1B. Plate current will flow through the primary winding and produce a magnetic field. As the signal shown by waveform W1 increases from point *a* to point *b*, the current through the primary winding will increase at a linear rate. The magnetic field will expand and will induce a voltage of the polarity shown in the drawing across the secondary winding. This induced voltage acts as a source voltage and causes current to flow up through the deflection coils and down through the secondary winding.



(A) Simplified Circuit.



(B) Waveforms of Currents and Voltages.

Fig. 1. Basic Circuit of Damper and Its Associated Waveforms.

Note that the polarity of the induced voltage is such that this voltage adds to the B+ voltage supplied to the plate of the damper tube. As a result, the damper continues to conduct at a decreasing rate until C1 attains a charge which equals the combined values of the B+ voltage and the induced

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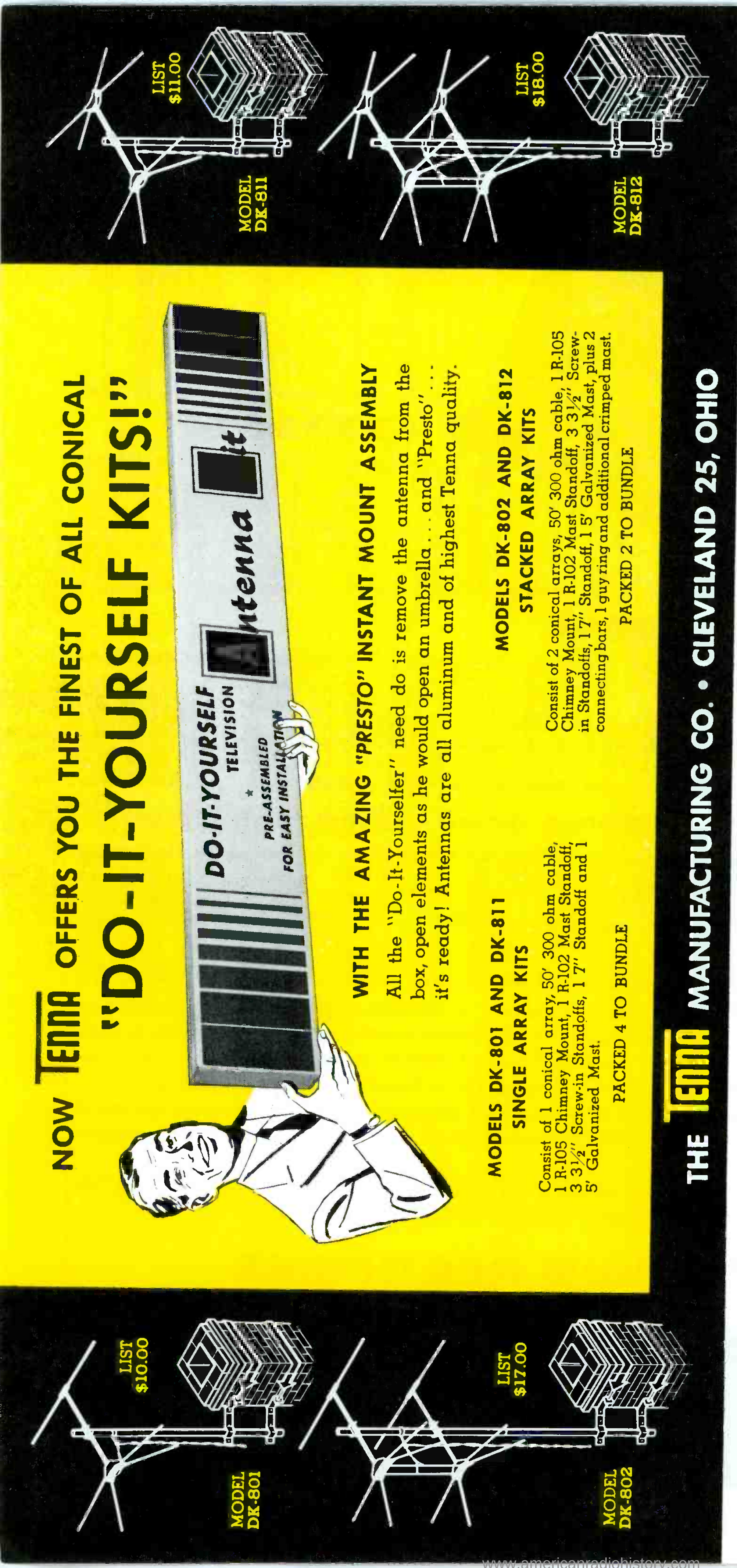
EDITOR'S NOTE: The material in this article was taken from the book, *Servicing TV Sweep Systems*, by Jesse Dines, a recent publication of Howard W. Sams & Co., Inc.

voltage. It should be mentioned at this point that the voltage induced across the secondary winding will remain fairly constant during the conduction period of the driver tube. The reason is that the linear rise in the current through the primary produces a magnetic field which expands at a linear rate, and the number of flux lines cutting across the secondary winding is the same for each instant.

When the signal voltage shown by waveform W1 goes in a negative direction from point *b* to point *d*, the driver tube is cut off. Since current no longer flows through the primary winding, the magnetic field collapses. The polarity of the voltage induced across the secondary by the collapsing magnetic field is the reverse of that obtained during the conduction period of the driver tube. The damper plate becomes negative with respect to the cathode, and therefore the damper tube cannot conduct. This reversal of the polarity of the voltage across the secondary winding starts at point *b* in waveform W3.

The current in the circuit starts to oscillate at this time. After point *2* is reached in waveform W2, the yoke current tends to go rapidly in a positive direction to points *3* and *4*. As the yoke current starts to go in this direction, the rapid rate of current change causes the polarity across the yoke to reverse again, and point *X′* becomes positive with respect to *Y′*. Because of this polarity reversal, the damper plate becomes positive with respect to the cathode and the damper tube conducts. Note from waveform W1 that the driver tube is cut off during this time.

When the damper tube conducts, it presents a heavy load across the deflection coils. This load is represented by R1 and lowers the Q of the circuit. The oscillatory current flows through the damper tube, and an average current flows through the deflection coils. While the damper tube is conducting, C1 is being charged toward a peak value. As the charge on C1 increases, the voltage across the damper tube decreases. As a result, the average current through the tube decreases and the current through the yoke also



decreases. This decay in yoke current is represented by the solid line shown from point 2 to points *11* and *12* in waveform W2. Note that this current decay is not absolutely linear.

If a linear sweep is to be obtained near point *g*, the current from the driver tube must increase at a slightly nonlinear rate, as shown from point *13* to *h* on waveform W2. The damper current and the current which flows during the conduction period of the driver tube will then combine to produce a resultant current which passes through zero at point *g*. This resultant current is shown by waveform W4. If this resultant current is to be obtained, the driver tube must begin conducting a short time before the damper tube stops conducting and must provide a current which will increase at a somewhat nonlinear rate. It is during the time that both tubes are conducting, therefore, that the current through the deflection coils is most likely to change at a nonlinear rate. It will be shown later that the horizontal linearity coil is used so that the desired linearity may be obtained. It is interesting to note that both tubes should be conducting at a time during horizontal scanning when the electron beam is near the center of the television screen. This means that the greatest effect on the horizontal linearity of a picture would be noted near the center of the screen.

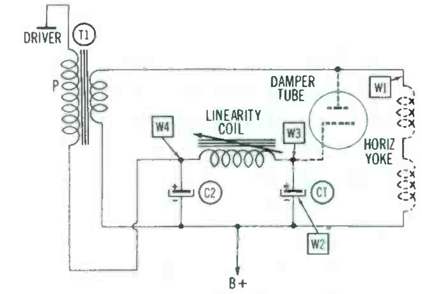
The main points discussed in this section could be briefly summarized as follows:

1. The damper tube contributes to the deflection current during the first portion of horizontal trace.
2. The driver tube contributes to the deflection current during the latter part of the trace.
3. The rapid reversal of yoke current during beam retrace between points *b* and *2* in waveform W2 is the first half cycle of the oscillatory current.
4. The driver tube begins to conduct a short time before the damper tube is cut off in order that there will be compensation for the nonlinear decrease in average damper current.

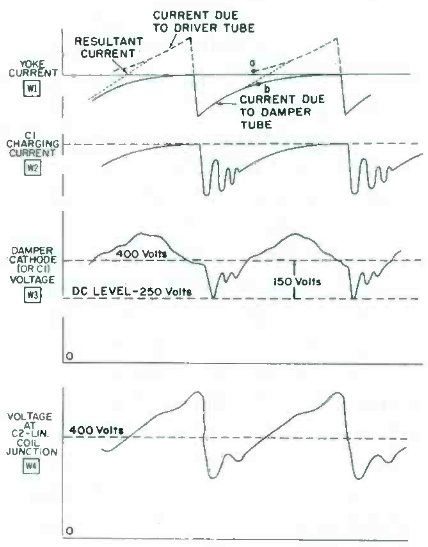
5. The horizontal linearity coil can be adjusted to correct for any nonlinearity which may exist.

Boost and Linearity

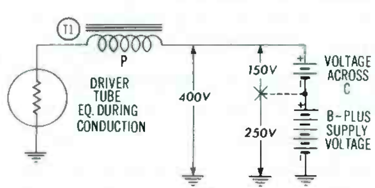
The boost capacitor and the linearity coil were shown in Fig. 1 in order that the operation of the damper circuit could be better explained. This type of circuit is fairly common in TV sets. Another very popular type is shown in Fig. 2. The difference between the circuits in Figs. 1 and 2 is that the low side of C1 in the former is grounded; whereas in the latter, the low side of C1 is returned to B+. The operation of both circuits is essentially the same because B+ is the same as AC ground.



(A) Boost and Linearity-Coil Circuits.



(B) Waveforms of Currents and Voltages.



(C) Equivalent DC Circuit.

Fig. 2. Circuits and Waveforms Associated with Boost-Voltage Development.

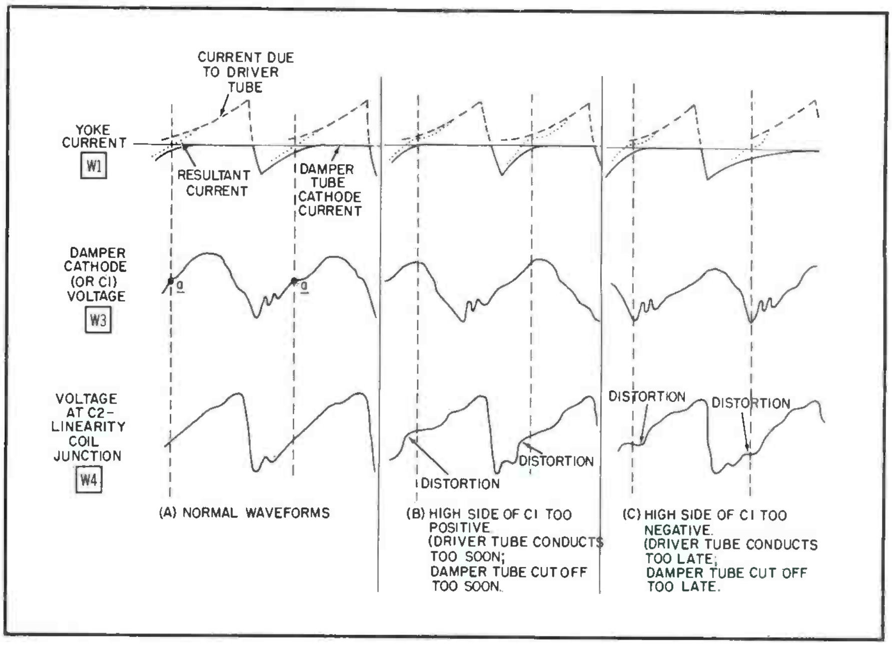


Fig. 3. Waveforms Required to Produce a Linear Yoke Current.

The linearity coil in Fig. 2 is connected in the current path from the driver-tube plate and completes the circuit from the primary of T1 to the cathode of the damper tube. C1 is the capacitor which provides the boost voltage, and C2 lends itself to additional filtering action. C1, C2, and the linearity coil form a pi-network. It should be remembered that all linearity circuits do not necessarily contain this pi-arrangement. Tapped linearity coils and L-networks are examples of other circuits which are employed.

Boost Capacitor

While the operation of the damper tube was being discussed, the operation of C1 was introduced. C1 is the boost capacitor. The explanation dealt only with the charge and discharge of C1. We will now more fully discuss the function of this component.

The solid line shown in waveform W1 in Fig. 2 denotes the current through the deflection coils during the conduction period of the damper. Note that this current changes gradually from a peak value to zero. The dashed line indicates the current which is produced during the conduction period of the driver tube. The dotted line is the resultant current through the deflection coils. The damper current is nearly the same as the charging current of C1. W2 is the waveform of this current. Note that the difference between the current shown by the solid line in waveform W1 and the current shown by waveform W2 lies in the fact that the latter is oscillatory. The reason for this is that the current through the deflection coils during the conduction period of the damper tube is a combination of two oscillatory currents which are 180 degrees out of phase. One current flows through the damper tube, and the other flows through the secondary winding of the transformer.

The method by which C1 charges was explained in the preceding section. It was mentioned that C1 charges with the polarity shown in Fig. 2A when the damper tube conducts. When the damper tube is cut off, the charge across C1 is reduced because of the conduction of the driver tube. Besides damping out the oscillatory current, the damper tube also serves to recharge C1 to its peak value.

Voltage waveform W3 which appears across C1 also contains oscillations because the charging current of the capacitor is oscillatory. The over-all shape of this curve resembles a parabola. Its final shape is influenced by the setting of the core in the linearity coil. The dotted line represents the average voltage across the capacitor, and this average voltage is shown to have a value of 400 volts with respect to ground. The average voltage across C1 is 400 minus 250 volts, or 150 volts; however, if a DC voltmeter were connected from the high side of C1 to ground, 400 volts would be measured. The average voltage at the cathode of the damper tube and at the plate of the driver tube has therefore been boosted; hence we have B+ boost. The reason we have this B+ boost may be seen more clearly by referring to the equivalent DC circuit which is shown in Fig. 2C. Batteries are used to represent the B+ voltage and the voltage across C1. The complete current path from the batteries is through the T1 primary and the driver tube.

The value of the B+ boost voltage is usually about one and a half times that of the B+ voltage. It may be only 40 volts greater than the value of the B+ voltage in one circuit or almost twice the value in another. Some circuits, especially those used in early television sets, do not contain a boost capacitor and therefore have no boost voltage; however, this is rare, since it is practical to obtain such a voltage simply by inserting a boost capacitor in the circuit.

Linearity Coil

Waveform W1 of Fig. 2 shows that during the time when both the damper and driver tubes are conducting simultaneously, both current waveforms must be of a predetermined shape in order for the resultant current to change at a fairly linear rate. Because of the variations in component values, it is difficult to design a sweep circuit which will produce perfectly linear changes in deflection current. The linearity coil is included in the circuit so that there will be a means for compensating for any deviations in values of components. More specifically, the inductance of the coil can be varied so that the shape of both current waveforms when their values are near zero can be altered.

The linearity coil is part of a resonant system which includes the capacitance values of C1 and C2. The approximate resonant frequency of these components is 15,750 cps. Because C1 and C2 are fixed, the inductance of the linearity coil is made variable so that the natural resonant frequency can be varied. It will be shown that deviation in the resonant frequency causes a deviation in the shape of the current waveforms.

In order for the linearity coil to do its job properly, it must affect the waveform of the driver current as well as the waveform of the damper current. If the waveform of the current of the driver tube is to be altered, the input sweep voltage or the DC operating voltages of the stage must be changed. Because the linearity coil is connected to the driver-tube plate through the primary of the transformer, the shape of the plate voltage can be altered. The current which flows through the damper tube depends upon the charge across C1. Varying the inductance of the linearity coil changes the waveform of the current through it. Since the current through the linearity coil affects the shape of the voltage across C1, adjustment of the coil will affect the shape of the current through the damper.

Adjustment of the linearity coil changes the relative phase of the current which flows through the linearity coil and therefore changes the phase of the voltage developed across C1. These phase changes affect the waveforms for the plate voltage of the driver tube and for the bias of the damper tube simultaneously. When the linearity coil is properly adjusted, the yoke current produced as a result of conduction of the driver tube will have an amplitude which corresponds to point *a* in waveform W1 and the yoke current produced as a result of damper conduction will have an amplitude which corresponds to point *b*. Note from waveform W1 that the two currents must be fundamentally equal in magnitude and opposite in direction so that a linear resultant current will flow.

To see more clearly how the linearity coil does its job, refer to the waveforms shown in Fig. 3. Waveforms W1, W3, and W4 of Fig. 2 have been redrawn to show the normal waveforms needed to produce a linear deflection current. Note that point *a* in waveform W3 of Fig. 3A occurs at the time when the resultant current of waveform W1 is at zero. Figs. 3B and 3C show how the adjustment of the linearity coil causes the voltage at the high side of C1 to become more positive or more negative; consequently, the resultant yoke current passes through zero too soon or too late.

As shown in Fig. 3B, the voltage waveforms across C1 and C2 have been distorted so that their amplitudes are more positive than normal at the time when the resultant deflection current should be at zero. As a result, the driver tube conducts too soon and the damper tube is cut off too soon. The amplitude of the resultant deflection current will be distorted, and horizontal sweep will be nonlinear.

When the voltages across C1 and C2 are like those shown by the waveforms in Fig. 3C, the driver tube begins to conduct too late and the damper tube conducts too long. This condition also causes distortion in the amplitude of the resultant deflection current.

▲

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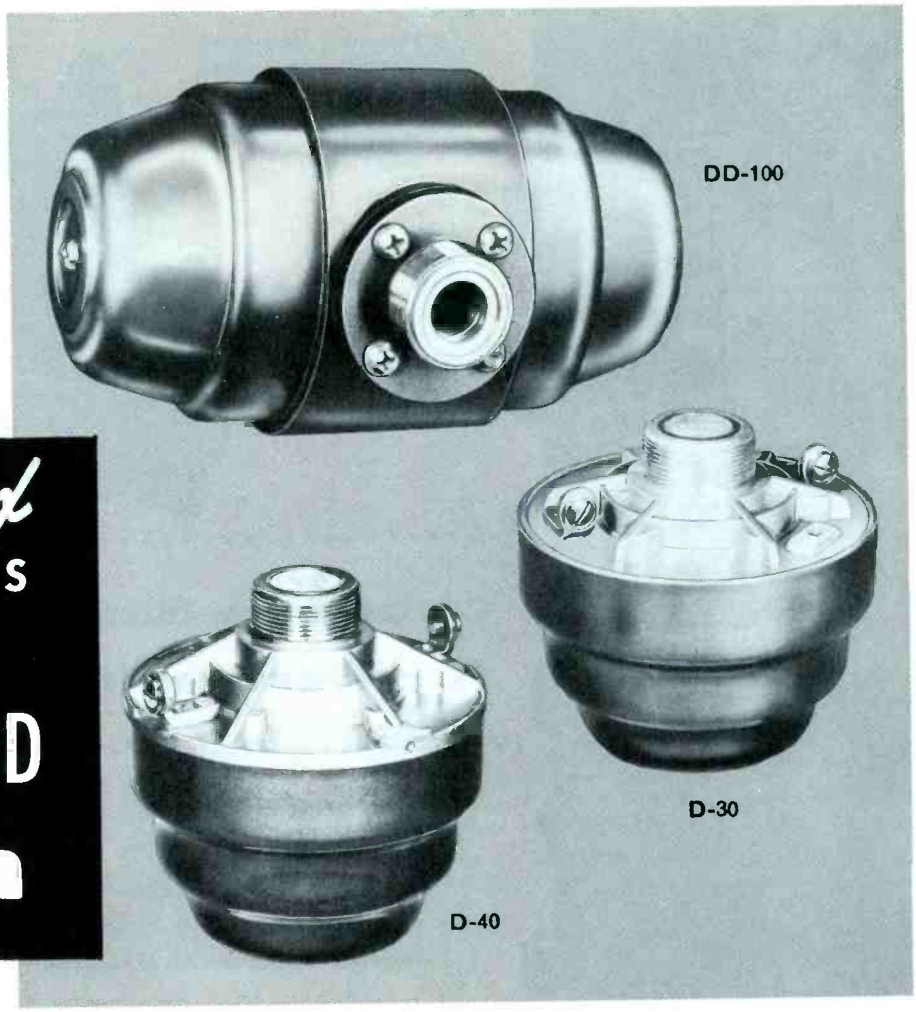

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MODEL	POWER RATING*	IMPEDANCE OHMS	FREQUENCY RANGE	LENGTH	DIA.	LIST PRICE
D-30	30 w.	16	75- 7,000	4 1/16"	4½"	$27.50
D-40	40 w.	16	75-10,000	4 9/16"	4½"	$36.00
DD-100	100 w.	8/32	75-10,000	5 5/16"	8½"	$96.50

*Integrated speech and music program material. For sine wave or siren signal input, reduce ratings one-half. Ratings apply only for frequencies above horn cutoff.

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Every Lifetime Driver Unit is unconditionally guaranteed for life against failure when operated according to the instructions accompanying the unit.

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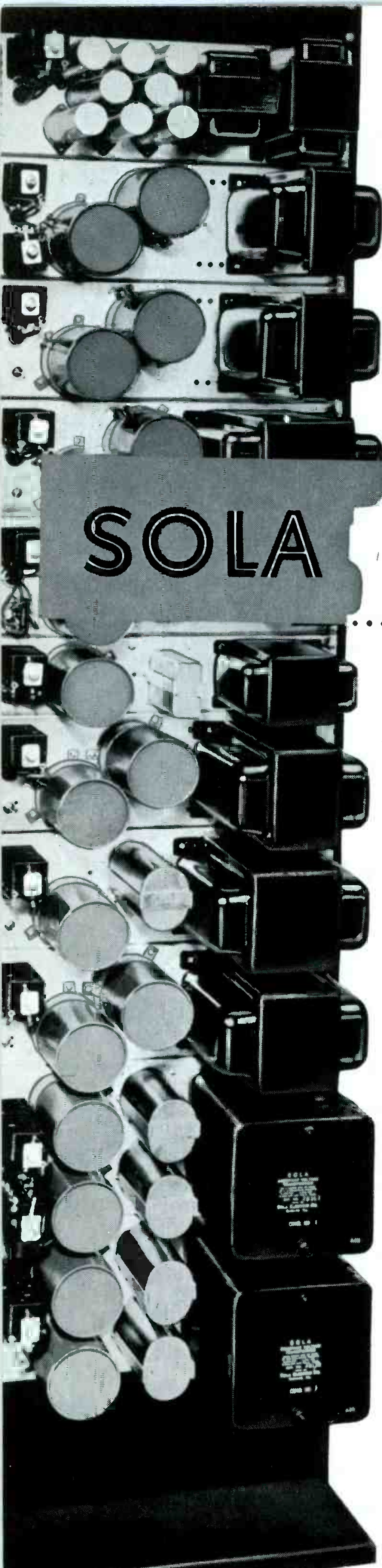

Note the space-saving compact design of this 150 volt DC 5 amperes Sola power supply for computer circuits. Panel height is only 7".

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Sangamo DCM Electrolytic Capacitors provide excellent capacity stability with long life . . . exceptionally low equivalent series resistance . . . extremely high capacity for case size in low voltage ranges. Special design permits high ripple current without overheating. Can be supplied in maximum energy content rating of 80-watt seconds with maximum voltage rating of 450 VDC. Maximum capacity value of 33,000 mfds. can be supplied at 15 WVDC.

The Sangamo DCM Electrolytic Capacitor is housed in a seamless, drawn aluminum container with gasket-sealed molded alkyd resin base thermosetting plastic cover. Detail of cover construction insures minimum contact resistance in current carrying members and provides an adequate safety vent in case of heavy overload.

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SC56-5

Dollar and Sense Servicing

by *John Markus*

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

FIREWORKS. Grasp a clear 200-watt light bulb by its glass end and hold the tip of the screw base against the top cap of the high-voltage rectifier tube while the set is operating. Do it while your wife or girl friend is watching, for a sure test of whether she still loves you. Do it for the woman who brags about how her husband can usually fix the set himself, and she'll never let him go near the set again. Do it just for your own amusement to see what pretty blue sparks you can get jumping from the filament to your hand through the ionized gas inside the lamp. It doesn't hurt a bit; but with an appropriate audience, a few grimaces of pain may be in order.

TIMING. All straws tossed into the hot winds of color TV point to this fall as D-day.

Straw No. 1—Sales of black-and-white sets are dropping, and the resulting competition is cutting manufacturer and dealer profit margins. Something big like color will be needed to "hypo" the market this fall.

Straw No. 2—Color prices have come down. RCA has cut the manufacturers' price of its three-gun color tube from $100 to $85 and has announced a $495 color set for the fall market. Other manufacturers likewise have sets under $500.

Straw No. 3—Color programming is going up both in quality and volume.

Straw No. 4—People still have money or credit for luxury items like color sets, what with employment at a peak and a bright future ahead.

This brings closer and closer the day when that first color set comes into your shop. Are you ready for it with men, equipment, and knowledge?

TRADE-INS. One headache coming up with color TV is the trade-in. Many customers will demand and get big trade-in allowances for their black-and-white sets. The dealer won't make any money on the deals until he sells the trade-in sets, but these will be a real drug on the market once color takes hold. Might be well to make plans now, perhaps co-operatively among several dealers in a locality, to make up trailerloads of these black-and-white trade-ins for economical transportation to low-income communities where they can be sold more readily.

Another countermeasure, likewise requiring advance planning, would involve convincing the customer to keep the black-and-white set as a second set. This calls for manufacturer cooperation in the form of national advertising or for plain old-fashioned hard selling such as has created two-car families for the auto industry. Separating the discount from the trade-in allowance during bargaining sessions may be one answer.

REVOLUTIONS. Printed wiring boards are here to stay. Estimates are that around 6,000,000 square feet of these boards will go into 1956 TV sets and another 1,600,000 square feet into radios, allowing an average of 1 square foot per TV set and 24 square inches for radios that have gone over to printed wiring. It has been estimated that 90% of the TV sets and 70% of the radios have done so.

Etched wiring dominates the printed-circuit field today, but plated wiring is gaining headway. GE has its huge automatic machine for putting down copper lines right where its wants them on the board and in the holes.

If you don't have that small soldering iron now, better get one, and practice up on your own speed techniques for replacing parts on wiring boards.

MAPPING. The distance to which a given TV station can spread its signals is being measured by a radar technique developed at the U. S. Signal Corps Labs at Fort Monmouth, N. J. The radar antenna is placed on top of the TV antenna tower and rotated to scan the surrounding territory. The resulting screen pattern showing how far the beam goes before it hits solid earth is then photographed and placed on top of an existing road or contour map. Every part of the terrain within the pattern then represents good line-of-sight reception territory.

NEW FIGURES. Latest estimate is that 35,000,000 U. S. households have TV, leaving about 12,000,000 households that do not. Though most of these holdouts are within range of TV, they are chiefly in the deep South or other areas where economic aspects preclude their becoming likely prospects for sales. For all practical purposes, the market for black-and-white TV in this country is now pretty well saturated.

This means that the service business for these sets is likewise well stabilized and that increased black-and-white business can only be obtained by doing a better technical and promotional job than the other guy. The big potential for more service business lies in color.

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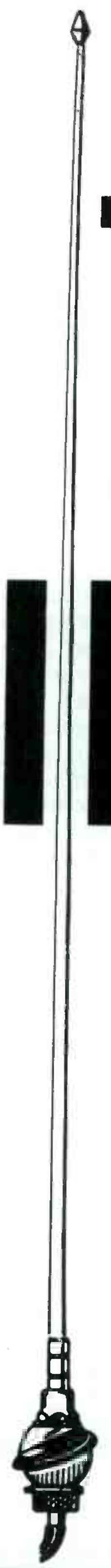

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A STOCK GUIDE for TV TUBES

The following chart has been compiled to serve as a guide in the establishment of proper tube stocks for servicing TV receivers. The figures have been derived by combining: (1) a production factor based upon the number of models and upon an estimate of the total number of receivers produced by all manufacturers, and (2) a depreciation factor based upon an average life of six years for each receiver and with the figures reduced accordingly every two months.

The figures shown are based upon a total of 1,000 units. This was done in order to eliminate percentages and decimals. A listed figure of 100 would therefore imply that that particular tube type constitutes 10 per cent of all tube applications in TV receivers.

Some consideration should be given to the frequency of failure of a particular type of tube. A tube used in the horizontal output stage will fail much more frequently than one used as a video detector. As a result, even though the same figure may be given for both tubes, more of the horizontal output tubes should be stocked.

The column headed '46-'56 is intended for use in those areas where television broadcasting was initiated prior to the frequency-allocation freeze. Entries in this column include all tubes used since 1946 except those having a figure of less than one per thousand—the minimum entry in this chart. The '52-'56 column applies to the TV areas which have been opened since the freeze. Because the majority of receivers in these areas will be of the later models, only the tubes used in these newer sets are considered in this column. The minimum figure of one per thousand also applies to this column.

The listing of a large figure for a particular type of tube is not necessarily a recommendation for stocking that number of tubes. It does indicate that this tube is used in many circuits and emphasizes the necessity for maintaining a stock sufficient to fill requirements between regular tube orders.

TUBE TYPES	46-56 Models	52-56 Models
*X155	–	–
c0A2	–	–
c1AX2	–	–
c1B3GT	41	43
1X2	3	1
1X2A	3	4
c1X2B	3	3
#2AF4	–	–
*#2AF4A	–	–
c3A2	–	–
c3A3GT	1	1
3AL5	1	1
3AU6	1	1
3BC5	1	1
3BN6	2	2
*3BY6	–	–
3BZ6	1	1
3CB6	5	5
*4BZ7	–	–
*5AS4	–	–
*5AS8	–	–
*5BE8	–	–
c5U4G	42	44
5U4GA	2	2
5U4GB	1	1
5U8	2	2
5V4G	5	–
5Y3GT	3	2
6AB4	2	2
6AC7	6	6
c#6AF4	4	4
#6AF4A	–	–
6AG5	23	7
6AG7	2	2

TUBE TYPES	46-56 Models	52-56 Models
c6AH4GT	3	4
c6AH6	7	7
6AK5	3	3
c6AL5	71	71
6AL7GT	4	–
c6AM8	2	2
#6AN4	–	–
c6AN8	6	6
c6AQ5	14	14
6AQ7GT	2	2
6AR5	5	–
6AS5	3	3
c6AS6	–	–
6AT6	3	3
c6AU4GT	2	2
*6AU4GTA	–	–
6AU5GT	3	3
c6AU6	114	107
6AU8	1	1
6AV5GT	2	3
c6AV6	16	17
6AW8	2	2
c6AX4GT	14	13
6AX5GT	–	2
c6BA6	11	8
6BC5	8	6
c6BC7	–	–
*6BC8	–	–
c6BD4	–	–
c6BD4A	–	–
6BE6	6	7
c6BG6G	9	5
6BH6	5	–
*6BH8	–	–

TUBE TYPES	46-56 Models	52-56 Models
c6BJ7	–	–
c6BK4	–	–
c6BK5	3	3
6BK7	2	4
c6BK7A	2	3
c6BL4	–	–
c6BL7GT	4	7
c6BN6	8	6
6BQ6GA	1	1
6BQ6GT	16	22
6BQ7	5	10
c6BQ7A	8	8
c6BY6	2	2
6BZ6	2	2
c6BZ7	8	4
c6C4	9	8
c6CB5	–	–
c6CB6	108	141
c6CD6G	9	1
*6CD6GA	–	–
6CF6	1	1
c6CL6	3	3
*6CN7	–	–
c6CS6	3	3
*6CS7	–	–
c6CU6	2	2
*c6DC6	–	–
6DE6	1	1
6J5	3	3
6J5GT	1	–
c6J6	28	26
6K6GT	13	8
6S4	8	9
c6S4A	–	–
6SH7GT	1	–
6SL7GT	2	2
c6SN7GT	61	65
c6SN7GTA	8	8
6SN7GTB	3	3
6SQ7	2	2

TUBE TYPES	46-56 Models	52-56 Models
6SQ7GT	2	2
#c6T4	–	1
c6T8	13	13
c6U8	15	16
6V3	2	3
c6V6GT	17	16
6W4GT	22	24
6W6GT	7	11
c6X8	6	8
6Y6G	2	1
7AU7	1	1
7N7	1	–
c12AT7	12	12
c12AU7	42	32
12AU7A	1	1
c12AV7	2	3
12AX4GT	2	3
12AX4GTA	2	2
12AX7	4	5
12AZ7	–	1
12B4A	1	1
c12BH7	10	13
12BH7A	1	1
*12BQ6GT	–	–
*12BR7	–	–
c12BY7	8	9
12BY7A	1	1
12BZ7	2	–
*12C5	–	–
12CU6	1	1
*12DQ6	–	–
12L6GT	1	1
12SN7GT	5	4
*19AU4A	–	–
25BQ6GT	3	4
25L6GT	5	5
25W4GT	1	1
5642	1	1
c6505	–	–

#A stock of these tubes should be maintained in UHF areas.

*New tubes recently introduced.

cThese tubes have been used in color television receivers.

One stop on plant tour was final reforming operation where completed capacitors are given several-hour final aging.

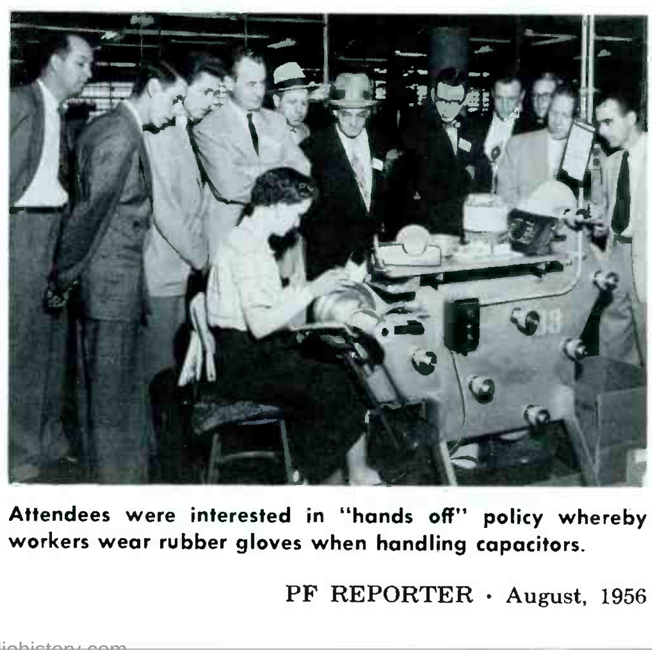
Servicemen Sound Off

Ask the average serviceman what one of his major problems is, and the chances are pretty good he'll reply something like this: "Getting manufacturers aware of our problems out in the field."

One manufacturer which has recognized this need, and done something about it, is P. R. Mallory & Co., Inc., Indianapolis, which recently held its third "Service Engineering Clinic," attended by 13 service technicians and shop owners from four midwest states.

Featured at the 2-day Clinic were guided tours of the firm's manufacturing facilities, together with informal meetings at which personnel from various engineering divisions of the company explained their progress in component design, and invited practical ideas and comments from servicemen attending. The ultimate purpose of such free interchange of thoughts between the serviceman and design engineer is the future planning and manufacture of better TV and radio components.

Earl Templeton, Mallory's distributor sales manager, remarked at the closing of the Clinic, "We welcome the opportunity of playing host to service engineers, and hope that Clinics and meetings such as ours will help to bring a greater understanding between the manufacturer and the service engineer, to the benefit of our mutual customer—the TV-owning public."



Attendees were interested in "hands off" policy whereby workers wear rubber gloves when handling capacitors.

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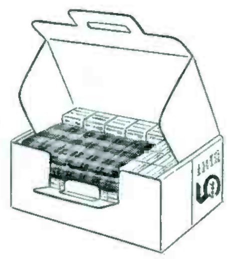

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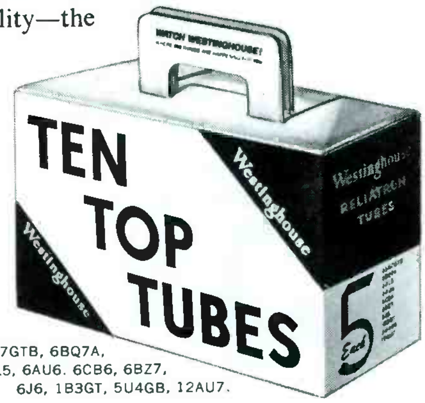

*6SN7GTB, 6BQ7A, 6AL5, 6AU6, 6CB6, 6BZ7, 6J6, 1B3GT, 5U4GB, 12AU7.

6ET-4112

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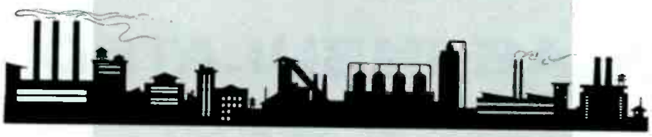
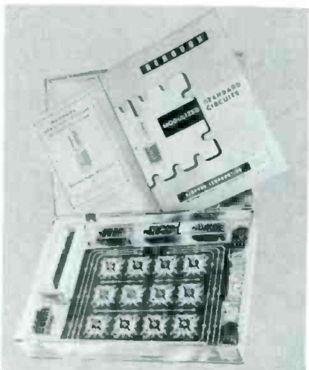
WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y.

Product Report

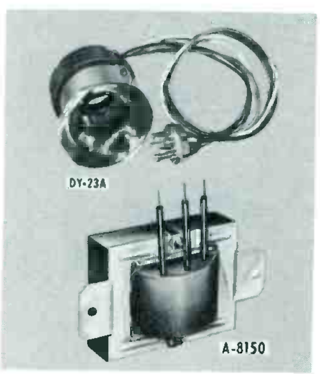


STANDARD-CIRCUIT MODULE KIT



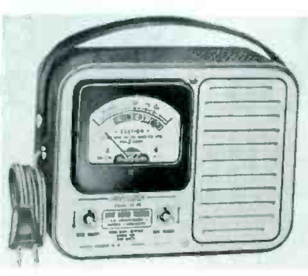
A module kit from which experimental and prototype circuits can be readily assembled on a breadboard is now being distributed by the Aerovox Corp., New Bedford, Mass. The introductory kit includes 7 standard-circuit modules, a 12-position module breadboard, and 50 banana plugs. Aerovox modules are commercialized versions of the original "Project Tinkertoy" and are now available in seven basic circuits.

YOKE AND TRANSFORMER REPLACEMENTS



Two new exact replacements have been added to the line manufactured by the Chicago Standard Transformer Corp., Chicago, Ill. The DY-23A deflection yoke which lists for $13.88 is an exact replacement for RCA part nos. 972459-2 and -3 and can be used in 27 models of the KCS96 and KCS97 chassis series. The A-8150 vertical-output transformer lists for $4.77 and is an exact replacement for RCA part no. C971798-1 which is used in 89 model variations of the KCS87, KCS92, and KCS93 series.

LINE-LOAD SURVEY METER

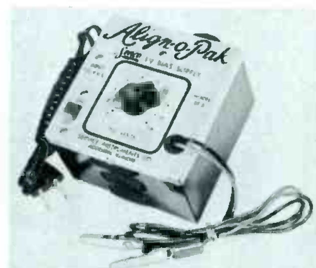


Precision Apparatus Co., Inc., Glendale, L. I., N. Y., has introduced a line-load survey meter that is designed to check the ability of any 110 VAC power line to handle appliance loads. Model AC-12 is simple to operate and even non-technical personnel can use it to check the load imposed on a line by various appliances. A customer may then be advised as to whether or not an appliance may be used without the additional expense of rewiring a power circuit. User's price on the AC-12 is $29.50.

NEEDLE CLINIC

The needle-merchandiser being introduced by the Electrovox Co., Inc., East Orange, N. J. enables the customer to see the worn condition of his needle at a glance. Consisting of an illuminated 100-power precision microscope which is mounted on a permanent storage base, and two lighted lucite needle replicas depicting a new and a worn needle, the display is available to Walco dealers under a special merchandising program.

TV BIAS SUPPLY



The availability of Align-o-pak Model BE3 has been announced by Service Instruments Co. (SENCO) of Addison, Ill. This TV bias supply will provide a DC voltage up to 18 volts, which is nearly twice that provided by an earlier unit, Model BE2. The voltage supplies are isolated, thereby allowing the use of two units in series to provide higher voltages. The price of either model is $7.85.

SOLDERLESS TERMINAL KIT

Vaco Products Co., Chicago, Ill., is making a special introductory offer on their Solderless Terminal Kit No. 395. The kit consists of an 8-inch cutting, stripping, and crimping tool with plastic-insulated handles; a plastic pouch with instructions imprinted on the back; and an assortment of terminals. The introductory offer also includes Vaco's 3/16" x 3" screwdriver.

BIAXIAL HI-FI SPEAKER

Development of a speaker with uniform frequency response from 40 to 18,000 cps has been announced by the RCA Tube Division, Harrison, N. J. The unit combines a 12-inch low-frequency woofer, a 3-inch high-frequency tweeter, and a cross-over network, and is capable of handling 12 watts continuously. The speaker, retailing for $55.95, comes complete with polarized plug-in leads and terminal boards.

Quicker Servicing

(Continued from page 9)

characteristics. The technician must know which tubes can be used for the substitution. Each group listed in Chart I consists of tubes that are mechanically identical and electrically similar. The technician should keep this chart handy for reference because its use will prevent erroneous indications caused by substitution of the wrong tube from confusing the diagnosis of a trouble.

The technician should always keep in mind that, when a stage of a receiver is being checked with a substitute tube, the circuit may not operate as well with the substitute as it would with the exact type. The average technician should be familiar with the more critical circuits and therefore be prepared to evaluate the results of a tube substitution. In other words, tube substitution in such critical circuits as UHF and VHF tuners, Synchroguide horizontal oscillators, and AFC stages may not produce positive results.

The service technician should bear in mind that the tubes listed in each group in the chart are not necessarily replacements for the other tubes in that group. They should therefore be substituted with reservation and for testing purposes rather than for replacements. There are tubes in many of the individual groups that can be used as short-term replacements over a weekend or until you can return with the correct tube.

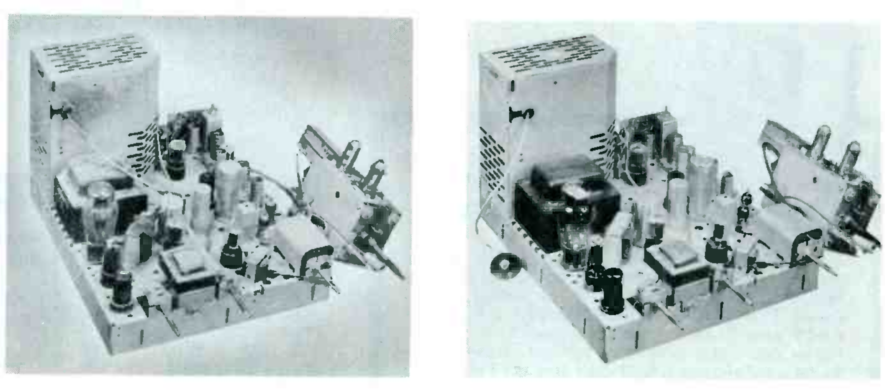
Customer Psychology

The customer, as service technicians will agree, is sometimes a strange creature. Perhaps this is because the woman of the house is the one who will usually call for TV service and will also be present when the service call is made. The psychology of a woman is a complex thing which scholars have been trying to figure out for centuries, with little success. One thing about a woman, however, is certain—she has little love for dirt in her house, and dust in the TV receiver will bother her. Only the fear of damage to the set or fear of the high voltage keeps her from thoroughly cleaning it at regular intervals.

We know that many times when a technician removes a chassis from the cabinet and the customer sees how dirty it is, she will comment, "Now you'll think I'm a terrible housekeeper!" By this comment, you are immediately informed of her concern about so much dirt in the set and of her desire to have the dirt removed. If you return the TV chassis after repairing it in the shop and it is still dirty, you are running the risk of losing the customer's confidence in your ability and therefore the risk of losing a customer.

An example of a dirty chassis is shown in Fig. 1A. This receiver was in service for about two years, and the chassis was not out of the cabinet during that period; so naturally, the dust collected. Notice the much improved appearance of the chassis in Fig. 1B. The cleaning of this chassis was accomplished in only 4 or 5 minutes by use of a 3-inch paint brush, but any brush with soft bristles would have served just as well.

If you should ever pick up a de-



(A) Chassis Before Cleaning. (B) Chassis After Cleaning.

Fig. 1. What a Cleaning Job Will Do for a TV Chassis.

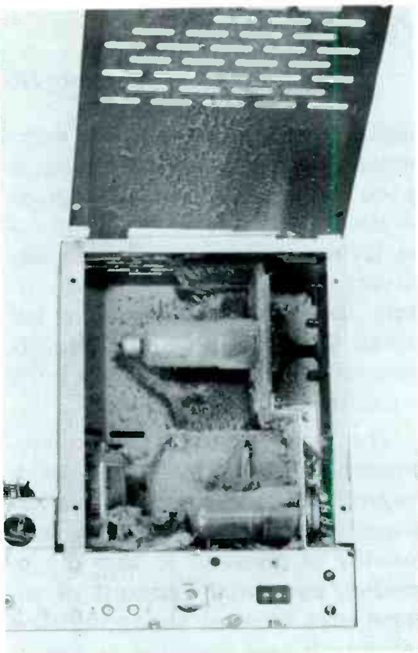


Fig. 2. Dust-Filled High-Voltage Compartment Before Cleaning.

fective chassis and take it into the shop for repairs and then return the chassis still dirty, the customer is very likely to have grave doubts about the quality of the repair job. In fact, he may even protest at paying the repair bill, especially if it is a large one. The moral of this story is: Never return a dirty chassis to a customer if you wish to keep him for a satisfied customer.

The photograph in Fig. 2 is an illustration of the high-voltage section of this same receiver. The dust which collected in this spot would not be visible to the customer; consequently, it would not constitute a problem in customer relations. If allowed to remain, however, this dust could collect moisture on humid days or in damp locations; and the arcing and corona discharge may cause the customer to be very unhappy and to complain of the snapping sounds and the streaks in the picture.

Although not pictured, the components on the underside of the chassis were also dust-covered. Since dust prevents effective radiation of heat by the components, steps to remove this dust are necessary. We found that the same soft brush was very effective in removing the dust and did not disturb the lead dress of any of the components. ▲

Video Amplifiers

(Continued from page 11)

limits upon the values of the components, however. If the capacitor is too large, it may have such great physical size that stray shunt capacitance is introduced into the circuit. In addition, leakage current through the capacitor between the B+ and input circuits becomes troublesome in very large capacitors.

The tube manufacturer's recommendation of maximum grid-to-ground resistance must be followed when the value of a grid resistor is chosen. If this is exceeded, any small amount of reverse grid current that might be caused by grid emission or gas in the tube would have an undue effect upon the grid voltage. C3, R4, C6, and R9 in Fig. 1 are typical of the coupling components which are found in practical circuits.

Capacitors in other parts of the video amplifier circuit can produce distortion at low frequencies. If a bypass capacitor is included in the screen circuit, it is made very large in value so that the high and low frequencies will be equally shunted to ground. Notice that the screen capacitor C4 in Fig. 1 has a value of 10 microfarads. The screen grid is sometimes returned directly to a B+ line if the correct value of screen voltage can be obtained in this manner.

When a bypass capacitor is used in the cathode circuit, it should also have such a large value that degeneration of low frequencies will be kept to a minimum. Uniform frequency response in the cathode circuit can be maintained very simply if an unbypassed cathode resistor is used. This is done in the circuit of Fig. 1. In an unbypassed cathode circuit, all portions of the video signal undergo a slight but equal amount of degeneration.

A decoupling network composed of a resistor and a capacitor is occasionally found connected into the plate circuit between the load resistor and B+. If designed properly, this network counteracts phase shift which is introduced into the circuit by coupling and bypass capacitors.

DC Restoration

The output signal of the video amplifier of Fig. 1 is AC coupled to the cathode of the picture tube through capacitor C6. The level of the DC voltage on the cathode is determined wholly by the setting of the brightness control. When the video signal is applied to the cathode, the average value of the signal always coincides with this preset DC level. Theoretically, this is not a workable arrangement because the composite video signal is supposed to play some part in the determination of the DC cathode voltage. Regardless of shifts which may occur in the average value of the video signal, the pedestals of the sync pulses in that signal should ideally remain at a constant DC level which is equivalent to the cutoff voltage of the picture tube. If they do so, they establish a fixed reference point for all black portions of the picture.

When the video signal is allowed to arrange itself around a fixed average value as is done in an AC-coupled amplifier, the level of the sync pedestals shifts to some extent whenever changes occur in the average level of brightness in the picture. A given shade of gray therefore is not reproduced exactly the same in a predominantly dark scene as it is in a light scene.

In actual practice, it has been found that a satisfactory picture can be obtained when an AC-coupled video amplifier is used. A majority of modern TV receivers contain this type of circuit. The appearance of retrace lines in the picture (potentially, a serious drawback of AC coupling) is prevented by the use of an efficient retrace-blanking circuit. Sharp negative pulses with an amplitude of more than 50 volts are obtained from the vertical deflection circuits and are applied to the grid of the picture tube. These pulses cut off the tube, and the retrace lines are not seen.

Many older models of receivers and a few of the new ones contain a diode which functions as a DC restorer. This tube re-establishes the fixed black level that is lost in capacitive coupling. The diode is generally used in two-stage amplifiers in which the video signal is

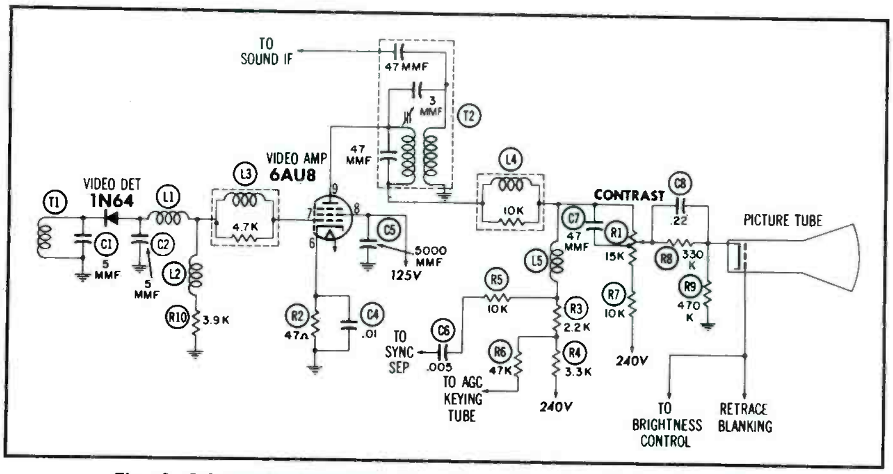


Fig. 3. Schematic Diagram of a Direct-Coupled Video Amplifier.

coupled to the grid of the picture tube. A part of the resistive path between the grid and ground is shunted by the diode. The amount of diode conduction depends upon the peak value of the tips of the sync pulses in the signal, and a capacitor is charged in proportion to the amount of conduction. The charge on this capacitor regulates the DC grid voltage of the picture tube, and the pedestals of the sync pulses are held at a constant level at all times. Use of the DC restorer ensures that all signals which represent black objects will drive the picture tube completely to cutoff if the brightness control is set correctly.

The DC level of the video signal can be preserved without the use of a DC restorer if direct coupling is used throughout the entire path of the signal from the output of the video detector to the driven element of the picture tube. A direct-coupled, single-stage video amplifier is shown in Fig. 3. Note the absence of any series capacitors in the signal path.

The 3.9K-ohm resistor R10 in Fig. 3 serves as a load resistor for the video detector and as a grid resistor for the video amplifier. The detector circuit has series and shunt peaking coils and a load resistor of low value for improvement of the wide-band frequency response of the detector.

The average DC voltage on the cathode of the picture tube is approximately 120 volts. This value is considerably higher than the value of 30 or 40 volts which is customarily found in AC-coupled circuits, but it is safely within the rated heater-to-cathode voltage of the picture tube.

The Sound Signal

The intercarrier sound system is now in almost universal use in TV receivers. In an intercarrier system, a 4.5-mc signal which contains audio modulation is a byproduct of video detection. This signal is utilized as an input for a sound IF stage which feeds the sound detector. Somewhere in the circuits of the video detector or video amplifier, two things must be accomplished. First, this 4.5-mc signal must be coupled to the sound section of the receiver; and second, the same signal must be prevented from reaching the picture tube.

In Fig. 1, the input signal for the sound IF stage is taken from the output circuit of the video detector through the very small capacitor C2. The parallel-resonant circuit consisting of L3 and C7 in the plate circuit of the video amplifier is tuned to 4.5 megacycles. The high series impedance at the resonant frequency of this tuned tank causes the sound signal to be blocked from the output circuit. A series-resonant circuit tuned to 4.5 megacycles and connected from the amplifier plate to ground would accomplish the same purpose.

The sound IF stage is coupled to the plate of the video amplifier in the circuit of Fig. 3. A 4.5-mc signal is developed within the parallel-resonant circuit which forms part of transformer T2. This signal is simultaneously coupled to the sound input circuit and is trapped out of the video output circuit.

Contrast and Brightness

Two different electrical locations of the contrast control are illustrated in the circuits of Figs. 1 and 3. Both types of connection are widely used. In Fig. 1, the control R1 is connected between the cathode of the video amplifier and ground. In this particular circuit, the grid resistor is returned to the cathode end of the control. The bias on the tube therefore is not varied when the control is reset; instead, the effective B+ voltage on the tube is varied. The grid resistor is grounded in some circuits of this type, and then a change in contrast setting does result in a change of bias. In either case, the gain of the tube is altered according to the contrast setting.

The contrast control R1 in the circuit of Fig. 3 is connected in parallel with the plate load resistor. The gain of the video amplifier is constant. A variable proportion of the output signal is tapped off at the arm of the contrast control and is applied to the picture tube. The plate load resistor in this circuit is composed of R3 and R4 in series, the peaking coils are L4 and L5, and the purpose of C7 is frequency compensation.

The brightness control is usually a potentiometer connected between B+ and ground. The variable voltage which is present at the arm of the control is applied to either the cathode or the grid of the picture tube.

Sync and AGC Signals

Sync-separator tubes and AGC keying tubes both require nearly identical input signals, and these signals are usually obtained from the plate circuit of the video amplifier. The sync signal is capacitively coupled, but the AGC signal must be directly coupled. Notice the sync input connections composed of R7 and C5 in Fig. 1 and R5 and C6 in Fig. 3. The AGC signal is tapped off through the isolating resistor R6. The load resistance is divided between the two resistors R3 and R4 so that a signal of reduced amplitude can be obtained for use in the AGC circuit. ▲

Audio Facts

(Continued from page 17)

impedances, depending upon the values of the circuit components; but the range is very wide. In fact, a cathode follower is considered to be an excellent circuit for wide-band applications.

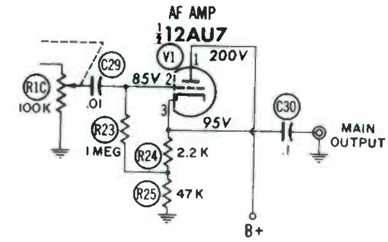


Fig. 2. Cathode-Follower Output Stage Used in Fisher Model 50-C Master Audio Control.

The values of the components used in the circuit in Fig. 2 were selected to obtain satisfactory matching of the output of the Model 50-C to the input of most any amplifier. Capacity has very little effect at audio frequencies on the output of a cathode follower; consequently, long shielded cables can be used to connect the Model 50-C to the input of an amplifier without causing a loss in high frequencies. A severe loss in high frequencies is suffered when a long shielded cable is connected to the high-impedance plate circuit of a conventional plate-loaded output stage. A high quality line transformer would have to be used if a long cable were to be connected to a high-impedance output circuit.

The output stage of the Model 50-C produces no gain because the output of a cathode follower is always less than its input. The input signal of a cathode follower is equal to the grid-to-cathode voltage plus the output voltage; therefore, the output voltage can never equal the input voltage, and the gain of the stage must be something less than one. Under what we might term normal conditions, the gain of a cathode follower is about 0.9. The characteristic of no gain is no disadvantage in the Model 50-C because the output stage is not required to amplify the signal. The preceding stages supply all necessary amplification, and the main function of the output stage is to provide correct impedance matching for efficient transfer of the signal.

Another advantage gained by using a cathode follower in the output stage is the low percentage of distortion produced. This low percentage is due to the negative current feedback developed because of the unbypassed cathode load resistors R24 and R25. Negative current feedback, as obtained with an unbypassed cathode resistor, and its effects were discussed in some detail in the "Audio Facts" column in July 1956.

Correct bias for the stage is obtained by connection of the grid resistor R23 to the junction of R24 and R25. The voltage developed across R24 serves as bias to control the operating conditions of the stage and thereby to control the amount of current that can flow through the tube.

The 12AU7 tube is a good selection for this application because of its high heater-to-cathode rating of 180 volts maximum. Since the cathode voltage can be high in a cathode follower, it is logical to select a tube with a high heater-to-cathode rating.

A cathode follower can handle a large input signal without developing distortion. In fact, the input signal can be much larger than the bias applied to the grid.

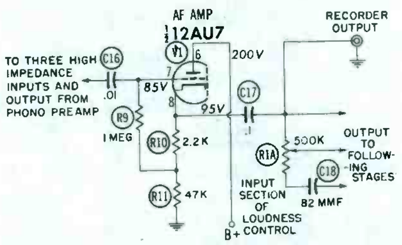


Fig. 3. Cathode-Follower Input Stage Used in Fisher Model 50-C Master Audio Control.

In addition, although it is of no great importance in this instance, there is no phase reversal of the signal in the output stage of the Model 50-C since the signals on the grid and cathode are in phase.

Used As Input Stage of Preamplifier

A similar circuit (Fig. 3) is used in an input stage of the Fisher Model 50-C. A cathode follower is used in this stage for just about the same reasons a cathode follower is used in the output stage.

This stage serves as the input stage for any one of three high-level, high-impedance inputs or for the signal from the output of the phono-preamplifier section. The high input impedance of the cathode follower V1 is very suitable for this situation of accommodating several high-impedance inputs, but the main reason for using the cathode follower is to take advantage of its output characteristics. This is another example of a cathode follower being used as an impedance-matching device.

The output signal is fed from the cathode of V1 through C17 to the loudness control R1. The impedance, and consequently the loading effect, of the loudness control varies when the setting of the control is changed. If the control were coupled to a high-impedance plate circuit, the loading would become undesirably heavy when the control is operated at or near its maximum setting. This disturbing effect is eliminated by the use of the cathode follower because the low-impedance output circuit of the cathode follower is not affected by the varying load.

An output to feed the input of a tape recorder is also fed through C17. This output is in parallel with the input of the loudness control, and both can be used at the same time without any undesirable effects. The recorder output will feed a tape recorder while the rest of the system which is fed by the loudness control will be used for monitoring. This satisfactory dual action is possible because of the output characteristics of the cathode follower, as explained in the preceding paragraph.

This stage produces no gain; but once again, gain is not the objective. The purpose of this stage is to provide stable and undistorted operation under varying conditions, and the desired results are obtained by virtue of the low-noise, low-distortion, and impedance-matching characteristics of the cathode follower.

Used As Tone-Control Stage

Cathode followers are often used in conjunction with tone-control circuits because of the impedance-matching, low-distortion, and wide-band characteristics of the cathode follower. The circumstances are so similar to those in the loudness-control circuit just discussed that it is not necessary to repeat the details.

Used As Driver Stage

Driver stages for class AB and B output stages must fulfill some exacting and severe requirements. A large signal must be supplied to the output stage without being distorted in the process. The situation is made more difficult for the driver stage when the output stage draws grid current, because then the driver stage must supply the power required to develop the flow of grid current. Stable and undistorted operation is difficult to achieve under such conditions. The cathode follower has characteristics that make it suitable for use as a driver stage. It can handle a large signal, has low distortion and low output impedance, and can drive an output stage that draws grid current.

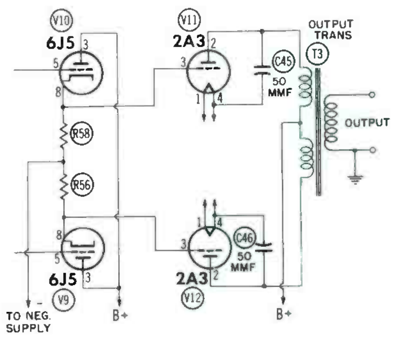


Fig. 4. Cathode-Follower Driver Stage Used in Brook Model 10C3 Amplifier.

The first example that came to our mind was the driver stage used in the Brook 10C3 amplifier, a portion of which is shown in Fig. 4. A pair of 6J5 tubes are cathode-coupled to a pair of 2A3 output tubes in a simple but very effective arrangement. The driver stage can handle the large signal required to drive the 2A3 tubes to full output. The low output impedance of the cathode follower aids in keeping distortion down when grid current flows.

Used As Output Stage of Amplifier

Cathode followers can be used in power output stages and can provide high quality reproduction.

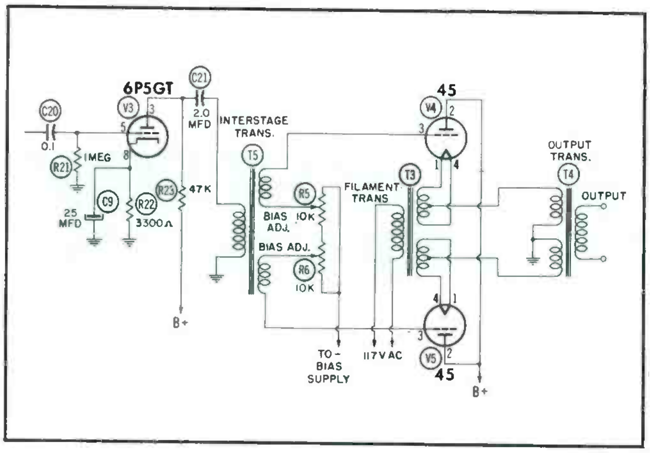


Fig. 5. Cathode-Follower Power Output Stage Used in Experimental Amplifier.

One disadvantage is the power output which is much lower than that obtained with the same tubes operating in a conventional plate-loaded stage. In addition, a large input signal must be fed to the cathode-follower, power-output stage because the cathode follower does not amplify.

Fig. 5 shows a cathode-coupled output stage like that used in an experimental amplifier which we constructed and used several years ago. The driver, a 6P5GT, was shunt-fed and transformer-coupled to the 45 tubes in the push-pull output stage. The 6P5GT, which can handle a large signal, and the interstage transformer were used to develop the large signal necessary to operate the cathode-follower output stage. Fixed bias was applied through the 10K-ohm potentiometers to the grids of the output tubes. The output transformer (with the same value of primary impedance as that used for conventional plate loading) is connected to the center taps of the filament windings since these output tubes have no cathodes.

The quality of reproduction obtained with this amplifier was excellent but the power output was limited. More output tubes would have had to be connected in parallel with the pair used in the output stage, and a power supply capable of supplying the additional current would have had to be used to gain a higher power output. These requirements along with the large driving signal needed have made the cathode follower impractical as a power output stage in an amplifier intended for general use. On the other hand, in amplifiers used in the laboratory, the cathode follower is sometimes used as a power output stage.

In addition to the audio applications discussed here, the cathode follower is used in all types of electronic equipment because of its distinctive characteristics that make it so useful in audio work. The circuit is simple, effective, and in many cases makes the use of an expensive impedance-matching transformer unnecessary in the manufacture of certain types of audio equipment. ▲

Printed Wiring Boards

(Continued from page 13)

and radio receivers use a paper-base phenolic material to which a copper wiring pattern is bonded. There are several ways in which the boards are produced, but the end result is essentially the same —a phenolic circuit board with a wiring pattern on one or both sides.

Acid Etching

One popular method of making printed wiring boards consists of bonding a thin layer of copper foil .0001 to .0004 inch thick to a thin layer of paper-base phenolic material. A chemical "resist" is then applied to the copper foil by a photographic process. (It could also be applied by a silk-screen process.) Resist is the term given

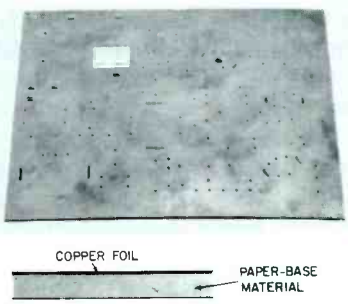


Fig. 1. Prepunched Copper Foil on Paper-Base Material. (*inset*—Drawing Showing End View of Enlarged Copper-Clad Board.)

to the coating that keeps the acid from removing the circuit pattern from the board. The copper foil thus treated is then subjected to an acid bath which removes the undesired surface area and leaves the area treated with the resist unharmed. Suitable steps are then taken to stop or neutralize the acid action, and the resist is removed. The required holes for component leads may then be punched.

In some cases, the holes may be punched in the board before the resist is applied. If they are, the pattern of the holes is used to help bring the pattern of the resist into alignment. This method has an advantage in that, if the resist pattern is not in registration with the hole pattern, the resist can be removed so that the board can be reprocessed. A prepunched metal-clad laminated board without the resist is shown in Fig. 1, and a board that has just been removed from the acid-etching tank is shown in Fig. 2. In the latter picture, the circuit pattern is still covered with the resist and all other copper has been removed by the acid.

Plating by Electrolytic Means

Another method of making printed wiring boards consists of electrolytically depositing or plating the electrical circuit pattern on the phenolic board. This is accomplished by applying a conductive material to the prepunched base material, by applying a resist to the background area but not to the pattern area, and by copper-plating the exposed conductive pattern. Since the conductive material also runs into the holes, the copper will plate the inside of the holes. The resist and conductive material in the background area are then removed with a solvent.

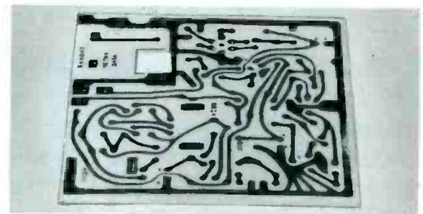
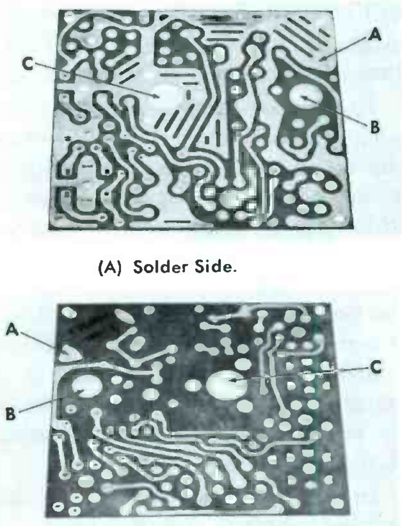


Fig. 2. Etched Board With Resist on Circuit Pattern.

This method produces what are sometimes called "plated-through holes" because the wiring patterns on both sides of the board are connected together by means of the plating inside the holes. A printed circuit board which was made by this technique is shown in Fig. 3A. Fig. 3B shows the circuit pattern on the other side of the board; and points A, B, and C correspond to the same points in Fig. 3A. The drawing in Fig. 4 shows a cutaway view of a printed wiring board with plated-through holes. It can be seen that the copper which lines the holes has the same thickness as the copper on each side of the board.

Embossing

A third method of producing printed wiring boards consists of application of a sheet of thin copper with adhesive on one side to a base material, and then the circuit pattern is embossed on the board by use of photoetched metal dies. In a process that employs both heat and pressure, the dies force the copper-foil pattern into the base material; and at the same time, the heat causes the adhesive to bond the copper foil to the base



(A) Solder Side.

(B) Component side.

Fig. 3. Printed Wiring Board With Plated-Through Holes.

material. This leaves the entire surface of the base material covered by the copper foil, but only the circuit pattern is recessed into the base material. The unwanted copper material is removed by mechanical means, leaving the desired circuit pattern embedded in the base material. The wiring foil is protected because there are no edges which might be caught on a

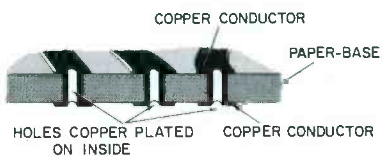


Fig. 4. Drawing Showing Details of Copper Coating on Both Sides of Board and Through Holes.

sharp object and be broken. This method of producing a printed wiring board does not require any etching with acid, and therefore there is no problem of neutralizing or removing the acid. The drawing shown in Fig. 5 should give a basic idea of the way the embossed type of printed wiring board is produced.

Applying Solder to Printed Wiring Boards

The conductor pattern which is

present on any printed wiring board is bonded to the surface of the board in some manner. In most cases, this bond consists of a thermosetting adhesive. This

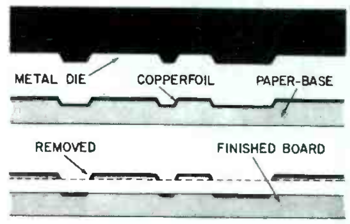


Fig. 5. Drawing Showing Embossed Type of Printed Board and Some Production Details.

means that, at a certain specified temperature during manufacture, the adhesive will set and thus bond the foil to the base material. If excessive heat is applied to the foil or conductor pattern during a repair job, a blistering of the board under the conductor will occur, and the conductor will become unbonded from the base material.

The solder used is of prime importance; it should be only a low-temperature solder. The recommended solder combinations are 63/37 or 60/40. These figures refer to the solder composition of 63 per cent tin and 37 per cent lead or 60 per cent tin and 40 per cent lead. The melting point of these is approximately 370° F, and they will easily flow and quickly adhere to the wiring foil.

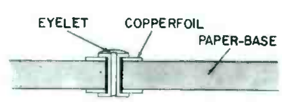


Fig. 6. Eyelets Connecting Pattern on Both Sides of Board.

Certain types of printed wiring boards will have the circuit pattern on both sides and will have connections at points between the two patterns. If the printed board has plated-through holes, these connections are an integral part of the plating process. If, however, the printed board is produced by a photoetching process, the connection between the two sides will be made by use of eyelets. It is important that these eyelets make good connection on both sides; for this reason, the eyelets are usually soldered to the foil on both sides. Fig. 6 shows an eyelet in this type of application.

Mechanical Considerations

We all know that steel will bend a great deal before it will break. However, this is not the case with plastics nor phenolic materials. There is a certain amount of flexing that a printed wiring board will stand before breaking, and a little care and thought should prevent any breakage of these units.

In a radio receiver, the printed wiring board may be the entire chassis assembly which mounts in the cabinet by means of several slots. Since there are few heavy components affixed to the printed circuit board and since the area of the board is relatively small, there is not too much danger that the board will be broken when it is being installed or removed from the cabinet or when a tube is being changed.

In a television receiver, the printed circuit board may be much larger and may have heavy components affixed to it. A printed circuit board is usually only a part of a TV receiver and may be considered as a subassembly. These subassemblies will be mounted in such a manner that the B– or ground bus of the printed circuit will make contact with the metal chassis. It is important that these connections make good contact but that no excessive pressure be applied to the board. To make sure that proper contact will be made, the manufacturer usually employs a lock washer or solders the bus to the chassis.

Electrical Considerations

The conductor strips on a printed wiring board perform the same function that wires and terminal strips do in conventional wiring. Some of the conductor strips distribute B+ voltages to the various parts of the circuit, and some of the strips carry the filament current to the tubes. If a parallel filament hookup is employed and if there are several tubes on the printed wiring board, the current flowing in the filament conductor strips could be in excess of one ampere. The conductor strips are only .00014 to .00028 inch thick and 1/32 to 1/16 inch wide. In the dip-solder operation, a film of solder coats all the conductor strips and increases their cross-sectional areas so that they can safely carry the currents required by the filaments and other circuits. One manufacturer gives the current capacity of the conductors on his paper-base, metal-clad boards as follows:

1. For a conductor 1/16 inch wide and .00015 inch thick and an allowable temperature rise of 40° C, the current capacity is 3.5 amperes.
2. For a conductor 1/32 inch wide and .00015 inch thick and an allowable temperature rise of 40° C, the current capacity is 2.5 amperes.

These figures are based on a room temperature of 20° to 30° C. The manufacturer further states that the current capacity can be increased when the temperature rise is less than 40° and must be decreased when the temperature rise is more than 40°.

The spacing between the conductor strips should be as wide as possible; in most cases, there will be at least as much space between the strips as the strips are wide. The actual insulation resistance between the strips is determined by the base material and the space between the strips. The insulation resistance of the paper-base material used in printed wiring boards is very high, and little or no trouble should be encountered with leakage between the conductor strips. ▲

Examining Design Features

(Continued from page 21)

may be operated while it is in the position shown in this figure, and extensive voltage and waveform

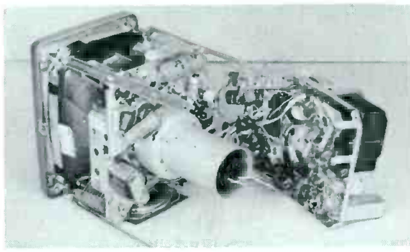


Fig. 2. RCA Victor Portable Receiver Partially Disassembled for Servicing.

checks can be made. Fig. 2 shows the front part of the receiver placed on its side in order that the service controls on the bottom edge of the front chassis will be accessible. The rear chassis remains upright so that the main operating controls on the top of this chassis can be reached easily.

Notice the metal hood that surrounds the neck of the picture tube. It is attached to the front chassis. The hood acts as a receptacle for the yoke, and it also shields the neck of the tube from the magnetic field of the power transformer. The ion trap is placed on a paper sleeve, and the technician should pull on this sleeve in order to extract the ion trap from inside the hood.

Circuit Description

Some unconventional circuitry is employed in the RCA Victor portable TV receiver. A block diagram of this receiver is shown in Fig. 3. Notice that dual tubes are used everywhere except in the horizontal output and high-voltage circuits. Four 6U8 tubes and one 6AW8 make up the entire tube complement of the RF, IF, video, sound, and sync sections of the receiver.

The tuner is of the switch type, and it receives only VHF channels. Since different sections of the same 6U8 tube are used as the RF amplifier and as the first IF amplifier, the IF stage is included in the tuner. The incoming signal is fed to the cathode of the triode RF stage, and AGC voltage is applied to the grid of the triode. In the mixer, the RF signal is con-

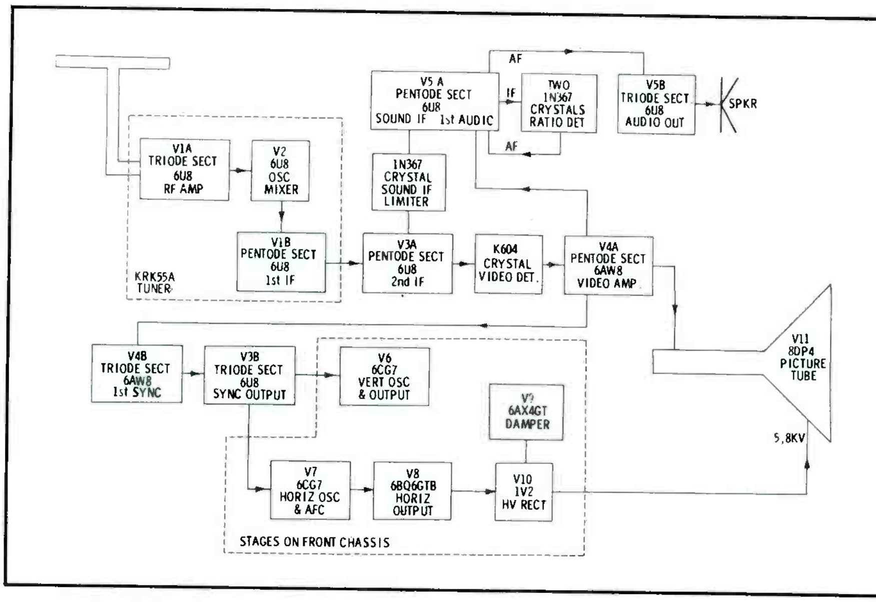


Fig. 3. Block Diagram of the RCA Victor Portable Television Receiver.

verted to an IF signal in the 41-mc range.

The plate circuit of the first IF stage V1B contains a tuned tank circuit which can be adjusted by means of a service control called the 41.25-mc sound boost. In the event that there is no setting of the fine-tuning control at which good sound together with a good picture can be obtained, the picture should be tuned in as clearly as possible and the sound-boost slug should be adjusted until the sound is improved. The RF oscillator trimmers should not be disturbed unless it is impossible to make a satisfactory adjustment of the sound-boost slug.

The audio section of the receiver includes a reflex amplifier V5A. A similar circuit was described in "Examining Design Features" in the February 1955 issue of the *PF REPORTER*. The tube V5A receives a 4.5-mc sound IF signal, amplifies it, and applies an output IF signal to a ratio detector. A demodulated audio signal is obtained in the output circuit of the ratio detector, and this signal is fed back to the grid of the reflex tube for further amplification. In the plate circuit of V5A, the IF signal is developed across an inductor and the audio signal is developed across a load resistor; consequently, the signals are amplified separately but simultaneously. The audio-frequency output of the reflex amplifier is applied to the other section V5B of the same tube. V5B is used as a power amplifier, and it drives the speaker.

The sync and sweep circuits of the portable receiver are conventional in many respects. One unusual feature is that the plate of the horizontal output tube is connected directly to the plate of the high-voltage rectifier. The 8-inch picture tube requires a potential of less than 6 kilovolts at the second anode, and this potential can be obtained by rectification of the voltage pulses which occur at the plate of the output tube. No step-up winding is necessary on the horizontal output transformer.

The horizontal output tube has the dual type number 6BQ6GTB/6CU6. This number signifies that the tube is the same size as the 6BQ6GT but that it has higher electrical ratings which are similar to those of the 6CU6. See the article "Changes in Tube Design" in the April 1956 issue of this magazine. An exact replacement is required in the event that this tube fails. An ordinary 6BQ6GT is not fully adequate for use in the 90-degree deflection system of this receiver, and a full-sized 6CU6 is so large that it will not fit in the available space.

Many of the components of the receiver are of familiar design, but there are some exceptions. For example, the potentiometers and the terminal strips are smaller than those which the technician is accustomed to seeing in television receivers. ▲

Shop Talk

(Continued from page 19)

primary task is to replace that tube and check the associated height and linearity adjustments. It does not mean that you are to readjust the sound or video IF system or the tuner or oscillator slugs for each of the channels. The set may need all of these adjustments, and you may know that they should be made; but unless the customer wants them made and is willing to pay for the time required to make them, you are simply wasting your time so far as income is concerned. Of course, you may want to do somewhat more than you absolutely have to (and many service technicians do) for the sake of good will. That will depend entirely on you; but keep in mind just what this extra service is costing you.

One of these extras that most technicians perform is tube checking. This will pay off if the tests can be carried out quickly and the set owner is willing to replace those tubes that require it. Usually, he is amenable to this; so the additional time spent is definitely worth while, both from your viewpoint and his.

Sometimes you will find that the set owner has previously checked some of the tubes himself, and he may inform you of this with the statement that further checking along these lines is not required. A useful answer in such cases is to point out: (1) that a tube can go bad at any time, (2) that checking the tubes will take only a few minutes, and (3) that tube checkers vary in sensitivity and that your instrument is very sensitive.

Look at the over-all situation this way. When you take your car into the garage to be greased, that is all that will be done to it, even if it needs a motor tune-up very badly. An alert mechanic will call your attention to a tune-up and will try to persuade you to have it done "as long as the car is in the shop, anyway." But if you decline to go along with his suggestion, then nothing will be done. That is all there is to it. And certainly your time as a TV technician is as valuable as his. ▲

SAMS

PF REPORTER

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2V. AMERICAN MICROPHONE (Electronics Division, Elgin National Watch Co.)

Catalog No. 47 on American Microphone phonograph cartridges and accessories. Lists prices, specifications and characteristics on complete product line. *See advertisement page* 66.

3V. ATLAS (Atlas Sound Corp.)

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6V. CHICAGO STANDARD (Chicago Standard Transformer Corp.)

Stancor Television Transformer Library. *See advertisement page* 31.

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