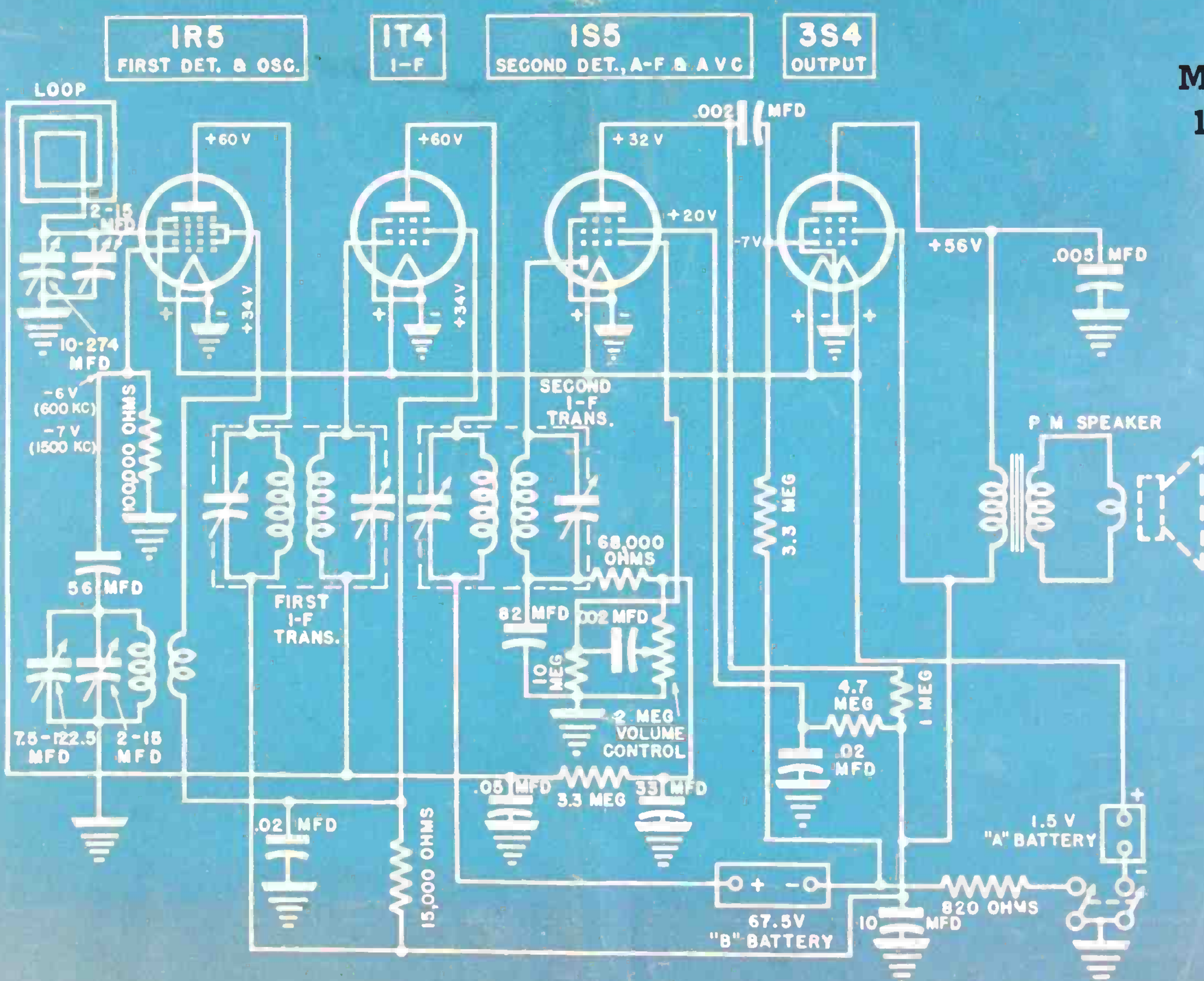
RADIO · TELEVISION · ELECTRONIC

SERVICE

March 1946



Postwar 4-tube personal receiver with an undistorted output of .05 watt. (See page 45.)

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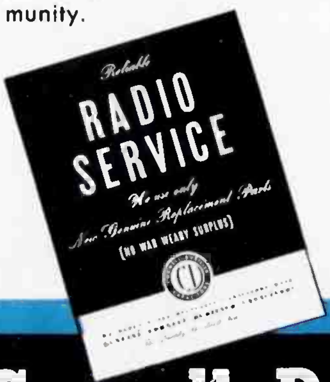

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EDITORIAL

THE past few weeks have seen the television-antenna problem become quite a debated subject. For it appears as if some have declared that a simple wire thrown about the room will provide sufficient pickup for bright television pictures. As a result Service Shop Men in television areas have been deluged with queries. If a simple strip of wire is all that is necessary to pick up the television signal, then why all the fuss about dipoles and reflectors, the Service Men have been asked.

It is possible to pick up television signals on a simple wire, if you are perhaps across the street from the transmitter or your house or apartment is in a direct line with the station's transmitter and that transmitter is exceptionally powerful. But such instances are rare!

Tests made in New York and other tall-building areas, showed that even at relatively short distances from the transmitters, reception was difficult except with a properly installed antenna. In one installation, only seven miles from the transmitter, an excellent antenna had to be supplemented by reflectors to secure a satisfactory picture.

Noise presents another problem that only an antenna can solve. To increase the signal-to-noise ratio, a good antenna and a noise-cancelling leadin are necessary. A wire about the room would be susceptible to all types of stray noises, even if the signal were good. A transmission line leadin also prevents noise pickup in the area where most noise is radiated, the house or apartment itself. Without a transmission line, fluorescent light and refrigerator motor noises would cause havoc on the television screen.

For proper television-signal pickup, an antenna is essential . . . and it must be properly installed. Some excellent suggestions on the subject of installation appear in R. B. Carwood's article in this issue of SERVCE. It's on page 16. We urge you to read it.

THE school sound system plan proposed by RMA and discussed in these columns some months ago, will soon be analyzed in a special RMA bulletin. The bulletin will describe system specifications, suggestions regarding operations and programming, and locations of studio and equipment. A sample maintenance contract will also be presented. This is *must* reading for all Sound Men. Availability date will be announced soon. Watch for it.

RADIO · TELEVISION · ELECTRONIC
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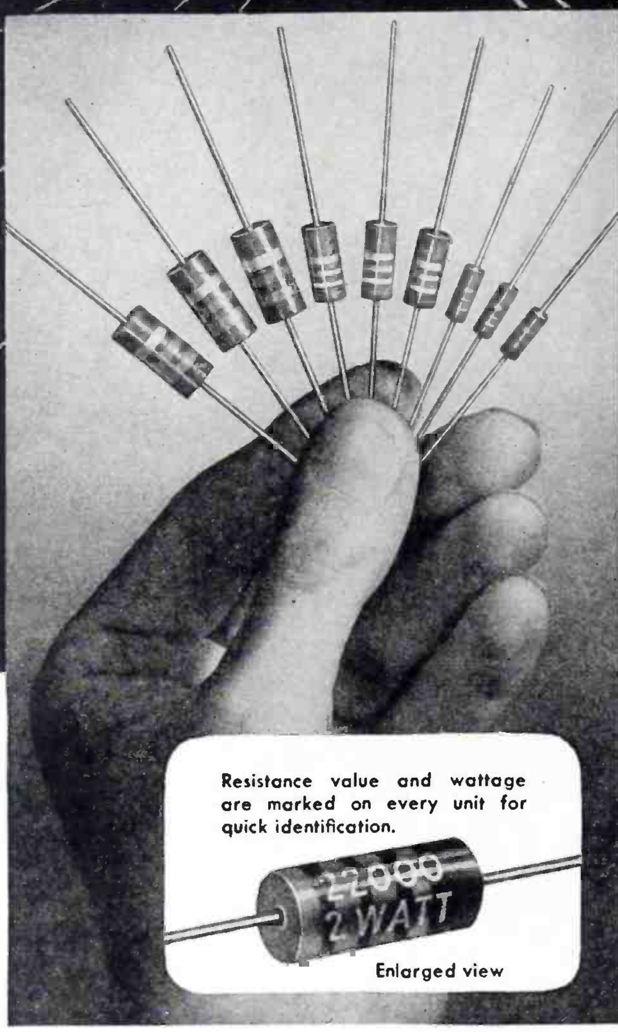

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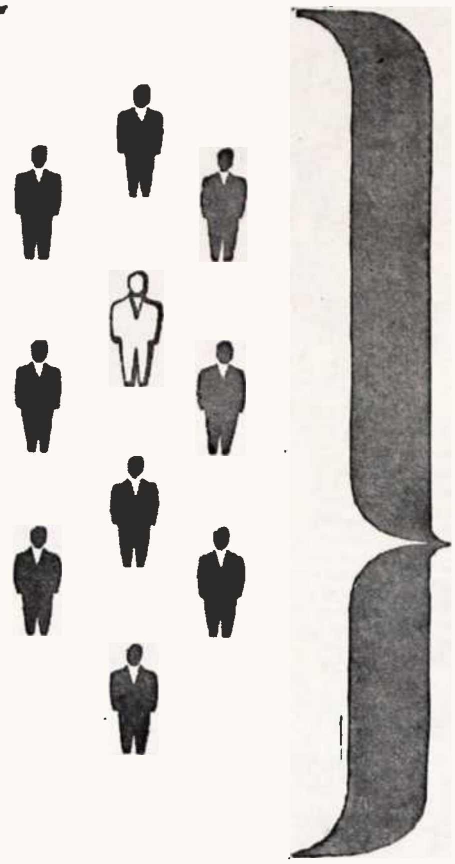

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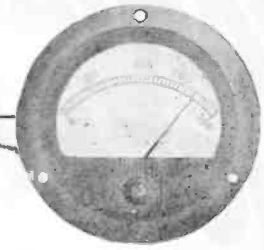

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RADIO SERVICE EDITION

MARCH *Prepared by* SYLVANIA ELECTRIC PRODUCTS INC., Emporium, Pa. 1946

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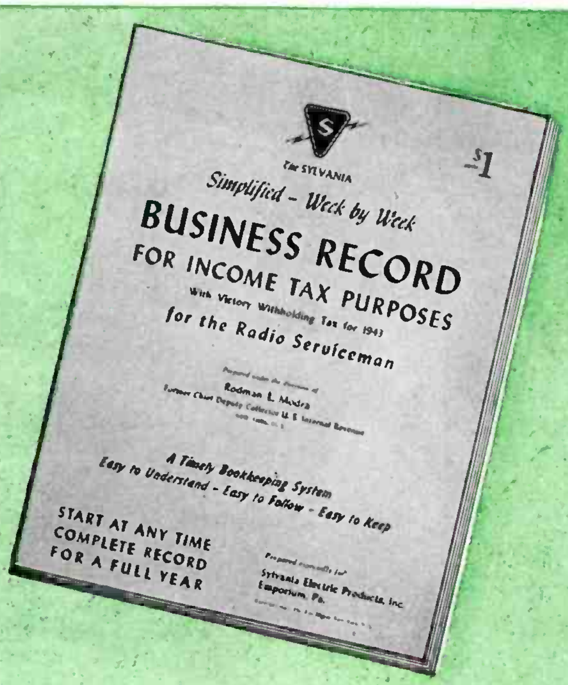

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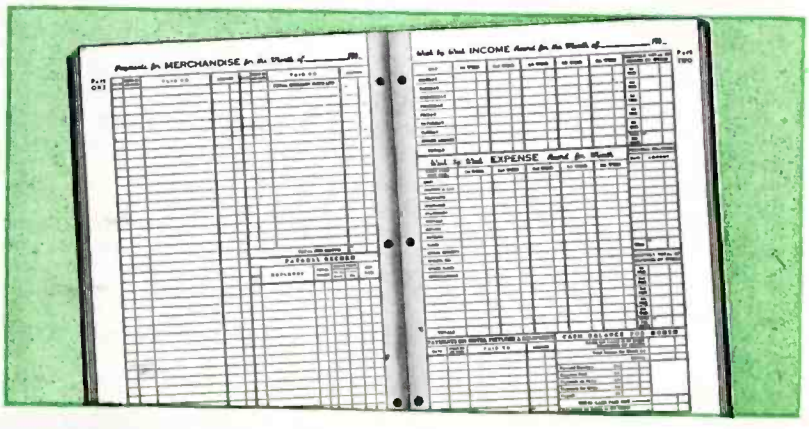

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COLOR DYNAMICS For Your Service Shop

by ALFRED A. GHIRARDI
Advisory Editor

DURING the hectic past 3 years of all-out war production, industry has spent millions of dollars on a wide variety of studies directed toward minimizing physical fatigue to improve the quality and increase the quantity of a worker's output. Radio manufacturers have greatly benefited by such investigations, because the production of intricate radio and electronic equipment involves an unusually large number of manufacturing, assembly, wiring and test operations that must necessarily be performed individually and by hand.

"Frequently the changes recom-

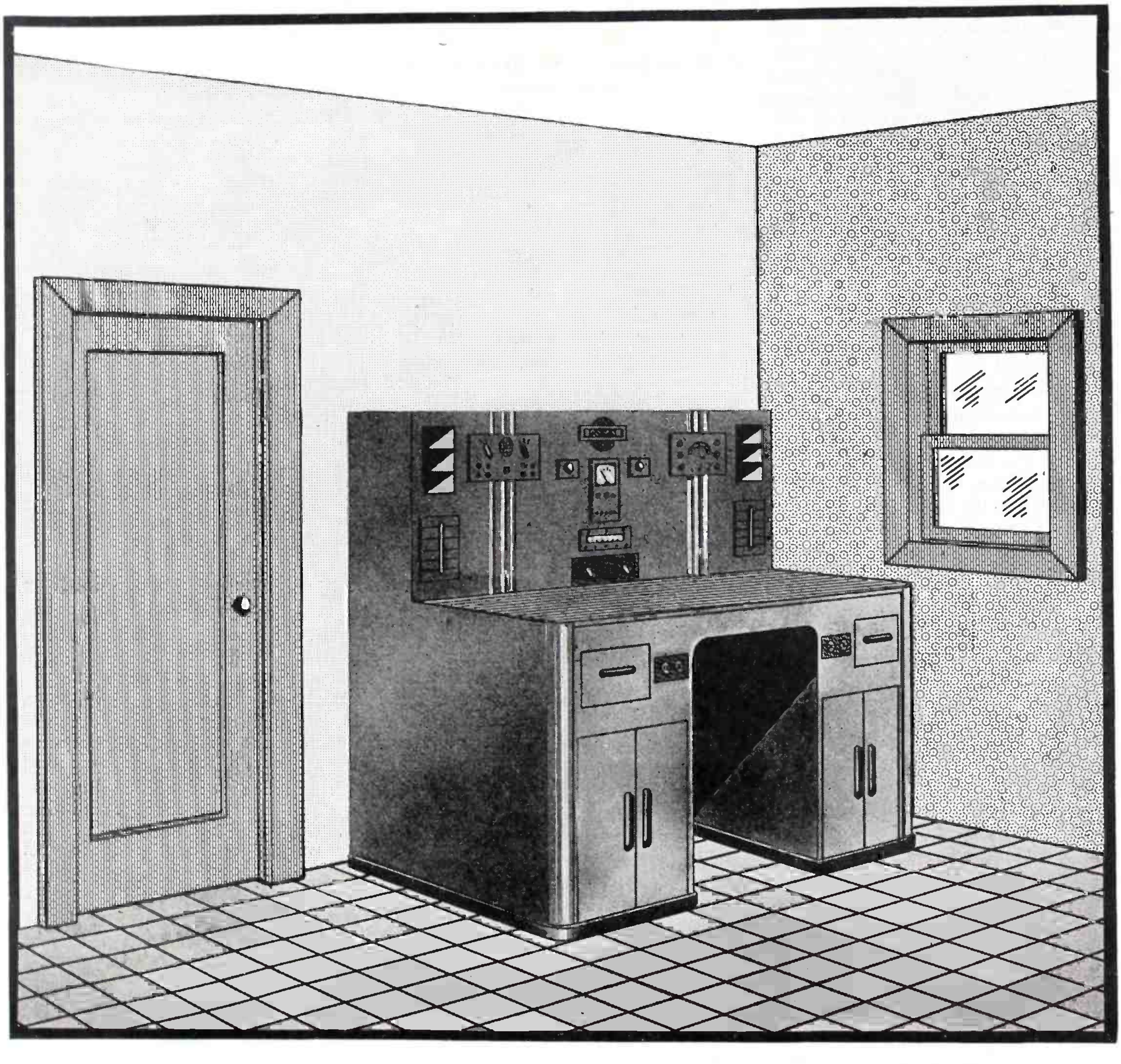


Fig. 1. A typical test bench and surroundings using color specifications suggested by *color dynamics* specialists. (See text for recommended colors).

mended as a result of such studies seem trifling. A worker's stool or bench is raised or lowered an inch or two. The handle of one tool is made slightly shorter, or the grip on another is changed, and often, after such changes, the production of the man or woman who uses that stool or tool is increased by ten to fifteen per cent. The history of modern industry abounds in examples of such *trifles* that have turned out to be of tremendous importance."*

Out of all these investigations has come at least one beneficial development that every radio Service Shop can apply to great advantage and at little cost in his own Service Shop — be it old or new, large or small. This is the new science of *color dynamics.*[1]

Causes of Eye Fatigue

Color, heretofore has been taken largely for granted in our everyday surroundings and activities. Until recently, particularly in industry, little conscious planning was given to its use. Choice of paint was predicated on service offered as a protective coating. Choice of color was based on such considerations as picking a shade which "would not show the dirt." Little or no thought was given to any useful purpose which color itself might be made to serve.

"Color dynamics deals with the scientific choice and application of *colors to produce definite* effects for specific purposes. Among the most important of these is the reduction of eyestrain and the promotion of cheerfulness and increased visibility.

"The movements of the eyeball are operated by seven muscles. Every time the eye moves from side to side or up and down, muscular action takes place. When the iris contracts or expands to adjust itself to a change in light intensity, that also requires effort by the sphincter muscle.

"Eye muscles get tired — just like any other set of muscles!

"Yet, curiously enough, this tiredness is not commonly felt in the eye itself. Eye fatigue communicates itself to other parts of the body. A worker suffering from eye fatigue feels tired 'all over.'"

Continued eye fatigue slows down a worker more than physical fatigue. It causes headaches, digestive upsets, nerves, depression, and many other disturbances. In addition, drab, cheerless surroundings encourage mental depression—make the job seem harder. All these lead to poorer quality, and reduced quantity, of work.

Application Benefits

At first thought, it may be hard to believe that the color on the top of the test bench at which the Service Man works all day, or on the instrument panel which faces him, or on the wall against which the bench is placed, could have a marked influence on the *quantity* and *quality* of the service work he can do and his physical well-being at the end of a long day of tedious work. But such is the case! The proper application of *color dynamics* cuts down unnecessary eye travel, reduces tension and the need for the Service Man to keep adjusting his vision continuously.

The principles of *color dynamics* will be reviewed, because they may be applied to great advantage by the radio Service Man in his shop.

Color Dynamics for Machines and Work Benches

Color dynamics' prime function is to separate the critical from the non-critical parts of the machine or work bench. Analyzing this the color dynamics specialists say:

1. "Focal Colors . . . The critical or operating parts of the machine or work bench should be given a color that comes quickly to the eye—a color that *pops up,* in strong contrast to the stationary or non-critical parts. This is known as a *focal color.* It focuses the worker's attention exactly where it should be—arrests his eye and reduces the unnecessary travel which is bound to occur when the whole machine or bench is a monotone in the usual *machine gray* or other such color.

(While the focal color used should be one that comes forward, it should not *hit you in the eye.* The paint used should be one that will dry to an egg-shell sheen which diffuses light and eliminates objectionable glare. This is important, since glossy colors which cause light to bounce back would lead to eyestrain.)

2. "Receding Colors . . . While the critical parts of the machine or bench must *come forward,* the non-critical parts must *drop back* so they do not force themselves upon the attention of the worker. The widely used machine gray does this to a certain extent but it is itself a somewhat depressing, morale-lowering color. After careful study, a receding color called *vista green* was developed for the body of the machine or work bench. No other color has such a relaxing effect on the human eye as green—yet it does not act as a depressant. The widespread use of green by *nature* in forest and field is the perfect proof of this point.

3. "Double Contrast Necessary on Machines . . . In selecting the *focal color,* it is important not only to choose one that is in sharp contrast to the non-critical parts of the machine but also one that affords a clear-cut contrast with the material being worked on. For instance, a focal color of light gray is completely wrong if the material is aluminum or stainless steel. The worker is constantly straining to see where the material ends and the machine or work bench begins. There is no easy-to-see line of division.

"The ideal situation is one where the focal color provides a satisfactory contrast with *both* the stationary part of the machine and the material flowing through it.

"When this *double contrast* is achieved, eye tension is reduced. The result of this improved visibility soon makes itself felt in the daily output of the worker."

Color Dynamics Applied to Walls and Ceilings

Walls and ceilings or *eye-rest surfaces* must be color-controlled. After all they are constantly in the vision field. The glare of sunlight can be used to demonstrate this problem. If we enter a dark motion-picture theatre, having been in the sunlight we find that for a minute or two we are so blinded that the seat cannot be located. Similarly, if you glance up from a light-colored bench to a dark wall (or vice versa) you experience the same effect to a lesser degree.

Eyes are certainly more comfortable when their direction of gaze changes frequently. Thus it is both natural and restful to raise your eyes from time to time.

If the work is light and the wall dark, or vice versa, the effect of such glances will be to require the eyes to make a quick readjustment for a different light intensity, and a second re-adjustment when the eyes again return to the work. The energy required to make these adjustments a few times is slight, but multiply it by several hundred during the course of the day and you have a very common source of eye fatigue. For this reason, eye-rest surfaces should have approximately the same general *tone* of color (though not necessarily the same color) as the one that is seen when concentrating on the bench. Thus it is not necessary to make fatiguing eye adjustments.

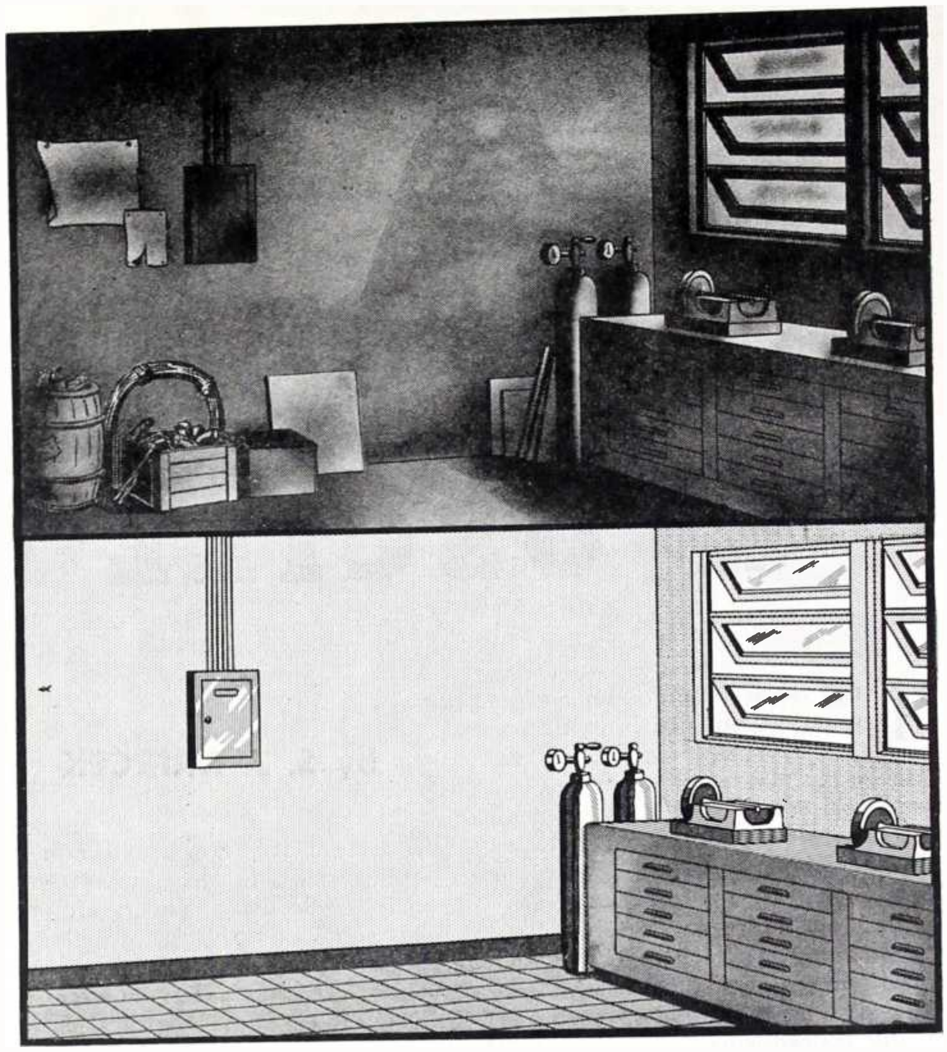
There are several other types of surfaces (receding, reflecting and morale-building) that require color control.

---

[1]A method recently developed in the paint division of the Pittsburgh Plate Glass Company. Highlights of an analysis of this science prepared by Pittsburgh Plate color specialists are offered throughout this paper.

*From Pittsburgh Plate analysis.

Fig. 2. Before and after appearance of a machine shop, showing striking effect of color dynamics application.



On this point the specialists say:

"It is advisable to make certain surfaces *recede* so that they do not call themselves to the attention of the worker. For example, a ceiling filled with beams, cross bracing, wires, and pipes gives an effect of visual clutter—seems to bear down on the worker. In cases where *direct* lighting is used and reflected light from the ceiling is of little or no value, a color like cascade blue gives an appearance of lightness and helps make the distracting ceiling seem to recede, thus giving the worker more apparent space and air to work in.

"When *indirect* lighting is used, colors with very high reflectance qualities are indicated for the ceiling.

"Color not only has a physiological effect on the worker's eye and body, it also has a psychological effect on his mind. One color can give a man a feeling of *lift*. Another can send him into the *blues*. Still another has a *disturbing* effect."

Cheerfulness plus restfulness — plus good visability — is the fundamental aim of color dynamics. All other things being equal, almost everyone feels a bit more lighthearted on a sunny day than when the skies are overcast. Yet many factories and Service Shops use colors on walls and ceiling which give the impression of a perpetual cloudy day.

Cheering up such an interior is extremely simple. For it is only necessary to use colors that suggest sunlight! After all, there is no law which rules that Service Shop walls should be painted in gloomy colors or a too dazzling white!

In those factories and service shops where the temperatures are likely to be high, *color dynamics* calls for cool colors to act as mental and emotional stabilizers. On the other hand, warm shades are advisable where low temperatures must be maintained.

Color Dynamics for Test Benches and Surroundings

At the request of the author, Pittsburgh's color experts made a special study of the color problems involved in the typical radio Service Shop. Their recommended color specifications, applying the principles of *color dynamics*, for the test bench and immediate surroundings, and also for the portion of the shop devoted to the display and sale of receivers and accessories (together with the scientific reasons for the selection of each color), are presented herewith.

Recommended Color Specifications[2]
Test Bench and Surroundings

1. *Front, sides, knee hole and instrument panel of test bench—Vista Green UC*-10076
2. *Top (working area)—Focal Green UC*-10074
3. *Circular or rectangular spots around switches, plugs and receptacles—Focal Orange UC*-10081
4. *Wall against which test bench is placed—Intermix of one part Eye Rest Green UC*-10121 *and one part White* 26-6
5. *Remaining three walls in room*—Intermix *of one part Rose Tan UC*-10119 *and four parts White* 26-6
6. *Doors and window sash—To be painted to match the respective wall areas and to receive a coat of satin finish varnish*
7. *Ceiling (if direct lighting is used)—Intermix of one part Eye Rest Green UC*-10121 *and four parts White* 26-6
8. *Ceiling (if indirect lighting used)—Intermix of one part Eye Rest Green UC*-10121 *and seven parts White* 26-6
9. *Floor, including base—Tile Red* 3-24

The color expert chose the foregoing colors for many scientific reasons:

"*Vista green* was selected for the instrument panel to accentuate location and to further facilitate easy reading of the various instruments. Vista green has also been used for the sides, front and knee hole of the unit to prevent any distraction from the work in progress.

"*Focal green* was recommended for the top of the bench, as this color is highly contrasting to the various metals used in the make-up of radio equipment.

"*Focal orange* was suggested for circular or rectangular spots around plugs, receptacles and switches for the purpose of quick spot identification.

"An intermix of *eye-rest green* was selected for the wall against which the unit is placed, since this surface will be a restful one when the Service Man glances up from his work. An intermix of *rose tan* was chosen for the remaining three walls to prevent the room from becoming monotonous, and act as a morale-building factor.

"An intermix of *eye-rest green* was selected for the ceiling so that this area will be in close relation with the wall against which the unit is placed and further increase the restfulness of this room. If indirect lighting is used, the shade of *eye-rest green* should be changed to a lighter shade by intermixing more white, so that the reflected light from the ceiling area will be that of a soft green light, which is restful to the eyes when doing precision work.

"*Tile red* was used for the floor for

(*Continued on page* 34)

[2]The paint numbers specified apply to the Pittsburgh line of paints.

TESTING With The C-R OSCILLOGRAPH

by S. J. MURCEK

THE visual indication for a given voltage fluctuation is written on the fluorescent screen of the cathode-ray tube in the form of a dynamic pattern, in which two general characteristics, *polarity* and *direction of the writing progression*, serve as voltage analysis guides. The polarity of a screen pattern is determined from the direction in which the curve line, as written on the screen, deviates from the horizontal axis of the screen. Thus, if the pattern curve line rises to a maximum *above* the center of the tube screen, the pattern has a *positive* polarity. Conversely, if the pattern curve line deviates, from the screen horizontal axis, to a maximum *below* the latter, the resultant pattern has a *negative* polarity.

The polarity of the screen pattern is further dependent on the nature of the vertical deflection amplifier of the oscillograph. In general, two-stage vertical deflection amplifiers are used. This permits the polarity of the screen pattern to agree with the observed voltage variation. Thus, an increasing voltage input to the vertical deflection system produces a corresponding positive pattern on the screen. Conversely, a negative, or decreasing, voltage input to the vertical deflection system develops a negative pattern. If, however, the oscillograph contains a vertical amplifier incorporating an *odd* number of voltage amplifying stages, the pattern polarity is obviously the inverse of the vertical input potential, producing a *positive* pattern for a *negative* voltage variation.

Most voltage variation patterns are written from the point of origin on the left-hand side of the screen. Thus, the fluorescing spot moves in a right-hand direction as the beam writes the pattern, resulting in *positive* writing progression. *Negative* progression may occur only if the horizontal deflection voltage is so altered that the fluorescent spot is visible only during its *negative* variation. Hence, since the sweep-frequency potential appears in a sawtooth form, in which the rate of the voltage decline is very high, the writing progression apparent on the screen pattern is *positive*.

Where the input voltage to the vertical deflection amplifier is of a-c form, the pattern written is a *sine wave*; Fig. 1. Such a wave form is early or

(*Continued on page* 31)

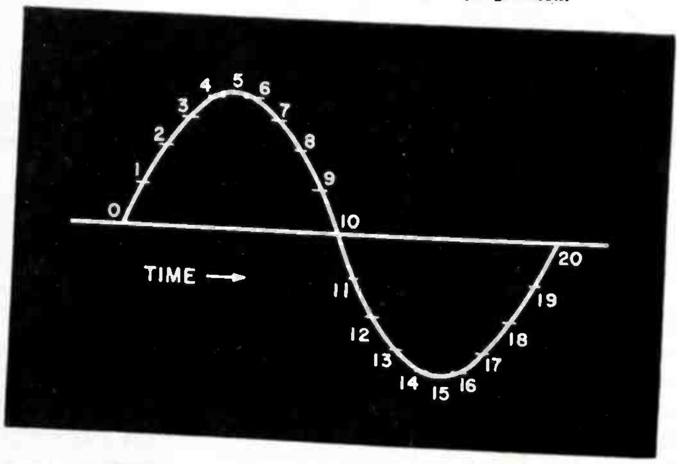


Fig. 1. A sinusoidal wave. In this type of waveform, the vertical deflection potential does not vary in direct proportion with the horizontal deflection potential. The proportional parts of the vertical deflection potential are shown in their proper progression.

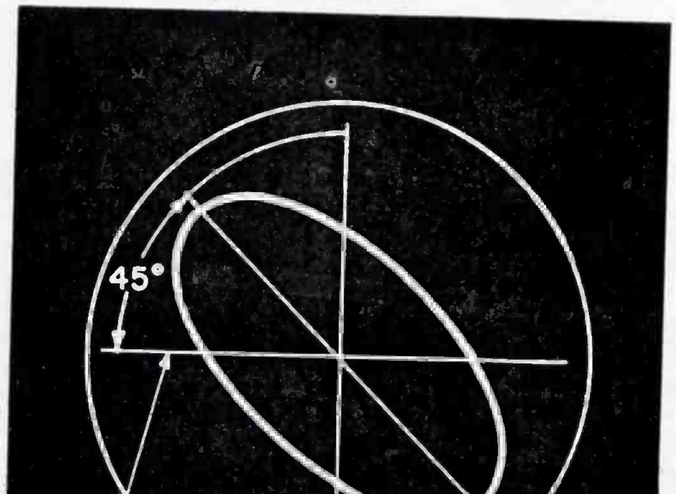
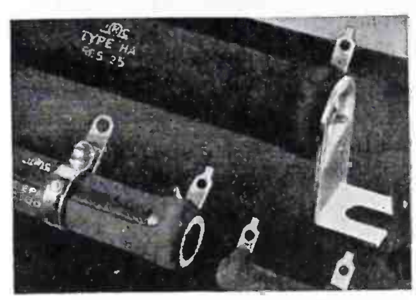
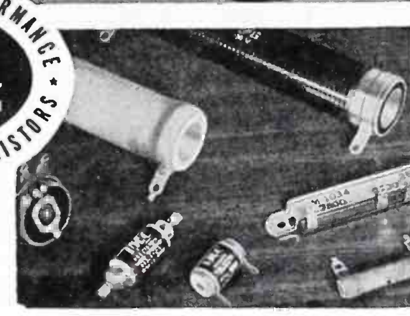


Fig. 2. Left-hand elliptic pattern. The a-c voltages producing this pattern are of approximately equal potential level, but are *less* than 90° displaced in phase relationship. As a result, the vertical positive maximum occurs early in the horizontal deflection cycle.





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Installing TELEVISION Receiver ANTENNAS

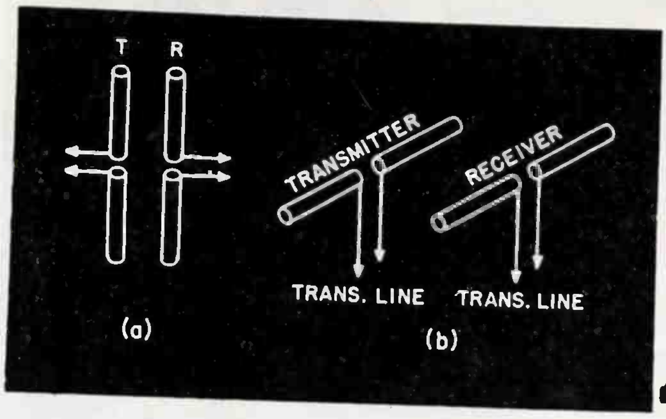


Fig. 1. Two methods of polarization. In *a*, the transmitting and receiving antennas are both vertically polarized. That is they are both erected in a vertical position. In *b*, the two antennas are both horizontally polarized. Greatest signal transfer is obtained when both antennas are in the same plane.

by R. B. CARWOOD

THE antenna plays an extremely important role in television receiver installations. These installations must be perfect or the image will be extremely distorted and in many instances, there'll be no image to see.

Because of the frequencies at which the new television transmitters will operate (44 to 88 mc and 174 to 216 mc) overall antenna lengths for most installations will run from 2½′ to 10′. The short length of antenna required permits the use of rod antenna of the extendible type in place of the usual wire antenna. This type of antenna will require a mounting device such as a pole or other extension.

At the very high frequencies, antennas are not only directional, but must also be polarized. In addition, they may be tuned to receive certain frequencies in preference to others or may be constructed to receive a broad band of frequencies in much the same way as the tuned circuit of the receiver.

Antenna Polarization

The polarization of an antenna is determined by the plane in which it is erected. Best results, insofar as signal pickup is concerned, are obtained when both the receiving and transmitting antennas are in the same plane, Fig. 1. Television transmitting antennas are constructed for horizontal polarization, that is, the antenna is horizontal to the earth. For this reason, receiving antennas must be erected in the same plane. Vertical antennas will give very poor results on television signals, unless they are erected quite close to the transmitter. The directional qualities of a horizontal receiving antenna are such that the greatest signal pickup is achieved in a direction broadside to the antenna, and the least pickup from the direction in which the ends are pointing. The transmitter antenna is usually designed for omnidirectional transmission. That is, its elements are so arranged that it sends out a good signal in all directions. Therefore, for best reception, the receiving antenna should face broadside in the general direction of the transmitter.

The most common type of receiving antenna used is the half-wave dipole, Fig. 2. Here, two quarter-wave sections are arranged in a horizontal position, with the two sections at an angle of 180°. By quarter-wave section is meant that each leg of the antenna is a quarter wavelength long, using the wavelength of the transmitted signal as the deciding factor. For example, a 5-meter signal is one whose points of maximum signal amplitude are 5 meters apart. Since each meter is approximately 40″, this signal, at its full wavelength is 200″ apart at its signal peaks. A quarter wave of the signal is represented by a distance of 50″, Fig. 3.

The wavelength of a signal may be determined from its frequency by dividing 300 by the frequency in megacycles. For example, a 60-megacycle signal has a wavelength of 300/60 or 5 meters.

When it is desired to receive a signal of a given frequency, the antenna may be designed to pick up the particular frequency in preference to other frequencies, in much the same manner as a tuned circuit. Antennas are tuned by varying their length. Thus, theoretically, a dipole antenna of the type shown in Fig. 2, will pick up a 5-meter signal best, when each leg or quarter-wave section is 50″ long. In actual practice, the best length is found to be about 90% of this value, so that actually, each section would be 45″ long. The formula used to determine the exact length of each section is:

$$L_{(\text{in feet})} = \frac{234}{f_{mc}}$$

where f is the video carrier frequency.

The loss in signal attending a reduction or increase in the actual length is not critical within 10% of the established value. However, losses may be observed, and an antenna cut exactly to

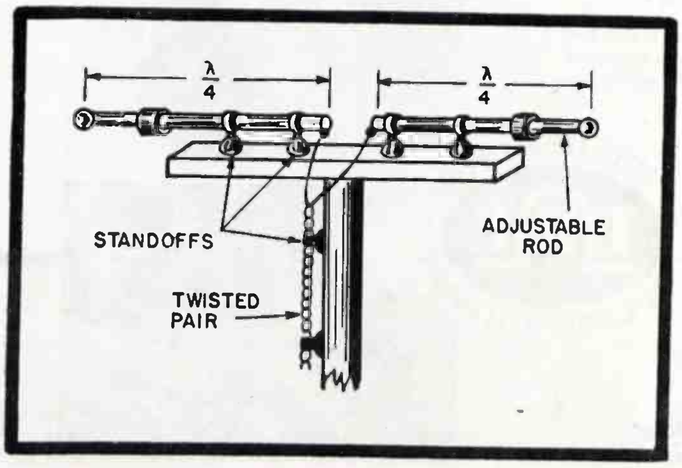
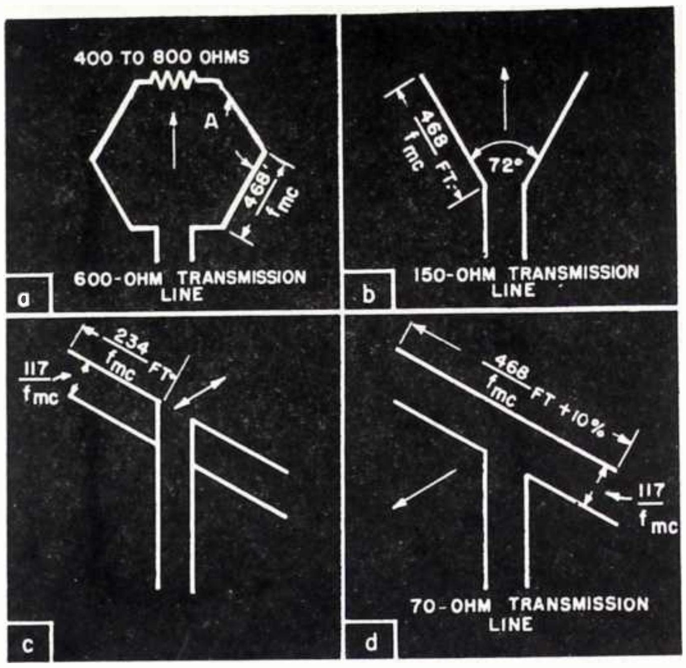


Fig. 2. A typical dipole receiving antenna. Two extendible rod antennas are mounted on standoffs on a board, and their lengths adjusted to receive the desired frequency. The leadin is attached to the inside terminals of each section.

Fig. 4. Various types of antennas used at high frequencies. In *a*, a rhombic antenna is shown. It consists of four half sections arranged in a diamond pattern. ($A = 90°$, approximately.) In *b* we have a highly directional type of *V* antenna. In *c*, a dipole has been installed on the same mount directly beneath another dipole to increase its signal pickup and directivity. In *d*, a reflector has been mounted behind the dipole to make it unidirectional.



length is better than one which deviates from its established value.

Other Antenna Types

The strength of the received signal may be further increased through the use of more elaborate antenna systems. These are shown in Fig. 4. These antenna forms are used to perform specific functions. Some are particularly suited for covering wide frequency bands, while others may be used to give best reception from a particular direction.

Fig. 4*a* shows a rhombic antenna, in which two *V* antennas are arranged in a rhomboid pattern. This type of antenna is used for covering a wide band of frequencies, with the four sides of the pattern tuned to the center frequency in the range desired, and a half wavelength long. Its directivity is in a line with the center of the two *V*'s, and in a direction away from the point where the leadin is connected. However, since it is a wired type of antenna, and occupies a large area, it is not suitable for most installations. In some installations it may be necessary to resort to this type of installation, when other methods fail, since its response is excellent.

Fig. 4*b* shows a V-type antenna whose directivity is determined by the angle between the two legs of the *V*. Normally, angles of 35° to 75° are used. This type of antenna is sharply directional from the center of the *V*, with little pickup from the sides.

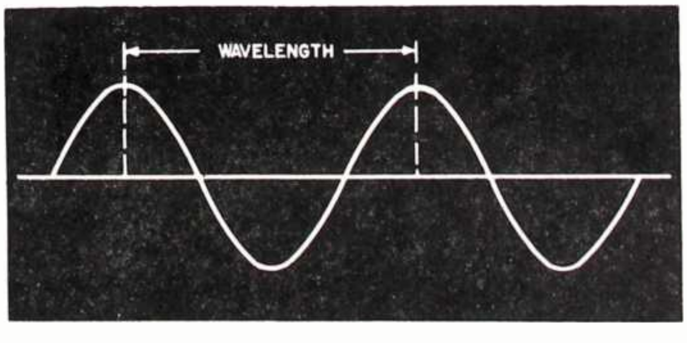
Two types of dipole installations are shown in Figs. 4*c* and 4*d*. In Fig. 4*c*, two pairs of dipoles are used with the second pair directly under the first pair, and spaced ⅛ wavelength of the desired frequency. The dipoles are connected in parallel for increased signal strength and directivity. This type of antenna is bidirectional. That is, it will receive signals from either broadside direction. Fig. 4*d* shows a dipole antenna that is unidirectional. The unidirectional characteristic is obtained by mounting a reflector directly in back of the dipole, spaced a quarter wavelength, and a half wavelength long. There is no connection to the reflector. This type of antenna will pick up signals in a direction into the dipole, with the reflector acting as a shield for signals coming from the opposite direction. In addition, the reflector increases the signal pickup of the dipole itself.

Antenna Directivity

The directivity of an antenna serves two purposes. In addition to increasing the signal pickup of the antenna from a particular direction, it also prevents interfering signals from being picked up from other directions. This latter function is actually the more important of the two, since it is a most effective means of preventing *ghosts* and noise pickup. These two are the most important interference factors. Where some rotation of the antenna is possible, without appreciable signal reduction, the antenna should be directed away from possible sources of diathermy interference, or high adjacent structures. This type of installation may require a communications setup between two men. Another possible method is to use a portable broad-band receiver tuned to television frequencies. By connecting the antenna to this special receiver, it is possible to determine the direction of noise sources. The second method has the disadvantage of not being able to determine if ghosts are present in the signal.

From personal experience, it can be stated that even the mild presence of a ghost in the picture is very annoying. For this reason, every effort should be made to remove them entirely. The reflecting surface responsibile may be a mile or more away. For example, in the New York area, the Palisades have been found responsible for ghosts on

Fig. 3. Relationship of frequency to wavelength. The wavelength is the distance between two adjacent peaks of a sine wave, and may be measured in meters, or feet. The distance is determined by the speed of electricity and the frequency of the sine wave.



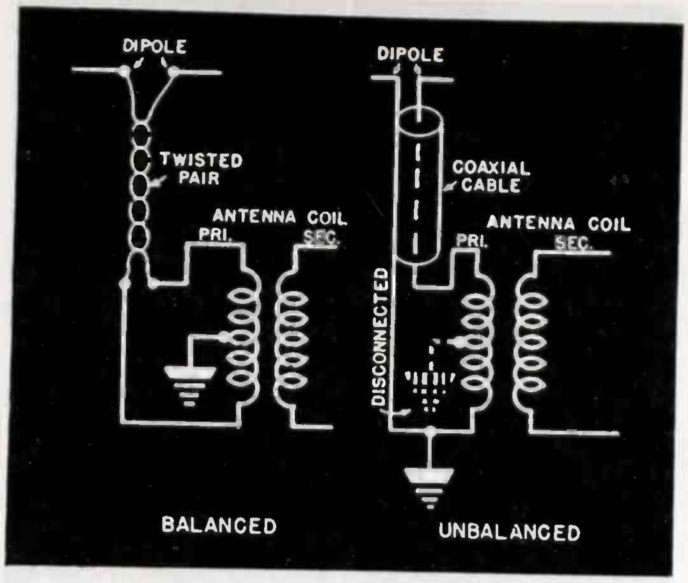


Fig. 5. Where a twisted pair is used for a leadin, the antenna coil primary must be centertapped to ground. If a coaxial transmission line is used, the centertap is removed, and the outside shield of the cable is grounded.

receivers installed on the west side of New York City. Thus, a visual inspection of the surrounding area may disclose nothing. In addition, ghosts may be present on rainy days, when the reflectivity of the surface responsible is increased. Again, the ghost may be reduced to a blurred image, when the reflecting surface is close by. All these factors add up to the need of *sweating it out* on the installation.

Antenna Lengths

The length of the dipole used must of necessity be a compromise.. That is, if it is expected to pick up three or more television channels with one antenna, some decision must be reached as to what frequency or wavelength to which the antenna will be tuned. Here, the Service Man will have to use his own judgment. As a specific example of procedure, let us take the New York area, where CBS operates on 54-60 mc, NBC on 66-72 mc, and DuMont on 76-82 mc. Three antennas might be installed with separate leadins and a switching arrangement at the receiver antenna posts, each antenna tuned and directed to its particular station. However, this might prove impractical, since seven stations are contemplated in the New York area, with possibly more in the distant future.

It is suggested then, that a preliminary survey be made in the particular location where the antenna is to be installed.

It is first necessary to compute the best antenna length for each station. For the New York stations, the lengths would be:

CBS (55.25 mc, video carrier) . . . dipole length, 50".

NBC (67.25 mc, video carrier) . . . dipole length, 41".

DuMont (77.25 mc, video carrier) . . . dipole length, 36".

The first step in the test requires that a temporary antenna, with adjustable sections, be installed. A chart is then made of the station signal strength, best direction, and best antenna length for each desired signal. Some arbitrary figure may be used for a comparison of the signals, such as the avc voltage in the audio portion of the receiver. The minimum requirement of the video portion of the receiver may be determined by rotating the antenna, noting too the avc voltage at which the picture starts to fade. The signal strength of the three signals can then be compared to determine their relative levels. Once the signal characteristics are determined, the antenna length and direction may then be arranged to favor the weakest signal, yet bring in the others.

Transmission Lines

The next important installation factor is the size and type of transmission line, or leadin. An antenna has a specific impedance at the point at which the leadin is connected. For example, a half-wave antenna's terminal impedance is 70 ohms, a full-wave antenna has a terminal impedance of 150 ohms, etc.

The primary of an antenna coil in a receiver is designed to work out of a given impedance, as established in its design. At broadcast frequencies, the input impedance of the antenna coil has a fairly broad acceptance, in that it is either a high-impedance type as used in house receivers, or a low-impedance type, as used in auto receivers. However, at the high frequencies, the matching of the antenna to the primary of the antenna coil must follow closer tolerances and practices. Thus, the transmission line becomes a matching device which must match the antenna to the antenna coil. This function becomes a simple one, in that the antenna itself must match the antenna coil in impedance, and the line then becomes a device for connecting the two. All three elements must therefore be of the same impedance.

A mismatch in impedances causes two conditions to arise. First, the signal delivered to the receiver is reduced. Second, mismatch will result in the creation of ghosts in the receiver, due to reflections being set up in the line itself. The impedance match is not critical, but impedance values should be kept within 5%.

The input system of the receiver may be either of the balanced, or unbalanced type, or a combination of both; Figure 5. In the balanced type, a twisted pair of wires of the correct impedance is connected to the two outside ends of a grounded center-tapped primary of the antenna coil. The unbalanced system is used where a coaxial transmission line is used between the antenna and the antenna coil. In the latter case, the grounded center tap is removed, and one end of the antenna coil is grounded. Either system may be used, depending on the installation conditions.

Twisted pairs are used where the leadin lengths are less than 75'. At lengths in excess of 75', the attenuation of the signal in the leadin may cause too great a loss of signal strength, necessitating the use of coaxial cable, which is a more efficient conductor.

The great majority of installations will undoubtedly use a twisted pair, since the cost of the coaxial leadin is quite high. In choosing a twisted pair, some investigation will be necessary in order to insure a minimum of loss of signal strength. The insulation used in the twisted pair exerts a great influence on the signal loss. Ordinary twisted wire, such as is used in electrical wiring, even if it is the right impedance, is not recommended, since it absorbs moisture easily, and the insulation is not suitable to high-frequency work. Impregnated types should be used, and their characteristics at high frequencies studied, before a decision is made.

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POSTWAR Receiver DIAL DRIVES

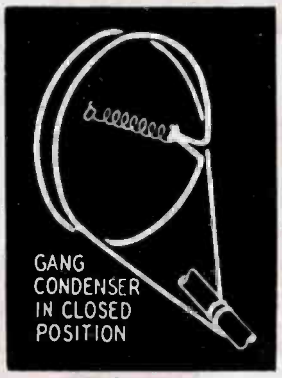


Fig. 1. Ward 54WG-1801A dial drive system.

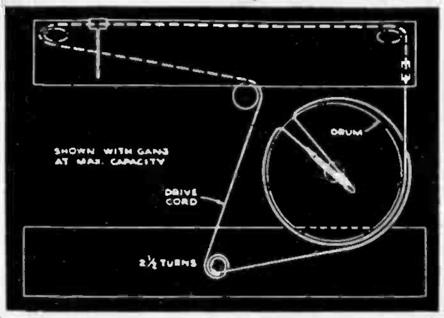


Fig. 2. Dial drive with idler pulleys used in RCA Victor 56 X 11.

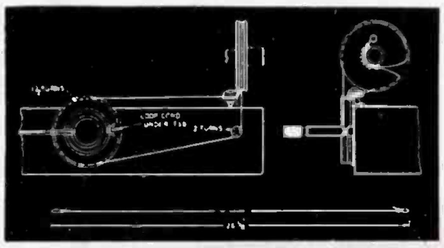


Fig. 3. G.E. 100 series drum drive.

by JOHN T. MARTIN

A VARIETY of control techniques are used in modern dial and capacitor drive systems. Before multiple tuning units were accepted, separate direct drives were used for each tuned stage, leading to as many as four tuning knobs per receiver. Then came the period when separate controls were mechanically linked by metal belts or other devices to provide a single tuning control. With the advent of gang capacitor units many types of friction drives were introduced to permit finer tuning with various step-up ratios. This was carried to extremes in some of the early all-wave sets where a high ratio was fine for short-wave tuning, but it seemed to take half a day to get across the broadcast band. Some of the better designed receivers had dual-ratio drives with coarse and fine tuning to satisfy all conditions.

Today friction drives are popular. Types include the rim drive with metal to metal, rubber to metal, or metal to plastic, and the metal to metal slotted disk where the driving roller runs in a slot. In many of the early designs the dial rotated in an opposite direction to the knob. Modern practice dictates that they run in the same direction.

Although any kind of dial may be floodlighted for illuminating, the practice has been carefully analyzed and we have many effect arrangements with translucent dials with rear lighting, and glass and plastic scales with end lighting. The celluloid disc did a good job with rear lighting, except for a certain amount of warping. Slide rule dials with separate scales afford varied colored lighting for different bands, etc.

There are many sets in operation with the once-popular airplane type dial. These used a separate drive shaft driving a drum and pointer with a fabric or metal belt or, later, a string. Spring loaded idlers were used for taking up slack.

Most postwar receivers feature slide-rule dials. They are, however, not too simple to record. Unless the method of stringing is obvious, a drive diagram should be studied. If the diagram is not available, it is a good idea to make a quick sketch of the stringing circuit before disassembling.

In the majority of receivers, the low-frequency end of the dial is at the left and, as the pointer moves from left to right, the tuning capacitor opens. This will probably be standardized. The pointer is usually set with the capacitor fully closed.

Current Dial Drive Types

Fig. 1 shows one of the simplest types of drive, used in Ward's Airline 54WG 1801A. In replacing the cord for this drive, a new drive cord 12″ in length is used, with one end tied to the tension spring. The other end of the tension spring is fastened to the hook on the drive pulley. Then the cord is passed through the slot in the drive pulley rim and continued around pulley one half turn, counterclockwise. Then 2½ turns are wound counterclockwise (from front of chassis) around tuning shaft. Cord is wound counterclockwise around drive pulley in back of previous ½ turn. Cord is then passed through the slot in the pulley rim. Tension spring is stretched and free end of cord tied to spring.

No idler pulleys are required. Incidentally in all recording operations, particular attention must be paid to the exact number of turns around the driving shaft, as too few will cause the string to slip and too many will cause the string to pile up and jam, eventually breaking the string or causing it

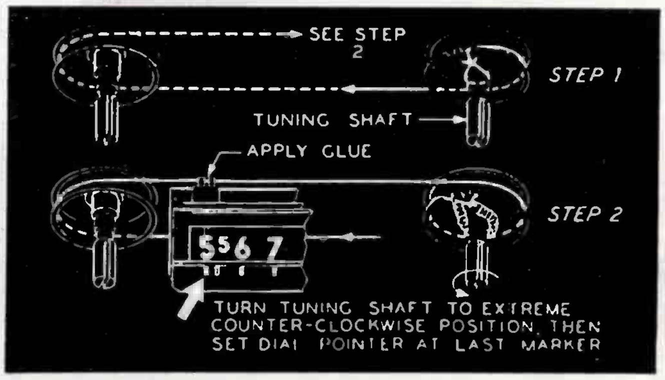


Fig. 4. Permeability-tuned receiver dial drive; Ward 54BR-1501A.

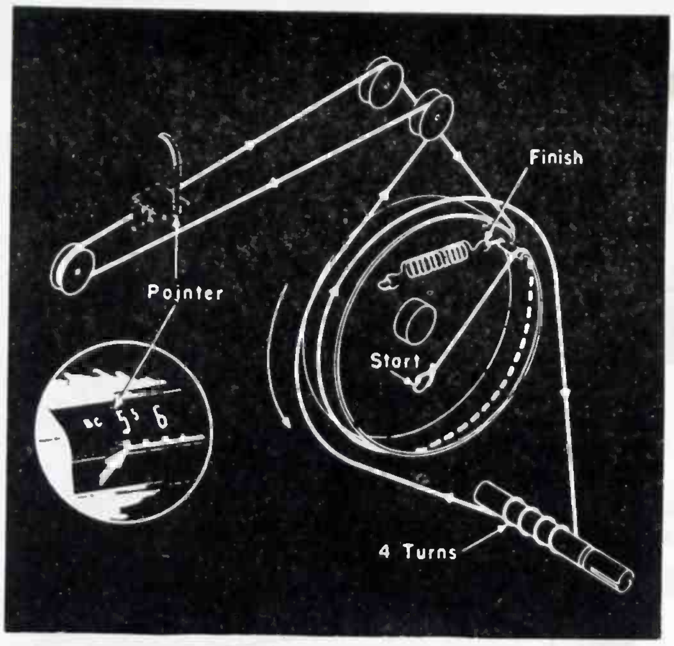


Fig. 5. Drum and three-idler drive system of Ward 54BR-1503A.

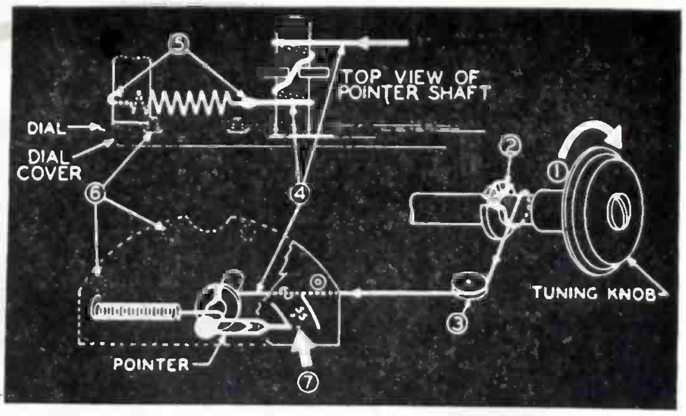


Fig. 9. Helical spring drive of Belmont 6D111.

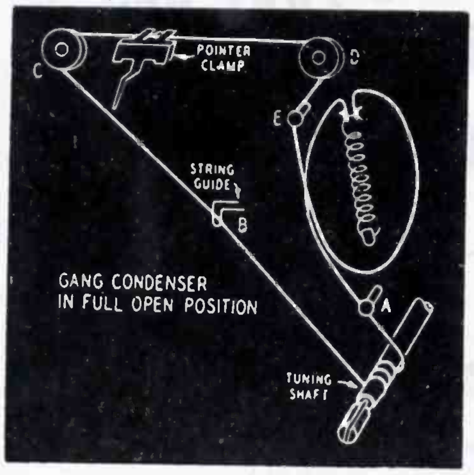


Fig. 6. Dial drive of Ward 54WG-2500A.

to jump off a pulley. The right amount of tension in the string and in the take-up spring is very important.

RCA Victor 56 X 11

In the RCA Victor 56X11, Fig. 2, four idler pulleys are used because it is necessary to change the plane of the cord. The weakest spot in the drive cord is usually found to be where the pointer is crimped around the cord. For long life a bit of tape or heavy craft paper should be placed around the string to protect it from the crimping. A bit of glue, cement, shellac or collodion should be applied to secure it.

G.E. 100 Series

In General Electric's 100 series, the pointer is attached to the drum, resulting in a simple drive; Fig. 3.

In recording this drive, the dial scale pointer is turned as far counterclockwise as possible. The pointer should coincide with the first marking at the left of the scale. If it doesn't, it is necessary to remove the chassis and slip pointer drum on cord until pointer is under reference mark when chassis is bolted in place.

Ward Dial Drives

A dial drive for a permeability tuned unit is shown in Fig. 4; Ward 54BR-1501A. The load being much lighter than a gang tuning capacitor, no step-up is used. The volume control shaft acts as a bearing for the large idler pulley. In replacing the cord, 18" of cord are needed (*step 1*). When tying the string to the tension spring, the spring should take up all the slack (*step 2*). Four turns are used around the drive shaft of Ward's 54BR-1503A, Fig. 5. A drum and three idlers are used.

In Ward's 54WG-2500A, Fig. 6, a 40" cord is used. In recording, the cord is tied to one end of the tension spring. The other end of the tension spring is hooked to the tab on the drive pulley. The cord is passed through the slot in the drive pulley rim and continued one-half turn counterclockwise around the drive pulley. Then the cord is passed around idler stud *A* and three turns clockwise are wound around the tuning shaft (turns must progress away from chassis). Cord is passed through string guide *B*, over pulleys *C* and *D* and around idler stud *E*. A ¾ turn is then wrapped counterclockwise around drive pulley.

Wells Gardner 37D14-600

The drive in the 37D14-600 of Wells

(*Continued on page 34*)

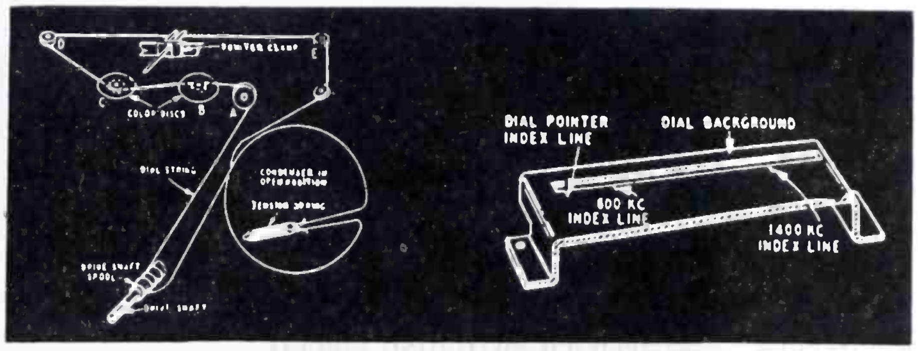
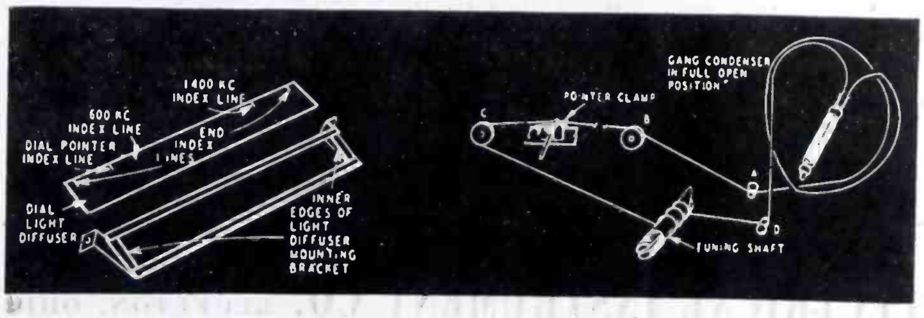


Fig. 7. Wells Gardner 37D14-600 dial system. (Above).

Fig. 8. Ward 64WG-1804A drive featuring a dial-light diffuser. (Below).



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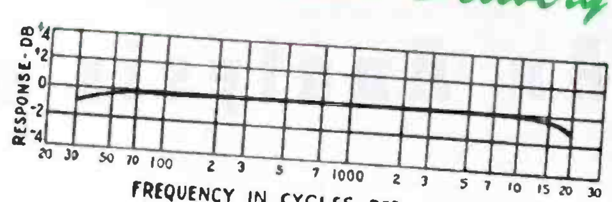

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LS-21	Single plate to push pull grids	8,000 to 15,000 ohms	135,000 ohms; turn ratio 1.5:1 each side. Split Pri. and Sec.	+14 DB	−74 DB	0 MA	$19.70
LS-30	Mixing, low impedance mike, pickup, or multiple line	50, 125, 200, 250 333, 500 ohms	50, 125, 200, 250, 333, 500 ohms	+17 DB	−74 DB	5 MA	$20.90
LS-30X	As above	As above	As above	+15 DB	−92 DB	3 MA	$26.10
LS-50	Single plate to multiple line	8,000 to 15,000 ohms	50, 125, 200, 250, 333, 500 ohms	+17 DB	−74 DB	1 MA	$19.70
LS-55	Push pull 2A3's, 6A5G's, 300A's, 275A's, 6A3's	5,000 ohms plate to plate and 3,000 ohms plate to plate	500, 333, 250, 200, 125, 50, 30, 20, 15, 10, 7.5, 5, 2.5, 1.2	+36 DB			$23.20
LS-57	Same as above	5,000 ohms plate to plate and 3,000 ohms plate to plate	30, 20, 15, 10, 7.5, 5, 2.5, 1.2	+36 DB			$16.25

The above listing includes only a few of the many units of the LS Series. For complete listing — write for catalogue.

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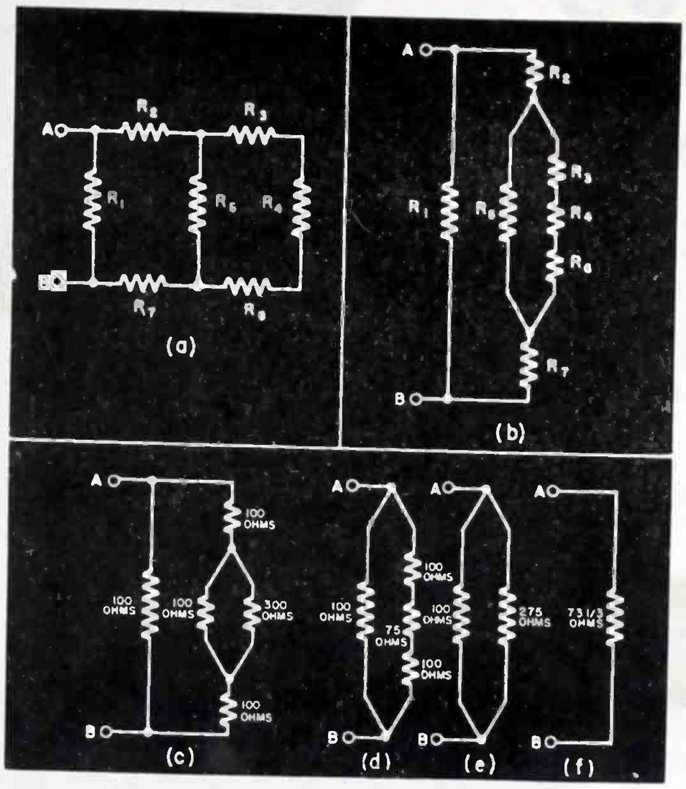


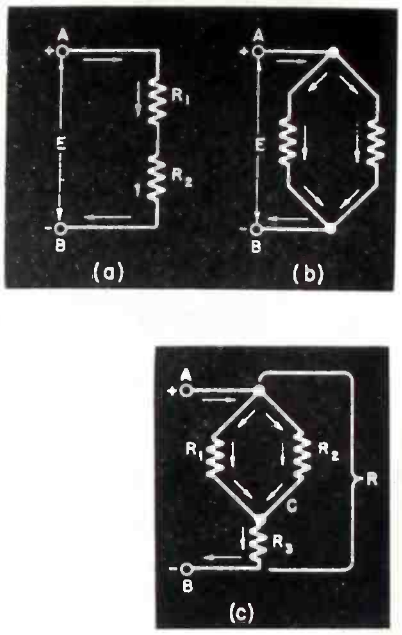


Fig. 9. Three circuits, where one or more resistors are used for a current path. In *a*, we have a series link; *b*, parallel connection; *c*, series-parallel setup.

Fig. 10. Complex resistance networks; *a* represents a typical case; *b*, a redrawing to simplify the problem of determining the total resistance of the network. In *c*, we have the actual values of the network shown. The next step in determining the resistor values is shown in *d*. In *e*, we have another step, where the second path has been reduced to an equivalent resistor. In *f*, the final value arrived at is shown.

VOLTAGE DISTRIBUTION

An Analysis of Various Systems

[*Part III*]

by L. A. MOHR

BY assigning values to the various components, the operation of circuits can be further demonstrated.

For example, in Fig. 9*a*, let us suppose the source voltage to be 10; R_1, 5 ohms; and R_2, 5 ohms, and we should like to know what current will flow in the circuit. Applying Ohm's law, $I = E/R$, where $E = 10$ volts and $R = R_1 + R_2 = 5 + 5$ or 10 ohms total. Then $I = 10/10$ or 1 ampere.

In *b*, the same two resistors have been placed in parallel. Assuming the same voltage of 10 volts, what current will flow from *A* to *B*?

$I = E/R$, where $E = 10$ volts and $R_1 = 5$ ohms, $R_2 = 5$ ohms.

To determine the current in the circuit in a simple way, we can first determine the current which will flow in each resistor, and then add them. Therefore, $I = E/R_1 = 10/5 = 2$ amperes. The same is true for R_2, since it is the same size as R_1, and is connected to the same two points. Therefore the total current flowing in the circuit is 4 amperes.

In *c*, the problem begins to get complicated. Here, we have a combination circuit, where two resistors are in parallel, and these two are in series with a third resistor.

There are several methods in popular use for solving of problems of this type. However, they all reduce to one problem: to find the resistor value equivalent to the three resistors in this network. Since the current in the circuit will be the result of the various paths it will follow between points *A* and *B*, the same current can be obtained with a single resistor of some undetermined value.

The simplest approach is to find a value of resistor, which when substituted for R_1 and R_2, the parallel combination, will cause the same current flow as these two resistors. The circuit will then reduce to that of Fig. 9*a*, two resistors in series, and the problem can then be easily solved.

Since we have already obtained the answer (Fig. 9*b*), we can now operate in reverse to find the resistance equivalent to R_1 and R_2 in parallel. In other words, we would determine the value of *R* required to cause a current flow of *4* amperes, when the voltage is 10.

Thus, $R = E/I = 10/4 = 2\frac{1}{2}$ ohms. This, then, is the equivalent resistance of two 5-ohm resistors in parallel.

Suppose now that we replace the R_1 R_2 network with its equivalent, a $2\frac{1}{2}$-ohm resistor. The problem has now been reduced to that of Fig. 9*a*; two resistors in series. If R_3 is also 5 ohms, then the total resistance in the circuit is $2\frac{1}{2} + 5$ or $7\frac{1}{2}$ ohms. Using Ohm's law again, the current is found to be $1\frac{1}{3}$ amperes.

If the voltage between points *A* and *C* had been known, it would have been comparatively simple to solve the problem. However, this is rarely the case in practice. It therefore becomes important to know some simple method for finding the equivalent for resistors in parallel. There are several methods that can be used. The simpler method is used where two resistors are in-

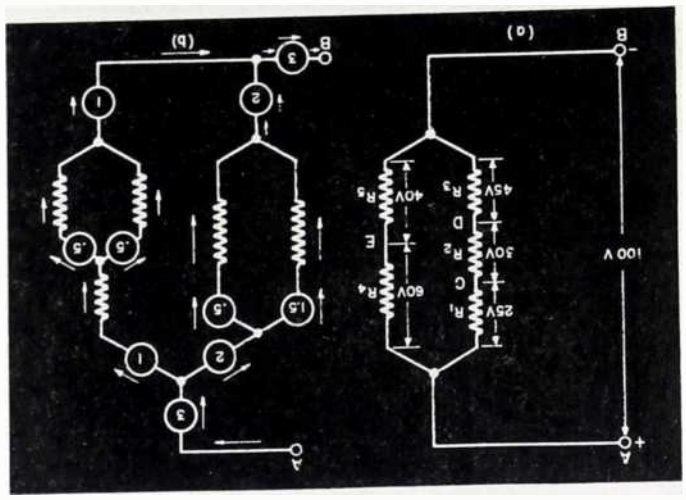


Fig. 11. An illustration of the sum of voltages between two points. In this network, the sum of the voltages as measured between any two points in any single path between points *A* and *B* must add up to 100 volts. Current relationships are shown in *b*.

volved. The formula is: $R = R_1 \times R_2 / R_1 + R_2$. For example, in the case of two 5-ohm resistors in parallel, 5 × 5 /5 + 5 = 25/10 = 2.5 ohms.

The same formula may be used for more than two resistors by breaking up the parallel resistors into groups of two. For example, suppose three 12-ohm resistors were involved. The resistors may be considered as two 12-ohm resistors in parallel, and then the resultant resistor in parallel with the third 12-ohm resistor. Thus, 12 ×12/ 12 + 12 = 144/24 = 6 ohms. Then 6 × 12/6 + 12 = 72/18 = 4 ohms, or the total resistance of the three 12-ohm resistors in parallel.

The same method may be used for four resistors, by dividing them into groups of two, then considering the resultant resistor values in parallel, thus arriving at a single resistor value.

The standard formula is: $R_{total} = R_1 + R_2 + R_3$, etc./$1/R_1 + 1/R_2 + 1/R_3$, etc. However, unless one has had a complete training in algebra, this formula is difficult to solve.

There are several tricks which may be used in finding equivalent resistor values for parallel combinations. For example, two resistors of equal value in parallel reduce to a resistance value of one-half of their individual value. For example, two 1,000-ohm resistors in parallel reduce to an equivalent resistance of 500 ohms. Three equal resistors in parallel reduce to an equivalent resistance of one-third the value of the resistor value, etc. Another point to remember is that the resistance of two resistors in parallel will always be less than either resistor.

In Fig. 10 we have a complicated resistive network. This illustration is shown in two forms. In the first diagram, *a*, we have a typical representation. The second form is shown to demonstrate how the same resistive network may be redrawn to simplify the problem of determining the total resistance of the network. As originally drawn in *a*, it would be difficult to determine the current paths and voltage drops. By redrawing it, as in *b*, the entire network reduces to a very simple problem of parallel networks.

Assuming that all the resistors are 100 ohms each, the parallel paths are two. One consists of R_1, the other consists of R_2 in series with a parallel path which consists of R_5 in parallel with R_3, R_4, R_6, with R_7 in series. Solving the network problem would follow the following steps. $R_3 + R_4 + R_6 = 300$ ohms in parallel with $R_5 = 100$ ohms = 300 × 100/300 + 100 = 30,000/400 = 75 ohms. This step is shown in *c*, and redrawn in *d* to show the next step. Fig. 10*e* shows the next step, where the second path has been reduced to an equivalent resistor, which is the sum of the resistors, or 275 ohms. This resistor is now in parallel with R_1, or 275 × 100/275 + 100 = 27,500/375 = 73⅓ ohms.

In any voltage distribution system, the sum of the voltages between two points must be equal to the sum of the voltages as measured between intermediate points. This is shown in Fig. 11. Here, a resistive network has been placed across a source voltage of 100 volts. The sum of the voltages as measured between any two points in any single path between points *A* and *B* must add up to 100 volts. In measuring voltages in a distribution system, the prods of the meter are placed between two points in the circuit, and the potential is then read. The voltage reading is thus determined by the two points selected, and their relationship. Thus, if the prods were placed between points *C* and *B*, the voltage reading would be 75 volts, or the sum of the voltage drops across R_2 and R_3. If the prods were placed at points *C* and *E*, the

(*Continued on page* 28)

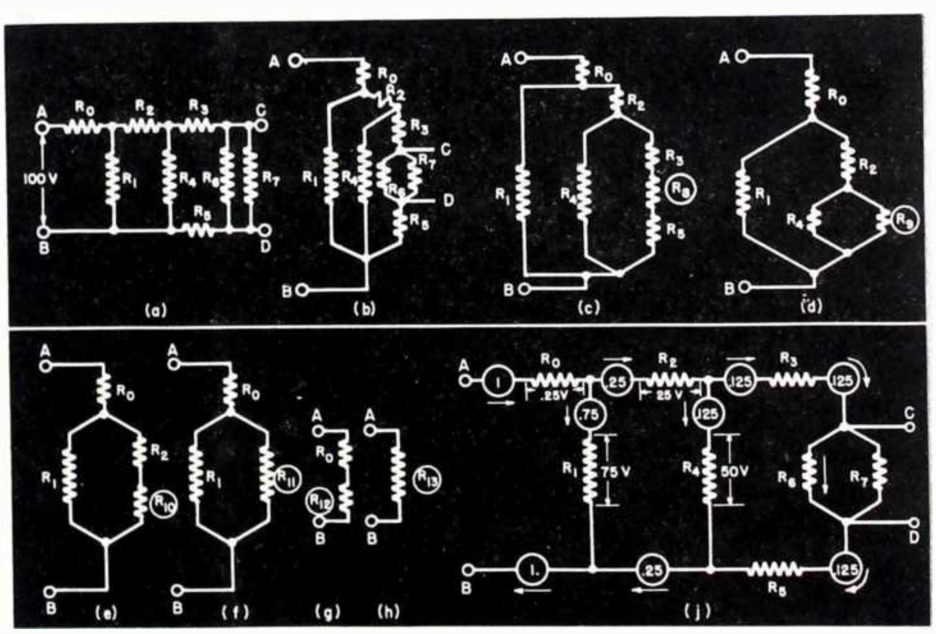
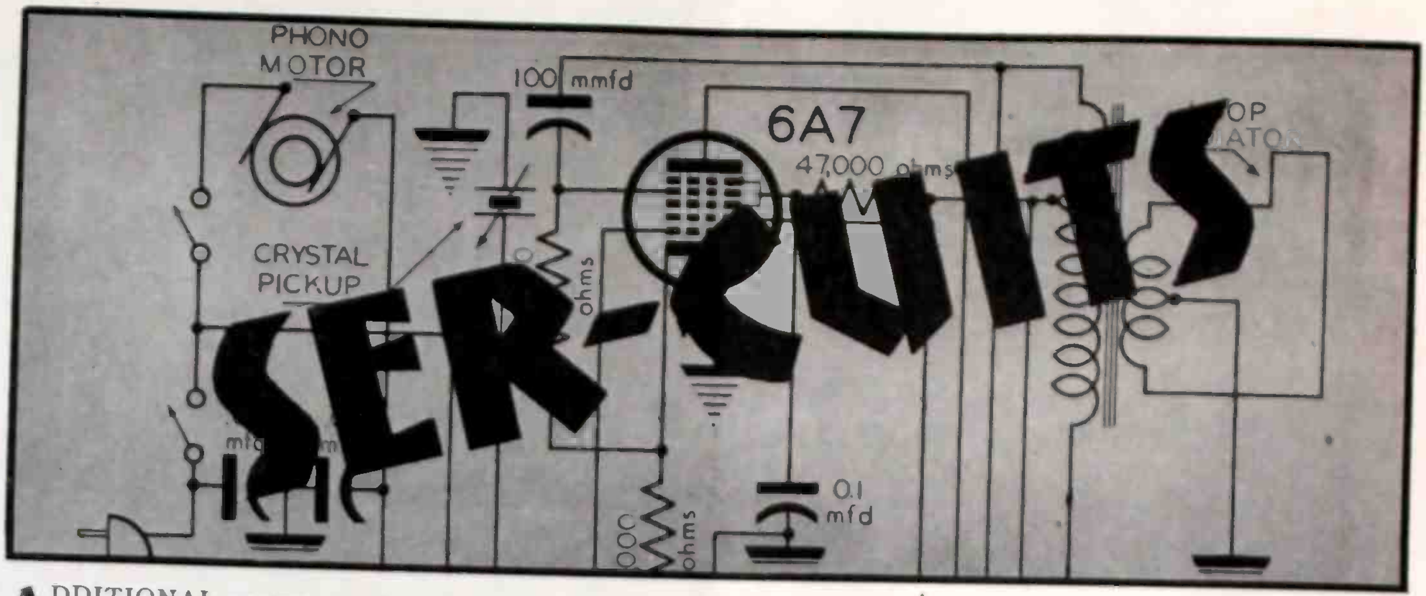


Fig. 12. Typical voltage distribution problem where we are to find the voltage across resistor R_6, which is to be applied to a circuit represented by R_7. In *b*, we have the network redrawn to simplify the solution. In *c*, the equivalent resistance, R_8, is determined. In the following steps—*d*, *e*, *f*, *g* and *h*—the successive procedures to determine equivalents are illustrated. The circuit of *j* is a redrawing of *a*, to show the voltages and currents as measured and computed for various resistive branches of the network. In these circuits, $R_0 = 25$ ohms; $R_1 = 100$ ohms; $R_2 = 100$ ohms; $R_3 = 150$ ohms; $R_4 = 400$ ohms; $R_5 = 100$ ohms; $R_6 = 200$ ohms and $R_7 = 600$ ohms.



SER-CUITS

by HENRY HOWARD

ADDITIONAL postwar receivers, just released, are offered this month.

A postwar model of a Truetone 4-tube and rectifier a-c/d-c receiver, D2610-1, with an antenna plate and permeability tuning, is shown in Fig. 1. The external antenna is capacity coupled to the plate and the plate is connected to the detector through a 250-mmfd capacitor. The oscillator is of the cathode feedback type. The 12SK7 i-f stage uses an unbypassed 100-ohm bias resistor. One of the 12SQ7 diodes

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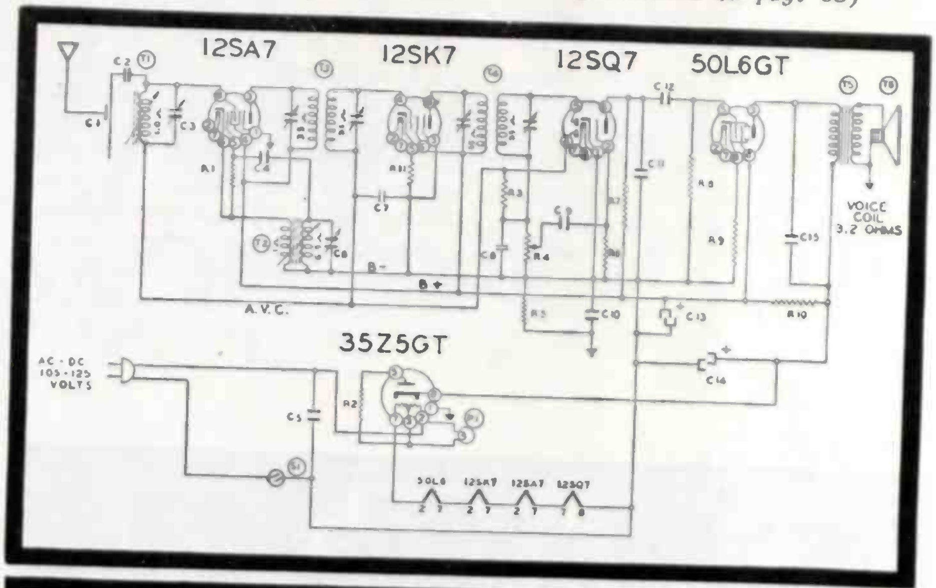


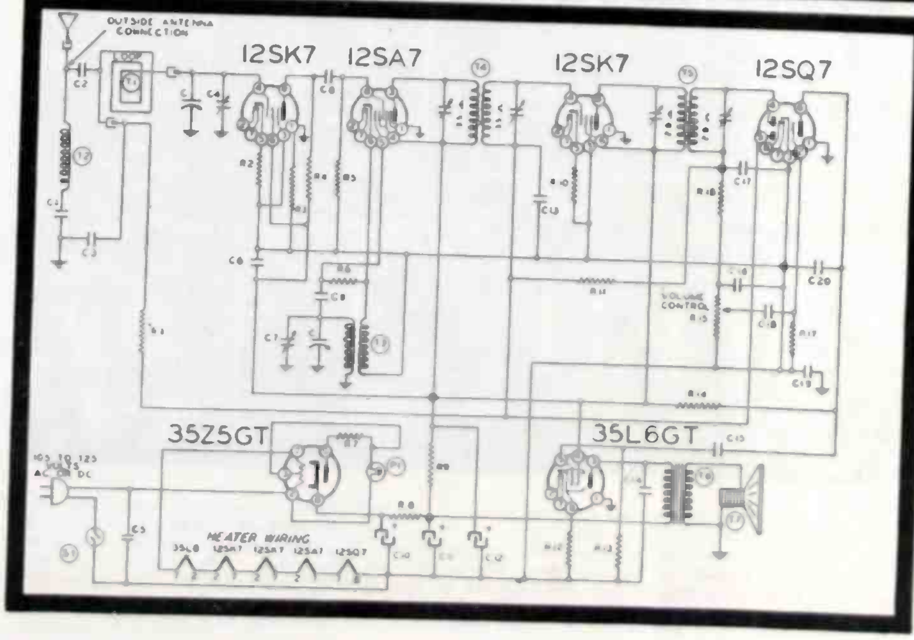
CONDENSERS

C2, C8	.00025 mfd., mica, 20%
C3, C6	Dual trimmer, antenna and oscillator
C4	.00005 mfd., mica, 10%
C5	.1 mfd., 400 volts, +50%-10%
C7	.05 mfd., 200 volts, 25%
C9	.002 mfd., 600 volts, 25%
C10	.15 mfd., 400 volts, 25%
C11	.0005 mfd., mica, 20%
C12	.01 mfd., 200 volts, 25%
C13, C14 or	Electrolytic, for 60-cycle sets, 20 mfd. x 150 volts, 40 mfd. x 150 volts
C13, C14	Electrolytic, for 25-cycle sets, 60 mfd. x 150 volts, 60 mfd. x 150 volts
C15	.01 mfd., 400 volts, 25%

RESISTORS*

R1	22,000 ohms, 10%, ½ watt
R2	22 ohms, 20%, ½ watt
R3	3.3 megohms, 20%, ½ watt
R4	Volume control, 500,000 ohms
R5, R7	150,000 ohms, 10%, ½ watt
R6	4.7 megohms, 20%, ½ watt
R8	330,000 ohms, 20%, ½ watt
R9	150 ohms, 10%, ½ watt
R10	1500 ohms, 10%, 1 watt
R11	100 ohms, 10%, ½ watt

Figs. 1 and 1a. Fig. 1 shows the Truetone D2610-1 a-c/d-c 4-tube and rectifier model featuring permeability tuning. List of parts is shown in Fig. 1a.



Figs. 2 and 2a. Fig. 2 illustrates the Truetone D2615 5-tube and rectifier a-c/d-c circuits, with autotransformer coupling. List of parts is shown in Fig. 2a.

RESISTORS

R1	150,000 ohms, 20%, ½ w.
R2	100 ohms, 10%, ½ w.
R3	150,000 ohms, 20%, ½ w.
R4	4700 ohms, 10%, ½ w.
R5	100,000 ohms, 20%, ½ w.
R6	47,000 ohms, 10%, ½ w.
R7	22 ohms, 10%, ½ w.
R8	220 ohms, 10%, 1 w.
R9	1200 ohms, 10%, 1 w.
R10	150 ohms, 10%, ½ w.
R11	3.3 megohms, 20%, ½ w.
R12	150 ohms, 10%, ½ w.
R13	470,000 ohms, 20%, ½ w.
R14	220,000 ohms, 20%, ½ w.
R15	Volume control, 1 megohm
R16	47,000 ohms, 20%, ½ w.
R17	4.7 megohms, 20%, ½ w.

CONDENSERS

C	2-gang variable
C1	.01 x 400 volts
C2	.000125 mica
C3	.02 x 400 volts
C4	Antenna trimmer on gang
C5	.1 x 400 volts
C6	.25 x 200 volts
C7	Oscillator trimmer on gang
C8	.0001 mica
C9	.0001 mica
C10	40 mfd. lytic x 150 w.v.
C11	20 mfd. lytic x 150 w.v.
C12	20 mfd. lytic x 150 w.v.

NOTE: C10, C11, C12 are in same unit. In 25-cycle sets values are 60 mfd., 40 mfd., 40 mfd.

C13	.05 x 200 volts
C14	.02 x 400 volts
C15	.004 x 600 volts
C16	.00005 mica
C17	.0001 mica
C18	.002 x 600 volts
C19	.2 x 400 volts
C20	.0001 mica

OHM'S LAW

(*Continued from page* 25)

voltage reading would be 35 volts, since point *C* is 75 volts above point *B*, and point *E* is only 40 volts above point *B*, which is common to both circuits.

The current relationships would also follow a definite pattern. This is shown in Fig. 11*b*. Here, an initial current divides up in the various branches of the resistive network. The sum of the currents flowing away must always equal the current flowing into any branch. The total current flowing into the system must always equal the total current flowing out. Neither current nor voltage can get lost in an electrical circuit. The method of measurement used for Fig. 11*a* is known as the measurement of voltage drop. We now see that voltage is not only measured at the source, but may be measured between any two points in a circuit.

Fig. 12 illustrates a typical voltage distribution problem. A resistive network has been placed between the two terminals of a voltage source. Suppose we want to find the voltage across resistor R_6, which is to be applied to a circuit represented by R_7. The problem may be attacked in two ways. (The network has been redrawn in Fig. 12*b* to simplify the solution.) We may either determine the voltage across R_7 by finding the current flowing through this resistor, or we may find the voltage across it by finding the voltage drop across it in parallel with R_6. Both methods will be demonstrated.

Starting at the output, R_6 and R_7 are in parallel. Therefore, $R = 200 \times 600/200 + 600 = 120{,}000/800 = 150$ ohms. We will call this equivalent resistance R_8, Fig 12*c*. We now have R_3, R_8, and R_5 in series. Therefore, $R_3 + R_8 + R_5 = 150 + 150 + 100 = 400$ ohms. We will call this equivalent resistor R_9, and the new circuit is shown in Fig. 12*d*. The next step is the solution of R_4 and R_9 in parallel. Therefore, $R = 400 \times 400/400 + 400 = 160{,}000/800 = 200$ ohms, which we will call R_{10}. This is shown in 12*e*. Since R_3 and R_{10} are in series, $R_2 + R_{10} = 100 + 200 = 300$ ohms, which we will call R_{11}. This step is shown in 12*f*. Now R_1 and R_{11} are in parallel. Therefore, $R = 300 \times 100/300 + 100 = 30{,}000/400 = 75$ ohms, which we will call R_{12}, 7*g*. Here, R_0 and R_{12} are in series, therefore $R = R_0 + R_{12} = 25 + 75 = 100$ ohms, or R_{13}, as shown in 7*h*. Since this is the equivalent resistance of the network, the current drain by the network is $I = E/R = 100/100 = 1$ ampere.

Fig. 12*a* has been redrawn in Fig. 12*j* to show the voltages and currents as measured and computed for the various resistive branches of the network. Since the entire current will flow from

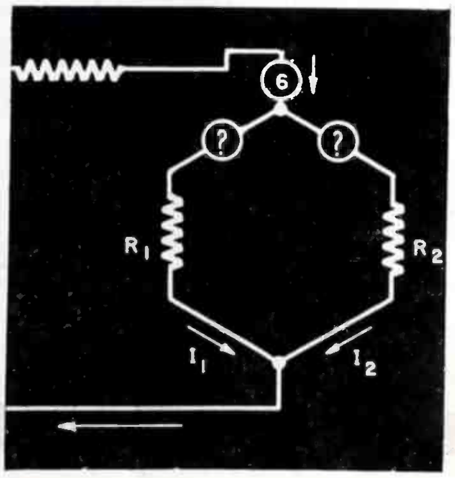


Fig. 13. Another type of problem, where the current in the circuit is known and it is desired to determine how the current divides up in the parallel path; $R_1 = 5$ ohms and $R_2 = 10$ ohms.

point *A*, this current must necessarily flow through R_9. To find the voltage drop across R_9, $E = IR = 1 \times 25 = 25$ volts.

Therefore, the voltage drop across R_1 must be 100 − 25 or 75 volts, since this is the first continuous path between points *A* and *B*, the two terminals of the 100-volt source. Now part of the 1-ampere current goes through R_1 and returns to point *B*, and the remainder continues on to R_2. Since the resistance of R_1 and the voltage drop across it are known, we may solve for the current, which is $I = E/R = 75/100 = .75$ ampere. Therefore, .25 ampere will flow through R_2. Since current and resistance are known for that portion of the circuit represented by R_2, we may solve for the voltage drop across it: $E = IR = .25 \times 100 = 25$ volts.

Since the voltage as measured between points *E* and *B* was found to be 75 volts, the voltage at point *F*, as measured to point *B* will be 25 volts less, or 50 volts. This represents the voltage drop across R_4, which lies between these two points. Therefore the current in this resistor is .125 ampere. The answer to the voltage drop across R_7 can now be found without solving any more current paths. Since the current through R_3 started out as .25 ampere, .125 ampere of which was bypassed through R_4, the remainder of this current, or .125 ampere must flow around the network represented by R_5, R_6, R_7, and R_8. Therefore, the current through R_6 and R_7 jointly must be .125 ampere. Referring to Fig. 12*c*, the equivalent resistance of R_6 and R_7 was found to be 150 ohms. Therefore, the voltage drop across R_7 is: $E = IR = .125 \times 150 = 18.75$ volts.

Since the voltage drop across the resistors is known, the current in each resistor may readily be found, by setting up an equation for each, with *I* as the unknown quantity.

Fig. 13 shows still another type of problem which is often encountered. Here, the current in the circuit is known, and it is desired to find out how the current divides up in the parallel path; R_1 is 5 ohms, and R_2 is 10 ohms. The rule of current, which obtains for parallel paths, is: Current in the resistors in a parallel circuit is in inverse proportion to the value of the resistors. This means that the greater current will flow through the lower value resistance. Where the voltage drop across the parallel path is known, it is simple to find the individ-

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ual currents. However, to find the individual currents without knowing the voltage drop, but knowing the total current, the problem becomes one of ratios. That is, $R_1 : R_2 = I_2 : I_1$. To understand how this operates, it is merely necessary to refer back to Ohm's law, which states that $E = IR$. The proportion equation merely says that the IR drops in each leg of the parallel circuit are identical, since both are equal to the same E. Since E is not known, two methods may be used to solve for the individual currents. For those not versed in mathematics, the simplest method is to first determine the equivalent resistance of the multiple path, and then solve for the voltage drop and finally the current, or to use the following formula and solve directly. Referring to Fig. 13, $I_1 = IR_2/R_1 + R_2$. Suppose we wanted to know the current through R_1 and R_2, if the total current is 6 amperes, and $R_1 = 5$ ohms, and $R_2 = 10$ ohms.

Applying the formula, $I_1 = 6 \times 10/5 + 10 = 60/15 = 4$ amperes.

Since 6 amperes is the total current, the current flowing through the other resistor is the remainder, or 2 amperes. Where more than two paths are involved, it is suggested that the voltage-drop method be used.

•

DEFLECTION CIRCUITS

The DuMont 14-inch television electrostatic receiver uses a special high-voltage driver tube, 6R6G pentode, for both deflection circuits.

In the GE models HM-225B and 226-B we have the magnetic deflection-type tube. A special 6AL6G power tetrode similar to a 6L6 or, better, an 807 fitted with a top cap for the plate, is used for protection against surges. Horizontal damping *RC* circuits are used in both primary and secondary of the matching transformer. An adjustment is provided in the secondary circuit. For vertical output a 6V6 is used without damping. Both yoke load circuits are grounded.

Magnetic deflection is also used in RCA models TRK-90 and 120. A 6L6 horizontal output and 5V4G diode damping tube is used across the yoke. A horizontal centering control supplying ±½ volt or so acts directly on the yoke, and a 5,600-ohm resistor shunts one of the vertical deflection coils for balancing. A 6J5 with a variable cathode resistor for vertical linearity supplies the vertical yoke.

OSCILLOGRAPH TESTING

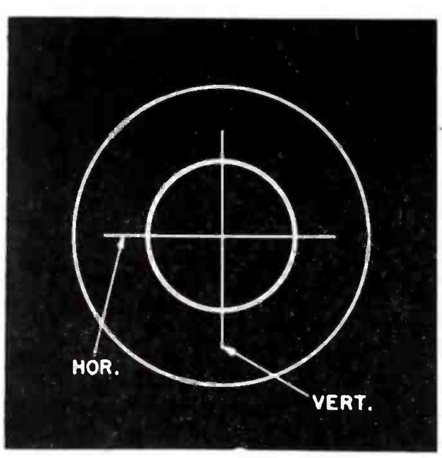
(*Continued from page* 14)

positive in phase position when a voltage maximum is indicated to the right of the screen center. A similar pattern, in which the maximum occurs to the left of the screen center, is known to be late, or *negative* in phase position. The preceding phase positions occur only if the pattern writing progression is positive. If the writing progression is in a positive direction, a maximum occurring within the first half-cycle of the a-c waveform appears in the early, or left-hand section, of the screen pattern, inasmuch as the horizontal deflection voltage variation begins the writing progression from the left-hand side of the screen.

With the exception of certain specific instances, such as that necessitating the determination of harmonic frequencies, the voltage impressed across the input terminals of the horizontal deflection amplifier varies linearly with respect to elapsing time, the latter potential being derived from the linear-time-base or *sweep-frequency* oscillator incorporated into the conventional oscillograph. If, under these conditions, an a-c potential is applied to the input terminals of the vertical deflection amplifier, a sine wave appears on the screen. Further, if the output frequency of the linear time base is in synchronism with the a-c input voltage, a *single* a-c *cycle* appears on the screen. Here, a single variation of the sweep frequency occurs within the period required for the completion of the a-c cycle. It is readily evident,

(*Continued on page* 32)

Fig. 3. Circular screen pattern. Here, the vertical and horizontal deflection potentials are exactly 90° out of *phase* with relation to each other, and are of approximately equal potential level. Further, each potential is of sine wave form, with the result that the vertical potential is always at a maximum when the horizontal potential passes through zero voltage level.



OSCILLOGRAPH TESTING

(*Continued from page* 31)

therefore, that *two* complete cycles appear on the electron screen if the sweep frequency is one-half that of the a-c wave under observation. Similarly, further decreases in the sweep frequency must result in the appearance of additional cycles on the screen, since the length of the sweep cycle must increase with a decrease in its frequency.

Where the horizontal sweep frequency is in synchronism with the a-c voltage under observation, and the latter is distorted by the presence of harmonics, this distortion is readily visible in the pattern, appearing as a wave of small amplitude, which is superimposed on the main a-c wave being studied.

Since most horizontal deflection amplifiers are provided with a switching system, which provides for the application of external voltages to the input amplifier terminals, it is possible to develop many types of waveforms, such as the circle and ellipses appearing in Figs. 2, 3 and 4.

A circle appears on the electron screen if the horizontal and vertical amplifier input potentials are of similar frequency, but displaced by 90° with respect to each other. Under these conditions, the horizontal voltage attains a maximum when the vertical voltage passes through a minimum. Conversely, the vertical potential attains a maximum when the horizontal potential is at its minimum. Further, the horizontal input potential fluctuation rate is at a minimum when the voltage attains either a positive or negative maximum. Hence, the horizontal writing progression is alternately positive and negative, respectively, as is also the vertical progression, and a circle appears on the screen.

In the right-hand, or *positive,* ellipse of Fig. 4 the vertical deflection potential attains a maximum, in negative voltage, to the left of the screen vertical axis, and a positive maximum to the right of the axis. Here, the indicated phase displacement between the vertical and horizontal deflection potentials is greater than 90°, and the vertical voltage wave is known to be late, or positive, in phase position with respect to the horizontal voltage. In the instance of the left-hand ellipse shown in Fig. 2, however, the vertical deflection voltage wave is early, or negative, with respect to the horizontal wave, the vertical positive voltage maximum now appearing to the left of the screen vertical axis. Hence, it is possible to determine, from the position of the oval or elliptic pattern, whether the phase angular relation present between the two given voltage waves is greater or less than 90°.

If the a-c potentials applied to the input terminals of the horizontal and vertical deflection amplifiers are in synchronism, a straight line appears on the screen. This line pattern lies at a 35° angle, with respect to the screen horizontal axis. Therefore, in the application of circular and elliptic patterns, the resolution of the pattern into a straight line indicates the approach of complete synchronism between two frequencies or waves. The development of the straight-line pattern results because the vertical and horizontal voltage maximums occur at precisely the same instant.

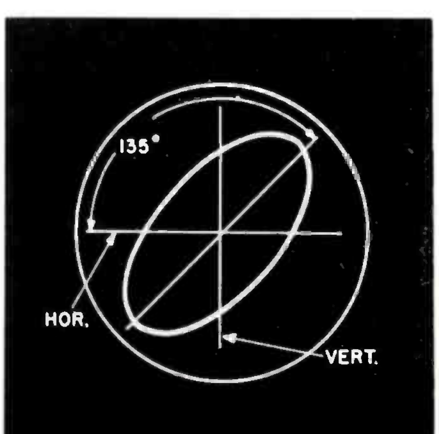
Lissajou Figures

Where the frequencies of the potentials applied to the input terminals of the vertical and horizontal deflection amplifiers differ in frequency, the pattern written on the electron screen of the cathode ray tube is one of the familiar *Lissajou Figures*.[1] This type of pattern varies either with the frequency or the frequency ratio applied to the deflection amplifier input terminals. Thus, if the vertical deflection frequency is 180 cps, and the horizontal component has a frequency of 60 cps, a single a-c cycle appears on the screen. Here, the ratio between the two frequencies is three to one. However, if the vertical deflection potential has a frequency of only 120 cps, a half cycle pattern appears on the

(*Continued on page* 34)

[1]*Application Notes Number 1,* Allen Du Mont Laboratories, Passaic, N. J.
H. J. Reich. *Theory and Application of the Electron Tube,* First Edition, pp. 594-595.

Fig. 4. Right-hand ellipse. In this pattern, the a-c vertical and horizontal components are of equal potential, but are displaced by an angle greater than 90°. Hence, the vertical *negative* maximum occurs early in the horizontal sweep cycles.



OSCILLOGRAPH TESTING

(*Continued from page* 33)

electron screen. Again, if the vertical deflection potential has a frequency of 240 cps, and the horizontal voltage a frequency of 120 cps, the pattern written on the electron screen resembles, somewhat, an athlete's barbell. In this instance, the ratio between the two frequencies is again two to one, *but the frequencies differ.*

Since the Lissajou pattern written on the screen varies either with the frequency or the ratio between the vertical and horizontal deflection frequencies, a detailed study of the various patterns is necessary. However, each of the various patterns serves as a ready means of frequency comparison, particularly in such instances wherein one of two given frequencies is known. Each pattern is also useful where the output frequency of a wave generator or oscillator must be adjusted precisely to a given harmonic of a known fundamental frequency.

[*To Be Continued*]

COLOR DYNAMICS

(*Continued from page* 13)

the same reason and to further increase the room's color appeal."

Recommended Color Specifications[1] Display Space

Commenting on the colors to be used in display areas, the experts say:

1. Walls . . . The main walls of the display space should be painted in cool, restful colors, such as shades of *cascade blue* or *eye-rest green*. These colors should be used on the larger areas of the store. Colors of attraction, such as *suntone*, *rose-tan*, or a let-down of these, may be used to good advantage on less important walls for holding the interest of the customer.

2. Ceiling . . . The ceiling in such a store may be painted *suntone*, or a let-down of *suntone*, to good advantage.

Credits

To the paint division of Pittsburgh Plate Glass Company the author offers his sincere thanks for the kind cooperation and the specially prepared data and recommendations for Service Shops included in this article.

DIAL DRIVES

(*Continued from page* 22)

Gardner uses a 600-kc and 1,400-kc index line for receiver alignment as well as a pointer index line for setting the pointer; Fig. 7. A 60″ cord is required.

In recording, cord is passed around idler pulley *A*, over color disc pulley *B*, under color disc pulley *C*, and around idler pulleys *D*, *E*, and *F*.

A ¾-turn counterclockwise is wound around drive pulley. Cord is passed through slot in rim, tension spring is stretched and cord tied to it.

Dial Light Diffuser

A dial light diffuser is featured in Ward's 64WG-1804A, Fig. 8. Recording is similar to procedures used for other Ward models.

Belmont 6D111

A good taut string is required in Belmont's 6D111, Fig. 9. Only 6″ of cord are required because the cord doesn't make a complete circuit but, instead, works against a helical spring.

(*Continued on page* 35)

DIAL DRIVES

(Continued from page 34)

In Fig. 10, Ward's 54BR-1505A, the cord has to turn two drums, one for the tuning capacitor and one for the dial. To hold calibration, the cord between the pulleys must not slip or stretch.

In replacing the cord a 36" string is used. In *step 3*, 1½ turns are wound clockwise, passing string under clip. Three turns are wound toward front of chassis (*step 4*).

Fig. 11 shows another form of drive with the spring directly in series, Truetone D2610.

There are several types of drive cord. Braided types are better than twisted types, strands parting more easily from the latter. Good quality fishline may often be substituted for standard drive cord. In pulley systems, the cord should leave the pulley in the plane of the pulley (it should be properly lined up) to prevent jumping the track.

Tracks in which the pointer slides should be lightly greased to prevent noise and sticking. However, the cord should not become greasy because this will decrease the friction between driving shaft and cord, causing slippage. When a string does get full of oil or grease and it is not desirable to replace it, powdered rosin or non-slip compound may be applied to combat the tendency to slip. All pulleys should be free-running.

Fig. 10. Ward 54BR-1505A drum drive.

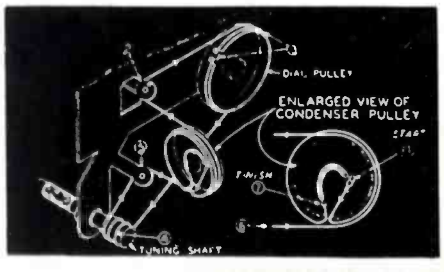
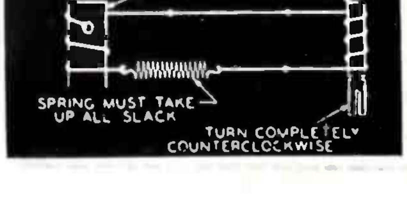


Fig. 11. Truetone D2610 drive using a spring in series.



NEWS

LEGION OF MERIT AWARDED TO JOHN F. RIDER

John F. Rider, Lt. Col. Signal Corps (retired) received the Legion of Merit medal at a formal military ceremony held at Fort Monmouth recently.

He was cited for his . . . "exceptional administrative service to the Signal Corps Publication Agency."

From November 1943 to May 1944, he planned and supervised the production of 60 technical manuals covering radar equipments already in theatres of operation but without adequate instructions for their installation, operation, maintenance and repair. This was accomplished 60 days prior to the completion date.

Production May 1944 to May 1945, under Lieutenant Colonel Rider's supervision as Executive Officer, Deputy Director and Acting Director of Signal Corps Publication Agency successively, reached a total of 1906 different publications.

* * *

SYLVANIA TUBE BOOKLET

A 20-page 8½" x 11" reference booklet giving typical operating conditions, characteristics and tube base diagrams for over 450 types of tubes used in receiver and industrial electronic applications has been announced by Sylvania Electric Products, Inc.

The tube base diagrams in the booklet are also available separately, printed on card stock and punched for wall mounting.

* * *

NEWS OF THE REPRESENTATIVES

A group of representatives of radio parts manufacturers headed by Gordon G. Moss recently held a meeting at the Cosmopolitan Hotel in Denver, Colo. to consider the formation of a new chapter of The Representatives. Members and non-members of the national body who attended the meeting included: Franklin Y. Gates, Gail Halliday, Leroy G. Moss, Gordon G. Moss, Richard A. Hyde, Ron Bowen, W. C. McCloud and B. A. Franklin. Representatives in the mountain states who are interested are invited to communicate with Gordon G. Moss, P. O. Box 428, Greeley, Colo.

Leonard Carduner, 401 Broadway; Dr. Irvin Brendel, 60 East 42nd St.; and Harold D. Weiler, 132 Nassau St., have become members of the New York chapter. A. J. Nelson, P. O. Box 2244, Denver, Colo. and D. E. Bursell, 2233 University Ave., St. Paul 4, Minn., have become members-at-large.

W. S. Trinkle has been reelected president of the Mid-Lantic Chapter. Other reelections included N. M. Sewell, vice pres.; and Samuel A. Jeffries, sect'y-treas.; Trinkle and Jeffries, along with John Keefe, Jr. were designated as delegates to the national convention in May.

Ernest L. Wilks has been elected president of the South Western chapter. M. F. Klicpera is now vice president, and Hal F. Corry is secretary-treasurer. Wilks, G. G. Willison and John M. Maynard were designated as delegates to the national convention.

Norman Neely, J. T. Hill, Vern T. Rupp and Herb Becker were named delegates of the Los Angeles chapter.

Richard F. Brookfield, Times Medical Bldg., Ardmore, Pa., and James P. Faries, 416 Hawarden Road, Springfield, Pa., have become members of the Mid-Lantic chapter.

The Missouri Valley chapter will be represented at the national meeting by R. W. Farris, F. C. Somers, Sr. and E. B. Lundgren.

The following members recently moved: Byron L. Moore to 202 Wardman Road, Kenmore 17, N. Y.; G. L. Koenig to 19 West Linwood Blvd., Kansas City 1, Mo.; E. B. Lundgren to 402 Manufacturers Exchange Bldg., Kansas City 6, Mo.; James Millar, 1000 Peachtree St., N. E., Atlanta, Ga.; K. E. Hughes to 303 W. 42d St., N. Y. 18.

●

RADIO PARTS SHOW BOARD OF DIRECTORS

Left to right: Kenneth C. Prince, general manager, show corporation; J. J. Kahn, Standard Transformer Corporation, director; H. W. Clough, Belden Manufacturing Company, president; John W. Van Allen, general counsel, Radio Manufacturers Association; Bond Geddes, executive secretary, R.M.A.; Leslie F. Muter, The Muter Company, director; R. P. Almy, Sylvania Electronic Products, director; Sam Poncher, Newark Electric Company, director; J. A. Berman, Shure Brothers, director; Charles Golenpaul, Aerovox Corporation, director; and W. O. Schoning, Lukko Sales Company, director.

N. Y.; and Leroy G. Moss to 1055 Pennsylvania St., Denver 3, Colo.

* * *

SPARKS AND LEEDOM JOIN SPRAGUE

George R. Sparks and John N. Leedom have been appointed field engineers of the Sprague Products Company, North Adams, Mass. Both men will work under the direction of research engineer Leon Podolsky.

* * *

JACK SIEGEL APPOINTED STAMFORD TRANSFORMER V-P

Jack R. Siegel has been named vice president in charge of sales and advertising for the Stamford Electric Products Company, Sunnyside Avenue, Stamford, Conn.

* * *

INSULINE CATALOG

A catalog, detailing the 1946 line of antennas and antenna accessories, has been released by the Insuline Corporation of America, 36-02 35th Avenue, Long Island City, N. Y.

Described are f-m and television antennas, as well as five different types of auto-radio antennas. Auto-radio antennas are adaptable to both Motorola and Delco receptacles.

* * *

PHILCO PARTS DIRECTORY

A quick-selector parts directory has been published by the accessory division of Philco Corporation.

Described are test equipment, tubes, capacitors, speakers, transformers, record blanks, vibrators and other items needed as repair parts and accessories for Philco and other makes.

* * *

V. L. HAAG NOW AEROVOX V-P

Vernon L. Haag, formerly assistant general manager of the Illinois Watch Case Company, has been elected vice president of Aerovox Corporation.

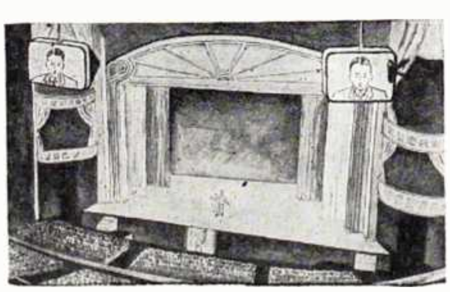
* * *

LUZERNE COUNTY RSA ELECTS OFFICERS

Hayden White has been elected president of the Radio Servicemen's Association of Luzerne County, 39 Gilligan Street, Wilkes-Barre, Pa. Max Freidrich was named vice president; Edward (*Continued on page* 39)

•

INTRA-AUDITORIUM VISION RELAY



Suggested method for relaying performer's features to remote audiences in large auditoriums or theatres.
(*Courtesy W. S. Stewart, International Photographer*)

SER-CUITS

(*Continued from page 26*)

is used as detector, the other supplies initial bias to the avc bus.

Truetone D2615

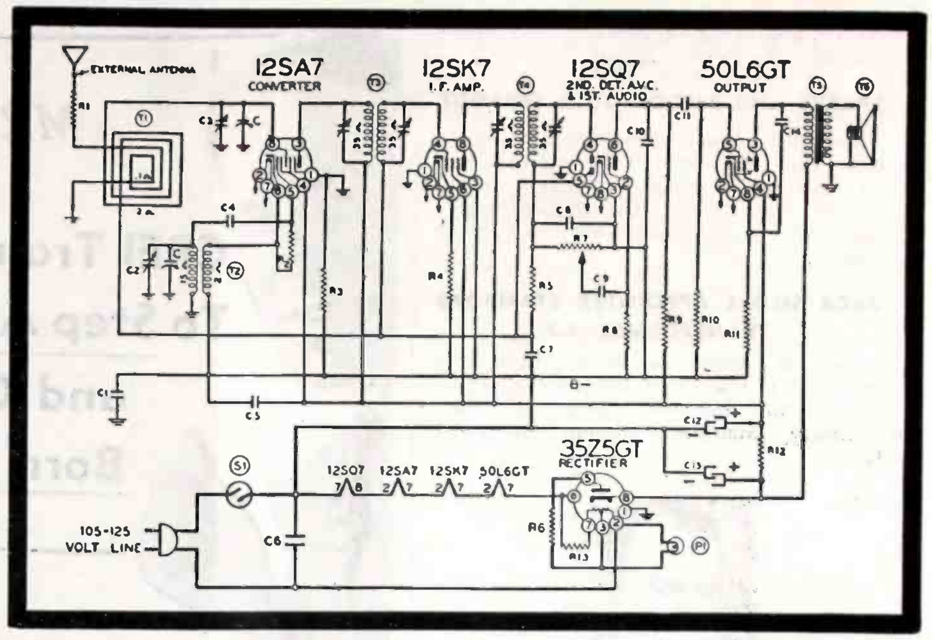
Another postwar Truetone model, D2615, is shown in Fig. 2. This receiver has an antenna equalizer with an autotransformer coupling system to the loop and r-f amplifier. Resistance coupling with a 4,700-ohm plate load resistor and 100,000-ohm grid resistor is used to the 12SA7 detector. The coupling, or blocking capacitor is a .0001. A 12SK7 i-f has a 150-ohm bias resistor. The power supply filter contains two RC sections; 40 mfd, 220 ohms and 20 mfd, followed by 1,200 ohms and 20 mfd. The 35L6 plate is fed at the end of the first section; all other elements after the second section.

Ward 54BR-1505A/1506A

Ward's Airline 4-tube and rectifier a-c/d-c models 54BR-1505A and 1506A, featuring an antenna series resistor in the loop primary and a cathode feedback oscillator, is shown in Fig. 3.

A 47-ohm i-f bias is used in the 12SK7 cathode. One diode is employed

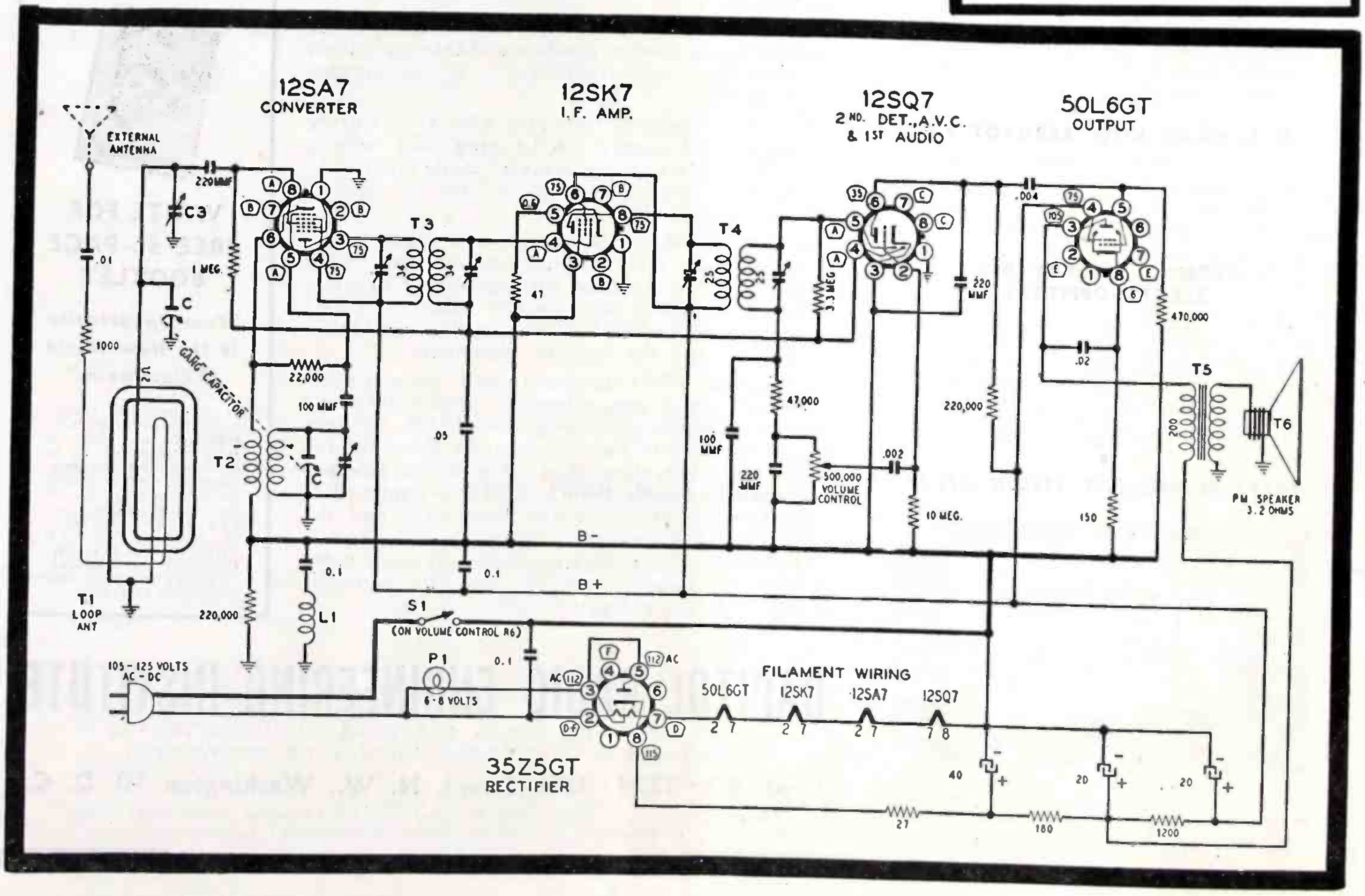
(*Continued on page 45*)



	CONDENSERS
C1	.2 x 400 volt tubular condenser
C4	.0002 mica type condenser, 20%
C5, C7	.05 x 200 volt tubular condenser
C6	.1 x 400 volt tubular condenser
C8	.0001 mica type condenser, 20%
C9	.002 x 600 volt tubular condenser
C10	.00025 mica type condenser, 20%
C11	.004 x 600 volt tubular condenser.
C12, C13	Electrolytic filter condenser, 50 to 60 cycles, 20 mfd.–40 mfd. x 150 volts
C12, C13	Electrolytic filter condenser, 25 cycles, 40 mfd.–60 mfd. x 150 volts.
C14	.02 x 400 volt tubular condenser
	RESISTORS
R1	1.000 ohm, ½ watt resistor, 20%
R2	47,000 ohm, ½ watt resistor, 10%
R3	220,000 ohm, ½ watt resistor, 20%
R4	47 ohm, ½ watt resistor, 10%
R5	3.3 megohm, ½ watt resistor, 20%
R6	22 ohm, ¼ watt resistor, 10%
R8	4.7 megohm, ½ watt resistor, 20%
R9	470,000 ohm, ½ watt resistor, 20%
R10	680,000 ohm, ½ watt resistor, 20%
R11	150 ohm, ½ watt resistor, 10%
R12	1200 ohm, 1 watt resistor, 10%
R13	83 ohm, 1 watt resistor, 20%

Figs. 3 and 3*a*. Ward's 54BR-1505A a-c/d-c model with antenna series resistor in loop primary is shown in Fig. 3. The list of parts appears in Fig. 3*a*.

Fig. 4. Fig. 4 shows Ward's 54BR-1503A using a grounded loop, resistance coupled to a converter.



NEWS

(*Continued from page 37*)

Buckman, secretary; C. F. Bogdan, corresponding secretary; and Ben Gerstein, treasurer.

Directors named include: Roy Stroh, Edmund Nowicki, Joseph Sincavage, and Milan Krupa.

The association has 45 active members. To promote their activities, the association plans to begin a local advertising campaign.

* * *

OHMITE BULLETIN

A four-page bulletin describing riteohm resistors has been issued by the Ohmite Manufacturing Company, 4835 West Flournoy Street, Chicago 44, Illinois.

* * *

R. M. DORE JOINS SHAPPE-WILKES

Robert M. Dore, for the past four years an agent of the Federal Bureau of Investigation, has joined Shappe-Wilkes Inc., New York, as head of research and merchandising.

* * *

AKEROYD LEAVES RAYTHEON

A. E. Akeroyd, manager of distributor sales for the Raytheon Manufacturing Company, Newton, Mass., has resigned.

He was the originator of the bonded electronic technician plan covering the bonding of Service Shops.

An announcement as to his future plans will be made soon.

ALMY AND RAINIER PROMOTED BY SYLVANIA

R. P. Almy has been appointed assistant general sales manager of the Sylvania radio division. Harold H. Rainier succeeds him as manager of distributor sales, radio division.

Left: H. Rainier
Above: R. P. Almy

* * *

CLAROSTAT CATALOG

A catalog, No. 46, describing wire-wound power resistors and glass-insulated flexible resistors; composition-element and wire-wound rheostats and potentiometers; tapped and tapered controls and switches; constant impedance input and output controls and attenuators; tube-type wire-wound resistors, automatic line voltage regulators and replacement line ballasts; power rheostats; and power resistor decade boxes, has been published by Clarostat Mfg. Co., Inc., 285-7 N. 6th St., Brooklyn, N. Y.

* * *

ALLIED CATALOG

A catalog listing tubes, test instruments, transformers, resistors, capacitors, rheostats, relays, switches, rectifiers, p-a units, tools, wire and cable, batteries, sockets, generators, power supplies, kits, receivers, etc., has been released by Allied Radio Corp., 833 West Jackson Blvd., Chicago 7, Illinois.

* * *

RAD-EL-CO ANTENNAS

Roto-Lok antennas for mounting in top cowl or top fender positions, have been announced by Rad-El-Co Manufacturing Co., 6300 Euclid Ave., Cleveland 3, Ohio.

BURGESS HEARING AID BATTERIES

Packaged assortment of 1½ volt "A" in three sizes, and 33 and 45-volt "B" hearing aid batteries, offered by the Burgess Battery Company, Freeport, Illinois.

NEW PRODUCTS

WALSCO FINISHING KIT

A kit containing all materials for flock finishing, including a flock gun, two shades of felt flock, undercoats, thinner, brush and instructions has been announced by the Walter L. Schott Company, Beverly Hills, California.

* * *

HICKOK VOLT-OHM-CAPACITANCE-MILLIAMMETER

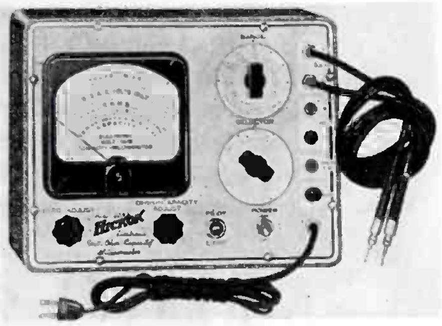
A test unit, model 203, designed to measure capacity, resistance, a-c and d-c (current and voltage) and inductance has been announced by Hickok Electrical Instrument Company, 10521 Dupont Avenue, Cleveland 8, Ohio.

A high input impedance is said to prevent loading when making voltage measurements. Ohmmeter circuit permits measurements from 1.0 ohm to 10,000 megohms.

Ranges are: Volts, a-c . . . 0-3, 12, 30, 120, 300, 1200; volts, d-c . . . 0-3, 12, 30, 120, 300, 1200; mils (d-c) . . . 0-3 12, 30, 120, 300, 1200; capacity . . . 0-10,000 mmfd in 2 ranges, 0-1000 mfd in 5 ranges; inductance . . . 50 mh-100 henries; ohms . . . 1.0 ohm to 10,000 megohms in seven ranges.

Said to permit measurement up to 5 mc. Sensitivity of meter, 350 microamperes. Input impedance: Volts d-c . . . 15 megohms; volts a-c . . . 12 megohms shunted by 100 mmfd.

Tubes used include: 2 6X5GT as a-c rectifiers; 1 6SJ7 as a cathode follower; 1 6SN7GT as a vacuum-tube voltmeter; and 1 OD3/VR150 as a voltage regulator.



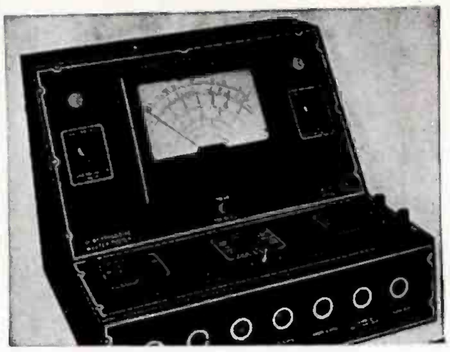
* * *

REINER MASTER TESTER

A tester that is said to be equivalent to 61 individual single-range meters, with eight types of testers (insulation, capacity meter, ohmmeter, a-c voltmeter, d-c voltmeter, a-c ampere meter, d-c ampere meter, and impedance-inductance meter) has been developed by Reiner Electronics Co., 152 West 25th St., New York.

Ranges of unit, model 456, are: a-c . . . 6-15-30-60-150-300-600-1,500-3,000-6,000-15,000-30,000 ma; d-c . . . 6-15-30-60-150-300-600-1,500-3,000-6,000-15,000-30,000 ma; a-c volts . . . 3-6-15-30-60-150-300-600-1,500-3,000-6,000; d-c volts . . . 6-15-30-60-150-300-600-1,500-3,000-6,000; ohms . . . 0-1,000-10,000-100,000-1 meg.-10 meg.-100 meg.-1,000 meg.; insulation tests . . . 500 volt/0-10,000 megohms; 1,000 volt/0-20,000 megohms: capacity (high) . . . 5-2,000 / .5-200 / .05-20 / .005-2 / .0005-.2/ .00005-.02 mfd; capacity (low) 1-100 mmfd.

Frequency range without probe, a-c volts 10 cps to 100 kc, 25 mmfd input capacity. With probe, 10 kc to 500 mc, 1 mmfd input capacity.

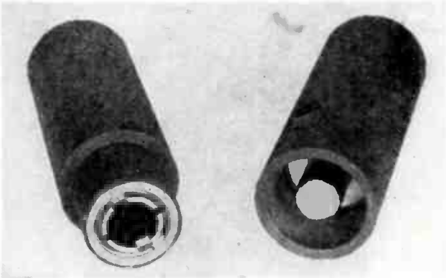


* * *

AIRESEARCH ELECTRICAL CONNECTOR

The Williams grip electrical connector providing a pressure contact, has been announced by the AiResearch division of the Garrett Corporation, 9851 Sepulveda Blvd., Los Angeles 43, California.

Pressure contact is developed by means of expansion or contraction actuated by a thread.



TUNABLE REJECTOR CIRCUITS

SOME communications receivers contain features exclusive to a particular model. Such a circuit is shown in Fig. 1 (Hallicrafters SX18). This is a tunable rejector circuit which is, in effect, an image rejector. Image pickup in a receiver is due to a signal riding through at a dial frequency setting of the image frequency minus double the i-f frequency. For example, suppose a receiver is tuned to 1000 kc, and the i-f frequency of the receiver is 500 kc. This means that the oscillator is oscillating at 1500 kc. A signal of 2000 kc, beating against the oscillator frequency will also produce a resultant frequency of 500 kc. Therefore, this 2000-kc signal may ride through the r-f section, particularly if it is a strong signal, and be picked up at 1000 kc on the dial. The circuit of Fig. 1 is actually a trap circuit, used on the high frequency bands to prevent, or shunt, this image signal out of the r-f circuit. The capacitor and coil, which are in series with each other, and in series with the primary of the antenna coil, form a series resonant circuit. At resonance, the capacitor and coil show the least reactance, or resistance to their resonant frequency. Therefore, any signal appearing in the primary of the antenna coil, of resonant frequency of the trap circuit, will be shunted into the secondary of the same transformer, cancelling itself. The rejector dial is calibrated the same as the main dial for the two bands on which it operates. In use, the rejector dial is tuned to the same frequency as the main dial. However, since it is actually tuned to the image frequency, the latter frequency is the one rejected.

In servicing communications receivers, it must be remembered that they are complicated mechanisms, requiring extreme care and patience in both repair and adjustment. For example, the SX28 requires 32 adjustments in the r-f portion alone, as well as 12 adjustments in the i-f and associated circuits. Some of these trimmers have to be readjusted several times before proper dial setting and performance is obtained. In addition, owners of communications receivers will undoubtedly demand high standards of performance. Therefore, the anticipated charges should reflect these conditions.

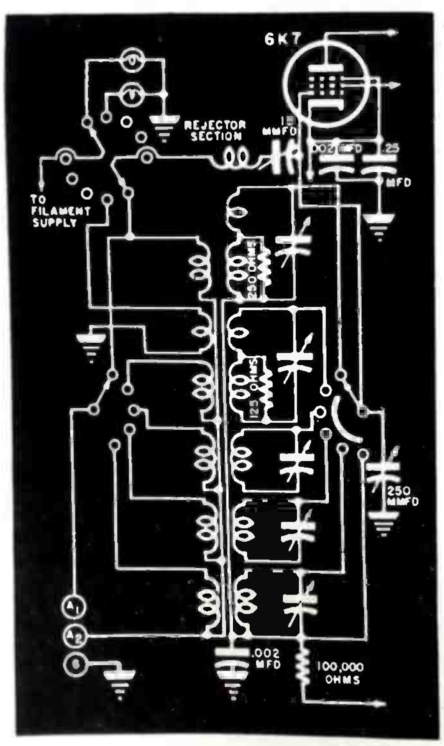


Fig. 1. Image rejector tuner as used in the Hallicrafters SX 18. The rejector tuner is used in conjunction with the main dial to tune out image signals on the two high-frequency bands.

OLD TIMER'S CORNER

by SERVICER

AFTER closing up my shop way past midnight a few weeks ago, I decided to walk home. It was one of those brisk spring nights, a perfect night for strolling. I chanced to take the street that leads past Joe's Service Shop and noticed that the lights were on. Joe was poring over a chassis. I rapped smartly on the window. Joe looked up, and seeing me, came over to let me in.

"What now, my friend," I asked, "why the burning of the midnight oil?"

"Have quite a mess of receivers to service," Joe sighed, "and I must get them out before tomorrow. Want to help?"

"Nary a chance," I rejoined. "I did all that I'm going to do for one day. You know the old adage 'All work and no play' . . ."

"Well, I just must get these sets out," Joe said. "And it seems as if I always get the tough sets to repair."

"Thought that you had a staff of veterans who were going to town on your repairs," I answered.

"I have, and they're a fine bunch of men," Joe said forcefully. "But it seems that they're only human too. They pick up the sets and find out what they have to do and then only do the easy ones.

"And what's worse than that" he continued, "the hard sets invariably belong to my best customers. The easy ones belong to the trade that goes by the door. So I have to burn the midnight oil to get the stuff ready for the nice people who played ball with me during the tough war years."

"Tain't that bad if you used the system I have put in at my shop," I said.

"What system?" Joe queried gingerly. "Can't be much good or you wouldn't give it to me so quickly!"

"Now, hold on there," I said. "What makes you think that it doesn't work? Besides, if you're going to act that way, I'll just let you suffer and suffer. Why am I giving it to you? Because if we find ways and means to assure fine and first-class service, then the whole texture of the radio servicing will be raised and we'll all get more business—including me," I finished tartly.

"Guess you're right," said Joe.

"Come on, why not quit now. Tell the folks you'll have their sets ready in a few days, and let's go out for a sandwich and some coffee. I'll give you the dope at the diner."

After we got to the eatery and had ordered, I told Joe the plan.

"When a set comes in for repair, Joe," I started, "we tag it with a number on a trouble tag, which has three detachable parts. The first part of the tag has the customer's name and address and the other side of the piece has columns for us to enter charges and labor costs. The second part has only the number and a blank space in which the costs and the parts which have been replaced can be entered. The third part has a place for the type of set and the number. This is given to the customer.

"The first part with the customer's name and address and the set number is detached when the set is received and is filed in a card-index file by number. I keep that in my desk so that the boys can't get at it. The remaining part with only the number, is left attached to the set.

Wall Record

"On the wall of the shop I have a large piece of beaver board, with the numbers in rotation in columns down the lefthand side and a space next to each number. I get about ten columns to a piece of beaver board. As the repairman takes a set down from the shelf for repair, he initials the set-number column on the board. When he has finished the set, he initials it again.

"In this way I accomplish three things. One, I know who is working on what set. Two, I know when a set has been finished by just referring to the board and noting that there are two initials opposite the set's number, even though they be the same initials. Three, there can be no favorites since the sets must be taken in rotation."

"That sounds good," Joe said, "go on."

"Well, I don't object to the men swapping repair jobs among themselves," I continued. "Only the man who finishes the work must initial the board. In this way, I can see who is 'gold-bricking.' I can also see who is taking the run of the mill work and doing a good job. And no one, except myself, knows whose set is being repaired so there can be no favorites.

"One thing sometimes upsets the apple cart. When the repair has been started, we sometimes find that we're lacking in parts. Then the repairman has to enter the set's number on a different board, to indicate waiting for a part. And he must enter his initials and the part needed opposite the set's number.

"By looking over these two boards every day, I can see what sets are being repaired, and what parts are needed. Then I order the needed parts and advise the repairman whose initials appear opposite the unfinished set that the part is in stock. He takes the set from the shelf and finishes it, initialling the main board and striking out the item on the *parts-needed-board*. That's all there is to it."

"Now why didn't I think of that?" Joe mumbled.

Effort Rewards

I added, "One thing is funny. Since I've put in the system, I've discovered that Bill Jones is the fastest man in the place and that he fixes everything that comes along. He's received two raises and will some day be a partner. And Jack, who can talk a blue streak on how well he can do this or that, is really only a 'talker' and not a 'doer.' He's still with me but I'm not impressed with his work and when he asks for a raise, which he'll do any day now, I can show him what he's been doing — or rather, not doing!

"Finally, I take the tag on the set on which the repairman enters the labor time and parts used for replacement, and enter this information on the tag I have left in the desk file. From this, I figure the price of the job and show the customer how I arrive at the figure, if he requests an itemized invoice."

"How's that strike you, Joe?" I asked.

"I like it so well, I'm going to start with it tomorrow," Joe said.

And he did.

SERVICING HELPS

ZENITH 8S586

Distortion on strong signals: If the avc circuit checks correctly, try replacing the 6U5 tuning eye, as a slight leakage in this tube will partially destroy the avc action, thereby creating the distortion.

•

PHILCO 70

Motorboating: Check for a shorted bypass capacitor in the grid circuit of the 47 output tube.

•

PHILCO C1908

Howl: If replacing a defective output transformer in this model results in a howl, interchange the transformer plate connections from the output transformer.

•

PHILCO 29

Occasional crackling noise: Ground speaker frame to radio chassis.

•

PHILCO C1808

Intermittent fluttering reception: Try the installation of a new vibrator.

•

MOTOROLA 250

Periodic oscillation especially on low-frequency end of dial: Poor grounding clips on variable capacitors: Replace or clean and spread old ones.

•

STROMBERG-CARLSON 486

No reception: Quite a few of these sets will be found to have open voltage dividers. Replace open sections with proper resistance 10-watt replacement units.

Edward Goldschmidt

G. E. TRANSLATOR JFM 90

Rushing noise all over dial: Replace mica insulation on trimmer capacitor of center section of tuning capacitor.

•

PILOT PORTABLE MODEL T-71

Loss of volume: Caused by defective 2-megohm resistor, from grid of 1T5 GT tube to chassis, changing resistance.

RCA 813K

Set inoperative, 5T4 rectifier tube and power transformer get very hot: Short in filter choke to ground, or chassis. Replace.

Claude M. Prew

POSTWAR PERSONAL RECEIVER

(See Front Cover)

THE postwar model of RCA Victor's 4-tube personal receiver, 54B1, 2 and 3, is shown on the cover this month.

Powered by a flashlight cell and a 67½-volt *B* battery, it has an undistorted output of 50 milliwatts and maximum output of 120 mw. A 1R5 first detector-oscillator utilizes an anode tickler which develops a rectified *No. 1* grid voltage of –6 at 600 kc and –7 v at 1,500 kc.

A plate supply filter composed of a 15,000-ohm resistor and a .02-mfd capacitor isolates the oscillator supply which also serves the 1T4 i-f amplifier screen. The second i-f transformer is wound to a higher impedance than the first. The detector load resistor of the 1S5 consists of 68,000 ohms in series with a 2-megohm volume control. The i-f filter is made up of the 68,000-ohm resistor flanked by 82 and 33-mmfd capacitors. The first audio section of a 1S5 pentode is fed through a .002-mfd capacitor to a 10-megohm grid leak.

A 3S4 output tube drives an elliptical 2″x3″ speaker. An 820-ohm resistor from *B*– to ground supplies bias to a 3S4 through a 3.3 megohm resistor. A 10-mfd capacitor shunts the *B* battery and a 820-ohm resistor, serving as an r-f and a-f bypass.

The receiver draws 250 ma from the *A* battery, giving an intermittent life of 3 to 5 hours; 8.5 ma from the *B* battery giving 25 to 40 hours life.

The voice coil impedance at 500 cycles is 11.75 ohms.

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SER-CUITS

(Continued from page 38)

as a detector, the other as diode gate. A 1-megohm volume control is used as a detector load resistor.

Ward 54BR-1503A/1504A

Ward's models 54BR-1503A and 1504A, shown in Fig. 4, features a .01-mfd antenna series capacitor; grounded loop, resistance coupled to the converter through 220 mmfd; improved r-f filtering of detector output with 100 mmfd, 47,000 ohms and 220 mmfd ahead of the volume control; additional *RC* filter section; and a tuned circuit between chassis and *B*– to minimize modulation hum.

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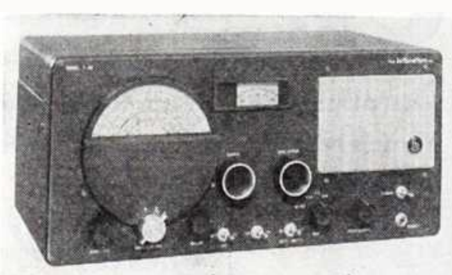
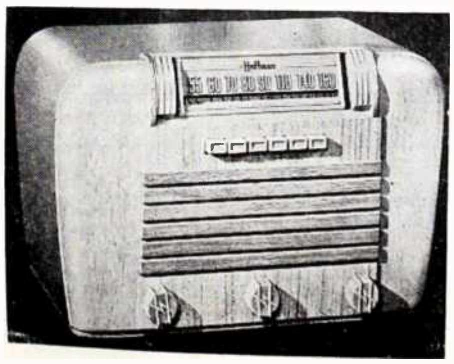
POSTWAR RECEIVERS



Above: Hallicrafters 9-tube communications four-band model, S-40, for the 550-kc to 44-mc bands.

Below: Hoffman 6-tube a-c table model, A 301, with permeability tuned oscillator. Has a tuned r-f stage.



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VOLUME AND TONE CONTROLS

Repairing, Reconditioning and Circuit Substitutions

[Concluding Installment]

It is a well-known fact that all carbon-element volume controls, especially those employing a taper, are more apt to become noisy when used in circuits in which direct current flows through the resistance element and the contact of the control. Therefore, when this control circuit is encountered in a receiver it is desirable to change the circuit so that the control is entirely isolated from any possible source of direct current.

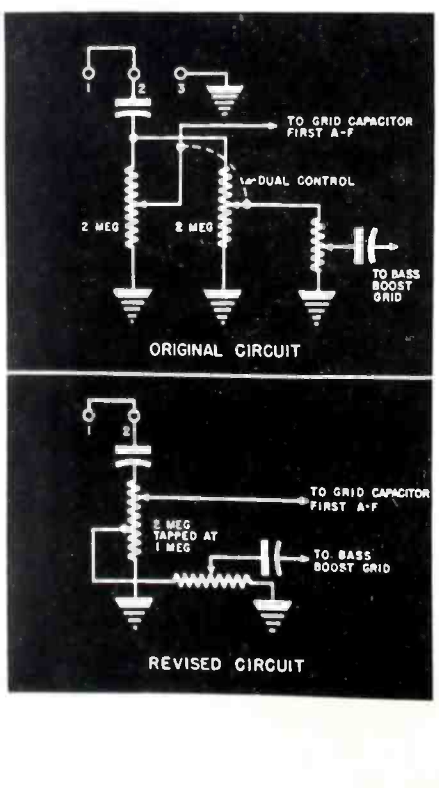
A recommended circuit change was illustrated at the bottom of Fig. 10 (page 33, Feb. 1946). Here the volume control is isolated from all flow of d-c through it by means of isolating capacitor, C_2, connected in series with it. A fixed resistor, R_1, has been inserted in the circuit to act as the diode load resistor. The direction of the diode current flowing through it is indicated by the arrow. The same value of volume-control resistance is used as was employed in the original circuit. The values most used in this circuit are 250,000 ohms or 500,000 ohms, with a left-hand taper.

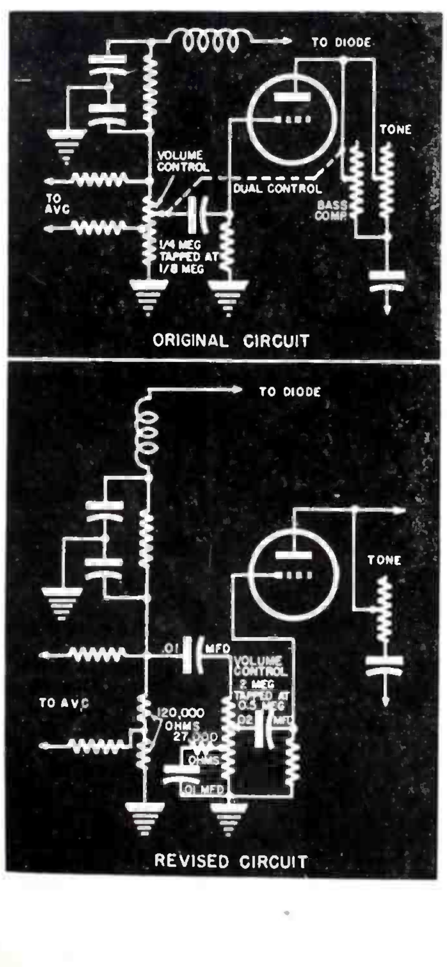
The method of obtaining volume control and *bass* compensation is used in several receivers, the tone quality being compensated automatically at the low levels (where compensation is primarily needed) by the bass-compensating resistor, as the volume control is manipulated. Whenever it is difficult to readily obtain a suitable replacement dual control for a receiver employing it, a substitute circuit may be used. A very satisfactory circuit suggested by IRC is one which uses a more readily obtainable single control which is tapped. Fig. 11 shows the original circuit, and the changed circuit. At the time this change in circuit is being made, the volume control can be removed from the diode circuit, as shown, by replacing the old volume control with two fixed resistors (1-watt or 2-watt carbon type) each having as near one-half the resistance value of the old volume control as commercial resistors of *preferred resistance value* will allow.

Another volume-control circuit using a dual control with one section controlling a bass-boost circuit is shown at the top of Fig. 12.

Since one section of the dual control is used only to supply voltage to the bass-boost circuit, this could be done very satisfactorily by means of a suitably placed tap on a single control as shown in the lower circuit in Fig. 12, suggested by IRC. To make the circuit change, the original control should be removed and replaced with a single 2-megohm control tapped at 1 megohm, as shown. —***Alfred A. Ghirardi.***

Figs. 11 (right and 12 (below). Fig. 11. Suggested changes for employment of single tapped volume control unit in a combined volume control and bass-compensation circuit that formerly used a dual-control unit. Fig. 12. Dual volume-control circuit (with one section controlling bass boost) which can be changed to use more readily available single control having a center tap.





JOTS AND FLASHES

TELEVISION programs will soon be on a twice-a-day schedule, according to Ralph B. Austrian, president of RKO Television. Speaking before an advertising group in Washington recently, he said that the newly scheduled telecasts will be on for two hours in the afternoon and two in the evening. . . . Hallicrafters Company have purchased the Electronic Winding Company, 5031 Broadway, Chicago. Irving Glerum has been named superintendent of the new unit.

. . . R. W. Vonasch has been appointed district manager of the North Jersey office of Ward Leonard Electric Co. Offices are at Industrial Office Building, Newark 2. . . . C-D recently received a Certificate of Achievement from the U. S. Navy. . . . Manufacturing facilities of C-D were recently expanded with the leasing of plant space at 55 Cromwell Street, Providence, R. I. . . . Newark Electric Company has opened a branch office at 212 Fulton Street, New York 7, N. Y. Hy Kahn is manager of the new store. . . . DeMambro Radio Supply, Boston, Mass., has been appointed Stromberg-Carlson sound equipment distributor.

. . . The Ideal Commutator Dresser Co., Sycamore, Illinois, has changed its name to Ideal Industries, Inc. . . . Paul K. Povlsen is now vice president and general manager of Maguire Industries, Inc. . . . Kenneth C. Prince has been named general counsel for the Hallicrafters Company. . . . The G. E. plant at Utica, N. Y., will produce table model receivers. . . . R. T. Schottenberg, Astatic jobber sales manager, and J. K. Poff, service engineer, recently attended the opening of the Rochester Radio Supply Company store in Rochester, N. Y. . . . Philco engineers have developed a 35-pound television camera and lightweight control unit. The equipment was used during the recent telecasts of the University of Pennsylvania football games from Franklin Field. . . . Russell Ranson, 116½ East Fourth Street, Charlotte, North Carolina, has been appointed Weston representative for Virginia, North Carolina and South Carolina. . . . Universal Microphone Company, Inglewood, California, will display microphones made since 1928, at the Radio Parts Show in Chicago, in May.

ADVERTISERS IN THIS ISSUE

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