RADIO & TELEVISION MAINTENANCE

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RADIO INDUSTRY NEWSLETTER

Edited by Joseph J. Roche

CRYSTAL BALL—As in the past, the end of the year brought its crop of predictions for 1950 and beyond. While they varied somewhat from each other, they were consistently optimistic. RCA's Folsom estimated this year's TV receiver production at 3,500,000, and G-E's Baker came up with the same figure. Mucher of Clarostat foresaw well over 3,000,000 sets sold during 1950, and Sylvania's Mitchell placed his prediction at 3¾ million. Emerson's Abrams, very optimistically, saw 5,000,000 telesets produced and sold this year. And a Raytheon study revealed that the GI Insurance dividend will buy more than a million telesets during the first three months of this year.

Looking a little further ahead, Abrams predicted 30 million receivers in use by 1955, while RCA's Sarnoff placed the number at 20,000,000 by 1954. DuMont's Muniz predicted a yearly teleset rate of 5 million by 1953.

As far as Sales & Service Organizations are concerned, these estimates mean that in 1950 the public will spend approximately $750,000,000 for new telesets, about $50,000,000 for installation, and roughly $100,000,000 for service and parts.

COLOR—The color allocation question remained undecided, pending resumption of FCC hearings and demonstrations during the latter part of February. However, a number of developments took place during the month. FCC chairman Coy turned a cool shoulder to RMA's proposal to establish an industry-wide committee to study and recommend color standards to the FCC; CBS started installation of its first color sets for public viewing (as instructed by the Commission); and RCA announced that it would have a single tube color unit ready for demonstration in less than 90 days (uses 3 tubes at present). In the meantime, people stopped seeing flying discs and announced that they had solved the colorvideo problem; like the man in Milwaukee who reported development of a system with no moving color filter, no mirrors, using standard transmitting equipment, adaptable to dot, line or field color sequence transmission and reception.

UHF—NBC put is experimental u-h-f TV transmitter on the air in Bridgeport. Special receivers and converters were designed by RCA for engineering observation, and were installed within a radius of 25 miles of the station. Broadcasts are in the band between 529-235 Mc, received only by special receivers.

PHONO DEVELOPMENTS—Peace was in sight in the record industry. Although it had denied it up to the last minute, RCA finally released the news that it would start production of a 33⅓ rpm record in March (in addition to its line of 78 and 45 rpms discs). The trade greeted the announcement with a sigh of relief, and record sales are expected to boom.

POLICY—RCA announced a new installation and service contract (in addition to its old one). This alternative contract provides for complete installation, parts and tube protection (including picture tube) for one year, unlimited service for 90 days, with a flat $5.75 flat rate per call thereafter. Price: $22.95 with built in, $39.95 with outdoor antenna for 10-inch sets. The other contract differs in that it provides unlimited service for one year.

BUSINESS BRIEFS—Motorola's Walter Stellner believes that television prices will stabilize at present low levels . . . Philco is going to expand its operations to produce and sell between 750,000 and 800,000 telesets in 1950 . . . Westinghouse expects to up its television output by 75% this year . . . Sylvania, which began producing telesets under its own name last September, is now featuring ten models ranging from $169.50 to $399.95 (new low prices).

How to Wire the 1950 modern Service Bench

Outlining the wiring plan for an efficient and safe service bench

By The Staff of **Radio & Television Maintenance**

IN the January issue of RADIO AND TELEVISION MAINTENANCE we presented step-by-step instructions for building the 1950 Modern Service Bench. This article will complete the details of the bench, giving a suggested plan for wiring it up.

In wiring up a bench, a number of factors have to be considered. These may be summarized as safety, efficiency, convenience, and economy. The plan presented here was designed to provide for all of them. Safety is achieved by the use of proper cable, automatic circuit breaker, master switch—pilot light combination, and approved mounting. The wiring plan makes for efficient maintenance by providing enough outlets to take care of all servicing needs. The outlets and switches are placed for convenience when working on the bench. And standard equipment was used throughout because it is easily and economically available.

Power

#14 non-metallic sheathed cable is used throughout the bench. This type cable is of rugged construction, but reasonably priced. If you prefer and don't mind going to the additional expense, you may want to use BX armored cable, which will give you an additional safety factor. However, non-metallic sheathed cable is quite satisfactory for most purposes. In wiring up the original bench model we used "Cresflex," a flexible non-metallic sheathed cable, manufactured by the Crescent Insulated Wire and Cable Co. The total length of cable required is twenty-two feet.

The cable is fastened to the bench by means of straps or staples and ⅜" flathead woodscrews. To be Underwriter approved it must be secured in place at intervals not exceeding 4½ feet, and within 12" from every outlet box or fitting.

Since your shop will generally be located in a building which is already wired, you will have a main power line available. If possible, the bench should have a separate line going to the main box. Standard house wiring will carry the load of the bench with all instruments turned on (about 1200 watts). If other appliances are plugged into the same line, however, it may overload. Therefore a separate line to the main box is recommended. If this is not possible, connect the bench to a standart outlet by means of a Hubbell male plug.

Circuit Breaker

From the main line, the bench cable goes directly to an automatic circuit breaker which will carry 15 amps and which will open at greater loads. The one used in the original bench model is tradenamed "Quick-lag" and is produced by Westinghouse. Equivalent breakers are manufactured by General Electric and Littelfuse. The circuit breaker is mounted in the upper right hand corner of the lower back panel (detail #6 of construction drawing in the January issue), in such a way as to be accessible from the front of the bench. After deciding on the location of the circuit breaker, drill holes in the back panel to bring the wire from the back of the panel, to and from the overload protection device.

Instead of a circuit breaker, you can use a conventional type fuse box with door and safety switch for 15 amp standard fuses. The fuse box is mounted in the same position and manner as the circuit breaker.

Master Switch

From the circuit breaker (or fuse box), the cable goes to a master switch—pilot light assembly. Such a master switch is highly desirable in service work. With it you can always be sure that everything is turned off, when you leave the shop. Without an arrangement as this, you may leave some instruments on all night, or you might forget to shut off the iron, or you may create various other fire hazards. The pilot light on the master switch assembly will warn you immediately if power is on. Then, if you flick the master switch, you will be sure that none of the instruments or equipments will be running after you have left.

The master switch—pilotlight assembly which was used is of the conventional 30 amp.—115 volts—lever operated type, and is mounted with associated gem box, as shown in the illustration. Appropriate holes must be cut in the back panel to accommodate this switch.

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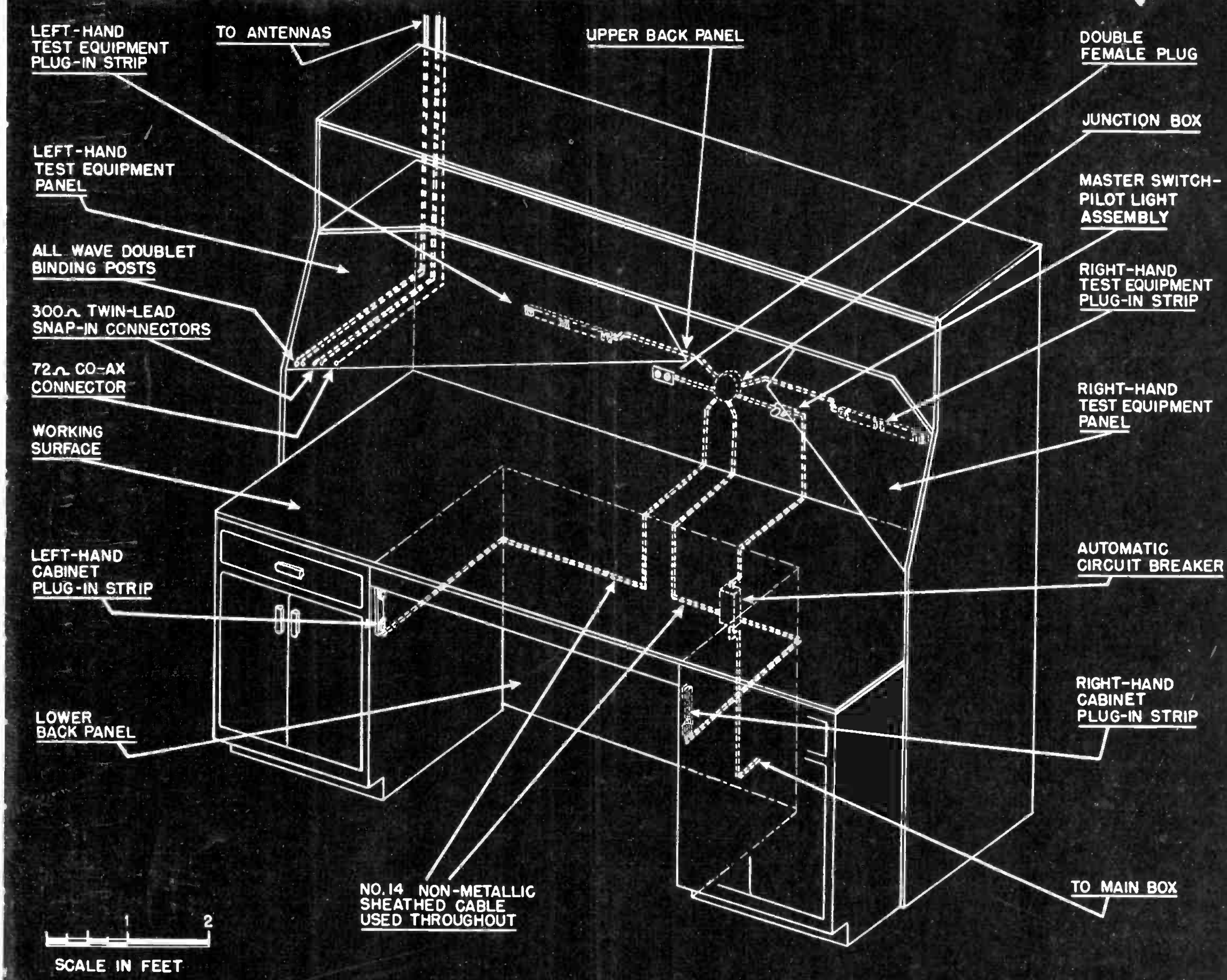
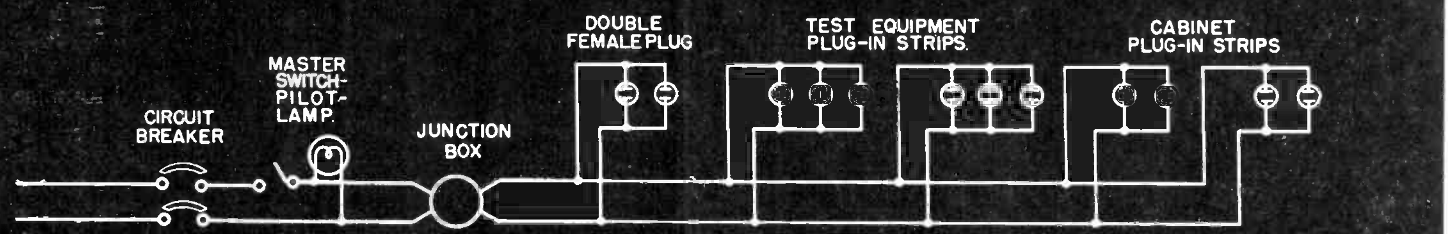
In the March issue . . .

Constructing Efficient INVENTORY RACKS

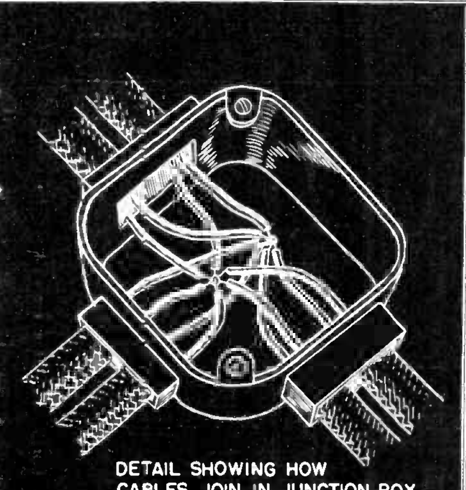
Complete in one issue step-by-step plans for building modern inventory racks designed especially for today's service requirements.



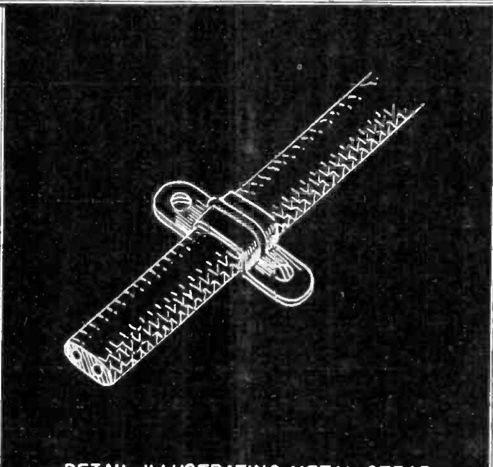
WIRING DIAGRAM OF BENCH



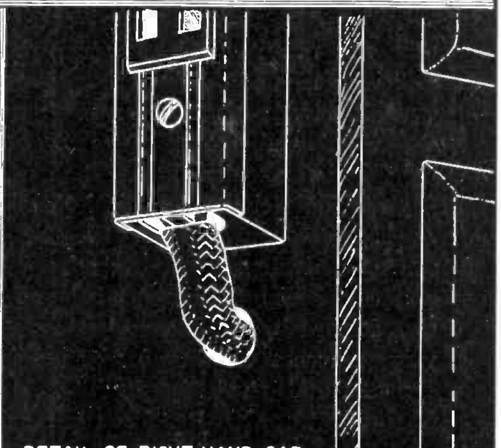
SCHEMATIC



DETAIL SHOWING HOW CABLES JOIN IN JUNCTION BOX



DETAIL ILLUSTRATING METAL STRAP USED TO MOUNT CABLES.



DETAIL OF RIGHT-HAND CABINET PLUG-IN STRIP. CABLE COMES THROUGH SIDE OF CABINET TO STRIP.

New Circuits

Several new tele-chassis now incorporate

by Morton G. Scheraga
Allen D. DuMont Labs.
Co-author, *Video Handbook*

KEYED A-G-C CIRCUITS

Another of our monthly features to bring you the latest in TV circuits. Follow them to keep up-to-date

THE purpose of automatic gain control (a-g-c) is to feed back a negative voltage to the grids of the r-f and i-f amplifier tubes in order to control their gain automatically. This negative voltage is proportional to the strength of the received video signal. The net effect of the system is to maintain a constant level of video signal at the grid of the picture tube and at the input to the sync circuits. In a perfectly operating a-g-c system, the picture contrast, after being set by the contrast control, remains the same, even when stations are changed.

Although the method of developing the a-g-c bias is simple in principle, the circuits that have been used in the past work well only under fairly ideal conditions. If the signals from all stations are not practically noise-free, or if the noise disturbances are rapid in nature, simple a-g-c circuits do not control the gain of r-f and i-f amplifiers well.

A simple a-g-c circuit is shown in Fig. 1. A portion of the video detector output is coupled through C1 to the plate of the a-g-c rectifier tube V1. The polarity of the signal is such that the diode conducts when the positive peaks of the sync signals are applied to the plate. Current flows through the tube and charges capacitor C2 to the peak value of the sync signals. This charge cannot leak off readily because of the long time constant (equivalent to the duration of about 10 horizontal lines) of the circuit formed by C2, R1, and R2. The voltage across C2 therefore remains constant and equal to the peak value of the sync signals. This voltage, tapped between R1 and R2, is the a-g-c signal. When the level of the sync signals increases for a period of time equal to more than ten horizontal lines, the negative voltage across C2 increases and a compensating voltage is applied to the amplifiers under control, reducing their gain automatically.

It should be noted that the a-g-c voltage is derived from the level of the sync signals rather than from the average amplitude of the video signal, as is done when a-v-c voltages are developed from the average audio signal in sound receivers. The average level of the video signal cannot be used for gain control bias because it represents the brightness of the scene. If the average voltage were used as a gain controlling bias, it would maintain the scene brightness at a constant level, even though it varied at the studio. A signal, if used for a-g-c, must be proportional to the maximum carrier strength of the television signal only. The sync signal fills these requirements. It represents 100% modulation of the carrier and has no relation to the brightness of the scene. When the carrier fades, the level of the sync signal changes, at which time the a-g-c system increases the gain of the receiver.

Shortcomings

The inherent design of this type of a-g-c system has the following limitations:

1. The time constant of the filter network consisting of C2, R1, and R2 must be made sufficiently long to filter out the 60-cycle synchronizing pulses. If the change in signal strength occurs in less than 1/60 of a second, the a-g-c bias will not change in time to prevent a sudden overload or fading of the picture. This effect is illustrated by the rapid fading and fluttering of the picture when an airplane passes over the antenna.

2. Noise signals add to the a-g-c bias and reduce the overall gain of the receiver, reducing the amplitude of the desired signal. In very weak signal areas where the signal-to-noise ratio is low, the noise signals may be so great as to produce an a-g-c voltage which will lower the gain of the amplifier to a value at which the video signal is completely reduced. In such cases, a-g-c is a decided disadvantage.

The disadvantages of conventional

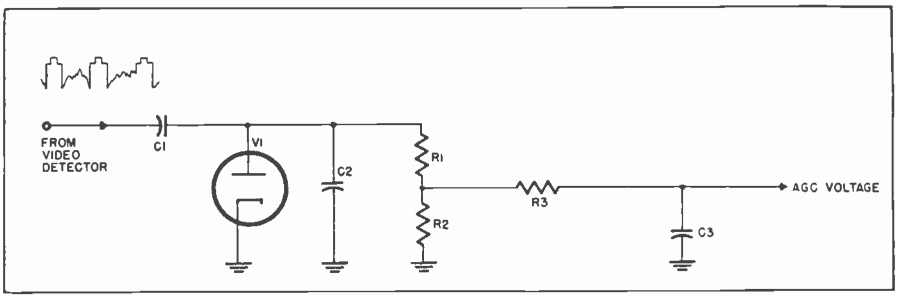


Fig. 1 Simplified diagram of a-g-c circuit. V1 conducts when the positive peaks of the sync signals are applied to plate. Voltage across C2 remains constant

a-g-c systems have been overcome to a great extent by a new type of a-g-c circuit that is being employed in many new receivers. It is known as *keyed a-g-c*. Several variations of this new circuit are being used, but they all operate on the same principle.

Keyed AGC

The basic operation of the keyed a-g-c system is shown in Fig. 2A. The composite video signal, including the d-c component, is applied to the grid of the a-g-c tube V1. Because of the polarity of the signal, the sync pulses drive the grid positive. Simultaneously, a pulse is fed back to the plate of the a-g-c tube from the horizontal sweep circuit. The a-g-c tube is operated with the plate at a lower potential than the cathode. The grid is operated a few volts negative with respect to the cathode, and is biased close to cut-off.

If only the sync pulses were applied to the grid, there would be insufficient d-c voltage on the plate to cause conduction, and the tube would be cut off. However, when a positive pulse from the horizontal sweep circuit is applied to the plate, its amplitude is sufficiently large to cause the tube to conduct momentarily. Since the pulse from the sweep circuit is synchronized to the incoming horizontal sync pulses, the a-g-c tube conducts only when a horizontal pulse is on the grid and when a positive pulse from the sweep circuit is on the plate. The phase relationship of these pulses is shown in Fig. 2B. When the sweep circuits are not synchronized, the keyed a-g-c does not function properly. The amount of plate current that flows during the conduction period depends upon the amplitude of the horizontal sync pulse. The bias on the grid is adjusted so that only the sync signals have sufficient amplitude to cause conduction, while the picture modulating signals will have no effect.

Since the video signal which is fed to the grid contains the d-c component of the picture, the tips of the sync signals are at the same level, except when the carrier signal changes. Should the carrier signal change, the level of the sync signals will vary, and more or less current will flow in the a-g-c tube. Neither picture modulating signals, nor noise signals which are superimposed upon them, can influence the a-g-c voltage because the tube is cut off between

FIG. 2A

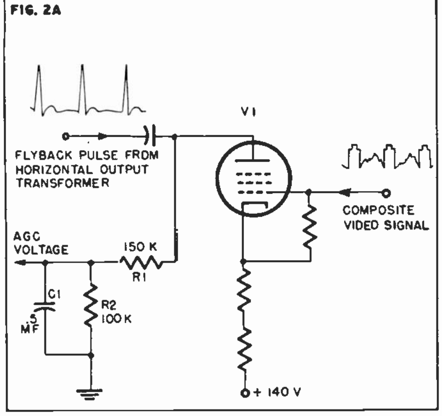


FIG. 2B

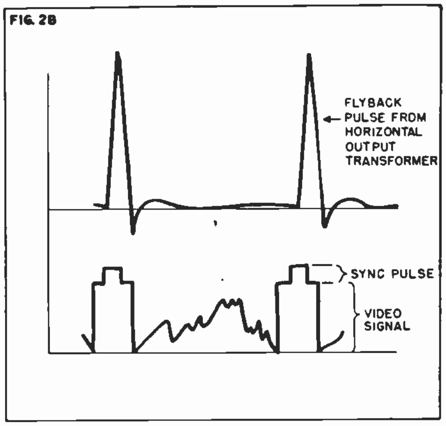


FIG. 3

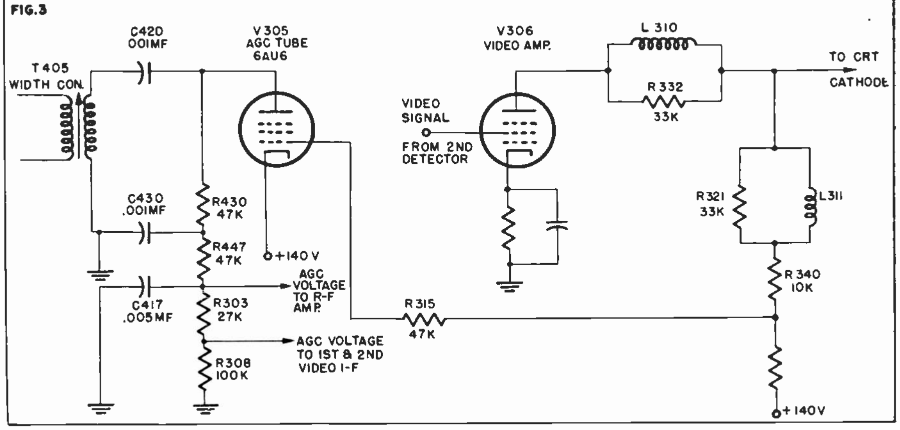


Fig. 2 Basic keyed a-g-c system is shown in **A**. **V1** conducts only when a horizontal pulse is on the grid, and when a positive pulse from the sweep circuit is on the plate. **B** shows the phase relationship between these two pulses

Fig. 3 Keyed a-g-c circuit as it appears in Admiral model **20A1, 21A1, 4J1**

successive horizontal sync pulses. This accounts for the excellent performance of receivers with keyed a-g-c circuits in very noisy areas. The small amount of noise which occurs during the sync pulse interval has little effect on the a-g-c bias.

The plate current of the a-g-c tube is a succession of 15.75 kc pulses, which occur whenever the tube conducts. During plate current conduction a d-c voltage is developed across the plate load resistor R1, in a manner similar to a half-wave rectifier. The developed a-g-c voltage is filtered by R2 and C1 and fed back to the grids of the r-f and i-f amplifiers. The time constant of the filter circuit is made only long enough to filter out the 15.75 kc pulses. It is therefore much shorter than the time constant of filter circuits in conventional a-g-c systems where the filter must remove the 60-cycle vertical sync component. The faster acting keyed a-g-c circuit permits it to compensate more qu ckly for rapid variations in the carrier signal level.

Typical of one form of the keyed a-g-c system is the circuit employed in several Admiral models, including the 20A1, 21A1, and 4J1. This circuit, as it appears the model 20A1, is shown in Fig. 3. The a-g-c tube is V305, a type 6AU6 pentode. The video signal is applied to the grid of the tube from the output circuit of the video amplifier V306. The d-c component is preserved in the video signal since the video amplifier is direct-coupled from the second video detector.

Commercial applications

A secondary winding on the horizontal width control, T405, serves as a source of the 15.75 kc pulses for the plate of the a-g-c tube. This voltage is supplied to the plate of V305 through capacitor C430, so that no d-c current can flow back through the secondary of T405. The application of the 15.75 kc pulsed plate voltage to the plate of V305 causes the tube to conduct only during the horizontal sync period. Rectified voltage

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Service Technique

Looking for the faulty section?

Let the PICTURE tell you

by Cyrus Glickstein
American Radio Institute

The picture information appearing on the screen gives you your best lead to the section in which to look for trouble

THE first step in TV trouble-shooting is to locate the defective section. An essential part of that first step is picture analysis. By that we mean the study of the information on the screen. This information, plus reference to the block diagram of the receiver, a check on the pertinent controls, and the sound coming through, make it fairly easy for the technician to decide in which section, or sections, to begin looking for a defect. Correct picture analysis will cut down considerably on servicing time.

It is not the aim of this article to present a large number of test patterns, and describe the faults they indicate. This has been amply done in many textbooks and service manuals. Our purpose here is rather to dissect the picture and to indicate how and why its various portions show in which sections to look for faults. Later we shall discuss how they even indicate defective stages and components.

The cathode ray tube

Suppose we begin the dissection with a closer look at the picture tube. In many respects it can be compared to an ordinary voltage amplifier tube:

1. A signal on the grid varies the current (beam of electrons) through the tube.

2. Current goes from cathode to plate (accelerating anode) when correct potentials are applied—although in the picture tube it hits the screen before reaching the anode.

3. As in any tube circuit, no current flows through the tube (and therefore the screen is blank) when—

a) there is no plate voltage (loss of high voltage).

b) there is an open filament.

c) filament voltage is not applied.

d) the tube is biased to cut-off. (The intensity control varies the bias on a cathode ray tube, and usually cuts off current when all the way down.)

4. The one feature which is unique to some picture tubes is the ion trap. It must be properly placed on the neck of the tube in order for the screen not to be blank or for the raster to be darkened around the edges.

Let's break down the information on the screen to determine which circuits are responsible for various characteristics. If the set is tuned in on an unused channel, a raster appears on the screen, a white rectangle of light without picture information. Here is what is happening:

The cathode of the tube is emitting a fine stream of electrons. The focus coil concentrates the beam to a sharp spot. The high voltage on the accelerating anode (aquadag coating) speeds up the beam and causes it to hit the screen with great force, which in turn makes the screen fluoresce. The horizontal deflection coil moves the spot rapidly from side to side, giving the appearance of a horizontal line. The vertical deflection coil pulls the beam down slowly, so that instead of one horizontal line, we have—through interlaced scanning—525 horizontal lines.

Producing the picture

The result of all this activity gives us a raster. The raster is turned into a picture by—

1. feeding picture information (video signals received from the transmitter) to the grid of the picture tube. These signals modulate the beam or vary the current flow through the tube, thereby changing the white lines of the raster into lines which vary in tone from black to white. This is another way of saying that we get a picture; for a picture is nothing more than a collection of light and dark areas in the proper places to convey the desired informations.

2. feeding sync pulses (also received from the transmitter) to the deflection circuits to trigger the sweeps, so that the beam will be at the right place at the time the video information arrives. Otherwise, a jumbled picture will result.

This raster, then, is produced in the receiver and requires no external signal to be seen. The raster becomes a picture when a signal, consisting of video information and sync pulses, is received from the transmitter.

Mechanical difficulties

The characteristics of the image on the screen, and the circuits responsible for producing those characteristics, are outlined in Table I, columns 1 and 2. If one or more of these characteristics is missing from the screen, we can look for trouble in the section responsible for producing it.

Before analyzing various types of troubles appearing on the screen, let's eliminate some mechanical difficulties:

If the picture is good, but simply tilted to one side: in an electrostatic tube, the tube must be turned. In a magnetic tube, the deflection yoke is rotated to straighten out the picture.

If the picture is off center, centering controls are adjusted. In some magnetic sets, centering controls have been omitted. In these receivers, the mounting nuts on the focus coil assembly are adjustable for proper centering in either direction.

To start with a simple problem,

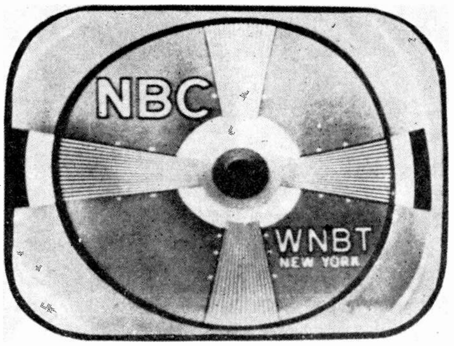

Fig. 1 Horizontal non-linearity, as indicated by non-circular circles

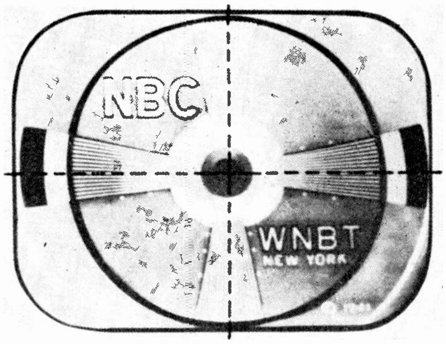

Fig. 2 Pattern should be mentally divided into quadrants to make linearity check

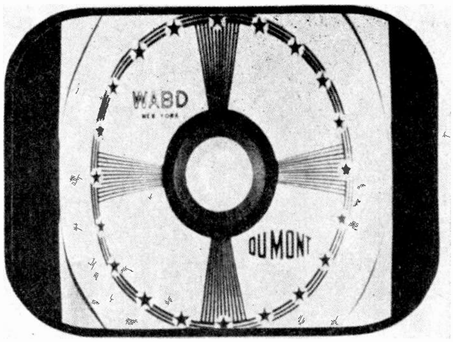

Fig. 3 Elliptical pattern—shows incorrect size rather than non-linearity

suppose only a horizontal line is seen on the screen. The first step is to adjust the vertical size and linearity controls. If this has no effect, the beam is obviously not being moved up and down, even though it is being moved from side to side; and we can immediately conclude that the trouble is in the Vertical Sweep section. Further checks are then made there.

The newcomer to television maintenance sometimes asks the question, "What do you do when there's nothing on the screen to show where to start looking for trouble?" Actually, a blank screen is a clear-cut indication of where to start looking for trouble. Suppose we get sound and a blank screen. Such a fault may be due to any one of several factors, as shown under 3, column 2, Table I. The proper servicing technique is to eliminate each one of these factors until the correct one is found.

First, the usual check of pertinent controls is made: the intensity control is turned completely up to make sure the picture tube is not biased to cut-off. If the tube is still blank, it is checked to see if the filament is lit. This is a quick double check for both a good filament and the presence of filament voltage. Naturally, if the filament is not lit, and the rest of the set is on, a further check is made here. We assume that the screen will be in good enough condition to show some light if the rest of the set is operating normally. The screen does not lose brilliance suddenly and completely, but tends to get duller in the course of operation over an extended period.

The next check would be for high voltage. If we have high voltage and a blank screen, the trouble is in the CRT or its associated circuit. If there is no high voltage, the High Voltage system is checked and, in sets using a kick-back voltage supply, the horizontal deflection system on which the high voltage depends. The specific checks will be discussed fully in later articles. The main point here is that we should follow the principle of using the information on the screen and from the speaker to indicate the defective section or sections in the receiver. Where there are several possibilities, each one is excluded by a specific check until the trouble is found.

Horizontal or vertical?

Sometimes the new television technician has a little trouble deciding whether the fault is in the horizontal or in the vertical sweep circuit. For example, let's take a picture which is normal but has a bright line all along the left edge. Which sweep is responsible? The question is easily answered if we keep in mind that the horizontal lines are under each other. Vertical deflection is not responsible for creating any lines of its own, but simply for placing the horizontal lines under each other by pulling the beam slowly and steadily downward as the horizontal circuits shift the beam quickly from side to side: *Therefore, any fault common to all horizontal lines will be expressed from top to bottom, or in a vertical direction.*

In other words, if each horizontal line starts out too slowy, and then sweeps across the tube fast (because of non-linearity in the saw-tooth), the beginning of each horizontal line is a little brighter than the rest, and

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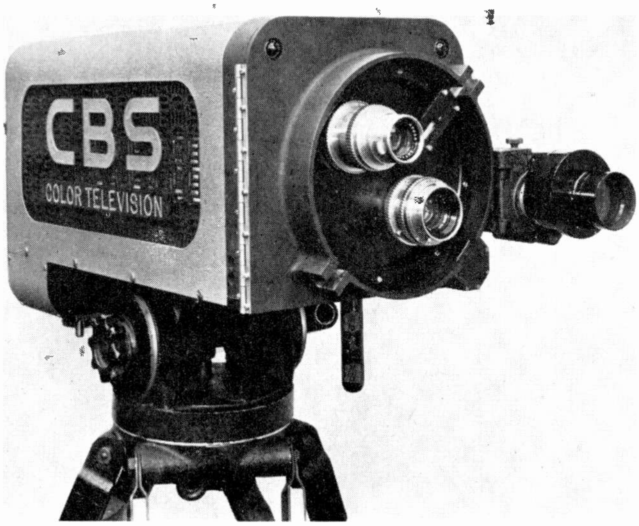
TABLE I — PICTURE ANALYSIS CHART OF TELEVISION RECEIVER [MAGNETIC, FLY-BACK, HIGH VOLTAGE SYSTEM, STANDARD A-C LOW VOLTAGE SYSTEM

Col. 1 Characteristics of picture.	Col. 2 Circuits responsible for characteristic.	Col. 3 If inoperative, effect on picture.	Col. 4 Preferred Method for Checking overall operation when screen information is inconclusive.
1. Width of picture.	Horizontal deflection circuit.	Blank screen (kick-back high voltage depends on horizontal sawtooth).	'scope at plate of horizontal osc., grid of horizontal output tube, and other checkpoints to check waveforms against service manual for correctness and amplitude.
2. Height of picture..	Vertical deflection circuit.	Horizontal line only.	Identical procedure, but applied to vertical sweep circuits.
3. Visibility (screen emits light - raster or picture).	Picture tube: a) is good (no open filament, etc.) b) has filament voltage. c) is not biased to cutoff. d) has high voltage. e) ion trap, if any correctly adjusted.	Blank screen.	Picture tube is checked for: a) Lit filament. b) Lit filament. c) Intensity control varied and volt. measured if necessary. d) High voltage is checked by spark test or voltmeter (if no high voltage, horizontal sawtooth is checked). e) Ion trap adjustments checked
4. Picture information.	Front end and video strip.	Raster, no picture.	Sweep generator at antenna terminals. 'scope at grid (or cathode of picture tube to check overall response (bandwidth and amplitude) of front end and video strip.
5. Picture is steady (not scrambled or torn out).	Sync circuits.	Picture does not hold still in either direction, horizontal or vertical	'scope at input and output of sync circuits to check correct wave-shape and amplitude of sync pulses



The Washington hearings are about over—

What will COLOR TV mean to YOU

What is behind the current discussion on color television? What systems have been presented to the FCC? What effect will color television have on you?

EVER since the middle of last year, when CBS transmitted a color video picture of a surgical operation over a closed system, the television industry has been a beehive of activity. Of course, work on color had been going on quietly for years (the first color system was demonstrated back in 1928, and in 1946 the FCC had already held hearings on the question), but the pressures which suddenly developed as the result of CBS's demonstration, stepped up activity all along the line. By the end of 1949, color systems—in various stages of development—had been announced by RCA, CBS, Color Television Inc., Sightmaster Inc., U. S. Television, Dumont, Optiko; and several other organizations.

Up to the middle of the year, color has not been the primary concern of the industry. 1949 had been the year of the Big Freeze. The FCC had suspended all new station authorizations, and manufacturers were unanimous in clamoring for the lifting of the freeze at the earliest possible date. By the time July had rolled around the FCC was finally ready with an announcement: It proposed to add 42 new u-h-f channels for TV use and set late August for the hearing of testimony of interested parties. Since CBS's color demonstrations took place almost at the same time as the u-h-f announcement was made, the Commission included the question of color on its agenda for the hearings.

Following a postponement, hearings finally got under way in September. By that time, however, the question of color had become so controversial (even Congress was taking an interest in it), that it was placed first on the agenda; and that phase of the hearings is only now nearing completion.

The pressures which became apparent at the hearings were generated by five distinct groups, some of which were for immediate adoption of color television, while others were for delay.

Manufacturers

Heading the list of witnesses were the manufacturers. They had the highest stakes in the hearings. They had poured millions of dollars into color research and development and were trying to safeguard the investment. They knew full well that only one system would be adopted, and that they would sustain a heavy loss if it would not be theirs.

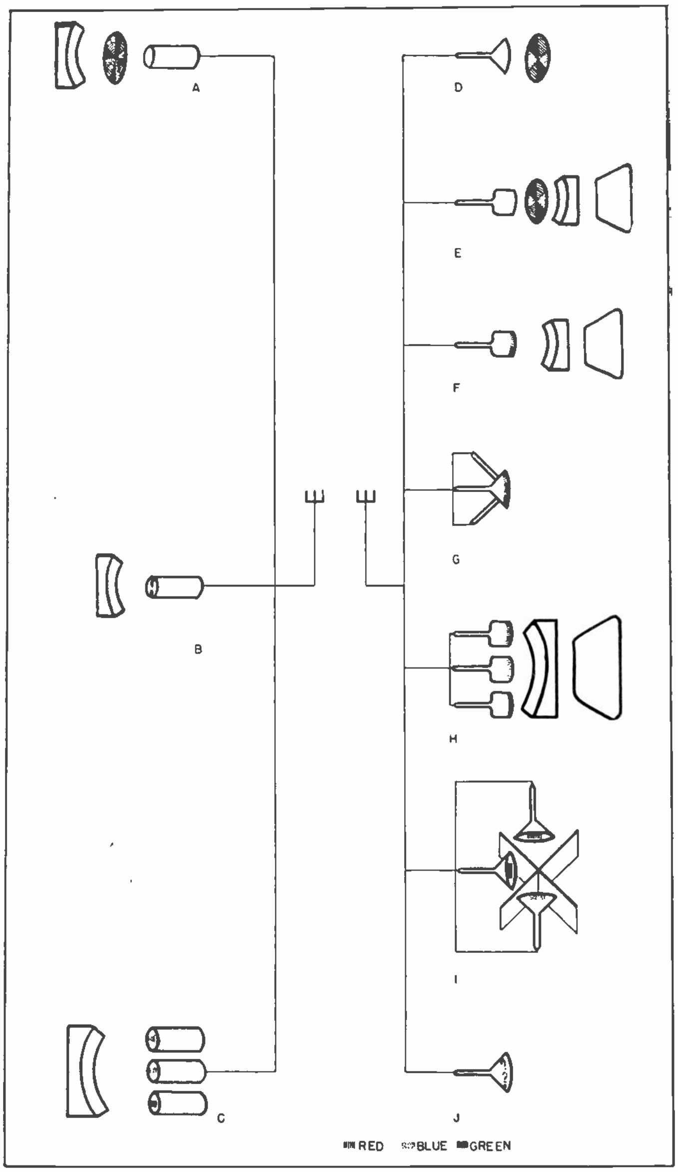
CBS called for immediate adoption of a color system. Its own system had about reached the highest state of development it would ever achieve, and any delay would only give its competitors a chance to catch up to, or overtake it.

RCA, most vehement challenger of the CBS system, on the other hand, was calling for delay. Its all-electronic system had not been fully perfected at the time the hearings were held and, although it was demonstrated, did not impress observers as favorably as CBS's. Against its imperfections, however, was the fact that RCA's system was all-electronic (CBS's was essentially mechanical), and was capable of considerable advancement. A delay in the decision would enable RCA to present an improved all-electronic system of color television.

Other witnesses, notably Dr. DuMont and Lee (Father of Radio) de Forest, also came out for postponement on the grounds that none of the systems was ready for general adoption at this time.

Another group, the broadcasters, also felt a little wary about color now. They had barely begun to make their enterprises pay, and were not inclined to make additional heavy investments in a venture whose success was by no means assured.

That of course, raised the one point which was being overlooked: what would the public do? How would it take to color? Would all those who owned black-and-white sets get adaptors, or buy new receivers? or would they stick to the sets they had? No one knew for sure; except that public clamor for color had been notably lacking, that black-and-white sets had been selling better than ever before, and that technicolor movies



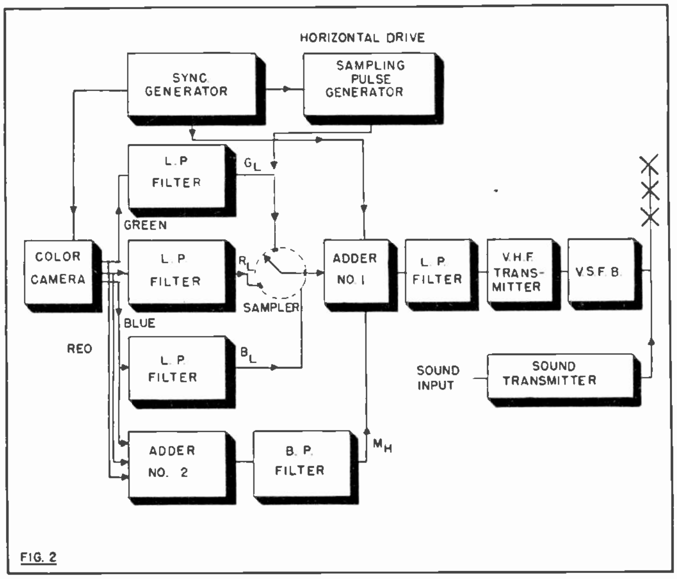


FIG. 2

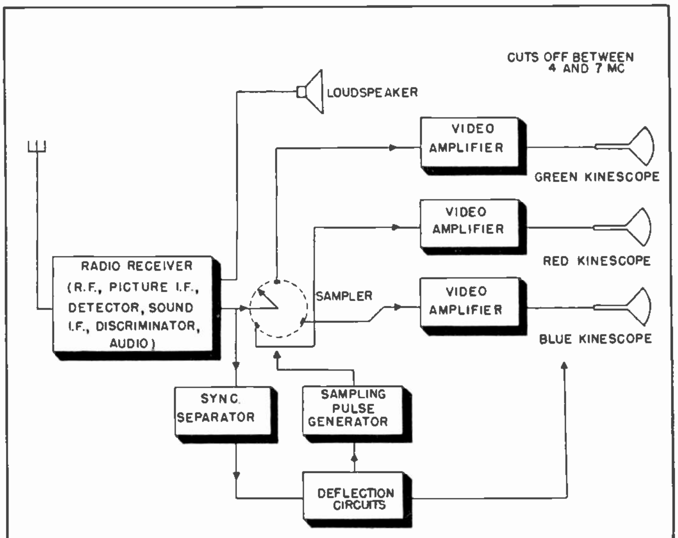


FIG. 3

Fig. 1 A—CBS single tube camera, lens, color disc; B—CTI camera; C—RCA 3-tube camera; D—CBS direct view receiver, disc; E—CBS projection set & disc; F—CBS electronic projection; G—Greer tube; H—RCA projection set, I—RCA direct-view receiver; J—Single gun-direct view: to be developed

Fig. 2 Block diagram of a color television transmitter as it would operate under the RCA system of color television

Fig. 3 Block diagram of RCA-type color receiver; no change in r-f, pix i-f, detector, sound i-f, discriminator, audio

have not even made a dent in black-and-white pictures.

This big question mark would remain even after all the decisions had been made. The FCC could not decree color TV. The public would have to buy. And that is a big IF.

While the various parties presented their views to the FCC, impartial engineers lifted a warning finger: they pointed to the past, noted that hasty decision had often caused more difficulties than they had solved; the original FM allocation had to be revised, and TV was even now experiencing the consequences of an allocation which had not looked far enough into the future.

As things stood, it did not seem likely that a decision on color television would be made in the immediate future, or that you would have to service color sets within the next few years. While a detailed analysis of present color video systems would therefore be premature, it is worthwhile to compare briefly the various proposals, before discussing the implications of color on the service industry.

The systems

Fig. 1 shows how three of the systems (those which already have been demonstrated to the FCC) operate, and how they differ.

The two outstanding features of the RCA system are (1) its all-electronic nature, and (2) its compatibility with current black-and-white TV; that is, the ability of present day telesets to receive its color signal, and reproduce it in black-and-white.

Here, briefly, is how the system works. It has been found that by combining the three primary colors red, blue, and green in television almost all other possible colors can be reproduced. This is achieved by utilizing a characteristic of the eye: persistence of vision. If you flash different colors in quick succession on a screen, the human eye, instead of seeing the different colors, will combine them into a new one.

Now in color television, the camera at the studio is equipped with three

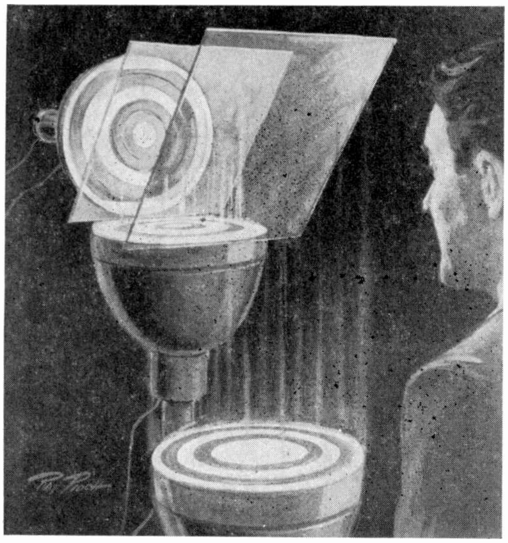


Fig. 4 RCA's direct-view picture reproducing system uses 3 tubes, mirrors which reflect only some colors, let others pass

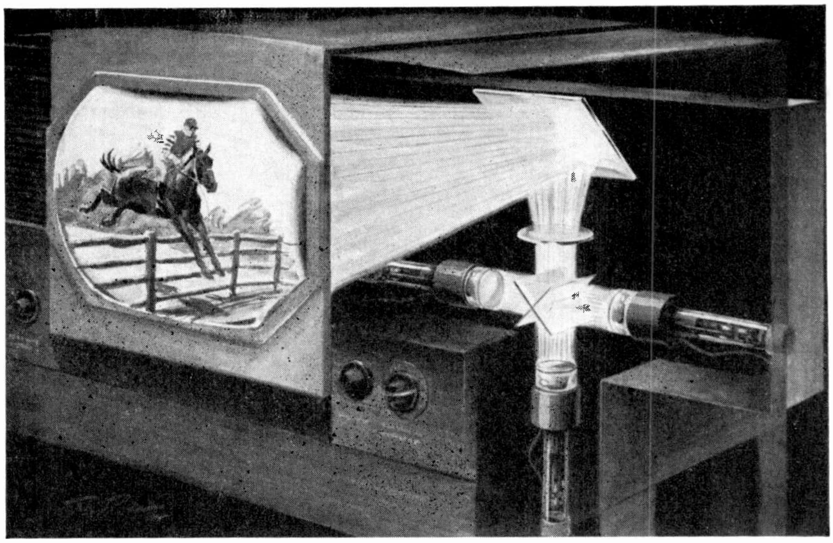


Fig. 5 RCA's color television converter, using small projection picture tubes and refractive optics. This as well as the arrangement shown in Fig. 4 are strictly experimental. They are only two examples of a number of such models

separate tubes. By using the proper filter, each of these tubes picks up one—and only one—of the three primary colors. Thus the scene is transmitted in three signals, which represent the three colors.

In transmitting the color picture, each of three colors is electronically sampled at the rate of 3,800,000 times per second per color, passed through low pass filters which eliminate signal components above 2 Mc, and combined in two "adders" into the composite color video signal. The combined signal is again passed through a low-pass filter, which cuts off at 4 Mc, and then applied to the modulator of a conventional television transmitter. A block diagram of such a transmitting system is shown in Fig. 2

At the receiving end, the process is reversed. The r-f circuits, i-f amplifiers, second detector, sound i-f's, discriminator, and audio circuits of the color receiver are identical with their counterparts in conventional sets. Added, however, is an arrangement which reverses (generally speaking) the process which took place at the studio.

A block diagram of the RCA color receiver system is shown in Fig. 3. The composite video and synchronizing signals from the second detector are fed to the sync separator which removes the video and sends the sync pulses to the deflection circuits. The signal from the second detector also enters the sampler and is there separated into the three original primary colors in synchronization with the switching rate at the transmitter. From the sampler, the pulses are passed to each of the video amplifiers and their respective picture tubes, thus producing on the face of the tube a picture for each respective color. The three separate images are then viewed simultaneously through filtering mirrors, and a color picture is seen. Fig. 4 shows how the RCA color picture is viewed.

CBS

The system which CBS presented to the FCC is essentially the same as the one it brought out back in 1946, except that it has been modified to operate within a 6 Mc channel (in 1946 it required 12 Mc.)

At the studio, the camera with a single pickup tube and image orthicon, through a set of color filters, extracts the red, blue and green components of the scene. These are transmitted in sequence, with a color switching rate of 144 per second (RCA's switching rate is 11,400,000 per second, CTI's is 15,750 per second).

At the receiver, they are reproduced, through color filters, or by the use of different color phosphor, at the same switching rate and in the same sequence; and persistence of vision combines the three primary colors so that the color of the original scene appears.

The camera used in this system consists of a single image orthicon tube with a 12-segment color disc, revolving at 720 revolutions per minute. This color disc acts to separate the scene into its primary colors, which are then transmitted in sequence. Standard broadcast transmitters without modifications are used. CBS color receivers use a single conventional picture tube and single gun, plus rotating disc (synchronized with the one at the receiver) to produce the image. A block diagram of a CBS type color receiver is shown in Fig. 6.

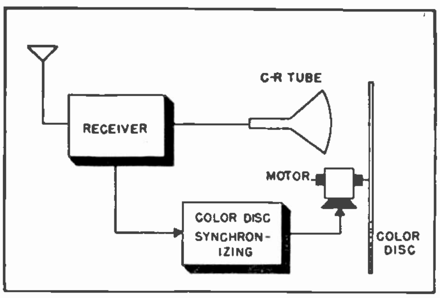


Fig. 6 Block diagram of a CBS-type color television receiver. Observe simplicity, but note also mechanical feature of system

When color comes . . .

As was pointed out earlier, the color systems presented to date have not been found altogether satisfactory. Nevertheless, we can safely assume, that color will some day be incorporated in television. What we are concerned with here is the effect which the introduction of color will have on the service industry.

First, it will mean renewed study on the part of the technician. Fortunately, the introduction of color

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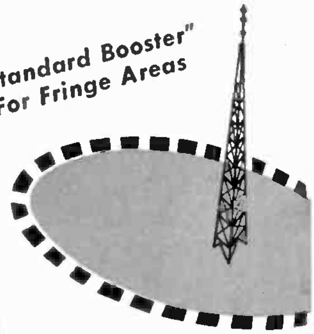
Good News FOR TV SERVICE MEN

"THE STANDARD BOOSTER" A new high gain TV preamplifier that assures your customers studio clear reception. This means plus profits for you by boosting your TV set sales in fringe areas. "The Standard Booster" features 2 knob control . . . continuous tuning, eliminates a switch from high to low channels . . . printed circuit trouble free operation.

"The Standard Booster" For Fringe Areas



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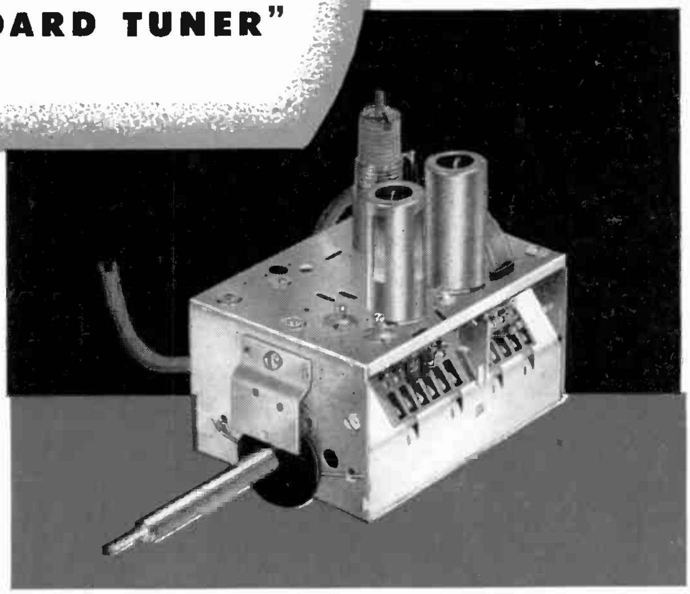
"Over 1,000,000 Standard Tuners Now In Use"

"THE STANDARD TUNER" is nationally recognized as the accepted replacement tuner by the trade. Incorporated as original equipment in over a *million* TV sets produced by the majority of the outstanding manufacturers. This is the tuner for you. It gives higher sensitivity . . . quick interchanging of channel inductors . . . adaptable to U.H.F. See your jobber for details.



Standard COIL PRODUCTS CO., INC.

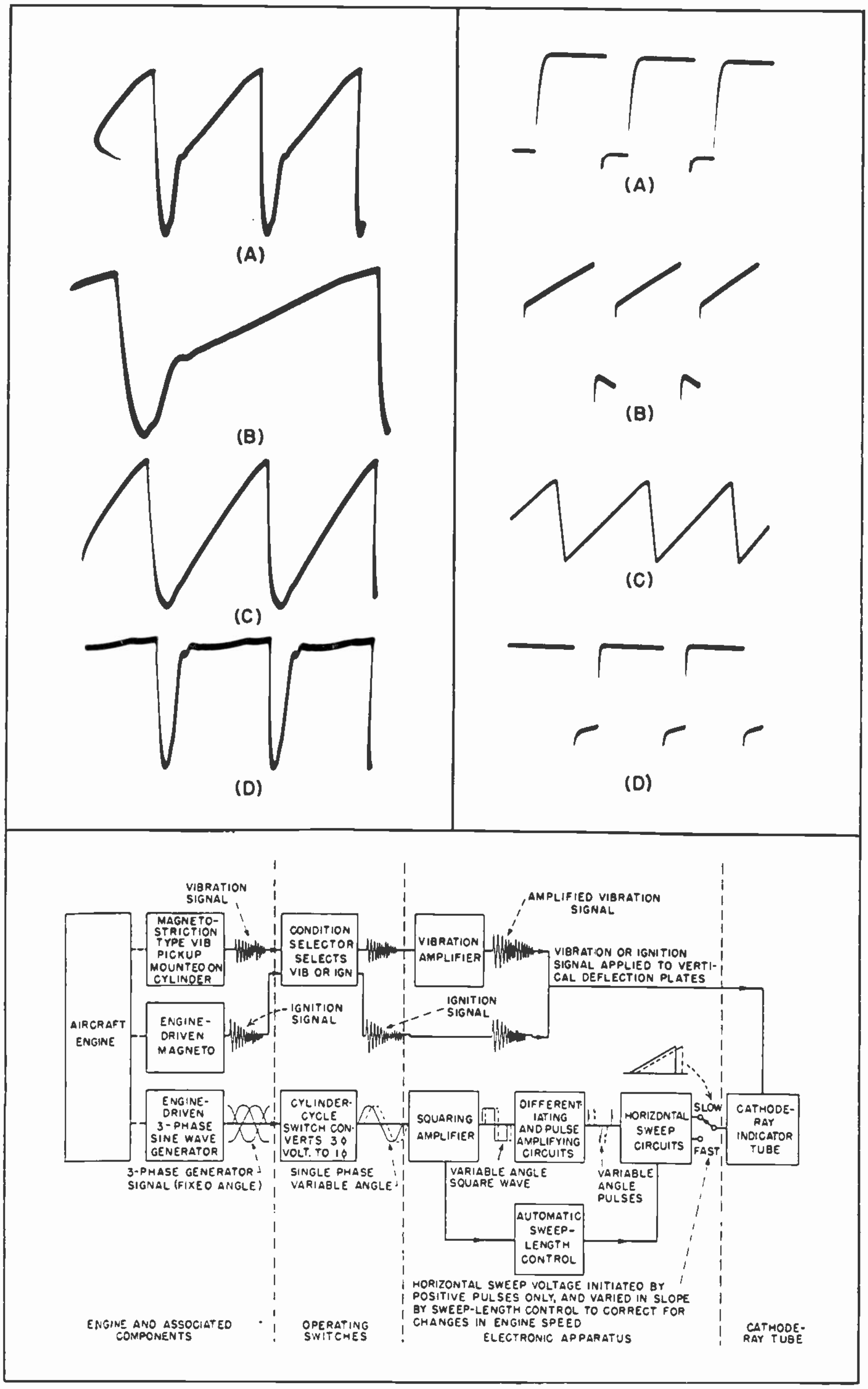
CHICAGO • LOS ANGELES • BANGOR, MICHIGAN

Build your profits and expand your TV service business now with these two great "Standard" products. Write today for complete profit information, specifications and performance data.

A major event in electronic literature:

The FINAL WORD on OSCILLOSCOPES

Rider is coming out with the most important book on oscilloscopes published in years. When it is released, it will make big news in the industry. Here is a preview of some typical material appearing in it.



courtesy Sperry

Upper left: typical blocking oscillator waveforms in TV deflection system. A&D for electromagnetic, C for Electrostatic deflection. B is one cycle of A spread out. **Upper right:** typical multivibrator waveforms. B is shape of output voltage for electromagnetic, C for electrostatic deflection (from chapter on Linear Time Bases). **Bottom:** Sperry aircraft engine electronic analyzer, described in detail in chapter on Scientific Applications.

WHEN we read recently in a Rider advertisement that a new edition of the well-known *Cathode-Ray Tube at Work* was in preparation and "that there never has been a book like this one," we thought it might be a good idea to take a look at the work that had been done on it, and to report our impressions to you. We therefore went up to see John F. Rider, president of the publishing firm bearing his name, to see whether there really had never been a book like this before. We have now returned from our visit, and we can report that the statement made in the ad was no exaggeration. When the book is published (probably in March), it will constitute one of the most important contributions which have been made to the industry.

It had been our intention to report on the book in the Trade Literature Department. However, after seeing the material which is going into the book, the vast area it will cover, and the thoroughness with which it is being prepared, we feel that it deserves more complete description.

The new *Cathode-Ray Tube at Work* will be an 8½ x 11 book of 900 pages, the equivalent of 1,600 pages in a conventional-size volume, completely covering the subject of oscilloscopes, their underlying theory and practical applications.

Coverage

Every month, John F. Rider, Inc.

receives over 250 publications from all over the world, dealing with the various phases of electronics. These, plus scientific books, constituted the research material that was consulted in preparing the new edition. Besides this world-wide, up-to-date library the firm also maintains its own laboratory. This was also put to work for the book.

When we went to see Mr. Rider, the chapter on Complex Waveform Patterns was just being completed. In the lab, an oscilloscope was connected to signal generators in such a way that various harmonics could be added and subtracted, and phase completely shifted. For example, what is the appearance of the trace of a complex wave with 100% fundamental and 5% second harmonic, with 10% second and 50% fourth harmonic without phase shift, with 15° phase shift, with 45° phase shift, with fourth, fifth, sixth, seventh harmonics and 30° phase shift, etc. All these conditions were easily produced, bringing about corresponding changes in scope patterns. All in all, about 1,600 different combinations of phase shifts and harmonics were produced and photographed, and will appear in this chapter alone. This mass of data has never been compiled before; and with it the technician should be able to determine the harmonic content as well as the phase relationships of almost any complex waveform he might encounter. All he has to do is compare the scope pattern with the corresponding photograph in the book, and he will have the answer.

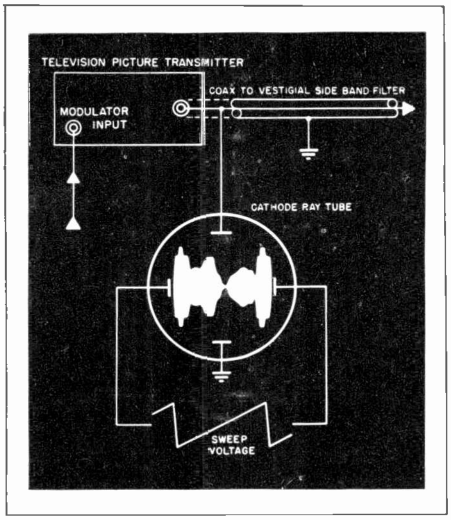
Fields

As a by-product of this laboratory work, a new oscilloscope process was discovered, which is now being patented: putting a tail on the spot. One of the problems which troubled the staff was to determine the direction in which the spot was traveling. Although this is important for many applications, conventional 'scopes do not show this direction of travel. What they did was to put a tail on the spot (looks like a little comet), and were thus able to tell the direction in which it moved. Since the process is just being patented, they would not divulge any information on it.

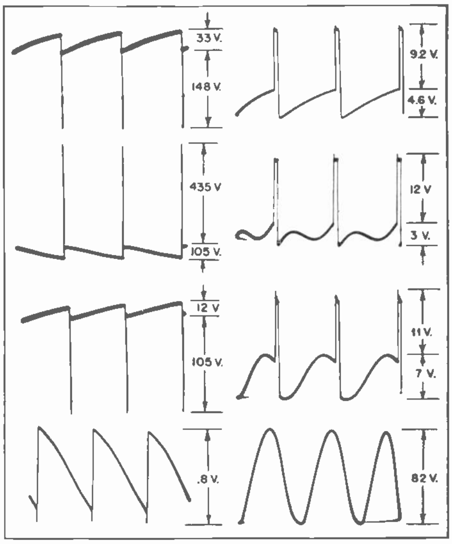
Although there are some chapters devoted to industrial, scientific, engineering, and educational applications of the oscilloscope (including such

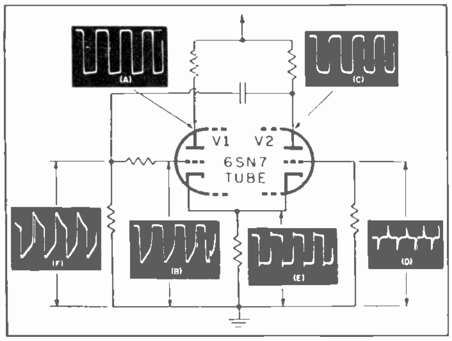
→ to page 30

Transmitter monitor for telecasts. Its functions are described in chapter on a-m, f-m and TV transmitter testing

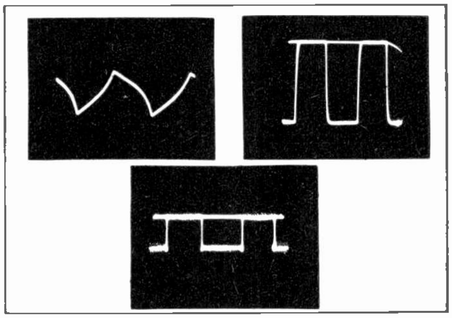


Pulse waveforms encountered in TV service. Chapter on TV Receiver Servicing describes how they are measured and checked

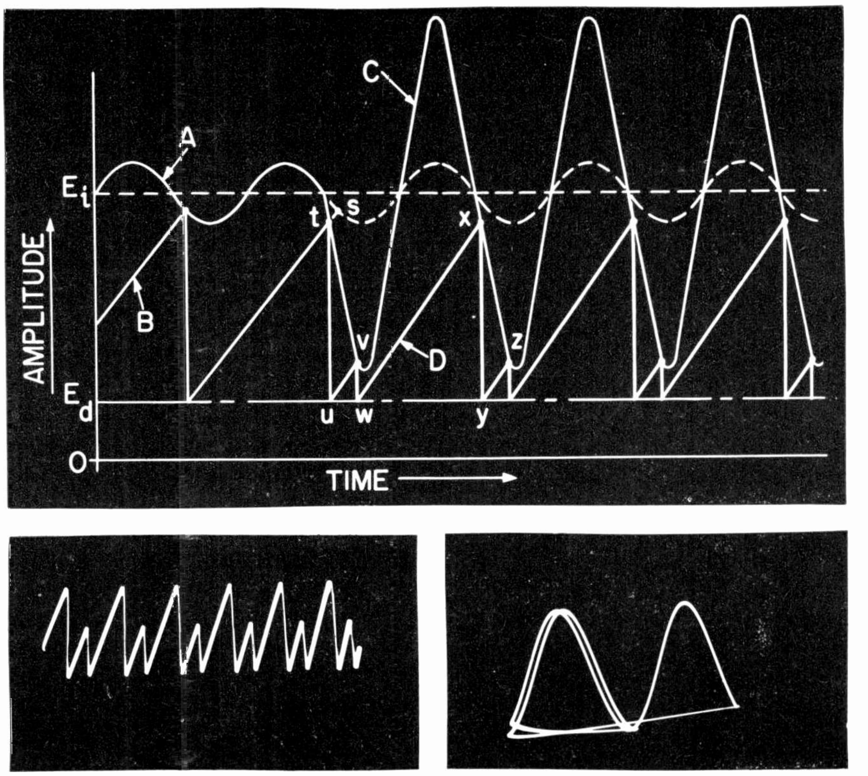




Photographs of plate, grid, and cathode waveform in typical cathode-coupled symmetrical multivibrator. This is taken from chapter on Linear Time Bases

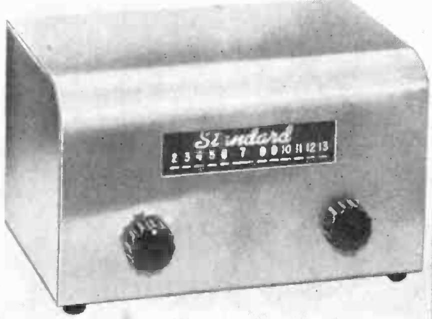


Square and modified square wave patterns appear in chapters on Audio Frequency Circuits and TV Receiver servicing. Book covers square wave testing in detail



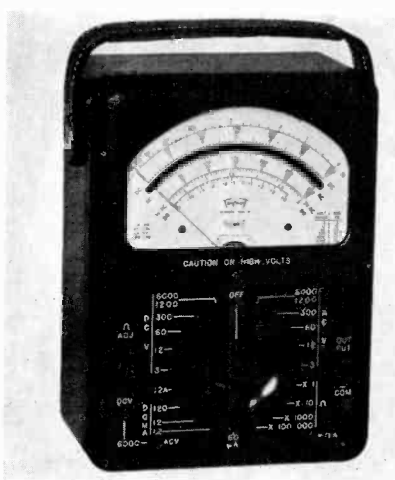
Top: Ionization potential *(A)* & relaxation oscillations *(B)* with normal sync. Ionization potential *(C)* & sawtooth signal *(D)* due to oversync. *Bottom* oscillogram of oversync sawtooth sweep *(left)*, resultant sine wave distortion *(right)*

the INDUSTRY *Presents*



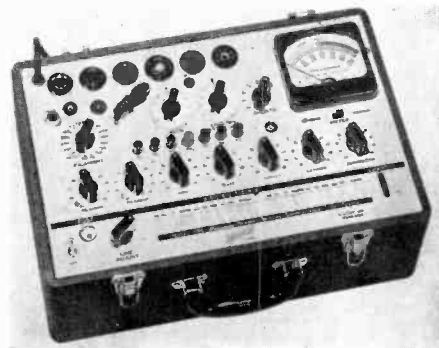
TV BOOSTER

This new booster, designated "The Standard Booster" has these features: high gain—boosts signal 10 times on high channels, more on low channels; good signal-to-noise ratio, simplified 2-knob control, fully shielded; adaptable either to a 300 or 75-ohm transmission line; printed circuit, single stage—one tube. Available through local jobbers or by writing **Standard Coil Products Co., Inc., at 2329 N. Pulaski Rd., Chicago 39, Ill., or 2901 E. Slausson Ave., Huntington Park, Calif.**



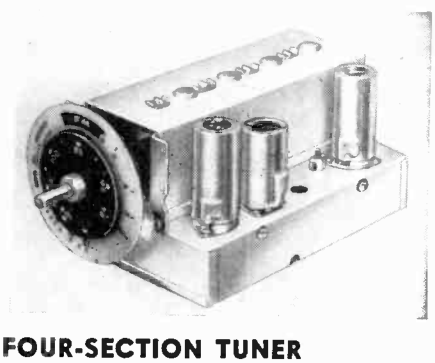
VOLT-OHM-MILLIAMMETER

Tripplet has come out with a new instrument, the volt-ohm-milliammeter Model 630-A. High accuracy is obtained in the instrument by the use of ½-w. resistors, each mounted in its own compartment. Ranges: DVC — 0-6000 (six ranges at 20,000 ohms/v); ACV — same ranges at 5000 ohms/v; 5 d-c current ranges; also decibel and output ranges; resistance ranges from 0-100 Megs. Instrument features unit construction. **Triplett Electrical Instrument Co., Bluffton, Ohio.**



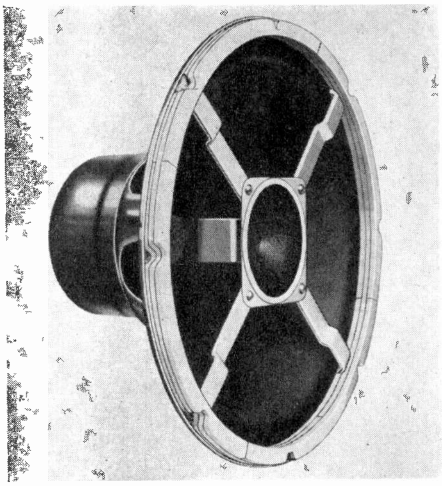
NEW TUBE TESTER

Hickok has now made available to the service industry its model 600 tube tester, built with dynamic mutual conductance circuits for high accuracy. Scale readings are directly in micromohs on the following ranges: 0/3000/6000/15,000 micromohs. Tests all tubes. For complete information and specifications, write to **H. D. Johnson, The Hickok Electrical Instrument Co., 10634 Dupont Ave., Cleveland 8, Ohio.**



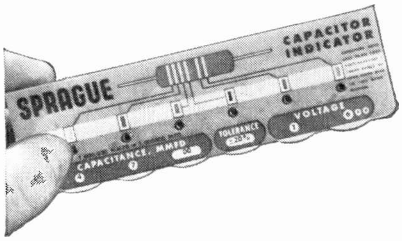
FOUR-SECTION TUNER

DuMont is offering a new four-section Inputuner, incorporating the latest Mallory-Ware spiral type Inductuner. The gain of the new tuner is double that of previous Inputuners made by DuMont, and has higher selectivity. The tuning range is continuous from 54 to 216 Mc (which covers the 12-channel TV and the entire f-m band. It operates efficiently on either 300 or 72-ohm antenna systems because of an input transformer incorporated in the tuner. Good band pass characteristics are present. **Allen B. DuMont Labs., 35 Market Street, East Paterson, N. J.**



NEW SPEAKERS

A number of new speakers have been announced by Utah. First is a group of two co-axials with low resonance woofer and specially engineered tweeter. These speakers have wide range, uniform response, high sensitivity. They come in two sizes: 15" woofer—5" tweeter (model CSP15P-5), and 12" woofer with 3" tweeter (model CSP12J-3). Utah also has added the following to its line: 5 models of TV replacement speakers, a 6" weatherproof outdoor speaker, and a 2" inter-com speaker with a 45-ohm voice coil. Specs are given in catalog No. 201. You can get it free by writing to **Utah, Inc., Huntington, Ind.**



CODE CALCULATOR

You'll want to get this capacitor indicator from Sprague. It's a pocket size plastic device with rotating dials printed in full, accurate colors. When flicked to the proper color bands, the dials instantly indicate capacitance, tolerance, and rated working voltage. Extremely handy. Obtainable for 15 cents from **Sprague Products Co., 91 Marshall St., North Adams, Mass.**

PHONO NEEDLES

A feature of the new series of "muted stylus" needles, brought out by Shure, is a handy cardboard tool for inserting the needle. Needle is placed in cartridge, thumb screw tightened, and card pulled away, leaving needle in place for use. Each card contains extra nut (just in case knurled thumb screw nut is lost). **Shure Brothers, Inc., Chicago, Ill.**

Let the Picture Tell You

→ from page 13

the result is a bright vertical line at the left edge of the screen. Various horizontal controls are adjusted, and if they don't correct the fault, a 'scope can be used to check the waveforms in the horizontal sweep circuits.

For similar reasons, troubles in the vertical sweep are generally evident in a horizontal direction. Suppose there is a fairly broad, bright horizontal area across the bottom of the screen, while the rest of the picture looks normal. The fault is not common to all horizontal lines, but only to several at the bottom. It is therefore not likely that this is a fault of the horizontal deflection system, and we therefore suspect the vertical. The vertical saw-tooth slowed down toward the bottom (non-linearity), and as a result the horizontal lines there are closer together and appear brighter. Again, the vertical controls are adjusted and if the trouble is not cleared, a further check is made in the vertical sweep circuit.

Problem of linearity

Sometimes, when a large part of the picture is non-linear, there may be some confusion as to where the non-linearity originates. Let us assume the circles in the pattern are stretched to the left (Fig. 1). A simple way to determine whether the horizontal or the vertical sweep is non-linear, is to divide the pattern mentally into quadrants, as shown in Fig. 2. First fold the picture mentally along the horizontal line. If the top half of the circle coincides with the bottom half (that is, is a mirror image), then the vertical linearity is adjusted properly. Next, fold the picture mentally along the vertical line. If the two halves coincide, horizontal linearity is OK. If they do not (as in Fig. 1), then the non-linearity is in the horizontal direction.

On the other hand, suppose we have an ellipse, as in Fig. 3. According to our rule, (since all halves are mirror images) we do not have non-linearity. The trouble with this picture is that we simply do not have the correct aspect ratio. To remedy this condition, either the vertical size must be increased, or the horizontal size decreased, whichever will fill the mask.

Picture analysis is not always simple. There are a large number of troubles which are caused by defects in more than one section. For example: the picture has poor definition (is fuzzy). This may be due to (1) focus, contrast, and/or intensity not properly adjusted, (2) poor high frequency response because of failure in the r-f, video i-f, or video amplifier circuits, (3) mismatch of antenna and lead-in. Here is another example: the picture is jittery vertically. This may be caused by (1) contrast control being too high or too low, (2) hold control not set correctly ,(3) defective sync or integrating circuits, (4) hum pickup or other defect in vertical sweep, and (5) noise received from antenna.

General rules

Instead of discussing a large number of such cases individually, it will be more helpful to point out some basic rules that will cover most situations of this kind. In those cases where the technician is not sure which section is faulty, there are generally three possibilities:

1) A spurious signal or noise is coming into the section from outside the set, or from another section, causing defective operation.

2) The defect has developed in the section because of a component becoming faulty.

3) A section has become defective because of a fault in the power supply feeding it.

Therefore, if there is a question as to the origin of a defect, first, of course, controls are manipulated. Second, the effect is observed on more than one channel. If trouble still persists, there are key check points for each section to determine whether the correct signal is going in and going out (see Table I, column 4). B+ can always be checked with a 'scope to determine excessive ripple —even high voltage B+, if a suitable voltage divider is arranged, and the 'scope leads attached to a low point of the divider.

The service technician does not have to memorize a large number of possible symptoms and causes of incorrect operation if he remembers that with the proper test instruments, he can check each suspected section for correct operation, and so determine the faulty one.

Keyed A-G-C

→ from page 11

is developed across R430, R303, and R308, and varies with the level of the sync pulses applied to the grid of V305. R447, R430, and C417 filter out the pulse ripple. A d-c bias voltage is developed across R308 and R303, and depends on the transmitted sync pulse level. This a-g-c bias is applied to the controlled r-f and i-f stages through appropriate decoupling networks.

A variation of the above keyed a-g-c circuit is incorporated in the Motorola TS-16 and TS-30 chassis. The a-g-c circuit is shown in simplified form in Fig. 4. It has two signal inputs. One signal is a constant amplitude positive sync pulse from the sync separator tube which is applied to both grids of a 12AU7 double triode, V11. This acts as a keying pulse, allowing these triodes to conduct only during the sync pulse time. The other signal is the composite video signal with negative sync pulses applied to the plate of V11B and the cathode of V11A. It is the amplitude of the sync pulse of this composite signal which determines the d-c bias developed in the circuit. The action of the circuit is as follows:

The positive keying pulse is applied to the grid V11A through C70 and differentiator C67 and R43. The amplitude of this pulse is about 7 volts peak under normal conditions. At the same time, under certain conditions, the composite signal with negative sync pulses applied to the cathode of V11A might have a peak-to-peak amplitude of about 9 volts. The grid-cathode bias developed would be about 8 volts so that this tube is cut off. When the sync pulse appears, the grid is driven positive by this sync or keying pulse and the cathode negative by the sync pulse developed in the composite signal. The resultant current flow charges C63 to a slightly negative potential. This is the a-g-c voltage which is applied directly to the plate of V11A and the cathode of V11B with every sync pulse, while C63 continues to charge negatively. As the plate of V11A is driven more negative, it begins to conduct less current. Simultaneously, the cathode of V11B is going more negative, bringing it closer to conduction, despite the negative composite signal applied to its plate. Eventually, this negative-going a-g-c voltage allows V11B to start conducting plate current, which tends to discharge C63 in opposition to the charging current from V11A. For a given signal strength, a stable condition is reached when the current in V11A, trying to charge C63 negatively, equals the current in V11B which is trying to discharge C63 back to ground potential. The a-g-c voltage thus obtained is about 4 or 5 volts on the average signal.

Should the signal strength suddenly increase, the keying pulse will remain constant in amplitude, but the video signal will increase in amplitude. This means that the cathode of V11A is driven more negative, resulting in increased plate current, and the plate of V11B is also driven more negative, resulting in less plate current. The end result is that C63 will be charged more negatively by the difference between these two currents, and a new balanced condition will exist with a more negative a-g-c voltage as the result. This greater negative bias corrects for the original increase in signal strength.

Should the signal strength decrease, the composite signal will have less amplitude, and both the cathode of V11A and the plate of V11B will be driven less negative. Now V11B will conduct more current than V11A, and C63 will discharge until a new equilibrium a-g-c voltage is reached.

The a-g-c voltage is applied to the grid of the r-f amplifier V1, to the grid of two of the video i-f stages, V3 and V5, and to the grid of the first video amplifier V8. To keep the r-f amplifier unbiased in weak signal areas, a delay is incorporated in the circuits. Resistor R42 is

→ to following page

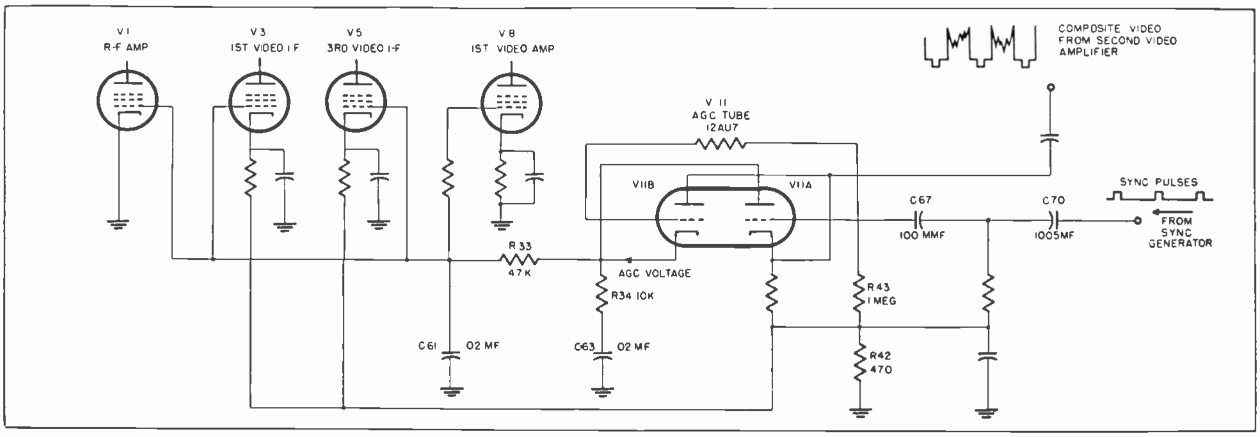


Fig. 4 Variation of keyed a-g-c in Motorola TS-16 and TS-30 chassis. Keying pulse is positive sync pulse from sync separator

Keyed A-G-C

→ from preceding page

placed in series with the cathode circuit of two video i-f stages, and the voltage drop across R42, due to the cathode current, raises the entire a-g-c circuit above ground by about 4 volts positive. Since the cathode of the r-f amplifier V1 is grounded, no negative bias will be applied to this tube under weak signal conditions, and the tube will operate at maximum gain. However, the grid of this tube will be biased negatively if the a-g-c circuit develops more than 4 volts negative bias to overcome the 4 volts positive bias, and strong signals will not be able to block the r-f stage. This delayed a-g-c voltage is also applied to the grid of the first video-amplifier, V8, in order to insure that the sync pulses of a suddenly applied strong signal will not be cut off in this tube. Were this to happen, no keying voltage would be obtained, and the a-g-c circuit would be inoperative.

The keyed a-g-c circuits just described should make possible the operation of receivers in poor signal areas where television reception might not otherwise be possible. In good or bad signal areas such circuits should eliminate or reduce fluttering, fading, tearing and overloading of the picture. In many cases, keyed a-g-c may make it possible to set the contrast control on one station and not have to touch it when tuning to another station, thus making it easier for the owner to operate his set. ✓ ✓ ✓

Color & You

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is still some time away, and there will be ample time for preparation. However, it might be a good idea to look into the matter of color in general in order to get a little headstart.

Secondly, new test equipment will be needed to service color sets, if and when they come. That means new investment. The technician who looks into the future will begin planning now to purchase additional equipment, so as to be ready when the time arrives.

Against these investments in time and money, we have to place the advantages which technicians will derive from the introduction of color TV. There is, of course, first the sale of color receivers and of adaptors. Closely tied to this is the additional income derived from the installation of such adaptors. Finally, the technician can expect an increasing number of service calls. Color television receivers will be considerably more complex than present day sets. In the all-electronic system, a large number of new circuits must be added, and the mechanical system requires both electrical and mechanical modifications. Under either condition, the possibilities of breakdown, and consequently the need for service, will be greatly increased.

Finally, color will add to the stature of the technician. Ever since he has been able to take TV in stride, his status in the community has been on the upgrade. Once he has mastered the problems of color TV, respect for him will increase further still. This is a somewhat intangible benefit. But in the long run, it will pay off in cold cash. ✓ ✓ ✓

Bench Wiring Plan

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From the master switch the cable is run to a junction box mounted on the back panel of the bench. It is located just below the level of the giant meter, and should have a minimum of 5 punch-out holes.

Outlets

From the junction box, five sections of cable go to four plug-in strips and one double female plug assembly, as follows:

Left-hand test equipment plug-in strip, mounted on the back of upper back panel, opposite left-hand test panel, facing in, and accessible from below the left-hand test equipment panel. This strip should have three outlets and one terminal section. Its function is to serve equipments in the left test equipment rack.

Right test equipment plug-in strip, mounted on the back of upper back panel, opposite right-hand test panel, facing in, and accessible from below the right-hand test equipment panel.

→ to following page

Bench Wiring Plan

→ from preceding page

This strip should also have three outlets and one terminal section. Its function is to serve equipments in the right-hand test equipment rack.

Left-hand cabinet plug in strip, two outlets and terminal section, mounted on the right-hand side of the left cabinet, as shown. Be sure that the strip is placed below the level of the drawer so that the cable can be brought through the inside of the cabinet without interfering with the movement of the drawer. Drill necessary holes to run the cable into and out of the cabinet. This strip serves as outlet for TV receivers, soldering iron, and miscellaneous equipments.

Right-hand cabinet plug in strip, two outlets and terminal section, mounted on left-hand side of right cabinet, as shown. Again the strip should be started below drawer level. Cable is run into and out of cabinets through appropriate holes. This strip provides outlets for telesets, iron, and miscellaneous equipments.

The National Electric Products Co. produces plug-in strips with 15 amp. receptacles, spaced either 6 or 12 inches apart, and wired with #12 rubber covered wire.

The double female plug and associated gembox is mounted on the left hand side of the back panel, below the left-hand instrument panel, as shown. Cut the back panel to accommodate this outlet. It serves miscellaneous test instruments.

The fluorescent fixture is not connected to the bench cable, but is plugged directly into a standard outlet of the main power line. It will thus stay lit, even though your circuit breaker opens or your fuses blow, allowing you to see what you are doing. Be sure you use filter and shielding with your fluorescent fixture.

If possible, all bench cables should be mounted either in back of the bench, or inside the cabinets. This, plus the use of plug-in strips will enhance the appearance of the bench.

6-volt Supply

The 6-volt power supply is mounted in the right hand test equipment rack, and plugged into the right test equipment plug-in strip. Other possible locations would be underneath the bench, plugged into one of the cabinet plug-in strips with output leads run to binding posts on the working surface of the bench; or the power supply can be simply placed on the working surface.

The giant meter is battery operated, and no a-c power is necessary. Instructions for wiring it up will come with any kit you may acquire.

Antenna Terminals

Three antenna terminals should be provided on the bench: one for a 72-ohm coaxial line, one for a 300-ohm twin lead, and one for an all-wave doublet. These terminals should be mounted as shown in the illustration.

For the 72-ohm line, use a coaxial connector, female. Then cut yourself a sufficient length of co-ax and attach male coax- connectors to each end, to connect the receiver to the antenna terminal.

For the twin-lead, you can use two binding posts or two snap-in connectors called Selectar. Using the latter, connect the twin-lead to two female snap-in connectors mounted on the bench and snap a piece of twin-lead into it by means of two male Selectars.

The antenna connector for the all-wave doublet can be provided by a double binding post.

This completes the wiring of the bench. It is basically a suggested plan. We have indicated some alternative arrangements; you will probably think of several others. We would certainly be interested in any ideas you may have. Let us know about them so that we can pass them on to our other readers. ✓ ✓ ✓

LIST OF PARTS

Cable, non-metallic, sheathed, No. 14	22 ft
Cable fasteners	18
Screws, flathead, wood, 3/8"	36
Hubbell plug, male	1
Circuit breaker, automatic, 15 amps. *	1
Switch, lever, 15 amps. 110 V. with pilot light	1
Gem boxes	2
Junction box, 5 punch-out holes	1
Plug-in strip (10 outlets)	60 in
Plug-in strip terminal sections	4
Outlet, double with face plate	1
Connector, co-axial	1
Connector, Selectar, male **	2
Connector, Selectar, female ***	2
Binding post, dual	1

* or fusebox with door and safety switch, 2 15 amp fuses.

** or dual binding post.

*** not required if dual binding posts are used.

Final Word on Oscilloscopes

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fields as antenna design, motor testing, electron-optics, vapor measurement, etc.), the greater part of the book is of immediate interest to the technician. It gives him the most complete information on the use of the oscilloscope in radio and television maintenance which is available at this writing. The early chapters deal with fundamentals, starting at the most basic level. We read a few of the early pages (and you can see a good sample in the "How It Works" book which accompanied Rider TV Manual III) and found them indicative of a good piece of work.

From these basic chapters the reader is taken, step by step, to the more complicated circuitry of oscilloscopes, and a complete analysis of all oscilloscopes made over the last decade and more in the United States, and some of those made overseas.

The book is definitive. That is, it will say all there is to be said about oscilloscopes, how they work, how they differ from each other, and how they are being used. It discusses the various applications which are made possible with increased frequency response of the amplifier, and lets the technician decide on the instrument which will be best suited for his particular needs.

In the words of John F. Rider, "if the service technician doesn't know how to use a 'scope, we'll teach him; if he has a 'scope, we'll teach him to get his money's worth out of it."

The chapters on servicing and alignment (a-m, f-m, p-a, t-v) are the most complete that we have seen, and will contribute greatly to the efficiency of the technician.

When we left Mr. Rider's office, there was only one word which could describe the impression we had gained of the book. It was staggering. Collected into 900 pages was all the information on both the theoretical and practical aspects of an art which is becoming increasingly important. The book has drawn on the knowledge of hundreds of scientists, engineers and technicians from all over the world and, without lifting their work, has made available in one volume the results of all their findings. Seldom has such a comprehensive task been undertaken by a publishing house. The date of its publication will be an important event in the radio industry. ✓✓✓

THE MARKET PLACE