RADIO HI-FI TV
Techni-talk
COMPLETE ELECTRONIC SERVICING INFORMATION
Vol. 19, No. 1 Spring, 1967

# COLOR TELEVISION - COLORIMETRY - I

Has the advent of color television been a surprise to the industry? Certainly not. As color photography followed black-and-white photography in the natural course of events, so color television follows monochrome television, again as a natural course of events. One simply has to look at his surroundings to appreciate the importance of color. In observing surrounding objects, stop at some item and describe it mentally. In doing this, the chances are good that one of the first points of description will be color.

Convinced of the desirability of adding color to television reproduction, the next problem is how to reproduce the ranges of colors which must be represented. How many colors are there? There is a phenomenon which has been seen by everyone time and time again that will answer this question most completely—a rainbow. Here is found the complete gamut of colors that can be seen by the human eye. How this phenomenon is created and how the colors can be reproduced is explained in the following paragraphs.

### Nature of Light

Color is a form of light. Therefore, to understand color it is first necessary to understand the nature of light. Light is one form of radiant energy which travels with wave motions. Other forms of this energy which are sure to be familiar to most service technicians are radio waves, infrared rays, ultraviolet waves, x-rays and gamma rays. All these forms of radiant energy are alike in one respect, they travel at a rate of about 186,000 miles per second in air. They differ, however, in wave length and frequency. The relationship between wave length and frequency is:

$$\text{Wave length (meters)} = \frac{300{,}000{,}000 \text{ (meters per second)}}{\text{frequency (cycles per second)}}$$

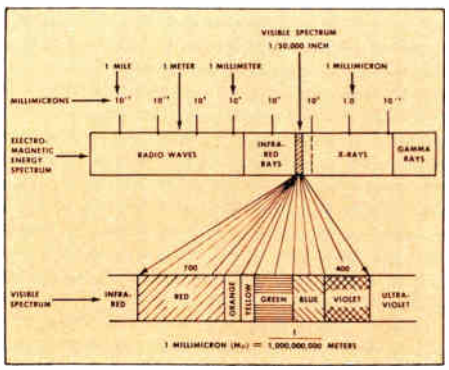



Fig. 1 Color: A Limited Spectrum of Electro-Magnetic Energy

The wave length and frequency relationships of the various forms of radiant energy can be seen more readily in Fig. 1, which is a representation of the radiant energy frequency spectrum. At one end are the previously mentioned gamma rays with their extremely short wave lengths, and at the other end are the radio waves whose wave lengths are in some cases miles in length.

In between infrared rays and x-rays is a small shaded area ranging from about 400 millimicrons (billionths of a meter) to 700 millimicrons in wave length. This portion of the radiant energy spectrum is known as light. Light is defined as that portion of the radiant energy spectrum which is visible to the human eye. As would be expected, the limits of light perception vary from one person to another. In fact, all talk of light and color must be done on the basis of the "standard observer", which is the average of many people since no two people see exactly alike in color vision.

The visible wave lengths can be more closely examined if they are removed from the spectrum and expanded, as is done in the lower part of Fig. 1. It is apparent immediately that the color sensation to the eye is determined by the wave length of light which is striking the retina of the eye. From long to short wave lengths, the colors pass from red to orange, yellow, green, blue and finally violet. Recalling the rainbow phenomenon, these color transitions have a familiar ring. The colors of the rainbow also go from red to violet, displaying the same range of colors seen on the expanded diagram of the radiant energy spectrum.

The rainbow is apparently formed by the selective dispersion of sunlight. Since sunlight is considered "colorless" or white, the first conclusion to be drawn is that white light is the result of all wave lengths of light being presented to the eye simultaneously. How then is the white sunlight broken up into its component colors or wave lengths as in the rainbow?

This is explained by another characteristic of radiant energy not yet mentioned. The speed of radiant energy varies with the medium through which it is passing. For example, when passing through glass, light has about two-thirds the velocity it has in air. This change in velocity is accompanied by refraction of the beam if the ray strikes the different medium at some oblique angle. The angle of refraction varies with the wave length of the light, and is largest for the shortest wave length. For that reason, the light will be broken up into its different wave lengths.

Water is the medium which causes this breakup in the case of the rainbow. As the white sunlight passes through the raindrops, the rays are refracted, and breakup occurs. This produces the rainbow.

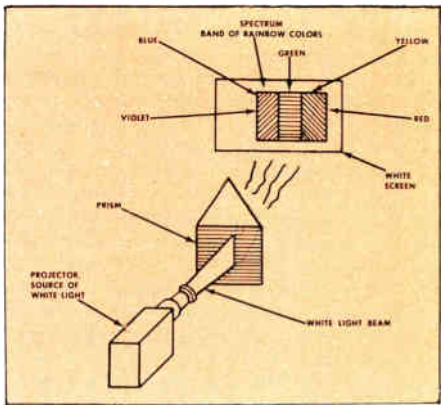
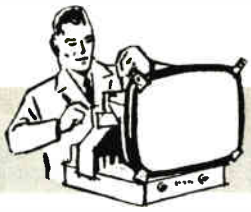



Fig. 2 The Prism as a Color Generator

A more satisfactory method of observing the visible spectrum can be performed in the laboratory using the same principle of refraction. Here the sunlight is replaced by a narrow beam of light, and the raindrop is replaced by a prism. Fig. 2 pictures this phenomenon. The spectrum, for convenience, is viewed by having it fall on a white screen. The colors of a spectrum of this type are pure colors, containing only one wave length of light at any one point on the spectrum.

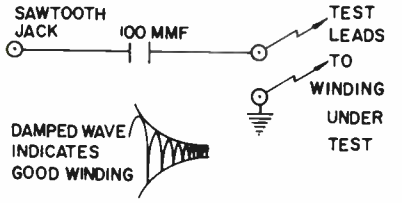
*(Continued to page 6)*



# BENCH NOTES

## SCOPE TEST FOR YOKE OR FLYBACK

I have used the following set-up to test flybacks and yokes for several years now and have found it invaluable in determining the condition of these components. My scope, (an Eico 460) as do many of the newer scopes on the market, provides a jack on the front panel for obtaining a sawtooth pulse. Scopes that do not have this provision can easily be modified by bringing out a connection from the horizontal sweep generator which gives a suitable sawtooth. For testing flybacks and yokes merely connect a 100 mmf mica condenser from the sawtooth jack to the vertical input on the scope. The scope's test leads from the vertical input are then placed across the winding of the

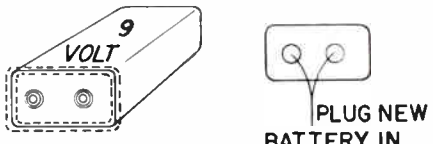



flyback or yoke you wish to test. A good winding will give you the familiar damped wave pattern shown below while a defective one will not. Any shunting resistors such as usually appear across the vertical windings on yokes will have to be temporarily disconnected for the test. The horizontal sweep frequency should be set to give a good pattern and will usually be between 1 and 10 kc. By trying this out on a flyback or yoke you know to be good will quickly show you the settings to use and the pattern to expect. You can easily demonstrate the sensitivity of the test by noting the effect of shorting the single turn filament lead of the 1B3 rectifier on a flyback.

*Fisher TV*
*760 S. 5th Ave.*
*Mt. Vernon, N. Y.*

## REPLACING BATTERY PLUGS

A replacement for some 6 and 9 volt battery plugs are sometimes hard to find. I have found that on some batteries a substitute may be taken from



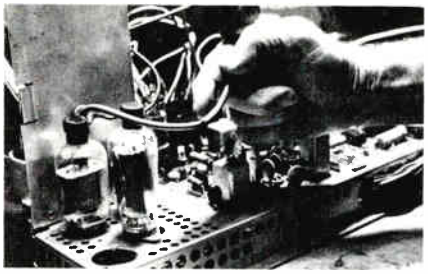

the battery it requires. After the battery has gone dead save it and pry up top edge thus releasing battery plug.

After this has been completed solder wires on two eyes on back of plug.

*Don Garrett*
*222 W. Willard St.*
*Muncie, Indiana*

## DEFECTIVE HI-VOLTAGE LEAD

After the color TV receiver has put on a few years of age, one of the big problems can be the Hi-voltage lead. Many times the Hi-Voltage lead will just hiss and give off ozone odors. In the photo this lead has arced clear through and sounds off with a loud cracking noise.



The arcing or hissing voltage leak can be seen with the back removed from the TV receiver. When the arcing becomes greater, white flashes and zig zagging lines appear on the TV screen. Many times you can see these lines before the arcing sound is heard.

*Homer L. Davidson*
*2821 - 5th Ave., South*
*Fort Dodge, Iowa*

## PARTS STORAGE

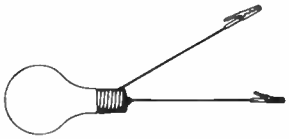
The idea is that an empty "pop case" serves as a handy parts storage bin for large parts such as transformers etc.

Also a empty coffee can with a plastic top is an excellent parts holder for a set you are working on. If you accidently knock over the can you won't have to hunt for small nuts, etc.

*Cal Abbott*
*17 Nelson Ave.*
*Bradford, Penna. 16701*

## FUSE SAVER

Here is a little tool that I have used for several years now with a great deal of success. Take a 6 or 7 watt 115 volt dial type lamp and solder two short clip leads about 3" long to it. Use plastic sleeves on the aligator clips the next time you come across a set that has an open fusible resistor, clip the

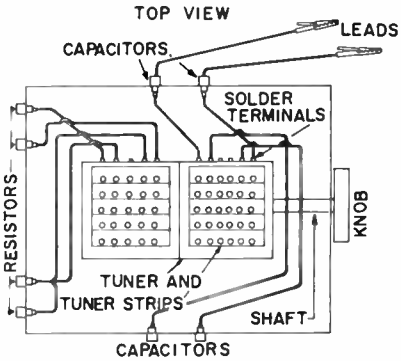


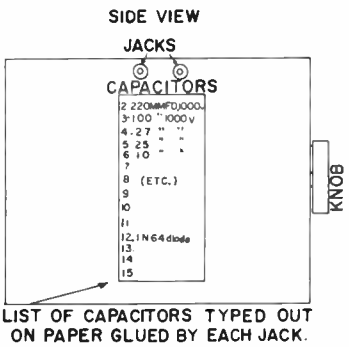

lamp across the fusible terminals, turn the set on with A.C. power applied. If the lamp glows bright, then dims, and then brightens again, it is safe to replace the fusible resistor, but if the lamp comes on bright and stays bright you have a short circuit such as rectifiers or filters.

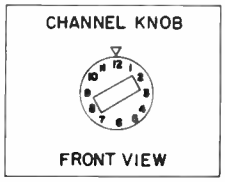
*Donald E. Byrd*
*623 Juniper*
*Walla Walla, Wash.*

## SUBSTITUTION BOX

An old cascode Turret Tuner can make a very useful Substitution Box. Almost any value of resistors and capacitors can be used. Most capacitors should be the ceramic type as some tubulars will not fit inside strips. The first step is to remove all electrical components. The resistor and capacitor values will depend on the user. I use one section for resistors and the other section for capacitors, with one space used for a diode. I use eight small jacks and have two clip leads as shown on drawing.




For example if a 220 MMFD is needed, switch channel to Channel 2. Insert leads and connect.

If builder wishes a diode can be installed on Channel 12. Any arrangement can be achieved, it depends on the constructor. Possibly some kind of switching arangement could be used to eliminate the eight Jacks to two, although I did not try it.

*Charles Jackson*
*Buckner, Illinois*

## NOTE:

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Caution: The ideas and suggestions expressed in this column are those of the individual writers. These ideas and suggestions have not been tried by the General Electric Company and therefore are not endorsed, sponsored or recommended.

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These three luggage-type service cases have the same features as ETR-2701, 2702 and 2704 except they are covered with a heavy laminated vinyl covering that resists scrapes, scratches and stains. They are almost impossible to wear out. All cases have nickel plated hardware and snap locks. Handles are bakelite and guaranteed against breakage.


### ARMORED VINYL LUGGAGE-TYPE SPECIAL "160"

Holds over one hundred and sixty tubes. Has egg-crate separators to keep miniatures, GT's and compactrons in place. Size — 18" x 8 7/16" x 12¼".

**ETR-4395, ARMORED VINYL SPECIAL "160" SERVICE CASE**
**Cost ..... $13.95**


### ARMORED VINYL LUGGAGE-TYPE GIANT "365"

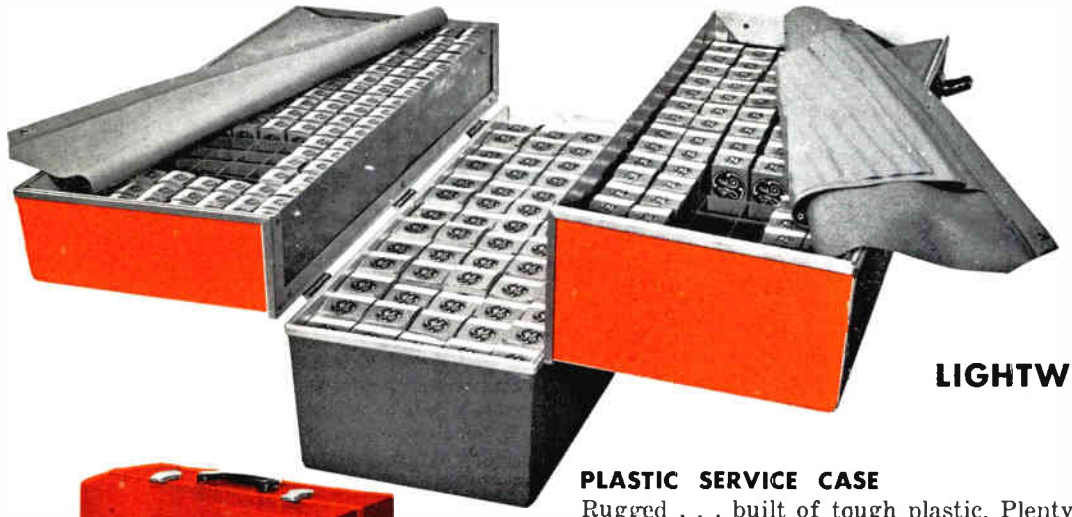
Holds over three hundred and sixty five tubes. Egg-crate separators keep miniatures, GT's and compactrons in position. Separate tool compartment is large enough to hold soldering gun, tools and parts.—Size — 22⅛" x 10⅝" x 16⅜".

**ETR-3915 ARMORED VINYL GIANT "365" SERVICE CASE**
**Cost ..... $23.65**


### ARMORED VINYL LUGGAGE-TYPE SERVICE MASTER "240"

Holds over two hundred and fourty tubes. Egg-crate separators hold miniatures, GT's and compactrons in position. Size—22⅛" x 8⅞" x 13¾".

**ETR-3750 ARMORED VINYL SERVICE MASTER "240" SERVICE CASE**
**Cost ..... $17.75**



## LIGHTWEIGHT PLASTIC


### PLASTIC SERVICE CASE

Rugged . . . built of tough plastic. Plenty of space to carry tubes and tools. Has egg-crate tube holders, separate tool compartment and a plastic curtain which holds job tickets, alignment tools, drop cloth, etc. Size — 22 3/16" x 8 15/16" x 15" high. A real featherweight at only 8 lbs. And that's about 4 lbs. less than most cases of comparable capacity. Colors — red-orange and grey.

**ETR-2700 PLASTIC SERVICE CASE**
**Cost ..... $24.95**



**Available at your General Electronic Compc**


## MATCHED PLASTIC TOOL CASES

Here is an assortment of plastic tool cases that will fulfill your complete requirements. Top section is orange-red and bottom grey as shown.

All three cases are made of high-impact polystyrene and are practically indestructible under normal usage. These cases are warp-free, impervious to grease, oil, salt water and even battery acid.

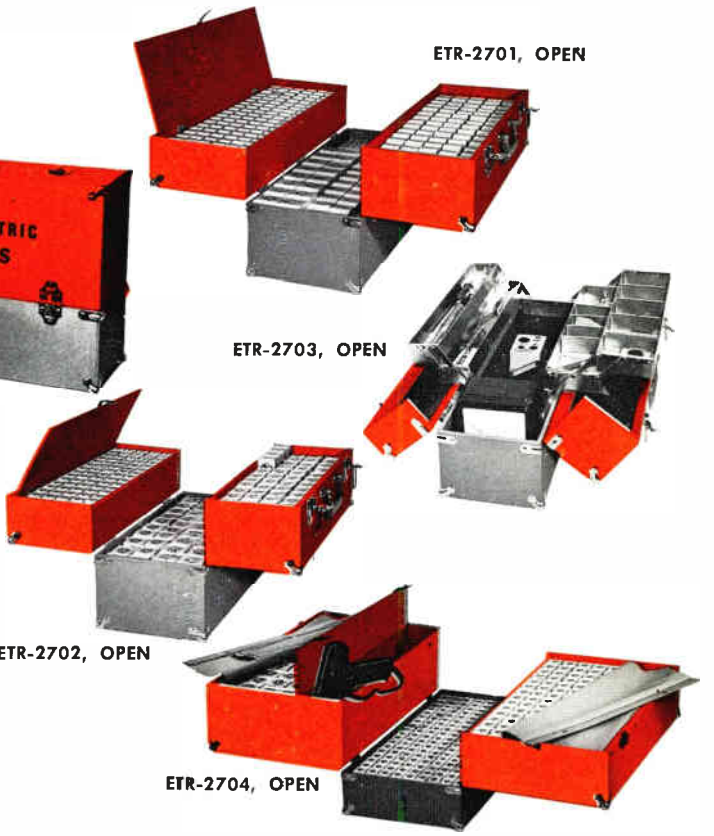
The top cover has overlapping edges which prevents water from dripping into case. ETR-3517 and ETR-3280 have two cantilever trays which open automatically as the cover is opened.

ETR-3516 also has two cantilever trays which are easily opened manually. Each individual tray has various size compartments to keep tools, parts, fuses, etc. separated and easy to locate and remove.

**ETR-3517 TOOL CASE**
18¼″ long, 9½″ wide, 9½″ high
Cost ..... $10.75

**ETR-3280 TOOL CASE**
15¾″ long, 8″ wide, 8¼″ high
Cost ..... $7.75

**ETR-3516 TOOL CASE**
14″ long, 6″ wide, 5½″ high
Cost ..... $4.25


## SERVICE MASTER "240" SERVICE CASE

Holds over two hundred and forty tubes. Carrying a large tube inventory with you eliminates costly, time-consuming trips back to the shop. Egg-crate separators keep tubes in place. Size—22¼″ x 9″ x 14½″. Weight — 9½ lbs.

**ETR-2701, "240" SERVICE CASE**
Cost ..... $15.00

## THE SPECIAL "160"

Holds over one hundred and sixty tubes. This junior-size case can also be utilized as a small-parts case. Tubes held in position with egg-crate separators. Size — 18″ x 8⅜″ x 11⁷⁄₁₆″. 8 lbs.

**ETR-2702, "160" SERVICE CASE**
Cost ..... $11.00

## THE GIANT "365"

Combination tube and tool case . . . holds 365 tubes plus tools to get the job done. Egg-crate separators keep tubes in position. 22⅛″ x 10⅝″ x 15¹³⁄₁₆″.

**ETR-2704, GIANT "365"**
Cost ..... $20.30

## HOME SERVICE TOOL CASE

Here, you've got the tools at hand for almost any home service job. Case is divided into compartments to provide an orderly arrangement of service tools . . . they're easy to see and right at your finger tips. Separate compartment for VOM. Size — 20¹³⁄₁₆″ x 6⅞″ x 9³⁄₁₆″. Weight — 5½ lbs. Colors — red-orange and grey.

**ETR-2703 HOME SERVICE TOOL CASE**
Cost ..... $13.25

**ıents Distributor or see coupon on page 7.**

# COLOR TELEVISION

*(Continued from page 1)*

The previous facts give no indication of reproduction methods; however, as far back as the year 1722 it was found that most of the colors of the spectrum could be duplicated by the proper mixture of three colors. A theory of human color vision evolved from these three-primary color experiments. This theory says that the retina of the eye contains three groups of light-sensitive elements, and each group responds to a different visual wave length. With the proper mixture of signals from these elements transmitted to the brain, the entire spectrum of visual colors is produced. The network of nerves which makes up the entire color-vision system is remarkably complex. When the nerve connections are improperly connected, normal color vision is lost, causing what is known as color blindness.

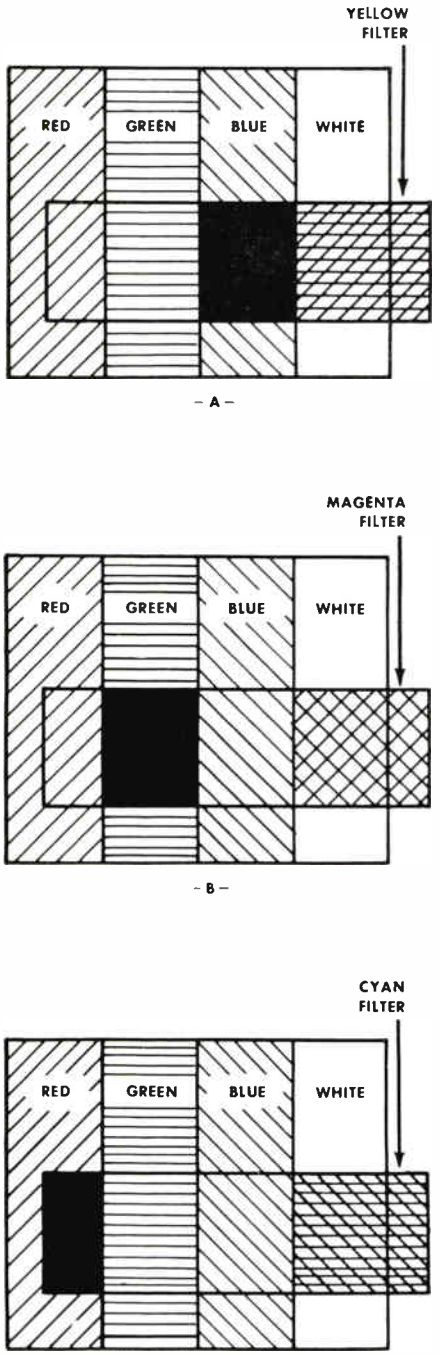



Fig. 3 Subtractive Filters

## Subtractive Primaries

Some of the earliest experiments with color mixtures were performed with pigments. The results of this type of color reproduction are seen today in modern printing, paints, and kodachrome slides. The primary colors found to give most satisfactory results are yellow, cyan and magenta. These primaries are known as subtractive primaries because they subtract (by absorption) unwanted wave lengths from white light. The absorption properties of the three primaries are illustrated in Fig. 3. The effect of absorption of a yellow filter is shown in A. Notice that green and red light is transmitted while the blue is absorbed. In B the magenta filter absorbs green and transmits red and blue; the cyan filter in C absorbs the red light and transmitted blue and green.

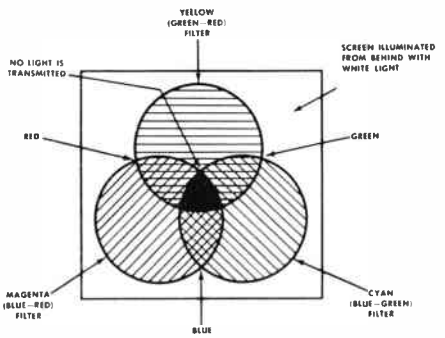



Fig. 4 Subtractive Method of Color Mixture

To carry the effect of absorption still further, a look at Fig. 4 will show what happens when two or more absorption filters are superimposed. Fig. 3 showed what the absorption properties of the filters were. Recall yellow absorbed blue but transmitted red and green frequencies: the cyan filter absorbed red but passed blue and green. When superimposed, each filter absorbs one band of frequencies from white light. For instance, the yellow filter absorbs the frequencies in the region of blue; the cyan filter then absorbs the frequencies in the region of red. If both of these bands of frequencies are absorbed from the same beam of white light, the result will be the remaining frequencies, or green. In a similar manner, yellow and magenta filters combined absorb all light but red, and magenta and cyan filters combine to give blue. As would be expected, the results of superposition of all three filters in absorption of all frequencies, or black.

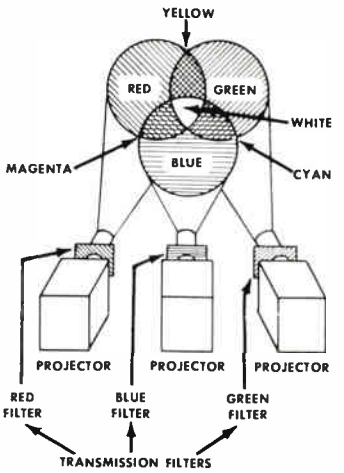



Fig. 5 Additive Method of Color Mixture

## Additive Primaries

The subtractive system of color reproduction just described works extremely well when working with pigments, slide projection, or any other case where the initial light source is white light. In color television, however, it would be more logical to work from three individual light sources and add them together on a screen. This would call for a new set of primaries. It was found that for additive colorimetry, as this process is known, the three colors which, as primaries, gave the most complete range of colors were red, green and blue. Fig. 5 shows the three additive primaries used in color television. The three overlapped circles of color represent three separate light sources, each with a different primary filter being projected on one screen so that they overlap partially to show the effect of superimposing two or more additive primaries. Notice that the result is the opposite of the subtractive primaries. Starting out with red, green and blue as our primaries, yellow, magenta and cyan are developed as a result of superimposing two of the primaries.

Red and green = yellow

Red and blue = magenta

Blue and green = cyan

When all three primaries are added together in the proper proportions, white is the result.

Red and green and blue = white

Without looking at specific colors one is certainly left with the impression at this moment that any color can be reproduced by proper addition of the proper primaries. This statement is almost true. Its limitations will be seen as the study of colorimetry progress.

# TELEVISION

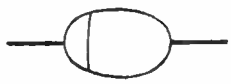
## TC SERVICE HINTS

The following TC problems and cures have been reported by the field and in the interest of saving service time, we are passing them on to you.

### Horizontal Sync Shift

Problem: if horizontal hold is set on strong signals, horizontal hold will not lock on weak low VHF channels and vice versa.

Cure: Check Y255, if shape is like this:



Replace with regular replacement part, ET57X35. This diode may cause a parasitic which will pull the horizontal oscillator frequency on weak low VHF channels. Very few diodes of this type were used in production.

### Poor Sensitivity — Snow

Cause: Open or shorted Q1 in VHF tuner.

Cure: Replace Q1 (Check for the same problem on the TA and TB Chassis).

### VHF Tuner Intermittent or No Operation

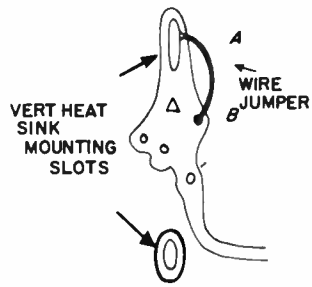
Cause: Poor solder joints, generally at Q2 terminal.

Cure: Go over entire VHF tuner solder points with low wattage soldering iron.

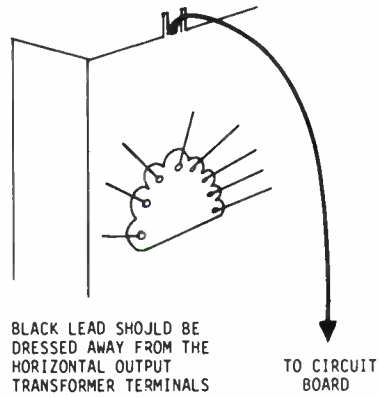
### Intermittent or No Vertical Sweep

Cause: Broken solder connection at Q19 vertical output heat sink where it is connected to the circuit board.

Cure: Q19 is a PNP power transistor and its case is the collector. Q19 is fastened to its heat sink with screws. The heat sink is soldered into the circuit board at point "A" (as shown in sketch). This solder point can be broken from the copper pattern by movement of the heat sink; resulting in no collector connection. A permanent repair is to connect a jumper wire from the heat sink to point "A" to point "B" on the bottom side of the board.




### HB/HC LEAD DRESS




There is a black wire connected from a lance on the top of the high voltage cage (looking from the rear) to the circuit board that passes over the horizontal output transformer solder terminals.

Since this lead is at ground potential, it should be dressed as far away from the horizontal output transformer terminals as possible.

This lead dress should be checked each time the set is serviced.

# CONSOLE PHONOGRAPHS

## NOISE ON AM FUNCTION

A static-like noise on AM function only, resembling that caused by a loose or intermittent electrical connection may be evidenced on certain 1965 Model Console Phonographs equipped with transistorized tuners.

This condition was experienced in the factory prior to the beginning of 1965 model production and was traced to the pilot lamps. The lamps being used at that time were No. 53 lamps and the cause of the interference was found to be due to the shorting of filament coil turns when the lamp was jarred or vibrated.

As a result of this, a new lamp No. 53X, was specified for production.

The filament coil of the No. 53X pilot lamp is supported in two places by a special supporting element. This practically eliminates the possibility of coil turn shorting.

For the most part, the No. 53X lamp has proved to be very satisfactory in this respect. A few instances have been reported from the field where much time has been spent tracking down this trouble.

We suggest, in the event of AM interference of this type, that the pilot lamps be disconnected at the filament supply to see if the interference disappears. Should the interference cease when the lamps are disconnected, reconnect the filament supply and check the lamps one at a time by tapping lightly while operating the set on a clear AM station.

Replace the offending lamp or lamps with a new EA6X27 pilot lamp. Be certain to also check the replacement lamp.

All EA6X27 lamps in replacement stock are No. 53X lamps.

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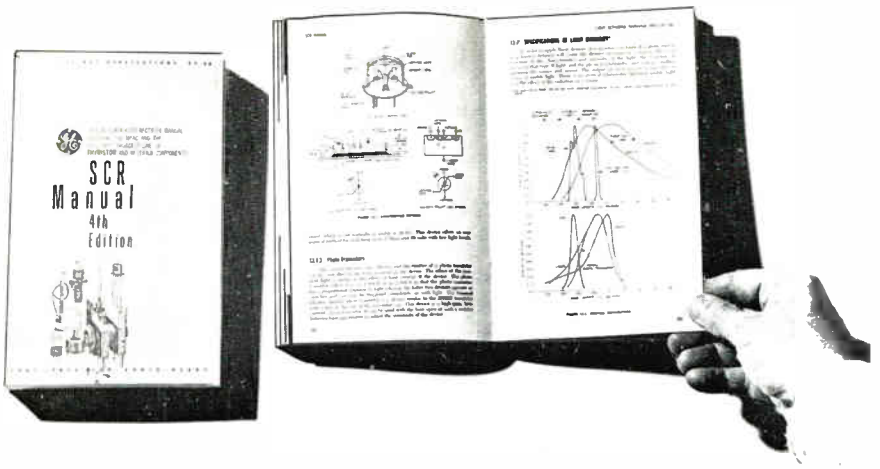


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