OF THE three main systems of color television that have been battling for FCC and public recognition, the recently approved CBS field-sequential system is most prominent today. The FCC has stated, however, that the door is not irrevocably closed against other systems, so interest remains strong in the numerous up. These are the side-by-side system of Color Television Incorporated (CTI), and the electro-optical system developed by RCA.

The pros and cons of these systems have been discussed with so much heat and so little moderation that the radio-phonist is not quite sure of any one of their technical features. The public—at whose expense this barrage of facts and counter-facts has been directed—is happily confused. The terms "compatibility" and "incompatibility" have been bandied about to such an extent that many laymen believe that it would be possible to get color pictures without modifying their present sets, if only a "compatible" system of transmission were used. At the other extreme is a sizable number who believe that present sets will become useless as soon as color television starts.

Let us review some of the technical facts to help clear up the nonsense. We have two systems using relatively simple mechanical apparatuses and two systems using more complex electronic equipment to produce roughly similar results. All these systems are standard black-and-white tubes with colored galvanic filters to insert the color into the images.

RCA has, in true, demonstrated a single tube which produces the three colors with the same phosphors. This promises a color system without filters and with only one instead of three picture elements as used in the present RCA setup, but whether a three-color tube can be mass-produced economically enough to be used in home receivers remains to be seen. At least three types of three-color tubes (RCA, General, and Du Mont) have been patented; none have yet been proven to be (or not to be) practical.

Another almost catchword is "mechanical system." It is made more appealing when CBS spokesmen remark in passing that their system could also work with electronic color tubes. The fact is that the adaptability of any of the systems is a function of the speed of switching from one color to another. Equipment that can be used by the fastest-switching one can be used by the other two, but not vice versa. Colors are switched more than ten million times a second in the RCA system, 33,700 times in the CTI system, and only 144 times per second by the CBS method. Therefore either CBS or CTI could transmit and receive with equipment available for the RCA method. CBS could also use equipment of the type required by CTI line sequences.

However, should CBS decide to rid itself of the stigma of a "mechanical system" and go electronic, it would have to accept some of the disadvantages as well as the advantages of the more complex systems. An excellent field-sequential system could be built up with three cameras and three lines...
Color Illustration 1—The CTI line-sequential system combines all three primaries in each of its six fields.}

as in the dot-sequential system, and similar complex and expensive methods would have to be used to solve them. With the color-wheel system now used by CBS (Color Illustration II), receiving and transmitting equipment differ little from that used for black-and-white. \(^{11}\) Color is supplied by transparent discs divided into red, blue, and green segments which rotate in front of camera and kinescope. The discs must be synchronized so that each segment

Color Illustration III—NCA's dot-sequential system, with four fields per picture, has a complex interface of dots.
Television

is in motion while the corresponding color field is transmitted. Thus, during a red field, a red filter ahead of the camera lens permits it to "see" only the red light from the scene, and the blue and green lights are blocked. At the same instant, a red filter in front of the lens allows the partial image of the viewer. The same thing happens during the blue and green frames, and the eye sees only the red, green, and blue primary images in such sequence that it reassembles them to form the picture in full color.

Instead of black-and-white's two interlaced fields per frame, with 50 complete pictures per second, Color pictures are composed of two interlaced color frames of three fields each. Therefore, instead of transmitting a whole field or frame in one of the primary colors, the color is switched at the end of each line. Frequencies at the CTI method change that the color is switched at the end of each line, so that the viewer's eye sees the colors in sequence. Because of this, the picture is not as sharp as in black-and-white, and the edge of objects is not as well defined. However, the system is designed to give a good reproduction of the colors.

A few of the many advantages of this system are the simplicity and ease of use. Since the only modifications required are the addition of a triangular wave generator and the addition of a color wheel, the system is easily implemented in existing equipment. Transmitters and receivers for color can be added to existing black-and-white systems at a fraction of the cost of installing color equipment.

The chief disadvantage of this system is its insensitivity. Because of the different line frequency, a standard color receiver tuned to a color signal will not see anything, either in black-and-white or color. Another disadvantage is the color signal, which is not as well defined as in black-and-white. However, the system is designed to give a good reproduction of the colors.

The CTI system

The system demonstrated by CTI (Color Television Conference) is the simplest system for transmitting color images. Instead of transmitting a whole field or frame in one of the primary colors, the color is switched at the end of each line. Frequencies at the CTI method change that the color is switched at the end of each line, so that the viewer's eye sees the colors in sequence. Because of this, the picture is not as sharp as in black-and-white, and the edge of objects is not as well defined. However, the system is designed to give a good reproduction of the colors.

RCA detsequential color

Probably never has been said about the RCA (Color Television Conference) detsequential system than both others. It is one of the simplest, the easiest to understand, and the most practical for future development of any of the three systems. Instead of transmitting the colors in the primary fields and lines, the RCA system transmits each line into the picture of primary color. Each color is switched or "complied" 42.4 million times per second, and a stream of colored light is seen on the viewing screen. These colors are combined to form a color picture such as the one of a color plate used in printing books or magazines. The colors of color printing do not fill the whole area, however, whereas those of RCA color television cover over 40%.

The RCA system, the color television of the future, contains a field encoder which is used to record the pictures for storage or transmission. The encoders are used to record the pictures for storage or transmission. The encoders are used to record the pictures for storage or transmission. The encoders are used to record the pictures for storage or transmission. The encoders are used to record the pictures for storage or transmission. The encoders are used to record the pictures for storage or transmission.

RCA's great advantage is its compatibility, but it has another—its greater definition than its rivals. The high frequencies of each of its three color components are selected together, so that no visual drift occurs in the receiving end. Instead of being speeded up as in the color system, the horizontal sweep of the receiver is slowed down to one-third the standard so that a single sweep will cover three lines, one in each primary color. These lines are used to create a three-color image. In that same way a sweeping system would select lines successively from each of them.

The CTI receiver may consist of three telescopes, each with a color filter ahead of the lens. The lines are so placed as to superpose the three images on a screen, where they appear as a full-color picture. It may also be a single tube, with the three color systems side by side on the screen and the same optical mixing system.

RCA's great advantage is its compatibility. It uses the old 525-line interlaced system. The disadvantages are the same as compared to CTI and another pioneer in a line sequential system. This in line fully accepts all components in which the lines seem to be crawling up and down the picture. It can be avoided by viewing the complete color interface in which six fields are required for a single color picture. The number of complete pictures is thereby decreased to 10 per second, which seems slow. Sponsors of the system say that the line delay circuit which prevents this from producing objectionable picture.

Disadvantages of the RCA system are the cost of the equipment and its operation. Costs are reduced to about 10,000 dollars per second, instead of 144 times in the color system at the 14,800 times of the CTI system. The simplicity of keeping the apparatus in perfect adjustment is unquestionably important. Color shift was one of the early problems of this system, and produced some interesting effects. These phenomena of a plate might appear more apparent, turning from yellow to brown as they were being carried to or from the center of the picture.

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This problem has been solved with a synchronizing system in which timing pulses are transmitted to provide exact dot registry.

Many engineers point to these very problems, and the ones that still exist, as one of the strong points in favor of RCA's system. This admittedly crude development already produces images which some feel are equal to those of any system, and cannot lag far behind by anyone's reckoning. Yet the system is new and at the beginning of its development, whereas others are well in sight of the end of theirs. To say that a system shows great room for improvement may not always be praise, but it is a significant factor when planning for the future.

In typical RCA receiving equipment, three kinescopes are used, one for each of the primary colors. The separate colors are mixed with the aid of dichroic mirrors, which are transparent to two of the primaries and reflect the third. The viewer sees a full-color picture on what appears to be the screen of the green tube, though actually the red and blue components are reflected from the mirrors. As stated before, a single three-color direct-viewing tube has been demonstrated, but is still in the developmental stage.

Besides the three methods described, a number of other incipient color television systems—not developed to the point of demonstration—have been proposed to the FCC. None of them are likely to replace one of the present systems as the final answer to color television, but the possibility cannot be excluded.

References

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