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DISPLAY SYSTEMS

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2 Sheets-Sheet 2

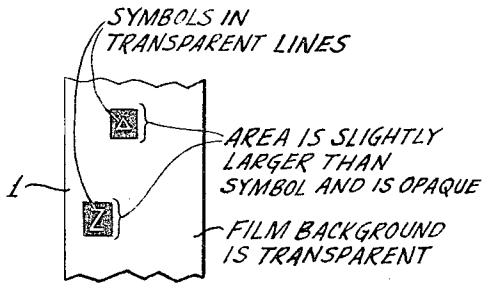


Fig. 1a.

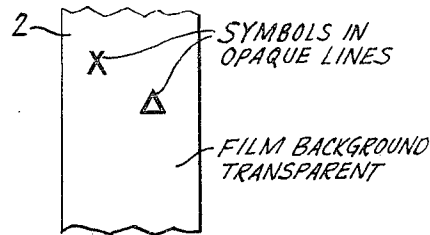
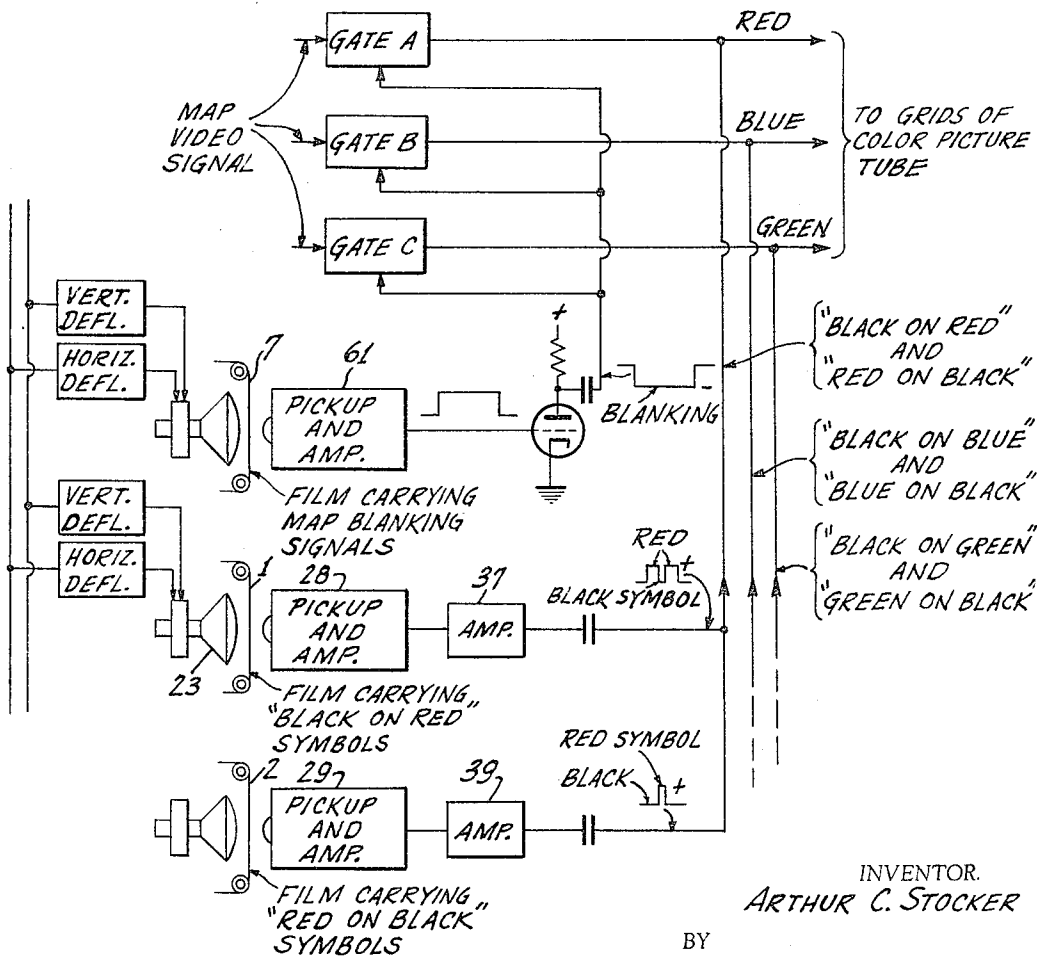


Fig. 1b.

Fig. 2.



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DISPLAY SYSTEMS

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My invention relates to display systems, and particularly to an improved method of and an improved system for displaying several classes of information, each readily distinguishable from the others.

My invention is particularly useful when applied to a display employing a multi-gun color tube such as a tri-color kinescope known as the shadow-mask color tube, tube type 21CYP22 being one example. For some types of color displays, such as displays showing small symbols in different colors, a departure from substantially perfect convergence of the electron beams, such as might easily occur with field maintenance, may seriously degrade the display when the color tube is operated in the usual way. For example, if the symbol to be displayed is a very narrow vertical bar to be displayed in cyan, conventional practice would require that the video signal representing the bar be applied to the blue and green guns. A substantial amount of horizontal misconvergence would cause the electron beams from the two guns to write respectively blue and green bars spaced apart on the screen, and a single bar of cyan color would not be obtained.

For a display of three classes of symbols only, in three colors, respectively, this kind of difficulty is readily avoided by having the symbol signal activate only one gun, for example the red gun for a red symbol, the blue gun for a blue symbol, and the green gun for a green symbol. Then convergence problems can be avoided for any one symbol by applying the symbol signal to only one gun. Thus, with a tri-color kinescope, three classes of symbols may be shown in the three basic or primary colors without any difficulty.

However, if more than three classes of symbols are to be shown, conventional practice would require that the symbol signal be applied to more than one gun of the color tube, resulting in the above-mentioned misconvergence difficulty in the absence of substantially perfect convergence of the electron beams. In accordance with the present invention, two classes of information may be displayed for each of the basic or primary colors of the display device. One of these two classes of information is displayed by applying the symbol signal to one gun as described above; to the red gun, for example, to obtain a red symbol. This is referred to as a "color on black" symbol. The second class of information may be displayed by applying to the same gun a signal representative of an area only slightly larger than the symbol, and also representative of a symbol inside this small area. This results in a symbol display, in the example assumed, consisting of a small red area having the symbol appearing in black within the red area. This is referred to as a "black on color" symbol. Thus, in the example utilizing a tri-color kinescope, six classes of symbols may be displayed in six color presentations without any beam convergence problem, namely, in red on black, blue on black, green on black, black on red, black on blue, and black on green.

Another example of an application of the invention is a display using a line-phosphor type of color tube, wherein mixed colors are secured by applying a rapid sweep across the phosphor lines and turning the beam on at appropriate phases of the sweep signal. Again the problems of fast sweeps and the phasing of the grid signal may be avoided by using only one color per symbol.

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Still other examples are a display using a monochrome kinescope or a display using an electro-luminescent panel.

For all of these examples the use of my invention will permit the display of two classes of information for each of the basic or primary colors of the display device, without increasing the problems of manufacture, adjustment, or maintenance.

An object of the invention is to provide an improved method of and means for producing and displaying two or more readily distinguishable classes or groups of symbols.

A further object of the invention is to provide an improved method of and means for producing a color display.

A further object of the invention is to provide improved color display apparatus utilizing a multi-beam color tube in which difficulties ordinarily caused by mis-convergence of the electron beams of the color tube are avoided.

A still further object of the invention is to provide improved color display apparatus wherein there may be displayed more classes of information than the number of basic colors, without undue complexity.

In practicing one embodiment of the invention, a shadow mask color tube such as one of the type previously identified, is employed. This is a three-gun tube, the electron beams from the three guns, respectively, impinging on red, blue and green phosphor dots, respectively, on the screen. The three guns preferably are biased to cut-off, or close to cut-off, so that as the beams (to the extent that they are present) scan the phosphor screen there is obtained a comparatively dark background. The scanning may be at an ordinary television scanning rate. Red, green and blue symbols may be presented on the screen by activating the red, green or blue guns, respectively, as mentioned above. These symbols are said to be displayed as "color on black" symbols since the symbols appear in color on a dark background.

In accordance with the present invention, additional symbols may be displayed as "black on color" symbols. In the example being described, this, in effect, provides a total of six color presentations that are available for symbol presentation or display when employing a three-color tube. A "black on color" symbol presentation is obtained by assigning an area only slightly larger than the symbol, this area to appear in color, and the symbol to appear inside this color area in black. For example, a "black on red" symbol may appear as a small square area of red with the symbol written in black inside this area. Thus, the symbol appears on a red background, small in area. Other symbols may appear as "black on green" or as "black on blue." For these "black on color" symbols there is no beam convergence problem because the symbol is obtained by applying the symbol signal to only one gun.

It will be evident that if the "color on black" symbols are displayed as positives, using photographic terminology, then the "black on color" symbols are displayed as negatives, again using photographic terminology. In the claims any reference to the display of the symbols as positives or negatives is a reference in photographic terms to such a display. It will be understood that the "color on black" symbol display might be considered as a negative, in which case the "black on color" symbol display is the positive.

Since no symbol is made by mixing colors, it is not necessary to use more than one gun for each symbol, and it is not necessary to provide precise convergence. At the same time, symbols can be displayed effectively in more classes than are represented by just the three primary colors.

The invention will be described in detail with reference to the accompanying drawing in which:

FIG. 1 is a schematic and block diagram illustrating one embodiment of the invention;

FIG. 1a is a view of a strip of photographic film on which symbols appear in a form suitable for "black on color" presentation;

FIG. 1b is a view of a strip of photographic film on which symbols appear in a form suitable for "color on black" presentation; and

FIG. 2 is a schematic and block diagram illustrating an embodiment of the invention in which a map is to be shown on the picture tube display along with the symbols.

In the several figures like parts are indicated by similar reference characters.

In FIG. 1 a tri-color kinescope, such as one of the shadow-mask color tubes previously mentioned, is indicated at 11. It has three electron guns 12, 13 and 14, each including a cathode 16 and a control grid 17. The three guns preferably are biased to cut-off or close to cut-off so that as the three electron beams (to the extent that they are present) are deflected to scan the color screen (not shown) the screen will be black or comparatively dark.

FIG. 1 illustrates, by way of example, how symbols may be made to appear on the screen of the tri-color tube effectively in six different color presentations, the video signal for a particular color symbol being applied to only one electron gun. Thus, a particular symbol cannot appear on the screen as two or three symbols side by side, and each of a different color, because of mis-convergence of the electron beams. In the example, the symbol or symbols to be displayed in a particular color are on a motion picture film which is scanned by a flying spot scanner. The symbols that are to be displayed as "black on red," "black on blue," and "black on green" symbols, respectively, are on films 1, 3 and 5, respectively. The symbols that are to be displayed as "red on black," "blue on black," and "green on black" symbols, respectively, are on films 2, 4 and 6, respectively. These symbols may, for example, represent aircraft in the vicinity of an airport, the aircraft at one altitude level being displayed in symbols of one class, and the aircraft at a different altitude level being displayed in symbols of a different class. These films may be driven intermittently in conventional fashion, as by a 2-3 intermittent motion commonly used in television transmission of motion picture film.

A drive for the film 1 is indicated at 21. Similar film drives (not shown) are provided to drive the other films 2 to 6, inclusive. Each film drive is driven by a synchronous motor connected to a 60-cycle power line, the motor for film drive 21 being shown at 22.

The flying spot for scanning each film is produced on the screen of a cathode ray tube. This tube for scanning film 1 is shown at 23. The cathode ray of tube 23 is deflected horizontally and vertically by deflection circuits 24 and 26, respectively, to produce a television type scan. The deflection circuits are synchronized by horizontal and vertical synchronizing pulses supplied from a synchronizing pulse generator 27. The generator 27 is phase locked to the 60 cycle power line whereby the film drives and the flying spot scanning are maintained in synchronism.

A photoelectric cell and amplifier unit picks up the light from the film being scanned to produce a video signal representing the symbol on the film. This unit for the film 1 is indicated at 28. Similar photoelectric cell and amplifier units 29, 31, 32, 33 and 34 are provided for the other films 2 to 6, respectively.

In the example being described, the symbols on film 1 are to be displayed as "black on red" symbols on the screen of tri-color tube 11. One way of supplying video signals representative of "black on color" symbols (in this instance, "black on red"), is shown in FIG. 1a. This

figure shows a strip of the film 1 carrying two symbols, a Δ and a Z. The film background is transparent or translucent and appear dark or black on the color tube display screen. An area only slightly larger than the symbol is made opaque, or at least darkened substantially, except for the symbol inside the area. The symbol itself is transparent or translucent. As the flying spot scanning scans across an opaque portion of film 1, positive video signal appears on the grid of the gun 12 to make a red display on the color screen. Thus the scanning of film 1 results in the display on the color screen of a black Δ inside a square red area, and a black Z inside a square red area. In the example illustrated, the video signal from unit 28 is supplied over a lead 36 to the receiver where it passes through an amplifier 37 and is supplied with positive polarity to the control grid of the red gun 12. The signal representing the symbol and its surrounding small area is indicated schematically by the graph "black on red" above lead 36.

The three beams from guns 12, 13 and 14 are deflected by horizontal and vertical deflection circuits which drive a deflection yoke 40 to scan the color screen in the usual television fashion. These deflection circuits, shown at 41 and 42, are synchronized with the flying spot scanning by horizontal and vertical synchronizing pulses transmitted from the generator 27 over a line 43.

The symbols on film 2 are to be displayed as "red on black" symbols. In the present example, the video signal from unit 29 is supplied over a lead 38 to the receiver where it passes through an amplifier 39 and is applied with positive polarity to the control grid of the red gun 12. This signal is obtained by the scanning of the symbols on film 2, an example of which is illustrated in FIG. 1b. In this example, the symbols (illustrated as X and Δ) are opaque, and are on a transparent or translucent film background. The resulting display on the color screen is that of red symbols on a black background. The signal representing the symbol is indicated schematically by the graph "red on black" above lead 38. This signal, of course, is representative of the shape or configuration of the symbol.

The symbols on film 3 are to be displayed as "black on blue" symbols on the screen of the color tube 11. The symbols to be displayed as "black on blue" symbols may be formed on the film 3 in the same way as illustrated in FIG. 1a. The "black on blue" video signal is supplied over a lead 44 to the receiver where it passes through an amplifier 46 to the control grid of the blue gun 13. The portion of this signal representing the blue area is of positive polarity at the control grid of gun 13.

The symbols on film 4 are to be displayed as "blue on black" symbols. The video signal from unit 32 is supplied over a lead 47 to the receiver where it passes through an amplifier 48 and amplified with positive polarity to the control grid of the blue gun 13. The symbols to be displayed as "blue on black" symbols may be formed on the film 4 in the same way as illustrated in FIG. 1b.

The symbols on film 5 are to be displayed as "black on green" symbols. The symbols to be displayed as "black on green" symbols may be formed on the film 5 in the same way as illustrated in FIG. 1a. The video signal from unit 33 is supplied over a lead 49 to the receiver where it passes through an amplifier 51 and is applied with positive polarity to the control grid of the green gun 14.

The symbols on film 6 are to be displayed as "green on black" symbols. The symbols to be displayed as "green on black" symbols may be formed on the film 6 in the same way as illustrated in FIG. 1b. The video signal from unit 34 is supplied over a lead 52 to the receiver where it passes through an amplifier 53 and is applied with positive polarity to the control grid of the green gun 14.

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Each of the video amplifiers 37, 39, etc., preferably is provided with means for adjusting its gain.

Preferably, the usual provisions are made to obtain reasonably good convergence of the three electron beams in the color tube. For example, dynamic convergence such as that employed in present commercial practice may be employed.

In general, one may employ any multi-gun color tube. Any suitable source of video signals representative of the symbols or images to be displayed may be used. For example, a computer output may be converted and fed into a continuous video tape loop to generate the desired display.

Instead of the use of movie film as indicated by 1 through 6, stationary film slides may be used and positioned manually in front of the flying spot scanners. This may be desirable where there is to be no rapid change in the symbols.

Mention has been made of one class of symbols representing aircraft at one altitude, and a second class of symbols representing aircraft at another altitude. Another example of different classes of symbols is the following: The army might want a display of the location of its own infantry, artillery and tank units, and a similar display of the corresponding enemy units. The display for these three types of units for own army and for the enemy army may be presented by six classes of symbols. The three own army units might be displayed by "color on black" symbols and the three enemy units displayed by "black on color" symbols.

It may sometimes be desirable to present a background display such as a map or the like as well as the symbols. However, whenever a map signal occurs at the same place in the picture as a symbol signal, either or both of two things may happen; the outline of the symbol may be confused by the lines of the map, or the color of the symbol may sum with the color of the map. In either event the identity and classification of the symbol will be confused. FIG. 2 illustrates a suitable arrangement for displaying both a map and the symbols without confusing the symbols.

As shown in FIG. 2, the video signals representing a map are supplied through gates A, B and C to the red, blue and green guns, respectively, of the color tube. The map signals may be obtained in any convenient manner, as, for example, from a flying spot scanner operating with a map film.

The simultaneous application of both map and symbol signals to the grids of the color tube is avoided in the example illustrated by generating a blanking signal each time a symbol signal is generated, and by applying this blanking signals to the gates A, B and C to block the passage of map signals therethrough. The blanking signals may be generated by employing a film 7 having opaque areas formed thereon at locations corresponding to the locations of the symbols on the films 1 to 6. The film 7 may be scanned by a flying spot scanner in synchronism with the scanning of films 1 to 6. Thus, there appears at the output of the photoelectric cell pickup and amplifier unit 61 a blanking pulse occurring simultaneously with any symbol signal. As a result, the map signal is suppressed in a small area surrounding the symbol so that no degradation of the symbol occurs.

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The present system may be employed with a display device presenting a monochrome display such as provided by a single-gun cathode ray tube presenting a black and white display. In such an application, the circuit and operation is the same as that described for a single gun of the shadow-mask color tube. Assume, for example, that the display device is a conventional black and white cathode ray tube. Then two classes of symbols may be displayed; one class of symbols is displayed as bright symbols on a dark background; another class of symbols is displayed as dark symbols, each inside a small bright area only slightly larger than the symbol. This display of two classes of symbols corresponds, for example, to the "red on black" and "black on red" display described in connection with FIGS. 1, 1a and 1b where the red is the bright part of the display.

If the display device is a single-gun cathode ray tube presenting a monochrome display, the gun preferably is biased so that, in the absence of applied signal, the screen is comparatively dark. Thus, the gun may be biased to or close to beam current cut-off, or it may be preferred in some cases to bias the gun so that the beam current, in the absence of applied signal, is at substantially less than maximum beam current, as for example at one-half maximum beam current.

One example of a monochrome display employing the invention is a display showing stock on hand in a store. The two classes of symbols may be (1) the symbols representing merchandise of which there is enough on hand, and (2) the symbols representing merchandise on hand which is below the minimum quantity requirement. The first class of symbols may be shown as "bright on dark" symbols, and the second class of symbols shown as "dark on bright" symbols.

What is claimed is:

In a system for displaying symbols, a display device, means for producing signals representative of the configuration of certain of said symbols, means for applying said signals to said display device with a polarity to make said symbols appear on said display device as bright symbols against a comparatively dark background, means for producing signals representative of symbol-containing areas, said areas being only slightly larger than the symbol inside the area, means for applying said last-mentioned signals to said display device with a polarity to make said last-mentioned symbols each appear on said display device as a comparatively dark symbol against a small surrounding bright area background, a circuit through which signals representative of a background display may be applied to said display device, a gate in said circuit, means for producing blanking pulses each of which occurs simultaneously with the occurrence of said signals representative of said symbols and said symbol-containing areas, and means for applying said blanking pulses to said gate to make it ineffective to pass signals for the duration of each blanking pulse.

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