

April 5, 1938.

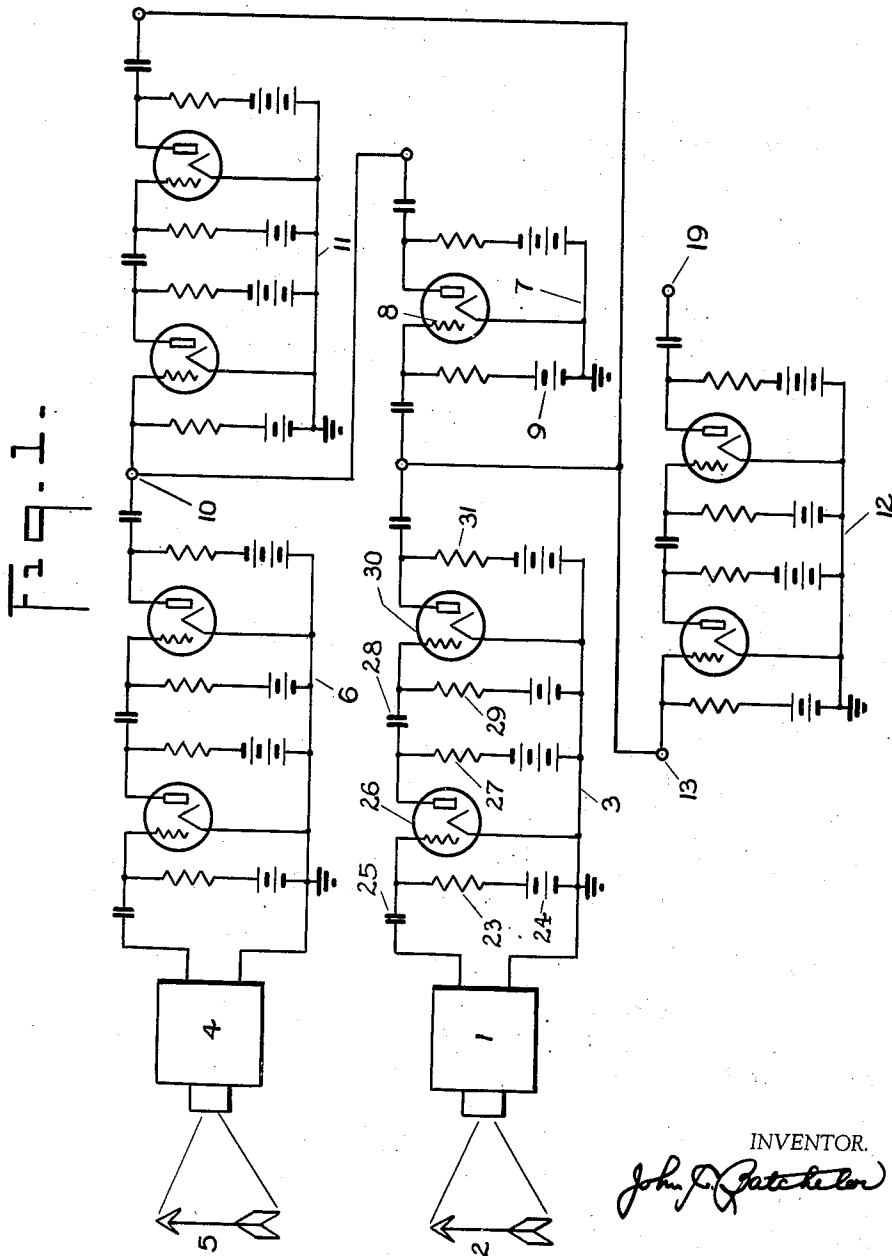
J. C. BATCHELOR

2,113,473

ELECTROOPTICAL METHOD AND APPARATUS

Filed Jan. 10, 1935

3 Sheets-Sheet 1



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Fig. 2.

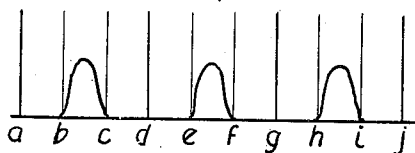


Fig. 3.

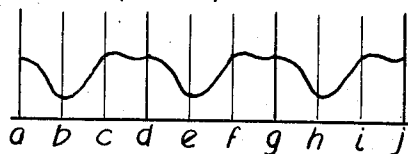


Fig. 4.

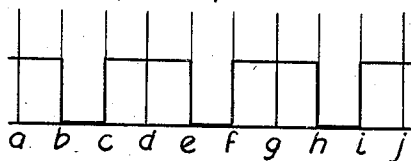


Fig. 5.

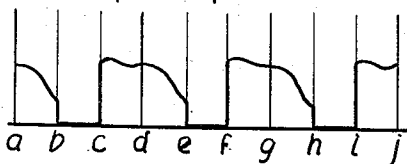


Fig. 6.

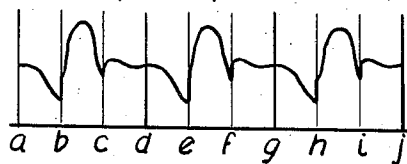
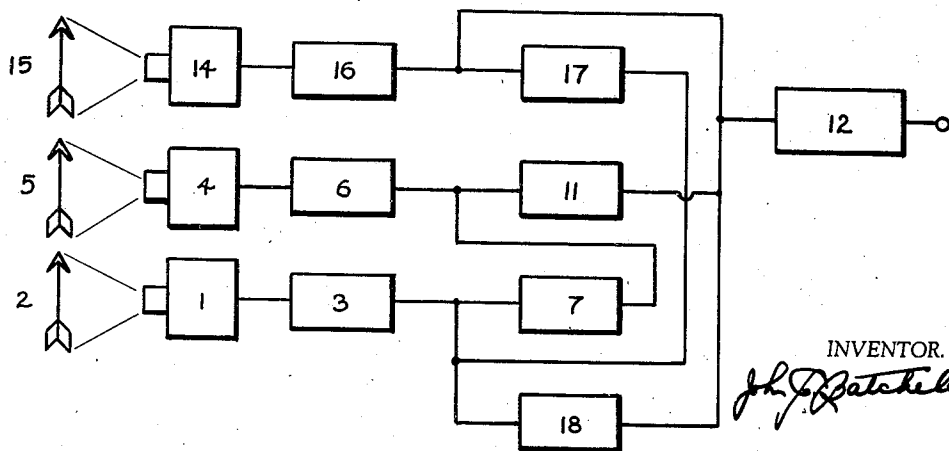


Fig. 7.



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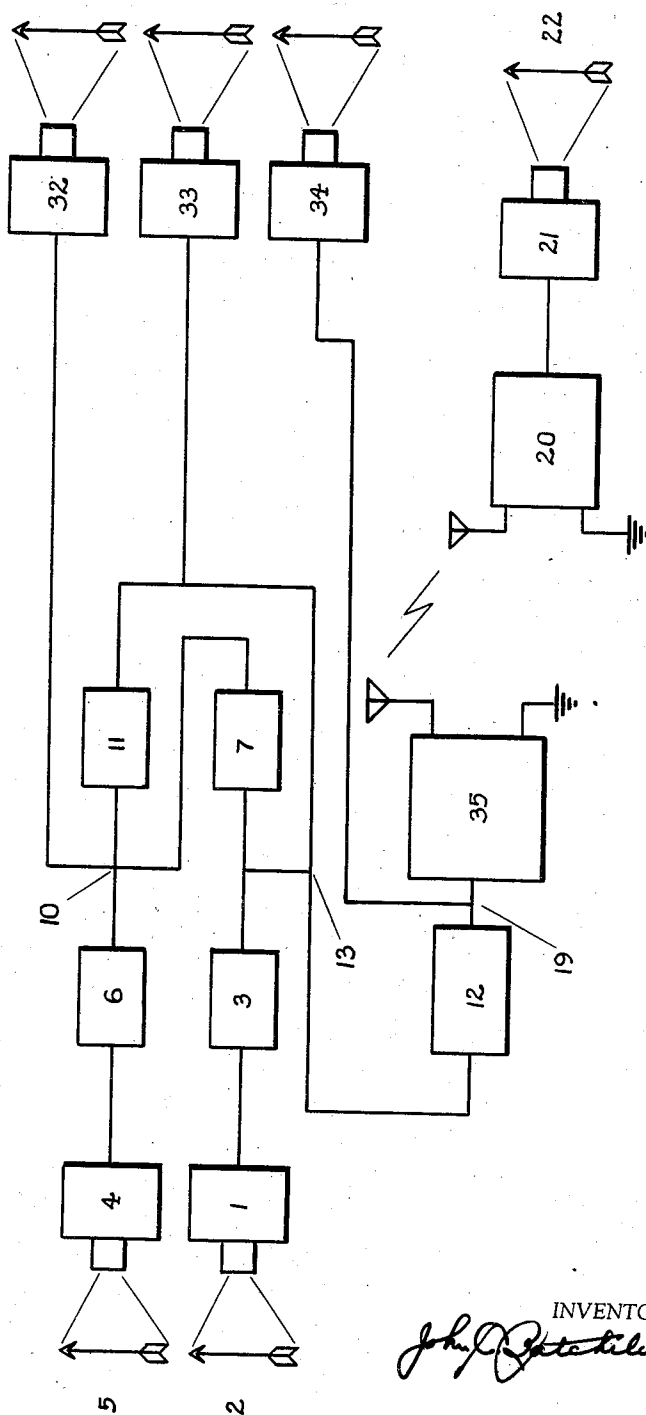
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Fig. 3.



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ELECTROOPTICAL METHOD AND
APPARATUS

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10 Claims. (Cl. 178—7.1)

My invention relates primarily to a television method, and, more particularly, to such a method and system wherein it is possible to combine signals resulting from the scanning of a plurality of objects in a manner such that when an image is reproduced from the combined signals, the illusion of a single group of objects having been scanned is created.

In the art of producing images for television transmission it is often desirable to portray action of a player or players before a background which is in the spirit of the action being portrayed. In order to do this, it is customary to follow the practice ordinarily followed in theatrical presentations and the like, of providing decorated scenery and other properties in such a manner that the action occurs among such properties and before such scenery. The provision of such scenery and properties, although adaptable to television practice, represents a very large cost, particularly in view of the fact that in general a performance for television transmission purposes is made but once and therefore the scenery must be redesigned and redecorated in order to render it adaptable for use in subsequent presentations.

Furthermore, in many cases where it is desirable to present action appearing against natural settings it is difficult or impossible to provide such settings in a studio for the purpose of transmitting television images thereof, and consequently the scope of subjects which lend themselves to television service is necessarily limited under present methods. Still further, in cases where action is to be portrayed against such backgrounds as street scenes, mob scenes and the like, it is necessary, in addition to providing suitable painted scenery, to provide a large number of people to make up the personnel for such scenes.

With the foregoing in mind, it is an object of my invention to provide means for utilizing as the background for action in programs for television transmission, miniature sets of scenery in a manner such that images of the action may be superimposed upon images of the miniature set without mutual interference between the two groups of signals. It is a further object of my invention to provide means for superimposing images of the action upon photographic reproductions of objects before which it is desired that the action appear to take place. Still further, it is an object of my invention to provide means for superimposing images of the action upon a background provided by motion picture film of

whatever subject may be desired, such as street scenes, outdoor scenes, marine scenes or crowds.

These and other objects will be readily apparent from the following descriptions of my invention.

In accordance with my invention, I prefer to use two television scanning devices of which one is adapted to scan the action of the performers acting before a background of uniform actinic value, and the second adapted to scan the material being used as the background for the performers. Means are provided whereby it is possible to utilize the output of the performer scanner to eliminate from the output of the scenery scanner, the components of the signal from the latter scanner at the points where they would coincide with the signal corresponding to the performer. Further means are provided for subsequently mixing the two signals in a manner such that the signal corresponding to the performer coincides with the space from which a portion of the scenery signal was obliterated, so that the resultant signal comprises the combination of the scenery and performer signals, and the portion of the scenery which should appear immediately behind the performer does not appear in an image reproduced from the final signal.

In order to explain my invention I shall refer to the appended diagrams showing certain embodiments of my invention. In the drawings, Figure 1 represents a schematic circuit of the scanning system; Figure 2 represents the voltage wave of the performer pre-amplifier output; Figure 3 represents the voltage wave of the scenery pre-amplifier output; Figure 4 represents the voltage wave of the output of the distorting amplifier; Fig. 5 represents the voltage wave of the mixer amplifier output; Figure 6 represents a voltage wave of the final output of the apparatus; Figure 7 represents a schematic circuit of a modified scanning system; and Figure 8 represents a schematic circuit of one embodiment of my system.

Referring to Figure 1, I have provided a television scanning device 1 which may be of any suitable type such as Nipkow disc, electronic scanning tube or other type of scanner adapted to produce a series of electrical impulses corresponding to a rhythmic scanning of the object 2 which may be the performers and/or other objects peculiar to the particular scene being portrayed. The signals created by the scanner 1 are amplified by the picture signal pre-amplifier 3 which may be of the conventional resistance coupled type and so designed that the phase

angle between the input and output signals is substantially zero. In the amplifier shown, the signal output from the scanner 1 is impressed upon the resistor 23 and bias battery 24 through the coupling capacitor 25 and is thus caused to modulate the grid of the thermionic amplifier tube 26. The output of the tube 26 appearing across the resistor 27 is in phase opposition to the input signal, and is appreciably greater in voltage. The voltage appearing across the resistor 27 is communicated through the coupling capacitor 28, to the resistor 29 and the grid of the tube 30. In this tube the signal is again amplified and the phase is again reversed, so that the output of the amplifier 3 appearing across the resistor 31 consists of a signal in phase with and greater than the input from the scanner 1.

A second scanning device 4, of any suitable type, is adapted to scan the object 5 comprising the scenery and/or other properties before which it is desired that the action of the object 2 appear to take place. The signal resulting from the operation of the scanner 4 is amplified by the scenery signal pre-amplifier 6, similar to the picture signal pre-amplifier 3.

When the voltage output of the picture signal pre-amplifier 3 is plotted as an ordinate against time as an abscissa, the wave form may for a single performer be as shown in Figure 2 where the time interval required for the scanning of one horizontal line in the case of rectilinear scanning, is represented by $a-d$, $d-g$ and $g-j$. If the background on which the performer appears is black and the light on the performer causes a positive voltage in the output of the amplifier 3, the signal will rise to a positive value as shown in the intervals $b-c$, $e-f$ and $h-i$. The output of the scenery signal pre-amplifier 6 may be similarly represented as shown in Figure 3. Thus it is apparent that, were the two signals mixed directly, there would result a certain fusion in a reproduced image which would create the appearance of the performer actually moving through the scenery.

In order to mix the signals from the amplifiers 3 and 6 in a manner such that the action appears to take place before the scenery, I have provided the distorting amplifier 7 of a nature such that a phase difference of pi radians exists between its input and output terminals, and this amplifier further has its grid 8 so biased by the battery 9, and has a tube of such constants, that as long as there occurs at the output of the picture-signal pre-amplifier 3 any signal having a value greater than zero, the maximum output of the amplifier 7 appears at its terminals. In this condition, when the signal represented in Figure 2 is impressed upon the amplifier 7, an output wave from the amplifier 7 is obtained similar to that shown in Figure 4, in which it is apparent that the phase angle has been changed by pi radians and the amplitude of the signal of Figure 4 reaches its maximum negative value at any point where the signal of Figure 2 has any value greater than zero. The output of the amplifier 7 is then conducted to the input terminal 10 of the mixing amplifier 11 which is similar to amplifiers 3 and 6. In addition, the output of the scenery signal amplifier 6 is also impressed upon the amplifier 11 at the terminal 10 so that the signals represented in Figures 3 and 4 are mixed or added each to the other in a manner such that the resultant output of the amplifier 11 will, in the case shown, have a voltage wave as shown in Figure 5, in which the intervals $b-c$, $e-f$ and

$h-i$ have a voltage corresponding to zero illumination from an object which might have generated such a signal. Thus, were the signal of Figure 5 used directly to reconstruct a television image, the image would appear to be that of the object 5 on which had been superimposed a silhouette of the object 2.

The signal output from the amplifier 11 is then conducted to the input terminal 13 of the amplifier 12, together with the output of the picture signal amplifier 3 in a manner such that the signals represented in Figures 2 and 5 are mixed to produce the signal of Figure 6 comprising components corresponding to the object 5 in the time intervals $a-b$, $c-e$, $f-h$ and $i-j$ and to the object 2 in the intervals $b-c$, $e-f$ and $h-i$. Thus when the signal of Figure 6 is used in the synthesis of a television image, the resulting image will appear to be that of the action of the object 2 occurring before the background object 5, and there will be no reproduction at the receiver of such parts or portions of the background 5 as would in reality be coincident with and therefore obscured to the eye by the object 2 if both objects 5 and 2 were composite on the same stage.

It is apparent that more than two objects may be used in accordance with my system by the simple addition of suitable scanning, amplifying and mixing devices. It is possible, further, by suitable combination of my circuits and devices to create the illusion of action taking place between two sets of scenery and/or properties so that the performers may be made to appear to pass behind all objects which appear before one scanner and before all objects which appear before a second scanner. Thus in Figure 7 the scanner 1 is provided for the performing object 2 and the scanner 4 for the background scenery object 5. Further, the amplifiers 3 and 6 are provided for amplifying the outputs of the scanners 1 and 4 and the distorting amplifier 7 and mixing amplifier 11 are provided as in the previous embodiment. In addition, another scanner 14 is provided to scan the object 15 designed to represent objects behind which the performance of the object 2 is to appear. A suitable signal pre-amplifier 16 having substantially zero phase shift is provided, and, since its output is always to be the foremost object in the final image, the output of the amplifier 16 is conducted directly to the final amplifier 12. Since the output of the picture signal amplifier 3 is to be obscured at points where objects appear in the scene 15, an additional distorting and phase reversing amplifier 17 is provided to produce a negative, block type signal similar to that of Figure 4 and corresponding to objects in the scene 15. The output of the amplifier 17 is added to the output of the picture signal pre-amplifier 3 at the input terminal of an additional mixing amplifier 18, similar to the amplifier 11, in a manner such that the output of the amplifier 18 will comprise the signals corresponding to the scanned object 2 over which are silhouetted objects in the scene 15. The output of the mixer amplifiers 11 and 18 are then also conducted to the final amplifier 12 so that the output of the amplifier 12 comprises all of the signal corresponding to the scene 15, the portion of the signal corresponding to the object 2 not obscured by a part of the signal from the scene 15 and the part of the signal from the object 5 which is not obscured by either of the signals resulting from the object 2 and the scene 15.

Thus, it may be seen that, following the principles set forth in the foregoing specification, many desirable illusory effects may be realized with great economy of scenery and properties.

By means of my device, further, it is possible to save considerable studio space in a direction along the optical axis of the performer scanner, because, by suitable choice of optical systems for the scanners, the scenery may be made to appear at great distances before or behind the performers. Furthermore, the illusion of continuous motion of scenery or performers over great distances may be created by suitable lenses and moving scenery, pictures of scenery or other objects used to provide the set.

A complete system embracing scanning, mixing, transmitting and receiving apparatus is shown in Figure 8 which includes the apparatus shown in Figure 1 with the addition of apparatus for transmitting and receiving signals, and reproducing an image therefrom. In this embodiment, the radio transmitter 35 is controlled by the amplifier 12 and is caused to radiate signals corresponding to the image signals created by the scanning and mixing apparatus. Radio receiving apparatus 20 is provided to receive and demodulate signals radiated by the transmitter 35. The output of the receiver 20 is impressed upon the image reproducer 21 whereby an image 22 is reproduced. Thus, an image 22 is reproduced which comprises images of portions of each of the scenes 2 and 5 at various, non-coincident areas.

In order to reproduce images from the signals generated by my system I have found it convenient to use a cathode ray tube reproducer of any of the several types well known in the art. It is possible, however, to use my system with any type of receiving apparatus in which the scanning routine is similar to that used by the scanning devices.

In many cases, for the purpose of facilitating proper adjustment of the various amplifiers, I have found it convenient to provide television image reproducing means operated from the outputs of the various amplifiers whereby the performance may be observed at any desired stage of the distorting and mixing operations. For example, in Figure 8, image reproducers 32, 33 and 34 have been connected at the terminals 10, 13 and 19, respectively, to facilitate adjustment of the amplifiers in the circuit. Obviously, a single reproducing means may be used and switched to the various points successively.

It is apparent that, by means of my apparatus, any desired degree of differential relative predominance may be created between various objects scanned, and by this means many interesting spectral effects and the like may be produced.

Moreover, various combinations of actinic values for the performer background and characteristics of distorting amplifiers may be devised by those skilled in the art, and such modifications should not be construed as limiting the scope of this invention as set forth in the following claims.

I claim:

1. In a television transmitting system, first, second and third scanning devices each operating independently of the others to scan different fields of view simultaneously, means driven by the picture signals developed by the first scanning device and operating responsive to such signals to eliminate the picture-signal wave from the third scanning device, means driven by the

picture signals developed by the third scanning device and operating responsive to such signals to eliminate the picture-signal wave from the second scanning device, and an amplifier common with respect to said scanning devices for combining the output signal waves therefrom.

2. In the art of television transmission, the method of producing a series of composite signals representing a composite scene including portions of each of two scenes and recurring at least at a rate of the order of that of motion picture frame repetition which comprises scanning a first scene to produce a first signal, transmitting said first signal to a first external circuit, simultaneously scanning a second scene to produce a second signal, said second signal including portions representing those parts of said second scene in whose stead it is desired to incorporate said first scene so that all portions of said signal may be immediately dissipated, transmitting said second signal to a second external circuit, removing from said second signal in said second external circuit the portions thereof at points where the insertion of said first signal is required, and mixing said second signal so modified and said first signal to produce a composite signal.

3. In the art of television transmission, the method of producing a series of composite signals representing a composite scene including portions of each of two scenes and recurring at least at a rate of the order of that of motion picture frame repetition which comprises scanning a first scene to produce a first signal, transmitting said first signal to a first external circuit, simultaneously scanning a second scene to produce a second signal, said second signal including portions representing those parts of said second scene in whose stead it is desired to incorporate said first scene so that all portions of said signal may be immediately dissipated, transmitting said second signal to a second external circuit, utilizing said first signal to modify said second signal by diminishing the magnitude thereof at points where the insertion of said first signal is required, and mixing said second signal so modified and said first signal to produce a composite signal.

4. In the art of television transmission, the method of producing a series of composite signals representing a composite scene including portions of each of two scenes and recurring at least at a rate of the order of that of motion picture frame repetition which comprises scanning a first scene to produce a first signal, transmitting said first signal to a first external circuit, simultaneously scanning a second scene to produce a second signal, said second signal including portions representing those parts of said second scene in whose stead it is desired to incorporate said first scene so that all portions of said signal may be immediately dissipated, transmitting said second signal to a second external circuit, utilizing said first signal to suppress in said second signal the portions thereof at points where the insertion of said first signal is required, and mixing said second signal after said suppression and said first signal to produce a composite signal.

5. In the art of television transmission, the method of producing a series of composite signals representing a composite scene including portions representing portions of each of two scenes and recurring at least at a rate of the order of that of motion picture frame repetition

which comprises scanning a first scene to produce a first signal, transmitting said first signal to a first external circuit, simultaneously scanning a second scene including those portions thereof at which it is desired to incorporate said first scene to produce a second signal, amplifying said first signal, amplifying said second signal, utilizing said first amplified signal to prevent amplification of the portions of said second signal at points where the insertion of said first signal is required thereby producing a modified second signal, and subsequently mixing said first amplified signal with said modified second signal to produce a composite signal.

6. In a television scanning system adapted to produce a series of composite signals from a plurality of views and recurring at least at a rate of the order of motion picture frame repetition, the combination of a first scanning device adapted to scan a foreground view and develop a foreground signal corresponding thereto, a first external circuit for receiving said foreground signal, a second scanning device adapted to scan a background view and develop a background signal corresponding thereto, a second external circuit for receiving said background signal, an amplifier supplied with said foreground signal from said first external circuit and adapted to develop therefrom a control signal for diminishing those portions of the background signal at which it is desired to insert the foreground signal, a mixing amplifier supplied with said control signal and with said background signal and adapted to develop therefrom a modified background signal in which the portions at which it is desired to insert the foreground signal have been diminished, and means for combining said modified background signal and said foreground signal to produce a composite signal.

7. In a television scanning system adapted to produce a series of composite signals from a plurality of views and recurring at least at a rate of the order of motion picture frame repetition, the combination of a first scanning device adapted to scan a foreground view, a first amplifier for amplifying the output of said first scanning device, a second scanning device adapted to scan a background view, a second amplifier for amplifying the output of said second scanning device, an amplifier supplied from said first amplifier and adapted to develop from the output signal of said first amplifier a control signal for suppressing those portions of the output background signal of said second amplifier at which it is desired to insert the foreground signal from said first amplifier, a mixing amplifier supplied with said control signal and the signal from said second amplifier and adapted to develop therefrom a modified background signal from which the portions at which the foreground signal is to be inserted have been removed, and means for combining said modified background signal and said foreground signal to produce a composite signal.

8. In a television scanning system adapted to produce a series of composite signals from a plurality of views and recurring at least at a rate of the order of motion picture frame repetition, the combination of a first scanning device adapted to scan a foreground view and develop a foreground signal corresponding thereto, a second

scanning device adapted to scan a performer view and develop a performer signal corresponding thereto, a third scanning device adapted to scan a background view and develop a background signal corresponding thereto, a first amplifier supplied with said foreground signal and adapted to develop therefrom a first control signal to reduce the intensity of those portions of the background and performer signals at which it is desired to insert the foreground signal, a second amplifier supplied with said performer signal and adapted to develop therefrom a second control signal to reduce the intensity of those portions of the background signal at which it is desired to insert the performer signal, and mixing means supplied with said foreground signal, said performer signal after the operation thereon of said first amplifier and said background signal after the operation thereon of said first and second amplifiers to produce a composite signal.

9. In the art of television transmission, the method of producing a series of composite signals representing a composite scene including portions of each of three scenes and recurring at least at a rate of the order of motion picture frame repetition which comprises scanning a first scene to produce a first signal, simultaneously scanning a second scene to produce a second signal, said second signal including portions representing those parts of said second scene in whose stead it is desired to incorporate said first scene, simultaneously scanning a third scene to produce a third signal, said third signal including portions representing those parts of said third scene in whose stead it is desired to incorporate said first and parts of said second scenes, removing from said second signal the portions thereof at points where the insertion of said first signal is required, mixing said second signal so modified and said first signal to produce a first composite signal, removing from said third signal the portions thereof at points where the insertion of said first composite signal is required, and mixing said third signal so modified and said first composite signal to produce a second composite signal.

10. In the art of television transmission, the method of producing a series of composite signals representing a composite scene including portions of each of three scenes and recurring at least at a rate of the order of motion picture frame repetition which comprises scanning a first scene to produce a first signal, simultaneously scanning a second scene to produce a second signal, said second signal including portions representing those parts of said second scene in whose stead it is desired to incorporate said first scene, simultaneously scanning a third scene to produce a third signal, said third signal including portions representing those parts of said third scene in whose stead it is desired to incorporate said first and parts of said second scenes, removing from said second and said third signal the portions thereof at points where the insertion of said first signal is required, removing from said third signal the portions thereof at points where the insertion of parts of said second signal is required, and mixing said first signal and the unremoved portions of said second and third signals to produce a composite signal.