Sept. 12, 1939. A. N. GOLDSMITH 2,172,936

TELEVISION CONTROL SYSTEM

Filed July 9, 1937 2 Sheets-Sheet 1

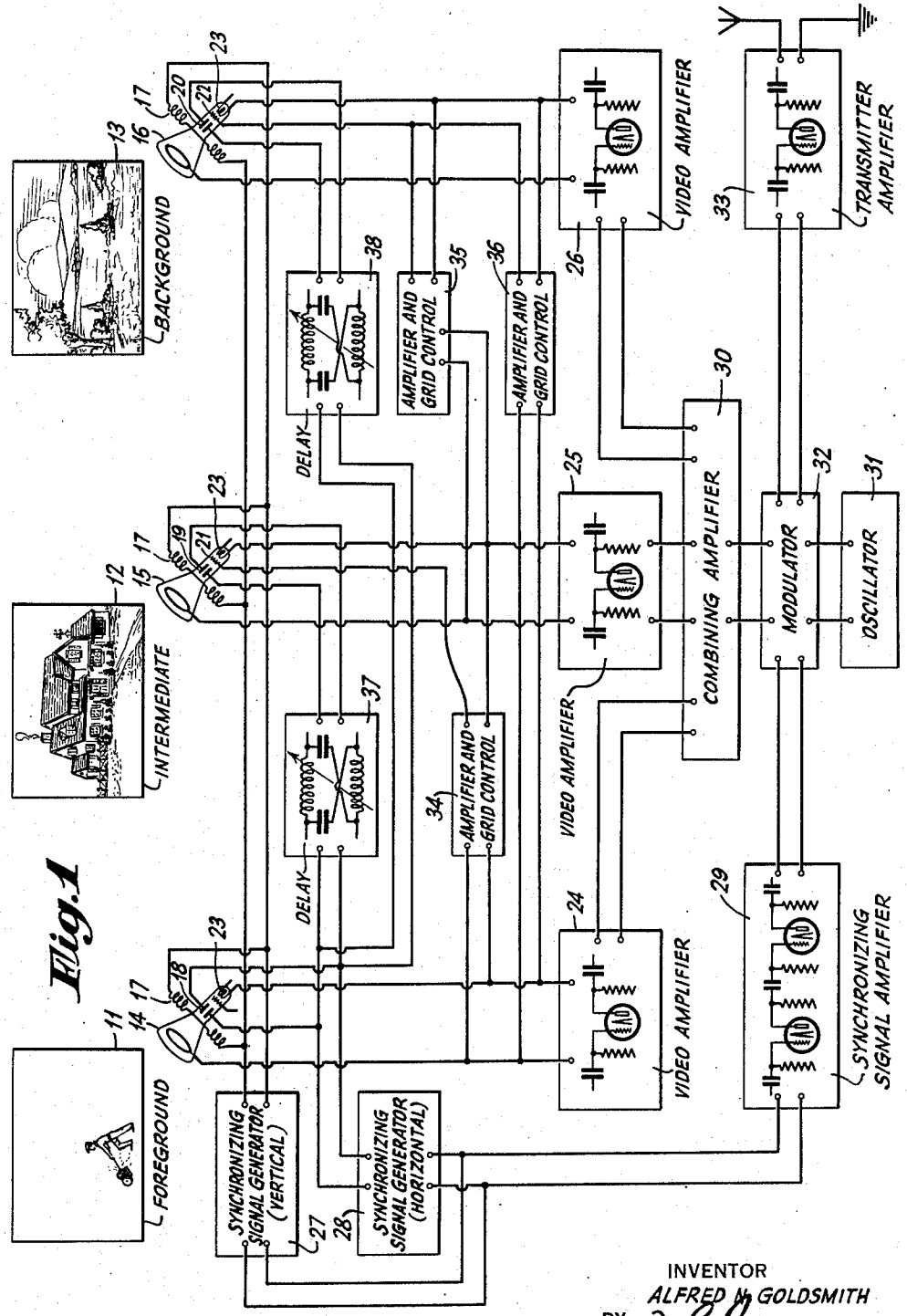


Fig. 1

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Fig. 2

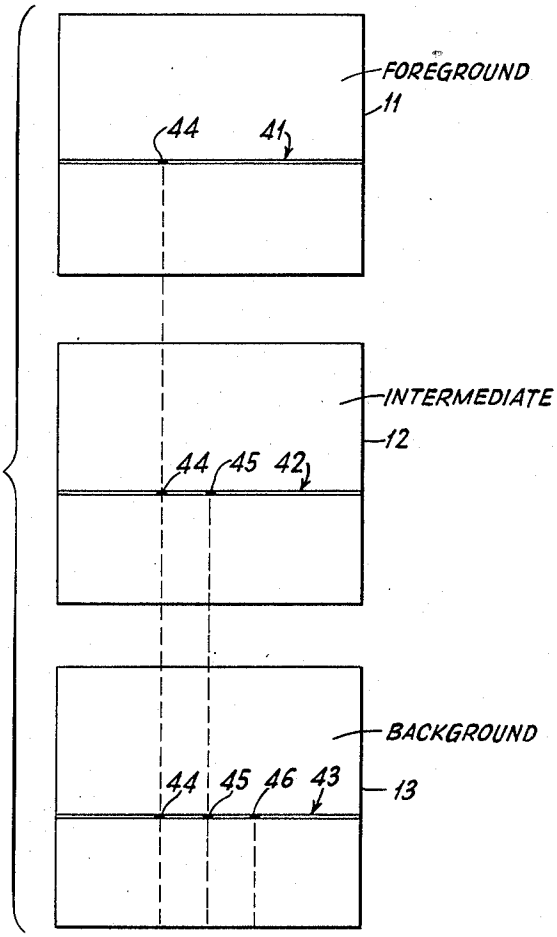
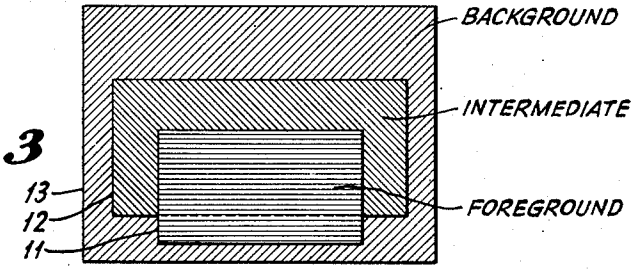


Fig. 3



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TELEVISION CONTROL SYSTEM

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10 Claims. (Cl. 178—7.2)

This invention relates to a system for producing composite pictures particularly as applied to television systems wherein it is desired to combine two or more images to produce a picture having the objects superimposed in a particular manner.

In the production of television pictures, it is not always feasible or possible to have available all of the natural settings necessary to produce the particular results desired in conformity with the studio production being given, and for this reason it becomes necessary to produce the desired picture by using some other means. It may become necessary, for instance, in a certain production to provide a forest scene or some landscape scene which cannot, of course, be brought or economically simulated into the studio. Under these conditions a still or moving-picture film is made of the particular desired background scene, and a composite picture is then produced using a portion or all of the still or moving picture scene with the actors or foreground scene superimposed thereon.

One object of the invention is, therefore, to provide means for producing composite pictures wherein the foreground, background or any other plane of action may be combined to produce a single picture having the particular desired portions of each of the separate scenes.

A further purpose of the invention is to provide means whereby a portion of the desired scene may be derived from a still picture or a moving picture film, the remaining portion being supplied from material or persons within the studio.

Another purpose of the present invention is to provide means whereby each of the different individual scenes to be fabricated may be scanned individually and the electrical impulses or signals derived therefrom combined in a particular manner under the controlling purely electrical means.

A further purpose of the invention is to provide a system wherein it is possible to place the actors in the foreground or background or any other plane of action and so combine the signals derived from scanning the separate scenes as to produce a realistic and natural appearance when the video signals resulting from scanning each separate field of acting are combined as will hereinafter be explained and from the combined signals or composite picture is reproduced as an electro-optical representation at desired receiving or monitoring points.

A further purpose of the invention is to provide means whereby the combining of the separate portions of the scenes and the contours or boundaries of the portions so combined are sharp and well defined in order that ghost-like images over a portion of one or more of the scenes or along the lines of demarcation between the portions of the scenes may be prevented.

A still further purpose of the invention is to provide a means whereby the means for producing sharp definition of the composite picture may be adjusted in order that the inherent delays in the operation of the system may be properly and sufficiently compensated for.

A still further purpose of the invention is to provide means whereby the scanning of the separate views may be carried on independently and simultaneously but may be controlled by appropriate electrical means so that scansion takes place in what is, in effect, a slightly out-of-phase operation.

Still further objects of the invention will become apparent and at once suggest themselves to those skilled in the art to which this invention is related, by reading the following specification and claims, particularly in connection with the drawings, in which:

Fig. 1 illustrates a system for producing composite pictures and for assuring sharp definition of the resulting composite picture,

Fig. 2 represents schematically a plurality of object areas and illustrates the inherent delay in the operation of a portion of the system, and

Fig. 3 shows a manner in which a plurality of views may be superimposed.

In Fig. 1 is shown a plurality of object areas 11, 12 and 13. These areas represent respectively the foreground, intermediate or middleground, and background of a picture that is to be combined to produce one single composite picture. Each of these separate object areas are individually scanned to produce independent series of signal impulses. These scanning systems are preferably in the form of cathode ray tube scanning devices, of the type described and disclosed by V. K. Zworykin in the Journal of the Institute of Electrical Engineers (British), vol. 73, Number 442 for October, 1933, on page 440 et seq., as well as the Proceedings of the Institute of Radio Engineers for January 1934, and further illustrated by his Patent Number 2,021,907, assigned to Radio Corporation of America or the pending application of V. K. Zworykin, Serial No. 732,750. The scanning devices have not been shown in detail, but it is to be understood that each includes a photosensitive mosaic (prepared, for example, as disclosed in U. S. Patents No.

2,020,305 of November 12, 1935, and No. 2,065,570 of December 29, 1936) upon which the object area is projected, with an electrode associated therewith from which electrical impulses may be derived. Each of the scanning devices also include means, such as an electron gun, for producing a cathode ray beam and separate means for causing vertical and horizontal deflection of the beam in order that the mosaic electrode upon which the optical image is cast may be systematically scanned. Each of the scanning devices also includes a control electrode element for controlling the intensity of the beam as generated by the electron gun.

The vertical deflecting means for scanning devices is shown at 17 in the figure and the energization of this means is controlled by the vertical synchronizing signal generator 27. In order that all of the scanning devices may be operated in synchronism, and that each scansion cycle may begin and end at exactly the same time in each of the scanning devices, all of the vertical deflecting means 17 of the scanning devices 14, 15 and 16 are connected in parallel.

The signal impulses as produced by each of the scanning devices are amplified by appropriate video frequency amplifiers 24, 25 and 26 which may be of the general character shown by United States patent of J. P. Smith, No. 2,045,315, or A. C. Stocker, No. 2,045,316, for example, which are individual to the particular scanning devices 14, 15 and 16 respectively. The outputs of the video frequency amplifiers are connected to a combining amplifier 30 and the output of this amplifier, together with the output of the synchronizing signal amplifier 29 and the oscillator 31 are fed to a modulator 32 which, in turn, supplies modulated radio frequency oscillations to a transmitter amplifier 33 to which the aerial network for the television broadcast system is connected.

With the system as so far described, and with each of the scanning devices operating, there will appear at the modulator a series of impulses or signals corresponding to the combined impulses of all of the scanning devices. If this train of impulses or signals were transmitted the result would be a ghost-like appearance of the separate views at the receiving apparatus. In order to prevent this, means are provided for suppressing the signals as generated by the intermediate and background scanning devices whenever an object is being scanned by the foreground scanning device 14. A similar means is also provided for suppressing the signals as generated by the background scanning device 16 whenever an object is being scanned by the intermediate scanning device 15. These means comprise the amplifier and grid control units 34, 35 and 36. The input of the first of these units is connected to the output of the scanning device 14 so that whenever an object is being scanned by this scanning device (which is assumed to be associated with the foreground) an output will appear at the amplifier 34. The output of the amplifier and grid control unit 34 is connected to the control grid 21 of the scanning device 15. A similar amplifying and grid control unit 36 is connected to the output of the scanning device 14 and the output of this amplifier is connected to the control grid 22 of the scanning device 16. Whenever there is a presence of signals from the scanning device 14, the amplifier and control devices 34 and 36 supply a voltage to the grid control elements 21 and 22 of the scanners 15 and 16, respectively, in order that the operation of these scanners will be blocked and, as a result, no signal output will be present from these scanning devices. Likewise, an amplifier and grid control unit 35 is connected to the output of the scanning device 15 which in turn controls the potential of the control grid 22 of the scanning device 16. Because of this unit the presence of signal current from the scanning device 15 blocks the operation of the scanner 16 so that no signal impulses are supplied to the video frequency amplifier 26 whenever signals are present as a result of scanning the intermediate or middleground field.

From the above description, it may be seen that the presence of an object before the scanning device 14 and the scanning of this object will suppress the operation of both of the scanning devices 12 and 13 associated with the intermediate and background area. Likewise, the scanning of an object in the intermediate area will suppress the operation of the scanner associated with the background area.

In actual operation, it has been found that in using the system as so far described a certain amount of fuzziness or ghost-like appearance is present along the side boundaries of objects appearing in the different action planes of the composite picture, that is, the line of demarcation between objects in the foreground and objects in the intermediate or background is not sharp and well defined. This fuzziness or ghost-like appearance along the sides of the separate elements of the composite picture is a result of inherent delays in the operation of the amplifier and grid control units and in the circuits associated therewith. Theoretically, as soon as scanning begins on an object in the foreground, the signals from the intermediate scanner should be immediately eliminated, but in view of the rate at which the scanning is carried out, and the unavoidable electrical lag in the control circuit, the suppression of the signals from the intermediate scanner is not immediate. This fact may best be explained by referring to Fig. 2 in which the foreground area being scanned is represented at 11, the intermediate or middleground at 12 and the background at 13. Let it be assumed that the particular line element being scanned in each of the views is represented at 41, 42 and 43 respectively, and that the particular element of the line 41 in the foreground area that the beam is scanning at the particular instant is at point 44. Suppose that at this instant an object is encountered in the foreground area and as a result a train of signals will start from the scanner 14. This train of signals is supplied to the video frequency amplifier 24 and to the amplifier and grid control unit 34 for controlling the scanning device 15. Before the control unit 34 has had time to take effect on the scanning device 15 and prevent the development of a beam therein, the scanning operation will progress to a point, for instance, as designated at 45. During the time between the points 44 and 45 in the intermediate area, signals are being supplied to the modulator from both the foreground and intermediate areas due to the lag and delay in operation of the control unit 34 and during this interval double images will be produced resulting in a ghost-like image. The same situation is also present with respect to the background area, the time required for the scanner 16 to be blocked corresponding to the distance between points 45 and 46 in the background area 13 of Fig. 2.

In order to compensate for the inherent delay in the electrical control circuit means are pro-

vided whereby the scanning operations of the separate scanning devices 14, 15 and 16 are not in exact synchronism and phase. The horizontal synchronizing signal generator 28 is provided for supplying the horizontal deflecting voltages and the horizontal deflecting plates or means 18 of the scanner 14 are connected directly to this generator. In order to delay the operation of the scanner 15, a delay network 37 is connected between the horizontal deflecting impulse generator 28 and the horizontal deflecting means 19 of the scanner 15. Many types of delay networks are suitable for this purpose and one form is schematically shown by the drawings although many other forms are shown by the Bell System Technical Journal for July 1928, commencing on page 512 et seq., as well as in "Communication Networks", Volume II, by Guillemin, published by John Wiley & Sons, New York. A similar delay network 38 is also connected between the horizontal deflecting impulse generator 28 and the deflecting means 20 of the scanning device 16. These delay networks 37 and 38 are adjustable in order that the very slight delay in the scanning of the intermediate and background areas may be varied in accordance with the inherent delay in the amplifier and grid control units connected to the two scanners.

By the use of these two delay networks it will be seen, therefore, that the intermediate and background scanning devices 15 and 16 will be caused to operate effectively in synchronism with the foreground scanner and that the background scanner 16 will be effectively caused to operate in synchronism with the intermediate scanner 12. When the delay networks 37 and 38 are properly adjusted the cut-off or suppression of operation of the intermediate or background scanners will take place at an instant corresponding to the exact instant at which the foreground scannnig device begins to produce signals as a result of the scanning of an object in the foreground. When these elements are used, therefore, the slight fuzzy or ghost-like appearance along the sides of the foreground objects which are superimposed on an intermediate ground or along the sides of an intermediate object which is superimposed over a background object, is eliminated with the result that the picture as received in the receiving apparatus is clear and more realistic.

It has been found that this ghost-like appearance does not occur at the top and bottom of superimposed views and the reason for this is obviously because of the fact that the scanning is in a horizontal direction and that the delay in the control units is materially less than the length of time required for the scanning devices to scan one line element of area. However, if these effects should become evident in pictures having a materially increased number of lines or a higher scanning rate, they can be eliminated by the methods herein disclosed.

Although the separate delay networks 37 and 38 are individually connected to the horizontal signal generator it is obvious that these networks may be connected in tandem, in which case the input to the delay network 38 would be connected to the output of the delay network 37.

Furthermore, the amplifier and grid control units 35 and 36 are shown as individual and separate units. It is conceivable that these two units may be combined into one unit, the input of which is connected to the signal output of both of the scanning devices 14 and 15 in an appropriate manner, and the output of which is connected to the control grid 22 of the scanning device 16.

Fig. 3 is included for the purpose of showing one manner in which three separate planes of action may be combined. While foreground 11 is being scanned, the portions of the intermediate and background lying directly behind the particular foreground will be suppressed. Likewise, when the intermediate area is being scanned, portions of the background area corresponding to the area immediately behind the intermediate area are also suppressed.

It is to be understood that it is not necessary to have all of the action in the foreground since the actors or moving part of the particular picture being produced may occupy an area corresponding to the intermediate or background planes. For instance, it may be desired to show a person walking behind a hedge, and in front of a wooded area. In such an instance, a film or other picture could be produced for supplying the hedge. A separate and independent film or picture could also be produced for supplying the wooded background. In producing the composite picture, these two films would be scanned separately and simultaneously by the scanning devices 14 and 16, while the scanning device 15 would be used to scan the particular actor as he walks across the television studio. When the signals from the three separate scanning devices are combined, the resulting composite picture is that of a person walking behind a low hedge with a wooded area as a background. By placing the foreground and background portions of the composite picture on moving picture films as in this particular example, the material necessary in the studio for producing the desired composite effect would be no more than the mere presence of the actor.

It is also to be understood that, so far as this invention is concerned, it is not necessary that the scanning devices be controlled by means of their grids but instead the signals from the particular scanning devices may be suppressed by making inoperative their associated video frequency amplifiers through appropriate grid biases or, in fact, by any other means whereby the desired results may be accomplished.

Many other modifications and changes in the invention and its application to other fields of use will of course become apparent to those skilled in the art and it is therefore intended that the invention shall be construed in a broad scope and shall read upon all modifications such as fall fairly within the spirit and scope of the disclosure and of the hereinafter appended claims.

What I claim is:

1. In a composite television system wherein background and foreground areas are provided, means for separately and independently scanning the two areas to produce separate series of video signals, means for reducing the signal level of the series of signals resulting from the background scanning operation during time periods of presence of signals in the series from the foreground scanning operation, means for delaying the scanning operation of the background area by an amount equal to the inherent time delay in the operation of said background signal reducing means, and means for producing from the signals representing the foreground area and the controlled level background area signals in a single series of signals representative of the combined background and foreground areas whereby the delay means may insure proper matching of

the foreground and background areas in the composite picture.

2. A system for producing composite television pictures wherein foreground, middleground and background areas are provided, means for separately and simultaneously scanning each of the areas to produce separate series of video signals, means for suppressing the signals from the middleground and background areas when signals are produced from the scanning of the foreground area, means for suppressing the signals from the background area when signals are produced from the scanning of the middleground area, means for delaying the scanning operation of the middleground and background scanning means by an amount equal to the inherent time delay in the operation of said delaying means in order to insure proper matching of the various areas, and means for combining the unsuppressed signals to form a single series of signals.

3. A system for producing composite television pictures wherein foreground, middleground and background areas are provided, means for separately and simultaneously scanning each of the areas to produce individual series of video signals, means for suppressing the signals from the middleground area when signals are produced from the scanning of the foreground, means for suppressing the signals from the background area when signals are produced from the scanning of the foreground or middleground areas, means for delaying the scanning operation of the middleground and background areas by an amount equal to the inherent time delay in the operation of said delaying means, and means for combining the unsuppressed signals to produce a single series of signals, the delay means operating to produce proper matching of the unsuppressed signals.

4. In a composite television system wherein a plurality of object areas representing different planes of a composite picture are provided, means for separately and independently scanning each of the object areas to produce separate series of video signals, means for suppressing the signals from any and all object areas lying in a plane behind an area from which signals are produced, means for delaying the scanning operation of certain of said scanning means by an amount equal to the inherent time delay in the operation of said suppressing means to insure proper time relation between the various signals, and means for combining the unsuppressed signals to produce a single series of signals.

5. In a system for producing composite television pictures, separate means to scan simultaneously two object areas to produce from each scanning an independent series of signals representative of the light values upon successive elemental areas of each object area, means to assemble the signals of each independent series into a single composite series of signals representative of the scanned object areas superimposed, means to reduce the normal output signal level of one signal producing system under the control of the other signal producing system in accordance with the presence of simultaneously produced signals developed in the other signal producing system, and means to delay the operation of said one signal producing system by an amount equal to the inherent time delay in said reducing means to insure accurate matching of the signals.

6. The method of producing composite television image signals which comprises independently and separately scanning a background and a foreground area to produce from each scanning a series of signals representative of each scanned area, utilizing one of the produced series of signals to control and obscure the other series during period of presence of the controlling signal, delaying the scanning of the background area to produce accurate time relation between the series of signals, and combining the output energy resulting from each scanning to produce a single series of signals representing superpositionings of the scanned areas.

7. The method of producing composite television image signals which comprises independently and separately scanning in a line by line manner a background and a foreground area to produce from each scanning a series of signals representative of each scanned area, utilizing one of the produced series of signals to control and obscure the other series during periods of presence of the controlling signal, adding to the controlling series of signals the resultant controlled series of signals, delaying the scanning of the background area by an amount less than the time required to scan one line, and combining the output energy resulting from each scanning to produce a single series of signals representing superpositionings of the scanned areas, the delaying of the scanning of the background area operating to insure proper matching of the series of signals.

8. The method of producing composite television image signals which comprises independently and separately scanning foreground and background areas, producing from the scannings a plurality of independent electric waves representative of the varying intensity of light and shadow on elemental areas of the scanned foreground and background areas, reducing the signal level of one of the electric waves representing one area to zero value during time periods where the electric wave representing the other area exceeds a predetermined effective intensity, delaying the production of one of the independent electric waves to insure accurate combining of the independent electric waves, and combining the output energy resulting from each scanning to produce a single series of signals representing superpositionings of the scanned areas.

9. The method of producing composite television image signals which comprises independently and separately scanning foreground and background areas in a line by line manner, producing from the scannings a plurality of independent electric waves representative of the varying intensity of light and shadow on elemental areas of the scanned foreground and background areas, reducing the signal level of one of the electric waves representing one area to a predetermined threshold value during time periods where the electric wave representing the other area exceeds a predetermined effective intensity, delaying the production of one of the independent electric waves by an amount less than the time required to scan one line, and combining the output energy resulting from each scanning to produce a single series of signals representing superpositionings of the scanned areas, the delaying operation resulting in accurate combining of the independent electric waves.

10. The method producing composite television image signals which comprises independently and separately scanning in a line by line manner a plurality of areas, producing from the scannings a plurality of independent electric

waves representative of the varying intensity of light and shadow on elemental areas of the scanned areas, reducing the signal level of one of the electric waves representing one area to a threshold value during the time periods when the electric wave representing another area exceeds a predetermined effective intensity, delaying the production of at least one of the independent electric waves to insure proper time relationship between the plurality of independent electric waves, and combining the output energy resulting from each scanning to produce a single series of signals representing super-positionings of the scanned areas.

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