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TELEVISION SIGNAL-REPRODUCING SYSTEM

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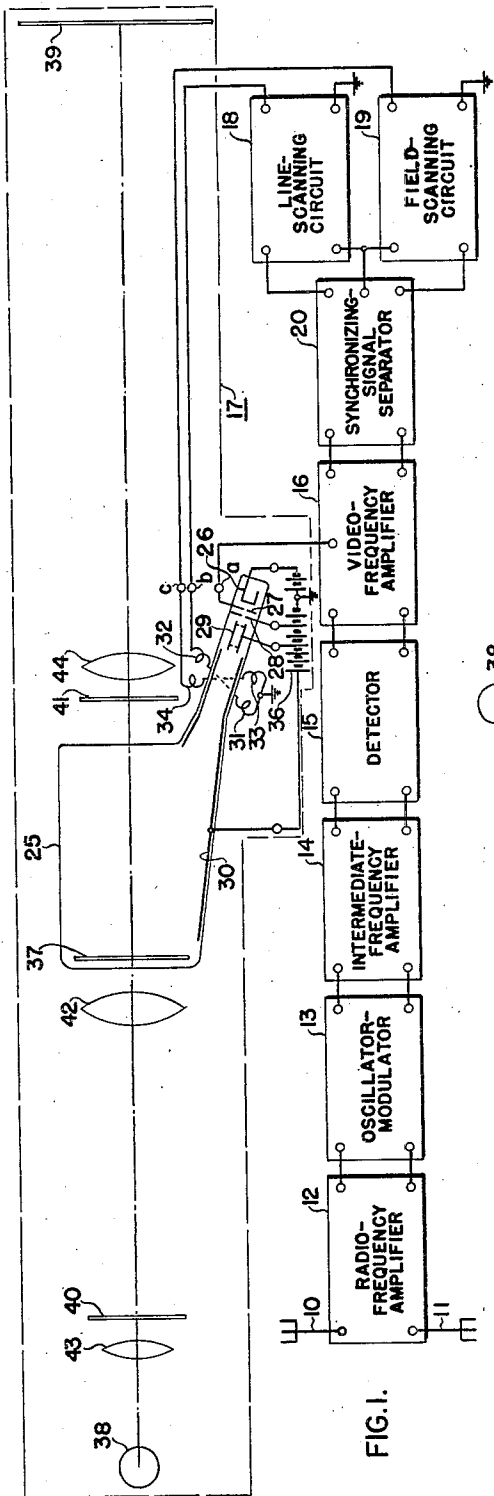


FIG. 1.

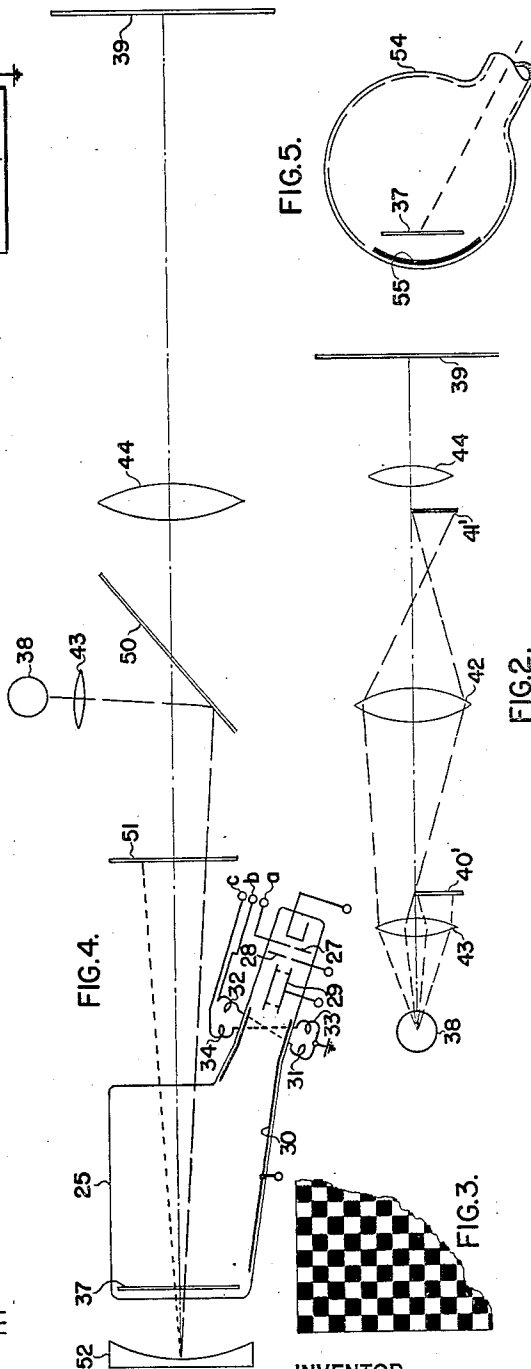


FIG. 2.

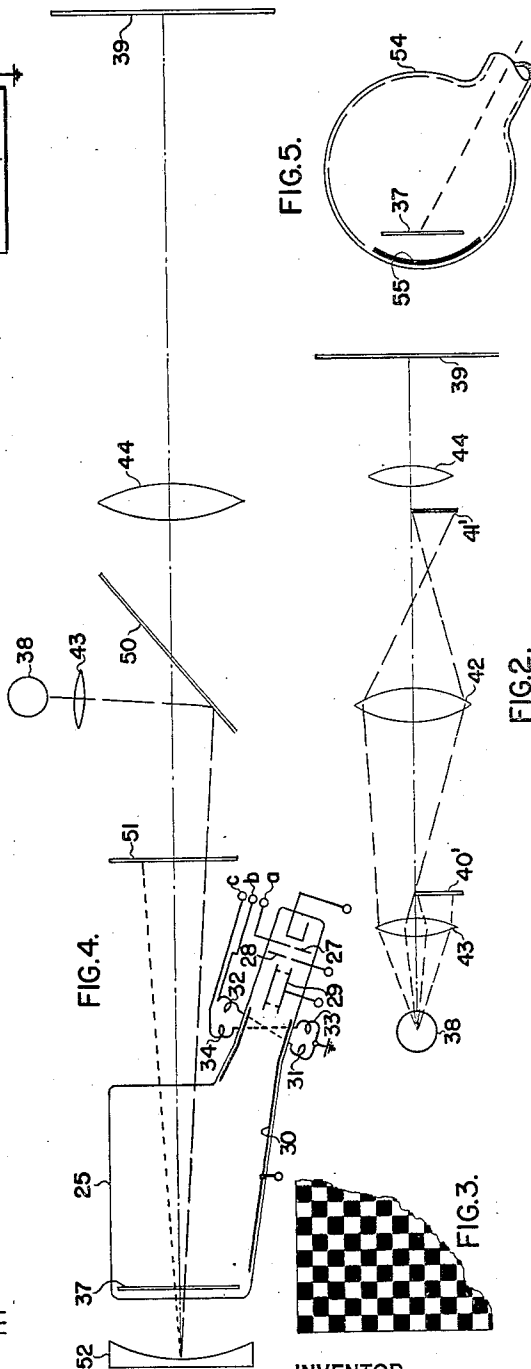


FIG. 3.

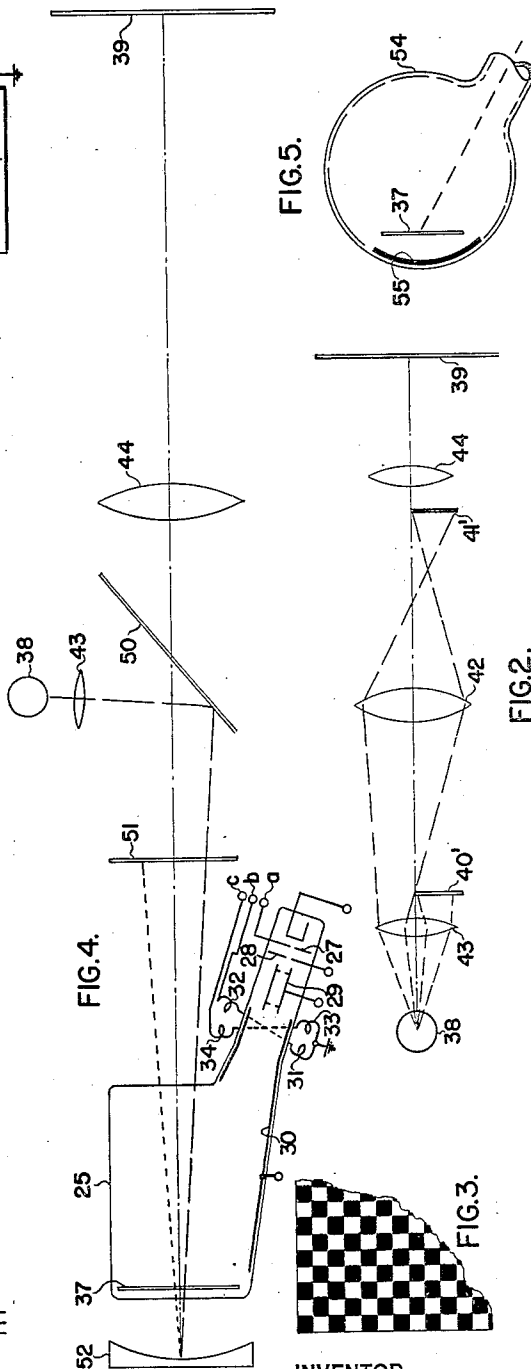


FIG. 4.

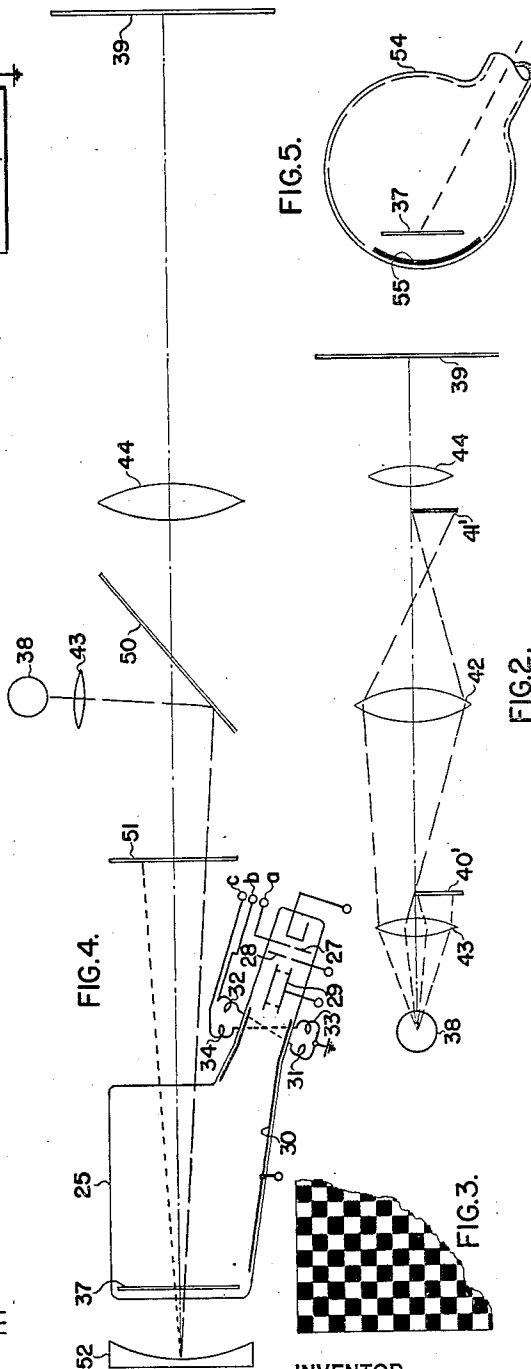


FIG. 5.

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TELEVISION SIGNAL-REPRODUCING
SYSTEM

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10 Claims. (Cl. 178—7.5)

This invention relates to television signal-reproducing systems generally and, particularly, to such systems of the type adapted to project an image of a relatively large size upon a screen.

In a television signal-reproducing arrangement it is frequently desirable to provide a reproduced image of relatively large size and satisfactory average brightness. Such an image has been very hard to procure for the reason that in most television signal-reproducing arrangements which have so far been proposed, the area of the reproduced image for a given average brightness of the reproduced image has been small. While some arrangements of the prior art are effective to produce a very small image with relatively intense average brightness, the average brightness is generally very much less than is desired if such an image is to be projected upon a large screen for viewing by an audience. The reason for this is that the maximum light available in the large image is limited by the amount of light available in the small image and the average brightness is decreased in inverse proportion to the increase in the size of the image.

It is an object of the invention, therefore, to provide an improved television signal-reproducing system which is not subject to one or more of the above-mentioned disadvantages of the arrangements of the prior art.

It is a further object of the invention to provide an improved television image projection system.

It is still another object of the invention to provide an improved television signal-reproducing system in which the maximum amount of light available in the reproduced image is not limited by the maximum amount of light produced by a cathode-ray beam incident on a fluorescent screen.

In accordance with the invention, a television signal-reproducing system comprises, a light source, a viewing means, and masking means having a plurality of elementary transparent portions and a corresponding plurality of elementary opaque portions and interposed in the optical path between the light source and the viewing means. The arrangement also comprises a lens system having a single optical axis disposed in the optical path and including means interposed in the light path between the transparent and the opaque portions normally effective to focus upon the above-mentioned opaque portions at least a portion of the light from the light source passing through the above-mentioned transparent portions. This arrangement also includes means for effectively altering the optical path length of elementary portions of the optical path through the lens system for varying the amount of light blocked from the viewing means by the opaque portions, together with means for con-

trolling the last-named means in accordance with the received television signal to form a visible image of the translated picture on said viewing means.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Fig. 1 of the drawing is a circuit diagram, partially schematic, of a complete television receiver of the superheterodyne type including a television signal-reproducing system in accordance with the invention; Fig. 2 is a diagram utilized to explain the principle upon which the television signal-reproducing system of the invention operates; Fig. 3 is a fragmentary diagram illustrating a detail of a portion of the signal-reproducing system of Fig. 1; Fig. 4 illustrates a modification of a portion of the signal-reproducing system of Fig. 1; while Fig. 5 illustrates a modification of the signal-reproducing device of Fig. 4.

Referring now more particularly to the drawing, the system illustrated comprises a receiver of the superheterodyne type including an antenna system 10, 11 connected to a radio-frequency amplifier 12 to which is connected in cascade, in the order named, an oscillator-modulator 13, an intermediate-frequency amplifier 14 of one or more stages, a detector 15, a video-frequency amplifier 16 of one or more stages, and an image-reproducing system 17. A line-scanning circuit 18 and a field-scanning circuit 19 are coupled to the output circuit of video-frequency amplifier 16 through a synchronizing-signal separator 20 and to the signal reproducing system 17, presently to be described in detail.

The stages or units 10—16, inclusive, and 18—20, inclusive, may all be of conventional well-known construction so that detailed illustration and description thereof are deemed unnecessary herein. Referring briefly, however, to the operation of the system described above, television signals intercepted by antenna circuit 10, 11 are selected and amplified in radio-frequency amplifier 12 and coupled to the oscillator-modulator 13 wherein they are converted into intermediate-frequency signals which, in turn, are selectively amplified in the intermediate-frequency amplifier 14 and delivered to the detector 15. The modulation components of the signal are derived by the detector 15 and are supplied to the video-frequency amplifier 16 wherein they are amplified and from which they are supplied to a brilliancy-control electrode of the image-reproducing system 17 and to the synchronizing-control elements of the scanning circuits 18 and 19. The intensity of a scanning ray of system 17 is modulated or controlled in accordance with the

video-frequency voltages impressed upon a control electrode in the usual manner. Scanning waves are generated in the line-scanning and field-scanning circuits 18 and 19, which are controlled by synchronizing-voltage pulses supplied from video-frequency amplifier 16, and applied to the scanning elements of the image-reproducing system 17 to produce electric-scanning fields, thereby to deflect the scanning ray in two directions normal to each other so as to trace a rectilinear scanning pattern on a screen and thereby construct the transmitted image.

Referring now more particularly to the details of the portion of the system of Fig. 1 embodying the present invention, there is provided in image-reproducing system 17 a cathode-ray tube 25 which may be of conventional type except for the construction of the target electrode thereof. This cathode-ray tube comprises an envelope in which is disposed an electron gun including cathode 26, control electrode 27, first and second accelerating anodes 28 and 29, and a collector electrode 30. Line-scanning coils 31, 32 and field-scanning coils 33, 34 are provided for the cathode-ray tube 25, operating potentials for the tube being provided from a suitable source of unidirectional operating potential such as battery 36. The cathode-ray tube 25 includes a target electrode 37, which is of insulating transparent material, such as mica, adapted to be locally heated by the electron beam of the tube when the beam is incident thereon. The reproducing system 17 also includes a light source 38, a screen or viewing means 39, and masking means having a plurality of elementary transparent portions and a plurality of elementary opaque portions and interposed in the optical path between the source 38 and the screen 39. The masking means comprises a mask 40 having a plurality of elementary transparent portions and a plurality of elementary opaque portions, and a mask 41 also having a plurality of elementary transparent portions complementary to the opaque portions of mask 40 and a plurality of elementary opaque portions complementary to the transparent portions of mask 40. The masks 40 and 41 are arranged in the optical path at the object and image planes of a lens 42, which has a single optical axis disposed in the optical path between the masks, while a condensing lens 43 is provided for concentrating the light from source 38 on the lens 42. The lens system also includes a lens 44 disposed to project the image of screen 37 on the screen 39.

Fig. 2 comprises a schematic diagram for use in explaining the operating principles of the television signal-reproducing system 17 of the receiver of Fig. 1. The arrangement of Fig. 2 comprises an optical system generally similar to that of Fig. 1 and similar elements in the two figures have identical reference numerals. In place of the masks 40 and 41 of Fig. 1, however, there is included in the system of Fig. 2 masks 40' and 41' which are completely opaque, each being effective to block completely at the mask all of the light in the optical path below the horizontal plane including the optical axis of the lens system illustrated. The optical system illustrated in Fig. 2 is one which has been utilized to investigate the effect of convection currents by utilizing the principle known as the "Schlieren effect."

In considering the operation of the arrangement of Fig. 2, it will be seen that the mask 41' is effective to block all of the light in the optical

path, at the position of the mask, below the horizontal plane including the optical axis of the system. Furthermore, it will be seen that the light which is blocked by mask 41' is all that transmitted by the system through the open space above the mask 40'. Therefore, under normal conditions, all of the light from the source 38 is completely blocked by either mask 40' or mask 41' and no light is incident on the screen 39. If, now, heated gas currents are passed through the air near the lens 42, the index of refraction of elementary portions of the optical path of the lens system are slightly changed so that masks 40' and 41' will no longer be exactly at the focal points of the lens 42 and a small amount of light will be passed by the system and fall on the screen 39 to form an image illustrative of the flow of thermal currents near the lens 42. However, the percentage of the total light of the system which can be passed by the arrangement of Fig. 2 is very minute.

In order to provide a useful amount of light in a television reproducing system utilizing the principles described with reference to Fig. 2, each of the masks 40, 41 provided in the system of Fig. 1 is composed of many elementary transparent portions and elementary opaque portions as illustrated by the fragmentary showing of Fig. 3. The lens system of Fig. 1 which has a single optical axis is so disposed in the optical path between the source 38 and the screen 39 that, under normal conditions, the lens system, which includes the lens 42 interposed in the light path between the transparent and the opaque portions, is effective to focus upon the corresponding and complementary opaque portions of mask 41 at least a portion, and preferably all, of the light from the source 38 which passes through the corresponding and complementary transparent portions of mask 40. Preferably one of the masks is produced as a photographic negative of the other so that each of the transparent portions of one mask is exactly complementary to a corresponding opaque portion of the other and vice versa.

The electron beam of tube 25 when scanned over the target electrode 37 is effective to heat successive elemental areas of the target and thereby alter the optical path length of elementary portions of the optical path through the lens system in order to vary or decrease the amount of light blocked from the screen by the successive opaque portions of the mask 41. The intensity of the cathode-ray beam of tube 25 is controlled by control electrode 27 and associated devices in the television receiver in accordance with the amplitude of the received television signal, thereby to form a thermal image of the translated picture on the target 37. The effective optical path lengths of elementary portions of the optical path through the lens system is caused to vary by variations of the index of refraction of target 37, due to heating, which is in the optical path, preferably closely adjacent the lens 42. As a result, the thermal image developed on target 37 is reproduced as a visible image on screen 39 the average brightness of which is limited only by the intensity of the source 38, so that any desired image brightness may be obtained. The control grid 27 and associated elements in tube 25 are therefore included in a means for controlling the electron beam in accordance with a received television signal to form a visible image of the translated picture on the viewing means 39. The target electrode 37, fur-

ther, is included in a temperature-responsive means for effectively altering the optical path length of elementary portions of the optical path through the lens system for varying the amount of light blocked from the viewing means 39 by the opaque portions of mask 41.

In Fig. 4, there is illustrated a modification of a portion of the reproducing system 17 of the invention utilizing a single mask in the two optical paths through which the light from the source is caused to pass in opposite directions. The arrangement of Fig. 4 thus comprises a light source 38, a semi-transparent mirror 50, a mask 51 which may be similar to the mask 40 of Fig. 1, and a concave mirror 52. The remaining portions of the system of Fig. 4 are identical to those of Fig. 1 and similar elements have identical reference numerals. The mask 51, therefore, is interposed in two optical paths between the source 38 and the viewing means 39. Mask 51 is placed at the center of curvature of the concave mirror 52 and the optical system is so disposed that some of the light from source 38 is reflected by the semi-transparent mirror 50 through the elementary transparent portions of mask 51 to the concave mirror 52, the light reflected from mirror 52 being normally completely blocked by the elementary opaque portions of mask 51 in a manner similar to that described above in explaining the operation of the arrangement of Fig. 1. The concave mirror 52 which is disposed in the optical paths of the system is, therefore, normally effective to focus upon the corresponding opaque portions of mask 51 at least a portion of the light from source 38 which passes through the transparent portions of that mask. The local heating caused by the scanning beam of tube 25 incident upon the target electrode 37 is effective to vary the optical path length of elementary portions of the optical path through the lens system, thereby to vary the amount of light blocked from the screen 39 at the opaque portions of mask 51. The lens 44 serves, as above described, to focus the light passed by target electrode 37 as a visible image on screen 39.

In Fig. 5, there is illustrated a portion of a cathode-ray tube which may be used in an arrangement similar to that illustrated in Fig. 4. The tube of Fig. 5 comprises an envelope 54, a target electrode 37 which may be identical to target electrode 37 of the cathode-ray tube 25, and a concave mirror 55 formed as a silver deposit upon the inner surface of the envelope 54, the function of mirror 55 being the same as that of mirror 52 of Fig. 4. The other portions of the tube of Fig. 5 may be identical to those of tube 25 and the operation of the tube of Fig. 5 in a signal-reproducing system in accordance with the invention will be completely understood from the description given above with reference to the arrangement of Fig. 4.

While there have been described what are at present considered to be the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A television signal-reproducing system comprising, a light source, a viewing means, masking means having a plurality of elementary transparent portions and a corresponding plurality of

elementary opaque portions and interposed in the optical path between said source and said viewing means, a lens system having a single optical axis disposed in said optical path and including means interposed in the light path between said transparent and said opaque portions normally effective to focus upon said corresponding opaque portions at least a portion of the light from said source passing through said transparent portions, means for effectively altering the optical path length of elementary portions of the optical path through said lens system for varying the amount of light blocked from said viewing means by said opaque portions, and means for controlling said last-named means in accordance with a received television signal to form a visible image of the translated picture on said viewing means.

2. A television signal-reproducing system comprising, a light source, a screen, masking means having a plurality of elementary transparent portions and a corresponding plurality of elementary opaque portions and interposed in the optical path between said source and said screen, a lens system having a single optical axis disposed in said optical path and including means interposed in the light path between said transparent and said opaque portions normally effective to focus upon said corresponding opaque portions at least a portion of the light from said source passing through said transparent portions, means for effectively altering the optical path length of elementary portions of the optical path through said lens system for varying the amount of light blocked from said screen at said opaque portions, and means for controlling said last-named means in accordance with a received television signal to form a visible image of the translated picture on said screen.

3. A television signal-reproducing system comprising, a light source, a viewing means, masking means having a plurality of elementary transparent portions and a corresponding plurality of complementary elementary opaque portions and interposed in the optical path between said source and said viewing means, a lens system having a single optical axis disposed in said optical path and including means interposed in the light path between said transparent and said opaque portions normally effective to focus upon said corresponding said opaque portions at least a portion of the light from said source passing through said transparent portions, means for effectively altering the optical path length of elementary portions of the optical path through said lens system for varying the amount of light blocked from said viewing means by said opaque portions, and means for controlling said last-named means in accordance with a received television signal to form a visible image of the translated picture on said viewing means.

4. A television signal-reproducing system comprising, a light source, a viewing means, masking means having a plurality of elementary transparent portions and a corresponding plurality of elementary opaque portions and interposed in the optical path between said source and said viewing means, a lens system having a single optical axis disposed in said optical path and including means interposed in the light path between said transparent and said opaque portions normally effective to focus upon said corresponding opaque portions substantially all of the light passing through said transparent portions, means

for effectively altering the optical path length of elementary portions of the optical path through said lens system for decreasing the amount of light blocked from said viewing means by said opaque portions, and means for controlling said last-named means in accordance with a received signal to form a visible image of the translated picture on said viewing means.

5. A television signal-reproducing system comprising, a light source, a viewing means, a mask having a plurality of elementary transparent portions and a corresponding plurality of elementary opaque portions and interposed in two optical paths between said source and said viewing means, a concave mirror disposed in said optical paths normally effective to focus upon said corresponding opaque portions at least a portion of the light from said source passing through said transparent portions, means for effectively altering the optical path length of elementary portions of one of said optical paths through said lens system for varying the amount of light blocked from said viewing means by said opaque portions, and means for controlling said last-named means in accordance with a received television signal to form a visible image of the translated picture on said viewing means.

6. A television signal-reproducing system comprising, a light source, a viewing means, two masking devices each having a plurality of elementary transparent portions and a corresponding plurality of elementary opaque portions and interposed in the optical path between said source and said viewing means, a lens having a single optical axis disposed in said optical path between said devices and interposed in the light path between said transparent and said opaque portions normally effective to focus upon said corresponding opaque portions of one of said masks at least a portion of the light from said source passing through said transparent portions of the other of said masks, means for effectively altering the optical path length of elementary portions of the optical path through said lens for varying the amount of light blocked from said viewing means by said opaque portions, and means for controlling said last-named means in accordance with a received television signal to form a visible image of the translated picture on said viewing means.

7. A television signal-reproducing system comprising, a light source, a viewing means, two masking devices each having a plurality of elementary opaque portions and a corresponding plurality of elementary transparent portions and interposed in the optical path between said source and said viewing means, said elementary opaque portions of each of said masks being complementary to said elementary transparent portions of the other of said masks, a lens having a single optical axis disposed in the optical path between said devices and interposed in the light path between said transparent and said opaque portions normally effective to focus upon said corresponding opaque portions of one of said masks at least a portion of the light from said source passing through said transparent portions of the other of said masks, means for effectively altering the optical path length of elementary portions of the optical path through said lens for varying the amount of light blocked from said viewing means by said opaque portions, and means for controlling said last-named means in accordance with

the received television signal to form a visible image of the translated picture on said viewing means.

8. A television signal-reproducing system comprising, a light source, a viewing means, masking means having a plurality of elementary transparent portions and a corresponding plurality of elementary opaque portions and interposed in the optical path between said source and said viewing means, a lens system having a single optical axis disposed in said optical path and including means interposed in the light path between said transparent and said opaque portions normally effective to focus upon said corresponding opaque portions at least a portion of the light from said source passing through said transparent portions, temperature-responsive means for effectively altering the optical path length of elementary portions of the optical path through said lens system for varying the amount of light blocked from said viewing means by said opaque portions, and means for controlling said last-named means in accordance with a received television signal to form a visible image of the translated picture on said viewing means.

9. A television signal-reproducing system comprising, a light source, a viewing means, masking means having a plurality of elementary transparent portions and a corresponding plurality of elementary opaque portions and interposed in the optical path between said source and said viewing means, a lens system having a single optical axis disposed in said optical path and including means interposed in the light path between said transparent and said opaque portions normally effective to focus upon said corresponding opaque portions at least a portion of the light from said source passing through said transparent portions, temperature-responsive means for effectively altering the optical path length of elementary portions of the optical path through said system for varying the amount of light blocked from said viewing means on said opaque portions, and means responsive to a received television signal for producing a thermal image on said last-named means, thereby to form a visible image of said picture on said viewing means.

10. A television signal-reproducing system comprising, a light source, a viewing means, masking means having a plurality of elementary transparent portions and a corresponding plurality of elementary opaque portions and interposed in the optical path between said source and said viewing means, a lens having a single optical axis disposed in said optical path and interposed in the light path between said transparent and said opaque portions normally effective to focus upon said corresponding opaque portions a portion of the light from said source passing through said transparent portions, a cathode-ray tube including a target electrode disposed in said path adjacent said lens, means for scanning said target electrode with the electron beam of said tube for effectively altering the optical path length of elementary portions of the optical path through said lens system to vary the amount of light blocked from said masking means by said opaque portions, and means for controlling the intensity of said cathode-ray beam in accordance with a received television signal to form a visible image of the translated picture on said masking means.

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