

May 30, 1967

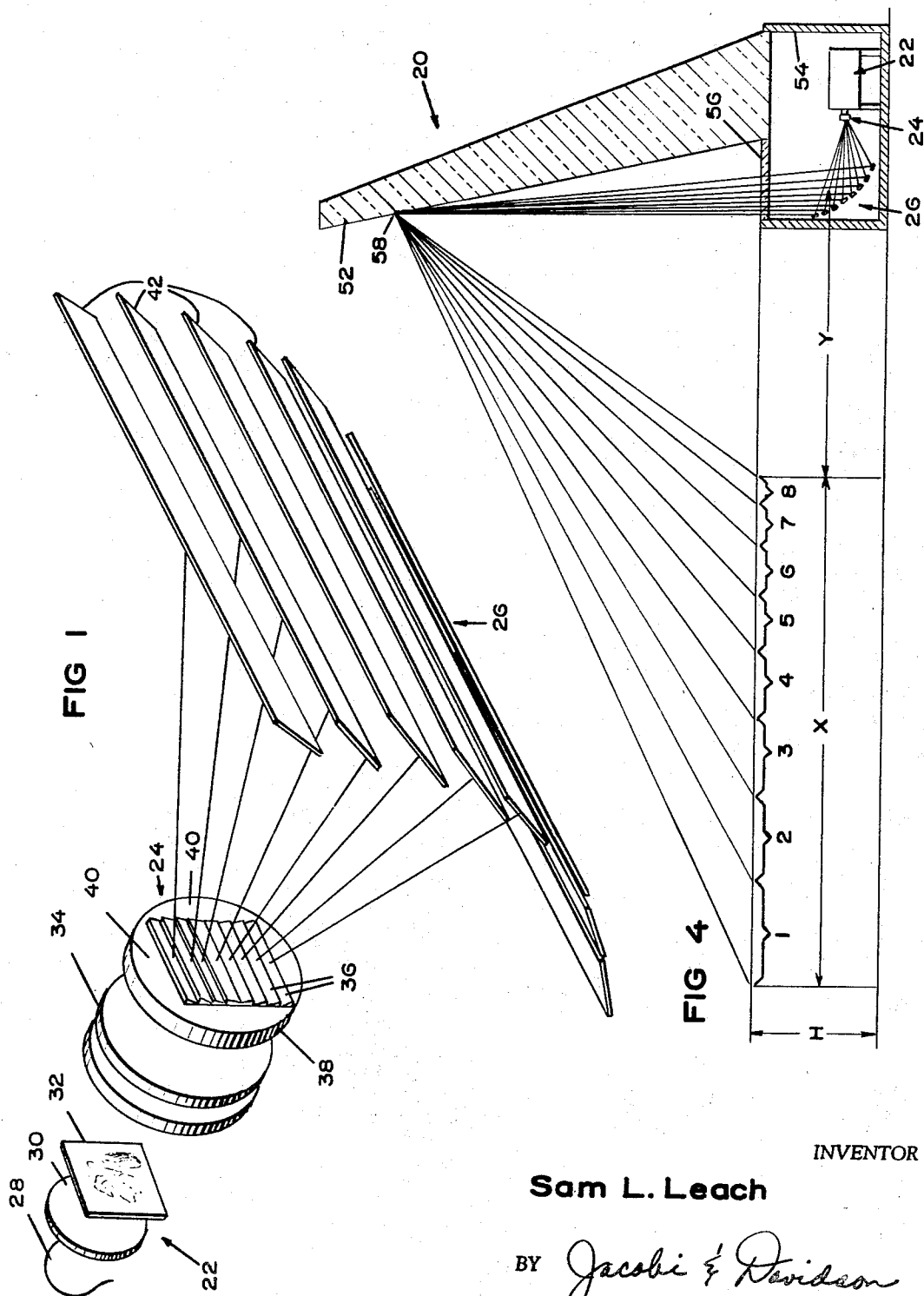
S. L. LEACH

3,322,032

IMAGE DISPLAY DEVICE

Filed March 26, 1965

2 Sheets-Sheet 1



INVENTOR

Sam L. Leach

BY *Jacobi & Davidson*

ATTORNEYS

May 30, 1967

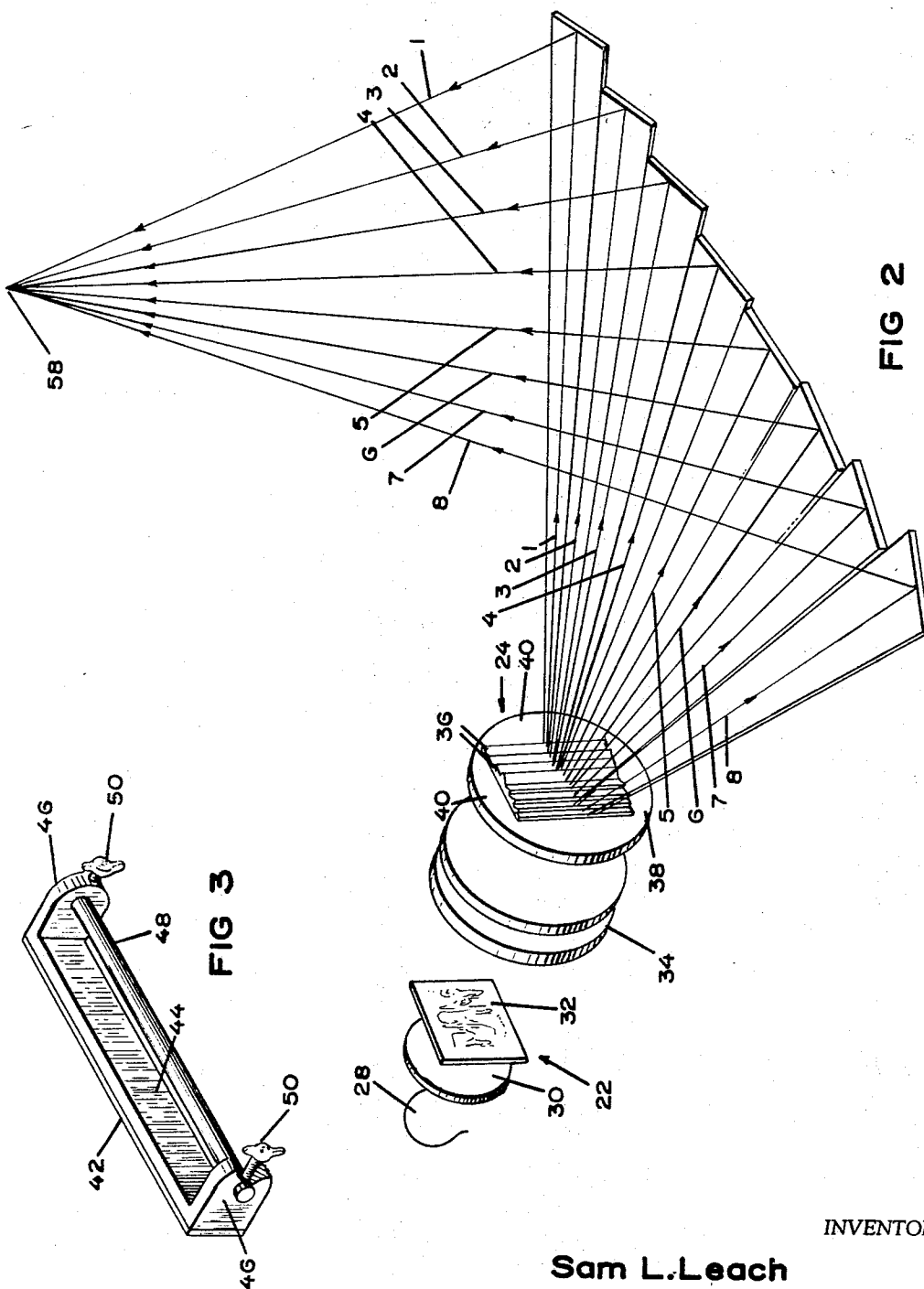
S. L. LEACH

3,322,032

IMAGE DISPLAY DEVICE

Filed March 26, 1965

2 Sheets-Sheet 2



INVENTOR

Sam L. Leach

BY

Jacobi & Davidson

ATTORNEYS

1

3,322,032

IMAGE DISPLAY DEVICE

Sam L. Leach, 400 Veteran Ave.,
Los Angeles, Calif. 90024

Filed Mar. 26, 1965, Ser. No. 442,873
12 Claims. (Cl. 88-24)

This invention relates to an image display device and more particularly it relates to an outdoor sign capable of transmitting an advertising display to passing vehicles, yet which is formed of a generally transparent material which will not obstruct observation of the landscape behind the sign. However, while the present invention is particularly concerned with outdoor signs or billboards, the principles set forth herein are applicable to many varied forms of display screens.

As is well known, one of the principal drawbacks and shortcomings associated with conventional outdoor advertising billboards is the fact that such billboards interfere with visual observation of the natural landscape. Many highways are bordered with literally hundreds of such outdoor billboards, and the cumulative effect of these billboards is to effectively obliterate the landscape on opposite sides of the highway. Such billboards are generally formed as large flat sheets which are mounted in wooden frames. The face of such sheets, upon which the advertising display is presented, is usually directed toward one or more traffic lanes along a highway whereby the advertising display is viewable by an occupant in a vehicle in these traffic lanes moving toward the billboard. However, an occupant in a vehicle travelling on the opposite side of the highway generally cannot see the face of the billboard, and instead, only sees the unsightly wooden supporting framework. Moreover, both the face and the supporting framework of such billboards are often allowed to deteriorate in appearance through lack of maintenance and repair. Thus, the presence of such billboards is found to be aesthetically offensive and highly objectionable by many people.

Another consideration with respect to conventional forms of outdoor advertising billboards is the fact that changing of an advertisement on such a billboard is an extremely lengthy and expensive operation. In some instances, the advertisements are painted on the billboard, in which event a change in advertisement necessitates covering over the former advertisement and the repainting of a new one. In other instances, the advertisement is formed on elongated strips of paper which must be pasted onto the billboard, in proper overlapping relationship. Regardless of whether the new advertisement is to be applied to the billboard by painting or by pasting, it will be apparent that the operation of applying the new advertisement to the billboard is extremely tedious and time-consuming, and thus is quite expensive.

When considering outdoor advertising billboards, one generally thinks of the aforementioned type, wherein the sign is supported in a wooden framework. However, another common type of outdoor sign is that which is attached to the side of a building. These signs are used particularly in crowded commercial areas where no open space is available for the previously mentioned type of sign. While it is, of course, highly desirable to use building mounted signs to deliver advertising messages in crowded downtown areas where the advertising message will reach a large audience, it is quite difficult to find suitable space on the side of a building to mount such a sign, since most buildings have windows therein which would be blocked by such a sign.

From the foregoing material, it should be apparent that it would be extremely beneficial and highly desirable to provide a sign board which is transparent in nature, but which has a highly polished surface, whereby an advertis-

2

ing image from a remote location may be specularly reflected from the surface thereof. A sign board of this type would overcome the drawbacks and deficiencies associated with the prior art in that it would not be unsightly, and that it would not interfere with visual observation of the landscape disposed behind the sign board. Additionally, the image or advertising display could be easily changed, without requiring any extensive painting, pasting, or other similar tedious and time-consuming operations on the sign board itself. Also, in the case of building mounted signs, a transparent sign could be placed directly over office windows, yet the office occupants could still see therethrough.

In the past, specular image transmitting surfaces have been widely known, at least in the form of mirror systems for transmitting images, yet none of these prior art image display units could be effectively used in an outdoor advertising display, such as a billboard. The reason for this becomes apparent when it is recognized that a billboard is primarily utilized to transmit an advertising image to occupants of moving vehicles, whose position with respect to the billboard is constantly changing. In all such prior art forms of image transmitting or reflecting devices, the image was reflected at a single angle, and the viewer was only able to observe the image if he was located at a particular point. Naturally, when a vehicle is moving toward a sign board, it is only momentarily at any particular point, and an image transmitted at a single angle would be only instantaneously observable. This, of course, would be wholly unsatisfactory in an advertising display, since, at the very least, a billboard must be viewable for several seconds to enable an observer to read and appreciate the advertising image thereon.

With the foregoing matter firmly in mind, it is, therefore, an object of the present invention to overcome the difficulties and deficiencies associated with prior art image displays, and to provide in their stead, an improved image display device.

Another object of the present invention is to provide an image display primarily for use as an outdoor advertising billboard, yet which is generally transparent in nature to permit selective observation therethrough.

Another object of the present invention is to provide an image display device which transmits an image to a viewer at multiple angles, thereby enabling the viewer to observe the image continuously throughout movement for a predetermined distance.

Further objects of the present invention include the provision of an image display device which: (a) is extremely attractive in appearance and is highly acceptable from an aesthetic viewpoint; (b) is capable of operation for extended durations of time without any maintenance or repair; (c) is relatively inexpensive to produce, yet which provides a startling and highly satisfactory image transmission effect; (d) can be selectively adjusted to predetermine a particular area or viewing field in which the image will be visible; and (e) which has an image transmission screen which is wholly transparent when viewed from the obverse side thereof to enable observation through the screen, yet which will properly and selectively reflect the desired image from the viewing surface thereof.

Other objects, advantages, and salient features of the present invention will become apparent from the following detailed description, which, taken in conjunction with the annexed drawings, discloses a preferred embodiment thereof.

The foregoing objects are attained by providing an enlarged screen, preferably the size of an outdoor advertising billboard, which is fabricated of a transparent material

having polished optical surfaces thereon. At least one surface of the screen is displayed angularly from a true vertical position. Beneath the screen and forwardly of the angularly disposed surface thereof, a projecting means is provided, with such projection means including a projection light, and an objective lens assembly. A film image carrying the particular material to be displayed, can be disposed between the light and the lens assembly whereby the light will transmit the image through the particular lens assembly to focus forwardly thereof. A deviation prism array, having a plurality of prismatic surfaces, disposed at varying angles, is juxtaposed forwardly of the lens assembly, and is designed to multiply the film images and to re-direct the same forwardly as multiple individual images. A plurality of individual image mirror surfaces are provided, with each such mirror surface being located to receive an individual image directed forwardly from a prismatic surface on the deviation prism. The individual mirror surfaces are adjustable, and are disposed at variable angles, to reflect each of the individual images upwardly to focus on a common point or line on the angularly disposed face of the viewing screen. The images are then reflected forwardly from the viewing screen at a plurality of separate angles, each such angle of reflection corresponding to the angle of the mirror surface from which the image was transmitted to the viewing screen.

As a result of the foregoing, multiple images are transmitted at varying angles from the surface of the viewing screen, and hence, each such image is viewable or observable from a different point of reference. However, the cumulative effect of such multiple angularly reflected images is to provide a continuous depiction of the image as an observer moves through the various angles in a direction toward the viewing screen. Assuming for instance, that the viewing screen of the present invention to be utilized as an outdoor advertising billboard disposed along the side of a highway, the multiplicity of reflected angular images might range from a distance of 50 feet ahead of the screen to a distance of 1500 feet ahead of the screen. As a vehicle driving along the highway approaches the screen, it would appear to be entirely transparent and the landscape behind the screen would be visible. However, as soon as the vehicle moves within 1500 feet of the sign, the first of the images transmitted from the screen would appear. Thereafter, as the vehicle continued to move toward the sign, it would pass the field of view of the first image, but would immediately enter the field of view of the next reflected image, and thus the image observed by a person in the vehicle would appear continuously. As the vehicle progressed toward the sign or screen, it would successively pass through each of the image fields, until at last it approaches within 50 feet of the sign. At that point, it would have moved through the last image field, and the image would no longer be observable from the screen. At that point, the screen again merely appears to the observer as a transparent sheet, and any landscape behind the screen can be viewed by looking through the screen. Naturally, a vehicle approaching the screen from the opposite direction would not receive any image whatsoever, and the screen would continuously appear only as a transparent sheet.

Other applications of the present invention will be described more fully hereinafter.

Referring to the drawings:

FIGURE 1 is a diagrammatic perspective view of the image forming and transmitting portion of the present invention;

FIGURE 2 is a perspective view similar to FIGURE 1, but shown partly in section and viewed from a different angle;

FIGURE 3 is a perspective view of one of the mirror sections used in the device of the present invention; and

FIGURE 4 is a sectional side elevational view of the device of the present invention.

In accordance with the principles of the present in-

vention, and as can be seen from FIGURES 1 and 4, the general arrangement herein includes a transparent screen generally designated 20, an image projecting means generally designated 22, a means generally designated 24 for receiving a projected image and for converting the same into a plurality of individual or separate images, and a plurality of angularly disposed surfaces generally designated 26, each positioned to receive an individual image from the means 24 and to transmit the same to the screen 20.

The projecting means 22 can be any form of suitable projection apparatus, and the particular type employed is not material from the standpoint of the present invention. Thus, in FIGURES 1 and 2, the projecting means is shown in simplified form as including a lamp or light 28 and a lens means 30 for properly focusing the illumination emitted from the lamp 28.

The particular image to be displayed is carried by a piece of film, or other suitable carrier, and is designated 32. The image can be a picture, a message, or any suitable combination thereof to provide an advertising display or any other form of display desired. As shown, the image layer 32 is disposed ahead of the focusing lens 30, and thereby receives the light rays from the lamp 28. An objective lens assembly 34 is provided forwardly of the image layer 32, whereby the light shining through the image layer 32 will cause the same to be focused forwardly and through the objective lens assembly to create at the forward end thereof, a projected image.

The means 24 is disposed forwardly of the lens assembly 34, and is adapted to receive the projected image therefrom and to convert the same into a plurality of individual images. As such, the means 24 is formed as a deviation prism array having a plurality of angularly disposed prismatic surfaces or faces 36 thereon. These prismatic surfaces may be mounted on a disc 38, and the peripheral area 40 surrounding the prismatic faces is covered with an opaque material to prevent image transmission therethrough. In the form shown in the present invention, the deviation prism is provided with eight prismatic surfaces 36, each disposed at an angle to the face of the disc 38. The two center prismatic surfaces abut one another and are disposed at equal and opposite angles to one another. Moving outwardly from the center of the prism, each prismatic surface 36 is disposed at a gradually increasing angle. Thus, the two outermost prismatic surfaces are disposed at the steepest angles, and such surfaces, as shown, are respectively formed at equal and opposite angles. It will, of course, be apparent that the particular number of prismatic surfaces 36, and their angular disposition, is not limited to that precise form shown herein, but rather, can be varied in any suitable manner which will be apparent to those skilled in the art of optics.

As aforesaid, the purpose of the means 24 is to convert the projected image from the layer 32 into a plurality of images. It is important to understand that because of the nature and disposition of the prismatic surfaces 36, the image from the layer 32 will not be divided into separate parts, but rather, a plurality of individual images, each complete in its own right, will be formed. In other words, in the particular embodiment shown herein, the prism 24 will create eight individual and separate images, each corresponding to the image carried by the layer 32. Although in actual operation the parts are disposed in the orientation shown in FIGURE 1, the exact nature of image production may be more readily apparent from FIGURE 2, where the parts are displaced 90° from the orientation of FIGURE 1. In FIGURE 2, each face 36 is shown producing a separate image, and each of the images is identified with a number. Since eight prismatic surfaces 36 are shown in FIGURE 2, the eight images produced therefrom are identified respectively by the numbers 1 through 8. It will also be appreciated from FIGURE 2 that the angular disposition of

5

the prismatic surfaces 36 assures that no reflected image from one face will superimpose upon or overlap an image from another face. Instead, each of the images 1-8 is transmitted at a different angle.

As shown in FIGURES 1 and 2, a plurality of angularly disposed reflective surfaces 26 are provided forwardly of the means 24. Each such reflective surface can be a mirror section 42 having a reflective face thereon directed at least partially toward the means 24. Each of the sections 42 is provided for receiving an individual image transmitted from one of the prismatic surfaces 36. In other words, one mirror section 42 is adapted to receive the image 1, the next adjacent mirror surface is adapted to receive the image 2, and so on. The location or placement of each mirror section 42 is determined by the optical deviation of its corresponding prismatic surface 36, while the width of each mirror section 42 is determined by the width of its corresponding prismatic surface 36 and the distance between the surfaces 36 and 42.

Although the mirror sections 42 are shown only diagrammatically in FIGURES 1 and 2, it is obvious that the sections must be suitably mounted in some manner, and preferably, the mounting means is adjustable. Thus, as shown in FIGURE 3, each section 42 may be adhered or otherwise secured to the formed surface of a plate 44 having a pair of spaced ears 46, 46, projecting from the rear thereof. Aligned apertures are provided through the ears 46 for reception of a rod 48 which projects outwardly beyond the ears 46 for mounting in some suitable frame. At least one, and preferably both of the ears 46, are provided with adjustable screws or wing nuts 50 which thread into an aperture which communicates with the apertures receiving the rod 48. Thus, when the wing nuts are tightened, the inner ends thereof frictionally engage against the rod 48 to fix the mirror sections 42 in some desired angular disposition. When and if it becomes desirable to change this angular disposition, such a change can be accomplished merely by loosening the wing nuts 50, by making the angular change, and by thereafter re-tightening the nuts 50.

The particular angular disposition of the mirror sections 42 can be seen from FIGURES 1, 2 and 4. As aforesaid, and as is apparent from FIGURE 1, the parts are oriented in the position shown in FIGURE 1. Thus, the lowermost mirror section 42 is disposed at some angle to a true vertical axis, and with each succeeding section 42, this angle gradually decreases until the uppermost section 42 is disposed at only a small angle with respect to a true vertical axis. While it has been stated that each of the individual sections 42 can be adjustably mounted in the manner shown in FIGURE 3, or in some other manner suitable to that purpose, it must be understood that the mounting of any particular section 42 must necessarily be correlated to the mounting of each other section 42. The reason for such correlation between sections 42 is that each of the individual images 1-8 must be reflected to exactly the same line or axis along the screen 20, as will be more fully described with respect to FIGURE 4.

In FIGURE 4, the viewing screen 20 is shown as an upstanding sheet, and it will be understood that in accordance with the principles of the present invention, this sheet is fabricated of some transparent material, as, for example, methyl methacrylate. The sheet is provided with at least one optically polished surface 52, which is capable of providing specular reflection therefrom. This polished surface 52 is displaced angularly somewhat from a true vertical axis so that reflection therefrom will shine generally downwardly. While the particular angle of displacement from a vertical axis can be varied somewhat, in no event would it exceed 45°, and in most instances, it would be considerably less than that. In FIGURE 4, the screen 20 is shown mounted in a base or casing 54 which contains the means 22, 24 and 26. This casing is preferably closed, and is provided with a transparent window 56

6

disposed above the reflective surfaces 26. As will be seen, each of the individual images 1-8 reflected from the means 26 is focused at a common line or axis on the polished surface 52 of the screen 20. This common line or axis is designated by the reference numeral 58. By changing the angular disposition of each of the reflective mirror sections 42, the height of the line 58 may be raised or lowered along the surface 52, but it must be understood as critical for purposes of the present invention, that regardless of the height of the line 58, it is essential that all of the images 1-8 merge together and focus at that line.

Because of the highly reflective nature of the polished surface 52, the images transmitted to the line 58 will be specularly reflected from the surface of the screen 20 and will be transmitted forwardly in the manner shown in FIGURE 4. Individual image 1, transmitted from the most nearly vertically disposed mirror section 42, will be transmitted or reflected the furthest distance from the screen 20. Individual image 8, reflected from the least vertically disposed mirror section 42, will be reflected the shortest distance from the screen 20. All of the other individual images will be disposed therebetween in the manner shown in FIGURE 4, and thus the images reflected from the screen 20 create an image viewing field having an effective length indicated as X at some mean height H above ground level. At that height, the viewing field terminates at some point spaced a distance Y away from the line 58 on the viewing screen. Thus, if it is assumed that the height H is the height of an observer's eye, the effective viewing field for that observer commences at a distance X plus Y from the screen and terminates at a distance Y therefrom. As the observer travels through the viewing field toward the screen 20, he will successively pass through reflected images 1-8. The angle at which any particular image reaches the observer's eye, if assumed to be the angle between the eye and the line 58, constantly changes; yet, the images are continually received by the observer's eye until he actually passes out of the viewing field. In other words, an observer approaching the screen 20 would first see the image 1, then the image 2, then the image 3, and so on, but since all such images are the same, having all been derived from the common image layer 32, the observer will not note any difference to be constant and continuous throughout the viewing in the appearance of the image, and the same will appear field.

For an example of the manner of operation of the present invention, let it be assumed that the screen 20 is provided along a highway as an outdoor advertising billboard. The reflective surfaces 26 can be adjusted to vary the height of the line 58, to adjust the length of the distance Y, which ends the viewing field at height H. If a vehicle is driving along a highway toward the screen 20, until the vehicle reaches the distance X-plus Y away from the screen 20, the screen merely appears as a transparent sheet, and an observer in the vehicle can merely look directly therethrough and can observe the landscape therebehind. However, assuming that the effective eye height of an observer in the vehicle is H, as soon as the vehicle approaches within a distance X plus Y from the screen 20, the screen will no longer appear to be transparent, but rather, will appear to carry an image 1. As the observer continues to drive toward the screen, he will pass out of the viewing field of the image 1, but he will then instantaneously see the image 2. When he passes out of the viewing field of the image 2, he will then instantaneously see the image 3, and so on. This will continue until the observer finally passes out of the effective field of the last image 8. At this point, the observer will be located a distance Y from the screen 20, and will have passed out of the total image viewing field. Thus, the screen will again appear to be merely a transparent sheet, and the observer will once again be able to look directly therethrough. Naturally, a car driving in the

opposite direction on the road beside the screen 20, will not receive any transmitted image from the polished surface 52, and hence the entire screen will merely appear as a transparent sheet through which landscape and other surroundings can be observed.

With the foregoing matter in mind, other applications of the principles of the present invention will become apparent. For example, the screen 20 could be mounted directly onto the side or front of an office building, even though the building had multiple windows therein. The occupants within the offices whose windows were covered by the screen would be able to look through the obverse side thereof and would thus be able to see outdoors. A person looking at the building would be able to see the windows therein only so long as he remained outside the image viewing field. However, when that person moved into the viewing field, he would no longer see the windows, and instead, his eyes would only receive the image specularly reflected from the screen.

Another possible application of the present invention is for use in a lecture hall, such as used in a university. The transparent screen 20 could be placed upon the rostrum and the viewing field could be selectively adjusted to span the lecture hall seats. Thus, a person sitting in any seat in the hall would see an image specularly reflected from the screen. Meanwhile, as an example, the lecturer could be setting up experiments behind the screen, and when a particular experiment was ready, the projector could be de-energized to terminate image transmission, whereupon the audience could look through the transparent screen to see the experiment.

Still another possible application of the present invention is for use as a cuing device for public speakers, television broadcasters and the like. At the present time, transparent reflectors are utilized as prompting means for such persons, but in all such instances, the image is transmitted or reflected linearly at a single angle, i.e., in a straight line to the viewer's eyes. While such a prompting or cuing means is satisfactory for a single person in a single location, it is wholly unsatisfactory if several persons must see the image, or if the speaker must move away from the lectern at which the image is directed. Also, if different speakers are to use the lectern, and the speakers are of different heights, an eye level image transmission for a speaker of one height would be altogether unacceptable for, and not visible to, a speaker of a different height. However, by using the principles of the present invention, a whole image viewing field would be created, and any number of persons within this field, regardless of their height or exact location, would receive the transmitted image.

The foregoing examples represent only a few of the possible applications of the present invention, and it is manifest that the present invention can be put to an almost limitless variety of uses.

After reading the foregoing detailed description, it should be apparent that the objects set forth at the outset of the present specification have been successfully achieved by the present invention. Accordingly, what is claimed is:

1. An image display device comprising:
 - a transparent screen having at least one optically polished surface thereon; and
 - means for transmitting a plurality of similar images at different angles to a common line along said surface whereby said surface will reflect said images at said different angles to form a viewing field wherein said image can be observed from a plurality of different angles,
 - said means for transmitting including a plurality of individual image reflecting surfaces;
 - said individual image reflecting surfaces each being disposed at a different angle;
 - said angles of said image reflecting surfaces being co-actively arranged to focus all of said similar images at said common line along said surface.

2. An image display device as defined in claim 1 wherein each of said reflecting surfaces is selectively angularly adjustable.

3. An image display device comprising:

- a transparent screen having at least one optically polished surface thereon;
- means for projecting an image;
- means for receiving a projected image and for creating therefrom, a plurality of separate images at different angles; and
- a plurality of angularly disposed reflective surfaces, each positioned to receive one of said separate images;
- said reflective surfaces transmitting said separate images to a common axis upon said optically polished surface;
- said polished surface specularly reflecting said separate images from said common axis to form a viewing field wherein said separate images are juxtaposed to one another and thus wherein said image can be observed from a plurality of different angles with respect to said polished surface.

4. An image display device as defined in claim 3 wherein said means for creating a plurality of separate images is a deviation prism having a plurality of angularly disposed prismatic surfaces thereon.

5. An image display device as defined in claim 3 wherein said angularly disposed reflective surfaces are selectively adjustable to vary the elevation of said common axis upon said optically polished surface, thereby varying the location of said viewing field.

6. An image display device as defined in claim 5 wherein each of said reflective surfaces is disposed at a different angle than each of the other reflective surfaces.

7. An image display device as defined in claim 3 wherein said optically polished surface is angularly displaced from a true vertical axis.

8. An image display device as defined in claim 7 wherein said angular displacement is less than 45°.

9. An image display device as defined in claim 7 wherein said angularly disposed reflective surfaces are located beneath said optically polished surface and are oriented to transmit said separate images upwardly thereonto.

10. A method for optically producing an image display visible from a plurality of varying angular positions, said method comprising the steps of:

- projecting a single image to be displayed;
- converting said projected image into a plurality of individual images, each disposed at a different angle; and
- directing said individual images to a common focal line on a specularly reflective screen, whereby said screen will reflect said images to produce an aerial image display visible from a plurality of varying angular positions.

11. A method as defined in claim 10 wherein said directing step includes receiving said individual images upon corresponding angularly disposed reflective surfaces which in turn direct said images to said common focal line.

12. A method as defined in claim 11 but further characterized by the step of selectively adjusting said reflective surfaces to selectively vary the location of said common focal line upon said specularly reflective screen.

References Cited

UNITED STATES PATENTS

1,019,141	3/1912	Engelsmann	88—24
1,906,215	4/1933	Nicolson	88—24
3,248,999	5/1966	Wheeler	88—24

NORTON ANSHER, *Primary Examiner.*

75 R. M. SHEER, *Assistant Examiner.*