March 9, 1971 E. J. SMITH 3,568,346

SIGN FOR CONVEYING INFORMATION TO AN OBSERVER MOVING WITH RESPECT THERETO

Filed July 22, 1968 4 Sheets-Sheet 1

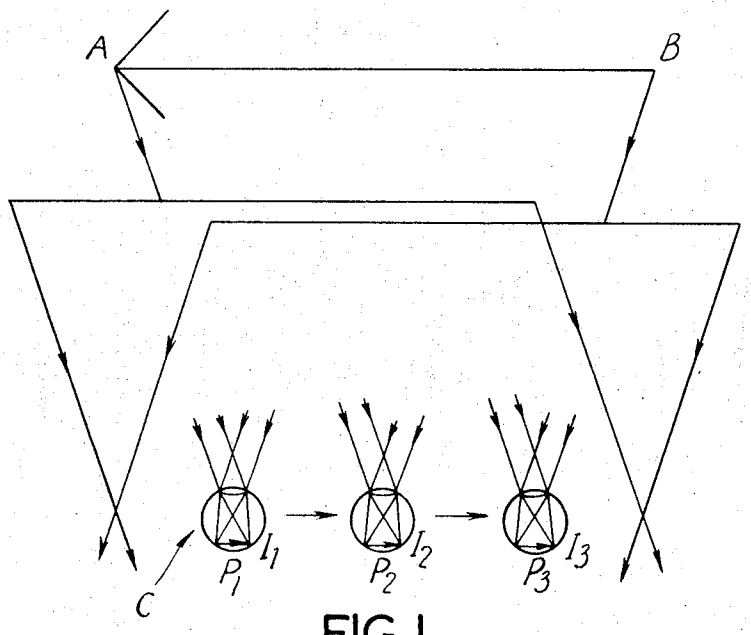


FIG. 1

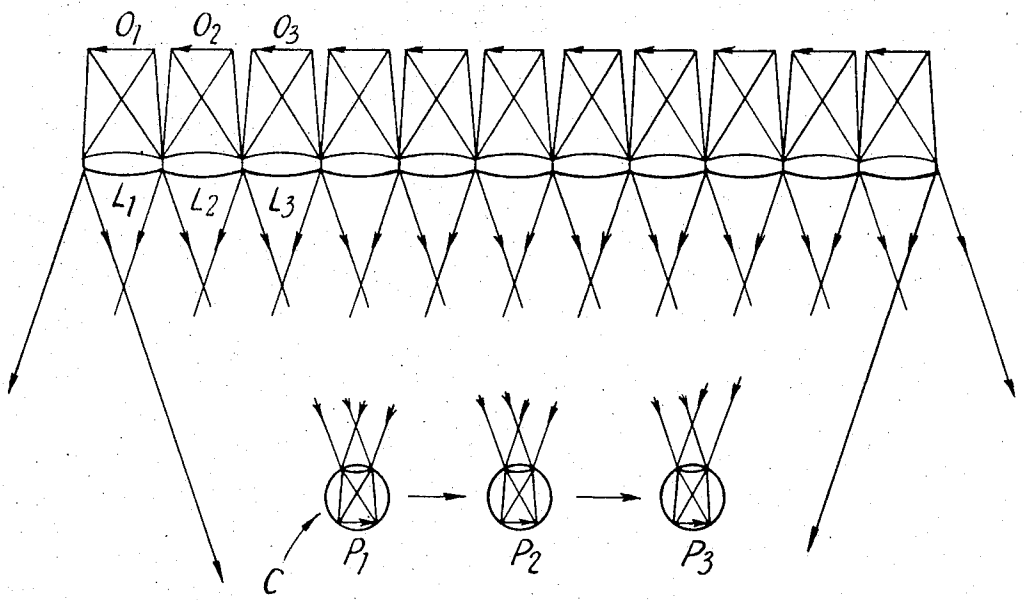


FIG. 2

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SIGN FOR CONVEYING INFORMATION TO AN OBSERVER MOVING WITH RESPECT THERETO

Filed July 22, 1968 4 Sheets-Sheet 2

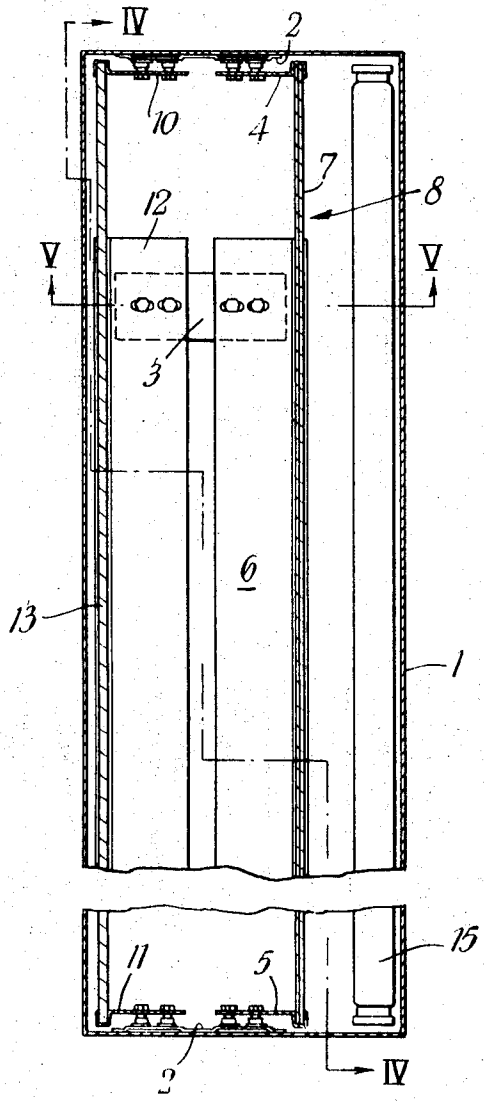
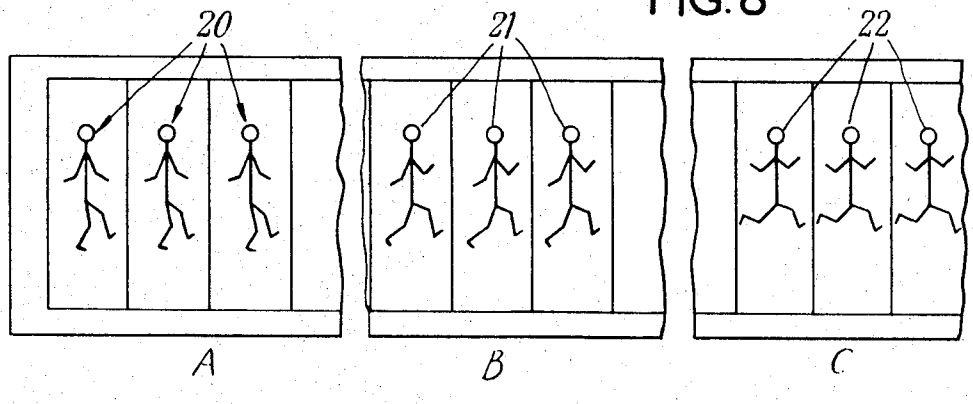


FIG. 3

FIG. 8



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SIGN FOR CONVEYING INFORMATION TO AN OBSERVER MOVING WITH RESPECT THERETO

Filed July 22, 1968 4 Sheets-Sheet 3

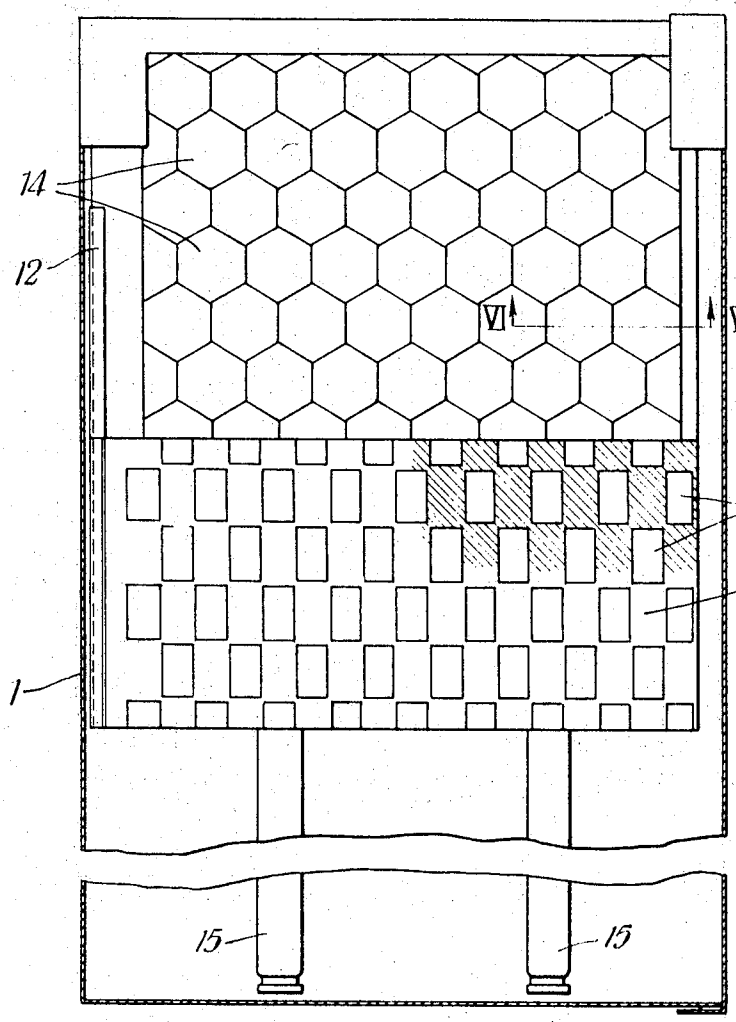


FIG.4

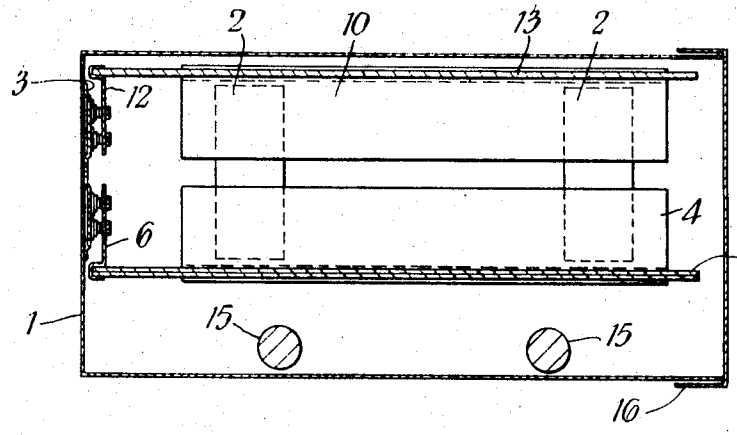


FIG.5

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SIGN FOR CONVEYING INFORMATION TO AN OBSERVER MOVING WITH RESPECT THERETO

Filed July 22, 1968 4 Sheets-Sheet 4

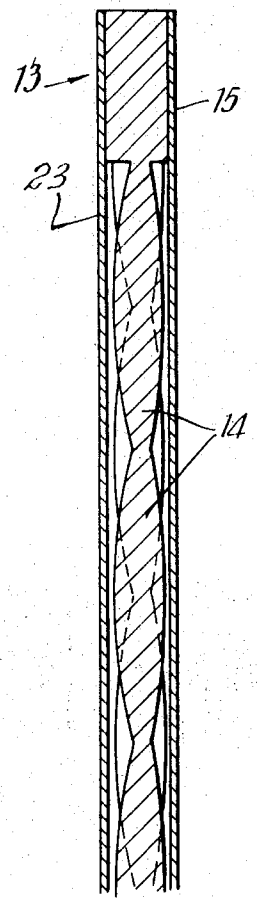
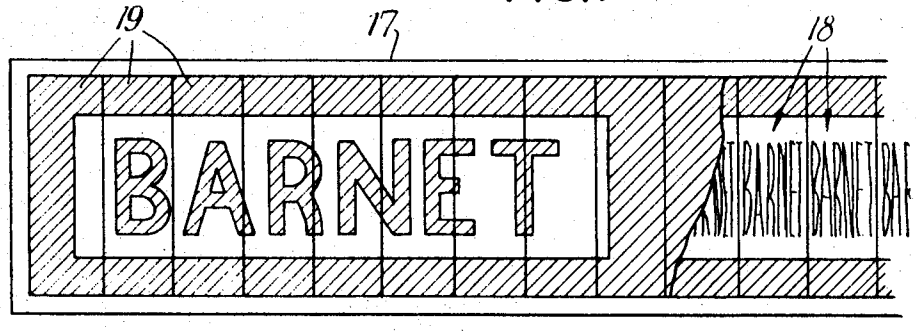


FIG. 6

FIG. 7



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3,568,346

SIGN FOR CONVEYING INFORMATION TO AN OBSERVER MOVING WITH RESPECT THERETO

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Int. Cl. G09f 7/00
U.S. Cl. 40—125 3 Claims

ABSTRACT OF THE DISCLOSURE

A sign for presenting information to an observer of the sign moving with respect thereto which comprises a housing, a plurality of identical optical objects linearly disposed within and secured to the housing, each optical object being a representation of the information the sign is to present, a plurality of lenses linearly disposed within and secured to the housing, each of said lenses being in registry with one of said optical objects and each of said optical objects being in the focal plane of the lens with which it is in registry, and a light source to illuminate said optical objects, so that an observer moving linearly past the sign has the impression that only one representation of the information is seen, which representation appears to be stationary with respect to the observer's movement.

This invention relates to a sign readable by an observer moving at speed with respect to the sign and is more particularly, but not exclusively, concerned with a sign to be situated by the side of a railway track for communicating information to persons in trains travelling along the track. Further, the invention relates to a method of presenting information to a person moving along a linear path at speed.

In order to be readable from a moving train, conventional track-side signs such as station name boards and advertisements are generally of a considerable size and are situated well away from the track. Further, they can often only be seen momentarily and read with difficulty. However, since they are functionally or commercially necessary they are much in evidence particularly on the approaches to main line stations.

It is an object of the present invention to provide a sign which will present information to an observer moving with respect thereto which information appears to be stationary with respect to the observer's movement i.e. which appears to move with and alongside the observer.

It is a further object of the present invention to provide a similar sign which presents information which moves with and alongside a moving observer but which is animated.

It is a still further object of the present invention to provide a method of presenting information to a person moving along a linear path at speed.

According to one aspect of the present invention there is provided a sign for presenting information to an observer of the sign moving with respect thereto, which comprises:

(a) a housing,
(b) a plurality of identical optical objects linearly disposed within and secured to the housing, each optical object being a representation of the information the sign is to present,
(c) a plurality of lenses linearly disposed within and secured to the housing, each of said lenses being in registry with one of said optical objects and each of said optical objects being in the focal plane of the lens with which it is in registry so that as an observer moves linearly past the sign and looks into the lenses thereof, identical images each corresponding to one of said optical objects are successively super-imposed on each eye of the observer, which images appear to be at infinity and hence of identical position and angular size, as a result of which the observer has the impression that he sees only one representation of the information the sign is to present, which representation appears to be stationary with respect to his movement, and
(d) a light source to illuminate said optical objects.

The lenses constitute the functional surface of the sign and the sign is so constructed that when it is viewed in a direction at right angles to the functional surface thereof by an observer moving past the functional surface, a plurality of identical images corresponding to said identical optical objects is successively superposed on the eye of the observer when the functional surface completely traverses the angle of view of the observer. Since identical and angular size in relation to the observer irrespective of sight of the two eyes are parallel and the images are seen without accommodation (each eye being focused at infinity), the observer has the illusion that he actually sees a single image at infinity, i.e., beyond the discriminating powers of stereoscopic vision, which maintains its position and angular size in relation to the observer irrespective of relative motion between the observer and the sign. Thus, the actual image seen by the observer appears to be stationary with respect to the observer's movement.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawings in which:

FIG. 1 diagrammatically illustrates the theoretical principles involved in the present invention,

FIG. 2 diagrammatically illustrates how the above principles are embodied in a sign of the present invention,

FIG. 3 is a longitudinal horizontal section through a first embodiment of the sign of the present invention,

FIG. 4 is a section along line IV—IV of the embodiment shown in FIG. 3,

FIG. 5 is a section along line V—V of the embodiment shown in FIG. 3,

FIG. 6 is a part section along line VI—VI of the embodiment shown in FIG. 4 on an increased scale,

FIG. 7 is a diagrammatic front view of another embodiment of a sign of the present invention, and

FIG. 8 is a diagrammatic front view of part of a further embodiment of a sign of the present invention.

Referring to FIG. 1, there is shown an object AB at a large distance from an eye C at position P_1 and focussed at infinity. The rays of light from extremity A of object AB form a parallel beam at the eye C and similarly the rays of light from extremity B of object AB form a parallel beam at the eye C. Further, the rays from any point on the object AB between intermediate extremities A and B also form a parallel beam at the eye C. The beams striking the eye C are converged by the lens of the eye and form an image I_1 of the object on the retina of the eye. If the eye is moved to position P_2, the above situation still applies with the result that an image I_2 is produced on the retina, this image being identical to image I_1. Similarly, image I_3 produced when the eye C is in position P_3 is identical to the images I_1 and I_2. Thus, during the movement of the eye from position P_1 to P_3, the image of the object produced on the retina of the eye is constant and hence the actual image seen by the eye appears to be stationary with respect to the eye.

Referring now to FIG. 2, there is shown a plurality of linearly disposed identical illuminated optical objects

denoted by O_1, O_2, O_3 etc. The objects are positioned behind a plurality of lenses L_1, L_2, L_3 etc., each object being in registry with a lens and disposed in the focal plane thereof. The rays of light from any point on object O_1 are thus collimated by associated lens L_1 and emerge as a broad beam of parallel light. Similarly, the light rays from the corresponding point on object O_2 are collimated by lens L_2 and emerge as a broad beam of parallel light which is parallel to the beam emerging from lens L_1. Further, this effect also occurs in respect of the corresponding points on the remaining objects. Thus the rays of light coming from all corresponding points on the objects O_1, O_2, O_3 etc. emerge from the lenses L_1, L_2, L_3 etc. as beams of parallel light. Hence as the eye C moves along a linear path from position P_1 to position P_2 and thence to position P_3, the situation is the same as that of FIG. 1 and thus a plurality of identical images are successively produced on the retina of the eye with the result that the relative motion between the objects and the eye is not apparent to the eye. Since the image seen by each eye of the viewer is identical and since the lines of sight of the two eyes are parallel and a sharp image is produced when the eyes are focussed at infinity, the eye is under the impression that it is looking at a distant object.

Referring to FIGS. 3 to 6, the sign comprises a box-like housing generally denoted by reference numeral **1** and fabricated by welding metal sheets together. Two cleats **2** are spot-welded to each end wall of the housing **1** and similar cleats **3** are distributed along and spot-welded to that wall of the housing **1** which will constitute the bottom wall of the sign in use. Each of the cleats is provided with two anchorages each anchorage being constituted by a pair of anchor nuts threaded to receive fixing bolts. A supporting channel **4** is secured by fixing bolts to one of the anchorages of each cleat **2** at one end wall of the housing and a similar supporting channel **5** is secured by fixing bolts to one of the anchorages of each cleat **2** at the other end wall. A further supporting channel **6** is secured by fixing bolts to one of the anchorages of each cleat **3** along the bottom wall of the sign. A support member **7** of transparent material backed by a light diffuser **8** is located in the channels **4**, **5** and **6**. The member **7** carries a plurality of identical transparent optical objects **9**, each object being a representation of the information the sign is to convey to the observer. The objects **9** are arranged in a multiplicity of rows, the objects **9** of each row being linearly disposed. The arrangement of the rows of optical objects is such that the objects **9** lie in a series of columns at right angles to the rows, each column containing either 8 or 9 optical objects and being staggered with respect to the adjacent columns.

Supporting channels **10**, **11** and **12** are secured by fixing bolts to the remaining anchorage of each cleat **2** and **3** in a similar manner to that described above with reference to channels **4**, **5** and **6**. Located within channels **10**, **11** and **12** is a lens assembly **13** comprising a plurality of integrally moulded contiguous lenses **14** each face of the moulding being protected by a sheet **15** of transparent material. Each lens **14** is a hexagonal-shaped spherical biconvex lens. Further, the lenses are arranged in a multiplicity of rows, the lenses of each row being linearly disposed. The arrangement of the rows of lenses corresponds to that of rows of optical objects **9**. Thus, the lenses **14** lie in a series of columns at right angles to the rows, adjacent columns of lenses being staggered with respect to one another. The lens assembly **13** is so located in the channels **10**, **11** and **12** that each optical object **9** is in registry with and in the focal plane of a lens **14** of the lens assembly. The correct positioning of the lens assembly **13** with respect to the objects **9** is achieved by the use of suitable shims on the fixing bolts threaded into the anchorages of the cleats **2** and **3** and by using supporting channels **4**, **5**, **6**, **10**, **11** and **12** provided with slots to receive the fixing bolts thereby allowing any necessary adjustment of the relative dispositions of the lens assembly **13** and the support member **7** to be made.

The housing **1** also has secured therein two fluorescent tubes **23** to illuminate the optical objects **9** through the diffuser **8**. The housing **1** has a removable lid **16** to facilitate replacement of the fluorescent tubes, or of the support member **7** when it is desired to change the information conveyed by the sign.

In use, the sign is suitably positioned, e.g. by the side of a railroad, with the lens assembly facing the track so that it can be seen by passengers travelling along the track. Due to the sign being constructed in accordance with the principles discussed with reference to FIGS. 1 and 2 of the drawings, the actual image seen by passengers moving past the sign appears to be stationary with respect to the passengers' movement. Further this is the case when the viewer moves in the direction in which the longitudinal axis of the sign extends and also when the viewer moves in a direction at right angles to said direction. Thus this embodiment is particularly suitable for positioning in sites where the direction of movement of the viewer is other than merely horizontal e.g. on escalators.

If desired, the hexagonal-shaped biconvex lenses **14** may be replaced by rectangular-shaped spherical biconvex lenses. However lenses of hexagonal shape are preferred since aberration is minimised due to the lenses approximating more to the ideal circular shape.

Further, it is not necessary for the rows of optical objects **9** and of lenses **14** to be such that the optical objects and the lenses lie in columns which are staggered. However such an arrangement is preferred since each part of the actual image seen is viewed through the paraxial zone of half the lenses and hence any optical errors are more evenly distributed.

If desired, the lenses may be cylindrical lenses. Such an arrangement is shown in FIG. 7 which illustrates diagrammatically the functional surface of a sign including such lenses and intended for use as a track-side sign to indicate the town Barnet is being approached. The sign includes a housing generally denoted by reference numeral **17** containing a single row of linearly disposed optical objects **18**, each in the form of the word "Barnet" (i.e. as shown in the right hand portion of FIG. 7). A plurality of linearly disposed rectangular-shaped cylindrical biconvex lenses **19** are also contained within the housing in a manner such that the axis of each lens is vertical and each optical object **18** is in registery with and in the focal plane of a lens **19**. Such lenses **19** have a divergent viewing zone and collimate rays of light from an object in the focal plane thereof in the horizontal plane only since the lenses have zero power in the vertical plane. Thus images produced by such lenses are astigmatic. It is thus necessary to compensate for this by using a distorted optical object as shown. The actual image seen by an observer moving linearly past the sign is as shown in the left hand portion of FIG. 7. Further, the actual image seen by the observer moving relatively to the sign appears to be stationary with respect to the observer's movement.

The angle subtended by the image to the viewer in the horizontal plane is constant, but decreases in the vertical plane as a function of the viewing distance. The relative horizontal and vertical proportions of the image thus vary in accordance with the viewing distance. In practice therefore the relative proportions of the images are so arranged that they are at an optimum value at the mean viewing distance. The lens height is greater than the object height and the zone in which the image is visible is divergent.

In practice, the sign shown diagrammatically in FIG. 7 may be constructed in an identical manner to that described with reference to FIGS. 3 to 6 but with the lens assembly **13** and optical objects **9** replaced respectively by a lens assembly comprising lenses **19**, and optical objects **18**.

By suitable design it is possible to construct a sign in accordance with the present invention which can be used

to present any visual matter e.g. pictorial or symbolic, in colour or in black and white. However the embodiment shown in FIG. 7 is suitable for non-pictorial matter only although it has the advantage of a lower cost.

If desired each element of the sign constituted by an optical object and its associated lens may be separated from adjacent elements by partitions. If these partitions are not present, it is possible for the optical object of one element to be viewed through the lens of the element adjacent thereto thus giving rise to secondary images at either side of the main image. For some applications, this need not be a disadvantage. Further, partitions are not necessary when the lenses are not contiguous. If the lenses are not contiguous, the image would flicker at a rate dependent on the relative speed of the viewer. Hence non-contiguous lenses can be used when the relative speed of the viewer is such that the image flicker cannot be detected by the eye.

The optical objects can be carried on a transparent material illuminated from the rear by the light source. Alternatively the optical objects may be carried on an opaque material and be illuminated by the light source from the front. The lenses can be moulded from a plastics material such as perspex (poly methylacrylate) or the like by for example an injection moulding technique. The box-like structure of the sign may be of welded sheet metal. The light source may be a fluorescent tube or filament lamp. Alternatively, the light source may be direct, reflected or refracted ambient light. Thus for example, if the sign is to be sited in a tunnel, the optical objects may be illuminated by light reflected from train windows.

In practice the sign may consist of a number of contiguous or spaced linearly disposed sections, the length of the sign being determined by the number of sections so assembled. Within each section, the actual image to be seen by the observer is determined by the optical objects carried on a support member removable from the housing. A wide variety of configurations is possible based on one standard section. Intermittent or flashing images which would be more effective and possibly more economical can be achieved by arranging sections or groups of sections at intervals. In this case the distance between the sections or the groups of sections should exceed the distance travelled by the observer in one sixteenth of a second i.e. the limit of persistence of vision on the retina. The sign may be of any convenient length irrespective of the angular magnitude of the image which is viewable from any point within a zone bounded by four planes, each plane including one peripheral boundary of the sign and being disposed at a predetermined angle to the surface of the lens assembly. Subject to a practical limit on viewing distance, the actual image seen by the observer in the zone maintains a fixed spatial relationship to the observer who passes the sign at speed. The duration of the actual image is a function of the sign length and the relative speed of the observer. The image persists for as long as the observer is directly in front of any part of the sign. Thus the viewing distance is a matter of convenience and hence the sign can be sited as close as practicable to the observer and its overall dimensions can be correspondingly reduced. Unlike a conventional track-side sign it can be sited in tunnels and in underground systems.

As the viewer passes the sign of the present invention, the actual image seen is maintained by a succession of images superposed on the retina, each image being related to a separate optical object as in the case of a conventional movie projector. By suitably varying the image produced on the retaina i.e. by suitably selecting the optical objects, any form of animation including "wipes," colour change and roller caption techniques can be effected without the use of switches or moving parts. This can be effected by constructing the sign so that it consists of a plurality of linearly disposed sections, all the optical objects of a given section being identical to one another but the optical objects of each section being slightly different to those of the adjacent sections. Thus each section produces a slightly different image, a cinematographic effect being produced when the sections are viewed consecutively. The sections may be spaced apart, when passing speeds are high, or contiguous. The optical objects of adjacent sections differ cinematographically i.e. each section is equivalent to a frame of a cinematographic film. The differences between optical objects of adjacent sections may thus be differences in shape or configuration or differences in colour, according to the type of animation the sign is required to exhibit. The length of each section is to be selected according to the average speed at which the observer is likely to pass the sign.

A sign which will present an apparently animated image to an observer moving with respect thereto is shown diagrammatically in FIG. 8 of the drawings. The sign is divided into a plurality of linearly disposed sections, a part of each of three adjacent sections being shown in the figure and being denoted by letters A, B and C. Section A comprises a plurality of identical linearly disposed optical objects **20** shown for the purposes of illustration as a human caricature in a first running position. Section A also comprises a plurality of linearly disposed lenses (not shown in the interests of clarity), each optical object being in registry with and in the focal plane of one of the lenses. Section B is essentially similar to section A, but the identical linearly disposed optical objects **21** consist of a human caricature in a second running position. Similarly, section C is essentially identical to section B but comprises identical linearly disposed optical objects **22** in the form of a human caricature in a third running position. The succeeding sections of the sign (not shown) have optical objects in the form of human caricatures in other running positions. The construction of the sign is thus such that any section comprises identical optical objects, the optical objects of adjacent sections being cinematographically different. When an observer moves past section A of the sign at speed in a linear direction with respect to the sign, a plurality of identical images each corresponding to an optical object **20** is superposed on the observer's retina and, because section A is constructed in accordance with the principles discussed with reference to FIGS. 1 and 2 of the drawings the actual image seen by the observer is a caricature of a human in the first running position and moreover the actual image appears to be stationary with respect to the observer's movement. Similarly, as the observer passes section B, a plurality of identical images each corresponding to an optical object **21** is superposed on the retina and the actual image seen by the observer appears to be a stationary caricature of a human in the second running position. In a similar way as the observer passes section C, the actual image seen is a stationary caricature of a human in the third running position. Corresponding actual images are observed as the observer moves past the succeeding sections. Thus the observer sees a plurality of cinematographic images as he passes from one end of the sign to the other and hence, due to the persistance of vision of the retina, the image seen by the observer appears to be animated i.e. the observer sees a caricature of a human running. Moreover, the image appears to be stationary with respect to the observer's movement i.e. the image appears to be travelling at the same speed as and along with the observer.

As an example of a track-side sign in accordance with the present invention consider the case where a one word station name sign is required at the approaches to a station. Since such a sign of the present invention need be no more than two feet from the carriage windows, the actual image seen by an observer of the sign need only be about 4 inches high and from about 12 to 18 inches long. This could be produced by constructing the sign so that it measures about 8 inches deep and has a length dependent upon

the desired duration of the image and the average speed of the train, say a length of 30 feet. Such a sign would produce an image which would be visible for 1 second to passengers in a train passing the sign at 20 m.p.h. If the train speed was 60 m.p.h., the passengers would see an image which was just as clear although its duration would be ⅓ of a second. The image would be visible to each passenger having a direct view of a carriage window, the stereoscopic effect inherent in the sign producing the illusion of a much larger sign disposed at a greater distance from the passenger. In situations where the speed of the viewer relative to the sign is likely to be particularly high, a very economical variant of the sign could be used consisting of small widely spaced units each measuring for example 8 inches x 8 inches x 2 inches and illuminated by a filament lamp.

If desired the sign of the present invention could be in the form of an all-weather railway signal the image of which could if required be picked by a lens and back-projected onto a screen in the driver's cab.

The sign of the present invention is also of use in elevator shafts to convey information to passengers in the elevator. In this case, the sign is disposed vertically in the elevator shaft, and the elevator itself is provided with a receiver lens and also with a light source adapted to illuminate the optical objects of the portion of the sign being passed by the receiver lens at a given time. The receiver lens picks up the image projected by the lenses of the sign and back-projects the image onto a screen located in the elevator in a position where it can be seen by the passengers. By suitably selecting the nature of the optical objects, it is possible to convey to the passengers in the elevator, information as to for example the departments or offices located on the floor being next approached by the elevator.

I claim:

1. A sign for presenting information to an observer of the sign moving with respect thereto, which comprises:

(a) a housing,

(b) a plurality of substantially identical lenses, said lenses being secured to said housing and disposed in columns and rows with each of said lenses in a column being located in vertical alinement with the other lenses in that particular column, with each of said lenses in a particular row being displaced vertically from said lenses in an adjacent row so as to form a staggered pattern,

(c) a plurality of identical planar optical objects disposed within and secured to said housing, with said objects located in spaced relation behind said lenses and in optical focus with said lenses, said objects being arranged in rows and columns registering with and corresponding to said rows and columns of said plurality of lenses, and said objects being a representation of the information the sign is to present, so that as an observer moves linearly past the sign and looks into said lenses thereof identical images each corresponding to said objects are successively superimposed on each eye of the observer forming a composite image with said composite image appearing free from distortion because said staggered pattern enables an observer to mentally selectively combine undistorted images into said composite image and in which said composite image appears to be at infinity and hence of identical position and angular size, as a result of which the observer has the impression that he sees only one representation of the information the sign presents, which representation appears to be stationary with respect to the observer's movement.

2. A sign as claimed in claim 1, wherein the lenses are hexagonal in shape and contiguous to each other.

3. A sign as claimed in claim 1, in which there are a plurality of adjacent sections, each of said sections comprising said optical objects and said lenses, and each of said sections having a representation which is cinematographically different from those of adjacent sections.

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U.S. Cl. X.R.

40—137; 352—58, 81