

# PATENT SPECIFICATION

(11)

1 582 345

1 582 345

(21) Application No. 27244/77 (22) Filed 29 June 1977  
 (31) Convention Application No. 705 069 (32) Filed 14 July 1976 in  
 (33) United States of America (US)  
 (44) Complete Specification published 7 Jan. 1981  
 (51) INT. CL.<sup>3</sup> G03B 21/00 //  
 G02B 21/22 21/36  
 G03B 21/10 21/28 21/60  
 (52) Index at acceptance  
 G2J 41C2 41D 41F 41M 8N  
 G2X 42



## (54) IMPROVEMENTS IN APPARATUS FOR ENLARGING AN IMAGE TO BE VIEWED

(71) I, HENRY JOHN TANCREDI, a citizen of the United States of America, of 9 Lamplighter Lane, Pennsylvania 19436, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 The present invention relates to viewing apparatus for enlarging an image to be viewed. Such apparatus can for example be used with microscopes.

15 Moving optical screens are well known and generally include lenticular screens having corrugations and/or protrusions. Such screens produce an image thereon which appears to have depth.

20 Prior art moving screens also include reflective screens having a plurality of curved surfaces which reflect light rays of a projected image. Such reflective screens tend to produce a three-dimensional image effect.

25 Heretofore, moving Fresnel or lenticular lenses have been employed in projection systems either in front of or behind a diffusion screen or with no screen at all. When the projected image to be made 30 visible to the observer is formed in or near the plane of the lens, the motion of the lens has no effect upon the formation of the image, and there is a secondary effect in that the exit pupil or cone of 35 vision projected through or from the lens is enlarged.

Heretofore, prior art moving screen projection apparatus has in general provided high-inertia low-speed moving screens, see 40 e.g. British Patent 1,275,917. Flexible endless belt screens have been employed over rollers, while rigid lens and screens have been orbited or revolved. None of the prior art moving screens have been sufficiently 45 simple in design, low in cost and high in

quality and brilliance and resolution. Some prior art screens have been curved to aid in compensating for distortion introduced by large angles deviating from a normal optical path.

50 Heretofore rotary screen projection apparatus has been expensive and unduly large. Such expensive rotary screen projection devices are difficult to assemble or service and their application has been restricted 55 to expensive medical and scientific laboratory applications.

The present invention is defined in the appended claims, to which reference should 60 now be made.

The invention will be described in more detail, by way of example, with reference to the accompanying drawings, in which:—

65 Figure 1 is a section in side elevation taken through a preferred embodiment of the viewing apparatus;

Figure 2 is a section in front elevation taken at lines 2-2 of Fig. 1;

70 Figure 3 is an enlarged section in elevation taken through a preferred form of flexible screen;

Figure 4 is an enlarged section in elevation taken through a first modified flexible screen.

75 Figure 5 is an enlarged section in elevation taken through a second modified flexible screen;

Figure 6 is an enlarged section in elevation taken through a third modified flexible screen;

80 Figure 7 is a schematic representation in plan view of a stereo optic projection lens system of a type adapted to be employed with the viewing apparatus of Figure 1;

Figure 8 is a schematic representation in plan view of another stereo optic projection lens system; and

85 Figure 9 is a schematic representation in plan view of yet another stereo optic pro-

90

jection lens system.

Refer now to Figures 1 and 2 showing a preferred embodiment moving screen viewing apparatus. A housing 10 comprises 5 upper and lower U-shaped members 11 and 12 having their vertical web members 13 to 16 fitted into slots of H-shaped structural members 17 and 18. Upper and lower members 11 and 12 are held together in 10 members 17 and 18 by four threaded rods 19 each having a blind threaded cap 21 at one end and a nut and lock washer 22 at the other end. The threaded caps 21 may be attached to the rods by lock tight 15 type adhesive. The ends of the H-shaped members 17, 18 and the ends of housing members 11, 12 are machined to exactly match at lines 23, 24 (Fig. 1) so that assembly of the rectangular housing 10 20 may be made without alignment match marks and other complex alignment devices.

The rear end of housing 10 is closed by a rectangular dome 25 having flanges 26 25 around the perimeter. There is a strip or small resilient pad of damping material 27 bonded to the horizontal webs 28, 29 of the upper and lower housing members 11, 12. Slots 31 in the sides of the H-shaped 30 structural members 17, 18 are adapted to receive the flanges 26 of dome 25 and to precisely locate the dome 25 relative to the housing. It will be understood that slots 31 are shown larger than required for purposes of illustration, and need only provide enough clearance to permit insertion or removal by sliding the flanges into or out of the slots 31 when the upper housing member 11 is removed.

40 The front end of housing 10 extends outward from viewing lens 32 to provide a flare or glare hood 33. Viewing lens 32 is preferably rectangular in shape and is cemented into a shape thin rectangular 45 mounting frame 34. Frame 34 may be made of metal but is preferably made of a mouldable shock resistant hard rubber or equivalent material. Frame 34 and viewing lens 32 are slidably mounted in slots 50 35 of H-shaped structural members 17, 18, shown enlarged for purpose of this illustration. It will be understood that the clearance for frame 34 in slots 35 need only be sufficient for ease of removal and insertion. In the preferred embodiment shown, the moulded frame 34 is shown with a slight taper on the base which cooperates with a matching taper in the slots 55 35. Since lower housing member 12 may be 60 sprung open during cleaning or service, no side clearance is required for proper operation, thus viewing lens 32 may be located precisely during assembly.

65 Field lens 36 is preferably circular in shape and is cemented into a circular aper-

ture 37 in rectangular mounting frame 38. The rectangular frame 38 may be cut from a thick plate of metal or rigid plastics. In the preferred embodiment shown the outer base edges of frame 38 are slightly tapered 70 so that they will cooperate with a matching taper in slots 39 of H-shaped structural members 17, 18. The slots 39 are precision milled in members 17, 18 at ten to twelve degrees from the vertical, thus, members 75 17, 18 are either left hand or right hand and are not interchangable. The precision milled slots 31 and 39 locate lens 32 and 36 at a predetermined fixed distance which is always the same when the apparatus is 80 assembled. Thus, disassembling for cleaning or repairing does not require factory tooling.

Damping pads or strips 41 of thin resilient material may be cemented into the 85 upper and lower housing members 11, 12 to prevent any possibility of frame 38 moving vertically in slots 39 due to slight vibration.

90 Motor means 42 comprises a commercially available shaded pole low horsepower, high speed motor provided with a shaft 43 and a mounting plate 44. It will be understood that the type of motor is not important so long as it is substantially vibration free at speeds in excess of 2000 r.p.m. Should the motor be supplied without a mounting plate 44, a plate may be connected to the motor housing or frame, preferably spaced apart from 100 the stator to permit cooling. In the embodiment shown, plate 44 is so connected by studs (not shown) extending from the frame 45 to provide a rigid member capable of supporting the weight of motor means 42. 105

110 Motor means 42 is positioned in housing 10 by a support plate 46 which fits into slots 47 in H-shaped members 17, 18 in a manner similar to frames 34 and 38. On both sides of plate 46 there are provided resilient mats 48 and 49 which may be attached to the plate by adhesive, not shown. The mats 48 and 49 are preferably rectangular in shape and approximately the size and shape of mounting plate 44. Support plate 46 and mats 48, 49 are removably mounted to mounting plate 44 by large head internally threaded cap nuts 51 115 cooperating with screws 52. It will be understood that appropriate apertures are 120 provided in the plates 44, 46 and mats 48, 49 to accommodate the nuts 51 and screws 52.

125 Since motor means 42 is fixed relative to plate 44, but not plate 46, substantially all vibration induced into motor means 42 through shaft 43 is damped out by mats 48, 49 which have a very low natural resonance and will damp out all the high frequency vibration of high speed motor 130

means 42. Resilient gromets or washers may be substituted for the mats 48, 49 but do not provide as accurate parallel alignment of plates 44, 46 nor do they absorb 5 vibrations as well.

Horizontal web 28 of upper housing member 11 is provided with a resilient strip 53 which applies a slight downward pressure on plate 46 which abuts the side 10 of horizontal resilient rectangular block 54 affixed to horizontal web 29 of member 12. The full weight of motor means 42 is applied to rectangular block 54 through plate 44 so that any vertical vibration is 15 damped. Any transverse vibration is absorbed by vertical resilient rectangular blocks 55 and 56 which are affixed to vertical webs 15 and 16 of lower housing member 12. The various damping means are 20 provided to eliminate vibration induced into shaft 43. Most high speed low cost motors have some clearance in the axial direction, however, at speed and under load the shaft and armature have a preferred 25 axial direction, which usually biases the shaft into the motor housing and against the rear bearing designed to take thrust. An O-ring 57 is provided on shaft 43 to prevent any lubricant from moving down 30 shaft 43 and being spun off in the area of the screen 58.

The moving screen 58, comprising a flexible laminate, as will be explained herein-after, is attached by adhesive 59 to moving 35 screen mounting means 61. Mounting means 61 comprises a precision turning having a cylindrical shaft adapter portion 62 and a disc shaped mounting portion 63. Preferably the turning is made of light 40 weight metal such as aluminum or a rigid stable plastics so that no rotational vibrational forces are produced at very high speeds in excess of 2000 R.P.M. The shaft adapter portion 62 may be provided with 45 a threaded aperture for receiving a small set screw 64. In a preferred embodiment show having a five inch diameter flexible screen the small set screw 64 in aluminum mounting means 61 did not introduce a 50 noticeable vibration. In apparatus requiring larger screens and mounting means 61, adhesive may be employed on shaft 43 to connect hub 62 without any imbalance.

It will be understood that mounting 55 means 61 is only a preferred way to manufacture shapes with a flat mounting surface 63 and that other equivalent symmetrical shapes may be substituted by any skilled machinest.

60 Preferably, moving screen 58 is attached to hub mounting means 61 and then hub 61 is mounted on shaft 43 at an exact predetermined distance from plate 46. In this manner the relative distance 65 between screen 58, viewing lens 32 and

fields lens 36 is fixed and the components will assume their relative position even though removed and replaced during cleaning because slots 31, 39 and 47 maintain their fixed position. As will be explained 70 hereinafter, moving screen 58 is preferably assembled as a laminate and die cut into a circular shape with a centre marker provided for purposes of mounting on hub 61. When the flexible screen 58 is rotated 75 at high speed it will become substantially flat and parallel to the rear surface 65 of field lens 36.

A pair of symmetrical Z-shaped extension rails 66 and 67 are connected by screws 80 68 to the bottom horizontal web 29 of housing member 12. The rails 66 and 67 form the support for the reflective surface means and the projection means. In the preferred embodiment shown the reflective 85 means comprises two first surface mirrors 69 and 71 mounted on a precision milled rectangular block 72. Fixed mirror 69 is cemented onto inclined surface 73 which was made by milling a slot in the centre 90 of block 72 more narrow than the width of block 72 leaving two triangular shaped ears 74. Adjustable mirror 71 is supported in a transverse slot 75 extending transversely through block 72. Mirror 71 is entrapped between two pivot pins 76 also extending transversely through block 73. A curved leaf spring 77 in slot 75 biases mirror 71 toward adjustment screw 78 in block 73 which is reached through access 100 hole 79 in housing member 12. It will be noted that mirror 71 extends upward into housing 12 and is in front of viewing lens 32. It has been discovered that while mirror 71 can be seen by an observer, it is not 105 seen nor does it obstruct the field of view of the image on screen 58 by an observer looking at the screen 58. This feature permits the optical path line 80 to intercept the flat screen at an angle less than ten 110 degrees from normal. In the preferred embodiment the optical path 80 intercepted the screen at less than eight degrees from a perpendicular, which exceeds the requirement for distortion free images employing 115 a microscope objective. Block 72 is clamped to rails 66, 67 after mirror 71 is adjusted to focus the image in the centre of screen 58 by a transverse plate 81 and screw 82 threaded into block 72. It will be understood that the optical path 80 may be adjusted and that the angle of support plate 46 may be changed to provide distortion 120 free images over a wide range of projection lens.

125 Microscope objective 83 in the preferred embodiment is a commercially available 10x to 20x power eyepiece objective such as those made by NIKON, Bausch and Lomb, or Zeiss. In a preferred embodiment 130

use where the projection apparatus is mounted on an existing monocular microscope, the microscope projection lens 83 may be removed from the customer's 5 microscope and placed in eyepiece block 84. Thus, it will be understood that the term projection lens means and projection means refers to the eyepiece block 84 with or without a lens in place and/or an 10 adapter ring placed in the optical path between the customers microscope and the reflective surface means comprising at least a single mirror like mirror 71.

Eyepiece block 84 is preferably rectangular in shape and is provided with a 15 horizontal cylindrical bore 85 for receiving objective projection eyepiece lens 83. A vertical cylindrical bore 86 is in the end of block 84 provides the entrance optical 20 path 80 which reflects off or first surface mirror 87 cemented onto incline surface 88 of block 84. The inclined surface 88 is provided by milling an inclined slot in the end of block 84 across the intersection 25 of bores 85 and 86. The slot is more narrow than the width of block 84, thus, leaving a pair of triangular ears 89.

Eyepiece block 84 is removable from the 30 end of Z-rails 66, 67 by removing end plate 91 held in place by tension plate 92 and screw 93. This permits the changing of eyepieces in block 84 if desired. Eyepiece block 84 is held in place by clamp screw 90 threaded through Z-rail 66.

35 It will be understood that the image viewing apparatus of Figures 1 and 2 may be sold with or without objective projection lens 83 and that adapter rings 94, 95 like those shown in phantom lines can be 40 employed to mount the viewing apparatus on a microscope.

The viewing apparatus may be provided 45 with a lens system 96 and a light system 97 having a beam splitter 98 housed in a housing 99 (shown in phantom lines) adapted to be mounted onto Z-rails 66, 67 or directly onto housing member 12.

In the viewer of Figure 1, the projection 50 optical system comprising lens system 96, mirror 87, eyepiece lens 83, and mirrors 69 and 71 provides an enlarged projected image of an object to be viewed. This image is formed at the screen 58 and is viewed by the lens 32. The field lens 36 55 adjacent the screen spreads the light to help to provide a uniform image brightness.

Refer now to Figures 3 to 6 showing 60 novel flexible moving screens of the type embodying the present invention. Screens 58 may be prepared as a fine element laminate and then die cut into a perfect circle before being cemented onto hub 61 by adhesive 59. The plastics layer 101 is preferably thin and highly flexible having a 65 first surface mirror 102 vacuum deposited thereon. The plastics material may be selected to be compatible with the deposited mirror surface. Lenticular laminate 104, 105 comprises an embossed surface layer 70 105 and a thermoplastic layer 104 which is moulded face to face thereto without destroying the embossments. Lenticular layer 104, 105 is substantially transparent and refracts or bends the light rays passing 75 therethrough. The lenticular laminate 104, 105 could have been provided with a second surface mirror layer, but it was found that there was a tendency for the layers 104, 105 to delaminate when exposed to heat 80 and high vacuum. Accordingly, the mirror surface 102 was placed on a separate layer 101 and layers 101, 102 and 104, 105 were joined by a clear adhesive layer 103. Adhesive layer 103 may be sprayed onto one 85 of the adjacent surfaces 102 or 104 or may be provided in sheet form having double sticky surfaces.

Screen 58A is a modified form of screen 58 wherein the thermoplastic layer 104 is 90 eliminated. The embossments on layer 105 are connected to first surface mirror 102 by a clear adhesive layer 103' which fills the void between layers 102 and 105. Layers 101, 102 and layer 105 may be joined by 95 first placing a resilient clear adhesive layer 103' on the mirror surface 102, then joining layer 103' to embossed layer 105 by employing a roller in a manner which eliminates air entrapment there- 100 between. When properly applied the adhesive layer 103' will not deform layers 101, 102 and 105. It would appear that in Figure 4 that a curved second surface mirror 102 could be deposited directly onto lenticular 105 embossed layer 105 and the adhesive 103' added behind. This may be done, however, it changes the optical characteristics because lenticular layer 105 does not then act as a double refractive optical layer. 110

Screen 58B, shown in Figure 5, comprises a lenticular layer 105' which has a pattern of reverse embossments. A first surface mirror 102' is deposited onto layer 105' and a transparent thermoplastic layer 115 is applied to the front surface for protection against dust and pollutants in the air. The smooth flat outer surface of protective layer 104' aids in maintaining the 115 optical surfaces clean.

Screen 58C, shown in Figure 6, is a modified form of screen 58B in which the protective layer 104' has been removed. The danger in using an embossed surface with an exposed first surface mirror is that 120 the surface will oxidize and become dull or collect dust, and become dull. While a first surface mirror enclosed in a housing will be protected to some extent, it is believed best to keep the mirror protected 130

with protective polish or even a very thin sprayed on coat of optically clear plastic.

The screens 58, 58A, 58B and 58C are preferably made of flexible layers of plastics material. The lenticular layers may be made of less flexible plastics to ensure that the lens patterns are maintained uniform. The lenticular layers 104, 105 were made of flexible materials which would hold a circular shape. The layer 101 and the mirror 102 deposited thereon were made highly flexible and would not support themselves until attached to layers 104, 105 by adhesive layer 102. When the screens 58 were attached to disc 63 or hub 61 by adhesive 59, the screen did not droop or bend so as to touch field lens 36. All screens shown assumed a substantially flat plane when rotated at high speeds.

It was observed that the image on screen 58 was of uniform brightness and presented no noticeable circles at speeds as low as 1800 R.P.M. employing high quality reflective surfaces and lens. When the screen 25 58 is properly centred on hub 61 it may be rotated at speeds in excess of 3600 R.P.M. without vibration. The flexibility of the screen enhances its self balancing characteristics and permits the screen to assume 30 a substantially flat optical surface. Due to the flatness of screen 58 and its parallelism to field lens 36, and the low angle of divergence from a normal optical path, an extremely sharp image may be projected onto screen 58. No special corrective field lens was needed and the screen 35 58 need not be curved to compensate for distortion in the system or to create a larger exit pupil.

A very bright image is obtained by using large aperture corrected projection lens to introduce a large amount of light. The bright image is maintained by using short distances between the projection lens 40 system and the moving screen and the bright image is not dispersed or distorted by employing a highly efficient screen having reflective surfaces. Screen 58, shown in Figure 3, is the least efficient element 45 in the system and was made to reflect about ninety-four percent of the light projected thereon. The lenticular surface of screens like screen 58 may be selected from numerous types of commercially 50 available embossed surfaces or may be designed especially to enlarge the exit pupil the minimum amount necessary to enhance viewing. Such special lenticular surfaces 55 will vary slightly depending on the projection lens system employed.

Having explained two reflective lenticular surfaces and two refractive lenticular surfaces employed in Figures 3 to 6, it will be understood that numerous other light- 60 weight flexible self balancing screens pro-

viding very high reflective flat disc surfaces would be operable in the present viewing apparatus.

The preferred embodiment of the present invention has been explained with reference to projection lens means comprising a monocular eyepiece block 84 with or without a single projection lens 83. Figure 7 shows in schematic representation in plan view a stereo optic projection lens system 75 for presenting two superimposed images from a stereo microscope onto a moving screen 58 after being directed by a single reflective mirror 71 of the type shown in Figure 1. The objective lens systems 107 70 each comprise two or more individual lens elements and are preferably of the type providing high optical speed (f opening), excellent definition and illumination and no distortion. Such lenses are well known 75 and commercially available from microscopes, projection systems and cameras. The image from the upper lens 107 is reflected from mirror 108 through eyepiece lens 111 and from reflective prism surface 90 113 onto reflective means 71. In similar manner the image from lower lens 107 is reflected from adjustable mirror 109 through eyepiece lens 111 and from reflective prism surface 114 onto reflective 95 means 71. Prism 112 is mounted for slideable movement as shown by the arrows which permits convergence of the optical paths 115. The lower optical path 115 is further adjustable by mounting mirror 109 100 in a manner which permits pivoting movement, as shown by the arrows, for extremely fine adjustment. While gross and fine adjustments are shown for converging the images in a horizontal plane as viewed 105 on screen 58, similar adjustments may be provided to converge the images in a vertical plane as viewed. In the system shown in Figure 7 the two stereo objective lens 107 are mounted for movement together to 110 provide for proper focusing upon an object (not shown).

Figure 8 shows a schematic representation a modified form of stereo optic projection lens system. In this system the 115 stereo objective lenses 110 direct their individual images through eyepiece lens 116 and 117 which are similar to objective lens 83 in Figure 1. The optical paths 121 are converged by passing through a fixed prism 118 and a pivoted prism 119, mounted for movement as shown by the arrows. The two images are reflected from lens means 71 onto screen 58 where they are superimposed upon each other. It will be understood that the optical paths 121 may be very close to each other and that prism 118, 119 may be mounted back to back on a movable block so as to provide convergence of the images in the horizontal 125 130

plane. Since objective lenses 110 can be mounted in a horizontal plane with provision for slight vertical adjustments no vertical adjustment of the images is required in 5 the field. Figure 9 shows in schematic representation another modified form of stereo optic projection lens system which can be employed with the viewing apparatus of Figures 1 and 2. The upper objective 10 lens 120 directs its individual images to a pair of fixed mirrors 122, 124, and through an oversize eyepiece lens 126 to reflective means 71. The lower objective lens 120 directs its image to a pivotally adjustable 15 mirror 123 and then to a fixed mirror 125 and through the eyepiece lens 126 to reflective means 71. The system shown in Figure 9 provides a long optical path.

It will be understood that the microscope lens system 96 shown in Figure 1 is removed when projection lens systems shown in Figures 7 to 9 in plan view are substituted therefor. Thus, it will be understood that the same basic viewing system 20 in housing 10 may be used for a large number of applications. The viewing system can thus be mounted on mono or stereo microscopes. If the microscopes are not provided with internal or external lighting 25 systems provision has been made to include a light system below the housing 10.

The viewing system is adapted to be assembled with a complete optic and lighting system for use with all types of 30 machinery and/or assembly operations over the large range of industrial and scientific microscopes. The complete optic system may be used as a very accurate jewelers loop for demonstrating the cut, 35 color and purity of precious stones. The complete optic system employing stereo optic lenses is particularly useful for colposcopes and other medical applications because the apparatus is small and compact 40 yet light in weight enabling it to be positioned very near the object to be enlarged and viewed. Because the viewing systems is highly efficient, less light is required and the device may be used to look into the eye 45 without harmful effects.

Having explained the novel mechanical features of the invention and illustrated their use in combination with several alternative objective systems, other objective 50 systems may be coupled to the novel viewing apparatus by those skilled in the art of optics.

WHAT I CLAIM IS:—

1. Apparatus for enlarging an image to 60 be viewed, comprising a housing, a projection optical system mounted in said housing for providing an enlarged projected image of an object to be viewed and for projecting said image along an optical path 65 proceeding from said projection optical

system, field lens means mounted in said housing having a front surface in said optical path proceeding from said projection optical system and having a rear surface opposite said front surface, moving 70 screen means mounted for rotary movement in said housing juxtaposed said rear surface of said field lens means and providing a substantially flat surface having optical lenticulations thereon in said optical 75 path proceeding from said rear surface of said field lens means, said moving screen means comprising a lightweight flexible plastics disc having a highly reflective surface thereon, and said image being formed 80 on said moving screen means, moving screen mounting means having a shaft adapter and a disc shaped moving screen mounting portion attached to a centre portion of said moving screen means, motor 85 means mounted in said housing and having a rotatable shaft fixed in said shaft adapter of said moving screen mounting means, and a viewing optical system positioned in said optical path proceeding from said 90 screen means and said field lens means for viewing said enlarged image on said moving screen means from the front of said field lens means.

2. Apparatus as set forth in claims 1, 95 wherein said moving screen means comprises a flexible plastics laminated disc which conforms to a substantially flat plane when rotated by said motor means.

3. Apparatus as set forth in claim 2, 100 wherein said flexible plastics laminated disc comprises a laminate having a reflective layer and an embossed lenticular layer.

4. Apparatus as set forth in claim 3, 105 wherein said embossed lenticular layer comprises two embossed lenticular layers connected in surface to surface contact and providing two outer smooth layers.

5. Apparatus as set forth in claim 4, 110 wherein said reflective layer comprises a flexible plastics layer and a coating of highly reflective metal bonded thereto.

6. Apparatus as set forth in claim 5, 115 wherein said reflective metal coating is applied to said flexible plastics layer as a first surface mirror and said first surface mirror is connected to said embossed lenticular layers with a transparent adhesive, and said moving screen mounting means is connected to said reflective layer at the side opposite said first surface mirror.

7. Apparatus as set forth in claim 1, 125 wherein said moving screen means comprises an embossed flexible plastics disc which rotates in a flat plane when rotated at high speed by said motor means, and further comprises a first surface mirror reflective surface applied to the embossed surface juxtaposed said field lens means.

8. Apparatus as set forth in claim 1, 130

wherein said moving screen means comprises a raised embossed flexible plastics disc which rotates in a flat plane when rotated at high speed by said motor means,

5 and further comprises a first surface mirror reflective surface applied to a highly flexible thin plastics sheet which is attached to said raised embossed flexible plastics disc by a filler adhesive which is substantially optically clear.

10 9. Apparatus as set forth in claim 1, wherein said moving screen means comprises a reflective screen having a coefficient of reflectivity of greater than ninety per-

15 cent.

10. Apparatus as set forth in claim 1, including reflective surface means mounted in said housing in said optical path between said projection optical system and

20 said field lens means.

11. Apparatus as set forth in claim 10, which further includes means for pivotally mounting at least one reflective element of said reflective surface means for ad-

25 justably positioning said optical path being directed toward said moving screen means.

12. Apparatus as set forth in claim 11, wherein said means for pivotally mounting a reflective element of said reflective sur-

30 face means comprises a pivot rod on each side of said reflective surface means, screw means cooperating with one side of said reflective surface means, and spring means biasing said reflective surface means into

35 engagement with said screw means.

13. Apparatus as set forth in claim 1, which further includes objective lens means mounted in said housing in front of said projection lens means between said object

40 and said projection lens means.

14. Apparatus as set forth in claim 13, wherein said objective lens means comprises a stereo pair of lenses and further includes means for converging the two

45 optical paths proceeding from said objective lenses on said reflective surface means.

15. Apparatus as set forth in claim 14,

wherein said means for converging the two optical paths further includes means for adjusting at least one of said two optical paths.

16. Apparatus as set forth in claim 10, wherein said reflective surface means comprises a mirror for projecting said enlarged image on said moving screen means, said mirror being positioned in the field of view of said viewing lens means but not in the direct viewing path of said moving screen means.

17. Apparatus as set forth in claim 1, wherein said motor means comprises a flat mounting plate slidably mounted in grooves in said housing and resilient means for mounting said motor on said mounting plate.

18. Apparatus as set forth in claim 17 which further includes resilient mounting means on the bottom of said housing for supporting said motor means in said grooves in said housing.

19. Apparatus for enlarging an image to be viewed of the type having a projection lens system for providing a projected image of an object along an optical path to a reflective surface and thence through a field lens to a moving reflective projection screen where the image is viewed through a viewing lens and the field lens, wherein said reflective projection screen comprises a lightweight flexible laminated disc having at least a lenticular layer and a highly reflective layer, and said flexible laminated disc when rotated at high speeds provides a self balancing projection screen which assumes a substantially flat lenticular plane.

20. Apparatus for enlarging an image to be viewed substantially as herein described with reference to the accompanying drawings.

REDDIE & GROSE,  
Agents for the Applicants,  
16, Theobalds Road,  
London, WC1X 8PL.

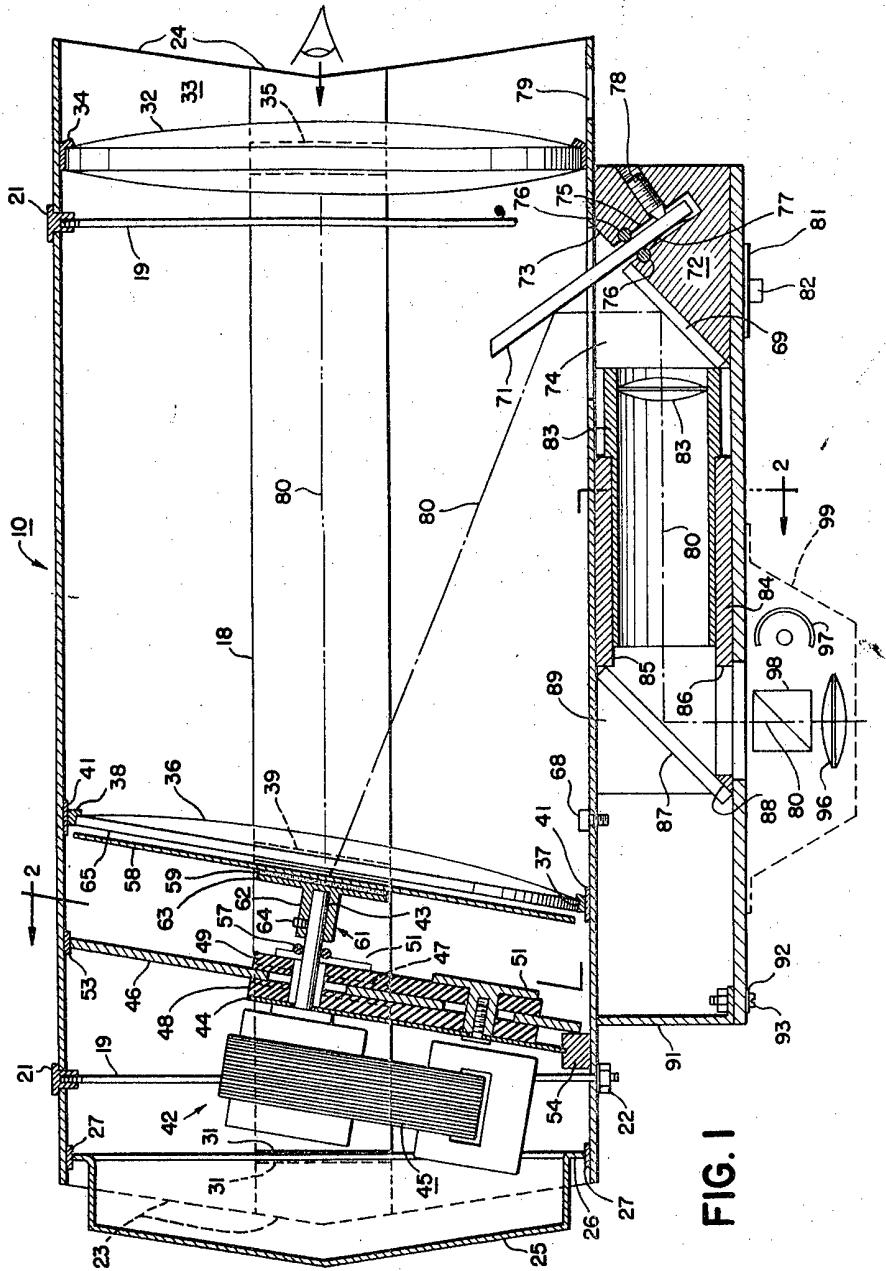
1582345 COMPLETE SPECIFICATION

3 SHEETS

This drawing is a reproduction of

This drawing is a reproduction of  
the Original on a reduced scale

Sheet 1



—  
E.G.

1582345 COMPLETE SPECIFICATION  
3 SHEETS *This drawing is a reproduction of  
the Original on a reduced scale*  
Sheet 2

FIG. 2

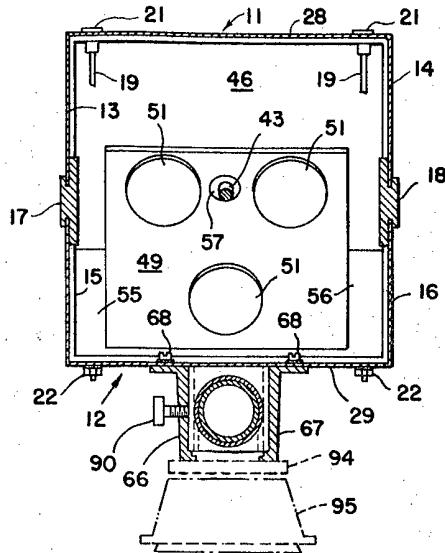


FIG. 3

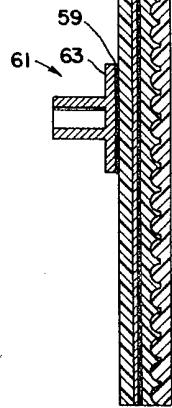


FIG. 4

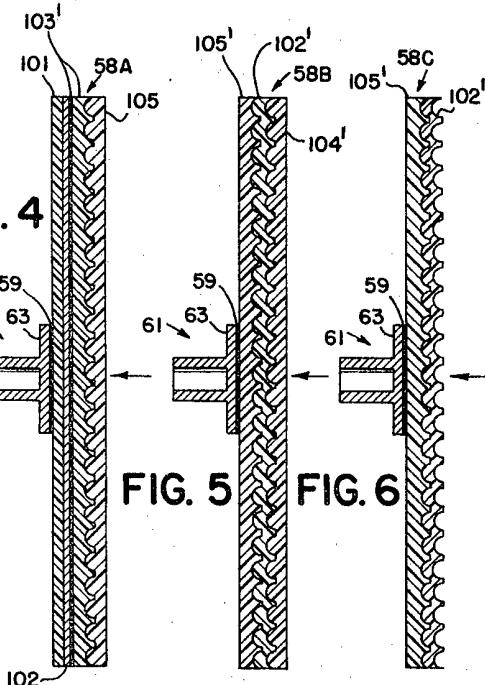


FIG. 5

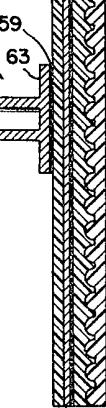


FIG. 6



1582345 COMPLETE SPECIFICATION

3 SHEETS

This drawing is a reproduction of  
the Original on a reduced scale  
Sheet 3

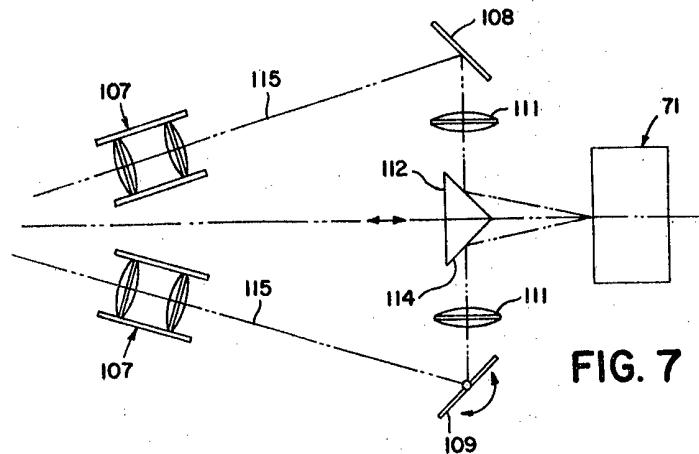


FIG. 7

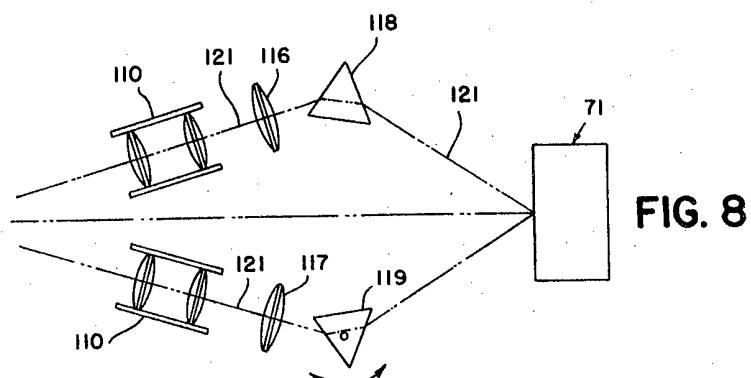


FIG. 8

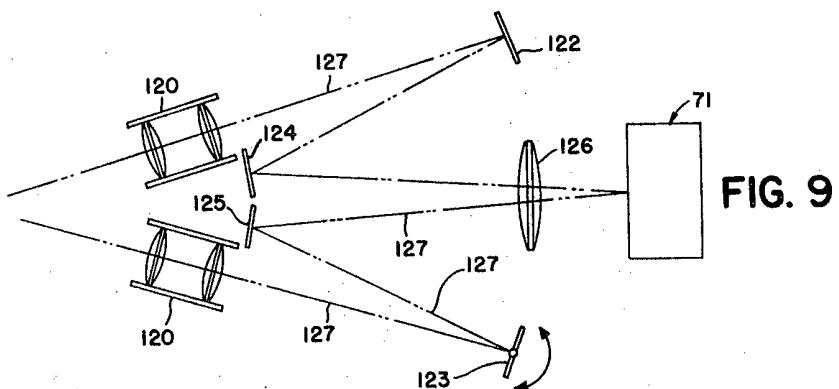


FIG. 9