

[54] **ROTARY PRISM DISPLAY**

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 [51] Int. Cl.G09F 9/00
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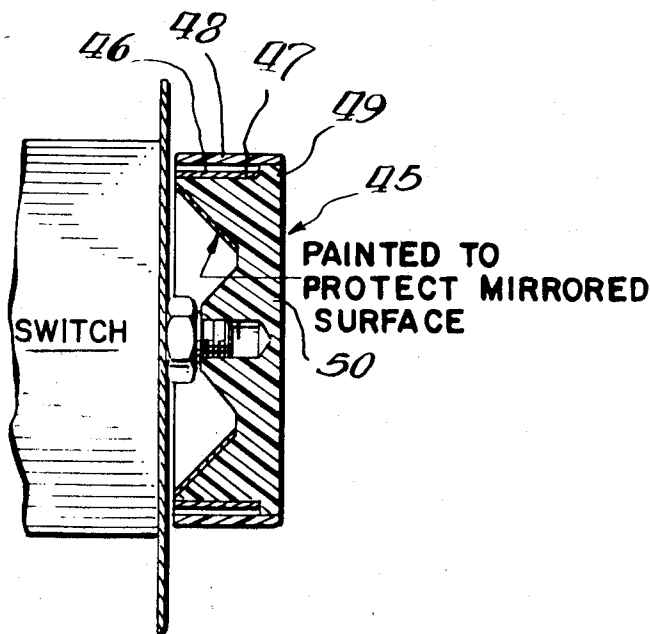
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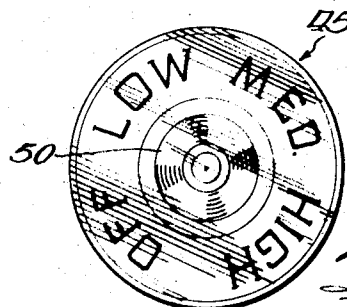
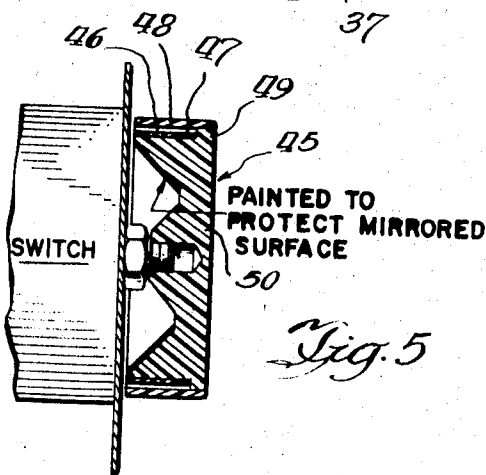
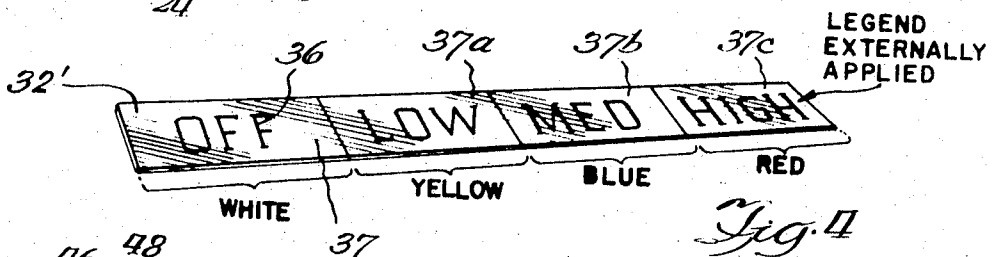
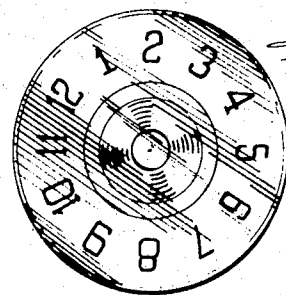
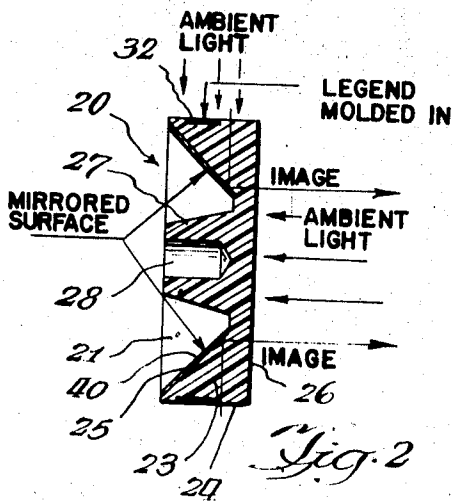
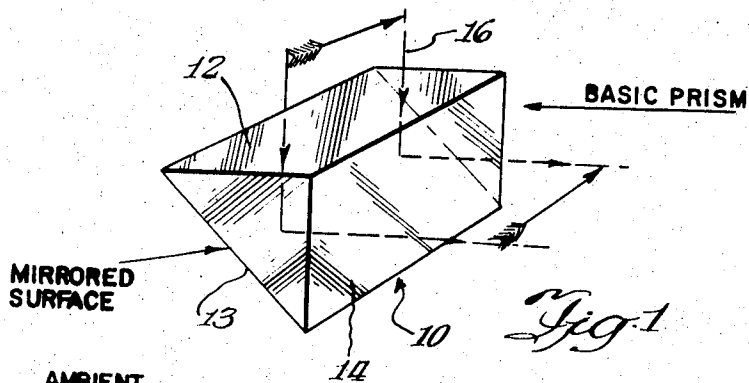
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[57] **ABSTRACT**

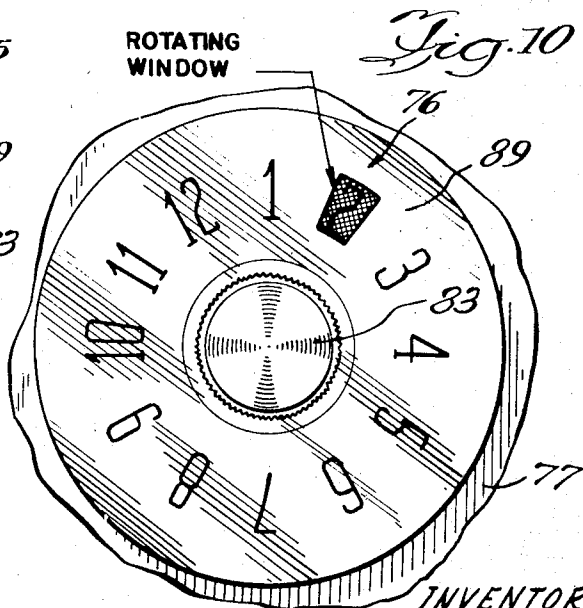
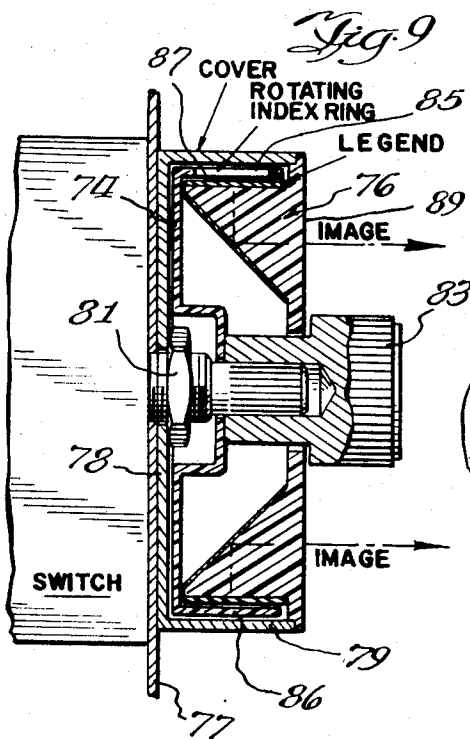
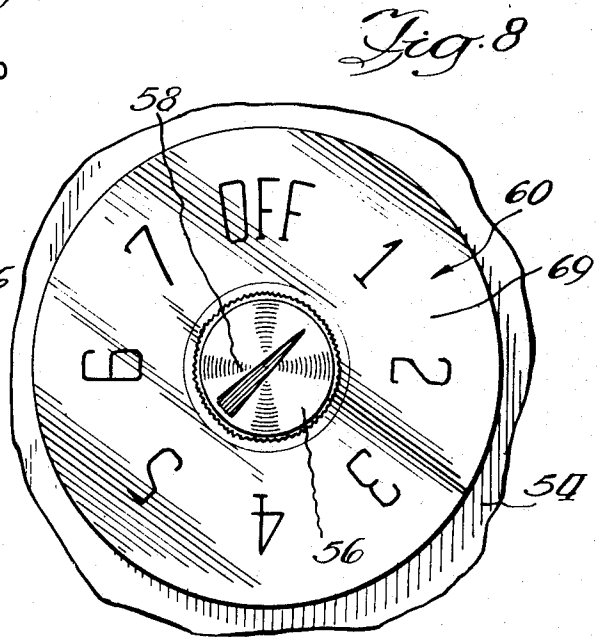
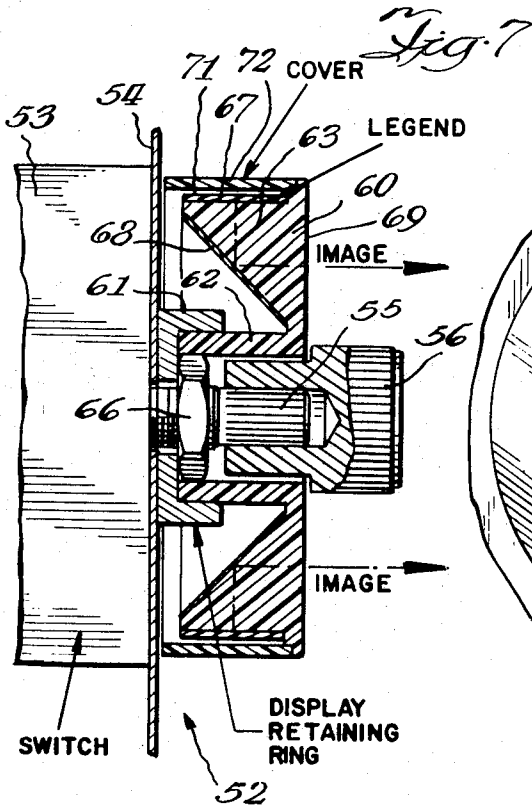
A rotary display device using a transparent circular prism having a conical reflecting surface, an object surface and an image surface. Indicia is positioned adjacent the object surface and is visible at the image surface at least partially by the use of ambient light from the image surface.

6 Claims, 34 Drawing Figures

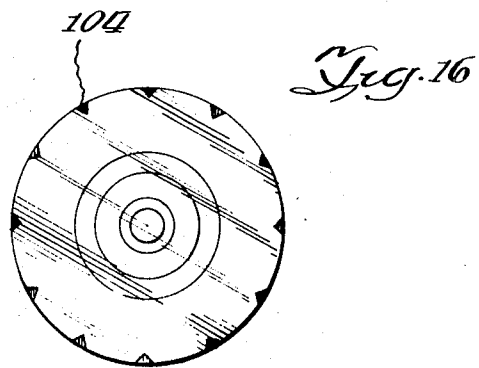
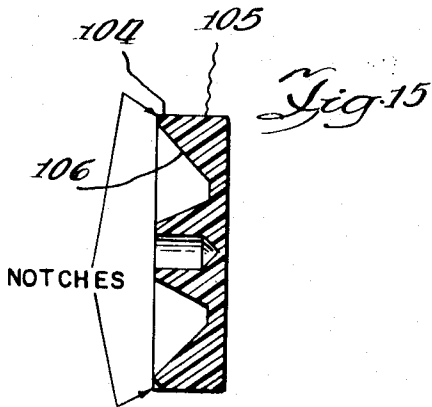
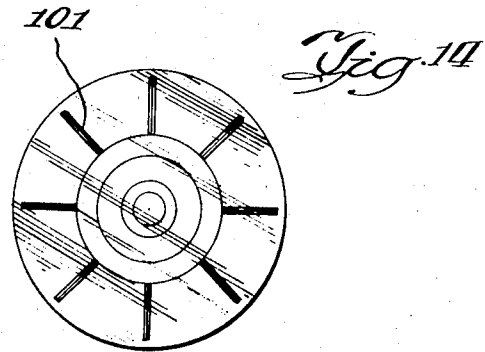
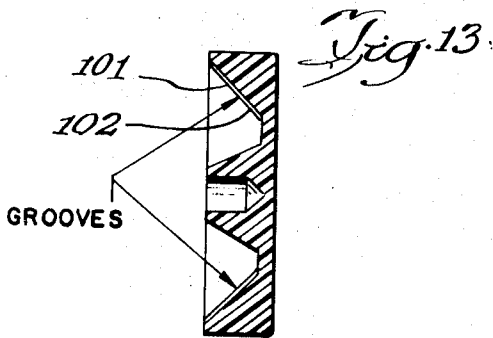
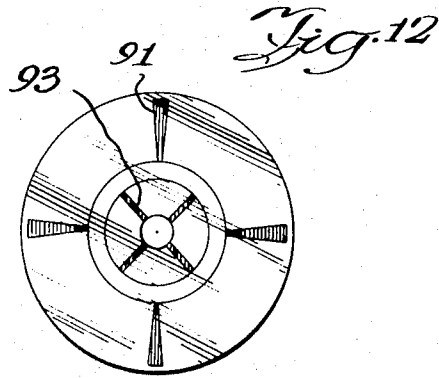
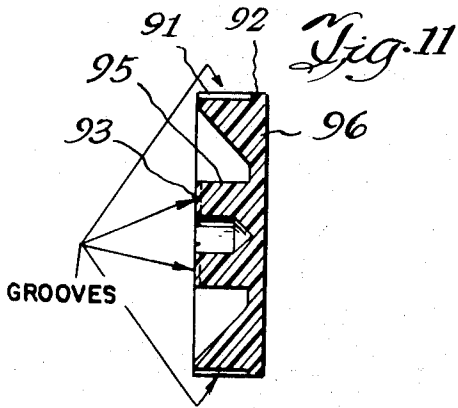




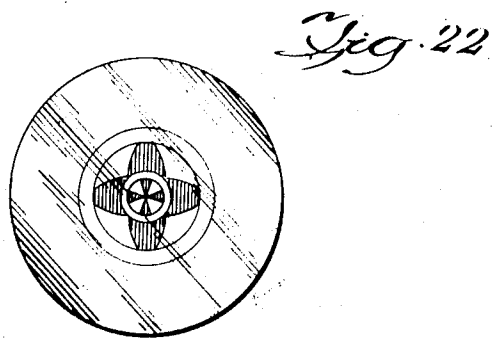
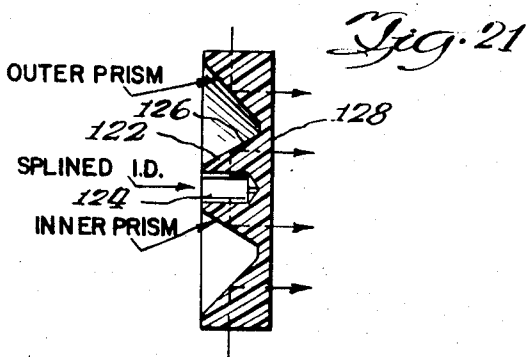
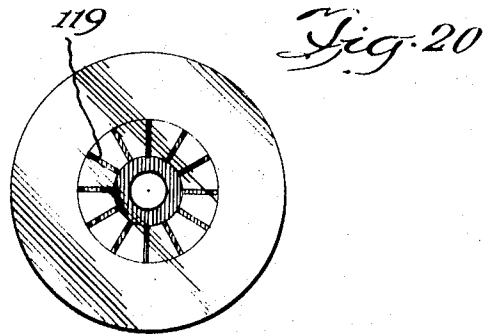
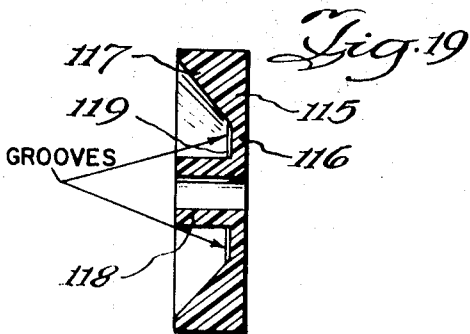
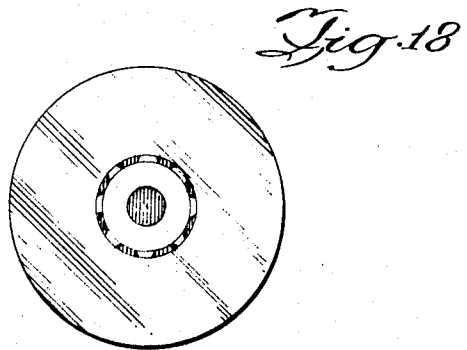
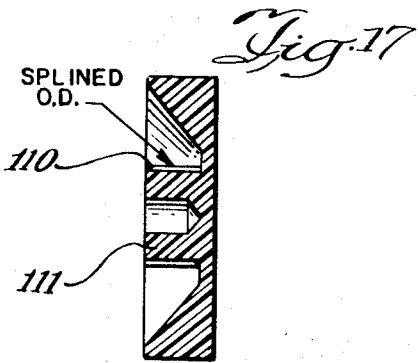
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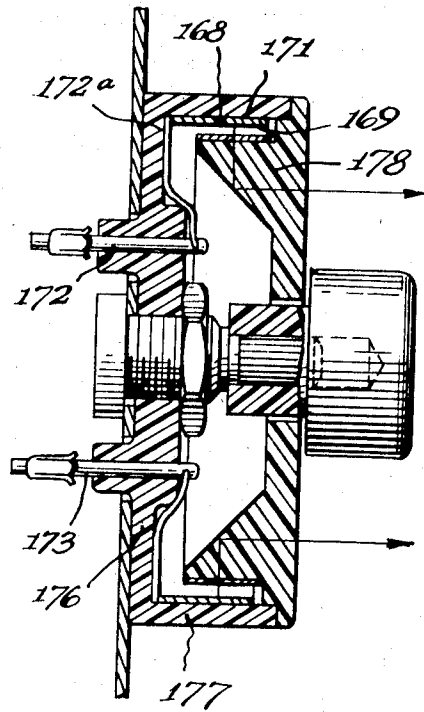
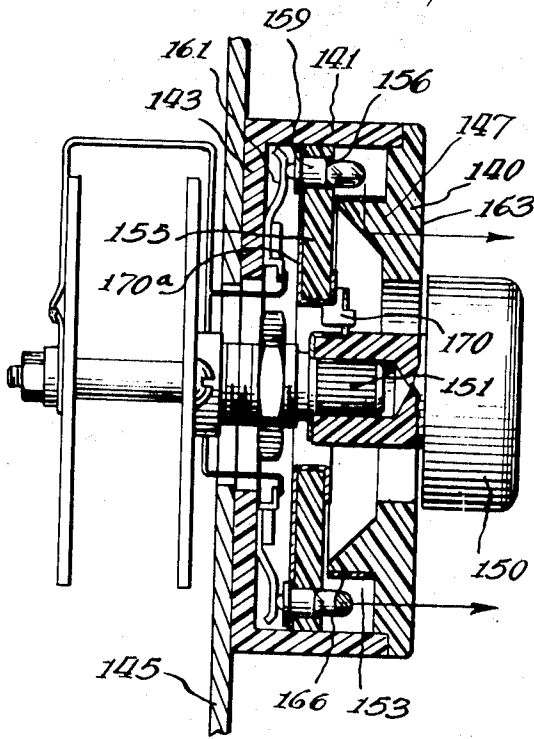
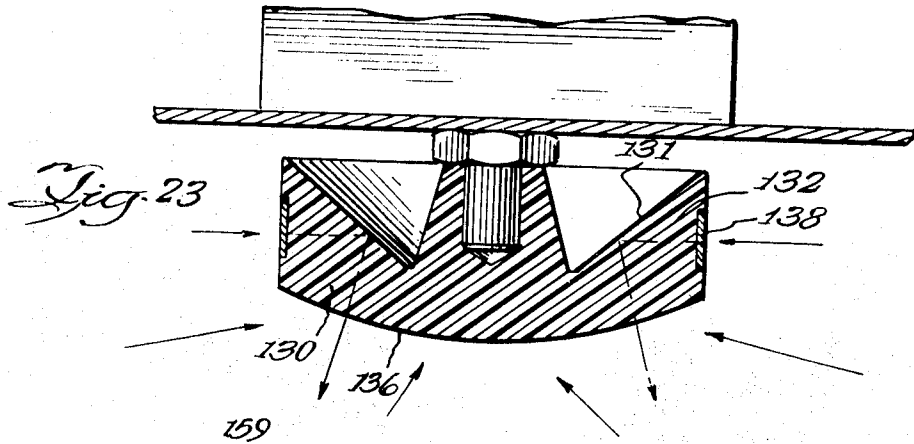
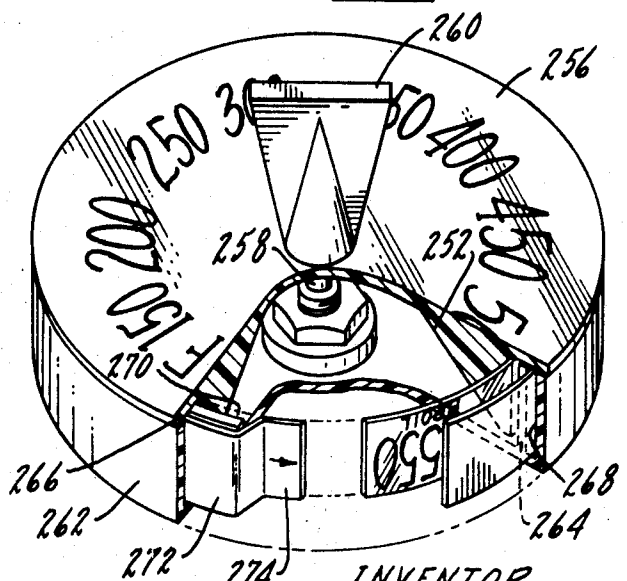
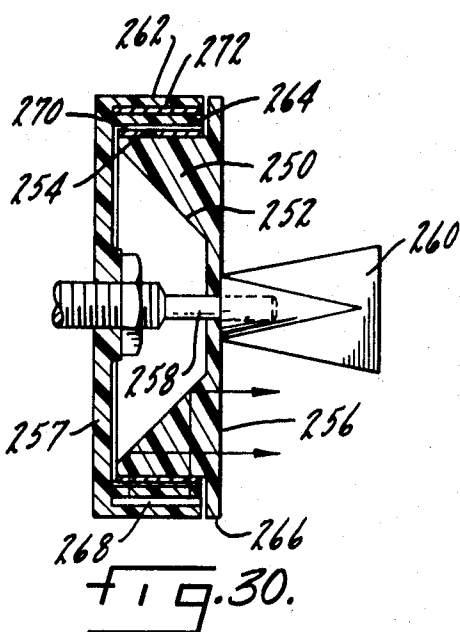
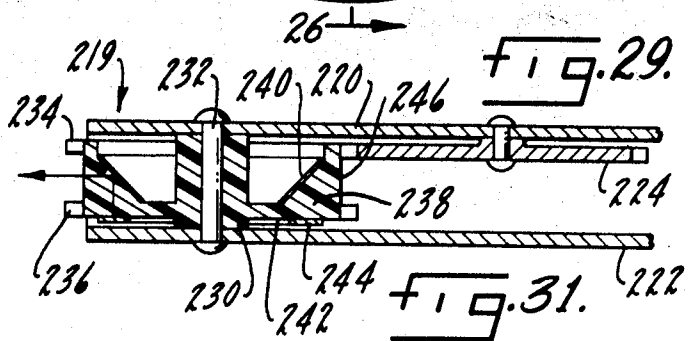
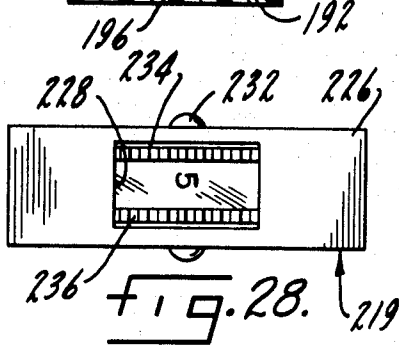
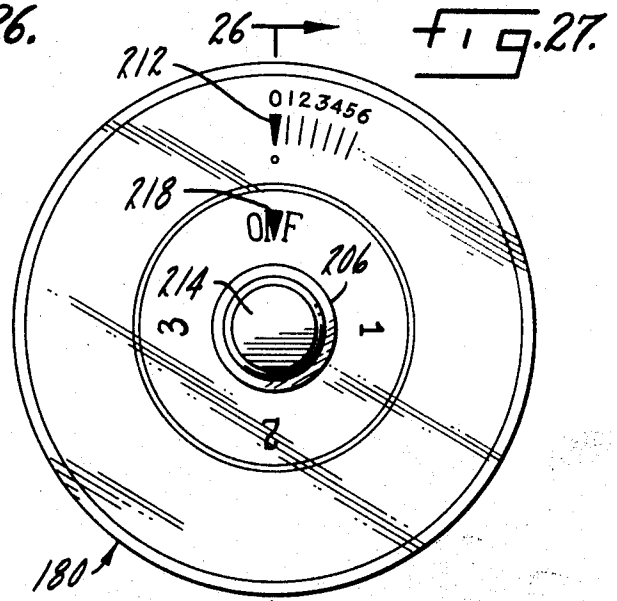
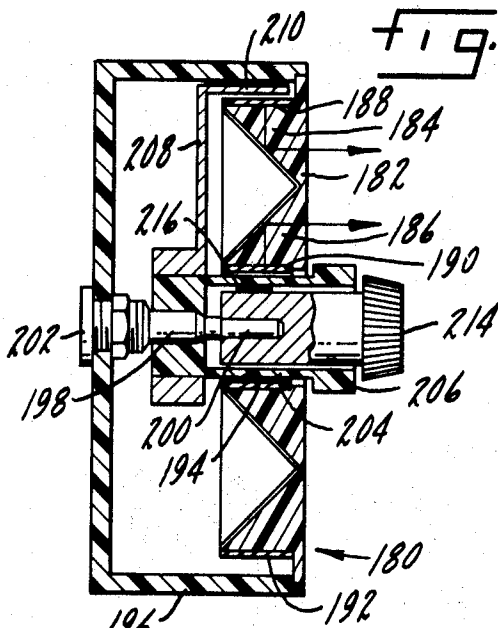


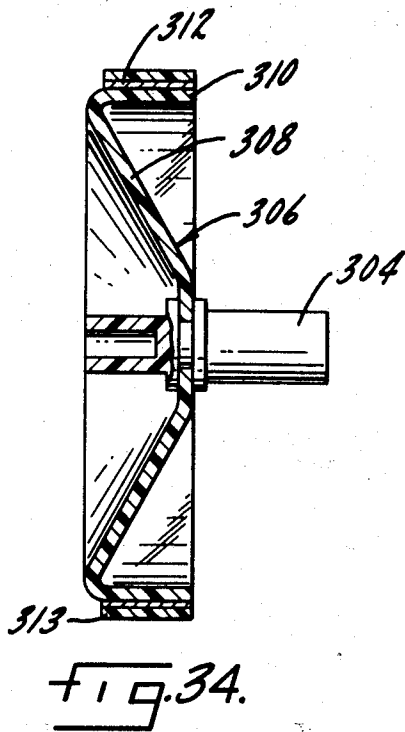
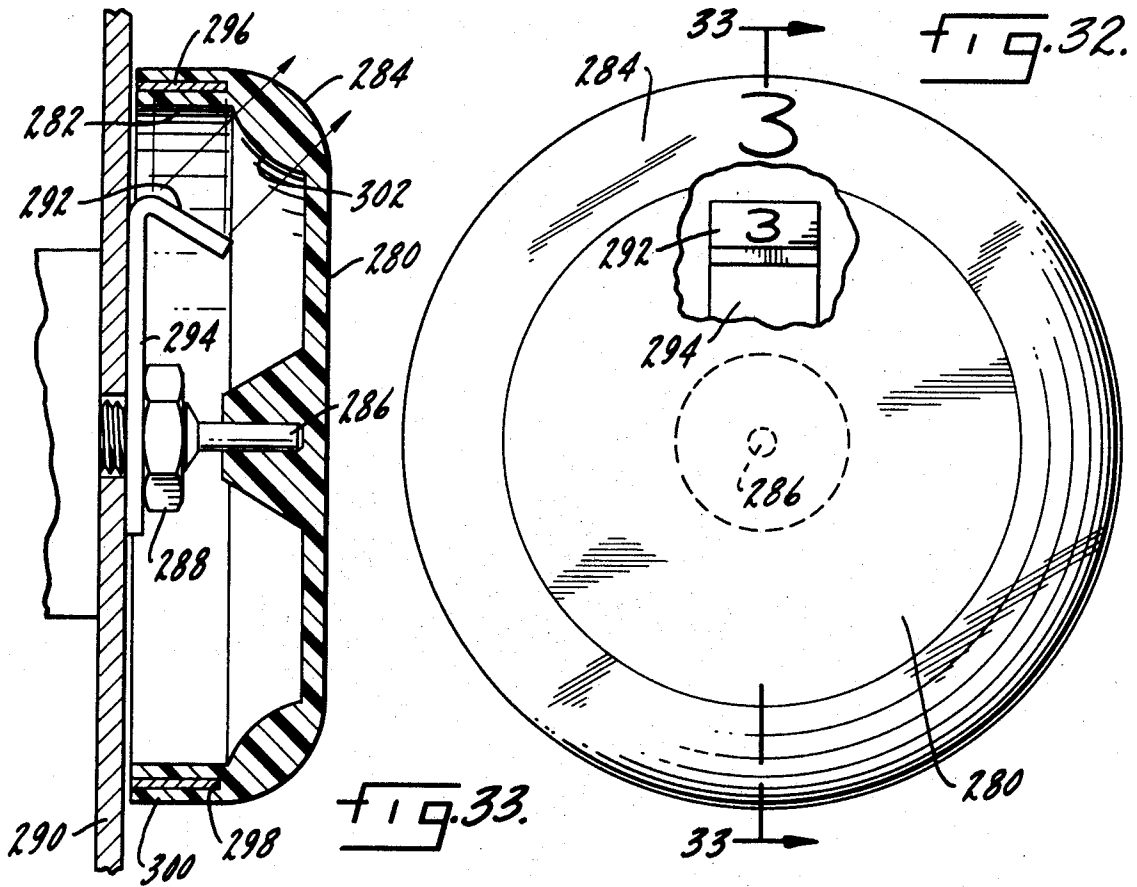
Fig. 24

Fig. 25

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ROTARY PRISM DISPLAY

This application is a continuation-in-part of my copending application Ser. No. 747,717 filed July 25, 1968.

BACKGROUND OF THE INVENTION

Prior efforts in the design of manually operable instruments have been largely centered on the mechanical components of the instrument. There has recently, however, been increased design emphasis on the man-machine interface. These efforts attempt to assist the operator so that he makes fewer mistakes and operates the instrument with less fatigue than in prior constructions, as well as increasing the aesthetic appeal of the machine.

There have been provided in the past instrument constructions which employ illuminating devices and color on the front of the instrument and while these have to some extent reduced operator fatigue, there has been a need for simplified instrument displays and control which will indicate the instrument position to the operator in a more positive manner. Furthermore, there has been a need for an indicating device that uses ambient light, eliminating electrical power drain, and reducing maintenance and wiring problems.

SUMMARY OF THE INVENTION

The present invention relates generally to display devices and more particularly to a rotary indicating device which through the use of a prism reflects a legend or color indication to the operator.

In one embodiment the display takes the form of a transparent circular prism which reflects a legend attached to the periphery of the prism to the viewer. One important advantage of this construction is that the legend may be viewed both from the periphery of the display and, by reflection, from the front. In addition, the display can be basically a one-piece molded part and the legends and colors on the periphery can be easily changed. The display can operate on ambient light, although in some instances electrical illumination may be utilized.

One purpose of the invention is a display of the type described in which both color, written indicia or graphic designs may be changed upon movement of the display.

Another purpose is a display which may be used only with ambient light or with the combination of ambient light and an internal supplementary light source.

Another purpose is a display of the type described using more than one circular prism.

Another purpose is a display of the type described in which both fixed and movable information may be simultaneously displayed.

Another purpose is a prism display of the type described including means for highlighting a particular portion of the display.

Another purpose is a display device that lends itself to ornamental variations.

Another purpose is a display device using a prism and including means for increasing the field of view.

Other purposes will appear in the ensuing specification, drawings and claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features and advantages will readily be apparent from the following specification and from the drawings, in which:

FIG. 1 is a perspective view of a conventional right angle prism,

FIG. 2 is a cross section of a rotary indicator embodying the principles of the present invention,

FIG. 3 is a front elevation of the indicator shown in FIG. 2,

FIG. 4 is a perspective view of an information-bearing legend of the type employed in the embodiment of FIGS. 5 and 6,

FIG. 5 is a cross section of a rotary indicator similar to that shown in FIG. 2 with a peripheral plastic or metal cover for reflection of color and indicia,

FIG. 6 is a front elevation view of the rotary indicator shown in FIG. 5,

FIG. 7 is a side elevation, partly in section, of a rotary indicator wherein the prism display is separate from the rotating means,

FIG. 8 is a front elevation of the device shown in FIG. 7,

FIG. 9 is a side elevation, partly in section, of an indicator construction similar to that shown in FIG. 7 with a rotary window indexing ring,

FIG. 10 is a front elevation of the indicator construction shown in FIG. 9,

FIGS. 11-22 are cross sections and front elevations of various indicator constructions generally similar to that shown in FIGS. 2 and 5 with various ornamental designs projectable to the front of the indicator and the viewer,

FIG. 23 is a cross section of a rotary indicator having a convex front face,

FIG. 24 is a cross section of a rotary indicator construction similar to that shown in FIG. 7 with incandescent light illumination,

FIG. 25 is a cross section of a rotary display similar to that shown in FIG. 24 with electroluminescent illumination,

FIG. 26 is a section along plane 26-26 of FIG. 27,

FIG. 27 is a front elevation of the indicator shown in FIG. 26,

FIGS. 28 and 29 show a thumb wheel assembly,

FIG. 30 is a cross section of a modified indicator using the combination of color and numerical indicia,

FIG. 31 is a perspective, with portions broken away, of the indicator in FIG. 30,

FIG. 32 is a front plan view, with portions cut away, of a further rotary display,

FIG. 33 is a section along plane 33-33 of FIG. 32, and

FIG. 34 is a vertical section through a further modified form of rotary display device.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 a conventional prism 10 may be constructed of glass, plastic or other suitable transparent material. The prism 10 consists of three intersecting surfaces 12, 13 and 14, with surfaces 12 and 14 being perpendicular to one another and surface 13 defining a 45° angle with each of the surfaces 12 and 14. The invention should not be limited to this particular angular relationship.

If the surface 13 (the hypotenuse) is highly polished, an object projected through the surface 12, which may be termed the object surface, and indicated by the rays 16, will be reflected by the surface 13 toward the face 14, which may be termed the image surface. Thus, an observer viewing the image surface 14 may see the object. The rays 16 transmitted from the prism through surface 14 are refracted in accordance with Snell's law, but the angles of refraction are not shown in FIG. 1 nor the following figures for simplicity.

The invention has application to conventional rotary switches or instruments where it serves as an indicator and a mechanical drive, as well as various other man-machine interface uses. For convenience, the invention will be defined in terms of an "indicator," without regard to mechanical application.

In applications where it is desirable to change the legend or indicia, or the color or artistic design displayed by the prism, the information may be on a colored film or other substrate 32' as shown in FIG. 4. The film 32' may have dark portions representing the indicia 36 with translucent colored or transparent portions 37, 37a, 37b, 37c surrounding the indicia. The film 32' may be wrapped around the surface 24 and fixed thereto by a suitable adhesive.

The objects or indicia may be illuminated both by ambient light passing radially through the surface 24 and by ambient light entering the image face 26. The indicia, as well as the colors, if a film such as 32' is employed, are reflected to the viewer by surface 25 which may have a mirrorized layer 40 thereon. Layer or coating 40 may be a vacuum deposition of

aluminum followed by a protective coating of paint. This minimizes spherical aberrations by assuring that the reflective surface is on rather than merely close to the prism. The reflective surface or mirrorized layer 40 improves the field of view over that which would obtain if the reflecting surface 25 were highly polished giving internal reflection. The indicia on legend 32 or 32' may be seen both from the front of the indicator by reflection and directly from the side of the indicator.

In FIGS. 5 and 6 a rotary indicator 45 is similar to that shown in FIG. 2, except that a translucent or transparent legend 46 extends the full width of object surface 47 and a transparent annular cover 48 surrounds the object surface. If there is not a requirement to edge read the object, then the annular cover 48 may be opaque, but it should have a reflective inside surface to reflect light rays, which entered the prism through the image face 26, back to the viewer. The cover 48 is supported on an annular shoulder 49 integral with body 50.

If the cover 48 is transparent, the indicia on the legend 46 is visible at the periphery of the indicator, as well as from the front, and the film is protected from damage. In some cases it might be desirable to construct the cover 48 of a resilient material for ease in use.

In the embodiment shown in FIGS. 7 and 8 the prism is stationary. More particularly, an instrument assembly 52 may include an instrument 53 supported on a mounting plate 54 and having a splined operator shaft 55 extending through the plate 54. Splined to shaft 55 is a cylindrical indicator 56 with a pointer 58 molded therein for indicating the position of the instrument. An annular prism body 60 is stationary and is supported by an annular mounting flange 61 in cooperation with a cylindrical inward projection 62 of prism portion 63. Flange 61 and body 60 are fixed to mounting plate 54 by an integral nut and nipple fitting 66 which is threadedly received in the mounting plate 54 or another fastener (not shown) on the opposite side of the mounting plate 54. Prism portion 63 consists of a cylindrical object face 67, a mirrorized layer 68 defining a reflecting surface on the hypotenuse of the prism, and a planar image surface 69. A legend-bearing translucent or transparent film 71 is provided similar to that shown in FIG. 4.

The indicia on the film 71 appears from the front, as shown in FIG. 8, as stationary indicia annularly arrayed about the indexible indicator 56. Cover 72 is transparent permitting the indicia to be viewed from the side as well as the front.

Rather than a pointer indicating the position of the instrument as in FIGS. 7 and 8, a shield or window ring 74 may be provided as shown in FIGS. 9 and 10. Prism body 76 is similar to prism 60, except that it is fixed to the mounting plate 77 by a radially extending portion 78 of cover 79 by a lock nut 81. Carried on the inner portion of an indexible indicator 83 is a ring 74 which has an opening or window 85 in a cylindrical portion 86. The portion 86 may be closely adjacent and surrounding legend film 87. The ring 74, which is opaque except for window 85, restricts the passage of light so that the indicia adjacent window 85 will be more brightly illuminated than any of the other indicia on legend film 87. In another application the window may be formed of color tinted material and the remaining portion of shield 74 transparent so that the indicia at the window will stand out. The instrument position is thus clearly indicated without the use of an arrow or electrical illumination.

As may be seen in FIGS. 11-22, the present display device lends itself particularly well to ornamental design. Various designs may be provided in the prism body itself to be observable by the viewer from the front. Moreover, although not shown in these figures, designs can be put on the legend film itself.

As shown in FIGS. 11 and 12 straight V-shaped grooves 91 in the object face 92 will appear as tapered grooves to the viewer from the front of the indicator. Grooves 93 may also be provided in the rear surface of central cylindrical boss 95 integral with body 96, and these appear from the front as shown in FIG. 12.

As shown in FIGS. 13 and 14 grooves 101 may be provided in reflecting surface 102. Notches 104 at the corner (FIG. 15) between object surface 105 and reflecting surface 106 around the annular edge will appear from the front, as shown in FIG. 16. Splines 110 on central cylindrical portion 111 in the embodiment shown in FIGS. 17 and 18 will produce a design which appears from the front, as shown in FIG. 18.

In FIGS. 19 and 20 a similar indicator 115 has a radial portion 116 interconnecting prism portion 117 and central cylindrical portion 118. The radial portion 116 has grooves 119 extending radially in the rear side thereof which appear as shown in FIG. 20.

The design may be reflected in a similar manner to the indicia by the provision of a second annular prism 122 in place of the central cylindrical portion, as shown in FIG. 21. An object such as splines in opening 124 will be reflected from surface 126 toward image surface 128 and appear as shown in FIG. 22 from the front face of the knob.

Luminous paint may be employed to produce other ornamental effects, as well as to protect the mirrorized layer 40 (FIG. 2), and might also be used for the legend itself. Moreover, the mirrorized layer 40 (or surface 93 in FIG. 11, or surface 119 in FIG. 19) may be masked such that a ring or rings are made in the center of the display to produce an ornamental effect.

As shown in FIG. 23 the front face of an indicator 130 may be convex in configuration to produce both an amplification or increased field of view for the image reflected from surface 131 of prism 132, as well as enhancing the indicator from an aesthetic standpoint.

While the rotary indicator embodiments thus far described are adapted to operate on ambient light without a separate source of power, in some instances it may be desirable to provide additional illumination and toward this end the embodiment shown in FIG. 24 includes incandescent light bulbs and the embodiment shown in FIG. 25 employs an electro-luminescent material for additional illumination.

Referring to FIG. 24, transparent prism body member 140 has a cylindrical opaque cover 141 fixed thereto with a radially inwardly extending portion 143 fixed to mounting plate 145 so that prism portion 147 in this embodiment is stationary. A rotary indicator 150 is carried by shaft 151 and a suitable pointer may be provided on the indicator for designating position. A translucent or transparent information-bearing film 153 is provided similar to that shown in FIG. 4.

Mounted within cover 141 is an annular light supporting member 155 having openings 156 therein receiving small electrical lights 159. Lights 159 are energized through spring contacts 161 fixed to inwardly extending cover portion 143. Again, the translucent portions of film 153 permit illumination peripherally through object face 166. A ground contact 170 is carried by indicator 150 and engages a conductor 170a surrounding light mounting plate 155.

In the FIG. 25 embodiment the lights are replaced by an electro-luminescent flexible tape 168 on the inside of the cover. Legends may appear on both the inner side 169 and the outer side 171 of tape 169 so that the information is visible both peripherally and from the front of the prism body. Electrical leads 172a extend from the tape 168 to conductors 172 and 173 fixed in a radially inwardly extending portion 176 of cover 177. The cover 177 may be transparent or translucent and the tape is adhered to the cylindrical inner surface thereof so that it is readily viewed through the cover as well as reflected by prism 178 to the front of the body.

FIGS. 26 and 27 show a rotary display 180 for a dual shafted instrument. Included in this assembly is a clear display 182 having oppositely disposed concentric annular prism portions 184 and 186 with object surfaces 188 and 190, respectively. Suitable legends 192 and 194 may be applied to the object surfaces 188 and 190, respectively, and appear as numerals from the front face of the display when reflected from their respective object surfaces as shown clearly in FIG. 27. The display 182 is fixed to a body portion 196 which is in turn fixed to the

face of an associated instrument. The instrument may have two shafts 198 and 200 separately rotatable for independent adjustment, that project within the body portion 196 through a central fitting 202 at the back of the body portion. The shaft 198 is hollow and rotatably receives the shaft 200.

Mounted and supported on the shaft 198 is a sleeve 204 constructed of clear material and having an annular knob portion 206 projecting from the front surface of display 182. Attached to the sleeve 204 at the rear end thereof is an indicating pointer 208 having an axially extending pointer portion 210 adjacent the object surface 182. An image of the pointer portion 210, as shown after reflection by the prism 184, is illustrated at 212 in FIG. 27. By manual rotation of the portion 206 the pointer 210 and shaft 198 are rotated to the desired position and a visual representation of the shaft position is provided by the image 212 of the pointer portion 210.

Fixed to the inner shaft 200 is a small knob 214 rotatable within and projecting from within the sleeve 204. A pointer 216 is fixed to the surface of the knob 214 and is reflected through the clear sleeve 204 and reflected by the inner prism 186 so that it appears as shown at 218 in FIG. 27 from the front face of the display. By manual rotation of the knob 214 the pointer 216 is rotated along with the inner shaft 200 so that the image 218 of the pointer gives a visual representation from the front face of the display of the position of shaft 200.

As shown in FIGS. 28 and 29, the present invention may also take the form of a thumb wheel device 219. Included are spaced frame members 220 and 222 rotatably supporting a gear 224 which is connected to operate a switch or the like, not shown. Mounted at the periphery of the members 220 and 222 is a cover plate 226 shown in FIG. 28 with an opening 228 therein exposing a portion of a thumb wheel 230. The thumb wheel 230 is supported on a pin 232 in turn mounted in the plates 220 and 222. The thumb wheel may be constructed of clear plastic and has gear teeth 234 and 236 for the purpose of operating it. The gear teeth 234 also engage and rotate the gear 224. The thumb wheel 230 includes an annular prism portion 238 having a mirrorized surface 240 formed as described above. A side surface 242 of the thumb wheel provides the object surface to which a legend 244 is applied or preferably molded therein. The legend may take the form of numbers so that they are reflected through the window 228 and the cover 226 as shown in FIG. 28, indicating the rotary position of the thumb wheel.

Also the legends may be molded into the periphery surface 246 to appear as shown in FIG. 28 and at the same time be reflected and viewed through the image surface as shown in FIG. 3.

FIGS. 30 and 31 illustrate a further form of the invention. A prism indicated at 250 may have a reflecting surface 252, an object surface 254, and an image face or surface 256. A cover 257 may be mounted on a shaft 258 with the shaft in turn having a turning knob 260 mounted on its outer end, outside of the prism 250. The cover 257 may have a pair of spaced circumferentially extending shields indicated at 262 and 264. The outer ends of these shields are closely adjacent a peripherally extending flange 266 of the prism 250. Between the shields 262 and 264 is an annular space which may be described as a track and which is indicated at 268. Between the inner annular shield 264 and the object surface 254 is a second annular space which may also be described as a track and is indicated at 270. A suitable legend or other indicia may be mounted adjacent the object face 254 as described above.

Within the outer track 268 is a strip or tape of a colored material, indicated at 272 in FIG. 31. The tape 272 is fastened at one end, indicated at 274, to the object face of the prism. The tape is positioned within the outer track 268, but because it is fastened to the prism, when the cover is rotated by knob 260, the tape 272 will be moved into the inner track 270, directly behind the legend or indicia on the object face. Thus not only will the indicia or legend give an indication of the position of the particular instrument to which the indicator is attached, but the arcuate length of visible color at the image

face will also give an indication of this position. Looking particularly at FIG. 31, and assuming rotation in a counterclockwise direction, movement of the cover will permit successively greater amounts of the tape 272 to be positioned within the inner track and thus visible from the image face.

The shield 264 is opaque, thus when the device is in the full off position, little or no color will be visible at the image face. However, as the knob 260 is rotated to successively turn the device away from the off position, successive amounts of color will become visible at the image face, inasmuch as the tape 272 will have moved into the track 270 between the opaque shield 264 and the object face 254. In effect, there will be a color indication of the position of the knob 260, as well as a visual indication from the position of the numbers at the image face.

FIGS. 32 and 33 show a further form of rotatable display device. A rotatable display member 280 may include a generally cylindrical object surface 282 and a curved image surface 284. Both the object surface 282 and the image surface 284 extend peripherally about the rotatable display member 280. The display member 280 may be suitably attached to a switch shaft 286 so that the display device not only provides useful information, but also operates a switch. The shaft 286 may be connected by a nut or the like 288 to a panel member 290. Inside of the display member 280 is a reflecting surface 292, again suitably mirrorized or treated to be highly reflective, and having a bracket portion 294 which is attached by the nut 288 to the panel member 290. Note particularly in FIG. 32 that the peripheral extent of the reflecting surface 292 is limited. Only that portion of an indicia tape 296 which is directly adjacent the reflecting surface 292 will be visible at the image surface 284. The indicia tape 296 may be embedded within the display member 280 or positioned within a groove 298 formed between the object surface 282 and a peripheral flange 300. The indicia tape, which may contain alpha-numeric information or a graphic design, or a color, may be suitably heat-sealed within the groove.

The image surface 284 is convex and there is a similar convex interior surface 302. The combination of the two convex surfaces provide magnification of the light rays reflected by the reflecting surface 292. The structure shown in FIGS. 32 and 33 includes an object surface and an image surface, both of which extend peripherally about the rotatable display member, with only the stationary reflecting surface having limited peripheral extent. The angle between the reflecting surface, image and object surfaces, may be readily varied, as will be apparent from the drawings. Not only does the reflecting surface limit what is displayed at the image surface, but the reflected light rays are substantially magnified by the double convex arrangement illustrated particularly in FIG. 33.

In FIG. 34 a switch shaft 304 may be suitably connected to a rotary display member indicated generally at 306. The member 306 may have a conical reflecting surface 308 and a generally cylindrical object surface 310. Outside of the object surface 310 is an indicia tape indicated at 312 physically attached to the object surface for rotation with it by a ring 313 which may be either transparent or opaque. In the construction of FIG. 3 there is no image surface. The viewer merely looks at the reflecting surface itself. Not only does the member 306 display the information from the indicia tape 312, but it will also be used in operating the switch itself. The principle disclosed in FIG. 34 may be easily adaptable to many of the other display devices illustrated herein. The display member 306 may be formed from a single sheet of plastic by a suitable heat molding or vacuum molding process. The principal advantage of the construction shown in FIG. 34 is the simple and economic production of the display member.

Of importance in the invention is the use of ambient light for a substantial portion of the indicators shown and described. In some applications ambient light comes only from the image face, assuming an opaque cover surrounding the object face. In other applications, ambient light, both in a peripheral direction, i.e., directly to the cylindrical object

face, and from the planar image face, are used to provide the display. In some applications, particularly in normally dark areas, for example the cockpit of an airplane, separate illumination, either in the form of light bulbs or an electroluminescent tape or the like, may be used to supplement ambient light.

Whereas the preferred form of the invention has been shown and described herein, it should be realized that there are many modifications, substitutions and alterations thereto within the scope of the following claims.

I claim:

1. A rotary display device for reflecting information to a viewer, including a light transmissive prism having a generally cylindrical object surface, a conical reflecting surface and an image surface, indicia adjacent said object surface, said object surface being at least partially light conductive so that indicia may be reflected by said reflecting surface to said image surface, at least partially by light transmitted from said image sur-

face to said object surface, and a cover attached to said display device, said cover being positioned outside of said indicia and being generally coextensive with said cylindrical object surface.

5 2. The structure of claim 1 further characterized in that said image surface is generally perpendicular to said object surface.

3. The structure of claim 1 further characterized in that said cover is light conductive.

10 4. The structure of claim 1 further characterized in that said cover is opaque.

5. The structure of claim 1 further characterized in that said cover is spaced outwardly from said indicia.

15 6. The structure of claim 5 further characterized by a circumferential shoulder extending outwardly from said cylindrical object surface, said cover being attached to the outer peripheral edge of said shoulder.

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