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[54] **READOUT**

[75] Inventors: **Aelred J. Kurtenbach; James B. Morgan,** both of Brookings, S. Dak.; **Paul A. Espeset,** Los Angeles, Calif.

[73] Assignee: **Daktronics, Inc.,** Brookings, S. Dak.

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[52] **U.S. Cl.** ..... **40/130 E,** 40/132 D, 340/381

[51] **Int. Cl.** **G09f 13/06**

[58] **Field of Search** ..... 40/130 E, 130 K, 40/132 D; 340/378 R, 381

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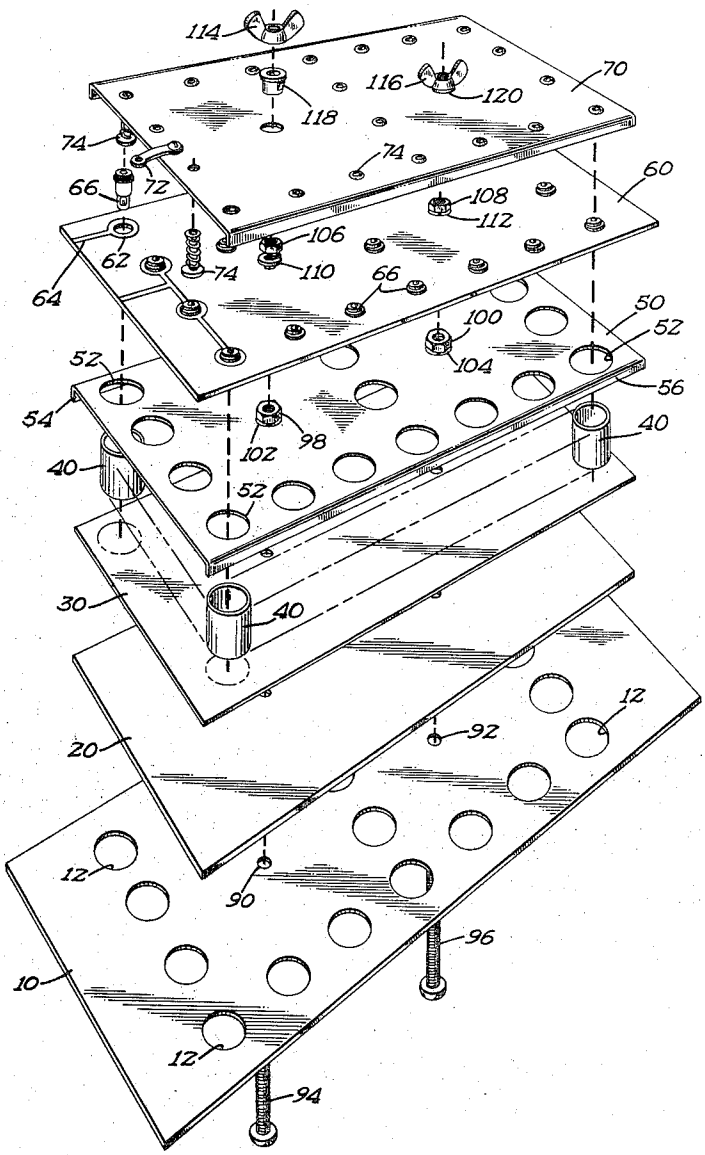
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Primary Examiner—Robert W. Michell
Assistant Examiner—John F. Pitrelli
Attorney—Keith B. Davis

[57] **ABSTRACT**

A seven-segment readout of the "dot" segment type in which light for each dot is coupled from a lamp through a light guiding cylinder sandwiched between a lamp board holding the lamp and a light diffusion member to a dot defining aperture of a faceplate, which dot defining apertures are configured to form the segments of a readout.

20 Claims, 2 Drawing Figures



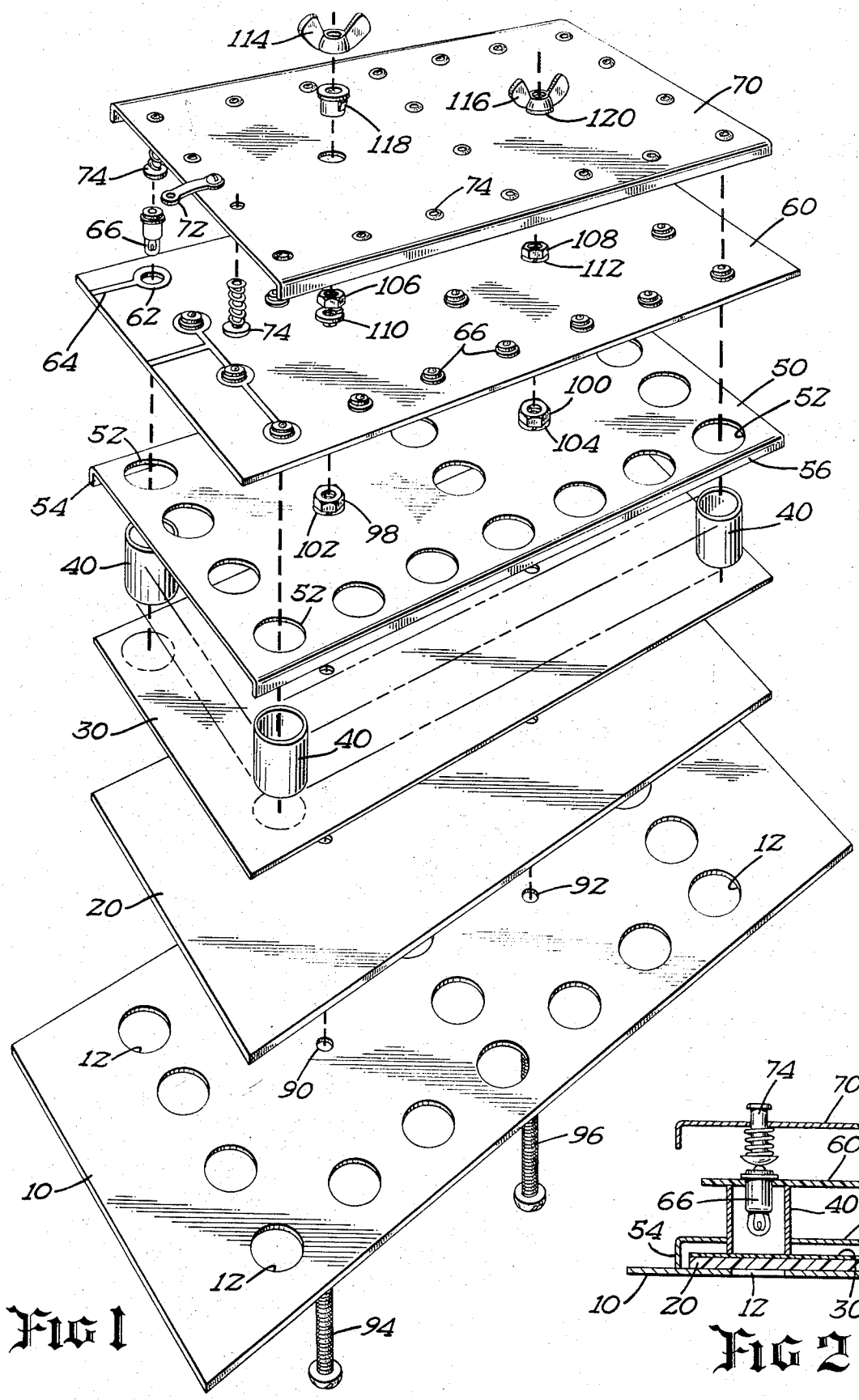

114
116
120
118
70
74
74
60
66
72
108
112
106
62
74
110
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64
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100
52
104
52
56
54
102
98
40
40
52
30
40
12
92
20
12
90
96
10
12
94

Fig 1

74
70
60
66
40
50
54
10
20
12
30

Fig 2

READOUT

BACKGROUND AND HISTORY

The present invention relates in general to apparatus for the optical display of information, and relates in particular to such apparatus in a form commonly referred to as a seven-segment readout.

In general, a seven-segment readout comprises seven optical segments in a generally angular figure-eight configuration. Three segments form the sides and top of the upper half of the figure-eight; three other segments form the sides and bottom of the lower half; and the seventh segment is common to the upper and lower halves, forming the bottom of the upper half and the top of the lower half. Through selective energization of the segments, each of the Arabic number digits zero through nine are optically displayed in a wellknown manner.

Most seven-segment readouts are either a fully illuminated segment or "bar" segment readout in which the entire segment is illuminated as nearly uniformly as possible, or a partially illuminated segment or "dot" segment readout in which a series of illuminated dots form each segment. The present invention relates specifically to a dot segment readout.

Seven-segment readouts have, for many years, had widespread application, including such types of applications as the digits of various types of score-boards and the digits of display panels of various electronic devices, for example, the display panels of operator consoles of spaceship launch control equipment and data processing equipment operator console display panels. Typically, readouts of the former type application have a readout digit which is several times larger in area than those of the latter application. Although the present invention was specifically developed as a readout of the former type, specifically as a scoreboard readout, the invention is of broader application and applies to readouts such as those of the latter type application as well.

An object of the present invention is to provide a dot segment readout, the individual dots of which are illuminated with a high-intensity lamp, yet appear to be uniformly illuminated throughout the dot area, all while providing a dot surface area several times larger than the end area of the lamp to provide large, clearly recognizeable dots which, in turn, provide readily discernible segments.

Another object of the present invention is to provide a readout assembly structure the components of which are low in cost, easy to assemble, and easy to disassemble for maintenance such as lamp replacement maintenance.

Yet another object of the present invention is to provide a readout assembly which facilitates easy and low-cost electrical inter-connection of the readout with the electronics which provides selective energization and illumination of the segments.

SUMMARY OF THE INVENTION

Briefly, the invention comprises a dot segment readout assembly having a faceplate, a light diffusion member underlying the faceplate, and, if desired, a color filter interposed between the faceplate and light diffusion member. The faceplate includes apertures which define the dots of the readout segments. A cylinder for each segment dot is positioned over the dot by a cylinder locating plate and is held in place by a lamp board having

apertures through which lamps protrude into each cylinder to provide a source of illumination for each dot. Each lamp includes an electrically conductive rim at its base, not unlike the rim of a firearms cartridge and each lamp-accepting aperture of the lamp board is provided with an electrical conductor proximate thereto. A back plate assembly is employed to hold the lamps in place in the lamp board apertures to force the lamp rims into contact with a said lamp board conductor proximate thereto. The back plate assembly includes means for making electrical contact with each lamp base, the lamp board conductor and back plate assembly thus providing the two contacts or "leads" necessary to connect each lamp into an electrical circuit and permit selective energization of the lamps as required to illuminate the various combinations of segments.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is an exploded view of a preferred embodiment of a seven-segment, angular, figure-eight dot segment readout according to the present invention.

FIG. 2 is a sectional view of a portion of an assembled readout illustrating the relationships of the components illustrated in FIG. 1 when the components are assembled.

DETAILED DESCRIPTION OF INVENTION

The invention shall now be described with reference to FIGS. 1 and 2 which illustrate different views of a preferred embodiment of the invention developed specifically for a scoreboard application. Referring now to FIG. 1, an exploded view is shown. A faceplate 10 is shown to have apertures therein, one of which is designated 12, defining the dots of the seven segments of a generally angular figure-eight. For the preferred embodiment, faceplate 10 is a parallelogram having major sides 8¾ inches long and minor sides 5⅞ inches long; the sides form an acute angle of about 83°; the plate 10 is fabricated from 0.04-inch thick vinyl clad steel; and the apertures are one-half inch diameter on 1-inch centers in rows and columns parallel to the faceplate sides.

In the preferred embodiment, a color filter 20 was employed between Faceplate 10 and a light diffusion member 30. Such filters are well known in the art and are commonly used to add clarity to a readout. They may be any of a variety of materials. For the preferred embodiment, filter 20 is one-eighth inch thick red or green or amber colored plexiglass, manufactured by the Rohm and Haas Company Philadelphia, Pa. and sold as their catalogue numbers 2433, 2092, or 2422, respectively.

Light diffusion member 30 is an important element of the present invention, in that it is a significant factor in providing uniform intensity illumination throughout each dot area. Conveniently, a single sheet of light diffusing material may be used to provide a light diffusion member for all dots. For the preferred embodiment, tracing film such as 0.003-inch thick, double matte, polyester tracing film sold by the Charles Bruning Company as their catalogue number 44–132 was found to provide excellent results.

A light guiding cylinder 40 is provided for each segment dot. The cylinder length is approximately equal to the cylinder width to aid in providing uniform dot intensity. For the preferred embodiment, cylinders 40 are cut from circular tubing into 0.625-inch lengths of 0.01-inch thick by 0.625-inch outside diameter brass

tubing. Use of such cylinders facilitates employment of high-intensity lamps because the cylinders transmit heat from the lamps into the air spaces between the cylinders. Metallic cylinders of course are efficient radiators and also can withstand greater heat than cylinders of other materials such as plastic.

A cylinder locating plate **50** includes apertures, one of which is designated **52**, in registration with the faceplate apertures. Apertures **52** each accept a cylinder **40** to locate the cylinder with respect to its corresponding faceplate aperture. As shown in FIG. **1**, in the preferred embodiment, cylinder locating plate **50** includes flanges **54** and **56** which, as shall be more clearly apparent in FIG. **2**, abut faceplate **10** to raise the surface of locating plate **50** sufficiently above light diffusing member **30** that cylinders **40** are held stably in plate **50** so as not to cant. In the preferred embodiment shown, flanges **54** and **56** are 0.25 inches and the apertures are five-eighths inch holes drilled in 0.04 inch thick terne plate steel.

A lamp board **60** sandwiches cylinders **40** between itself and the light diffusing member **30**. The lamp board **60** includes a lamp aperture over each cylinder and also includes an electrical conductor proximate each lamp aperture.

In the preferred embodiment, lamp board **60** comprises an etched printed circuit board fabricated from 0.062-inch thick epoxy board clad on one side with 0.0027-inch thick copper; etched printed circuit paths on the board form a conductive ring around each lamp aperture, such as ring **62**; and all rings corresponding to lamps of the same segment are common to a conduction path, such as conduction path **64**. As shown, the conduction paths lead to an edge of board **60** to facilitate connection of the paths to lamp selection circuitry (not shown) all or part of which circuitry can be included on the lamp board. It will be appreciated that such connection may be the easiest and least expensive of any of a number of conventional means, including wire-wrap terminals, solder terminals, male-female engaging terminals, and standard male-female printed circuit card connectors, the particular connection employed being immaterial to the present invention. A lamp **66** completes the lamp board assembly. For the preferred embodiment, IEE standard No. 387 AS25 lamps rated at 28.0 volts and 0.040 amps and having an end area about one-eighth the area of the cylinders are used.

Back plate assembly **70** serves to hold the lamps in the lamp apertures and provides an electrical contact to each lamp.

For the preferred embodiment, assembly **70** is fabricated from 0.04 thick terne plate steel in the same manner as the cylinder locating plate **50** to realize economies in the manufacture of the readout by minimizing the number of different manufacturing operations. Attached to the steel plate is a common terminal **72** and a plurality of rivet mounted spring contacts, there being a spring contact for each lamp. For the preferred embodiment, spring contacts **74** were the Lewis, 0.22-inch outside diameter by three-eighths-inch compression contacts. It will be appreciated that upon forcing of the spring contacts **74** into contact with the bases of lamps **66**, all lamp bases are connected to common through a path consisting of a contact **74**, back plate **70** and common terminal **72**, thereby permitting selective activation of any segment group of lamps by completing the electrical circuit through the appropriate connectors of lamp board **60**.

Fastening means hold the foregoing described components together as a unitary dot segment readout assembly.

For the preferred embodiment, assembly is facilitated by a pair of holes **90** and **92** in each of face-plate **10**, color filter **20**, diffusion member **30**, cylinder locating plate **50**, lamp board **60**, and back plate **70**. A pair of bolts, **94** and **96** (No. 10, three-sixteenths inch in diameter by 1¾ inches long) secure the assembly by means of hex nuts, **98** and **100**, and lock washers, **102** and **104**, at the locating plate **50** level of assembly; by hex nuts, **106** and **108**, and lock washers, **110** and **112**, at the lamp board **60** level of assembly; and by wing nuts, **114** and **116**, at the back plate **70** level of assembly. Non-conductive, press-in grommets, **118** and **120**, in back plate **70** insulate bolts, **94** and **96**, from the back plate.

The relationships of the various components in their assembled condition are shown in FIG. **2**, a sectional view taken along the axis of a cylinder **40**. Referring now to FIG. **2**, the flange **54** is shown to position locating plate **50** with reference to faceplate **10** through the action of nut **98** and nut **100** (not shown). Nuts **106** and **108** (not shown) force lamp board **60** onto cylinders **40** to press the other end of the cylinders against diffusion member **30**, thereby forming nearly light tight seals on both ends of the cylinders and forcing diffusion member **30**, color filter **20**, and face-plate **10**, into intimate contact with each other. The balance of the assembly is secured by wing nuts **114** and **116** (not shown) which force the back plate **70** downwardly along the shafts of bolts **94** and **96** (not shown) to compress the springs of spring contacts **74**, thereby insuring good electrical contact between the spring contacts **74** and the bases of lamps **66** and between the lamp rims and the circuitry rings around the lamp apertures.

Having taught how to make and use the invention by means of the foregoing description of the illustration of a preferred embodiment of the invention as shown in FIGS. **1**, and **2**, the invention for which letters patent are sought shall now be defined by means of the following claims.

What is claimed is:

1. A dot segment readout comprising:

A. a faceplate having apertures therein defining the dots of the segments of a readout;

B. a light diffusion member underlying the faceplate and coextensive in area with at least each of said apertures;

C. a light guiding cylinder for each said aperture, said cylinder having a length approximately equal to the width of said aperture;

D. a cylinder locating plate having apertures both in registration with the apertures of said faceplate and of dimensions for accepting said light guiding cylinders to hold said cylinders in axial alignment with said faceplate apertures;

E. a lamp board sandwiching said cylinders between said light diffusion member and said board, said board having a lamp aperture over each cylinder and having an electrical conducter proximate each lamp accepting aperture;

F. a lamp in each lamp board aperture, the end area of each of which lamps is approximately one-eighth of the cylinder cross-sectional area, each of which

lamps includes a rim for holding the lamp in said lamp accepting aperture and for making electrical contact with a said electrical conducter;

G. a back plate assembly for holding said lamps in said lamp apertures and for providing an electrical contact to each of said lamps:

H. fastening means for holding the faceplate, light diffusion member, light guiding cylinders, cylinder locating plate, lamp board, lamps, and backplate assembly together as a unitary dot segment readout assembly.

2. A readout according to claim 1 wherein

said faceplate dot defining apertures are configured to form the segments of a generally angular figure-eight seven-segment readout;

said cylinder is a circular tube; and

said diffusion member is a polyester film.

3. A readout according to claim 2 wherein

said circular tube has a length of five-eighths of an inch and a diameter of five-eighths of an inch; and

said diffusion member is 0.003 inch thick double matte polyester tracing film.

4. A readout according to claim 1 wherein

said electrical conductors of said lamp board comprise printed circuit paths, which paths interconnect the electrical conductors of all lamp apertures of a segment, and which paths include a circuit path which leads to an edge of the lamp board to facilitate selective energization of the readout segments; and

said electrical contacts provided by said back plate assembly to each of said lamps are electrically common.

5. A readout according to claim 4 wherein

said cylinder is a circular tube; and

said diffusion member is a polyester film.

6. A readout according to claim 5 wherein

said circular tube has a length of five-eighths of an inch and a diameter of five-eighths of an inch;

said diffusion member is 0.003-inch thick double matte polyester tracing film; and

said back plate assembly comprises an electrically conductive plate having electrically conductive spring contacts secured thereto in a pattern in registration with the faceplate segment dot apertures whereby when the back plate assembly is urged toward the lamp board by said fastening means, said spring contacts are compressed against the base of said lamps to hold the lamps in the lamp board and to provide a common electrical path to all bases through paths comprising the electrically conductive spring contacts and electrically conductive plate.

7. A readout according to claim 6 wherein

said cylinder locating plate comprises a flat plate having apertures therein for accepting said cylinders and having flanges extending therefrom to space the flat plate from said faceplate whereby said cylinders are held stably in the apertures of said flat plate in axial alignment with an axis normal to the faceplate surface.

8. A readout according to claim 7 further comprising

J. a color filter interposed between said faceplate and said diffusion member.

9. A readout according to claim 8 wherein

each of said faceplate, filter, diffusion member, cylinder locating plate, lamp board, and back plate include a pair of aligned apertures; and

said fastening means comprises a pair of bolts each of which is passed through one of said aligned holes; a nut on each bolt turned down against the cylinder locating plate whereby the locating plate is secured to the faceplate; a nut on each bolt turned down against the lamp board whereby the lamp board sandwiches the cylinders between itself and the light diffusion member and forces the light diffusion member, color filter, and faceplate into intimate contact; and a nut on each bolt turned down against the back plate assembly whereby the back plate assembly contacts hold the lamps in the lamp board assembly to provide a unitary dot segment readout assembly.

10. A readout according to claim 1 wherein

said back plate assembly comprises an electrically conductive plate having electrically conductive spring contacts secured thereto in a pattern in registration with the faceplate segment dot apertures whereby when the back plate assembly is urged toward the lamp board by said fastening means, said spring contacts are compressed and press against the base of said lamps to hold the lamps in the lamp board and to provide a common electrical path to all bases through paths comprising the electrically conductive spring contacts and electrically conductive plate.

11. A readout according to claim 10 wherein

said electrical conductors of said lamp board comprise printed circuit paths, which paths interconnect the electrical conductors of all lamp apertures of a segment, and each of which paths includes a circuit path which facilitates selective energization of the associated readout segments.

12. A readout according to claim 11 wherein

said cylinder locating plate comprises a flat plate having apertures therein for accepting said cylinders and having flanges extending therefrom to space the flat plate from said faceplate whereby said cylinders are held stably in the apertures of said flat plate in axial alignment with an axis normal to the faceplate surface.

13. A readout according to claim 1 further comprising

J. a color filter interposed between said faceplate and said diffusion member.

14. A readout according to claim 13 wherein

said back plate assembly comprises an electrically conductive plate having electrically conductive spring contacts secured thereto in a pattern in registration with the faceplate segment dot apertures whereby when the back plate assembly is urged toward the lamp board by said fastening means, said spring contacts are compressed and press against the base of said lamps to hold the lamps in the lamp board and to provide a common electrical path to all bases through paths comprising the electrically conductive spring contacts and electrically conductive plate; and

said electrical conductors of said lamp board comprise printed circuit paths, which paths interconnect the electrical conductors of all lamp apertures of a segment, and each of which paths includes a

circuit path which facilitates selective energization of the associated readout segments.

15. A readout according to claim **14** wherein

said cylinder locating plate comprises a flat plate having apertures therein for accepting said cylinders and having flanges extending therefrom to space the flat plate from said faceplate whereby said cylinders are held stably in the apertures of said flat plate in axial alignment with an axis normal to the faceplate surface.

16. A readout according to claim **13** wherein

said lamp board comprises an electrically conductive plate; and

said back plate assembly comprises a printed circuit board carrying printed circuit paths thereon and having electrically conductive spring contacts secured thereto in a pattern in registration with the faceplate segment dot apertures and in electrical contact with said printed circuit paths; which paths facilitate selective energization of each group of spring contacts corresponding to a readout segment whereby when the back plate assembly is urged toward the lamp board by said fastening means, said spring contacts are compressed and press against the base of said lamps to hold the lamps in the lamp board.

17. A readout according to claim **1** wherein

said cylinder locating plate comprises a flat plate having apertures therein for accepting said cylinders and having flanges extending therefrom to space the flat plate from said faceplate whereby said cylinders are held stably in the apertures of said flat plate in axial alignment with an axis normal to the faceplate surface.

18. A readout according to claim **17** wherein

said back plate assembly comprises an electrically conductive plate having electrically conductive spring contacts secured thereto in a pattern in registration with the faceplate segment dot apertures whereby when the back plate assembly is urged toward the lamp board by said fastening means, said spring contacts are compressed and press against the base of said lamps to hold the lamps in the lamp board and to provide a common electrical path to all bases through paths comprising the electrically conductive spring contacts and electrically conductive plate; and

said electrical conductors of said lamp board comprise printed circuit paths, which paths interconnect the electrical conductors of all lamp apertures of a segment, and each of which paths includes a circuit path which facilitates selective energization of the associated readout segment.

19. A readout according to claim **17** wherein

said lamp board comprises an electrically conductive plate; and

said back plate assembly comprises a printed circuit board carrying printed circuit paths thereon and having electrically conductive spring contacts secured thereto in a pattern in registration with the faceplate segment dot apertures and in electrical contact with said printed circuit paths; which paths facilitate selective energization of each group of spring contacts corresponding to a readout segment whereby when the back plate assembly is urged toward the lamp board by said fastening means, said spring contacts are compressed and press against the base of said lamps to hold the lamps in the lamp board.

20. A readout according to claim **1** wherein

said lamp board comprises an electrically conductive plate; and

said back plate assembly comprises a printed circuit board carrying printed circuit paths thereon and having electrically conductive spring contacts secured thereto in a pattern in registration with the faceplate segment dot apertures and in electrical contact with said printed circuit paths; which paths facilitate selective energization of each group of spring contacts corresponding to a readout segment whereby when the back plate assembly is urged toward the lamp board by said fastening means, said spring contacts are compressed and press against the base of said lamps to hold the lamps in the lamp board.

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