This invention relates generally to a lamp socket and its related electrical connections, and more particularly to an improved lamp socket for an edge-lighted panel combined with improved means for connecting the socket to a source of electrical power.

Edge lighted panels are well known in the art and have wide applicability, particularly in the illumination of instrument, control, and console panels in aircraft. In such panels, light is usually transmitted through the edge of a plastic sheet. The sheet is provided with an opaque surface coating except for transparent areas in the shape of letter or numeral characters through which light is emitted. The letter or numeral characters form the nomenclature identifying the control positions of the switches, instruments, and other devices assembled on the panel.

A troublesome problem in the construction of such panels is the dimensioning and positioning of lamp sockets so that they won't unduly restrict the proper disposition of the control devices to be mounted on the panel. In present day panels, it is necessary to have a portion of the lamp socket project from the back surface of the panel in order to accommodate proper electrical connections. The wiring, itself, for making the electrical connections to the sockets necessitates the use of restricted space in a control box or other housing to which the panel is secured. It will further be appreciated, as a consequence of this type of construction that dimensional changes in the construction of the control devices mounted on the panel as well as actual changes in mounting locations must always be conditioned upon possible interference with the lamp sockets projecting from the back of the panel.

It is, therefore, an object of the present invention to provide a lamp socket and associated electrical connecting means for an edge lighted panel, which occupies substantially less space in the back of the panel than present day constructions.

Another object is to provide a lamp socket and associated electrical connecting means for an edge lighted panel, in which neither the lamp socket nor its electrical connecting means will present design limitations in the disposition of control devices used in conjunction with the panel.

A further object is to provide a lamp socket and associated electrical connecting means for an edge lighted panel, in which all interconnections in the form of separate physical wires for the lamp sockets are substantially eliminated.

A still further object is to provide a lamp socket and associated electrical connecting means for an edge lighted panel, in which the lamp socket has an appreciably lower weight and appreciably smaller overall dimensions as contrasted with lamp sockets presently available.

Briefly, these and other objects and advantages of the present invention are achieved by providing a printed circuit on at least one surface of the panel in combination with an improved lamp socket embodying conduct-
a first conducting means 29 which comprises upright members 30 integrally formed with a horizontal member 31 and a ring member 32. The horizontal conducting member 31 is positioned so as to be partially exposed within the interior of the cap. The ring conducting member 32 is also partially exposed and is firmly retained in a recessed section 33 within the cap 27.

The cap 27 has inner threading 34 for screwing down on a cylindrical section 35 of a lamp retaining fixture 36 disposed within the fixture 13. The fixture 36 additionally comprises legs 37 integrally connecting the section 35 through the core 20 of the panel with a beveled base member 38. The base member 38 is disposed in a countersunk portion of the aperture 13 so as to be substantially flush with and yet contact the connecting portion 17 of the printed circuit 16 on the back of the panel. For this purpose, it is desirable to have the connecting portion 17 extend inwardly into the countersunk portion of the aperture 13.

The legs 37 of the fixture are imbedded in an annular plastic shell 39 having a threaded portion 40 adapted to extend beyond the front surface of the panel and receive an annular nut 41. The nut 41 is screwed down into pressing engagement with the annular connecting portion of the core 20. Immediately above the nut 41 is a resilient washer 42 which may be retained by hoop tension within the cap 27 below the ring conductor 32. The nut 41 thus performs a double function. It serves first as a means in cooperation with the base member 38 of firmly securing the fixture 36 within the panel; second, it acts as a conducting link from annular connecting portion 12 through the washer 42 to the ring 32 of the conducting means 29.

The fixture 36 is dimensioned to receive a standard lamp 43 which is inserted as shown in Fig. 4 so that the bulb portion 44 extends down between the legs 37 of the fixture within the aperture 13 in the panel. The upper metallic flanged end of the lamp is adapted to rest on the upper edge of the cylindrical section 35 of the fixture 36, whereby an insulated contact 45 of the lamp 43 will contact the exposed portion of the conducting member 31 when the cap 27 is screwed onto the fixture. To further assure proper connection between the contact 45 and the member 31, a spring 46 may be disposed on the inner surface of the base 38 so as to bias the lamp 43 upwardly.

It will thus be apparent that current will flow through the printed circuit 11 to the annular connecting portion 12 and then through the nut 41, the washer 42, and thereby through the members 32, 30, 29 to the contact 45 of the lamp. The return circuit will be from the metallic flange of the lamp 43 down through the fixture 36 to the base member 38 in contact with the annular portion 17 of the printed circuit 16 on the back of the panel. The plastic shell 39 in addition to its conventional purpose of filtering light into the core 20, also serves as a means of insulating the nut 41 from the return circuit through the fixture 36.

Although in a preferred construction, printed circuits 11 and 16, respectively, are provided on each side of the panel, it will be readily appreciated that both printed circuits may be formed on one side of the panel. For example, in the view of Fig. 5, there is shown a panel 50 having first printed circuit 51 and a second printed circuit 52, the circuits having respective terminals 53 and 54. Circuit 52 is provided with annular connecting portion 55, adapted to come into engagement with the nut 41, for example, in the embodiment of Fig. 4. Circuit 51 in this instance includes semi-annular connecting portions 56, which are formed in this shape to avoid cross-overs between circuits 51 and 52. As shown in Fig. 6, with this type of circuit arrangement, it is necessary to include an additional conducting means in the form, for example, of members 57 connected to the portion 56 and extending through to the back surface of the panel. These conducting members 57 may be formed integrally with the core 20 and are dimensioned so as to have exposed end faces 58 on the back surface of the panel. The end faces 58 are adapted to contact the base 38 of the fixture 36, thereby completing the circuit through the socket up to the printed circuit 51. Of course, with such a modification, the outer diameter of the base 38 must be designed proportionately greater in order to be vertically aligned with the connecting portion 56.

The socket 24 shown in Fig. 4 is particularly desirable for use where design advantages are achieved by not having the socket project beyond the back surface of the panel. In such instances, the conventional backing plate may be positioned in close proximity to the back of the panel. However, in certain applications, the design requirements may be different. In this regard, Fig. 7 and Fig. 8 are illustrative of other possible embodiments of the present invention.

In Fig. 7, there is shown a lamp socket 60, which may be advantageously employed where it is essential that the socket project a minimum distance from both the front and back surface of the panel. The socket 60 is provided with a front insulating cap 61 which has an upper surface 62 contoured as shown to minimize light reflection. The cap 61 has an axially post 63 extending a short distance to enable fastening thereto of one end of a spring 64. The spring 64 is used as a means of resiliently retaining a standard lamp 65 having a bulb portion 66 and an insulated contact 67.

Disposed within the aperture 13 is a fixture 68 having an increased diameter threaded flange 69 adapted to connect, for example, the annular portion 12 as in Fig. 1. The cap 61 is provided with internal threading at 70 for connecting to the flange 69. The fixture 68 comprises, in addition to the flange 69, conducting legs 71 extending through the thickness of the core 20, and a cylindrical section 72 projecting beyond the back surface of the panel. The panel 60 is provided with an engaging portion 73 and section 72 of the fixture is an annular plastic shell 73 provided with a threaded end 74 where it extends from the back of the panel.

In this embodiment of Fig. 7, there is additionally provided a cup-like rear cap 75 having an outer insulating surface 76 and an inner conducting surface 77. The inner surface 77 is threaded for connection to the threaded end 74 of the shell 73 and is adapted to engage the lamp contact 67 when the socket 60 is assembled. Towards this objective, the inner surface 77 may be provided with a contact head 78.

In an alternative socket 60 on the panel 10, the fixture 68 is first positioned in the aperture 13. The rear cap 75 may then be connected to the threaded end 74 of the shell 73. Thereafter, the cap 61 is threaded down onto the flange 70 resulting in the positioning of the lamp 65 within the fixture 68. As the latter step is taking place, the contact head 78 on the inner surface will come into engagement with the lamp contact 67, urging the lamp towards the post 63 and overcoming the opposite biasing action of the spring 64. The spring 64 will consequently be compressed and urged radially outward into contact with the fixture 68.

In a preferred construction, the spring 64 is designed to have high pitch spiral turning about the bulb 66 portion of the lamp and several low pitch turns encircling the base portion of the lamp. By having only one turn about the bulb 66, there is a minimum of interference with light dispersal into the core 20. The outer peripheral diameter of the spring 64 is slightly less than the inner diameter of the fixture in order to allow non-frictional positioning of the lamp 65 within the fixture 68. As indicated previously, when the cap 75 is screwed on, the spring 64 will expand radially as it is compressed; however, the greater proportion of this expansion will take place in the lower pitch turns about the base of the lamp where there is the least resistance.

It will be apparent, therefore, that one path of current will flow from the connecting portion 12 (in Fig. 1)
through the flange 69, and thereafter through the legs 68 and contacting surface of the lamp 65. The return path will be from the lamp contact 67 to the inner surface 77 and to the connecting portion provided on the back surface of the panel 10. With the embodiment of Fig. 7, it is not necessary, of course, to provide a countersunk area in the aperture 13.

In Fig. 8, there is shown a lamp socket 80 of a design preferably used on panels where the socket projections from the front surface of the panel are to be kept to a minimum. The socket 80 is associated with a fixture 81 acting as a conducting means and including a crown face 82 and legs 83. The crown face 82, as in the other embodiments, is provided in order to minimize light reflection which might adversely affect the viewing of the panel. Although the crown face 82 is shown as projecting above the front surface of the panel a slight distance, it will be evident that the face 82 could be modified to be flush with the front surface in a manner similar to the construction used for the base 35 in Fig. 4.

The legs 83 extend through the thickness of the panel to integrally connect with a cylindrical section 84 of the fixture 81. In a construction similar to the previous embodiments, an annular plastic shell 85 surrounds the legs 83 and the section 84 of the fixture. There is shown disposed in the fixture a standard lamp 86 having a bulb portion 87 positioned so as to emit light into the core 20. The insulated lamp contact is indicated at 88.

The socket 80 further includes a cap 89 mounted on the back face of the panel and comprising an outer insulating surface 90 and an inner conducting surface 91. Secured to the inner surface 91 of the cap 89 is a spring-like conducting member 92 positioned to engage the lamp contact 88 and has the lamp 86 upwardly within the fixture 81. The cap 89 may be threaded onto the plastic shell 85 as at 93.

When the lamp socket 80 is mounted on panel 10, as in Fig. 1, the flow of current will be through the connecting portion 12 to the crown face 82, which may be provided with an insulated cover 94, and then down through the legs 83 to the metallic base flange of the lamp 86. The return circuit will be from the lamp contact 88 through the conductor 92 and thereafter on the conducting surface 91 to the printed surface provided on the back of the panel.

It will be apparent that many changes and modifications may be made in the lamp socket and associated electrical connecting means of the present invention. For example, the socket structures shown in Figs. 4, 7, and 8 could be reversed in assembly on the panel to conform with spatial limitations of the particular design. It will also be evident that the socket shown in Figs. 7 and 8 could with slight modification be adapted for use with the panel construction of Figs. 5 and 6. Preferably, a suitable indexing means in the form of a key and keyway, respectively, on the fixture and sidewalls (not shown) of the aperture 13 might be provided in order to assure that the legs of the fixture would always be disposed so as to result in minimum light obstruction to the proper illumination of the particular corresponding nomenclature. Consequently, the invention is not to be thought of as limited to the particular printed circuit and lamp socket embodiments shown on the drawings for illustrative purposes.

In addition, although the current flow has been described as from the front surface of the panel through the sockets to the rear surface, wherein the rear surface may be at ground potential, it is clear that the front surface printed circuit may be grounded and current applied to the rear surface.

From the foregoing description, it will be seen that the improved lamp socket and associated electrical connecting means of the present invention result in more flexible edge lighted panel constructions. In addition, the features of this invention enable substantial reduction in the overall weight and spatial requirements of edge lighted panels.

We claim:

1. An edge lighted panel comprising, in combination: a light transmitting core in the form of a flat sheet having a plurality of apertures in predetermined spaced relationship with respect to each other; printed circuit means consisting of a first and a second series of narrow paths of electrically conductive material coated on portions of opposite faces of said sheet and extending between said apertures, said paths having a width less than the diameter of said apertures, and means for connecting said paths adjacent said apertures on both faces of said sheet, said connecting means being shaped about said apertures to define circular connecting portions concentric with said apertures; and a plurality of lamp sockets mounted, respectively, in said apertures, each of said lamp sockets being provided with a first and a second terminal and including: an opaque insulating cap having an open end engaging said sheet and surrounding and covering both the adjacent circular connecting portion of the printed circuit means on one face of said sheet and the adjacent open end of the corresponding aperture; a first annular conducting member electrically connected to said first terminal and disposed wholly within said cap in engagement with said adjacent circular connecting portion; a second annular conducting member electrically connected to said second terminal; insulating means intermediate said first and second annular members; and a conducting base member electrically connected to said second annular member, said base member engaging the adjacent circular connecting portion of the printed circuit means on the other face of said sheet, and said base member being flush with said other face of said sheet.

2. An edge lighted panel comprising, in combination: a light transmitting core of insulating material in the form of a flat sheet having a plurality of apertures in predetermined spaced relationship with respect to each other; printed circuit means including a first series of narrow paths of electrically conductive material coated on portions of one face of said sheet and extending between said apertures, said paths having a width less than the diameter of said apertures, means for connecting said paths adjacent said apertures, said connecting means being shaped about said apertures to define circular connecting portions concentric with said apertures, and said printed circuit means further including a second series of narrow paths of electrically conductive material coated on portions of said one face of said sheet in spaced but adjacent relation to said first series of paths and also extending between said apertures and having a width less than the diameter of said apertures, means for connecting said paths of said second series adjacent said apertures, said last-mentioned connecting means being defined by arcuate connecting portions spaced outwardly from said apertures and said first-mentioned connecting portions, an electrically conductive element extending from each of said arcuate connecting portions through said sheet to the other face thereof; and a plurality of lamp sockets mounted, respectively, in said apertures, each of said lamp sockets being provided with a first and a second terminal and including: an opaque insulating cap having an open end engaging said sheet and surrounding and covering the adjacent connecting portions of said printed circuit means and the adjacent open end of the corresponding aperture; a first annular conducting member electrically connected to said first terminal and disposed wholly within said cap in engagement with said adjacent circular connecting portion of said first series of narrow paths; a second annular conducting member concentric with said first annular member and constituting said second terminal; insulating means intermediate said first and second annular members; and a conducting base member electrically connected to said second annular
member, said base member engaging the adjacent electrically conductive element on the other face of said sheet, and said base member being flush with said other face of said sheet.

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