United States Patent

Jones et al.

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[54] FLUORESCENT PANEL LAMP

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[73] Assignee: **General Electric Company**

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[21] Appl. No.: **1,633**

[52] **U.S. Cl.** **313/109**, 313/204

[51] **Int. Cl.** **H01j 00/00**, H01j 17/04

[58] **Field of Search** ..... 313/109, 204, 109 X

[56] **References Cited**

UNITED STATES PATENTS

2,555,749	6/1951	Krefft	313/204 X
2,501,376	3/1950	Breadner et al	313/109 X
2,446,712	8/1948	McIlvaine	313/109 X

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[57] **ABSTRACT**

A fluorescent panel lamp having substantially uniform brightness over its face, and wherein the discharge channel is molded in both faceplate and backplate. Uniform brightness is achieved by making the gaps or slots between parallel channels narrow and deep in order to have multiple light reflections which raise the brightness within the slots approximately to that of the channels. A slot depth at least 1.2 times the slot width wherein the channel walls on each side do not depart from vertical by more than 10° is required. A lamp having eight channels within a nominal 12 inch size provides more light and operates more efficiently on lower current at higher wattage.

6 Claims, 5 Drawing Figures

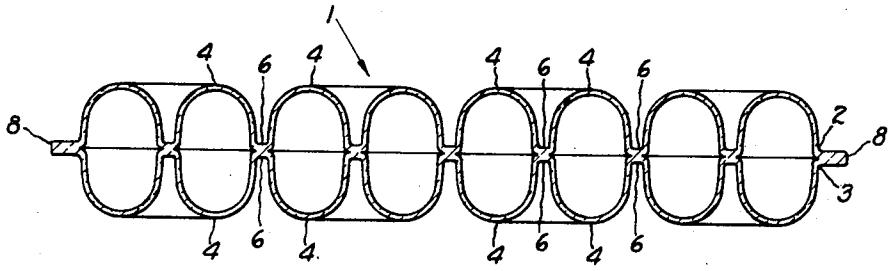


Fig. 1.

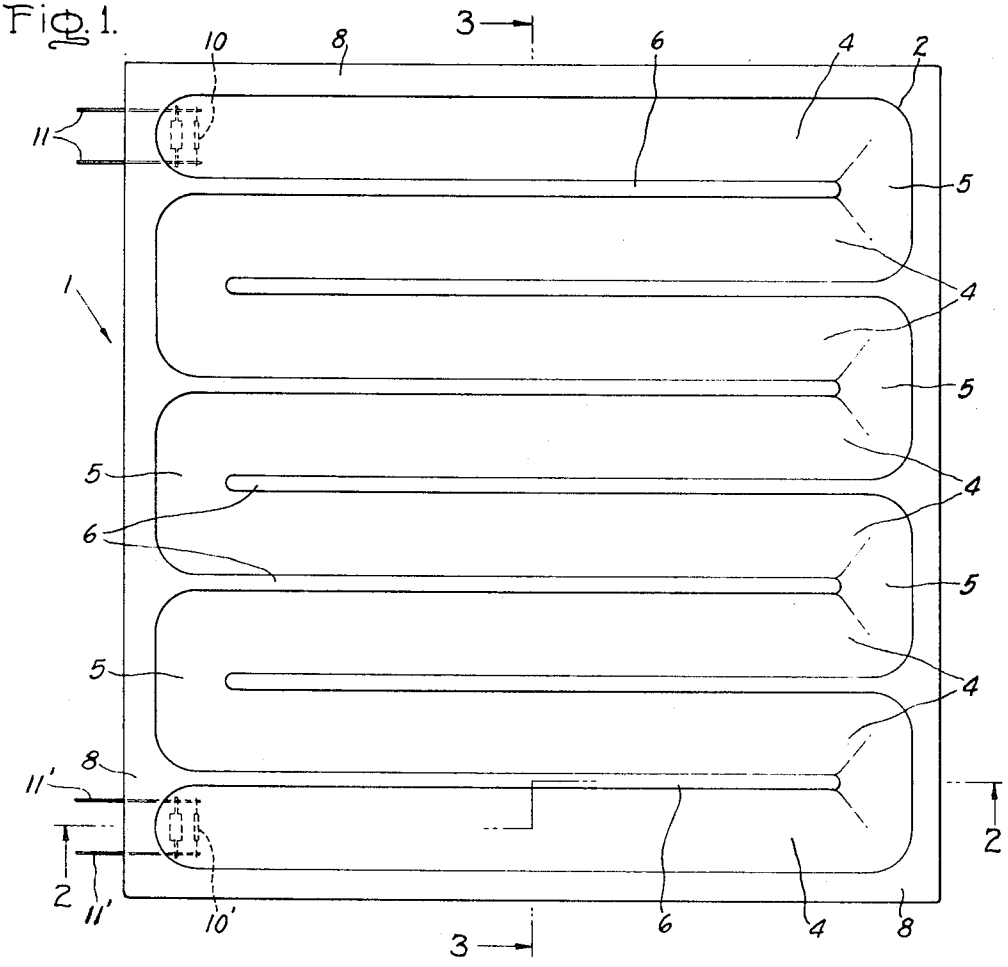
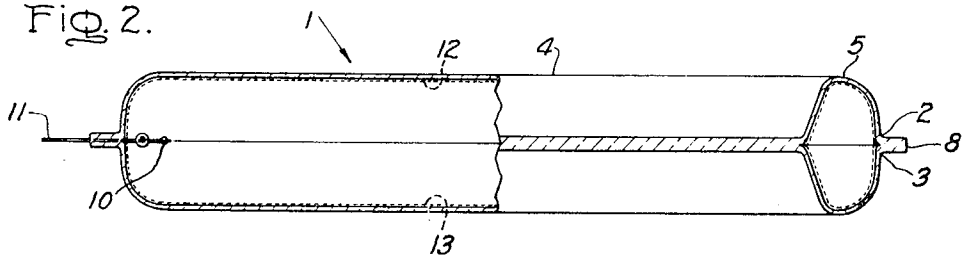


Fig. 2.



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Fig. 3.

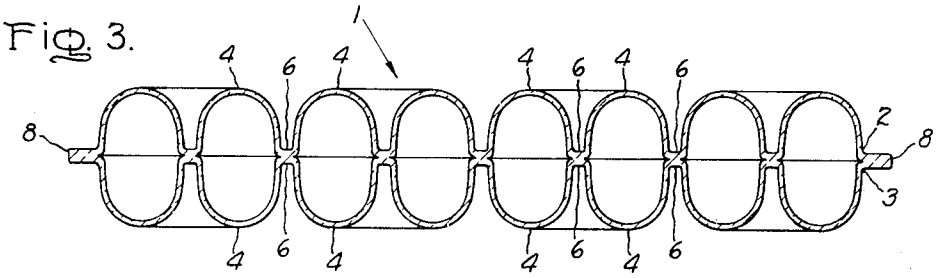


Fig. 5.

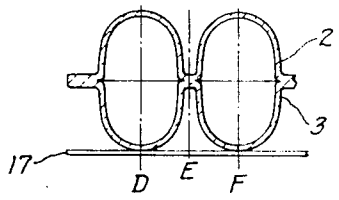
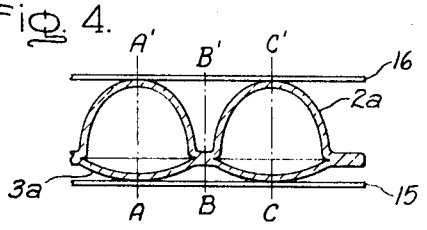


Fig. 4.



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FLUORESCENT PANEL LAMP

BACKGROUND OF THE INVENTION

This invention relates to fluorescent panel lamps and more particularly to features which improve the uniformity of brightness and the appearance of the faces.

In fluorescent panel lamps, the discharge path is a labyrinthine channelway formed between a pair of vitreous components sealed together along their margins. The length of the discharge path is a principal determinant of light output and luminous efficiency in a lamp, and the panel lamp provides a relatively long discharge path for its size. Panel lamps offer compactness and ease of handling and may be described as area light sources by contrast with the usual elongated fluorescent lamps which may be described as line sources. Area light sources permit the use of smaller and more compact fixtures and are of particular interest in connection with the lighting of smaller spaces and enclosures.

In many panel lamp applications, at least one face of the lamp is exposed to view and it is important that such face have a pleasing appearance. When the sinuous course of the bright discharge is visible through the face, it detracts from the appearance of the lamp. In the square panel lamp designated FP12S manufactured by applicants' assignee and which has been on the market for several years, the labyrinthine channelway through which the arc extends is molded in the backplate. The faceplate is generally planar but is provided with a pattern of shallow embossments corresponding in width to the channel or grooves in the backplate which help to camouflage the sinuous path of the discharge. In a square lamp, the shallow embossments may be of square outline giving somewhat the appearance of a quilt or checkerboard as taught by U.S. Pat. No. 3,226,590-Christy.

The flat areas or lands of glass at the base of the gaps or slots forming partitions between channels in the molded plate seat on corresponding lands in the other plate. The partitions between channels in the backplate do not extend across the entire width of the lamp but terminate short of the end walls in order to have sections joining adjacent channels together into one continuous discharge channelway from end to end. In the commercially available square panel lamp, the partitions extend alternately from one end wall to a point short of the other end wall leaving gaps alternating on opposite sides of the lamp through which the discharge passes from one channel to the next. When the lamp is lit, the areas in the faceplate which are overlain by the partitions in the backplate are darker and the contrast is particularly noticeable at the breaks or gaps in the partitions which stand out brightly. The dark lines make the sinuous course of the bright discharge more visible through the faceplate and this detracts from the appearance of the lamp. Thus even though the configuration of the faceplate by shallow embossments camouflages appreciably the sinuous pattern of the discharge, further improvements are desirable. Improvements in efficiency and in the total light output from a given size of lamp are also desired.

SUMMARY OF THE INVENTION

We have found that the dark lines which outline the discharge path on the faces of the panel lamp in its current commercial version may be practically eliminated from the molded plate side of the lamp by suitable design of that plate. The molded plate heretofore has been the backplate and has been hidden from view by combining it with an embossed faceplate. Our panel lamp is made by sealing together two molded plates, that is two of the type of plate formerly known as the backplate in which the labyrinthine channel is molded. This means an economy in manufacture since a single mold suffices and a single design of vitreous plate need be manufactured and stored.

In accordance with our invention, the dark areas or lines corresponding to the partitions between channels are effectively obliterated by making the gaps or slots between channels narrow and deep with near vertical walls. To assure

reasonable uniformity of brightness a depth of slot is required which is at least 1.2 times its width wherein the partition walls on each side of the slot do not depart from perpendicular to the plane of the lamp by more than 10°. By suitable proportioning of the channels and slots, a uniformity of brightness may be achieved such that at a distance of 10 feet or so from the lamp, its face appears like a luminous flat plate of substantially uniform brightness.

By making the panel lamp from molded plates with narrower slots or gaps between channels along with channels reduced in width, it is now possible to accommodate eight channels in the 12 inches square modular size of lamp which formerly accommodated six only. This means that the discharge path is lengthened 33 percent resulting in higher efficiency and more light output from a given size of lamp and weight of glass. At the same time the voltage drop across the lamp is increased which permits the design of a more efficient ballast.

DESCRIPTION OF DRAWINGS

In the drawings FIG. 1 is a plan view of a square fluorescent panel lamp embodying the invention.

FIG. 2 is a side sectional view through the lamp taken on line 2—2.

FIG. 3 is a transverse sectional view through the lamp taken on line 3—3.

FIG. 4 shows the brightness ratios over the face of prior lamps.

FIG. 5 shows the brightness ratios over the face of lamps embodying the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the drawings and more particularly to FIGS. 1 to 3, the illustrated fluorescent panel lamp 1 embodying the invention is a square eight-channel lamp whose nominal dimensions are 12 inches on a side. It is made up of a pair of molded glass plates 2,3 sealed together along their margins. In both plates there are molded eight parallel grooved sections in the nature of folds defining channels 4 extending side by side and joined together by short sections 5 where the lengthwise partitions 6 end, thereby cooperatively forming a continuous grid-like channelway. The edges of the two plates are hermetically sealed together along the outer periphery forming a marginal ledge 8 running around the four sides of the lamp. Sealing may be done by heating the glass above its strain point and applying sufficient pressure to the margins to cause lateral flow of glass. Along the internal junctures where the bottom walls 6 of the partitions come together, the glass surfaces are pressed together into close conformance but are not sealed or fused together. Provided there is close conformance of the glass surfaces along the junctures, the electric discharge will not leak through and short circuit but will follow the labyrinthine channel from end to end.

Discharge supporting electrodes 10,10' are provided at opposite ends of the channelway and comprise a tungsten filament coated with activating material; they are supported on inleads 11,11' sealed through the marginal ledge 8. A complete lamp will of course include appropriate bases (not shown) having terminals to which the external ends of the inleads 11,11' are connected. A suitable type of base adapted to be engaged by a telescoping bar-type connector is described in U.S. Pat. No. 3,253,176-Pate et al., "Panel Lamp with Terminal Bases."

Prior to sealing the plates 2,3 together, they are coated with phosphor on the inside surfaces. In many applications it is desirable to have the lamp emit a greater proportion of its light downwardly through the front or faceplate than through the backplate, and to this end, phosphor coating 12 applied to the backplate may be thicker than coating 13 applied to the faceplate. Desirably, the phosphor coating covers both plates entirely including the flat areas at the base of the slots or partitions between channels in order to provide a uniformly white appearance to the faces of the lamp when unlit.

Even though the plates 2,3 are uniformly coated with phosphor, in prior panel lamps having the cross section illustrated in FIG. 4 comprising molded backplate 2*a* and shallowly embossed faceplate 3*a*, the sinuous course of the discharge through the lamp was quite discernible during operation. The core or center of the discharge in each channel naturally tends to be brightest. The flat lands 6 of glass at the base of the partitions stands out in dark contrast because there is not ultraviolet radiation reaching the phosphor under them and causing light to be emitted.

In accordance with the invention, the sinuous pattern is effectively camouflaged by forming each plate to a cross section such that the gaps or shots between channels are quite narrow and deep. A suitable cross section which will substantially obliterate the dark lines corresponding to the partitions is shown in FIGS. 3 and 5. There are two reasons for the increase in brightness within the slots. First the greater relative depth of the slot exposes a larger phosphor-coated light-producing area within the slot. Second the sides of the slot or partition walls are near vertical, that is almost perpendicular to the plane of the lamp. This results in more internal reflections within the slot between the partition walls than is the case with the more open and slanting walls illustrated in FIG. 4.

A useful indication of the variation in light across a face of a panel lamp can be obtained by laying a thin clear glass plate against the face of the lamp and measuring the brightness at the plate as shown at 15 and 16 in FIG. 4 and at 17 in FIG. 5. In the case of the prior design illustrated in FIG. 4, the brightness opposite the slot at point B on the front face intended to be seen was only 30 percent of that at points A and C. On the backface in which the channelway was molded and which was not intended to be seen, the brightness in the slot at point B′ was 75 percent of that at points A′ and C′. Thus on both sides of the prior lamp, there is great contrast between channel brightness and slot brightness. However in the improved design according to our invention illustrated in FIG. 5, the brightness at point E is substantially equal to that at points D and F. In some samples the brightness at point E was actually observed to be a few percent higher than at point D and F. The equal brightness in channels and slots make the sinuous pattern unnoticeable at a distance of a few feet.

The factors which determine the amount of light coming out of the slot and the ratio of slot brightness to channel brightness are (1) the slot-width in relation to the slot depth and (2) the steepness of the walls defining the slot. These factors are interrelated and substantial uniformity of brightness across the face can be observed with various choices among them. In general, however, to achieve uniformity sufficient to give the effect of a panel of light to the casual observer viewing the lamp within a room, it is necessary to have a depth of slot at least 1.2 times its width wherein the channel walls on each side of the slot do not depart from perpendicular by more than 10°. Preferably the depth of slot should be 1.5 times its width or better and the departure from perpendicular not more than 7.5°. Greater brightness uniformity may be achieved by increasing the ratio of slot depth to width or by reducing the angle by which the slot walls depart from the vertical.

In the preferred embodiment of the invention illustrated in FIGS. 1 to 3 and 5 of the drawing, the channel-width measured on the outside to the beginning of the radius near the base 6 of each slot was 1.17 inches and the width of the gap or slot between channels measured at the same place was 0.187 resulting in a channel-width to slot-width ratio of 6.3/1. The height of each channel measured from the median plane of the lamp to the rounded top is 0.0938 inch. The channel walls within the slot approach the base at an angle of 7.5° from the vertical or perpendicular to the median plane over a depth about two times the slot width measured to the median plane of the lamp. This choice of parameters resulted in a lamp wherein the brightness within the slots was substantially equal to that at the midpoints of the channels.

Our improved lamp illustrated in FIG. 1 utilizes eight channels instead of six channels as in the prior lamp. This is made possible by combining the feature of the narrower slots with slightly narrower channels. Since both channels in our improved design are molded and contribute half of the cross section of the channelway, no reduction in cross section of the discharge channel need take place. The longer arc path entails a higher lamp voltage and this means that for the same input watts into the lamp, a lesser current suffices.

Comparing our improved eight-channel panel lamp with the prior six-channel lamp, representative operating conditions are as follows:

Item	Six Channel	Eight Channel
Current	0.6 amp	0.43 amps
Lamp Volts	135	180
Cathode Watts	6.5	6.5
Total Watts	75	72
Lumens (100 hr.)	4400	5000
LPW	57	70
Face Lumens	2500	3500
Lumen Maintenance (3000 Hr.)	85%	90%

It will be observed from the above data that the performance of the eight-channel lamp of our invention is superior to that of the prior six-channel lamp. Thus our invention not only obliterates the unsightly sinuous pattern of the discharge but provides a lamp having higher efficiency and greater lumen output and which utilizes a less expensive lower current ballast.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A fluorescent panel lamp comprising a pair of thin-walled vitreous plates sealed together along their margins, at least one of said plates being formed with parallel grooves in the nature of folds joined together alternately at opposite ends, said grooves defining channels between said plates and said channels together forming a continuous discharge channelway, electrodes sealed into the ends of said channelway and an ionizable medium therein, a phosphor coating on the inside surfaces of said plates, said channels being separated on the outside by outwardly flaring slots open to the atmosphere, said slots being narrow and deep with a slot depth at least 1.2 times the slot width wherein the channel walls on each side do not depart from perpendicular by more than 10° in order to increase the brightness within the slots and camouflage the discharge pattern.

2. A lamp in claim 1 wherein both plates are cooperatively grooved to define said channels.

3. A lamp as in claim 1 having a slot depth at least 1.5 times the slot width wherein the channel walls on each side do not depart from perpendicular by more than 10°.

4. A lamp as in claim 1 having a slot depth at least 1.5 times the slot width wherein the channel walls on each side do not depart from perpendicular by more than 7.5°.

5. A lamp in claim 1 having a slot depth about 2 times the slot width wherein the channel walls on each side do not depart from perpendicular by more than about 7.5°.

6. A lamp as in claim 1 having a slot depth about 2 times the slot width wherein the channel walls on each side do not depart from perpendicular by more than about 7.5° and which is 12 inches square in nominal size and comprises eight channels forming the channelway.

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