

[54] **LUMINAIRE COMPRISING MEANS
FOR REDUCING TEMPERATURE OF
EXTERIOR REFRACTOR**
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1969, abandoned.
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240/92, 93, 106, 41.3, 41.4, 46.01, 46.51,
46.55, 46.57, 46.59, 78 LD, 14

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[57] ABSTRACT

A luminaire for indoor area lighting is provided with an intermediate member for at least diffusing and optionally distributing light emitted from a high intensity light source onto a prismatic lens, with means for diffusing light reflected by the luminaire housing, with the refractor and the intermediate member having such a relationship to each other that the efficiency of the luminaire will be increased and the temperature of the exterior refractor is minimized permitting fabrication thereof from plastic.

9 Claims, 10 Drawing Figures

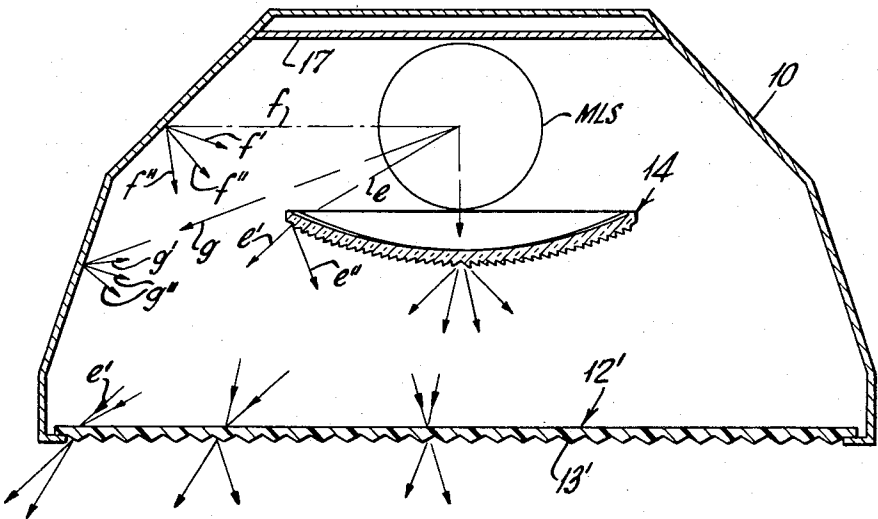


Fig. 1.

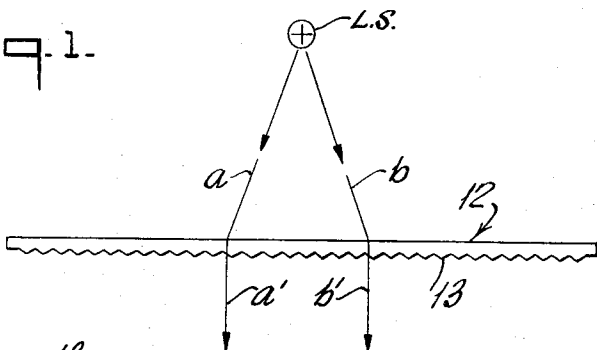


Fig. 2.

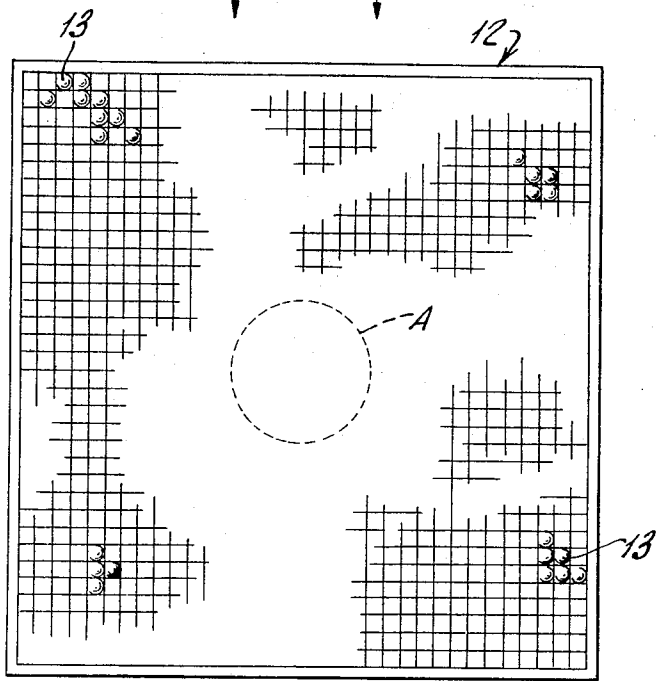
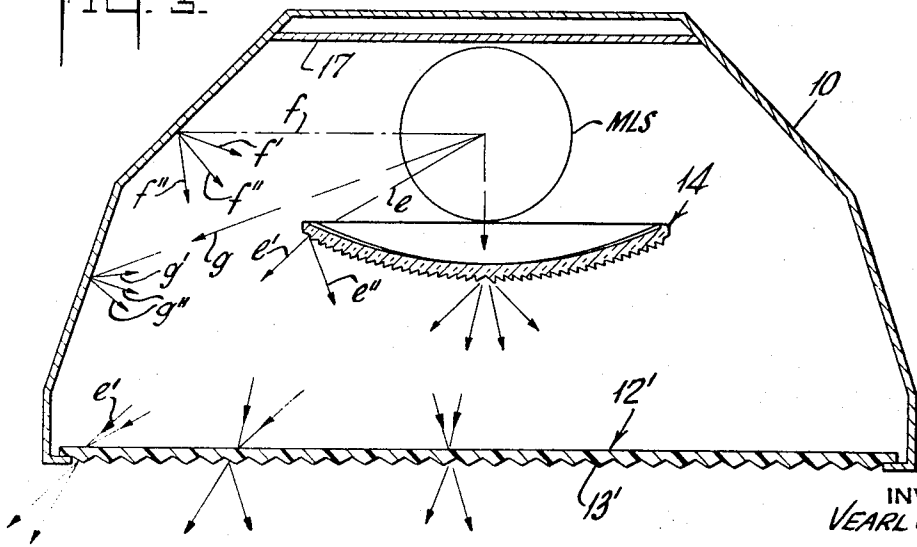
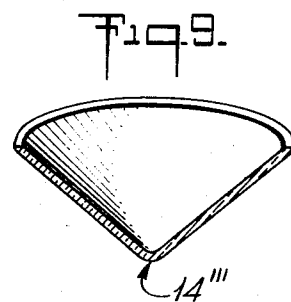
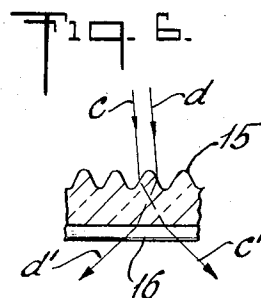
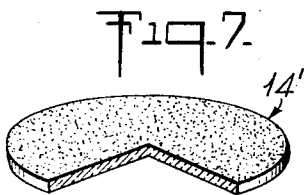
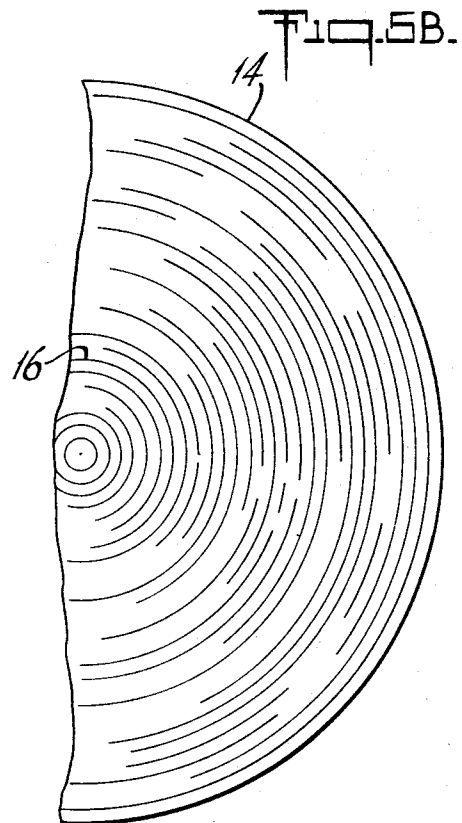
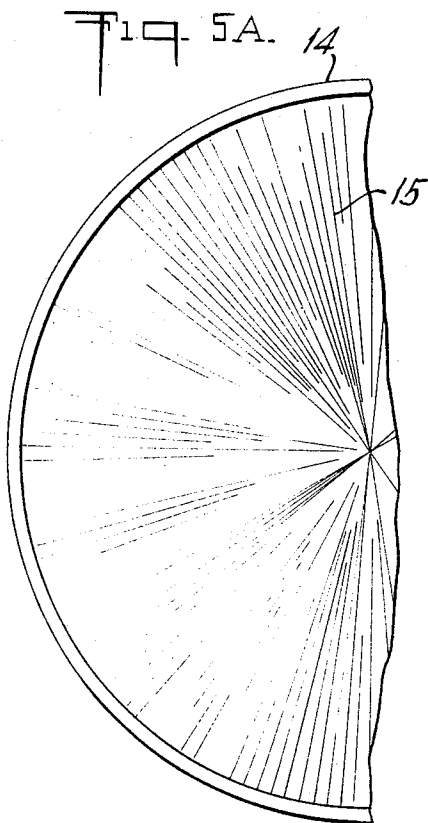
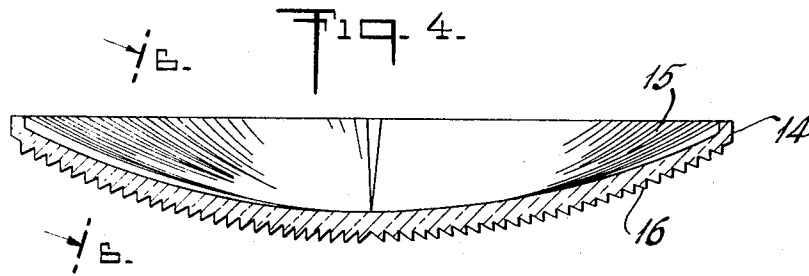


Fig. 3.



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LUMINAIRE COMPRISING MEANS FOR REDUCING TEMPERATURE OF EXTERIOR REFRACTOR

This application is a continuation-in-part of application Ser. No. 816,873, filed Mar. 19, 1969, now abandoned.

This invention relates to luminaires and more particularly to the recessed or suspended ceiling or surface mounted type which utilize relatively small and concentrated light sources and which are used for indoor lighting purposes.

Mercury lamps are presently being manufactured with such desirable characteristics that a demand for luminaires utilizing these lamps has arisen in the stores, banks and other interior lighting areas. When luminaires using mercury lamps are compared to luminaires with other light sources, it is found that the former is relatively expensive, such a lamp requires ballast equipment in order to function. Therefore, to bring about an economical utilization of these lamps, to make such luminaires competitive with standard lighting units, the light distribution pattern from a particular luminaire utilizing a concentrated light source such as a mercury lamp must be significantly larger than the light distribution arising from present luminaires which utilize low intensity or non-concentrated light sources in order that the higher cost of these high intensity light source luminaires will be offset by there being required fewer of them to provide the desired light distribution.

At first attempts were made to achieve this increased light distribution in high intensity sourced luminaires by simply increasing the size of the luminaire. But by simply increasing the size of the present optical systems, greatly enlarged costs were encountered and as a result of the increased ratio of lens size to source size very poor brightness patterns were created, that is, the appearance of high intensity and low intensity inter-related streaks became very apparent as a result of inadequate diffusion.

Somewhat the same situation occurred in the early days of fluorescent lighting when it was found that the optical systems used for incandescent lamp sources were not practical with fluorescent lamps due to the differences in the size and brightness characteristics of the two types of sources. The solution to the problem and the one most commonly used today for fluorescent light sources is to substitute a painted steel housing for the standard reflector. This greatly increases the diffusion characteristics of the luminaire housing and thereby reduces the maximum to average brightness ratio of the luminaire. To control high angle glare the opening of the luminaire is covered with a refractor panel or lens, as they are called, which has cut-off prisms thereon. Since the primary purpose of this panel is to cut off high angle glare it is made up of prisms having one fixed angle. Being of one fixed angle these prisms are inherently limited in their diffusing characteristics.

Since the fluorescent sources utilized in these luminaires are elongated and since a plurality of these sources are usually utilized in close spatial relationship in a given luminaire, these sources have a large effective area and therefore light emitted from these sources will strike any particular point of the refractor panel throughout a wide angular range, and this results in there being no further need to diffuse this emitted light.

When a concentrated high intensity light source is utilized, the light which would strike a particular point on such a refractor panel would not be incident throughout a relatively wide angular range as in the case of a fluorescent source. Therefore the mere use of refractor panels having cut-off prisms which proved satisfactory when fluorescent sources were utilized is not adequate when these concentrated light sources are utilized if the luminaire is to have a light distribution ratio of maximum to average brightness which would be acceptable for use as an indoor light luminaire.

Also the refractor lenses suitable for fluorescent light sources do not take into account the emission of a high degree of heat, which is typical of high intensity light sources, resulting in unwanted heat, disrupting normal heat flow patterns whether they arise from air heating or cooling.

Accordingly, it is an object of the present invention to provide luminaires with high intensity light sources for lighting the interior areas and more particularly large interior areas such as stores, banks and the like.

It is a further object to provide a luminaire with a high intensity light source and which provides a relatively high degree of diffusion of light from the source.

It is a further object to provide such a luminaire wherein the brightness contrast will be low.

A further object of the present invention is to provide a mercury lamp luminaire wherein build up in heat intensity at the exposed refractor surface is minimized, so that it can be made of plastic or other economical substances.

It is a further object to provide substantially uniform distribution of light from the mercury lamp luminaire.

Another object is to increase efficiency in such luminaires.

The present invention achieves the above objectives by painting the luminaire housing with a high reflectance paint and by placing a light diffusing element which may optionally direct light incident thereon between the mercury or other high intensity light source and a cut-off prism panel. The intermediate member is positioned to prevent light emitted from the source from being directly incident on the cut-off prism panel thereby providing the additional necessary diffusion for all the light emitted and this member may be optionally specially designed to distribute light onto the cut-off refractor in the proportions desired to obtain the desired optical effect.

When the intermediate member is made of glass, the infrared energy emitted as light rays from the mercury or other high intensity source are redistributed by the member. This, therefore, reduces the prism panel temperature and thereby, makes the temperature comfortable and allows utilization of plastic in the making of the prism panel.

Turning now to the drawings:

FIG. 1 is an elevational sectional view of a prior art fluorescent luminaire in which is utilized a high intensity light source;

FIG. 2 is a view of the prior art fluorescent luminaire along axis II — II of FIG. 1;

FIG. 3 is an elevational, cross-sectional view of a preferred embodiment of a luminaire according to the present invention;

FIG. 4 is an elevational, cross-sectional view of the intermediate member of the luminaire having the preferred embodiment shown in FIG. 3;

FIG. 5 A-B is a divided bottom plan view and top plan view of the intermediate member of FIG. 4 as viewed in the direction of arrows $V_1 - V_2$;

FIG. 6 is a cross-sectional, partial view of the intermediate member taken along VI - VI of FIG. 4, showing typical rays indicating the lateral diffusion provided by the member;

FIG. 7 is a cross-sectional view of an intermediate member made in accordance with the teachings of the present invention having a second preferred embodiment;

FIG. 8 is a cross-sectional view of an intermediate member having a third preferred embodiment; and

FIG. 9 is a cross-sectional view of an intermediate member having a fourth preferred embodiment.

Referring now, more specifically to the drawings:

FIG. 1 illustrates a refractor panel or lens 12 utilized in prior art fluorescent lamp luminaires. These refractor panels 12 carry cone shaped cut-off prisms 13 for internally reflecting light which would otherwise be emitted at high angles. The light source, diagrammatically illustrated in FIG. 1 as L.S. is a high intensity light source and in particular, represents a mercury lamp source.

As has already been mentioned, fluorescent light sources, though having a relatively high intensity, have a large effective area and are not therefore very concentrated. These prisms 13 which act so well to cut off high angled light by internally reflecting the same do little to diffuse incident light. When such a lens is utilized with a high intensity light source L.S. the rays a, b , are not diffused by the lens 12 but are emitted as a', b' , and as a result the observer, beneath the luminaire, views the light source L.S. as a substantially circular image A which has a high brightness level with the remaining refractor areas being dark. The brightness contrast is not substantially reduced by the light diffusion which results from the utilization of a luminaire housing which has high reflectance paint thereon. This contrast therefore makes use of this type of luminaire in combination with a high intensity light source undesirable for indoor lighting purposes.

Of course, the configuration of light distributed can be varied with the utilization of pyramid shaped prisms but since the prism angle cannot be varied substantially due to the fact that the lens 12 is primarily utilized as a means for preventing high angle glare no diffusion can be obtained in addition to that arising from the luminaire housing covered with high reflectance paint.

FIG. 3 illustrates a preferred embodiment of the present invention. The luminaire is comprised of five primary components. A high intensity light source M.L.S. (diagrammatically shown) as for instance a mercury lamp, a housing 10 painted with high reflectance white paint on the inner surface and which is utilized in the place of a reflector to achieve higher light diffusion properties, a heat baffle 17 placed at the top of the housing 10, lens 12' including cone shaped cut-off prisms 13', on the light emitting surface thereof enclosing the housing 10, and a light diffusing and directing member 14 positioned between the high intensity light source M.L.S. and the lens 12'.

In this preferred embodiment, the light directing member 14 is positioned a substantial distance (approximately one-third the width of the lens) above the lens 12'. This placement results in a substantial amount

of the light which is reflected and diffused by the housing 10 only passing through lens 12'.

The luminaire housing 10 is coated on its internal surface with a high reflectance paint (not shown). As can be seen in FIG. 3 light incident thereon f, g is diffused into infinite components diagrammatically shown as (f', f'', f''' and g', g'', g''') which are shown in this figure optically so that the longer the ray the more light will be diffused into that ray direction.

It can also be seen in FIG. 3 that a large percentage of the rays diffused and reflected by the housing f', f'', g', g''' will not strike the light diffusing and directing panel 14 but will only strike the lens 12' and pass therethrough. This is desirable since the housing 10 with its high reflectance coating diffuses the reflected light to a sufficient degree that no further diffusion is required and since the loss of light through transmission is significant by so positioning the diffusing panel 14 the efficiency of the luminaire will be increased.

Also since the light directing member 14 redistributes a portion of the infrared light incident thereon, excessive hot areas which would occur on lens 12' if it received energy directly from the source, are avoided. By separating the two refractors 12' 14 and by having the air therebetween communicate freely with the air within the luminaire housing a means is provided to uniformly distribute the heat energy absorbed by the light directing member 14 and the panel 12' and which is transferred to the air therebetween, within the luminaire housing which thereby reduced substantially the temperature of panel 12'. This is desirable in that this refractor could then be made of an acrylic plastic or the like which would result in a more economical unit. This objective of uniform heat distribution can be further achieved by the utilization of a heat baffle 17 positioned internally at the uppermost part of the luminaire housing 10.

The light directing and diffusing member 14 shown in FIGS. 3, 4 and 5 is comprised of a light incident surface and a light emergent surface. There is a series of radial flutes 15 on the light incident surface. As can be seen in FIG. 6 light rays c, d , incident upon these flutes 15 are diffused laterally c', d' . In addition, the light emergent surface has a series of concentric prisms provided with curved or fluted emergent surfaces which provide further diffusion of rays such as e and which provide concentration of light from the source, such as at e' and e'' to thereby direct such light onto the lens 12' as shown by the typical ray e' striking the left area of the lens in FIG. 3.

Theoretically, the luminaire of the invention should be designed specifically for a particular light source shape. While we think of the mercury lamp source as having a concentrated point source, in truth, the source has a finite size and shape depending upon the type of lamp. Generally, the source is longer in varying degree along the lamp axis. Some lamps have a phosphorescent coating on the bulb which modifies the color of the light generated by the arc and effectively increases the size of the source. Therefore, a different light directing member 14 could be made having the optimum design of prisms and flutes for each of these lamp variations. But the preferred embodiment illustrated in FIGS. 4 and 5 is a compromise design that works satisfactorily with all lamps presently available.

The invention has been illustrated with reference to a preferred embodiment utilizing a prismatic diffuser 14 positioned intermediate the lens 12' and the light source M.L.S. which provides a controlled diffusion since prisms 16 are utilized to redirect the light incident thereon in a predetermined way on lens 12'. This combination of an intermediate diffusing and light directing member provides the best brightness contrast and light distribution control.

In many work situations such a high degree of control is not required. In such situations the intermediate member 14 need only act as a diffusing element without controlling the distribution of light incident thereon. Such an intermediate member 14' could be made of a plain diffusing material such as opal glass, etched or sand blasted glass, or glass with some diffusing material applied to the surface of the glass (FIG. 7). If it were desired to achieve a brightness contrast which would be better than that provided by this simple diffusing intermediate member 14', the intermediate member 14'' made of the plain diffusing material could be designed so that the density of the diffusing material would be higher in the center of the intermediate member than it would be at the edges thereof (FIG. 8). Additionally by designing the intermediate member 14''' so that the center of the diffuser is farther away from the light source a better brightness contrast could be obtained. This could be done by making the depth of the intermediate member greater without changing the diameter 14''' (FIG. 9). A conically or spherically shaped intermediate member would be advantageous in achieving these results.

What I claim is:

1. A luminaire comprising a housing, a high intensity light source mounted within said housing, first refractor means for closing the bottom opening of said housing, means for reducing the temperature at said refractor means mounted between said light source and said first refractor and comprising means for intercepting direct light from said light source that would otherwise strike said first refractor, said temperature reducing means including means for diffusing said intercepted light, said first refractor including cut-off means for internally reflecting light which would otherwise be emitted at relatively high angles, the interior surface of said housing comprising means for diffusing light from said light source and for directing a portion thereof to said bottom opening, said temperature reducing and light diffusing means being spaced from said first refractor so that a substantial portion of the light from said light source which is diffused by said housing and directed therefrom to pass out of said bottom opening will not be intercepted by said temperature reducing and light and wherein said temperature reducing and light diffusion means further comprises means for redistributing a portion of the infrared heat energy of said intercepted light, and wherein substantially all of said temperature reducing and light diffusing means and the periphery thereof is spaced from said first refractor so that air will be freely circutable between said first refractor and said temperature reducing and light diffusing means.

2. A luminaire comprising a high intensity light source, a first light controlling member spaced from said light source, a second light controlling means positioned intermediate the source and first light con-

trolling member for reducing the temperature at said first light controlling member and comprising means for intercepting substantially all direct light from the source which would otherwise be incident on said first member and for diffusing such light upon the incident surface of said first member, a housing completely enclosing the source and said light controlling means and having a substantially wholly diffusely reflective internal surface, the internal surface of said housing constituting means for receiving direct light from the light source and diffusely reflecting the same to said first member, said housing having an opening, said first member extending across and filling that opening and comprising means for receiving diffused light from said light controlling means and for receiving diffused light from said housing internal surface and for redirecting the same onto relatively large areas said light controlling means being fabricated of glass and being spaced from said light source and said first member and the periphery of said light controlling means being spaced from said housing so as further to constitute means for redistributing heat energy of the light incident thereon and for permitting circulation of air thereabout.

3. A luminaire as claimed in claim 2 wherein said diffusing means includes concentric prisms.

4. A luminaire comprising a high intensity light source, a housing surrounding said source and having an opening, an interior surface of the housing being diffusely reflective whereby that portion of the light from the source incident upon the interior surface is diffusely reflected to said opening, a light diffusing means positioned between said source and opening and spaced from said source and opening and from said housing for reducing the temperature at said light controlling member, said diffusing means being located to intercept substantially all direct light between said source and opening and a light controlling member positioned in said opening to intercept substantially all light passing therethrough and to receive diffused light from said housing and said light diffusing means, said light controlling member having means for internally reflecting light which would otherwise be emitted at relatively high angles through said opening, said diffusing means being heat resistant and of material to absorb and redistribute heat from the light source which otherwise would be directed upon localized areas of said light controlling member, and said light controlling member being of a thermo plastic material and being so located relatively to the light source that it would be adversely effected by the heat from said light source but for the interposition of said diffusing means.

5. A luminaire as claimed in claim 4 wherein said housing is shaped to intercept substantially all light from the source that does not pass directly from the source to said light controlling means.

6. A luminaire as claimed in claim 4 wherein said diffusing means comprises flutes extending radially from the center thereof.

7. A luminaire as claimed in claim 4 wherein substantially all of the internal surface of said housing is diffusely reflective.

8. A luminaire comprising a housing substantially all of the internal surface of which is diffusely reflecting, a high intensity light source mounted within said housing

and being enclosed thereby, a bottom opening in said housing, a prismatic light distributing means for closing the bottom opening of the housing, prismatic light diffusing means for reducing the temperature at the light distributing means located between the light source and the light distributing means and comprising a generally circular element having on that surface thereof closest to the light source a plurality of radially disposed flutes and on its opposite side a plurality of annular prisms whereby direct light incident upon said fluted surface is emitted from said other surface in a diffused fashion and infrared heat energy is redistributed, said light diffusing means having its periphery spaced from the internal surface of the housing and being of such size and so located that the light distributing means is substantially evenly and only illuminated by diffused light from said diffusing means and by diffused light reflected from said housing, said prismatic light distributing means having prisms formed therein for directing the diffused light issuing therefrom above a low angular range and into a wide area.

9. A luminaire comprising a high intensity light source, a housing surrounding said source and having an opening, all of the interior of the housing being diffusely reflective whereby that portion of the light from the source incident upon the interior surface of the

housing is diffusely reflected to said opening, a light diffusing element positioned between said source and said opening and spaced from said source and opening and from said housing, said element being located to intercept substantially all direct light between said source and opening, and a light controlling member positioned in said opening to intercept substantially all light passing therethrough and to receive diffused light only from said housing and said light diffusing element, said light controlling member having means for internally reflecting light which would otherwise be emitted at relatively high angles from said opening, said diffusing element being heat resistant and of a material to absorb and redistribute a substantial portion of the heat from the light source which otherwise would be directed upon localized areas of said light controlling member and said light controlling member being of a thermoplastic material and so located relatively to the light source that it would be adversely effected by the heat from said light source but for the interposition of said light diffusing element whereby said light diffusing element is constituted as means for protecting the light controlling member against the adverse affects of the heat from said light source.

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