

[54] **LAMP FOR USE IN A HIGH PRESSURE ENVIRONMENT**

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[58] Field of Search ..... 240/11.2 E, 11.2 R, 240/11.3, 11.4, 26, 47, 1.4

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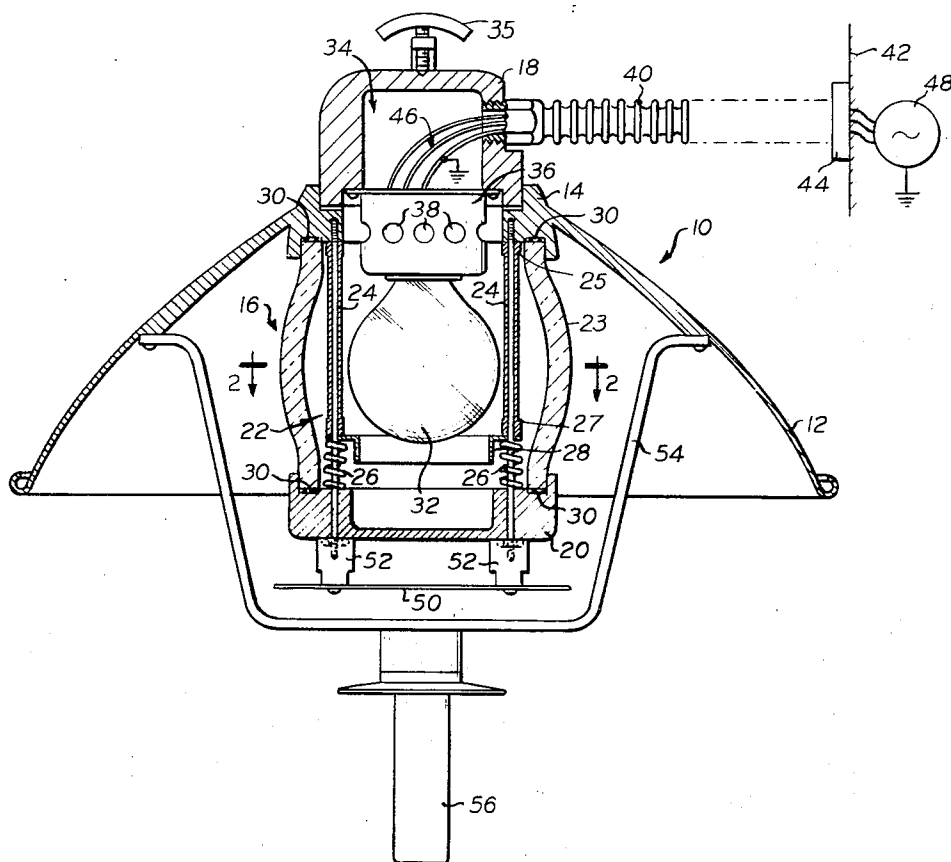
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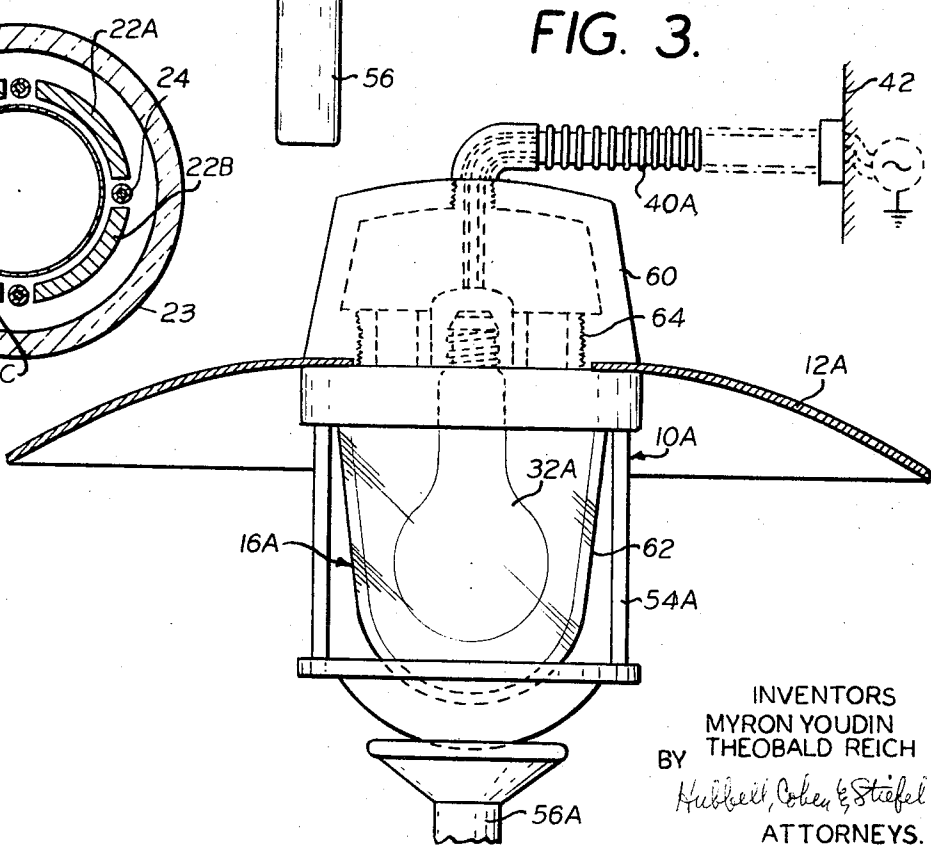
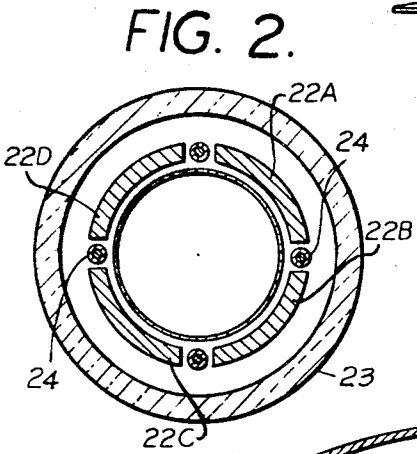
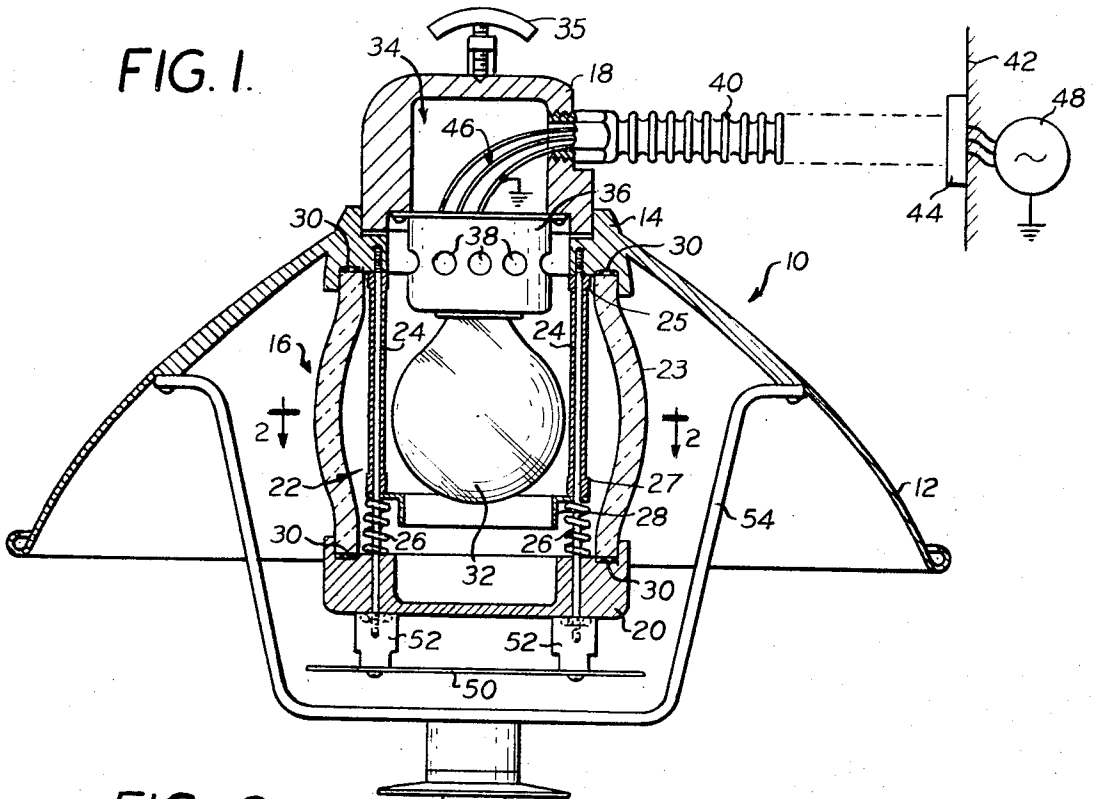
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**ABSTRACT**

In a lamp for use in a chamber containing a high pressure environment preferably greater than one atmosphere wherein the lamp includes a light source and a substantially pressure tight explosion-proof housing, the light source being located within the housing interior and the housing exterior being capable of withstanding pressures greater than atmospheric pressure, means are provided which are cooperatively associated with the housing for maintaining the interior of the housing substantially at atmospheric pressure while the interior of the chamber exterior to the housing is at a higher pressure, the housing being substantially non-porous with respect to the chamber interior.

**5 Claims, 3 Drawing Figures**





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## LAMP FOR USE IN A HIGH PRESSURE ENVIRONMENT

### BACKGROUND OF THE INVENTION

#### 1. Field of the Invention

The present invention relates to lamps for use in high pressure environments.

#### 2. Description of the Prior Art

Lamps for use in operating room environments at normal atmospheric pressures are well known. Such prior art lamps are normally explosion-proof but are not pressure tight as an explosion-proof housing only requires that the housing be strong enough to withstand explosion or implosion, such as due to combustible vapors. In such lamps, an explosion-proof globe is provided in which is contained a light source. These conventional surgical lights normally must be easily adjustable, shadow reduced and have a heat filtered light source to prevent burning the patient. In addition, a hyperbaric light must be explosion and implosion proof, as was previously mentioned, and because of the greater fire hazard in a hyperbaric chamber, must have all electrical cables enclosed in a metallic conduit as a precaution against mechanical damage to the insulation.

The globes of such lamps are normally closed at at least one end, or both ends depending on the type of lamp, by a porous end cap. These caps are porous so as to vent hot vapors into the hyperbaric chamber atmosphere to reduce the possibility of explosion or implosion. However, since the light sources or bulbs which are normally utilized with such lamps are not rated to withstand pressures as high as the pressures normally utilized in a hyperbaric chamber, which may range as high as six to eight atmospheres, there is always a danger of implosion of the bulb due to the high pressure gasses entering the globe housing through the porous end caps. Normal venting of these vapors from the interior of the lamp housing to the hyperbaric chamber atmosphere does not significantly reduce this danger of implosion of the bulb.

Some light sources, although not surgical lamps, have been provided wherein a conduit is connected to the exterior of the hyperbaric chamber, such as in a fixed lamp installation. However, such lamps also contain a porous, that is non-pressure tight, housing which permits the high pressure gasses contained within the hyperbaric chamber to enter the housing. Such lamps are not designed to maintain the interior of the housing at atmospheric pressure. Accordingly, the high pressure gasses entering the interior of the housing are not vented rapidly enough to maintain the interior of the housing at atmospheric pressure while the hyperbaric chamber is maintained at a pressure significantly above this. Therefore, the danger of implosion of the bulb still exists in such lamps. Accordingly, to date no satisfactory lamp for use in a high pressure environment which is both explosion-proof and pressure tight, has been provided.

The present invention overcomes these disadvantages of the prior art.

### SUMMARY OF THE INVENTION

A lamp for use in a chamber containing a high pressure environment is provided. This environment pressure is preferably normally greater than atmospheric pressure. The lamp includes a light source and a sub-

stantially pressure tight housing wherein the light source is located within the housing interior. The housing is preferably explosion-proof and has a means cooperatively associated therewith for maintaining the interior of the housing substantially at atmospheric pressure while the interior of the chamber exterior to the housing is at a higher pressure. The housing is substantially non-porous with respect to the chamber interior whereby the housing interior is substantially pressure tight with respect to the chamber interior high pressure surrounding environment.

### BRIEF DESCRIPTION OF DRAWING

FIG. 1 is a sectional view of the preferred embodiment of the present invention taken through the center thereof;

FIG. 2 is a sectional view of the embodiment shown in FIG. 1 taken along the line 2—2; and

FIG. 3 is a front elevation, partially in schematic, of an alternative embodiment of the present invention.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings in detail and especially to FIG. 1 thereof, a surgical lamp, generally referred to by the reference numeral 10, for use in a high pressure hyperbaric chamber is shown by way of example. Lamp 10 preferably includes a parabolic reflector 12, such as one having a polished aluminum reflecting surface. The parabolic reflector 12 is conventional and preferably includes a central or hub portion 14 having recesses and a through hole therein for aiding in the assembly of the lamp 10 in conventional fashion. The lamp 10, in addition to the parabolic reflector 12, includes a substantially pressure-tight housing 16. The housing 16 preferably includes an upper end cap or dome 18 and a lower end cap or dome 20, end caps 18 and 20 being spaced apart from each other and located at the ends of the housing 16. These end caps 18 and 20 are non-porous and are preferably composed of a metal such as non-porous 2024 aluminum alloy made by the Alcoa Corporation, although any non-porous lightweight high pressure resistant material may be preferably utilized without departing from the present invention. The housing 16 also preferably includes a globe 23 and a heat filter 22 so as to provide a heat filtered light source to prevent burning the patient. Most preferably, the heat filter 22, preferably cuts out yellow light to protect the patient from the high intensity light. The globe 23 preferably consists of implosion and explosion resistant glass, such as Pyrex, which is preferably implosion and explosion resistant to at least nine atmospheres for use in a high pressure hyperbaric chamber.

As can be seen by reference to FIG. 2, the heat filter 22 is preferably composed of four sections 22A, 22B, 22C and 22D which are held in position between channels 25 and 27. Upper end cap 18 preferably is clamped into parabolic reflector hub 14 by means of clamping screw 35. The heat filter 22 is preferably maintained in compression between upper channel 25 and the lower channel 27 by means of filter supporting rods 24 which are secured to the end caps preferably by threaded bolts in conventional fashion and are maintained in compression by means of spring members 26 and a deflection sleeve 28. The deflection sleeve 28 is preferably located at a fixed predetermined position on the filter support rods 24 for protecting the springs 26 from

the intense heat generated by the light source associated with the lamp 10. Preferably, a rubber gasket or some other resilient material is located at the end points of contact between the globe 23 and the end caps 20 and 14, and between the end cap 18 and hub 14. These gaskets 30 are maintained in compression by the filter support rods which also serve as the rods and the nuts or spacers 52 so as to complete the housing 16.

As was previously mentioned, the lamp 10 includes a high intensity light source 32 which is preferably mounted in a through hole in central opening 14 which is in communication with a central recess 34 in the upper end cap 18. The light source 32, which is mounted in conventional fashion and is supported in upper end cap 18, includes a collar 36 at the socket end of the light source 32 which collar includes a plurality of apertures or vents 38 for permitting heated air in the area surrounding the light source 32 to escape there-through into the interior of the housing 16 and recess 34 in upper end cap 18. Preferably, a tubing conduit 40, which is most preferably a flexible metal tubing conduit, is secured to upper end cap 18 through an opening therein in pressure tight relationship with one end thereof, having the other end thereof secured to the wall 42 of the chamber in which the lamp 10 is mounted, such as by means of a rotary seal 44 so as to reduce torsion stress on the conduit 40 such as during flexure thereof.

The conduit 40 preferably serves the dual function of a passageway for the electrical wires 46 which provide power to the light source 32 from a conventional power source 48, preferably located external to the hyperbaric chamber, and as a conduit for venting gasses contained within housing 16 which are at a higher pressure than the chamber exterior, which is preferably at atmospheric pressure, or one atmosphere. Preferably, the conduit 40 provides a shield for the electrical wires or cable 46 to avoid any danger of noxious fumes being provided to the interior of the hyperbaric chamber in the event of insulation fire. The conduit 40 in venting any gasses contained within the interior of the housing 16 at a pressure greater than one atmosphere, will of course also vent any hot gasses contained within the housing 16 interior such as due to the heating of the air contained therewithin at turn-on of the lamp. Preferably, the gaskets 30 can be compressed so as to still permit minimal leakage to the interior of the housing 16 due to the pressure differential between the hyperbaric chamber interior and the housing interior so as to provide for a continuous air purge of the conduit 40 if desired.

As also shown in FIG. 1, the lamp 10 also preferably includes a conventional deflection plate 50 spaced from the lower end cap 20 by means of conventional spacers 52 for deflecting any hot gasses external to the housing 16 in the path of the high intensity light source 32 so as to prevent these gasses from being directed towards the patient. In addition, the lamp 10 also preferably includes a conventional U-shaped supporting bracket 54 having a handle 56 secured thereto at the center thereof for purposes of moving the lamp 10, or adjusting its position with reference to work surface such as along a track, during normal usage thereof.

When the lamp 10 is utilized in a high pressure environment greater than atmospheric pressure or one atmosphere, such as in a hyperbaric chamber which is normally maintained at up to three atmospheres abso-

lute for normal patient therapy and up to six atmospheres absolute for treating patients for the bends and oxygen toxicity studies, the interior of the housing 16 is maintained at approximately one atmosphere absolute of pressure despite the much greater pressure of the surrounding chamber interior due to the non-porous housing 16 and the venting provided by the conduit 40. In this manner, conventional high intensity light sources 30 may be utilized within their normal pressure rated capacity, which is normally between one and two atmospheres absolute, without fear of implosion of the light source 30 due to substantial high pressure occurring within the interior of the housing 16.

Referring now to FIG. 3, an alternative embodiment is shown which is similar to that previously described with reference to FIG. 1 with the exception that the housing 16A only consists of an upper dome 60 which bears the lamp socket, and a lower, color corrected glass dome 62 which functions as the heat filter, glass dome 62 being secured to upper dome or end cap 60 to form an explosion-proof enclosure similar to that provided by means of the two end caps 20 and 18 and the heat filter 22 of the embodiment shown in FIG. 1. The interior of the housing 16A is vented through the upper dome 16 through tubing conduit 40A which is fastened at one end in pressure tight relationship to an opening in end cap 60 and at the other end in pressure tight relationship to an opening in the chamber wall 42 so as to communicate with the chamber exterior which is preferably at one atmosphere. In addition, a plurality of channels 64 are provided which are similar to vents 38 for venting heated air.

As was previously mentioned, the conduit 40A serves the dual function of venting gasses to the exterior of the chamber so as to maintain the housing 16A interior at approximately one atmosphere, and providing a passageway for the insulated electrical wires used to energize the light source 32A.

Once again, if preferred, gaskets may be utilized between the end points of contact between the glass dome 62 and the upper end cap 60 so as to enable a minimal slight leakage of air through the gasketed seal between the domes 60 and 62 for continuous air purge of the conduit 40A. Both the glass dome 62 of the embodiment shown in FIG. 3 and the heat filter 22 of the embodiment shown in FIG. 1 are preferably designed so as to be implosion and explosion resistant under high pressure such as at least nine atmospheres. The lamp 10A shown in FIG. 3 also preferably includes a parabolic reflector 12A similar to the reflector 12 previously described with reference to FIG. 1.

By utilizing the lamp of the present invention, a conventional low pressure rated light source may be utilized in a high pressure environment in which the light source or bulb can be maintained at approximately atmospheric pressure despite the high pressure environment surrounding the lamp housing or globe.

It is to be understood that the above described embodiments of the invention are merely illustrative of the principles thereof and that numerous modifications and embodiments of the invention may be derived within the spirit and scope thereof such as by providing any type of non-porous housing in conjunction with a conduit for venting the interior of the housing to the exterior of the high pressure environment which exterior is at atmospheric pressure.

What is claimed is:

1. In a lamp for use in a chamber containing a high pressure environment greater than a predetermined normal atmospheric pressure wherein said lamp includes a light source and a housing, said light source being located within said housing interior and said housing exterior being capable of withstanding pressures greater than said atmospheric pressure, the improvement comprising means cooperatively associated with said housing for maintaining at least the portion of the interior of said housing surrounding said light source substantially at atmospheric pressure while the interior of the chamber exterior to said housing is at said greater high pressure, said housing including means for substantially isolating said housing interior environment from said chamber interior environment, a globe capable of passing light therethrough, said globe being in surrounding relationship with said light source and being closed at opposite ends thereof to complete said housing by said isolation means, said maintaining means comprising a conduit in communication at one end with the interior of said housing through said isolation means and at the other end with the exterior of said chamber, said housing further comprising means for maintaining said globe in compression, said compression means including compressible gasket means in communication with said housing interior and said chamber interior for enabling a predetermined minimal amount of leakage of gas from said

chamber interior to said housing interior for continuously purging said conduit while maintaining said housing interior substantially at atmospheric pressure, said chamber exterior being at said normal atmospheric pressure, said conduit venting any gasses in said housing interior to said chamber exterior, whereby said housing interior is substantially pressure tight with respect to the chamber interior high pressure surrounding environment.

2. A lamp in accordance with claim 1 wherein said globe is a filter for heat due to said light source, said light source and said globe comprising a heat filtered light source.

3. A lamp in accordance with claim 1 wherein said lamp further comprises an electrical conductor for supplying power to said light source, said conduit further providing a passageway for said conductor between said light source and a source of power therefor.

4. A lamp in accordance with claim 1 wherein said housing exterior is capable of withstanding pressure excursions in the range of at least one to eight atmospheres when said housing interior portion is maintained at a pressure of substantially one atmosphere.

5. A lamp in accordance with claim 1 wherein said isolation means comprises end cap means composed essentially of an aluminum alloy.

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