United States Patent

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[54] **THERMALLY DISSIPATIVE ENCLOSURE FOR PORTABLE HIGH INTENSITY ILLUMINATING DEVICE**

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[52] **U.S. Cl.** ....**240/47,** 240/11.2 A

[51] **Int. Cl.** **F21v 29/00**

[58] **Field of Search**....................240/47, 41.35, 41, 11.4, 3, 240/1.3, 46.13

[56] **References Cited**

UNITED STATES PATENTS

3,371,202	2/1968	Moore et al.	240/41.15
3,379,868	4/1968	Taillon	240/11.4
2,703,374	3/1955	Fruengal	313/149
3,018,365	1/1962	Wenman et al.	240/90
2,817,069	12/1957	Pennow	340/25
3,361,903	1/1968	Brown	240/47
1,494,134	5/1924	Ritterrath	240/47
2,884,513	4/1959	Giller	240/41.15

FOREIGN PATENTS OR APPLICATIONS

386,538	1/1933	Great Britain	240/47
182,785	1/1955	Austria	240/47
884,136	4/1943	France	240/47
928,966	6/1963	Great Britain	240/47

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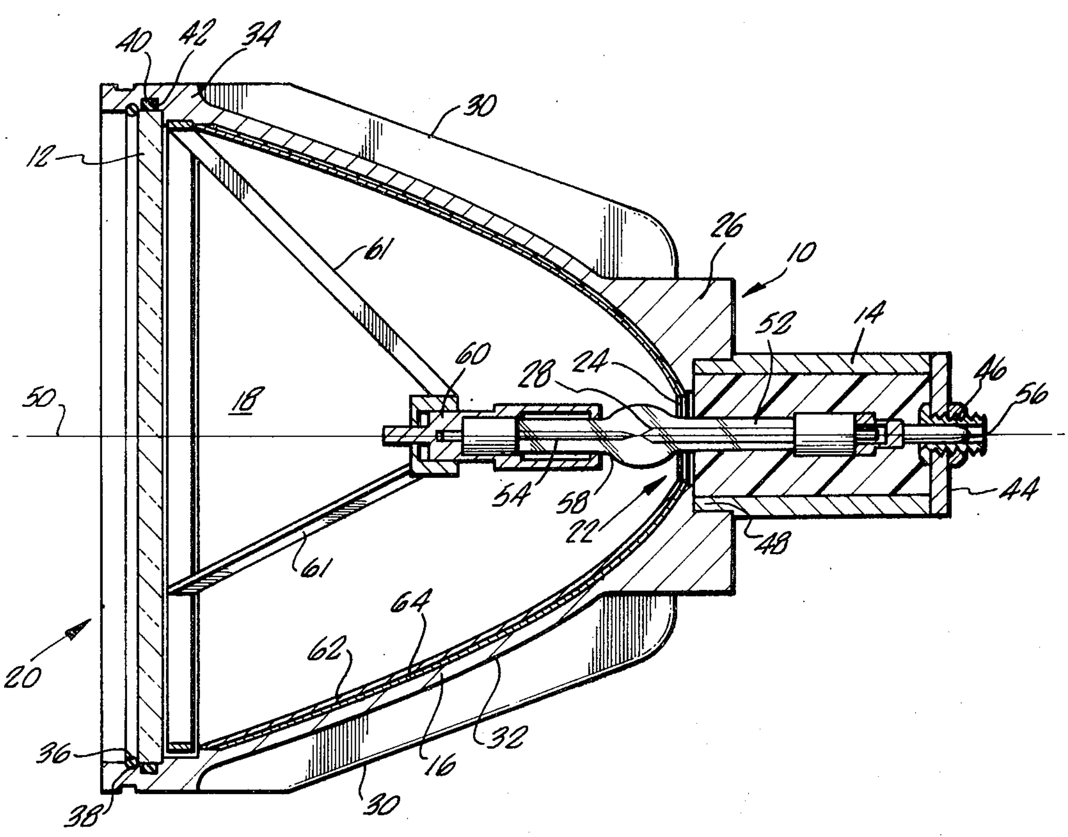
[57] **ABSTRACT**

A sealed, thermally dissipative enclosure for a portable high-intensity illuminating device is disclosed. The enclosure includes a housing shell having an exterior surface equipped with a plurality of outwardly extending fins and which is configured to form a cavity. A reflector having a specular mirror-like surface is situated in the cavity of the housing shell. An aperture, extending through the housing shell and the reflector and generally aligned along the longitudinal axis of the enclosure, is provided to accommodate a light source. A cup-shaped receptacle is included to provide a lamp socket, or other power connection, and to seal the aperture by having a portion thereof secured to the shell housing. The cavity is sealed by a faceplate which is securely retained in the mouth of the cavity. The dissipation of thermal energy is facilitated by positioning the reflector, in the cavity of the housing shell, to obtain optimal transfer of thermal energy from within the enclosure through the housing shell to the surrounding atmosphere.

9 Claims, 4 Drawing Figures



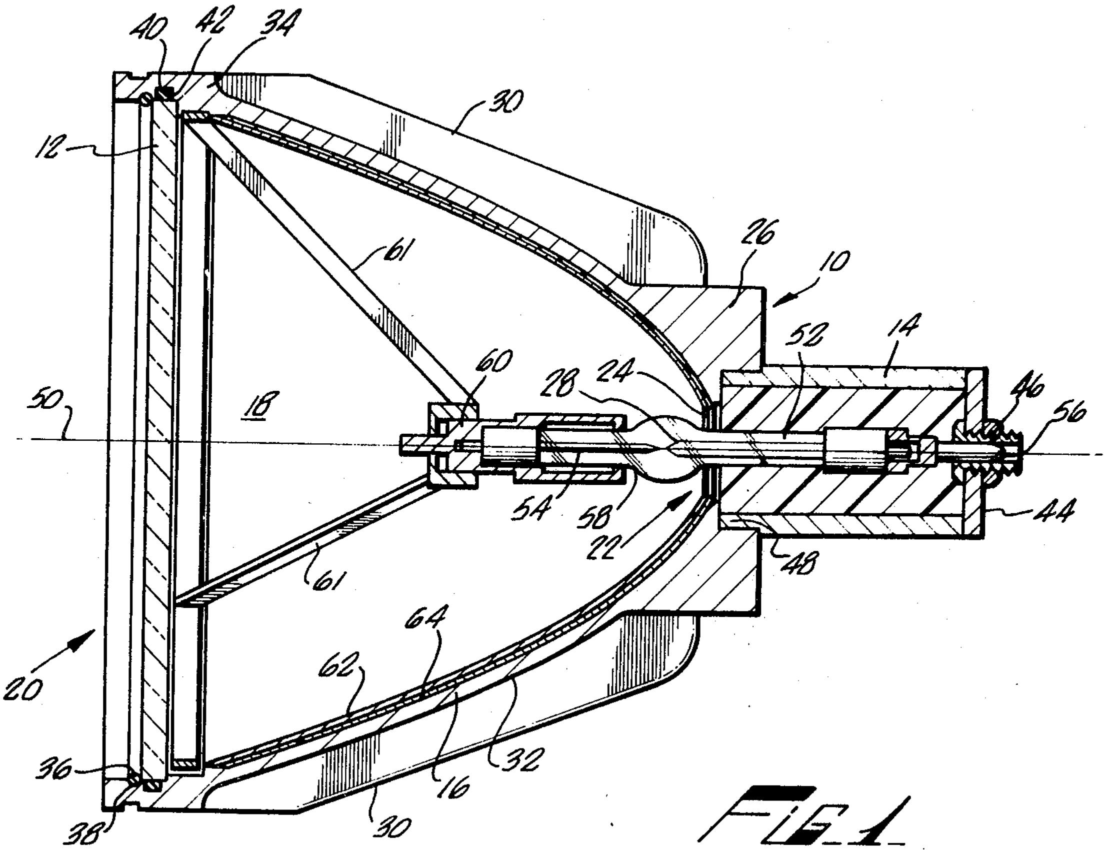


FIG_1

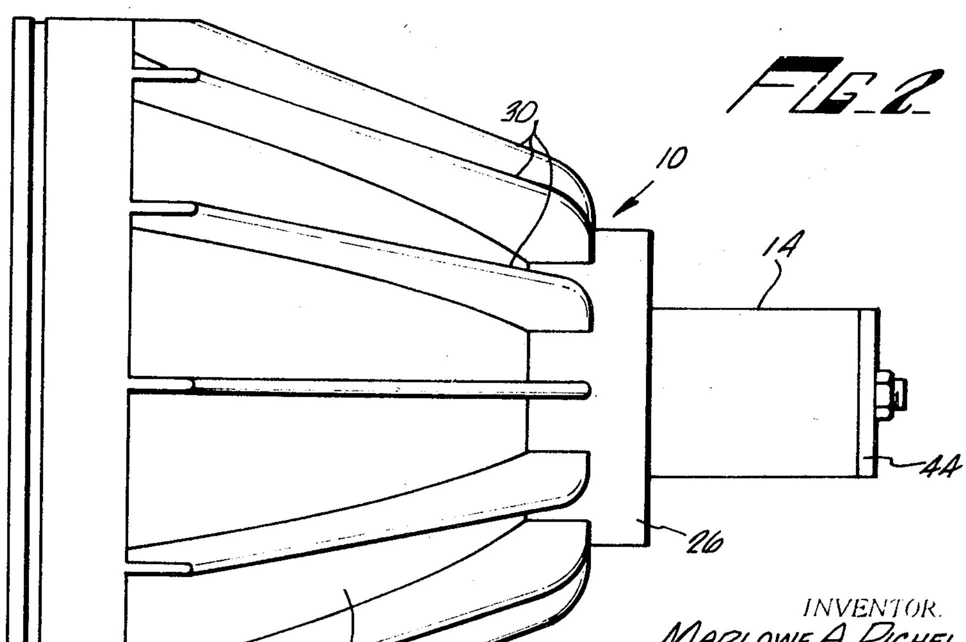


FIG_2

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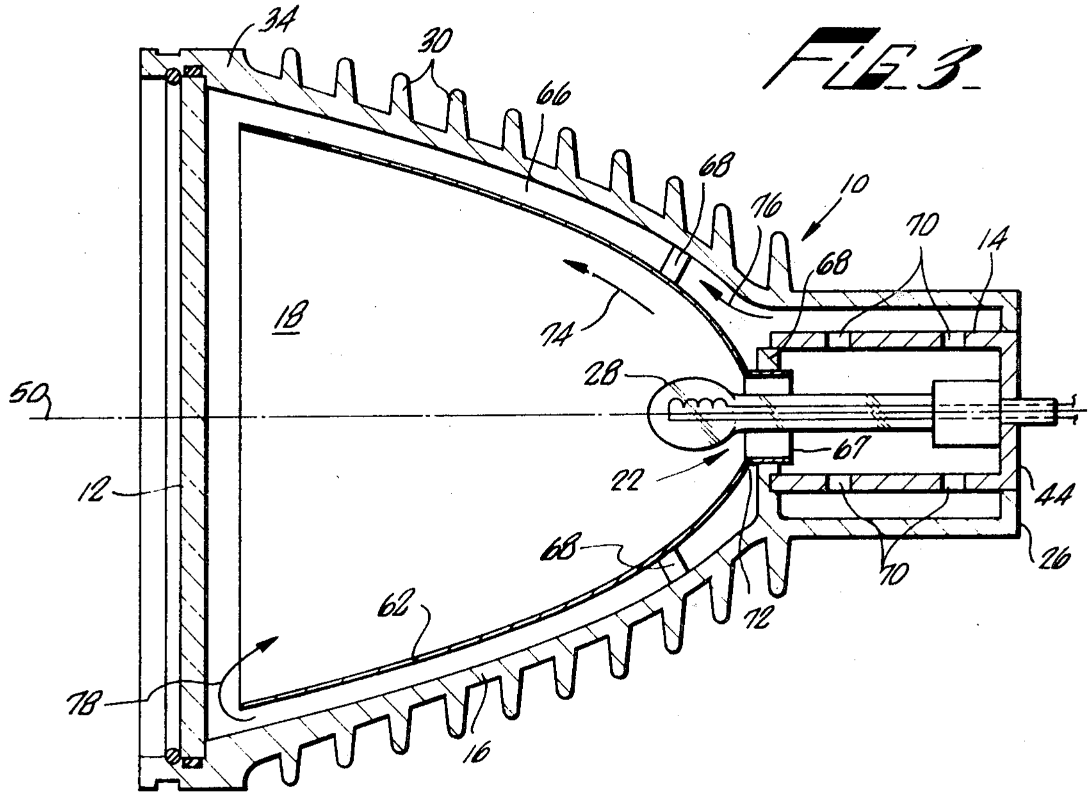
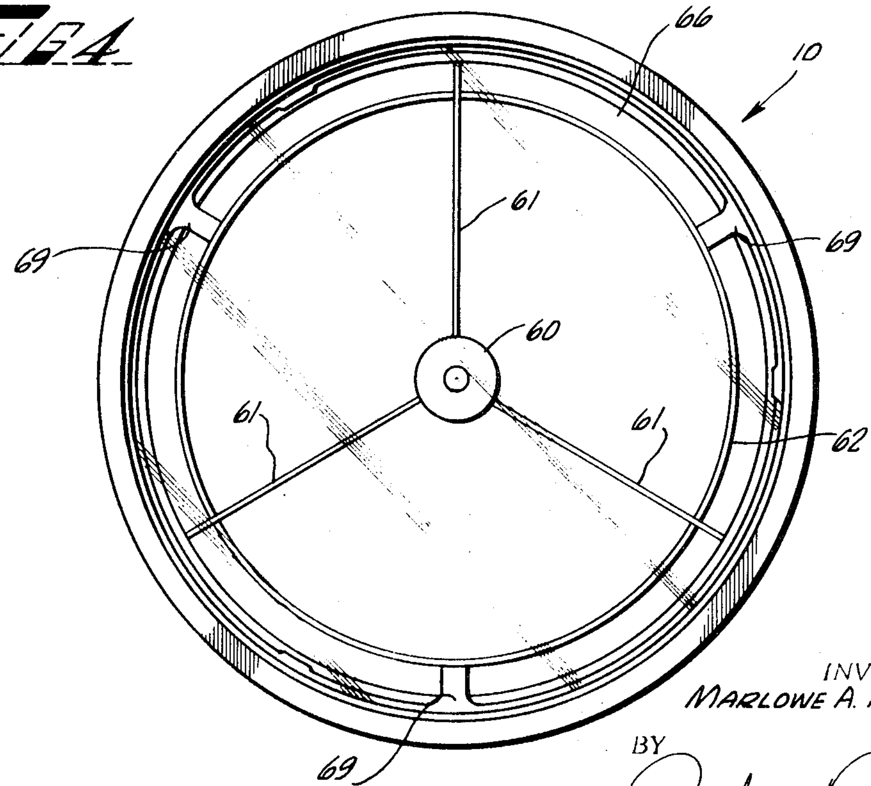


FIG. 3

FIG. 4



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THERMALLY DISSIPATIVE ENCLOSURE FOR PORTABLE HIGH-INTENSITY ILLUMINATING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention generally relates to portable high intensity illuminating devices. More specifically, the present invention concerns a sealed thermally dissipative enclosure for high intensity illuminating devices, which enclosure is characterized by the ability to efficiently dissipate thermal energy generated by high intensity lamps or light sources employed in such devices.

2. Description of the Prior Art

The advent of much improved, miniature high intensity light sources has made possible a new generation of portable high intensity illuminating devices. Generally, such high intensity illuminating devices date back to at least World War II during which they were used in great numbers, for example, as aerial searchlights to enable the visual detection and observation of flying aircraft and other targets. These vintage illuminating devices were, for the most part, relatively large and presented then, as do contemporary devices now, the serious problem of controlling and dissipating the relatively large amount of heat or thermal energy generated by the light source, which problem if left unsolved would ultimately render the illuminating device inoperative.

The simplest method of dissipating the excessive heat or thermal energy is to leave the lamp housing unsealed and/or provide apertures in the housing to facilitate heat transfer to the atmosphere by, for example, forced convection and/or radiation. This method is obviously inapplicable to illuminating devices, such as the present invention, which are sealed for the purpose of providing a weatherproof and immersible unit which is maintained internally free of grit, grime, dirt and the like.

As such, other techniques have been employed with sealed lighting devices, which techniques generally involve the use of additional equipment or structure. One such technique is to employ a direct fan, or the like, for forcing air across and/or through the lighting device or, for sealed systems, some form of internal to external heat exchanger. This technique, while generally sufficiently efficient to accomplish the desired cooling, or dissipation of thermal energy, is cumbersome and contributes to added expense and size when used in connection with portable lighting devices intended to be hand-held, as with the present invention.

Another prior art technique of dissipating undesirable and excessive thermal energy is to employ a refrigerant type of fluid circulating system. Typically, such techniques can be employed to dissipate great amounts of thermal energy due to the extreme efficiency of such heat transfer methods. However, the capabilities of such fluid circulating systems generally far exceed the cooling requirements of portable hand-held lighting devices. Additionally, such fluid cooling systems have the disadvantages of being costly and requiring the use of potentially substantial amounts of auxiliary equipment. Consequently, such fluid cooling systems are considered to be generally unsuitable for use with portable, hand-held lighting devices.

It is therefore the intention of the present invention to provide an enclosure for a sealed, lightweight, hand-held, high intensity lighting device, which enclosure will efficiently and effectively enable excessive heat generated by the light source to be dissipated without having to resort to the cumbersome, costly and complex cooling techniques available in the prior art.

SUMMARY OF THE INVENTION

Briefly described, the present invention involves a sealed thermally dissipative enclosure for a hand-held high intensity lighting device.

More particularly, the subject enclosure includes a housing shell having a multiplicity of outwardly extending fins and which is configured to provide a cavity. A reflector, having a specular mirrorlike surface is situated in the cavity in a manner allowing optimal transfer of thermal energy to the housing shell. A faceplate is employed to seal the mouth of the cavity, while a light source accommodating aperture, extending through the housing shell and the reflector, is sealed by a cuplike receptacle which is provided with an appropriate socket, or other electrical connection, for providing power to the light source. Where an elongate light source having electrodes at opposing ends is employed, a spider-support member is included for the purpose of providing an additional power connector, additional support for the light source, and an additional thermally conductive path to the housing shell.

The many attendant advantages of this invention will be more readily appreciated as the same becomes better understood by reference to the following detailed description which is to be considered in connection with the accompanying drawings wherein like reference symbols designate like parts throughout the figures thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a schematic diagram illustrating a cross-sectional side view of one embodiment of the present invention taken along the longitudinal axis thereof.

FIG. **2** is a schematic diagram illustrating an exterior side of a housing shell incorporated in the present invention.

FIG. **3** is a schematic diagram illustrating a cross-sectional side view of a modified embodiment of the present invention taken along the longitudinal axis thereof.

FIG. **4** is a schematic diagram illustrating a front view of the embodiment shown in FIG. **3** wherein a spider-support member is included to accommodate an elongate light source having electrodes at opposing ends.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1** and **2** of the drawings, a sealed thermally dissipative enclosure, in accordance with the present invention, generally includes a housing shell **10**, a faceplate **12** and a base receptacle **14**.

The housing shell **10**, which may be fabricated from a material such as aluminum, brass, or the like, that is strong and is characterized by good thermal conductivity, includes a closed wall **16** which forms an open-ended cavity **18** having a mouth portion **20** and a base portion **22**. The wall **16** is generally thin to enable thermal energy contained in the cavity **18** to be readily dissipated by being transferred through the wall **16** to the surrounding atmosphere. An aperture **24** is provided at a base end **26** of the housing shell **10** for the purpose of receiving a light source **28**.

A plurality of outwardly extending fins **30** are spacedly situated on the exterior surface **32** of the wall **16** and extend along the longitudinal dimension of the housing shell **10**. These fins **30** serve to effectively increase the exterior surface area of the housing shell **10** and thereby enhance the amount of cooling or heat dissipation that can be obtained by convection and/or radiation from the exterior surface **32** to the surrounding atmosphere. The fins **30** should be relatively thin but yet thick enough to allow thermal energy to be effectively and readily conducted outwardly from the cavity **18** through the wall **16** and out through the fins **30** for the width thereof.

The faceplate **12** is retained at the mouth portion **20** of the cavity **18**, for the purpose of sealing the cavity **18**. A peripheral ledge portion **34**, formed about the interior surface of the wall **16**, near the mouth portion **20**, may be provided to receive the faceplate **12**. An annular retaining ring **36**, which may be seated in a groove **38**, can be used to secure the faceplate against the ledge portion **34**. Preferably the outer diameter of the faceplate **12** is appropriately sized, relative to the inner diameter of the cavity **18**, at the mouth portion **20**, to allow the faceplate **12** to be seated against the ledge portion **34**. An annular sealing ring **40** is situated in a groove **42** which is essentially centered on the edge of the faceplate **12**, when such faceplate 12 is seated against the ledge portion 34. This annular sealing ring 40 is provided to enhance the sealing accomplished by the faceplate 12.

The faceplate 12 should be transparent and be made of a strong heat resistant material such as "Pyrex," or the like. Where, for example, the enclosure is intended to house an infrared source, then the faceplate 12 should be constructed of a material that optimally allows only electromagnetic energy having infrared wavelengths to be projected therethrough. It is to be understood that the faceplate 12 may also serve as a transmissive filter for electromagnetic energy having any other desired wavelengths.

The base receptacle 14 may be generally configured to have a cuplike shape. A closed end 44 is equipped with an appropriate power connection such as a terminal 46. An open end 48 of the receptacle 14 is physically mounted on the base end 26 of the housing shell 10 in any fashion and is preferably aligned along the longitudinal axis 50 of the housing shell 10. In addition to providing a power connection for the light source 28, the receptacle 14 serves to seal the cavity 18 which communicates with the interior of the receptacle 14 through the aperture 24. This sealing provided by the receptacle 14, not only accomplishes the earlier-mentioned objectives of keeping the enclosure internally clean, but additionally, isolates the components of a power source (not shown) from corrosive gases, such as ozone, that may be formed by the intensive radiant energy generated in the cavity 18.

A material characterized by good thermal conductivity and capable of serving as an electrical and radio frequency insulator should be used in fabricating the receptacle 14.

Any high intensity lamp that is readily available in the prior art may be used for the light source 28. For example, an incandescent bulb, as shown in FIG. 3, or an arc lamp, as shown in FIG. 1, may be used.

An exemplary high intensity arc lamp would be a Xenon short arc lamp which is structurally illustrative of arc lamps in general. Such a Xenon short arc lamp generally includes a pair of closely spaced electrodes which are illustrated as being an anode 52 and a cathode 54. The application of a high voltage pulse, usually of radio frequency, via the terminal 56 will produce ionization of the Xenon gas contained within a quartz envelope 58. This ionization permits current flow through the ionized gas between the anode 52 and the cathode 54, which current flow causes an arc between the tips of the anode 52 and the cathode 54. High intensity light is thereby produced. Otherwise stated, the current flow effectively creates a plasma ball of relatively small size and high radiant energy intensity between the tips of the anode 52 and the cathode 54, high intensity light being thereby produced. An electrical path to ground is provided by a spider-support member 60 having a plurality of outspread legs 61 which are appropriately secured at one end to the housing shell 10 and which are mutually secured at the other end.

The radiant energy is directed out of the cavity 18 by a reflector 62 which is provided with a specular, mirrorlike surface. The reflector 62 may be generally constructed of a metal, such as nickel, copper or aluminum, which lends itself to a variety of conventional fabrication techniques. The reflector 62 should also be appropriately coated with a high reflectivity material such that a relatively small percentage of the thermal energy generated by the light source 28 is absorbed. The reflector 62 may of course be fabricated to have any desired shape such as a deep concave configuration which is intended to maximize the reflection of radiant energy out of the cavity 18. In that the fabrication techniques concerning reflectors having a desired degree of geometric accuracy is not intended as a part of the present invention, further discussion relating to the construction of reflectors is not hereinafter pursued.

As may be readily appreciated, a high intensity light source such as a Xenon short arc lamp will generate a significant amount of nonradiated thermal energy along with the desired radiated energy. This thermal energy will of course be substantially derivative from the earlier mentioned plasma ball but will also be contributed to by reason of the anode 52 and cathode 54 becoming extremely hot due to resistance to the relatively high currents required to operate the light source 28.

Although a relatively small percentage of the heat generated by the source is usually absorbed by the reflector 62, temperatures in the neighborhood of 400° F. have been measured at the reflector 62 in the vicinity of the aperture 24. These high temperatures, unless compensated for by the efficient dissipation of thermal energy, will ultimately produce the destruction of the light source 28.

To this end, the reflector 62 may be mounted on the interior surface of the wall 16 of the housing shell 10 to provide an efficient thermally conductive path to the housing shell 10 such that the thermal energy absorbed by the reflector 62 may be readily and efficiently conducted to the cooler exterior surface of the wall 16, including the fins 30, and thereby be dissipated by convection and/or radiation.

In some instances, the reflector 62 may be integrally secured to or formed on the interior surface of the wall 16 to provide the best thermally conductive path. Any of the available techniques presently known in the prior art may be used for this purpose. In other instances, where practical considerations dictate that specific mirror materials or fabrication techniques, such as electroforming, be used, the reflector 62 may be separately fabricated and subsequently mounted on the interior surface of the wall 16. In such instances, it may be difficult to obtain a perfect match between the configuration of the outer surface of the reflector 62 and the interior surface of the wall 16. Should this be the case, vacant pockets, providing a poor thermally conductive path, would be present if the reflector 62 were to be merely mounted against the housing shell 10. As such, a filler material 64, may be sandwiched between the reflector 62 and the wall 16. The thermal conductivity of such a filler material 64 may be enhanced by the inclusion of metal particles therein. It is to be noted that, the filler material 64 may also serve as an adhesive for the purpose of bonding the reflector 62 to the wall 16 if the reflector is not otherwise secured to the wall 16. Additionally, to compensate for differences in the coefficient of thermal expansion between mirror and housing materials, or different amounts of thermal expansion due to temperature differentials between the reflector 62 and the housing shell 10, the filler material 64 should be somewhat flexible. It has been found that silicon rubber or certain epoxy adhesives, having suspended metal particles therein, are suitable filler materials.

Additional thermally conductive paths are provided to the housing shell 10 by the legs 61 of the spider-support member 60, by the receptacle 14, and by the faceplate 12. For example, the legs 61 of the spider-support member 60 serve to provide a direct thermally conductive path to the housing shell 10 for thermal energy conducted to the spider-support member from the cathode 54 and for absorbed thermal energy radiated thereon from the light source 28.

The receptacle 14 similarly serves to provide a thermally conductive path to the housing shell 10 for the thermal energy conducted to the receptacle from the anode 52 through the electrical connector 46, and for the absorbed thermal energy radiated thereon, from the light source 28 and the included heated anode 52.

The faceplate 12 will ordinarily absorb some thermal energy as the radiant energy provided by the light source 28 is projected therethrough. This absorbed thermal energy is conducted to the ordinarily cooler peripheral portions of the faceplate 12 and then conductivity transferred to the yet cooler housing shell 10 where the thermal energy is dissipated.

As earlier mentioned, heat or thermal energy transferred to the housing shell 10 will be dissipated by being conducted outwardly to the cooler exterior surface 32 including the fins 30 which serve to greatly increase the area of the exterior surface contacting the surrounding atmosphere. Dissipation of the thermal energy conducted to the exterior surface of the housing shell **10** is then accomplished by the convention and/or by radiation to the atmosphere.

While the illustrated arrangement of the fins **30** in FIGS. **1** and **2** is generally longitudinal with respect to the housing shell **10**, any other arrangement of the fins **30** may be readily employed. For example, FIG. **3** illustrates the fins **30** as being formed on the exterior surface of the housing shell **10** as a series of outwardly extending, generally concentric rings that are spacedly distributed along the length of the housing shell **10**.

The use of the fin arrangement shown in FIG. **2** has been found to enable a greater amount of cooling by convection due to air being readily permitted to flow upwardly across the exterior surface of the housing shell **10**. This upward airflow of course occurs with the fin arrangement of FIGS. **1** and **2**, but is not as readily accomplished as with the fin arrangement of FIG. **3**.

Referring to FIG. **3** in greater detail, along with FIG. **4**, a modified mounting arrangement for the reflector **62** and the receptacle **14** is illustrated. As shown, both the reflector **62** and the receptacle **14** are spacedly mounted, in an essentially concentric arrangement, within the housing shell **10**, such that a surrounding channel **66** is provided between the wall **16** of the housing shell **10** and the receptacle **14** and reflector **62**.

In this arrangement, the reflector **62** may be formed to have a flange **67** to enable the reflector **62** to be appropriately mechanically secured to the housing shell **10**.

The housing shell **10** may then be formed to have intermittent protrusions **68** which provide points of attachment that allow open passage of gas between the housing shell **10** and the reflector **62**. In the alternative, or in addition, intermittent protrusions **69** (FIG. **4**) may be situated in the neighborhood of the ledge **34** to secure the reflector **62** at the mouth thereof.

The receptacle **14** may have the closed end **44** thereof secured to the base end **26** of the housing shell **10**. Any mechanical or other method may be employed. It is to be noted that the base end **26** of the housing shell **10** has been lengthened, or extended, to encompass the receptacle **14** in the arrangement of FIGS. **3** and **4**.

A plurality of apertures **70** may be provided in the walls of the receptacle **14**. These apertures **70** serve to connect the surrounding channel **66** with the interior of the receptacle **14**.

In the mounting arrangement of FIGS. **3** and **4**, the thermal energy generated by the light source **28**, and confined in the housing shell **10**, is transferred to the housing shell **10** by convection via the surrounding channel **66**, as well as by conduction through the thermally conductive paths provided by the receptacle **14**, the faceplate **12**, and the legs **61** of the spider-support member **60**, when used.

More specifically, let it be assumed that the housing shell **10** of the enclosure is maintained in a horizontal position, i.e., the longitudinal axis **50** is horizontal. Heat generated by the light source **28** will naturally tend to flow upwards in the general direction of the arrows **74** and **76**. In that the housing shell **10** is sealed, the coolest gas situated at the lowest part of the housing shell **10** will consequently be continually forced or drawn upward into the cavity **18** by convective currents, as generally indicated by the arrow **78**. These convective currents will thus tend to carry the heat away from the hottest region of the cavity **18**, near the base portion **22** of the cavity **18**, and then out of the cavity **18** primarily towards the upper portions of the surrounding channel **66** where the thermal energy is absorbed by the wall **16** of the housing shell **10**. The convection currents will also tend to distribute the heat or thermal energy throughout the surrounding channel **66** and thereby expose large portions of the wall **16** to the heat.

As earlier discussed, the thermal energy absorbed by the receptacle **14** and the faceplate **12** will be conducted to the housing shell **10**. The heat absorbed by the walls of the receptacle **14** will also be transferred to the housing shell **10** by convection, and by radiation.

Similarly, the thermal energy absorbed by the reflector **62** will be transferred to the housing shell **10** by convection and by radiation. Additionally, the points of attachment through the protrusions **68** and/or **69** will serve to conduct a portion of the thermal energy absorbed by the reflector **62** to the housing shell **10**.

It is to be noted that although the convective cooling provided by the arrangement of FIG. **3** has been explained in connection with an enclosure that is maintained in a horizontal position, it has been found that the convective cooling is as, if not more, effective when the illuminating device is being waved and turned about in the ordinary course of usage.

It is to be further noted that although an incandescent lamp has been illustrated in the modified arrangement of FIG. **3**, that an elongate arc lamp having a pair of electrodes extending to the opposed ends thereof may be accommodated by the mere employment of a spider-support member **60**. FIG. **4** illustrates a frontal view of such a combination.

From the foregoing discussion, it is now evident that the present invention provides a thermally dissipative enclosure that is usable to form a sealed, hand-held high intensity illuminating device.

While preferred embodiments of the present invention have been described hereinabove, it is intended that all matter contained in the above description and shown in the accompanying drawings be interpreted as illustrative, and not in a limiting sense, and that all modifications, constructions and arrangements which fall within the scope and spirit of the present invention, may be made.

What is claimed is:

1. A thermally dissipative, sealed enclosure for a hand-held illuminating device accommodating an arc lamp having an elongate shape and a pair of longitudinally aligned electrical terminals said enclosure comprising:

a housing shell including a closed wall configured to form a cavity having an open-mouthed portion and a base aperture, and a plurality of outwardly extending fins spacedly formed on said closed wall for effectively increasing the exterior surface area of said housing shell;

a thermally conductive receptacle having a cuplike configuration forming a closed portion and an open portion, said receptacle being secured to said housing shell for sealing said base aperture, said receptacle serving as a radio frequency insulator;

a thermally conductive faceplate secured to said housing shell for sealing said open-mouthed portion;

a thermally conductive reflector having a configuration conforming to said cavity and positioned in said cavity to facilitate the transfer of thermal energy, generated in said cavity by said source of radiant energy, to said housing shell; and

a thermally conductive spider support member including one or more elongate legs having one end thereof secured at the open-mouthed portion of said housing shell and another end thereof mutually secured to support an electrical terminal of said arc lamp.

2. The apparatus defined by claim **1** wherein said wall of said housing shell includes an interior surface, said apparatus further including a filler material sandwiched between said interior surface and said reflector, said filler material being adapted to provide thermal conduction between said reflector and said housing shell.

3. The apparatus defined by claim **2** wherein said filler material includes particles of thermally conductive material.

4. The apparatus defined by claim **3** wherein said outwardly extending fins are elongate and longitudinally extend across the exterior surface of said closed wall of said housing shell.

5. The apparatus defined by claim **3** wherein said outwardly extending fins are a series of protruding rings longitudinally distributed across the length of the exterior surface of said closed wall of said housing shell.

6. The apparatus defined by claim **1** wherein said wall of said housing shell includes an interior surface, and wherein said reflector is mounted a predetermined distance from said interior surface for providing a channel between said interior surface and said reflector.

7. The apparatus defined by claim 6 wherein said receptacle includes a portion thereof that is partially enclosed by said housing shell, said partially enclosed portion of said receptacle including a plurality of apertures.

8. The apparatus defined by claim 7 wherein said outwardly extending fins are elongate and longitudinally extend across the exterior surface of said closed wall of said housing shell.

9. The apparatus defined by claim 7 wherein said outwardly extending fins are a series of protruding rings longitudinally distributed across the length of the exterior surface of said closed wall of said housing shell.

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