Feb. 27, 1968 W. C. MOORE ETAL 3,371,202

MEDICAL HEADLIGHT

Filed July 21, 1966 2 Sheets-Sheet 1

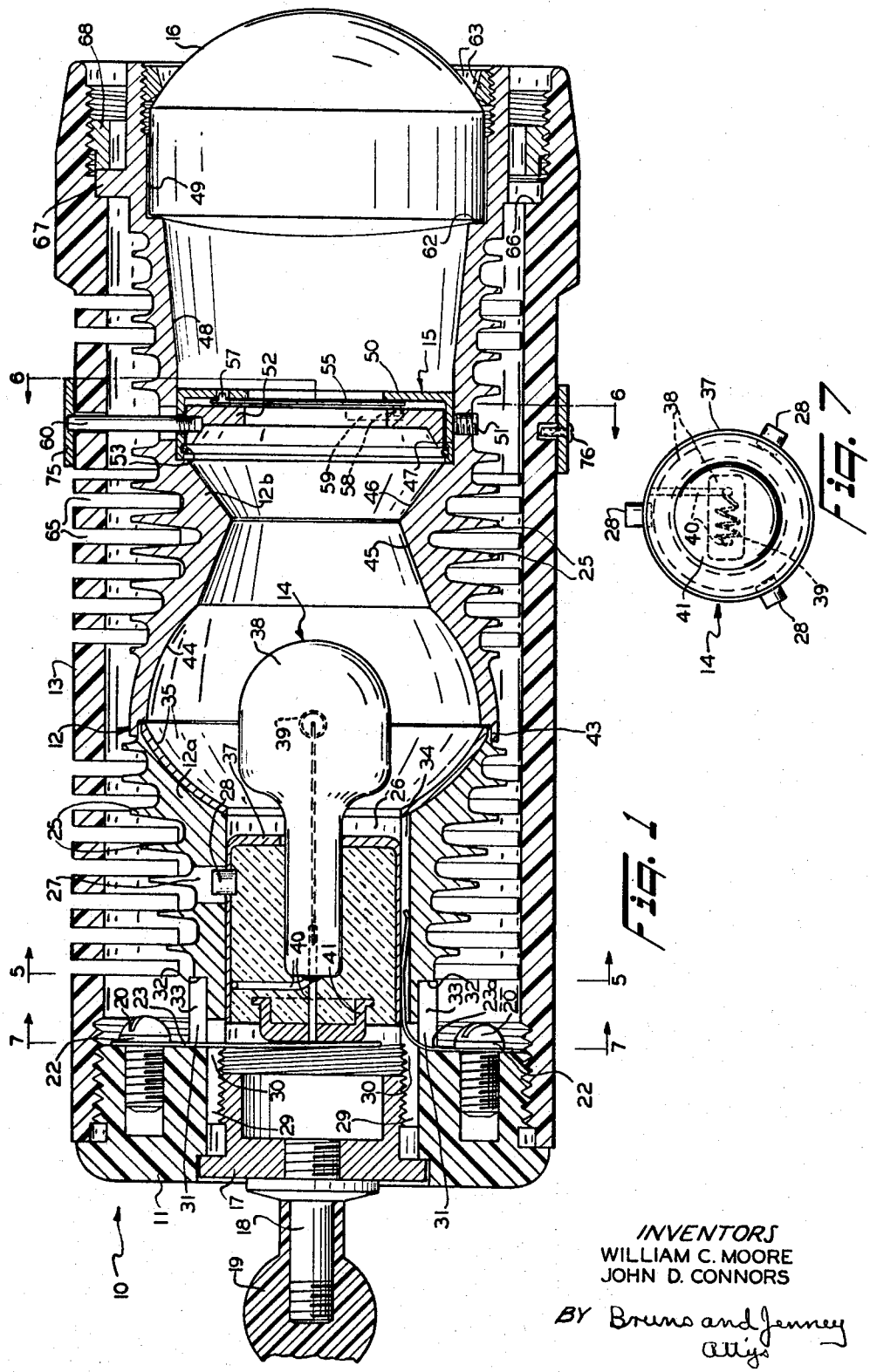

Fig. 1

Fig. 7

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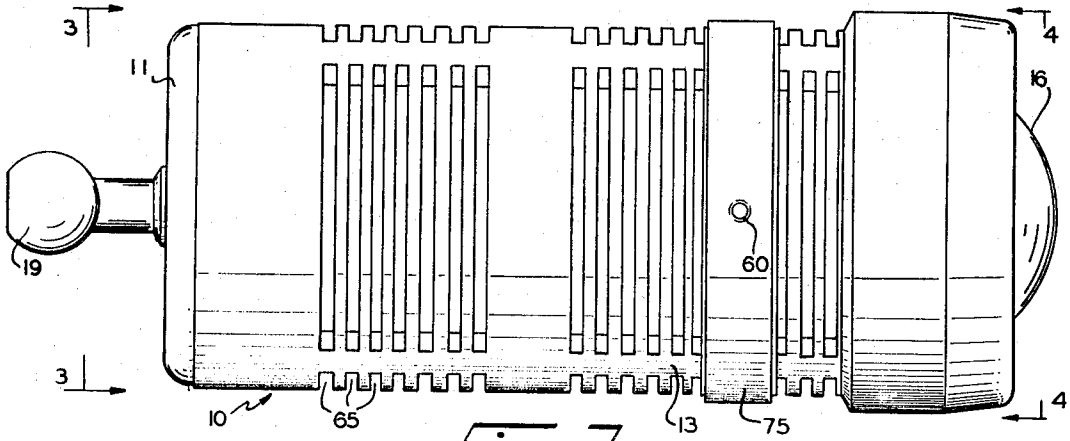

Fig. 2

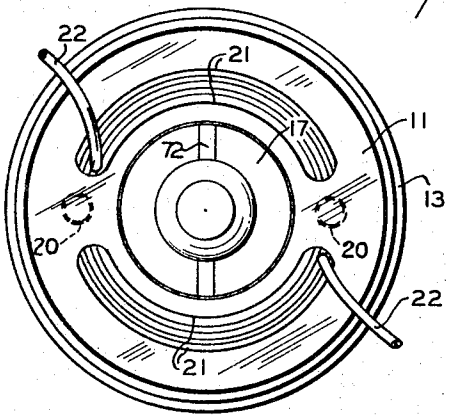

Fig. 3

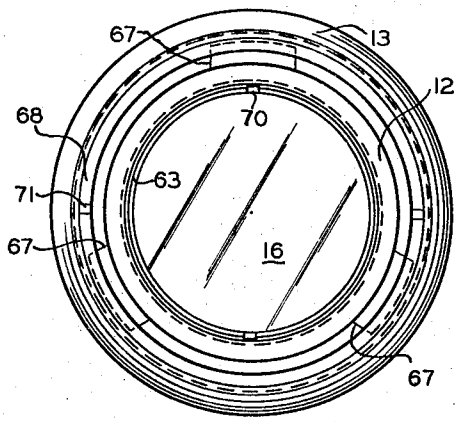

Fig. 4

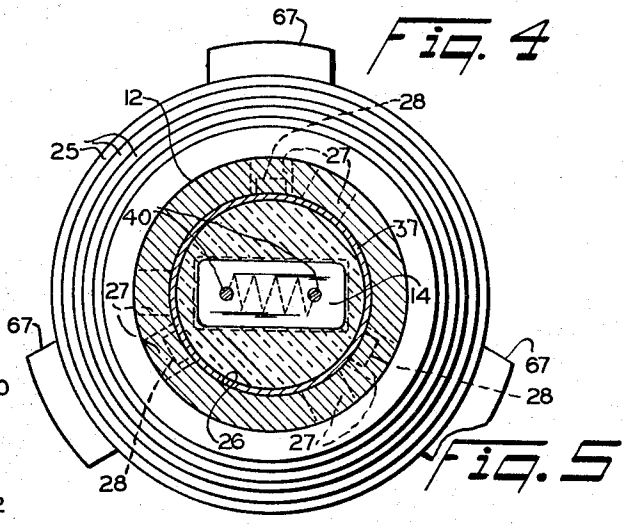

Fig. 5

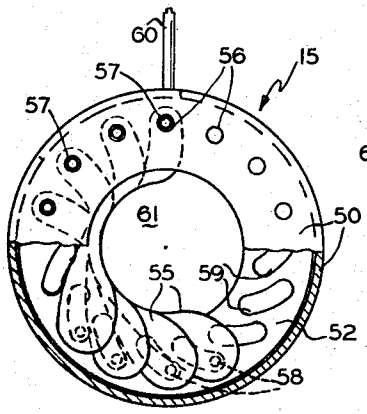

Fig. 6

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MEDICAL HEADLIGHT

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7 Claims. (Cl. 240—41.15)

This invention relates to a medical headlight and more particularly to a headlight providing a manually controllable high brilliance field of illumination of substantially uniform intensity and free of striae.

The principal object of the invention is to provide a headlight adapted to be worn on a headband and having a low-wattage and high intensity light source, a light reflecting and projecting system for uniformly projecting forward the maximum amount of light, and manually operable iris diaphragm means for controlling the size of the illuminated field.

Another important object is to provide such a headlight having a substantially uniformly illuminated field free of striae and areas of contrasting brilliance.

Still another object is to provide such a headlight which is light in weight and from which heat is dissipated rapidly, but which does not become painfully hot to the touch.

A further object is to provide such a headlight furnishing a highly illuminated field with a minimum of projected heat thereat.

Other objects and advantages will become apparent from the following description in conjunction with the accompanying drawings, in which:

FIGURE 1 is an enlarged longitudinal sectional view of a headlight embodying the invention;

FIGURE 2 is a plan view thereof on a reduced scale;

FIGURES 3 and 4 are rear and front elevational views thereof, respectively; and

FIGURES 5, 6, and 7 are sectional views on the lines 5—5, 6—6, and 7—7, respectively, of FIGURE 1.

In the drawings the headlight **10** comprises a base **11**, an inner housing **12**, an outer housing **13**, a light source **14**, and iris diaphragm assembly **15**, and a condensing lens **16**.

The annular base **11** is of an electrically nonconductive material and is provided with a threaded metal plug **17** at its center to which is secured a metal stud **18** which has a plastic covering **19** having a ball-shaped configuration adapted to be adjustably secured in a socket attached to a headband, not shown. Base **11** is provided with a pair of terminal wire screws **20** threaded into the forward side thereof. A pair of curved slots **21** in the base, best seen in FIGURE 3, between the screws, provide openings through which lead wires **22** pass from a transformer or other source of electricity, the wires having their ends secured by the screws **20** to metal contact strips **23** and **23***a*, respectively, as best seen in FIGURE 1.

The inner housing **12** is of aluminum and is made in two parts, a tubular rear section **12***a*, and a hollow forward section **12***b*. Both sections are provided with a plurality of radially projecting annular heat-dissipating fins **25** therearound and the rear section has a central lamp-receiving socket **26**. The socket is provided with three bayonet type slots **27**, best seen in FIGURE 5, for reception of lugs **28** on the lamp **14**.

The rear section **12***a* is provided with an internally threaded annular flange **29** projecting into the central passage of the base **11** and with which plug **17** is threadedly engaged. The annular flange **29** is diametrically slotted at **30** so that the contact strips, **23** and **23***a* can pass therethrough.

Base **11** is also provided with a forwardly projecting annular flange **31** engaged against an appropriate annular

shoulder **32** around the rear end of housing section **12***a*. Flange **31** is also diametrically slotted at **33** for the passage therethrough of contact strips **23** and **23***a*, a longitudinally extending slot **34** being provided in the lamp receiving passage **26** for the reception of the bent over end of strip **23***a*.

The forward end of the housing section **12***a* has an elliptical depression in which an elliptically curved reflector **35** is secured by swaging over the end of housing section **12***a*. Reflector **35** is a brass or other metal made diffusive by finely etching or sand blasting its reflecting surface before it is coated to make it reflective and it is shaped to reflect forward light from the source **14** as hereinafter further described.

Reflector **35** has a central passage therethrough conforming to the outline of passage **26** including the forward ends of the bayonet slots **27**, so that base **37** of lamps **14** may be inserted rearwardly and removably secured in passage **26**.

Lamp **14** is of the quartz-iodine type for maintaining the glass envelope **38** thereof free from tungsten deposits. The usual tungsten filament **39** is supported in the glass envelope **38** on a pair of terminal wires **40** which extend through the end of the narrowed neck of the envelope, one being soldered or welded to the metal base cup **37** and the other being similarly secured to the metal center lamp contact **41** as best seen in FIGURE 7. Lamp base **37** bears the lugs **28** and is filled with a ceramic material which secures the envelope, base, and center contact together in the usual manner.

The configuration of housing section **12***a* is such that filament **39** lies substantially in the plane of the forward end of reflector **35** and at one focal point of the elliptical reflector **35**, and the configuration of the reflector is such that its other focal point is slightly rearward of the diaphragm **15** and on the housing axis.

The forward section **12***b* of the inner housing is provided with an annular flange **43** fitting closely around the forward end of the section **12***a* and the rearward end of section **12***b* is rounded to provide a rearwardly facing interior spherical surface **44** which is polished for reflecting divergent light back on to the elliptical reflector **35**. The center of curvature of surface **44** is substantially at the center of the filament **39** and on the axis of housing **12** so that light emitted from source **14** forward, but nonaxially, is reflected back to be again reflected forward from reflector **35**.

Forward of the reflective surface **44**, housing section **12***b* has a converging frusto-conical interior surface **45** which is also polished to collect diverging rays of light and reflect them substantially axially and forward. Another frusto-conical interior surface **46** forward of the reflective surface **45** diverges forwardly to a cylindrical portion **47** of the passage in which is secured the iris diaphragm assembly **15**. Forward of the diaphragm the passage walls at **48** diverge again to another cylindrical portion **49** in which is secured the lens **16**.

The iris diaphragm assembly **15** comprises a cup shaped outer member **50** secured in the housing passage by setscrew **51**. An annular inner member or plate **52** is rotatably secured within member **50** by a snap ring **53**. Between plate **52** and the centrally apertured forward wall of member **50** are secured a plurality of leaf members **55** in fan-like manner, only one leaf being shown in FIGURE 1.

As best seen in FIGURE 6 the outer member **50** is provided with a plurality of holes **56** disposed in a circle around its central aperture and each hole **56** journals a stud or projection **57** from the forward face at one end of a leaf **55**, only four leaves being shown. At the other end of each leaf a stud or projection **58** extends in the

other direction into one of a plurality of grooves or slots **59** in the forward face of the rotatable plate **52**, as shown in the lower portion of FIGURE 6 where the outer member **50** is shown cut away.

Radially of the inner plate **52** a diaphragm operating lever **60** threaded into the plate projections through appropriate slots in the outer member **50**, inner housing **12**, and outer housing **13**. When lever **60** is turned to the left, as viewed in FIGURE 6, it will be apparent that the size of the central aperture **61** will be constricted and, when turned to the right, will be enlarged.

At the forward end of housing **12** an annular shoulder **62** is provided against which the lens **16** is secured, the forward end of housing **12** being internally threaded and a lens retainer ring **63** threadedly secured therein against the forward face of the lens. Lens **16** is aspheric and designed to condense the light coming through the diaphragm aperture **61** forward of the lens upon the field to be illuminated.

The outer housing **13** is of a molded plastic material having poor heat conduction quality, such as polycarbonate plastic, and is provided with a plurality of circumferentially disposed ventilating slots **65**, as best seen in FIGURE 2. At its rear end housing **13** is threadedly engaged with the base **11**, as clearly shown in FIGURE 1, and at its forward end an internal annular shoulder **66** is provided. Three radially projecting and equiangularly disposed ears **67** extend from the forward end of the inner housing **12**, as best seen in FIGURES 4 and 5, and rest against the shoulder **66**.

Forward of the ears **67** a housing retaining ring **68** is threadedly engaged against the ears in the internally threaded forward end of the outer housing **13**. The retaining ring **68** secures the forward end of housing **12** coaxially within housing **13**, holds the portions **12***a* and **12***b* of the inner housing together, and, together with plug **17**, compresses portion **12***a* against the slotted annular flange **32** at the forward end of the base **11**. Both retainers **63** and **68** and the plug **17** may be diametrically slotted, at **70**, **71**, and **72**, respectively, for appropriate spanner type wrenches or tightening tools, as indicated in FIGURES 3 and 4.

A slip ring **75** encircles the outer housing and the shouldered outer end of the diaphragm operating lever **60** is engaged therewith. One or more pins or screws **76** projecting radially inward from the ring **75** are engaged in appropriate arcuate grooves around the outer housing for securing ring **75** on the housing.

In operation, the headlight **10** is worn on a headband, the ball **19** attached to base **11** being gripped in a socket on the headband, and the light may be directed manually in the desired direction. When the headlight is turned on, by a switch not shown, light is directed forward of lens **16** and the size of the spot or illuminated portion of the field is regulated by turning ring **75** as desired.

Since light from the reflective surface system is focused at a point on the housing axis short of the diaphragm **15**, the light is centered or focused on the aperture **61**, whatever its size and then condensed by lens **16** and projected to the area to be illuminated.

Using a 12-watt lamp **14**, the intensity of the light at the center of the illuminated spot at a distance of 14 inches from lens **16** measures 500 foot-candles, the intensity of the light at portions of the spot away from the center falling off very gradually. At this distance the spot is about 6½ inches diameter when the aperture is enlarged to its maximum and the intensity is about 300 foot-candles near the perimeter. This is about five times the light output of ordinary headlamps of the prior art.

The continuously enclosed passage in the inner housing from source to lens in combination with the elliptical-spherical reflector system **35**, **44** has been found to utilize about 25% more of the light from the source than conventional systems and the conical reflector **45** has been found to add about 7% more to the light effectively utilized by the lens.

Controlling the size of the illuminated field or spot by the iris diaphragm, instead of by more conventional means increasing or decreasing the distance between a lens and the source, has been found to completely eliminate contrasting bright and less bright areas in the spot because the image of the element **39** is never projected through the lens system on to the field. Moreover, principally because of the diffused surface on the elliptical reflector, uniformity of light over the area of the spot is increased and the annular lines or striae usually present with conventional headlights are also eliminated.

A 12-watt light source of the quartz-iodine type, besides maintaining its brightness throughout the life of the lamp due to the washing away by the iodine of the usual tungsten deposits on the glass envelope, has been found to have a useful life of 80 hours or more of continuous use, as against 50 hours for the best of the more conventional lamp systems. Moreover, the continuously enclosed passage in the inner housing **12** from light source to lens allows the low-wattage lamp **14** to heat up and remain at its optimum operating temperature. Instead of cooling the lamp, the fins **25** on the inner housing and the slots **65** in the outer housing provided for cooling the inner housing while allowing lamp **14** to remain at its optimum operating temperature.

Furthermore, the heat dispersion system including the finned metal inner housing and the plastic slotted outer housing has been found ample for cooling the headlamp even though a high brightness lamp is used, and the outer housing does not become so warm to the touch of the wearer as to cause discomfort while adjusting the light.

As will be apparent to those familiar with the art, the invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The embodiment disclosed therefore is to be considered in all respects as illustrative, rather than restrictive, the scope of the invention being indicated by the appended claims.

What is claimed is:

1. A medical headlight adapted to be secured on a headband, comprising: a base of electrically non-conductive material; a hollow inner housing having an elongated, axially extending light passage therethrough, said housing being secured at one end to the base; a condensing lens secured in the passage at the other end of the housing; a light source secured in the passage adjacent the base; an iris-diaphragm assembly secured across the passage between the source and the lens, the assembly having an aperture variable in size disposed coaxially within the passage; the inner housing have a plurality of internal annular reflective surfaces between the base and the diaphragm including a first elliptically curved surface around the source for reflecting light substantially axially forward of the source toward the lens, a second spherically curved surface forward of the source for reflecting light emanating non-axially forward from the source back on to the elliptical surface, and a third frusto-conical surface forward of the spherical surface for reflecting light emanating non-axially forward from the source toward the diaphragm aperture; a tubular outer housing around and spaced from the inner housing, the outer housing being secured at one end to the base and secured at its other end coaxially about the forward end of the inner housing; and means operable from outside the outer housing for manually controlling the size of the diaphragm aperture.

2. The headlight as defined in claim **1** characterized by the elliptical reflective surface being of a light diffusive character.

3. The headlight defined in claim **2** characterized by having the inner housing of heat-conductive material, having heat dispersal fins projecting radially from the inner housing toward the outer housing, and having its outer housing of a material having low heat conducting

characteristics, the outer housing being perforate for dispersal of the heat from the fins.

4. The headlight defined in claim 3 characterized by the light source being of the quartz-iodine type.

5. The headlight as defined in claim 1 characterized by the elliptical reflective surface having a focal point on the axis of the inner housing adjacent the aperture of the iris diaphragm and between the diaphragm and the source.

6. A medical headlight adapted to be adjustably secured on a headband, comprising: an annular base of electrically non-conductive material; a hollow inner housing having an elongated, axially and continuously extending light passage therethrough; means securing said housing at one end co-axially to the base; a condensing lens secured in the passage at the other end of said housing; a high-intensity light source of the quartz-iodine type secured in the passage adjacent the base; electrically conductive means supported by the base for operatively connecting said source with an electrical power supply; an iris diaphragm assembly secured across the passage between the source and the lens and having an aperture variable in size disposed coaxially within the passage; the inner housing having a plurality of internal annular reflective surfaces between the base and the diaphragm including a first elliptically curved diffusive surface around the source for reflecting light from the source axially forward toward the lens upon a small area adjacent the diaphragm aperture between the diaphragm and the source, a second spherically curved surface forward of the source for reflecting light emanating non-axially forward from the source back on to the elliptical surface, and a third frusto-conical surface forward of the spherical surface for reflecting light emanating non-axially forward from the source toward the diaphragm aperture; a tubular outer housing coaxially around and spaced from the inner housing, the outer housing being secured at one end to the base and secured at its other end to the forward end of the inner housing; the inner housing being of metal and having heat dispersing fins projecting toward the outer housing, the outer housing being of plastic and being perforate for the dispersal of heat from the fins; and means extending through slotted apertures in the inner and outer housings

for manually controlling the size of the diaphragm aperture.

7. In a medical headlight having a quartz-iodine light source at one end an outer housing of material having low heat conduction, and a light condensing lens at its other forward end for directing light upon the field to be illuminated; the improvement comprising: an inner housing having a light passage axially therethrough and being secured coaxially at either end to the outer housing, means in the passage for removably securing the source therein, an iris diaphragm coaxially secured in the passage between the source and the lens and having a central aperture variable in size, means extending outward of the outer housing for regulating the aperture size, the inner housing having a plurality of annular inner surfaces substantially continuously connected from around the light source to the lens including an elliptically curved diffused reflective surface around the source for reflecting diffused light therefrom axially forward toward the lens upon a small area adjacent the diaphragm aperture between the diaphragm and the source, a spherically curved reflective surface forward of the source for reflecting light emanating non-axially forward from the source back on the elliptical surface, and a forwardly converging frusto-conical reflective surface forward of the spherical surface for reflecting light emanating non-axially forward from the source toward the diaphragm aperture, and means for cooling the inner housing without cooling the light source, whereby light of substantially uniform intensity across the field is directed forward of the lens.

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