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SURGICAL HEADLIGHT AND LIGHT SOURCE

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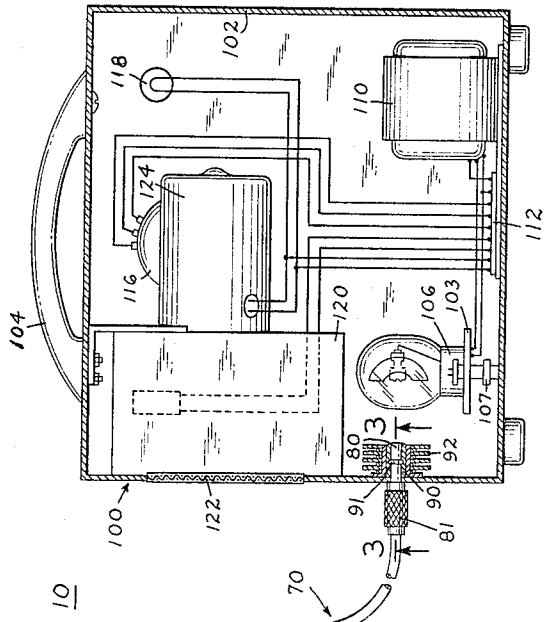


FIG. 1.

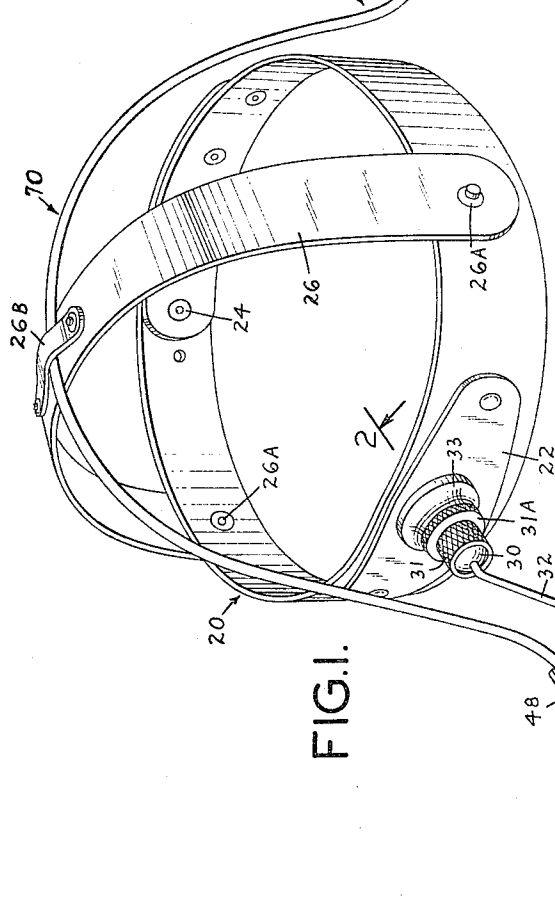


FIG. 3.

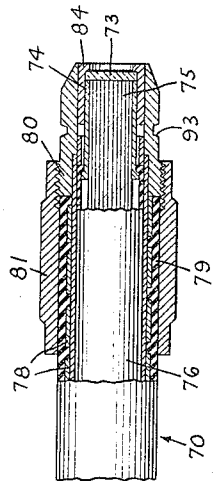
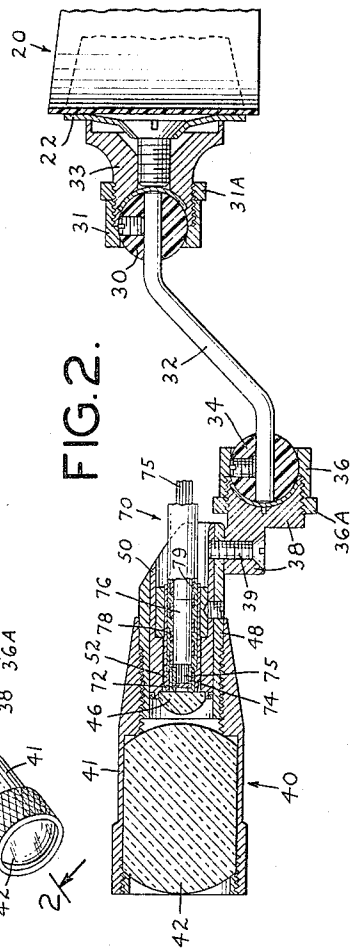


FIG. 2.



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SURGICAL HEADLIGHT AND LIGHT SOURCE

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The present invention relates to an illumination device adapted to be attached to the person of a user. More particularly, this invention relates to an illumination device, adapted, in a preferred embodiment, to be worn on the head of a user, which is especially suitable for use in carrying out procedures that require the highest degree of precision particularly in closely-confined areas.

When a conventional head lamp is utilized as a light source for illumination of a work area, a lamp and lens assembly of relatively large and bulky dimension is required to obtain high intensity illumination of the work area. Apart from its weight, such an arrangement when used to provide high intensity illumination is characterized by the generation of a large quantity of radiant heat which is projected along with the light to the area being illuminated. It is often necessary to limit the intensity of illumination to a lower value than that desired in order to avoid damage to the object under view from excessive heat. For example, in the carrying out of precision jewelry and metal working techniques or in the performance of medical or surgical procedures, the heat sensitivity of the object under view may be such as to result in unsatisfactory illumination for the work required to be carried out.

The present invention overcomes such difficulties, as well as others associated with conventional light sources, especially in illuminating small, confined work areas. In carrying out the present invention, light from a high intensity light source is transmitted by a long, flexible light carrier to a lens system adapted to be worn by or attached to the body of the user. The high intensity light source may be located at any convenient place and may, if desired, be adapted to be carried by or attached to the body of the user. The light carrier, which may be 3 to 6 feet or more in length, ensures that the high light source is remote and isolated from the lens system which serves to direct light onto the work area. A high degree of flexibility and control of the intensity of the light and the area illuminated is provided by ready adjustment of its focus afforded by the construction of the lens system and full control over the degree of energization of the lamp.

The long light carrier provides good thermal insulation between the light source and the lens system. In addition, an effective heat dissipating means, associated with the light source serves to maintain at a safe value the operating temperature of the end of the light carrier presented to the light source.

It is a principal object of the present invention to provide an improved illumination device particularly well suited for the illumination of objects which are sensitive to or adversely affected by the heat associated with conventional lighting devices which is exceedingly simple, compact and adapted to be carried by the user.

It is a further object of the present invention to provide an improved illumination device, particularly well-suited for carrying out medical examinations, surgical procedures, and the like, for directing a cool, high intensity light beam onto a work area in front of the user, which is of exceedingly simple, compact design and adapted to be attached to the body of the user.

It is another object of the present invention to provide an illumination apparatus, adapted to be worn on the head of the person, for directing a high intensity light beam at a viewing area in front of the eyes of the person, wherein the portion of the apparatus carried on the head is of significantly reduced size and weight compared to conventional head-mounted lamps heretofore known.

It is still another object of the present invention to provide an illumination device, adapted to be carried on the head of a user and directable at a point in front thereof, which is especially suitable for close work within small, confined areas.

The foregoing and other objectives, features and advantages of the present invention will be more readily understood upon consideration of the following detailed description of the invention, taken in conjunction with the accompanying drawings:

FIGURE 1 is a partially perspective, partially sectional view of the illustrative embodiment of the present invention;

FIGURE 2 is a fragmentary, sectional view of this illustrative embodiment, the sectional plane passing through the lines 2—2 in FIGURE 1; and

FIGURE 3 is a fragmentary, sectional view of this illustrative embodiment, the sectional plane passing through the line 3—3 in FIGURE 1.

Referring now to FIGURE 1, there is shown therein an illustrative embodiment of an illumination device **10**, according to the present invention. The major elements of the device comprise a lens housing **40**, a flexible light carrier **70**, and a high intensity light source **100**. Light from the source **100** is directed onto one end of an elongated bundle of glass fibers contained within the light carrier **70** and transmitted thereby to the lens system in the housing **40**, where it is then projected onto the work area to be illuminated. The lens housing **40** is supported by an arm member **32** which is attached to a band **20** adapted to be worn about the head of the user.

The band **20** may be of any suitable construction and in the present instance is in the form of a flexible belt which wraps around the head of the wearer and is adjustably secured by one or more tabs **24**. A cross band **26** may be connected adjacent to its opposite ends by means of studs **26A** to opposite sides of band **20**. The cross band **26** is adapted to pass over the head of the wearer and approximately at its top carries a loop member **26B** through which the light carrier **70** passes.

The arm member **32** is connected to the band **20** by means of a ball joint comprising a ball **30**, preferably formed of nylon, affixed to one end of arm **32**. Cooperating with the ball **30** is a retaining ring **31** which has a central opening, the diameter of which is smaller than that of the ball. The retaining ring **31** is in adjustable threaded engagement with a swivel housing **33** to which the ring **31** is locked by means of a threaded bezel ring **31A**. The swivel housing **33** is fixed to a support plate **22** which is in turn riveted to the band **20**.

The arm member **32** extends from the ball joint **30** and is suitably angled to form a support for the lens housing **40**. Further articulation of the arm **32** with the housing **40** is provided by means of a second ball joint comprising a ball **34**, also preferably formed of nylon, affixed to the opposite end of arm **32**. The ball joint **34** is similar to ball joint **30** and comprises retaining ring **36**, bezel ring **36A** and a swivel housing **38**.

The swivel housing **38** is connected to one end of a sleeve **48** forming part of the lens housing **40**. The other end of this sleeve **48** is externally threaded for engagement with an internally threaded cover tube **41**. Coaxially fitted within the sleeve **48** is a tubular lens holder **50** through one end of which the light carrier **70** extends. Supported at the other end of this lens holder is a hemispheric diffuser lens **46** which is positioned adjacent to an end of the light carrier **70** in a manner which will hereinafter be more fully described.

An objective lens **42** is mounted inside the cover tube **41** and held in place by means of a bezel ring. The objective lens **42**, together with the hemispheric diffuser lens **46**, provides a projection system for light emerging from the end of the light carrier **70**. The cover tube **41** is in threaded engagement with the sleeve **48** whereby the objective lens may be displaced axially relative to the hemisphere lens **46**, thus providing a variable focus for the lens system.

As shown in FIGURES 2 and 3, the light carrier **70**, which serves to transmit light from the high intensity light source **100** to the lens housing **40** carried on the head of the wearer, has a central, flexible bundle **75** comprising a large number of extremely small diameter light-conducting glass-coated glass fibers tightly packed together at the opposite ends of the bundle to form cylindrical arrays approximately ¼ inch in diameter. The fiber glass bundle **75** may be six feet or more in length and may be manufactured in accordance with the method described in a copending application of Lawrence E. Curtiss, Serial No. 76,868, filed December 19, 1960, now Patent No. 3,236,710.

The glass fibers **75** of the bundle are enclosed in a flexible sheath **76** formed of latex or other suitable material. Each of the opposite ends of the sheath **76** is sealed to a sleeve **74** carrying planar lenses **72, 73**, respectively, which abuts against one of the polished end faces of the bundle. A spirally-wound spring **78**, preferably formed of stainless steel, extends along the bundle to protect the same without impairing its flexibility and the entire assembly, except for its ends, is covered by a protective flexible casing **79** formed of suitable material such as a plastic or the like.

As has been pointed out, one end of the light carrier **70** extends into the lens housing **40** and, as most clearly shown in FIGURE 2, a bushing **52** within the lens holder **50** serves to anchor the end of the carrier **70** against the flat surface of the lens **46**, whereby the end face of the bundle **75** is positioned in the focal plane of the lens system which also includes the objective lens **42**.

For removably connecting it to the light source **100**, the light carrier **70** is fitted with a plug-in connector **80** for insertion into a receptacle or jack **90** mounted in the side wall of the light source housing **102**. The end of the light carrier **70** carrying the planar lens **73** is positioned in the connector **80** and is anchored in place by means of its engagement with sleeve **81** which in turn is in threaded engagement with the connector **80**. The exterior surface of the connector **80** makes good surface-to-surface contact with the interior surface of the tubular jack **90** and has an annular recess **93** for clamping engagement with an annular spring **91** carried by the jack.

When, as in the present instance, the light supply **100** is of compact, light construction suitable for use as a portable unit, the housing **102** is conveniently provided with a handle **104**. A lamp **106**, capable of providing an intense beam of light, is mounted in a socket supported on a platform **103** in the housing **102**. A lamp suitable for providing a sufficiently intense light is one manufactured by Sylvania Electric Products, Inc., under the designation ASA–DLG 150 T14 TER/LV. The light from the lamp is brought to a sharp focus at a point located a short distance in front of the lamp bulb. Adjustable means, of which only the adjusting screw **107** is shown in FIGURE 1, are provided so that the platform **103** upon which the lamp and its socket are mounted may be shifted horizontally and vertically relative to the end face of the light carrier **70**. Thus, precise adjustment of the position of the lamp **102** is provided to bring the focal point of the lamp into register upon the end face of the light carrier **70**.

Heat generated by the lamp **106** is dissipated by means of a blower **120** juxtaposed to a screened opening **122** and driven by motor **124**. A radiator assembly, made up of a plurality of annular fins **92** in good thermal contact

through the jack **90** with the connector **80** and the end of the glass fiber bundle, prevents damage to the latter which would otherwise result from melting of the glass of the fibers from the intense heat present at the focal point of the lamp.

An on-off switch (not shown) as well as a pilot lamp **118** are provided to facilitate control of the unit. Advantageously, a rheostat **116** is utilized in conjunction with the transformer **110** required to operate the lamp **106** from a 120 volt power line. The rheostat **116** is operated by means of a suitable control knob to provide desired variations in the level of energization of the lamp **106**.

In operation, the band **20** is worn on the head of the user with the lens housing **40** projecting forwardly and above the eyes. With the connector **80** plugged into the light supply **100** and the switch turned on, the desired degree of light intensity can be obtained from the objective lens **102** by adjusting the control knob of the rheostat **116**. The area illuminated is readily controlled, both by shifting the position of the lens housing **40** relative to the control arm **32** about the ball joint **34** and by shifting the arm about the ball joint **30** relative to the band **20**. Thus, a wide range of vertical and lateral articulation is provided which facilitates illumination and viewing of areas both above and below the viewer as well as to the right or left. Also, adjustment of the focus of the lens system may be readily controlled by rotating the cover tube **41**. Rotation of the cover tube **41**, that is, adjustment of the focus of the lens system, serves to vary the diameter of the illuminated area. Thus, by these adjustments a wide range of both light intensity and light distribution are readily and rapidly available.

The light leaving the objective lens **42** is very cool compared to that available at the lamp **106** and yet provides a level of illumination of up to about 6000 foot candles or more on a plane about five inches from the lens **42**. Adjustment of the focus of the present embodiment permits variation of the diameter of the illuminated area from about 1.5 to 5 inches at a distance of about five inches from the objective lens **42**. Thus, a level of illumination far greater that that available hitherto is provided by the illuminating device of the present invention which is especially well suited for use as a headlight by doctors or surgeons.

In addition to providing a cool, readily controllable light, the illuminating device provided in accordance with the present invention is also exceedingly light and compact so that it may be worn by the user with a minimum of fatigue or interference with the work being carried out.

The terms and expressions which have been employed here are used as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding equivalents of the features shown and described, or portions thereof, it being recognized that various modifications are possible within the scope of the invention claimed:

What is claimed is:

1. A headlight for use in carrying out surgical procedures, comprising means for attachment to the body of the user including a headband adapted for encircling the head of the user, an elongated arm member, first adjustable ball and socket joint means connecting one end of said arm member to said headband, connected to and extending forwardly from said headband, a lens housing, second adjustable ball and socket joint means connecting said housing to the other end of said arm member, an elongated light-conducting flexible bundle of a large number of extremely fine glass-coated glass fibers having one end thereof extending in and connected to said housing, a high intensity light source having a sharply focused light beam, means removably receiving and anchoring the other end of said light-conducting bundle substantially at the focus of said light beam, cooling means including an array of radiator fins in good thermally con-

ductive relation with said other end of said light-conducting bundle, a cross band connected adjacent to the opposite ends thereof to the opposite sides of said headband, means connecting said light-conducting bundle to said cross band, and lens means mounted in said housing for directing and focusing light from said one end of said light-conducting bundle onto an area to be illuminated.

2. A headlight for use in carrying out surgical procedures, comprising means for attachment to the head of a user including an adjustable flexible band, an elongated arm member connected to and extending forwardly from said band, a lens housing, adjustable ball and socket joint means connecting the opposite ends of said arm member to said housing and to said band, an elongated light-conducting flexible bundle of a large number of extremely fine glass-coated glass fibers having one end thereof extending in and connected to said housing, a high intensity light source having a sharply focused light beam and means removably receiving and anchoring the other end of said light-conducting bundle substantially at the focus of said light beam, cooling means including an array of radiator fins in good thermally conducting relation with said other end of said light-conducting bundle, lens means mounted in said housing, and means for focusing light from said one end of said light-conducting bundle onto an area to be illuminated and for adjusting the size of the illuminated area in a plane a predetermined distance from said housing and for adjusting the intensity of the light incident thereon.

3. Apparatus as set forth in claim 2 comprising a power supply control means including a rheostat for selectively adjusting the intensity of said light beam, said cooling means including blower means for dissipating heat from said fins and said light source, and means for adjusting the position of said light beam relative to said other end of said light-conducting bundle.

4. A headlight for use in carrying out surgical procedures, comprising an adjustable flexible band, a cross band connected adjacent opposite ends thereof to the opposite sides of said flexible band and adopted to pass over the top of the head of the user, a tubular lens holder and a diffuser lens carried thereby, a sleeve enclosing said lens holder, a cover tube and an objective lens mounted therein, said cover tube being rotatably mounted on said sleeve for displacing said objective lens toward and away from said diffuser lens, an elongated arm member, adjustable ball and socket joint means connecting the opposite ends of said arm member to said sleeve and to said flexible band, an elongated light-conducting flexible bundle with a large number of extremely fine glass-coated glass fibers having one end thereof extending in and connected to said lens holder with said one end of said light-conducting flexible bundle juxtaposed to said diffuser lens, means on said cross band for engaging said light-conducting flexible bundle, a high intensity light source including means for forming a sharply focused light beam, means removably receiving and anchoring the other end of said light-conducting bundle substantially at the focus of said light beam, cooling means including an array of radiator fins in good thermally conducting relation with said other end of said light-conducting bundle, power supply control means including a rheostat for selectively adjusting the intensity of said light beam, said cooling means including blower means for dissipating heat from said fins and said light source, and means for justing the position of said light beam relative to said other end of said light-conducting bundle.

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