United States Patent

[11] 3,626,170

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[21] Appl. No. 768,703
[22] Filed Oct. 18, 1968
[45] Patented Dec. 7, 1971
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[54] **DENTAL OR SURGICAL OPERATING LIGHT**
7 Claims, 4 Drawing Figs.

[52] U.S. Cl. 240/1.4, 240/41.15
[51] Int. Cl. F21v 7/00
[50] Field of Search 240/1, 1.4, 4.2, 41.15

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ABSTRACT: An improved operating light which provides both a general horizontally oriented light pattern of limited vertical and horizontal dimensions for generally illuminating a desired region and an intense but cool source of localized illumination which can be pinpointed in a specified area such as the oral cavity of a patient. The localized illumination is achieved by providing a convex lens in the main reflector of the light, which lens focuses light through a right angle prism onto one end of a fiber-optic bundle, which then transmits the light to the area wherein spot illumination is desired.

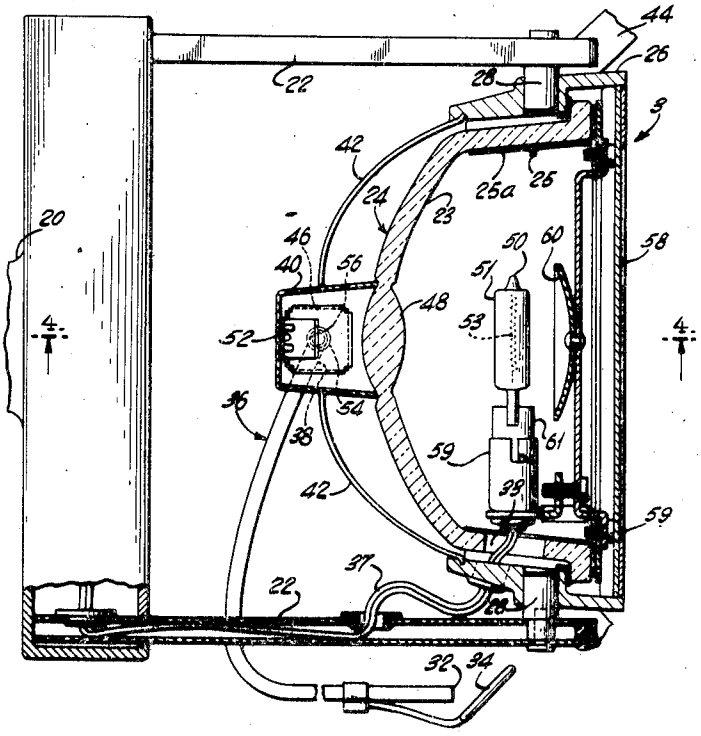


Fig. 1.

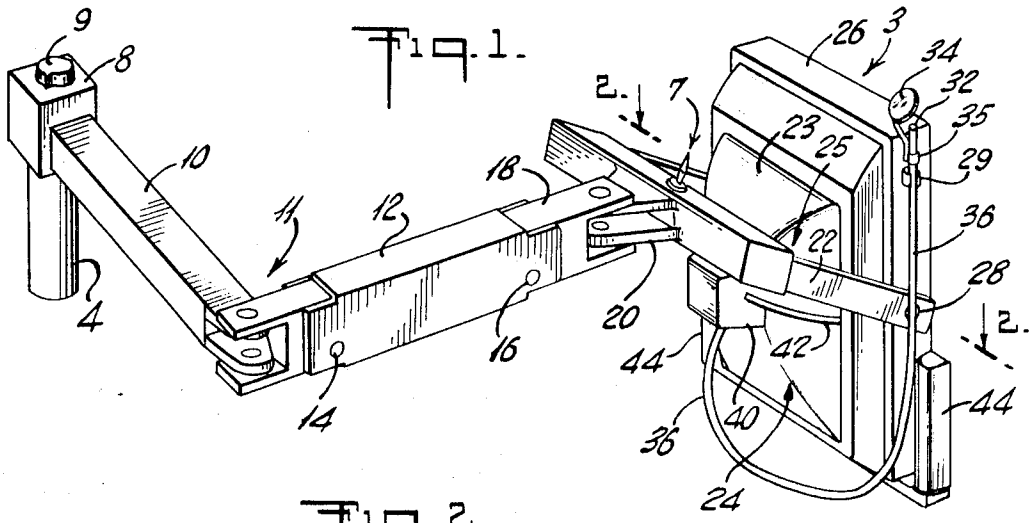
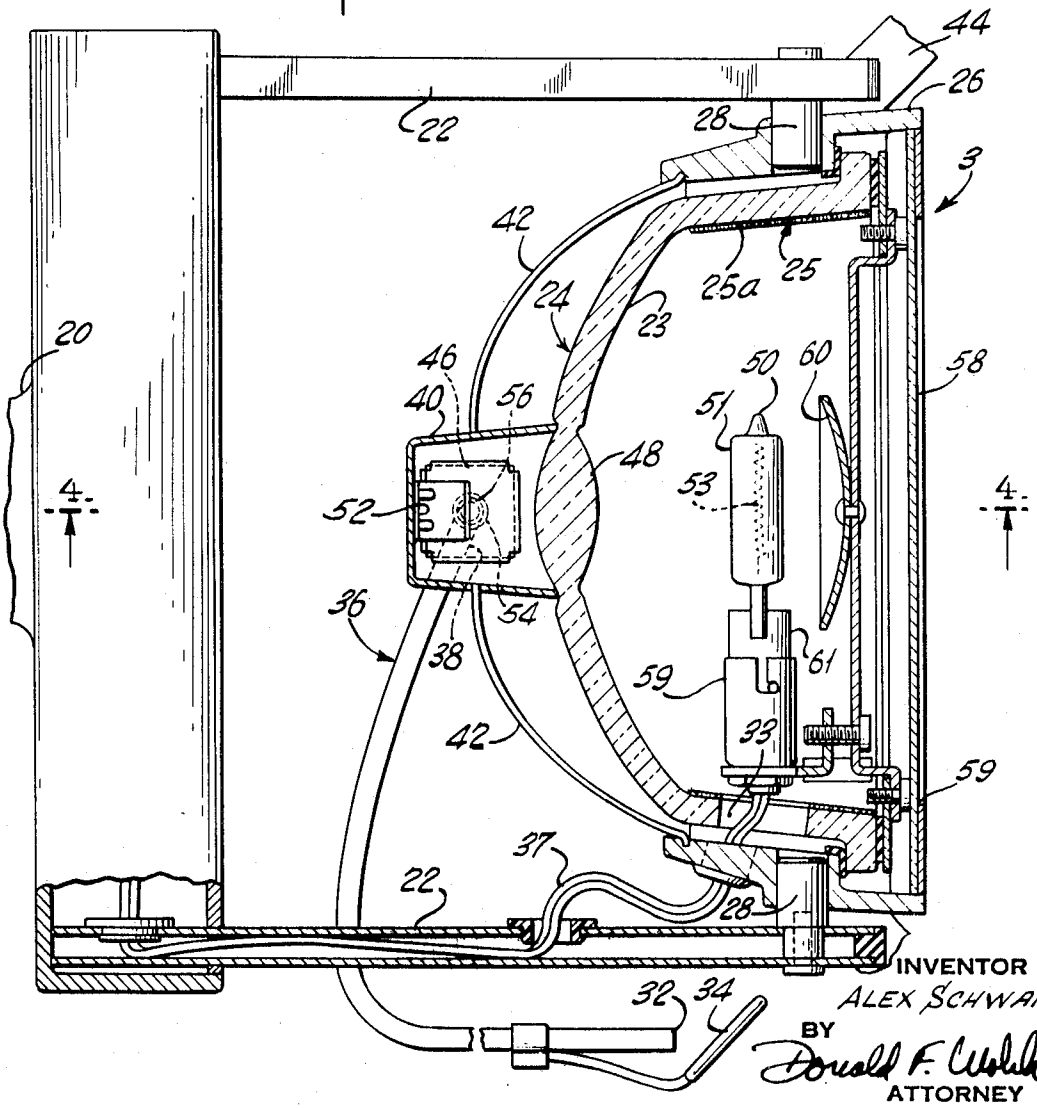


Fig. 2.



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Fig. 3.

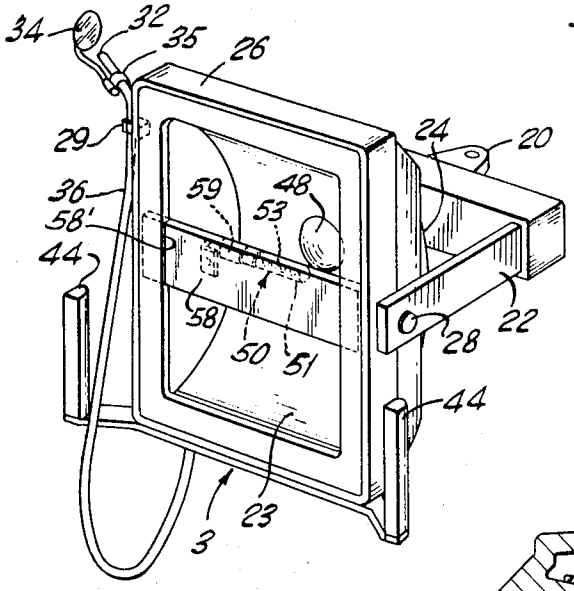
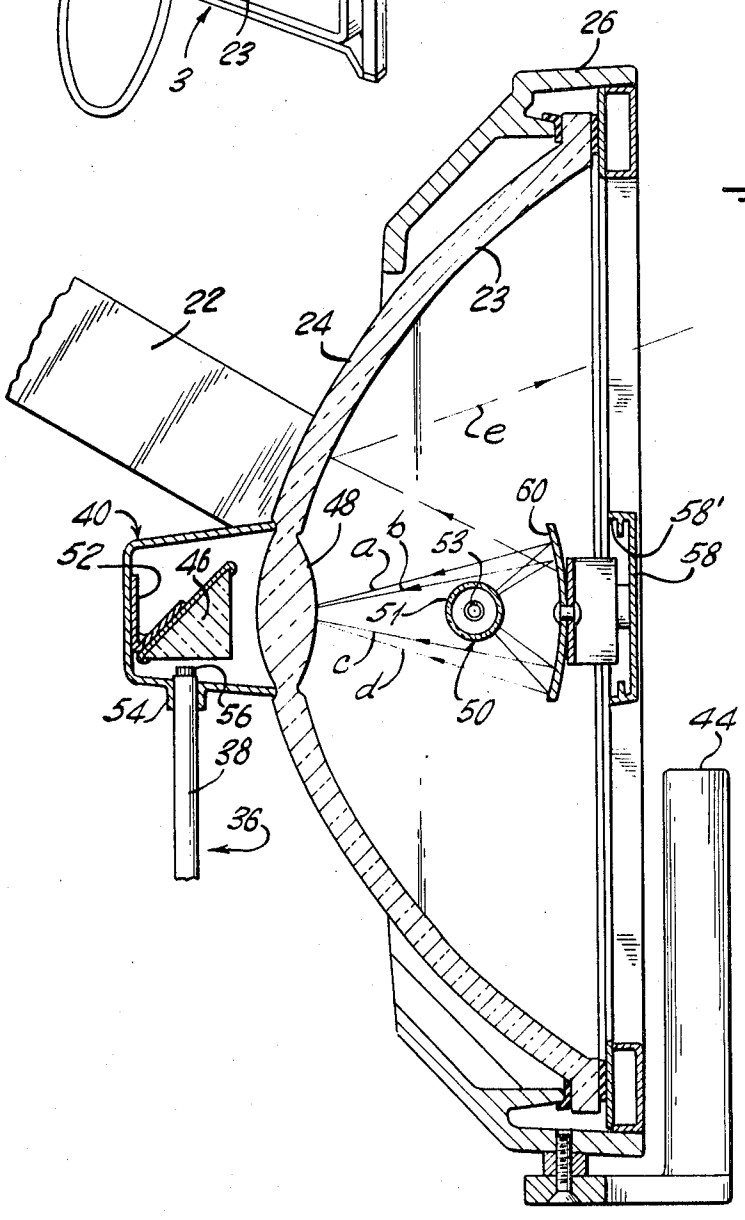


Fig. 4.



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DENTAL OR SURGICAL OPERATING LIGHT

BACKGROUND OF THE INVENTION

This invention relates generally to an improved lighting source. More particularly, it relates to a lighting device for dental and surgical procedures where it is desired to have a general beam illumination of a given area and also to have a spot source of illumination in a small area such as the oral cavity of a person undergoing dental or surgical procedures.

In the past when both of the above type of illumination were desired, it was necessary to have a more or less standard operating light and a separate unit to provide local high-intensity spot illumination. These local spot illuminators have normally employed a separate fan cooled light source suitably packaged in a light tight container. The light generated may then be focused onto an outlet port, which port is in communication with a noncoherent optic bundle consisting of glass or plastic fibers and wrapped with a suitable sheathing. These external light sources normally cost several hundred dollars and, of course, require additional space in the region where the patient is located.

In contrast to the lighting sources heretofore available, the operating light of the instant invention provides not only a general beam of reflected light having a desired pattern which falls onto a generally designated area, but also provides a "-spot" source of light for illuminating a specific localized area.

SUMMARY OF THE INVENTION

The lighting device of the present invention produces a general beam of light having a horizontally oriented light pattern wherein the vertical dimension of the beam is more limited than the horizontal dimension. This is a desirable feature in the dental lamp field since it then becomes possible to provide a beam of light for illuminating the general area focuses it the patient's mouth while at the same time avoiding the shining of the light from the lamp into his eyes. This desirable result is achieved by the utilization of a vertically oriented reflector of particular construction behind a frontally shielded horizontally oriented light source with the light source and reflector disposed in such a manner that the device produces a beam of reflected light having the desired geometry discussed above. Since this desired pattern is *spread over a comparatively larger area* (in the horizontal direction), movement by the attending doctor or dentist in the vicinity of the lamp may be tolerated without blocking off the general illumination on the patient.

As an important feature of the instant invention, means are also provided for supplying an intense, yet cool, localized beam of light, which beam may be directed to a particular location independent of the location of the general beam described above.

These means comprise in combination a noncoherent flexible fiber-optic bundle which uses as its light source the frontally shielded horizontally oriented light source which provides the lamp's general beam. In a preferred embodiment a converging lens of predetermined characteristics is fitted into the vertically oriented reflector of the lamp, which lens gathers the light falling upon it and focuses it through a right angle prism onto one end of the fiber-optic bundle. This end of the optic bundle is housed within a "lighttight" enclosure positioned on the back of the vertically oriented reflector.

If desired, a filter may be interposed between the converging lens and the end of the optic bundle to remove those wavelengths which produce heat while allowing the visible wavelengths to pass through unhindered. It will be appreciated, however, that the converging lens itself may be provided with a suitable reflective coating to remove unwanted wavelengths, thus avoiding the use of a separate filter. A sufficient length of fiber-optic bundle is provided so that its distal end can reach those areas where spot illumination is desired. In the immediate proximity of the distal end, means are provided for attaching various instruments such as dental mirrors and the like. Thus, by use of the instant device, a dentist, for example, can direct a localized high intensity beam of light onto a small area within the oral cavity of the patient while at the same time proceeding with various dental operations.

It is, therefore, an object of the present invention to provide a novel and improved lighting device which projects a general beam over a comparatively large area while at the same time being capable of projecting a localized high-intensity beam over a comparatively smaller area.

It is another object of the instant invention to provide a new and improved lighting device for use in the dental field for illuminating the general area of a patient's mouth while providing means for spotlighting a particular area, e.g. within the patient's oral cavity with a high intensity, yet cool, localized beam.

These and other objects as well as a fuller understanding of the instant invention will be made more apparent by the following detailed description taken in conjunction with the accompanying drawings.

IN THE DRAWINGS

FIG. 1 is an isometric view of the improved lighting device constructed in accordance with the instant invention.

FIG. 2 is an enlarged plan sectional view of the head of the instant device taken along the line 2—2 in FIG. 1.

FIG. 3 is a frontal perspective view of the lamp head of the instant device.

FIG. 4 is a cross-sectional view of the lamp head of the instant device taken along the line 4—4 of FIG. 2.

Referring to the figures in detail and specifically to FIG. 1, reference numeral 4 denotes an upright support post which may be an extension of a standard dental unit. Housing 8, which contains a solid-state power control (not shown) is pivotally mounted on upright 4. The voltage output of the power control (which may be of the silicon controlled rectifier type) is conveniently controlled by means of potentiometer 9, which also may serve to turn the lamp on and off. An articulated arm indicated generally at 11 has its innermost portion 10 connected to the housing 8. Arm portions 12 and 18 complete the articulated arm 11. The lighting head of the instant device indicated generally at 3 is attached to the distal end of articulated arm 11 by means of a yoked member 22. As will be readily apparent, head 3 may be pivoted vertically or horizontally for adjusting its position to beam light emanating therefrom to any desired location. It will be understood that the mounting arrangement depicted in FIG. 1 is exemplary only, as other mounting systems may be employed to equal advantage. In this vein, head 3 may also be pivotally suspended from a ceiling or wall mounted fixture.

As previously indicated, head 3 is supported by yoke member 22 and in this regard pivot pins 28 extend inwardly from yoke 22 to engage a frame member 26 of the head 3. The main reflector of the lamp, indicated generally by reference numeral 24, is positioned within the frame 26. The reflector 24 comprises a coated member which in a preferred embodiment is formed from a single piece of glass and is positioned in a vertically oriented manner. The geometry of the reflector, which will be discussed in greater detail hereinafter, is such that it possesses both longitudinal and transverse curvatures. The coating used on reflector 24 and which is applied to its concave surface comprises a plurality of coats which form a so-called "cold-mirror" reflecting surface. The "cold-mirror" surface is of the type including plural layers of "dichromic" vacuum deposited film which gives the mirrored surface the property of reflecting visible light just as a silvered surface while at the same time allowing it to transmit infrared radiation through the reflector to the rear without absorption. This property allows a "cool" beam of light to be reflected from the "cold-mirror" surface. The rear surface of the reflector (i.e. the convex side) may be stippled to give soft diffusions of light to the rear. Thus, no light would be reflected off adjacent walls.

Reflector 24 is provided with a rear reflective surface 23, which has a shape which is a portion of an elliptic paraboloid such that a vertical plane perpendicular to and bisecting the transverse center line of reflector 24 will intersect the rear reflective surface 23 along a vertically oriented curved line substantially conforming to a portion of an ellipse. Surface 23 is further characterized in that a horizontal plane bisecting and perpendicular to the longitudinal center line of the reflector 24 will intersect the rear reflective surface 23 along a horizontally oriented curved line having a plurality of curved segments forming a continuous curved line. This curved line has a central region with a greater radius of curvature than the radius of curvature of the curved segments on opposite sides thereof.

The rear surface of reflector 24 may be further characterized in that it possesses transverse and longitudinal curvatures symmetrically arranged on opposite sides of transverse and longitudinal center lines of the reflector 24. Reflector 24 is also provided with side portions 25, which may be coated with a flat black finish 25*a* to avoid extraneous reflections.

An important feature of the instant invention is represented by the components designated by the reference numerals 36 and 40 in FIG. 1. Element 36 is a flexible elongated noncoherent fiber-optic bundle having a free end 32 and and end 38, which is in communication with a lighttight box 40, which also houses a right-angle prism (indicated at 37 in FIG. 2). Box 40 is held up against the outside or rear reflective surface 23 or reflector 24 by suitable means such as support rods 42, which are cast into frame 26 of the head 3. Clip means 29 are provided on frame 26 to retain optic bundle 36 when the latter is not in use. Attachment means 35 are also provided on bundle 36 in the proximity of the free end 32 for attaching various dental instruments such as a mirror 34. The operation of this fiber-optic bundle will be more readily understood by referring to FIG. 2 in which the same reference numerals identify the same parts shown in FIG. 1.

The light source of the instant lamp, identified by the reference numeral 50, comprises what is normally termed a Quartzline bulb such as the type manufactured by the General Electric Company of Schenectady, N.Y. which is identified as Model No. Q250CL/DC 120V. Thus, the light source 50 includes an elongated tube 51 which houses a coiled filament 53 having a length of about 0.650 inch. While being comparatively small (e.g. 2 ½ inches in length), the intensity of light generated by it is very high. Light source 50 is provided with a socket member 61, which in turn is engaged by a linkage 59 et al. which serves to both correctly position light source 50 for focusing purposes and to electrically connect the source 50 to the electrical conductors 37, which extend from a source of electrical power (not shown) to housing 59 through yoke 20, pivot member 28, frame 26 and aperture 33. Linkage 59 serves to position light source 50 in a horizontally extending position with the filament 53 being substantially parallel to the horizontal or transverse center line of the reflector 24. Filament 53 is also located at the inner focus of the reflector 24, which in a preferred embodiment is a distance of 1.75 inches from the point formed by the intersection of the reflector's transverse and longitudinal center lines.

A converging lens 48 is fitted into the rear surface 23 of the reflector 24, which lens has as its center the above mentioned point. The function of this lens is to gather direct and reflected light from source 50 and to focus it through right-angle prism 37 upon end 56 of optic bundle 36 within the box 40. Prism 37 is maintained within box 40 by means of spider support 52. Bundle 36 enters box 40 and is held in place by suitable means such as friction clamping means 54.

The light focused upon end 56 of optic bundle 36 is transmitted via the bundle (which is sheathed with a suitable opaque coating of polyvinyl chloride, for example) to its distal end 32. The high-intensity light emanating from end 32 may be directly focused on the desired location or may (as illustrated) be reflected off of a small dental mirror 34 onto the desired location. To the latter end, attachment means 35 are provided on bundle 36 to facilitate the attachment of such a mirror. Means 35 may also be used to secure other instruments to the free end of bundle 36 so that the dentist may have a source of cool, high-intensity light which illuminates the work area of the particular instrument he is utilizing and which "follows" the instrument as it is manipulated.

Referring to FIG. 3, which is a frontal perspective view of the lamp head of the instant invention, reference numeral 58 identifies a shield which is transversely disposed across the face of the head and in front of the light source 50 which is shown in phantom line. Shield 58 is retained in slots 59 within the vertical portions of frame 26. The functions of shield 58 is twofold. Its first purpose is to shield light source 50 from the direct view of the patient so as to avoid glare. The second function of shield 58 will be more readily apparent by examining the cross-sectional elevational view thereof provided in FIG. 4.

In FIG. 4 it is seen that shield 58 is provided with a concave rear surface 60. Surface 60, which is a reflective surface, is designed to reflect light beams impinging upon it from light source 50 back to converging lens 48 in the manner indicated by the light-beam-representing lines *a*, *b*, *c* and *d*. Thus, lens 48 "sees" not only the light source 50 but those reflected from surface 60 as well. This, of course, increases the intensity of the light being focused on end 38 of optic bundle 36. It will also be apparent that some of the light beams impinging on surface 60 will be reflected back onto the main reflector 24, and then from the reflector 24 out of the front of the lamp in the manner illustrated by line *e* in FIG. 4. Thus, the design of the instant invention is such that light which would normally be wasted (i.e. due to the "dead-spot" in front in shield 58) is utilized to its fullest potential.

By way of example, one specific form of a lighting device constructed in accordance with the instant invention is one in which the reflector 24 has an overall width of about 6 ⅝ inches and an overall length of about 9 ¼ inches. A vertical plane perpendicular to the transverse center line of reflector 24 and including the transverse center line of the reflector 24 would intersect the rear surface 23 along a vertically oriented curved line forming a portion of an ellipse having a major axis of about 19 ** inches and a minor axis of about 8 ⅛ inches with a focal length approximately 36.00 inches.

The convex lens 48 fitted into the above-described reflector has a diameter of about 1 ½ inches with a focal length of approximately 3 inches, and the optic bundle 38 has a diameter in the range of from about 0.125 inch to about 0.375 inch and preferably about 0.250 inch. Optic bundle 38 may be of any desired length; however, a convenient length will normally be in the range of 5 to 6 feet.

The light source 50 may be a General Electric Quartzline lamp rated at 250 watts, 2.1 amps and operated at 120 volts. The power control within housing 8 controls line voltage from 0–120 volts, but in a preferred embodiment, minimum output setting is put at 100 volts or approximately 190 watts. Variable potentiometer 9 allows the user a choice as to the amount of illumination desired. The color of the main light pattern produced by the instant device is in the range of about 4500° to about 5500° Kelvin.

Reflector color convection will be designed to improve (by an unknown factor) the color characteristics of the light source even when operating at reduced voltage.

While the lighting device of the instant invention has been described in considerable detail by way of illustrating and description, it is to be understood that this is not intended for purposes of limitation and, hence, in determining the full scope of the invention reference should be had to the following claims.

What is claimed is:

1. An improved lighting device which comprises a single light source having a filament for providing illumination when energized, reflector means having a reflective surface with an interior and exterior side, said reflector means extending above, below and partially around said light source, a converg-

ing lens integral with said reflective surface for gathering and focusing beyond said exterior side of said reflective surface, a portion of the illumination provided by said filament, and an optic bundle having a first end and a second end, said first end being disposed as to receive the light gathered by said converging lens, said second end being displaceable to an area remote to said light source whereby light may be transmitted from said first end to said remote area via said optic bundle.

2. The lighting device of claim 1 wherein shield means are disposed forwardly of said light source in covering relation to said filament.

3. The device of claim 2 wherein the side of said shield means closest to said filament is a reflective surface of such configuration so as to reflect a portion of the light impinging thereupon back to said converging lens.

4. The device of claim 3 wherein the reflective surface of said shield is so shaped as to also reflect light back to the reflective surface of said reflector.

5. The device of claim 4 further characterized in that the said reflector is vertically oriented and is in the shape of a portion of an elliptic paraboloid having a vertical height greater than the horizontal width and presents a concave surface to said filament.

6. An improved dental light for illuminating the oral cavity of a patient to facilitate dental and surgical procedures, which light comprises in combination, a light source having a horizontally oriented filament for providing illumination when energized, a vertically oriented reflector means disposed behind said light source and extending vertically above and below said light source, said horizontally oriented filament extending transversely with respect to said vertically oriented reflector means, shield means disposed forwardly of said light source in covering relation to said horizontally oriented filament, a converging lens disposed within said reflector means at a point behind said light source, said lens receiving and focusing a portion of the illumination provided by said filament, an optic bundle having a first end and a second end, said first end being disposed so as to receive the light focused by said converging lens, said second end being displaceable to an area remote to said light source whereby light may be transmitted from said first end to said remote area via said optic bundle.

7. The dental light of claim 6 further characterized in that the side of said shield means closest to said filament is a reflective surface of such configuration so as to reflect a portion of light impinging thereupon back to said converging lens and another portion of light back to said reflector means and wherein a right-angle prism is positioned behind said reflector means, said right-angle prism receiving illumination from said converging lens and thereafter transmitting said illumination to the first end of said optic bundle.

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