June 24, 1930. R. H. WAPPLER ET AL 1,767,266

ILLUMINATING DEVICE FOR DIAGNOSTIC INSTRUMENTS

Filed April 14, 1928

Fig. 1.

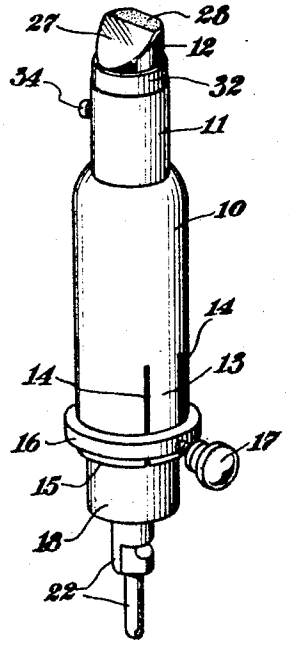



Fig. 2.

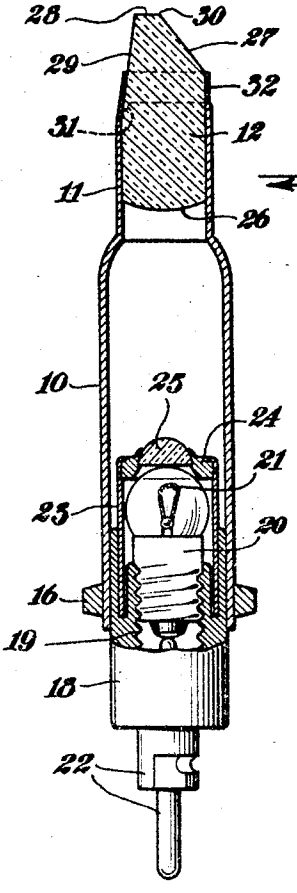



Fig. 3.

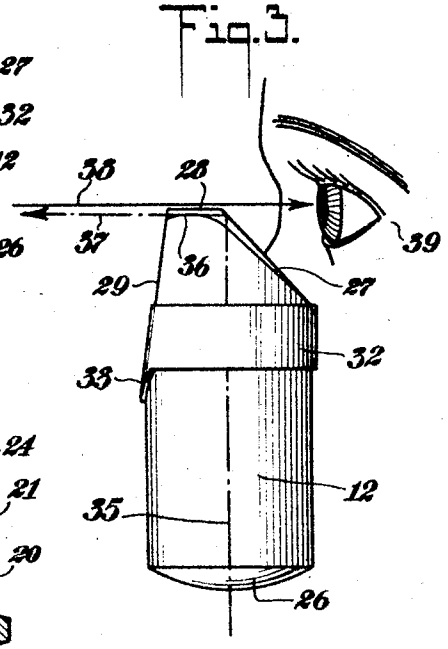



Fig. 4.

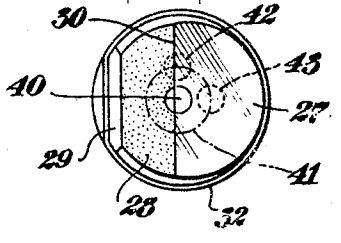



Fig. 5.

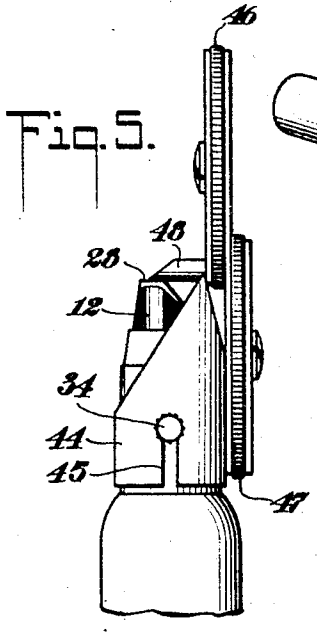
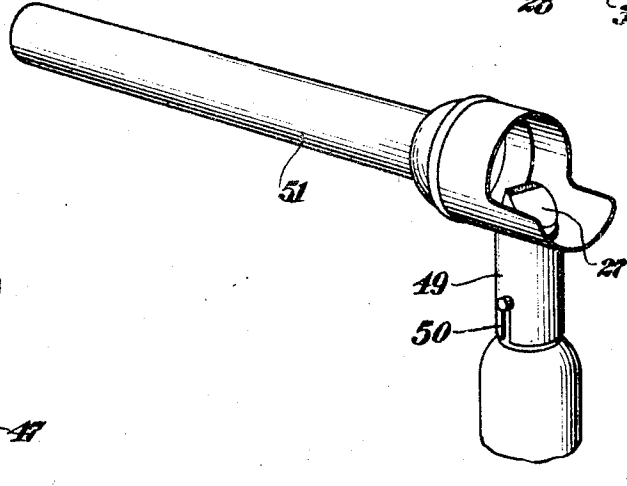



Fig. 6.




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# UNITED STATES PATENT OFFICE

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## ILLUMINATING DEVICE FOR DIAGNOSTIC INSTRUMENTS

Application filed April 14, 1928. Serial No. 270,023.

Our present invention relates generally to diagnostic instruments and has particular reference to an illuminating device for employment therewith.

The type of illuminating device or illuminator to which our present invention relates is one wherein a beam of light from a suitable light source is projected along a desired line which is closely aligned in a predetermined manner with the line of sight leading from the object being illuminated to the eye of the observer.

A general object of our invention is to provide an illuminator which can be used with equal facility with a large variety of diagnostic instruments, thereby resulting in standardization.

The foregoing object will be more fully appreciated when it is borne in mind that different diagnostic instruments necessitate widely different illuminating features. For example, one type of diagnostic instrument, such as the ophthalmoscope, demands considerable accuracy of illumination, with magnitude of illumination as a secondary factor. On the other hand, a diagnostic instrument such as a bronchoscope or the like calls for strong illumination with accuracy as a secondary consideration. Other types of instruments, such as the urethroscope, require both light concentration and accuracy.

Accordingly, the illuminating devices heretofore employed have varied greatly in accordance with the varying requirements of different instruments. Illuminators designed for accuracy have embodied extremely small specially constructed lamps; illuminators for different purposes have been constructed with lamps of different characteristics and sizes. The wide variation of lamp sizes has by itself constituted a considerable disadvantage in view of the fact that for each type of lamp a different type of socket had to be provided, and with a given socket, only a particular type of lamp could be employed.

It is a more particular object of our present invention to provide an illuminator wherein a standard socket and lamp are employed, and wherein means are provided for rendering such standard lamp efficiently usable for all requirements of illumination.

It is a feature of our invention to employ a lamp such as the ordinary two and a half volt lamp of the character widely used in ordinary flashlights and the like. In addition to reducing the expense of manufacture, a construction of this character is highly desirable from the standpoint of lamp replacement.

Another feature of our invention lies in providing means for compensating for the inaccuracies of such standard lamps. Such lamps being manufactured in extremely large quantities with no specialized requirements in mind, the filaments of such lamps are in practically all cases inaccurately centered within the bulb. Moreover, the filaments are not particularly small nor even uniform.

Our present invention provides an illuminator of the character mentioned with testing and adjusting means whereby such inaccuracies may in most cases be compensated for and whereby extreme inaccuracies, rendering the bulb totally useless, can be at once detected and the lamp thereby replaced by another.

Briefly, our invention comprises a tubular casing or the like, means for mounting an incandescent-filament lamp of the standard nature referred to within said casing, optical means including a reflecting surface for receiving the rays from the filament and directing them along the desired line, and means for adjusting the lamp within the casing so as to control, in a predetermined manner, the direction in which the light rays are initially projected onto said reflecting surface and from there in the ultimate direction.

In combination with the foregoing, it is a feature to provide concentrating means for projecting the rays from the filament against said surface.

Another feature lies in providing means for visibly indicating the direction in which such rays are projected.

Another object of our invention relates to optical devices in general and to an illuminator of the present character in particular. Heretofore, wherever an objective has been associated with a cylindrical casing or the like, it has been customary to cement such objective into position. One object of our present invention is to provide an optical device of this character wherein a cylindrical casing provided with an open end is combined with an objective removably applicable into association with such end. In this way, the objective may be independently sterilized where desired.

In an illuminator of the present character, the objective is non-symmetrical with respect to the axis of the casing, and it is accordingly an object of our invention to provide means for locating the objective in the same predetermined proper position every time it is applied.

Accordingly, it is another feature of our invention to provide an objective which comprises nothing more than a cylindrical element of glass or the like, suitably ground to provide the necessary optical characteristics, and provided with a peripheral shoulder, preferably constituted of a separately applied band, which shoulder cooperates with the casing end to assure the repeated proper positioning of the objective, in a removable manner, into association with the casing.

For the attainment of the foregoing objects and such other objects as may hereinafter appear or be pointed out, we have provided a device embodying the features of our invention and illustrated in the accompanying drawings in which—

Figure 1 is a perspective view of an illuminator constructed in accordance with our present invention;

Figure 2 is a longitudinal cross-sectional view through the same, showing the general arrangement of the parts;

Figure 3 is an elevational view on an enlarged scale of the prism forming part of our device; the travel of the light rays being diagrammatically indicated;

Figure 4 is a plan view of Figure 3;

Figure 5 is an elevational view of the top portion of the device, taken in the same direction as Figure 2, and showing the device associated with one type of diagnostic instrument; and

Figure 6 is a perspective view of the top portion of the device showing it in association with a different type of diagnostic instrument.

Referring to Figures 1 and 2, we have shown a substantially tubular casing 10 having a slightly reduced upper portion 11, the latter being adapted to receive suitable optical means such as the prism 12 which will be more fully described hereinafter.

The lower portion of the casing 10 is provided with an integral tab 13 formed by cutting parallel slits 14 along substantially parallel longitudinal lines from the rear edge 15 of the casing. A clamping ring 16 encircles the lower portion of the casing 10 and is fixedly attached, as by soldering, to all portions of the casing 10 except the tab 13. A set screw 17 extends through the ring 16 and is adapted to bear against the tab 13 to force the latter inwardly when desired.

Telescopically mounted within the lower portion of the casing 10 is a sleeve or the like 18 provided with a suitable threaded socket 19 for the accommodation of a lamp 20. The latter, and the socket 19, are of usual and well-known construction and need not be described in greater detail. It may be pointed out, however, that the lamp is mounted coaxially within the casing 10 and is provided with a filament 21 of well-known character.

The end portion of the sleeve 18 is provided with suitable contacts 22 for permitting the establishment of the desired electric circuit through the socket 19 and the lamp 20.

A removable cap for the lamp 20 is separably associated with the sleeve 18 and comprises the skirt portion 23 and an end 24. Within the latter is mounted a concentrating lens 25.

After the lamp has been applied to the socket 19, the cap for the lamp is associated with the sleeve 18, and the latter is then inserted into the rear portion of the casing 10. The sleeve is so designed as to fit snugly within the casing 10 while permitting adjustment thereof not only in an axial direction but also rotatably. After the sleeve 18 has been properly located and adjusted, as will be pointed out hereinafter, a tightening of the set screw 17 will effect a clamping of the sleeve 18 and all the parts associated therewith within the casing 10, as shown in Figure 1.

The prism 12 is substantially cylindrical so as to fit into the portion 11 of the casing 10. Its rear face 26 is convex as shown most clearly in Figures 2 and 3.

The outer surface or portion of the prism 12 is suitably ground to provide an oblique face 27, an adjacent portion or face 28 which is substantially transverse to the tube axis and to the axis of the prism, and a slightly beveled surface 29 opposite the surface 27.

The surfaces 27, 28, and 29 are plane and constitute the outer surface of the prism 12, as distinguished from the inner or rear surface 26 thereof. The portion 27 is arranged at substantially 45° to the axis of the prism and preferably crosses said axis by a slight

degree at its outer edge 30. The surface 27 is unsilvered and constitutes and internally-reflecting surface. The face 28 is roughened so as to constitute a ground glass screen, the purpose of which will be presently described. The face 29 is only slightly inclined with respect to the axis of the prism.

The cylindrical surface of the prism is blackened, as by a suitable coating of paint or the like.

To enable a proper predetermined positioning of the prism within the portion 11, the upper edge of the latter is provided with a V notch 31, and a band 32 is cemented about the prism 12 adjacent to the rearmost portion of the surface 27, the band 32 having a V-shaped portion 33 which is adapted to register with the notch 31. A set screw 34 extends through the wall of the portion 11 and bears directly against cylindrical wall of the prism 12 to clamp the prism in position.

The construction described in the previous paragraph is of importance from the standpoint of (*a*) independently sterilizing the objective, and (*b*) simplifying the construction of the objective in general. As will be pointed out hereinafter, the set screw 34 serves also as a guide for the selected diagnostic instrument which is applied to the illuminator. The objective being non-symmetrical with respect to the axis of the casing, it is of the utmost importance that its removability be accompanied by means for assuring a proper repositioning thereof every time it is applied to the casing and to the subjection of the set screw. The complementary and registerable irregularities illustratively exemplified in the present instance by the notch 31 and the portion 33 serve to assure such proper repositioning. More particularly, the band 32 constitutes a peripheral shoulder which is adapted to abut the edge of the casing, thereby limiting the extent to which the cylindrical objective is inserted, and the registration of the two complementary irregularities referred to serves to predetermine the circumferential or angular location of the prism with respect to the set screw 34.

It will be obvious that the foregoing phase of our invention is not necessarily limited to an illuminating device of the present specific character, but may find wide applicability in connection with the optical devices in general wherein an objective, whose simplification and sterilization is desirable, is associated with the end of a cylindrical casing.

In Figures 3 and 4 we have indicated the manner in which the light rays travel, and for purposes of clarity we have indicated the line of travel of only an axial ray. More particularly, the ray 35 emanating from the filament 21 is concentrated, by means of the lens 25 and the convex surface 26 against the reflecting surface 27. It impinges the latter closely adjacent to the outer edge 30 thereof, and is there internally reflected to travel along the transverse line 36 underlying and closely adjacent to the surface 28. Upon leaving the surface 29, the ray travels along the direction 37 which is inclined upwardly by a very slight degree. The ray 38 emanating from the object illuminated by the ray 37 lies closely adjacent to the latter and passes immediately over the surface 28 to the eye 39 of an observer. It will be understood that the eye 39 is placed closely adjacent to the device as indicated in Figure 3 when the device is employed.

Referring to Figure 4, we will point out that the ideal concentration of the rays from the filament 21 will result in focusing a spot 40 upon the outer surface of the prism. The major portion, if not all, of the spot 40 should lie immediately to the right of the edge 30 but centrally with respect to said edge. When the light rays are thus directed, the user is assured that they are being transmitted with maximum intensity along the lines 36 and 37 of Figure 3.

By providing a screen of the surface 28, a proper allocation of the focus, such as the spot 40, can be easily determined, tested, and controlled by the user before tightening the set screw 17. After the sleeve 18 has been adjusted axially so as to bring the image on the outer surface of the prism into approximate focus, the sleeve 18 is rotated slowly and the position of the focus is carefully noted. In most cases, the focus will be found to lie eccentric with respect to the true axis of the prism and casing, and upon rotation of the sleeve 18, the focus will travel through a circular path such as that indicated at 41 in Figure 4. So long as the focus lies in its entirety upon the ground glass portion 28, it will be obvious that the reflecting surface 27 will not be operating at its maximum efficiency.

In Figure 4 we have shown a possible position 42 into which the focus may be brought, this position being one wherein the majority of the rays strike the surface 27 immediately adjacent to the edge 30. It would appear that this location of the focus would be most efficient, but this is not the case because of the fact that it is not centered with respect to the edge 30 and hence with respect to the face 29 through which the rays emerge. We have shown a further possible positioning of the focus, 43, this position being one wherein the rays are centered with respect to the edge 30 but impinge upon the surface 27 at a slightly greater distance to the right of the edge 30. Such a positioning of the focus is more efficient and should be chosen, as between these two.

It is obvious that when a focus is observed to travel through a path 41, the filament 21 of the lamp 20 is so inaccurately positioned

within the lamp that no adjustment of the sleeve 18 will possibly position the focus at the point occupied by the spot 40 of Figure 4. It may therefore be desirable to discard the lamp entirely and to choose another. Where the filament 21 is only slightly out of accurate axial alignment, however, it is preferable and highly satisfactory to adjust the sleeve 18 so as to bring the focus into a position corresponding to that of the spot 43 in Figure 4. After this has been done, the set screw 17 is tightened and the instrument may be employed.

We will point out at this time that in the absence of a construction of the present character, the satisfactory employment of a standard lamp of the character shown in Figure 2 is a matter of pure chance. If the filament of a selected lamp happens to be absolutely accurate in position within the lamp, the device would operate quite efficiently. Or, even if the filament were inaccurate, if the lamp, after application thereof to the socket, happens to assume one certain position within the casing, then the device might also operate quite well.

Our present invention removes this factor of chance by not only rendering the lamp adjustable in the manner described, but at the same time providing means for observing the effects of such adjustment, and hence controlling such adjustment in a comprehensive and predetermined manner. Thus, by means of our invention, the inaccuracies of the filaments 21 are either compensated for so as to enable the practical employment of standard lamps with maximum efficiency, or in an extreme case, where a particular filament 21 is found to be excessively inaccurate, such utter inaccuracy is at once made manifest to the user and he may immediately discard the lamp entirely.

To illustrate the wide applicability of our invention, we have shown the device of Figure 1 employed with an ophthalmoscope in Figure 5 and with a bronchoscope or the like in Figure 6.

The ophthalmoscope of Figure 5 is provided with a sleeve 44 having a slot 45 which fits over the stem of the set screw 34. A wheel 46 carries a plurality of different lenses, and a similar wheel 47 is mounted with respect thereto so that any two desired lenses may be brought into alignment with the small tube 48 which rests upon the surface 28 of the prism 12. The ophthalmoscope typifies those instruments wherein it is essential that the light ray 37 approach as accurately as possible the line of sight 38.

The bronchoscope of Figure 6 has a sleeve 49 and a slot 50 corresponding to the sleeve 44 and the slot 45 of Figure 5; and comprises the relatively large tube 51 which is inserted into the body. The length and size of the tube 51 require a high degree of illumination but render accuracy secondary in nature. Our present device is efficiently usuable with a diagnostic instrument of this character as well as with an instrument of the character illustrated in Figure 5.

It will be understood that the adjustment of the lamp is effected once each time a new lamp is initially employed. The showings of Figures 5 and 6 are therefore intended merely to illustrate the efficient nature of our device, such widely different diagnostic instruments having heretofore necessitated widely different illuminators for employment therewith respectively.

Our present illuminating device has been satisfactorily and efficiently employed not only with the instruments of Figures 5 and 6, but also with auriscopes, tongue depressors, tracheoscopes, nasoscopes, laryngoscopes, proctoscopes, urethroscopes, and other similar instruments.

It will be noted that the prism is unsilvered. We have found silvering to be unnecessary because of the ability to control the direction in which the light rays are concentrated from the lamp filament upon the reflecting surface. The feature of direction-control of the light rays is therefore one which cooperates with the feature of objective-removability; for the unsilvered nature of the objective together with its removability permits the objective to be independently sterilized wherever such procedure is deemed desirable.

It will be also understood that changes in the details herein described and illustrated for the purpose of explaining the nature of our invention may be made by those skilled in the art without departing from the spirit and scope of the invention as expressed in the appended claims. It is therefore intended that these details be interpreted as illustrative and not in a limiting sense.

Having thus described our invention and illustrated its use, what we claim as new and desire to secure by Letters Patent is:—

1. In an illuminating device for diagnostic instruments, a tubular casing, an incandescent-filament lamp coaxially mounted in one end of said casing, optical means in the other end of the casing and including a reflecting surface against which the light rays from the filament are directed and by which said rays are transmitted laterally from the casing, and means for rotatably adjusting said lamp in said casing to control the direction in which the light rays are directed against said surface.

2. In an illuminating device for diagnostic instruments, a tubular casing, an incandescent-filament lamp coaxially mounted in one end of said casing, a prism in the other end of the casing and having an outer surface which comprises an internally-reflecting portion oblique to the tube axis, means for con-

centrating the light rays from the filament through said prism and against said outer surface, and means for rotatably adjusting said lamp in said casing to control the direction in which the light rays are concentrated through said prism.

3. In an illuminating device for diagnostic instruments, a tubular casing, an incandescent-filament lamp coaxially mounted in one end of said casing, a prism in the other end of the casing and having a convex rear surface and a forward surface which includes an internally-reflecting portion oblique to the tube axis, said rear surface being designed to concentrate the light rays from the filament upon said forward surface, whereby those rays which impinge the oblique portion will be transmitted laterally from the prism, and means for rotatably adjusting said lamp in said casing to control the direction in which the light rays are concentrated by said rear surface.

4. In an illuminating device for diagnostic instruments, a tubular casing, an incandescent-filament lamp coaxially mounted in one end of said casing, a prism in the other end of the casing and having an outer surface which comprises a reflecting portion oblique to the tube axis and an adjacent non-reflecting portion substantially perpendicular to the tube axis, means for concentrating the light rays from the filament through said prism and onto said outer surface, whereby those rays which impinge the oblique surface will be transmitted laterally along a patch skirting said adjacent portion, and means for rotatably adjusting said lamp in said casing to control the direction in which the light rays are concentrated against said outer surface.

5. In an illuminating device for diagnostic instruments, a tubular casing, an incandescent-filament lamp coaxially mounted in one end of said casing, a prism in the other end of the casing, said prism having a convex rear surface, and a forward surface comprising an internally-reflecting portion oblique to the tube axis and an adjacent roughened portion substantially perpendicular to the tube axis, said rear surface being adapted to concentrate the light rays from the filament upon said forward surface, whereby those rays which impinge upon the oblique portion will be transmitted along a path underlying and substantially parallel to said roughened portion, and means for rotatably adjusting said lamp in said casing to control the direction in which the light rays are concentrated by said rear surface.

6. In an illuminating device for diagnostic instruments, a source of light comprising an incandescent-filament lamp, a tube coaxially enclosing said lamp, optical means in the end of said tube for receiving the rays from said lamp and transmitting them laterally from the tube, and means for rotatably adjusting the lamp within said tube to effect a desired positional relationship between said filament and said optical means regardless of the positional mounting of the filament within the lamp.

7. In an illuminating device for diagnostic instruments, a source of light comprising an incandescent-filament lamp, a tube coaxially enclosing said lamp, optical means in the end of said tube and including a reflecting surface arranged at substantially 45° to the tube axis, said optical means being adapted to receive the rays from the lamp and reflect them laterally from the tube, and means for rotatably adjusting the lamp within said tube to effect a desired positional relationship between said filament and said reflecting surface regardless of the positional mounting of the filament within the lamp.

8. In an illuminating device for diagnostic instruments, a source of light comprising an incandescent-filament lamp, a tube coaxially enclosing said lamp, optical means in the end of said tube for receiving the rays from said lamp and transmitting them laterally from the tube, and means for rotatably adjusting the lamp within said tube to effect a desired positional relationship between said filament and said optical means regardless of the positional mounting of the filament within the lamp; said means comprising a lamp socket, a sleeve carrying said socket and telescopically arranged with respect to said tube, and clamping means for releasably securing said sleeve to said tube in desired relative position.

9. In an illuminating device for diagnostic instruments, a source of light comprising an incandescent-filament lamp, a tube coaxially enclosing said lamp, a prism in the end of said tube for receiving the rays from said lamp and transmitting them laterally from the tube, said prism having an internally-reflecting surface arranged at substantially 45° to the tube axis and an adjacent surface substantially perpendicular to the tube axis and constituting the extreme end surface of the prism, and means for rotatably adjusting the lamp within said tube to effect a desired positional relationship between said filament and said surfaces regardless of the positional mounting of the filament within the lamp.

10. In an illuminating device for diagnostic instruments, a source of light comprising an incandescent-filament lamp, a tube coaxially enclosing said lamp, a prism in the end of said tube for receiving the rays from said lamp and transmitting them laterally from the tube, said prism having an internally-reflecting surface arranged at substantially 45° to the tube axis and an adjacent surface substantially perpendicular to the tube axis and constituting the extreme end surface of the prism, and means for rotatably adjusting the lamp within said tube to effect a desired positional relationship between said

filament and said surfaces regardless of the positional mounting of the filament within the lamp; said adjacent surface being roughened to provide a light-diffusing screen upon which said positional relationship may be observed.

11. In an illuminating device for diagnostic instruments, a source of light comprising an incandescent-filament lamp, a tube coaxially enclosing said lamp, optical means in the end of said tube for receiving the rays from said lamp and transmitting them laterally from the tube, and means for rotatably adjusting the lamp within said tube to effect a desired positional relationship between said filament and said optical means regardless of the positional mounting of the filament within the lamp, said optical means being constructed and arranged to visibly indicate said positional relationship.

12. In an illuminating device for diagnostic instruments, a source of light comprising an incandescent-filament lamp, a tube coaxially enclosing said lamp, optical means in the end of said tube for receiving the rays from said lamp and transmitting them laterally from the tube, and means for rotatably adjusting the lamp within said tube to effect a desired positional relationship between said filament and said optical means regardless of the positional mounting of the filament within the lamp, said optical means comprising a ground glass surface interposed substantially in the path of the light rays passing therethrough so that said positional relationship will be visibly indicated.

13. In an optical device of the character described, the combination of a cylindrical casing having an open end, and an objective removably applicable into association with said end, whereby said objective may be independently sterilized if desired; said objective being provided with means for locating the objective in the same predetermined position every time it is applied.

14. In an optical device of the character described, the combination of a cylindrical casing having an open end, and an objective removably applicable into association with said end, whereby said objective may be independently sterilized if desired; said objective comprising a portion adapted to enter said casing, and means for limiting the extent of entry to a predetermined amount.

15. In an optical device of the character described, the combination of a cylindrical casing having an open end, and an objective removably applicable into association with said end, whereby said objective may be independently sterilized if desired; said objective comprising a portion adapted to enter said casing, and means for limiting the extent of entry to a predetermined amount; said means comprising a peripheral shoulder carried by the objective and adapted to abut the edge of said casing.

16. In an optical device of the character described, the combination of a cylindrical casing having an open end, and an objective removably applicable into association with said end, whereby said objective may be independently sterilized if desired; said objective comprising a portion adapted to enter said casing, and means for locating said portion in the same predetermined position every time it is applied; the edge of said casing having an irregularity therein, and said means comprising a peripheral shoulder carried by said objective and having a complementary irregularity, said shoulder being adapted to abut said casing edge with said irregularities in registry.

17. In an optical device of the character described, the combination of a cylindrical casing having an open end, and an objective removably applicable into association with said end, whereby said objective may be independently sterilized if desired; said objective being provided with means for locating the objective in the same predetermined position every time it is applied; the edge of the casing having a notch, and said means comprising a shoulder adapted to engage and register with said notch.

18. In an illuminator of the character described, a cylindrical casing having an open end, an objective removably applicable into association with said end, said objective being non-symmetrical about the axis of said casing, and means for securing the objective in the same predetermined position every time it is applied; said means comprising complementary registerable irregularities provided upon the casing edge and upon the objective respectively.

19. In an illuminator for selective use with a plurality of diagnostic instruments, a cylindrical casing having an open end, an objective removably applicable into association with said end, a set screw for engaging the objective when it is applied and serving also as a guide for the selected diagnostic instrument, said objective being non-symmetrical about the axis of said casing, and means for locating the objective in the same predetermined position relative to said set screw every time it is applied, said means comprising a pair of complementary and registerable abutments associated with the casing and with the objective respectively.

20. In an illuminating device for diagnostic instruments, a cylindrical casing having an open upper end, an incandescent-filament lamp coaxially mounted in the lower end of said casing, optical means in the open upper end and comprising an objective provided with a reflecting surface against which the light rays from the filament are directed and by which said rays are transmitted lat-

erally from the upper end of said casing, and means for rotatably adjusting said lamp in said casing to control the direction in which the light rays are directed upwardly through the casing against said reflecting surface; said objective being removably applicable into association with said upper end so as to be independently sterilizable, and said objective comprising a portion adapted to enter said upper end, and means for locating said portion in the same predetermined position every time it is applied.

In witness whereof we have signed and sealed this specification this 3rd day of February, 1928.

REINHOLD H. WAPPLER.
F. CHARLES WAPPLER.