

Sept. 24, 1940.

J. F. COLLINS

2,215,635

HOSPITAL STERILIZING UNIT AND CONTROL

Filed June 3, 1939

2 Sheets-Sheet 1

Fig. 1.

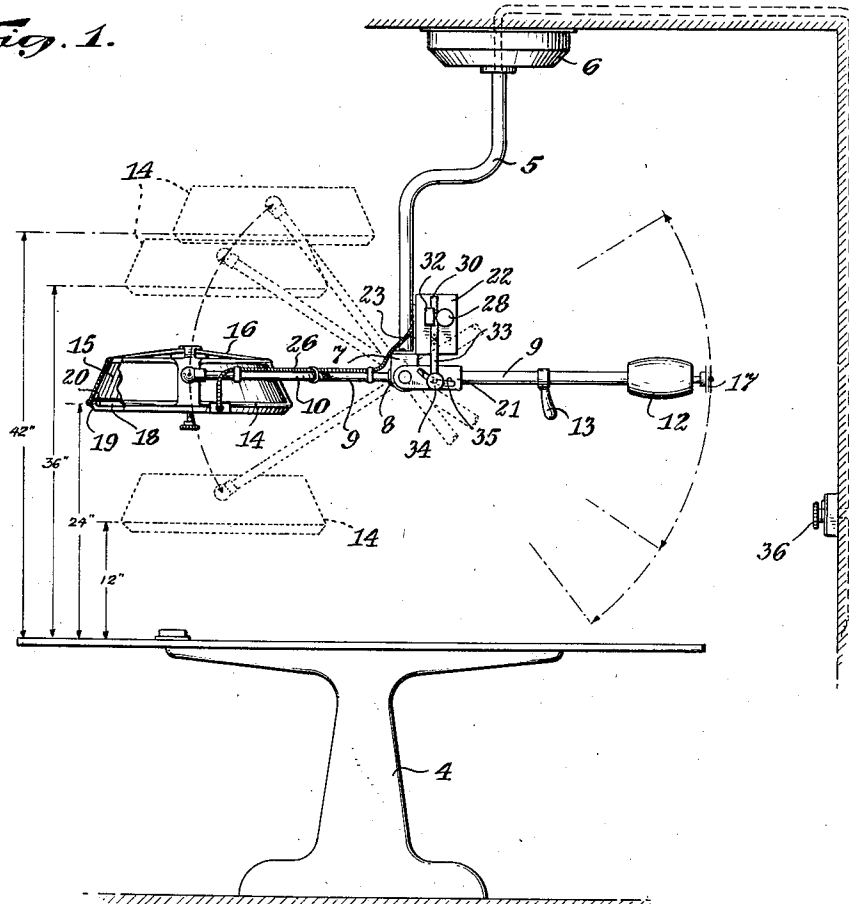


Fig. 2.

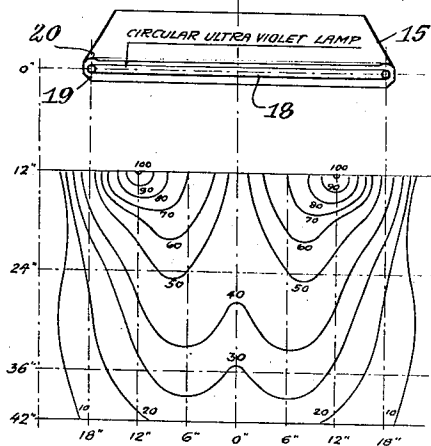
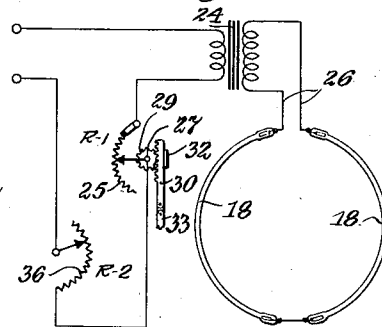


Fig. 3.



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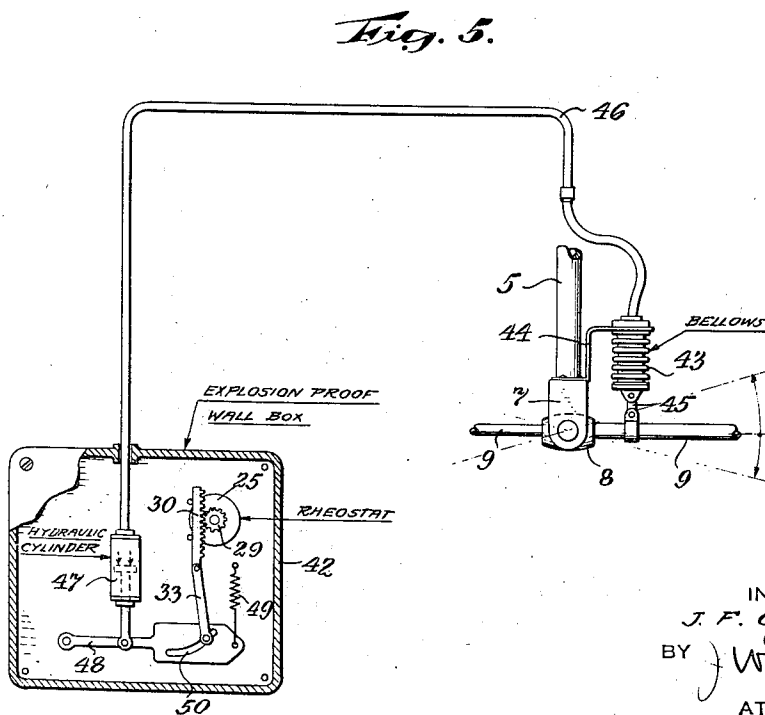
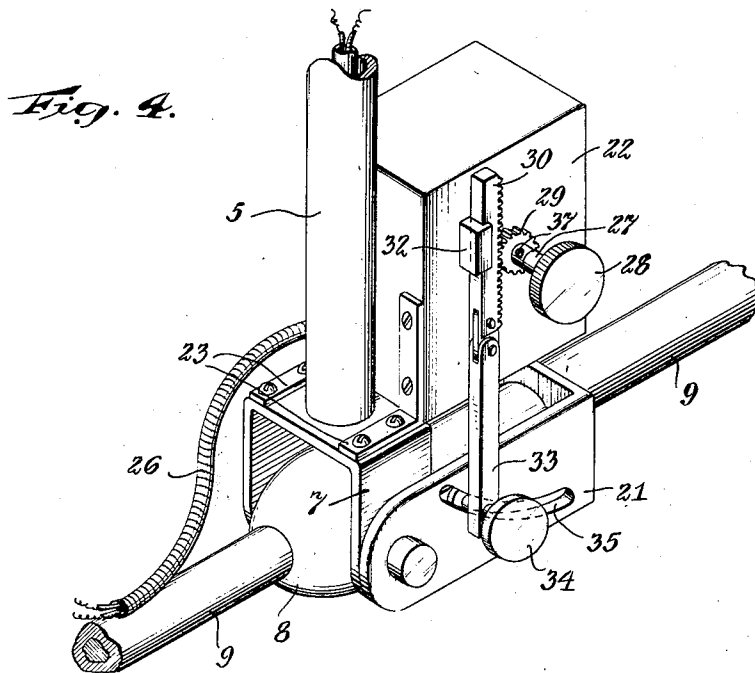
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HOSPITAL STERILIZING UNIT AND CONTROL

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2 Sheets-Sheet 2



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HOSPITAL STERILIZING UNIT AND
CONTROL

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Application June 3, 1939, Serial No. 277,139

7 Claims. (Cl. 250—88)

The present invention relates to lighting apparatus particularly adaptable to hospital operating rooms and the like wherein an intense beam of shadowless illumination as well as a substantially coinciding beam of invisible ultra-violet radiations is produced.

Apparatus for producing an intense beam of shadowless illumination especially adaptable to hospital operating rooms, draftsmen's tables and metal chasers' and engravers' benches has long been known to the art. It has also been suggested to employ a source of ultra-violet radiations in conjunction with the visible illumination for hospitals since their bactericidal and therapeutic effect in preventing infection and hastening wound healing following a surgical operation is now well recognized.

An apparatus of this type is shown and described in the copending application of Joseph F. Collins and Cornelius J. Kraissl, Ser. No. 277,138, filed June 3, 1939, assigned to the same assignee as the present invention, and this invention constitutes an improvement of such apparatus.

As disclosed in the above noted application the apparatus is so constructed as to have substantially universal movement with the lighting unit proper being movable toward or away from an operating table upon which the patient reclines during a surgical operation. Movement of the unit thus varies the intensity per unit area of the visible illumination as well as the intensity of the invisible ultra-violet radiations. It is exceedingly essential that the intensity of these latter radiations be controlled so as to maintain the intensity reaching the patient constant and at the highest value to which uncovered viscera may be exposed without harmful adhesions or other undesired results ensuing. Heretofore this has necessitated manual resetting of the controls for the ultra-violet source by an operator at each new position of the light unit.

It is accordingly an object of the present invention to provide a lighting apparatus particularly adaptable for hospital operating rooms wherein an intense beam of invisible ultra-violet radiations is produced with the apparatus adjustable toward or away from a patient and wherein the intensity of the radiations automatically varies with changes in the distance between the source of ultra-violet and the patient.

Another object of the present invention is the provision of a lighting apparatus particularly adaptable for hospital operating rooms wherein an intense beam of shadowless illumination is produced together with a substantially coinciding

beam of invisible ultra-violet radiations with the apparatus adjustable toward or away from a patient and in which the intensity of the ultra-violet is initially set at a desired value and automatically maintained at such preset value despite variations in the distance between the source of ultra-violet and the patient.

Still further objects of the present invention will become obvious to those skilled in the art by reference to the accompanying drawings wherein:

Fig. 1 is a side view of the lighting apparatus of the present invention shown positioned over an operating table and adjustable to various vertical positions with part of the apparatus broken away to better illustrate the same.

Fig. 2 is a graphic illustration of the intensity distribution of ultra-violet radiations from the apparatus as shown in Fig. 1.

Fig. 3 is a schematic diagram of an electrical circuit for energizing the source of ultra-violet radiations.

Fig. 4 is a perspective view on an enlarged scale of a portion of the apparatus shown in Fig. 1 and showing one embodiment of the control mechanism for the source of ultra-violet, and

Fig. 5 is a diagrammatic view of a modification which the control mechanism for the ultra-violet source may take with parts of such mechanism broken away to better illustrate the same.

Referring now to the drawings in detail, the device as shown in Fig. 1 suspended over an operating table 4 comprises a support including an offset depending member 5 rotatably secured to a ceiling flange or the like 6 covering the usual electric outlet box (not shown). A bifurcated member 7 is carried by the lower extremity of the member 5 and suitably journaled therein is a ball joint 8. Extending through this ball joint 8 and rotatable with respect thereto is a shaft 9 having a bifurcated end portion 10. The opposite end of the shaft is provided with a counterweight 12 and near this end is a handle 13 for manually rotating the shaft 9 with respect to the ball joint 8.

Pivotaly connected to the extremities of the bifurcated end portion 10 of the support is the lighting unit proper comprising a framework 14 supporting a reflector which preferably is formed of a plurality of inclined trapezoidal mirrors 15 of highly polished metal or glass circumferentially positioned with respect to a common axis. The unit is open both at the top and bottom, but at the top is provided with a spider 16, the radial arms of which intersect at the common axis about which the reflecting mirrors 15 are disposed.

A control knob 17 protrudes from the counter-weight 12, as shown in Fig. 1, which operates mechanism (not shown) disposed interiorly of the shaft 9 and bifurcated end portion 10 so that upon rotation of the control knob 17 the unit is rotated about the pivot formed at the extremities of the bifurcated end portion 10 so as to dispose the lower periphery of the unit parallel to the top of the table 4 when the shaft 9 is rotated about the pivot point formed by the connection of the bifurcated member 7 with the ball joint 8, as shown in the dotted lines in Fig. 1.

A source of illumination, such as an incandescent lamp (not shown), is disposed at the focus of an annular Fresnel lens, (not shown) and supported at the common axis of the frame member 14 so that the light is refracted and projected by the mirrors 15 in a cone-shaped beam in the direction of the table 4, as shown and described more in detail in the above noted copending application. As, also shown and described in such copending application, the lighting unit is provided with a source of highly bactericidal radiations, such as a pair of semi-circular ultra-violet lamps 18, disposed about the periphery of the unit 14 and the periphery is inclined slightly inward, as shown at 19, to form a shield which, in conjunction with an upper parabolic section 20 forms a complete ultra-violet reflecting portion integral with the reflector 15 for causing the projection of a beam of ultra-violet radiations which substantially coincides with the intense beam of visible radiations.

The entire apparatus thus far described is substantially identical to that disclosed in the above noted application. When the lighting unit is moved so that the distance between the unit and the patient lying upon the table 4 is altered, the shaft 9 of the support rotates about its pivotal connection, as previously mentioned, thus disposing the lighting unit closer or farther from the patient. Movement of the unit accordingly increases or decreases the intensity per unit area of the visible illumination.

At the same time the intensity of the ultra-violet radiations generated by the source 18 is likewise varied as the intervening atmosphere absorbs a greater or lesser amount of such radiations, depending upon whether or not the distance between the unit and the patient is increased or decreased. Heretofore, and as shown in the above noted application, this has necessitated manual adjustment of the controls for the ultra-violet light source so that the intensity will be maintained within specified limits, since it is imperative that maximum intensity be available at the level of the patient without causing disadvantageous results to exposed viscera such as would result in adhesions or other complications following a surgical operation, and yet at the same time prevent infection from air-borne micro-organisms entering the incision.

To eliminate the necessity for manual adjustment in each new position of the lighting unit and at the same time ensure a constant preselected intensity at all positions, mechanism such as shown more particularly in Fig. 4 is provided. As can be more readily seen from this figure, a yoke member 21 is pivotally connected to the bifurcated member 7 and the shaft 9 passes through the base portion of the yoke member so that the yoke member 21 and shaft 9 move as a unit about the pivotal connection formed with the bifurcated member 7.

A housing 22 is supported by brackets or the

like 23 secured to the bifurcated member 7, and such housing encloses a high tension transformer 24 (Fig. 3) as well as a control means such as a rheostat 25 with the ultra-violet source 18 being connected to the secondary winding of the transformer 24 by means of a cable 26. A shaft 27 provided with a control knob 28 protrudes from the housing 22 and a pinion gear 29 is affixed to this shaft 27, which gear meshes with a rack bar 30 movable in a projecting guide-way 32. The rack bar 30 is pivotally connected to a link member or connecting-rod 33 with the opposite end of this link member adapted to be secured to the yoke member 21 by means of an adjusting nut and bolt arrangement 34, which nut and bolt are adjustable with respect to the yoke member 21 by movement thereof in an arcuate slot 35 provided in the side of the yoke member 21.

By reference more particularly to Fig. 3 it will be noted that, as before mentioned, the ultra-violet source 18 receives energy from the secondary winding of the transformer 25 enclosed in the housing 22. The primary winding of this transformer is connected to the usual source of electrical energy of the customary potential of 110 or 220 volts, and in series with the primary winding and the source is the rheostat 25 as well as a rheostat 36.

The purpose of the rheostat 36, which as shown in Fig. 1 may be mounted on the wall of the hospital operating room, is to initially set the intensity of the ultra-violet source 18 so as to maintain the intensity reaching the patient constant and at the highest value to which uncovered viscera may be exposed without harmful adhesions or other harmful results ensuing, and at the same time destroy air-borne micro-organisms which are so frequently the cause of post-operative infection.

Although for the sake of simplicity a variable resistance or rheostat 36 is shown, it is to be understood that other control means may be employed, such as providing the transformer with various taps so that different voltages may be supplied to the source 18, or the magnetic flux in the transformer may be varied by means of a variable air gap, or by a variable magnetic shunt.

After initially setting the rheostat 36 for a given patient, the control mechanism carried by the housing 22 is next initially adjusted. This is accomplished by raising the lighting unit to its extreme position, as shown by the dotted lines in Fig. 1. The set screw 37 of the pinion gear 29 is then loosened and the control knob 28, which is connected by the shaft 27 to the arm of the rheostat 25, is turned until the desired intensity is obtained on the operating table. This intensity is measured by well known measuring devices and may consist of a system such as that shown in U. S. patent to Harvey C. Rentschler No. 2,037,924.

When the ultra-violet meter records the desired intensity, the pinion set screw 37 is tightened against the shaft 27, thus locking the pinion gear 29 to the shaft. The lighting unit is then lowered to its lower limit and the control adjusting nut 34 loosened and moved in the slot 35 until the ultra-violet meter records the same intensity as it did with the lighting unit in its uppermost position. The adjusting nut 34 is then tightened to fix the position of the link 33 in the arcuate slot 35. This accordingly initially adjusts the mechanism carried by the lighting apparatus and once it is adjusted, it need not be again disturbed. Upon movement of the lighting unit

from its lowermost position in closest proximity to the patient to its uppermost or farthest position from the patient, the current input to the ultra-violet source 18 is thus automatically integrated to the proper value so that the intensity of the projected ultra-violet is varied to overcome the absorption of the ultra-violet radiations by the atmosphere between the limits of travel of the lighting unit.

This accordingly maintains a constant ultra-violet intensity on the operating table regardless of the height or distance between the patient and the ultra-violet source, with this intensity being that initially set by the manually operable rheostat 36. As shown in Fig. 1, the lighting unit is movable from a minimum spacing between the unit and the table 4 of approximately 12 inches to a maximum spacing of approximately 42 inches which would normally cause a variation in intensity, as can be more readily appreciated from Fig. 2.

By reference to this figure it will be noted that at the top of the graph the intensity is expressed in percentage. The abscissa represents distance in inches from the center line of the unit, whereas the ordinate represents distance from the light to the patient from a minimum of approximately 12 inches to a maximum of approximately 42 inches. It will thus be seen that at a minimum spacing of 12 inches between the ultra-violet source and the patient the intensity per unit area is much greater, as indicated by the numerous intensity lines intersecting the line indicative of the 12-inch spacing.

As the spacing is progressively increased, however, from the minimum of approximately 12 inches to the maximum of approximately 42 inches, the intensity per unit area progressively decreases at various intermediate spacings of 24 and 36 inches, as shown by the lesser number of intensity lines intersecting the various lines indicative of such spacing of 24 and 36 inches. Since it is desirable, as above noted, to maintain the intensity constant as initially set by the manually operable rheostat 36, the rheostat 25 is automatically adjusted so as to include or exclude additional resistance in the circuit for the primary winding of the transformer which in turn increases or decreases the current supplied to the ultra-violet light source 18.

Adjustment of the arm of rheostat 25 automatically follows vertical movement of the lighting unit carried by the shaft 9. This automatic adjustment ensues due to the fact that the rack bar 30 is connected by means of the connecting rod or link 33 to the shaft 9 and upon vertical movement of the rack bar, the pinion gear 29 in mesh therewith causes rotation of the shaft 27 to which the movable arm of the rheostat 25 is also secured.

In Fig. 5 a modification of the automatic intensity control for the ultra-violet source is shown. In this modification the rheostat 25 may be encased in a housing 42 disposed on the wall of the operating room, in which case the housing 42 would be explosion-proof, or on the wall of another room in which no explosive vapors are present, in lieu of being carried by the apparatus itself, as shown in Figs. 1 and 4. An expansion bellows 43, however, is carried by a bracket or the like 44 affixed to the bifurcated member 7, which bellows is mechanically connected by means of a pivoted link 45 to the shaft 9. This bellows 43 is connected by means of a conduit 46 to a hydraulic cylinder 47 disposed within the wall housing 42.

The piston of the hydraulic cylinder is pivotally connected to a pivoted arm 48 having its free end normally biased by a spring 49, and an arcuate slot 50 is provided in the pivoted arm to which the connecting rod or link 33 is connected, with the opposite end of such link being connected to the rack bar 30 in the same manner as previously described in the modification shown in Figs. 1 and 4. The conduit 46 together with the hydraulic cylinder and bellows is filled with a fluid which, upon compression of the bellows 43, upon lowering of the lighting unit forces the fluid against the piston of the hydraulic cylinder 47, thus causing downward movement of the pivoted arm 48 and the link 33 and rack bar 30 against the tension of the spring 49 with attendant rotation of the rheostat 25 due to the engagement of the pinion gear 29 with the rack bar.

When the lighting unit is raised, thus causing expansion of the bellows 43 with release of pressure on the piston of the hydraulic cylinder 47, the potential energy of the spring 49 will cause upward movement of the pivoted arm 48 together with the piston of the hydraulic cylinder 47 and the connecting link and rack bar 30 in an opposite manner to that previously described.

It will thus be seen that in both modifications adjustment of the rheostat 25 automatically follows movement of the lighting unit relative to the patient reclining on the table top so that the intensity is integrated between the upper and lower limits of movement of the lighting unit, thereby maintaining a constant intensity as initially set by the manually controlled rheostat regardless of the spacing between the patient and the ultra-violet source. This accordingly automatically ensures the proper intensity required to destroy air-borne micro-organisms which are a contributing factor in post-operative infection, and at the same time precludes the possibility of the intensity being injurious to exposed viscera which might otherwise cause harmful adhesions or other undesirable results following a surgical operation.

Although several embodiments of the present invention have been shown and described, it is to be understood that still further modifications thereof may be made without departing from the spirit and scope of the appended claims.

I claim:

1. A lighting apparatus particularly adaptable to hospital operating rooms comprising a support, means carried by said support for generating highly bactericidal ultra-violet radiations and projecting the same toward a patient disposed upon an operating table, means for moving said ultra-violet generating means with respect to a patient on said table, and means automatically responsive to movement of said ultra-violet generating means toward or away from a patient to maintain the intensity of said ultra-violet radiations constant at the level of the patient in all spaced positions of said ultra-violet generating means relative to the patient.

2. A lighting apparatus particularly adaptable to hospital operating rooms comprising a support, means carried by said support for generating highly bactericidal ultra-violet radiations and projecting the same toward a patient disposed upon an operating table, means for moving said ultra-violet generating means with respect to said table, means connected to said ultra-violet generating means and operable to cause a predetermined intensity of ultra-violet radiations at the level of a patient on said operating table, and

means connected to said ultra-violet generating means and operable upon movement of the latter toward or away from a patient to maintain said predetermined intensity at the level of the patient on said operating table regardless of the spacing between said ultra-violet generating means and said table.

3. A lighting apparatus particularly adaptable to hospital operating rooms comprising a support, means carried by said support for generating highly bactericidal ultra-violet radiations and projecting the same toward a patient disposed upon an operating table, means for moving said ultra-violet generating means with respect to a patient on said table, means electrically connected to said ultra-violet generating means and operable to preset the intensity of the radiations reaching the level of a patient on said table, and means automatically responsive to movement of said ultra-violet generating means toward or away from a patient to maintain the preset intensity of said ultra-violet radiations constant at the level of the patient regardless of the spacing between said ultra-violet generating means and the patient.

4. A lighting apparatus particularly adaptable to hospital operating rooms comprising a support, a source of highly bactericidal ultra-violet radiations carried by said support and movable substantially universally with respect to said support for projecting the radiations from any angle toward a patient disposed upon an operating table, means electrically connected to said source of ultra-violet radiations for causing a variation in the intensity of the radiations emanating therefrom, and means connecting said last mentioned means to said support and operable upon movement of said source of ultra-violet radiations in a vertical plane toward or away from a patient to automatically vary the intensity of said ultra-violet radiations and maintain the intensity thereof at the level of the patient constant in all spaced positions of said source of ultra-violet radiations relative to the patient.

5. A lighting apparatus particularly adaptable to hospital operating rooms comprising a support, a source of highly bactericidal ultra-violet radiations carried by said support and movable substantially universally with respect to said support for projecting radiations from any angle toward a patient disposed upon an operating table, means for energizing said source of ultra-violet radiations, control means electrically connected to said energizing means and carried by said support for varying the intensity of the radiations emanating from said source of ultra-violet, and mechanical means connecting said support and said control means for causing operation of the latter upon movement of said ultra-violet source in a vertical plane toward or away

from a patient to automatically cause a variation in the intensity of said ultra-violet radiation in inverse relation to the change in distance between said source and the patient on the operating table for the purpose of maintaining a constant intensity at the level of the patient in all spaced positions of said source of ultra-violet radiations relative to the patient.

6. A lighting apparatus particularly adaptable to hospital operating rooms comprising a support, a source of highly bactericidal ultra-violet radiations carried by said support and movable substantially universally with respect to said support for projecting radiations from any angle toward a patient disposed upon an operating table, means for energizing said source of ultra-violet radiations, control means electrically connected to said energizing means for varying the intensity of the radiations emanating from said source of ultra-violet, and hydraulic actuated means associated with said control means and said support and operable upon movement of said ultra-violet source in a vertical plane toward or away from a patient to cause operation of said control means with attendant variation in the intensity of said ultra-violet radiations in inverse relation to the change in spacing between said source and a patient on the operating table for the purpose of maintaining a constant intensity at the level of the patient in all spaced positions of said source of radiations relative to the patient.

7. A lighting apparatus particularly adaptable to hospital operating rooms comprising a support, a source of highly bactericidal ultra-violet radiations carried by said support and movable substantially universally with respect to said support for projecting radiations from any angle toward a patient disposed upon an operating table, means for supplying electrical energy to said source of ultra-violet radiations, a rheostat electrically associated with said electrical supply means and said source of ultra-violet radiations and operable to vary the intensity of the radiations emanating from the latter, and means associated with said support and with said rheostat and operable upon movement of said ultra-violet source in a vertical plane toward or away from a patient to cause operation of said rheostat with attendant variation in the intensity of said ultra-violet radiations in inverse relation to the change in perpendicular spacing between said source and a patient on the operating table for the purpose of maintaining a constant intensity at the level of the patient in all spaced positions of said source of radiations relative to the patient.

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