United States Patent

Rietveld

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[54] **IRRADIATION DEVICE**

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[73] Assignee: **U.S. Philips Corporation,** New York, N.Y.

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[52] **U.S. Cl.**.....**250/86,** 350/271

[51] **Int. Cl.**.....**H01j 37/00**

[58] **Field of Search**.....250/86; 350/271

[56] **References Cited**

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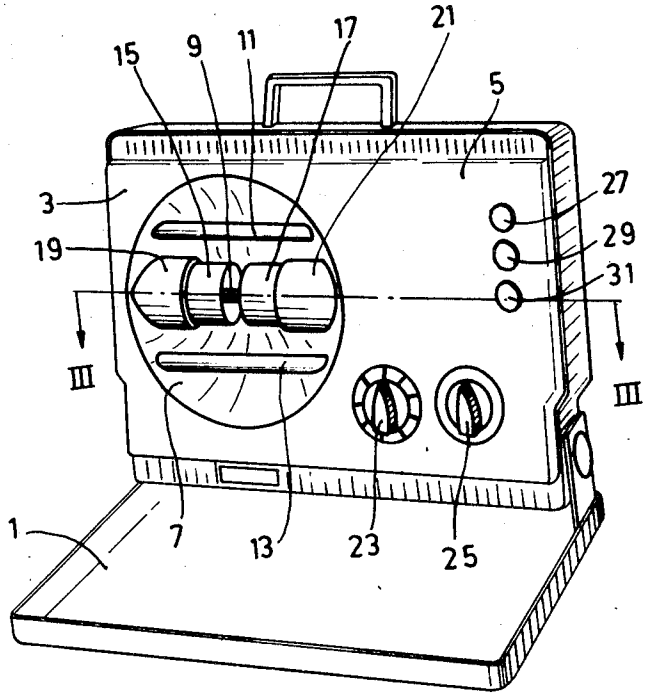
Assistant Examiner—C. E. Church
Attorney—Frank R. Trifair

[57] **ABSTRACT**

An irradiation device having a source of UV radiation and two filter screens mounted for movement toward and away from each other so as to fully or partly block the irradiation source. A time program device is provided so as to open and maintain the screen apart for a set period of time, which is constant for each irradiation period. The distance by which the screens are displaced is adjusted in accordance with the day of the radiation treatment. The device therefore operates with a constant irradiation time but variable radiation intensity.

6 Claims, 8 Drawing Figures



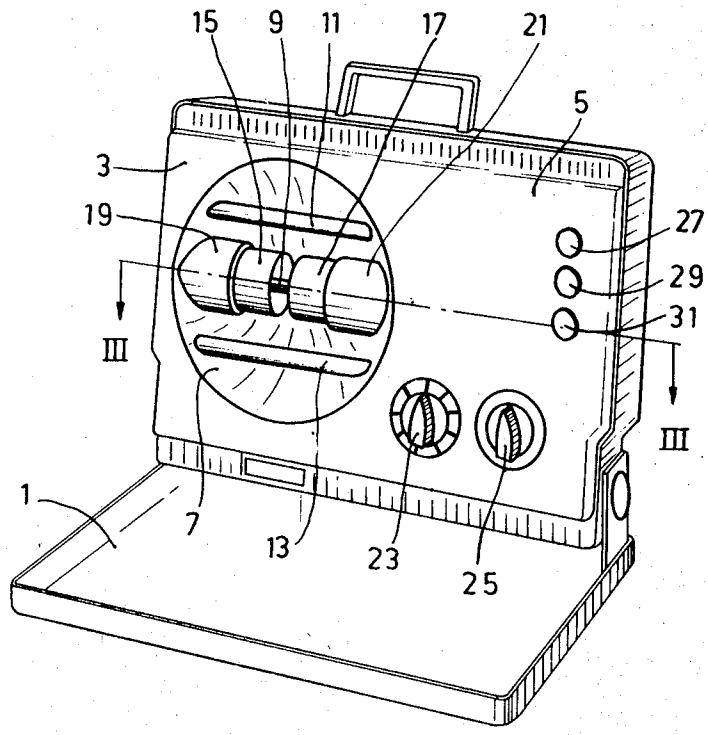


Fig.1

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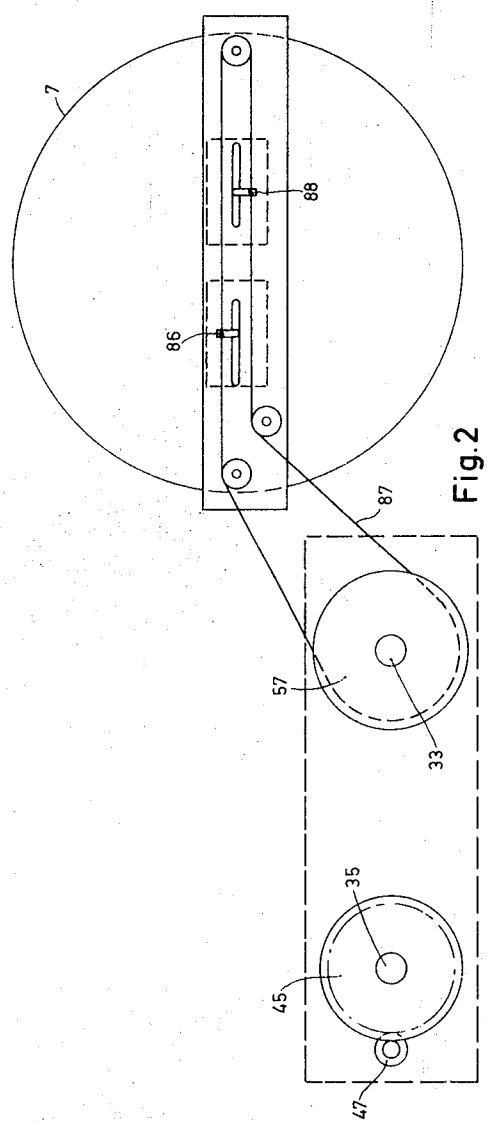

Fig.2

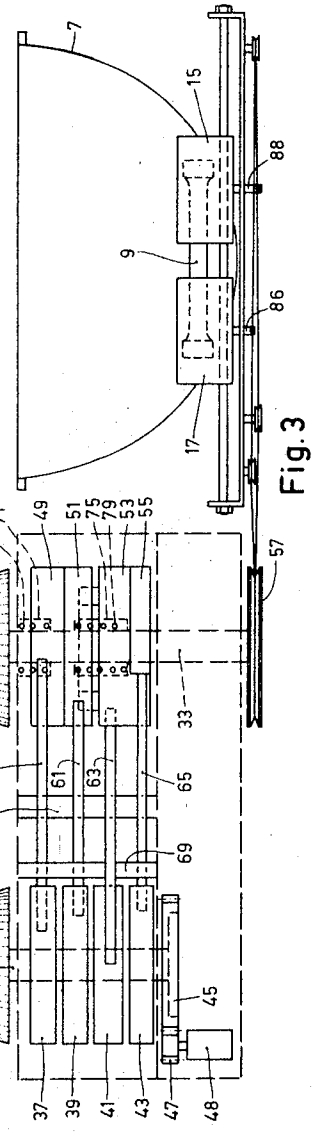

Fig.3

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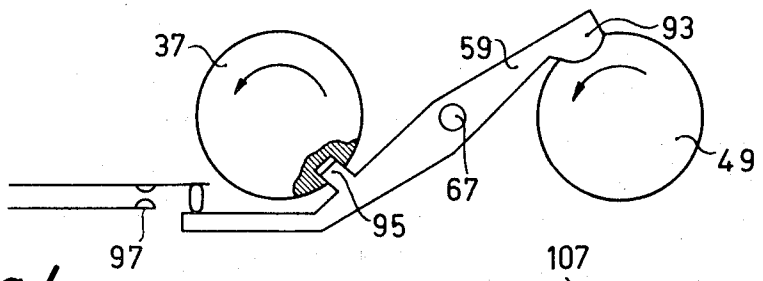

Fig.4

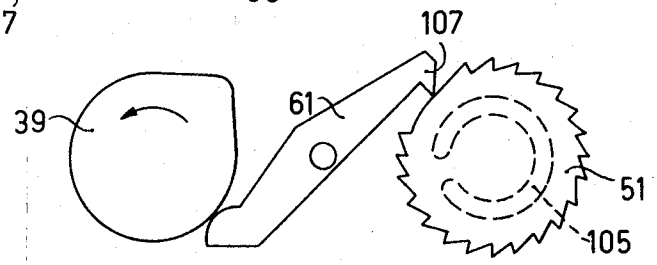

Fig.5

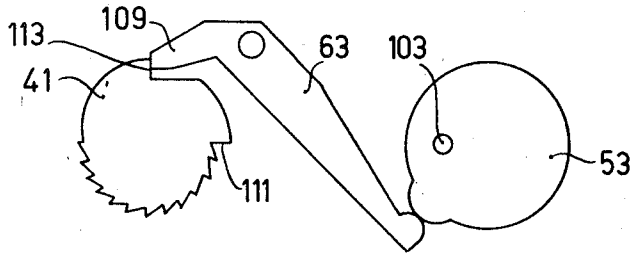

Fig.6

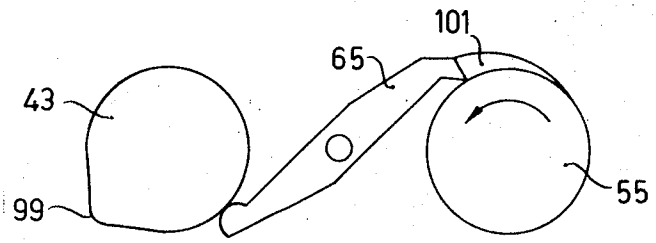

Fig.7

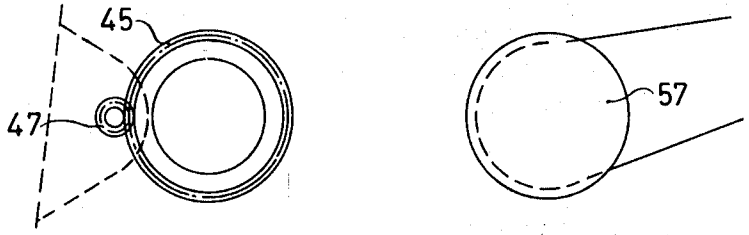

Fig.8

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IRRADIATION DEVICE

The invention relates to an irradiation device comprising a reflector having at least one UV irradiation source incorporated therein, (such as a high-pressure mercury vapor discharge lamp). The device is provided with two screens which are movable in a direction at right angles to the radiation path and which filter the UV radiation. Such a device is known from the published Dutch Pat. application No. 6,600,788 (U.S. Pat. No. 3,466,443).

In this known device, axially movable filters arranged coaxially around the radiation source, are used.

By moving said filters towards each other or away from each other, it is possible, for example, to control the mutual ratio of UV_A and UV_B radiation as a result of which an improved matching to the specific skin sensitivities of the persons to be irradiated in theory becomes possible.

When using such as device it is the usual course of treatment to gradually increase the dose of the UV radiation emanating to the person to be treated. This is accomplished by exposing the person to the radiation of said device for increasingly longer periods of time. Initially, for example, only 1 minute duration of radiation is required but in the course of several days said duration may increase to, for example, 20 minutes, which is a time-consuming process.

It is the object of the invention to avoid this drawback by means of a device which is characterized in that it comprises means by which the screens are first moved apart over an adjustable distance in a programmed manner, which screens, during nonoperation of the device, entirely close the radiation path. The screens are kept apart for a constant period of time, and are then moved again back to the closed position after which the radiation source is switched off. The desirable increase in dosing, is not obtained by constant levels of irradiation in the conventional manner, and gradually increasing the radiation time, but by increasing the intensity of the radiation as the cure progresses and keeping the exposure time short and constant. The exposure time may be chosen to be, for example, 5 minutes. In order to achieve this objective, the screens, which substantially prevent passage of the UV_B and UV_C rays, are each time moved further apart as the cure progresses. The irradiation device according to the invention may then be characterized as a device for short irradiation duration.

Screens of a suitable glass filter which takes away a considerable part of the visible light which causes dazzling, are preferably used so that it is less unpleasant for the person to be treated.

Since the discharge tube present in the irradiation device according to the invention needs a certain time to reach the operating temperature, a certain time should elapse between the instant of switching on the UV source and the instant of opening the screens. According to an embodiment of the irradiation device, such means provided for that purpose become operative only when the radiation intensity of the radiation source has reached a substantially constant value. This becomes possible, for example, by using a rather simpler time mechanism which is adjusted at a constant time.

The supply of the radiation source is preferably interrupted in an analogous manner a short period of time after the screens have been closed again. The device is constructed so that said interruption can be delayed, if desirable, by adjusting the time switch device back again to the switching instant a short period of time before the beginning of opening the screens; in that case the device is ready for operation for a next person to be irradiated.

In accordance with the invention, it is therefore possible to provide an irradiation device which has a particularly short radiation time for each day of the radiation cure, while in addition the danger of exposing a person to be irradiated to an excessive dose of radiation is prevented since the irradiation device automatically switches off after a certain irradiation time.

In order that the invention may be readily carried into effect, one embodiment thereof will now be described in greater detail, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 is a perspective view of the irradiation device according to the invention in the opened position

FIG. 2 is a diagrammatic rear view of the device shown in FIG. 1, in which the cover plate is not shown,

FIG. 3 also diagrammatically shows the arrangement taken on the lines III—III of FIG. 1,

FIGS. 4 to 8 serve to illustrate the operation of the adjusting mechanism.

The irradiation device according to the invention in the example shown in formed as a box 1, to which a cover 3 is connected.

A reflector 7 is arranged in the box 1 which comprises a front plate 5. A UV radiation source 9 formed as a high-pressure mercury vapor discharge lamp, and two IR radiators 11 and 13 are secured in said reflector.

The UV radiation source 9 is surrounded by two screens 15 and 17 which can be moved apart in the axial direction FIG. 1 shows the screens in a slightly moved apart position. These screens consist of a suitable colored glass filter which substantially prevent passage of the UV_B and UV_C parts of the radiation spectrum of the radiation source 9 during operation.

The screens 15 and 17 are arranged within two rigidly secured metal cylinders 19 and 21. The device is further provided with two adjusting dials 23 and 25 which are adjusted in accordance with the radiation program to be performed and are connected, in a manner to be described in detail, to an adjusting mechanism for switching on and off the radiation source 9 and the programmed opening and closing of the screens 15 and 17. The front plate 5 also has a voltage switch 27, and selection switches 29 and 31 of the conventional type for switching on IR or UV+IR.

The device diagrammatically shown in FIGS. 2 and 3 comprises the adjusting dials 23 and 25 which are secured to the ends of shafts 33 and 35.

Discs 37, 39, 41 and 43 are secured to the shaft 35 and can hence be rotated by rotating the dial 25. By means of a slipping clutch, the shaft 35 is coupled to a toothed wheel 45 which itself meshes with a ring of teeth 47 secured to the shaft of an electric motor 48.

The other shaft 33 comprises two discs 49 and 51 secured thereto, and three discs 53, 55 and 57 which are secured together and can simultaneously be rotated relative to the shaft 33.

Levers 59, 61, 63 and 65 are secured between the shafts 33 and 35 and cooperate with the discs present on said shafts, they can be rotated about shafts 67 and 69, respectively The large the rotation of the disc 57, the more the screens 15 and 17 move apart. The disks 37, 39, 41, 43, 49, 51, 53, 55 and 57, as well as the levers cooperating therewith, have a shape which is shown in detail in FIGS. 4, 5, 6, 7 and 8 serving for illustrating the operation. This will be described in greater detail hereinafter.

The irradiation device described in general is constructed to serve as an irradiation device for constant radiation duration and controllable radiation intensity. This control is obtained by choosing the screens 15 and 17 to consist of a material which substantially prevents transmission of the UV_B and UV_C radiation and by adapting daily the distance over which the screens move apart. During nonoperation of this device the screens 15 and 17 are closed. The person to be irradiated need operate only the on-off switch 27 and one of the selection switches 29, 31 (IR or UV+IR) and rotate the adjusting dial 23 to a position which corresponds to the desired irradiation day of a irradiation cure divided over a number of days. After these operations, everything runs off automatically.

Actually, by rotating the dial 23 the radiation source is switched on and only after said radiation source has reached its temperature are the screens opened and kept open for a constant period of time. The screens are then moved again to

the closed position and the radiation source is automatically switched off after some decay time.

The above-described shaft-adjusting mechanism is provided in order to carry out the described program so as to achieve the desired purposes.

In order to clarify the operation, FIGS. 4–8 show the various possible positions of any two discs with a lever present between them. By rotating the dial 23 to an adjusting position, determined by the chosen day of an irradiation cure, the thick portion 93 of the lever 59 is pushed out of a recess of the disc 49. The lever 59 then rotates about the shaft 67, the pawl 95 flips out of a recess of disc 37 and a switch 97 is operated as a result of which the IR-sources 11, 13 and/or the UV-source 9 are switched on. Simultaneously the motor 48 for driving the ring of teeth 47 is switched on and the shaft 35 is thereby caused to slowly rotate. After a given rotation of the shaft 35, the cam 99 of the disc 43 engages the lever 65 which is thereby rotated and releases the pawl 101 of the disc 55. As a result of the torsion spring 79 can relax, the discs 53, 55, 57 being rotated over an angle which corresponds to the angle of rotation of the previously adjusted dial 23. For this purpose, a pin 103 on the disc 53 moves in a groove 105 of the pawl wheel 51 up to the end of said groove; since the disc 57 is rotated over a given angle the screens 15 and 17 will be moved apart over a distance corresponding thereto by means of the belt 87 and the irradiation starts. This belt is rigidly secured to the screens 15 and 17 by means of coupling members 86 and 88. Since the disc 53 has been rotated and the lever 63 runs over the toothed part of pawl disc 41, the dial 25 is blocked against back rotation from that instant on.

After an irradiation of approximately 5 minutes the lever 61 is lifted by the cam on the disc 39 so that the end of the lever 61 constructed as a pawl 107 is released from the pawl wheel 51. Under the influence of the torsion spring 71, the discs 49, 51, 53, 55 are again moved back to their initial position. The pulley 57 also rotates back to its initial position so that the screens 15 and 17 are closed again. The lever 63 is lifted again by the return movement of the disc 53. The pawl disk 41 and the shaft 35 can hence be rotated back.

Approximately 2 minutes after the return of the screens 15 and 17 to the closed position, The disc 37 has returned to its initial position. The cam 95 again falls in the recess of the disc 37, so that said disc is blocked, the switch 97 is opened and the electric motor 48 is stopped. The left-hand part of the lever 59 again falls in the recess of the disk 49.

With this device it is possible to rotate the dial 25 to the left in the period between closing of the screens 15 and 17 and switching on the radiation device, so in the period in which the lever 63 is lifted from the pawl disk 41, in which the slipping clutch becomes operative. This dial 25 is rotated back until the pawl 109 abuts against the projecting part 111 of the disk 41. The dial 23 can then be adjusted in a desirable position and a following radiation period (for example, for a following person to be irradiated) occurs rather rapidly. Since the trajectory between the projecting part 111 and the part 113 is not used, a reheating of the UV source 9 is avoided.

If it should be desirable to switch off the irradiation device in an accelerated manner, it is only necessary to rotate the dial 25 to the right until the part 95 of the lever 59 falls in the recess of the disk 37.

What is claimed is:

1. An irradiation apparatus comprising a housing, a reflector carried on said housing, at least one UV irradiation source mounted within said reflector, a pair of movably mounted filter screens for blocking passage of at least a portion of said radiation and arranged within the reflector so as to be displaceable in a direction which is substantially at right angles to the path of radiation, a time program device for automatically adjusting the position of said filter screens with respect to said UV irradiation source so as to vary the intensity thereof over a predetermined period of time, adjusting means connected to said filter screens for causing displacement thereof in response to operation of said time program device, means for initiating operation of said program device, whereby said filter screens remain in a position so as to fully block the radiation path during nonoperation of the irradiation apparatus, are then moved to adjusting positions during operation of the apparatus in response to operation of the time program device so as to vary the intensity of the radiation and be maintained at an open position with respect to the UV irradiation source for a set period of time, and then moved to said fully closed position, and means for automatically switching off the source of radiation after said filter screens are returned to the fully closed position.

2. The irradiation apparatus according to claim 1 wherein said means for initiating operation of said time program device also operates to switch on said source of radiation, and further comprising means for delaying displacement of said screens from its initial closed position until the radiation intensity of the radiation source has reached a substantially constant value.

3. The irradiation apparatus according to claim 2 further comprising means for initiating operation of the time program device after said screens have been returned to the fully closed position and prior to said automatic means switching off the source of radiation.

4. The irradiation apparatus according to claim 3 wherein said time program device comprises a shaft-adjusting mechanism having a plurality of adjustment positions corresponding to the number of days of the radiation treatment, transmission means associated with each of said positions for connection with said filter screens so that said screens will be displaced a different distance from the fully closed position at each of said adjustment positions to thereby vary the intensity of radiation over the same period of time from one position to the next.

5. The irradiation apparatus according to claim 4 wherein said means for initiating operation of the program device and for operating the radiation source comprises a switch connected to the shaft-adjusting mechanism.

6. The irradiation apparatus according to claim 5 further comprising at least one IR radiation source mounted on said reflector and arranged for operation with said UV radiation source, and wherein said UV radiation source comprises a high-pressure mercury vapor discharge lamp.

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