

April 25, 1944.

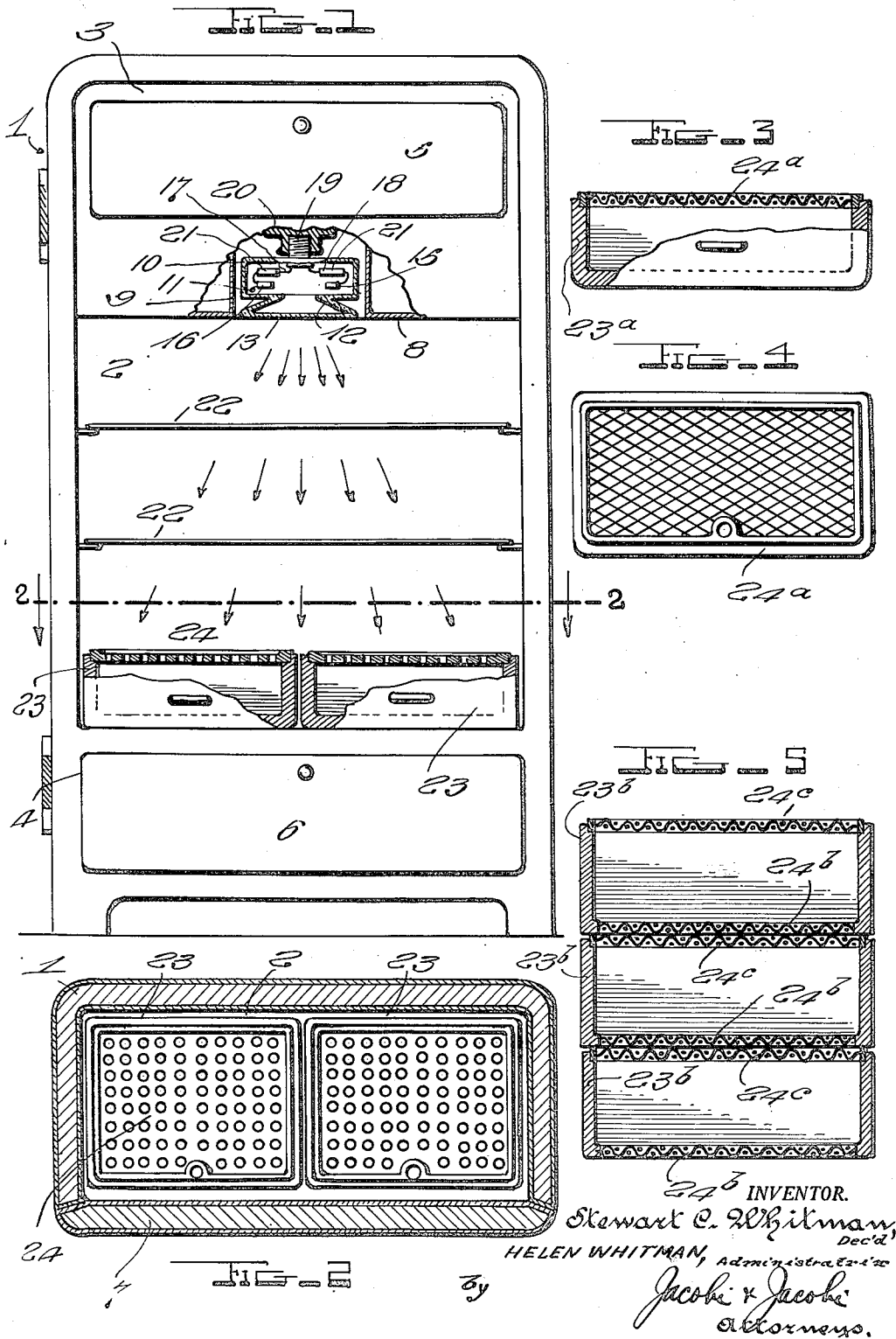
S. C. WHITMAN

2,347,307

## IRRADIATING REFRIGERATOR AND THE LIKE

Original Filed April 4, 1941

3 Sheets-Sheet 1



April 25, 1944.

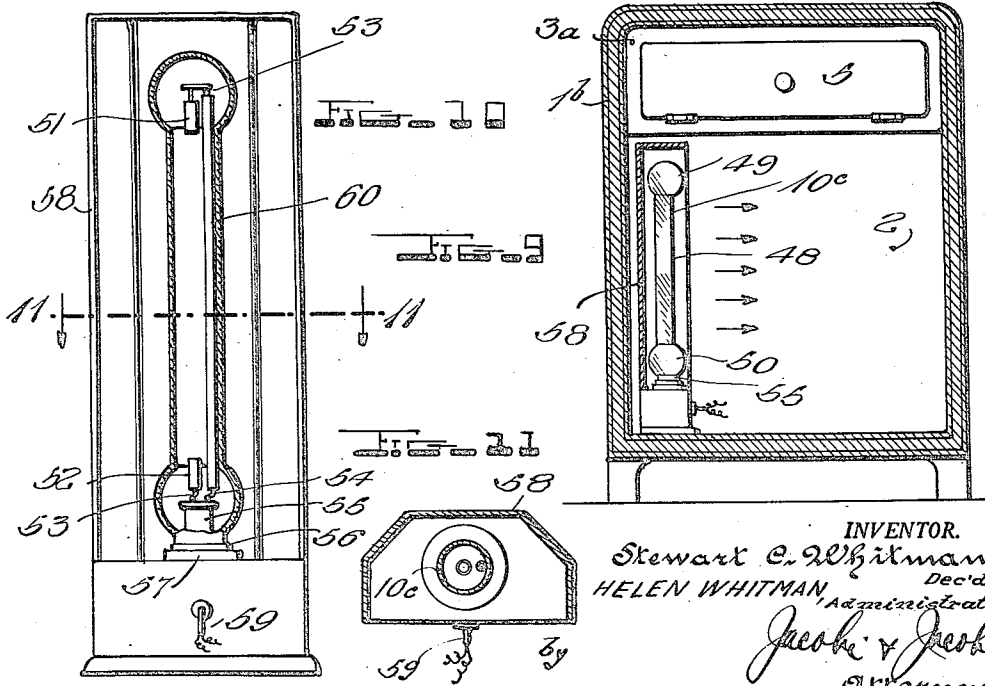
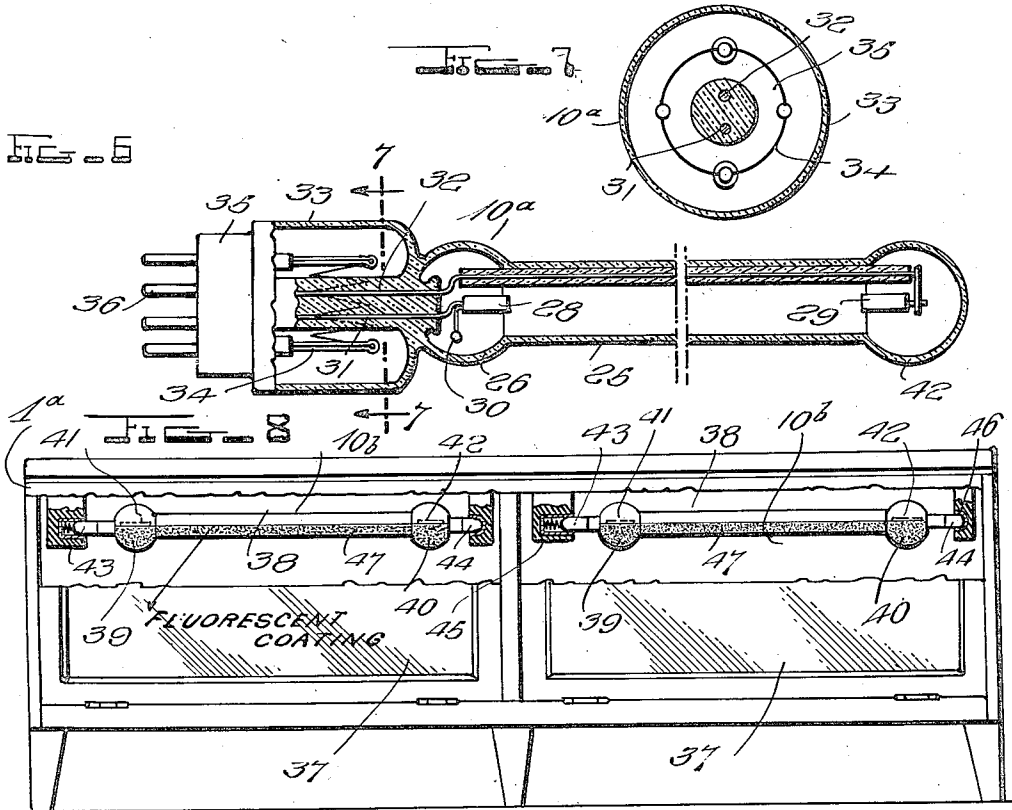
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IRRADIATING REFRIGERATOR AND THE LIKE

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3 Sheets-Sheet 2



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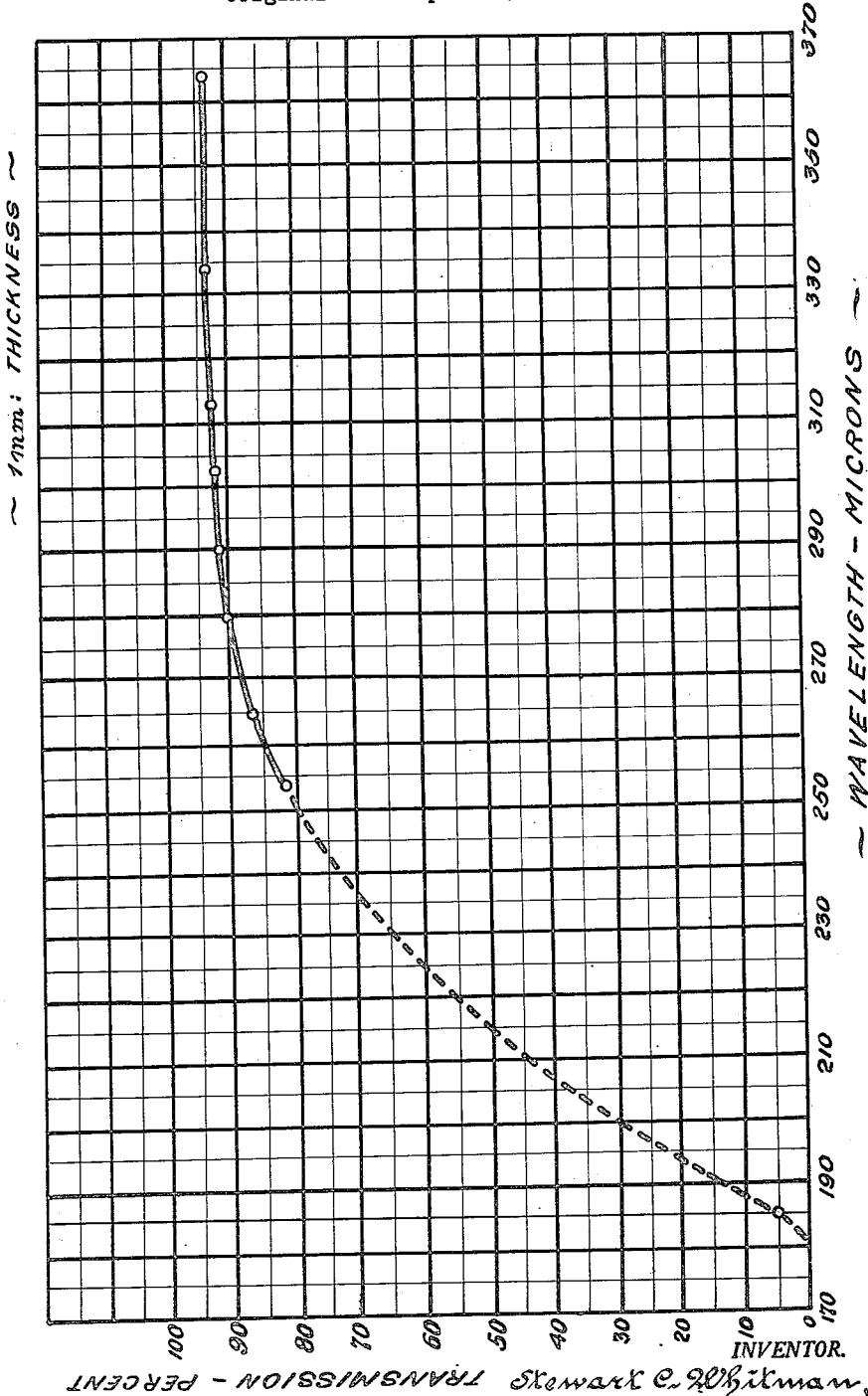
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IRRADIATING REFRIGERATOR AND THE LIKE

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3 Sheets-Sheet 3

1mm THICKNESS



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## UNITED STATES PATENT OFFICE

2,347,307

IRRADIATING REFRIGERATOR AND THE  
LIKE

Stewart C. Whitman, deceased, late of New York,  
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Original application April 4, 1941, Serial No.  
386,936. Divided and this application Novem-  
ber 12, 1941, Serial No. 418,800

4 Claims. (Cl. 250—51)

This application is a division of an application for patent filed April 4, 1941, Serial No. 386,936, by the said Stewart C. Whitman, deceased.

This invention relates to improvements in refrigerators, and particularly to refrigerators of the irradiated type.

The main object of the invention is to provide an ultraviolet irradiated refrigerator wherein undesired biological activity may be effectually governed and controlled.

Another object of the invention is to provide means whereby ultraviolet rays may be propagated and irradiated throughout a wide area in the refrigerator.

Still another object of the invention is to provide irradiating means which is of simple type and compact in character, while at the same time adapted to operate at high efficiency and comparatively low cost.

Still another object of the invention is to provide a construction and arrangement of ultraviolet discharge tube for refrigerators which is adapted for directional discharge and which will operate either on high or low pressure and successfully on low pressure.

Still another object of the invention is to provide an ultraviolet tube for refrigerators which will furnish both ultraviolet radiation and visual illumination.

Still another object of the invention is to provide as a combined sterilizing and illuminating element for refrigerators a unitary ultraviolet tube and fluorescent tube of a character designed to give illumination highly suitable for a refrigerator.

Still another object of the invention is to provide a refrigerator having food trays embodying walls which will transmit ultraviolet radiation.

With these and other objects in view, the invention consists of the features of construction, combination and arrangement of parts herein-after fully described and claimed, and as now shown in the accompanying drawings, in which—

Fig. 1 is a front elevation of a refrigerator, with doors removed to expose the interior thereof, and showing arranged therein novel means embodying the invention for irradiating the interior of the refrigerator.

Fig. 2 is a sectional plan view on the line 2—2 of Fig. 1.

Fig. 3 is a view in front elevation, with parts broken away and in section, of one of the refrigerator trays or food receptacles, showing a different form of perforate or screen wall from that shown in Figs. 1 and 2.

Fig. 4 is a top plan view of the tray or receptacle shown in Fig. 3.

Fig. 5 is a vertical section showing an arrangement of superposed trays having perforate top and bottom walls, which may be employed.

Fig. 6 is a view of a double tube unit for producing both illuminating and ultraviolet rays.

Fig. 7 is a section on the line 7—7 of Fig. 6.

Fig. 8 is a front elevation of the lower portion of a refrigerator having doors and tubes arranged in compartments therein for irradiating the refrigerator in an upward direction and also illuminating the same.

Fig. 9 is a sectional view through a refrigerator having an irradiated unit arranged vertically therein, and which may be of removable and portable type.

Fig. 10 is a front view of the unit shown in Fig. 9.

Fig. 11 is a cross-section on the line 11—11 of Fig. 10.

Fig. 12 is a graph showing the transmission values of an ultraviolet tube embodying the invention and of a given wall thickness at different wave length microns.

Referring now more particularly to Figs. 1 to 5, inclusive, of the drawings, 1 designates a refrigerator casing of any suitable or conventional type. This casing is shown as provided with a refrigerating chamber 2 and top and bottom compartments 3 and 4, respectively, which compartments may be provided with doors or drawers 5 and 6, respectively. The compartment 5 may serve to contain or form the enclosing casing of a refrigerating unit, including all parts or all parts excepting the compressor, while the compartment 6 may serve as a bottom storage compartment or as a receptacle or enclosing casing for the refrigerant compressor. Where the compressor is arranged in the bottom compartment and is of compact character the bottom compartment may be suitably divided and serve also as a storage compartment for foodstuffs or other materials to be preserved. The refrigerating chamber 2 and upper portion of the casing containing the compartment 3 may be closed by a suitable type of door 7, illustrated in Fig. 2.

The compartment or casing 3 is separated from the top of the refrigerating compartment 2 by a partition wall 8 and located in the base of said compartment 3 and opening at its bottom through said wall 8 is a lamp chamber 9 in which is positioned an ultraviolet irradiation tube 10. This tube 10 comprises an envelope formed of a rectangular discharge chamber portion 11 and

outwardly and downwardly flaring transmission chamber 12 communicating at its contracted side with the bottom of the chamber 11 and provided at its enlarged side or portion of greatest diameter with a projecting lens 13 which is located in the opening in the wall 8 and preferably lies flush with or in the plane of said wall. Within the chamber 11 are disposed spaced crater electrodes 14 and 15 and suitably supported by one of the electrodes is a mercury containing cup 16. Leads 17 and 18 extend from the respective electrodes to terminals arranged within a screw plug 19 fixed to the casing portion 10 and adapted for engagement with a socket 20 to support the tube in position and connect the electrodes with a source of current. The electrodes are preferably provided with insulating glass sleeves 21 to prevent arcing or sputtering and to ensure discharge of the rays into the chamber 12 for transmission through the lens 13. The lens 13 may be formed of thin ultraviolet ray transmitting glass and sealed to the rest of the tube, which may be formed of thicker ordinary glass. This type of tube may be operated on high or low voltages and the use of the glass sleeves 21 is particularly important where the tube is operated on low voltage since sputtering is more likely to occur on low voltage tubes than on high voltage tubes. The form of the tube shown is especially desirable for refrigerators as the form of the lens 13 adapts a wide angle type of lens to be used which will transmit the ultraviolet radiation over a wide area of the chamber 2, thus allowing effective irradiation to be obtained at a comparatively low cost for installation and operation of the irradiating means.

Within the chamber 2 may be positioned at suitable elevations shelves or trays 22 which may be removably mounted for convenience in cleaning or repairing the interior of the refrigerator. The shelves are in practice of any suitable openwork or reticulated material or otherwise formed to render them penetrable to the passage of the ultraviolet rays supplied by the tube 10. Also positioned within the refrigerator, preferably in the base of the chamber 2, as shown, are drawers, trays or other suitable receptacles 23 to contain foodstuffs or other materials to be preserved. As shown in Fig. 1, two or more such trays 23 may be arranged side by side, and each of these trays is provided with a lid or cover 24 which is perforated or otherwise formed to render it penetrable by ultraviolet rays. In the present instance the lids or covers 24 are shown as provided with openings therein through which the downwardly projected ultraviolet rays may enter the receptacles 23.

In Fig. 3 there is shown a similar storage receptacle 23a which may be used and which is provided with a lid or cover 24a preferably formed of woven wire or other screen material, the cover 24a being shown in plan in Fig. 4.

In Fig. 5 there is shown receptacles 23b, each of which is open at bottom and top and provided with a screen or other openwork bottom 24b and a lid or cover 24c having a body of screen or other suitable openwork material. Receptacles 23b so formed may be stacked in a tier one upon the other, for the purpose of securing economy of storage space, and the openwork bottom and top portions thereof will permit passage of the ultraviolet rays to the foodstuffs or other materials to be preserved therein.

In place of the openwork, perforate sheet metal or screen material covers or lids or lids and bot-

toms of receptacles of the character described, lids or lids and bottoms formed of glass or any other suitable material penetrable by ultraviolet rays may be employed.

In Figs. 6 and 7 there is shown a double tube unit 10a which is highly suitable for use in refrigerators in providing for both ultraviolet radiation and illumination. In this tube, the intermediate elongated transmission portion 25 of the tube is provided with enlarged terminal portions 26 and 27 and with electrodes 28 and 29 respectively positioned in such enlarged terminal portions. One of these electrodes suitably supports a mercury cup 30. The leads 31 and 32 for both electrodes are brought out through the same end of the tube, so that the long lead 32 extends throughout the length of the tube from electrode 29 to a point adjacent to and beyond electrode 28. An incandescent or fluorescent lamp 33 is integrally formed on the enlarged terminal portion 26 of the ultraviolet lamp and is equipped with the usual electrodes and fluorescent layer or incandescent filament. In the present instance the lamp 33 shown is of the incandescent lamp type and provided with a suitable incandescent filament 34. The lamp 33 is sealed at its connection with the enlargement 26 and also provided with a sealed base 35, and the leads from the electrodes 28 and 29 and terminals of the filament 34 extend through this sealed base 35 and terminate in prongs 36 for connecting the elements of the tube with the terminals of an electric circuit when the tube is properly fitted within a receiving socket. It is possible with this type of tube having a filament type of bulb for illumination to employ a filament which will operate on the same voltage as that used for the ultraviolet tube, thus permitting of the use if desired of a two-prong base. In this case it is also possible, of course, to employ a transformer having only two secondary taps for the single operating voltage required, instead of having three taps to provide different voltages for the two parts of the tube unit. It is further possible to design the conducting filament for operation on 110 volts, so that it may be connected directly to the commercial supply without passing current through a transformer, in which case a four-prong base is required, but two prongs are not connected to the transformer secondary. In the use of such a tube 10a it may be positioned in an opening in the wall 8 so that the transmission portion 25 of the envelope will be exposed to the chamber 2, and so that the lamp 33 may be disposed to illuminate such chamber, and the arrangement may be such that the filament 34 will be energized and deenergized when the door 7 is opened and closed, as will be readily understood.

In Fig. 8 there is shown a modified construction in which the ultraviolet tubes, which are also of illuminating character, are arranged at the base of the refrigerator casing. As shown the refrigerator casing 1a is provided at its base with outwardly opening doors 37 and positioned within the casing are ultraviolet tubes 10b, one arranged on each side of the vertical center of the casing. Each of these tubes comprises an envelope having an elongated transmission portion 38 and enlarged terminal portions 39 and 40 within which are respectively disposed the crater electrodes 41 and 42. The construction and mounting of these electrodes may be similar to that employed in tube 10a. The tube 10b, however, has its enlarged portions 39 and 40 pro-

vided with sealed contact terminals 43 and 44 respectively which engage conducting sockets 45 and 46 arranged in the refrigerator casing. One of these sockets may be formed to allow of endwise sliding insertion and withdrawal movements of the tube and be provided with a spring or other holding means therein for retaining the inserted tube in position. The tubes 10b are arranged to direct the ultraviolet rays upwardly within the refrigerator and have the lower surfaces of their discharge portions 28 provided with fluorescent coatings 47 for the purpose of effecting illumination of the portions of the casing in which they are arranged.

In Figs. 9 to 11, inclusive, there is shown a refrigerator casing 1b having a refrigerating unit or compartment 3a at its top and having arranged therein adjacent one of its upright walls an ultraviolet radiation tube which directs the rays horizontally across the casing. This tube 10c comprises an envelope having an elongated discharge portion 48 provided with enlarged terminals 49 and 50, respectively, in which are disposed the crater electrodes 51 and 52, respectively. The leads 53 and 54 from these electrodes are connected with a transformer 55 of suitable type and extend outward through a sealed base 56 suitably fitted within a socket 57 in the base of a lamp casing or support 58 having conductors 59 for the supply of current from a suitable source. The elongated lead 54 from the electrode 51 is provided with a sheathing 60 of glass or other suitable insulating material. The tube 10b is supported in an upright position in the casing 58 which has an open side facing the refrigerating space or chamber 2 of the refrigerator 1b so that the ultraviolet rays will be projected horizontally across the refrigerator and in contact with any foodstuff or material which may be stored therein. This type of ultraviolet ray irradiation device may be of a portable type so that it may be applied for use to any refrigerator, or it may be a fixture of the refrigerator and formed as a part of the equipment thereof when the refrigerator is manufactured.

Tubes of the class disclosed may be operated at either high or low voltage to produce radiation generated in the particular wave lengths suited for irradiating refrigerators. For this purpose, however, it is preferred to use wave lengths between 2400 and 4000 Angstrom units and low pressures, from 2 to 4 millimeters with a voltage from 250 to 500 and a current drain of 1 to 5 milliamperes according to the area of space to be covered. This low striking and operating voltage assists in reducing certain operating difficulties. The tubes which are disclosed have the substantial advantage that they are relatively inexpensive in production and deliver an intense beam of ultraviolet radiation at minimum investment cost. These tubes may be set into shallow recesses in the refrigerator chamber walls or in compartments therein and disposed so as to radiate a beam of ultraviolet radiation over a wide angle in the refrigerator interior. It will be noted that in the forms of tubes disclosed the electrodes are positioned in a compartment or compartments of the envelope separated from the discharge portion of the envelope by a restricted neck or necks, so that the discharge between the electrodes takes place in a separate chamber of the envelope and will only to an extremely small extent discolor the surface of the envelope through which ultraviolet radiations is transmitted. As stated, those por-

tions of the tubes designed for ultraviolet radiation are preferably formed of a glass which has high transmission power in the ultraviolet spectrum band, while the remaining portion of each tube may be made of ordinary and cheaper glass. However, if desired, the whole envelope may be formed of an efficient ray-passing glass, in which case it may be desirable to apply to the non-transmission portion of the envelope some suitable paint or varnish substantially opaque to ultraviolet radiation in order to prevent tube losses. In all such cases the ultraviolet transmitting glass, of whatever character, should be of a definite wall thickness.

The graph, Fig. 12, shows the transmission values of an ultraviolet tube embodying the invention and made of a given wall thickness at different wave length microns.

From the foregoing description, taken in connection with the accompanying drawings, the construction, operation and advantages of the invention will be readily understood without a further and extended description. While the structures disclosed are preferred, it will, of course, be understood that changes in the form, construction and arrangement of parts may be made within the scope of the appended claims without departing from the spirit or sacrificing any of the advantages of the invention.

What is claimed as new and patentable is:

1. In an irradiated refrigerator, a refrigerator casing having a refrigerating chamber and a compartment separated by a wall from said chamber, said wall having a slot therein a chamber within and closed against the compartment and having an open side facing the slot in said wall, and an ultraviolet tube disposed within the chamber of the compartment and comprising an envelope having a discharge portion and a flaring transmission portion communicating at its contracted side with the tube and provided at its enlarged side with a lens facing the open side of the chamber and slot in the wall and lying substantially in the plane of said wall, and electrodes in said discharge chamber for producing ultraviolet rays.

2. In an irradiated refrigerator, a refrigerator casing having a refrigerating chamber, a compartment at the top of said chamber including a wall separating it from the chamber, a lamp casing within the compartment and opening at its bottom through said wall, and an ultraviolet tube in said lamp casing comprising an envelope having an upper discharge portion and a lower flaring transmission portion, said flaring transmission portion being provided with a wide angle lens located in the plane of said opening for projecting ultraviolet rays over a wide area of said refrigerating chamber, and electrodes in said discharge portion of the tube for propagating such rays.

3. A refrigerator having a refrigerating chamber, a lamp chamber, a partition wall between said chambers formed with an opening therein, and an ultraviolet tube housed within the lamp chamber and embodying an envelope having a discharge portion and an outwardly flaring transmission portion projecting laterally therefrom and facing the opening in the partition wall, said transmission portion communicating at its contacted side with the discharge portion and being provided at its enlarged side with a wide angle lens disposed substantially in the plane of the wall and adapted to project the ultraviolet rays into the refrigerating chamber, and ultra-

violet ray producing means in the discharge portion of the envelope.

4. In an irradiated refrigerator, a refrigerator casing having a refrigerating chamber, a compartment at the top of said chamber including a wall separating it from the chamber, said wall having an opening therein, and an ultraviolet tube in said compartment comprising an envelope having an upper discharge portion and a lower flaring transmission portion, said flaring trans-

mission portion being provided with a wide angle lens located in the plane of said opening for projecting ultraviolet rays over a wide area of said refrigerating chamber, and means in said discharge portion of the envelope for producing ultraviolet rays.

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