

[72] Inventor **Alfred Landry**
 7589 Calvocado, Lemon Grove, Calif.
 92045

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Primary Examiner—Morris O. Wolk
Assistant Examiner—Joseph T. Zatarga
Attorney—Markva, Smith & Kruger

[54] **WATER STERILIZER**
 9 Claims, 6 Drawing Figs.

[52] U.S. Cl..... **21/102,**
 21/54 R, 250/43, 250/48

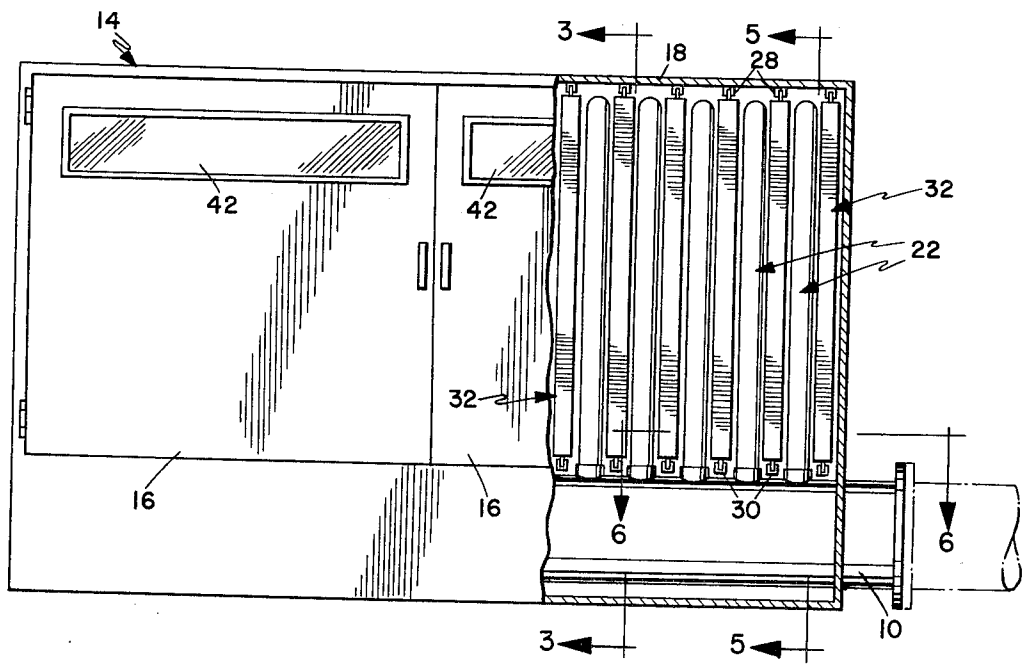
[51] Int. Cl..... **A61L 3/00**

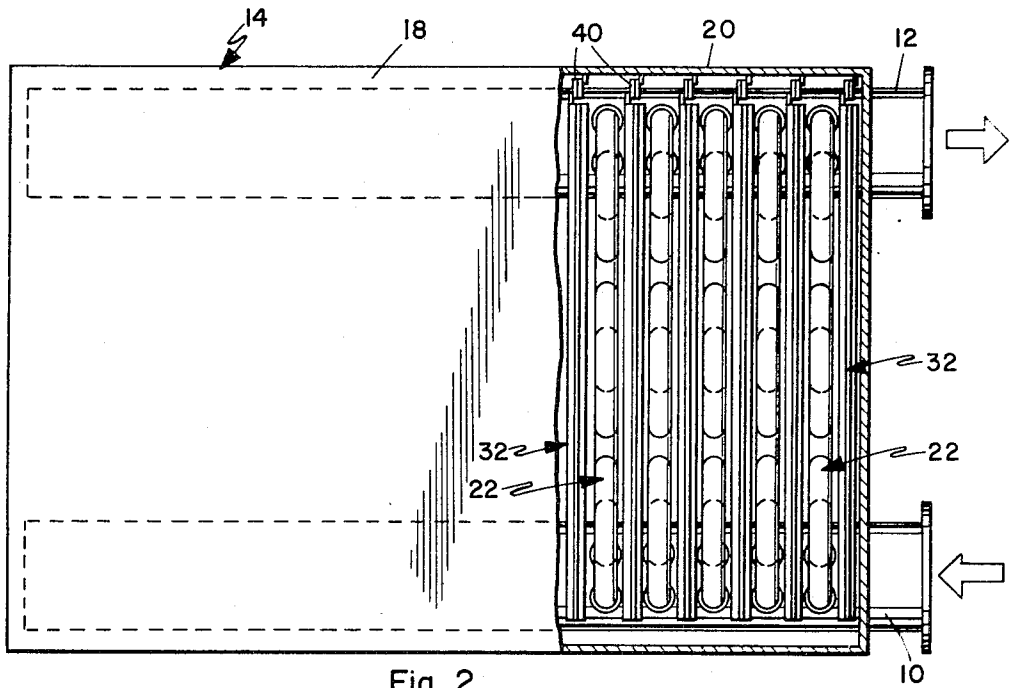
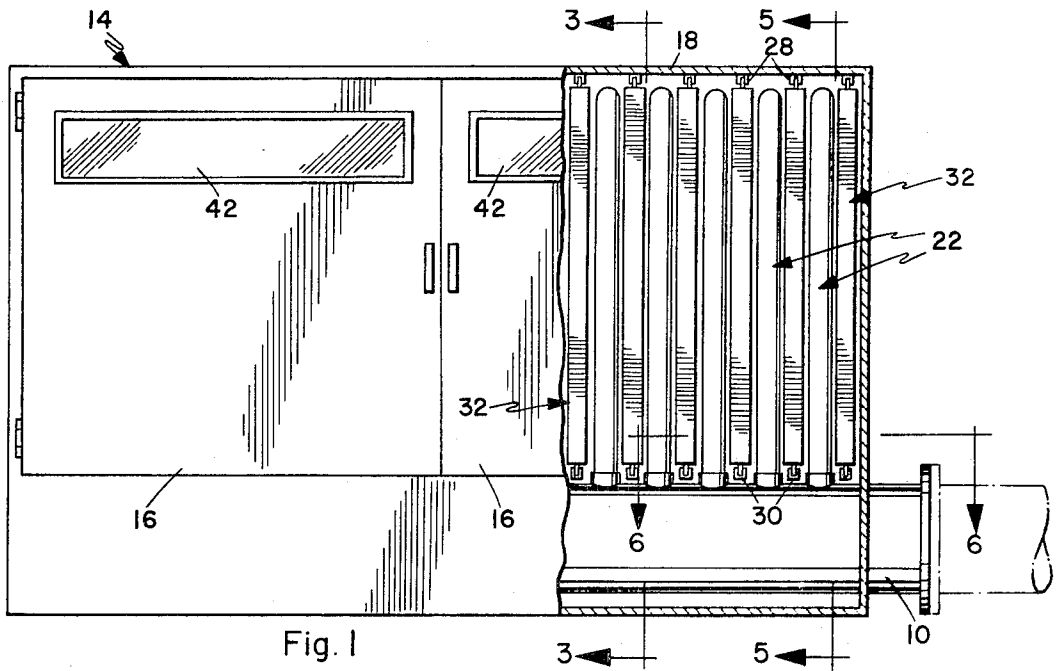
[50] Field of Search..... 21/54, 101,
 102; 250/43, 48

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ABSTRACT: The water sterilizer is proposed for large-volume, continuous flow operation with spaced banks of transparent irradiation media flow tubes of nonstick material fixed within a cabinet. The tubes are nested in interdigitated loops in each bank. Between the banks of fixed tubes are multiple germicidal lamps and reflectors mounted on frames slidable between the banks of tubes and slidable out of the cabinet for inspection and replacement of the lamps.





INVENTOR.
ALFRED LANDRY
BY
Knox & Knox

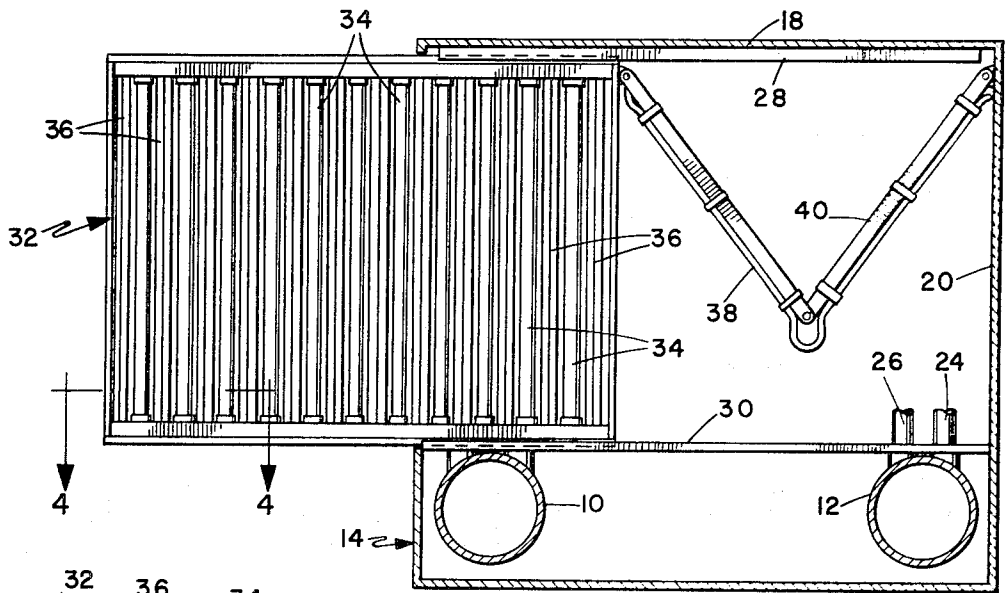


Fig. 3

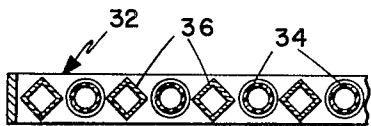


Fig. 4

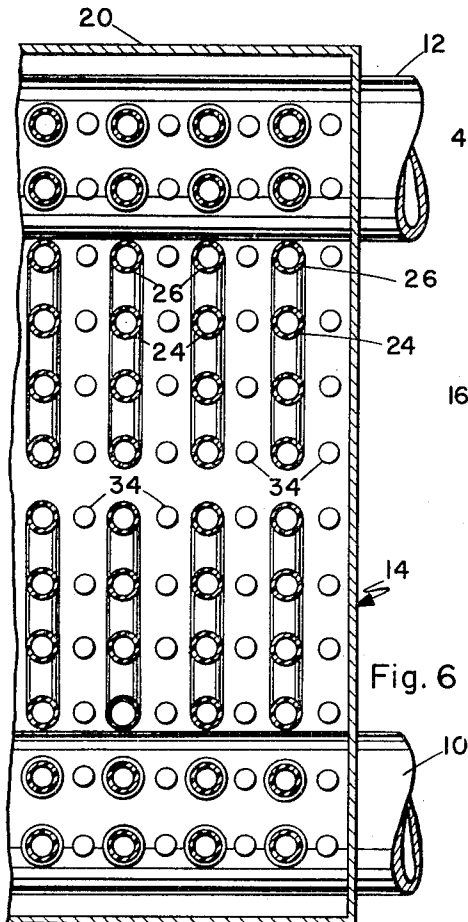


Fig. 6

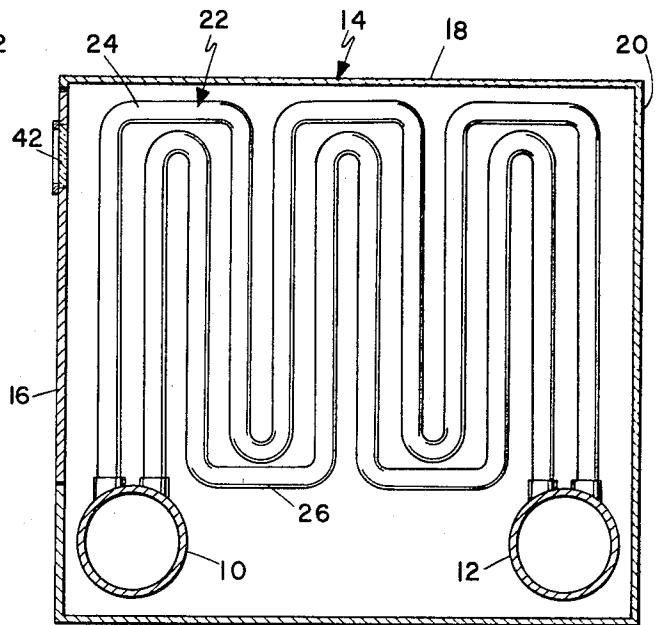


Fig. 5

INVENTOR.
ALFRED LANDRY
BY
Knox & Knox

WATER STERILIZER

BACKGROUND OF THE INVENTION

The need for water sterilization is regarded as critical and mounting steadily and prior apparatus has sometimes failed to provide economical large volume treatment because resort to larger media flow pipes has reduced effective kill of fungi, bacteria and viruses. Fused silica or quartz used in prior art flow tubes has been subject to deterioration known as solarization with loss of transmittability and such materials, including glass, all tend to accumulate a film on the inside of the tubes in use, and inspection and replacement of lamps has in the past usually involved considerable down time of the apparatus.

SUMMARY OF THE INVENTION

Fixed main inlet and main outlet pipes are parallel and spaced apart with banks of irradiation tubes connecting the pipes and arranged transversely of the pipes to define spaces between the banks. The tubes are return-folded with the loops of the tubes in each bank interdigitated. Frames carrying the germicidal ray lamps are disposed in the spaces between the banks of tubes and these frames are easily withdrawn without electrical disconnection of the lamps for inspection and any needed replacement. The tubes are of nonstick material and there are multifaced reflectors mounted on the frames between the lamps. The frames are preferably slidably mounted transversally of a cabinet housing the tubes so that the frames can be individually withdrawn with their complement of lamps and reflectors. The interdigitation of the loops of the tubes and the multiplicity of the tubes in each bank achieves a large flow volume without undue increase in the diameter of the tubes, thus maintaining an extremely high germicidal efficiency.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of the water sterilizer with one side of the cabinet partially cut away.

FIG. 2 is a top plan view with part of the top of the cabinet broken away.

FIG. 3 is a vertical sectional view on the line 3—3 in FIG. 1 with the corresponding frame, carrying its complement of lamps and reflectors, partially extended. This view also illustrates the flexible electrical connection to the frame. The irradiation tubes are largely omitted for clarity.

FIG. 4 is an enlarged horizontal sectional view of a sliding frame with its lamps and reflectors, taken on the line 4—4 in FIG. 3.

FIG. 5 is a vertical sectional view on line 5—5 in FIG. 1 and designed to illustrate only the interdigitated looping of one bank of tubes.

FIG. 6 is an enlarged fragmentary sectional view on the line 6—6 in FIG. 1 of the main inlet and outlet pipes, the irradiating tubes and the lamps. The frames and reflectors being omitted for clarity.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Large-volume flow of the media being sterilized, usually but not necessarily water, is provided for in the instant sterilizer construction. A large main inlet pipe 10 and a main outlet pipe 12 are capped at the ends thereof and are preferably disposed in parallel spaced relation in the lower portion of a cabinet generally indicated at 14. The cabinet is represented as rectangular in plan and elevation and with access doors 16 at one side, a top panel 18 and a fixed wall 20 opposite the doors.

To handle such large-volume flow banks 22 of irradiation tubes indicated individually at 24 and 26 are connected to and between the main inlet and outlet pipes 10 and 12 as best illustrated in FIG. 5. The tubes 24 and 26 each define a generally planar folded path across the cabinet and transversely of the inlet and outlet pipes, with the loops of the tubes interdigitated to effect greater compactness. Although two tubes are shown in each bank, the present concept embraces use of three or

more tubes in each bank with only minor and obvious variation.

Pairs of rails, each pair having an upper rail 28 which may be fixed to the top panel 18 of the cabinet and a bottom rail 30 which may be terminally secured to the sides of the cabinet, provide sliding mounting for generally planar frames 32. The banks 22 of irradiation tubes are spaced apart just sufficiently to accept the frames 32 therebetween. Each frame carries a plurality of germicidal ray generators 34 ordinarily ultraviolet ray lamps terminally socketed in the frame and preferably disposed parallel to and along the full length of each leg of each loop of tubes 24 and 26. It will be noted also that the generators or lamps 34 are disposed on two sides of tubes 24 and 26 for maximum exposure. For further increasing the efficiency of radiation elongated reflectors 36 are interposed between each pair of lamps 34 in each frame 32. These reflectors 36 are approximately the same length as said lamps 34 and parallel therewith, being terminally secured in the frames 32. The cross-sectional shape of the reflectors 36 may vary somewhat but a preferred form is the illustrated square section polished aluminum tubing which has been demonstrated as highly efficient.

The material of the tubes 24 and 26 is that sold under the trademark TEFLON which is known technically as FEP (fluorinated ethylene propylene). This material has the characteristics of being transparent to germicidal rays from the lamps 34 and has nonstick properties such that no film builds up on the tubes 24 and 26 during use. This results in the efficiency of transmission of the rays through the tubes into the media remaining constant, without cleaning the tubes. These tubes are also inert to all chemicals likely to be encountered in the present application.

Electrical connection to the lamps 34 in each frame 32 is effected through a flexible cable 38 protected by a hinged carrier 40 to allow flexing without damage to the cables when the frames are pulled out, as indicated in FIG. 3, for inspection of the lamps and possible replacement when necessary.

Although germicidal radiation will ordinarily have to be stopped while the doors 16 are open, a reasonably efficient inspection can be accomplished through protective glass windows 42 in the doors, during operation. Of course these doors are opened to permit selective withdrawal of the frames but electrical interlock switches are incorporated in the power circuit to prevent inadvertent opening during operation of the lamps 34.

While water is probably the media being sterilized, the instant apparatus is equally suitable for like processing of several fluid foods and beverages, and in preparing sterile fluids for scientific and medical uses.

Having described and illustrated the invention, what is claimed is:

1. A sterilizer unit for fluid media comprising:

- a. a main inlet and outlet media flow means disposed on opposite sides of the unit,
 - b. a plurality of parallel banks of irradiation tubes composed of a material that is transparent to germicidal rays and through which said fluid media flows,
 - c. said irradiation tubes being connected to and extending between said inlet and outlet means,
 - d. said parallel banks having spaces therebetween and
 - e. frames movably mounted within said spaces and having germicidal ultraviolet ray generators operably mounted thereon and carried thereby selectively into operative position within said spaces and into inoperative position for inspection and replacement of the generators.
2. A sterilizer unit as defined in claim 1 wherein said frames include reflectors mounted thereon which are disposed between the generators to enhance the efficiency of the ultraviolet rays.
3. A sterilizer unit as defined in claim 1 wherein said irradiation tubes have a diameter sufficiently small to allow penetration of the ultraviolet rays through the fluid media and are composed of fluorinated ethylene

- propylene whereby film buildup is prohibited on the inside of the tubes to allow transmission of ultraviolet rays over an extended period of time.
- 4. A sterilizer unit as defined in claim 1 wherein each said bank has a plurality of tubes connected to and extending between said inlet and outlet means, said irradiation tubes being serpentine within the plane of each corresponding frame and including loops which are interdigitated for greater compaction of the tubes within each said frame. 5
- 5. A sterilizer unit for fluid media comprising: 10
 - a. a cabinet,
 - b. main inlet and outlet media flow means disposed on two different sides of the cabinet and located therein,
 - c. parallel banks of irradiation tubes connected to and extending between said inlet and outlet means thereby providing flow of all media from the inlet to the outlet means in each bank, 15
 - d. said banks having spaces therebetween and being disposed generally in planes transversely of said inlet and outlet means, 20
 - e. said irradiation tubes being constructed of a material that is transparent to germicidal ultraviolet rays and has non-stick properties whereby there is no film buildup upon the inside of the tubes during extended use thereof, 25
 - f. frames movably mounted in said spaces between the banks, and
 - g. germicidal ultraviolet ray generators and reflectors operably mounted on said frames, said reflectors being disposed between said generators, 30
 - h. said frames being movable into operative positions within the cabinet and into inoperative positions outside the cabinet for inspection and replacement of said generators.
- 6. A sterilizer unit as defined in claim 5 wherein 35

- said irradiation tube material is fluorinated ethylene propylene.
- 7. A sterilizer unit as defined in claim 5 wherein each said bank has a plurality of tubes connected to and extending between said inlet and outlet means, said irradiation tubes being serpentine within the plane of each corresponding frame and including loops which are interdigitated for greater compaction of the tubes within each said frame.
- 8. A sterilizer unit as defined in claim 7 wherein said reflectors are multifaced and elongated in the direction of the ray generators.
- 9. A sterilizer for fluid media comprising:
 - a. main inlet and outlet media flow pipes in parallel with respect to each other,
 - b. parallel banks of irradiation tubes connected to and extending between said inlet and outlet pipes,
 - c. said banks having spaces therebetween,
 - d. said irradiation tubes composed of a material that is transparent to germicidal rays, and
 - e. frames slidably mounted in said spaces and extending transversely of said parallel inlet and outlet pipes,
 - f. said frames having germicidal ray generators operably mounted thereon and carried thereby selectively into operative position in said spaces and into inoperative position for inspection and replacement of the generators,
 - g. said irradiation tubes in each bank being serpentine and disposed in a vertical plane adjacent a corresponding pair of said frames,
 - h. said irradiation tubes in each bank having interdigitated loops for greater compaction of tubes within each said vertical plane.

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