United States Patent [19]

MacFarlane

[11] **3,861,872**

[45] **Jan. 21, 1975**

[54] **STEAM STERILIZER**

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[22] Filed: **Apr. 2, 1973**

[21] Appl. No.: **347,329**

[52] **U.S. Cl.** **21/56,** 21/98, 165/105

[51] **Int. Cl.** **A61l 3/00,** F28b 1/06, F28f 19/06

[58] **Field of Search** 21/98, 94, 56; 165/105, 165/133, 135; 23/290

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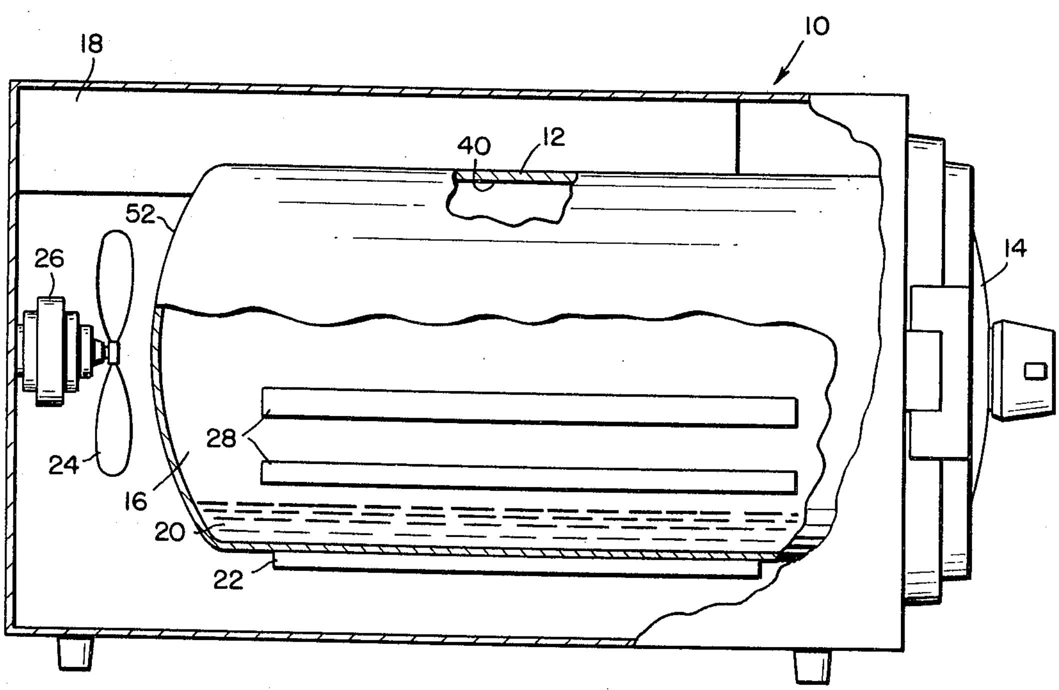
[57] **ABSTRACT**

In a steam sterilizer of the self-contained, single shell, steam generating type, the interior surface of the chamber is roughened (as by sandblasting) to prevent the formation of water droplets, during cool-down, on all interior surfaces located above the load, to prevent water from dripping onto the load and thus to minimize the amount of moisture absorbed by the load during the sterilization process.

8 Claims, 4 Drawing Figures



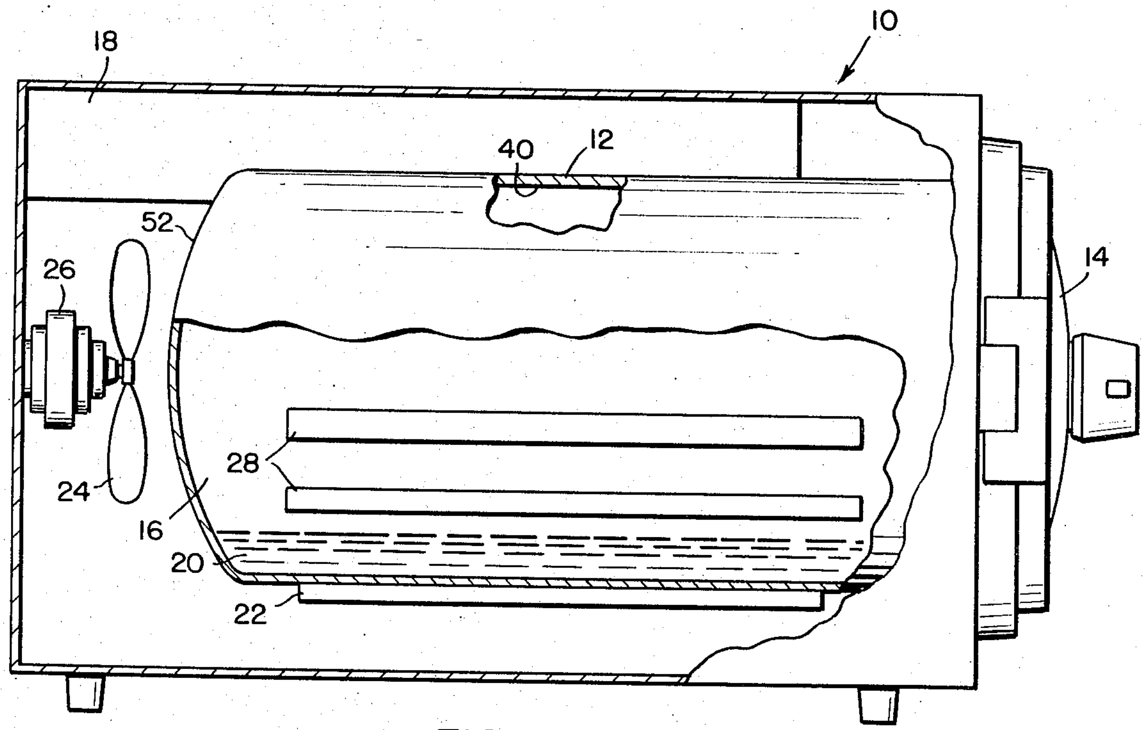


FIG. 1

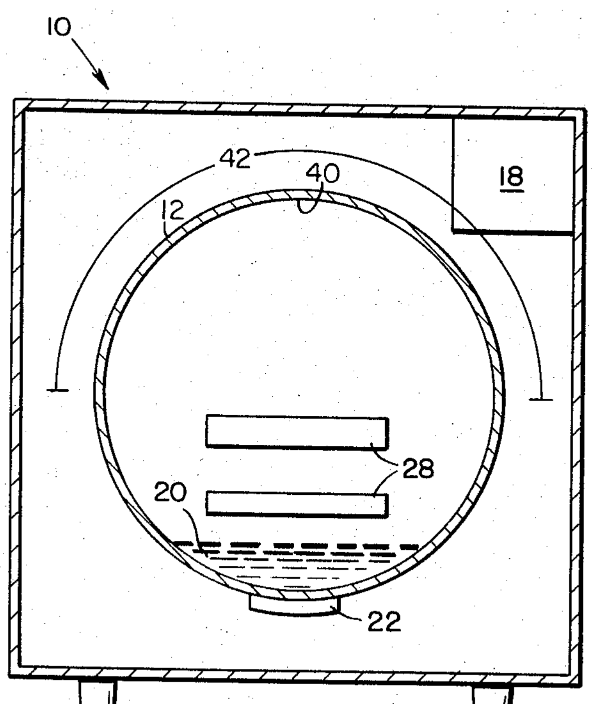


FIG. 2

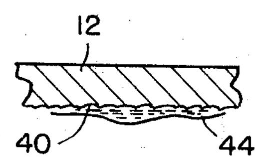


FIG. 3

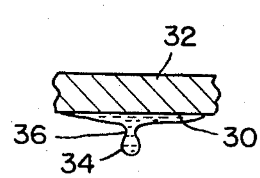


FIG. 4
PRIOR ART

STEAM STERILIZER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to steam sterilization, and in a preferred embodiment, to minimizing moisture absorption by the load in a self-contained, single shell, steam generating type of sterilizer.

2. Description of the Prior Art

In a steam sterilizer of a self-contained, steam generating type, the steam remaining in the chamber after sterilization, is dissipated prior to opening the door to the closed vessel. The method and apparatus described in the Skaller U.S. Pat. No. 3,361,517 minimizes many of the problems associated with rapid dissipation of the steam. However, this patented system does not solve the problem of the formation of water droplets at the top of the sterilizing chamber during cool-down. Should water droplets fall onto a wrapped package causing wet spots, air-borne and/or surface bacteria can easily penetrate such wet spots and re-contaminate the previously sterile contents. The above-mentioned Skaller patent employed an inner shell over the goods to prevent droplets from dropping onto the load. Regarding the sandblasted surface of the present invention, it is known to sandblast the interior of a jacketed rectangular sterilizing vessel to enhance the appearance of the welds.

It is a primary object of the present invention to provide an improved method and apparatus for overcoming the above-mentioned problem inherent in the prior art, without requiring the use of an inner liner over the load.

It is a specific object of the present invention to provide a method and apparatus for preventing the formation of droplets on the interior surface of the upper area (hereby defined as that area overlying the load-containing area of the sterilizing chamber), of the sterilizing vessel and the consequent falling of such droplets onto the load.

SUMMARY OF THE INVENTION

The formation of water droplets on, and the consequent dropping of water droplets from, the interior surface of the upper area of a self-contained, single shell, steam sterilizer, are prevented according to the present invention as follows. The interior surface of at least the upper area of the sterilizing vessel is treated (for example, by sandblasting) to provide a surface on which the formation and development of droplets is prevented or reduced. The sandblasted surface preferably has a roughness of about 250–300 microinches. The roughness causes the condensate to form over a large area with a low profile configuration. This is in sharp contrast to the formation of heavy droplets with a low amount of contact area between the droplet and the vessel surface when a highly polished interior surface is used, due to the low surface tension between the condensate and the surface. The condensate is more readily flashed off of the surface, by whatever heat is available in the vessel wall, when there is a larger area of contact between the condensate and wall. Further, the interior surface of the upper area is kept free of irregularly shaped surface features, because droplets tend to form on such features.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more fully understood by reference to the following detailed description thereof, when read in conjunction with the attached drawings, wherein like reference numerals refer to like elements, and wherein:

FIG. **1** is a schematic longitudinal cross-sectional view through a steam sterilizer made according to the present invention;

FIG. **2** is a schematic transverse cross-sectional view through the sterilizer of FIG. **1**;

FIG. **3** is an enlarged fragmentary view through the upper area **42** of FIG. **2**; and

FIG. **4** is an enlarged fragmentary view through an upper area of a prior art sterilizer vessel.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

With reference now to the drawings, FIGS. **1–3** show a preferred construction of a steam sterilizer incorporating the present invention, while FIG. **4** shows the formation of water droplets as occurs in prior art sterilizers. Reference will first be made to the general type of sterilizer to which this invention relates, a brief description of the prior art will then be made, and the present invention will then be described in detail.

FIGS. **1–3** show a steam sterilizer **10** designed for operating automatic cycles to process such items, for example, as wrapped instruments, unwrapped instruments for immediate use, cotton dressings and bandages, disassembled syringes, liquids, and solutions. The system employed for the sterilization process is the admission of a controlled amount of distilled water into the chamber which is heated to provide steam. The steam rapidly and effectively penetrates the load. A fan cooling system rapidly cools the vessel **12** after the sterilizing phase, condensing the chamber steam and moisture in the load. The sterilizer **10** includes a cylindrical pressure vessel **12** (preferably of stainless steel) having a door **14** and enclosing a sterilizing chamber **16.** The sterilizer **10** also includes a water supply tank **18** for filling a water reservoir **20** inside the chamber **16.** A heater **22** [such as a dual wattage (100W/1500W) strip heater] is located adjacent the bottom of the vessel **12.** A fan **24** operated by a motor **26** (for example a 1/100 H.P. 3000 RPM motor) accelerates the condensation process during cool-down. The goods to be sterilized are placed in a plurality of trays **28** in the chamber **16.**

The preferred sterilizer **10** is a table top model that heats to about 280° F in about 24 minutes. A temperature of about 270° F is maintained for a minimum of about 3 minutes, and above 250°F for a minimum of about 8½ minutes. The vessel **12** is cooled by the fan **24** to about 195°F in about 17 minutes. The cycle time from a cold start is about 42 minutes.

The details and operation of a self-contained, steam generating type of sterilizer, such as shown in U.S. Pat. No. 3,361,517 are well-known to those skilled in the art and therefore need not be described in detail here. The present invention, which is an improvement on such well-known type of sterilizers will now be described in detail.

Referring now briefly to the prior art shown in FIG. **4**, it is a well-known problem of self-contained, single shell, steam generating sterilizing vessels that high interior surface condensation forms during the cool-down period of the cycle when the motor **26** is energized and rotates the fan **24** causing rapid condensation in the chamber **16.** FIG. **4** shows the prior art wherein an interior surface **30** of a sterilizer vessel **32** has a highly polished smooth surface on which condensate forms, with very low surface tension between the condensate and the interior surface **30,** into droplets **34** with a very low contact area **36** between the droplet and the surface **30.** The latent heat that remains in the upper portion of the vessel **12** during cool-down is not sufficient to cause the droplet **34** to flash off of the surface **30.** Further, water droplets tend to form from condensate at irregularities, such as openings and areas of non-uniform thicknesses, on the interior surface **30** of an upper area **42.**

With reference now to FIGS. **1–3** (particularly FIG. **3**), this problem is solved, according to the present invention by providing an interior surface **40** of at least the upper area **42** of the vessel **12** (overlying the load-containing area of the sterilizer), with a roughened finish. The surface **40** is roughened such that condensate **44** will not "bead" or form droplets that can drop onto the load, but rather the condensate will form over a large area of the surface **40** with a low profile configuration (in sharp contrast to the formation of the droplets **34**). The roughness can be provided, for example, by sandblasting the surface **40.** The roughness obtained depends, of course, on the grit used and can be conveniently expressed in microinches. The roughness of 250–300 microinches has been found to give superior results in preventing development of moisture droplets **34,** while it has been found that a matte finish of **45** microinches will allow droplets **34** to form. The useful range of roughness is above 50 microinches and the preferred range is 250–300 microinches. Other methods of treating the interior surface **40** than sandblasting can, of course, be used to provide the rough surface. While the roughness is necessary only in the upper area **42,** it can be employed over the entire inner surface of the chamber **16** if desired. For example, it may be easier to sandblast the entire inner surface than to restrict it to just one area thereof.

The formation of droplets on irregularities (not shown) is prevented by eliminating irregularities (such as openings and areas of non-uniform thickness) from the interior surface **40** of the upper area **42.** The formation of droplets at irregularities is caused by a heat sink effect wherein the area immediately adjacent to the irregularity is cooler than the surrounding area.

The term "flash off" is hereby defined for use in the present specification and claims to mean the instantaneous, nearly instantaneous, and very rapid evaporation or change of condensate from the liquid to the gas or vapor state.

The term "droplet" is hereby defined for use in the present specification and claims as meaning condensate such as shown in FIG. **4** wherein the area of a horizontal cross-section at a mid-point is smaller than that at the largest part of the droplet.

Other means for preventing or reducing the formation of droplets can be used such as other means for roughening a smooth surface, or even by forming the surface with a rough finish when it is initially made. The rough surface can be the inside surface of the vessel **12** as shown and described above or a liner with a rough surface can be inserted into the vessel. Alternatively, the interior surface can be coated with a material with a high affinity for water that will reduce the formation of droplets **34.**

The invention has been described in detail with particular reference to the preferred embodiment thereof, but it will be understood that variations and modifications can be effected within the spirit and scope of the invention as described hereinabove and as defined in the appended claims.

I claim:

1. In a self-contained, single shell, steam generating sterilizer including a sterilizing vessel having a sterilizing chamber therein, and a fan adjacent the vessel for cooling the outside surface of the vessel, the improvement comprising:

a. the interior surface of an upper area of said vessel, overlying substantially all load-containing areas of said chamber, having a surface roughness greater than 50 microinches, said surface roughness being such that the formation thereon, from condensate, of water droplets, is less than that which would occur under the same conditions on a surface having a roughness of less than 50 microinches.

2. The apparatus according to claim **1** wherein said vessel is cylindrical with a horizontal axis.

3. The apparatus according to claim **1** wherein said entire interior surface of at least said upper area is uniform.

4. In a self-contained, single shell, steam generating sterilizer including a sterilizing vessel having a sterilizing chamber therein, and a fan adjacent the vessel for cooling the outside surface of the vessel, the improvement comprising:

a. said vessel being cylindrical with a horizontal axis;

b. the interior surface of an upper area of said vessel, overlying substantially all load-containing areas of said chamber, having a surface roughness between about 250 and 300 microinches.

5. In the method of reducing load absorption of water during cool-down while sterilizing a load in a self contained, single shell, steam generating sterilizer including a cylindrical sterilizing vessel having a sterilizing chamber therein and means for cooling the outside surface of the vessel, the improvement comprising:

a. providing the interior surface of an upper area of said vessel, overlying substantially all load-containing areas of said chamber, with a surface roughness greater than 50 microinches, such that the formation thereon, from condensate, of water droplets, is less than that which would occur under the same conditions on a surface having a roughness of less than 50 microinches.

6. The method according to claim **5** wherein said providing step comprising providing said roughness over only said upper area.

7. The method according to claim **5** wherein said providing step comprises providing said roughness in the range of about 250–300 microinches.

8. The method according to claim **5** wherein said entire interior surface of at least said upper area is uniform.

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