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R. D. CASTLE ET AL

3,147,068

CLOSURE APPARATUS FOR PRESSURE CHAMBER

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2 Sheets-Sheet 1

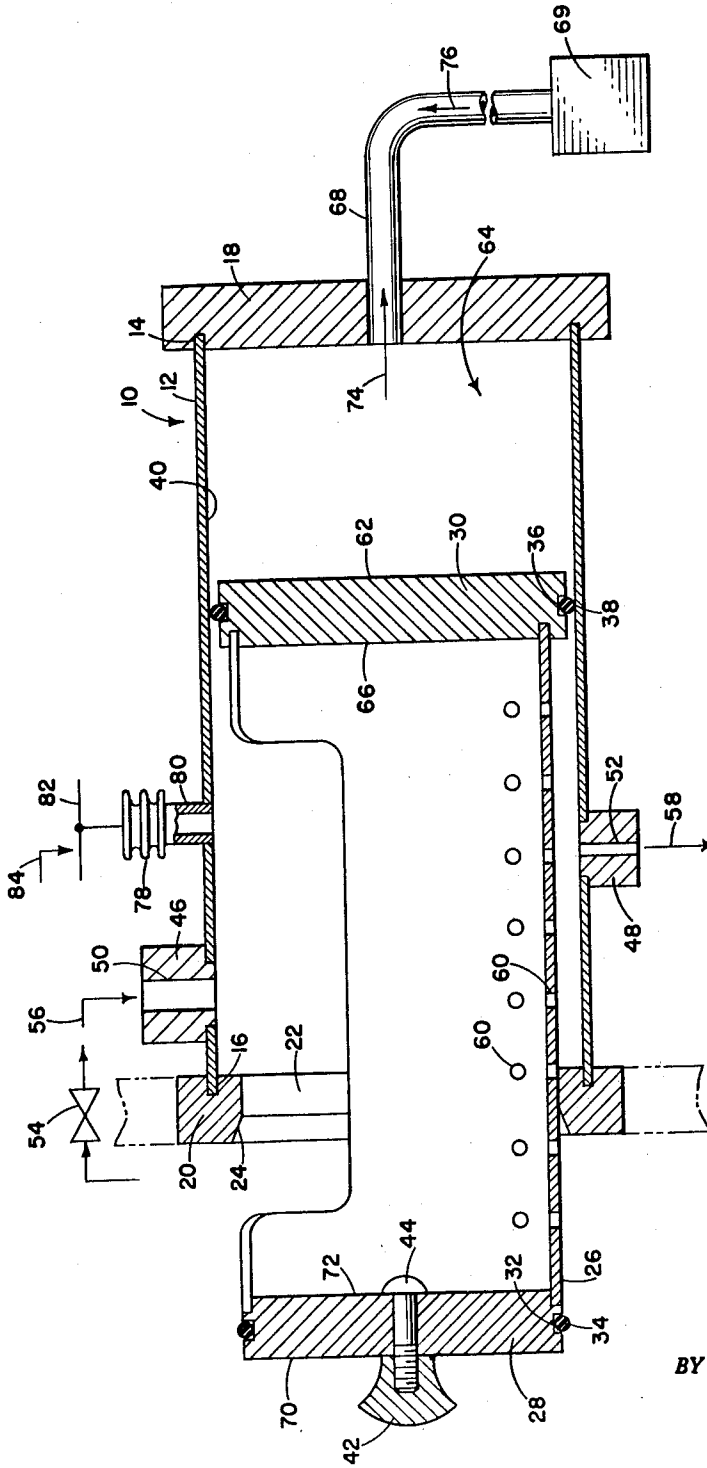


Fig. 1

INVENTORS.  
RICHARD D. CASTLE  
SAM PAPALIA  
BY *Thomson, Reesell  
& Schow*  
ATTORNEYS

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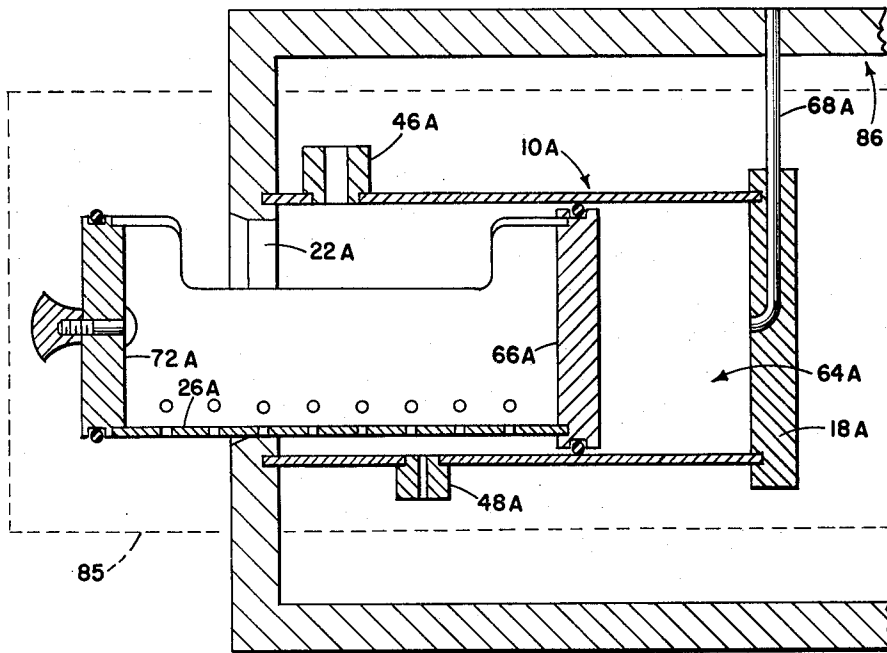


Fig. 2

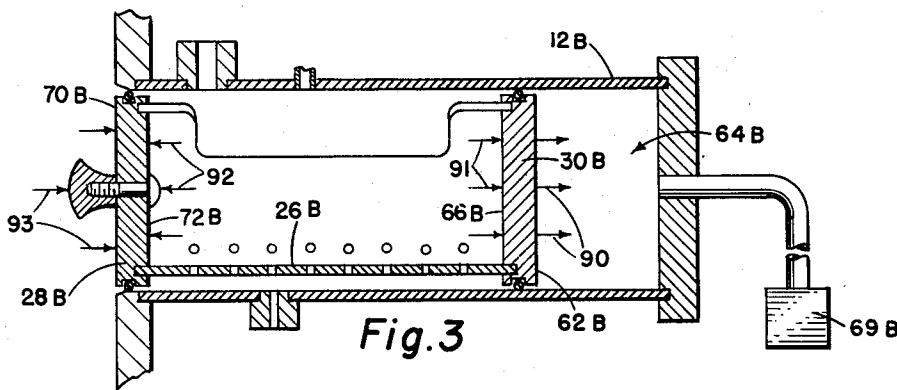


Fig. 3

INVENTORS.  
RICHARD D. CASTLE  
SAM PAPALIA  
BY *Johnson, Russell & Schow*  
ATTORNEYS

3,147,068

**CLOSURE APPARATUS FOR PRESSURE CHAMBER**

Richard D. Castle and Sam Papalia, Rochester, N.Y.,  
assignors to Wilmot Castle Company, Rochester, N.Y.,  
a corporation of New York

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15 Claims. (Cl. 21-98)

This invention relates to closure apparatus for a pres-  
surized chamber and particularly for use with a steam  
sterilization chamber.

The basic concept of this invention comprises a slid-  
ing tray extending through an opening in the sterilizer  
chamber, and having rigidly mounted at opposite ends  
thereof two plates, a closure plate and a locking plate.  
The closure plate is adapted for closing and sealing the  
opening through which the tray otherwise extends. The  
locking plate is slidably sealed to the inside periphery  
of the sterilizer chamber so that an outside surface of  
the locking plate is sealed from the pressure inside the  
sterilizer while an inside surface of the locking plate is  
exposed to that pressure. When the closure plate is  
substantially closed, the inside surfaces of both plates  
facing each other are both exposed to the internal pres-  
sure of the sterilizer.

The basic principle of this invention resides in produc-  
ing a greater force or total pressure on the locking plate,  
carried internally of the sterilizing chamber, in a direc-  
tion away from an open position than the total pressure  
applied to the closure plate in the opposite direction. This  
principle of differential total pressures may be accom-  
plished by a reduction of pressure on the outside surface  
of the locking plate, sealed against internal pressure of  
the chamber, to a value sufficiently less than atmospheric  
pressure present on the outside surface of the closure  
plate to maintain the tray and attached plates in the  
closed position. Also, the simplest and most novel manner  
of providing the differential total pressure is by making  
the inside surface of the locking plate, exposed to the  
internal pressure of the chamber, of sufficiently larger  
area than the inside surface of the closure plate to main-  
tain the tray and attached plates in the closed position.

In the sterilizer art, it has heretofore been necessary  
to provide doors or closure plates having various locking  
devices for maintaining the door in the closed position  
when the chamber is pressurized, whereas this invention  
provides the novelty of the second plate, rigidly attached  
to the door by means of the tray, being supported inter-  
nally of the chamber and having only one surface respon-  
sive to internal pressure of the chamber.

The novel concept of making the inside surface area  
of the locking plate, carried inside of the chamber, larger  
than the inside surface of the door is particularly novel  
and useful for sterilization, in that this construction de-  
pends completely upon the internal pressure of the cham-  
ber. The operator is prevented from opening the door to  
the sterilizer or other pressurized chamber until the in-  
ternal pressure of the chamber itself has been reduced to  
a safe value.

Therefore, it is a significant object of this invention to  
provide closure apparatus for a sterilizer or other pres-  
surized chamber which obviates the necessity of latch ele-  
ments commonly thought of as necessary for pressurized  
chambers.

A further object of our invention is the provision of  
closure locking apparatus for a sterilizer or other pres-  
surized chamber based on sufficient differential total pres-  
sure, applied to a locking plate carried internally of the  
chamber and a closure plate or door, to maintain the lat-  
ter in a closed position.

Another object of this invention is to provide closure  
apparatus for a sterilizer or other pressurized chamber  
having a locking plate rigidly spaced from a closure plate  
and having a larger surface area exposed to internal pres-  
sure of the chamber than the closure plate.

It is a further object of this invention to provide sim-  
pler, more satisfactory, and less expensively manufactured  
closure apparatus for sterilizers and other pressurizable  
chambers.

An additional feature of this invention is the selective  
increase and decrease of pressure on the outside surface  
of the locking plate sealed from internal pressure of the  
chamber for selectively controlling the opening and clos-  
ing of the door respectively. Hence, it is another object  
of this invention provide apparatus for selectively con-  
trolling the opening and closing of a door or closure mem-  
ber for a sterilizer or other pressurizable chamber by  
pressure.

Other objects and advantages of this invention will par-  
ticularly be set forth in the claims and will be ap-  
parent from the following description, when taken in con-  
nection with the accompanying drawings, in which:

FIG. 1 is a side elevational view in section of one em-  
bodiment of this invention.

FIG. 2 is a side elevational view in section of a second  
embodiment of this invention.

FIG. 3 is a side elevational view in section of a third  
embodiment of this invention.

With reference to FIG. 1, a vessel generally indicated by  
the numeral 10 defines a pressurizable chamber compris-  
ing a cylindrical shell or main body portion 12, oppo-  
site ends of which are rigidly mounted in annular  
grooves 14 and 16 of a vertically disposed back plate  
18 and a vertically disposed front plate 20, respec-  
tively.

Front plate 20 has a circular opening 22, including an  
outwardly tapered portion 24. Opening 22 slidably sup-  
ports a substantially cylindrically shaped tray or basket  
26. A door or closure member 28 and a locking plate  
30 are rigidly mounted at opposite ends of tray 26, which  
serves to connect plates 28 and 30 in spaced relation-  
ship.

It will be understood that in the preferred embodiment  
of the invention illustrated in FIG. 1, that the locking  
plate 30 is larger in diameter than the closure plate 28.

Plate 28 is provided with an annular peripheral groove  
32 receiving an O-ring seal 34 adapted for sealing the  
closure plate 28 within annular opening 22. The locking  
plate 30 is likewise provided with a peripheral groove  
36 receiving an annular O-ring seal 38 for slidably seal-  
ing plate 30 to the inside periphery 40 of the cylindrical shell  
12.

Closure plate 28 is provided with a handle 42, rigidly  
mounted thereon by a bolt 44, for manual control of the  
tray 26. Tray 26 is preferably adapted to receive medical  
or dental instruments for sterilization within the sterilizing  
vessel 10.

Shell 12 is provided with an inlet fitting 46 and an out-  
let fitting 48. An inlet hole or bore 50 of fitting 46 is  
larger in diameter than a corresponding outlet hole or  
opening 52 of fitting 48 for the purpose hereinafter de-  
scribed. Steam is introduced through a valve 54 from a  
source of steam under pressure. Steam is diagram-  
matically indicated by the arrow 56 entering fitting 46  
and being discharged through fitting 48 as indicated by  
the arrow 58.

A plurality of perforations 60 are provided in the tray  
26 for diffusion of the steam after passing through the  
articles (not shown) to be sterilized therein, thereby  
facilitating the discharge of steam out the bottom of tray  
26 through outlet opening 52 and preventing any substan-

tial accumulation of condensation in the bottom of the tray.

It will be understood that as the tray 26 and attached plates 28 and 30 are moved from an open position, such as illustrated in FIG. 1, to a closed position, as illustrated in FIG. 3, in which the closure plate 28 and opening 22 are in vertical or radial alignment, the seal 38 slidably seals an outside surface 62 of locking plate 30 from the internal steam pressure of the shell 12. When the closure plate 28 is in the closed position with the opening 22, the right hand portion of the shell 12 surrounding locking plate 30 must be concentric therewith in order to maintain sealed relationship between locking plate 30 and shell 12. A portion of shell 12 generally indicated by the numeral 64 is of varying volumetric area depending upon the position of locking plate 30 relative to back plate 18. Portion 64 of the sterilizer shell 12 communicates through a conduit 68 with either atmosphere or a pressure reducing system 69. Portion 64 must be vented in order for the air therein to escape as the tray 26 is moved from the open position to the closed position and for air to return to portion 64 upon opening of the tray 26.

From the above description, it will be understood that after the tray 26 has been filled with the dental, medical or other instruments or articles to be sterilized therein and moved to the closed position above described, the steam will be introduced into the shell 12 through valve 54 and inlet opening 50.

It is significant that the inlet 46 is provided intermediate plates 28 and 30 when in the closed position. The force or total pressure on the outside or external surface 62 of locking plate 30 is, at least, no greater than the force or total pressure on an outside or external surface 70 of the closure plate 28 in the opposite direction. The total steam pressure exerted on the inside surface 66 of the larger diameter locking plate 30 is sufficient to overcome the total pressure exerted on an inside surface 72 of the smaller diameter closure plate 28 and exert a force on the locking plate 30 in a direction to the right as viewed in FIG. 1, thereby to maintain tray 26 and attached plates 28 and 30 in the closed and sealed position.

Increased and decreased pressure from a pressure control system 69 controls the movement of the tray 26 between the open and closed positions respectively. In this regard, the locking plate 30 serves as a piston.

After the instruments have been received in the tray 26, a manually operated treadle (not shown), controlling the pressure system 69, is actuated to effect a withdrawal of air from portion 64 in the direction indicated by an arrow 74, thereby to move the sealed locking plate 30 to the right until the closed position is reached. Thereafter, the vacuum produced by the pressure system 69 may be maintained to increase the total pressure on the locking plate 30 in a direction to the right as viewed in FIG. 1 or it may be discontinued.

After sterilization has been completed in the vessel 10, the flow of air from the pressure system 69 may be reversed to introduce increased air pressure, indicated by the arrow 76, thereby to move the tray 26 to the left, as viewed in FIG. 1, to the open position again.

The differential size of the inlet and outlet openings 50 and 52 permits the steam being introduced through inlet opening 50 to flow into the vessel 10 at a faster rate than it is expelled through the smaller diameter opening 52. Thus, steam pressure builds up inside the vessel despite continued exhaust. The illustrated embodiment of FIG. 1 shows a diameter ratio of 3:1. It will be understood that this ratio could be varied to meet specified conditions. Bacteriacidal action is effected by building up the steam pressure to a peak well above the necessary sterilizing pressure, as for example, to a peak of 60 pounds per square inch (p.s.i.) and thereafter cutting off the steam pressure. In order to build up a chamber pressure of, for example, 60 p.s.i., a line pressure of at least 70 p.s.i. is preferable for a construction where the inlet opening is  $\frac{3}{8}$  inch diameter and the outlet opening is  $\frac{1}{8}$  inch diam-

eter; such a construction contemplates a sterilizing cycle lasting between 40 and 60 seconds. The relative size of the inlet and outlet openings depend on the line pressure of the steam and the size of the vessel. Each of these factors can be varied to give the desired cycle starting at zero pressure and preferably going to 60 p.s.i. chamber pressure and dropping back down to zero pressure.

In order to automatically accomplish the above described cycle, a pressure or temperature responsive device such as a pressure sensitive bellows 78 is provided in open communication with the inside of vessel 10 through a conduit 80. Bellows 78 carries a contact switch 82 which makes and breaks a circuit, including a contact 84, which closes valve 54 when the chamber pressure reaches a selected value such as 60 p.s.i. After the valve 54 is closed, the chamber pressure drops from the selected peak value of 60 p.s.i. to atmospheric pressure. Thus, apparatus is provided whereby the sterilizing chamber defined by the shell 12 is always open to atmospheric pressure with an outlet of selected size sufficiently small enough to permit pressurization of the sterilizing chamber up to a selected peak value, at which value the valve 54 is automatically closed to cut off steam pressure to the chamber, and the chamber pressure then drops down to atmospheric pressure.

Thus, a complete cycle has been described and after the internal pressure of the vessel 10 has reached atmospheric pressure the operator may manually open the tray 26 by pulling handle 42 to the left as viewed in FIG. 1 if the sealed portion 64 of the shell 12 is vented to atmosphere, or in the alternative, depress the treadle (not shown) for operating the fluid pressure system 69 to introduce air pressure indicated by the arrow 76 into the sealed portion 64 and automatically move the tray 26 to the left.

Illustrated at FIG. 2 is an embodiment of this invention in which all of the parts included within the broken-line rectangle 85, having suffixes "A," correspond to the same numbered element of FIG. 1 without the suffix "A." In FIG. 2, the parts encircled by broken line 85 are adapted for closing and sealing a larger pressurizable chamber generally indicated by the numeral 86.

The pressurized chamber 86 might well be a fuel tank on an airplane or any other pressurized chamber. In the event that this invention is used for closing and sealing an aircraft fuel tank, it will be understood that fuel is introduced through the opening 22A. In this particular embodiment, the sealed portion 64A of vessel 10A is vented to atmosphere through a conduit 68A which rigidly supports the back end or back plate 18A of the vessel 10A. It will be further understood that the pressure built up in the larger vessel 86 will communicate with the inside surfaces 66A and 72A of plates 28 and 30 through both fittings 46A and 48A.

With reference to FIG. 3, this embodiment of this invention has parts corresponding to those illustrated in FIG. 1 which are designated by the same numeral followed by the suffix "B." In this embodiment, the closure plate 28B and the locking plate 30B are of the same diameter. Differential forces or total pressures on plates 28B and 30B, to effect locking of the composite tray 26B, plate 28B and plate 30B in a closed and sealed position, is fulfilled by continuously applying reduced pressure to the outside surface 62B of plate 30B, as indicated by the arrows 90. This reduction in air pressure is created by pressure system 69B. Internal pressure of the vessel between plates 28B and 30B exerted on the inside surfaces 72B and 66B thereof, respectively illustrated by the arrows 92 and 91, are equal and counterbalance each other. Arrows 93 illustrate atmospheric pressure exerted on the outside surface 70B of plate 28B.

Thus, the internal pressure in the chamber exerted over equal surface areas, as indicated by arrows 91 and 92, simply counterbalance each other and the sum of the pressures exerted by the atmosphere, indicated at 93, and

5

by the reduced air pressure, indicated at 90, apply a total pressure to the right as illustrated in FIG. 3, sufficient to maintain the closure plate 28B in the closed and sealed position illustrated in FIG. 3. Hence, it will be understood that, as used in the claims, the phrase "locking means . . . for producing a sufficiently greater total pressure on said locking plate . . . than the total pressure on said closure plate . . ." or similar phrases are broadly directed to either the FIG. 1 or FIG. 3 concept or their equivalents.

While there has been shown and described the preferred form of mechanism of this invention it will be apparent that various modifications and changes may be made therein, particularly in the form and relation of parts, without departing from the spirit of this invention as set forth in the appended claims.

We claim:

1. Improved apparatus for combination with a vessel defining a pressure chamber having an opening, said improvement comprising:

- (a) a door member supported outside of said chamber for closing and sealing said opening;
- (b) door locking means inside said chamber including a locking plate inside said chamber which is connected to said door, said locking plate being constructed so as to be responsive to a greater total internal chamber pressure than the total internal chamber pressure on said closure plate in an opposite direction for maintaining said door in a closed position.

2. Improved apparatus for combination with a vessel defining a pressure chamber having an opening, said improvement comprising:

- (a) a closure plate supported outside said chamber for closing and sealing said opening;
- (b) closure plate locking means, including a locking plate inside said chamber which is connected to said closure plate for producing a sufficiently greater total pressure on said locking plate in a direction toward closure of said closure plate than the total pressure on said closure plate in an opposite direction thereby to maintain said closure plate in a closed position.

3. Improved apparatus for combination with a vessel defining a pressure chamber having an opening, said improvement comprising:

- (a) a closure plate supported outside said chamber adapted for closing and sealing said opening when in a closed position, said plate having a first pressure responsive surface;
- (b) closure plate locking means, including a locking plate inside said chamber connected to said closure plate in spaced relationship and having first and second pressure responsive surfaces and means in said chamber for substantially sealing said second surface of said locking plate from the internal pressure of said chamber, for producing a sufficiently greater total pressure on said locking plate in a direction toward closure of said closure plate than the total pressure on said closure plate in the opposite direction thereby to maintain said closure plate in said closed position.

4. Apparatus in accordance with claim 3 in which: said first surface of said locking plate is larger than said first surface of said closure plate.

5. Apparatus in accordance with claim 3 in which said last mentioned means comprises: pressure reducing means communicating with said second surface of said locking plate.

6. Apparatus in accordance with claim 3 including: pressure control means for selectively increasing and decreasing the pressure on said second surface sufficient to move said plates and connecting means respectively between said opened and closed positions.

7. Improved apparatus for combination with a vessel

6

defining a pressure chamber having an opening, said improvement comprising:

- (a) a closure plate adapted to close and seal said opening from outside said chamber when in a closed position, said plate having a first surface responsive to pressure within said chamber;

- (b) closure plate locking means, including a locking plate connected in spaced relationship to said closure plate and having a first surface responsive to internal pressure of said chamber, for producing a sufficiently greater total pressure on said first surface of said locking member than on said first surface of said closure member when in substantially said closed position to lock said closure plate in substantially said closed position.

8. Improved apparatus for combination with a pressure chamber vessel having an internal longitudinally extending portion of uniform cross-section and an opening substantially in registry with said portion, said improvement comprising:

- (a) a closure plate supported outside of said chamber adapted to close and seal said opening when in a closed position;

- (b) closure plate locking means, including a locking plate connected in spaced relationship to said closure plate and being slidably sealed to the inside periphery of said uniform cross-section portion and pressure inlet means communicating with said chamber intermediate said plates when said closure plate is in said closed position, for producing a sufficiently greater total pressure on said locking plate in a direction toward closure of said closure plate than the total pressure on said closure plate in the opposite direction thereby to maintain said closure plate in said closed position.

9. Apparatus in accordance with claim 8 in which said last mentioned means includes: fluid pressure reducing means communicating with that end of said uniform cross-section portion opposite said opening.

10. Apparatus in accordance with claim 8 including:

- (c) a second vessel defining a second pressure chamber of larger volumetric area than said first chamber and embracing said first vessel, said chambers being in open communication with each other.

11. Apparatus in accordance with claim 8 in which:

- (c) said plates are connected by means defining a tray for supporting goods to be sterilized.

12. Improved apparatus for combination with a pressure chamber having an internal longitudinally extending portion of uniform cross-section, and an opening smaller than and in registry with the inside periphery of said portion, said improvement comprising:

- (a) a closure plate supported outside of said chamber adapted to close and seal said opening when in a closed position;

- (b) a larger locking plate connected to said closure plate in spaced relationship and substantially mating with the inside periphery of said uniform cross-section portion and slidably sealed therein;

- (c) pressure inlet means communicating with said chamber intermediate said plates when said closure plate is in said closed position, and

- (d) outlet means between that end of said portion opposite said opening and atmosphere to maintain substantially atmospheric pressure on an external surface of said locking plate.

13. Apparatus in accordance with claim 12 including:

- (e) pressure control means connected to said outlet means for selectively increasing and decreasing pressure on an external surface of said locking plate facing away from said opening with sufficient pressure to move said plates respectively between an open position and said closed position.

14. Sterilizer apparatus comprising, in combination,
- (a) a vessel defining a steam chamber having front end and back ends,
- (b) said vessel having a longitudinally extending portion of uniform cross-section terminating at said back end, 5
- (c) said vessel having an opening in said front end smaller than and in registry with the inside periphery of said portion,
- (d) a closure plate supported outside of said chamber adapted to close and seal said opening when in a closed position, 10
- (e) a locking plate substantially mating with the inside periphery of said uniform cross-section portion and slidably sealed therein, 15
- (f) conduit means extending from a source of steam pressure to a portion of said chamber intermediate said plates when said closure plate is in said closed position,
- (g) means extending through said opening for connecting said plates in spaced relationship, and 20
- (h) a second opening extending through said back end of said vessel for maintaining substantially atmos-

- pheric pressure intermediate said locking plate and said back end of the vessel.
15. Apparatus in accordance with claim 14 including:
- (i) pressure control means communicating with said second opening for selectively increasing and decreasing pressure intermediate said locking plate and said back end of the vessel sufficiently to move said plates and connecting means selectively between an open position and said closed position.

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