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STERILIZER AND POWER-OPERATED DOOR THEREFOR

Filed March 5, 1964

3 Sheets-Sheet 1

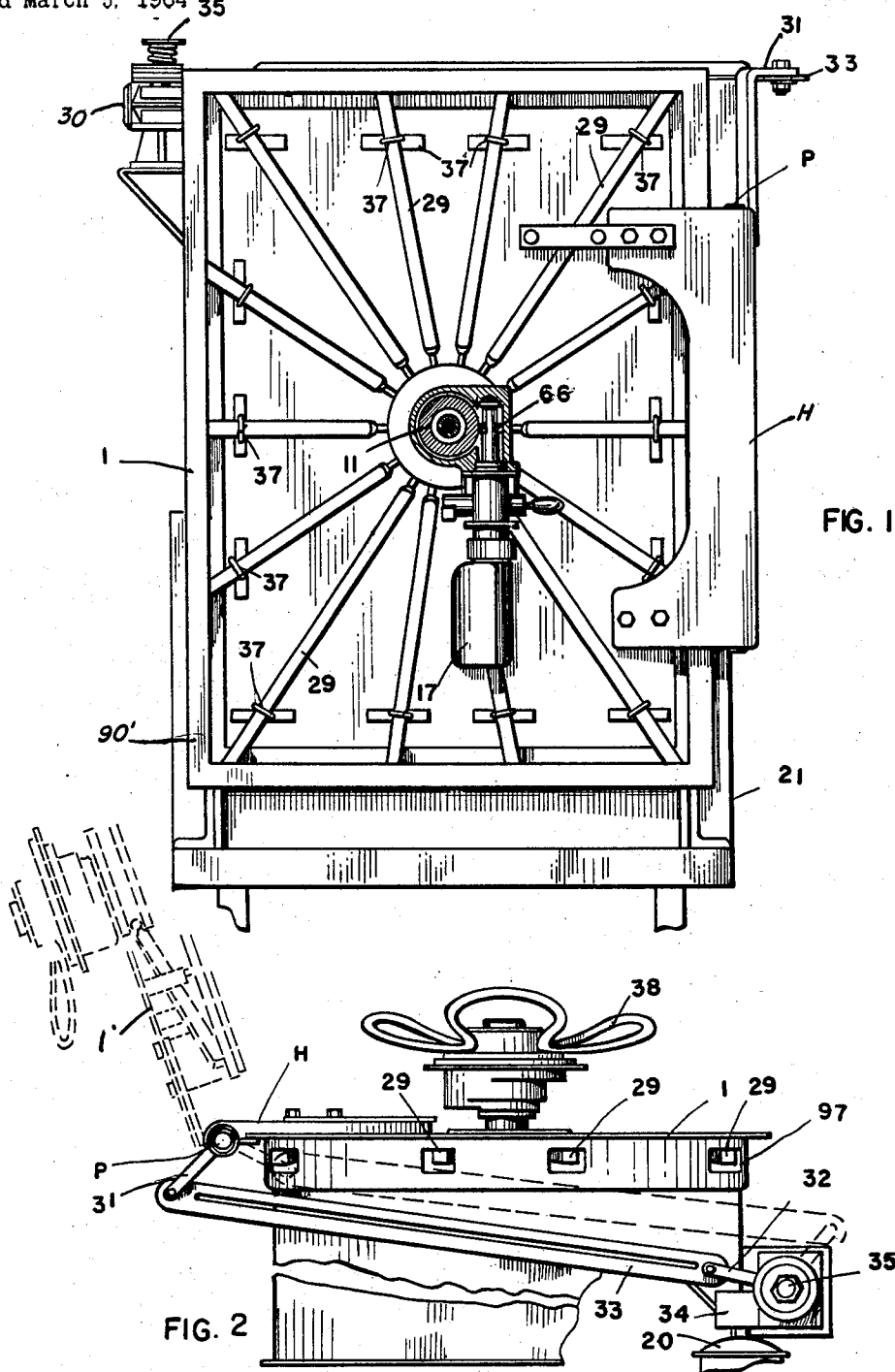


FIG. 1

FIG. 2

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3 Sheets-Sheet 2

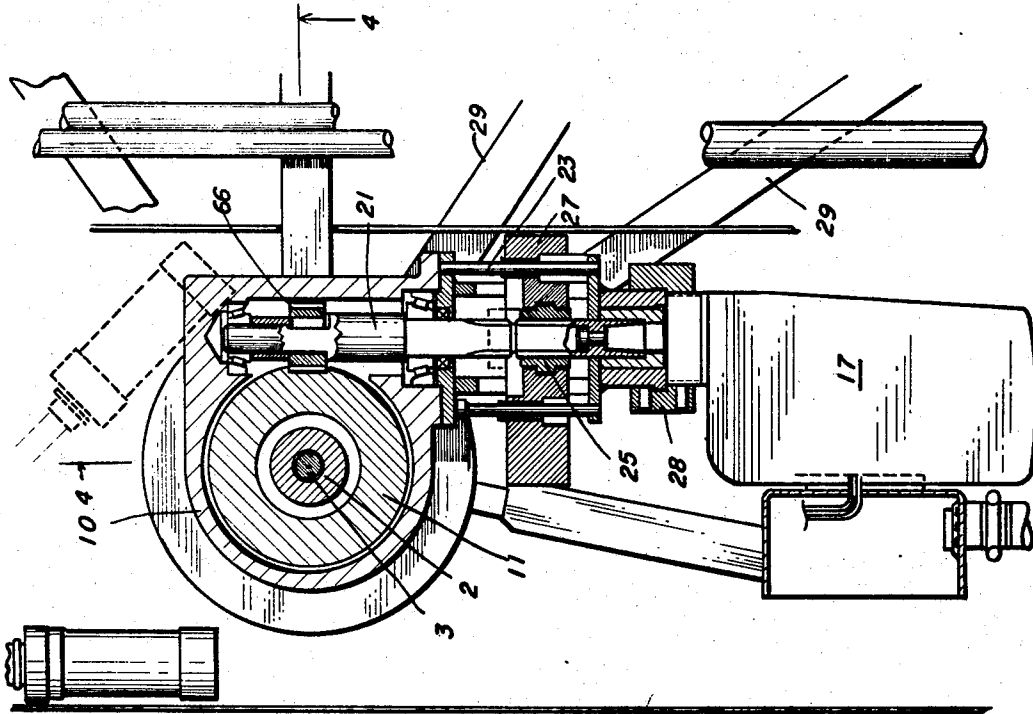


FIG. 3

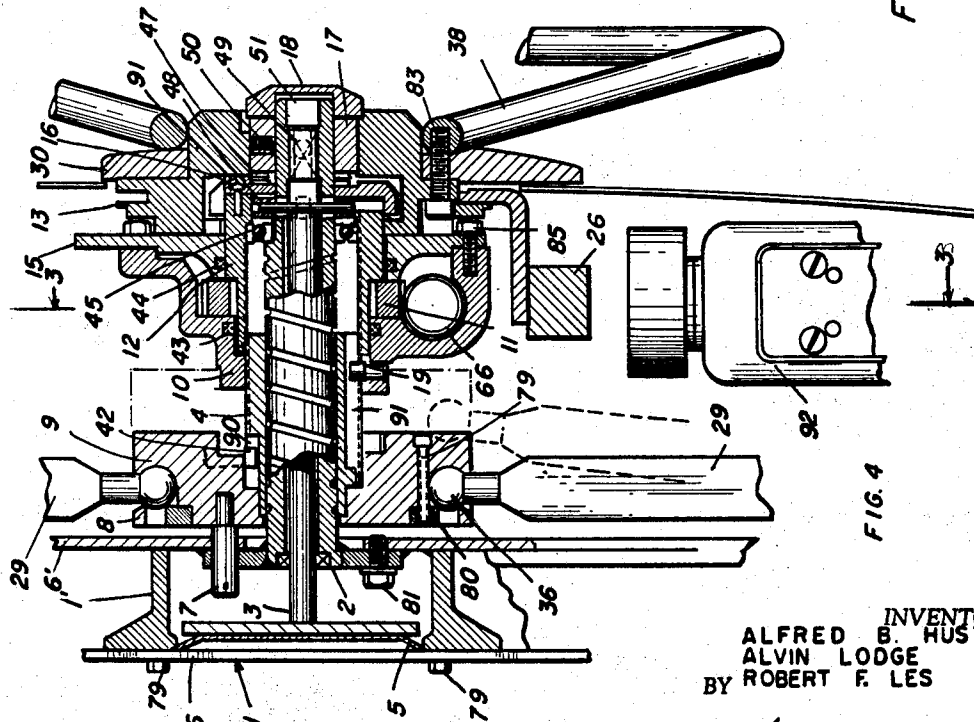


FIG. 4

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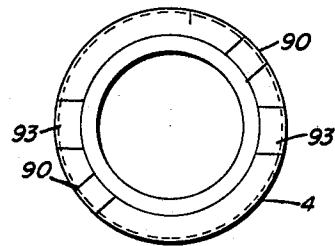
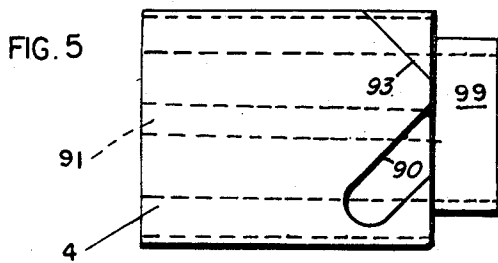


FIG. 6

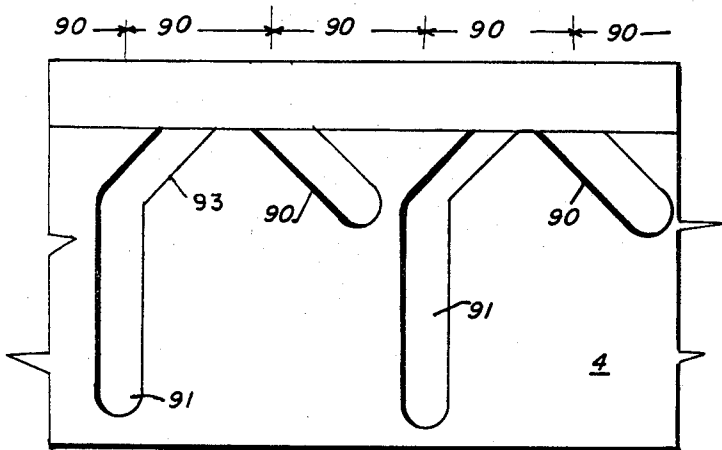


FIG. 7

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3,385,655

## STERILIZER AND POWER-OPERATED DOOR THEREFOR

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14 Claims. (Cl. 21—91)

### ABSTRACT OF THE DISCLOSURE

The present invention provides a motor controlled mechanism whereby a sterilizer door may be swung to closed position by a motor operating through a linkage. The clamping action moves radiating arms outward under a rim on the chamber to clamping position and then swings the arms about a fulcrum with the outer end of the arm engaging the rim of the chamber.

This invention relates to sterilizers and more particularly, to sterilizers of the type used in hospitals and other environments where sterile goods are required.

Sterilizers such as the one shown in Patent No. 2,592,705 had swinging doors that were clamped in closed position on a chamber by a manually actuated clamping mechanism. These clamping mechanisms had radiating arms on the door. The outer ends of the arms engaged a fixed clamping means on the sterilizer and an intermediate part of the arms engage and rock about a fulcrum on the door to move the ends of the arm axially relative to the chamber and clamp and unclamp the door. A manually actuated lever was attached to a socket plate in the door which held the inner ends of the arms. The socket plate was rotated by means of this lever, to retract the outer ends of the arms from under the clamping ring in the chamber. Thus, to close such a sterilizer door and clamp it three manual operations were necessary. (1) Swing the door closed, (2) actuate the lever to move the ends of the arms outward under the clamping ring, and (3) rotate the hand wheel to clamp the arms. To open the door the same three operations were necessary in reverse sequence. These manual operations are time consuming and require the services of personnel.

It is, accordingly, an object of this invention to provide an improved sterilizer door and operating means therefor.

Another object is to provide a door and operating mechanism which is simple in construction, economical to manufacture, and simple and efficient to use.

Another object of the invention is to provide an improved control mechanism for a door.

With the above and other objects in view, the present invention consists of the combination and arrangement of parts hereinafter more fully described, illustrated in the accompanying drawings, it being understood that changes may be made in the form, size, proportions, and minor details of construction without departing from the spirit or sacrificing any of the advantages of the invention.

In the drawings:

FIG. 1 is a front view partly in cross section of a sterilizer and door according to the invention;

FIG. 2 is a top view of the door and actuating mechanism showing the door swung to open position in phantom lines;

FIG. 3 is a cross sectional view of the door actuating mechanism taken on line 3—3 of FIG. 4;

FIG. 4 is a longitudinal cross sectional view taken on line 4—4 of FIG. 3;

FIG. 5 is an enlarged side view of the screw used in the operating mechanism;

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FIG. 6 is an end view of the screw shown in FIG. 5; and

FIG. 7 is a planar development of the outer surface of the screw.

Now with more particular reference to the drawings, a sterilizer 21 has a door 1 swingably supported thereon by means of a suitable hinge H which is fixed to the door and pivots on the hinge pin P.

The door shown has a clamping mechanism in some respects like that shown in Patent No. 2,592,705, for example. However, instead of the mechanism being manually operated as in the said patent, the door locking arrangement disclosed herein is operated by a mechanism including a motor 17 and the door is swung open and closed by means of a mechanism including a motor 20, arms 31 and 32 and links 33.

The locking arrangement is made up principally of the post 2 fixed to the door which extends outwardly perpendicular therefrom; the socket plate 9 which is slidably supported on the post; the arms 29 which rock around the fulcrum members 37' with their outer ends received by the rim on the chamber 1 and their inner ends received in the socket plate; and the hollow, externally threaded screw 4 which has the nut 12 threadably received thereon which, in turn, supports the housing 10.

The housing has the pin 19 on it which is received in the axial slot 91 in the outside of the screw. The dowel 42 is fixed to the socket plate and received in the slot 90 of the screw and pin 7 which is fixed to the socket plate slides in a hole in the door during the initial part of the outward movement of the socket plate 9 and screw 4 during the opening cycle. As soon as the pin 7 has moved out of the hole in the door, the socket plate 9 is free to rotate. Thus, a continual drive of the motor moves pin 19 into the angular part of slot 91, thus rotating the screw relative to the housing 10 and the dowel 42 moves in the slot 90, thus rotating the socket plate relative to the door and pulling the arms 29 inward toward the center of the door and out of the openings 97 in the chamber.

The push rod 3 is fixed to the diaphragm 5 and is slidably received. The push rod 3 has the dowel 48 on the outer end thereof and this dowel engages the cap 16 when it is pushed outward, thus preventing the cap from rotating when there is pressure on diaphragm 5 in the chamber. This is a safety device to prevent accidentally opening the door when there is steam under pressure in the chamber.

The arm 31 is fixed to the door 1, arm 32 is fixed to the shaft 35. Both arms are connected together by means of intermediate link 33 and act as a crank. Motor 20 acting through the gear box 34 swings the arm 31 around the pivot 35. The intermediate link 33 transmits this force from arm 32 to arm 31. Thus the door is swung from the full line position 1 to the dotted line position 1" by motor 20.

The door 1 is made up of the spaced plates 6 and 6' held in spaced relation by the bracket 1' held in place by studs 79. The diaphragm 5 has the push rod 3 fixed to it and pin 47 extends through the outer end of push rod 3. The gear box assembly is supported on the outer end of post 2.

Post 2 is fixed to plate 6' by studs 81 and extends outwardly at right angles thereto. The gear box 10 is non-rotatably supported on the door. Handwheel 38, cap 13, cap 18, and nut 12, are rotatably supported on the outer end of the post 2; all of which are fixed together by stud 83 and driven in rotation in either direction through gear 11 by motor 17. These elements are carried for rotation on the post 2 by anti-friction bearing 45. Sealing rings 43 and 44 sealingly engage the outside of nut 12.

The screw shown in detail in FIGS. 5, 6, and 7 is in the form of an externally threaded cylinder which has a smooth cylindrical internal surface which freely slides on the outside cylindrical grooved surface of post 2. Screw 4 has a reduced size end that is received in the counterbore in socket plate 9. The screw has short slots 90 which are disposed at 45 degrees to the axis of the screw and long slots 91 which have a straight part parallel to the axis of the screw and an angular part disposed at 45 degrees to the axis. During the initial part of the opening procedure, screw 4 is restrained against free rotation on post 2 by dowel 42 in the straight part of slot 90. Dowel 42 is pressed into socket plate 9 which is received in cam grooves 90 in screw 4. Thus, straight grooves 91 guide screw 12 straight in and out on guide pin 19. Dowel 42 moving in slot 91 enters the angular part of slot 91 and causes socket plate 9 to rotate approximately 30 degrees during the last part of its outward movement to pull arms 29 radially inward and bring their ends from under flange 90 so that the door can be opened.

Internally threaded nut 12 is driven by motor 17 by way of gear 11, energizes externally threaded screw 4 which is connected to socket plate 9 by dowel 42, creates in an out motion of socket plate 9 to lock and unlock the door.

Threaded screw 4 slides without rotating on post 2 during the first part of its outward movement because socket plate 9 and threaded screw 4 are restrained against rotation by pin 7. Pin 7 is fixed to socket plate 9 and slides in a hole in door 1. Pin 19 is fixed to housing 10 and is slidably received in slot 91. Slot 91 has a portion parallel to the central longitudinal axis of center post 2. Radially disposed pins 19 solidly fixed in relation to the door 1 are attached to housing 10. Other radially disposed pins 42 are fixed to the socket plate.

Slidable engagement means consists of cam slots 91 in the outside surface of screw 4 so arranged that the slots 91 engaging pins 19 guide threaded screw 4 with a linear outward motion during the initial part of the threaded screw travel. The slots 91 have a screw-wise lead during the outer part of the threaded screw travel as the pin 19 enters the angular part 93 of slot 91.

Cam slots 91 engaged by pins 19 have a screw-wise lead in the opposite direction to angular parts 93.

During the inner part of the travel threaded screw 4 and socket plate 9 move together because socket plate 9 is restrained against rotation by pin 7, pin 42 cannot move down inclined slot 90 because pin 19 slides in the axial part of slot 91 preventing threaded screw from turning during the inner part of its travel.

During the outer part of threaded screw 4 travel socket plate 9 is free to rotate since pin 7 has moved out of the hole in door 1. Socket plate 9 has moved into engagement with shoulder 94 on housing 10 therefore it cannot move outward any further.

As threaded screw 4 continues its outward travel, pin 19 enters the angular part 93 of slot 91 rotating threaded screw 4 in a first direction. Since threaded screw 4 is moving outward and socket plate is stopped at this stage by housing 10 pin 42 is urged to move in slot 90.

During this part of the travel, the grooves 90 of threaded screw 4 are having engagement with pins 42 and cause rotation of socket plate relative to screw 4. Screw 4 is at the same time rotating relative to housing 10. These two relative rotations are additive giving the socket plate double the angular travel of a single system.

Guide pins 7 which may be two in number, for example, are fixed to the socket plate 9 at their outer ends and extend axially thereto. The pins 7 freely slide in holes in plate 6'. The pins 7 thus prevent the socket plate from rotating relative to the door during the few initial rotations of nut 12, which produces the first part of the movement of the socket plate 9.

The arms 29 extend radially from the socket plate 9. These arms have balls 36 fixed to their inner ends that are received in sockets in the socket plate and are held in

place by the studs 79 and lock washers 80. The arms 29 extend through loops 37 which are fixed to the door and over the fulcrum members 37' which are slightly raised above the outer surface of the door. The sterilizer has a flange 90' fixed to it which defines a space between it and the end of the sterilizer. The outer ends of the arms 29 are received under flange 90'. When the socket plate 9 is moved outward by the nut, the outer ends of the arms 29 will rock inward away from this flange 90 and allow the door to release. When the nut 4 is moved inward, the outer ends of the arms will be forced away from the sterilizer chamber. Thus, they will rock around the fulcrum members, their ends will exert a force on the flange 90' and force the door into sealing engagement with the end of the sterilizer.

The gear 11 is keyed to the nut 12 and the nut 12 is fixed to the cap 16 by means of the cap screws 91. Gear 11 and nut 12 rotate freely on bearing 45 which supports the nut 12 on post 2.

The motor 17 is reversible and may be of the general type commonly used on electric hand drills or it could be of any other suitable type of motor. The motor 17 is supported on the door 1 and it has the shaft 21 with the worm wheel 66 keyed thereto. The worm wheel 66 engages the worm gear 11 and rotates it both backward or forward, depending on the direction of rotation of the motor. The shaft 21 is connected to the motor drive shaft by means of the collar 28 which is rotatably received in the hub assembly 27 and supported on pins 23. Pins 23 rigidly support the motor 17 on gear box 10.

It will be seen that the motor 17 will rotate the worm gear 11 through the worm wheel 66 which will, in turn, move the screw 4 in or out along the post 2. When the motor 17 moves the inner ends of arms 29 away from the door, the outer ends will release their clamping force on the under side of flange 90'.

As the socket plate moves further from the door, pin 7 moves out of the hole in plate 6'. As the socket plate is drawn out still further pin 7 is no longer restrained against lateral movement and the socket plate is now free to rotate, pin 19 enters the inclined part of slot 91. This produces a torque on screw 4 and socket plate 9 rotates as pin 19 follows slot 91. Thus, the initial outward movement of the socket plate will not rotate but will cause the arms 29 to rock around their fulcrum 37' and release their clamping force on the door. Further movement of the socket plate will cause it to rotate as it moves, as pin 7 moves out of its hole in the pin 19, enters the angular part of the groove 91 and dowel 42 moves in groove 90. This will move the outer ends of arms 29 radially inwardly to disengage the door rim 90'. Motor 20 can then be energized to swing the door open. Motors 17 and 20 can either or both be controlled by manually actuated switches or by any other suitable control circuit.

The foregoing specification sets forth the invention in its preferred practical forms but the structure shown is capable of modification within a range of equivalents without departing from the invention which is to be understood is broadly novel as is commensurate with the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A sterilizer comprising a chamber adapted to contain gas under pressure,
- said chamber having an opening, a door closing said opening and means swingably attaching said door on said chamber,
- means to open and close said door,
- clamping means to clamp said door in closed position and motor means to actuate said clamping means,
- said clamping means comprising arms supported on said door, each arm having one end disposed adjacent the center of said door and extending outward and terminating adjacent to the edge of said door,

said arms having means thereon to engage clamping means on said chamber, means to move said arms to clamp said door in closed position, said means to move said arms comprising a motor, a screw member on said door, a nut on said screw, motor means on said door to move said nut on said screw toward and away from said door and means on said nut engaging said arms moving said arms with it to clamp said door to closed position and to release said door. 10

2. The sterilizer recited in claim 1 wherein, said nut has a gear member connected thereto and said motor has a shaft having a gear thereon engaging said gear on said nut. 15

3. The machine recited in claim 2 wherein, means on said arms to clamp said door comprises a fulcrum member on said door adjacent the outer end of each said arm, and said means on said chamber comprising a member on said sterilizer receiving the outer end of each said arm thereunder whereby said arms urge said fulcrum member and thereby urge said door to sealing relation when said nut is driven toward said door. 20

4. A sterilizer comprising a chamber and a door, means to swing said door open and closed, means to clamp said door in closed position, said clamp means comprising a post fixed to said door generally at the center thereof, threaded means on said post, a motor on said door having drive means engaging said threaded member for rotating said threaded member, a socket plate on said post, said threaded member engaging said socket plate, moving said socket plate with it toward and away from said door, 35

arms having one end engaging said socket plate, the other end adapted to engage said sterilizer chamber, said arms forcing said door into sealing engagement with said chamber tank when said motor moves said threaded member in one direction. 40

5. The sterilizer recited in claim 4 wherein, said motor is connected to said threaded member by means of a guide member said threaded member being slidable on said guide member toward and away from said door. 45

6. The sterilizer recited in claim 4 wherein, said motor is supported on said post with the shaft of said motor generally perpendicular to said post.

7. A sterilizer comprising a chamber and a door, means to swing said door open and closed, means to clamp said door in closed position, said clamp means comprising, a post fixed to said door generally at the center thereof, a hollow screw slidably supported on said post, a socket plate supported on said screw for movement toward and away from said door, 55

means on said socket plate engaging said door holding said socket plate against rotation with said nut, during a part of its outward movement, but allowing said socket plate to move toward and away from said door, 60

a nut on said screw, a motor supported on said door, said motor having drive means connected to said nut whereby said nut may be selectively driven on said screw to move said screw toward and away from said door, 65

arms having their inner ends attached to said socket plate and their outer ends adapted to engage means on said chamber adjacent the periphery of said door, fulcrum means on said door engaging an intermediate part of each said arm, said arms being rocked on said fulcrum by said motor whereby said door is forced into sealing engagement with said chamber. 70

8. The sterilizer recited in claim 7 wherein, said post is hollow and has a push rod extending there-through, a diaphragm on said door, the inner end of said push rod engaging said diaphragm and locking said screw against rotation when said chamber has a medium under pressure therein.

9. In combination, a sterilizer having a chamber with a door and a means to close and fasten said door, said means to fasten said door comprising a socket member adjacent said door movable toward and away from it, arms each having means on one end engaging said socket plate and the other end engaging said chamber, a reversible motor on said door, screw and nut means connecting said socket member to said motor, said arms forcing said door into sealing engagement with said chamber when said motor drives said nut to swing said arms in one direction, said arms releasing said door when said motor drives said nut to swing said arms in another direction.

10. The door recited in claim 9 wherein, said screw and nut means comprises means to rotate said socket member relative to said door when said nut has rotated beyond a predetermined amount during opening whereby said arms are moved radially inwardly to release them from said chamber.

11. In combination, a chamber, a door and means to clamp said door in closed position on said chamber, said door having arms having inner and outer ends, the inner ends of said arms terminating adjacent the center of said door, means on said chamber engaging said outer ends of said arms when said door is closed and clamped, means on said door engaging the inner ends of said arms, moving the outer ends of said arms to force said door to sealed position on said chamber and moving said arms toward the center of said door from engagement with said chamber and a single drive means actuating said means on said door, said means on said door engaging said arms comprising a screw member, a motor on said door, and connected to said means recited for operating said means, means attaching the inner ends of said arms to said screw member, means to guide said screw member toward and away from said door, means on said screw member restraining it against rotation during its initial movement from said door whereby the clamping force on said arms is released, and means on said screw rotating it during its final movement from said door whereby said arms are moved from said means on said chamber.

12. The combination recited in claim 11 wherein, said screw member has external threads thereon and a nut is disposed on said door, said screw having a first and a second rotating means thereon, said first rotating means holding said motor against rotation relative to said screw member during the initial part of the outward movement of said screw, a first member holding and engaging said door, holding said screw against rotation relative to said door during the initial part of its rotation, said rotating means rotating said screw member relative to said door during the final stages of its rotation.

13. In combination, a chamber and a door with sealing means for forming a seal between said door and said chamber, and means to force said door into sealing relation with said chamber and said sealing means, said means to force said door into sealing relation comprising spaced outwardly radially extending arm members extending generally parallel to the plan of said door, 75

fulcrum members disposed between said door and an intermediate part of each said arm,  
 means on said chamber to receive the outer ends of said arms thereunder,  
 a center post on said door extending outward generally perpendicular therefrom,  
 socket plate slidably supported on said post, inner end of each said arm being secured to said socket plate,  
 a hollow externally threaded screw slidably supported on said post,  
 a nut threadably engaging said screw,  
 a housing supported on said nut,  
 motor means on said housing for rotating said nut to move said screw toward and away from said door,  
 a pin on said socket plate slidably engaging said door during the initial part of its movement away from said door whereby said socket plate is held against rotation during said initial movement,  
 said pin disengaging said door during the final part of said socket plate outward movement,  
 a dowel member on said socket plate,  
 a first and a second slot in said screw,  
 said first slot receiving a member on said housing holding said housing against rotation relative to said

screw during said initial part of said screw's outward movement and rotating said screw relative to said housing during the final part of its movement, said second slot rotating said socket plate relative to said screw during the final part of its outward movement whereby said outer ends of said arms are moved toward the center of said door and from said means to receive the outer ends of said arms.

14. The combination recited in claim 13 wherein, a push rod is disposed concentric to said post, a diaphragm on the inside of said door and engaging said push rod, and means on the outer end of said push rod engaging means on said nut for holding said nut against rotation when a medium under pressure is disposed in said chamber.

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