

[54] AUTOCLAVE

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abandoned.
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21/104
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21/104; 23/290

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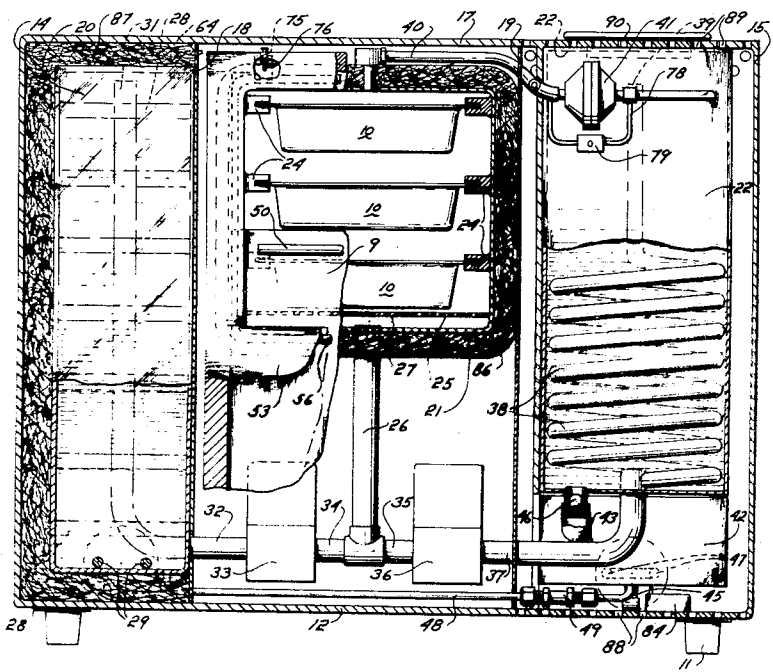
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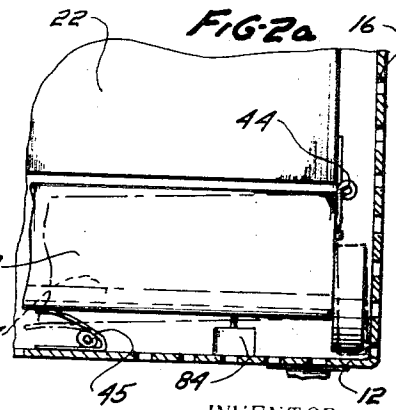
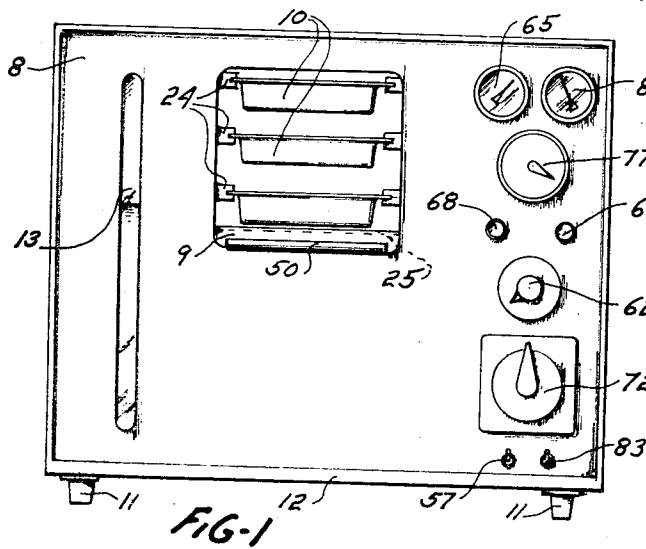
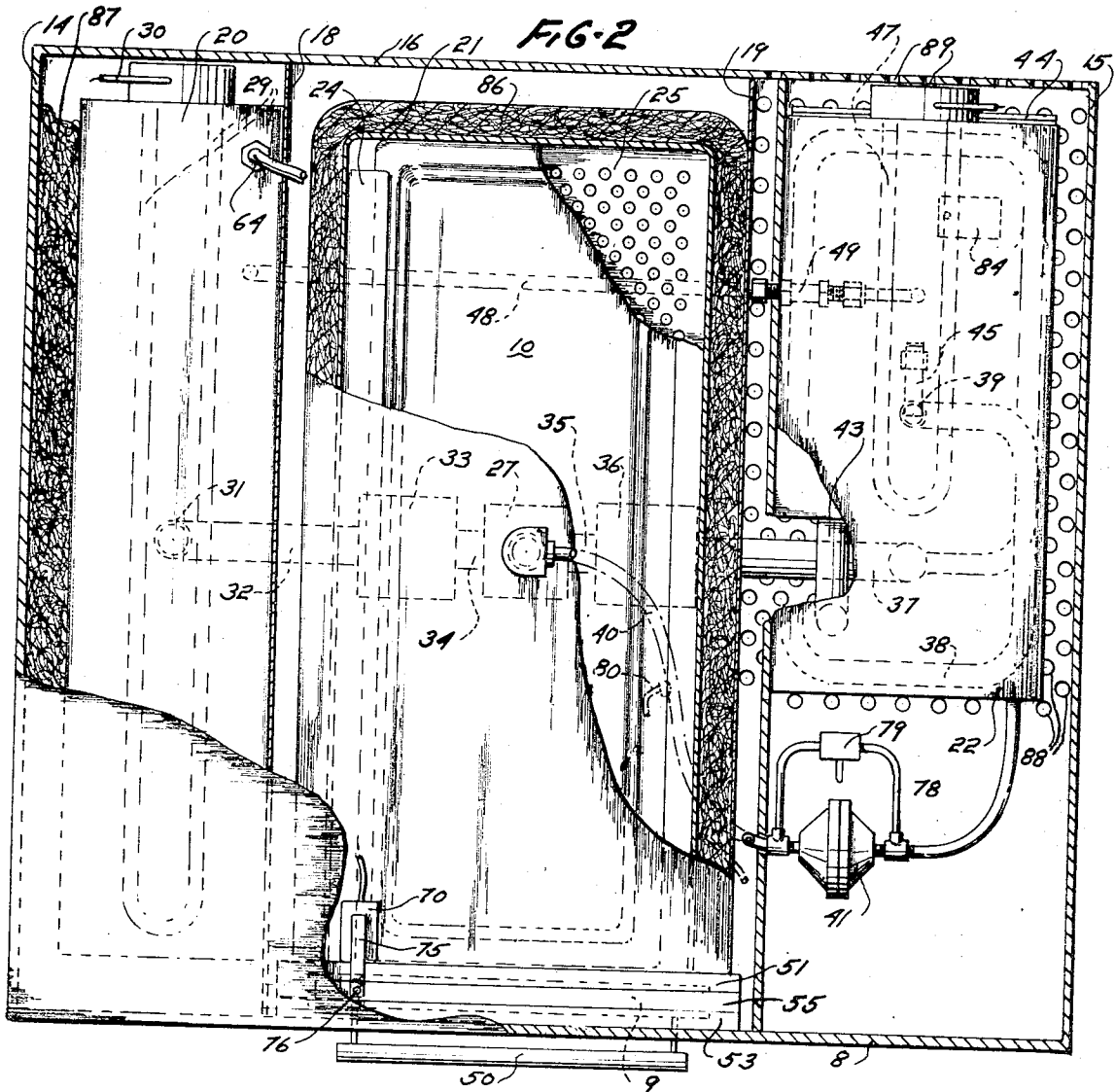
[57] ABSTRACT

An autoclave, particularly adapted for use as a sterilizer, and in which the functions of steam generation and sterilization are performed in separate steam generating and autoclaving chambers, with provision for controlled delivery of steam from the generating chamber to the autoclaving chamber. A feed water system is also provided incorporating a receptacle for receiving sequential batches of feed water and for heating such batches to a temperature providing a pressure adequate to deliver the batch into the steam generating chamber.

The equipment further includes a closure for the autoclaving chamber and means interlocking the operation of the closure with the function of transfer of steam from the generating chamber to the autoclaving chamber. The closure for the autoclaving chamber is in the form of a sliding door mounted adjacent to the access opening into the autoclaving chamber in a manner providing for sealing of the door under the influence of the pressure of the steam introduced into the autoclaving chamber from the steam generating chamber.

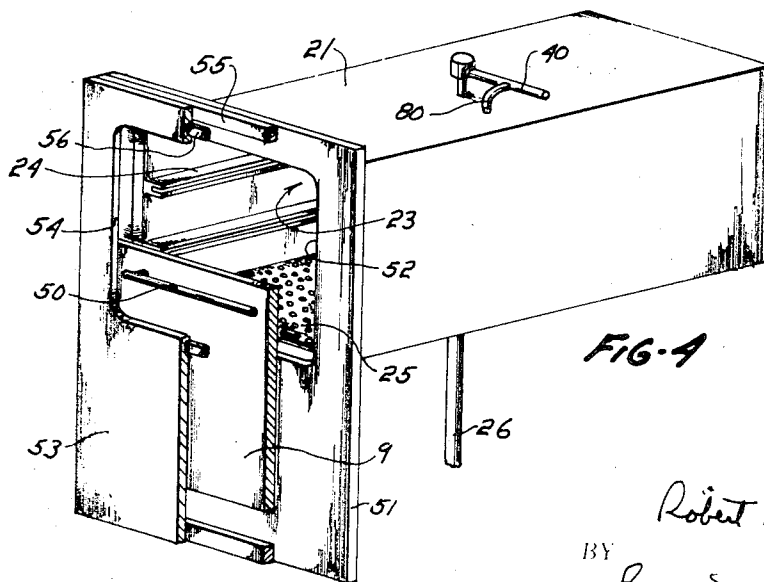
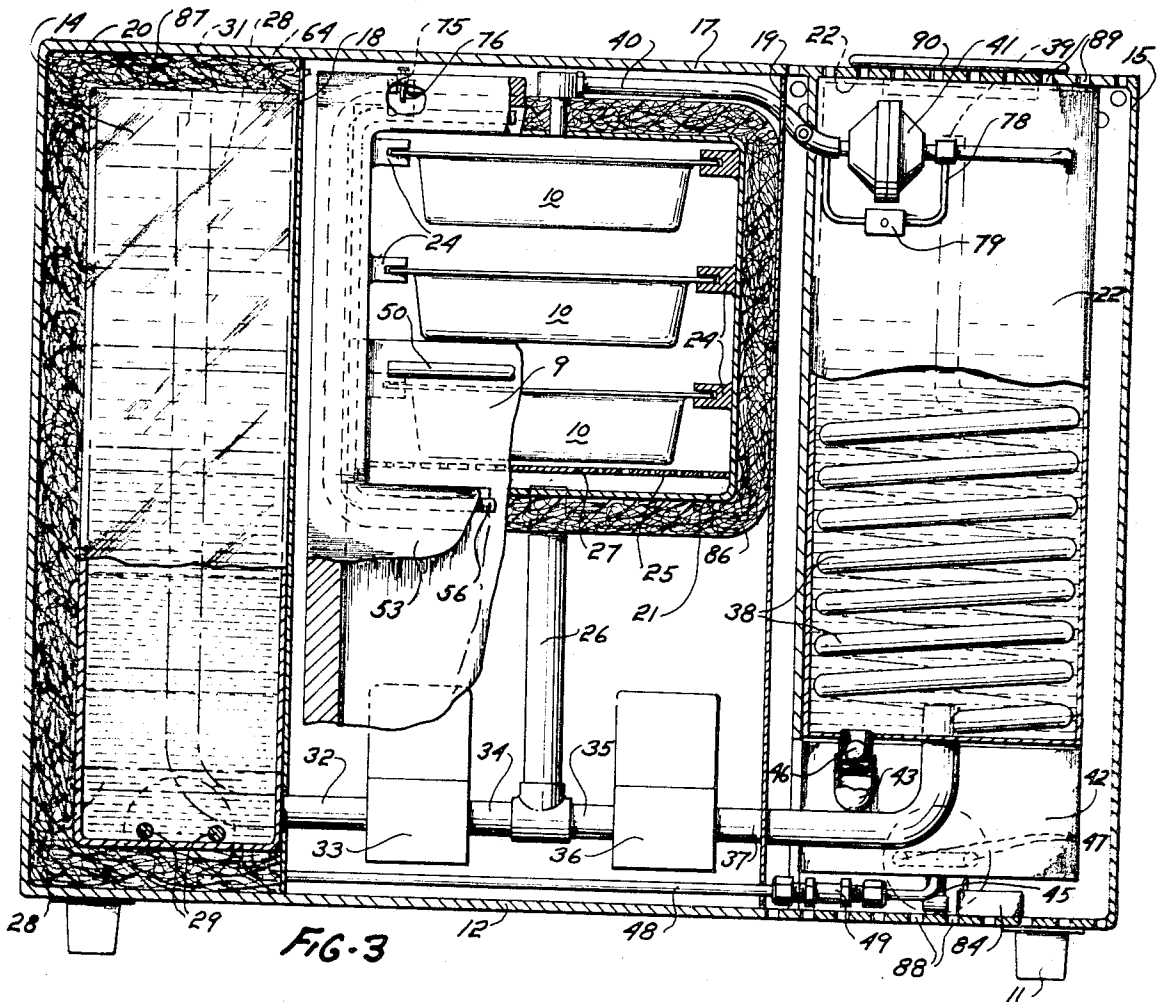
5 Claims, 8 Drawing Figures





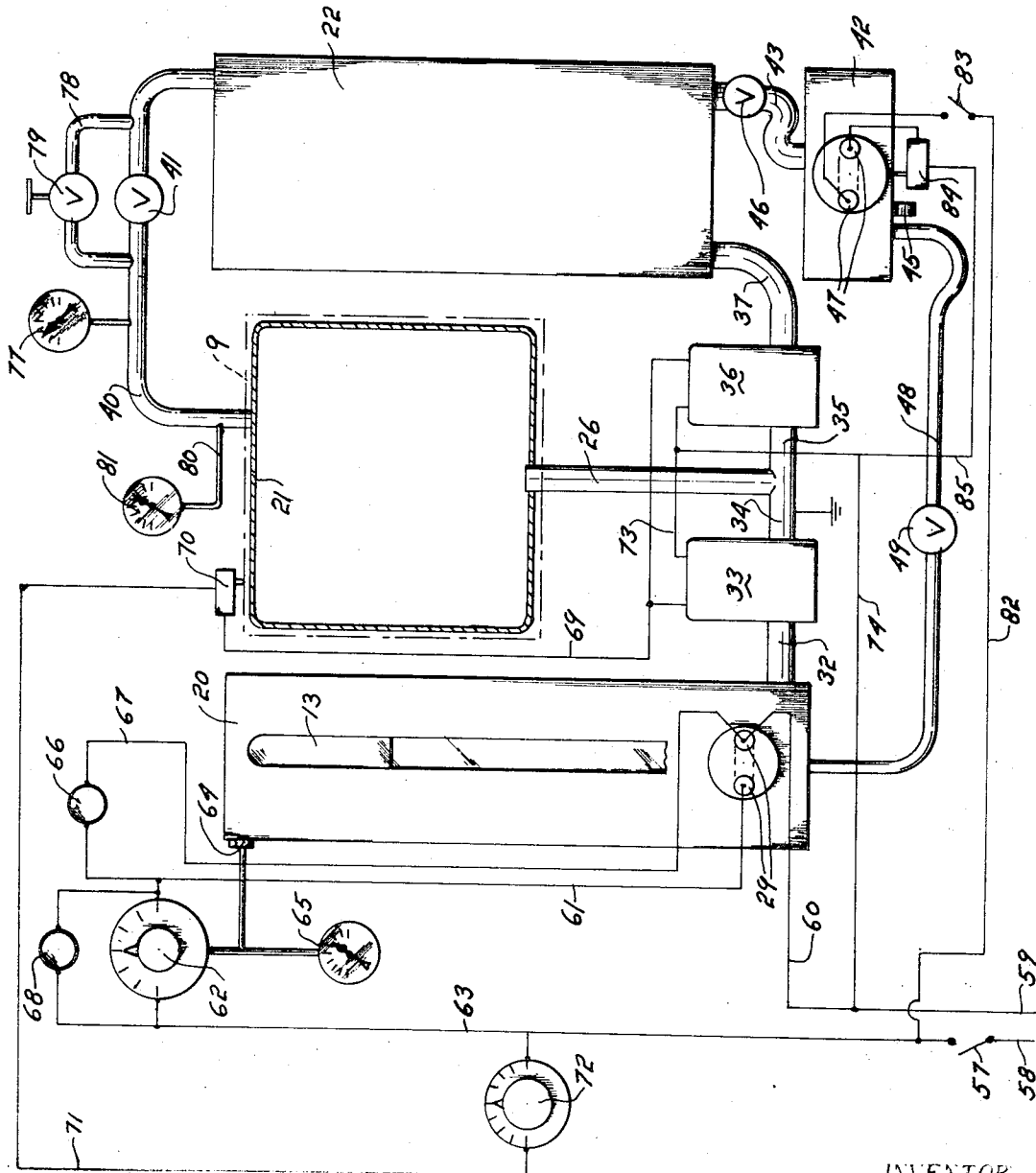
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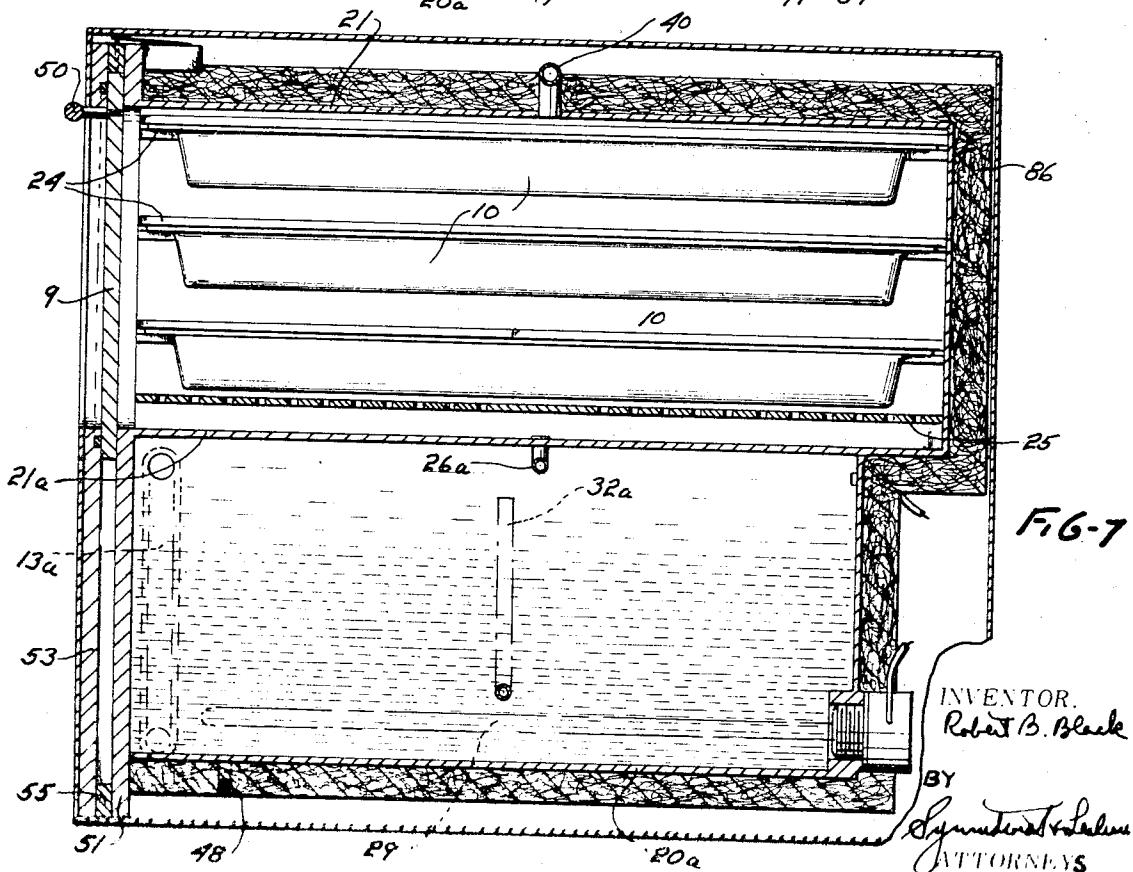
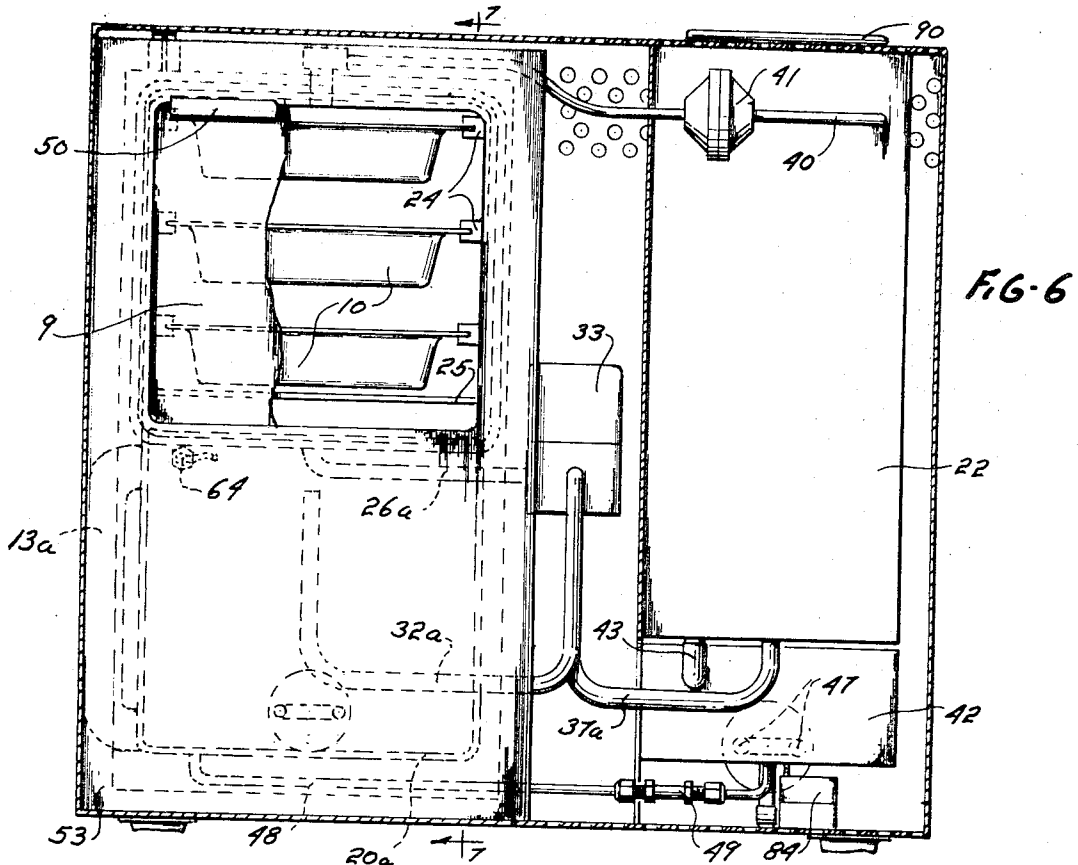


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FIG. 5



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AUTOCLAVE

This application is a continuation of Ser. No. 813,537, filed Apr. 4, 1969 and now abandoned.

This invention relates to autoclave equipment and is especially concerned with equipment of this type adapted for use as a sterilizer, particularly as a sterilizer for instruments and other articles employed in dental and surgical work. Although various features of the invention are applicable to autoclave equipment generally, since most features of the invention are of special applicability and advantage in sterilization equipment, the description hereinafter is primarily related to the use of the equipment as a sterilizer.

Sterilization of surgical equipment and instruments is a basic necessity in hospital routine and in the practice of dentistry and medicine. It is a matter of common knowledge that certain forms of bacteria are not only highly resistant to sterilization, but are also extremely dangerous if not destroyed.

It is an overall general objective of the present invention to provide equipment affording to the medical, dental and surgical professions a more rapid, convenient, and effective means and system for sterilization than has been provided by any equipment or system heretofore employed.

A number of methods for sterilization have been used or proposed, including employment of both liquid and gaseous chemicals, dry heat, ultraviolet rays, X-rays, as well as the more common pressurized steam systems. The pressurized steam systems as presently known and used, and also various of the other systems are all subject to a number of disadvantages. For instance various of the prior systems are relatively slow in their action. Some detrimentally affect the instruments or equipment being sterilized, and some are not considered sufficiently reliable and effective for safe use, particularly where it is desired to ensure destruction of the spores of certain disease producing bacteria, such as Clostridia.

Although pressurized steam systems are probably the most rapid and efficient sterilization systems employed, according to the present state of the steam sterilization art, the full capability and potential of the steam system is not realized, either because of the relatively slow operating or cycling time, or because the equipment is not adapted to operate at a sufficiently high pressure and thus at a sufficiently high temperature to insure the rapid destruction of all forms of bacteria. One reason for the deficiencies of the present steam systems lies in the fact that most of the steam sterilizers employ an autoclaving chamber which must serve a double purpose by functioning as both steam generator and sterilizing chamber. The requirements of steam generation on the one hand and sterilization on the other hand are in certain respects antagonistic to one another.

With the foregoing in mind, it is an important objective of the present invention to provide autoclaving or sterilization equipment in which separate chambers are provided to perform the functions of steam generation on the one hand and autoclaving or sterilization on the other hand.

This has numerous advantages including the fact that the sterilization time required can be greatly reduced because the steam generating chamber has a built up reserve which can be delivered instantly at will into the autoclaving chamber as needed for the purpose of au-

toclaving or sterilizing successive batches of instruments or other equipment to be sterilized. The time cycle required for sterilization is greatly reduced by this system, since, and by way of contrast, a chamber in which both sterilization and steam generation occur necessarily requires a substantial period of time for "warm up," i.e., for the heating of the chamber walls and associated structure up to the temperature needed for the steam generation and sterilization.

Another aspect of the currently available steam sterilization systems which has limited the usefulness of those systems is related to the type of closure or door employed to cover the access opening of the steam generating and autoclaving chamber used. In a typical prior art equipment, the door for the autoclave is a pivoted door which must be fastened with special securing devices designed to draw the door tight against the seal surrounding the access opening, and after the sterilization operation is concluded and the interior pressure reduced, such securing devices must again be released in order to gain access to the interior of the chamber for the purpose of withdrawing the instruments or other articles processed.

Closure equipment of the kind just mentioned is disadvantageous because of the time and inconvenience involved in securing and loosening the door holding devices. In addition, the prior door arrangements are disadvantageous because in some cases the securing devices must work against the pressure within the chamber which normally has a tendency to loosen the seal.

It is another major objective of the present invention to provide an access door arrangement requiring no securing devices of any kind, so that the operations of tightening the securing devices before sterilizing a batch, and subsequently loosening the securing devices, are completely eliminated. This is accomplished according to the present invention by the employment of a sliding door which is so mounted and arranged with relation to the access opening of the autoclaving chamber than when in use, the pressure within the chamber automatically serves to hold the door in closed position and further automatically serves to tighten the seal.

With a door arrangement of this kind as contemplated by the invention, it also becomes more practicable to increase the steam pressure used, because the seal is tightened in accordance with the pressure increase and is not dependent upon mechanical tightening devices. The increase in the pressure and temperature of the steam which is contemplated in accordance with the present invention in turn makes possible shortening the sterilization time. Taking into account the time savings resulting not only from the use of higher pressures and the increased facility of opening and closing the access door, but also resulting from the assignment of the functions of steam generation and sterilization to separate chambers, it is possible according to the present invention to provide a total cycle time for sterilization in the order of 1 to 3 minutes in comparison with 15 to 30 minutes as required by prior known equipment.

It is a further object of the invention to provide separate chambers not only for generation of steam and for sterilization purposes, but also for condensation of

steam being discharged from the sterilization chamber at the end of a sterilization operation. The present invention thus contemplates the provision of three chambers, one for steam generation, one for sterilization and one for condensation and storage of the resultant water formed, and it is a further object of the invention to provide interconnections and interlocked controls for these three chambers, functioning in a manner to expedite the overall operation and also to ensure safety and efficiency of the equipment in use.

Still another object of the invention is to provide a novel feed water system for delivering "make-up" or feed water into the steam generating chamber.

This is accomplished in the preferred practice of the invention by utilizing the water resulting from condensation of steam discharged from the sterilization chamber, whereby the water employed, such as distilled water is recirculated through the system and thus does not require repeated filling and draining of a treatment chamber as is the case with many prior devices for this general purpose.

It is also an object of the invention to provide a feed water system in which successive batches of feed water are received in a feed water receptacle which is automatically heated as a result of introduction of the water into the receptacle up to a temperature and thus up to a pressure above that prevailing in the steam generating chamber, provision being made for automatic transfer of such a batch of preheated feed water into the steam generating chamber under the influence of the pressure developed in the feed water receptacle.

Another object of the invention is to provide an autoclaving chamber equipped with guide means facilitating the insertion and removal of trays of instruments or articles to be sterilized, the tray and tray supports being arranged so that the trays may readily be at least partially withdrawn from the autoclaving chamber after opening of the access door, with the trays supported in exposed position so as to accelerate cooling of the trays and the contents.

How the foregoing objectives and advantages are attained will appear more fully from the following description referring to the accompanying drawings illustrating two embodiments of equipment according to the present invention, and in which:

FIG. 1 is a front elevational view of one form of autoclaving equipment constructed according to the present invention, this view showing the access door for the autoclaving chamber in open position;

FIG. 2 is a top plan view on a larger scale, showing the equipment of FIG. 1, with certain parts broken away and shown in horizontal section, as will further appear;

FIG. 2a is a fragmentary view of certain parts, as will be explained;

FIG. 3 is a front sectional elevation of the equipment of FIGS. 1 and 2, this view being on the scale of FIG. 2 and also having certain parts broken away and other shown in vertical section;

FIG. 4 is an isometric view of the autoclaving or sterilizing chamber of the embodiment of FIGS. 1, 2 and 3, having an access door arrangement according to the present invention, parts of the door and of the mounting therefor being broken off and shown in section;

FIG. 5 is a diagrammatic view of the equipment of FIGS. 1 to 4, illustrating the steam generating and condensing chambers in outline and illustrating in vertical cross section the shape of the autoclaving chamber, this view including a diagrammatic representation of the piping, valve and control arrangements and including also a schematic diagram of the electrical control circuits employed;

FIG. 6 is a front partial sectional view of another form of equipment according to the invention; and

FIG. 7 is a side view of portions of the equipment shown in FIG. 6, the steam generating and autoclaving chambers being shown in vertical section, as indicated by the section line 7—7 on FIG. 6.

Referring first to the embodiment illustrated in FIGS. 1 to 5 inclusive, attention is first directed to FIG. 1 which shows an overall front elevation of the equipment as enclosed in a casing and with the various controls exposed at the front panel. Here it will be seen that the front casing wall 8 is provided with an aperture in the upper central portion of the equipment in general registry with the access opening to the interior of the autoclaving or sterilization chamber. The door 9 for the access opening is shown in open position, so as to expose three trays 10 positioned in spaced superimposed relation. These trays may be inserted into and withdrawn from the autoclaving chamber through the aperture in the front wall of the casing as will readily be apparent.

The front panel 8 of the equipment shown in FIG. 1 also serves to mount various gauges, instruments and controls as will be mentioned as this description proceeds, and the entire unit is adapted to be supported by rubber feet 11 which project downwardly from the base 12 of the casing or support structure for the various parts of the apparatus.

Toward the left of the front panel in FIG. 1 there appears a gauge glass or window 13 through which the level of water in the steam generating unit to be described may be observed.

From FIGS. 2 and 3 it will be observed that the casing includes not only the front and bottom walls 8 and 12 but also side walls 14 and 15, back wall 16 and top wall 17. These casing walls may be made up in any convenient manner as by assembling separate metal sheets. The interior of the casing is also here shown as divided by two upright partitions 18 and 19 which in effect serve to divide the interior space into three compartments each adapted to receive one of the operating chambers of the equipment. Thus, toward the left of the unit the steam generating chamber 20 is positioned between the casing wall 14 and partition 18. Between the partitions 18 and 19 the autoclaving chamber 21 is received, and between the partition 19 and the side wall 15 the condenser chamber 22 which serves as a water reservoir, is received.

As above noted the sterilization or autoclaving chamber 21 is provided with an access opening in its front end, as indicated generally at 23 in the perspective view of FIG. 4. This autoclaving chamber is of generally rectangular shape, being closed at its side, bottom, top and rear end, as is clearly shown in the drawings. Along the inside of the two side walls of the autoclaving chamber grooved guides 24 are provided in pairs, each pair of guides being adapted to receive the

marginal flanges which are provided at the upper side edges of the trays 10.

Near the bottom of the autoclaving chamber is a perforated partition or plate 25, spanning the chamber from one side wall to the other and extended throughout the length of the chamber. A centrally located steam inlet pipe 26 passes through the bottom wall of the autoclaving chamber and terminates below the perforated plate 25, this pipe 26 serving as the inlet or supply line for steam delivered from the steam generating chamber into the autoclaving chamber. The central area of the plate 25 just above the inlet 26 is imperforate, as indicated at 27 (see FIGS. 2 and 3), and this aids in distributing the incoming steam in the space below the perforated plate 25. The perforations then serve to distribute the incoming steam throughout the entire volume of the autoclaving chamber.

Since steam is to be delivered into the autoclaving chamber, it is not necessary for that chamber to be designed to function as a steam generator. According to the invention the steam generation function is assigned to the steam generating chamber 20 which comprises a receptacle or tank of generally rectangular shape, closed at all sides. Transverse braces or stay bolts 28 are extended between the relatively large area side walls of the chamber in order to provide adequate strength to resist the internal pressure, even where the chamber is constructed of relatively thin metal sheet.

In the bottom of the steam generating chamber 20, preferably projecting through the back wall near the bottom wall is an electrical heating element 29, this element advantageously being of U-shaped form and having electrical connections such as indicated at 30 (FIG. 2) extended from its ends to the current supply and control system. The off take of steam from the chamber 20 is effected by the upwardly open offtake or discharge pipe 31 which extends downwardly through the generating chamber to a point near the bottom and then passes through the inner side wall of the chamber in a horizontal run as indicated at 32 in FIG. 3. The portion of this steam offtake indicated at 32 connects with a solenoid operated control valve 33 which in turn delivers the steam through pipe 34 to the inlet pipe 26 of the sterilizing chamber 21 as plainly appears in the drawings.

At the conclusion of a sterilizing operation, steam is discharged from the sterilizing chamber 21 through the connection 26 which previously served as the inlet connection, this exhaust steam being delivered through the pipe 35 and the solenoid operated valve 36 to the connection 37 which extends into the bottom of the condenser chamber 22. The condenser chamber serves as a reservoir for feed water to be returned to the steam generating chamber and a helical condenser pipe 38 disposed within the water in the condenser chamber receives the exhaust steam from the pipe 37 and, during the upward flow through the coil 38, the exhaust steam is caused to condense, the water ultimately discharging from the upper open end 39 of the condenser pipe into the interior of the condenser chamber, so that the water thus returns to the feed water system for ultimate return to the steam generating chamber.

As will be explained in greater detail in connection with FIG. 5 herebelow, the valve 36 is closed when valve 33 is opened to admit steam into the autoclaving

chamber. Conversely the valve 33 is closed when the valve 36 is opened to deliver the exhaust steam from the autoclaving chamber into the condenser.

Another connection is provided between the autoclaving chamber 21 and the condenser chamber 22. This connection, indicated at 40 serves to deliver air being displaced from the top of the autoclaving chamber at the time when steam is admitted into the bottom of that chamber. The pipe 40 is provided with a temperature responsive valve 41 which closes automatically upon appreciable rise in temperature in consequence of some steam flowing through the pipe 40 as the autoclaving chamber is being charged. The connection of this pipe 40 with the condenser chamber 22 provides for return to the feed water reservoir of any liquid or condensate escaping from the autoclaving chamber through the pipe 40.

The feed water system includes a receptacle 42 located below the level of the condenser chamber so that water will flow by gravity from the feed water reservoir into the receptacle 42. This flow may occur from the outlet connection in the bottom of the condenser chamber, through a flexible section of pressure resisting tubing 43 extended through a side wall of the feed water receptacle 42. The flexibility of the connection 43 permits vertical movement of the feed water receptacle 42, and it will be noted that the receptacle 42 (see FIG. 2a) is mounted by means of a pivot 44 providing for upward and downward movement of the receptacle 42. A spring 45, which may be made adjustable, normally holds the receptacle 42 in its upper position, but will yield and permit downward movement of the receptacle when the receptacle is nearly filled with water entering through the connection 43. A check valve 46 is located in the connection 43 and serves to prevent upward flow of steam or water from the receptacle 42 into the bottom of the condenser chamber.

A U-shaped electrical heating element 47 is positioned in the receptacle 42 and serves to heat the water therein and thereby develop pressure by means of which the batch of water entrapped in the receptacle 42 may be returned to the steam generating chamber 20. A connection 48, desirably formed of flexible tubing so as to accommodate the vertical motion of the receptacle 42, extends from the receptacle to the bottom of the steam generating chamber, this connection also being provided with a check valve 49 adapted to block flow in the direction from the steam generating chamber back into the receptacle 42.

Before considering the control system and operating arrangements in connection with the diagram of FIG. 5, particular attention is now directed to the access door for the autoclaving chamber, and the mounting of that door in association with the access opening of the autoclaving chamber. The arrangement of these parts can best be understood from inspection of FIG. 4. Here it will be seen that the access door 9 comprises a flat plate which is vertically movable. Upward motion, as by lifting on the insulated handle 50, serves to close the access opening, and downward motion opens the access opening, as will readily appear from FIG. 4.

The door mounting structure comprises an inner flat plate 51 having an opening 52 in registry with the access opening into the autoclaving chamber, and the

inner side of this plate is preferably welded to the walls of the chamber itself. A similar outer plate 53 having an opening 54 in registry with the access opening is positioned in parallel relation to the plate 51, the two plates being held in separated positions by the apertured spacing plate 55 which extends around the periphery of the other plates. Gaskets between plates of approximately one thirty-second of an inch thickness result in about one-sixteenth of an inch clearance space between the sliding door and the plates between which it slides. At the inner side of the outer plate 53, surrounding the aperture 54 therein, and thus surrounding the region of the access opening into the autoclaving chamber, the plate 53 is provided with a groove for receiving a sealing ring 56, formed, for example, of rubber. This sealing ring is adapted to be engaged by the outer face of the door 9 when the door is closed. In the absence of pressure within the autoclaving chamber 21, the door preferably has sufficient clearance between the plates 53 and 51 and also between the sealing ring 56 and the plate 51 so that by the action of gravity on the door, the door will drop down to the lower or open position. On the other hand when it is desired to carry out a sterilization operation, after the articles or instruments are inserted into the chamber, the door is lifted to its closed position and steam is then caused to enter the autoclaving chamber, and just as soon as some steam pressure develops, that pressure will act upon the door to push the door outwardly against the sealing element 56 and this will retain the door in its closed position automatically against the action of gravity. Moreover, this action will result in increasing the tightness of the seal with increase in pressure within the autoclave. Still further, at the termination of a sterilization operation, when the steam is being exhausted from the autoclave, when the pressure drops to a level approaching atmospheric pressure, the door will automatically drop open, without requiring the attention of any attendant and without manually loosening any securing device.

Turning now to the diagram of FIG. 5, it is first to be understood that it is contemplated according to the invention that the steam generating chamber remain heated and in condition serving as a reservoir for pressurized steam at all times when it is expected that sterilization operations may desirably be performed. For example, it is expected that in the use of the sterilizer during the course of a day, the equipment will be powered and the steam generating chamber will remain heated throughout the day so that a supply of steam is always available for instant use whenever it is desired to effect a sterilization operation. In situations where it may be desired to sterilize instruments at any time during the day or night, for instance in a hospital, the equipment may be powered and the steam generating chamber charged at all times.

Having in mind the foregoing contemplated aspects of the operation, the equipment may be plugged into a power supply line, for instance, a 120 volt, 60 cycle power supply line and the equipment may be turned on and off by means of the master switch 57 shown not only on FIG. 5 but also on the control panel in FIG. 1. This switch is in one side of the power supply comprising the lines 58 and 59. A connection 60 extends from the line 59 to one side of the heater element 29 in the steam generating chamber. The other side of the heater

element 29 is connected by a wire 61 with one side of an adjustable pressure responsive switch 62, the other side of that switch being connected as indicated at 63 with the side of the line 58 through the master switch 57. A steam connection 64 is extended from the steam generating chamber to the pressure switch 62 and acts to open switch 62 when the pressure rises to a predetermined level, which point may be adjusted by setting the switch 62. The connection 64 is also employed to operate a pressure gauge 65, the switch 62 and the gauge 65 both being shown in FIG. 1 as well as in FIG. 5.

Signal lights are provided so as to indicate whether the heater in the steam generator is on or off. These lights desirably include a red light 66 connected at one side to the wire 61 and at the other side by a wire 67 with the terminal of the heater 29 with which wire 60 is associated. Therefore when switch 62 is closed, thereby energizing the heater element 29, the red light is turned on. On the other hand when switch 62 is open, the red light 66 is de-energized but the white light 68 will be lighted, because of current supplied at one side through the connection 63 and at the other side through the connection 61, through the heater element 29 itself, and the connection 60 to the opposite side of the power supply.

The solenoid operated valve 33 for delivering steam from the generating chamber to the sterilizing chamber 21 is controlled by a circuit including the wire 69, microswitch 70, wire 71 and the timer switch 72, the opposite side of which is connected with the wire 63 and thus with the side 58 of the power supply in which the master switch 57 is inserted. The other side of the solenoid operated valve 33 is coupled as indicated at 73 with the wire 74 extending to the side 59 of the power supply. Therefore, with both the microswitch 70 and the timer switch 72 closed, the solenoid operated valve 33 is actuated to open the steam supply line to the autoclaving chamber. At the same time the solenoid operated valve 36 is actuated to close the exhaust steam line 35-37, both of these solenoid operated valves (33 and 36) being controlled by the same timing circuit. For the purposes just mentioned the valve 33 (normally closed type) is arranged to open when its solenoid is energized, and the valve 36 (normally open type) is arranged to open when its solenoid is de-energized.

The timer controlled switch 72 is adapted to be set so as to close the circuit for any desired interval of time, for instance two minutes, and provided the microswitch 70 is at that time also closed, the steam inlet valve 33 will remain open and the steam exhaust valve 36 will remain closed until the set time runs out. This will break the circuit at the timer switch in consequence of which the steam supply valve 33 is closed and the exhaust valve 36 is opened.

It is now pointed out that the actuating element for the microswitch 70 is positioned in the path of the door 9. Thus, as best seen in FIGS. 2 and 3, the microswitch 70 is provided with an arm 75 carrying an actuating pin 76 positioned to be engaged by the upper edge of the door 9 when the door is lifted to close the access opening. In operation, the timer will be set to a predetermined setting and then the door is manually raised to the closed position and this immediately actuates the

microswitch 70 to complete the circuit which will open the supply valve 33 and close the exhaust valve 36. At the end of the cycle of operation established by the time switch 72, the steam supply valve 33 will close and the exhaust valve 36 will open, and after dissipation of the pressure in the autoclaving chamber, the door 9 will automatically drop down to the open position, thereby opening the microswitch 70, which will prevent unintentional readmission of steam into the autoclaving chamber should timer actuated switch be again turned on until the door is again manually lifted to its closed position.

During the interval of initial entrance of steam into the autoclaving chamber the air in the chamber will be exhausted through the pipe 40 as above mentioned and through the temperature responsive valve 41, until the temperature of that valve rises appreciably, which will thereby shut the valve and thus maintain the desired pressurized condition within the autoclaving chamber. The pipe 40 is further used as a source of steam for the reading of temperature by the temperature gauge or thermometer 77 (see also FIG. 1) and, in order to ensure accuracy of reading of this thermometer, a bypass 78 is provided around valve 41, this bypass being provided with an adjustable needle valve 79 by which the bypass may be choked down to a small bleed port.

The pressure within the sterilizing chamber is indicated by a pressure gauge 81 provided on the panel as will be seen from FIG. 1, this gauge being connected by small tube 80 to pipe 40.

The heater element 47 in the receptacle 42 of the feed water supply system is connected with one side of the power supply by means of the wire 82 in which a control switch 83 is provided (see also FIG. 1). The other side of the heater 47 is connected through microswitch 84 with a wire 85 which in turn is coupled with wire 74 leading to the other side 59 of the power supply line. The actuating element of the microswitch 84 is positioned to be engaged by the receptacle 42 when it has moved to down position by weight of the water from the feed water reservoir in the bottom of the condenser chamber 22. This microswitch is adapted to close the circuit when the receptacle 42 moves downwardly and to open the circuit when the receptacle 42 is lifted by the springs 45. Therefore, when the switch 83 is closed and water flows downwardly from the condenser chamber 22 into the receptacle 42, the consequent downward motion of the receptacle 42 will activate the heater 47 and upon the attainment of a temperature and pressure somewhat above those prevailing in the steam generating chamber 20, the charge of water in the chamber 42 will be delivered through the connection 48 and the check valve 49 into the steam generating chamber.

With the gauge glass 13 visible at the front panel of the equipment, it may readily be determined when the switch 83 should be closed in order to deliver one or more sequential batches of feed water from the condenser chamber into the feed water receptacle 42 and from there into the steam generator. As an alternative to the manual switch 83, a switch operating automatically under the influence of the level of the water in the steam generating chamber may be employed to automatically activate the heater in the water receptacle 42, and thereby provide for introduction of additional

water into the steam generating chamber whenever the level of the water drops below a predetermined point.

The various chambers of the equipment and other parts of the apparatus, especially those parts coming in contact with the steam or water, are desirably formed of corrosion resistant metal such as stainless steel. The autoclaving chamber is also desirably provided with appropriate lagging or insulation such as indicated at 86. Similar insulating material 87 may be provided around at least certain of the walls of the steam generating chamber 20. On the other hand it is desirable to maintain the condenser chamber relatively cool, and for this purpose air circulation apertures may be provided in the casing walls in the vicinity of the condenser chamber, for instance in the bottom wall or floor as indicated at 88 in FIG. 3 and also in the top wall 17 as indicated at 89 in FIG. 3.

The condenser chamber is of course a low pressure chamber, preferably substantially atmospheric pressure and a removable lid or cover 90 (see FIG. 3) may be provided for the purpose of introducing make up water, although, because of the circulation system established by the equipment, make up water need be introduced only infrequently.

Turning now to the embodiment illustrated in FIGS. 6 and 7, it is to be noted that the autoclaving chamber and door arrangement of this embodiment are identical to those employed in the first embodiment. However, instead of arranging the steam generating chamber to the left or to a side of the autoclaving chamber 20, in the embodiment of FIGS. 6 and 7, the steam generating chamber is positioned below the autoclaving chamber, as is indicated at 20a. Moreover, instead of positioning the solenoid valves 36 and 33 below the autoclaving chamber, these valves are positioned either between the autoclaving chamber and the condensing chamber, as clearly appears in FIG. 6, or between the autoclaving chamber and the left wall 14 (FIG. 3) or behind the steam generator 20a. Connection 32a serves to deliver steam from the generating chamber to the solenoid valve for controlling admission of steam into the autoclaving chamber, and connection 26a runs from the solenoid valves to the autoclaving chamber and serves both for steam admission and for exhaust of steam, in the latter event the steam being directed through valve 36 to the connection 37a which leads to the condensing coil provided in the condenser chamber 22 which is located in relation to the autoclaving chamber in the same general arrangement as in the first embodiment.

The disposition of the steam generating chamber below the autoclaving chamber, preferably with a single partition wall such as indicated at 21a in FIG. 7 serves an important function in the embodiment of FIGS. 6 and 7. During the interval of sterilization, a substantial amount of steam condensation normally occurs on the upper, back and side walls of the autoclaving chamber, and this condensation flows down the walls and in the arrangement just described when this condensation reaches the common partition 21a between the autoclaving and steam generating chambers, the heat in the generating chamber will be transferred through the wall 21a to the accumulating moisture, thereby that water. This revaporization process results in substantial reduction of water consumption per sterilization cycle.

It will be understood that control systems of the kinds fully described above with reference to the first embodiment, and particularly with reference to FIG. 5 will be employed in the embodiment of FIGS. 6 and 7 and also that a feed water system of the kind described above may likewise be utilized in the embodiment of FIGS. 6 and 7. A gauge 13a indicating the water level in the generating chamber 20a may also be provided.

The use of the feed water receptacle 42 and the electrical heating system providing for delivery of batches of feed water from the receptacle to the steam generating chamber is of special advantage where it is desired to maintain continuous operation of the sterilizer equipment, as, for example, in hospital use. However, in equipment intended for use throughout only a portion of the day, for instance from 9:00 a.m. to 6:00 p.m., as in the office of a dentist or doctor, the equipment may be somewhat simplified. For example, the feed water receptacle 42 and its heater, with the control system provided, as described above with particular reference to FIGS. 3 and 5, may be omitted, and the connection 48 may be directly coupled with the lower part of the condensing chamber 22. In this variant, upon shutting off the power supply (as by the shut off switch 57) the temperature and pressure in the steam generating chamber will drop in the course of a few hours. The temperature drop will be sufficient to lower the pressure to a value below atmospheric pressure, in consequence of which the water present in the condensing chamber 22 will automatically be drawn into the steam generating chamber, so that when the power switch 57 is again closed, for instance at the commencement of the next day's use of the equipment, adequate water is present in the steam generating chamber to continue the operation through a substantial number of sterilization cycles.

It will be understood that other forms of feed water pumps or an injector could be used to transfer water from the condenser chamber to the steam generating chamber.

We claim:

1. Sterilization equipment comprising a sterilizing chamber having space therein for receiving articles to be sterilized, a connection communicating with said chamber below said space, steam supply means includ-

ing a steam supply valve operably connected to said connection for admitting steam into the chamber through said connection, steam exhaust means including an exhaust valve operably connected to said connection for exhausting steam from the chamber through said connection, an air discharge connection communicating with the autoclaving chamber above said space, and a valve in said air discharge connection with thermally operating means for closing the air discharge connection upon passage of steam from the chamber through the air discharge connection.

2. Equipment as defined in claim 1 and further including a perforated steam distributing plate in the sterilizing chamber above the steam connection at the bottom thereof.

3. Equipment as defined in claim 1 in which the steam supply means further includes a steam generating chamber connected to deliver steam through the steam supply valve into the sterilizing and the equipment further including a steam condensing chamber into which the exhausted steam is delivered through the steam exhaust valve.

4. Equipment as defined in claim 3 and further including a connection for delivering condensate from the condensing chamber to the steam generating chamber.

5. Equipment as defined in claim 4 in which the steam generating chamber is a closed pressurized vessel having heating means for steam generation and in which the condensing chamber is open to atmosphere, and the connection for delivering condensate from the condensing chamber to the generating chamber having a check valve therein providing against flow from the generating chamber into the condensing chamber but providing freedom for flow from the condensing chamber to the generating chamber, the equipment further including control means for the heating means for steam generation providing for cooling of the generating chamber and thus for condensation of steam therein with accompanying decrease in pressure and resultant delivery of condensate from the condensing chamber into the steam generating chamber under the influence of atmospheric pressure in the condensing chamber.

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