Feb. 14, 1967 B. D. PILE 3,304,149

FIELD STERILIZER

Filed June 24, 1963 4 Sheets-Sheet 1

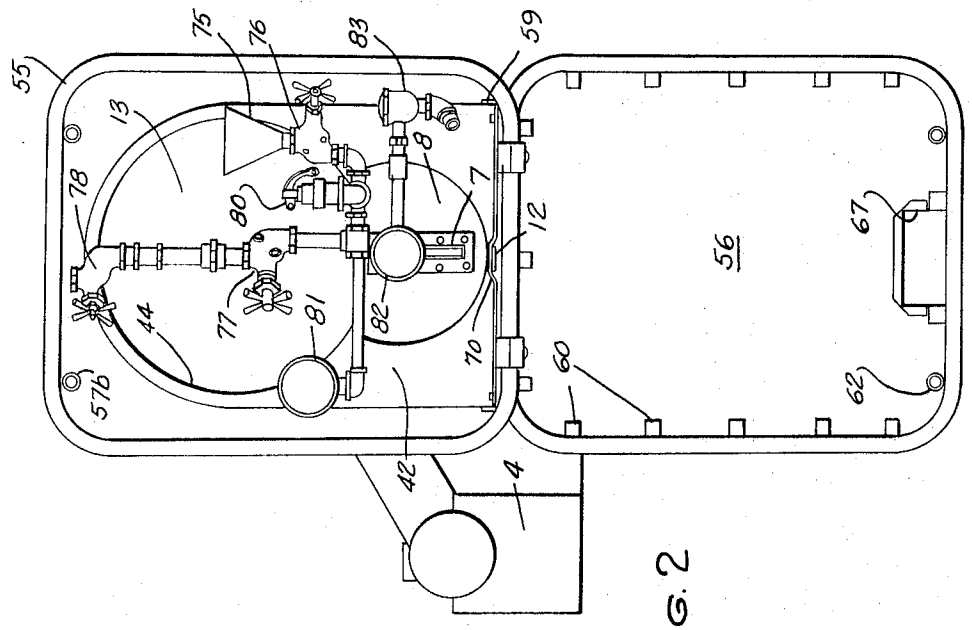

Fig. 2

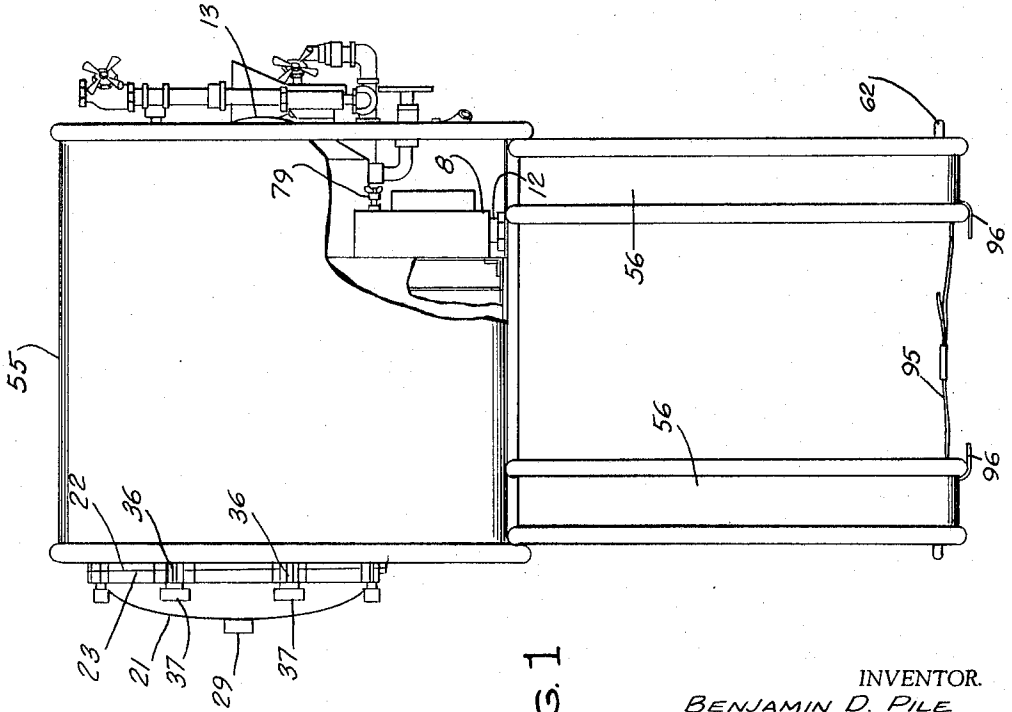

Fig. 1

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FIG. 3

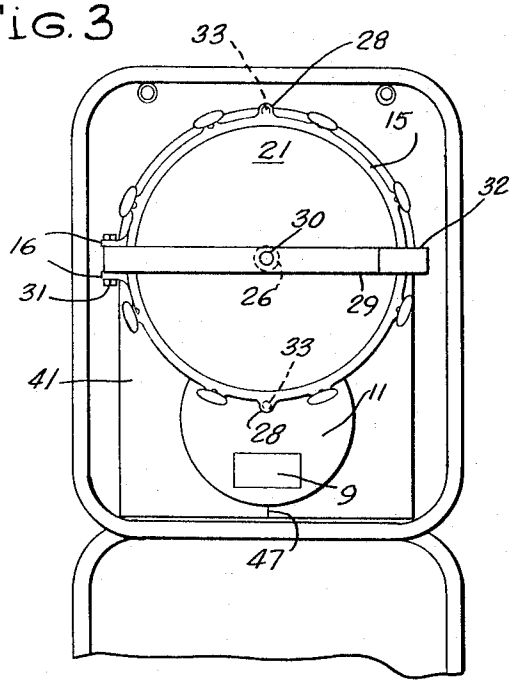
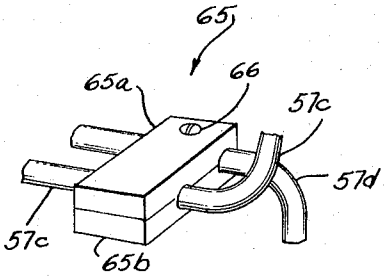


FIG. 9



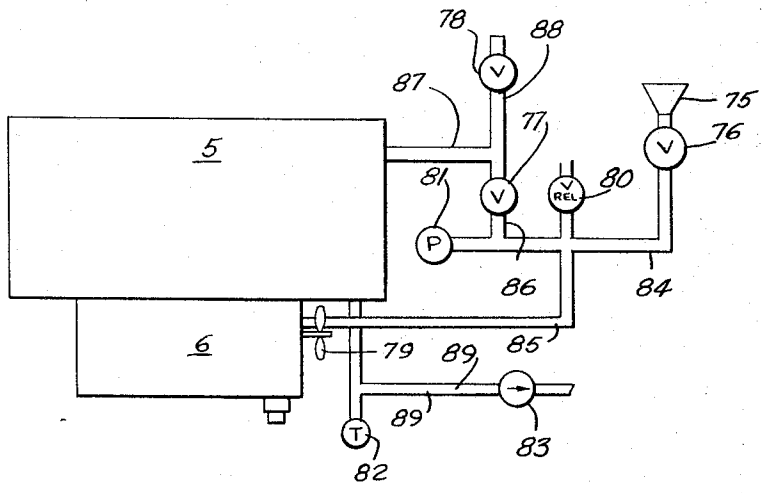


FIG. 6

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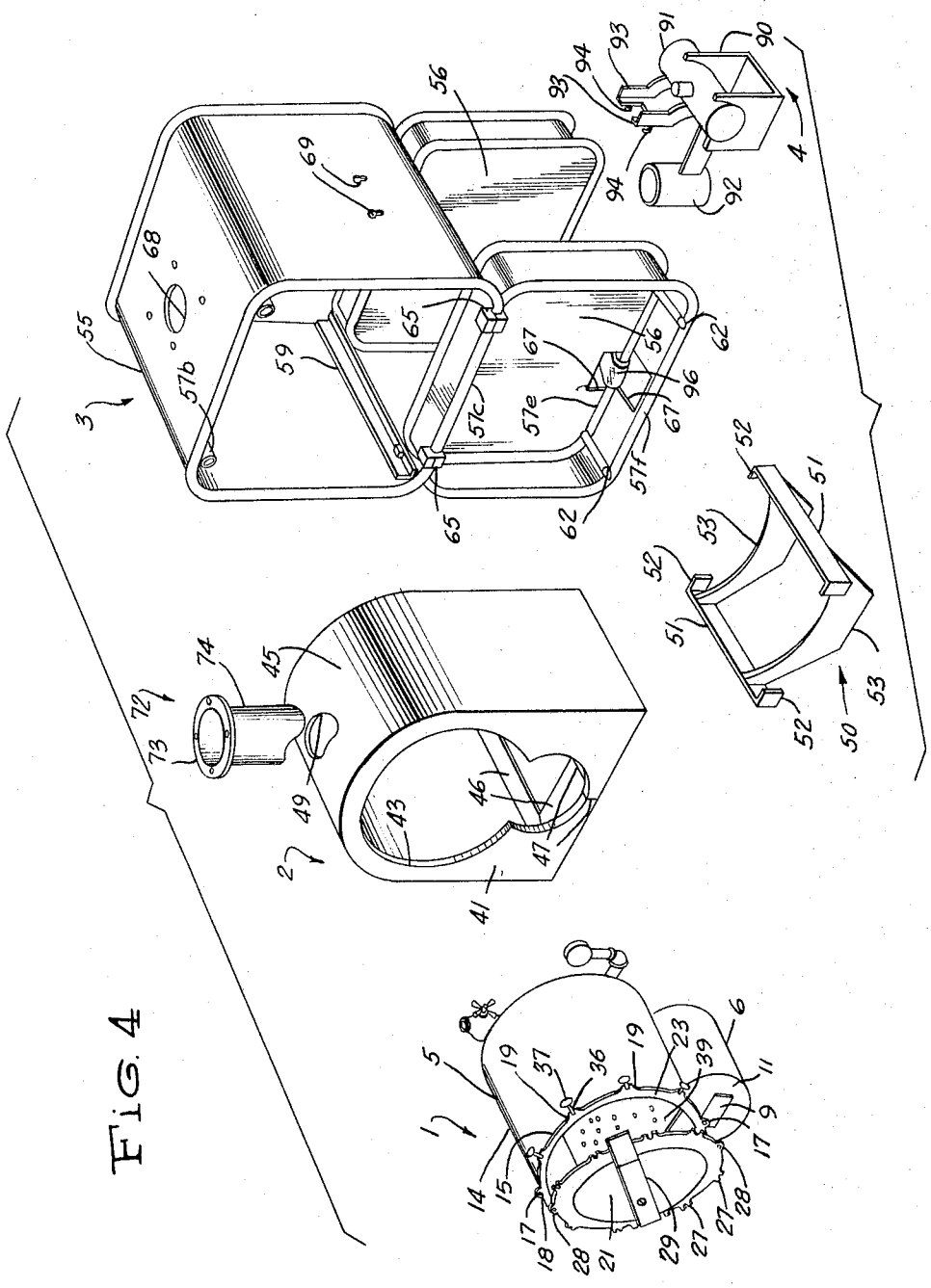

Fig. 4

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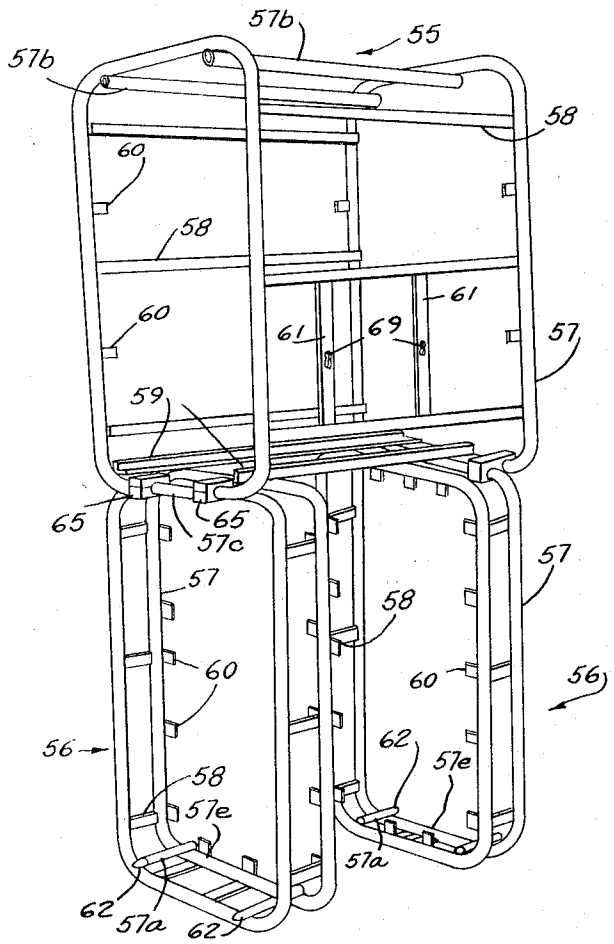

Fig. 8

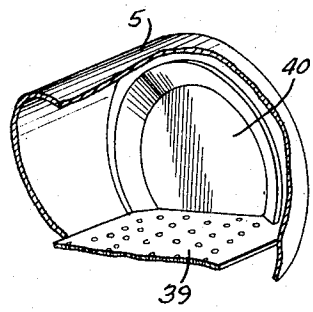

Fig. 5

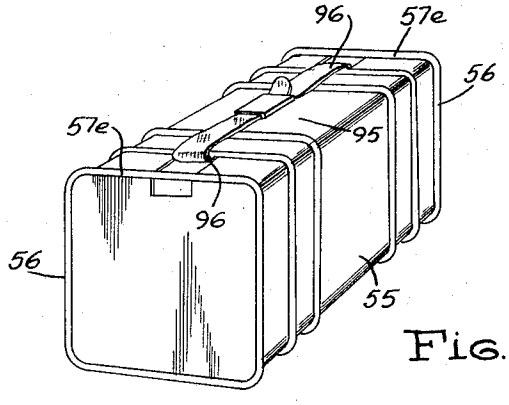

Fig. 7

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3,304,149

FIELD STERILIZER

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Filed June 24, 1963, Ser. No. 290,265
3 Claims. (Cl. 21—98)

The invention described herein may be manufactured and used by or for the Government for governmental purposes without payment to me of any royalty.

The present invention relates to the field of apparatus for sterilizing surgical dressings, instruments and the like.

Two general types of steam sterilizers or autoclaves are presently used for sterilizing surgical dressings, surgical and dental instruments and the like. The double shell type sterilizer typically comprises two concentric cylinders, the inner shell serving as the sterilizing chamber and the space between shells functioning as the steam generator. For the sterilizing operation steam produced in the generating space is admitted to the inner chamber. After the sterilizing period the steam is exhausted from that chamber and the dressings or instruments are left therein to be dried by heat transmitted through the sterilizing chamber walls. The typical double shell sterilizer is expensive to manufacture and heavy.

The other type steam sterilizer in general use is the single shell type. In the single shell sterilizer a quantity of water is introduced into the sterilizing chamber itself, heat is applied directly to the sterilizing chamber and the steam is generated therein. After the sterilizing period is completed, steam is exhausted from the chamber and the heating of the chamber continues until the contents of the sterilizer are dried. Burning or scorching of dressings is a common occurrence with single shell sterilizers particularly when the source of heat is a direct flame.

In addition to the deficiencies just described, most of the steam sterilizers or autoclaves in common use have other characteristics which limit their value to military or other medical organizations operating in the field. The complicated design and special features of conventional sterilizers which may be desirable at permanent medical installations may cause operating and maintenance problems in the field.

Accordingly, an object of this invention is to provide a simple efficient lightweight sterilizer which can be economically manufactured and which is suitable for use in the field.

Another object of this invention is to provide a steam sterilizer having a sterilizer chamber separate from the steam generator in which the steam generator functions as a heat sink to prevent overheating of the sterilizer chamber during the drying cycle.

Another object of the invention is to provide a steam sterilizer having a carrying or shipping case which when opened serves as a stand to support the sterilizer in an elevated position.

These and other objects and advantages of the invention will be made clear in the drawings and in the description which follows.

In the drawings:

FIG. 1 is a side elevation with parts broken away of the field sterilizer in its operating position;

FIG. 2 is a rear elevation of the field sterilizer in its operating position.

FIG. 3 is a partial front elevation of the field sterilizer in its operating position;

FIG. 4 is an exploded perspective view showing most of the principal elements of the field sterilizer;

FIG. 5 is a perspective view partly in section of a part of the sterilizer chamber;

FIG. 6 is a diagrammatic representation of the sterilizer's plumbing;

FIG. 7 shows the sterilizer in its closed or carrying condition;

FIG. 8 is a perspective view of the frame of the carrying case; and

FIG. 9 is an enlarged perspective view of the hinge used with the covers.

The field sterilizer comprises four principal components as most clearly appears in FIG. 4; a chamber unit **1**, a fume hood **2**, a carrying case **3** and a burner unit **4**. The chamber unit **1** is mounted in the fume hood **2** which is in turn mounted in the carrying case **3**. The burner unit **4** is attached to the carrying case when the sterilizer is operated. When the sterilizer is transported, the burner unit **4** may be carried within the chamber unit **1**. Aluminum or other lightweight metal is used to the maximum extent practicable for the various components of the sterilizer.

The chamber unit **1** comprises a generally cylindrical sterilizer chamber **5** and a steam generator chamber **6**. The steam generator chamber which is fabricated as a section of a cylinder closed at both ends is seam welded along its upper edges to the bottom surface of sterilizer chamber **5**. Thus a portion of the bottom surface of the sterilizer chamber serves as the top surface of generator chamber **6**. A visual type water gauge **7** is provided in the rear end wall **8** of the generator chamber **6**. A rectangular cleanout hole **9** with a removable cover is provided in front wall **11** of the generator chamber. A water drain nipple **12** closed by a removable threaded plug is welded into the bottom of generator chamber **6**.

Sterilizer chamber **5** is closed by curved end wall **13** welded to the cylindrical body portion **14** of the sterilizer chamber. A generally circular door flange **15** of cast aluminum alloy is welded to the front edge of cylindrical body portion **14**. Integrally formed with the flange and extending outward from its periphery are a pair of door posts **16**, a pair of guide projections **17** having holes **18** drilled therethrough, and a plurality of bifurcated projections **19**. Transverse aligned holes are bored through the two legs of each bifurcated projection **19**.

Circular outwardly curved sterilizer door **21** is cast from an aluminum alloy. The door rim face **22** seats against face **23** of the sterilizer flange when the door is closed. A door gasket, not shown, of the O-ring type received in a circular groove cut into door rim face **22** forms a pressure tight seal between the door and sterilizer flange when the door is closed. One-fourth inch diameter butyl rubber door gasket of 60 durometer hardness is satisfactory.

Sterilizer door **21** is formed with a central boss **26**, a plurality of bifurcated projections **27** at its periphery matching projections **19** in sterilizer flange **15** and top and bottom projections **28** matching the guide projections **17** on the sterilizer flange. Curved door arm **29** is attached by screw **30** or other suitable means to central boss **26** of the door. A bolt **31** which passes through aligned holes in the door posts and a hole in the proximal end of the door arm serves as the hinge pin on which sterilizer door **21** pivots. A door handle **32** of heat insulating material is attached to the distal end of door arm **29**. Guide pins **33** having conical head portions adapted to be received in holes **18** of guide projections **17** are attached to top and bottom projections **28** of the door.

The locking means by which the sterilizer door **21** can be brought into and held in tight sealing engagement with sterilizer flange **15** comprises a plurality of toggle bolts **36** and hand nuts **37**. Each toggle bolt **36** is pivotally mounted on a toggle bolt pin between the arms of

one of the bifurcated projections 19. The distal end of each toggle bolt is threaded and receives a hand nut 37. The toggle bolts may be swung outward when the door is to be opened. When the sterilizer door has been closed and is to be locked, the toggle bolts may be swung forward so that their shafts lie between the arms of the bifurcated projections 27 on the door. The operator may then manually tighten hand nuts 37 thereby locking the door in sealing engagement with the sterilizer flange. The operator grips the insulated door handle to open and close the door; when the door is being closed guide pins 33 are received in guide holes 13 thus insuring proper alignment between the door and the sterilizer flange.

A horizontal rectangular perforated shelf plate 39 is attached by intermittent welding at its edges to the interior wall of sterilizer chamber 5 along the lines formed by the intersection of sterilizer chamber 5 and generator chamber 6. Thus, shelf plate 39 functions not only as a shelf to hold material being sterilized but also as a structural member when the generator chamber is filled with steam under pressure and the sterilizer chamber is at atmospheric pressure. A generally circular flanged steam diffuser plate 40 is affixed to the back edge of shelf plate 39. When steam is admitted to the sterilizer chamber, in a manner to be described hereafter, it is deflected toward the walls of the sterilizer chamber by steam diffuser plate 40.

The chamber unit 1 may be chromic acid anodized both externally and internally to prevent corrosion and pitting. The chamber unit 1 is mounted in the fume hood 2 which supports the chamber unit and serves as a flue to channel the products of combustion from the burner past the cylindrical body portion 14 of the sterilizer chamber. The fume hood 2 which may be fabricated of sheet aluminum comprises identical front and rear walls 41 and 42, respectively. End opening 43 in the shape of two overlapping circles is cut through the front wall 41 and a similar opening 44 is cut through the rear wall 42. Openings 43 and 44 correspond in size and shape to the cross section of the chamber unit. The front and rear walls of the fume hood are welded at their top and side edges to a continuous side wall portion 45. The upper parts of the side wall portion curves to form half of a cylinder. The length of the fume hood measured along side wall portion 45 is slightly less than the distance between front wall 11 of steam generator 6 and water drain nipple 12 in the steam generator. Thus when chamber unit 1 is placed within fume hood 2, the steam generator 6 may be supported by both the front and rear walls of the fume hood while nipple 12 falls just outside the fume hood.

Fume hood 2 is open at its bottom except that the front and rear walls and the side wall portion are bent inwardly at their bottoms at right angles to form a lip 46 whose purpose will appear presently. To facilitate installation and repair a transverse cut 47 may be made through the bottom of the front and rear walls and their adjacent lips 46. With such cuts the bottom portions of the front and rear walls may be pulled apart expanding the diameter of the openings 43 and 44. Hood splices, not shown, formed from lengths of aluminum angle may be used to removably span transverse cuts 47. When they are fastened to lips 46 on both sides of cuts 47 by bolts or other suitable means the fume hood 2 is a unitary structure. Circular opening 49 is made through the top of the fume hood.

A flame deflector 50 consisting of two longitudinal members 51 having front and rear lip portions 52 and a pair of spaced lateral plates 53 is mounted within fume hood 2 by bolts passing through front and rear walls of the fume hood and the adjacent lip portions 52 of the flame deflector's longitudinal members. The lateral plates 53 which are curved at their centers to correspond with the radius of steam generator 6 restrict the flame from the burner to a relatively small area of the steam generator and result in more efficient heating. The lateral plates also form a saddle on which the bottom of the steam generator rests.

The carrying case 3 in which the fume hood and chamber unit subassembly is mounted comprises a rectangular case body 55 open at both ends and at its bottom. The framework of case body 55 and case end covers 56 appears most clearly in FIG. 8. It may be fabricated of aluminum tube members 57 and bar stock members 58. A pair of spaced aluminum angles 59 form the longitudinal members in the bottom of case body 55. A number of rectangular aluminum tabs 60 are welded to the framework providing additional surfaces to which the outer skin may be spot welded. A pair of burner support members 61 formed of flat bar stock are transversely attached to two longitudinal bar stock members on one side of case body 55.

Cover aligning plugs 62 having rounded heads are fixed within tube members 57*a* at the top sides of case end covers 56. The cover aligning plugs project beyond the end of tube members 57*a* and are adapted to be received within the ends of tube members 57*b* when the covers are closed. Thus cover aligning plugs 62 function to align the end covers and case body when the carrying case is closed. The top and sides of case body 55 are covered with sheet aluminum which may have spaced apart corrugations. The exterior ends, top, bottom and sides of end covers 56 are likewise covered with sheet aluminum. The sheet aluminum for both the case body and end covers is welded to the several tube, bar stock and angle members which comprise the frame and to the rectangular tabs 60.

The details of a suitable hinge for attaching the end covers 56 to the case body 55 are shown in FIG. 9. Each hinge 65 is in the shape of a generally rectangular block having two parallel passages drilled therethrough. The hinge is made in two halves 65*a* and 65*b* and is assembled with tube member 57*c* of the case body passing through one hinge passage while tube member 57*d* of an end cover passes through the other hinge passage. The hinge halves 65*a* and 65*b* are held together by hinge screw 66 which passes through tube member 57*d*. Each hinge 65, therefore, is freely rotatable about tube member 57*c*. Each cover 56 is capable of 180° rotation between a closed position and an open position in which case body 55 may be supported upon the upstanding end cover 56.

Rectangular openings 67 are made in the top and end walls adjacent tube member 57*e* in each end cover 56. These openings make it possible for personnel to grasp tube members 57*e* when lifting the sterilizer. They also cooperate in a manner to be explained hereinafter with a locking strap in locking the carrying case in its closed and in its operating positions.

A circular opening 68 is cut in the top of case body 55 directly over the position which circular opening 49 of fume hood 2 will occupy when the fume hood is installed in the carrying case. A pair of keyhole shaped burner mounting slots 69 are cut through one of the sides of case body 55 and through the underlying burner support members 61.

The manner in which chamber unit 1, fume hood 2 and flame deflector 50 are assembled has already been described. The chamber unit-fume hood subassembly is mounted within case body 55 with the bottom side edges of fume hood 2 received in and supported by angle members 59. The side portions of the fume hood's bottom lip are fastened to angle members 59 by screws or other suitable means. The chamber unit-fume hood subassembly is further secured to case body 55 by transverse retainer member 70 (see FIG. 2). Retainer member 70, which is attached at its ends to the bases of angle members 59, receives water drain nipple 12 in a central opening. A fume chimney 72 comprising a flange 73 and a

cylindrical portion **74** is bolted by its flange to case body **55** with the cylindrical portion **74** depending through circular opening **68**. The cylindrical portion **74** of the fume chimney is of larger diameter than opening **49** of the fume hood. Cylindrical portion **74** is of such a length and its bottom edge is so curved that there is a close fit between the bottom edge of cylindrical portion **74** and the top of fume hood **2**.

The sterilizer plumbing is diagrammatically illustrated in FIG. 6. It comprises a funnel **75**, gate valves **76**, **77** and **78**, air release valve **79**, safety valve **80**, pressure gauge **81**, temperature gauge **82** and a trap **83**. To reduce weight it is desirable that the piping which includes branches **84**, **85**, **86**, **87**, **88**, and **89** and all fittings be of aluminum. However, to save expense, or for emergency repairs, standard piping or fittings of any material may be used. Valves **76**, **77** and **78** have cast aluminum bodies with stainless steel stems and seats. They are of the non-rising stem gate type. Trap **83** should have an element operating at about 250° Fahrenheit. It should vent air and condensation from sterilizer chamber **5** when that chamber is being filled with steam and should stop venting after the 250° Fahrenheit temperature is reached. The functions of the various fittings will be explained more fully hereafter when the operation of the sterilizer is described.

Any suitable heat source may be used as a burner unit to generate steam in generator chamber **6**. In addition to being capable of generating an adequate supply of steam at sterilizing temperatures and pressures, it is desirable that the burner unit be lightweight and able to burn leaded gasoline which is often the only fuel readily available during military field operations. The burner unit **4**, illustrated, comprises burner frame **90**, a fuel tank **91**, a burner proper **92** and a pair of burner support brackets **93**. Each burner support bracket **93** has a button shaped projection **94** thereon adapted to removably engage one of the keyhole shaped burner mounting slots **69**. The burner proper **92** is so located in relation to burner bracket **93** that when the burner unit is attached to case body **55** by means of projections **94** the burner proper **92** is located underneath steam generator **6**. It should be apparent that although it is convenient to utilize a burner which can be attached to the case body, it is not essential that the burner unit be so attached. For example, a burner supported upon a box underneath the open bottom of case body **55** will operated quite satisfactorily.

An adjustable locking strap **95** having hook elements **96** at each end is also provided. Locking strap **95** is used to lock the end covers **56** in their closed condition when the sterilizer is transported in the manner shown in FIG. 7, the hook elements engaging tube member **57***c* of each end cover. Adjustable strap **95** is similarly used to interconnect and secure end covers **56** in their open position as shown in FIG. 1.

In order to use the sterilizer it is first set up in the operating position illustrated in FIGS. 1–3. The dressings or other material to be sterilized are placed on shelf **39**. The sterilizer door **21** is closed and secured by swinging toggle bolts **36** forward and tightening hand nuts **37**. Water is added to steam generator chamber **6** until the liquid level reaches to top of water gauge **7**. Air release valve **79** which may be of any conventional design is opened while the water is added to allow air to escape from the generator chamber. Water fill valve **76** is open and steam inlet valve **77** is closed during the filling operation. Water poured into funnel **75** passes through branches **84** and **85** to the generator chamber **6**. After water has been added water fill valve **76** and air release **79** are closed.

After water is added to the steam generator the generator should be heated by burner **92** until pressure gauge **81** indicates that the pressure within the steam generator is about 25 pounds per square inch gauge. Steam inlet valve **77** is opened and steam exhaust valve **78** is checked to make sure that it is closed. Steam is then able to flow from the steam generator **6** through branches **85**, **86** and **87** into the sterilizer chamber **5**. Air and condensate will be forced out of sterilizer chamber **5** through branch **89** and will escape through trap **83**. When pressure gauge **81** again registers 16 to 17 pounds and the temperature as shown on temperature gauge **82** registers 250° to 254° Fahrenheit the sterilization period begins. These pressure and temperature ranges may be maintained during the sterilizing process by regulating the heat applied to the steam generator. The pressure release or safety valve **80** should be set to open at approximately 25 pounds pressure.

At the end of the sterilizing period steam inlet valve **77** should be closed and steam exhaust valve **78** opened permitting steam to escape from the sterilizer chamber through branches **87** and **88** to the atmosphere. When the flow of exhausting steam becomes negligible, sterilizer door **21** should be opened slightly. The drying period then commences. The burner continues to apply heat to both the steam generator and to the exterior of the sterilizer chamber sides. Burner operation should be regulated during the drying period so that the pressure shown on pressure gauge **81** does not exceed 24 pounds. When the drying cycle is completed the load is removed from the sterilizer chamber and the burner is shut off or allowed to continue burning depending on whether additional material is to be sterilized or not. When the burner is finally shut down the pressure wtihin the steam generator should be allowed to drop to zero by cooling. When pressure gauge **81** registers zero, air release valve **79** should be reopened to prevent any vacuum from forming within the steam generator chamber **6**. The generator chamber **6** serves as a buffer or heat sink which prevents scorching of dressings or other material subject to damage by overheating.

A prototype field sterilizer of the present invention has been constructed largely of aluminum alloy materials. The sterilizing chamber is 16 inches in diameter and 24 inches in length and the steam generator has a capacity of approximately 3 gallons of water. A burner unit weighing only 7 pounds with a tank capacity of approximately 1 gallon of gasoline was used. The burner which is of the self-generating type has a 30,000 B.t.u. rating and a fuel jet orifice approximately $\frac{1}{32}$ of an inch in diameter. With an orifice this large the burner is less likely to become clogged and leaded gasoline can be used with satisfactory results.

When closed, the prototype field sterilizer is 23 inches wide by 36 inches long by 27½ inches high. The weight of the prototype field sterilizer complete with the burner is 125 pounds. The present standard field sterilizer used by the Army Medical Corps which is of comparable capacity occupies a cube of 21.96 cubic feet compared with the 15 cubic feet occupied by the field sterilizer of the present invention and the standard field sterilizer weighs 480 pounds nearly four times as much as the prototype of the present invention.

It will be apparent to persons skilled in the art that the chamber unit described herien, although it is ideally suited to and intended for use in combination with a fume hood and carrying case, could be supported in any suitable supporting frame and utilized as a steam sterilizer. It should also be apparent that many of the details of the embodiment described herein may be varied without departing from the principle of the invention.

I claim:

1. A field sterilizer comprising:

(a) a carrying case including a body portion open at opposite ends and at the bottom thereof and having a fume opening in its top surface and a pair of end covers, each cover hingedly attached to said body portion at the bottom edge of one of the open

ends, the said end covers being pivotable through an angle of about 180° between their closed positions and their open positions in which they serve as a stand for the sterilizer;

(b) a chamber unit mounted within the body portion of said carrying case including a sterilizer chamber having an access opening at one end and a sealing door for selectively closing said access opening and a steam generator chamber affixed to the bottom surface of said sterilizer chamber;

(c) heating means comprising a burner unit disposed in heat transfer relationship with said steam generator chamber for producing steam therein;

(d) a flue-like fume hood intermediate said chamber unit and said carrying case substantially encasing the sides and top of said chamber unit and communicating with the opening in the top of the body portion of said carrying case;

(e) means including a valve, interconnecting said generator chamber and said sterilizer chamber, for selectively admitting steam from said generator chamber into said sterilizer chamber;

(f) a trap connected to said sterilizer chamber for allowing air and condensate to escape from said sterilizer chamber when steam is admitted thereto; and

(g) a valve connected to said sterilizer chamber for selectively permitting steam to escape from said sterilizer chamber.

2. A field sterilizer as described in claim 1 wherein said burner unit is selectively attached to the body portion of said carrying case with the burner proper subjacent said steam generator chamber.

3. A field sterilizer as described in claim 1:

(a) wherein the sterilizer chamber is generally cylindrical in shape and the steam generator chamber is a section of a cylinder, the longitudinal axes of the two chambers being parallel to each other; and

(b) wherein a shelf is disposed within said sterilizer chamber the sides of said shelf affixed to the inner wall of the sterilizer chamber adjacent the junctures of the side wall of the sterilizer chamber with the side wall of the steam generator chamber.

References Cited by the Examiner

UNITED STATES PATENTS

470,966	3/1892	Andre	21—98
698,711	4/1902	Kellogg	21—98
717,448	12/1902	Pease et al.	21—98
791,490	6/1905	Parmentier	21—84
2,112,639	3/1938	Underwood	21—98

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