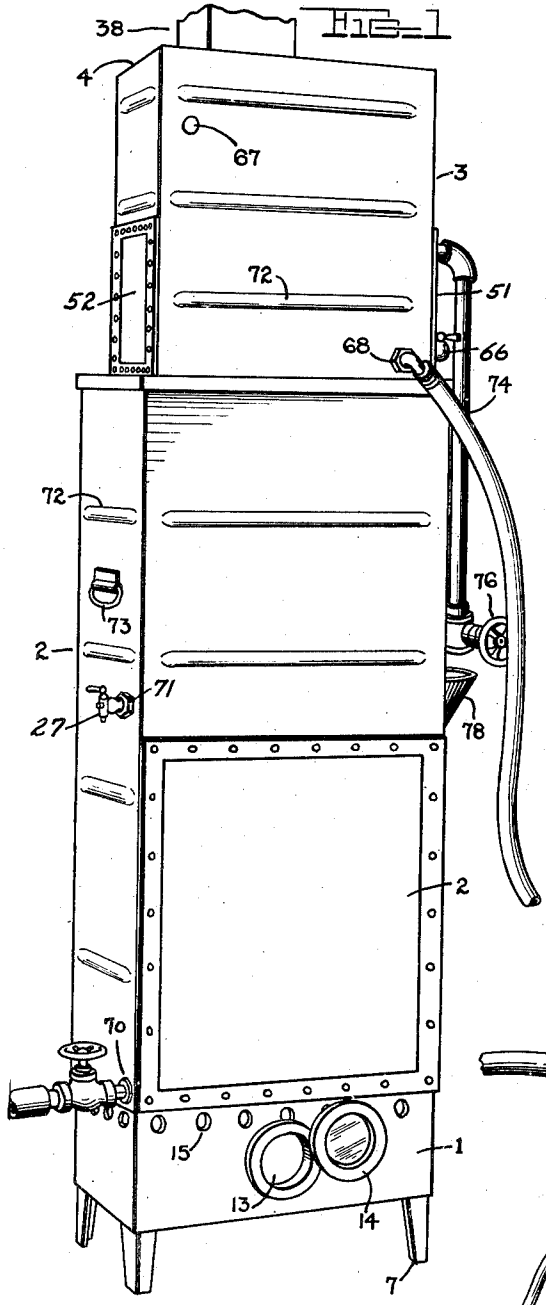
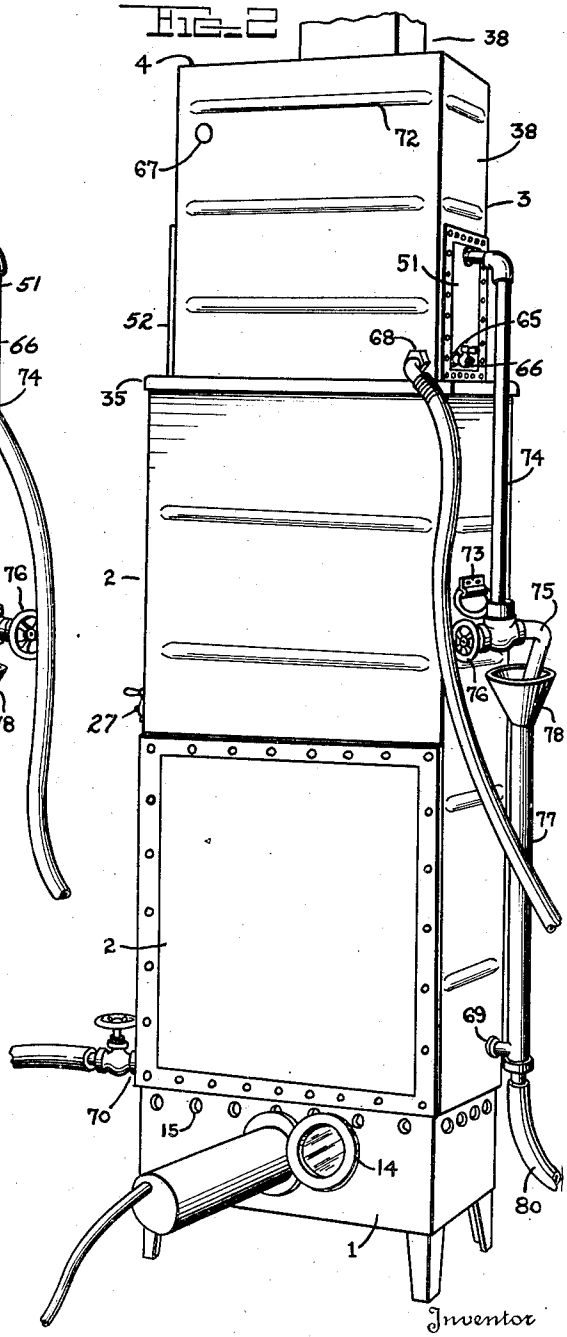
July 5, 1949. E. S. CLEMENS 2,475,481

PORTABLE WATER STILL

Filed June 29, 1945

3 Sheets-Sheet 1





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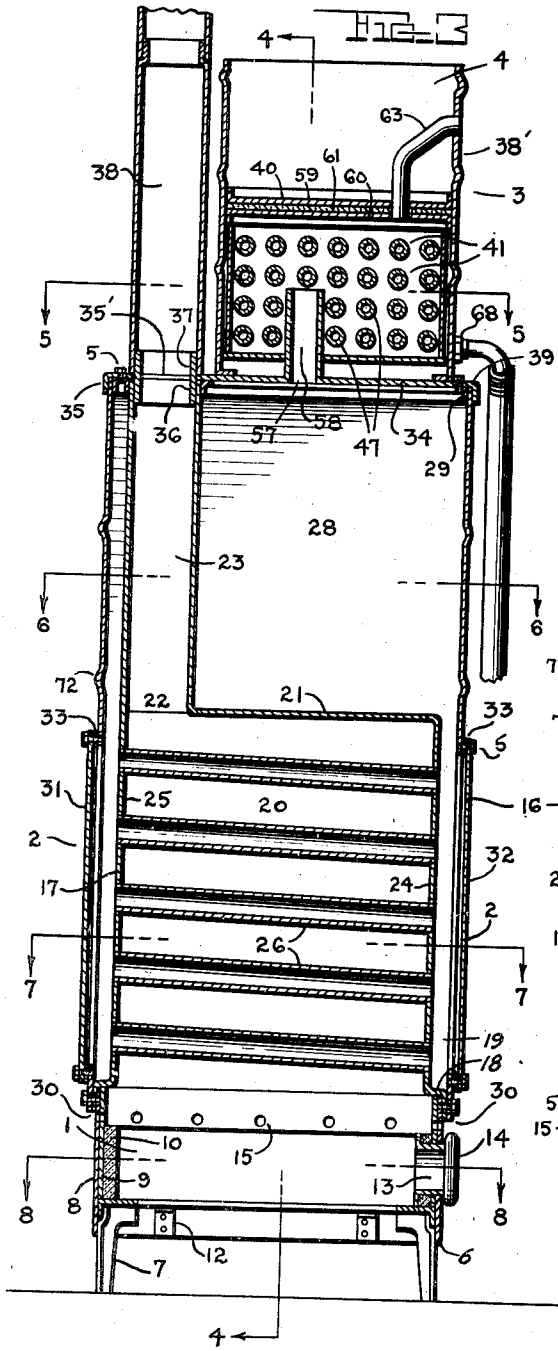
Attorneys

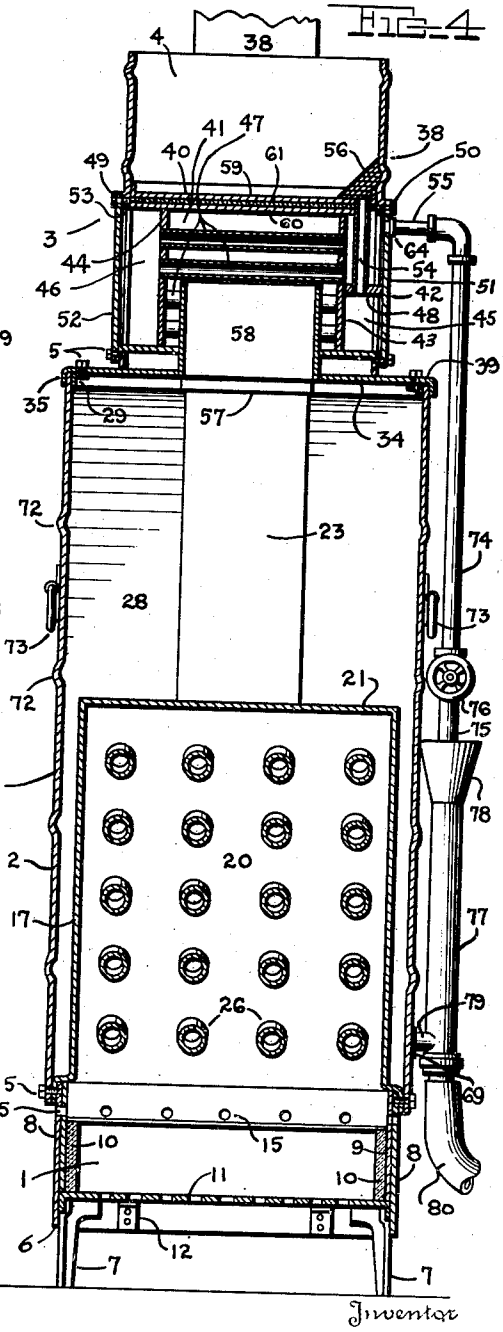
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FIG 5

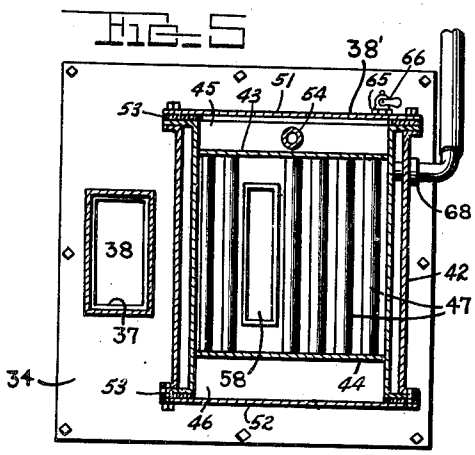


FIG 6

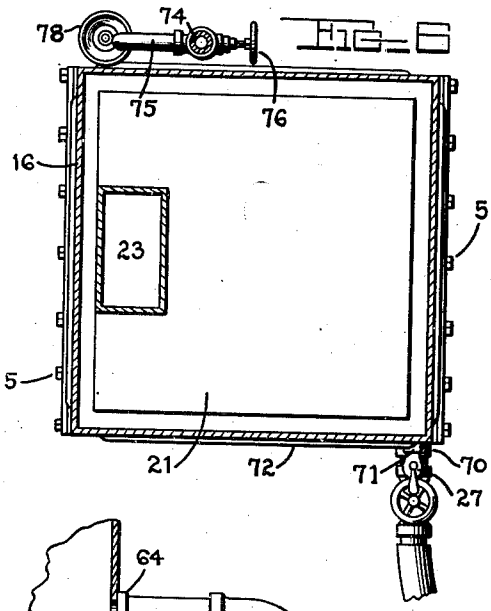
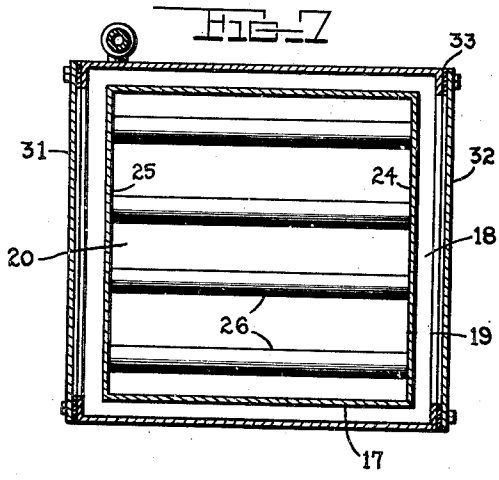


FIG 7



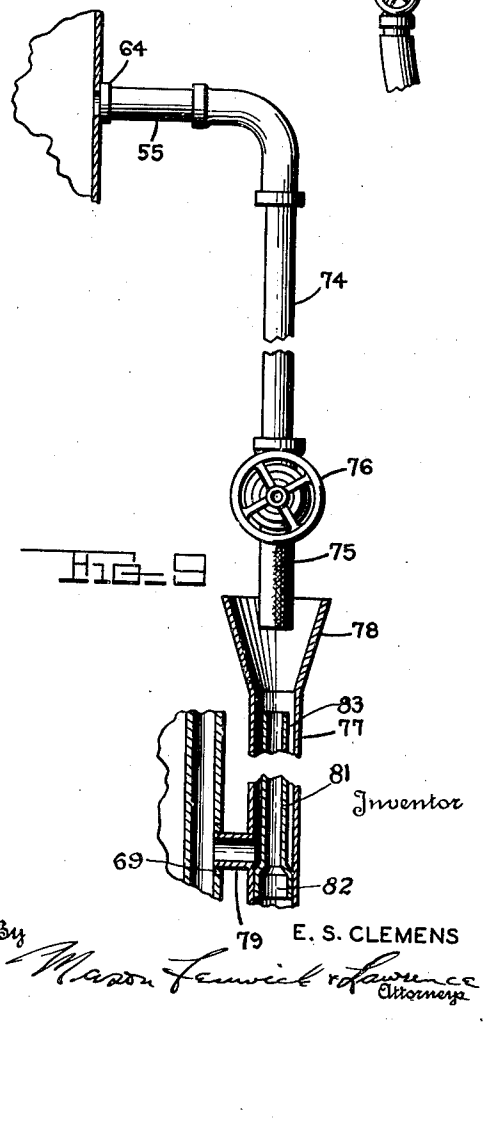


FIG 8

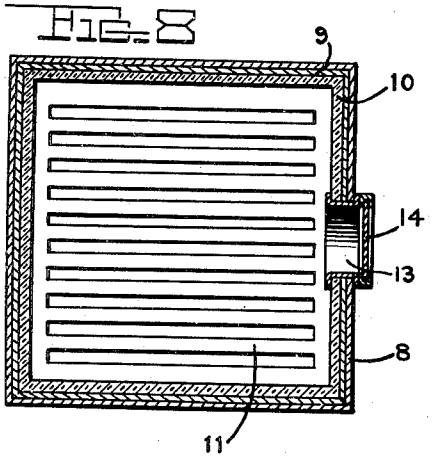


FIG 9

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2,475,481

UNITED STATES PATENT OFFICE

2,475,481

PORTABLE WATER STILL

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Application June 29, 1945, Serial No. 602,298

6 Claims. (Cl. 202—163)

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This invention relates to a portable water still.

It has for its general object to provide a still particularly designed for military use, although not restricted to this field of employment. The invention contemplates the provision of a still which can be dismantled into sections and compactly arranged for transportation, and readily assembled for use without expert skill; which is simple and rugged in construction, efficient in operation, adapted to distill all conditions of water, and to use any type of fuel, practical in difficult situations, and easy to service and maintain in working condition.

Other objects of the invention will appear as the following description of a preferred and practical embodiment thereof proceeds.

In the drawings which illustrate a practical embodiment of the invention:

Figure 1 is a perspective view of the water still, showing the front and one end;

Figure 2 is a similar view showing the front and the opposite end;

Figure 3 is a vertical section viewed from the side;

Figure 4 is a vertical section taken along the line 4—4 of Figure 3;

Figure 5 is a cross-section taken along the line 5—5 of Figure 3;

Figure 6 is a cross-section taken along the line 6—6 of Figure 3;

Figure 7 is a cross-section taken along the line 7—7 of Figure 3;

Figure 8 is a cross-section taken along the line 8—8 of Figure 3;

Figure 9 is a detail view, partly in section, showing the water level controlling means.

Referring now in detail to the several figures, the still is made in three stacked demountable sections, a lower combustion chamber unit 1, an intermediate evaporator unit 2, and an upper condenser unit 3, the latter including a storage chamber 4, for raw water to feed as make-up to the evaporator and for cooling the condenser. The construction is characterized by the absence of any pipe interconnection between the units which has to be disconnected before the units can be disassembled. The apparatus is thoroughly workable with the units merely resting one upon the other, but for security, they are shown suitably fastened together by means such as the screws 5.

Combustion chamber unit

In the illustrated embodiment of the invention, the combustion chamber is defined by a four-

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sided enclosure 6, open at the bottom and top, supported on detachable legs 7, so as to provide access to draft from beneath. The enclosure consists of an outer wall 8 of sheet metal, and an inner removable metallic wall 9, nested therewithin and supporting a lining 10 of fire brick material. A grate 11 extends against the lower part of the combustion chamber, supported upon detachable lugs 12, secured at intervals about the lower end of the enclosure 6. The inner wall 9 rests freely upon the grate.

The front wall of the enclosure 6 is formed with an opening 13, extending above the level of the grate, closed by a door 14. This is a feed door for solid fuel, and alternatively, provides an entrance for a liquid fuel burner.

The enclosure 6, about its upper periphery, may have the auxiliary air ports 15 communicating with the combustion chamber. The open top of the enclosure 6 terminates in a transverse plane.

The evaporator unit

The evaporator comprises a rectangular outer casing 16, the lower part of which is spaced in relation to the rectangular inner casing 17. Said casings are joined at their lower ends to a bottom plate 18, having the form of a hollow rectangle. Thus, a water chamber 19 is formed, surrounding on all sides a flue box or chamber 20, in open communication with the combustion chamber.

The inner casing 17 includes a transverse top plate 21, forming the top of the flue box, and provided with a stack opening 22 at the rear, which communicates with a stack 23, secured to the top plate in fluid tight manner.

The front and back walls 24 and 25 of the inner casing 17 constitute tube sheets, supporting water tubes 26 which bridge the flue box 20 and are exposed to the hot combustion products from the combustion chamber passing through said flue box. The water tubes open through the tube sheets into the water chamber 19, and slope upward toward the rear so as to promote discharge of steam from said tubes and circulation of water therethrough, and to avoid the formation of a steam lock in said tubes. A petcock 27 penetrates the outer casing 16, at a point a short distance above the level of the transverse plate 21, and in filling the evaporator unit the petcock is left open until water issues therefrom so that under normal working conditions the top of the flue box is submerged and the en-

tire flue box surrounded by water, promoting the conservation of heat.

In operation, all the water in the water chamber is circulated repeatedly through the tubes **26**, thus becoming uniformly heated, finally to the boiling point, so that it boils not only in contact with the tubes, but also in contact with the flat surfaces of the flue box, thus providing boiler structure to ensure a copious generation of steam from all parts of the water body.

The outer casing **16** extends above the flue box, as shown, forming a steam chamber **28**, in which the steam collects and passes to the condenser unit. The upper end of the outer casing **16** has the inwardly extending peripheral flange **29**, and the stack **23** terminates substantially in the plane of said upper end.

The bottom plate **18** of the evaporator unit rests upon the upper end of the combustion chamber unit, while the outer casing **16** extends below the bottom plate **18**, forming a flange **30**, which more or less closely surrounds the combustion chamber unit, holding the two units in longitudinal alignment. Said units may be fastened together by screw bolts, passing through the flange **30** and into the outer wall **8** of the combusion chamber.

For the purpose of giving access to the tubes **26** for cleaning them, the front and back walls of the outer casing **16** are provided with door openings confronting the open ends of the tubes and closed by door plates **31** and **32**, with intervening sealing gaskets **33**, secured by means such as nuts, engageable with fixed studs projecting from the outer casing about said door openings.

The condenser unit

The condenser unit is superposed upon the open top of the evaporator unit. It consists of a base plate **34**, serving both as the cover of the evaporator unit, and as the bottom of the condenser. This plate is at least large enough to be congruent with the upper end of the casing **16**, and is preferably formed with shallow downturned marginal flanges **35**, which lap the outer casing **16** and hold the condenser unit in alignment with the evaporator unit.

At the rear, the base plate **34** is provided with an opening **35'**, positioned to register with the end of the stack **23**, surrounded on the upper and lower sides by the respective collars **36** and **37**, the former of which enters the end of the stack **23**, while a removable stack section **38** slips over the latter. There may be more than one removable stack section, as shown, fitted together in the manner of ordinary stovepipe.

The condenser casing **38'** is secured to the base plate **34**, forwardly of the stack collar **35**. Said stack collar and the condenser casing are inset from the periphery of the base plate **34**, to provide a clear marginal flange **39** all around the base plate, a little wider than the inturned flange **29**, which it overlies. This construction permits the condenser unit to be secured to the evaporator unit by screws passed through the marginal flange **39** and the underlying flange **29**. It also permits the base plate to be inverted with the condenser stowed within the steam chamber **28** of the evaporator unit to reduce the overall height of the apparatus, for shipment. In this position the reverse side of the marginal flange **39** rests upon the flange **29** and the two parts may be screwed together.

The condenser casing **38'** is open at the top and divided transversely by the partition **40** into two chambers, the lower being the condenser chamber, while the upper is the water storage chamber **4** previously referred to. Within the lower or condenser chamber is a tube nest **41**. This comprises a hollow shell **42**, preferably of rectangular cross-section, having tube sheets **43** and **44** inset from its opposite end to form headers **45** and **46**. A bundle of tubes **47** bridge the space between the tube sheets, the tubes opening through the tube sheets into the headers.

One of the headers, for example, the header **45**, is divided into upper and lower halves by a transverse partition **48**, extending between the sides of the shell **42**, resting against the tube sheet **43**, and having its forward edge in the plane of the end of the shell **42**. Thus, when the open ends of the headers are closed, the lower half of the header **45** has communication with the upper half of said header, solely through the tubes, thereby establishing a two-way circulation through the tube bundle.

The outer ends of the shell **42** have outwardly directed peripheral flanges **49** and **50** secured to adjacent walls of the condenser casing **38'**, so that the tube nest is made of unitary part of the condenser unit. Said walls have door openings congruent with the open ends of the headers **45** and **46**, giving access to the open ends of the tubes for cleaning them. Said openings are closed by doors **51** and **52**, which are screwed to the flanges **49** and **50**, a sealing gasket **53** intervening, the door **51** making contact with the front edge of the partitions **48**.

A feed water pipe **54** extends from the water storage chamber **4**, through the partition **40**, through the upper half of the header **45**, through the partition **48**, which supports its lower end, and discharges into the lower half of the header **45**. Cooling water is thus fed from the storage chamber **4**, to the lower half of header **45**, and passes through the lower tubes of the bundle to the header **46**, then back through the upper tubes of the bundle to the upper half of the header **45**, from which it is discharged through a nipple **55**, mounted in the upper part of the door **51**. A strainer **56** within the water storage chamber **4** guards the inlet of the pipe **54**.

The base plate **34** has an opening **57**, which establishes communication between the steam chamber of the evaporator unit and the condenser chamber. This opening is in comunication with the space within the tube nest surrounding the tubes **47**, by means of a steam stack **58**, which extends to an appreciable height within the tube nest so as to constitute a dam to prevent pure water condensate which collects in the lower part of the tube nest from spilling back into the evaporator unit. The steam stack is long and narrow and arranged with its longitudinal dimension parallel to the tubes so as to obstruct the tube space to the least extent.

The partition **40**, which forms the roof of the condenser chamber and the floor of the water storage chamber is preferably made of two metal places **59** and **60** with a sheet of heat insulating material **61** therebetween, to prevent dissipation of heat from the condenser chamber to the water in chamber **4**.

A steam vent tube **63** extends from the top of the tube nest through the partition **40**, and has its upper end opening in the side wall of the casing **38'**. This lateral arrangement of the opening of the vent tube is preferable to having it open vertically within the chamber **4**, for it avoids the risk of raw water being poured down through it

when the chamber 4 is being filled, which would contaminate the pure water condensate in the tube nest. The end of the vent tube 63 is supported by the casing 38' and terminates flush with said casing so that it presents no obstruction to the insertion of the casing 38' into the steam chamber of the evaporator when the parts are nested for shipment.

External connections

The door 51 has a bushing 64 into which the nipple 55 is screwed, also a bushing 65 for the petcock 66 which taps the lower part of the tube nest for draining the latter, when desired.

The wall of the water storage chamber 4 has a normally plugged bushing 67 near the upper end of said chamber to which a filling hose may be attached. Ordinarily, the water storage chamber will be filled by means of a bucket. The casing 38' also has a bushing 68 connected by an internal nipple with the lower part of the tube nest, to which bushing a hose may be attached for conducting the distilled water to a container or reservoir. The lower part of the casing 16 of the evaporator unit has the bushings 69, 70 and 71, the first two communicating with the water chamber 19 near the bottom thereof, while the last named communicates with the outer casing 16 above the top of the flue box. The bushing 69 is for a feed water connection, the bushing 70 for a drain hose, and the bushing 71 for the petcock 27, already mentioned.

All of the bushings above referred to are permanently fixed, but the connection which they receive are removable so that the outside contour of the apparatus may be reduced to substantially flat surfaces which may be snugly packed in a chest.

The sides of the outer casing 16 are formed with outwardly extending transverse reinforcing ridges 72, and provided with hinged handles 73, which when flat do not project beyond a plane embracing the tops of adjacent ridges.

The feed water line from the condenser to the evaporator comprises two sections, mechanically unconnected, the upper section including the nipple 55, an elbow fitting, a pipe 74, a valve 76 at the lower end of this pipe, and a small length of flexible hose 75 forming the outlet. The positioning of the valve 76 at the lower end of the pipe 74 is important, since the velocity of flow of cooling water through said valve is a function of the head of cooling water above it. Since the level of water in the condenser chamber may vary considerably from time to time, if the valve 76 were close to the water level, the velocity of flow through said valve would be subject to considerable fluctuations, but by having the valve at the lower end of the pipe, the entire column of water in the pipe is a constant and major portion of the head, so that variations in the depth of cooling water in the condenser chamber have but little effect upon the uniformity of velocity of flow through the valve. The lower section consists of a tube 77 of relatively large diameter, having an open funnel 78 at the top and a lateral nipple 79 near the bottom, which screws into the bushing 69. The lower end of the tube 77 is connected to a drain hose 80. The hose 75 dips freely into the funnel 78. When it is desired to dismantle the feed water line, the hose 75 is taken out of the funnel, then the pipe 74 can be twisted in a counterclockwise direction to unscrew the upper section from the bushing 64, and the lower section can be similarly removed by twisting the tube 77 in a counterclockwise direction, the need for a wrench being obviated.

The valve 76 controls the flow of cooling water through the condenser tubes 47. This cooling water warmed in the condenser, discharges into the tube 77 where part of it is diverted through the nipple 79 as make-up water to the evaporator, while the excess drains off through the hose 80. There will always be an excess of water discharged from the hose 75 over the amount required for make-up.

Means are provided to maintain a constant level of water in the evaporator. This means is shown in Figure 9. It comprises an overflow tube 81 of smaller external diameter than the inside diameter of the tube 77, arranged coaxially in the tube 77. It has an enlarged base portion 82, which frictionally engages the inner wall of the tube 77 below the nipple 79. Thus, an annular chamber 83 is formed between the funnel and nipple. The tube 81 has a through bore communicating with the hose 80. The position of the upper end of the tube 81 determines the water level in the evaporator, which may be adjusted by pushing the tube 81 up or down within the tube 77.

In operation, the valve 76 is adjusted to supply water to the funnel 78, in excess of the make-up requirement which passes through the nipple 79, but not so much as is beyond the capacity of the overflow tube 81 to carry off.

It is to be understood by those skilled in the art that the specific details of construction as described are by way of example and not to be construed as limiting the scope of the invention.

What I claim as my invention is:

1. Portable water still comprising an evaporator unit and a separable invertible condenser unit supported on said evaporator unit, said evaporator unit including an open topped casing, hooded boiler structure occupying the lower part of said casing, a stack extending from said boiler structure hood upwardly through said casing adjacent one side thereof terminating substantially in the plane of the upper end of said casing, said condenser unit including a plate forming the cover of said casing, having a stack opening therethrough registrable with the upper end of said stack, and having condenser structure built upon the upper side thereof offset from said stack opening, said stack opening and condenser structure being inset from the edges of said plate to provide a surrounding flange engageable with the top of said casing, said plate being securable to said casing in either normal or inverted position, said casing enclosing a steam chamber above said boiler structure having an unoccupied portion beneath said condenser structure of such size and shape as to contain said condenser structure when said plate is in inverted position.

2. In a portable water still of that type which comprises an evaporator unit and a condenser unit supported in superposed relation to said evaporator unit, and an underlying source of hot combination products, in combination; said evaporator unit comprising an outer casing, an inner casing with closed transverse top and open bottom, with the lower portion of said outer casing spaced from the sides of said inner casing, a transverse wall about the perimeter of said inner casing at the bottom connecting said inner and outer casings, defining with said casings a water chamber about said inner casing extending above said transverse top, said inner casing constituting

a flue chamber with reference to the underlying source of hot combustion products and having a stack opening through said transverse top, said evaporator unit including means for controlling the liquid level in said water chamber, comprising an open topped chamber exterior to said outer casing having a connection with said water chamber below the liquid level therein, said open topped chamber extending above the desired water level in said water chamber, an overflow pipe in said open topped chamber having its open upper end at the desired water level and having its lower end discharging exterior to said open topped chamber.

3. Portable water still as claimed in claim 2, including tubes extending across said flue chamber opening into opposite sides of said water chamber.

4. In a portable water still of that type which comprises an evaporator unit and a condenser unit supported in superposed relation to said evaporator unit, and an underlying source of hot combustion products in combination; said evaporator unit comprising an outer casing, an inner casing with closed transverse top and open bottom, with the lower portion of said outer casing spaced from the sides of said inner casing, a transverse wall about the perimeter of said inner casing at the bottom connecting said inner and outer casings, defining with said casings a water chamber about said inner casing extending above said transverse top, said inner casing constituting a flue chamber with reference to the underlying source of hot combustion products and having a stack opening through said transverse top, and tubes extending across said flue chamber opening into opposite sides of said water chamber, said tubes being inclined in the same direction, means for supplying cooling water to said condenser, means for supplying spent cooling water from said condenser to said water chamber, and means for maintaining the level of water in said water chamber above the transverse top of said flue chamber.

5. Portable water still as claimed in claim 4, said water chamber being open to the upper portion of said outer casing, the latter constituting a steam chamber, and means for establishing communication between said steam chamber and said condenser unit.

6. In a portable water still of that type which comprises an evaporator unit and a condenser unit supported in superposed relation to said evaporator unit, and an underlying source of hot combustion products, in combination; said evaporator unit comprising an outer casing, an inner casing with closed transverse top and open bottom, with the lower portion of said outer casing spaced from the sides of said inner casing, a transverse wall about the perimeter of said inner casing at the bottom connecting said inner and outer casings, defining with said casings a water chamber about said inner casing extending above said transverse top, said inner casing constituting a flue chamber with reference to the underlying source of hot combustion products and having a stack opening through said transverse top, and tubes extending across said flue chamber opening into opposite sides of said water chamber, said tubes being inclined in the same direction, said outer casing being provided with removable door plates confronting the ends of said tubes, means for supplying cooling water to said condenser, means for supplying spent cooling water from said condenser to said water chamber, and means for maintaining the level of water in said water chamber above the transverse top of said flue chamber.

EDWIN S. CLEMENS.

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