

May 8, 1945.

R. C. FORD

2,375,640

MEANS FOR DISTILLING LIQUIDS

Filed Oct. 13, 1943

4 Sheets-Sheet 1

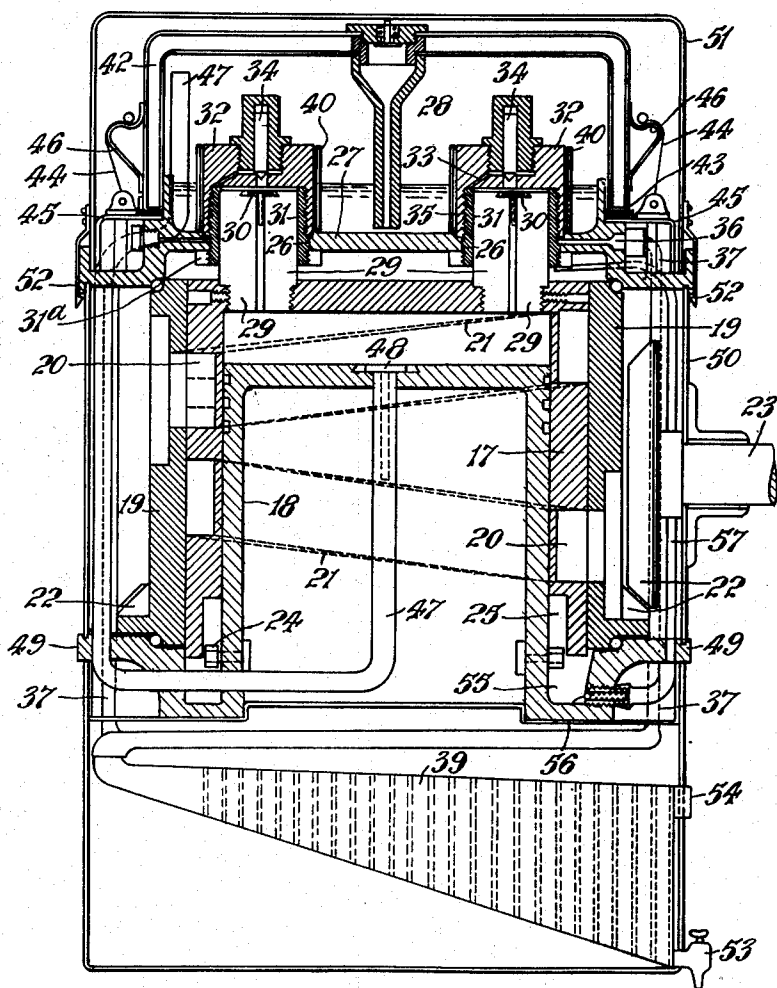


Fig. 1.

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4 Sheets-Sheet 2

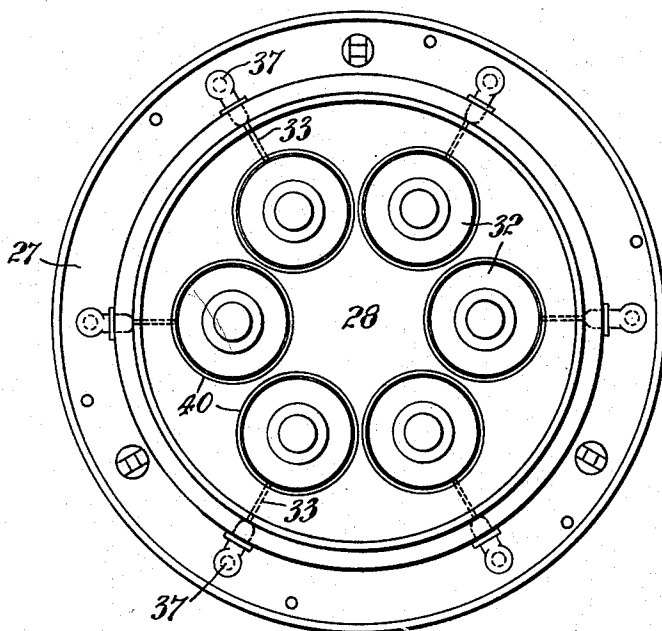


Fig. 2.

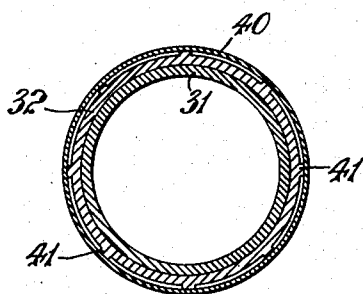


Fig. 3.

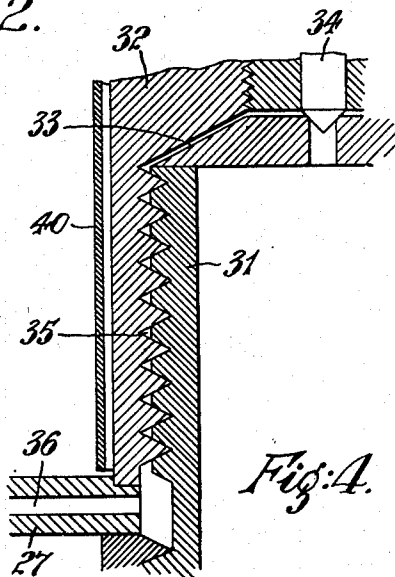


Fig. 4.

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4 Sheets-Sheet 3

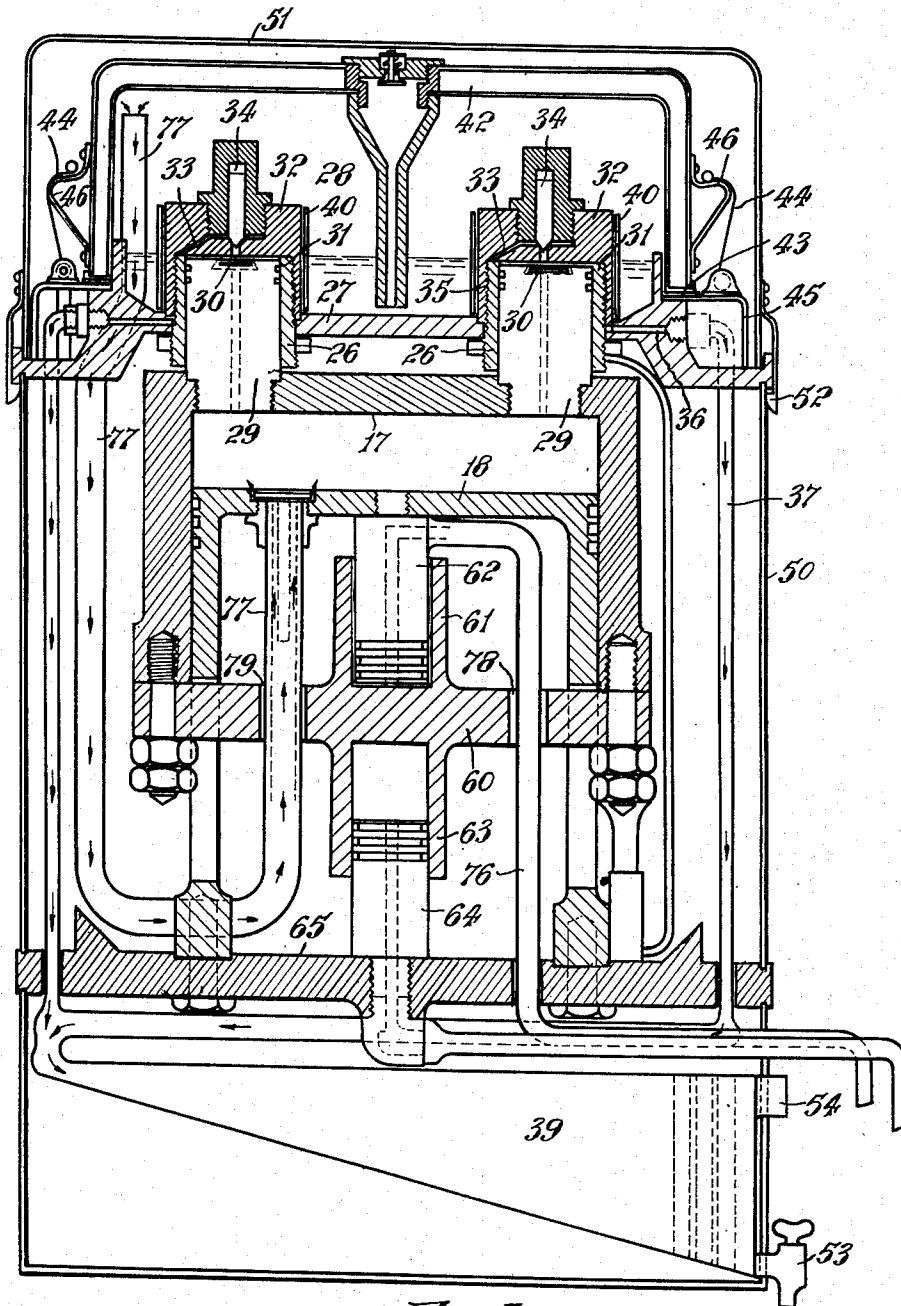


Fig. 5.

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4 Sheets-Sheet 4

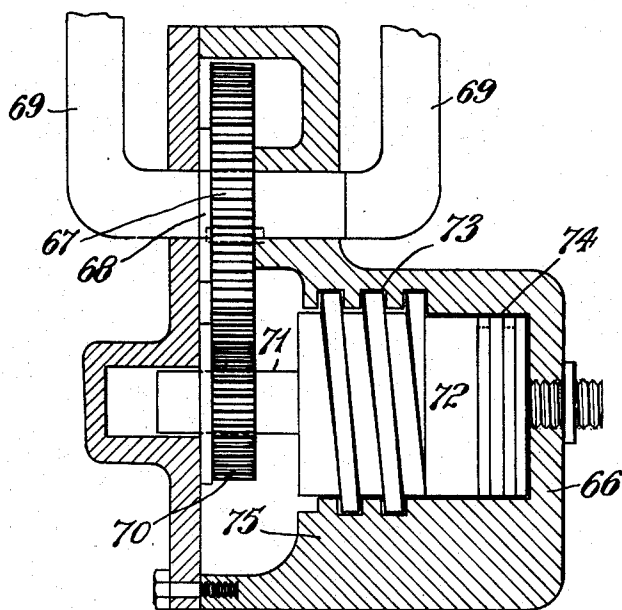


Fig. 6.

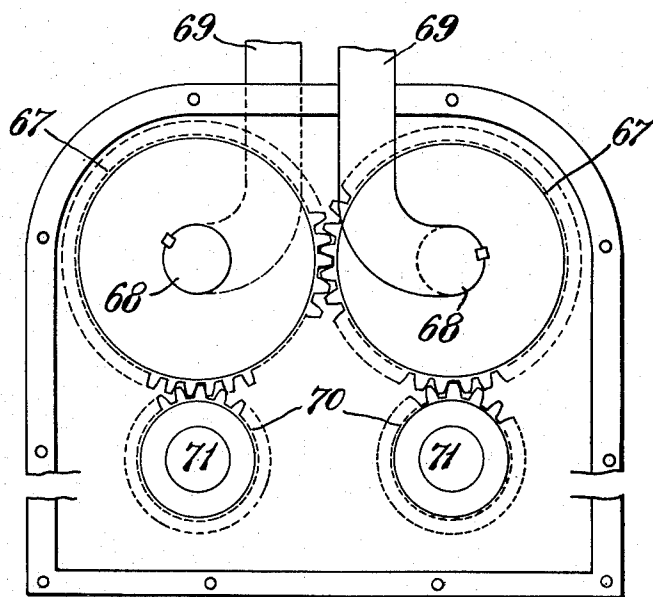


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UNITED STATES PATENT OFFICE

2,375,640

MEANS FOR DISTILLING LIQUIDS

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EnglandApplication October 13, 1943, Serial No. 506,097
In Great Britain July 9, 1942

2 Claims. (Cl. 202—163)

This invention relates to the separation of a liquid from non-volatile impurities by distillation and has for its immediate object to provide an improved method of obtaining pure drinking water from sea water and other liquids not suitable for human or animal consumption.

A further object of the invention is to provide apparatus for this purpose of a simple, compact and portable nature in which the use of fuel for heating purposes is entirely dispensed with.

The improved method of distilling liquids is distinguished from existing methods in that the heat required for evaporation is derived from compression of a mixture of air and steam or vapour drawn from an enclosed container for the liquid, said mixture being forced under the compression pressure through one or more narrow conduits arranged in close proximity to one or more thin films of the said liquid, and thence to a condenser.

The invention involves the use of a compressor which is of the multi-stage type and driven either mechanically or hydraulically.

In the accompanying drawings,

Figure 1 is a sectional view of one form of apparatus embodying the present invention.

Figure 2 is a plan view of the same with top cover removed.

Figure 3 is a cross-sectional view on a larger scale of one of the high pressure cylinders.

Figure 4 is a detail view in vertical section and on a larger scale of part of one of the high pressure cylinders.

Figure 5 is a view similar to Figure 1 in which the two stage compressor is driven by hydraulic means.

Figure 6 is a sectional view of one of the pumps for operating the low pressure cylinder in Figure 5.

Figure 7 is an end view thereof with the cover plate removed.

In one form of the improved apparatus shown in Figures 1, 2, 3 and 4, the compressor employed is of the two-stage type comprising a reciprocating low pressure cylinder 17 co-operating with a stationary plunger 18. The cylinder is operated by means of a rotatable member 19 arranged concentrically therewith and provided with rollers 20 engaging helical grooves 21 in the exterior of the said cylinder. The said rotatable member is driven by bevel gear 22 from a shaft 23 which may itself be driven either by power or manually. The said cylinder may be prevented from rotation by means of rollers 24 on the plunger engaging grooves 25 in the cylinder.

The high pressure cylinders 26, of which there may be any desired number, are carried by a horizontal stationary plate 27 which is upwardly flanged to form a container 28 for the liquid to be distilled. The plungers 29 for the high pressure cylinders are carried by and move with the low pressure cylinder 17 and are fitted with non-return valves 30 at their inner ends.

Each of the high pressure cylinders is made in two parts, an inner part 31 which is secured to the plate 27 by means of a nut 31^a, and an outer part 32 screwing onto the upper end of the inner part. The said outer part, which forms the head of the cylinder, is formed with a passage 33 controlled by a non-return valve 34, one end of said passage being open to the interior of the cylinder 26 and the other end communicating with a narrow spiral passage 35 in the cylinder wall. This spiral passage, see Figure 4, may be conveniently formed by taking off the crests of the thread between the inner and outer parts 31, 32 and communicates at its lower end with a duct 36 in the plate 27, whence it is continued by means of a pipe 37 opening at its lower end into a condenser 39.

The outer part 32 of each high pressure cylinder is fitted with a removable sleeve 40 which is a sliding fit on shallow longitudinal ribs 41, see Figure 3, formed on said outer part. The narrow annular space thus formed between the sleeve and the outer part of the cylinder is open at each end, the lower end dipping below the level of the liquid in the container. The said container 28 is closed in a fluid-tight manner by means of a removable cover 42 having double walls with lagging between them, said cover being secured in position on a rubber seating 43 carried by a shouldered part of the plate 27, by means of springs 44 secured to an annular member 45 of angle section, and adapted to engage projections 46 on the cover. Communication between the closed container and the low pressure cylinder 17 is established by means of a pipe 47, controlled by a non-return valve 48 in the head of the plunger.

The rotatable member 19 actuating the low pressure cylinder is mounted on ball bearings between the plate 27 aforesaid and a flange 49 at the lower part of the stationary plunger 18.

The whole of the apparatus is enclosed in an outer casing 50 the upper part 51 of which is secured to the plate 27 by releasable catches 52 and is removable to give access to the cover 42, whilst the lower part houses the condenser 39 which may be of the tubular or any other suit-

able type and provided with a run-off tap 53 for the distilled water and an outlet 54 for dry air.

The high pressure plungers 29 are automatically lubricated at each compression stroke of the low pressure cylinder 17 from a trough 55 in the flanged lower end of the low pressure plunger 18, the oil being forced through a non-return valve 56 and conveyed by pipes 57 to each high pressure cylinder. The excess oil in draining back to the trough serves to lubricate the bearings for the rotatable driving member 19 and the outer surface of the low pressure cylinder 17.

The apparatus is operated by rotating the shaft 23 which may be done either by power or manually, as by means of pedal gear or hand wheel. When the apparatus commences to operate air is exhausted through the pipe 47 from the enclosed container 28 on the induction or upward stroke of the low pressure cylinder 17 whence on the subsequent compression or downward stroke the initially compressed air is forced into the high pressure cylinders 26 through the non-return valves 30 in their plungers 29 by which it is further compressed on the following induction stroke of the low pressure cylinder. From the high pressure cylinders the air is forced past the non-return valves 34 into the spiral passage 35 between the screw threaded parts of each high pressure cylinder and thence to the condenser 39. The heat generated by the high pressure produced in this way quickly raises the temperature of the walls of the high pressure cylinders thereby causing evaporation of the thin films of the liquid occupying the narrow annular spaces between the sleeves 40 aforesaid and the outer parts 32 of the high pressure cylinders. At the same time the exhaustion of air and vapour above the liquid reduces the boiling point of the latter. The vapour or steam produced escapes from the open upper ends of the narrow spaces between the sleeves 40 and cylinders 26 into the closed container 28 whence it is exhausted and initially compressed by the continued operation of the low pressure cylinder and further compressed in the high pressure cylinders after which it passes by way of the spiral passages 35 and tubes 37 to the condenser. This cycle of operations can be continued so long as their remains any liquid in the container.

Another form of apparatus embodying the same main principle of the invention is shown in Figure 5. In this form the low pressure cylinder 17 is operated by fluid pressure. Otherwise the construction and operation of the apparatus is substantially the same as above described with reference to Figures 1 to 4.

For the purposes of operation by fluid pressure the lower end of the low pressure cylinder 17 carries a cross-head 60, the sides of the stationary plunger 18 being slotted at the lower end to accommodate the movement thereof. The upper face of the cross-head carries or is formed with a small centrally arranged cylinder 61 which co-operates with a fixed plunger 62 secured to the underside of the head of the stationary low pressure plunger 18 which is hollow. The lower face of the cross-head is also formed or fitted with a similar cylinder 63 which co-operates with a plunger 64 fixed to the base member 65 supporting the low pressure plunger. These cylinders are alternately supplied with fluid under pressure to actuate the low pressure cylinder 17, by means of a pair of pumps 66, see Figures 6 and 7, which may be operated in any suitable manner. Where the apparatus is required for use in a con-

finied space, as for example, in a crowded life boat, the said pumps may be arranged for manual operation. In this case each pump may be separately operated through gearing by a lever and the gearing of one pump interconnected with that of the other so that the depression of one lever effects the return of the other. For example, in the arrangement shown in Figures 6 and 7 a gear wheel 67 is fixed to the spindle 68 of each lever 69, said wheels being in constant mesh with each other and each of them is also in constant mesh with a pinion 70 on an extension 71 of their respective pump plungers 72. The said plungers are each formed with a screw thread co-operating with an internal thread 73 in the pump body, the thread in the case of one pump being right hand and the other left-hand. Each plunger, as it is rotated, is given a reciprocatory motion in its cylinder 74 by the co-action between its screw thread and the corresponding thread on the stationary pump body 75. The extension 71 of each plunger is free to slide through its driving pinion 70 axial displacement of which is prevented in any suitable way.

To accommodate a pipe 76 leading from one of the pumps to the upper cylinder 61 on the cross-head and also the pipe 77 leading from the enclosed container 28 to the low pressure cylinder 17, the cross-head 60 is formed with suitable openings 78, 79 respectively.

In an alternative construction which is otherwise the same as that shown in Figure 5, the low pressure cylinder is stationary and the plunger thereof adapted for operation by fluid pressure, the upper face of the latter is formed with a central circular recess which functions as a cylinder for a fixed plunger on the plate aforesaid. The lower face of the low pressure plunger is in this case provided with a small plunger working in a cylinder forming part of or attached to the low pressure cylinder. The low pressure plunger is operated positively in each direction by means of a pair of pumps, one of which delivers liquid under pressure into the bottom of the cylindrical recess in the upper face of the low pressure plunger for the induction stroke of the latter, whilst the other pump delivers fluid into the small cylinder in the case of the low pressure cylinder for the return or compression stroke. The said pumps may be operated in sequence in a manner similar to that above described or in any other suitable way. For example, the two pumps may be arranged in axial alignment with each other with a single double-ended plunger co-operating therewith. This plunger may be reciprocated by forming it with right and left-hand screw threads and giving it a movement of rotation or oscillation about its axis, the screw threads co-operating with fixed parts suitably screw-threaded internally. Rotary or oscillatory movement may be imparted to the plunger by means of a pinion operated in any suitable manner by hand or pedal, or by power.

I claim:

1. Apparatus for distilling liquids comprising an enclosed container for the liquid to be distilled, a condenser, a compressor having a low pressure cylinder and a plurality of high pressure cylinders each of which is in direct non-return communication with said low pressure cylinder, said low pressure cylinder having a non-return intake communicating with said container above the level of the liquid therein and each of said high pressure cylinders having a spiral passage in the wall thereof communicat-

ing at one end with the delivery side of said high pressure cylinder and at the other end with said condenser, the bore of said passage being less than that of the intake to said high pressure cylinder, a sleeve surrounding each high pressure cylinder with clearance so as to leave a narrow annular space open at each end, one end of said space being below and the other above the level of the liquid in said container, and means for operating said compressor.

2. Apparatus for distilling liquids comprising an enclosed container for the liquid to be distilled, a condenser, a compressor having a low pressure cylinder and a plurality of high pressure cylinders protruding into said container through the liquid therein and each having di-

rect non-return communication with said low pressure cylinder, said low pressure cylinder having a non-return intake communicating with said container above the level of the liquid therein, 5 said high pressure cylinders each having a spiral passage in the wall thereof communicating at one end with the delivery side of such cylinder through a non-return valve and at the other end with said condenser, the bore of said passage 10 being less than that of the intake to said high pressure cylinder, means for maintaining a thin film of said liquid around and in contact with the exterior of each high pressure cylinder, said films being open at their upper ends to said con- 15 tainer, and means for operating said compressor.

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