

1,362,666.

Patented Dec. 21, 1920.

2 SHEETS—SHEET 1.

FIG. 1.

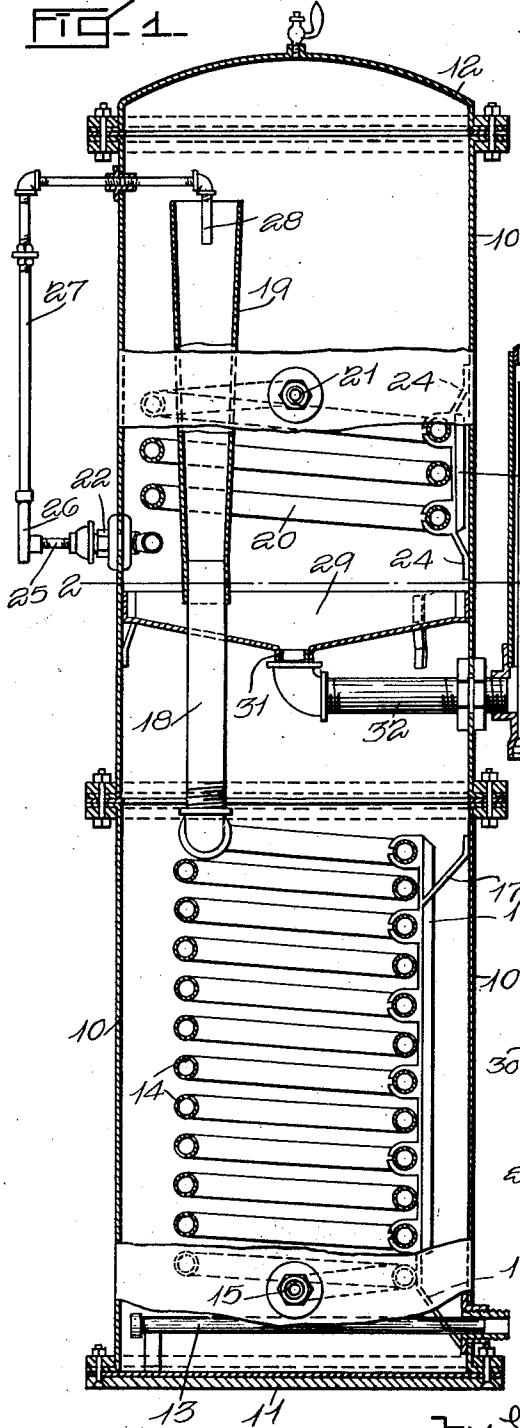


FIG. 3.

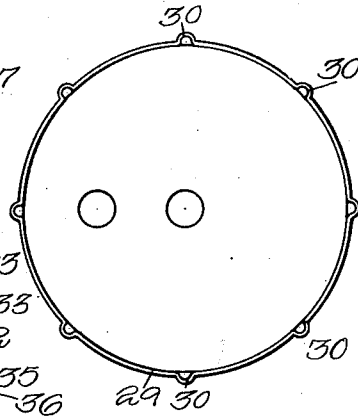
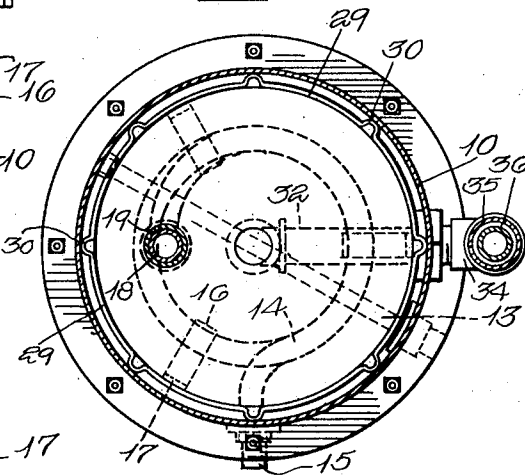


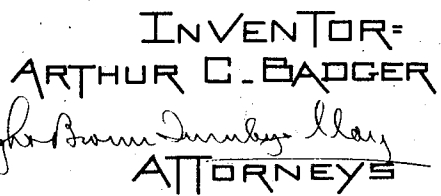
FIG. 2.



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Fig. 4.



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COMPOUND STILL.

1,362,666.

Specification of Letters Patent.

Patented Dec. 21, 1920.

Application filed January 29, 1917. Serial No. 145,074.

To all whom it may concern:

Be it known that I, ARTHUR C. BADGER, a citizen of the United States, residing at Newton, in the county of Middlesex and State of Massachusetts, have invented new and useful Improvements in Compound Stills, of which the following is a specification.

The present invention relates to distilling apparatus particularly such as are intended for distilling water, or for purifying any liquid by distillation, as distinguished from stills which are designed for fractional distillation.

The objects of the invention are to increase the efficiency of and simplify, with reduction of cost of construction, stills of the character indicated. As the intended principal use of the still wherein the present invention is embodied is for distillation of water, I will in the following description describe the apparatus as a water still and refer to the liquid being distilled as water, but without thereby intending in any wise to limit the field of usefulness of the invention. The objects before mentioned are accomplished by, first, placing the heating member and the condensing coil or element, in the same body of liquid in one container; second by providing means for delivering the condensate of the heating fluid, when such fluid is the vapor of the liquid being distilled, to the condensate of the distilled fluid; third, by providing means for removing excess of the liquid and foreign matter contained therein from the container at a level intermediate that of the condensing element and the heating element.

In the drawing forming a part of this application, I have shown two of the forms in which the invention may be embodied.

Figure 1 is a vertical section of one form of apparatus embodying the invention.

Fig. 2 is a section on line 2—2 of Fig. 1.

Fig. 3 is a plan view of the catch pan.

Fig. 4 is a sectional view of a modification of the invention wherein the heat for distillation is furnished by heating flames.

Referring first to Figs. 1, 2, and 3, 10 represents a shell of any convenient construction, but preferably made of sheet metal having a bottom 11 and an upper head 12. This structure constitutes the tank or container for the body of water or other liquid to be distilled, and it may be cylindrical or of any other form and may have any construction desired by the maker or user.

Passing through the side or shell of the container near its bottom is an inlet pipe 13 constructed at its outer end to permit of connection with a pipe for conducting water or other fluid thereto, said inlet pipe being open in any convenient manner within the container so as to discharge the water thereinto. A coil 14 which constitutes the condenser of the still is contained in the lower portion of the shell or tank and terminates in a pipe 15 passing through the side of the shell near its bottom and externally threaded to connect with an eduction pipe. The condenser may be constructed of tubing formed into a helical coil or may have any other desired formation or construction. When constructed as here shown it is preferably supported and positioned by stays 16 which are engaged with certain turns of the coil and are attached by straps 17 to the shell. As many of these stays may be provided as are necessary to hold the coil with the desired degree of rigidity. The upper or inlet end of the coil terminates in a rising pipe 18 which enters and is hermetically joined to the bottom end of a funnel shaped tube 19 which rises to a point near the upper end of the container and is provided to receive and draw in the vapors generated from the water by heating. For this reason, said tube is called in this specification a vapor receiver.

A heating coil 20 is contained in the upper part of the water space of the tank and its ends 21 and 22 pass through the shell. This coil may receive steam or any other heating agent, but preferably the heating agent used is steam. A pipe for supplying live steam may be connected with the end 21 of the heating coil. Stays 23 and connecting straps 24, similar to the stays 16 and straps 17, are provided for positioning and securing the heating coil.

To the outlet end 22 of the coil is connected a coupling 25 leading to a steam trap 26 of which the outlet is connected to a pipe 27 passing upward and thence through the side of the tank near its upper end to a position above the vapor receiver 19, said pipe having its outlet end 28 directed into said receiver.

Between the coils 20 and 14 is placed what may be called a funnel or catch pan 29 which extends substantially over the entire cross sectional area of the shell, but is formed to leave spaces between its periphery and the shell through which water may flow freely

upward. As appears from the plan view of the funnel shown in Fig. 3, its peripheral lip has outwardly projecting offsets 30 which may center the funnel in the tank and leave ample spaces for the flow of water. A nipple 31 surrounds and projects downward from a hole in the bottom of the funnel and is joined to an outlet pipe 32 which passes through the side of the shell 10 and is connected with an overflow and water level controller 33. The latter consists of a T connection 34, an outer tube 35, an inner or overflow tube 36 and a cap or head 37 closing the upper end of the tube 35. The lateral opening of the T is connected to the pipe 32, its upwardly directed opening, which is of greater diameter than the lower opening, is connected to the tube 35; and the inner tube 36 passes through the T to the lower opening, in which it is sealed. A discharge pipe may be screwed into the threaded lower opening of the T for carrying away the waste water.

The operation of the still may now be readily understood. The water is admitted to the tank through the inlet 13 at the bottom. Being at relatively low temperature, this water condenses and cools the vapors in the condensing coil 14. An excess of water is admitted over what is evaporated, consequently the water rises and fills the tank up to the level regulated by the overflow, which is established by the upper end of the tube 36 in the overflow connection. In thus rising the water is able to flow freely around the periphery of the funnel 29. The upper portion of the body of water so supplied to the tank is boiled by the heat furnished through the coil 20, and the vapors thereby generated rise to the top of the tank and are drawn into the tube 19 by reason of the partial vacuum caused by condensation of the vapors in the coil 14 and by the continual withdrawal of the condensed water from this coil. Whatever sediment or other foreign matter may be carried by the water in suspension is caught in the catch pan 29 and carried out of the still with the excess of water through the overflow.

It will be appreciated that the heat which is delivered to the incoming water from the condensed vapors assists in raising the temperature of the water to the boiling point, thereby resulting in economy of operation. The evaporating element and the condensing element of the still are located in the same tank or chamber instead of in two separate containers or tanks, as has been the general practice heretofore, and there is not even a separating partition between the two. This results in economy of material and therefore in cost of construction, as well as reduction of heat radiation and therefore in economy of operation. The funnel or catch pan 29 is

not provided as a partition, but is provided simply to catch sediment.

A further important advantage of this apparatus results from the means consisting of the connection 25, trap 26 and pipe 27 for conducting the condensate of steam in the heating coil 20 to the condenser, adding this condensate to that of the water distilled in the chamber and thus increasing the output.

In Fig. 4 I have shown an apparatus embodying essentially the same principles in a different construction, and employed also a different heating means, specifically the heated gases produced by combustion of fuel. In this form of the apparatus the upper part 10^a of the container is enlarged or widened to a greater diameter than the lower part 10^b, the enlargement being abrupt and arranged to overhang a pipe 38 and a series of burners 39 rising therefrom. The pipe 38 encircles the part 10^b of the container and is fed with fuel from a supply pipe through a coupling 40. The bottom of that part of the shell which overhangs the burners is preferably concaved or recessed, as indicated at 41, to confine the heated gases, and there is also provided an annular apron 42 which surrounds this part of the shell and the gas burners to retain the products of combustion still further in contact with the outer wall of the enlarged part 10^a. 43 represents one of a number of hangers and 44 one of a number of brackets which support the fuel pipe and the apron.

The supply inlet is a perforated annularly formed pipe 45 at the bottom of the container, having an external connection 46. The condenser is an annular cylinder composed of an outer plate or shell 47, an inner plate or shell 48, an annular bottom plate 49 and top plate 50. The inlet for the vapors is a tube 51 open at its upper end and rising to near the top of the container, being connected to a chamber formed by circular heads 52 and 53 within the upper end of the inner wall 48 of the condenser. The sides of this chamber open through the upper end of the inner shell 48 to admit vapors and condensate to this condenser. An outlet 54 passes from the bottom of the condenser through the shell 10^b to discharge the condensed water.

The overflow pipe is shown at 55 and is connected to a pan or funnel 56 the same in principle as the funnel 29. A water level controller consisting of the coupling 57, outer tube 58, and inner tube 59, is connected to the pipe 55 and is of the same principle as the corresponding water level controller shown in Fig. 1.

The same form of condenser as shown in Fig. 4 may be applied to the still shown in Fig. 1, and the coil condenser shown in Fig. 1 may be equally well employed in the still

shown in Fig. 4; or any other desired type of condenser may be used in either modification.

In both modifications the same essential principle of the invention is embodied, namely the combining of a heating chamber with a condenser chamber in the same tank or outer shell, with no structural division between them. To the best of my knowledge hitherto it has been the practice to separate the heater or evaporator from the condenser, making these elements as distinct units. My invention combines the two in one unit, with the result of securing great economy in first cost of manufacture, and heat economy in operation.

The second principal feature of the invention is embodied in the form shown in Fig. 1 and consists in the means for adding to the product of the still, the condensate of the heating vapor. This feature is of use in any still in which water is evaporated by the heat of steam, which is the principal intended use of the still herein illustrated and described. It is also operable of course in any connection where the heating agent is the vapor of the liquid, being distilled whatever such liquid may be. The importance of this part of the invention is readily appreciated as being that it greatly increases the output of the still without added expense.

What I claim and desire to secure by Letters Patent is:

1. A still comprising a container open continuously from top to bottom, means for heating the contents of the upper part of said container, a condenser in the lower part of said container having an inlet rising above the surface of the contained liquid, a catch pan in the container below said heating means having an outlet passing through the shell of the container, means for admitting liquid to the lower part of the container and means for discharging said condensate from the condenser.

2. A still comprising a container open continuously from top to bottom, means for heating the contents of the upper part of said container, a condenser in the lower part of said container having an inlet rising above the surface of the contained liquid, means for admitting liquid to the lower part of the container and means for discharging said condensate from said condenser, an overflow outlet from the container at a point above the condenser, and a catch pan crossing the interior of the container having a discharge opening at its lowest point in connection with said overflow outlet.

3. A still comprising a container open continuously from top to bottom, means for heating the contents of the upper part of said container, a condenser in the lower part of said container having an inlet rising

above the surface of the contained liquid, means for admitting liquid to the lower part of the container and means for discharging said condensate from said condenser, a discharge outlet from the container at a point intermediate the heating means and the condenser, a funnel-shaped catch pan arranged across the container above said outlet with a circulation space between its rim and the container shell and an opening at its lowest point connecting with said outlet, and a controller into which said outlet discharges for maintaining the level of liquid in the container at a point above the heating means.

4. A still comprising a container open continuously from top to bottom, means for heating the contents of the upper part of said container, a condenser in the lower part of said container having an inlet rising above the surface of the contained liquid, means for admitting liquid to the lower part of the container, means for drawing said condensate from said condenser, an overflow outlet from the container at a point above the condenser, and a catch pan arranged to discharge into said outlet and constructed to extend across substantially the transverse area of the container at a level between said heating means and said condenser for collecting and discharging sediment carried by the liquid.

5. A still comprising an outer casing or shell, a condenser arranged in the lower part of said shell, a heater contained in the upper part of said shell and adapted to receive a heat-carrying vapor, said heater having an inlet and an outlet passing through the shell, an induction tube leading from the condenser to the upper part of the shell above the normal level of liquid therein, and means for conducting to and discharging into said induction tube from said heater the liquid produced by condensation of the vapors in the latter.

6. A distilling apparatus comprising an outer shell or container having an inlet for the liquid to be distilled, a condenser located in the lower part of said container and provided with an inlet conduit communicating with the upper part or vapor space of the container to receive vapors generated from the liquid in the container, a heating element located within the container above said condenser adapted for receiving hot vapor of the same liquid as that which is distilled in the apparatus, and a conduit issuing from the heating element and extending into the inlet conduit of the condenser, for conducting to the latter the liquid condensed from the vapors in said heating unit.

7. A still comprising a shell having a single interior chamber, a steam coil contained in the upper part of said chamber,

a condenser contained in the lower part of said chamber having its inlet extended into the vapor space of the chamber, a steam trap for collecting the water of condensation from said coil, and a conduit leading from said steam trap to a point whence it is able to discharge into the condenser inlet.

8. The method of distilling water which consists in providing a body of water in a container wherein is arranged a condenser having a vapor inlet connected with the vapor space of the container, circulating

steam in thermal contact with the water in said container, whereby said water is evaporated and the circulating steam is more or less condensed, and causing the condensate of such steam to enter the condenser; vapor generated from the water in the container being drawn from the vapor space of the still into the condenser and condensed therein.

In testimony whereof I have affixed my signature.

ARTHUR C. BADGER.