Aug. 20, 1929. C. F. BRAUN 1,725,052

BUBBLE STILL

Filed Sept. 7, 1926 2 Sheets-Sheet 1

Fig. 1.

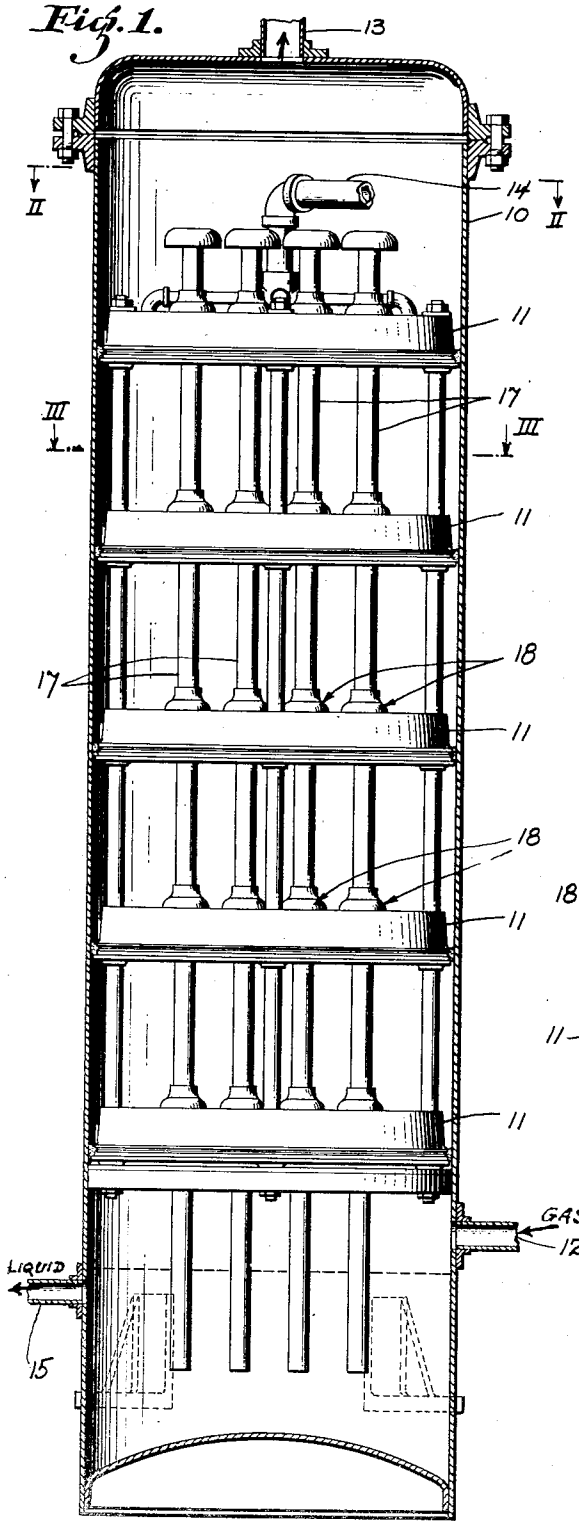


Fig. 2.

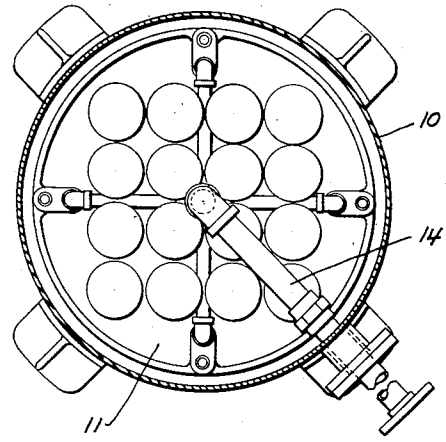
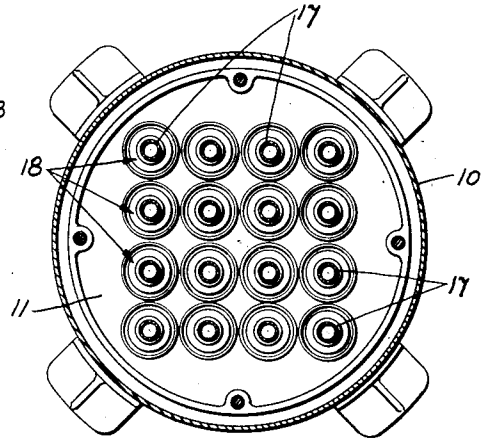


Fig. 3.



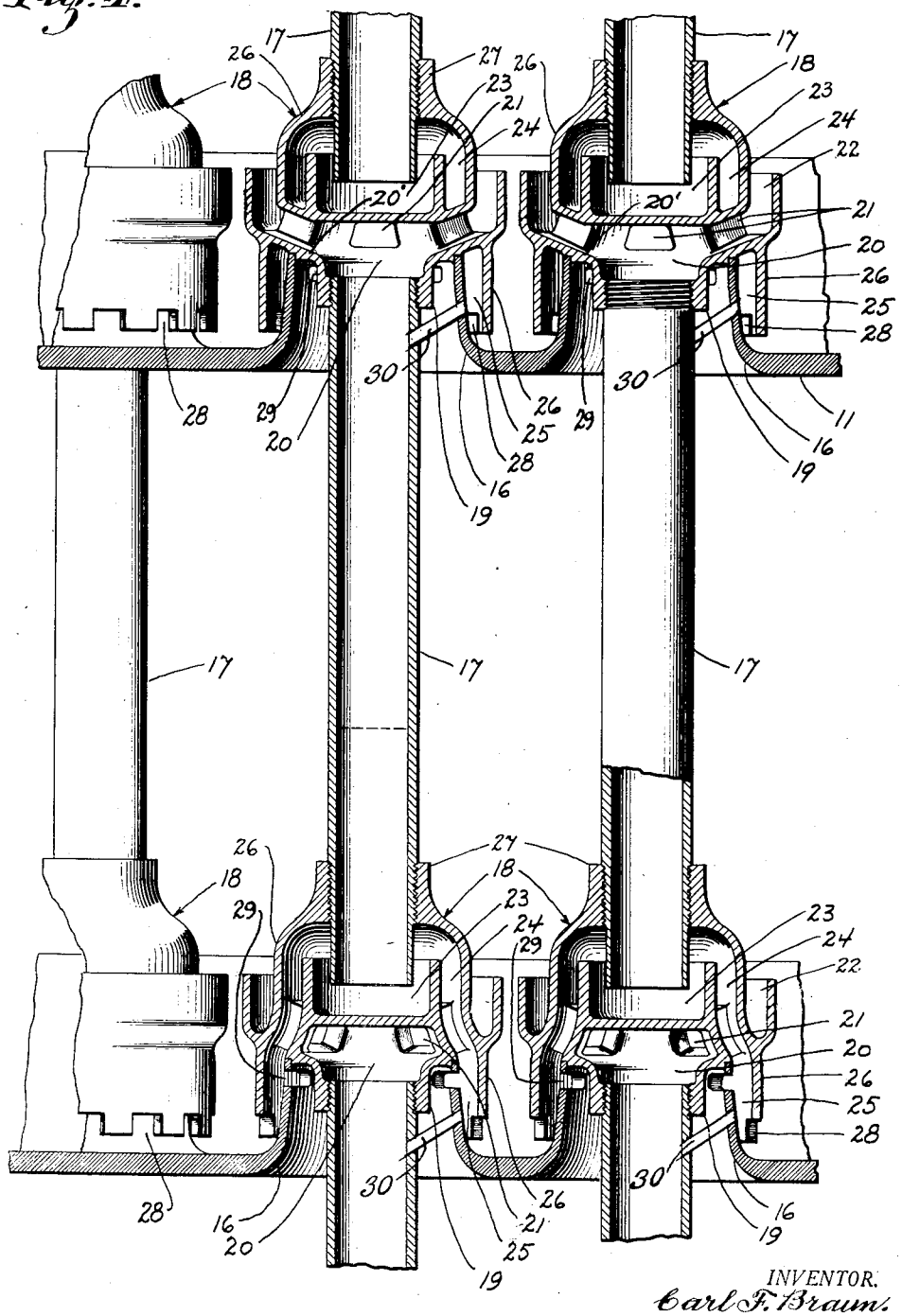
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Fig. 4.



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Patented Aug. 20, 1929. 1,725,052

UNITED STATES PATENT OFFICE.

CARL F. BRAUN, OF PASADENA, CALIFORNIA.

BUBBLE STILL.

Application filed September 7, 1926. Serial No. 133,837.

This invention relates to interfacial contact apparatus, and particularly pertains to improvements in bubble stills, absorbers, scrubbers, and the like.

It is the principal object of the present invention to provide means in an interfacial contact apparatus whereby a liquid and gas or vapor may be brought into intimate contact and suitably commingled in a manner to insure intimate interfacial contact throughout the entire cross-sectional area of the apparatus and with an accurate proportional mixing of the commingling fluids, the present device being an improvement on that type of apparatus shown in the co-pending application of Alois Kremser, entitled "Interfacial contact apparatus", Serial Number 141,214 filed by him on the 12th day of October, 1926, and pending concurrently herewith. Throughout the specification it will be understood that the term "interfacial contact" is here used in the sense that minute particles of liquid and gases or vapors flowing through this apparatus will have intimate and thorough contact with each other.

The present invention contemplates the provision of an outer enclosing shell fitted with a plurality of transverse bubble plates spaced from each other to form intermediate contact compartments, and within which compartments are disposed bubble cap structures having induction and eduction conduits for both a downwardly flowing liquid and an upwardly passing gas or vapor, the cap being further designed to produce maximum turbulence of the fluids as they commingle in each of the compartments.

The invention is illustrated by way of example by the accompanying drawings, in which

Fig. 1 is a view in central vertical section through a still embodying the present invention;

Fig. 2 is a view in transverse section taken on line 2—2 of Fig. 1 showing the uniform manner of arranging the bubble cap structures;

Fig. 3 is a view in transverse section showing the bubble cap arrangement as seen on the line III—III of Figure 1.

Fig. 4 is an enlarged fragmentary view showing the details of construction of the bubble cap structure.

Referring more particularly to the drawings, 10 indicates an enclosing shell. Mounted within the shell and arranged and spaced in superposed relation to each other is a plurality of transverse bubble plates 11. A vapor or gas inlet pipe 12 is in communication with the shell at a point below the lowermost bubble plate 11, and the vapor or gas outlet pipe 13 is in communication with the shell at a point above the uppermost bubble plate 11. A liquid inflow pipe 14 is in communication with the top of the still at a point above the upper plate 11, and a liquid drain pipe 15 is in communication with the bottom of the still below the lowermost bubble plate 11. It will be understood that it is desired to bring the downflowing liquid and the upwardly passing vapor or gas into intimate interfacial contact, whereby actions of distillation, absorption, scrubbing, or the like, may take place between the liquid and the gas or vapor. It has been the common practice in this type of apparatus to provide the bubble plates 11 with a plurality of inverted cups or bubble caps having their bell mouths below the level of an accumulated supply of liquid resting on each of the bubble plates, to insure that upwardly flowing gas will pass out into the impounded body of liquid, surplus liquid overflowing the upper lip of the drain pipes, one of which is nominally provided for each of the bubble plates and through which pipe the surplus liquid is conducted to the subjacent compartment. Due to the fact, however, that there is no provision in the ordinary structures of this class to insure uniform and proportional mixing of the liquid and gas or vapor in the compartments, the stills operate inefficiently, and with that idea in view a structure has been here provided as generally indicated at 18, by which a uniform and proportional downflow of liquid may be obtained throughout the sectional area of the apparatus, and a uniform and proportional upflow of gas or vapor may be maintained and brought into intimate contact with the liquid. The structure comprises an upwardly projecting nozzle 16 formed as a part of the bubble plate 11. A plurality of these nozzles are uniformly distributed over the area of the bubble plate in symmetrically geometric arrangements and in vertical alignment when the assembled series of bubble plates is considered. Extending through the center of each of these nozzles is a vertically disposed drain pipe 17, to the upper end of which is

mounted a bubble cap structure 18. The outer diameter of the drain pipe is considerably less than the inner diameter of the opening through the nozzle 16, thus providing an annular passageway within the nozzle and around the drain pipe through which upwardly flowing gases or vapors may pass. The bubble cap structure 18 comprises a central threaded boss 19 which receives the upper end of the drain pipe 17. This boss is formed as a continuation of a liquid drain chamber 20 which is in direct communication with the drain pipe 17, and has a plurality of radial ducts 21 communicating with an overflow launder 22. Disposed directly above the chamber 20 and formed integrally therewith is a weir cup 23, into which the lowermost end of a superposed drain pipe 17 projects. It will be understood that the drain pipes 17, through the height of the still, are in longitudinal alignment, and that their opposite ends are assembled within a bubble cap structure 18, as shown in Figs. 3 and 4. The weir cup 23 forms a liquid seal for the lower end of the drain pipe 17, and causes an accumulation of liquid to be held in the drain pipe, the level of this accumulation agreeing with the difference of pressure in the contact compartment from which the liquid is being drained and the contact compartment into which the liquid is draining. This oil overflows the lip of the weir cup 23 and then flows downwardly through a passageway 24 to an annular mixing compartment 25 which circumscribes the nozzle 16 on the bubble plate and is formed by a wall 26 of rectangular or cylindrical shape. This wall agrees in position and operation with the ordinary inverted bell mouth of a bubble cap. The wall 26 continues upwardly and is formed with a boss 27 which accommodates the downwardly projecting end of the drain pipe 17. The launder 22 is formed around the wall 26, and is drained through the ducts 21, which pass through the wall and into the chamber 20 without communicating with the overflow compartment 24. In order to create additional turbulence, the lip of the bubble cap wall 26 is formed with a plurality of slotted serrations 28, through which the commingling liquid and gases and vapors may be projected into the mass of liquid impounded upon the bubble plate, and the level of which is determined by the height of the launder 22.

In operation of this invention liquid is delivered to the apparatus through the liquid inflow pipe 14, and is there distributed upon the upper bubble plate. It may then pass downwardly after reaching a certain level above the wall 26 through the drain pipes 17, which are uniformly and symmetrically arranged over the sectional area of the structure. This liquid will flow down the pipe 17 and into the first weir cup 23, after which it will overflow the weir cup and pass downwardly through the overflow compartment 24 into the annular mixing chamber 25. Here it will meet the gas or vapor which has been delivered to the bottom of the shell through the inflow pipe 12. This gas passes upwardly through the nozzle 16 in the bubble plates and strikes a deflecting surface 20', where it is diverted into a horizontal direction of travel, to be projected through openings 29 into the annular mixing chamber 25 surrounding the nozzle 16. Here the gas will meet the downwardly flowing liquid which has overflowed the lip of the weir cup 23, and due to the velocity of the gas stream will tend to flatten the stream of liquid against the side wall 26 of the bubble cap. The gas then bubbles through the layer of liquid which fills the bubble plate 11 to the level of the top of the wall 26. The liquid and gas or vapor will then commingle and pass downwardly by violent projection through the restricted orifices formed by the slotted openings 28 in the lower edge of the wall 26 and the space between the lip of the bubble cap and the upper surface of the bubble plate 11. This action will be that of projecting these fluids through a restricted orifice to increase their velocity and to thus increase their turbulence. The fluids will then pass into the body of liquid resting upon the bubble plate 11, and will work their way upwardly through this liquid, producing a violent ebullition thereof. The vapors as they pass upwardly from the body of the liquid will strike the underface of the bubble plate forming the top of the compartment. Attention is directed to the fact that there is no direct passageway for the vapor to follow in reaching the compartment above that in which the action is taking place, and that the vapors must of necessity follow a circuitous path of travel. It will be understood that the pressure of the upwardly flowing vapors will be sufficient to prevent the oil which overflows the weir cups and stands upon the plate 11 from passing through openings 29 and cause it to accumulate on the plate 11.

It will thus be seen by this arrangement that the liquid and gas or vapor will be uniformly subdivided into quantities which will be in direct proportion to each other and which will be brought into interfacial contact uniformly over the sectional area of the still, thus insuring a maximum interfacial contact between the downwardly flowing fluid and the upwardly flowing fluid, and thus making it possible to obtain a maximum action between the liquid and the gas or vapor. It will also be evident that due to this arrangement the manufacturing cost may be simplified, since all of the bubble

plates and all of the bubble cap structures are made in duplicate, thus eliminating separate machine operations for the different bubble plates and the different bubble caps.

When the apparatus is first set in operation it will be understood that there will not be any accumulation of liquid upon the bubble plates, and it is necessary to insure that liquid will accumulate upon the bubble plates to a level which will submerge the lower edges of the walls 26 and the serrations 28. This is accomplished by providing ducts 30 which establish communication between the drain pipes 17 and the bubble plates. The upper ends of these ducts pass through the side wall of the nozzles 16, and the lower ends of the ducts pass through the wall of the drain pipes 17. By this arrangement, oil which is delivered to the still through the inflow pipe 14 will then flow downwardly and accumulate beneath upper bubble plate 11 until reaching the level of the drain ducts 30 carried by that plate, after which the oil will overflow into the drain pipe 17 until the weir cup at the lower end thereof has been filled to seal the drain pipe. The oil will then overflow the weir cup and accumulate on successive bubble plates in the manner previously described. In this way the lower ends of all of the drain pipes would be provided with a liquid seal and the lower ends of all of the members 26 will be submerged in liquid so that the gas which flows upwardly will not be able to pass directly through the drain pipes, and so that it will also be compelled to pass through a body of liquid on the bubble plates at all times during the operation of the still.

While I have shown the preferred form of my invention as now known to me, it will be understood that various changes might be made in the combination, construction and arrangement of parts by those skilled in the art, without departing from the spirit of the invention as claimed.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. An interfacial contact apparatus comprising an outer shell and a plurality of bubble plates forming contact compartments within the shell, drain pipes leading from one compartment to the next succeeding lower compartment conducting an overflow of liquid from an upper compartment to a lower compartment, said drain pipes being in longitudinal vertical alignment, and means interposed between adjacent ends of said pipes for mixing a downwardly draining liquid with an upwardly flowing vapor or gas and causing both to be projected with turbulent action into another body of liquid accumulated upon a bubble plate, and means for draining a surplus of said body of liquid through the same mixing structure.

2. An interfacial contact apparatus comprising an outer shell, a plurality of bubble plates extending transversely of the shell and dividing the shell into a plurality of superposed compartments, means for delivering a gas to the bottom of the shell and for causing it to flow upwardly through the compartments, means for delivering a liquid to the top of the shell and for causing it to flow downwardly through the compartments, means for causing the downwardly flowing liquid to accumulate to a predetermined depth in each compartment, means whereby the liquid flowing downwardly into one compartment and the gas flowing upwardly from another compartment will be brought into intimate contact within a commingling structure and will be projected into the accumulated body of liquid in the compartment into which the liquid and gas flow, and means embodied in the co-mingling structure for permitting a direct overflow of liquid from the body of liquid in one compartment into the area of contact of the liquid with the upwardly flowing gas in the next succeeding lower compartment.

3. An interfacial contact apparatus comprising an outer shell, a plurality of bubble plates therein and spaced from each other to form a series of superposed contact compartments, said bubble plates each being formed with a series of systematically arranged openings throughout their area to permit substantially uniform flow and distribution of fluids through the compartments, means for establishing a downward flow of liquid successively through the compartments, a circumscribing wall structure around each of the openings through said bubble plates for creating a desired accumulation of liquid upon the floor of each compartment and thereafter permitting it to overflow therefrom into the next succeeding lower compartment, and an upwardly projecting flange around each of the openings in the bubble plate each forming a nozzle projecting into an overflow structure whereby the downwardly flowing liquid and the upwardly flowing gas may be brought into intimate contact and may thereafter be projected into the accumulated quantity of liquid within the said compartment.

4. An interfacial contact apparatus, comprising an outer shell through which a downwardly flowing liquid and an upwardly flowing gas pass, a plurality of bubble plates dividing the shell into superposed compartments, said plates each having upwardly projecting nozzles through which the gas passes, bubble caps covering said nozzles and extending downwardly around the sides thereof to form a passageway for the gas from the nozzle and under the marginal edge of the cap into the compartment, means

causing the liquid to accumulate to a desired level above the lip of the cap and on the floor of each compartment, a pipe extending downwardly through said nozzle and conducting the overflowing liquid from an upper into a lower compartment and means for creating a liquid seal in said overflow pipe at a point above the level of the liquid in the compartment.

5. An interfacial contacting apparatus comprising an outer shell through which a liquid and a gas flow in counter directions, a plurality of bubble plates dividing the shell into superposed compartments, said plates each being formed with upwardly projecting nozzles through which the gas flows successively from the lowermost to the upper compartments, bubble caps one of which covers each of the nozzles and extends downwardly around the sides thereof to form a passageway for the gas and to cause it to flow out from beneath the lip of the bubble cap, means for causing the liquid to accumulate to a desired level above the lip of the bubble caps and on the floor of the compartments and a pipe extending downwardly through a nozzle in one bubble plate to the bubble cap in the next lower bubble plate and through which said overflowing liquid may pass.

6. An interfacial contacting apparatus comprising an outer shell through which a liquid and a gas flow in counter directions, a plurality of bubble plates dividing the shell into superposed compartments, said plates each being formed with upwardly projecting nozzles through which the gas flows successively from the lowermost to the upper compartments, bubble caps one of which covers each of the nozzles and extends downwardly around the sides thereof to form a passageway for the gas and to cause it to flow out from beneath the lip of the bubble cap, means for causing the liquid to accumulate to a desired level above the lip of the bubble caps and on the floor of the compartments and a pipe extending downwardly through a nozzle in one bubble plate to the bubble cap in the next lower bubble plate and through which said overflowing liquid may pass, and means for creating a liquid seal between the compartments and in the pipe.

CARL F. BRAUN.