

Nov. 14, 1933.

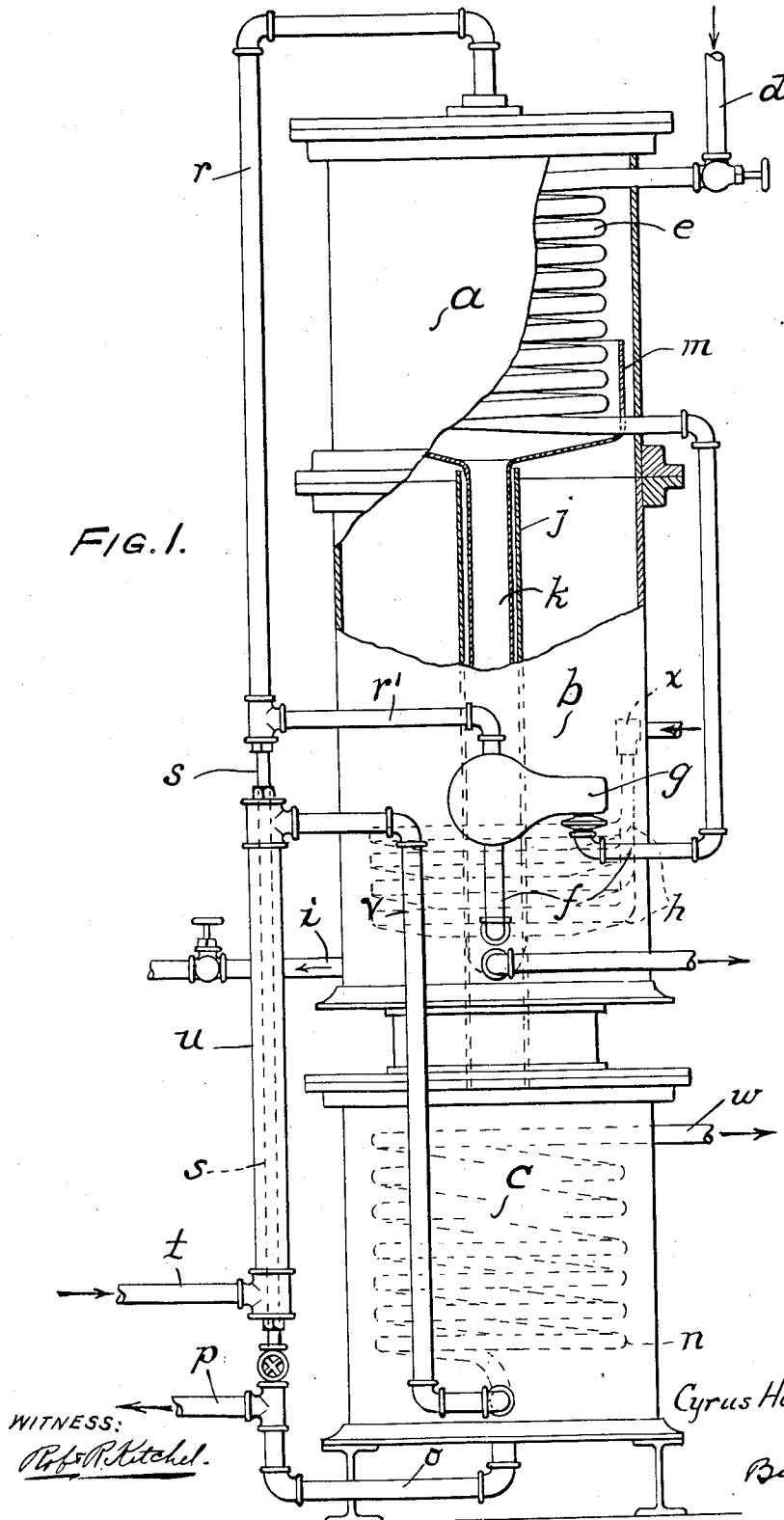
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1,935,183

APPARATUS FOR DISTILLING DRY CLEANERS' SOLVENT

Filed Jan. 3, 1929

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

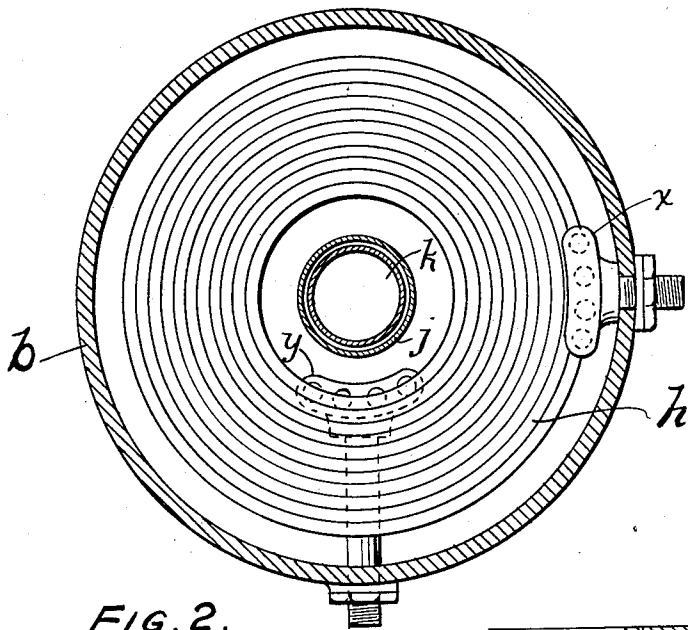


FIG. 2.

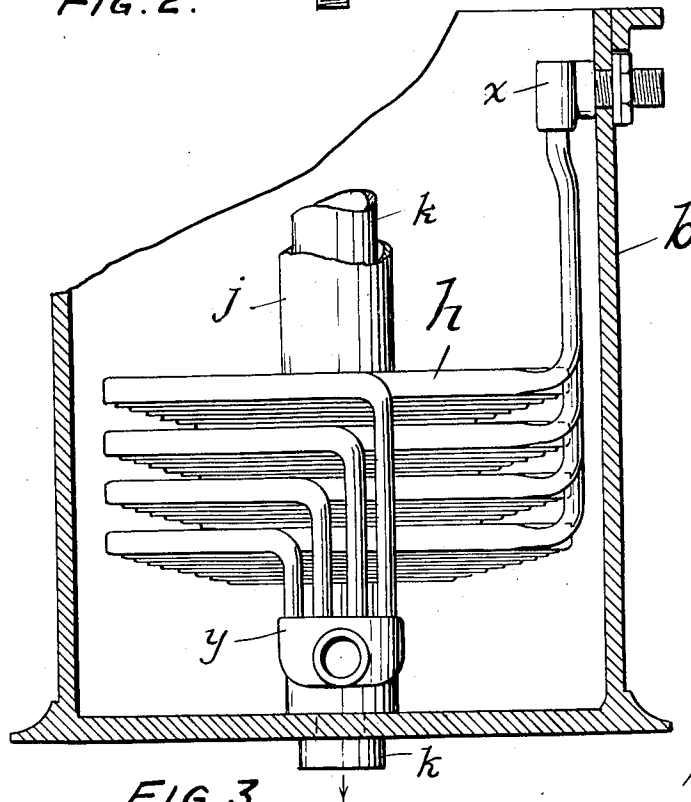


FIG. 3.

WITNESS:

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UNITED STATES PATENT OFFICE

1,935,183

APPARATUS FOR DISTILLING DRY
CLEANERS' SOLVENTCyrus Howard Hapgood, Nutley, N. J., assignor
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Application January 3, 1929. Serial No. 330,009

16 Claims. (Cl. 196—15)

The object of my invention is to provide a still for the distillation of dry cleaners' solvent, gasoline or other similar liquid which, through use or otherwise, contains impurities which can be removed by distillation. One of the practical requirements of such a still is that it shall be constructed cheaply, to which end it is desirable that it shall be made up, as far as possible, from stock materials so that the constructing operation may be largely one of assemblage. Another practical requirement is that the still shall occupy a floor space of small area.

My invention comprises a still responding to the above requirements and having also other advantages, particularly economy in consumption of heat, continuity of operation, prevention of accumulation of permanent gases, and avoidance of loss of solvent vapor with permanent gases.

A still embodying my invention in a preferred form is shown in the accompanying drawings, in which—

Fig. 1 is a general elevation of the apparatus, partly in section.

Figs. 2 and 3 are, respectively, a sectional plan view and elevation of the evaporator.

The machine comprises a solvent cooling chamber *c*, a solvent evaporating chamber *b* mounted on the cooling chamber, a heat exchanging chamber *a* mounted on the evaporating chamber, and coils and pipe connections as hereinafter described.

The solvent liquid to be distilled flows through a pipe *d* into and through a coil of pipe *e* in the chamber *a*, wherein the solvent is preliminarily heated by heat exchange with solvent vapors as hereinafter described. The heated liquid solvent thence flows through a pipe *f*, in which is interposed a feed regulator *g*, into the evaporating chamber *b*. In chamber *b* are a coil or coils of pipe *h* through which circulates steam, which evaporates the solvent, leaving a residue containing impurities and which, from time to time, may be withdrawn through drain *i*.

The solvent vapor rises and enters chamber *a*, wherein it transfers much of its heat to the inflowing solvent in coil *e*, the vapor being largely condensed and flowing down, through a pipe *j*, into the cooling chamber *c*.

Extending through pipe *j* is a tube *k* (preferably composed of asbestos covered with sheet metal), the upper part of which is expanded to form a funnel-shaped upper end *m* extending outside the coil *e* near the wall of chamber *a*, leaving an annular space between it and the wall for the upflow of solvent vapor. If the funnel were

eliminated, the vapor would not be compelled to flow into heat exchange relation with an effective length of the coil *e* and there would be very partial condensation with limited heat transfer. The funnel also acts to collect solvent that has condensed and deliver it to tube *k*. The tube *k* and funnel *m* are made of non-heat conducting material in order that the solvent should not be reheated in the course of its downflow through funnel *m* and tube *k*.

In chamber *c* are a coil or coils of pipe *n* through which circulates cold water, whereby the remaining vapor flowing from heat exchanger *a* is condensed and the condensate is cooled. The cooled solvent is pumped out through pipe *o* and thence through pipe *p*, the pump, not shown, being positioned on pipe *p* or an extension thereof.

It is preferred to make coils *h* in the solvent evaporating chamber, as shown in Figs. 2 and 3, namely, of tubing which is relatively wide and thin in cross-section and which is wound upon itself spirally; there being preferably a number of coils arranged in multiple and connected, at top and bottom, with manifolds *x* and *y*. The coils *n* in the solvent cooling chamber may be of any conventional type.

In the evaporating operation, a small amount of permanent gas may be driven off which, without some provision to prevent it, would accumulate in the top of chamber *a* and ultimately prevent the successful operation of the still. Such permanent gas, together with small amounts of solvent vapor that may be entrained therewith, escapes through pipe *r* and thence through a smaller pipe *s* to the pipe *p*. Surrounding pipe *s* is a pipe *u*, which, at the bottom, connects with a cold water inlet *t*. From the top of pipe *u* extends a pipe *v*, which connects with the inflow end of coils *n*. *w* is the water outlet from coils *n*.

Any condensible vapor escaping through pipe *r* condenses in pipe *s*, and this condensate and any incondensable gases flowing along therewith are carried away, through pipe *p*, with the cooled solvent from pipe *o*.

It is found desirable to maintain as high a vacuum as possible in the chambers *a*, *b* and *c* when distilling.

The pipe *r'* connected with pipe *r* and regulator *g* functions to equalize the pressure between the solvent evaporating chamber *b* and the feed regulator *g*. If this pressure were not equalized, the liquid levels in solvent evaporating chamber *b* and the feed regulator *g* would not be maintained the same.

Among the novel structural features and ad-

vantages may be enumerated the following:

The heat exchanger is, in effect, the upper part of the evaporator chamber.

Means are provided for accumulating the condensed vapors which are condensed by the heat exchanging coils and for conveying said condensed vapors, by gravity, with the uncondensed vapors, to the condenser.

The top of the heat exchange chamber is connected by a pipe with the bottom of the condenser chamber to equalize pressure, the pipe having a loop below the liquid level of the condenser to form a liquid seal.

The suction line to the pump is taken off of this pressure equalizing line at the level of the condensed liquid in the condenser.

The pump has greater capacity than actually needed to remove liquid from the condenser, the excess capacity of the pump being utilized for drawing non-condensable vapors from the top of the heat exchange chamber down through the equalizer pipe and with the condensed liquid through the pump. In this way one pump serves as both a wet vacuum pump to remove only liquid from the bottom of condenser c and as a dry vacuum pump to remove only gases from the exchanger.

The lower part of the equalizer pipe is water-cooled in order to condense such condensable gases as may be drawn down through this equalizer pipe from the top of the heat exchange chamber.

Having now fully described my invention, what I claim and desire to protect by Letters Patent is:

1. A still for distilling liquid such as dry cleaners' solvent, which comprises a solvent cooling chamber, a solvent evaporating chamber, a heat exchange chamber in the upper part of the evaporating chamber, a coil in the heat exchange chamber through which the solvent to be distilled flows and in which the solvent is preliminarily heated by solvent vapor and the discharge end of which extends downward and opens into the evaporating chamber, means affording communication between the evaporating chamber and the heat exchange chamber for the upward flow of solvent vapor, means affording a closed passage for the flow of solvent from the heat exchange chamber downward through the evaporating chamber to the cooling chamber, a coil in the cooling chamber through which a cooling fluid is adapted to flow to effect cooling of the solvent, and means for outflow of cooled solvent from the cooling chamber.

2. A still for distilling liquid such as dry cleaners' solvent, which comprises a lower cooling chamber in which solvent is condensed and cooled, a middle evaporating chamber, above the cooling chamber, in which solvent is evaporated, an upper chamber above the evaporating chamber in which solvent is preheated by heat exchange with solvent vapor, means to convey solvent through the upper chamber to the middle chamber, means for passage of solvent vapor from the middle chamber to the upper chamber, means providing a passage for solvent from the upper chamber, through, but out of heat-conducting relation with, the middle chamber, to the lower chamber, and means to withdraw cooled solvent from the lower chamber.

3. A still for distilling liquids such as dry cleaners' solvent, which comprises a solvent cooling chamber, means therein to cool the solvent, a second chamber, means to effect evapora-

tion of the solvent in the lower part of the second chamber, means in the upper part of the second chamber to effect heat exchange between the solvent vapors and the inflowing solvent before the latter is evaporated, and a conduit for outflow of cooled and condensed vapors from the upper part of the second chamber to the cooling chamber and providing a space between it and the wall of the second chamber for inflow of vapors from the locus of evaporation to the locus of heat exchange.

4. A still for distilling liquid such as dry cleaners' solvent, which comprises a lower cooling chamber in which solvent is condensed and cooled, a middle evaporating chamber, above the cooling chamber, in which solvent is evaporated, an upper chamber above the evaporating chamber in which solvent is preheated by heat exchange with solvent vapor, means to convey solvent through the upper chamber to the middle chamber, a pipe connecting the upper and lower chambers and extending through the middle chamber, and means providing an annular passage for vapor from the middle chamber along the lower wall of the upper chamber, said passage opening into the upper chamber a substantial distance below the upper end thereof.

5. A still for distilling liquids such as dry cleaners' solvent, which comprises a solvent cooling chamber, means therein to cool the solvent, a second chamber, means to effect evaporation of the solvent in the lower part of the second chamber, means in the upper part of the second chamber to effect heat exchange between the solvent vapors and the inflowing solvent before the latter is evaporated, a pipe providing a passage for downflow of condensed solvent and uncondensed vapors, said pipe extending through the lower part of said second chamber and expanded at its upper end to provide a narrow annular passage surrounding it for upflow of vapors into heat exchange relation with inflowing solvent.

6. A still for distilling liquid such as dry cleaners' solvent, which comprises a solvent cooling chamber, a second chamber superimposed of the solvent cooling chamber, a heat exchanger in the upper part of the second chamber through which solvent to be distilled flows and in which the solvent is adapted to be preliminarily heated by solvent vapors, an evaporator in the lower part of said second chamber, a conduit for the passage of solvent from the heat exchanger downward to the evaporator, and a conduit affording within it a passage for condensate from the heat exchanger downward to the cooling chamber and around the outside of which solvent vapors are adapted to flow upward from the evaporator to the heat exchanger.

7. A still for distilling liquid such as dry cleaners' solvent, which comprises a lower cooling chamber in which condensed solvent is cooled, a middle evaporating chamber, above the cooling chamber, in which solvent is evaporated, an upper chamber above the evaporating chamber in which solvent is preheated by heat exchange with solvent vapor, means in the respective chambers to effect said cooling, evaporation and heat exchange, means to convey solvent through the upper chamber to the middle chamber, a tube of non-heat conducting material extending through the middle chamber and communicating at opposite ends with the upper and lower chambers and expanded at its upper end to provide a narrow annular passage between its upper end and the inner wall of the upper cham-

ber, the upper end of said passage terminating substantially above the bottom and substantially below the top of the upper chamber, the solvent vapor flowing through said passage from the middle chamber into the upper chamber.

8. A still for distilling liquid such as dry cleaners' solvent, which comprises a chamber through which are adapted to flow solvent to be evaporated and, in heat exchange relation therewith, solvent vapor, an evaporating chamber adapted to receive preheated solvent from the first chamber and from which solvent vapor is adapted to flow into the first chamber, a cooling chamber adapted to receive solvent from the first chamber, means in the respective chambers to effect said heat exchange, evaporation and cooling, a pipe communicating with the upper part of the first chamber and adapted to receive vapor therefrom, means independent of said cooling chamber to cool and condense condensible vapor flowing from the first chamber through said pipe, and a solvent outflow pipe connected with said vapor receiving pipe and said cooling chamber.

9. A still for distilling liquids such as dry cleaners' solvent, which comprises a solvent cooling chamber having a bottom discharge for cooled, condensed solvent, a solvent evaporating chamber, a heat exchange chamber in which the vapors from the evaporating chamber are largely condensed by heat exchange with solvent flowing toward the evaporating chamber, means in the respective chambers to effect said cooling, evaporation and heat exchange, means to convey solvent from the heat exchanging chamber to the cooling chamber, and a pressure equalizing pipe line between the vapor space in the top of the heat exchanging chamber and the bottom discharge from the cooling chamber.

10. A still for distilling liquids such as dry cleaners' solvent, which comprises a solvent cooling chamber, a solvent evaporating chamber, a heat exchange chamber in which the vapors from the evaporating chamber are largely condensed by heat exchange with solvent flowing toward the evaporating chamber, means in the respective chambers to effect said cooling, evaporation and heat exchange, means to convey solvent from the heat exchanging chamber to the cooling chamber, and a pressure equalizing pipe line between the top of the heat exchanging chamber and the bottom of the cooling chamber, said pipe line having a loop below the liquid level of the cooling chamber to form a liquid seal.

11. A still for distilling liquids such as dry cleaners' solvent, which comprises a solvent cooling chamber, a solvent evaporating chamber, a heat exchange chamber in which the vapors from the evaporating chamber are largely condensed by heat exchange with solvent flowing toward the evaporating chamber, means in the respective chambers to effect said cooling, evaporation and heat exchange, means to convey solvent from the heat exchanging chamber to the cooling chamber, a pipe through which the cooled solvent is adapted to outflow from the cooling chamber, a pipe communicating with the upper part of the heat exchange chamber and through which incondensable gas is adapted to outflow from the heat exchange chamber, and a third pipe connected with the other two pipes and through which both cooled solvent and incondensable gas may be withdrawn from the still.

12. A still for distilling liquid such as dry cleaners' solvent, which comprises a chamber through which are adapted to flow solvent to be

evaporated and, in heat exchange relation therewith, solvent vapor, an evaporating chamber adapted to receive preheated solvent from the first chamber and from which solvent vapor is adapted to flow into the first chamber, a cooling chamber adapted to receive solvent from the first chamber, means in the respective chambers to effect said heat exchange, evaporation and cooling, a pipe communicating with the upper part of the first chamber and adapted to receive vapor therefrom, and means adapted to convey a cooling fluid into heat exchange relation with said vapor pipe and thence through the cooling chamber into heat exchange relation with the solvent therein.

13. A still for distilling liquid such as dry cleaners' solvent which comprises a solvent cooling chamber, an evaporator, a heat exchanger adapted to receive solvent vapors from the evaporator and in which the solvent to be distilled is preheated and solvent vapors cooled and condensed, means in the respective chambers to effect said cooling, evaporation and heat exchange, means for conducting cooled and condensed solvent from the heat exchanger to the cooling chamber, and a pipe through which is withdrawable incondensable vapors from the heat exchanger and condensed solvent from the cooling chamber, said means being so arranged as to provide a liquid seal formed by condensed solvent between said cooling chamber and said pipe.

14. A still for distilling liquids such as dry cleaners' solvent, which comprises a solvent cooling chamber, a solvent evaporating chamber, a heat exchange chamber in which the vapors from the evaporating chamber are largely condensed by heat exchange with solvent flowing toward the evaporating chamber, means in the respective chambers to effect said cooling, evaporation and heat exchange, means to convey solvent from the heat exchange chamber to the cooling chamber, a pressure equalizing pipe line between the top of the heat exchanging chamber and the bottom of the cooling chamber, and a pipe connected with said pipe line and through which cooled solvent from the cooling chamber and incondensable gas from the heat exchanger are adapted to be pumped by a suction capacity greater than that required to withdraw the solvent, thereby enabling the use of a pump which serves both as a liquid pump and a dry vacuum pump.

15. A still for distilling liquids such as dry cleaners' solvent, which comprises a solvent cooling chamber, a solvent evaporating chamber, a heat exchange chamber in which the vapors from the evaporating chamber are largely condensed by heat exchange with solvent flowing toward the evaporating chamber, means in the respective chambers to effect said cooling, evaporation and heat exchange, means to convey solvent from the heat exchange chamber to the cooling chamber, a pipe through which the cooled solvent is adapted to outflow from the cooling chamber, a second pipe communicating with the upper part of the heat exchange chamber and through which incondensable gas is adapted to outflow from the heat exchange chamber, a third pipe connected with the other two pipes and through which both cooled solvent and incondensable gas may be withdrawn from the still, and means to cool the incondensable gas flowing through the first pipe whereby any solvent vapors entrained therewith will be condensed and withdrawn through the third pipe.

16. A still for distilling liquids such as dry

cleaners' solvent, which comprises a solvent cooling chamber, a solvent evaporating chamber, a heat exchange chamber in which the vapors from the evaporating chamber are largely condensed by heat exchange with solvent flowing toward the evaporating chamber, means in the respective chambers to effect said cooling, evaporation and heat exchange, means to convey solvent from the heat exchange chamber to the cooling chamber, a pipe through which the cooled solvent is adapted to outflow from the cooling chamber, a second pipe through which incondensable gas is

adapted to outflow from the heat exchange chamber, a third pipe connected with the other two pipes and through which both cooled solvent and incondensable gas may be withdrawn from the still, and means to cool the incondensable gas flowing through the second pipe whereby any solvent vapors entrained therewith will be condensed, said cooling means comprising a jacket surrounding such pipe and through which the cooling medium for the solvent is adapted to flow on its way to the cooling chamber.

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15	90
20	95
25	100
30	105
35	110
40	115
45	120
50	125
55	130
60	135
65	140
70	145
75	150