March 18, 1930. R. E. WILSON 1,751,182

ART OF CONTINUOUS DISTILLATION OF HEAVY HYDROCARBON OILS

Filed April 3, 1925 2 Sheets-Sheet 1

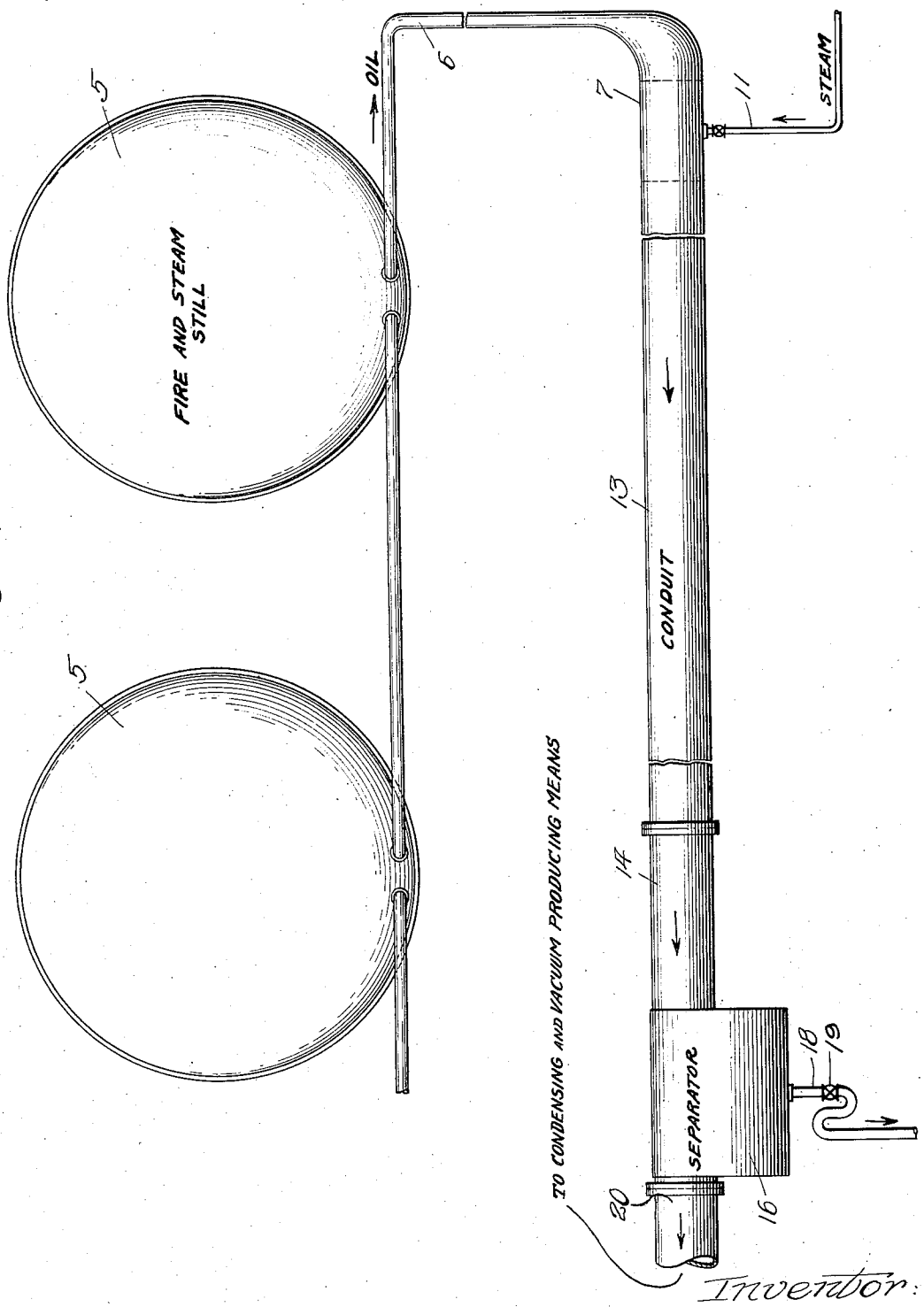


Fig. 1.

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Fig. 4.

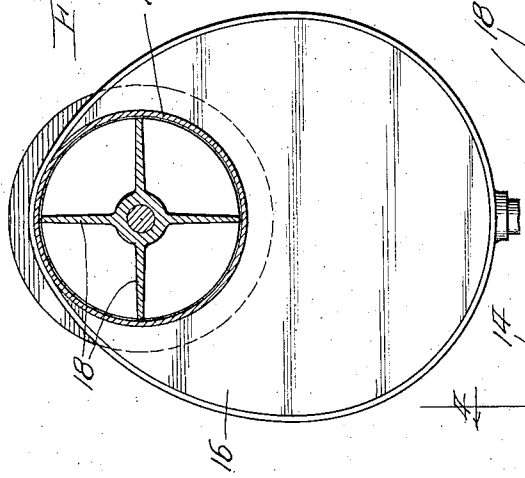


Fig. 3.

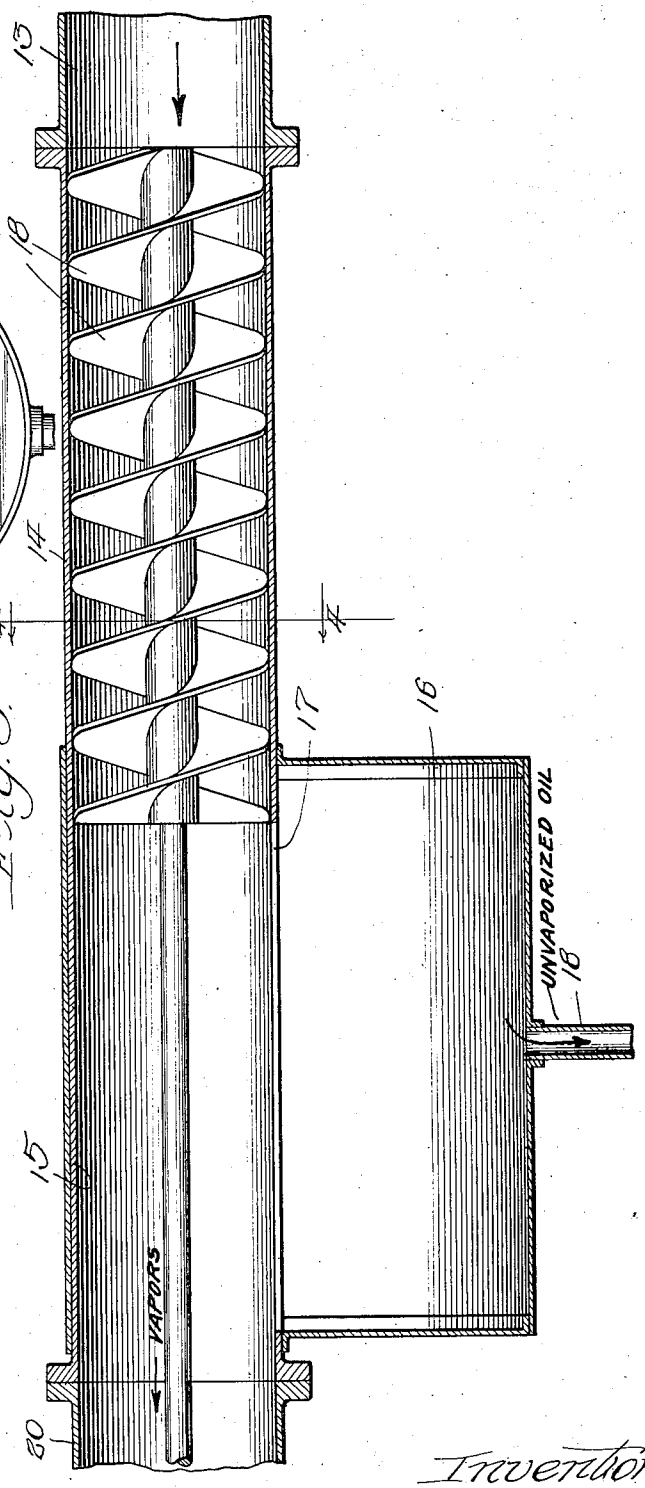
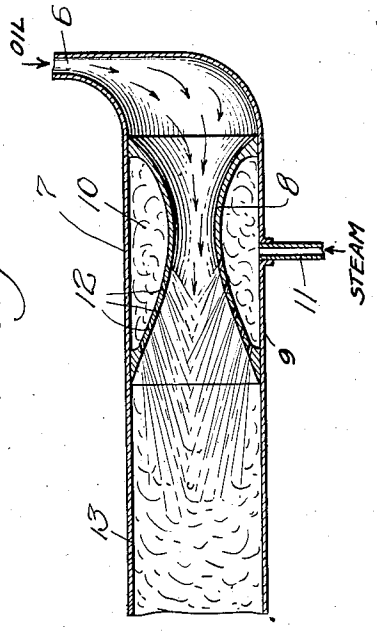


Fig. 2.



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UNITED STATES PATENT OFFICE

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ART OF CONTINUOUS DISTILLATION OF HEAVY HYDROCARBON OILS

Application filed April 3, 1925. Serial No. 20,423.

The present invention relates to the continuous distillation of hydrocarbon oils, and more particularly of heavier hydrocarbon oils, such as residues from fire and steam distillation processes, under vacuum, and will be fully understood from the following description, illustrated by the accompanying drawing, in which:

Figure 1 is a diagrammatic view of apparatus suitable for carrying the invention into effect;

Fig. 2 is a sectional detail view showing diagrammatically a mixing device for use in connection with the present invention;

Fig. 3 is a longitudinal sectional view showing diagrammatically the construction of a vapor separator; and

Fig. 4 is a transverse sectional view of the separator.

Referring more particularly to the drawing, the numeral 5 indicates the stills of a continuous battery in which crude oil or other hydrocarbon is subjected to fire and steam distillation. From the last of the stills 5 of the continuous battery, the oil passes through a pipe 6 to a mixing device 7, a suitable construction of which is shown in section in Fig. 2. The mixer 7 may suitably be formed with a central nozzle 8 for the introduction of oil, this nozzle being suitably of the converging-diverging type surrounded by a casing 9 forming a chamber 10 into which superheated steam is introduced through the pipe 11. The expanding portion of the tube 8 is provided with openings 12, directed in the direction of flow of the oil. The mixer 7 opens into a conduit 13, through which the mixture of oil and steam passes, the duration of the travel of the mixture through the conduit 13 being such that substantial thermal equilibrium is attained.

From the conduit 13, the mixture of vapors and oil enter a separator 14, in which the unvaporized oils are separated from the vapors by mechanical action, preferably by centrifugal action and without substantial reduction in velocity of movement of gas through the apparatus. In the form illustrated, the separator may suitably consist of a central conduit 15, the end portion of which is partly surrounded by an outer casing 16, the latter being eccentric to the central conduit 15. Within the casing 16 the conduit 15 is provided near its exit end with a longitudinal slit on its lower side extending a portion of its length, as shown at 17. Within the conduit 15, is a plurality of spiral vanes or an Archimedean screw 18, which is substantially fixed in position and extending partly through the conduit. In passing through the conduit 15, the mixture of vapors and unvaporized liquid is given a rapid rotating or whirling movement by vanes 18, thereby throwing out upon the walls of the conduit the unvaporized liquid, which drains through the opening 17 into the outer casing 16. It is drawn from the casing 16 through a conduit 18, preferably trapped, the flow of the liquid being controlled, for example, by valve 19, so that the outlet from the casing 16 is covered with liquid and the discharge of gas through the pipe 18 is prevented. Gases and vapors pass out of the separator through the conduit 20, which leads to any suitable condensing device, and if desired, to a vacuum producing apparatus (not shown).

To illustrate the present invention, it may be described in connection with the distillation of a hydrocarbon oil residue derived from the fire and steam distillation of, for example, a mid-continent crude to a 20% bottom. The initial distillation of the crude oil is accomplished in the battery of continuous stills, of which the still 5 shown is the end still. From the end still 5 this residue oil is drawn at a temperature, for example, of 680 to 700° F., by the injector action of the steam supplied through the nozzle openings 12 of the mixer 7.

To the outer jacket 10 of the mixer superheated steam is supplied in proportion to effect the desired distillation of the oil; thus, from 3 to 10 pounds per gallon of oil distillate may be used. Under the conditions hereinafter described, from 4 to 5 pounds of steam per gallon of distillate has been found sufficient to distill such a residue under an absolute pressure of 25 to 75 millimeters to a bottom of 3 to 6% on the original crude.

The superheated steam may suitably be supplied at a temperature of 1000 to 1200° F. In operating with an absolute pressure of 25 to 100 millimeters in the conduit 13, and with the superheated steam supplied at substantially atmospheric pressure, a temperature of 700 to 750° F. may be maintained in the conduit 13. The openings 12 may be proportioned so that the velocity of flow of the steam therethrough is from two to three thousand feet per second and is reduced to two to five hundred feet per second in the conduit 13. The expansion of the steam effects a reduction of its temperature, while simultaneously atomizing and propelling the oil, thereby avoiding the application of excessive temperatures to the oil. Within the tube or conduit 13 there is a reversion of heat, which aids in vaporization of the oil.

In the conduit 13, substantial thermal equilibrium between the oil and the steam is attained, resulting in the desired volatilization of the oil. The length of the conduit may suitably be from 40 to 80 feet, the conditions set forth being such that the application of the heat of the steam to the oil is effected without appreciable cracking of the oil.

After leaving the conduit 13, the mixture enters the central conduit 15 of the separator 14, in which a rapid rotary or whirling movement is imparted thereto by the screw. The particles of unvaporized oil are driven outward through the opening 17 into the outer casing 16, the vaporized oil and steam making its way through the conduit 20 to any suitable condensing and pressure control devices (not shown).

It is readily apparent that the invention may be applied directly to crude oils or to other types of hydrocarbon oils than the residual oil in connection with which the invention has been particularly set forth, and that the operation may be conducted under atmospheric (or superatmospheric) pressure, the superheated steam being then supplied with an additional differential of pressure sufficient to produce the desired thermal conditions in the mixing device and equilibrium conduit, in the manner herein set forth in connection with vacuum operation. The invention is more particularly intended for use in vacuum operation.

I claim:

1. The method of distilling hydrocarbon oils which comprises supplying to unvaporized oil residuum superheated steam at a temperature of about 1000° F. upwards in a quantity sufficient to effect the desired vaporization, the steam being expanded upon admixture with the oil, causing the oil to traverse an externally unheated conduit in intimate admixture with the steam to effect substantial thermal, equilibrium of the mixture, and then causing the resulting mixture to be set in whirling movement, with velocity sufficient to throw unvaporized oil out of the vapors.

2. The method of distilling hydrocarbon oils which comprises supplying to unvaporized oil residuum superheated steam at a temperature of about 1000° F. upwards in a quantity sufficient to effect the desired vaporization, the steam being expanded upon admixture with the oil, causing the oil to traverse a conduit in intimate admixture with the steam to effect substantial thermal equilibrium of the mixture, then causing rapid whirling movement of the mixture without substantially reducing the velocity of its movement, thereby throwing unvaporized oil out of the mixture, and collecting and withdrawing the unvaporized oil.

3. In the distillation of hydrocarbon oil, atomizing the oil with superheated steam, the temperature of the steam being such as to supply substantially all the heat required for the volatilization of the oil, conveying the intermingled steam and oil through a conduit to permit them to come to substantial thermal equilibrium, and imparting to the intermingled steam and oil a whirling movement without substantial change in velocity of movement, thereby separating the unvaporized oil, separately removing the separated oil and maintaining a pressure substantially below atmospheric throughout.

4. In distilling hydrocarbon oils, bringing intermingled hydrocarbon oil and superheated steam into thermal equilibrium during continuous passage through a conduit under vacuum and imparting to the mixture a whirling movement without substantially reducing its velocity, thereby throwing out of the mixture and separating the unvaporized oil.

5. In apparatus for the distillation of hydrocarbon oils, a mixer comprising an expanding nozzle, means for supplying unvaporized oil to said nozzle, a conduit into which said nozzle opens, the nozzle being provided with openings on its expanding side directed in the direction of flow of oil, means for supplying superheated steam to said openings, the steam being expanded on passage through the openings and immediately intermingling with the oil and traversing the conduit, means at the end of the conduit for imparting a rapid whirling movement to the mixture of oil and vapors, thereby throwing out unvaporized oil particles, and means for collecting the unvaporized oil.

6. In apparatus for the distillation of hydrocarbon oils under vacuum, a conduit, means for supplying unvaporized oil thereto, means for intermingling superheated steam with the oil entering the conduit and simultaneously expanding the steam, thereby causing the steam and oil to traverse the conduit, and means at the end of the conduit to im-

part to the mixture of steam and oil a rapid whirling movement without substantial change in the velocity, thereby separating unvaporized oil therefrom.

7. In the distillation of hydrocarbon oil, atomizing the oil with superheated steam, the temperature of the steam being such as to supply substantially all the heat required for the desired volatilization of the oil, conveying the intermingled steam and oil through a conduit to permit them to come to substantial thermal equilibrium, and imparting to the intermingled steam and oil a whirling movement without substantial change in velocity of movement, thereby separating the unvaporized oil, and separately removing the unvaporized oil.

8. In distilling hydrocarbon oils, bringing intermingled hydrocarbon oil and superheated steam into thermal equilibrium during continuous passage through a conduit, imparting to the mixture a whirling movement without substantially reducing its velocity, thereby throwing unvaporized oil out of the mixture, and separating such unvaporized oil.

9. In distilling hydrocarbon oils, passing hydrocarbon oil and steam in continuous passage through a conduit, thereby bringing such oil and steam into thermal equilibrium, then imparting to the mixture a whirling movement without substantially reducing its velocity, thereby throwing unvaporized oil out of the mixture, and separating such unvaporized oil.

10. In the distillation of hydrocarbon oils, subjecting a mixture of hydrocarbon oil and steam in substantial thermal equilibrium to a whirling movement while in continuous flow at a rate of 200 to 500 feet per second, thereby throwing out unvaporized oil, and substantially immediately separating out such unvaporized oil.

11. In distilling hydrocarbon oils, passing hydrocarbon oil and steam in continuous passage through a conduit, thereby bringing such oil and steam into thermal equilibrium, then imparting to the mixture a whirling movement without substantially reducing its velocity, thereby throwing unvaporized oil out of the mixture in the form of a layer, and separating such layer of unvaporized oil.

12. In the distillation of hydrocarbon oils, subjecting a mixture of hydrocarbon oil and steam in substantial thermal equilibrium to a whirling movement while in continuous flow at a rate of 200 to 500 feet per second, thereby throwing out unvaporized oil in the form of a layer, and substantially immediately separating out such layer of unvaporized oil.

ROBERT E. WILSON.