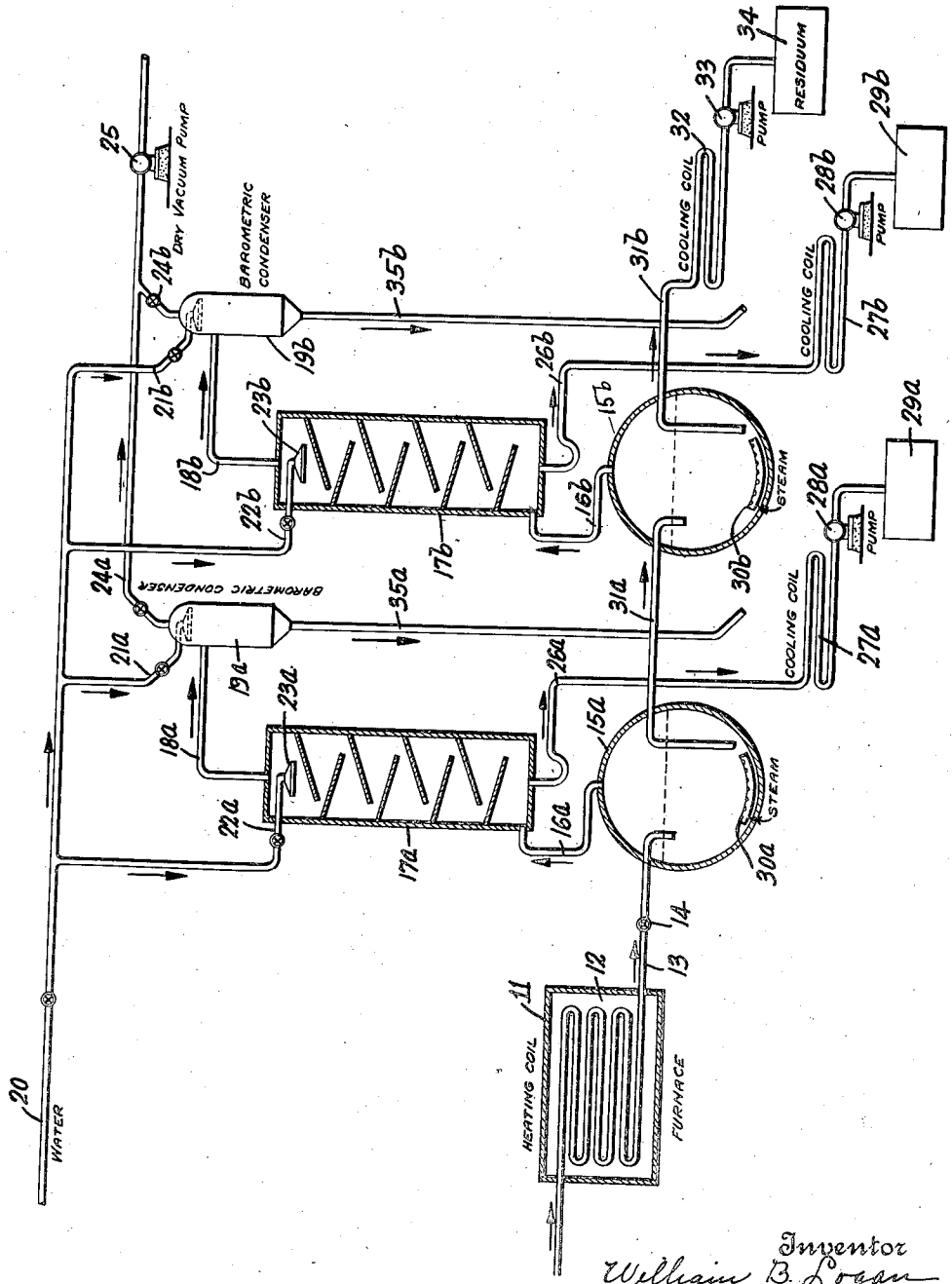
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VACUUM DISTILLATION

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VACUUM DISTILLATION

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This invention relates to vacuum distillation and more particularly to a process for the distillation of mineral lubricating oils under vacuum. In its broadest aspect the invention comprises a process wherein mineral lubricating oil is vaporized in a still, after which the heated vapors pass into a frictionating tower where they are condensed, wholly or in part, by means of cooling supplied through the direct introduction of water into the oil vapors, the entire process being conducted under sub-atmospheric pressure.

The invention may be readily understood from a description of the procedure of the process considered in connection with the accompanying drawing which represents in diagrammatic sectional elevation an apparatus which may be employed for carrying on the process. The apparatus illustrated in the drawing is shown and described merely for the purpose of aiding and understanding the process and it is to be understood that any other suitable apparatus may be substituted for that shown.

Referring to the drawing, there is provided a heating coil 11 for the purpose of heating the oil to be distilled, the coil being placed in a suitable furnace 12. Connected to the coil by the flow line 13, fitted with the valve 14, is a still 15*a* which is placed in a suitable furnace (not shown). A suitable means is provided for introducing steam into the still below the level of the liquid contained therein, as the perforated pipe 30*a*. The still is connected by means of the vapor line 16*a* to the fractionating tower 17*a* provided with suitable baffles as shown. From the bottom of the tower 17*a* a connection 26*a* is provided, passing through the cooling coil 27*a* to which the pump 28*a* connects and discharges to the storage tank 29*a*. From the top of the tower 17*a* a vapor line 18*a* is provided passing to the barometric condenser 19*a*.

A water line 20 from a suitable source supplies water to the barometric condenser 19*a* through the connection 21*a* and also to the upper portion of the tower 17*a* through the connection 22*a* and the spray 23*a*. From the top of the barometric condenser a line 24*a* is connected to a dry vacuum pump 25. The water supplied to the barometric condenser 19*a* is discharged together with any condensate entering the condenser through the connection 18*a*, through the line 35*a* to a suitable hot-well (not shown) which may be fitted with means for separating oil and water.

An overflow line 31*a* provides a means for the contents of the still 15*a* to overflow into the next still of the series 15*b*. In the apparatus as illustrated only two stills are shown connected in series but any number of stills might be used, depending upon the number of fractions which it is desired to obtain. The still 15*b* with its corresponding tower, barometric condenser, water connections, etc. is a substantial counterpart of the still 15*a* and its connected tower, barometric condenser, etc. From the still 15*b*, which in the present instance is the last still of the series, the overflow line 31*b* is connected to the pump 33 through the cooling coil 32, the pump discharging into the residuum container 34.

The operation of the process in connection with the apparatus shown may be as follows:

A suitable charging stock, for example an intermediate cut obtained from a Gulf Coastal crude petroleum, is supplied from a source (not shown) to the heating coil wherein it may be heated to the temperature desired, say for example 600° F. The oil in the heating coil is maintained at pressures equal to atmospheric or above. The valve 14 is partially opened allowing the oil from the heating coil to be continuously drawn into the still 15*a*, which is maintained under a pressure less than atmospheric, preferably under an absolute pressure of about 25–50 mm. of mercury. Distillation of the oil takes place within the still 15*a* and the degree of distillation may be controlled both by the addition of heat to the still and also by the introduction of a carefully regulated quantity of steam through the perforated pipe 30*a*. The oil vapors evolved from the still consist chiefly of lubricating oil fractions and these pass from the still through the vapor line 16*a* to the fractionating tower 17*a*.

In the apparatus described for the purpose

of illustrating the invention, the fractionating tower has been illustrated as a simple baffle tower. However, it will be understood that other suitable types of towers, such for example as packed towers or bubble towers, may be used, the type of tower depending in general upon the degree of fractionation which it is desired to accomplish. In the present instance in which the distillation of an intermediate fraction of a Gulf Coastal crude is contemplated, close fractionation of the various "cuts" is not required and accordingly the comparatively inefficient but inexpensive baffle tower serves the desired purpose.

The vapors entering the lower portion of the baffle tower pass upward where they come in contact with a spray of water introduced through the connection 22*a* and the distributer 23*a*. The temperature maintained in the tower is such that the water is accordingly vaporized, thereby abstracting heat from the oil vapors which are thus condensed and drop down through the tower. By the regulation of the quantity of water introduced through the connection 22*a* substantially any proportion of the oil vapors may be condensed in the tower 17*a*.

The steam which was introduced into the still 15*a* passes on through the tower 17*a* and out through the line 18*a* together with the steam generated from the water introduced through the connection 22*a*. As pointed out in the preceding paragraph, the steam may carry with it a certain quantity of oil vapors, depending in general upon the degree of cooling applied to the top of the tower by the introduction of a controlled amount of water through the connection 22*a*. The steam passing through the line 18*a* enters the barometric condenser 19*a* where it comes in contact with cool water introduced through the connection 21*a* and is condensed, thus producing a vacuum both on the tower 17*a* and the still 15*a*. The water from the barometric condenser is discharged through the line 35*a* to a suitable hot-well system.

The oil condensed in the tower 17*a* collects in the lower section from which it flows by gravity through the line 26*a* and the cooling coil 27*a*, from which it is forced by means of the pump 28*a*, to a storage tank 29*a*, maintained under normal atmospheric pressure.

As shown in the drawing, a second still 15*b* is provided which is substantially a counterpart of the still 15*a* but which normally will be maintained at a higher temperature than 15*a*. Undistilled oil from the still 15*a* overflows through the line 31*a* into the still 15*b* where it undergoes further distillation at a higher temperature, the fractions thus distilled off being heavier and more viscous than those distilled from the still 15*a*. The operation of the still 15*b* is in general substantially the same as that described for the still 15*a* with the exception of the increased still temperature and a varying quantity of water required to be supplied to the top of the tower 17*b*. As shown in the drawing, the still 15*b* represents the last still in the series of stills. It was mentioned in a previous paragraph that any desired number of stills may be employed in the series. From the last still in the series, in this instance still 15*b*, the undistilled residuum overflows by way of the line 31*b*, through the cooling coil 32, from which it is forced by means of a pump 33 to a suitable storage receptacle 34, maintained under normal atmospheric pressure.

The cooling of the upper portion of the fractionating tower by means of the direct introduction of water therein is of particular importance in connection with the vacuum distillation of mineral lubricating oils and the employment of this procedure results in the economical production of the highest grades of distillate lubricating oils. In the case of ordinary distillation under normal atmospheric pressure, other means of cooling might readily be employed. For example, a cool fluid might be circulated through suitable pipe coils in the upper portion of the tower, the fluid never coming directly in contact with the oil vapors. However, in the case of vacuum distillation, such an arrangement is not practical as the rarified condition of the vapors would make necessary the use of an enormous pipe surface, so great in fact as to be impractical. On the other hand, the more or less usual method of applying cooling to the top of a fractionating tower during the distillation of lighter oils such as gasoline, that is, the direct introduction of cool oil, is not practical where it is necessary to produce highly purified and stable lubricating oil distillates. Thus, if cool lubricating oil, or any other oil, were introduced into the top of the towers 17*a*, 17*b*, etc., all of the cooling-oil would not be evaporated and portions of this oil would be subjected to enough heat and over a sufficient period of time to produce impurities which would not only darken the color but destroy other desirable properties of the oil, such for example, as resistance to emulsification. Such oil would then be collected with condensed vapors from the still thereby contaminating them to an undesirable extent. The cooling of the towers by the direct introduction of water has none of these disadvantages and, in the vacuum distillation of mineral lubricating oil, it is by this means alone that a desirable product may be economically obtained.

Obviously many modifications and variations of the invention, as hereinbefore set forth, may be made without departing from the spirit and scope thereof, and therefore,

only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. The process of distilling mineral lubricating oil which comprises continuously vaporizing the oil under an absolute pressure not exceeding 25–50 mm. of mercury, passing evolved vapors into a tower, introducing water into the upper portion of the tower whereby a portion of said vapors are condensed and the water evaporated, withdrawing steam and oil vapors from the upper portion of the tower and withdrawing condensate comprising the desired lubricating oil from the lower portion of the tower.

2. The process of distilling hydrocarbon lubricating oil which comprises vaporizing the oil in a still in the presence of steam, passing the oil vapors into a tower, introducing water into the upper portion of the tower whereby a portion of said vapors is condensed and the water evaporated, withdrawing steam and oil vapors from the upper portion of the tower, and withdrawing condensate comprising the desired lubricating oil from the lower portion of the tower, the process being carried on under an absolute pressure not exceeding 25–50 mm. of mercury.

3. The continuous process of distilling hydrocarbon lubricating oil which comprises continuously introducing the oil into a heated still wherein vaporization takes place, passing the oil vapors into a tower, introducing water directly into the upper portion thereof whereby a major portion of said vapors is condensed and the water evaporated, withdrawing steam and a relatively small quantity of oil vapor from the upper portion of the tower, and withdrawing and collecting the condensate comprising the desired lubricating oil from the lower portion of the tower, the process being carried on under an absolute pressure not exceeding 25–50 mm. of mercury.

In witness whereof I have hereunto set my hand this 7th day of December, 1927.

WILLIAM B. LOGAN.