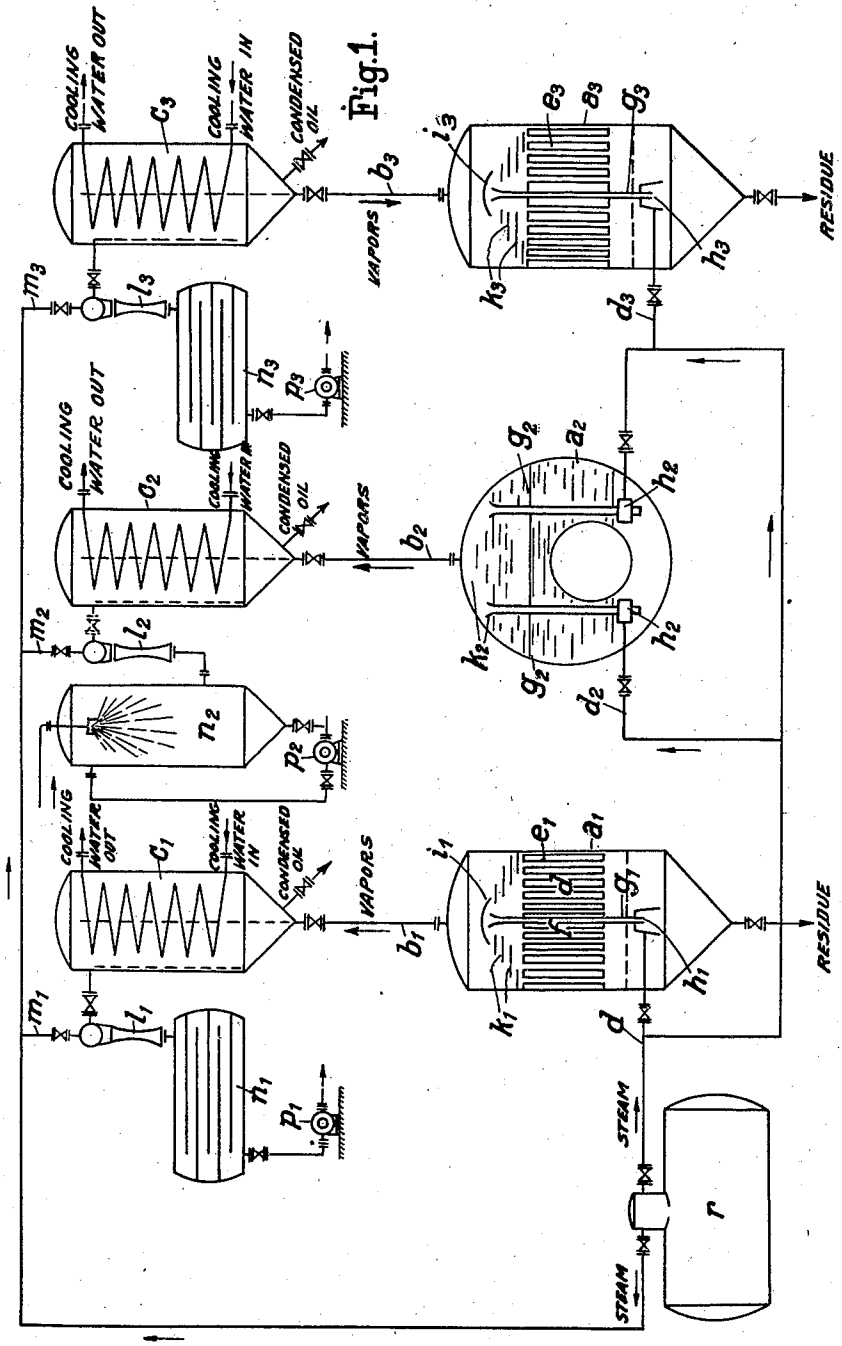
April 5, 1932. M. GENSECKE 1,852,205

PROCESS FOR THE CONTINUOUS OR INTERMITTENT VACUUM DISTILLATION OF MINERAL OILS

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Fig. 1.



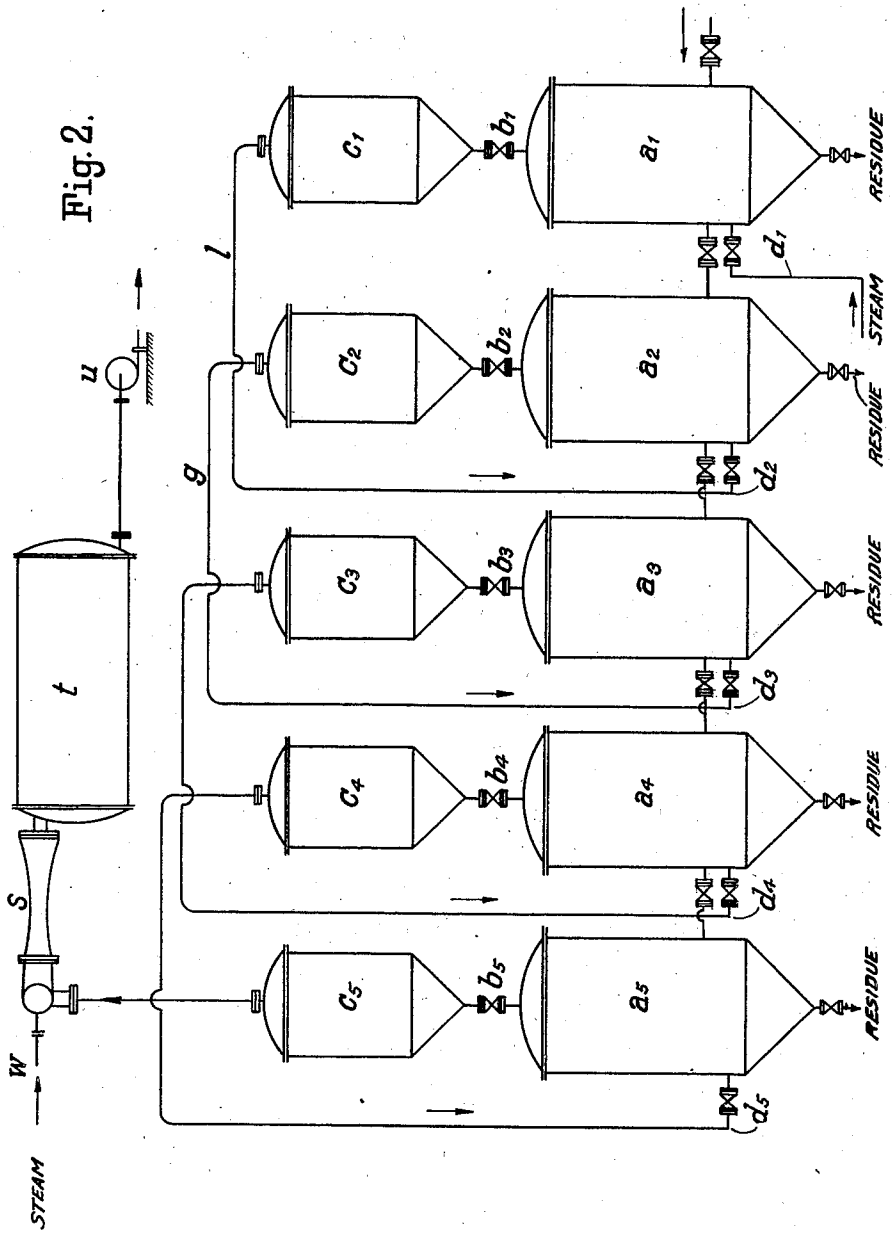
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PROCESS FOR THE CONTINUOUS OR INTERMITTENT VACUUM DISTILLATION OF MINERAL OILS

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Fig. 2.



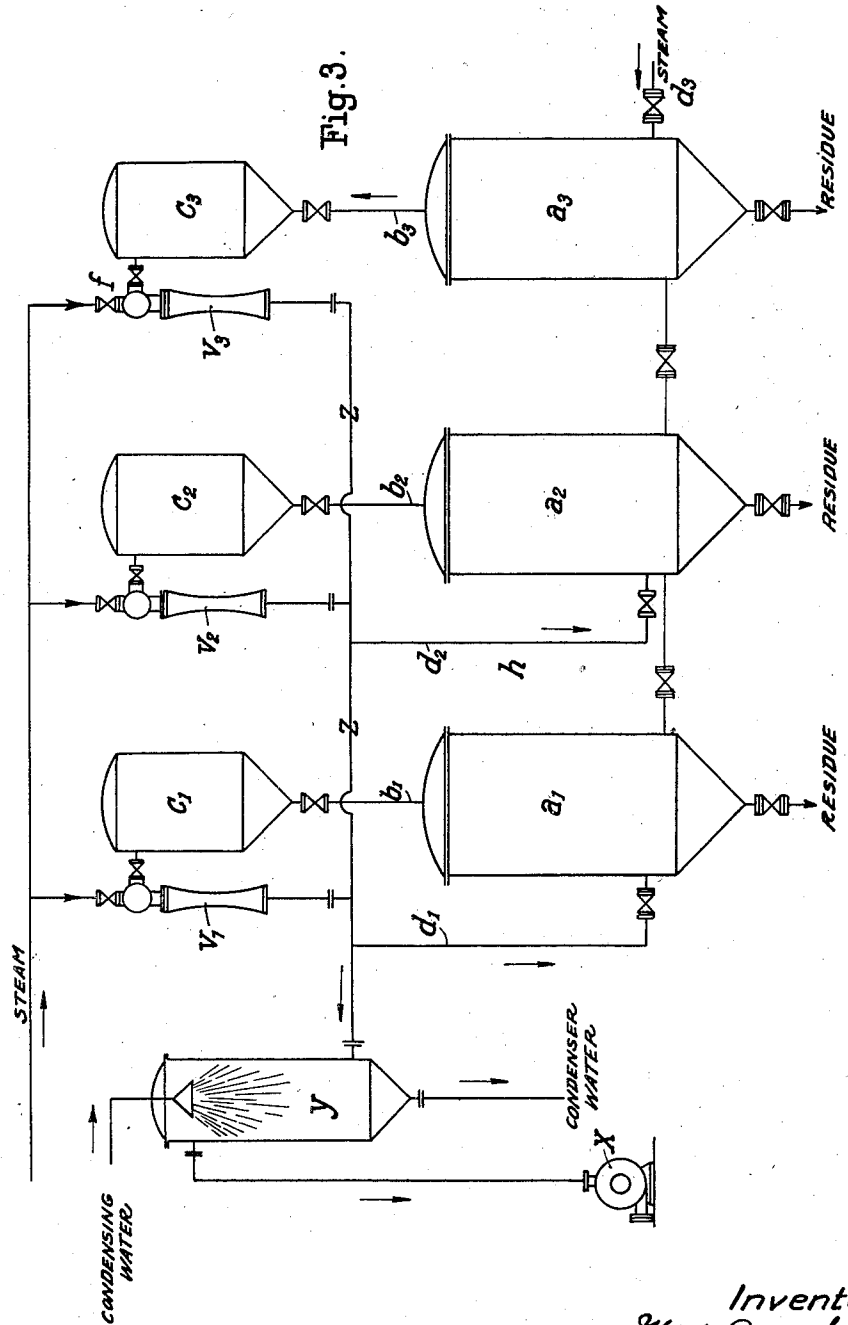
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Fig. 3.



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UNITED STATES PATENT OFFICE

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PROCESS FOR THE CONTINUOUS OR INTERMITTENT VACUUM DISTILLATION OF MINERAL OILS

Application filed February 24, 1928, Serial No. 256,750, and in Germany December 3, 1926.

This invention relates to a process for the continuous or intermittent vacuum distillation of mineral oils.

The splitting up of mineral oils into the usual commercial fractions is frequently effected by means of vacuum distillation. This distillation is generally performed by heating the mineral oil in a plurality of stills arranged in serial order, in relation to the direction of flow of the oil; such stills being for example often constructed in the form of a Cornish boiler. The evolved oil vapours are led from each still into a condensing apparatus which, in conjunction with an air pump, maintains a negative pressure in the plant, equivalent, in the most favourable circumstances, to a pressure, of 20 to 30 mm. of mercury.

In order to accelerate the volatilization by reducing the vapour pressure of the oil, it is usual to pass steam through the oil in the stills. These measures are however insufficient to prevent decomposition (burning) of the mineral oil in contact with the heating surfaces.

It has now been found that this disadvantage can be completely obviated if the oil is distributed in the still in thin layers in such manner that the oil vapour is formed only at the surface of this layer, the same degree of vacuum being employed.

The beneficial effect of the new process can be explained by the fact that in the usual processes, a sufficient intermingling of the oil in the still cannot be obtained, in spite of the introduction of steam. If, however, according to the present invention, the oil is kept in motion in the still, by means of a suitable conveying device, in such a manner that a mist of oil is continuously formed in the space above the liquid level, the mixing is naturally rendered far more intimate, especially if care be taken to ensure that the circulation of the oil is most intensive in the vicinity of the heating surfaces. This circulating movement of the oil however affords also another very essential advantage.

In the known processes, the formation of oil vapour can only start in the vicinity of the heating surface. Above these there was generally a column of oil of 1.5–0.7 metres high, so that the formation of the oil vapour did not proceed under the vacuum prevailing in the still, but under a pressure constituted by a combination of the pressure corresponding to the vacuum in the still and of the pressure of the liquid column situated above the resulting bubbles of vapour.

According to the present invention, the formation of the oil vapour is transferred to the thin films of oil produced above the liquid level in the still, whilst the heating surface merely effects the heating of the oil, and no longer causes the formation of the oil vapour. In contradistinction to the known processes, the oil vapours are produced under a uniform pressure which corresponds to the vacuum present in the still.

Moreover by the introduction of the steam into the still, the pressure under which the formation of the oil vapour proceeds can be considerably reduced. This auxiliary steam is preferably employed simultaneously for the production of the thin films of oil, for example by conveying the oil in the still by means of this steam according to the principle of air-lift pump applied to liquids. The vacuum in the still can be further increased by forcing the aforesaid conveying steam or other auxiliary steam (after it has been freed from the oil vapours) into the steam condenser by means of conveying devices which produce an increase of pressure, (for example steam injectors).

In this case also, the vacuum in the steam condenser is that determined by the temperature of the cooling water.

The vacuum on the suction side of the steam injector apparatus, that is, in the oil-condensing plant and in the still, is however increased in accordance with the adjustment of the steam injector apparatus.

This embodiment of the invention is also advantageous in those cases in which the oil is not heated in stills but in tubular coils or the like and is evaporated in thin layers after distribution.

Thus it is possible, by this invention, to carry out the distillation under a higher vacuum than was hitherto attainable, and to reduce the distillation temperature correspond-

ingly, to below the vaporization temperature of the oil; so that the new process is also accompanied by less drastic treatment of the oil during distillation.

Although in previous processes it was theoretically possible to increase the introduction of steam into the oil under treatment to such an extent that the partial pressure of the oil vapours formed at the deepest points of the still was, for example, not more than the equivalent of 10 mm. of mercury. This procedure however, entailed using such large amounts of steam that the distillation became uneconomical as soon as the vacuum was reduced to below 20 mm. of mercury.

In carrying out the present invention, it is preferable to employ a still of such construction that the oil is raised to a high level and allowed to trickle down over heating surfaces arranged above the oil level; or the heating surfaces are placed in the oil and the heated oil is raised, allowed to run down plates on which the formation of the oil vapour takes place, and returned to the heating surfaces. Such agitating devices produce an exceedingly active circulation, so that the oil cannot burn or become superheated. Experience has shown that the amount of steam for this agitation, including the steam for operating the injector apparatus producing the high vacuum, amounts to only a fraction of the amount of distilling steam employed at present for reducing the partial pressure.

If, however, it is desired to economize with regard to the steam required for the agitating apparatus, the oil can be agitated by other devices, such, for example, as centrifugal pumps and the like, which pumps are preferably disposed outside the still. The most favourable arrangement from the economical point is to couple these agitating pumps direct to steam turbines, which for example expand the steam from 25 atmospheres down to about 10 atmospheres the steam at this pressure being admitted to the injecting apparatus for producing the high vacuum in the still.

The invention will hereinafter be more fully explained with reference to the accompanying drawings in which:—

Figs. 1 to 3 illustrate the methods of connecting up the parts in various embodiments of the invention.

In all the figures of the drawings a^1, a^2, a^3, . . . indicate stills which are in communication with the dephlegmators or oil condensers c^1, c^2, c^3 . . . by means of the conduits b^1, b^2, b^3, . . . The distilling or conveying steam is admitted to the stills through the conduits d^1, d^2, d^3. Closing and regulating valves are provided in the conduits b^1, b^2, b^3 . . . and d^1, d^2, d^3 . . .

Fig. 1 shows two different embodiments of the still. The vessels a^1 and a^3 are provided with the heating system e^1, e^3, disposed above the oil level. One or more agitating pumps, consisting of the upcast pipes g^1, g^3 into which the steam is introduced at h^1, h^3 and which may be provided at their upper ends with distributors i^1, i^3, lift the oil which is thereby uniformly distributed over the heating surfaces by means of the baffles k^1, k^3, down which it runs in order to be circulated anew. The preferred heating agent in this case consists of superheated steam. The apparatus a^2 is constructed as a flame-tube boiler, to be heated by flue gases. The agitating devices are arranged on both sides of the heating tubes, but, in other respects the design is similar to that of the stills a^1, a^3, the baffles k^2 being, however, so arranged that the oil is positively led back over the surface of the flame tubes. It is of course obvious that all stills in the same plant may be of the same construction.

The plant is operated in the following manner: The distilled oil vapours, admixed with agitating steam, pass through the conduits b^1, b^2, b^3 into the dephlegmators or condensers c^1, c^2, c^3. After deposition of the distillates in c^1, c^2, c^3, the steam is aspirated by the injectors l^1, l^2, l^3 (which are operated by live steam coming from the conduits m^1, m^2, m^3) and is condensed in the condensers which may be of any desired construction, for example surface condensers such as n^1, n^3 or as spray condensers n^2. Air is evacuated from the condensers n^1, n^2, n^3 by means of ordinary air pumps p^1, p^2, p^3. Instead of the individual condensers a common condenser can be employed, in which case all the steam condensers are connected thereto. r is the boiler for generating the working steam. The oil is conducted through all the stills in succession and treated in each until the desired fraction has distilled off.

The economy in steam obtained by the present process can be further increased by effecting the distillation in the individual stages under different degrees of vacuum, thus enabling the steam which has passed through a still to be utilized as driving or conveying steam in subsequent stills after the oil vapour has been removed by condensation. The vacuum can, for example, be so adjusted that the drop in pressure between two successive apparatus is equal to the losses in flow and the level of the oil in the previous still. In this embodiment of the invention it is only necessary to provide the last still with a steam injector for producing the high vacuum, as is shown diagrammatically in Fig. 2.

The working steam is introduced into the first still a^1 at d^1, and after the oil vapours (which must naturally have a higher boiling point than water) have been separated in the condenser c^1, the steam is passed through the conduit d^2 into the next still a^2. The absolute pressure is for example, 750 mm. of mercury in a^1, and 600 mm. in a^2,

above the oil level. After the oil distillates from the still a^2 have been condensed in the condenser c^2, the steam is admitted through the conduit d^3 to the still a^3, and so on. The last still a^5 is provided with a high-vacuum steam injector s which forces the vapours into the condenser t in which the air pump u maintains normal vacuum. w is the live steam conduit for the injector apparatus s.

The economy of steam as compared with the embodiment illustrated in Fig. 1 in which all stills work under a constant degree of vacuum, can also be obtained with the arrangement shown in Fig. 3. In this embodiment the steam conveyed by the steam injector apparatus v^1, v^2, v^3 from the condenser c^1, c^2, c^3 is condensed in the condensers y. However, live steam is admitted to only one of the stills, for example, a^3, through the conduit d^3. The mixture of steam and oil vapour passes through the conduit b^3 into the condenser c^3 in which the oil vapour is condensed, and from which steam alone is aspirated by the injector apparatus v^3. Part of the steam is drawn off from the collecting conduit z to the condenser y and another portion is admitted to the still a^2. From the still a^2 the vapours are passed (again under high vacuum) through the conduit b^2 to the condenser c^2. The steam injector v^2 aspirates the mixture of oil and water vapour and conveys part of the steam, as above described into the still a^1. The condenser y is connected with an air pump x.

For the purpose of preventing losses due to the prevalence of excessively high temperatures in the still, the heating can be effected in all embodiments for example, by means of highly superheated steam at 450° C., which circulates between the heating system of the stills and a superheater.

In addition to the above-described arrangements a series of other arrangements are possible without departing from the spirit and scope of the invention as defined in the appended claims, so that the process can be adapted to all special local conditions as well as to the condition of the oil to be distilled.

What I claim is:

1. In a process for the vacuum distillation of mineral oils in heated stills which comprises continuously elevating the heated oil from the lower part of the still into the vapor space of the still by means of steam, finely dividing the oil in said vapor space under a vacuum, and condensing the oil from the resulting mixture of vaporized oil and steam without any substantial condensation of the steam, the improvement which comprises maintaining the vacuum in said still by steam injecting the uncondensed steam into a condenser.

2. In a process for the vacuum distillation of mineral oil in a plurality of serially arranged heated stills under successively increasing degrees of vacuum which comprises continuously elevating the heated oil from the lower part of the still into the vapor space of the still by means of steam, finely dividing the oil in said vapor space under a vacuum, and condensing the oil from the resulting mixture of vaporized oil and steam without any substantial condensation of the steam, the improvement which comprises elevating the oil in the successive stills by means of the uncondensed steam from the preceding still and maintaining the vacuum in said stills by steam injecting the uncondensed steam from the last still of the series into a condenser.

3. In a process for the vacuum distillation of mineral oil in a plurality of serially arranged heated stills under successively increasing degrees of vacuum which comprises continuously elevating the heated oil from the lower part of the still into the vapor space of the still by means of steam, finely dividing the oil in said vapor space under a vacuum, and condensing the oil from the resulting mixture of vaporized oil and steam without any substantial condensation of the steam, the improvement which comprises elevating the oil in the successive stills by steam injecting into it at least a portion of the uncondensed steam from the preceding still and maintaining the vacuum in said stills by steam injecting the uncondensed steam from the last still of the series into a condenser.

In testimony whereof I affix my signature.

MAX GENSECKE.