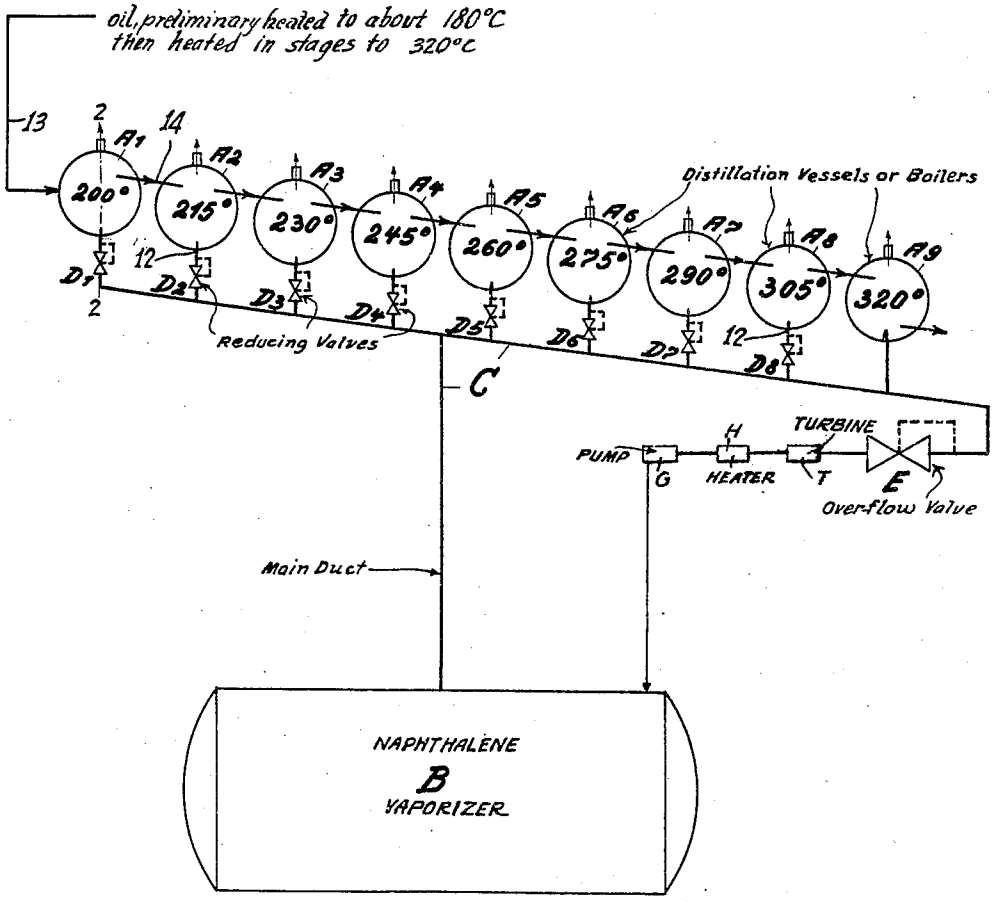
Nov. 21, 1933. E. DAUB 1,936,293

HEAT EXCHANGER

Filed Dec. 21, 1929 2 Sheets-Sheet 1

Fig. 1



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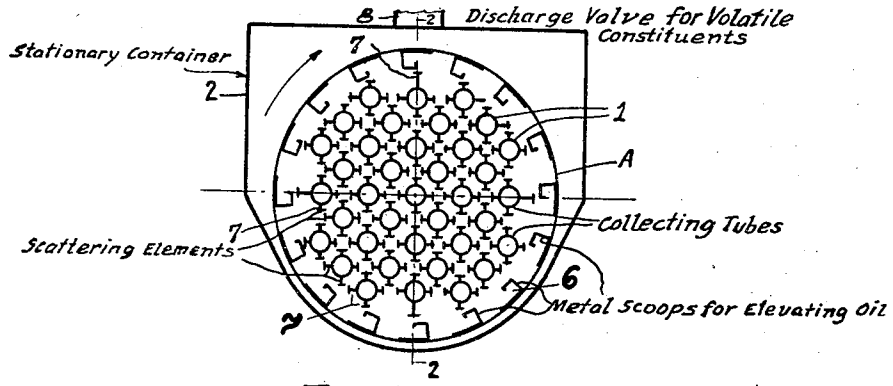


Fig. 3.

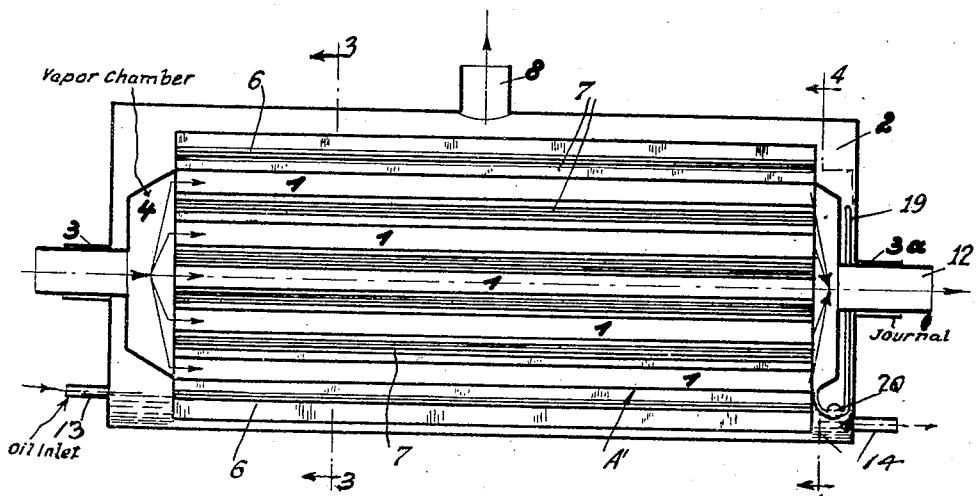
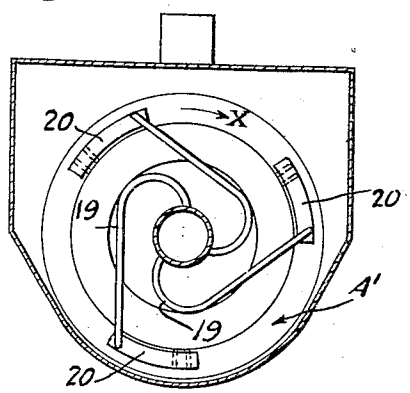


Fig. 2.

Fig. 4.



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Patented Nov. 21, 1933 1,936,293

UNITED STATES PATENT OFFICE

1,936,293

HEAT EXCHANGER

Ernst Daub, Dortmund, Germany

Application December 21, 1929, Serial No. 415,702, and in Germany March 19, 1927

4 Claims. (Cl. 257—79)

This invention relates to the heating of substances in the solid, liquid and gaseous states by the heat of condensation of heating media preferably naphthalene having a lower specific heat of condensation and a higher boiling point than water. The object of the invention is to provide means whereby naphthalene, or other substance having similar properties, may be used in industrial or chemical processes for bringing any solid, liquid or gaseous substances to a desired temperature and for maintaining said temperature constant.

The drawings illustrate diagrammatically means for heating a substance to a desired temperature.

Figure 1 shows diagrammatically a distillation plant for stepwise distillation employing the present process, illustrating by way of example a manner of regulating the temperature during the working up of the oil in the more difficult cases; Fig. 2 shows a sectional elevation along lines 2—2 of Figs. 1 and 3; Fig. 3, a cross section of a boiler taken along line 3—3 of Fig. 2; and Fig. 4 is a similar section along line 4—4 of Fig. 2.

The distillation vessels or "boilers" A_1 to A_9, see particularly Figures 2 to 4, through which the oil flows under gravity, have a temperature difference of about 15° C. In a naphthalene vapourizer B naphthalene vapour is produced having a pressure corresponding to the requirements of the highest heating stage. The naphthalene vapour enters a common main duct C with this pressure and passes directly to the heating system of the 320° C. vessel, A_9, through the conduit C. On the other hand, the naphthalene vapour, before entering the other vessels or boilers A_1 to A_8 of the system has its pressure reduced by throttling it down by means of the reducing valves D_1 to D_8 in the inlet pipes 12. The reducing valves may be controlled automatically in such a way that the pressure necessary for the different vessels is always ensured. In order that no excess pressure may be formed in the main conduit, the naphthalene vapour flows out through an overflow valve E at such a rate that the pressure in the main conduit described above, always remains constant. The overflow valve E is controlled automatically by the pressure of the main conduit. The overflowing naphthalene vapour may be utilized with advantage in different ways. For example it can drive a turbine by expansion and so produce electric current and subsequently be used for preliminarily heating the oil or for producing steam or it may be used directly for heating. The intermediate insertion of naphthalene vapour or steam accumulators may be recommended. For conducting the whole process it is only necessary, therefore, that the naphthalene vaporizing plant ensures that at least the pressure of the main conduit is maintained, which is not difficult to attain. The condensed naphthalene is returned by a pump G to the vapourizer B.

When the quantities to be worked up are not so large that the use of a series of separate vessels is justified, the stepwise distillation may also be carried out in a single apparatus.

Referring to Figures 2 and 3, the boiler comprises a collection of tubes, 1 rotatably mounted in journals 3 and 3a in a stationary container 2. The heating vapour enters through the trunnion 3, spreads out in a chamber 4 in open communication with the tubes 1, flows through the latter wholly or partially condensing therein. Partial condensation enables larger quantities of fresh vapour to be supplied and therefore yields greater throughputs. After flowing through the tubes 1, the heating vapour is led away through the trunnion 3a and the condensate is collected in the tubular member 20 and delivered by pipes 19 into the hollow trunnion 3a through which it flows into the next boiler A_2 and so on through the entire battery of boilers. The oil is introduced into the chamber 2 of boiler A_1 at 13 and flows in series through all the boilers from A_1 to A_9. The level of the oil in the several boilers can be regulated by the height of the oil exit. By means of sheet metal scoops, cups, or similar ladling devices 6, which surround the collection of tubes in a suitable manner and are connected therewith (they may also be replaced by other devices, e. g. such which spray up the oil) the oil is elevated owing to the rotation of the tube nest and is distributed on the heated scattering structure 7. The T-shaped members 7 also assist in elevating the liquid. The constituents which become volatile are drawn off through an outlet 8 provided with a valve, which permits the pressure to be regulated, rectified (i. e. separated into two fractions) or condensed by cooling, to form the first finished product.

The interior constructiton of the boiler or treatment vessel as well as the oil supply and discharge therefrom is best shown in Figures 2, 3 and 4. The condensate from the entire battery of boilers is forced into the vaporizer B by means of a pump G.

The naphthalene vapour flowing over out of the main pipe valve E passes either into a turbine

T or a heat exchange apparatus H or into a steam storage vessel and from there, according to circumstances, is forced back into the vapourizer B as condensate or even as vapour. The inlet supply pipe 13 for feeding oil into the individual vessel A_1 lies at the side of the vessel opposite the oil outflow 14, so that the oil must flow through the vessel A_1 through its entire length. In the example the vessels are illustrated as simply as possible in order to simplify the showing.

In Figure 4 the bent tubes 19 are shown which carry away the condensate. At the lowest point of the vessel, the condensate is emptied into the members 20 and it flows during the rotation of the tube nests in the direction of the arrow X through the bent tubes 19 and into the hollow trunnion 3*a*.

What I claim is:

1. An apparatus for heating solid, liquid or gaseous substances, comprising a rotary tubular apparatus having a tube system rotatably mounted in a closed space adapted to utilize the heat of condensation from elements having a lower specific heat of condensation and a higher boiling point than water, the said tube system being provided with means for raising and scattering the substances under treatment and with collecting means adapted to distribute the substances on the said scattering means.

2. An apparatus according to claim 1, in which said raising means comprises ladle elements on the tube system.

3. An apparatus according to claim 1 in which said scattering means comprises radially directed T-shaped elements on the tubes.

4. An apparatus according to claim 1 in which said raising and scattering means comprise ladle elements and T-shaped members in the tube system.

ERNST DAUB.