

June 26, 1928.

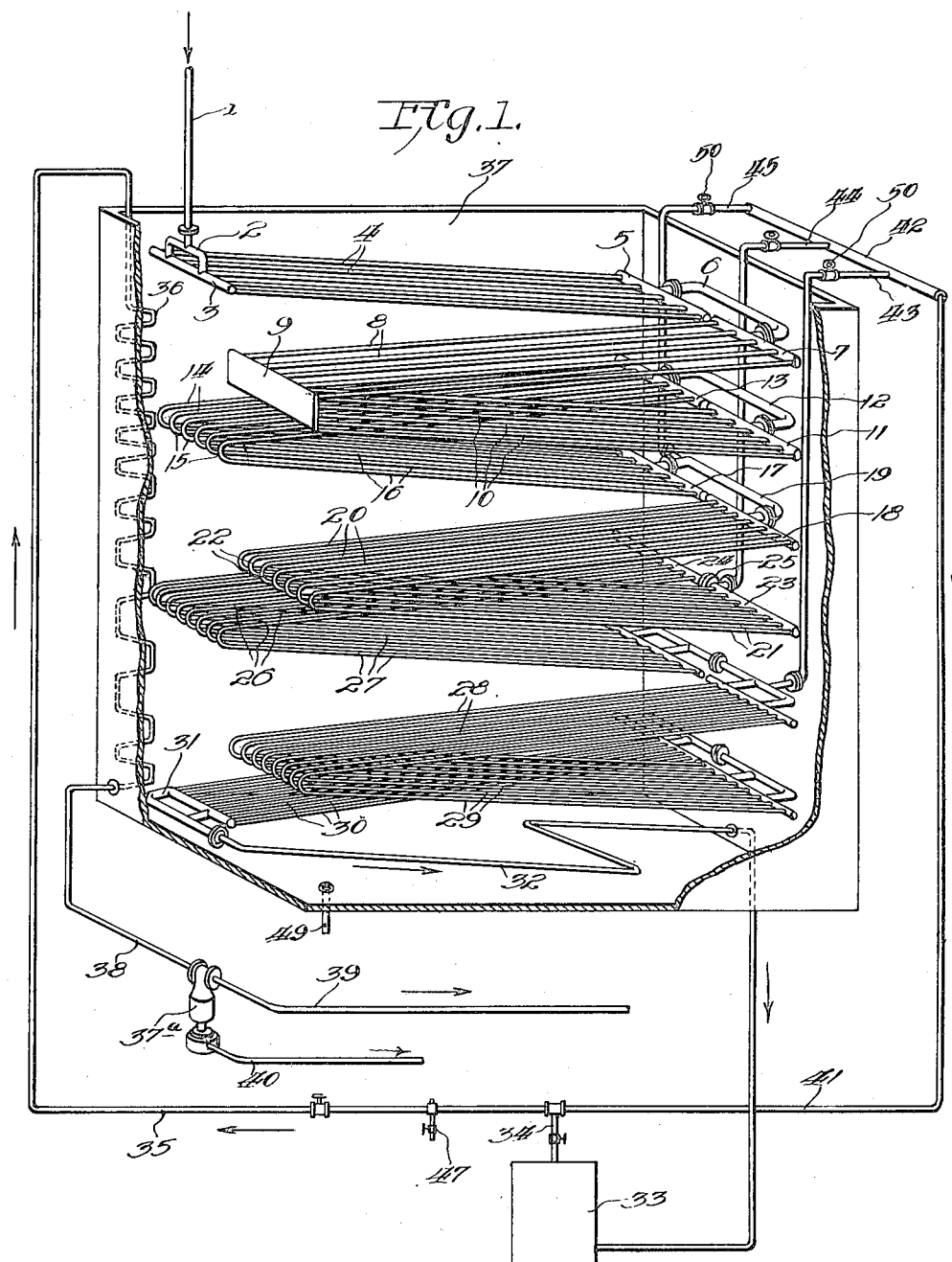
1,674,850

A. G. BOGARDUS

CONDENSER

Original Filed Dec. 26, 1922

3 Sheets-Sheet 1



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3 Sheets-Sheet 2

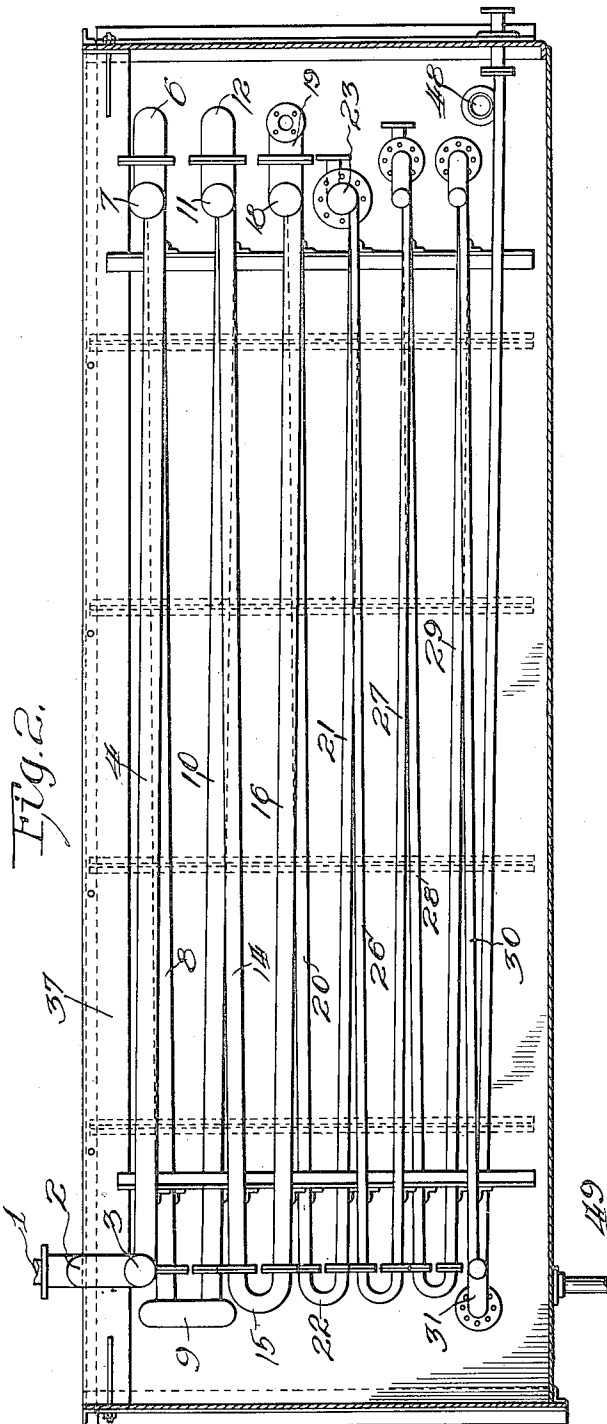


Fig. 2.

Fig. 4.

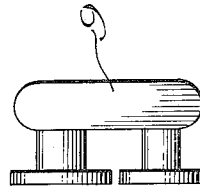
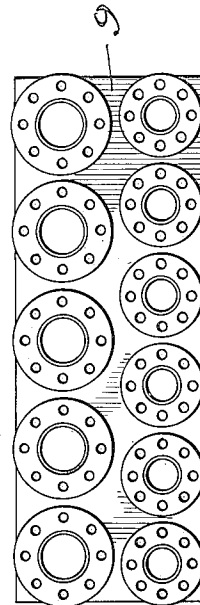


Fig. 3.



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Fig. 5.

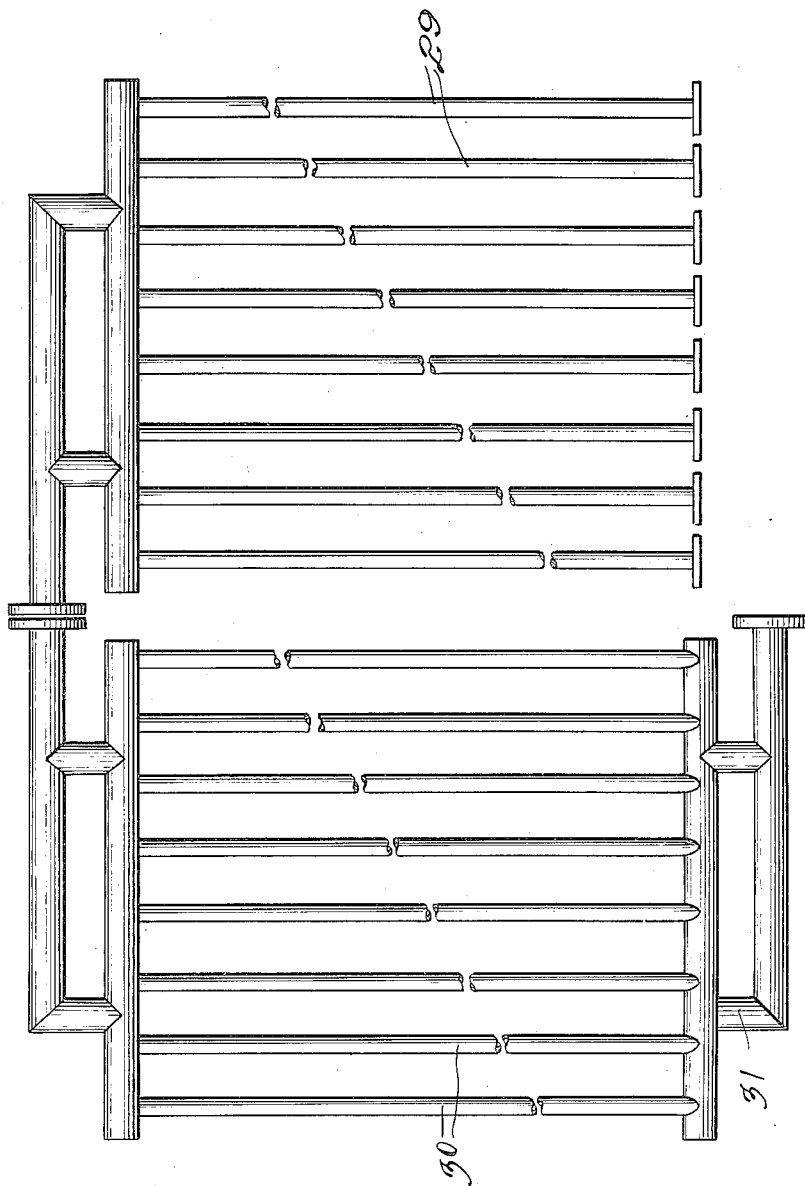


Fig. 6.



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UNITED STATES PATENT OFFICE.

ARTHUR G. BOGARDUS, OF CHICAGO, ILLINOIS, ASSIGNOR TO UNIVERSAL OIL PRODUCTS COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF SOUTH DAKOTA.

CONDENSER.

Application filed December 26, 1922, Serial No. 608,810. Renewed January 13, 1928.

This invention relates to improvements in condensers and refers more particularly to a condenser particularly adapted for the treatment of heated vapors such as those generated and evolved in the distillation or cracking of hydrocarbon oil. The condenser however, may be used for liquefying vapors of any kind with equal effectiveness.

Among the salient objects of the invention are to provide a condenser in which the cross section area is greatly increased over the common type of coil condenser, and one in which by the use of an increased number of tubes with connecting headers, shorter lengths may be employed and the pitch of the separate flights increased, the latter being an important factor in the rapidity of flow and in the draining of the tubes; to provide a condenser in which the obstructive gases are removed at separate levels whereby back pressure is minimized, and the velocity of the liquid's passage through the tubes substantially increased; to provide a condenser in which the surface exposure of the tubes through which the vapors pass to the cooling medium is greatly increased, and in general to provide a condenser of the character referred to.

Fig. 1 is a diagrammatic elevational view of the condenser, the outside box portion being broken away to disclose the positioning of the tubes and headers.

Fig. 2 is a side view of the apparatus with one side of the box removed showing the positioning of the coils.

Fig. 3 is a detail of the elongated header.

Fig. 4 is an end view of the header shown in Fig. 3, and Fig. 5 is a detail view of the header and tube construction showing the cross-over transfer pipes.

Fig. 6 is a side view of the construction shown in Fig. 5.

Referring to the drawings, the vapors to be condensed are introduced through the pipe 1 which is connected to a Y connection 2 communicating with a header 3. Into this header are welded the tubes 4 which are pitched downwardly and terminate in a second header 5. The header 5 has connection through the transfer pipe 6 with a similar header 7 which is in turn connected by the tubes 8 with the elongated header 9 shown in detail in Fig. 3, the tubes 8 having flanged connections with the header 9, five tubes connecting to the upper portion of

the header, and six tubes of small diameter connected to the bottom portion of the header. The six tubes connected to this bottom portion of the header designated by the numeral 10 in Fig. 1 terminate in the header 11 which communicates through the transfer line 12 with a second header 13 positioned at the same level as the header 11, and directly adjoining it on the opposite side of the condenser box. To the header 13 are connected six tubes 14 which are connected by return bends 15 to the six tubes of the next lower flight 16 communicating with the header 17. In a like manner the header 17 is connected to the header 18 by transfer line 19, and in the same manner the tubes 20 connected to the header 18 connect to the lower tubes 21 through the return bends 22. The tubes in the flight 21 are connected to a header 23 which is elongated to form a header 24 on the opposite side of the condenser box. The two headers are joined by flange connections 25. Thus other flights of tubes 26, 27, 28, 29 and 30 succeed the upper flights, and are connected in the headers and by transfer lines in a similar manner.

The tubes in the final or lowest flight 30 are connected to a header 31 which in turn has connection with the outlet pipe 32 by means of which the liquid distillate or condensate is directed to the receiving tank or other type of collecting means 33. A pressure relief pipe 34 is connected into the top of the collecting tank, and this pipe has connection through a line 35 to a zigzag pipe or coil 36 positioned in the condenser box near the banks of tubes and serves to liquefy any vapors which may be mixed with the uncondensable gas. A separator 37^a is positioned in the discharge line 38 of this zigzag tube or coil whereby the gas is directed through the line 39 while the liquid portion is drawn off through the pipe 40. Valves may be positioned at any convenient portions of these lines to control the flow of the liquid and gases. An equalizing gas line 41 connects to the header 42 which also communicates through the separate lines 43, 44 and 45 with headers at different levels, or with the different flights of the tubes. The purpose of these connecting pipes and equalizing gas lines is to maintain an equal pressure upon the different portions of the condenser thereby preventing accumulation of gases or vapors in the isolated portion of

the apparatus, and producing back pressure which tends to retard the flow and decrease the efficiency of the apparatus. Heretofore, the condensation of the vapors has been materially hampered by the building up of back pressure in a condensing apparatus, and reducing to a considerable extent the volume of vapors which it is possible to treat in this type of apparatus.

- 10 It is obvious from the diagrammatic view that an increased volume of vapors may be caused to circulate through a plurality of tubes in place of the single coil now commonly employed in condensing devices.
- 15 Also, the use of a plurality of tubes permits an increased gradient or pitch to the tubes which facilitates the flow of the liquids which are condensed in the apparatus.

In the device shown, the tubes in the first bank of tubes are of relatively large cross section the arrangement being such that the tubes decrease in diameter and increase in number down to the lower flight or banks where the tubes are of smaller cross section terminating in a single pipe which leads to the receiver or collector.

There are a number of factors which are variables, namely the cross section of the different flights according to the amount of vapors and gases to be treated, the number of tubes used in each flight, the character of the headers or return bends which will vary according to the cheapness of manufacture. Further, the positioning of the equalizing gas lines may be varied, that is, these gas lines may be tapped into the headers where they most effectively remove gases or vapors producing back pressure, and the entire contour or size of the condenser box together with the length of the tubes will obviously vary with the size of the apparatus to which it is connected, and the character of the vapors and gases to be treated.

It will be noted that it has been necessary in certain cases to depart from the scale of the drawings to show the details of the apparatus. The different sizes of the tubes could not be effectively shown in the diagrammatic view, nor could the collecting means or gas separator be kept to scale.

A further novelty of the device is the method of connecting the tubes to the headers, as shown in Fig. 6. The tubes as shown are welded on a tangent to the header so that there is no pocketing of small quantities of the liquid in the headers when the apparatus is drained.

A thermometer 47 is connected to the pipe 35 for ascertaining the temperature of the vapors, and a similar device may be used in the inlet line 1, if desired.

The cooling medium is introduced into the condenser box through the pipe 48 and drained through the line 49. Valves 50 are positioned in the gas lines 43, 44 and 45 for

regulating the gas escape from the separate headers. Under light load, gas will normally be relieved from the upper headers, and as the load is increased, gas may be removed from subsequent or lower headers such as those connected to the pipes 43 and 44.

The condenser may be used under atmospheric or superatmospheric pressure with equal effectiveness and lends itself admirably to the condensation of oil vapors due to the unobstructive flow and steep pitch or gradient of the tubes.

I claim as my invention:

1. A condenser for liquefying hydrocarbon oil vapors, consisting in a container through which a cooling medium is passed, cooling tubes positioned between headers and arranged in banks serially connected, said banks inclined downwardly, a discharge line connected to the final header and relief gas lines interposed at predetermined intervals adapted to prevent the accumulation of gas pockets during condensation.

2. A condenser of the character described, consisting in a container through which a cooling medium is circulated, a plurality of banks of tubes comprising headers with tubes connected therebetween, serially connected, said banks inclined and positioned in zigzag relation, gas lines for relieving the banks of gas accumulations at different levels, and a discharge line connected to the final header.

3. A condenser of the character described, consisting in a container through which a cooling medium is circulated, a plurality of banks of tubes comprising headers with tubes connected therebetween, serially connected, the tubes of said banks diminishing in cross section at a predetermined ratio and inclined to facilitate the flow of the condensed liquids.

4. A condenser of the character described, consisting in a container through which a cooling medium is circulated, a plurality of banks of tubes comprising headers with tubes connected therebetween serially connected, the tubes of succeeding banks diminishing in cross section and increasing in number at a predetermined ratio, and inclined downwardly to facilitate the flow of the condensed liquids.

5. A condenser for liquefying hydrocarbon oil vapors comprising a container through which a cooling medium is passed, cooling tubes forming a conduit, for the vapors, extending downwardly through said container, gas outlet lines communicating with said conduit at predetermined intervals in its length to permit the escape of gas from the conduit and thereby prevent the formation of gas pockets in the conduit during condensation.

ARTHUR G. BOGARDUS.