April 2, 1940. M. H. KOTZEBUE 2,195,887

FRACTIONAL CONDENSER

Filed Feb. 5, 1937 3 Sheets-Sheet 1

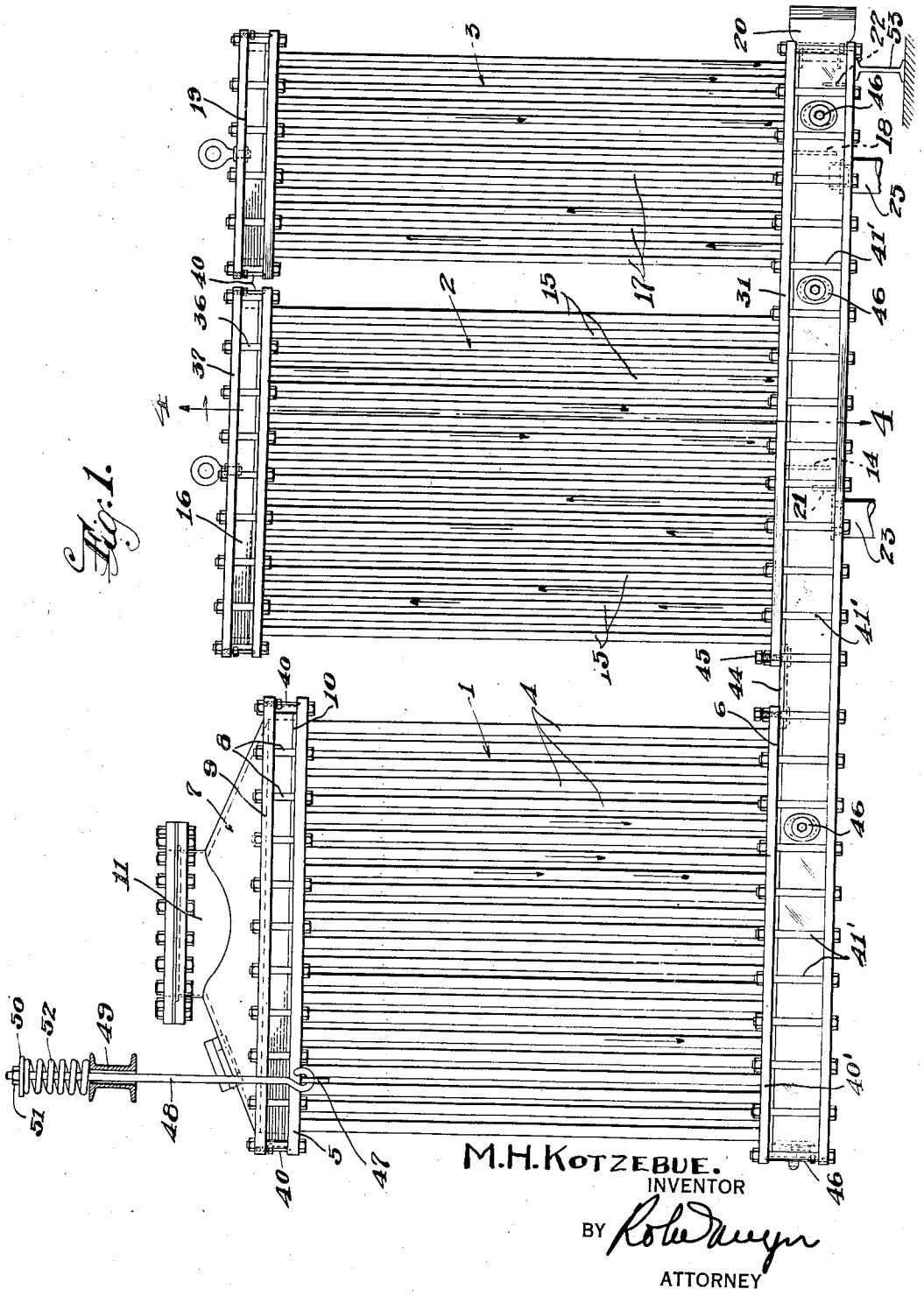


Fig. 1.

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Filed Feb. 5, 1937 3 Sheets-Sheet 2

Fig. 2.

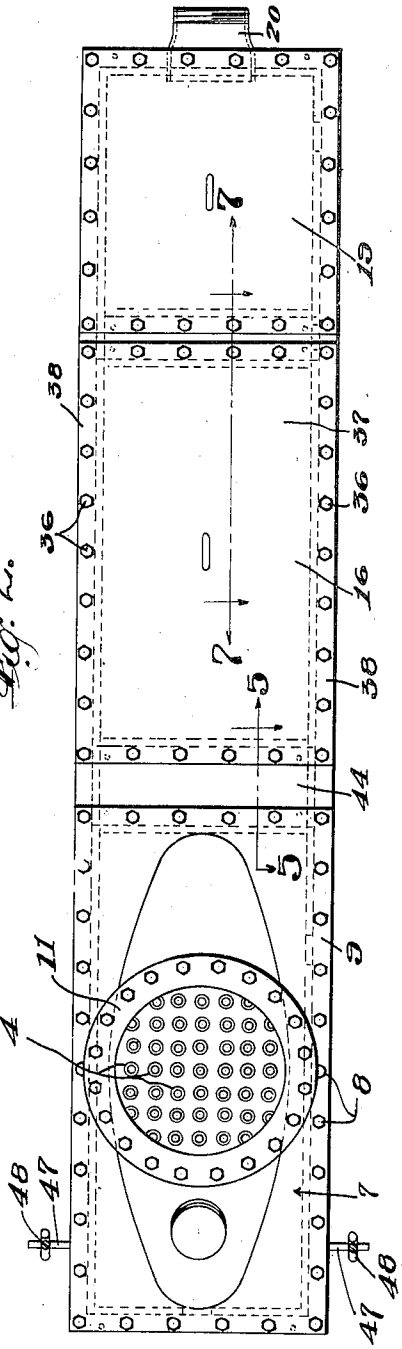
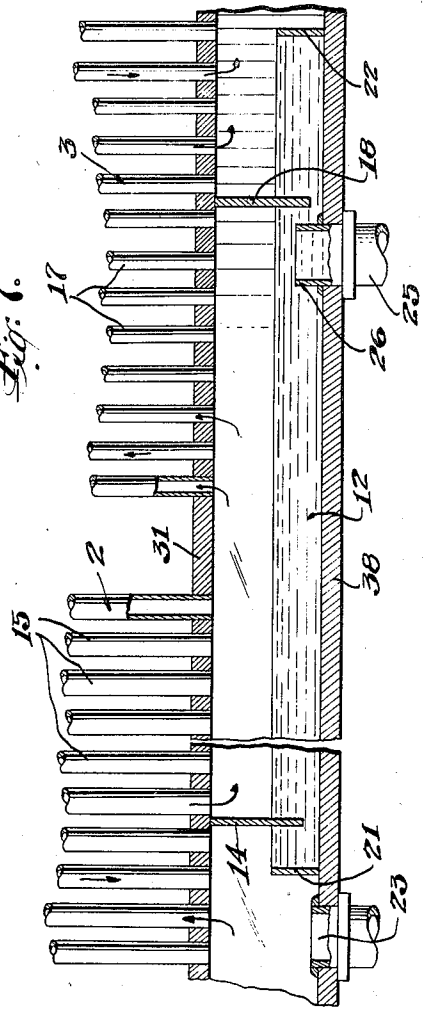


Fig. 7.



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Filed Feb. 5, 1937 3 Sheets-Sheet 3

Fig. 3.

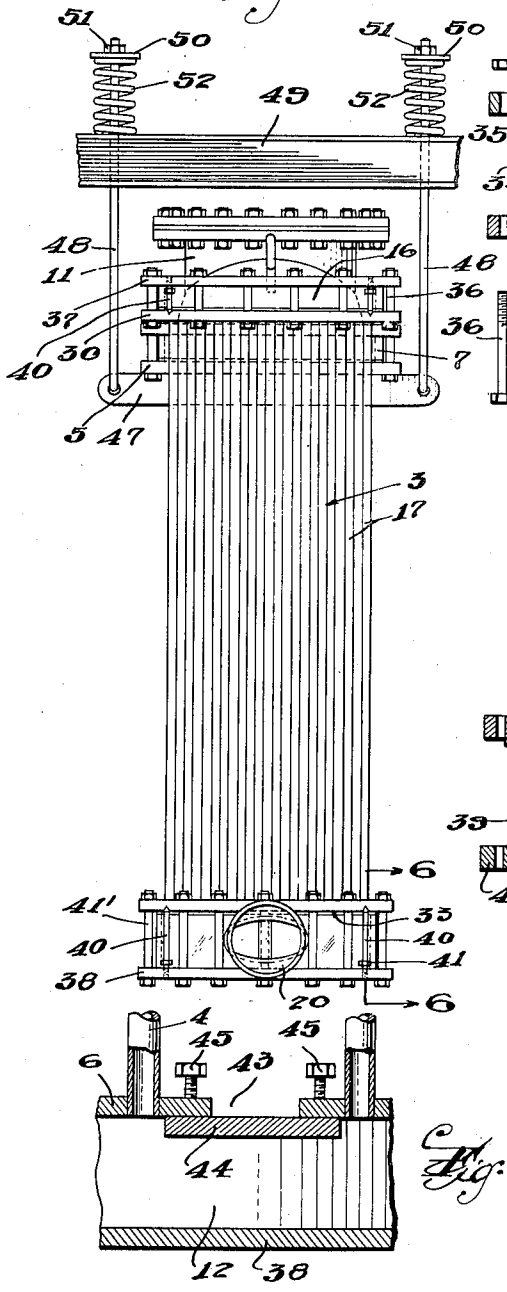


Fig. 4.

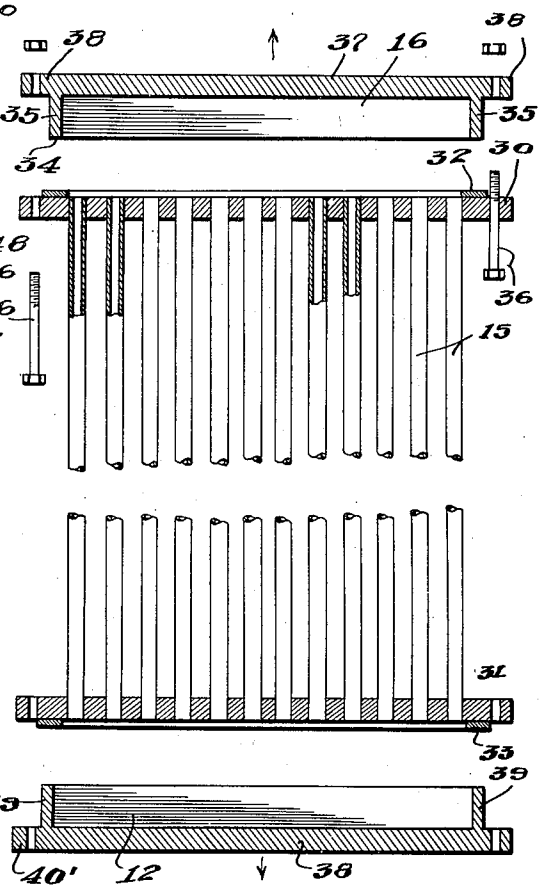


Fig. 5.

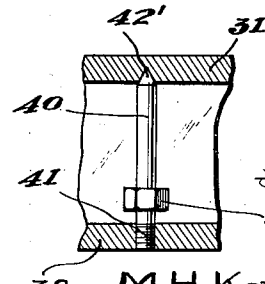


Fig. 6

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UNITED STATES PATENT OFFICE

2,195,887

FRACTIONAL CONDENSER

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Application February 5, 1937, Serial No. 124,247

3 Claims. (Cl. 257—42)

This invention relates to condensers, and more particularly to fractional condensers for use in the refining of petroleum.

An object of the present invention is to provide a condenser in which the flow of the fluid to be condensed is in vertical paths through the tubes resulting in a lower pressure drop in the fluid during its passage through the condenser, and one in which the tubes and liquid boxes or heads are arranged whereby the liquid condensed is collected for predetermined numbers of passes of the condenser permitting the operation of the fractions of the fluid treated and the drawing off of the heavy fractions or rather the high boiling point hydro-carbons or liquids first. This saves subsequent processing and retains more heat in the liquid than would be the case if such fractions passed through the entire condenser structure, and since in petroleum fractionating, this usually goes to a cracking furnace, it results in a saving of fuel required for reheating.

Also, by providing a fractional condenser as specified, the withdrawal of the higher boiling point hydro-carbons or liquids at the terminus of intermediate passes of the condenser results in a reduced quantity of fluid passing through the subsequent passes of the condenser which in turn permits the use of smaller diameter tubes in the subsequent passes and results not only in a saving in cost of the condenser but in the quantity of cooling water required in the condenser operation.

Another object of the invention is the provision of yieldable supporting means such as springs at the inlet end of the condenser, the expansion and contraction of which compensates for expansion and contraction under temperature variances of the tubes of the condenser, and also of the feed pipe line to the condenser and eliminates the need of expensive expansion joints in the condenser installation.

A further object of the present invention is to provide a fractional condenser as specified which, owing to the vertical positioning of the tubes and the manner of connecting the fluid boxes to the tube heads renders the tubes easily accessible for cleaning, both inside and outside, and materially reduces both the labor and expense required for cleaning the tubes.

With these and other objects in view, as may appear from the accompanying specification, the invention consists of various features of construction and combination of parts, which will be first described in connection with the accompanying drawings, showing a fractional condenser of the preferred form embodying the invention, and the features forming the invention will be specifically pointed out in the claims.

In the drawings:

Figure 1 is a side elevation of the improved fractional condenser.

Figure 2 is a top plan of the improved fractional condenser.

Figure 3 is an end elevation of the fractional condenser.

Figure 4 is a fragmentary view partly in section and partly in elevation of the condenser showing certain of the parts separated.

Figure 5 is a detail cross section taken on the line 5—5 of Figure 2.

Figure 6 is a detail section taken on the line 6—6 of Figure 3.

Figure 7 is a fragmentary section taken on the line 7—7 of Figure 2.

Referring more particularly to the drawings, the improved fractional condenser which is particularly designed for use in the condensing of petroleum products, but which is also applicable for various other uses in the condensing of gases, vapors, or the like, comprises a plurality of sections 1, 2, and 3, arranged in any suitable manner and connected so that the fluid or vapors to be condensed will pass in a multiplicity of passes through the condenser for effecting thorough, complete, and economical condensation thereof. The first section 1, which is the inlet section comprising a plurality of tubes 4 of uniform diameter which are carried by or connected to tube heads 5 and 6. The inlet header or vapor box 7 is removably attached to the upper inlet end of the section 1 through the medium of bolts 8 which extend through the flange 9 on the header 7 and the tube head 5. A gasket 10 is positioned between the meeting surfaces of the inlet header 7 and the tube head 5. The inlet header or box 7 has a flanged connection 11 formed centrally thereon by means of which the feed line which delivers the vapor, etc., to be condensed, to the condenser, is connected. As clearly shown in the drawings, the tubes 4 extend vertically and their lower ends are attached to the lower tube head 6 and they open out into the return and collection header or box 12. The collection and return header 12 extends throughout the full length of the fractional condenser structure, whereas the inlet header 7 extends only over the inlet ends of the tubes 4 of the inlet section 1 of the condenser. A partition 14 projects downwardly into the collection and return header 12 intermediate of the width of the section 2 of the

fractional condenser and provides a division plate whereby the vapors which are uncondensed during the passage through the first or inlet section 1 will be directed upwardly through substantially one-half of the tubes in the second section 2. The vapors passing upwardly through the portion of the tubes 15 of the section 2 enter the header or box 16 and pass therethrough to and downwardly through the remaining tubes in the section 2 thereby providing two passes for the vapors to be condensed through the section 2 of the condenser. From the return tubes 15 of the section 2 of the condenser, the uncondensed vapors pass again into the collection and return header 12 and from thence upwardly through a part of the tubes 17 of the section 3, being directed upwardly into these tubes by the partition 18 which extends downwardly into the return and collection header 12. The uncondensed vapors passing upwardly through a portion of the tubes 17 pass into and laterally through the header 19 at the upper end of the section 3 and return through the outermost tubes 17 to the collection and return header 12. The condenser is so constructed that practically all of the vapor fluid or the like delivered thereto at the inlet 11 will be condensed either before it reaches the last downward pass of the section 3 or in this pass, however, if any vapors or gases are not so condensed, they are drawn off, or pass outwardly from the collection and return box 12 through the outlet 20.

The tubes 4, 15 and 17 are all arranged vertically so that the condensation will fall or pass downwardly therethrough concurrent to the flow of the vapors and gases and collect in the collection and return header 12.

The collection and return header 12 is provided with means whereby the fractional condensate may be withdrawn from different sections or portions of the collection and return header 12, thereby permitting the drawing off of the high boiling point hydro-carbons or liquids first, which saves subsequent processing, retains more heat in the condensed liquid withdrawn, eliminates the necessity of passing all of the condensate completely through the return header and refractionating or separating the constituents of different boiling points, and reduces the quantity of cooling water required. Also, it permits the passing directly to a cracking furnace of the heavy fractions or high boiling point hydro-carbons with a resultant savings in fuel required for reheating the hydro-carbons. To permit the withdrawal of the condensate from different sections of the return and collection header, dams 21 and 22 are placed in the collection and return header 12 and extend upwardly from the bottom thereof. The first dam 21 is preferably placed a short distance forwardly of the deflecting partition 14 and an outlet 23 is provided directly in advance of the dam 21; thus the hydro-carbons having the higher boiling point may be withdrawn from the collection and return header as they are condensed in the inlet section 1 and the first or upward pass of the second section 2 of the fractional condenser. The dams 21 and 22 cooperate to form a condensate retaining portion intermediate the inlet and outlet ends of the return and collection header 12. A predetermined level of liquid or condensate in the space between the dams 21 and 22 is provided by the fact that the take-off outlet 25 projects upwardly into the return and collection box 12 as clearly shown at 26 in Figure 7 of the drawings. The level of liquid in the collection space between the dams 21 and 22 is maintained above the lower edges of the deflecting partitions 14 and 18, so as to provide liquid seals to prevent the by-passing of vapors through the collection and return box 12 to the outlet 20, and consequently to insure the proper flow of the vapors to be condensed through the tubes of the various sections 2 and 3. While only three sections are disclosed in the present fractional condenser, it is to be understood that any number of sections having any desired number of passes may be provided without departing from the spirit of the present invention.

The improved fractional condenser is constructed so that it may be cheaply and economically manufactured, and quickly, easily and cheaply assembled, and in Figure 4 of the drawings, a vertical cross section through the condenser is shown, showing the various parts disassembled and in proper relation for assembly. This view shows a cross section through one of the sections of the condenser other than the inlet or first section 1, as for instance, through the section 2 on the line 4—4. The tubes 15 are attached in any approved manner to the tube sheets or tube heads 30 and 31, and gaskets 32 and 33 are placed against the outer sides of the tube heads. The inner edges 34 of the flanges 35, which form the side walls of the head 16 engage against the gasket 32 and are clamped there against by means of the attaching bolts 36 for securely clamping the header forming member upon the tube head 30. As clearly shown in the drawings, the header forming member 37 which cooperates with the tube head 30 to form the header 16 has flanges 38 thereon which project beyond the flanges 35 to provide bolt receiving portions. The collection and return header or box 12 is similarly constructed, that is, it comprises the bottom 38 and the upstanding flanges 39 which engage against the gasket 33 and the flanges 40 which receive the bolts 41 for securely connecting the collection and return box structure 12 to the lower tube head 31. From this view it will be seen that the construction and assembly of the various sections of the condenser is quite simple and it is to be understood that all of the sections are constructed in the same manner as shown in Figure 4. Spreader bolts 40 are provided which may be connected by threads as shown at 41 to the flanges 38 or 40. These spreader bolts have nut heads 42 formed thereon to facilitate their threading into the flanges 38 or 40 and their ends opposite to the threaded ends 41 are preferably pointed as shown at 42' for engagement with the respective tube heads 31 and 30. These spreader bolts 40 are pointed to protect the gaskets 32 and 33 during the assembly of the fractional condenser or during the removing of the tube bundles, by leaving a clearance space between the edges of the flanges 34 and 39 and the respective tube heads 30 and 31, which permits the gaskets to be put into place and the head or box-forming castings may then be slowly lowered into position by adjustment of the spreader bolts 40.

The return and collection box 12 will have an open space on its upper side between the first inlet section 1 and the next section of the fractional condenser due to the fact that the tube head 6 does not extend across to the second section 2. This space which is shown at 43 in Figure 5 of the drawings is closed by a removable plate 44 which is attached to the respective tube heads 6 and 31 by bolts 45. This plate is detachably connected

to the tube heads 6 and 31 so as to permit its disconnection when it is desired to re-tube the condenser.

Suitable man-holes are provided to permit access to the interior of the collection and return box 12 and these man-holes are closed by approved type removable man-hole covers 46.

The present invention comprehends simple, efficient and inexpensive means to compensate for expansion and contraction in the tubes and piping connections of the condenser under heat variances, during operation, and this structure comprises a supporting bar 47 which is removably inserted between certain of the tubes near the outermost end of the inlet section 1 and it engages against the under side of the tube head or sheet 5, as clearly shown in Figures 1 and 3 of the drawings. Suspending rods 48 are detachably connected to the ends of the bar 47 and they extend upwardly through a suitable girder or support 49, extending therethrough and having plates 50 mounted on their upper ends and held against movement off the ends of the suspending rods 48 by nuts 51. Suspension springs 52 are mounted about the rods 48 between the plates 50 and the rigid support 49, so as to provide yieldable support for the inlet section of the fractional condenser. The outlet end of the fractional condenser is supported upon a suitable rigid support 53. Expansion and contraction in the tubes and in the inlet or feed pipe to the fractional condenser will be compensated for by swinging movement of the fractional condenser permitted by the yieldable suspension thereof through the medium of the rods 48 and the springs 52.

The improved fractional condenser may be submerged in a tank (not shown) through which the cooling water is circulated or it may have the cooling water projected directly against its tubes, as conditions at the point of installation require.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. In a fractional condenser, a plurality of vertical tubes, upper and lower fluid boxes at the upper and lower ends of the tubes, means in the lower fluid box for causing fluid to pass through the tubes in a plurality of passes, said lower fluid box receiving condensate from the tubes, means in the lower fluid box segregating the condensate from certain of the fluid passes, an outlet whereby the segregated condensate from the intermediate fluid passes of the condenser may be withdrawn independently of the condensate from other passes and means co-operating with said outlet to maintain a higher level of condensate in the portion of said fluid box receiving condensate from said intermediate fluid passes.

2. In a fractional condenser, a plurality of vertical tubes arranged in groups, upper fluid boxes at the upper ends of said tubes, a collection and return fluid box at the lower ends of the tubes in all of said groups, means in said collection and return box for directing the fluid to be condensed in a plurality of passes through said tubes, said collection and return box receiving condensate from the tubes, means in the lower fluid box whereby condensate may be withdrawn therefrom near the terminus of certain of the intermediate passes of the fluid flow through the tubes, and means in said collection and return box for maintaining a predetermined level of condensate in portions of the box, said means arranged to maintain a higher level of condensate in one portion of said fluid box than in others.

3. In a condenser, a plurality of vertical tubes, upper and lower fluid boxes at the upper and lower ends of the tubes, means in the lower fluid box for causing fluid to pass through the tubes in a plurality of passes, said lower fluid box receiving condensate from the tubes, inwardly extending spaced dams in said fluid box for segregating the condensate from the intermediate passes from the condensate of the other passes, and an outlet for the space in the fluid box between said dams arranged to maintain a higher condensate level in said space than in other portions of the fluid box.

MEINHARD H. KOTZEBUE.