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HEAT EXCHANGER AND ABSORBER

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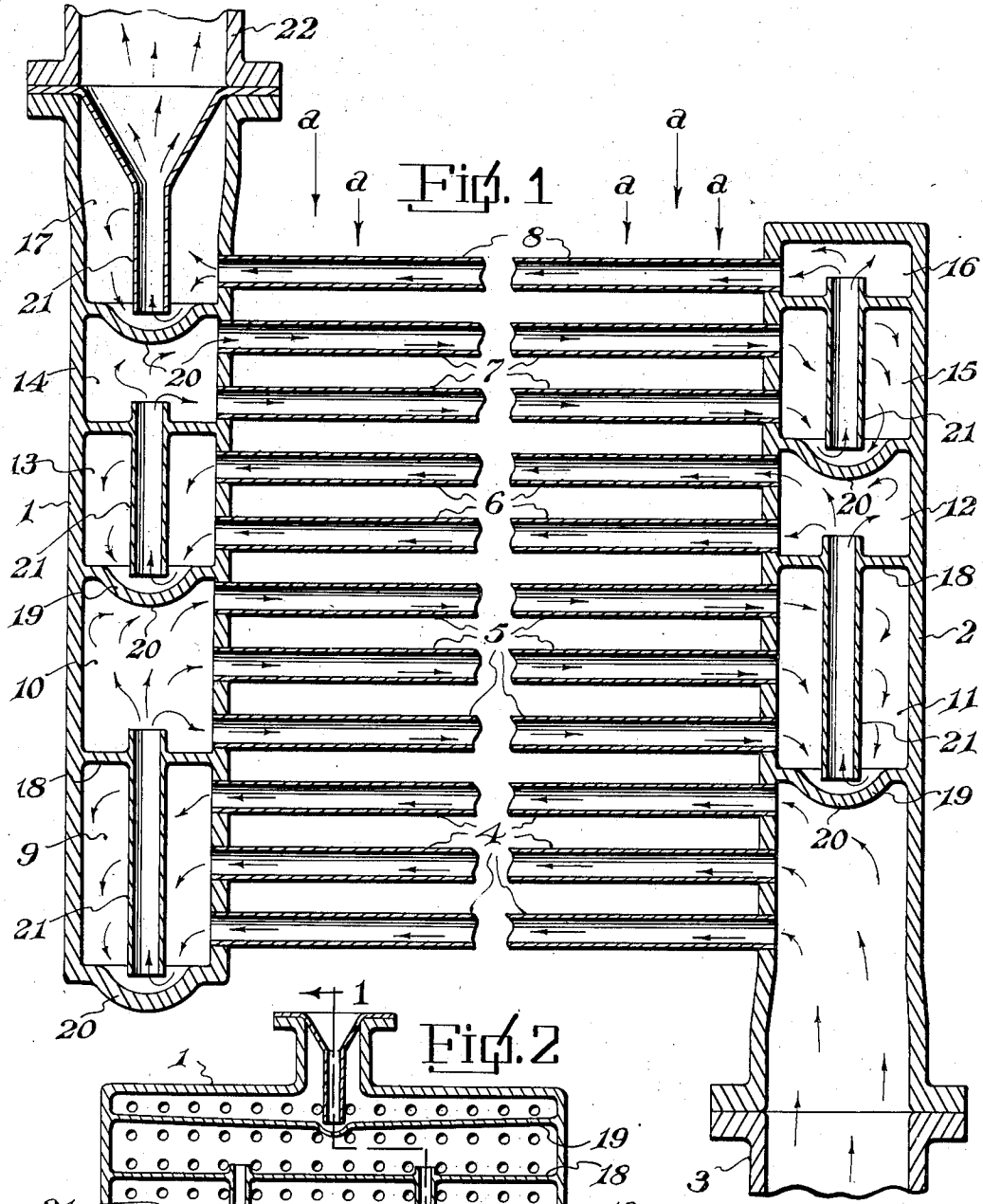


Fig. 1

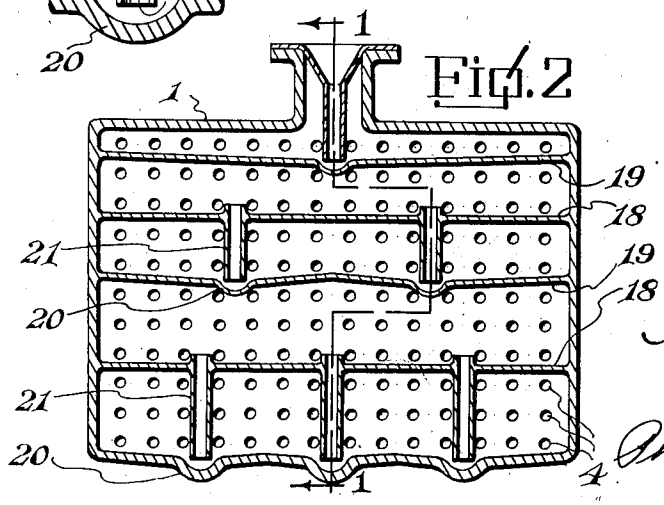


Fig. 2

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HEAT EXCHANGER AND ABSORBER

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2 Claims. (Cl. 257—28)

The invention relates to heat exchangers and absorbers and has for its object to provide an exchanger through which condensible vapors pass upwardly from the bottom thereof through the tubes towards the cooler upper side of the exchanger, and provided with means whereby the condensate from the lower tubes is lifted in an atomized form from level to level in the exchanger towards the cooler upper side of the exchanger, and finally discharged from the upper end of the exchanger.

A further object is to provide a heat exchanger and absorber wherein the flow of gas is introduced at the bottom of the exchanger and circulates towards the cooler upper end of the exchanger where the higher volatile elements, which have remained in suspension all through the exchanger, are gradually brought into condensed form as they near the cooler tubes.

A further object is to provide means whereby the condensed elements, at the different elevations in the exchanger, are lifted from elevation to elevation and broken up for mixture with the volatile elements in the next elevations, thereby preventing the clogging of the tubes incident to collection of condensate and consequent reduction of heat exchange efficiency through the tubes.

A further object is to provide a heat exchanger and absorber into which condensible vapor is introduced at the bottom and condensing on its upward travel through the unit, which unit is cooled by a fluid from the top downwardly. The bottom feed allows the first elements which condense, which are the heavier portions in the condensible vapor, to condense at a higher temperature than lighter fractions. Also to provide means whereby the condensate is carried along with the condensible vapor through an atomizing action and mix with the condensible vapors in step by step stages in the exchanger from the bottom upwardly towards the cooler upper side of the exchanger, for condensing lighter fractions of the condensible vapor.

With the above and other objects in view the invention resides in the combination and arrangement of parts as hereinafter set forth, shown in the drawing, described and claimed, it being understood that changes in the precise embodiment of the invention may be made within the scope of what is claimed without departing from the spirit of the invention.

In the drawing:

Figure 1 is a vertical longitudinal sectional view through the exchanger taken on line 1—1 of Figure 2.

Figure 2 is a vertical transverse sectional view through the exchanger head.

Referring to the drawing the numerals 1 and 2 designate the forward and rear heads of the exchanger and 3 the intake pipe carried by the lower end of the header 2 and through which the hot gases pass to the exchanger. The headers 1 and 2 are connected together by superimposed groups of tubes, each group being designated by the numerals 4, 5, 6, 7 and 8. The tubes are horizontally disposed, as shown in Figure 1, and a cooling fluid passes downwardly over the tubes in the direction of the arrows *a*, Figure 1. This cooling medium may be water, oil or air.

The headers 1 and 2 are provided with chambers 9, 10, 11, 12, 13, 14, 15, 16 and 17, and into which the various groups of tubes 4, 5, 6, 7 and 8 discharge. The chambers of the headers are formed by partitions 18 and 19, and which partitions 19, preferably incline so that condensate passing from any of the tubes into the chamber 9, 11, 13 and 15 will flow into the sump depressions 20 whereby the condensate will be forced upwardly through the vertical tubes 21 by the gas or lighter elements and is sprayed upwardly in a fine spray so it will mix with the lighter elements and again be condensed together with the other elements which have been absorbed with them and traveling in a course which becomes cooler and cooler towards the upper end of the exchanger and a closer approach to equilibrium is reached between the condensible vapors and the condensate. As the two reach the point of equilibrium their merging properties for each other are intensified and they merge. This condition creates a greater absorption action, therefore a greater recovery of fluid condensate from a given volume of gas or vapors. It will be seen that the condensate continuously forming will always be atomized through the tubes 21 into a finely divided state in the chambers and intimately mixed with the balance of the condensible vapors and carried along thereby, and that the condensing tube surfaces will always be free of any large bodies of condensate in the bottoms thereof, consequently a high rate of transfer will be obtained since the tube surfaces available will always be free of bodies of condensate in liquid form, and therefore be more readily utilized for purely condensing surfaces. In operation the condensate that is continuously forming will not drop into the bottoms of the various tubes and thereby block off portions of the tube surfaces.

Instead, the condensate being formed will always be intimately mixed with the balance of the condensible vapors, and will be partially buoyed by it and carried along at the same velocity, hence it will be seen that all available tube surfaces for condensing duty are obtained and a high transfer heat rate between the hot gases and the cooler condensing medium.

The hot gases or vapors pass through the tubes 4 where the heavy condensates are separated and where the cooling medium is warmest; then the condensate passes into the chamber 9 and the sump 20 therein, then is atomized upwardly through the tube 21 by the higher volatile elements, and is sprayed into the chamber 10 and is taken up by the gases and absorbed thereby and then pass through the tubes 5 where other elements are condensed and discharged into the chamber 11 where they are atomized upwardly through the tubes 21 into the chamber 12 where other elements are condensed and the gases mixed, and thence the condensate and gases are again mixed and the same operation repeated until the finished product is discharged from the chamber 17 through the discharge pipe 22. It will be noted that as the cooling medium cools the upper pipes 8, the high volatile elements are circulated towards the coolest point in the exchanger, which is the upper tubes, which are first contacted by the cooling medium.

It will also be noted that the condensate, at the different stages, is boosted to the top of the exchanger by the higher volatile elements and the higher volatile elements are finally subjected to the cooler tubes for obtaining a maximum efficiency and the heavier portions contained in the condensible vapor will be treated in the lower warm tubes as they will condense out at a higher temperature than some of the lighter fractions. It is obvious that when the cooling medium passes downwardly over the various tubes, it will absorb heat, hence the lower tubes 4 will be hotter incident to the heating of the cooling medium and also because the hot gases or vapors first enter the lowest tubes. It has been found that where the vapors are introduced from the bottom of an exchanger without the means of elevation and condensate allowed to accumulate in large quantities in a fluid form, "slugging" its way out, the condensate flowing along on the bottoms of the tubes blocks off much of the heat exchange surface which was needed for the condensible vapors still in suspension. Also the condensate would accumulate rapidly at one point and retard the normal flow of building up a back pressure. The usual action was the building up to a certain point and then "slug" through the tubes in mass, and by accumulating in this large quantity, the condensate would not have the opportunity to absorb, by contact, some of the higher volatile elements, which were still in an aeriform state. By applicant's device the accumulation of condensates in the tubes is prevented and the flowing gas used for boosting the condensate from each state of the exchanger upwardly from the warm end of the exchanger to the cool end and finally from the exchanger, thereby overcoming all of the objections now experienced with exchangers of the ordinary type.

It will also be seen that the gases are circulated towards the coolest point of the exchanger, which is the top and that the condensate is kept in suspension and intermingled with the higher volatile elements just as long as possible, thereby insuring a higher degree of absorption. By keeping the condensate in suspension and in a mist form mixed with the higher volatile elements, which normally remain in suspension, there is a great chance for them to amalgamate, as there is a greater contact area between the two when in a mist form than there would be if the condensate were flowing along the bottoms of the tubes.

The chambers of the headers are preferably progressively reduced in size as shown in Figure 1 and the number of tubes in communication with the chambers varies similarly, as it is obvious as the elements are brought from a gaseous state to one of condensation, less space is needed to handle the load.

The invention having been set forth what is claimed as new and useful is:

1. A heat exchanger comprising headers in spaced relation to each other, tubes connecting said headers in groups, said headers having partitions therein forming chambers with which the groups of tubes communicate thereby forming an upward circuitous passage through the exchanger, a discharge pipe carried by one of said headers, means carried by alternate partitions whereby uncondensed vapor will lift the condensate from chamber to chamber for merging with the non-condensed vapors as they pass through the groups of tubes said last named means comprising spraying nozzles extending above the partitions on which they are carried, the lower ends of said nozzles terminating in condensate collecting depressions in the other partitions.

2. A device as set forth in claim 1 wherein the depression carrying partitions having surfaces inclining towards the depressions.

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