Feb. 23, 1932. H. H. DOW 1,846,955

HEAT EXCHANGE APPARATUS

Filed Aug. 26, 1926 2 Sheets-Sheet 1

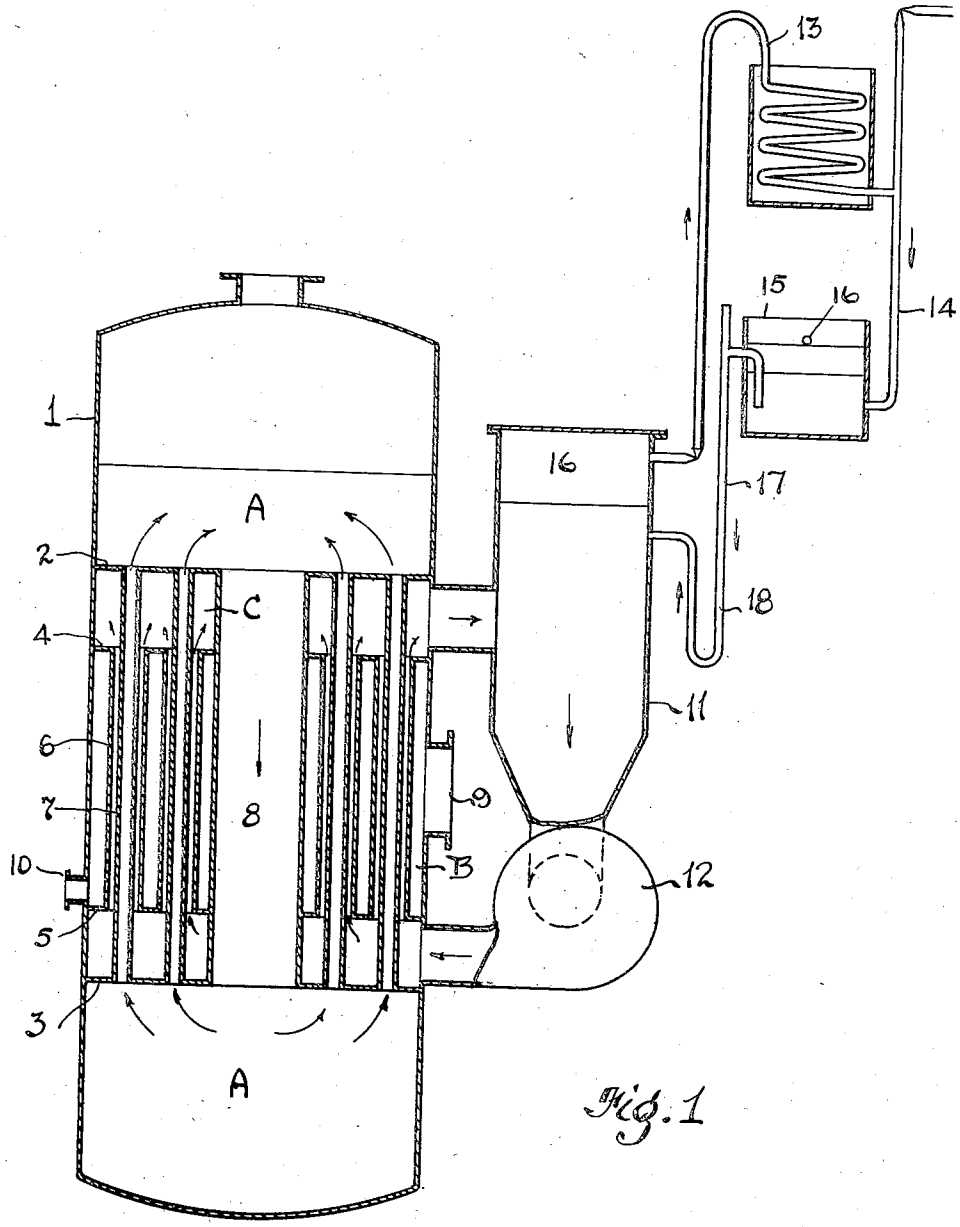


Fig. 1

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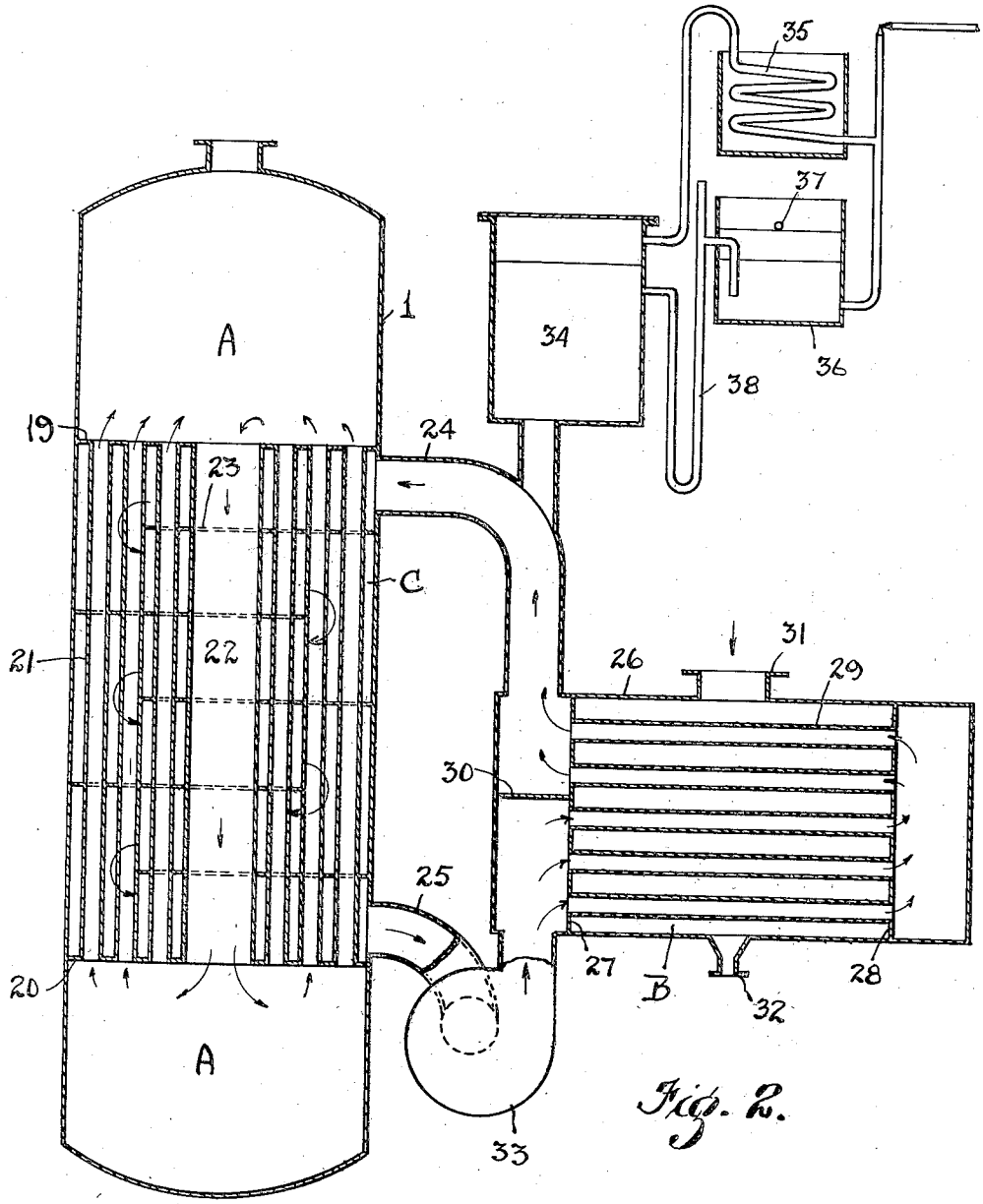


Fig. 2.

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UNITED STATES PATENT OFFICE

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HEAT EXCHANGE APPARATUS

Application filed August 26, 1926. Serial No. 131,798.

This invention relates to systems involving a step of heat exchange, and more particularly where there is considerable difference of pressure between the fluids concerned or where there is possible danger if interleakage should occur. It is among the objects of the invention to provide such systems, having a safeguard in these contingencies. Other objects and advantages will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, the invention, then, consists in the features hereinafter fully described, and particularly pointed out in the claims, the following description and the annexed drawings setting forth but few of various forms in which the principle of the invention may be employed.

In said annexed drawings:—

Fig. 1 is a schematic view in section of an embodiment of my invention; and Fig. 2 is a similar view of a modification.

In its general aspects, my invention contemplates a system including a means for containing a hot fluid, and a means for containing a fluid to be heated, there being an intermediary fluid for transferring heat from the one to the other.

In Fig. 1 reference numeral 1 designates a container for the fluid to be heated. Depending upon the particular application of the invention, this will vary, but for example may be a boiler for containing water to be heated. An outer set of partitions or tube sheets 2, 3, and an inner set of partitions or tube sheets 4, 5, are arranged in the container 1, and tubes 6 extend between the inner tube sheets 4, 5, while smaller tubes 7 extend between the outer tube sheets 2, 3, and lie within the tubes 6. There is thus provided a compartment A having a well or larger channel 8 arranged as desired, and a series of tubes 7 connecting the respective portions of the compartment, while an inner compartment B is formed in relation to the compartment A and having a connection 9 as an inlet for a hot fluid and an outlet 10. Between these respective compartments A and B, there is thus a third general compartment C, this comprising the space between the partitions 2 and 4 and the tubes 6 and 7 and the partitions 3 and 5. Preferably I connect this general compartment C with an expansion chamber or standpipe 11, and to accelerate the circulation, it is desirable to include a pump 12 in the circuit between the chamber 11 and the compartment C.

With a fluid such as water in the chamber A, and a fluid in the chamber B to give up heat to such water, it will thus be seen that the respective fluids are separated by the intermediary compartment C which is provided with a heat-transfer fluid of suitable character. Desirably this heat-transfer fluid is maintained in active circulation, preferably such as to involve turbulence. In this manner a more effective transfer is realized. If now, the difference of pressure between the fluid in chamber A and the fluid in chamber B be considerable, there will be a tendency toward leakage through joints, and if the pressure in chamber C be sufficiently lower than that in chamber A such leakage will be seen to occur from chamber A into the intermediary fluid in chamber C. This intermediary not only allows of a stepping down of pressure gradient of the fluids in the various chambers, i. e., from a working pressure in chamber A to lower pressures in chambers B and C, although the pressure of fluid in chamber C may be at approximately that of the fluid in chamber B or higher than such pressure, but in the case of such fluids as on mixing would start detrimental action, I am thus enabled to interpose an effective barrier by virtue of such intermediary fluid in the chamber C. For instance, if the fluid in compartment A be water and the fluid in compartment B were aluminum bromide to be condensed from vaporous state, the temperature of such bromide under a pressure of one atmosphere is above 506° F. while water in the compartment A at a temperature raised say to 486° F. would represent a pressure of about 600 pounds absolute, thus involving a differential which would be extremely difficult to hold even by the best possible seams, and any leakage of water into the aluminum bromide compartment would result in the formation of hydrobromic acid

with disastrous results. The intermediary compartment C in such case would thus furnish an additional set of barrier walls and a corresponding stepping down of the abrupt pressure gradient, and at the same time by proper selection of the intermediary fluid in the compartment C, all danger of disastrous interaction in case of leakage will be avoided. Carrying the foregoing illustration further, if the intermediary fluid be for instance diphenyl oxide, its boiling point at a pressure of one atmosphere is about 496° F., thus giving an intermediary which allows of ready heat-transfer from the aluminum bromide to the water compartment, and any leakage from the water compartment under its relatively high pressure would occur into the diphenyl oxide with harmless results. By adding a condenser system including a condenser 13 having suitable cooling means, and a drawoff pipe 14 to a separator 15, any leakage occurring from the water compartment A into C would be in state of vapor and would pass off from the top or vapor space 16 of the receptacle 11 along with any diphenyl oxide vapor to the condenser 13 where both would be condensed and flow down to the separator 15. In this the water would stratify above the diphenyl oxide condensate and would flow off through the overflow 16, while the diphenyl oxide would return by pipe 17 and trap 18 to receptacle 11.

In the form shown in Fig. 2, instead of including the heating fluid chamber B within the walls of the container 1, it is located outside. A set of partitions or tube sheets 19, 20, is provided and tubes 21 extend therebetween, there being also if desired a well 22. The chamber A thus has tubes joining its different portions, and immediately surrounding the tubes is an intermediate chamber C. Baffles 23 may be arranged in this compartment to provide a more efficient distribution of the fluid therein. Connecting with the compartment C is an inlet 24 and an outlet 25 in relation to a shell 26 which is provided with partitions or tube sheets 27, 28. Tubes 29 extend between these tube sheets and a partition 30 may be arranged in the header space so as to more effectively divert the fluid to flow through the tubes. Between the partitions or tube sheets 27, 28, there is thus formed a general compartment B having an inlet connection 31 and an outlet connection 32. In this arrangement a hot fluid for instance is passed in from any source through connection 31, and circulates about the tubes 29 to the outlet connection 32, giving up heat in its passage to the fluid inside of the tubes, this being circulated, preferably actively by pump 33 so as to pass around through the compartment C in the container 1 and thereby give up heat to the fluid in compartment A. An expansion tank or standpipe 34 is desirably arranged in relation with the compartment C, and a condenser system including a condenser 35 and a separator 36 with overflow 37 and return pipe 38 is preferably arranged in relation.

In whatever embodiment therefore, it will be seen that an intermediary compartment and intermediary heat-transfer fluid is provided between the main fluids concerned, and this makes possible the handling of chemical substances either in the sense of cooling and condensing on the one hand, or heating and vaporizing on the other, without detrimental effects from leakage. Moreover, a power plant utilizing the properties of high boiling liquids may be arranged on this order, for instance a high boiling point substance such as aluminum bromide can be used as a primary power-vapor giving up its energy to a turbine or the like, and then be returned to its boiler through a heat exchange relationship with water in a water boiler to generate steam which may be used as a secondary power-fluid in a corresponding unit, and with the intermediary heat-transfer fluid as contemplated by this invention, the large pressure differential can be readily handled without dangers which would otherwise be inherent in attempt at conjoint use of such agents.

This invention will thus be seen to be capable of application with various substances and in various relationships, where an intermediary heat transfer agent can be employed to eliminate dangers otherwise inherent.

Other modes of applying the principle of the invention may be employed, change being made as regards the features disclosed, provided the means or steps set forth in any of the following claims, or the equivalent of such, be employed.

I therefore particularly point out and distinctly claim as my invention:—

1. In apparatus of the character described, the combination of a container for a fluid to be heated, outer and inner sets of tube sheets therein, tubes extending between the inner tube sheets, smaller tubes positioned within said tubes and extending between the outer tube sheets, an external container in communication with the tubes which extend between the inner tube sheets, and a pump for circulating a fluid through said external container and communicating tubes.

2. In apparatus of the character described, the combination of a container for a fluid to be heated, a double set of partitions associated therewith providing a chamber for a heating fluid and a chamber intermediate for a heat-transfer fluid, and means for separating from such heat-transfer fluid leakage-contaminations of other fluid.

3. In apparatus of the character described, the combination of a container for a fluid to be heated, a container for a heating fluid, an intermediate container in heat exchange relation with both the aforesaid for containing

a heat-transfer fluid, a pump for circulating such fluid through said intermediate container, a vapor off-take from the top of said intermediate container, a condenser for said vapor off-take, a separator for condensate, and a connection from the separator to said intermediate container.

Signed by me this 20th day of August, 1926.

HERBERT H. DOW.