

Aug. 30, 1927.

1,640,746

C. F. BRAUN

HEAT EXCHANGER

Filed March 14, 1922

2 Sheets-Sheet 1

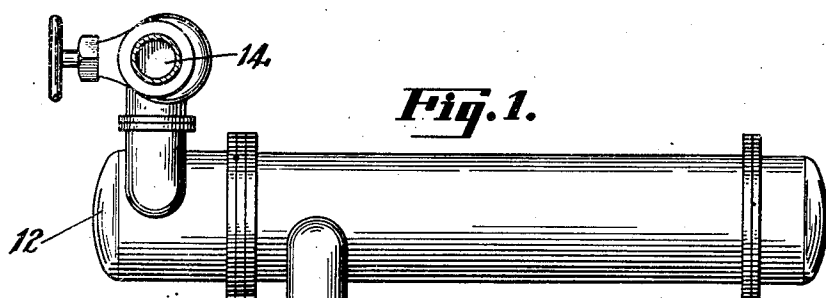


Fig. 1.

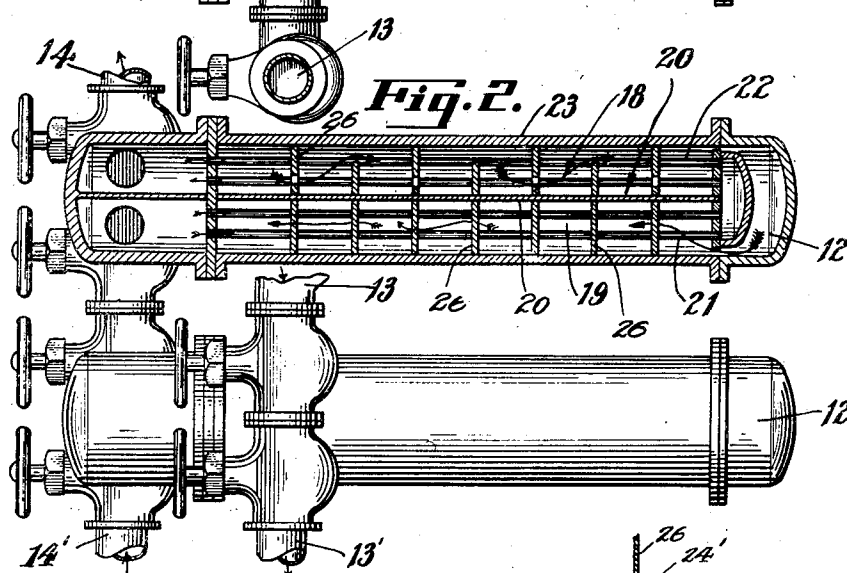


Fig. 2.

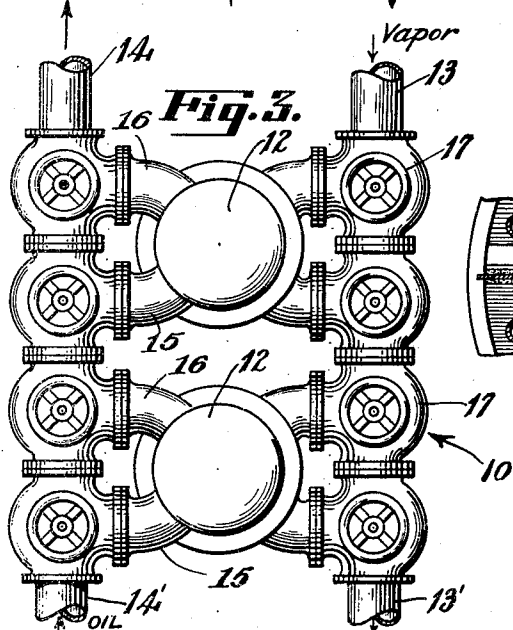


Fig. 3.

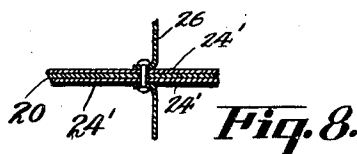


Fig. 8.

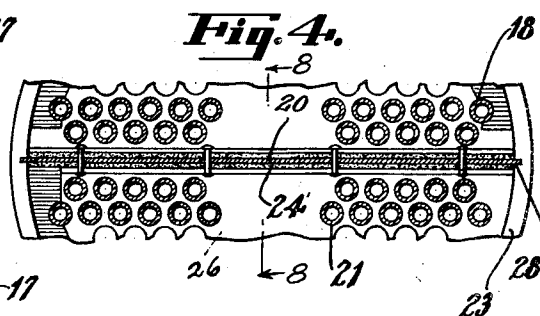


Fig. 4.

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2 Sheets-Sheet 2

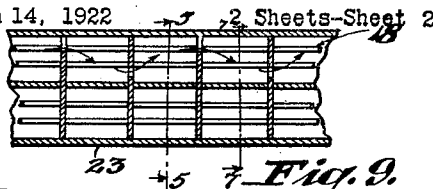


Fig. 5.

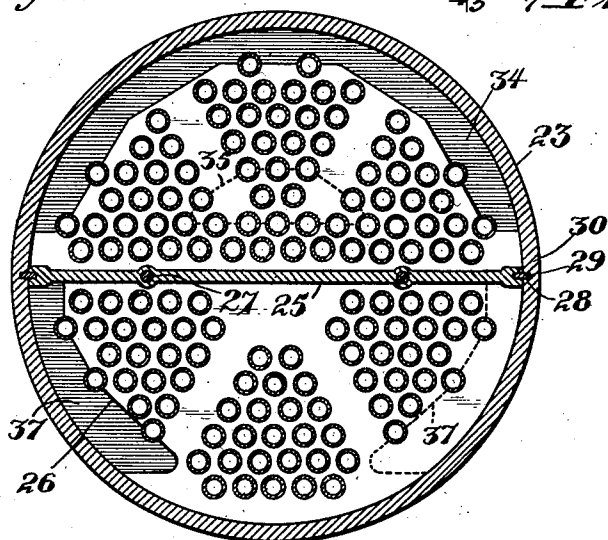


Fig. 7.

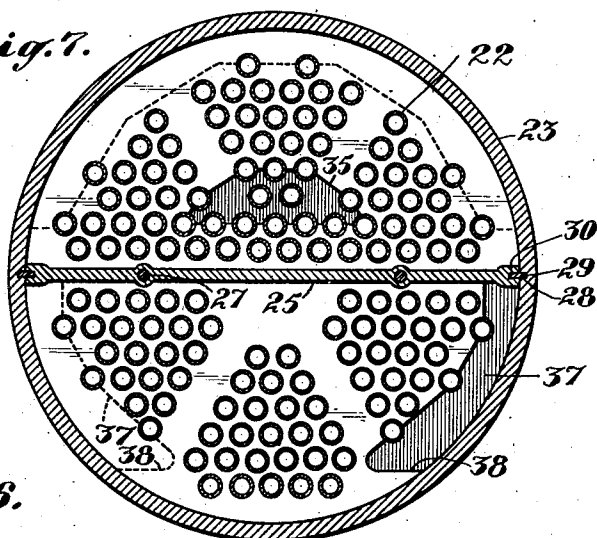
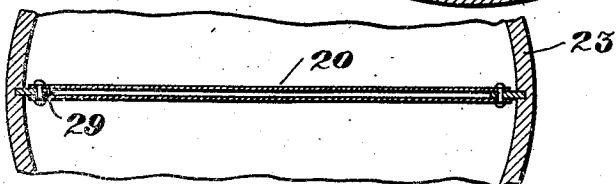


Fig. 6.



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UNITED STATES PATENT OFFICE.

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HEAT EXCHANGER.

Application filed March 14, 1922. Serial No. 543,585.

This invention relates to heat exchanging apparatus, such as condensers, dephlegmators, and the like.

In bringing about an exchange of heat from one fluid to another as, for example, when a fluid is to be cooled or in some instances condensed as when fluids are circulated in counter-directions through the particular passageways of a multi-pass heat exchanger, objectionable conduction of heat takes place between the passageways, whereby the cooling fluid may to an objectionable extent be reheated as it reaches its point of eduction.

It is the principal object of the present invention, therefore, to prevent the undesirable transmission of heat from one fluid to another as they flow along parallel passageways, thus insuring that a fluid may be condensed and at the same time its condensate may also be cooled as the circulation is carried on and that a desired progressive transfer of heat may take place between the fluids.

The present invention contemplates the use of a plurality of exchanger units, through which counterflows of fluid may be brought about and controlled to permit the fluids to circulate through a desired number of units thereby making it possible to reduce the temperature of the fluid to be cooled to an accurate determined degree.

The invention is illustrated by way of example in the accompanying drawings, in which:

Fig. 1 is a view in plan showing an assembled heat exchanger and more particularly disclosing the relative positions of the flow pipes.

Fig. 2 is a view in side elevation showing a pair of heat exchangers forming a part of the heat exchanger installation with which the present invention is concerned, one of said heat exchangers being shown in central vertical section.

Fig. 3 is a view in end elevation showing the heat exchangers disclosed in Fig. 2, and more particularly disclosing the flow pipe and valve arrangement.

Fig. 4 is a fragmentary view in transverse section through one of the heat exchanger units, showing a particular form of longitudinal partition wall.

Fig. 5 is a transverse sectional view on the line 5—5 of Fig. 9.

Fig. 6 is a fragmentary view in section showing a form of insulated partition wall.

Fig. 7 is a transverse sectional view on the line 7—7 of Fig. 9.

Fig. 8 is a detail longitudinal sectional view on the line 8—8 of Fig. 4.

Fig. 9 is a fragmentary view in longitudinal section showing a form of the invention in which the longitudinal partition is in sections.

Referring more particularly to the drawings, 10 indicates a condenser installation, particularly adapted for use in refining oil. In Figs. 2 and 3 it will be seen that this installation comprises a plurality of superposed parallel condensers 12. These condensers are preferably disposed with their forward ends in vertical alignment and with inlet and outlet passageways systematically arranged at opposite sides of the condensers.

Each of the condensers is intended to accommodate counter currents of circulating fluids, as, for example, vapor may be supplied through a pipe 13 and oil delivered through a pipe 14'. These fluids may pass in series through the several condensers, entering induction conduits 15 and leaving the condensers through eduction conduits 16. The bolting flanges of like induction and eduction conduits are superposed and lie in a single vertical plane, thus making it possible to supply each of the conduits with a three-way by-pass valve 17. By this arrangement it is possible to quickly control the circulation of fluid through any or all of the condensers so that a desired exchange of heat may be effected in each of the condensers.

It is to be understood that the fluid delivered to the condenser unit by conduit 13 may be carried away by a conduit 13', while the fluid delivered to the unit by conduit 14' may be carried away by conduit 14.

The circulation of one fluid takes place along parallel passageways 18 and 19 of each condenser, as, for example, the fluid from pipe 13 may pass into the shell, thereafter traveling along passageway 18, above a longitudinal partition wall 20, then passing around the end of this wall and returning to the eduction conduit 13' along passageway 19. At the same time a counter flow of another fluid is brought about through tubes 21 extending longitudinally of the lower passageway 19, after which the flow of

this fluid is continued through tubes 22 extending longitudinally of the upper passageway 18. The relative velocities of flow of the two fluids may be readily regulated by the various valves 17 associated with each of the condensers.

In vapor condensers of the type shown in the drawing, an outer shell 23 is provided and is divided longitudinally by a partition wall 20. As shown in Fig. 2 of the drawing, this partition comprises a single sheet of material extending substantially the length of the shell, as indicated at 20. By reference to Figs. 5 and 7 of the drawing another form of partition wall will be found, comprising a plurality of partition members 25. These members are interposed between transverse baffle plates 26 and are secured in position by stay bolts 27. These bolts extend longitudinally of the shell through the transverse baffle plates and the interposed partition members. A tight joint is made between the edges of the partition members 25 contiguous to the inner face of the shell by the formation of diametrically opposite key-ways 28 cut throughout the length of the shell, which key-ways receive splines 29 projecting from the opposite edges of the partition members and into the key-ways. The splines are carried by grooves 30 formed along the edges of the partition members. In the structure shown in Fig. 4 the opposite edges of the continuous partition 20 project into the key-ways 28 to produce the joint. In either structure it is thus possible to readily withdraw the tube nest in its assembled condition if desired, and at the same time to insure that when the tube nest, transverse baffle plates and longitudinal partition wall are positioned within the shell two parallel passageways 18 and 19 will be formed.

In order to create a desired turbulence of the fluid passing through the shell the transverse baffle plates 26 have been provided. The portions of the baffle plates extending above the longitudinal partition are alternately formed, one with its marginal edge cut away to provide a substantially semicircular opening 34 between this edge and the upper half of the shell wall, while the intermediate baffle plates are formed with an approximately central opening 35 above the longitudinal partition. By this arrangement the fluid circulating along passageway 18 may be caused to alternately flow along and across the tubes 22 toward the central opening 35 of one baffle plate, and then outwardly and around the semicircular marginal edge of the next succeeding baffle plate. This will create turbulence throughout the length of the passageway and around the tubes, while requiring a very simple and inexpensive baffle plate structure.

It is desirable to maintain a body of condensate on the floor of the passageways along which the vapors are travelling and in order to bring this about it is necessary to accumulate the condensate along the floor and to retard its flow so that it will not readily drain off. This is done by forming the portions of the baffle plates extending above and below the longitudinal partition member with riffle portions 38 which act as dams to impound a quantity of condensate between the baffle plates and on the floor formed by the longitudinal partition and the lower portion of the shell. In order to do this the openings formed in the baffle plates for the circulation of fluid through the shell do not extend to the bottoms of the respective passageways but terminate a distance above the floor and thus provide riffles indicated at 38. It will be evident that the riffles which are above the floors will retard the flow of the condensate longitudinally of the shell and will create a body of condensate between the baffle plates and on the floors of the passageways. The riffles 38 will establish a level for the impounded condensate, at the same time permitting any excessive amount of condensate to flow through the openings 37. This baffle construction also makes it possible to progressively cool the condensate as it passes through the condenser, due to the fact that the accumulated condensate will flow along the floors of the passageways in contact with certain of the tubes.

In the type of condenser here shown, where fluid flows successively through passageways 18 and 19, it commonly occurs that the heat of the influent fluid will be carried across the longitudinal partition by the baffle plates. This heat will thus be directly transferred from the fluid at its high point of temperature to the same flow of fluid at a time when it should have acquired a minimum low temperature and after it has passed in counter direction along the cooling pipes. This condition will, however, tend to again raise the temperature of the fluid as it reaches the eduction passageway, thus to a certain extent counteracting the cooling action which has already taken place.

For this reason it is contemplated to pass the fluid to be cooled successively through a series of condensers, thereby confining the temperature differences of the influent and effluent fluid to a narrow limit of range. This will not only insure an efficient heat transfer but will also prevent undue strains in the metal of the condenser structure, as ordinarily the temperature variations along the opposite sides of the longitudinal partition will vary considerably. Further heat transfer from one passageway to the other may be limited by covering the opposite sides of the longitudinal partition member

with heat insulating material or otherwise incorporating heat insulating material in the partition, in which case it may be desirable to form the baffle plates 26 in two halves, as shown in Fig. 4. These halves may be secured to opposite sides of a longitudinal partition member 20 and a thickness of heat insulating material may be interposed between the baffle plates and along the partition wall, as indicated at 24'.

In arranging the heat exchangers in series as shown in Fig. 2 the operation of the exchangers is greatly facilitated by the provision of the three-way by-pass valves having all of their stems parallel and their operating wheels in single or parallel planes at the ends of the exchangers. These valves will make it possible for the frictional drop of the circulating fluids to be regulated and also the temperature in each exchanger which in some heat exchangers, such as fractionating condensers, is desirable. The provision of by-pass valves also makes it possible for the individual heat exchangers to be cut out from the flow to permit them to be inspected, cleaned and repaired.

Attention is directed to the fact that in the transverse sections of the condensers here shown the baffle plates are firmly secured around the tubes which extend through them. In practice, it has been found that this will insure a more thorough transfer of heat from one fluid to the other, and will thus produce a more efficient cooling action. By referring to Figs. 4 and 6 it will be seen that partition members are provided which tend to eliminate the transfer of heat from one side of the partition wall to the other. In Fig. 4 suitable insulating material is embodied in the partition wall. However, in Fig. 6 the well known insulating properties of a fluid are employed, such as an intervening air space, which will tend to prevent the heat from being transferred from one spaced plate of the partition through the other.

In operation, the plant is constructed as shown in the drawings, where it will be seen that a plurality of condensers is used. These condensers are connected to operate in series as controlled by the valves 17.

Due to the relatively small temperature differences between influent and effluent temperatures in the several exchangers, strains will be greatly relieved in the structures and at the same time it will be insured that heat transfer will progressively take place without material intermittent retardation as the cooled fluid reaches the induction ports of the series of exchangers, and, furthermore, the condensate may be progressively cooled as it flows through the shell.

It will thus be seen that the invention here disclosed insures an efficient heat transfer from one fluid to another, while utilizing a

convenient and readily controlled apparatus for bringing about the result.

While I have shown the preferred form of my invention as now known to me, it will be understood that various changes might be made in the combination, construction and arrangement of parts by those skilled in the art, without departing from the spirit of my invention, as claimed.

Having thus described my invention, what I claim and desire to secure by Letters Patent is:

1. In a heat exchanger, a shell, a longitudinally extending tube nest unit comprising a plurality of parallel tubes, means for separating the tubes into groups extending along longitudinal passageways, and means for creating a tight joint between the separating means and the shell, while permitting the tube nest unit to be removably secured within said shell.

2. A heat exchanger comprising an outer tubular shell, a plurality of transverse baffle plates disposed within said shell, partition members interposed between the baffle plates and dividing the shell into a plurality of circulating passageways which communicate with each other at one end of the shell, a plurality of tubes extending lengthwise of the shell and through said baffle plates, and means for creating a flow of fluid alternately around the marginal edge of one upper passage baffle plate and through a central opening in the next succeeding plate, while creating a flow in the lower passageway alternately around one side of one baffle plate and the opposite side of the next succeeding plate.

3. A heat exchanger comprising an outer tubular shell, a plurality of transverse baffle plates disposed within said shell, partition members interposed between the baffle plates and dividing the shell into a plurality of circulating passageways which communicate with each other at one end of the shell, and a plurality of tubes extending lengthwise of the shell and passing through the baffle plates, said baffle plates being provided alternately near their centers and at their peripheries with openings for creating a flow of fluid alternately around the marginal edge of one baffle plate and through a central opening in the next succeeding baffle plate.

4. In a heat exchanger a tubular shell, a tube nest extending longitudinally thereof and enclosed thereby, a heat insulating partition structure extending longitudinally of the tube nest separating the tubes into groups and dividing the shell into parallel passageways through which a fluid may flow in counter current to the fluid passing through the tube nest.

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