Aug. 11, 1942. G. T. JACOCKS 2,292,524

HEAT EXCHANGER

Filed March 19, 1941 2 Sheets-Sheet 1

Fig. 1.

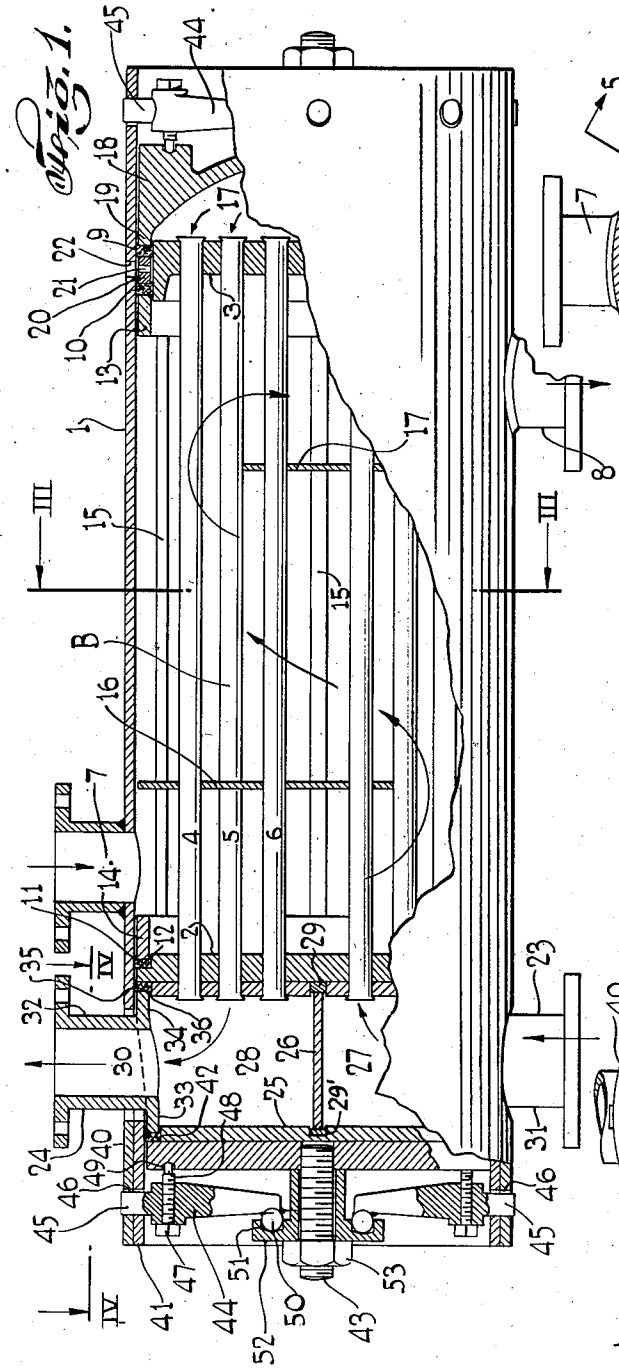


Fig. 3.

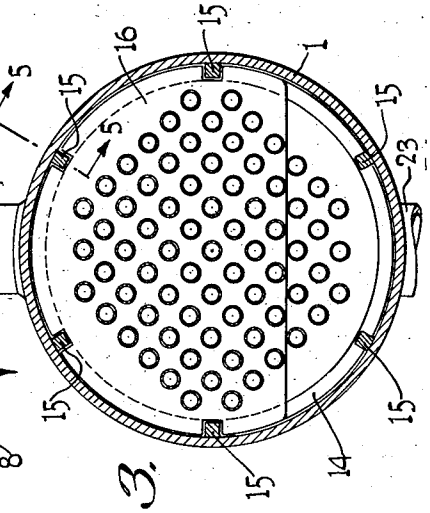
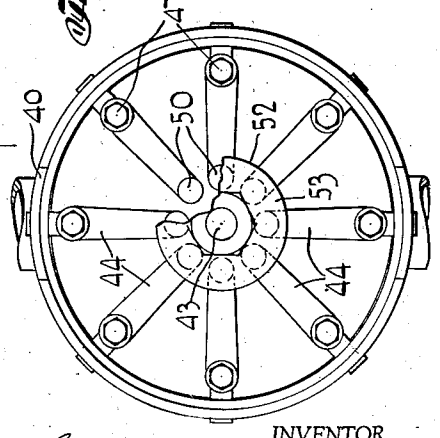


Fig. 2.



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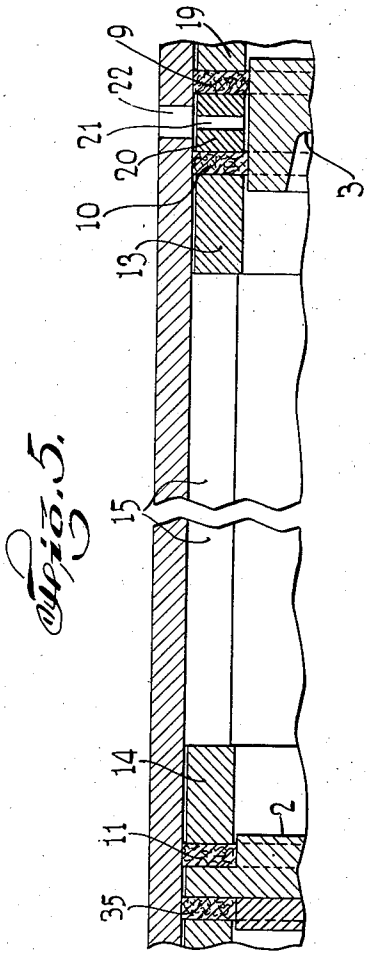


Fig. 5.

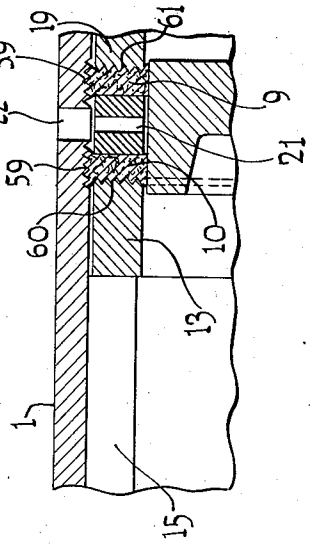


Fig. 6.

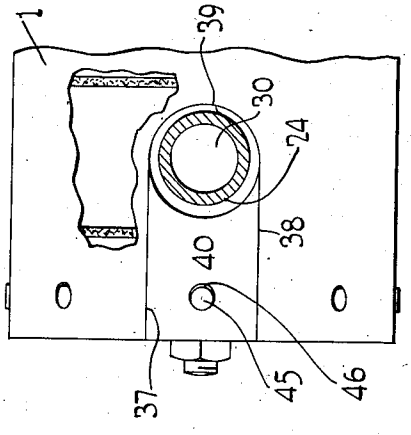


Fig. 4.

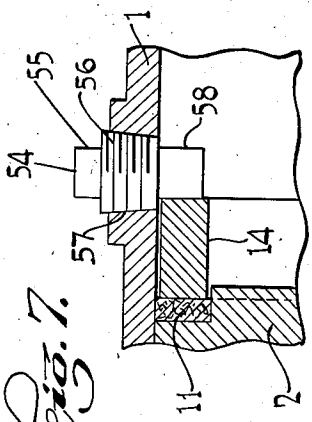


Fig. 7.

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UNITED STATES PATENT OFFICE

2,292,524

HEAT EXCHANGER

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Application March 19, 1941, Serial No. 384,062

3 Claims. (Cl. 257—236)

This invention relates to heat exchangers.

A principal object of this invention is the production of a device of the type specified which will be simple to construct, efficient in operation, and afford unusual facilities for disassembling.

Other objects and advantages will appear as the description of the particular physical embodiments selected to illustrate the invention progresses and the novel features will be particularly pointed out in the appended claims.

In describing the invention in detail and the particular physical embodiments selected to illustrate the invention, reference will be had to the accompanying drawings and the several views thereon, in which like characters of reference designate like parts throughout the several views, and in which:

Figure 1 is a side elevational view, partly in section showing a device embodying applicant's invention; Fig. 2 is an end view of the device as shown in Fig. 1; Fig. 3 is a cross-sectional view of the device as shown in Fig. 1 on the plane indicated by the line III—III of Fig. 1, viewed in the direction of the arrows at the ends of the line; Fig. 4 is a fragmentary top view of the device as shown by Fig. 1 with some parts broken away to more clearly show the construction; Fig. 5 is an enlarged view more clearly showing some parts of Fig. 1; Fig. 7 is a view of a modified form of ring retaining means as used by applicant; Fig. 6 is a modified form of gasket seat means as used by applicant.

In Fig. 1, numeral 1 designates a container of a heat exchanger. This container may be of any of the usual or ordinary forms. In the particular device shown the container is of cylindrical form open at each end, that is, it is a hollow cylinder. The container should be made of any of the usual or ordinary materials and preferably steel, although the nature of the materials treated will govern the material of the container.

This container encloses the so-called "bundle," designated as a whole by B. This bundle comprises generally a fixed tube sheet 2 and a floating tube sheet 3. Between the tube sheets and extended into each sheet are tubes as 4, 5 and 6.

For the purpose of heat exchange, fluid is passed around the outside of the tubes, as 4, 5 and 6. This is conveniently done by providing an inlet 7 and an outlet 8.

In order to prevent the fluid passing under and around the tubes 4, 5 and 6 from leaking out around the tube sheets, it is necessary to make fluid tight joints between the fixed tube sheet 2 and the floating tube sheet 3 and the shell 1. The fluid tight joints mentioned are made by using gaskets as 9, 10 and 11. The gasket 11 bears against a face of the fixed tube sheet 2. In the particular form shown in Fig. 1, the fixed sheet 2 is formed with a rabbet 12 in which the gasket 11 is positioned. This is to prevent the gasket from squeezing inwardly along the diameter of the fixed tube sheet. The gaskets 9 and 10 bear against the peripheral surface of the floating tube sheet 3.

As an abutment for the gaskets 10 and 11 there are provided gasket rings as 13 and 14. These gasket rings are positioned intermediate the ends of the cylindrical shell 1 and against the interior surface thereof and spaced apart as shown. Means are provided, to be hereinafter more fully described, for forcing the fixed tube sheet 2 longitudinally against the gasket ring 14 with the gasket 11 thereby squeezed therebetween and means are provided, to be hereinafter more fully described, for forcing the gasket 10 against the gasket ring 13 to thereby force it outwardly against the peripheral face of the floating tube sheet 3. These forces tend to move the rings 13 and 14 toward one another and longitudinally of the shell 1. To resist this tendency and to hold the gasket rings 13 and 14 in proper position, applicant, as shown in Fig. 1, provides a plurality of butt bars 15, more clearly shown in Fig. 3. These butt bars are positioned against the inner face of the cylindrical shell 1 and extend between the gasket rings 13 and 14 so that any force tending to move the gasket rings toward one another is resisted by said butt bars. These butt bars may be attached to the inside surface of the cylindrical shell 1 in any suitable or appropriate manner, preferably by a few spot welds so that they will remain in desired position while the parts are being assembled.

By the devices hereinbefore described, it will be seen that a fluid tight joint is made between the fixed tube sheet 2 and the shell 1 and between the floating tube sheet 3 and the shell 1 so that the space served by inlets 7 and 8 is cut off from the remainder of the cylindrical shell space and fluid may pass therethrough, being suitably interrupted as required by baffles such as 16 and 17. As the heat exchanger shown is designed to have material flow through part of the tubes 4, 5 and 6 in one direction and return through part of the tubes such, as 4, 5, and 6, in the opposite direction, means are provided

for effectuating this purpose and for connecting all of the tubes with a single chamber at one end. The single chamber at one end is designated 17 and is formed by floating tube sheet 3 and a floating tube sheet or head cover 18. This floating tube sheet cover has a gasket bearing portion 19 bearing against gasket 9 so that if means are applied to the floating tube sheet cover 18 to force it in a direction toward the floating tube sheet 3 it will compress gasket 19 and force it both against shell 1 and the periphery of the floating tube sheet 3, thereby making a fluid tight joint at that point.

It is desired to provide for a telltale or leakage indication. This is done by providing a leakage ring 20 positioned between gaskets 9 and 10. This leakage ring is positioned between the periphery of the floating tube sheet 3 and the inner surface of the shell 1 and at desired points is provided with an orifice therethrough 21 aligning with an orifice 22 in the cylindrical shell. When all of the parts are forced tightly together, if any leakage occurs around gasket 10, it may pass through the orifice 21 and orifice 22 and so be detected by one observing the device from the outside of the shell.

On the left hand end of the shell are provided the means for allowing inlet and exit of material to the tubes and from the tubes. At 23 is positioned an inlet and at 24 an outlet both communicating with a chamber formed by the closing head 25 and the fixed tube sheet 2 which chamber is divided into two portions by the partition 26. Fluid flowing through 23 will pass through the lower tubes of the bundle B toward the right as viewed in Fig. 1 and then through and by the chamber 17 to the upper tubes of the bundle and thence through an outlet 24, the fluid through the inlet occupying the chamber 27 and the fluid to the outlet occupying the chamber 28, there being a gasket 29 seated in the fixed tube sheet 2 against which the partition 26 is forced to prevent leakage of fluid directly between chambers 27 and 28, there being also a gasket 29' at the other end of the partition 26 between it and the head 25 to prevent leakage at that point.

The inlets 23 and 24 are formed so as to be practically one integral piece, including the duct 23 and the duct 24 formed with the walls 31 and 32. The inlet connections are further provided with walls as 33 and 34 which merge and form a ring extending completely around and adjacent the inside surface of the cylindrical shell 1. The wall 34 abuts a gasket 35 positioned in a rabbet 36 of the fixed tube sheet 2.

In order to form the inlets 23 and 24 as a single integral piece and still be able to introduce such integral piece into the shell, applicant first cuts away a portion, as included between the lines 37 and 38, as shown by Fig. 4, including the rounded portion as designated by 39. This is done to the shell both at the location of inlet 23 and at the location of outlet 24. When this cut away portion 40 is removed the walls 31 and 32 of the duct portions can be moved into place longitudinally of the shell and be positioned as shown in Fig. 1. After the inlet connections are in place a fastening ring 41 is slipped longitudinally into the shell 1 and then the portion 40 which was cut away, or a similar portion, is slipped back into place acting as a filler and may be spot welded or otherwise suitably fastened permanently to the ring 41.

In order to seal the chambers 27 and 28, a closing head 25 is preferably rabbeted as at 42 and a gasket seated therein and the head 25 so positioned that the head bears against the edge of the ring wall 33 with the partition 26 bearing against the gasket 29'. The closing head 25 is then fastened in place by any suitable or appropriate means but preferably by the means as disclosed in applicant's copending application Serial No. 378,385 filed February 11, 1941 for a Closure. This method of fastening includes a threaded stud 43 attached to the head 25 and closure levers 44 positioned radially beyond the closure head 25. These closure levers have an end 45 projecting through orifices, as 46, formed through the fastening ring 41 and the shell 1 and the fillers 40. There is a stud 47 in each closure lever which stud has an unthreaded end 48 which seats in a cavity 49 in the closure head 25. The closure levers also have preferably somewhat spherical heads 50 seated in complementary formed cavities 51 in a compression head 52. When all of the closure levers 44 are properly positioned as shown in Fig. 2 the compression plate 52 is placed over the stud 43 and then a nut 53 is applied to the stud to force the head 25 toward the wall ring 33 thereby compressing the gasket 42 and the gaskets 29 and 29' and making a fluid tight joint at such parts. It is to be observed that even before compression plate 52 is put in place, the levers 44 will remain in place even if vertical, because of stud 47 entering cavity 49.

The floating head cover 18 is forced against the gasket 29 by similar closure levers 44.

In Fig. 7 an alternative method of restraining longitudinal movement of gasket rings, as 14, is shown. This means includes a stud 54 which has, preferably, a squared head 55 and a threaded portion 56 engaging in a threaded orifice 57 of a cylindrical shell 1 and having a protruding portion 58 extending within the cylindrical shell 1 against which the gasket ring 14 may abut and thereby be restrained from longitudinal movement in one direction.

In Fig. 6 an improved surface for contacting the gaskets at the floating head end of the tube bundle is shown. The interior surface of the shell 1 at the point 59 is serrated as shown in Fig. 6 on both sides of the leak orifice 22 and the side face of the gasket ring 13 is also serrated as at 60 and the end face 19 of the floating tube sheet cover is also serrated at 61. By making the surfaces mentioned serrated, and serrating either in one direction or in two or a plurality of directions, surfaces are formed which are particularly efficient in preventing leakage in that the material of the resilient gaskets as 9 and 18 may flow into the serrations and thereby make a more efficient fluid tight joint.

From the above description it will be seen that a heat exchanger has been devised which is extremely easy to assemble and disassemble. After the device is assembled as shown in Fig. 1 it may be easily disassembled by turning off the nut 53, withdrawing the closure levers 44, then taking out fastening ring 41 and head 25 whereupon the inlet ducts 23 and 24 may be removed as a whole and then the entire tube bundle 24 may be withdrawn longitudinally.

Although I have particularly described several particular physical embodiments of my invention and explained the operation, construction and principle thereof, nevertheless, I desire to have it understood that the forms selected are merely illustrative, but do not exhaust the pos-

sible physical embodiments of the idea of means underlying my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A heat exchanger, including, in combination: a metallic shell of cylindrical form open at each end; a first gasket ring positioned intermediate the ends of the shell against the inner surface thereof; a second gasket ring positioned at a distance from the first gasket ring and similarly bearing against the inner surface of the shell; a plurality of relatively long butt bars independent of the rings and extending between and abutting the rings and positioned in close contact with the inner surface of the shell; ring gaskets, one positioned on the remoter side of each ring; a fixed tube sheet; means for forcing the face of said tube sheet against the first said gasket; a floating tube sheet; tubes extended between and through the sheets and attached liquid tight therein; said floating tube sheet bearing on its peripheral face against the second gasket; means forcing the second gasket toward its adjacent ring and against the periphery of the floating sheet whereby the floating sheet may move longitudinally of the shell and a liquid tight joint may be maintained between the floating sheet and its associated gasket and means for passing fluid around the tubes and means for passing fluid through the tubes.

2. A heat exchanger, including, in combination: a metallic shell of cylindrical form open at each end; a tube bundle including a fixed tube sheet and a floating tube sheet and tubes therebetween; gasket rings positioned inside the shell and against the inner surface thereof; gaskets abutting the gasket rings, said sheets abutting the gaskets for making a fluid tight joint, means forcing the rings and gaskets toward one another and relatively long butt bars independent of the rings extending between the rings for preventing movement thereof toward one another, said butt bars positioned against the inside surface of the shell.

3. In a heat exchanger of the type including, a metallic shell of cylindrical form open at each end, a tube bundle including a fixed tube sheet and a floating tube sheet and tubes therebetween, the combination of gasket rings positioned inside the shell and against the inner surface thereof; gaskets abutting the gasket rings, said gaskets providing an abutment for the sheets for making a fluid tight joint; means forcing the rings and gaskets toward one another and relatively long butt bars independent of the rings exending between the rings for preventing movement thereof toward one another, said butt bars positioned against the inside surface of the shell.

GEORGE T. JACOCKS.