May 19, 1936. J. B. FORBES 2,041,328

HEAT EXCHANGER

Filed Aug. 12, 1935 2 Sheets-Sheet 1

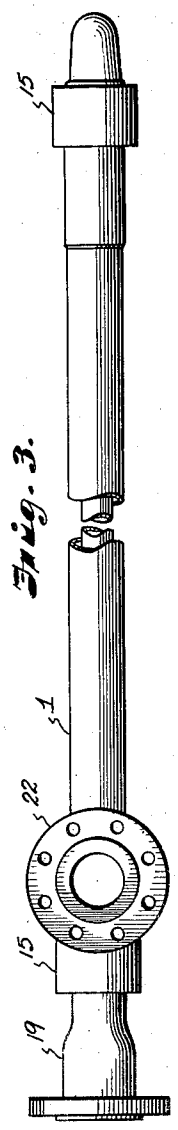


Fig. 3.

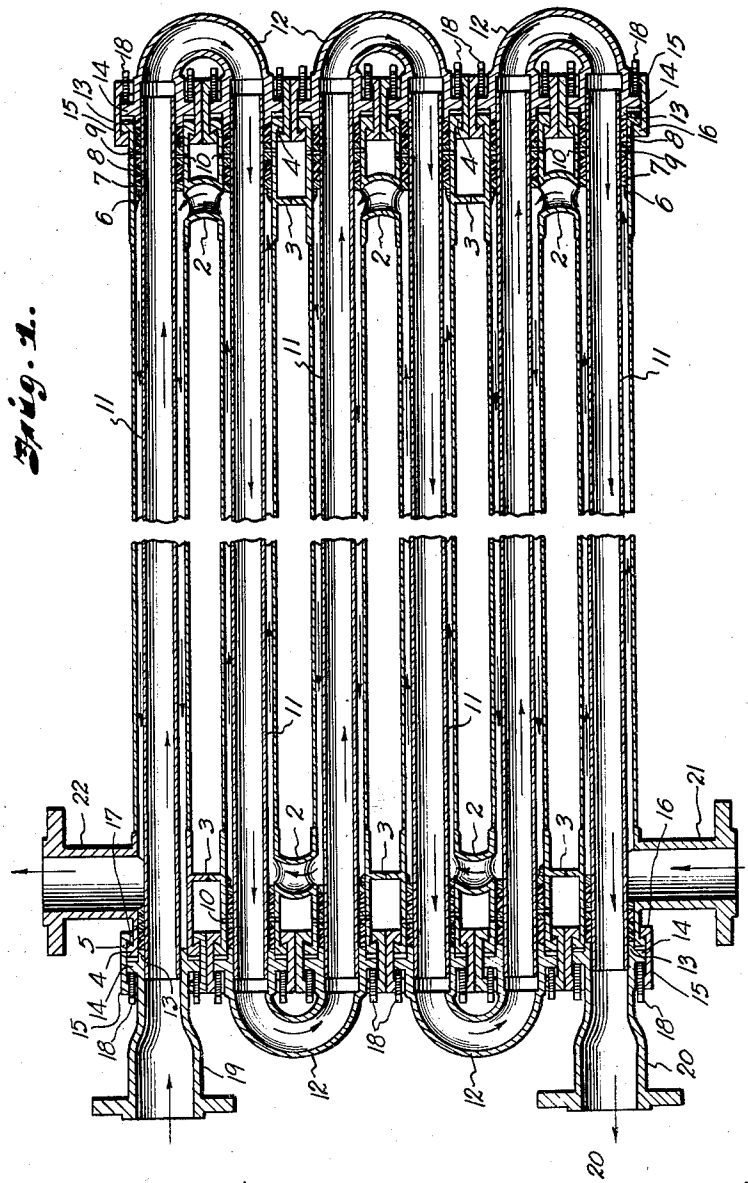


Fig. 1.

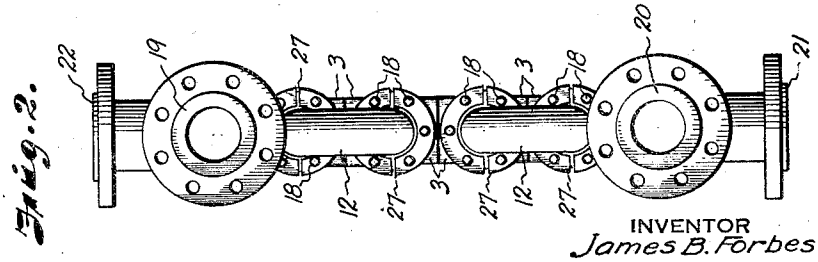


Fig. 2.

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Fig. 4.

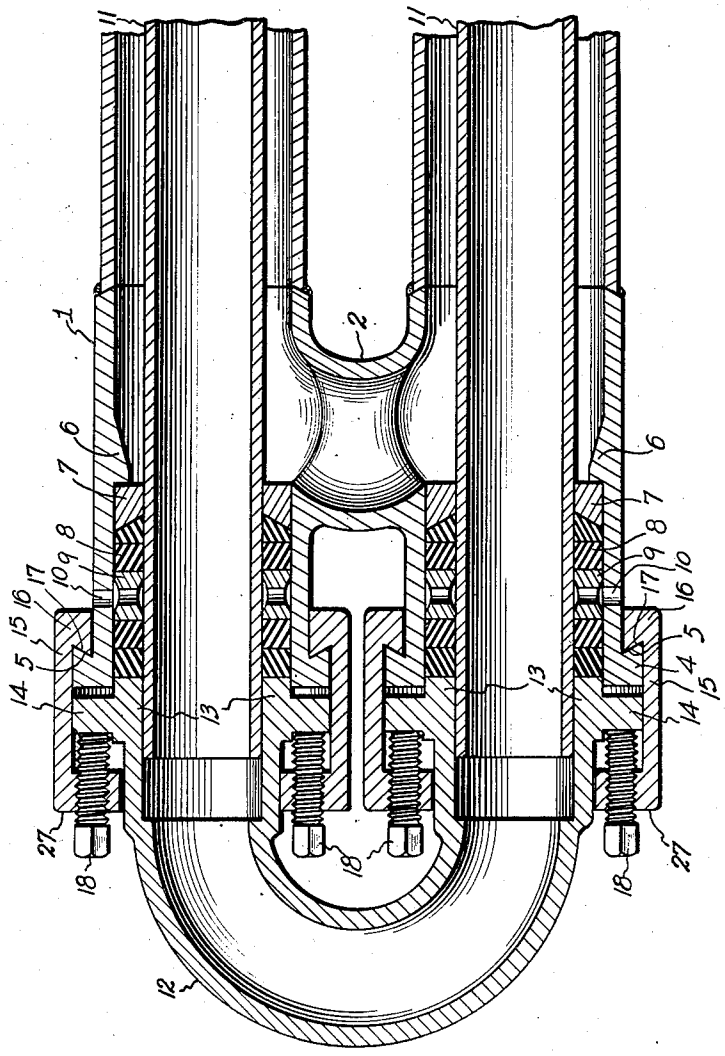
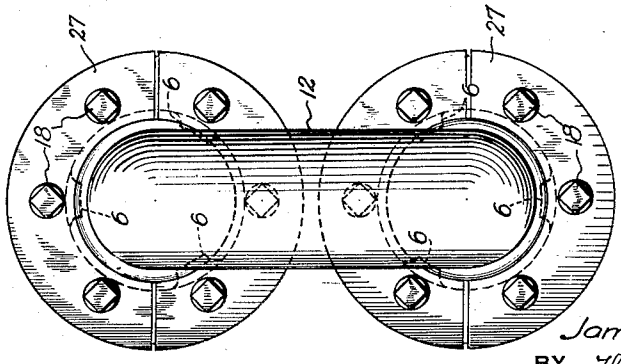


Fig. 5.



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HEAT EXCHANGER

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Application August 12, 1935, Serial No. 35,822

10 Claims. (Cl. 257—247)

My invention relates to heat exchangers of the double tube type and more particularly to the manner of connecting tube elements of the heat exchanger to form continuous fluid passageways.

In the double pipe heat exchangers known heretofore, particularly those of the liquid to liquid type such as are commonly used in the petroleum industry for the handling of highly viscous fluids such as crude petroleum and other heavy oils, considerable difficulty has been experienced in cleaning the surfaces in contact with the viscous liquids. The reason for this lies in the manner in which the inner and outer tubes of the heat exchanger are connected through return bands and packing glands. The disassembly of these elements requires considerable time, thus making the cleaning of the surfaces a costly and uneconomical task. Equipment associated with the heat exchanger often must be shut down for long periods during the cleaning resulting in operating inefficiency since this associated equipment is often not ready for shut down itself.

The double pipe exchangers in use heretofore have been constructed with the inner and outer tubes held in fixed relationship through return bends and glands. Such construction has frequently resulted in warping and bending of these tubes due to expansion and failure to adequately provide for the same.

Other disadvantages also existed such as lack of flexibility of the heat exchanger which, when designed for use in a particular installation, was not adapted or adaptable to use in a different installation under other operating conditions.

It is an object of my invention to provide a double pipe heat exchanger particularly adapted to the handling of highly viscous fluids.

It is another object of my invention to provide a double pipe heat exchanger in which all surfaces contacted by the viscous liquid are quickly and easily accessible for cleaning.

It is a further object of my invention to provide a double pipe sectional heat exchanger with respect to which sections may be quickly and easily attached or removed to adapt the exchanger to changed operating requirements.

Other and further objects of my invention will appear from the following description and the appended claims.

In the accompanying drawings which form part of the instant specification and are to be read in conjunction therewith, and in which like reference numerals are used to indicate like parts in the various views,

Figure 1 is a sectional view in elevation of a heat exchanger embodying my invention.

Figure 2 is an end view in elevation of the heat exchanger shown in Figure 1.

Figure 3 is a plan view of the heat exchanger shown in Figure 1.

Figure 4 is an enlarged sectional view in elevation of a detail of Figure 1.

Figure 5 is an end view in elevation of the detail shown in Figure 4.

In general, the heat exchanger of my invention is formed of a number of tube elements, each element consisting of an outer casing, or tube, enclosing an inner tube to thereby form a pair of fluid conducting passageways. Each casing is internally formed at each end with a number of lugs against which annular collars surrounding the inner tube abut to position the inner tube spacedly within the casing and at the same time act as bases of receptacles for packing. The outer periphery at each end of a casing is formed with a flange adapted to be engaged by the sections of a split removable clamping ring. This clamping ring is provided with an inwardly extending flange through which pass a number of compression screws adapted to be forced into contact with an outwardly extending flange of an entrance piece used for directing the fluid in the inner tube. This, in addition to serving as a fluid conducting element is also formed with a skirt portion adapted to act as a gland for exerting pressure on the packing located in the receptacle between the outer face of the inner tubing and the inner face of the outer casing. Such construction permits the erection of this unit in one or more sections. Where more than one section is desired, the adjoining ends of pairs of the outer casings are fixedly connected to serially unite the casings in fluid conducting relationship, while the adjoining ends of pairs of the inner tubes are removably joined by means of return bends with split removable clamping rings serially uniting the inner tubes to form a fluid conducting passageway. When this construction is used, the removable return bends have a pressure exerting function as glands similar to the fluid conducting piece previously mentioned. The inner tube, or tubes, are removably attached in all instances and are free to expand and contract independently of the outer tube or casing, thereby allowing great flexibility in the matter of temperatures of the fluids passing through the various passages.

Referring now more particularly to the drawings, a number of tubular casings 1 are con-

nected in pairs at adjoining ends by return bends 2, the casings of each pair being spaced from each other at alternate ends by the spacing elements 3 projecting in opposite directions from the outer surfaces of the casings. These spacing elements are in abutting relationship without being secured together, this construction permitting the heat exchanger to be built up of as many pairs of casings as are necessary to meet the required operating conditions. The outer periphery of each casing is formed at each end with a flange 4 having its rear face 5 inclined to the outer surface of the casing to thereby form a recess adapted to be engaged by a clamping element. The inner surface of each casing adjacent each end is formed with a number of lugs 6 projecting inwardly of the casing and forming a shoulder against which an annular collar 7 is adapted to bear. A number of rings 8 of packing material between which is located an annular lantern gland 9 are positioned within the casing against the collar 7. Drainage orifices 10 are formed in the walls of the casing and communicate with the lantern gland. Positioned within the casing is a tube 11 supported by the collar 7 in spaced relationship with the casing and forming therewith an annular fluid conducting passageway. This tube passes through the packing rings and lantern gland 9 and projects for a short distance as shown beyond each end of the casing.

A return bend 12 having skirt portions 13 snugly fitting within the annular passageway formed by the casing and tube and adapted to bear as a gland against the packing has each skirt portion formed with a peripheral flange 14 on its outer surface. A sectional clamping device formed by a split ring 15 has one end formed with a flange 16 having an inclined inner face 17 adapted for engagement with a flange 5 of casing 1. The opposite end of the clamping ring is formed with a flange 27 carrying a number of threaded bolts 18 adapted to bear upon one face of the flange 14 of the return bend 12.

An entrance piece 19 having one end constructed in all respects similar to each end of the return bend is connected to one end of the heat exchanger while an exit piece 20 similarly constructed is connected to the other end.

An inlet nozzle 21 is connected to the first of the series of casings forming the heat exchanger while an outlet nozzle 22 is connected to the last of the series for passing liquid therethrough.

I preferably form each end of a casing as a separate tubular element attached to the casing in any suitable manner as by welding. By such construction I am enabled to provide a greater wall thickness necessary to provide the structural strength to withstand the loads imposed by the clamping devices.

After the parts of the exchanger have been assembled in their proper relationship as shown, the return bends and the inlet and exit pieces are subjected to sufficient pressure by drawing up the bolts in the clamping devices to cause the skirt portions of each to compress the packing in the receptacles formed by the casing 1, inner tube 11, and lugs 6. In this way a liquid tight seal is formed although such fluid as may leak through the packing can be readily drained therefrom through the orifices 10 communicating with the lantern gland 9.

It will be seen that I have accomplished the objects of my invention and have provided a heat exchanger adapted for varying operating conditions by the addition or removal of sections as desired. I have also provided a heat exchanger whose various parts may be readily and quickly disassembled to permit cleaning of all surfaces exposed to fluids passing therethrough. I have also provided a heat exchanger whose parts are free to expand or contract with varying temperatures thereby eliminating bending and distortion of the tubes and the attendant disadvantages.

It will be understood that certain features and sub-combinations are of utility and may be employed without reference to other features and sub-combinations. This is contemplated by and is within the scope of my claims. It is further obvious that various changes may be made in details within the scope of my claims without departing from the spirit of my invention. It is, therefore, to be understood that my invention is not to be limited to the specific details shown and described.

Having thus described my invention, what I claim is:

1. A heat exchanger comprising an outer casing, means forming a flange on the outer surface of said casing adjacent one end thereof, means forming a shoulder on the inner surface of said casing adjacent said end, a collar abutting said shoulder means, an inner conduit member positioned within said casing and spaced therefrom by said collar, packing in said space, a gland slidably fitted between said casing and said inner conduit member, a flange on the outer surface of said gland and clamping means engaging flanges on the casing and the gland for drawing said casing and gland together and compressing said packing against said collar.

2. A heat exchanger comprising an inner conduit member, an outer casing surrounding the same, said conduit member and casing forming a fluid passageway therebetween, an orifice in the wall of said casing adjacent each end, means forming a shoulder projecting inwardly from the inner surface of said casing adjacent each end, a collar abutting the shoulder means at each end, packing sealing each space between the casing and inner conduit member between said collars and the ends of said inner conduit member, a flange on the outer surface of said casing at each end thereof, a gland slidably fitted between said casing and inner conduit member at each end, a flange formed on each of said glands and clamping means engaging a flange on said casing and a flange on the adjacent gland for drawing said casing and glands together and compressing said packing against said collars.

3. A heat exchanger comprising a casing having a peripheral flange at each end, lugs positioned internally of the casing adjacent each end, openings in the casing wall area between the lug positions for admitting and withdrawing liquid from the casing, a collar abutting said lugs at each end, a tube supported internally of said casing by said collars, said casing and tube forming with each other an annular passageway, packing means positioned in the passageway between each end of the casing and the adjacent collar, tubular fluid conducting means engaging the ends of said tube and snugly fitted within the end portions of said passageway, peripheral flanges on said fluid conducting means and clamping means disposed about the periphery of and engaging adjacent flanges on said casing and on said fluid conducting means for drawing said last mentioned members together

4. A heat exchanger as defined by claim 3, each packing means including rings of packing material, and an annular lantern gland interposed between said rings.

5. A heat exchanger as defined by claim 3, including drainage orifices formed in said casing communicating with that portion of the annular passageway containing said packing means.

6. A heat exchanger as defined by claim 3, the flanges on said casing having their rear face inclined to the surface of said casing to form a recess therewith adapted to receive an engaging portion of said clamping means.

7. A heat exchanger as defined by claim 3, said clamping means at each end comprising a plurality of flanged sections of a ring, two flanges on each section, one of said flanges on each said section having an inclined rear face adapting said flange for engagement with a recess formed by a flange on said casing, and the other of said flanges being provided with an adjusting screw adapted for engagement with the flange on one of said fluid conducting means.

8. A heat exchanger comprising a plurality of pairs of nested tubes, means connecting adjoining ends of the outer tubes to form a continuous fluid passageway, means forming shoulders internally of each of said outer tubes, means surrounding said inner tubes and abutting said shoulder means, positioning each nested pair of tubes in concentric spaced relation whereby an annular passageway is formed, packing means in said passageway, return bends connecting adjoining ends of the inner tubes to form a continuous fluid passageway, said return bends each having annular skirt portions fitted within the annular passageways, flanges formed on said outer tubes and said return bends and adjustable clamping means engaging the flanges on said outer tubes and said return bends for drawing said members together whereby said annular skirts will compress said packing against said shoulder means.

9. A heat exchanger comprising an outer casing member, means forming a flange on the outer surface of said member adjacent one end thereof, means forming a shoulder on the inner surface of said casing member adjacent said end, an inner conduit member positioned within and having its periphery spaced from said casing member, sealing means positioned in the space between said shoulder means and the adjacent end of said casing member for effecting a fluid-tight fit between said casing member and said inner conduit member, a gland snugly fitted between said casing member and said inner conduit member and bearing on said sealing means, a flange on the outer surface of said gland and clamping means engaging the flanges on the casing member and said gland for drawing said members together and pressing said sealing means against said shoulder.

10. A heat exchanger comprising an inner conduit member, an outer casing surrounding the same, said conduit member and casing forming a fluid passageway therebetween, means forming a shoulder projecting inwardly from the inner surface of said casing adjacent each end, a collar abutting the shoulder means at each end, packing sealing each space between the casing and inner conduit member between said collars and the ends of said inner conduit member, a flange on the outer surface of said casing at each end thereof, a gland slidably fitted between said casing and inner conduit member at each end, a flange formed on each of said glands and clamping means engaging a flange on said casing and a flange on the adjacent gland for drawing said casing and glands together and compressing said packing against said collars.

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