

April 23, 1940.

D. W. WILSON ET AL

2,198,555

CONTACT CHAMBER

Filed Jan. 27, 1937

2 Sheets-Sheet 1

Fig. 1.

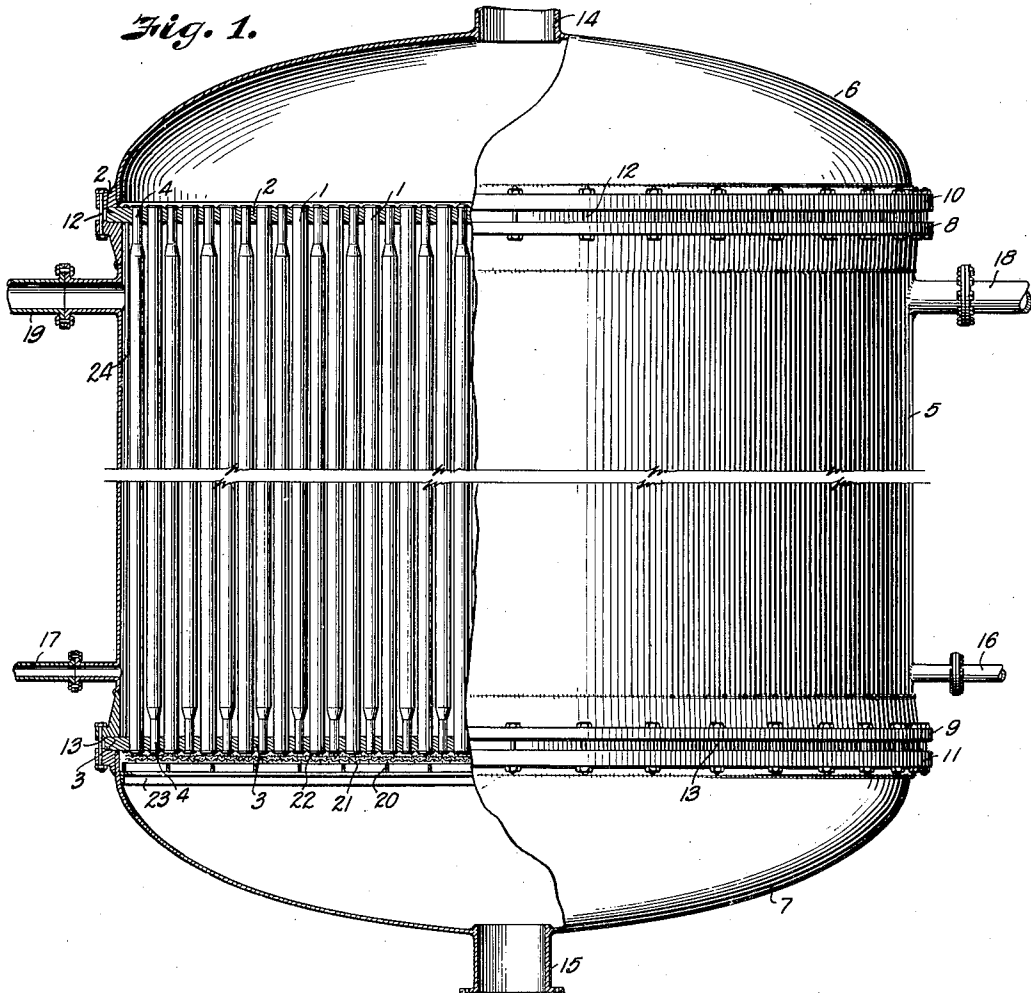
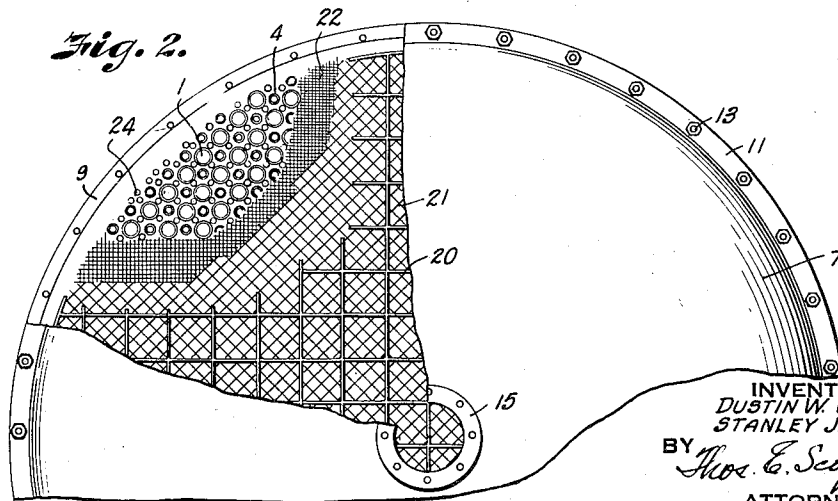


Fig. 2.



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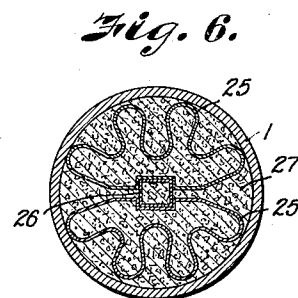
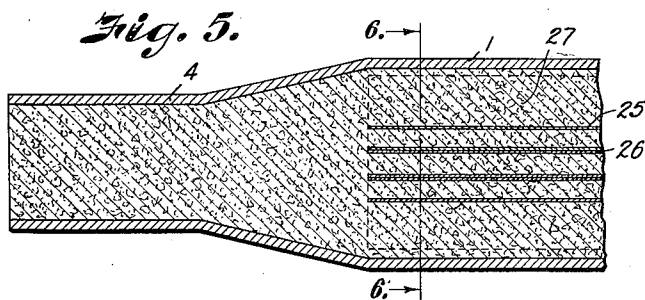
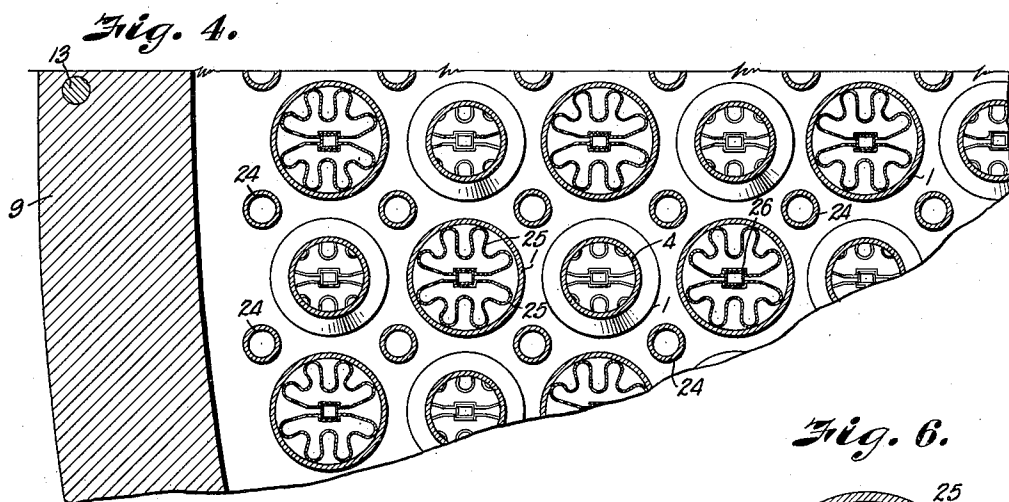
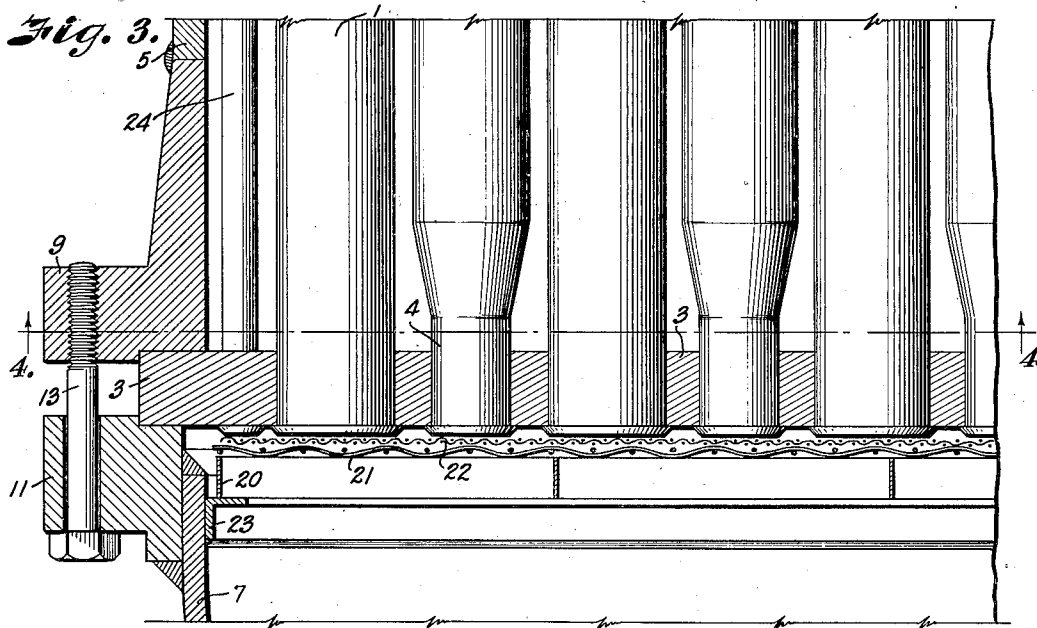
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2 Sheets-Sheet 2



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2,198,555

CONTACT CHAMBER

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Application January 27, 1937, Serial No. 122,654

2 Claims. (Cl. 23—288)

Our invention relates to contact chambers, and more particularly to catalytic contact chambers provided with heat exchange means adapted to be used without catalytic material as heat exchangers.

In many processes employing catalysts, the reaction is either endothermic or exothermic, so that it is necessary to supply or remove heat; consequently requiring provision of a contact chamber which is at once a contact chamber and a heat exchanger.

One object of our invention is to provide a contact chamber construction in which heat may be supplied or removed.

Another object of our invention is to provide a heat exchanger construction in which a large area of heat exchange surface is provided in a minimum of space.

Other and further objects of our invention will appear from the following description.

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

Fig. 1 is an elevation of our contact chamber with parts in section.

Fig. 2 is a fragmentary bottom plan view of the contact chamber shown in Fig. 1, with parts broken away.

Fig. 3 is an enlarged sectional elevation of a portion of the contact chamber shown in Fig. 1.

Fig. 4 is a sectional view taken on the line 4—4, Fig. 3.

Fig. 5 is an enlarged sectional elevation of a portion of a tube of our contact chamber heat exchanger.

Fig. 6 is a sectional view taken on the line 6—6, Fig. 5.

In general, our invention contemplates the provision of a plurality of tubes containing heat conducting members in which there may be positioned, if desired, a contact material or catalyst. The tubes are positioned within a chamber into which a heat exchange medium may be introduced and removed for providing heat exchange and removing or adding heat to material which may be passed through the tubes.

More particularly, referring now to the drawings, a plurality of tubes 1 have their respective ends secured to tube sheets 2 and 3. Each tube 1 is formed with one end 4 of reduced diameter, and adjacent tubes are assembled with the portions of reduced diameter alternately secured to the top and bottom of the tube sheets

in order to enable the tubes to be closely positioned, so that a large aggregate internal volume will be provided with respect to the volume of the casing 5.

Headers 6 and 7 cover the upper and lower tube sheets respectively. Any suitable assembly may be used. As shown, the casing 5 is provided with upper flange 8 and lower flange 9. The upper head 6 is provided with a flange 10, and the lower head 7 is provided with a flange 11. Bolts 12 clamp head 6 to flange 8, and bolts 13 clamp head 7 to flange 9. An inlet connection 14 is provided in header 6 for the material to be passed through the tubes 1, and an outlet connection 15 is provided in header 7 for withdrawing the material passing through the tubes. In Fig. 1 the contact chamber is designed for an exothermic contact reaction in which large quantities of heat must be removed. Water is introduced into the casing 5 through inlet connections 16 and 17, and steam is withdrawn from connections 18 and 19, it being understood, of course, that suitable baffles for diverting the flow of water or steam may be provided, if desired, and any suitable heat exchanger medium other than water may be employed as the heat removing or heat supplying agent.

In the case of catalytic use, a catalytic contact material 27 is placed within the tubes 1. In order to prevent the contact material, which is usually kieselguhr or small particles of clay on which there has been deposited metals, compounds of metals, or combinations thereof, from falling out of the tubes by gravity, we provide a grid 20, which supports a heavy mesh screen 21, which in turn supports a fine mesh screen 22. The grid is in turn supported by an annular flange 23 welded or otherwise secured to the header 7. This construction may be readily seen by reference to Fig. 3.

In the construction shown, the chamber may vary in internal diameter from 4 feet to 16 feet and have a casing length from 4 feet to 30 feet. The tubes 1 may vary in size from 1 inch to 6 inches (I. D.) internal diameter. The heavy mesh screen may have 1-inch squares, and the fine mesh may be 20 per linear inch.

In order to obtain a still further heat exchange surface or area, we may place in the interstices of the large tubes, smaller tubes 24.

The catalytic material is a poor conductor of heat and in order to remove the heat rapidly, it is desired that no contact material shall be far removed from a heat conducting surface. For this purpose we employ means for conducting

heat away from the catalytic material, clearly shown in Figs. 4, 5 and 6.

Elongated, corrugated tubes, vanes or flexible spiders 25 of heat conducting material are placed within the tubes 1, as shown, two of the elongated corrugated tubes 25 being employed. These are made of steel, copper, brass or the like, or of any suitable material, and may be made of extremely thin material. In order to secure the heat conducting members 25 within the tubes 1 by friction, we provide an internal spreader 26 of any desired cross sectional shape. The spreader is adapted to be inserted between the corrugated heat conducting members 25, which are sufficiently flexible to permit its entry. It is contemplated that other means of holding the flexible tubes, vanes or spiders may be employed. In this manner, as will be obvious by reference to Fig. 6, no portion of the catalytic contact material is very far removed from a heat conducting surface. The heat conducting members 25 are in contact with the internal walls of the tube 1, and are adapted to conduct heat from within the tube through the walls of the tube 1 to the heat exchange medium surrounding the tube.

It will be observed that we have provided a contact chamber from which heat may be conducted and supplied at comparatively high rates, and in addition are able to maintain uniformity of temperature throughout the catalytic mass. Our apparatus, for example, would be of value as a heat exchanger between gases or vapors which would be passed through the interior of the tubes, and liquid. It is understood, of course, that if the chamber is used as a catalytic contact chamber, the interior of the small tubes 24 are also filled with contact material, but since these are of small diameter auxiliary heat exchange means 25 need not be employed, since no portion of the contact material will be very far removed from the metallic heat conducting surface.

From the foregoing it will be seen that we have accomplished the objects of our invention. We have provided a catalytic contact chamber in which exothermic heat of a reaction may be removed, or endothermic heat of a reaction may be supplied at a sufficient rate to enable the process to be conducted in a continuous manner. Process conditions frequently require close control of temperature, making it imperative for large amounts of heat to be removed or supplied rapidly. By means of our construction we are enabled to control the process temperature within narrow limits, due to the large area of heat exchange surface which we supply.

While we have described a single pass for the materials passing through the tubes and the heat exchange medium around the tubes, it is to be understood that a plurality of passes may be used if desired. For example, both the inlet and outlet connections may be formed in one header and a baffle dividing said header into two chambers provided so that the fluids passing through

the tubes will pass downwardly through one set of tubes and upwardly through another set of tubes to the outlet. In addition to the above a floating tube sheet construction may be employed.

The conventional practice in heat exchange construction is to have considerably greater external than internal area with respect to the tubes and the space surrounding the tubes. In the present structure for the areas for which the exchange is contemplated it is most desirable to have the internal area as large as possible and there is no disadvantage in having the external area small, as the circulating fluid is in all cases adequate to remove or supply the heat.

Heat exchangers having the internal area at least 120% of the external area can be readily manufactured according to the structure shown and the proportion of internal to external areas of the order of $2\frac{1}{2}$ to 1 have been obtained and proportions of 3 to 1 may be realized.

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 our claims. It is further obvious that various changes may be made in details within the scope of our claims without departing from the spirit of our invention. It is, therefore, to be understood that our invention is not to be limited to the specific details shown and described.

Having thus described our invention, what we claim is:

1. In a catalytic contact heat exchange apparatus, a casing, a pair of tube sheets positioned within said casing, heat exchanger tubes extending between said tube sheets, headers for said tube sheets, elongated corrugated metallic core members positioned within said tubes contacting the interior walls thereof and having portions extending within said tubes, catalytic contact material within said tubes positioned on both sides of the walls of said cores to substantially completely fill the internal cross sectional area of said tubes, means for introducing material to be contacted with said catalyst into one of said headers for passage through said tubes, and means for introducing a heat exchange medium into said casing.

2. In a catalytic contact heat exchange apparatus, a heat exchanger tube, an elongated metallic core having an extended surface positioned within said tube, said core contacting the interior walls of said tube at a plurality of places thereon and having portions extending into the interior area of said tube, catalytic material positioned within said tube on both sides of the walls of said elongated metallic core member and substantially completely filling the cross sectional area of said tube.

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