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# PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

## Improvements in or relating to Bubble Column Type Reaction Vessels

We, FARBWERKE HOECHST AKTIENGESELLSCHAFT, vormals Meister Lucius & Brüning, a Body Corporate recognised under German Law, of 6230 Frankfurt (M) Hoechst, Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which is to be performed, to be particularly described in and by the following statement:—

The present invention relates to bubble column type reaction vessels having internal partitions to guide the reaction mixture and which are fitted with heat exchangers and gassing equipment.

It is known to partition a bubble column type reaction vessel by a flat separating wall into two shafts of equal cross-section or by a cylindrical separating wall into a shaft of circular cross-section and a second shaft of annular form surrounding the first shaft. The reaction takes place in one of the shafts, while the other is used to return the reaction mixture. Furthermore, it is known to fit reaction vessels of simple cylindrical form which are not subdivided, as well as those which are, with heat exchangers and gassing equipment. The heat exchangers for the dissipation or supply of heat mostly consist of single tube serpentines or of hairpin tube elements.

In the case of a known vessel with a cylindrical separating wall, the temperature along the reaction shaft is difficult to control. It is especially difficult to obtain an isothermal reaction which is often desired or necessary. In many cases, the known partitioning is not sufficient. A heat exchanger in the form of a single tube serpentine arranged, for example, in the reaction shaft or in the circulating shaft for indirectly cooling the reaction mixture does not give satisfactory control over the reaction temperature. To subdivide the cooling area to facilitate an isothermal reaction and to provide a multi-tube heat exchanger calls for special constructional and engineering measures which may be very complicated due to the apertures in the partition wall and/or the vessel wall required to receive the tubes. However, with installations of that kind the principal disadvantage of heat exchange tubes of serpentine and hairpin configuration, namely, the danger of obstructions and inaccessibility when repairs become necessary, is not overcome.

The installation of serpentine- and hairpin-like heating or cooling elements in simple cylindrical vessels is difficult. In many cases, control in the vessel, which is desirable for an optimum reaction, is abandoned and the heat exchanger is taken out of the vessel and fitted into an external cycle. In this case additional conveying means are required for maintaining and controlling circulation of the reaction mixture through the external cycle.

Vessels are known which are not fitted with heat exchangers. However, vessels of this type can only be used for reactions which take place without appreciable generation of heat or in which the generated heat does not affect the reaction to any significant extent. If the vessel has no partition or guiding means for the reaction mixture uncontrollable changes may occur with regard to the conditions of flow and the course of the reaction, especially when varying amounts of substances are passed through the vessel.

The present invention provides a bubble column type reaction vessel with internal circulation of the reaction mixture which does not present the aforesaid disadvantages.

The bubble column type reaction vessel of the invention has several shafts which are partitioned from one another by plane separ-

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ating walls and connected with one another at each end of the vessel which has heat exchange means and gassing equipment.

The vessel is partitioned by two parallel separating walls into a reaction shaft and two circulating shafts. The heat exchange means consist of straight tubes, arranged in groups preferably in planes at right angles to the motion of the reaction mixture and parallel to the separating walls. The tubes extend from one side of the vessel to the other through the reaction shaft, and terminate in opposed collecting or deflection chambers externally of the reactor wall. The interiors of the collecting or deflecting chambers are accessible via removable covers.

With a vessel of the kind just described the circulation of the reaction mixture is easy to survey and to control and the reaction temperature can be well controlled so that optimum conditions can be established for exothermal as well as endothermal reactions.

A reaction vessel embodying the present invention will now be described by way of example with reference to the accompanying drawings of which:—

Fig. 1 is a longitudinal section of the vessel along a vertical plane,

Fig. 2 is a transverse cross-section taken at right angles to the section of Fig. 1, and,

Fig. 3 is a part longitudinal section along a plane normal to that of Fig. 1.

Two separating walls 1 divide a cylindrical reaction vessel into a reaction shaft 2 and two circulating shafts 3 both of segment-shaped cross-section. The difference in density between liquid in the reaction shaft through which gas bubbles and the liquid in the circulating shafts which is practically free from gas bubbles causes the liquid to circulate upwardly through shaft 2 and into the open spaces at the top and the bottom of the separating walls 1.

The vessel is fitted with a heat exchanger consisting of straight tubes 5 arranged in horizontal groups and in parallel position with regard to the walls 1. These tubes extend through the reaction shaft 2 through the wall 8 of the vessel and connect to opposed collecting or deflecting chambers 7. The wall of the reactor forms the bottom of the tubes. As can be seen from the drawings, a large heat exchange surface is provided in a relatively small space.

The interiors of the chambers 7 are accessible via removable covers 6. When the covers are taken off the ends of the tubes are exposed and they can be readily cleaned even when the vessel is in use. This is especially advantageous when river water or other contaminated cooling liquids are used in an exothermal reaction. Defective tubes are also easily replaced.

Preferably, the reaction vessel is composed of several shell rings each of which is provided with at least one group of heat exchange tubes and two collecting or deflecting chambers and at least one installation for the supply of gas.

A construction of the type just described enables the vessel to be shortened or lengthened as may be required by different operating conditions.

The embodiment illustrated in Figs. 1 and 2 is composed of three superposed shell rings each containing a group of heat exchange tubes 5, two opposite collecting or deflecting chambers 7 and one gas supply 10. The shell ring in the centre can be dispensed with or instead of one shell ring, a plurality of shell rings may be arranged between the head ring and the bottom ring. In any case, the division referred to above into a reaction shaft and two circulating shafts is maintained. The groups of heat exchange tubes can be charged and connected in appropriate manner in dependence on the reaction conditions in each case. The supply of gas to each shell ring is a further effective help to adjust optimum reaction conditions. The gas supply installations 10 may comprise centrally-disposed tubes containing a number of openings for the gas to issue in known manner over the tube wall. The tubes can be passed once or twice through the vessel walls without having to pass through the separating walls 1.

The circulation of a mixture in the vessel can be influenced by the shape of the ends of the separating walls in connection with a level control device. To control the level a control valve of known construction may be connected to a sleeve 12.

It is advantageous to use separating walls whose upper ends are provided with indentations, slits or perforations. The upper part 11 of separating wall 1 shown in Fig. 3 has slits 13 of different depth and has the function of a weir. Either separating wall may be provided, in the upper part 11, with such slits, or with indentations or perforations. In order to achieve a better mixing of the components of the reaction mixture, it may be desirable to provide each separating wall 1 with a weir. The weirs may be the same or they may be of different shape and height.

WHAT WE CLAIM IS:—

1. A bubble column type reaction vessel having two internal parallel longitudinal separating walls dividing the vessel into a reaction shaft and two circulating shafts both interconnected with the reaction shaft at the ends of the vessel and heat exchange equipment comprising tubes arranged in groups extending through the reaction shaft and the tubes of a group connecting with one another in collecting chambers whose interiors are accessible via removable covers.

2. A bubble column type reaction vessel as claimed in claim 1, wherein the vessel is com-

posed of several superposed shell rings each being provided with a least one group of heat exchange tubes, at least two collecting or deflection chambers and at least one installation for the supply of gas.

3. A bubble column type reaction vessel as claimed in claim 1 or 2, wherein the separating walls are provided at the top with weir-like overflows with indentations, slits or perforations.

4. A bubble column type reaction vessel substantially as described with reference to and as illustrated by the accompanying drawings.

ABEL & IMRAY,
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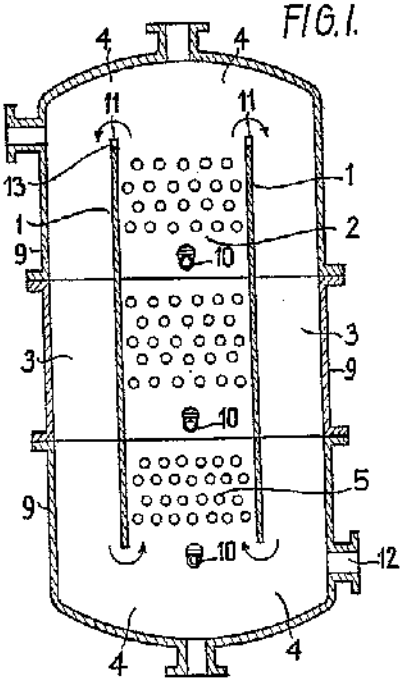
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

FIG.1.



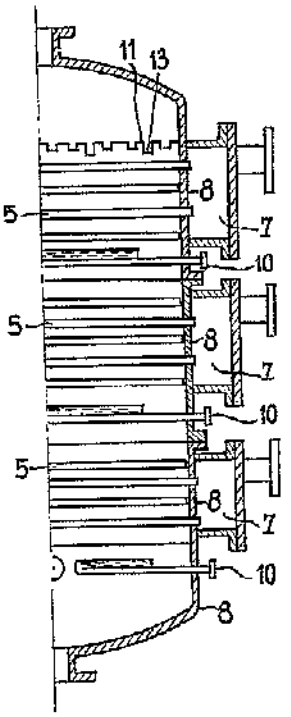




FIG.3.

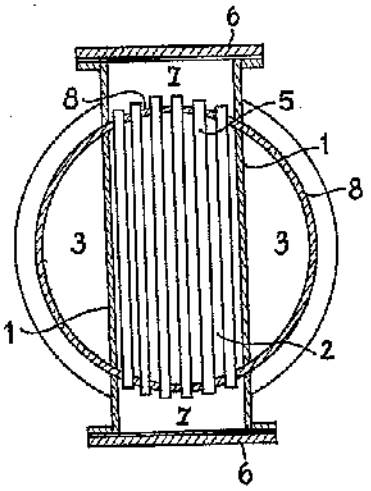



FIG. 2.