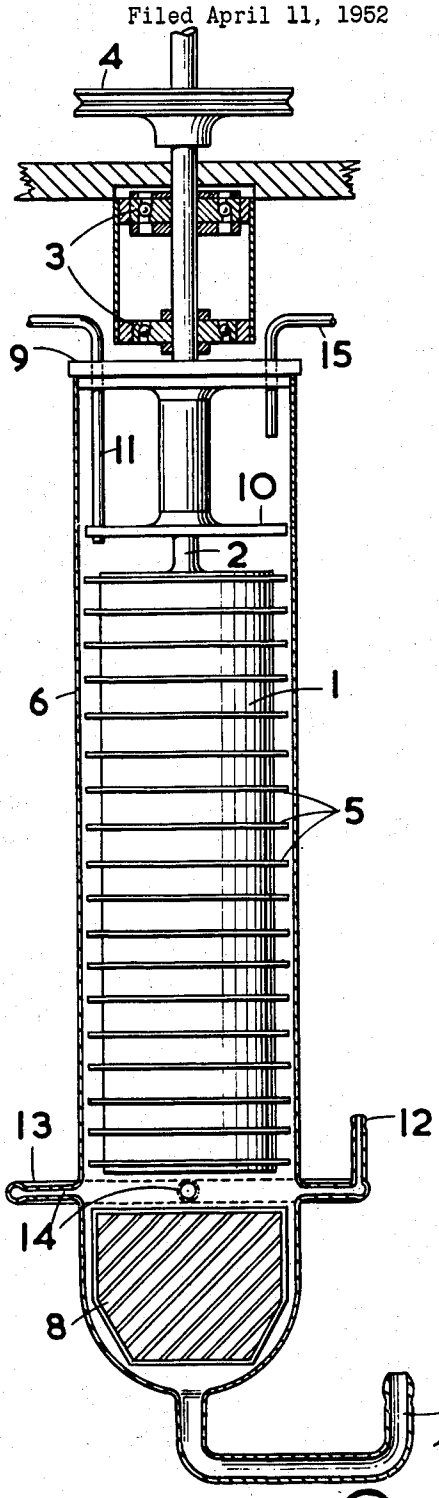
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FLUID CONTACTOR APPARATUS

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FLUID CONTACTOR APPARATUS

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1 Claim. (Cl. 23—270.5)

This invention relates to fluid contactor apparatus of a type comprising a cylindrical column mounted coaxially and adapted to rotate within a cylindrical vessel.

An apparatus of this form has been described by Sir Geoffrey Taylor in the Transactions of the Philosophical Society 1923, vol. 223A, p. 289. As the inner column is rotated a series of oppositely rotating toroidal vortices one above the other are set up in a liquid in the annular space between the columns. When used for contacting two fluids the vortices are set up in the continuous phase at very low speeds and as the speed is increased the dispersed phase becomes broken up by the shearing action into droplets small enough for them to be carried into the vortices.

In small scale laboratory apparatus the vortices are approximately circular in cross section and are packed closely together. The efficiency of the column or its number of equivalent theoretical plates is related to the number of vortices and this number is a maximum when they are arranged in a close pattern as in the said small scale apparatus.

It is found, however, that approximately circular section vortices are formed only if the width of the annulus in the radial direction is more than one half the radius of the inner member. When sealed up to form part of a production plant the retention of these proportions means that the vortices assume large dimensions and for a given number of equivalent theoretical plates a column of considerable height is required.

If, in an attempt to produce smaller vortices, the width of the annulus is reduced so that it is a small fraction of the radius of the inner member, the vortices, instead of remaining circular, tend to elongate in the vertical direction, their height becoming several times their radial width, and no advantage in respect of a reduction in height of the column is obtained.

We have discovered that it is possible to control the vortex pattern so as to reduce the height of the vortices and to this end according to the invention a plurality of annular fins are provided on the rotor such that two contra-rotating vortices are contained within each pair of fins.

In any such system comprising an inner rotating column the invention may be applied to reduce the height of the vortices even if they are normally of circular section but the invention is of the greatest advantage when the relative dimensions are, as stated above, such that tall elongated vortices would be produced in the absence of control. Hence the invention is of particular application when the annular space has a radial dimension less than half the radius of the rotor in which case the fins may be spaced apart along the rotor approximately twice the radial dimension of the annular space.

A small scale production column in accordance with the invention will now be described by way of example with reference to the accompanying drawing which is a vertical cross section of the apparatus. The column is designed to extract a solute from an aqueous solution

by means of an organic solvent and consists of an inner stainless steel cylinder or rotor **1** suspended from a vertical shaft **2** mounted in substantial bearings **3** and arranged to be driven by a belt drive on to a pulley **4** by an electric motor such that the cylinder **1** rotates slowly about its axis. The cylinder **1** is 5¼ in. diameter and carries 18 annular fins or thin annular plates **5** spaced about 1 in. apart and projecting ⅜ in. from its surface.

The outer cylinder or stator **6** is a cylindrical glass vessel 6¼ in. internal diameter and somewhat longer than the rotor **1**. The bottom of the vessel **6** is rounded and provided with an outlet **7** at its lowest point for the aqueous raffinate. This non-cylindrical bottom part is "blanked-off" by a loose fitting lead filled polythene plug **8** having a flat upper surface which is about 1 cm. below the bottom of the rotor **1**.

A polythene cover **9** closes the top of the vessel and supports a polythene baffle **10** just above the top of the rotor **1**.

The aqueous feed is taken in through a polythene tube **11** to a point just below the baffle **10**. As stated above the aqueous raffinate is removed from the lowest point of the vessel through the outlet **7**. The solvent feed is taken from a connection **12** on a manifold **13** to four spaced inlets **14** level with the bottom of the rotor **1** and the solvent outlet is by suction through a polythene tube **15** from the highest part of the vessel **6**.

In the operation of the apparatus large drops of the solvent entering through the inlets **14** are subjected to a shearing stress and break up into small droplets small enough to be carried into the vortices. In the column as a whole the two liquids move in countercurrent direction passing the edges of the fins from one vortex system to another to do so. The maximum flow rate is thus largely determined by the clearance between the fins and the rotor which clearance may vary within wide limits so long as pairs of contra-rotating vortices are sustained between each pair of fins.

The optimum peripheral velocity depends on the viscosity and interfacial tension of the particular fluids used and can be readily determined by trial. For extraction from aqueous solution by organic solvents in an apparatus of the size above described high extraction rates were obtained over a range of speeds from 110 to 300 R. P. M. according to the particular solutions and solvents. With one particular system five theoretical plates were obtained in the apparatus described.

We claim:

A fluid contactor apparatus to which fluids to be contacted are fed and from which extract and raffinate are removed comprising a cylindrical containing vessel, a cylindrical rotor, means mounting said rotor for rotation coaxially within said vessel to leave an annular space having a radial dimension less than half the radius of the rotor, a plurality of thin annular fins on said rotor spaced apart along the rotor approximately twice said radial dimensions so as to confine between each pair two contra-rotating substantially circular vortices, conduit means for feeding the fluids to be contacted to the vessel and conduit means for removing the extract and the raffinate.

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