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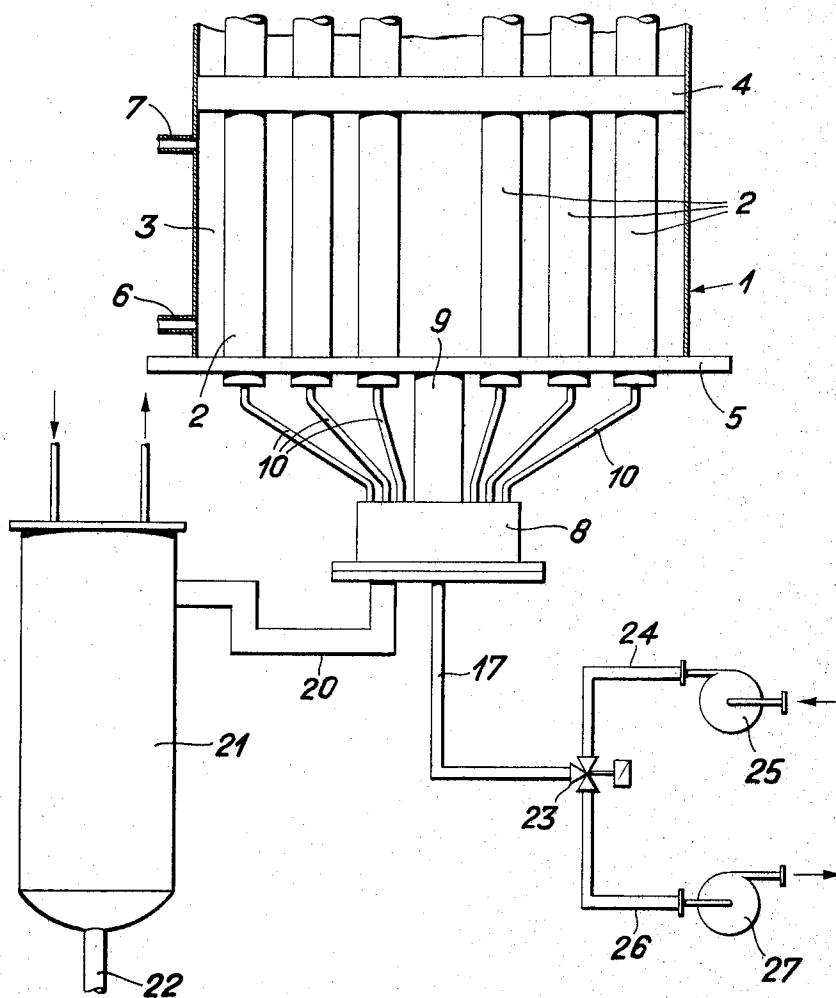
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MATERIAL EXCHANGE COLUMNS

Filed Nov. 16, 1962

2 Sheets-Sheet 1

Fig. 1



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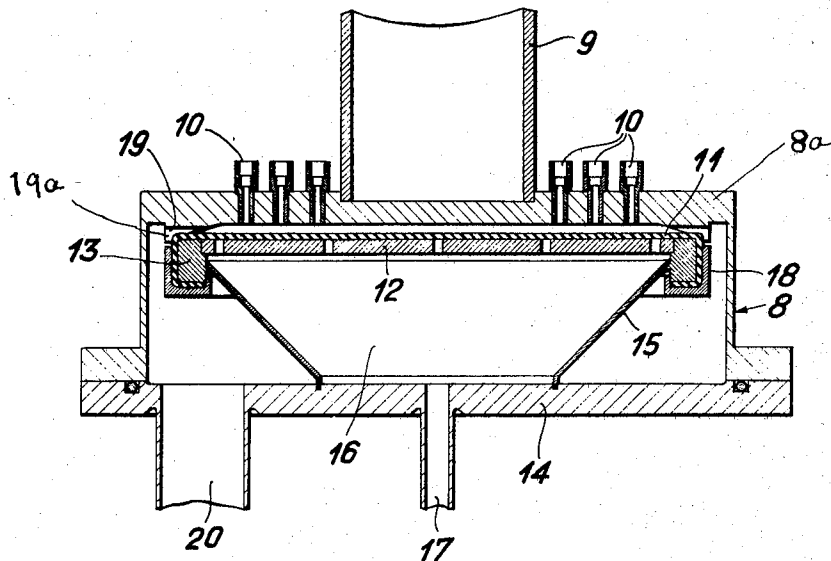
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Fig. 2



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MATERIAL EXCHANGE COLUMNS

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1 Claim. (Cl. 137—625.4)

This invention relates to exchange columns having a plurality of ducts or channels in which a liquid and a gaseous or vapor-like medium are caused to flow in opposite directions, and more particularly to the extraction of a product material from such columns.

Exchange columns of this kind are used for distillation, rectification, extraction, absorption and similar processes. In known exchange columns of the type to which the invention relates, all the exchange channels open into a common collecting or removal chamber from which the desired enriched product can be withdrawn through a pipe having a closure member such as a valve. In an improved version of such known apparatus, each channel is provided with means for effecting withdrawal of the product from that channel, this means having a throttling element or constriction therein and also a closure element such as a valve whose opening is greater than that of the throttling element. This improved version obviates the risk present in the first type of known apparatus above-described wherein, at times when no product is being withdrawn from the column due to closure of the valve in the common withdrawal line from the collecting chamber, the product might flow from one exchange channel to another through the throttling elements associated with those channels and through the collecting chamber.

In one particular form of such improved apparatus which has been heretofore proposed, a plate is in operative connection with locking elements of the valves for the individual channels and can be reciprocated through the agency of one or more pressure-medium-operated bellows type devices. This system of operating the valves leads to a relatively high constructional outlay, more particularly in the case of a column having a large number of exchange channels and a correspondingly large diameter. Also, unless the closure members are of absolutely identical construction, they may not all open and close simultaneously.

In the apparatus of the invention instead, the withdrawal pipes or lines from the various channels of the column open individually into a common collecting vessel and are provided there with a common closure device which takes the form of a flexible diaphragm. The diaphragm is connected on one side to a controllable source of pressure, which may be either pneumatic or hydraulic. By variation of pressure on this one side of the diaphragm, the other side of the diaphragm can be stressed into sealing relationship with the ends of the withdrawal pipes from the individual exchange column channels inside the collecting vessel, in order to interrupt withdrawal of the product from the channels, or the diaphragm can be withdrawn from engagement with those withdrawal pipes. To this end, the diaphragm is held in a support which defines for the said one side of the diaphragm a control chamber which is closed off from the remainder of the interior of the collecting vessel. Means may be provided for applying a variable pressure to this control chamber, and hence to the one side of the diaphragm. An advantage of the invention is thus that by means of a single closure device all of the individual channel withdrawal pipes can be closed off from the collecting vessel and from each other.

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In one advantageous embodiment of the invention, the diaphragm support comprises a metal plate within the control chamber. The plate is pierced with a number of apertures and is disposed in a metal ring secured to the baseplate of the removal tank by means of a hollow member, the diaphragm being clamped between the metal ring and a clamping ring.

Advantageously, the top cover plate of the removal tank continues on its underside as an annular member formed on its periphery with slots serving as exit apertures for product.

Advantageously, when the invention is used in a material exchange column used to separate heavy from light water, a rubber diaphragm is used. Of course, it is convenient to use a rubber diaphragm when the substances being treated in the column are not such as attack rubber. In other cases the diaphragm is made of some other resilient substance which is not attacked by the substance being treated in the column. For instance, resilient plastic is suitable in many cases.

Other features of the invention will become apparent from the exemplary embodiment which will be described hereinafter and which is diagrammatically illustrated in the accompanying drawings wherein:

FIG. 1 is a side elevation, partly in section, of one form of apparatus according to the invention for removal of the product from the lower end of a material exchange column, and

FIG. 2 is a fragmentary vertical section at an enlarged scale of the apparatus of FIG. 1.

In FIG. 1 there is shown the lower end only of a material exchange column 1 having a plurality of parallel channels 2. The piping which supplies the mixture of material to be separated, such as for example a mixture of light water and heavy water, has therefore been omitted. Only six exchange channels 2 are shown, but in practice a larger number of exchange channels, for instance possibly more than 100, will be necessary for many separating processes. Assuming that the product is to be removed in vapor form, the channels 2 extend through a vapor chamber 3, the upper and lower boundary surfaces of which are formed as members 4 and 5 which function as supports for the channels 2. Hot vapor is supplied to and withdrawn from the chamber 3 through pipes 6 and 7. Above the member 4—i.e., in the portion of the channels 2 wherein the material exchange process takes place, the channels are usually filled with packing. Throttle capillaries (not shown) are disposed in the bottom part of the channels. A tank 8 for receiving the product, for instance concentrated heavy water in vapor form, is suspended below the column from the member 5 by means of a support 9. Extraction tubes 10 connected to the channels open into the tank 8.

FIG. 2 illustrates in detail a preferred embodiment of the invention, beginning with the extraction tubes 10. The lower ends of these tubes pass through and are secured to the cover plate 8a of the tank 8. Within the tank there is disposed a closure member 11 which takes the form of a diaphragm and which is operable to close and to open all of the tubes 10. In the case of a column employed for the separation of heavy water from light water, the diaphragm may be made of rubber. The diaphragm is held between a ring 13 and an outer clamping ring 18, and an apertured metal plate 12 extends across the ring 13. The ring 13 in turn is supported from the baseplate 14 of the tank 8 by means of a hollow conical member 15. The member 15 defines with the diaphragm 11 a chamber 16 which is sealed in gas-tight fashion from the remainder of the interior of the tank 8.

The underside of the cover plate 8a may include an annular projection 19 bearing against the periphery of

the diaphragm, with slots 19a in that projection to give access between the space within the tank above the diaphragm and the remainder of the interior of the tank which is outside the member 15.

A pipe 20 connects the interior of the tank 8, exteriorly of chamber 16, with a condenser 21. The liquified product may be either withdrawn directly from the condenser or taken through a pipe 22 to a collecting tank, not shown.

In this embodiment, the control chamber 16 can be selectively connected through a pipe 17 and a three-way valve 23 to a pipe 24 and pressure pump 25 or to a pipe 26 and vacuum pump 27. Conveniently, the valve 23 is a solenoid valve and is controlled, for example, by a timer (not shown) in dependence upon a preset removal or extraction program. During the time when no product is being removed and in which the product is being enriched in the bottom part of the channels 2, the exit orifices of the tubes 10 are closed in gas-tight fashion by the diaphragm 11. To this end, the control chamber 16 is connected via the pipes 17 and 24 to the pressure pump 27, the pressure in the chamber 16 being higher than the pressure in the channels 2. To remove the product, for example for a few minutes every hour, the chamber 16 is connected by the valve 23 to the vacuum pump 27 so that the pressure in the chamber 16 is reduced below the pressure in the channels, and the product then flows from the channels through the tubes 10 and tank 18 into the condenser 21.

When the pressure in the material exchange column is below atmospheric pressure, the control chamber 16 may, to close the closure member 11, simply be connected to atmosphere, while to open the closure member the chamber 16 can be connected to a vacuum pump which produces a correspondingly low pressure below the pressure of the column.

It may occasionally be convenient for the system to be controlled by a densimeter which is advantageously disposed in the pipe 22. In this case the opening time, instead of being preset, is controlled automatically in

dependence upon the concentration of the product in the condenser 21. The opening time decreases for decreasing concentration and increases for increasing concentration. The product can therefore be automatically maintained within a desired range of concentrations.

Of course, the invention is not limited to the embodiment described. For example, the product can be removed in liquid form. Also, the removal system or device according to the invention can be disposed at the upper end of the exchange channels in material exchange columns of the kind in which the more volatile ingredient of the mixture is removed during particular time intervals.

I claim:

Apparatus for controlling the removal of a product from a material exchange column having a plurality of vertically extending exchange channels therein, said apparatus comprising a tank beneath said channels, a separate conduit extending from each of said channels to the interior of said tank, said conduits terminating within said tank substantially in a common plane, a flexible diaphragm supported within said tank adjacent said plane and beneath the openings of said conduits within said tank in position to be stressed simultaneously against, and alternatively to be simultaneously retracted from, the openings of all of said conduits in said tank, means defining a chamber communicating with the side of said diaphragm opposite said openings and closed from the remainder of the interior of said tank, and means to apply a variable pressure to said chamber.

References Cited by the Examiner

UNITED STATES PATENTS

1,644,792	10/1927	Remy	137—103
2,612,185	9/1952	Allen	251—25 X
2,677,390	5/1954	Davis	251—61 X
2,698,711	1/1955	Newcomb	251—61 X

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