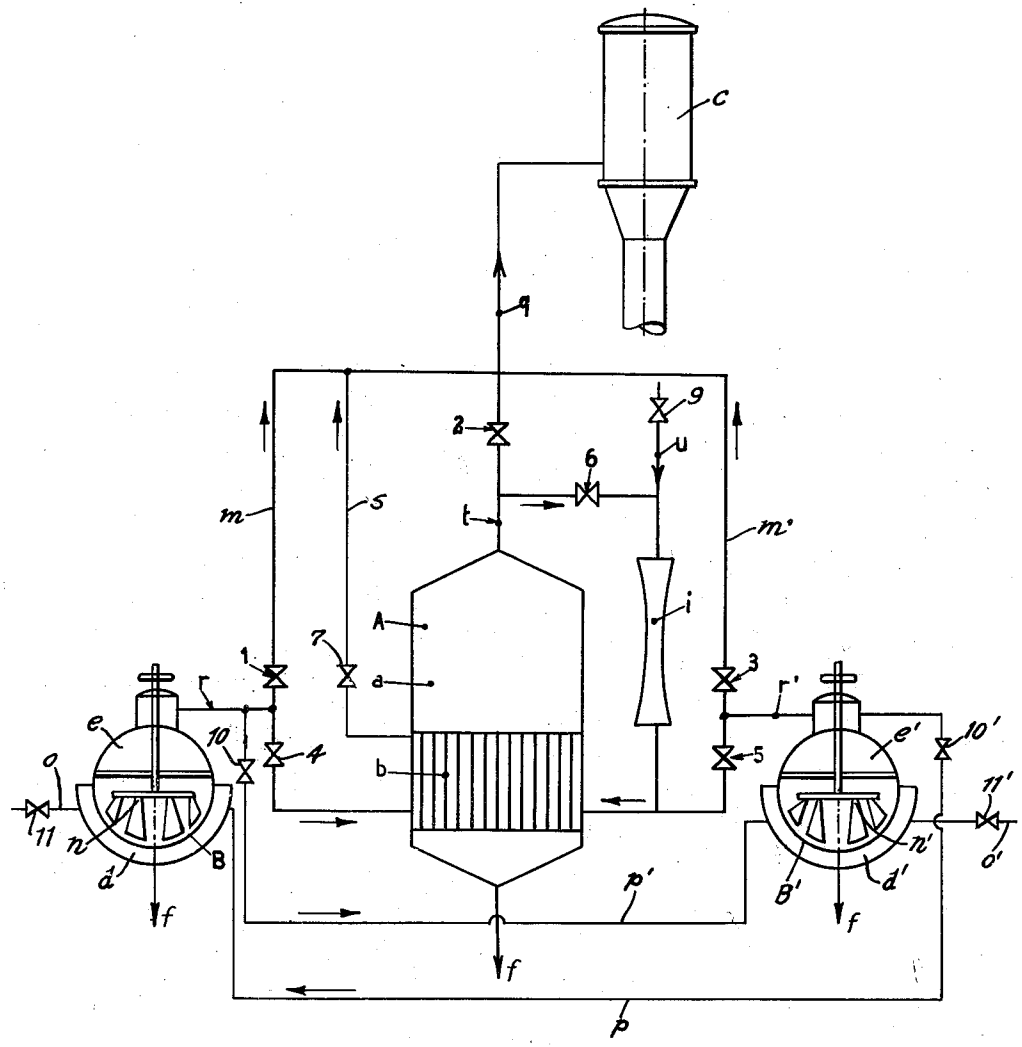
Dec. 4, 1951 A. B. OTTOLENGHI 2,577,090

EVAPORATING PLANT OPERATING BY THERMOCOMPRESSION

Filed Dec. 4, 1947



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Patented Dec. 4, 1951 2,577,090

UNITED STATES PATENT OFFICE

2,577,090

EVAPORATING PLANT OPERATING BY THERMOCOMPRESSION

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Application December 4, 1947, Serial No. 789,659
In Italy December 22, 1942

1 Claim. (Cl. 159—20)

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This invention relates to an evaporating apparatus, more particularly for concentrating juices, which affords a considerable economy in operation.

A process of evaporizing liquid while progressing it through a series of vessels or evaporating units which are permanently connected with each other, so that a certain evaporating unit of the series is constituted the initial one, to which the weak liquid is always introduced, and another evaporating unit is constituted the terminal one, in which the liquid is always evaporated to greatest specific gravity and from which the liquid concentrate is discharged, is generally known.

It is also known to operate said concentration in a multiple effect apparatus in order to obtain the highest economy in live steam consumption, that is by connecting an evaporating chamber of an initial unit with the heating chamber of the next one and so on, in some cases suitable condensing apparatus being employed in order to ensure a high vapor ouput from the last units.

The chief object of the present invention is to provide an evaporating apparatus comprising in combination a thermocompressor and a plurality of evaporating units connected in such a manner as to obtain either fractional concentration or multiple effect, using in each operation suitable means for securing the highest efficiency of the plant.

A further object of this invention is to provide a multiple effect evaporating apparatus comprising an evaporating unit, a thermocompressor coupled with said evaporating unit, a number of evaporating units having a stirring means, valved conduit means for connecting said plurality of evaporating units with each other and with said first evaporating unit in such a manner that a multiple effect apparatus is obtained. Means for cutting off said thermocompressor from said first evaporating unit are employed.

A further object of this invention is to provide an apparatus of the type described in which vapor condensing means are provided having valved conduit means for separately connecting and disconnecting said first and second mentioned evaporating units with said condensing means.

The invention will be better understood by reference to the accompanying drawing which shows diagrammatically an apparatus in its preferred embodiment.

A shows an evaporator operating by thermocompression and comprising an evaporating chamber *a*, heating chamber *b*, thermocompressor *i* fed by the live steam conduit *u*, and pipes *t* and *q*, which connect the evaporating chamber *a* with the condensing unit.

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A pipe S provided with a cock 7 connects the chamber *b* with the condensing apparatus C when it is desired to operate in vacuum also in the heating chamber.

B, B' are conventional single-acting evaporators, each of which is provided with a double bottom, *d*, *d'* for heating purposes, and an evaporating chamber *e*, *e'* connected with the heating chamber *b* of the evaporator A by means of the conduits *r*, *r'* and cocks 4, 5, respectively.

The evaporating chambers *e*, *e'* may be connected with the condensing unit C through conduits *m*, *m'* provided with cocks 1 and 3, respectively, when it is desired to operate the evaporators B, B' in vacuum.

A plant of this kind may operate, for instance, in the following manner. The evaporator A is utilised for the preliminary concentration of the juices to be processed and which shall be brought to their final degree of density in the evaporators B, B' generally in the form of flasks and provided with suitable stirring means *n*, *n'* for an efficient mixing of the concentrate which may be at the end of the operation, in a viscous condition.

At the start of the operation, when all the evaporators A and B, B' are filled with fresh juice of low density, large quantities of steam are evolved, as is well known, and under these conditions the steam generated in the evaporators B, B' may be sufficient for feeding the evaporating unit A.

During this stage, the thermocompressor *i* is cut off by closing the valve 9, the live steam inlet U as well as the valve 6 in order to cut off any communication between the evaporating chamber *a* and heating chamber *b* of the unit A.

The valves 1, 3 connecting the units B, B' with the condensing apparatus C are also closed, the condensing apparatus communicating merely with the unit A through the open valve 2.

All the steam generated in the units B, B' is conveyed through the valves 4 and 5 into the heating chamber A.

Consequently, by starting the operation with the fresh juice, and holding the valves 4 and 5 open, the evaporator A performs the function of a second effect, the first effect being performed simultaneously by two evaporating units B, B' operating now as double-acting units.

On the other hand, according to the initial consistency of the juice, it may be useful to perform the described first step, that is the starting step, operating by treble-effect instead of a double-effect only. In this case the heating chamber *d* of the evaporator B will be connected by means of a pipe *p* provided with a cock 10' with the evaporating chamber *e'* of the evaporator B'. By closing the valves 1, 3, 5, 6, 9, 10 and opening the valves 4 and 10' the treble-effect is obtained in which the units B', B and A are the first, second and third-effect vessels, respectively, the live steam being supplied to the heating chamber *d'* of the first effect unit B' through a tube O' provided with a cock 11'.

An alternative treble effect can be obtained by connecting the heating chamber *d'* of the unit B' with the evaporating chamber *e* of the unit B by means of a pipe *p'* provided with a cock 10 and by closing the valves 1, 3, 4, 6, 9, 10' and 11' and opening the valves 5 and 10, the live steam inlet being now the cock 11 and the tube O.

All the operations as described can be performed with or without intervention of the condensing unit C by opening or closing the valve 2.

However, it is known that, all other conditions being equal evaporation decreases as concentration proceeds, so that in carrying out the above described process a point is reached at which the steam evolved by the units B and B' would no longer be capable to produce a sufficient evaporation in the unit A.

It then becomes necessary to provide a supplementary source of heat adapted to afford sufficient evaporation in the unit A with a low consumption of power.

With this object in view, the thermocompressor *i* will be connected to the plant by opening the valves 6 and 9 after having closed the valves 4, 5, 10 and 10'. At the same time the two evaporating units B and B' will be connected to the condensing apparatus C by opening the valves 1, 3, each of said units being fed separately by live steam inlet pipes O and O'.

In this manner, the units B and B' will be single-acting, while the unit A operates with a high efficiency afforded by thermocompression.

A transfer of a juice from the unit A to either one or both the units B, B' for a final concentration can be performed with usual means generally known. However, the arrows *f* indicate diagrammatically the discharge ports of the units A, B and B'.

It will be seen that after the preliminary concentration in the evaporator A, the juice may be further concentrated within the units B, B' also by a double-effect process independently from the operation of the unit A operating in regenerative cycle. For this purpose it is sufficient to hold the valves 1, 4, 5, 10' and 11' closed and

open valves 11, 10 and 3 so that the unit B becomes a first-effect vessel and B' the second-effect one.

Many other combinations are possible, as for example when it is desired to operate the evaporating units B only or unit A only, as may be required in periods of reduced activity without reaching the highest concentrations.

In the first case the unit A will be cut-off by closing the valves 2, 4, 5, 6, 7 and 9 and the remaining valves being in the "open" or "closed" position in order to operate the evaporators B and B' separately or by double-effect as above described.

In the second case, by opening the valves 2, 6 and 9 and closing valves 1, 3, 4, 5, 11 and 11', the evaporator A will be operated in a regenerative condition.

The plant may obviously comprise a plurality of units A and B, leaving unaltered its main properties within the scope set forth in the appended claim.

What I claim is:

Evaporating apparatus comprising in combination a first evaporating unit, a thermocompressor adapted to be connected with and disconnected from said unit, valved means connecting said thermocompressor with a live steam conduit, two evaporating units having stirring means, valved conduits for supplying live steam separately to each said last unit, valved conduits connecting the evaporating chamber of either of said last mentioned units, with the heating chamber of the other unit and with the heating chamber of said first mentioned unit, and a condensing apparatus adapted to be selectively connected with either of the evaporating chambers of said three units and with the heating chamber of the first mentioned unit.

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