R. MELLOR.

FEED REGULATING DEVICE FOR EVAPORATORS.

APPLICATION FILED FEB. 12, 1910.

991,342.

Patented May 2, 1911.

Fig. 2.

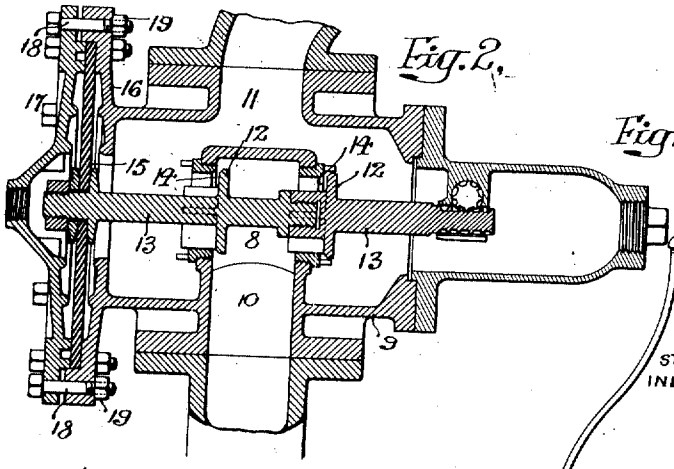


Fig. 1.

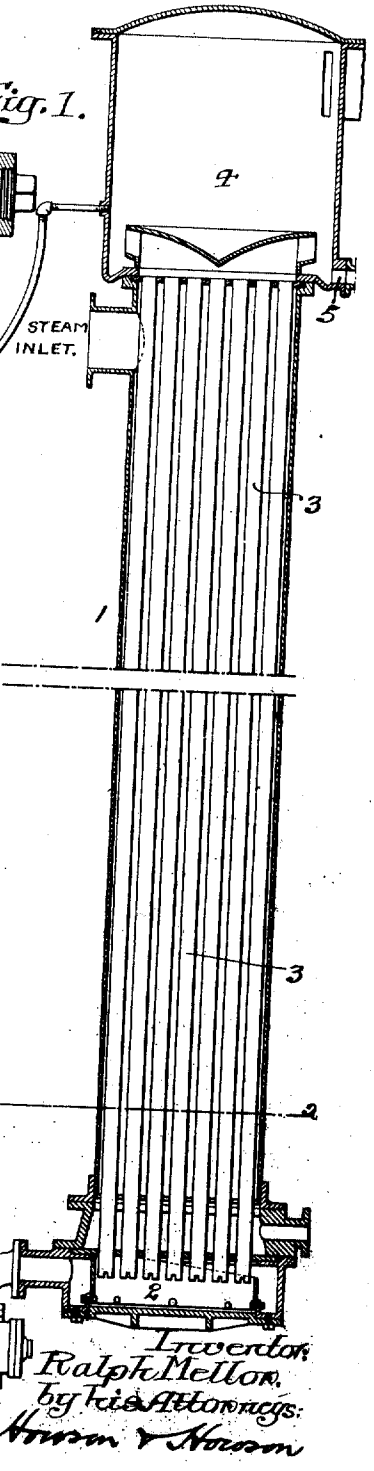


Fig. 3

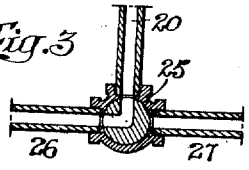


Fig. 4

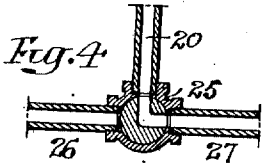
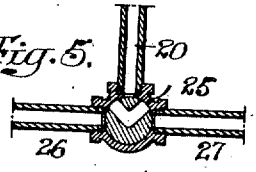


Fig. 5.



Witnesses.—
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UNITED STATES PATENT OFFICE.

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FEED-REGULATING DEVICE FOR EVAPORATORS.

991,342. Specification of Letters Patent. Patented May 2, 1911.

Application filed February 12, 1910. Serial No. 543,541.

To all whom it may concern:

Be it known that I, RALPH MELLOR, a citizen of the United States, residing in Philadelphia, Pennsylvania, have invented certain Improvements in Feed-Regulating Devices for Evaporators, of which the following is a specification.

My invention relates to apparatus designed for evaporating liquids; being especially applicable to evaporators of the "climbing film" type, although not necessarily limited to such apparatus, and the object of my invention is to regulate the feed of the liquid undergoing concentration. This and other features of my invention will be fully pointed out hereinafter, reference being had to the accompanying drawings, in which:

Figure 1, is a view of a single evaporating effect of the Kestner type, to which the feed regulating device forming the subject of my invention may be applied; Fig. 2, is a sectional view of the feed valve employed for the evaporating effect shown in Fig. 1, the operation of which is controlled by my improved regulating device, and Figs. 3, 4 and 5, are sectional views illustrating different operative positions of a valve employed in connection with the feed regulating device forming the subject of my invention.

It may be readily understood in the operation of any form of evaporator, whether of the film-climbing or standard type, that it is extremely easy to effect regulation if conditions remain constant. In other words, if the steam pressure, vacuum, and temperature of feed juice remain the same, a fixed opening of the feed valve and a fixed opening of the discharge valve will mean uniform density of discharge; such condition being as nearly ideal as it is possible to accomplish. If any of these conditions vary, the density of the discharge will vary. In standard evaporators or in any evaporator having a large volume of juice, a variation in steam pressure for instance will not immediately affect the discharged liquid on account of the large volume acting more or less as a governor for smoothing out or rendering innocuous these conditions. In the case of a film or flash type evaporator, however, working in multiple, the conditions are quite different, and when the steam pressure, for example, falls the feed remaining the same, the evaporation in pan number one immediately decreases; the result being that the tubes, in the case of an evaporator of the Kestner type, become more or less filled with liquor. As soon as this occurs, the actual evaporating surface is reduced and as evaporation in pan number one becomes less, due not only to the fall in steam pressure but also due to the reduction in efficient evaporating surface, evaporation in the remaining pan or pans will be decreased in the same way. When the steam pressure is increased, the mass of juice already in pan number one and partially filling the tubes of the same is apt to be mechanically projected from them, causing a large flow of thin liquor into pan number two, and so on throughout the other pans, resulting in a discharge at the final outlet of a body of thin liquor. To avoid these conditions, when the steam pressure is reduced from any cause, the feed should be proportionately reduced. The object of my invention therefore is to produce a uniform density of discharge by so regulating the supply of liquor that pan number one on the one hand cannot become flooded, and on the other hand cannot become empty.

Referring to the drawings, 1 represents an evaporating effect of the Kestner type, in which liquor is fed to a suitable chamber 2 at the lower part of the same from which it rises through a series of vapor heated tubes 3, finally overflowing into an upper chamber 4 wherein separation of the steam and liquid may be effected by suitable means; the liquid passing through an independent discharge pipe 5 to any desired point or to another effect in the case of a multiple effect apparatus, while the vapor or steam may pass to the heating space of the next pan, to a suitable condenser, or be otherwise disposed of.

Controlling the feed to the evaporator is a valve 8, clearly illustrated in Fig. 2, and mounted within a casting 9. This valve is of the balanced type and the shell or casting 9

is provided with a suitable inlet 10 and outlet 11 for the liquid passing the valve. The valve is duplex in character; comprising flanges 12 carried by a suitable stem 13 and arranged to engage seats 14 carried by the shell 9, and in the present instance, as shown in the drawings, it is arranged to work horizontally. The valve stem is suitably connected at one end to a diaphragm 15 held between the end wall 16 of the valve casing and a suitable cap-plate 17 by means of suitable bolts and nuts 18 and 19. The liquid passing said valve and entering the tubes 3, therefore, may act upon one surface of the diaphragm, while liquid of another character may act upon the other surface of the diaphragm; balancing the valve, whereby a constant and uniform feed to the tubes may be effected.

The liquid on the other side of the diaphragm is disposed in a stand pipe 20 suitably connected to the cap-plate 17 and the height of such liquid may be controlled by a valve 25 of such character than when in one position more liquid from a suitable source and under sufficient head may be admitted into said stand pipe via the connection 26; when in another position the liquid may be tapped or drained from the stand pipe via the connection 27, and when in a third position inlet and outlet of liquid to and from said stand pipe is cut off. The upper end of this stand pipe is connected with the vapor space of the separating chamber 4, in the present instance by means of a pipe 26.

The inner (or under) side of the diaphragm is in connection with the liquid in the evaporator, and the upper (or outer) side of the diaphragm is under constant pressure due to a definite head of liquid in the stand pipe 20. In addition to this the barometric pressure on either side of the diaphragm is balanced; the space above the diaphragm being connected with the vapor space in the chamber above the tubes 3; the space below the diaphragm (or its inner side) being also in communication with said vapor space through the volume of liquid in the chamber 4 and lower ends of the tubes. It will then be seen that any variation in the barometric pressure in pan number one will not affect the diaphragm in either direction. The diaphragm will yield in one direction when the liquid head in the pan overpowers the liquid head above the diaphragm, and conversely. As the diaphragm moves in one direction, the valve closes; when it moves in the opposite direction the valve opens.

Under certain conditions, it may be desirable to vary the height to which the liquor in the pan is allowed to rise, and this may be accomplished by adding to or reducing the head of liquid above (or on the outer side of) the diaphragm. One way of accomplishing this result is by means of a three-way cock such, for instance, as shown in the sectional views, Figs. 3, 4 and 5, and indicated at 25, the casing of such valve being so arranged that one opening connects with a pipe 26 from a suitable source (not shown) of water under sufficient head to fill the desired space in the stand-pipe; another opening connects with a pipe 27 leading to a vacuum space or spaces at a lower pressure than the barometric pressure above the diaphragm, and the third connects with the stand-pipe above the diaphragm. In lieu of a single cock, three independent valves or cocks, or, in fact, two, might be employed to accomplish the same purpose. In instances where it may be undesirable or inconvenient to directly connect the stand pipe 20 with a source of liquid (or water) supply, the regulation of the column of liquid (or water) within said stand pipe may be accomplished by the use of a piston or plunger fitting said stand pipe or a pipe communicating therewith and movable therein to raise or lower the effective head of such column of liquid. In such case special provision may be made for introducing liquid or water into said stand-pipe independently of the supply connection shown in the drawings.

The line *x*—*x* indicates the approximate height of the liquid in the stand-pipe and the liquid undergoing treatment in the tubes 3. The stand-pipe may be provided with a gage glass 31; couplings 32 being provided to connect the same therewith. A plurality of couplings are shown in case it may be desired to shift the gage glass when changing the height to which the liquid may rise in the stand-pipe. A thermometer may be attached to the coupling disconnected from the gage glass. In lieu of a gage glass, a pressure gage may be employed to indicate height of liquid in stand-pipe and tubes.

The operation of my feed valve depends upon the rate of evaporation in pan number one, and is under complete control of the operator, but is independent of the variations in feed, operation of the pumps, and changes of pressure, or vacuum of said pan number one.

The valve stem is shown with a toothed end in engagement with a toothed rod whereby the valve may be operated by hand at any desired time. This mechanism is designed to be easily operable so that any movement of the diaphragm due to changes in pressures acting upon the same will be transmited to the valve stem whose movement in either direction will not be retarded by the toothed rod. There may be, of course, considerable play between the teeth of the valve stem and those of the rod.

The advantages of my improved safety feed and density control valve are: preven-

tion of flooding; prevention of change in rate of feed due to variation in feed pump or vacuum; control of the percentage of evaporation; control of rate of feed of liquid undergoing treatment, and prevention of pulsations in a film ev. porator.

I claim:

1. In an evaporator, means for feeding liquid thereto, a valve controlling such feed, a diaphragm connected to said valve and in engagement on one side with the liquid fed after it has passed said valve, and means for applying liquid to balance the head on the opposite side of said diaphragm, said latter body of liquid being in communication with the evaporator and subject to the varying degrees of pressure exerted therein.

2. In an evaporator, means for feeding liquid thereto, a balanced valve controlling such feed, a diaphragm connected to said valve and in engagement on one side with the liquid fed after it has passed said valve, and means for applying liquid to balance the head on the opposite side of said diaphragm, both bodies of liquid being in communication with the evaporator and subject to the varying degrees of pressure exerted therein.

3. In an evaporator, means for feeding liquid thereto, a valve controlling such feed, a diaphragm connected to said valve and in engagement on one side with the liquid fed after it has passed said valve, means for applying liquid to balance the head on the opposite side of said diaphragm, said liquid being in communication with the evaporator and subject to the varying degrees of pressure exerted therein, and means for controlling the volume of such liquid.

4. In an evaporator, means for controlling and regulating the feed of liquid thereto comprising a balanced valve, a diaphragm carried by said valve and in contact with the liquid undergoing treatment after it has passed said valve, a separating chamber forming part of the evaporator, means for applying liquid to the opposite side of said diaphragm, and means for placing such liquid in communication with the vapor chamber of the evaporator.

5. In an evaporator, means for controlling and regulating the feed of liquid thereto comprising a balanced valve, a diaphragm carried by said valve and in contact with the liquid undergoing treatment after it has passed said valve, a separating chamber forming part of the evaporator, means for applying liquid to the opposite side of said diaphragm, means for placing such liquid in communication with the vapor chamber of the evaporator, and means for controlling the volume of such liquid.

6. In an evaporating apparatus comprising a vacuum chamber, a conduit for supplying liquid thereto, a valve controlling the flow of such liquid, a chamber connected to the conduit, a diaphragm spanning said chamber and connected to said valve, means for maintaining a column of liquid of controllable height in contact with the outer side of said diaphragm, a separating chamber forming part of said evaporating apparatus, and means for placing such column of liquid in communication with said separating chamber.

7. In an evaporating apparatus comprising a vacuum chamber, a conduit for supplying liquid thereto, a valve controlling the flow of such liquid, a chamber connected to the conduit, a diaphragm spanning said chamber and connected to said valve, means for maintaining a column of liquid of controllable height in contact with the outer side of said diaphragm, and means for placing such liquid in communication with the vapor chamber of the evaporator.

8. The combination of a vacuum evaporator having means for feeding liquid thereto, with a feed controlling device, said feed controlling device comprising valved operating means adapted to be operated in one direction by the pressure of liquid within the evaporator and in the other direction by the pressure of a stationary column of liquid of controlled height, and means for balancing out the disturbing influence of the vacuum within said evaporator upon said pressures.

9. The combination with a vacuum evaporator having means for feeding liquid thereto, of a feed controlling device, said feed controlling means comprising a connected valve and diaphragm, and said diaphragm being exposed on the one side to the pressure of liquid within the evaporator and on the other side to the pressure of a stationary column of liquid of controlled height, and also comprising an equalizing pipe establishing communication between the chamber containing said stationary liquid column and the vacuum space of said evaporator.

10. In an evaporator, the combination of a vacuum evaporating chamber, with a feed conduit for supplying liquid thereto, a valve controlling the flow of liquid through said conduit, a two-part chamber having its inner part in open relation to said conduit, a diaphragm connected to and controlling said valve and spanning said two-part chamber, means for establishing and maintaining a column of liquid of controlled height, said means being in open communication with the outer part of said two-part chamber, and an equalizing pipe connecting such means with the vacuum space of the evaporator chamber.

11. In an evaporator, means for controlling and regulating the feed of liquid thereto comprising a balanced valve, a diaphragm carried by said valve and in contact with

the liquid undergoing treatment after it has passed said valve, a separating chamber forming part of the evaporator, means for applying liquid to the opposite side of said diaphragm, and means for placing such liquid in communication with said separating chamber.

In testimony whereof, I have signed my name to this specification, in the presence of two subscribing witnesses.

RALPH MELLOR.

Witnesses:
MURRAY C. BOYER,
WM. A. BARR.