Feb. 18, 1941. D. I. ASHWORTH 2,232,198

PROCESS AND APPARATUS FOR TRANSFERRING AN EMULSIFIABLE FLUID FROM A ZONE OF HIGH PRESSURE TO A ZONE OF LOW PRESSURE

Filed July 30, 1937

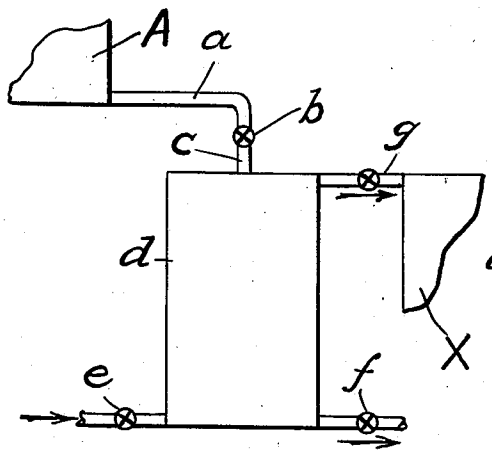


FIG. 1.

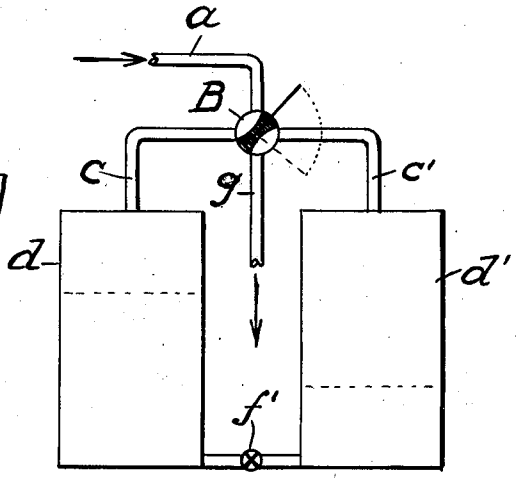


FIG. 2.

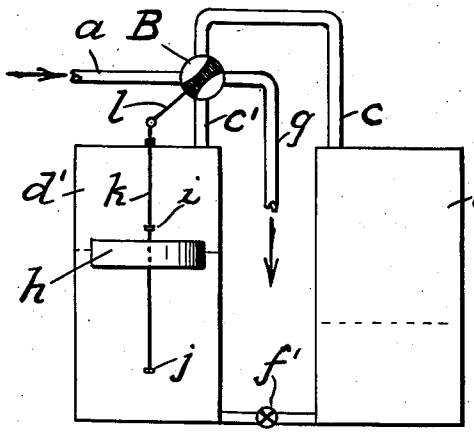


FIG. 3.

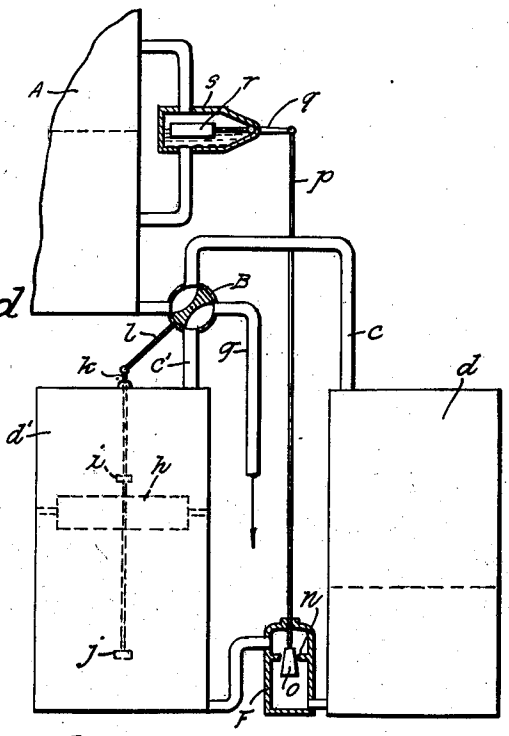


FIG. 4.

INVENTOR

WITNESS:

Daniel Irving Ashworth

BY

Bussir and Harding

ATTORNEYS.

Patented Feb. 18, 1941 2,232,198

UNITED STATES PATENT OFFICE

2,232,198

PROCESS AND APPARATUS FOR TRANSFERRING AN EMULSIFIABLE FLUID FROM A ZONE OF HIGH PRESSURE TO A ZONE OF LOW PRESSURE

Daniel Irving Ashworth, Wappingers Falls, N. Y., assignor to The De Laval Separator Company, New York, N. Y., a corporation of New Jersey

Application July 30, 1937, Serial No. 156,448

19 Claims. (Cl. 137—68)

My invention comprises a method of and apparatus for releasing an emulsifiable liquid or mixture of liquids from a zone of high pressure to one of low pressure without atomization or emulsification.

In an application for patent filed by me September 25, 1936, Serial No. 102,511, I describe a process for treating oils under high pressure and heat. At one point in that process the oil, which, at that time, has water mixed with it, must be, after being cooled, released from a container at high pressure to one at atmospheric pressure. I have found that if this is done by allowing it to flow through a throttle valve, the oil and water, as stated in the description of such application, will be so strongly emulsified that it is commercially impossible to separate them. While pumps, operating as motors, will often avoid atomization, still, under high pressure, some of the mixture is forced through the clearances between the pump members and is strongly emulsified.

I have found that, if a chamber is filled with a non-miscible liquid, as for instance water, and a connection between the oil container and the chamber opened wide, while an outlet for the water is only partly opened, the oil will flow into the chamber quietly at the slow rate at which the water can flow through the partly opened outlet. When the chamber is nearly filled with oil, it can be disconnected from the container and connected with a receptacle at atmospheric pressure, and the water flowing back into it will cause the oil to flow out quietly.

In the accompanying drawing which illustrates different embodiments of my invention:

Fig. 1 is an elevational diagrammatic view of a manually operable device for intermittent release of oil;

Fig. 2 is a similar view of a manually operable device for continuous release of oil;

Fig. 3 is a similar view of an automatically operable device for continuous release of oil and

Fig. 4 is a view, partly in section, of the device of Fig. 3, showing the application thereto of means to so control the flow of water that the oil level is maintained uniform at a certain point in the apparatus under high pressure.

Referring first to the construction shown in Fig. 1:

From a container A for oil at high pressure leads a pipe *a*—*c*, having a valve *b*, to a chamber *d*, which is fillable with a non-miscible liquid, as for instance water, through a pipe with a valve *e*. *f* is a throttle valve in a pipe for the release of water from the chamber *d*. *g* is a pipe with a valve for controlling the outflow of oil from the chamber through a pipe to a receptacle X at lower pressure.

In operating the device shown in Fig. 1, the valve *e* is opened and the chamber *d* is nearly filled with water, during which valve *b* is closed. Valve *e* is then closed, and while the valve in pipe *g* is kept closed, valve *b* is fully opened and valve *f* partly opened. The high pressure of oil in the pipe *a* will force it into the chamber *d* as fast as the water can escape through the valve *f*. Because the valve *b* is wide open there will be no atomizing or emulsifying action on the oil. When chamber *d* is nearly filled with oil, which can be determined by observation of an ordinary gauge glass attached to its side, valves *f* and *b* are closed and valve *g* is opened wide. Because oil and water are both incompressible, the pressure will immediately drop to that of the low pressure receptacle X to which pipe *g* is connected. Opening valve *e* will admit water to drive out the oil. Then valve *e* and the valve in pipe *g* are now closed, valve *b* is opened wide and valve *f* partly opened and the chamber *d* again fills with oil.

Referring to Fig. 2:

The pipe *a* from the container for oil at high pressure communicates, through a manually operable four-way valve B, with branch pipes *c* and *c'*, connecting respectively with the tops of chambers *d* and *d'*; pipes *c* and *c'* also communicating, through valve B, with an oil outflow pipe *g* leading to a receptacle for oil at low pressure. A throttle valve *f'* is applied to a pipe connecting the bottoms of the chambers *d* and *d'*.

With the apparatus shown in Fig. 2, starting with tank *d* full of water and tank *d'* nearly empty, if valve B is in the position shown, oil can flow from the container A at high pressure through pipe *a*, valve B and pipe *c* into container *d* as fast as the water can flow through throttle valve *f'*, while the air in container *d'* escapes through pipe *c'*, valve B and pipe *g*. When the container *d* is nearly full of oil and container *d'* is full of water, valve B is turned 90°, whereupon oil will flow through pipe *a*, valve B and pipe *c'* into tank *d'*, forcing water through throttle valve *f'* into tank *d* and displacing oil through pipe *c*, valve B and pipe *g* to a receptacle at low pressure.

Fig. 3 shows the same construction as Fig. 2, with the addition of a float *h* sliding freely, between stops *i*, *j*, on a rod *k* connected, by a lever *l*, with the valve B. The float *h* has a weight intermediate between the weights of equal vol-

umes of oil and of water. With the parts in the position shown, oil is flowing through pipe *a*, valve B and pipe *c* into chamber *d*, forcing water through throttle valve *f'* into chamber *d'* and oil out of chamber *d'* through pipe *c'*, valve B and pipe *g* to a receptacle at low pressure. As the water rises it will carry the float *h* with it until the float strikes the stop *i*, when it will also lift the rod *k*, and, through the lever *l*, turn the valve B until the connections are reversed, when oil will flow into chamber *d'* and out of chamber *d*. As the water level in chamber *d'* falls, the float falls with it until it strikes the stop *j*, lowers the rod *k* and turns the lever *n* to return valve B to the position shown in Fig. 3.

Any well known means may be used to retard the start of movement of valve B until there is force enough to cause it to make a complete reversal quickly. Or it may be operated by any suitable means or on a definite time schedule.

Referring to Fig. 4:

F is the body of a valve which replaces the valve *f* or *f'* in any of the previous figures. It is shown as replacing the valve *f'* of Fig. 3. It has a circular valve seat *n* for a tapered valve *o*, which is movable, inside the seat *n*, by a rod *p* connected, by a lever *q*, to a float *r* in a chamber *s* wherein it is desirable to maintain a uniform level. When oil is being discharged from the container A water flows through valve body F. If the rate of discharge is so fast that the level in the container falls, the float *r* will also fall and, by raising the taper valve *o* will decrease the area of the flow passage, causing a reduction in the rate of discharge. If the rate of discharge from container A is so slow that the level in the container rises, the float *r* will rise and lower the taper valve *o* to increase the area of the flow passage.

In the process of the patent application hereinbefore mentioned, it is desirable that the level of the oil be maintained uniform at a certain point in the apparatus. The chamber *s* of Fig. 4 is connected to the apparatus so that its center is at about the desired level. If the level of oil in chamber *s* rises, the float will rise and move the tapered valve *o* downward, as above described, so that water can flow more rapidly and let out more oil. Conversely, if the level of oil in chamber S lowers, valve *o* will move upward and increase the throttling so that water and oil will both move more slowly.

From the foregoing description it will be understood that my invention comprises means, controllable manually or automatically, to discharge oil from a container at high pressure to a receiver at low pressure, either intermittently or continuously, without wiredrawing, atomization or emulsification; and also means for automatically maintaining a uniform level of oil in any desired part of an apparatus in which oil is so discharged from high pressure to low pressure.

While in the foregoing description I have used the word "oil" in referring to the liquid being discharged and "water" in referring to the control liquid, the apparatus is useable for discharge of any liquid liable to be deleteriously affected by throttling and for any control liquid non-miscible with the liquid being discharged, any two such liquids being the equivalents, in my invention, for oil and water. It will be understood that the specific details of the different embodiments described may be varied without departing from my invention.

What I claim and desire to protect by Letters Patent is:

1. In means for transferring an emulsifiable liquid from a zone of high pressure to a zone of low pressure without substantial atomization or emulsification, the combination with a high pressure container and a low pressure receiver for the liquid to be transferred, of two intermediate chambers adapted to contain a body of liquid non-miscible with the first named liquid, means affording communication between each chamber and the container and between each chamber and the receiver, an independent connection between the two chambers for back and forth flow of said non-miscible liquid, valve means operable to connect the container with one chamber and the receiver with the other chamber and alternately therewith to reverse said connections, thereby causing liquid from the container, subject to the pressure therein, to expel, to the low pressure receiver, through an intermediate body of non-miscible liquid, a succession of previously discharged bodies of the first named liquid, and means restricting the rate of flow of non-miscible liquid through said independent connection, said communicating means being relatively unrestricted, thereby allowing transfer of the emulsifiable liquid from the container to the receiver without atomization or emulsification thereof notwithstanding the pressure difference between the container and the receiver.

2. An apparatus for the transfer of an emulsifiable fluid from a high pressure zone to a low pressure zone and for maintaining a substantially uniform level of fluid in the high pressure zone, comprising a high pressure container and a low pressure receiver, an intermediate chamber fillable alternately with said fluid and a fluid non-miscible therewith, and means to throttle the flow of said non-miscible fluid and to vary the throttling of the flow inversely with changes of level in said container.

3. In means for transferring an emulsifiable fluid from a zone of high pressure to a zone of low pressure without substantial atomization or emulsification, the combination with a high pressure container and a low pressure receiver for the liquid to be transferred, of two intermediate chambers adapted to contain a body of fluid non-miscible with the first named fluid means affording communication between each chamber and the container and between each chamber and the receiver, an independent connection between the two chambers for back and forth flow of said non-miscible fluid, valve means operable to connect the container with one chamber and the receiver with the other chamber and alternately therewith to reverse said connections, thereby causing fluid from the container, subject to the pressure therein, to expel, to the lower pressure receiver, through an intermediate body of non-miscible fluid, a succession of previously discharged bodies of the first named fluid, and means to throttle the flow of said non-miscible fluid through said independent connection and to vary the throttling of the flow inversely with changes of level in the container.

4. An apparatus for the transfer of an emulsifiable fluid from a high pressure zone to a low pressure zone, comprising a high pressure container and a low pressure receiver, two intermediate chambers adapted to be filled alternately the one with said fluid and the other with another fluid non-miscible therewith, a cross connection between the two chambers for flow from each

chamber to the other of non-miscible fluid, means to connect one of said chambers with said container and the other with said receiver and alternately therewith to reverse said connections, whereby each of said chambers is subjected alternately to the high pressure and to the low pressure and the non-miscible fluid is forced back and forth between the two chambers, and means restricting the rate of flow of non-miscible fluid through said cross connection, said connecting means being relatively unrestricted, thereby allowing transfer of the emulsifiable fluid from the container to the receiver without atomization or emulsification thereof notwithstanding the pressure difference between the container and the receiver.

5. An apparatus for the transfer of an emulsifiable fluid from a high pressure zone to a low pressure zone, comprising a high pressure container and a low pressure receiver, two intermediate chambers, a cross connection between them, said chambers containing a quantity of fluid (non-miscible with the first mentioned fluid) great enough to more than fill one of them, a multiported valve adapted in its movement to connect one chamber with the container, thereby placing that chamber under high pressure, and the other chamber with the receiver, thereby placing the second chamber under low pressure, and alternately therewith to reverse said connections, so that each of the chambers is alternately filled with the first named fluid pushing the non-miscible fluid therein to the other chamber and with non-miscible fluid pushing the first named fluid therein to the receiver, and means to throttle the flow of non-miscible fluid through said cross connection to thereby control the rate of flow of the emulsifiable fluid through said multiported valve, whereby transfer of the emulsifiable liquid from the container to the receiver is effected without atomization or emulsification thereof notwithstanding the pressure difference between the container and the receiver.

6. An apparatus for the transfer of an emulsifiable fluid from a high pressure zone to a low pressure zone, comprising a high pressure container and a low pressure receiver, two intermediate chambers, a cross connection between them, said chambers containing a quantity of fluid (non-miscible with the first mentioned fluid) great enough to more than fill one of them, a multiported valve adapted in its movement to connect one chamber with the container, thereby placing that chamber under high pressure, and the other chamber with the receiver, thereby placing the second chamber under low pressure, and alternately therewith to reverse said connections, so that each of the chambers is alternately filled with the first named fluid pushing the non-miscible fluid therein to the other chamber and with non-miscible fluid pushing the first named fluid therein to the receiver, automatically operating means to effect said reversal of connections and means to throttle the flow of non-miscible fluid through said cross connection to thereby control the rate of flow of the emulsifiable fluid through said multiported valve, whereby transfer of the emulsifiable liquid from the container to the receiver is effected without atomization or emulsification thereof notwithstanding the pressure difference between the container and the receiver.

7. In means for transferring an emulsifiable liquid from a zone of high pressure to a zone of low pressure without substantial atomization or emulsification, the combination with a high pressure container and a low pressure receiver for the liquid to be transferred, of an intermediate chamber adapted to contain a liquid non-miscible with the first named liquid, valve-controlled means to effect displacement of non-miscible liquid by flow of the first named liquid from said container into said intermediate chamber and alternately therewith, to effect displacement, by the non-miscible liquid, of the first named liquid so admitted into said chamber and its discharge to the receiver, and means to maintain the first liquid, before its release from the high pressure container, at an approximately constant level, said last named means comprising a valve, controlling the rate of flow of the non-miscible liquid, operable by minor variations in said level.

8. An apparatus for the transfer of an emulsifiable fluid from a high pressure zone to a low pressure zone and for maintaining a substantially uniform level of fluid in the high pressure zone, comprising a high pressure container and a low pressure receiver, two intermediate chambers, a cross connection between them, said chambers containing a quantity of fluid (non-miscible with the first mentioned fluid) great enough to more than fill one of them, a multiported valve adapted in its movement to connect one chamber with the container, thereby placing that chamber under high pressure, and the other chamber with the receiver, thereby placing the second chamber under low pressure, and alternately therewith to reverse said connections, so that each of the chambers is alternately filled with the first named fluid pushing the non-miscible fluid therein to the other chamber and with non-miscible fluid pushing the first named fluid therein to the receiver, and means controlled by the rise and fall of fluid in said container to control the rate of flow of non-miscible fluid through said cross connection so that its rate increases or decreases with rise and fall of fluid in said container.

9. In an apparatus for the transfer of an emulsifiable fluid from a high pressure zone to a low pressure zone, a high pressure container, a low pressure receiver, an intermediate chamber adapted to receive such fluid and also a fluid non-miscible therewith and into which is adapted to be admitted, alternately, emulsifiable fluid from the container to effect discharge from said chamber of the non-miscible fluid, and non-miscible fluid to effect discharge from said chamber of the emulsifiable fluid into the low pressure receiver, and means to throttle the outflow of the non-miscible fluid and to vary the throttling of the flow inversely with changes of level in said container.

10. In an apparatus for the transfer of an emulsifiable fluid from a high pressure zone to a low pressure zone, a high pressure container, a low pressure receiver, an intermediate chamber adapted to receive such fluid and also a fluid non-miscible therewith and into which is adapted to be admitted, alternately, emulsifiable fluid from the container to effect discharge from said chamber of the non-miscible fluid, and non-miscible fluid to effect discharge from said chamber of the emulsifiable fluid into the low pressure receiver, means operable by the rise and fall of level of the non-miscible fluid in said intermediate chamber, to effect said alternate operation and means restricting the rate of discharge from said chamber of the non-miscible fluid, the con-

nection from the high pressure container to the intermediate chamber and from the intermediate chamber to the receiver being relatively unrestricted, thereby allowing transfer of the emulsifiable fluid from the container to the receiver without atomization or emulsification notwithstanding the pressure difference between the container and the receiver.

11. In an apparatus for the transfer of an emulsifiable fluid from a high pressure zone to a low pressure zone, a high pressure container, a low pressure receiver, an intermediate chamber adapted to receive such fluid and also a fluid non-miscible therewith and into which is adapted to be admitted, alternately, emulsifiable fluid from the container to effect discharge from said chamber of the non-miscible fluid, and non-miscible fluid to effect discharge from said chamber of the emulsifiable fluid into the low pressure receiver, means to throttle the outflow of the non-miscible fluid and vary the throttling of the flow inversely with changes of level in said container, and other means, operable by the rise and fall of level of the non-miscible fluid in said intermediate chamber, to effect said alternate operation.

12. The herein described process of transferring an emulsifiable liquid from a zone of high pressure to a zone of low pressure, without substantial atomization or emulsification, which comprises displacing, by emulsifiable liquid from the high pressure zone, liquid, non-miscible with the first liquid, from one of two intermediate zones to the other and at the same time utilizing the flow of non-miscible liquid into the second intermediate zone to displace emulsifiable liquid therein into the low pressure zone; alternately with the above operation displacing, by emulsifiable liquid from the high pressure zone, the non-miscible liquid in the second intermediate zone into the first intermediate zone and at the same time utilizing the flow of non-miscible liquid into the second intermediate zone to displace emulsifiable liquid therein into the low pressure zone and restricting the rate of flow of the emulsifiable liquid into and out of each intermediate zone solely by restricting the rate of displacement of the non-miscible liquid from one intermediate zone to the other, thereby avoiding atomization or emulsification of the emulsifiable liquid in its transfer from the high pressure zone to the low pressure zone notwithstanding the pressure difference between the high and low pressure zones.

13. The herein described process of transferring an emulsifiable liquid from a zone of high pressure to a zone of low pressure without atomization or emulsification, which comprises displacing a body of liquid, non-miscible with the first named liquid, by flowing the first named liquid from the high pressure zone while such flowing liquid is closed from communication with the low pressure zone, closing communication between the high pressure zone and the body of the first named liquid that has effected said displacement, opening communication between said body of first named liquid and the low pressure zone and by means of said non-miscible liquid displacing said body of first named liquid and discharging it to the low pressure zone, controlling the said series of operations by the rise and fall of the level of said body of non-miscible liquid and restricting the rate of displacement of the non-miscible liquid by the emulsifiable liquid solely by restricting the outflow of the non-miscible liquid.

14. The herein described process of transferring an emulsifiable liquid from a zone of high pressure to a zone of low pressure without atomization or emulsification, which comprises displacing a body of liquid, non-miscible with the first named liquid, by flowing the first named liquid from the high pressure zone while such flowing liquid is closed from communication with the low pressure zone, closing communication between the high pressure zone and the body of the first named liquid that has effected said displacement, opening communication between said body of the first named liquid and the low pressure zone and by means of said non-miscible liquid displacing said body of first named liquid and discharging it to the low pressure zone, throttling the displacement of the non-miscible fluid, and varying said throttling inversely with changes of level of the emulsifiable liquid in the high pressure zone.

15. The herein described process of transferring an emulsifiable liquid from a zone of high pressure to a zone of low pressure without atomization or emulsification, which comprises displacing a body of liquid, non-miscible with the first named liquid, by flowing the first named liquid from the high pressure zone while such flowing liquid is closed from communication with the low pressure zone, closing communication between the high pressure zone and the body of the first named liquid that has effected said displacement, opening communication between said body of first named liquid and the low pressure zone and by means of said non-miscible liquid displacing said body of first named liquid and discharging it to the low pressure zone, controlling the said series of operations by the rise and fall in said intermediate chamber of the level therein of non-miscible liquid, throttling the displacement of the non-miscible fluid, and varying said throttling inversely with changes of level of the emulsifiable liquid in the high pressure zone.

16. The herein described process of transferring an emulsifiable liquid from a zone of high pressure to a zone of low pressure, without atomization or emulsification, which comprises displacing a body of liquid, non-miscible with the first named liquid, in an intermediate zone closed from communication with the low pressure zone, by flowing the emulsifiable liquid from the high pressure zone to the intermediate zone and thereby discharging therefrom the non-miscible liquid, closing communication between the high pressure zone and the intermediate zone and opening communication between the intermediate zone and the low pressure zone and by means of said non-miscible liquid displacing the emulsifiable liquid from the intermediate zone and discharging it into the low pressure zone, and controlling the rate of said inflow of the emulsifiable liquid from the high pressure zone to the intermediate zone by flowing it through a relatively unrestricted passage while so restricting the rate of outflow of the non-miscible liquid as to prevent emulsification or atomization.

17. In means for transferring an emulsifiable liquid from a zone of high pressure to a zone of low pressure without substantial atomization or emulsification, the combination with a high pressure container and a low pressure receiver for the liquid to be transferred, of an intermediate transfer chamber, liquid flow connections between said chamber and the container and receiver respec-

tively, means to supply to the transfer chamber, under a pressure greater than that in the receiver, another liquid non-miscible with that to be transferred and to discharge from the transfer chamber, under a pressure less than that in the container, said non-miscible liquid, said transfer chamber, except for said means and connections, being hermetically closed, means adapted to connect the container with the transfer chamber while throttling the discharge of non-miscible liquid and to connect the transfer chamber with the receiver while throttling the supply of non-miscible liquid.

18. In means for transferring an emulsifiable fluid from a zone of high pressure to a zone of low pressure without substantial atomization or emulsification, the combination with a high pressure container and a low pressure receiver for the liquid to be transferred, of two intermediate chambers adapted to contain a body of fluid non-miscible with the first named fluid, means affording communication between each chamber and the container and between each chamber and the receiver, an independent connection between the two chambers for back and forth flow of said non-miscible fluid, valve means operable to connect the container with one chamber and the receiver with the other chamber and alternately therewith to reverse said connections, thereby causing fluid from the container, subject to the pressure therein, to expel, to the low pressure receiver, through an intermediate body of non-miscible fluid, a succession of previously discharged bodies of the first named fluid, automatically operating means controlling said valve means and adapted to effect said reversal of connections, and means to throttle the flow of said non-miscible fluid through said independent connection and to vary the throttling of the flow inversely with changes of level in the container.

19. An apparatus for the transfer of an emulsifiable fluid from a high pressure zone to a low pressure zone and for maintaining a substantially uniform level of fluid in the high pressure zone, comprising a high pressure container and a low pressure receiver, two intermediate chambers, a cross connection between them, said chambers containing a quantity of fluid (non-miscible with the first mentioned fluid) great enough to more than fill one of them, a multiported valve adapted in its movement to connect one chamber with the container, thereby placing that chamber under high pressure, and the other chamber with the receiver, thereby placing the second chamber under low pressure, and alternately therewith to reverse said connections, so that each of the chambers is alternately filled with the first named fluid pushing the non-miscible fluid therein to the other chamber and with non-miscible fluid pushing the first named fluid therein to the receiver, means controlled by the rise and fall of the liquid level in said chambers adapted to control the operation of said multiported valve to effect said reversal of connections, and means controlled by the rise and fall of fluid in said container to control the rate of flow of non-miscible fluid through said cross connection so that its rate increases or decreases with rise and fall of fluid in said container.

DANIEL IRVING ASHWORTH.