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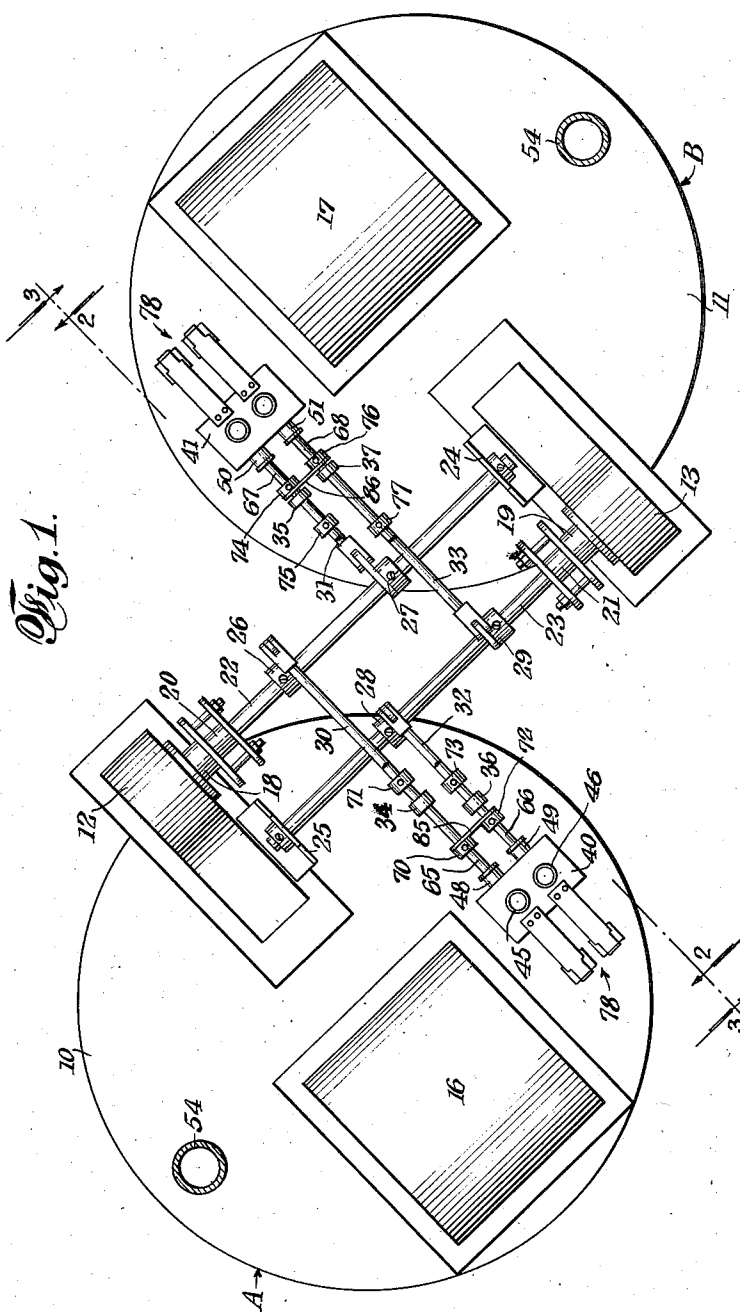
S. A. W. OKELL ET AL

2,093,474

CONTINUOUS PUMPING UNIT

Filed June 19, 1936

3 Sheets-Sheet 1



INVENTORS
Stanley A. W. Okell
Walter F. Dennerle
BY
Curt, Henklein + Nolsky
ATTORNEYS

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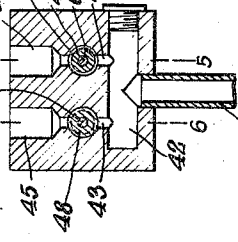
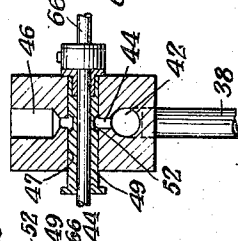
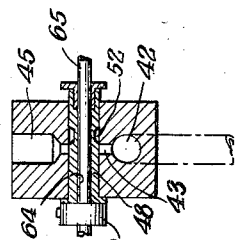
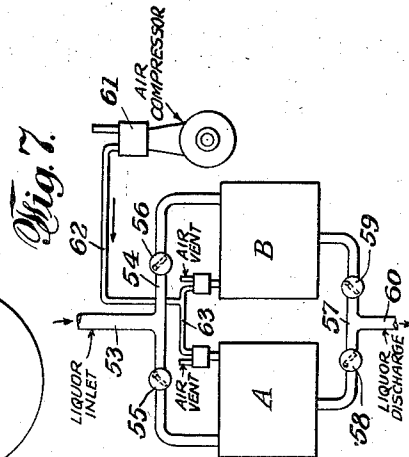
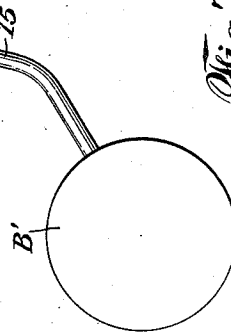
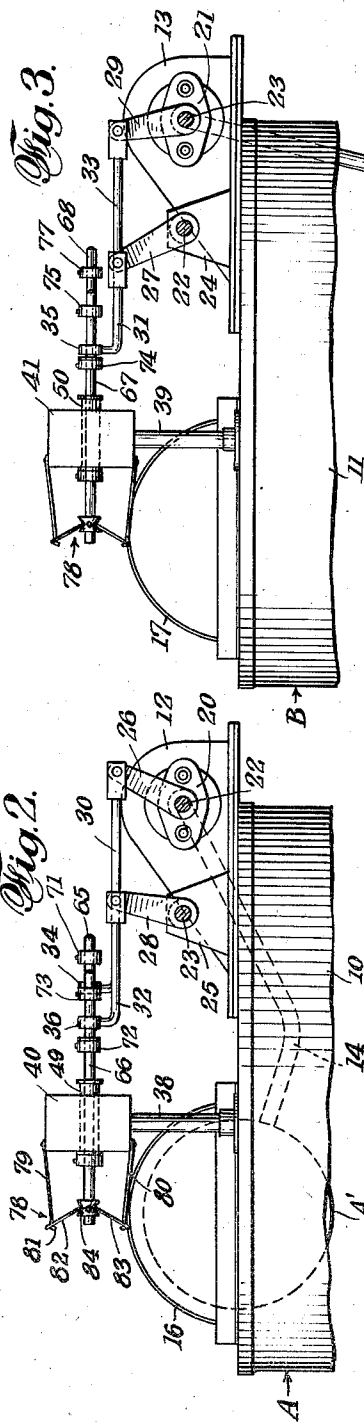
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CONTINUOUS PUMPING UNIT

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3 Sheets-Sheet 2



INVENTORS
 Stanley A. W. Okell
 Walter F. Kammerer
 BY
 Grant, Klemm & Nelsky
 ATTORNEYS

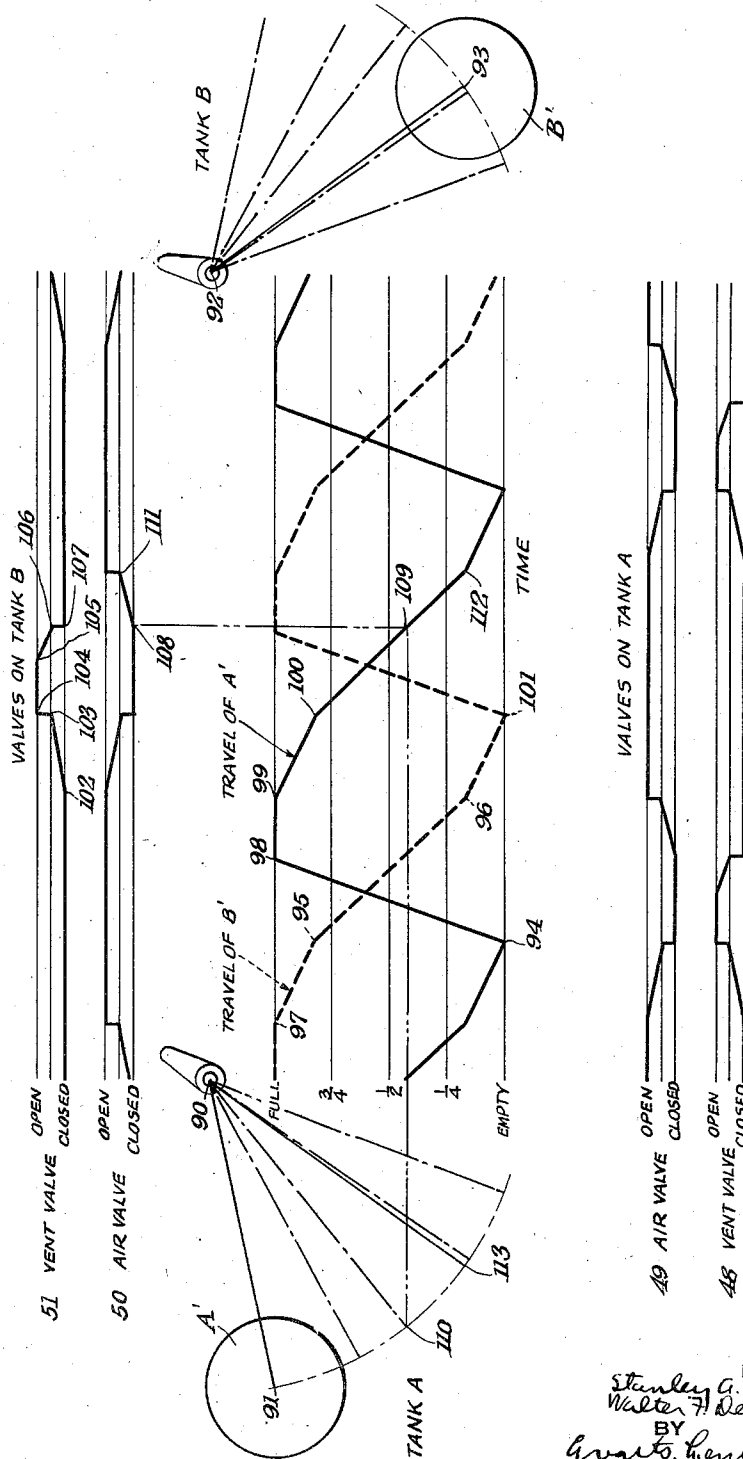
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S. A. W. OKELL ET AL
CONTINUOUS PUMPING UNIT

2,093,474

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3 Sheets-Sheet 3



INVENTORS
Stanley G. W. Okell
Walter F. Demmerle
BY
Gwart, Hummel & Nolsky
ATTORNEYS

UNITED STATES PATENT OFFICE

2,093,474

CONTINUOUS PUMPING UNIT

Stanley A. W. Okell, Cranford, N. J., and Walter
F. Demmerle, Stony Brook, N. Y., assignors to
John J. Naugle, New York, N. Y.

Application June 19, 1936, Serial No. 86,090

20 Claims. (Cl. 103—248)

Our present invention relates to pumping mechanisms and aims to provide a device of the general character indicated, which is simple in construction, easy and economical to fabricate and assemble, and adapted to deliver a continuous discharge.

In the accompanying specification we shall describe, and in the annexed drawings show, an illustrative embodiment of the pumping mechanism of the present invention. It is, however, to be kept in mind that we do not wish to be limited to the exact details herein described and shown for purposes of illustration only, inasmuch as changes may be made in the details of construction without the exercise of the inventive faculties, and within the scope of the claims hereto appended.

Before describing our invention in detail, we deem it advisable, briefly, to refer to the prior art in the field to which the present invention belongs, and to point out the disadvantages thereof, and the manner in which the present invention overcomes the same.

While not limited thereto, the present invention finds particular use in connection with the refining of sugar. In such operations, sugar liquor in a supply tank has thoroughly mixed therein a decolorizing medium, such as a highly activated vegetable carbon. The mixture of liquor and carbon is generally pumped to a filtering device containing a plurality of filter leaves, and the liquor passes through these leaves, which are of fine mesh, the carbon becoming deposited upon the leaves in the form of a cake, and absorbing the impurities from the liquor as the latter passes therethrough. It has been necessary in the past to use either a pneumatic ejector or a centrifugal pump for delivering the liquor and carbon suspended therein from the supply tank to the filtering device. The pneumatic ejector operates in a discontinuous manner; that is, after it has delivered a certain quantity of liquor, its operation ceases while it is being refilled and it does not again pump liquor until it has become filled. During the refilling operation, there is a drop in the pressure in the line between the pump and the filtering device, and this results in the carbon cake dropping off the filter leaves. The disadvantages of such operations are believed to be obvious, and require no further discussion here. The use of centrifugal pumps presents other disadvantages. For one thing, it is difficult to use pumps of this character in connection with vegetable carbon suspensions for the reason that a high degree of corrosive action takes place on

the pump impellers due to the high velocity of the metallic moving parts against the liquid containing the suspension. For another thing violent mechanical agitation, such as is obtained by using centrifugal pumps, breaks down the flocs of the suspension which causes a condition of dispersion or deflocculation, thus preventing the attainment of a high filtration rate.

These disadvantages are eliminated by means of the pumping mechanism of the present invention, by means of which we obtain an even, continuous flow. Other advantages of the present invention will become obvious to those skilled in the art to which the present invention relates as the detailed description thereof progresses.

In the accompanying drawings:—

Fig. 1 is a top plan view of the pumping mechanism of the present invention;

Fig. 2 is a transverse, sectional view, partly in elevation, taken along line 2—2 of Fig. 1;

Fig. 3 is a similar view taken along line 3—3 of Fig. 1;

Fig. 4 is an enlarged, transverse sectional view, taken substantially through the center of a valve housing constituting part of the present invention;

Fig. 5 is a vertical, sectional view, taken along line 5—5 of Fig. 4;

Fig. 6 is a similar view, taken along line 6—6 of Fig. 4;

Fig. 7 is a schematic view, showing the manner in which the pumping mechanisms of the present invention are hooked up in a pumping system; and

Fig. 8 is a graphic chart, showing the proper chronological order of the operations of the various parts of the pumping mechanisms of the present invention.

Referring now more in detail to the aforesaid illustrative embodiment of the pumping mechanism of the present invention, and with particular reference to Figs. 1 to 6 inclusive of the drawings, the letters A and B generally designate cylindrical tanks of any desired capacity provided with covers 10 and 11. The covers are respectively provided with housings 12 and 13 opening into the tanks through the covers, and adapted to enclose the upper ends of float rods 14 and 15, carrying at their outer ends floats A' and B'. The latter are adapted to rise and fall within the tanks A and B in accordance with the quantity of liquid therein, and in order to obtain the greatest capacity from the tanks, the covers 10 and 11 thereof are further provided with domes 16 and 17, which are receptive of the floats A' and B'

when the latter are in their uppermost positions.

The housings 12 and 13 are provided with stuffing boxes 18 and 19, and glands 20 and 21, and journaled in the stuffing box 18, extending within the housing 12 where it is affixed to the upper end of the float rod 14, is a shaft 22, and journaled in the stuffing box 21 to extend within the housing 13 where it is affixed to the upper end of the float rod 15, is a shaft 23. The outer end of the shaft 22 is journaled in a bearing 24, and the outer end of the shaft 23 is journaled in a bearing 25.

Fixed upon the shaft 22 intermediate the gland 20 and bearing 24, are cranks 26 and 27, and fixed upon the shaft 23 intermediate the gland 21 and bearing 25 are cranks 28 and 29. The cranks 26, 27, 28 and 29 are respectively pivotally connected with connecting rods 30, 31, 32, and 33, each of which has its outer end upturned to support a sliding collar designated in the drawings at 34, 35, 36 and 37.

Communicating with the interior of the tanks A and B through the covers 10 and 11 adjacent the domes 16 and 17, are pipes 38 and 39, which pipes are adapted to support valve blocks 40 and 41, and at the same time communicate with a manifold 42 with which each of the blocks is provided. Inasmuch as each of the valve blocks 40 and 41 are similar in construction, only one of the same will be described in detail, reference being had particularly to Figs. 4, 5 and 6 of the drawings.

The manifold 42 communicates with vertical passages 43 and 44, the former communicating with an air vent 45, and the latter communicating with an air inlet 46. Traversing the vertical passages 43 and 44, are horizontal openings 47, and each of the openings 47 is adapted to house a piston valve, four of which are shown in the drawings, designated at 48, 49, 50 and 51. The valve 48 is the vent valve of the tank A and the valve 49 is the air inlet valve of the same tank while the valve 50 is the air inlet valve of the tank B and the valve 51 is the vent valve of the same tank.

Each of the valves 48, 49, 50 and 51 is provided with an annular groove 52, adapted, when the valves are operated within the blocks 40 and 41, to register with the vertical passages 43 and 44, thus opening or closing the communications between the atmosphere and the interior of the particular tank or the source of compressed air and the interior of the particular tank.

Before describing the details of the mechanism of the present invention any further, it is thought that a better understanding of the coming description will be had if at this point the manner of hooking up the pumping mechanism of the present invention is referred to.

In Fig. 7 of the drawings, there is shown an inlet pipe 53, which communicates with a source of supply of liquor, and which leads to a manifold 54, provided with a check valve 55 for the tank A and 56 for the tank B. Beyond each check valve, the manifold communicates with the tanks A and B. The tanks are provided with an outlet manifold 57 including check valves 58 and 59, beyond which the manifold communicates with a discharge pipe 60. A source of compressed air, such as the compressor 61 communicates through the pipe 62 with a manifold 63, which branches off so as to communicate with the passages 46 of each of the valve blocks 40 and 41, the passage 45 of each of such blocks communicating merely with the atmosphere.

Resuming the detailed description of the mechanisms of the present invention, each of the valves 48, 49, 50 and 51 is provided with a central longitudinal opening 64 adapted to receive valve operating rods 65, 66, 67 and 68, and respectively slidable on each of these rods are the sliding collars 34, 36, 35 and 37.

Upon the outer end of each of the rods 65, 66, 67 and 68, there is fixed a collar 69, the purpose of which, as will be more fully understood from the description of the operation of the present invention, is to operate the valves 48, 49, 50 and 51 in one direction. Fixed upon the rod 65, with the sliding collar 34 intermediate the same, is a pair of collars 70 and 71. Fixed upon the rod 66 with the sliding collar 36 intermediate the same, is a pair of collars 72 and 73. Fixed upon the rod 67 with the sliding collar 35 intermediate the same, is a pair of collars 74 and 75; and fixed upon the rod 68 with the sliding collar 37 intermediate the same, is a pair of collars 76 and 77.

Inasmuch as it is necessary that the pumping mechanisms of the present invention function smoothly and continuously, it is desirable that the valves 48, 49, 50 and 51 operate with a "snap action". For this purpose, we provide each of such valves with a toggle arrangement 78. Inasmuch as all of the toggle arrangements are the same, we shall describe only one. Affixed to the upper and lower surfaces of the valve blocks 40 and 41, adjacent each valve, are flat springs 79 and 80, the inner ends of which are bent, as at 81, to support toggle members 82 and 83. The inner ends of the latter engage a grooved collar 84 fixed upon the corresponding valve operating rod. By means of such arrangement, as the valve operating rods 65, 66, 67 and 68, are moved in either direction, the toggle members 82 and 83 are moved toward their vertical positions and the slightest movement beyond such vertical positions, known as dead center, causes the springs 79 and 80 to move the valve operating rods with a "snap action" in the same direction. This in turn operates the corresponding valve.

In order that the discharge from the tanks A and B be continuous, it is necessary that the floats A' and B' of the tanks A and B operate the air valves 49 and 50 to close the same, but, the opening of said valves must be performed by the opposite tanks; that is, the opening of the valve 49 must be performed by the float B' of the tank B and the opening of the valve 50 must be performed by the float A' of the tank A. In order to carry this out, there is affixed to the collars 70 and 76 arms 85 and 86, the outer ends of these arms being provided with openings larger than the diameter of the rods 66 and 67, so that they may freely slide along the same.

This completes the description of the mechanics of the pumping mechanism of the present invention, and the structural operation thereof is as follows:

Assuming that the tank A is almost full of liquor and is in the act of discharging the same, at such time the float A' will be descending, and the shaft 22 to which such float is attached, will be rotating, so that the crank 26 will push the connecting rod 30. This motion causes the sliding collar 34 to move along the rod 65 so that it impinges upon the arm 85 fixed to the collar 70. As the float A' continues to descend, the vent valve actuating rod 65 is pushed through the piston valve 48, and the outer end of the arm 85 slides upon the valve operating rod 66, and impinges upon the fixed collar 72. Thus both col-

lars 70 and 72 are moved along together until the toggles 78 of the valves 48 and 49 reach their dead center positions. At this instant, the toggles trip and cause the collars 70 and 72 to be moved forwardly with a "snap action" to actuate the valves 48 and 49, opening the former and closing the latter. As the air escapes from the tank A through the pipe 33, manifold 42 and openings 43 and 45, the pressure within such tank drops and a fresh charge of liquor from the source of supply passes through the pipe 53, manifold 54, past the check valve 55 and into the tank A. As the fresh charge enters the tank A, the float A' rises. As the float A' rises, the crank 26 pulls the sliding collar 34 backwardly until it impinges upon the fixed collar 71. This causes the vent valve operating rod 65 to be moved backwardly until, when the tank is full, the toggle 78 of this particular valve trips again in the opposite direction, and closes the vent valve 48. However, as the collar 70 moves backwardly under the action of the rising float A', the arm 85 backs away from the fixed collar 72, thus leaving the air inlet valve 49 of the tank A in its closed position. It will, therefore, be seen that while the arm 85 acts to close the air inlet valve 49, it does not open this valve.

The opening of the air valve 49 on the tank A is effected by the action of the float B' of the tank B. When the tank B is on its pumping stroke and the float B' is descending, the crank 28 on the shaft 23, which is operated by the float B', pulls the connecting rod 32 which causes the sliding collar 36 to move along the rod 66 to pull the fixed collar 73, thus causing the valve operating rod 66 to be moved in the direction of the tank B. At a predetermined time, this movement causes the toggle 78 of the valve 49 to reach its dead center position after which it trips, and causes the valve 49 to open. Inasmuch as both tanks A and B are constructed exactly the same, and are connected with each other through their respective valve mechanisms in exactly the same manner, the cycle of operations just described, is exactly the same for the valves 50 and 51 of the tank B.

This completes the description of the operation of the mechanics of the pumping mechanism of the present invention, but it is thought that a more thorough understanding of the same will be had by referring to the graphic chart shown in Fig. 8 of the drawings.

In this figure, the center of the shaft 22 of the float A' of the tank A is designated by the reference character 90, and the arc through which the center 91 of the float A' travels is also indicated. On the right of this view, the center of the shaft 23 which carries the float B' of the tank B is indicated at 92 and the arc through which the center 93 of the float B' travels is also indicated. The illustration at the top of this view indicates the operation of the valves 51 and 50 of the tank B and the illustration at the bottom of this view indicates the operation of the valves 49 and 48 of the tank A. In the central illustration of this view intermediate the arcs of the floats A' and B' it is indicated the height of the liquid in either or both of the tanks, at any instant, the time units being plotted as abscissae, and the depths of the liquid in the tanks as ordinates. The full line indicates the depth of the liquid in the tank A and the broken line indicates the corresponding depth in the tank B.

Starting from the left of this illustration, it is to be noted that both tanks are pumping until

the point of time indicated by the reference characters 94 and 95 is reached. At this point the tank A has reached the end of its pumping stroke and immediately starts to refill by gravity, this being indicated by the sharp upturn in the graph immediately after reaching the point 94. Directly above the point 94, at the point 95, it is to be noted that the tank B continues pumping at twice the rate at which it was pumping, as indicated by the steeper slope of the graph between the points 95 and 96. The tangent of the angle made by the line between the points 95 and 96 with the horizontal is exactly twice the tangent of the angle made by the line between the point 97, which was the start of the pumping stroke of the tank B, and point 95 which was the point at which time the tank A stopped pumping. It is to be noted that the tank A reaches the top of its filling stroke at the point 98, and the rate of filling is considerably greater than the rate of pumping as indicated by the slope of the graph between the points 94 and 98. This is easily arranged by making the intake pipes to the pumps of larger bore than the discharge pipes.

When the point 98 is reached it will be noted that the tank B is still pumping alone, and that the tank A remains stationary in a filled position, as indicated by the graph, between the points 98 and 99. By adjusting the fixed collars on the valve rods, it is possible to arrange the operation of the pumping mechanism of the present invention so that either of the tanks will open the air valve of the other tank and start the pumping at any desired point toward the end of the stroke of the tank which is approaching the end of its stroke at that time. Thus when the tank B reaches the point 96, substantially less than $\frac{1}{4}$ of its stroke from the lower limit, the air valve of the tank A is opened with the result that tank A starts pumping from the point 99 and continues until the point 100 is reached, at which time the tank B has reached the point 101 corresponding to the end of its pumping stroke. From the point 99 to the point 100 the tank A is pumping at half its normal rate, and correspondingly from the point 96 to the point 101 the tank B is pumping at half its normal rate. However, at the point 101 the tank B finishes pumping and starts to fill so that from the point 100 on the tank A pumps at double its rate.

These cycles are repeated and it will be understood that inasmuch as at least one tank is always pumping, the pumping strokes overlap, and there is no interruption in the discharge. The amount of overlap of the strokes of the pumps of the tanks A and B measured in time units, is the projection on the horizontal of the points 99 and 100, or 96 and 101.

The illustration of the operation of the valves of the tank B and the illustration of the operation of the valves of the tank A are projected from the center illustration. In the upper illustration, there is shown two sets of three horizontal lines, corresponding respectively to the operation of the vent and air valves of the tank B, the median line of each set of three lines corresponding to the dead point of the toggle of the particular valve. The outside lines of each set show respectively the opened and closed positions of the valve, while the distance between the two outside lines corresponds to the total travel of the toggle of the particular valve.

The toggle travels for half of its total distance slowly which brings it at the dead point. Thereafter it travels substantially instantaneously for

the remaining half of its distance. This is graphically represented on the chart, where, for example, at the point 102, the toggle of the vent valve 51 of the tank B begins to be pushed slowly to its dead point indicated at 103. At this instant, the toggle trips, and the instant opening of the valve 51 is effected, as indicated by the short vertical line intermediate the point 103 and the point 104. The time period during which the valve 51 remains open is indicated by the horizontal line between the point 104 and the point 105, and thereafter the toggle starts to be actuated in the opposite direction as indicated by the sloping line from 105 and the point 106. Upon reaching the point 106, the toggle snaps past the dead point, and the valve 51 closes, this being indicated by the short vertical line between the point 106 and the point 107. Exactly the same cycle of operations takes place for the rest of the valves, and hence a detailed description is deemed unnecessary.

Referring now to the two diagrams showing the arcs through which the floats A' and B' travel, it is to be noted that the angular position of the lines 90-91 or 92-93 is determined by projection from the points 94, 98, 99, 100, etc. Similarly, from any given angular position of the float rods of the floats A' and B', the corresponding depths of liquid in the particular tank can be ascertained by projecting in the opposite direction. For example, if it is desired to determine the angular position of the float A' of the tank A at the instant when it begins to move the toggle for opening the valve 50 of the tank B, it is to be noted that this operation begins at the point 102. The corresponding level of the center of the float A', is obtained by projecting vertically downward from the point 102 until the vertical line intersects the graph representing the tank A at the point 109. Projecting horizontally to the left from the point 109, we intersect the arc which indicates the locus of the center of the float A' of the tank A at the point 110. This is, therefore, the point at which the center of the float A' of the tank A is located when it begins to actuate the toggle of the air valve of the tank B. Similarly, by projecting downward from the point 111, the graph of the tank A is intersected at the point 112, and projecting from this point horizontally, we get the point 113 on the arc of the float A'. By joining the points 110 and 113 to the center 90, there is obtained the angle through which the float rod of the float A' moves during the whole of the operation of the opening of the air valve 50 of the tank B. By utilizing these various calculations, the size of the cranks and connecting rods, and the points at which the fixed collars should be positioned on the valve operating rods can readily be determined.

This completes the description of the aforesaid illustrative embodiment of the present invention, and the operation thereof. It will be noted from such description that the pumping mechanisms of the present invention are simple in construction, easy and economical to fabricate and assemble, and result in a pumping unit whereby there may be obtained an even, continuous discharge. Other advantages of the device of the present invention will be obvious to those skilled in the art to which the present invention relates.

What we claim as our invention is:

1. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks,

and means, associated with each of said tanks and operable by the charging and discharging thereof, to open and close the air outlet and only close the air inlet of its own tank, and open the air inlet of the other tank.

2. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, means, associated with each of said tanks and operable by the charging thereof, to close the air outlet of its own tank, and means, associated with each of said tanks and operable by the discharging thereof, to only open the air inlet of the other tank and open the air outlet and only close the air inlet of its own tank.

3. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and operable by the charging and discharging thereof, to successively close the air outlet of one of said tanks, then open the air inlet of the same tank, and thereafter simultaneously open the air outlet and close the air inlet of the other of said tanks.

4. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and operable by the charging and discharging thereof, to successively close the air outlet of one of said tanks at the end of its own charging stroke, then open the air inlet of the same tank as the other tank nears the end of its discharge, and thereafter simultaneously open the air outlet and close the air inlet of said second tank when the latter reaches the end of its discharge.

5. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and operable by the charging and discharging thereof, to open and close the air outlet and only close the air inlet of its own tank, and open the air inlet of the other tank, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets and adjustable connections intermediate said floats and said valves.

6. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, means, associated with each of said tanks and operable by the charging thereof, to close the air outlet of its own tank, and means, associated with each of said tanks and operable by the discharging thereof, to only open the air inlet of the other tank and open the air outlet and only close the air inlet of its own tank, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets and adjustable connections intermediate said floats and said valves.

7. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and operable by the charging and discharging thereof, to successively close the air outlet of one

of said tanks, then open the air inlet of the same tank, and thereafter simultaneously open the air outlet and close the air inlet of the other of said tanks, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets and adjustable connections intermediate said floats and said valves.

8. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and operable by the charging and discharging thereof, to successively close the air outlet of one of said tanks at the end of its own charging stroke, then open the air inlet of the same tank as the other tank nears the end of its discharge, and thereafter simultaneously open the air outlet and close the air inlet of said second named tank when the latter reaches the end of its discharge, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets and adjustable connections intermediate said floats and said valves.

9. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and operable by the charging and discharging thereof, to open and close the air outlet and only close the air inlet of its own tank, and open the air inlet of the other tank, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets, valve operating rods associated with said valves, a plurality of collars fixed upon said rods at predetermined points, and connections intermediate said floats and said rods, operable by said floats, slidable along the length of said rods and cooperable with said collars to actuate said valves.

10. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, means, associated with each of said tanks and operable by the charging thereof, to close the air outlet of its own tank, and means, associated with each of said tanks and operable by the discharging thereof, to only open the air inlet of the other tank and open the air outlet and only close the air inlet of its own tank, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets, valve operating rods associated with said valves, a plurality of collars fixed upon said rods at predetermined points, and connections intermediate said floats and said rods, operable by said floats, slidable along the length of said rods and cooperable with said collars to actuate said valves.

11. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and operable by the charging and discharging thereof, to successively close the air outlet of one of said tanks, then open the air inlet of the same tank, and thereafter simultaneously open the air outlet and close the air inlet of the other of said tanks, each of said means including a float oper-

able within each of said tanks, valves controlling said air inlets and outlets, valve operating rods associated with said valves, a plurality of collars fixed upon said rods at predetermined points, and connections intermediate said floats and said rods, operable by said floats, slidable along the length of said rods and cooperable with said collars to actuate said valves.

12. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and operable by the charging and discharging thereof, to successively close the air outlet of one of said tanks at the end of its own charging stroke, then open the air inlet of the same tank as the other tank nears the end of its discharge, and thereafter simultaneously open the air outlet and close the air inlet of said second named tank when the latter reaches the end of its discharge, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets, valve operating rods associated with said valves, a plurality of collars fixed upon said rods at predetermined points, and connections intermediate said floats and said rods, operable by said floats, slidable along the length of said rods and cooperable with said collars to actuate said valves.

13. In a device of the class described, a tank having a liquor inlet and a liquor outlet, an air inlet for receiving compressed air to the interior of said tank to eject the liquor therefrom, an air outlet for venting the compressed air to the atmosphere to permit refilling of said tank, valves controlling said air inlet and air outlet, and means, operated by the rise and fall of the liquor in said tank, for opening and closing said air outlet valve, but only closing said air inlet valve, in combination with means operatively coupled with said first-named means for opening said air inlet valve.

14. In a device of the class described, a tank having a liquor inlet and a liquor outlet, an air inlet for receiving compressed air to the interior of said tank to eject the liquor therefrom, an air outlet for venting the compressed air to the atmosphere to permit refilling of said tank, valves controlling said air inlet and air outlet, and means, operated by the rise and fall of the liquor in said tank, for opening and closing said air outlet valve, but only closing said air inlet valve, said means including a float operable within said tank, a valve-actuating rod associated with each of said valves, a plurality of collars fixed on said rods at predetermined points, connections intermediate said floats and said collars, and means, secured to one of the collars carried by the rod of said air outlet valve, engageable with one of the collars carried by the rod of said air inlet valve when the rod of said air outlet valve moves toward said valve's open position only, in combination with means operatively coupled with said first-named means for opening said air inlet valve.

15. In a device of the class described, a tank having a liquor inlet and a liquor outlet, an air inlet for receiving compressed air to the interior of said tank to eject the liquor therefrom, an air outlet for venting the compressed air to the atmosphere to permit refilling of said tank, valves controlling said air inlet and air outlet, and means, operated by the rise and fall of the liquor in said tank, for opening and closing said air out-

let valve, but only closing said air inlet valve, said means including a float operable within said tank, a valve-actuating rod associated with each of said valves, a plurality of collars fixed on said rods at predetermined points, connections intermediate said floats and said collars, and an arm, secured to one of the collars carried by the rod of said air outlet valve, having an opening at its outer end to permit its sliding along the length of the rod of said air inlet valve, engageable with one of the collars carried by the rod of said air inlet valve when the rod of said air outlet valve moves toward said valve's open position only, in combination with means operatively coupled with said first-named means for opening said air inlet valve.

16. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and operable by the charging and discharging thereof, to open and close the air outlet and only close the air inlet of its own tank, and open the air inlet of the other tank, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets and adjustable connections intermediate said floats and said valves, said floats, valves and adjustable connections being oppositely disposed.

17. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, means, associated with each of said tanks and operable by the charging thereof, to close the air outlet of its own tank, and means, associated with each of said tanks and operable by the discharging thereof, to only open the air inlet of the other tank and open the air outlet and only close the air inlet of its own tank, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets and adjustable connections intermediate said floats and said valves, said floats, valves and adjustable connections being oppositely disposed.

18. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and

operable by the charging and discharging thereof, to successively close the air outlet of one of said tanks, then open the air inlet of the same tank, and thereafter simultaneously open the air outlet and close the air inlet of the other of said tanks, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets and adjustable connections intermediate said floats and said valves, said floats, valves and adjustable connections being oppositely disposed.

19. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and operable by the charging and discharging thereof, to successively close the air outlet of one of said tanks at the end of its own charging stroke, then open the air inlet of the same tank as the other tank nears the end of its discharge, and thereafter simultaneously open the air outlet and close the air inlet of said second named tank when the latter reaches the end of its discharge, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets and adjustable connections intermediate said floats and said valves, said floats, valves and adjustable connections being oppositely disposed.

20. Pumping mechanism comprising, a pair of tanks charged from a common source of supply and discharging into a common outlet, an air inlet and an air outlet for each of said tanks, and means, associated with each of said tanks and operable by the charging and discharging thereof, to open and close the air outlet and only close the air inlet of its own tank, and open the air inlet of the other tank, each of said means including a float operable within each of said tanks, valves controlling said air inlets and outlets, valve operating rods associated with said valves, a plurality of collars fixed upon said rods at predetermined points, and connections intermediate said floats and said rods, operable by said floats, slidable along the length of said rods and co-operable with said collars to actuate said valves, said floats, valves, collars and connections being oppositely disposed.

STANLEY A. W. OKELL.
WALTER F. DEMMERLE.