

May 20, 1941.

D. S. WILLSON

2,242,714

LIQUID DISPENSING APPARATUS

Filed Sept. 7, 1939

2 Sheets-Sheet 1

FIG. I.

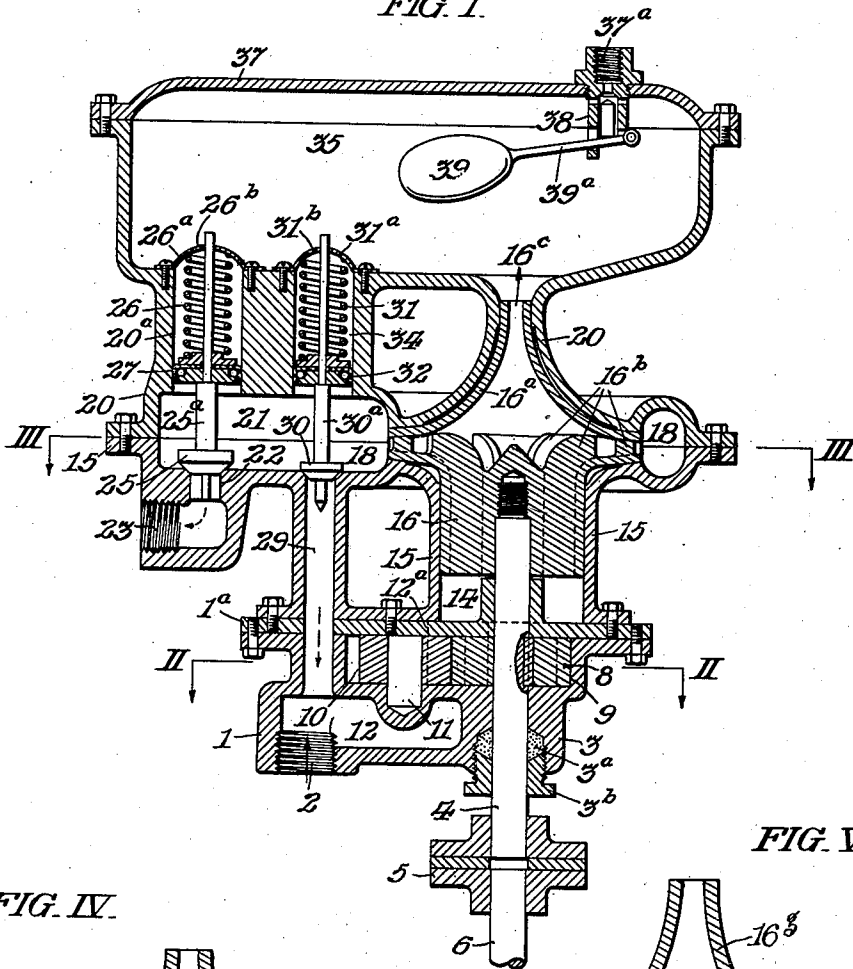


FIG. IV.

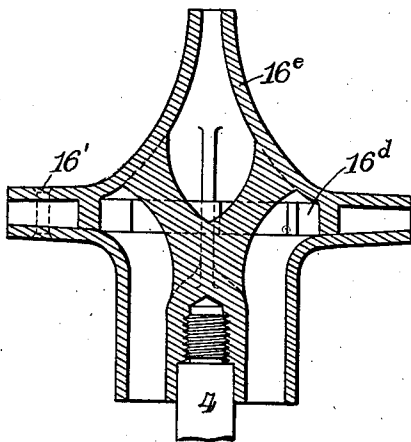
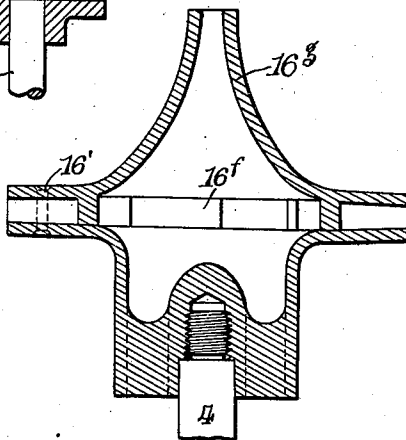


FIG. V.



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2 Sheets-Sheet 2

FIG. II.

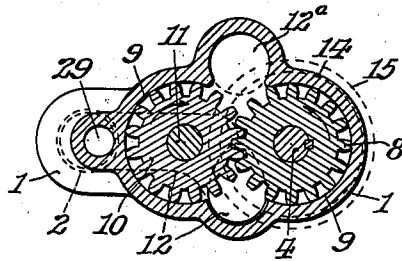
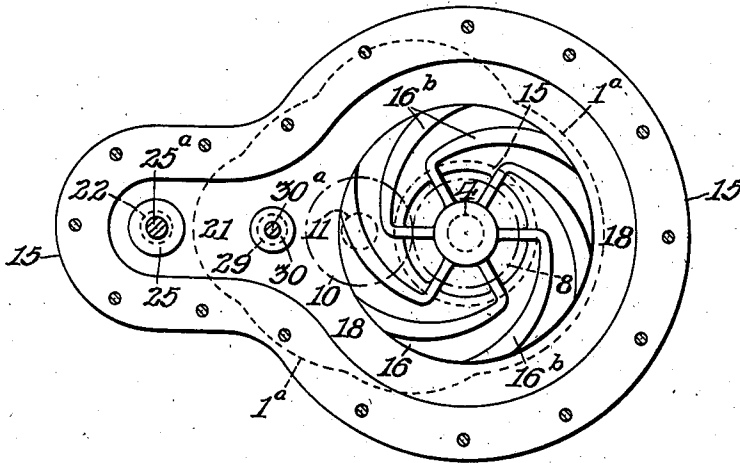


FIG. III.



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## UNITED STATES PATENT OFFICE

2,242,714

## LIQUID DISPENSING APPARATUS

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Application September 7, 1939, Serial No. 293,660

13 Claims. (Cl. 103-5)

My invention relates to apparatus which may be employed in dispensing gasoline, wherein entrained air is separated from the liquid to be dispensed, during the dispensing operation, and eliminated from the apparatus into the surrounding atmosphere. My invention may be conveniently embodied in apparatus of the type known to the trade as a "curbstand," containing a positive displacement pump designed to lift the liquid from an underground tank and discharge it to the inlet of a centrifugal pump by which said liquid is discharged through a conduit terminating in a flexible hose through which the liquid is dispensed. Such hose has a valve at its distal end, spring pressed to normally close it, but permitting it to be opened by the dispensing operator. Such hose connection and valve are not shown in said drawings, as they are ordinarily employed in such liquid dispensing apparatus.

In the form of my invention chosen for illustration, it may be necessary to prime the pump with liquid and, thereafter, the positive displacement pump initially lifts the liquid from the underground tank and discharges it into a cavity between that pump and the centrifugal pump, and the latter effects the separation of the lighter fluid from the liquid, which lighter fluid is first discharged into an expansion chamber and thence into the atmosphere through a vent, which vent is controlled by a float valve. Said valve insures that the expansion chamber shall never contain such an amount of liquid that any liquid will be discharged into the atmosphere through said vent.

In that form of my invention, I have found it convenient to mount the rotors of both of said pumps upon a single shaft conveniently adapted to be rotated by an electric motor. Any gasoline which may accumulate in the expansion chamber due to condensation of gasoline vapor or which may accumulate in said expansion chamber by reason of expansion of the gasoline in the pumping system when the pump is idle, is drawn into the centrifugal pump when the latter is rotated and is discharged into the receiving chamber connected with the discharge of the centrifugal pump, as is hereinafter explained. Said receiving chamber is connected with the suction side of the positive displacement pump by a by-pass conduit which is normally closed by a spring pressed valve which opens under abnormal pressure in said receiving chamber which may be produced by the continued operation of the pumps after the operator

has permitted the hose valve to close to stop the dispensing operation. When said by-pass valve is thus opened, continued operation of the pumps merely idly circulates the liquid in the pump casing.

My invention includes the various novel features of construction and arrangement hereinafter more definitely specified.

In said drawings, Fig. I is a somewhat diagrammatic vertical sectional view of a convenient embodiment of my invention, wherein an integral pump casing, conveniently formed of several separable members, incloses both pumps.

Fig. II is a cross sectional view of the structure shown in Fig. I, taken on the line II, II in the direction of the arrows on said line.

Fig. III is a cross sectional view of the structure shown in Fig. I, taken on the line III, III in the direction of the arrows on said line.

Figs. IV and V are vertical sectional views of respectively different modified forms of the centrifugal rotor.

Member 1 of the pump casing has the liquid supply inlet 2 conveniently connected with the subjacent reservoir tank of liquid by a conduit, which has at the lower end of it a check valve which opens upward upon operation of the pump, but is normally closed to retain the liquid in said conduit. As such conduit and valve are ordinarily employed in connection with liquid dispensing apparatus, they are not illustrated. Said casing member 1 has the bearing 3 for the rotary pump shaft 4 conveniently provided with the coupling 5 for connection with the motor shaft 6. Said bearing 3 forms a box for the packing 3<sup>a</sup> which is retained by the packing box nut 3<sup>b</sup>. Said pump shaft 4 has rigidly connected therewith the positive displacement pump rotor 8 which is of the gear type and seated in the recess 9 in said casing member 1, in mesh with the other gear element 10 of the positive displacement pump, which latter is journaled to rotate idly in said recess 9 on the stud shaft 11 which is fixed at its lower end in said casing member 1.

Said casing member 1 has the intake duct 12 leading from said inlet 2 to said gears 8 and 10. Liquid is drawn around between the gears and the recess 9, and at the point where the gears mesh the liquid is squeezed out through the port 12<sup>a</sup> in the casing member 1<sup>a</sup> which is a diaphragm plate forming a cover for said recess 9 in the casing member 1.

Said port 12<sup>a</sup> opens into the cavity 14 in the casing member 15 between the positive displacement pump and the centrifugal pump rotor which

is conveniently formed of the member 16 which is rigidly connected with the end of said shaft 4 and carries the hollow rotor vent member 16<sup>a</sup> which is rigidly connected with said rotor member 16. As shown in Fig. III; said centrifugal rotor member 16 has rigidly connected therewith a circular series of evolute blades 16<sup>b</sup> in the space between the perimeters of said rotor members 16 and 16<sup>a</sup> through which the liquid is centrifugally discharged into the annular passage 18 formed between said casing member 15 and the casing member 20 which is rigidly connected therewith.

As shown in Fig. III; said annular passage 18 opens into the receiving chamber 21 which is inclosed between said casing members 15 and 20. Said receiving chamber has the outlet port 22 communicating with the liquid dispensing outlet 23 opening through said casing member 15. As shown in Fig. I, said outlet port 22 is normally closed by the control valve 25 under pressure of a spring 26 which bears upon the piston 27 which is rigidly connected with the stem 25<sup>a</sup> of said valve 25 and is mounted to reciprocate in the spring chamber 20<sup>a</sup> in said casing member 20. That construction and arrangement are such that the liquid centrifugally discharged from the annular passage 18 into the receiving chamber 21 is not permitted to escape therefrom through the dispensing outlet 23 until the liquid is under such pressure upon the piston 27 as to compress the spring 26 and open the valve 25 from its seat at the port 22.

As shown in Fig. I, the liquid by-pass duct 29 extends from said receiving chamber 21 back through the casing members 15, 1<sup>a</sup>, and 1 in communication with the inlet duct 12 on the suction side of the positive displacement pump. Said duct 29 is normally closed by the by-pass valve 30 under pressure of the spring 31 which bears upon the piston 32 which is rigidly connected with the stem 30<sup>a</sup> of said valve and is mounted to reciprocate in the spring chamber 34 in said casing member 20.

Said casing member 20 forms the expansion chamber 35 which is continually in communication with the hollow interior of the centrifugal rotor member 16<sup>a</sup> to receive the lighter fluid including air and vapor of the liquid, separated from the liquid to be dispensed.

I find it convenient to mount in said chamber 35, rigidly connected with said casing member 20, the abutment plate 26<sup>a</sup> for the spring 26, which plate forms a slide bearing for the valve stem 25<sup>a</sup>. Said plate 26<sup>a</sup> has the perforation 26<sup>b</sup> to permit egress and ingress of fluid from the spring chamber 20<sup>a</sup> incident to the reciprocation of the piston 27. I also mount in said chamber 35 the abutment plate 31<sup>a</sup> for the spring 31, which plate forms a slide bearing for the valve stem 30<sup>a</sup>. Said plate 31<sup>a</sup> has the perforation 31<sup>b</sup> to permit egress and ingress of fluid from the spring chamber 34 incident to the reciprocation of the piston 32.

The casing member 37 forms a closure for said expansion chamber 35, but has the vent 37<sup>a</sup> leading from said casing to the outer atmosphere. I find it convenient to provide said vent with the float valve 38 operatively connected with the float 39 by the lever 39<sup>a</sup>. The latter construction and arrangement insures that the expansion chamber 35 shall never contain such an amount of liquid that any liquid will be discharged into the atmosphere through said vent 37.

I have found it preferable to so design the

centrifugal pump rotor that if it were entirely filled with liquid it would have a greater delivery capacity than the delivery capacity of the positive displacement pump which operates at the same speed. For instance, it has been found desirable to have a maximum delivery capacity of the centrifugal pump approximately 1.2 to 1.3 times the capacity of the positive displacement pump, so that the centrifugal rotor is partly filled with air during operation. While operating, the liquid is thrown to the outer walls of the inclosure of that rotor and the liquid is discharged into the receiving chamber under the combined pressures resulting from the positive displacement pump and the centrifugal pump.

The effective radius at which the liquid enters the centrifugal pump through the casing member 15 is greater than the effective radius of the vent at the top of the centrifugal rotor member 16<sup>a</sup>, and therefore, the centrifugal force of rotation is effective in preventing the liquid from being crowded toward the center of rotation and upward through the rotor vent 16<sup>c</sup>. The relationship of delivery capacity of the two pumps, together with said difference in centrifugal effects within the centrifugal rotor itself, minimizes the possibility of liquid being delivered out through the rotor vent 16<sup>c</sup>. However, liquid which may be contained in the expansion chamber 35 is pumped out at the next successive operation of the pumps when the outlet valve at the end of the hose is opened by the operator to permit dispensation of the liquid.

Although apparatus constructed as illustrated herein is satisfactorily operative; a stand pipe may be provided connected with the cavity in the casing member 15 below the centrifugal rotor 16, to maintain a gravity head to deliver liquid to the centrifugal rotor, with the effect that the pressure built up by the centrifugal rotor when the outlet valve is closed is automatically maintained by the operation of the centrifugal pump. If such a stand pipe is provided, it would be desirable to have a suitable receiving chamber at the top thereof with a return valve duct which would return the liquid back to the suction side of the positive displacement pump in the same manner as the by-pass duct 29. Furthermore, the centrifugal pump may also be designed to produce less pumping capacity than the positive displacement pump and thus a small amount of liquid may be forced out of the rotor vent 16<sup>c</sup> with the lighter fluid. In such an arrangement it would be desirable to provide a float-operated valve in the lower portion of chamber 35 to return the liquid through a suitable conduit to the suction side of the positive displacement pump and thus prevent the liquid level from rising above a predetermined level during normal operation.

Although I have found it convenient to employ a positive displacement pump of the twin gear type illustrated; any other suitable form of displacement pump may be employed in association with a centrifugal pump to effect such two-stage operation as herein contemplated; to wit, a first stage in which the displacement pump merely progresses the liquid without eliminating lighter fluids therefrom, and in the second stage the centrifugal pump effects both the separation and elimination of the lighter fluids from the liquid.

Fig. IV shows a vertical sectional view of a form of centrifugal rotor different from that shown in Fig. I in that the radial partitions in the liquid inlet thereof extend above the evolute

blades 16<sup>d</sup> instead of merging with the inner ends of such blades, and the blades and said partitions are cast in unitary relation with the upper rotor member 16<sup>e</sup> of the rotor.

Fig. V shows a vertical sectional view of a centrifugal rotor differing from the others above described in that the radial partitions in the liquid inlet thereof terminate below the evolute blades 16<sup>f</sup> which are cast in unitary relation with the upper rotor member 16<sup>e</sup>. In all three forms of rotors illustrated, the upper and lower members are conveniently rigidly connected by rivets 16<sup>g</sup>.

In view of the prior art, I disclaim both the broad combination of a pump, separator, and by-pass, and of two pumps connected in series, and call attention to several distinctive characteristics of my invention: First, a pump of the positive displacement type, such as is shown in Fig. II, which continually prevents direct communication between the liquid supply inlet 2 and the port 12<sup>a</sup> leading to the centrifugal pump. Second, a displacement pump of the type which positively controls and limits the passage of all the fluid mixture which is supplied to the centrifugal pump. Third, the positive displacement pump has no function of separating the liquid and lighter fluids of the mixture. Fourth, such separating function is performed solely by a single centrifugal pump rotor. Fifth, that single centrifugal rotor also solely effects the forcible elimination of the lighter fluids from the apparatus. Sixth, liquid gasoline is dispensed by progressing it in two distinct steps or stages, whereby the separation of the lighter fluids is facilitated by the continual formation of an attenuated vapor space in coaxial relation with the centrifugal rotor separator.

Moreover, that method of dispensation may be effected by other means than two pumps of different capacity rigidly connected with the same rotary shaft, and consequently operated at the same speed, as in the apparatus illustrated. For instance, the two pumps may be of the same capacity but operated at different speeds.

However, I do not desire to limit myself to the precise details of construction, arrangement, or method of operation herein set forth, as it is obvious that various modifications may be made therein, without departing from the essential features of my invention, as defined in the appended claims.

I claim:

1. The combination with a pump casing inclosing a pump chamber having a liquid supply inlet and a liquid dispensing outlet and a vent to the outer atmosphere from the upper portion of said casing for the escape of lighter fluids including air and vapor of said liquid; of a positive displacement pump mounted to rotate in the lower portion of said casing and continually preventing communication between said liquid supply inlet and liquid dispensing outlet, and limiting and controlling the passage of fluid from said inlet to said outlet by its operation; a centrifugal pump including a rotor impeller which receives only fluid discharged from said first pump in said casing and is adapted to separate the liquid from the lighter fluids in the mixture from the positive displacement pump and forcibly discharge the liquid toward said liquid dispensing outlet and the lighter fluids toward said vent; an annular passage for liquid in registry with the perimeter of said centrifugal rotor; a receiving chamber in said casing

in communication with said passage; a port in said receiving chamber leading to said dispensing outlet; a spring pressed control valve normally closing said port; a piston connected with said control valve, of greater area than the latter, adapted to open said control valve when the fluid pressure in said receiving chamber is sufficient to overcome the stress of the valve closing spring.

2. A structure as in claim 1; including an expansion chamber in said casing in communication with an axial discharge outlet from said centrifugal rotor and having a vent to the atmosphere for the lighter fluids separated from the liquid solely by the rotary impeller of the centrifugal pump.

3. A structure as in claim 1; wherein the centrifugal impeller rotor is hollow, formed of two separate and distinct hollow members in axially spaced relation at their perimeters and having evolute impeller blades rigidly held between them.

4. A structure as in claim 1; wherein rotors of both the positive displacement pump and the centrifugal pump are rigidly connected with the same driving shaft.

5. A structure as in claim 1; wherein rotors of both the positive displacement pump and the centrifugal pump are rigidly connected with the same driving shaft; the centrifugal pump rotor being of such capacity that if it were entirely filled with liquid it would have a greater delivery capacity than the delivery capacity of the positive displacement pump although operating at the same speed.

6. The combination with a pump casing inclosing a pump chamber having a liquid supply inlet and a liquid dispensing outlet and a vent to the outer atmosphere from the upper portion of said casing for the escape of lighter fluids including air and vapor of said liquid; of a positive displacement pump mounted to rotate in the lower portion of said casing and continually preventing communication between said liquid supply inlet and liquid dispensing outlet, and limiting and controlling the passage of fluid from said inlet to said outlet by its operation; a centrifugal pump including a rotor impeller which receives only fluid discharged from said first pump in said casing and is adapted to separate the liquid from the lighter fluids in the mixture from the positive displacement pump and forcibly discharge the liquid toward said liquid dispensing outlet and the lighter fluids toward said vent; an annular passage for liquid in registry with the perimeter of said centrifugal rotor; and a duct leading from said annular passage to said liquid dispensing outlet.

7. The combination with a pump casing inclosing a pump chamber having a liquid supply inlet and a liquid dispensing outlet and a vent to the outer atmosphere from said casing for the escape of lighter fluids including air and vapor of said liquid; of two pumps, each including a rotor; said rotors being successively operative upon mixture of liquid and lighter fluids received through said inlet, but the first pump operative upon said mixture arranged to continually prevent communication between said liquid supply inlet and liquid dispensing outlet limiting and controlling the passage of fluid from said inlet to said outlet by its operation; a single shaft rigidly connecting said rotors in axially spaced relation in said casing; and ducts in said casing leading from said liquid supply

inlet to the first pump and from the discharge side of the first pump to the inlet side of the second pump; and a duct in said casing leading from the discharge side of said second pump to said liquid dispensing outlet; whereby the liquid is progressed in two distinct stages by the respective pumps; wherein the second pump is centrifugal and of greater volumetric capacity than the first pump; whereby lighter fluid included in the liquid received by the second pump from the first pump is eliminated by the second pump and discharged to said vent, even when the liquid discharge outlet is closed.

8. The combination with a pump casing inclosing a pump chamber having a liquid supply inlet and a liquid dispensing outlet and a vent to the outer atmosphere from said casing for the escape of lighter fluids including air and vapor of said liquid; of two pumps, each including a rotor; said rotors being successively operative upon mixture of liquid and lighter fluids received through said inlet, but the first pump operative upon said mixture arranged to continually prevent communication between said liquid supply inlet and liquid dispensing outlet limiting and controlling the passage of fluid from said inlet to said outlet by its operation; a single shaft rigidly connecting said rotors in axially spaced relation in said casing; and ducts in said casing leading from said liquid supply inlet to the first pump and from the discharge side of the first pump to the inlet side of the second pump; and a duct in said casing leading from the discharge side of said second pump to said liquid dispensing outlet; whereby the liquid is progressed in two distinct stages by the respective pumps; wherein the second pump is of greater volumetric capacity than the first pump; and means in said second pump rotor for separating out lighter fluids, including air and vapor of said liquid, from the liquid before it is discharged by said second pump; whereby lighter fluid included in the liquid received by the second pump from the first pump is eliminated by the second pump and discharged to said vent.

9. In liquid dispensing apparatus; a hollow centrifugal rotor formed of two primarily separate hollow members, axially opposed in coaxial relation with their circular perimeters in axially spaced relation; the hollow interior of said rotor being of much greater axial extent at its axis than at its perimeter, and one being of greater axial extent at its axis than the other and having a single outlet vent at its axis for lighter fluids; the other of said members having an axial shaft, whereby the rotor is turned, and having a liquid inlet in eccentric relation to its axis; and a series of evolute blades between said rotor members in rigid relation with both; whereby, upon rotation of said rotor by its shaft, liquid introduced to the hollow interior thereof through said eccentric inlet is immediately thrown to the perimeter of the rotor and discharged

through the perimetral openings between said evolute blades, with the effect of separating lighter fluids theretofore occluded and entrained in said liquid and permitting such lighter fluids to escape through said axial vent outlet.

10. A structure as in claim 9; wherein the evolute blades are cast in unitary relation with the rotor member having the axial shaft; and there is a circular series of liquid inlets eccentric to the axis of said shaft respectively extending through that rotor member between adjoining evolute blades.

11. A structure as in claim 9; wherein the rotor member having the axial outlet vent for lighter fluids is conical and has said outlet at its apex.

12. The combination with a pump casing inclosing a pump chamber having a main liquid supply inlet connected to a source of supply of liquid and a main liquid dispensing outlet and a vent to the outer atmosphere from said casing for the escape of lighter fluids including air and vapor of said liquid; of a positive displacement pump for withdrawing liquid from the source of supply and discharging said liquid to the inlet side of a centrifugal pump and continually preventing communication between said liquid supply inlet and liquid dispensing outlet, and limiting and controlling the passage of fluid from said inlet to said outlet by its operation; a centrifugal pump including a rotor impeller having an inlet for fluid discharged from said first pump and a discharge outlet connected with said main liquid dispensing outlet; and means in said rotor impeller for separating out lighter fluids, including air and vapor of said liquid, from the liquid before it is discharged by said centrifugal pump; whereby said positive displacement pump functions solely to progress mixture of liquid and lighter fluids received through said supply inlet, without separating them, and such separation is effected solely by the operation of said centrifugal pump.

13. The combination with a pump casing inclosing a pump chamber having a main liquid supply inlet connected to a source of supply of liquid and a main liquid dispensing outlet and a vent to the outer atmosphere from said casing for the escape of lighter fluids including air and vapor of said liquid; of a positive displacement pump functioning solely for withdrawing liquid from the source of supply and discharging said liquid to the inlet side of a centrifugal pump; a centrifugal pump including a rotor impeller having an inlet for fluid discharged from said first pump and a discharge outlet connected with said main liquid dispensing outlet; means preventing inlet of liquid to said second pump, except from said first pump; and means in said rotor impeller for separating out lighter fluids, including air and vapor of said liquid, from the liquid before it is discharged by said centrifugal pump and for discharging said lighter fluids to said vent.

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