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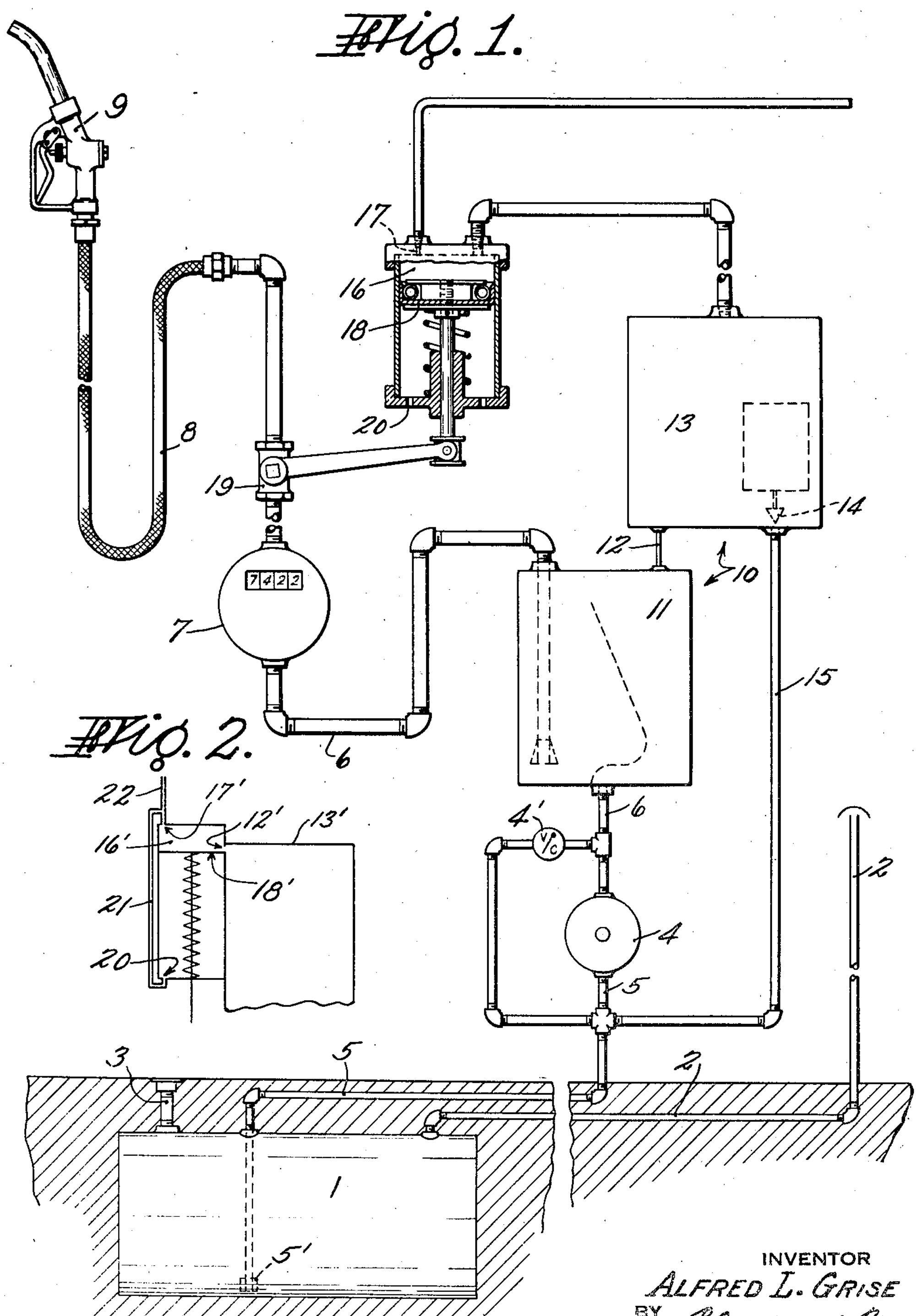

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LIQUID DISPENSING APPARATUS

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1 Claim. (Cl. 221—95)

This invention relates to liquid dispensing apparatus of the kind used and known as gasoline "pumps." The same general kind of apparatus is used also for dispensing liquids such as fuel oil for Diesel engines, furnace oil, and many others.

According to the main feature of my invention I provide automatic means to control the liquid delivery, such means being operable in an emergency. This means is operable automatically upon an overloading of the air separator. It will not operate at all if the air separator is operating at or below a predetermined air separator capacity for the particular apparatus.

The purpose is to predetermine the capacity of the air separator and prevent the operation of the apparatus from putting more work on the air separator than it can do. Under some conditions of prior art operation an apparatus may in the beginning operate without trouble and later on give false measurement because the air separator is being unintentionally overloaded. This is particularly liable to happen in dispensing Diesel engine oil. The latter will not separate from air as readily as gasoline will.

This will all be clear to one skilled in the art from a disclosure of my improved structure, its mode of operation, and some of its important results. These will be referred to in connection with the accompanying drawing, in which—

Fig. 1 is a diagrammatic view of the apparatus; and

Fig. 2 is a detail of the air separator and automatic control device of Fig. 1 with a slight modification.

The functions of the illustrated apparatus in general from end to end are as follows: The liquid is kept underground in tank 1, vented through pipe 2, and filled through pipe 3. Pump 4 moves the liquid from the tank through suction pipe 5 to a point above ground near the point of dispensing. The pump discharges into pipe line 6. Meter 7 in this line measures the liquid discharged by the pump through hose 8 and hand-controlled nozzle valve 9. The air separator 10 is in the pipe line 6 between the pump and meter. A check valve 5′ at the entrance to the suction line and nozzle valve 9 at the dispensing point are closed when no liquid is being delivered. Thus, the apparatus is kept filled with liquid between the tank and the hand valve.

The general operation of this kind of apparatus is first to close a switch for a motor, not shown. The motor operates the pump constantly. Until the hand valve 9 is opened manually for delivery, the pump merely operates to by-pass liquid through suitable passages between the suction and discharge sides of the pump. An automatic spring loaded by-pass valve 4′ for this purpose is set to stay closed until the desired discharge pressure is built up by the pump, and when it is reached in pipe line 6 the by-pass valve opens, and the pump tends to maintain that pressure and by-pass the liquid to avoid excess pressure. The apparatus is ready for delivery operations about as soon as the pump motor is turned on. There is no appreciable delay.

When delivery begins by opening valve 9, liquid moves through line 6 and air separator 10. The air is taken out of the liquid; the latter then passes through meter 7 and accurately measured liquid within permitted tolerances is delivered through valve 9. If the latter is wide open there is little or no by-passing of liquid through the pump passages. The pump then discharges to its full capacity, and the liquid goes at the maximum rate through the air separator, the meter, and the delivery nozzle. When delivery is made at less than the maximum rate, the pump by-passes the difference up to its full capacity.

During these delivery operations at the maximum rate, any leak in the apparatus on the suction side of the pump, at any point all the way back to the underground tank, admits air. It is drawn in by the suction. For a given size leak in this line the maximum quantity of air will of course be drawn in during the maximum rate of delivery. At this time the maximum load is put on the air separator for that size leak.

Air separators are used throughout the trade in different sizes, each size designed with the idea of a maximum load capacity for it. If overloaded in any particular apparatus, an air separator becomes inefficient. It permits more air to be measured with liquid than permitted by accepted tolerances and the whole apparatus is inefficient for accurate measuring purposes within accepted practical limits.

Consider the case of air leaking in suction line 5. It joins the liquid pumped into separator 10. In this, it rises to the top of liquid in main chamber 11, goes out with some liquid through restricted passage 12 to secondary chamber 13. In this chamber float valve 14 controls passage 15. The liquid accumulating in chamber 13 lifts valve 14 and returns to the suction side of the pump by passage 15. The air cannot return as valve 14 closes with liquid above it and the air goes to the top of this liquid. So far, the structure and operation are of the prior art. In that art the air is commonly vented freely to the atmosphere from the top of a chamber like 13.

In my improvement, as illustrated, this air has a passage from chamber 13 to the piston chamber 16. From the latter a vent passage 17 leads to the atmosphere. The passage 17 is restricted, say to less than a sixteenth of an inch, and for a particular purpose. The separator is arranged so it can feed air, separated from liquid, and pass more air over to chamber 16 than can be vented through passage 17 to the atmosphere. This is preferably arranged to occur as the upper limit of efficient air separator operation is about to be reached. The pressure in the apparatus on the discharge side of the pump moves the air along the path described. The action under emergency conditions to be explained is for air from the separator to partially vent itself out passage 17 and to accumulate under sufficient pressure in chamber 16, to operate its piston 18.

This piston is spring loaded, tending to move upwardly. When up, the connection indicated with valve 19 keeps that valve wide open. The valve is in the discharge passage from the meter, but it could also be placed on the liquid inlet passage to the meter. Its object is to control the liquid flow from the pump to the dispensing point. The connection illustrated between the valve 19 and piston 18 is to make this an automatic control.

When more air is forced in chamber 16 than can get out vent passage 17, air pressure results. This moves piston 18 down and moves valve 19 to closed position. When closed, the valve stops liquid delivery. This being stopped, no air can reach the meter. The air separator then has no liquid passing through it. Consequently, it is given time to free itself from its overload of air. The result is that I have a new and useful means to automatically prevent overloading the air separator and to prevent the false measurement of liquid.

One important advantage is that I may use a smaller size air separator in dispensing apparatus without having the latter condemned by the officials of weights and measures. A common condition of air separator use is to provide for the contingency of an air leak in the suction line. A tight suction line has no need of an air separator. But there is enough chance for leaks that officials require an efficient air separator to guard against them. In official tests leaks are made in the suction line and air separators must be designed to satisfy the officials in passing such tests. As a consequence, many separators are of exceedingly large size. They have heretofore been commonly made of a capacity to take care of the largest leak used in testing a particular dispensing apparatus. Such capacity and leak size may go beyond the manufacturer's judgment of what is practical, but he must conform to official testing regulations before the apparatus can be used. Thus, it is common practice for dispensing apparatus with properly installed suction lines to be working with expensive, oversize air separators. This common practice is all for the contingency of a maximum size leak that may never occur. The practice is carried on to satisfy the judgment of the officials in safeguarding the public from false measurement in the sale of expensive liquids. Such judgment of extremely safe tests of automatic measurements is supported by the need not only for inadvertent errors, but for deliberate ones. One way to cheat is to make a large air leak in a suction line deliberately. My invention may be used to automatically stop delivery when the air leak is excessive so as to permit a smaller size air separator to be used. And such air separator may be used in the combination of my invention so as to prevent false measurement and satisfy official requirements.

Some aspects of operation will be discussed. When the piston starts down under pressure, it goes a short distance and then the valve snaps shut. The reason for this seems to be that the pressure on opposite sides of the valve, being different, this difference is suddenly in favor of shutting as soon as the valve approaches its seat. That is to say, the piston pressure starts the valve to its seat; then the pressure of the liquid trying to squeeze through the smaller valve opening makes the high pressure side aid the piston movement and the valve snaps shut. As this happens during a delivery, the operator should turn off the pump motor. The liquid in the system then becomes quiet. This makes for ideal conditions of air separation. The air then rises through the liquid and is vented. The air pressure on the piston is relieved. The spring returns the piston to its original position and the automatic valve is opened. This all takes place in a short time, a matter of seconds rather than minutes. The system being thus cleared of its excess air, the motor switch is turned on by the operator and delivery is resumed. It goes on until the system again works to shut off delivery automatically. The cycle can be repeated as long as desired. But of course the operator does not like the interruption and he will get the leak fixed as soon as he can. Meanwhile, he can use the apparatus to deliver. Such delivery is, however, always a safely measured one. This is all the official sealers of weights and measures are interested in. They will pass the apparatus through their tests and the user is benefited as well as the manufacturer.

Other advantages are as follows: A separator of given capacity can be used with a pump having a higher rate of delivery than such separator capacity would ordinarily accommodate. The reason is that the separator will not be overloaded during any delivery through the meter. The pump delivery is stopped automatically whenever there is enough load on the separator to adversely affect the liquid measurement. The delivery is not made low to fit the air separator, nor the air separator made big to fit the rate of delivery. The latter is not stopped except in an emergency. If the apparatus is maintained in good condition the emergency never arises. If the apparatus springs a bad leak, it can be kept in use for delivery, but only with intermittent stops to clear the excess air. The necessary automatic stop in an emergency gives the operator substantial and prompt notice of the needed repair.

The invention is particularly useful in dispensing apparatus used for large volume and fast deliveries. A special case will illustrate this. Assume an apparatus used to deliver twenty-five gallons a minute: in prior art apparatus this rate of flow from a long suction line through a meter on engineering principles requires an air separator of a capacity commensurate with the largest amount of air that can flow with liquid through the line to the separator and still serve liquid fuel to any satisfactory extent. This large-size separator is objectionable for a good many reasons. Because a smaller one would seem to work satisfactorily for the most part, there is a temptation to compromise and use the smaller one. But there is another difficulty. The fast rate of flow through the smaller separator decreases its efficiency. The fast flow tends to rush the air bubbles along with the liquid to the meter before they all have time to separate This is particularly true of liquid fuel for Diesel engines. Consequently, while the smaller separator will continue to remove a lot of air, due to a substantial leak altogether too much air will pass for measurement with liquid in the meter. However, with my combination the air that is separated when the separator is working at about its top capacity will operate to stop the delivery. Then, if the apparatus is stopped the air will be cleared through the vent and delivery can then be started again. It can operate until too much air again accumulates in the separator. Thus, the measurement is made accurately during delivery, the customer is served, the operator knows he should make a repair and this happens when the apparatus springs a substantial leak. Otherwise, the apparatus is always available for its intended twenty-five gallons a minute delivery.

There is another objection to the use of very large volume air separators in high rate liquid delivery apparatus. The larger they are the larger air leaks they will keep hidden in such apparatus. Thus, in idle periods liquid fuel in large quantities will leak unobserved from leaks in the underground suction line. The rest of the apparatus except the tank holds a large quantity with a hydraulic head acting through the leak. However, the operator of apparatus with my invention is made aware of a really bad leak as soon as it acts to put the air separator at its upper limit of work. There is a constant and substantial check of the condition of the apparatus under the operator's observation at the point of dispensing. The unusual presence of a bad leak is translated into an automatic and intermittent stopping of the wanted delivery.

The disclosure of Fig. 1 is of course diagrammatic, to show the main operation of the combination. The main invention is in the combination.

In Fig. 2 I have shown a preferred arrangement of secondary chamber 13 and piston chamber 16. Its purpose will now be stated.

It is known that air separators release vapor as well as air to the atmosphere. It has been a convenience to describe the main operation of Fig. 1 apparatus as air separation. But of course the air carries more or less vapor, particularly in dispensing gasoline. The vapor as well as air might interfere with the desired operation.

Due to the tendency of vapor to condense when held under pressure liquid might collect on top of piston 18 as the piston cylinder is connected to the apparatus of Fig. 1. By connecting it as indicated in Fig. 2 any such liquid will be drained back, as indicated, to chamber 13'.

The passage 12' is located level with the top of the piston when the latter is not under pressure. When it is under pressure the piston will be below the passage. When the apparatus stops, the piston is spring returned to the level of passage 12'. Thus, even a few drops will have a chance to drain back.

In the normal operation there will be no pressure tending to condense vapor. I am concerned merely with the abnormal operation when my emergency device is in use to avoid overloading the separator. I wish to avoid the chance of collecting liquid above the piston of the emergency device. If it did collect there it might block off the air vent passage after the leak in the suction pipe was repaired. This fact might not be detected and my plan to drain back avoids the chance.

In Fig. 2 I show the parts primed which correspond generally to those of Fig. 1. I also show the bottom of the piston chamber connected to the free air vent 22 by pipe 21. This will avoid any liquid that leaks past the piston getting out of the apparatus from the bottom. It will be appreciated that over a long period of time enough condensed liquid, a few drops at a time, might clog the intended operation of the air pressure means. Fig. 2 shows one way to avoid that chance.

I do not intend to state exact sizes for openings which I refer to herein as restricted. However, a workable principle is this: A restricted opening between chambers 11 and 13 should be small enough to avoid a substantial drop in pump delivery pressure by reason of the amount of liquid by-passed through chamber 13 and return passage 15. A passage of about one-eighth inch diameter can be used. Of course, it can and would be varied by different designers, but not much.

The passage 12' is not so important. It merely needs to be large enough to let all separated air or vapor into chamber 16'. The passage 17' is important and needs to be small enough, on the order of a small fraction of an inch, to insure enough back pressure of air to operate the piston in chamber 16' under the conditions I have stated. However, it should not be too small to vent air in the quantity desired under the conditions when no pressure operation of the piston is desired. This is the quantity of air that the separator can handle efficiently at about the maximum liquid delivery rate of a particular apparatus. The sizes may each be determined for any particular apparatus by any means, as a calibrating valve, to vary the restrictions until they fit that apparatus and let it work according to the principles herein disclosed. Then that apparatus may be regularly built with such openings as thus determined provided in it permanently, with or without a valve.

Many features in a commercial embodiment of the invention will not look much like the combination of elements diagrammatically shown in Fig. 1. A dispensing "pump" is ordinarily built with most of its elements very closely packed into a decorative outdoor casing. Some elements are combined in one casting. Thus, the commercial apparatus as built is not so simple to show. I have taken the diagrammatic form which the man skilled in the art can now readily make up in many varying commercial forms to fit his manufacturing convenience and other aspects of production.

I claim as my invention:

A dispensing apparatus adapted to pump liquid from storage to dispensing points and to measure the liquid substantially freed from air, including in combination a conduit having therein a pump with a back pressure relief device, an air separator apparatus, a meter, a dispensing valve, all connected by the conduit in the recited order and somewhere in said conduit between said pump and said dispensing valve a normally open automatically controlled valve adapted for complete closing to stop dispensing entirely while the pump is operating and the dispensing valve is open and in the event of an emergency, pneumatic mechanism adapted to entirely close said valve in the event that air beyond the air venting capacity of said air separator apparatus is pumped into the latter, restricted means to vent to the atmosphere air freed from liquid in said separator apparatus, said means being restricted enough in its venting function so as to build up air pressure in said apparatus as the latter tends to be loaded beyond its intended separating capacity, and a connection for such air pressure to operate said pneumatic mechanism for its automatic valve actuating purpose.

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