

Nov. 8, 1966

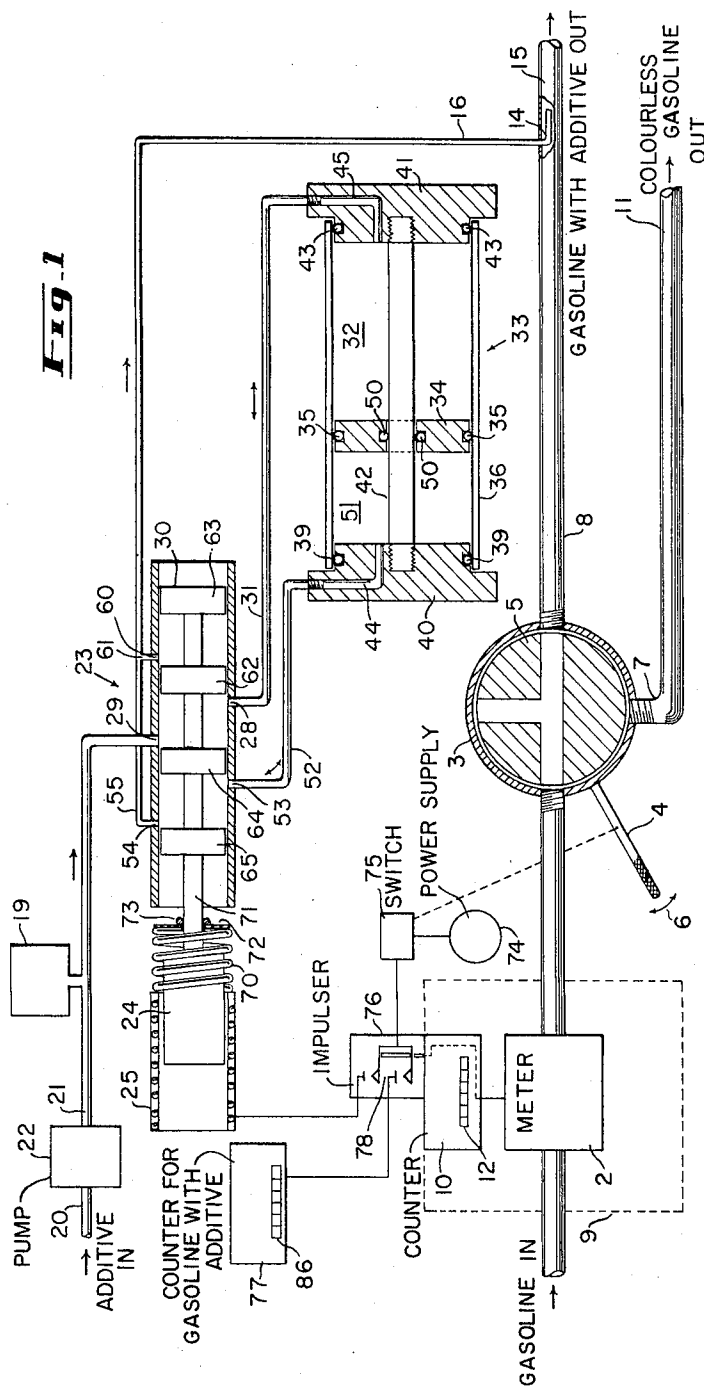
W. D. HENDERSON

3,283,957

LIQUID PROPORTIONING SYSTEM

Filed Jan. 26, 1965

4 Sheets-Sheet 1



Nov. 8, 1966

W. D. HENDERSON

3,283,957

LIQUID PROPORTIONING SYSTEM

Filed Jan. 26, 1965

4 Sheets-Sheet 2

Fig. 2

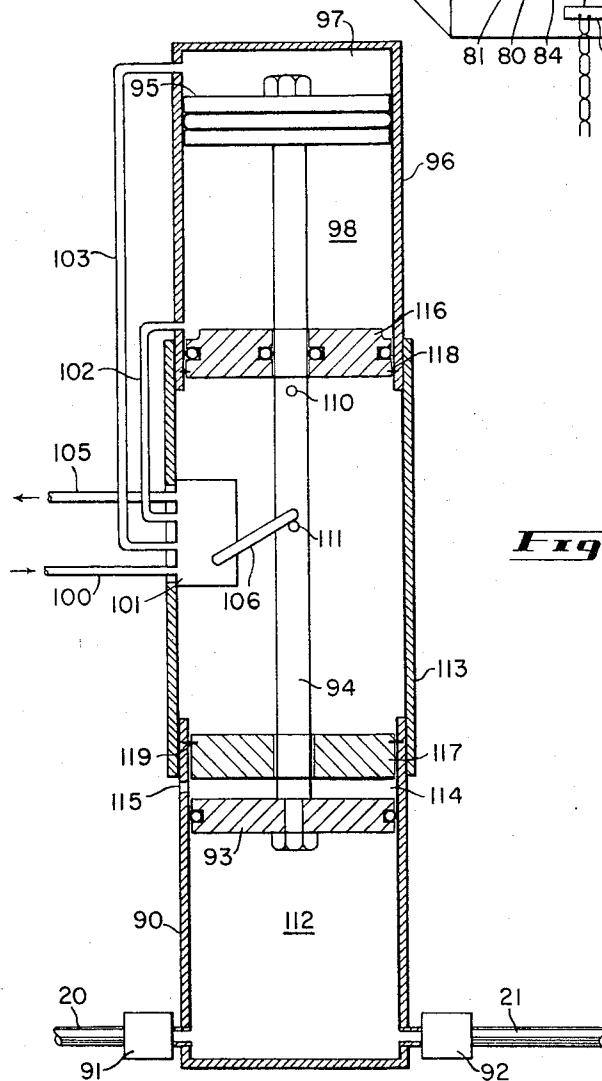
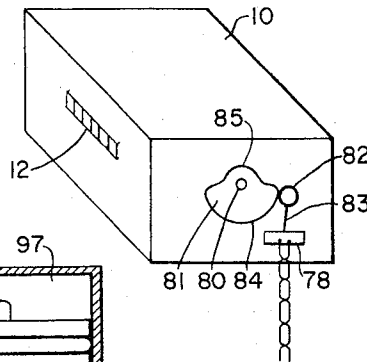


Fig. 3

Nov. 8, 1966

W. D. HENDERSON

3,283,957

LIQUID PROPORTIONING SYSTEM

Filed Jan. 26, 1965

4 Sheets-Sheet 3

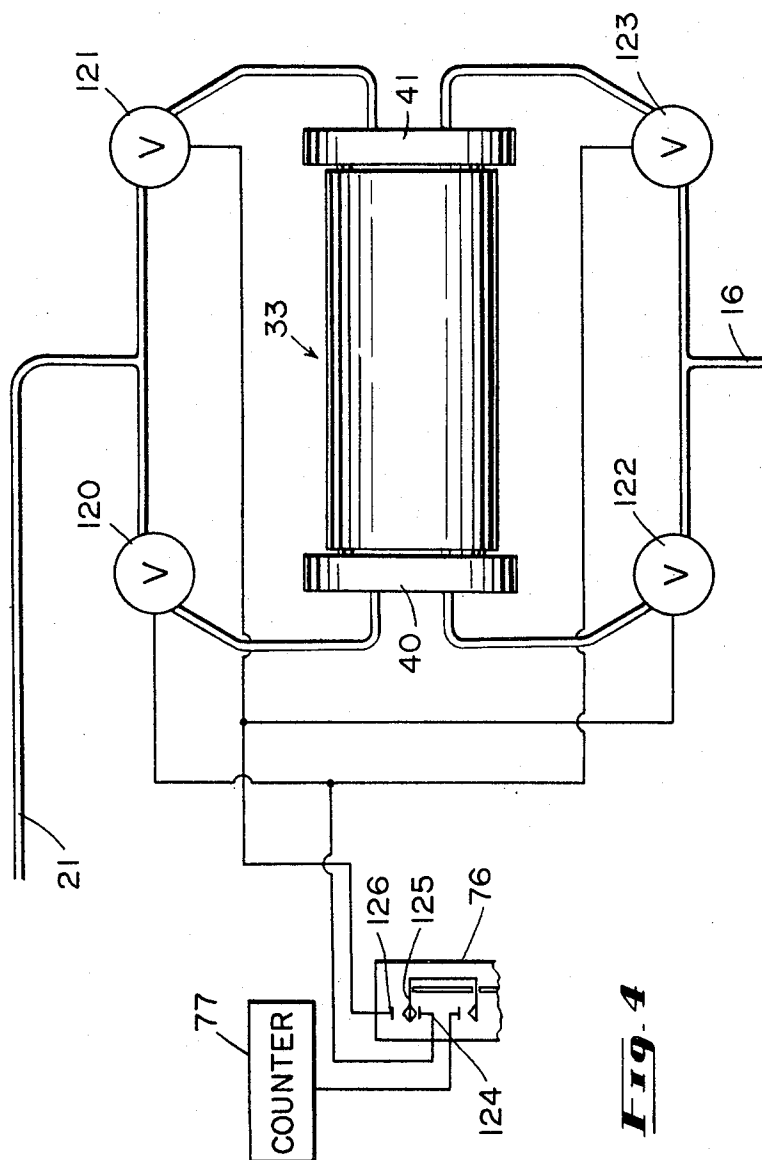


Fig. 4

Nov. 8, 1966

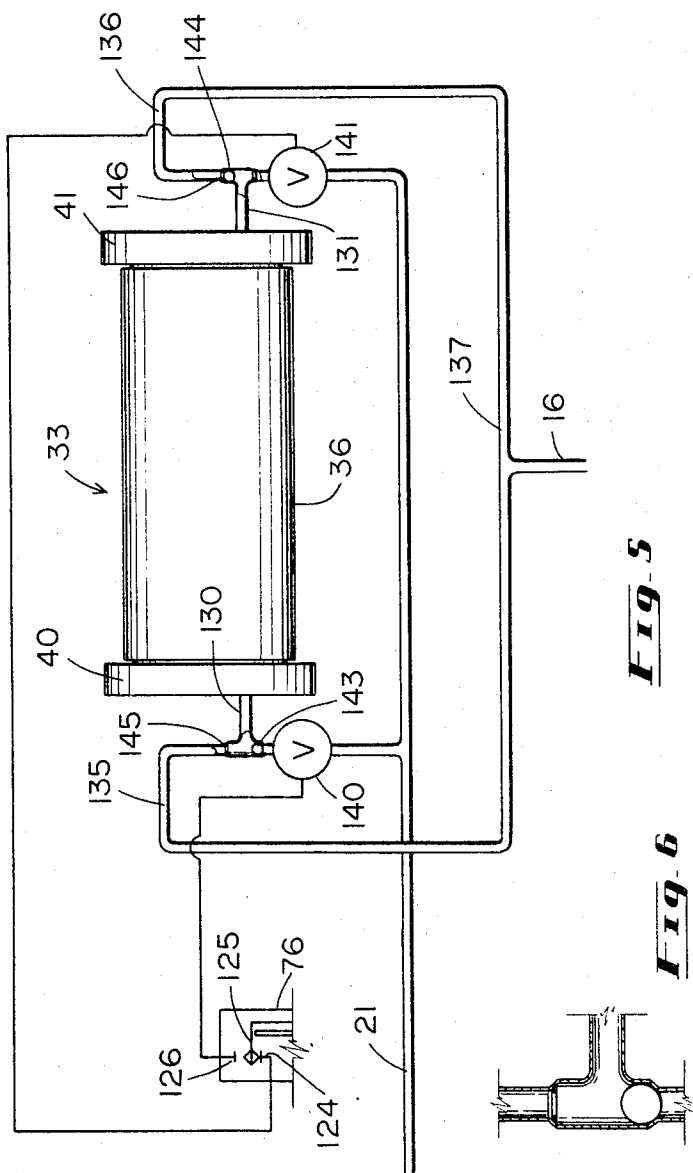
W. D. HENDERSON

3,283,957

LIQUID PROPORTIONING SYSTEM

Filed Jan. 26, 1965

4 Sheets-Sheet 4



1

3,283,957

LIQUID PROPORTIONING SYSTEM

William Dick Henderson, 2328 Henderson Highway,
Winnipeg, Manitoba, Canada

Filed Jan. 26, 1965, Ser. No. 428,084

Claims priority, application Canada, Jan. 27, 1964,

894,153

8 Claims. (Cl. 222—57)

This invention relates to a method and apparatus for the introduction of an additive liquid into another.

In the delivering and dispensing of gasoline it sometimes becomes necessary to add a colouring agent to that fuel which is sold at a lower rate of or at no tax and destined for use in certain specific government approved applications so that the fuel may be distinguished from gasolines sold in the normal manner and upon which the normal taxes including road tax are paid. The colouring of the low taxed gasoline deters its unauthorized use in vehicles on the highways and has, for instance, become required by law in the Canadian province of Manitoba as from January 1, 1964.

While it is perfectly possible to store colourless gasoline for normal sale in one tank and in another to place that to which dye has been added, this may be both inconvenient and expensive because it requires not only two sets of tanks but also that they be filled from separate supply trucks. In most cases separate storage tanks will also be required at the depot from which the trucks are filled.

In following the teaching of the present invention it becomes possible to supply gasoline to a service station for storage in a single tank, from which coloured or colourless gasoline can be dispensed as required and from which the quantity of coloured gasoline is registered independently. Where it is not intended that the additive introduction should be made at the service station, then this may conveniently be made at the gasoline supply depot where bulk storage of only the colourless product would be required, or even on the supply truck.

In accordance with the invention there is provided in a system for discharging liquid to which additive is to be made in controlled proportion, the improvement which comprises, means for supplying a liquid additive under pressure, metering means for injection of known quantities of the additive and means for permitting the additive to feed into the liquid in accordance with a measured flow of liquid.

In a preferred embodiment the metering means comprises a cylinder with a floating piston and a four way valve for admitting additive first to one side of the piston and exhausting from the other and then to the other side of the piston and exhausting from the one. In a further preferred embodiment the four way valve is operated by a solenoid controlled by a switch operatively connected to a meter for the liquid.

The invention will be described more fully now with reference to the accompanying drawings in which:

FIGURE 1 shows a partly diagrammatic layout of the system according to the invention for metering additive into a stream of gasoline,

FIGURE 2 shows a side view of a gasoline counter mechanism with an attached impulser for operating the additive dispensing metering solenoid and the additive counter of FIGURE 1,

FIGURE 3 shows a suitable pump for the system of FIGURE 1,

FIGURE 4 shows a further inventive embodiment,

FIGURE 5 is a partly diagrammatic view of yet a further embodiment using shuttle valves, and FIGURE 6 shows an enlarged detail of FIGURE 5.

2

In the system shown in FIGURE 1 gasoline is pumped from a tank (not shown) and is delivered to inlet 1. It then passes to a meter 2 and to a three way routing valve 3 whose handle 4 (which connects to insert 5) can be rotated as shown by double headed arrow 6 to connect inlet 1 either to the colourless gas line 7 or to a line 8. When the valve 3 is set so that the gasoline passes through line 7 it operates meter 2, operates counter 10 of conventional design well known in the art and is allowed to be dispensed through a suitable hose (not shown) from outlet 11. Since meter 2 and counter 10 may be officially sealed, as depicted by surround 9, it will be appreciated that the record of gasoline dispensed can be read at counter 10 on dials 12.

When the valve 3 is rotated to the position shown in FIGURE 1 gasoline which enters line 8 passes through meter 2 and then enters line 8 passing by injector nozzle 14 and is discharged at outlet 15 through a suitable hose. When gasoline is discharged from outlet 15 an additive from line 16 is caused to be mixed at nozzle 14 with a colourless gasoline.

Additive is brought to the system through inlet 20 and is forced into pipe 21 by pump 22. If desired a hydraulic accumulator 19 may be placed on pipe 21. It then passes to a push-pull four way valve 23 operated by armature 24 of a solenoid 25. In the position shown for the plunger 30 of the valve 23 liquid passes from line 21 to port 29, to port 28, and into the line 31 to be led to the right hand space 32 of a floating piston meter 33. This meter 33 comprises a piston 34 sealed by an O-ring 35 to run in a cylinder 36. There are end plates 40 and 41 which are held within the cylinder 36 by a tie rod or tube 42 which screws into the end plates. Each plate 40 and 41 is sealed to the cylinder 36 by an O-ring 39 and 43 respectively and includes a passage 44 and 45, respectively formed in each plate to allow liquid connection with the space adjacent that plate. The piston 34 is also sealed for sliding on tie member 42 by an O-ring 50. Each of the O-rings substantially prevents leakage of liquid between it and the surfaces with which it cooperates. Liquid in the space 51 to the left of piston 34 is connected through a pipe 52 and can pass to port 53 of the four way valve 23. This liquid passes across the valve to port 54 into a pipe 55 whence it can travel to tube 16. Liquid is prevented from escaping into the valve 23 through pipes 60 at port 62 by the piston discs 62 and 63 on plunger 30. In the alternate position of the four way valve 23 the plunger 30 moves to the left so that line 52 becomes connected to pipe 21 and line 28 connects to pipe 60. At this time the liquid cannot escape from the four way valve via pipe 55 because the space to which it connects is sealed against liquid egress by the piston discs 64 and 65 on plunger 30. A spring 70 is provided on the shaft 71 of plunger 30 and bears against the end of solenoid 25 and a washer 72 cooperating with a flange 73 raised on shaft 71.

The solenoid 25 is supplied from a power source 74 through a switch 75 controlled by the position of handle 4 on valve 3. When the valve is set to pass gasoline into line 8 the switch 75 is put on. Connection then passes to an impulser 76 and thence to solenoid 25 and impulse counter 77. The impulser 76 is operated from the shaft of the dial in counter 10 showing for instance, tenths of gallons. The impulser switches 78 are opened and closed once for every gallon delivered. Where the rate of delivery of fuel is high it may be desirable to operate the switch less often, say, once for every ten gallons. In this instance the size of the metering device 33 would need to be increased so that the correct proportion of additive was introduced.

Referring to FIGURE 2 the dials 12 of counter 10 are

carried on a shaft 80 which shaft directly drives the tenths gallons counter wheel and through gearing, between the wheels, operates those for gallons and tens and hundreds etc. A cam 81 is mounted on this shaft 80 and has bearing against it a roller 82 carried on the operating arm 83 of the limited movement switch 78. This cam 81 is so shaped that when roller 82 is riding on its larger circumference 84 the switch is thrown into one of its positions and when it drops down onto the circumference 85 it is in its other position. If desired the cam 81 may be replaced by one having a larger number of raised portions than the single one shown here, and may for instance operate switch 78 two, three, or more times for each revolution of shaft 80. In my Canadian Patent 636,731 and British Patent 914,651 a ten point star cam is disclosed for generating ten impulses for each revolution of the shaft on which it is mounted. Each operation of switch 78 also generates an impulse for impulse counter 77 which records the number of pulses on dials 86. Although a double pole switch 78 has been shown, in some instances both solenoid 25 and counter 77 may be fed from the same pole. (The return wire to source 74 for both solenoid and counter has been omitted for clarity). Alternatively if it is desired to send impulses to the counter 77 more often than to solenoid 25 a separate cam and switch can be used for each.

Let us now examine the operation of this device having reference to FIGURE 1. When the system is arranged for delivering colourless gas (i.e. that with no additive) from outlet 11 the three way valve 3 is turned so that the gas is diverted into tube 7 where it is dispensed in the usual manner and measured on counter 10. When it is intended to dispense gasoline which contains an additive such as a dye, the three way valve 3 is set in the position shown in FIGURE 1 and pump 22 is started. Details of a suitable pump will be given later but its action is to present additive in the line 21 at a suitable pressure for injection, 60 to 125 lbs./in.² being normal. Now with the four way valve 23 in the position shown, the additive passes into the centre port 29 of the four way valve 23 through line 31 and into space 32. This additive exerts a pressure on piston 34 forcing the liquid already present in space 51 through line 52, through port 53, into line 55, through tube 16 and out of nozzle 14 into the stream of gasoline. Since the metering device 33 is of small size, say $\frac{1}{15}$ of an ounce measure for each throw, only a small amount of additive will be injected into the gasoline for each reversal of the valve 23. In the position shown we have assumed that solenoid 23 is in its deenergized position but after the first half gallon (or other specific volume as determined by the number of points on cam 81) the switch 78 will be closed and four way valve 23 will be reversed. The additive then passes from line 21 into line 52, space 51, and ejects that from space 32 to line 31 and into tube 16. After the next half gallon of gasoline the solenoid is again deenergized, the valve 23 is placed in its first position and another $\frac{1}{15}$ of an ounce of additive is free to pass into the colourless gasoline flowing through line 8.

In the example given above $\frac{2}{15}$ oz. of additive would be introduced for each gallon of gasoline but this can be varied by operating the solenoid 25 more often or by increasing or decreasing the capacity of the spaces 51 and 32 in metering device 33. The device 33 ensures that for each chosen amount of gasoline an accurately measured quantity of additive is injected into the gasoline automatically and occurs only when valve 3 is in the position of FIGURE 1. Only at this time is the solenoid free to operate and the counter 77 to record. There is thus available a reading on dials 86 which gives the volume of gasoline with additive dispensed.

While many types of constant pressure delivery pumps will be suitable for item 22, the arrangement shown in FIGURE 3 has been found to be very satisfactory. The pump consists of a working cylinder 90, fed from line 21

through a check valve 91 and from which discharge is made into line 21 through a check valve 92. A piston 93 runs in the cylinder 90 and is connected to a driving shaft 94 operated by a piston 95 in a cylinder 96. Piston 95 is free to run the length of cylinder 96 under the action of air pressure introduced into space 97 and 98. Air is led into line 100 under pressure and can be diverted by four way reversing valve 101 either into line 102 connecting to space 98 or into line 103 connecting to space 97. The reversing valve connects that of the pair 102 and 103 which is not connected to pipe 100, to pipe 105 whence it passes to exhaust. The position of the valve is altered by operating arm 106 which is contacted at each end of the travel of shaft 94 by pins 110 and 111 respectively. It can be seen that on its operating stroke the pressure in space 97 will determine the force exerted by piston 93 on the liquid space in 112. The cylinders 90 and 96 are aligned by supporting tube 113, and air is allowed to enter and leave the space 114 above piston 93 by a vent 115. Suitable O-ring seals are provided on pistons 93 and 95 and also on block 116 where it contacts shaft 94 and cylinder 96. Support blocks 116 and 117 are retained in place by circlips 118 and 119 engaging their respective cylinders.

In other instances the pump 22 may be replaced by additive feed from a closed container, the upper part of which contains air under a chosen pressure. A dip tube into the liquid additive in the container will then discharge the liquid from the container and may be coupled into line 21. This will be more suitable for small installations. As a protective measure to prevent the operation of the additive counter 77 if the container feeding inlet 20 is exhausted, a level sensitive switch may be placed in that container. This switch would preferably be in series with the supply 74 and the impulser 76 (but may also be in the connection between impulser and counter 77), and would prevent operation of the solenoid 25 and counter 77 (or counter 77 alone) when the level in the additive container dropped below a chosen minimum.

Although by way of example I have shown an apparatus and method for the introduction of additive to gasoline the invention is not restricted to this and may be employed when any two miscible liquids are to be blended in known proportions. The reading of the counter 77 is directly related to the number operations of solenoid 25 and hence to the volume of additive dispersed which in turn is proportional to the volume of liquid passing through meter 2. It is thus seen that the system may be usefully employed for dispensing soft drinks (in which the syrup is treated as the additive and is mixed with carbonated water) beer or wine to which additive may be introduced. Milk might also be dispensed where the cream would be introduced as an additive to skimmed milk and in which the purchaser could arrange to pay for his milk on the basis of the quantity of cream additive made.

While the apparatus of FIGURE 1 operates very satisfactorily in driving the meter 33, in some cases it is useful to replace the four way valve 23 by the scheme shown in FIGURE 4. In this the pipe 21 leads to two on-off solenoid valves 120 and 121 which in turn are connected to ends 40 and 41 of the meter 33 respectively. The ends 40 and 41 are also connected to two additional on-off valves 122 and 123. These valves 122 and 123 lead to injector pipe 16. The impulser 76 is now modified to include an additional contact 124. Solenoids 120 and 123 are connected to be energized when the moving leaf 125 is in connection with contact 124. The remaining two solenoids 121 and 122 are connected to be energized when leaf 125 is in connection with contact 126.

Assuming therefore that when a solenoid valve is energized it is opened for passage of liquid through it, in the situation depicted in FIGURE 4 valves 120 and 123 will be open so that liquid additive flowing through line

5

21 will pass through valve 120 and enter end 40 of meter 33. Liquid will be forced out of end 41 through valve 123 into pipe 16. As cam 81 continues to turn, leaf 125 will be switched into its other position and valves 121 and 122 will be energized whereas 120 and 123 will be released. Liquid will then flow through pipe 21 into end 41 of meter 33 and out of end 40 through valve 122 into pipe 16.

It should be noted that if the rate of flow of liquid through pipe 8 is known the meter and impulser combination for driving either the four-way valve 123 of FIGURE 1 or the four solenoids of FIGURE 4 may be replaced by a timer which will alternate valve 23 or switch the valves 120 to 123 at regular intervals as chosen by the rate of flow through pipe 8. This timer requires the constant rate of flow through pipe 8 but in many cases may be a cheaper satisfactory way of obtaining a required quantity of additive per gallon. A timer may also be used for alternating the four way valve 23 if desired.

The arrangement of FIGURE 4 may be modified as shown in FIGURE 5. The meter 33 has one pipe 130 and 131 leading into each end 40 and 41 respectively. Shuttle ball containing T-junctions shown in detail in FIGURE 6 are connected to 130 and 131 respectively and from the junctions pipes 135 and 136 lead respectively to a simple T-junction 137. Pipe 16 (see also FIGURE 1) leaves junction 137 to carry additive into pipe 8.

The other sides of the shuttle ball junctions are fed respectively from pipe 21 (see also FIGURE 1) through solenoid valves 140 and 141. Valves 140 and 141 are connected respectively to contacts 126 and 124 so that they operate alternately as leaf 125 is in connection with 126 or 124. A shuttle ball 143 and 144 is included in each junction, and can seat on a seal 145 and 146 to close the flow through pipe 135 or 136.

In operation let us assume that leaf 125 is alternated between contact 124 and contact 126 as described for FIGURE 4. In the position shown for FIGURE 5, valve 141 has just opened while valve 140 is closed and the piston 34 (not shown) is at the right hand end of cylinder 36 and starts to move to the left. Entering additive will be under pressure in pipe 21 and will blow shuttle ball 144 into contact with seat 146. Ball 143 remains below the level of pipe 130 under gravity resting against the narrowed part of the T, being denser than the additive liquid. Thus the additive leaves meter 33 through pipe 135 until the piston reaches the left hand side of cylinder 36. Subsequent to this, valve 140 is operated and valve 141 releases. Ball 143 is blown against seat 145 and ball 144 drops under gravity below the level of pipe 131. The seating and unseating of the balls is enhanced if the shuttle balls are not too greatly denser than the additive liquid and if there is a pressure loss in liquid passing through the meter 133. Use of a tightly fitting piston will help.

The use of the device of FIGURE 5 is advantageous where cost is a prime consideration since it avoids the two extra solenoid valves of FIGURE 4. If desired the valves 140 and 141 may be replaced by a single three way valve feeding each shuttle ball junction from pipe 21. In one position of the three way valve liquid flows to the right hand ball junction, in the other position it flows to the left hand junction. The three way valve may be operated by a solenoid similar to that shown at 25 in FIGURE 1 by an impulser 76 as in that drawing.

I claim:

1. Apparatus for discharging liquid and for introducing additive into said liquid in controlled proportion which comprises, a liquid flow line, metering means for said additive for supplying additive to said liquid in a chosen proportion to flow of said liquid in said flow line, means for supplying liquid additive under pressure to said metering means, said metering means comprising, a cylinder, a floating piston in said cylinder, first and second valves for respectively passing additive into and from said cylinder on one side of said piston, third and fourth valves for respectively passing additive into and from said cylinder on the

6

other side of said piston, means for opening said first and fourth valves and said second and third valves alternately for passing additive to and from said metering means in accordance with liquid flow in said flow line, means for leading metered additive from said metering means into said liquid, routing means for liquid in said flow line, and means for energizing said first and fourth and said second and third valve opening means in accordance with the setting of said routing means.

2. Apparatus as defined in claim 1, comprising electric means for operating said first and fourth, and said second and third valves, and means operatively connecting said routing means and said electric means.

3. Apparatus as defined in claim 2, comprising a meter for liquid in said flow line and means operatively coupling said liquid meter and said valves.

4. Apparatus as defined in claim 2, comprising a meter for liquid in said flow line, a pair of switch means connected to said meter, said meter closing one switch of said pair whilst holding open the other and holding open the one whilst closing the other, means connecting said one switch to said first and fourth valve for operation thereof and means connecting said other switch to said second and third valve for operation thereof.

5. Apparatus as defined in claim 4, said other switch being opened before closing of said one switch and then said one switch being opened before closing of said other.

6. Apparatus as defined in claim 5, said valves being electric solenoid valves.

7. Apparatus as defined in claim 1, said first and second valves comprising a first shuttle valve, and said third and fourth valves comprising a second shuttle valve for leading additive to and leading additive from one and the other sides of said pistons respectively, electrically operated fifth and sixth valves connecting said additive supply means to said first and second shuttle valves respectively, and a first and a second switch for alternately energizing said fifth and sixth valves respectively, and means operatively connecting said routing means and said first and second switch.

8. In a system for discharging liquid into which a liquid additive is introduced in controlled amounts including means for supplying such additive under pressure and for metering quantities of such additive into the flow of said liquid in accordance with a measured quantity of said liquid flow, the improvement in additive metering apparatus comprising a cylinder, a floating piston in said cylinder, four-way valve means connected to said additive supplying means and to said cylinder for admitting additive to one or the other side of said piston and simultaneously providing for exhaustion of such additive from the other side of said piston into said discharging liquid, means for changing the position of said four-way valve means in accordance with the predetermined flow of said liquid including a solenoid operatively connected to control said four-way valve means for moving said valve means in one of two positions in accordance as said solenoid is energized or deenergized, a meter for measuring the quantity of flow of said liquid, a switch controlled by said meter for controlling the operation of said solenoid for moving said four-way valve means alternatively into its said positions, routing means for said liquid, and means for energizing said switch in accordance with the setting of said routing means.

References Cited by the Examiner

UNITED STATES PATENTS

2,045,502	5/1936	Wade	222—57 X
2,527,136	10/1950	Kagi et al.	222—57 X
2,638,247	5/1953	Taylor	222—57 X
3,208,644	9/1965	Bergson	222—249

FOREIGN PATENTS

403,465	9/1924	Germany.
---------	--------	----------

ROBERT B. REEVES, *Primary Examiner*.

HADD S. LANE, *Examiner*.