Feb. 15, 1966 H. A. WITCHER 3,235,348

APPARATUS FOR INJECTING A FLUID INTO A SECOND FLUID

Filed Sept. 12, 1963 2 Sheets-Sheet 1

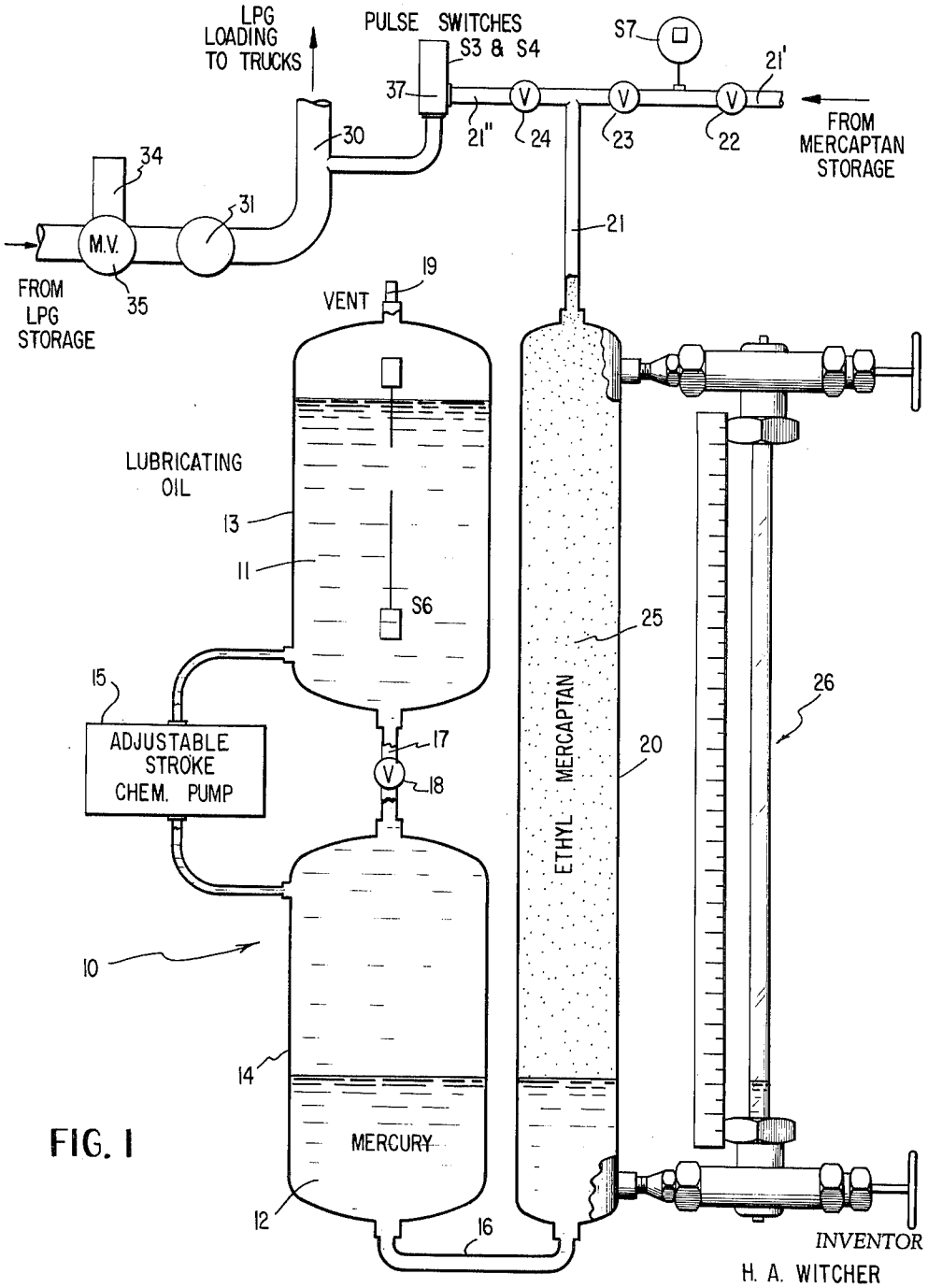


FIG. 1

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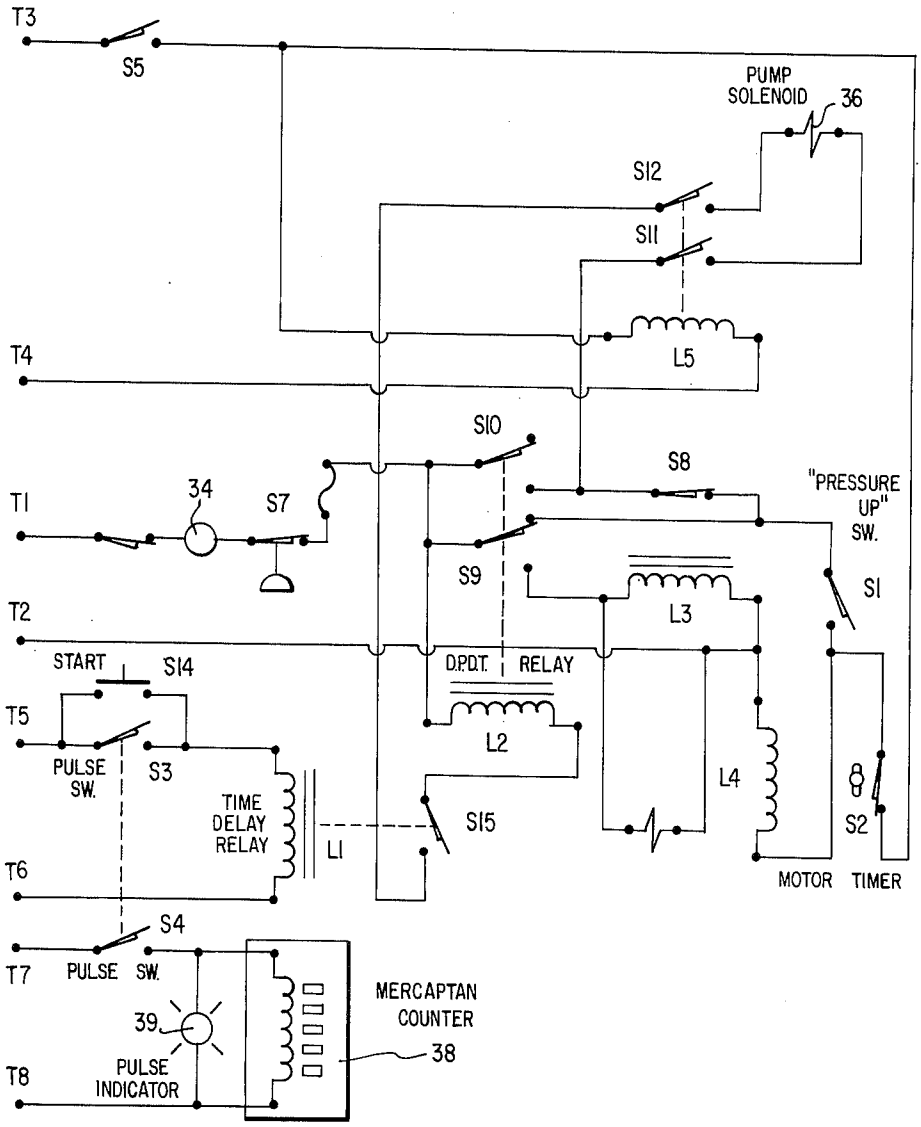
BY McLean & Boustead
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APPARATUS FOR INJECTING A FLUID INTO A SECOND FLUID

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FIG. 2



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3,235,348

APPARATUS FOR INJECTING A FLUID INTO A SECOND FLUID

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11 Claims. (Cl. 48—195)

The present invention relates to an apparatus for the accurate and automatic incremental addition of a known quantity of a first fluid to a flowing stream of a second fluid in a predetermined ratio. In its more specific aspects, the present invention relates to an automatic odorizing apparatus wherein a known odorizing agent, e.g. ethyl mercaptan, is added to a flowing stream of a fluid to be odorized, e.g. liquefied petroleum gas.

It is common practice to add an odorizing agent in small quantities to normally odorless fuel gases which are either toxic or, when mixed with air, form explosive mixtures. Since fuels such as natural gas (methane) and liquefied petroleum gas (propane and butane) do not have appreciable odor themselves, it is necessary to add odorizing agents, such as mercaptans and sulfides, so that the presence of such materials in the atmosphere can be readily detected. According to the present invention, a method and apparatus are provided whereby such an odorizing agent can be conveniently added in accurately metered quantities to a fuel without contaminating the immediate atmosphere.

It is a primary object of the present invention, therefore, to provide a means for adding known increments of a first fluid in a predetermined ratio to a flowing stream of a second fluid. It is a further object of the present invention to provide a method and apparatus for odorizing a product by the injection of metered amounts of the odorizing agent into the product without allowing escape of odorizing agent to the atmosphere. It is still another object of the present invention to provide an apparatus which can be conveniently used by a truck driver or a loading operator at a small bulk plant to odorize liquid petroleum gas with an odorizing agent, such as ethyl mercaptan, while the fuel is being loaded onto a transportation vehicle such as a truck. Other objects, advantages and features of the present invention will become apparent to those skilled in the art from the detailed description hereinbelow.

Materials which can be used as odorizing agents in the present invention are well-known in the art and are commonly low molecular weight compounds of carbon and sulfur, generally in the 2 to 7 carbon atom range, such as ethyl mercaptan, propane mercaptan, amyl mercaptan, dimethyl disulfide, dioxane or the like. The mercaptans are generally preferred; however, these compounds present special difficulties since they attack and destroy the rubber piston cups and valves in the usual metering pumps so that the pumps fail rapidly when used to inject the mercaptan into the fuel. The mercaptans also attack valve gaskets and seals made of Teflon.

In its more general aspects the apparatus of the present invention provided for the accurate and automatic incremental addition of a known quantity of a first fluid to a flowing stream of a second fluid in a predetermined ratio, comprises a metering means including a positive displacement pump having a predetermined displacement per stroke and a pair of reservoirs including a first reservoir and a storage reservoir for the first fluid. The positive displacement pump intoduces a predetermined amount of a liquid pumping medium into the first reservoir and displaces a liquid piston, or cushion, arranged between the reservoirs, by an amount equivalent to this predetermined amount from the first reservoir into the storage

reservoir for the first fluid which simultaneously forces an amount of the first fluid equivalent to the predetermined amount into a flowing stream of the second fluid.

The liquid piston, or cushion, arranged between the reservoirs, forms a liquid trap to separate the first fluid from the pump. This trap serves to dampen the effect of the metering pump, and smooth out the flow of the first fluid, as it is forced into the second fluid from the storage reservoir. Additionally, when mercaptans are used as the first fluid, the liquid trap serves to protect the pump from the deleterious effects thereof. The liquid used to form the liquid piston may be any fluid immiscible and inert with the first fluid and the liquid pumping medium. Since mercaptans are generally absorbed by oily solvents having comparatively low vapor pressures, such as mineral oils, the selection of a material for the liquid piston or cushion is especially important. A mercury trap is particularly effective as the cushion since the mercaptans, for example, are not miscible therewith; however, when using mercury as the cushion, it is necessary to avoid contacting the mercaptan and the mercury in the presence of air since the two react under such conditions.

The metering pump of the present invention is automatically controlled by a metering system including a positive displacement meter having an output responsive to the volume of flow of the second fluid which output controls the positive displacement pump through the energizing circuit therefor to introduce the predetermined amount of liquid pumping medium into the first reservoir in a predetermined ratio with respect to the volume of flow of the second fluid. The liquid pumping medium used according to the present invention may be any fluid which is easily pumped in small, accurately metered amounts and which has a specific gravity less than that of the liquid forming the liquid piston. Lubricating oil is the preferred liquid pumping fluid.

The present invention will be further described with reference to the attached drawing wherein

FIGURE 1 is the flow sheet for a preferred embodiment of the present invention arranged for installation at a small bulk plant loading station; and

FIGURE 2 is a wiring diagram for an energizing circuit to be used in controlling the operation of the embodiment illustrated by the flow sheet of FIGURE 1.

The metering system of the present invention, as illustrated in FIGURE 1, accurately measures the amount of a first fluid injected into a flowing stream of a second fluid and injects the first fluid into the second fluid in a predetermined ratio while recording the amount of each fluid used. In the detailed description hereinbelow, the present invention will be described with reference to the addition of 1 cc. ethyl mercaptan odorizing gas to each 15 gallons of a liquefied petroleum gas being loaded into a truck at an adjacent loading station (not shown) although obviously the system is not limited thereto.

The metering pump, generally designated as **10** in FIGURE 1 for pumping the ethyl mercaptan odorizing agent from reservoir **20** to the liquefied petroleum gas loading line **30** essentially consists of the liquid pumping medium **11**, any liquid of specific gravity less than mercury and inert with mercury, such as lubricating oil, mercury cushion **12** and the positive displacement pump **15**. The liquid pumping medium **11** is contained in two reservoirs, **13** and **14**, with reservoir **13** serving as a storage reservoir. Reservoir **14** is arranged adjacent the mercaptan reservoir **20** and is interconnected with the bottom of the mercaptan storage reservoir **20** by line **16** which is used, together with the bottom ends of reservoirs **14** and **20** to form a trap for the mercury cushion **12**. As shown in FIGURE 1, reservoir **14** has a larger diameter than reservoir **20** so that the cross-section of the side of the mercury trap formed by mercury cushion **12** in the reservoir **14**

is larger than the cross-section of the side in reservoir 20. This ratio of the size of the sides of the mercury trap is so arranged to provide an accurate displacement of the mercaptan when small amounts are pumped. The mercury trap tends to seek the same level in each of reservoirs 14 and 20 through line 16. Line 17, which may be closed by valve 18, directly connects reservoirs 13 and 14 and by-passes pump 15. Reservoir 13 is vented to the atmosphere through line 19.

The positive displacement pump 15 is an adjustable stroke, chemical pump and is connected between reservoirs 13 and 14. Pump 15 has a predetermined displacement per stroke and introduces on demand an accurately metered amount of the liquid pumping medium from reservoir 13 into reservoir 14, e.g. 1 cc. per 15 gallons of liquefied petroleum gas. When the metered amount of liquid pumping medium is introduced into reservoir 14, it displaces the mercury cushion 12 by an equivalent amount from reservoir 14 into reservoir 20, which in turn displaces the metered amount, 1 cc., of ethyl mercaptan from the reservoir 20 into line 21.

The mercaptan storage reservoir 20 is filled from a mercaptan storage (not shown) via line 21' and line 21. During filling of the mercaptan reservoir 20, valves 22 and 23 in line 21' are opened and valve 24 in line 21'' is closed. Sight glass 26 conveniently indicates the amount of mercaptan 25 present in storage reservoir 20. The mercaptan being ejected from the mercaptan storage reservoir 20 is injected into the liquefied petroleum gas loading line 30 through lines 21 and 21''. Passage of mercaptan through line 21'' pulses a pulsing device 37, more fully described hereinafter.

Liquefied petroleum gas is loaded into trucks at a loading station (not shown) from a storage plant (not shown) through loading line 30. To provide for accurate metering of the ethyl mercaptan in a predetermined ratio with respect to the liquefied petroleum gas, a positive displacement meter 31 is provided in line 30 for measuring the volume of liquefied petroleum gas flowing through line 30. After a predetermined flow of liquefied petroleum gas, e.g. 15 gallons, switch S5 (see FIGURE 2) is actuated by meter 31. Switch S5 actuates the metering pump 10, as described more fully hereinafter, to inject the predetermined metered amount of ethyl mercaptan, 1 cc., into loading line 30. Accordingly, switch S5 regulates the amount of ethyl mercaptan odorizing agent added in proportion to the volume of flow of the liquefied petroleum gas measured through meter 31. Motor valve 35 is provided in loading line 30 to close and prevent flow of liquefied petroleum gas to the truck through loading line 30 when operated by solenoid valve 34. The actuation of values 34 and 35 includes several safety features, more fully described hereinbelow, including a low level switch S6 in reservoir 13 and a pressure switch S7 in line 21'.

Having now described the metering apparatus of the present invention, the operation of the apparatus will be described with reference to the wiring diagram of FIGURE 2, as well as the flow sheet of FIGURE 1.

After the truck to be loaded with liquefied petroleum gas arrives at the truck loading dock, the truck driver or loading attendant connects a static electricity grounding line and loading line 30 to the truck. The loading attendant also checks the amount of mercaptan 25 in storage reservoir 20 by sight glass 26. If the amount of mercaptan 25 in storage reservoir 20 is insufficient to odorize the volume of liquefied petroleum gas required for the truck being loaded, valve 24 is closed and valves 22 and 23 are opened. Valve 18 is also opened, carefully allowing the mercury levels is reservoirs 14 and 20 to come to equilibrium, and storage reservoir 20 is filled with the ethyl mercaptan odorant from line 21' through line 21. After the mercaptan storage reservoir 20 has been filled to the desired level and the mercury levels in reservoirs 14 and 20 have come to equilibrium, valves 22, 23 and 18 are closed and valve 24 is opened. The liquefied petroleum gas loading pump (not shown) for loading line 30 is also started. Since reservoir 13 is open to the atmosphere through vent 19, reservoirs 14 and 20 will be at approximately atmospheric pressure at the time of filling mercaptan storage reservoir 20. These reservoirs must be brought to the pressure of the liquefied petroleum gas loading line 30 for accurate measuring of odorant delivery and introduction of the mercaptan into the loading line 30. The pressure in reservoirs 14 and 20 is increased through a start-up procedure whereby "pressure-up" switch S1 is first closed to complete a circuit between terminals T1 and T2 through switch S9 of the double pole and winding L4 (see FIGURE 2). FIGURE 2 illustrates the circuit as it appears prior to starting of loading operations. Energization of winding L4 actuates motor timer S2 which energizes winding L5 according to the pulsing thereof. Winding L5 closes switches S11 and S12 when energized. Solenoid 36 of the pump 15 is energized and pulses the pump 10 when switches S11 and S12 are closed, as more fully described hereinbelow, until reservoirs 14 and 20 are pressured to line pressures and a one-stroke delivery of the mercaptan odorant is made into the liquefied petroleum gas loading line 30 through line 21''.

Energization of winding L5 closes switches S11 and S12 arranged on either side of the pump solenoid 36. In order to complete the circuit for pulsing solenoid 36 according to the motor timer S2, however, it is necessary to first press the pushbutton start switch S14 and close the circuit between terminals T5 and T6 to energize the time delay relay L1 which closes switch S15. Time delay relay L1 is designed to keep switch S15 closed for a predetermined period of time, e.g. up to 60 seconds, even if the energizing circuit thereof is broken. Closure of switch L15 completes a circuit between terminals T1 and T2 for actuating the pump solenoid 36 through the winding of the double pole, delayed time relay L2 in one direction and through switch S12, the winding of solenoid 36, switch S11, switch S8, switch S1 and winding L4 in the other direction. As is seen, pulsing of solenoid 36 is dependent on pulsing of winding L5 by the motor timer S2.

Operation of the motor timer S2 is limited, however, since double pole, delayed time relay L2 is designed to throw switches S9 and S10 after a predetermined period of time to break the energizing circuit for winding L4 described above. When switch S9 is thrown from the position as indicated in FIGURE 2, winding L3 is energized to open switch S8. Since, as described above, winding L4 is energized through a circuit including switch S9 operation of motor timer S2 is stopped. Furthermore, energization of solenoid 36 by the start-up procedure is dependent on switch S8 being closed since switch S10 is open during the start-up procedure so that after relay L2 throws switches S9 and S10 neither the solenoid 36 nor motor timer S2 can be operated according to the start-up procedure. Pressure-up switch S1 is also ineffective when relay L2 and winding L3 are energized.

If it is desired to build up the pressure in reservoir 14 and the storage reservoir 20 still higher, it is necessary to wait for the time delay period of relay L1 at which time switch 15 is opened by de-energization of relay L1 and winding L2 is de-energized. Winding L4 may now be energized again and the above start-up procedure repeated by closing "pressure-up" switch S1 and pressing switch S14.

The start-up procedure is terminated with delivery of one-stroke delivery of odorant, approximately 1 cc. Delivery of odorant closes pulse switch S3 and completes the circuit between terminals T5 and T6 to energize the time delay relay L1, relay L2 and winding L3 as described hereinabove. Energization of relays L1 and L2 will keep switches S9 and S10 in position to de-energize the motor timer S2 and prevent pulsing of solenoid 36 except through switch S5, i.e. in the position opposite to that

shown in FIGURE 2. The metering system is ready for normal operation and the loading line 30 is opened allowing liquefied petroleum gas to flow into the truck tank. Valve 35 in loading line 30 is automatically opened upon energization of any of windings L2, L3 or L4.

The flow of liquefied petroleum gas through loading line 30 causes positive displacement of meter 31 to pulse switch S5 closed with the flow of a predetermined amount of liquefied petroleum gas, approximately every 15 gallons. With each 15 gallons of liquefied petroleum gas, the solenoid 36 of pump 15 is also pulsed since winding L5 is energized by closure of switch S5 to close switches S11 and S12. Switch S5 completes a circuit for winding L5 through terminals T3 and T4. Pulse switch S3 arranged parallel to the pushbutton start switch S14, has been previously energized by the passage of odorant through the line 21'' so that relays L1 and L2 and winding L3 are energized and switches S8, S9 and S10 are in the position opposite to that illustrated in FIGURE 2. The actual energization of solenoid 36 is through a circuit between terminals T1 and T2 comprising, at one side, switch S11, switch S10, switch S9 and winding L3, and at the other side, switch S12, switch S15 and relay L2. This circuit, with the exception of switches S11 and S12, is maintained through relay L1, and consequently relay L2 and winding L3, so that pulsing of winding L5 by switch S5 automatically pulses pump solenoid 36 one stroke to inject a predetermined amount of odorant through pulsing device 37 into the liquefied petroleum gas in proportion to the flow thereof.

As the mercaptan is forced into the loading line 30 it passes through the pulsing device 37 (see FIGURE 1) which contains pulse switches S3 and S4. Pulse switches S3 and S4 are closed by the flow of mercaptan therethrough. Closure of pulse switch S3 completes a circuit between terminals T5 and T6 to energize the adjustable time delay relay L1 and maintain windings L2 and L3 in energized condition as described hereinabove. If the pulse switch S3 is not energized at a predetermined rate, as determined by the time delay setting of relay L1, relay L1 is de-energized and switch S15 is opened which in turn opens the circuit for solenoid 36, preventing operation of the pump 15. Therefore, as truck loading continues, 1 cc. of mercaptan is injected as each incremental volume of 15 gallons of liquefied petroleum gas passes through the meter 31.

A mercaptan counter 38 is provided to register each pulse of mercaptan through the device 37. Switch S4 completes a circuit between terminals T7 and T8 to energize the counter 38 with each pulse of mercaptan. Since the amount of mercaptan added with each pulse is known and the pulses are added in a known proportion to the liquefied petroleum gas, the amount of odorant and liquefied petroleum gas added is known in addition to the amount of mercaptan per volume of liquefied petroleum gas measured. Pulse indicator 39, which may be a light or buzzer, is connected in parallel with counter 38 to provide an easy way for the operator to quickly determine if the system is operating correctly.

The system of the present invention includes several safety features to avoid injecting mercaptan into the LPG in too large quantities and to avoid injecting mercaptan into the atmosphere. Valve 35, arranged in loading line 30, is a normally open safety valve controlled by solenoid 34 arranged in the main energizing circuit between terminals T1 and T2. The main energizing circuit is completed whenever relay L2 or winding L4 are energized so that valve 35 is normally open during both start-up and normal operation of the system. Valve 35, however, provides a safety check on the system through pressure switch S7 arranged in line 21' and low level switch S6 in reservoir 13. If the pressure builds up in the line 21', switch S7 opens, breaking the main energizing circuit, and de-energizing solenoid 34 to close valve 35 and prevent further flow of liquefied petroleum gas. Opening of switch S7 also prevents energization of pump solenoid 36 to prevent flow of mercaptan since the pump is also operated through this main energizing circuit. Low level switch S6 operates in a similar manner to prevent flow of both mercaptan and liquefied petroleum gas when the level of pumping liquid 11 in reservoir 13 is too low. Since the level in reservoir 13 is proportionate to the amount of mercaptan 25 in storage reservoir 20 and to the pressure thereof, low level switch S6 also effectively stops the system when the mercaptan level is too low.

As an added safety feature, if the operator leaves valves 24 and 23 open, mercaptan will be pumped to storage and no flow through pulse switch S3 will cause the time delay switch L1 to prevent loading and shut down operation of the metering system as discussed above.

Transferring the ethyl mercaptan from the mercaptan storage reservoir 20 through the measuring system of the present invention including pulse switch S3 enables a simple but very accurate control of the ratio of mercaptan to liquefied petroleum gas. Additionally, since this system is completely closed to the atmosphere except for the one vent in the pumping medium reservoir 13, leakage of the odorizing agent from the system is effectively prevented.

As will be evident to those skilled in the art various modifications of this invention can be made in light of the foregoing disclosure and discussion without departing from the spirit and scope of the present invention.

It is claimed:

1. An apparatus for incrementally adding known quantities of a first fluid in a predetermined ratio to a flowing stream of a second fluid, comprising conduit means through which the second fluid flows, said conduit means having therein a metering means having an output responsive to the flow of said second fluid through the conduit, a first closed liquid reservoir having an inlet and an outlet, said inlet being provided with a pump means having a predetermined displacement per stroke for introducing a known quantity of liquid into said first reservoir, a second closed reservoir for said first fluid having an inlet and an outlet, the outlet of said first reservoir and the inlet of said second reservoir communicating with each other through a liquid piston formed by a body of a liquid immiscible and inert with the liquid in said first liquid reservoir and said first fluid whereby introduction of said known quantity of the liquid into said first reservoir displaces an equivalent amount of said first fluid from said second reservoir, the outlet for said second reservoir communicating with said conduit means for the second fluid, and an energizing circuit for activating said pump means, the outlet of said metering means including means in said energizing circuit for completing said circuit upon the metering of a predetermined flow of said second fluid through said conduit means to thereby introduce the known quantity of said first fluid in a predetermined ratio into said second fluid.

2. An apparatus as defined in claim 1 wherein said liquid piston is a mercury trap.

3. An apparatus as defined in claim 1 wherein said liquid piston comprises a liquid-filled trap communicating at one side thereof with said first reservoir and at the other side thereof with said second reservoir, the cross-seciton of said trap at said one side being greater than the cross-section of said trap at said other side thereof.

4. An apparatus for incrementally adding known quantities of an odorizing agent selected from the group consisting of low molecular weight compounds of carbon and sulfur having from 2 to 7 carbon atoms in a predetermined ratio to a flowing stream of a petroleum fluid which comprises conduit means through which the petroleum fluid flows, said conduit means having therein a metering means having an output responsive to the flow of said petroleum fluid through the conduit, a first closed liquid reservoir having an inlet and an outlet, said inlet being provided with a pump having a predetermined

displacement per stroke for introducing a known quantity of liquid into the first reservoir, a second closed reservoir for the odorizing agent having an inlet and an outlet, the outlet of the first reservoir and the inlet of the second reservoir communicating with each other by a mercury filled trap forming a liquid piston therebetween whereby introduction of said known quantity of the liquid into said first reservoir displaces an equivalent amount of said odorizing agent from said second reservoir, the outlet for said second reservoir communicating with said conduit means for the petroleum fluid, and an energizing circuit for activating said pump for one stroke, the output of said metering means including switch means in said energizing circuit for completing said circuit upon the metering of a predetermined flow of said petroleum fluid through said conduit means to thereby introduce a known quantity of odorizing agent in a predetermined ratio into the petroleum fluid.

5. An apparatus as defined in claim 4 wherein said liquid in the first reservoir is lubricating oil, and further including a storage reservoir for said lubricating oil, conduit means connecting said storage reservoir with said first reservoir and valve means in said last-mentioned conduit means, said pump being connected in said conduit means.

6. An apparatus for incrementally adding known quantities of a first fluid in a predetermined ratio to a flowing stream of a second fluid, comprising conduit means through which the second fluid flows, said conduit means having therein a motor operated valve operable to close fluid communication through the conduit means and metering means having an output responsive to the flow of said second fluid through the conduit, a first closed liquid reservoir having an inlet and an outlet, said inlet being provided with a pump having a predetermined displacement per stroke for introducing a known quantity of liquid into the first reservoir, a second closed reservoir for said first fluid having an inlet and an outlet, the outlet of said first reservoir and the inlet of said second reservoir communicating with each other through a liquid piston formed by an enclosed body of a liquid immiscible and inert with the liquid in said first liquid reservoir and said first fluid whereby introduction of said known quantity of the liquid into said first reservoir displaces an equivalent amount of said first fluid from said second reservoir, the outlet for the second reservoir communicating with said conduit means for said second fluid, and circuit means including an energizing circuit for activating said pump to introduce a known amount of said liquid into said first reservoir, the output of said metering means including means for completing said energizing circuit upon the metering of a predetermined flow of said second fluid through said conduit means to thereby introduce said known quantity of first fluid in a predetermined ratio into said second fluid, and actuating means for said motor-operated valve including means actuated by the flow of said first fluid for maintaining said motor-operated valve in open position.

7. An apparatus as defined in claim 6 wherein said last-mentioned means is a pulsing device arranged in the communication between said second reservoir and said conduit means, and wherein said actuating means further includes switch means in said energizing circuit and a time delay means actuated by said pulsing device for closing said switch means for a predetermined period of time upon flow of said known quantity of first fluid through said pulsing device, whereby, if said pulsing device is not actuated at a predetermined rate, said time delay means through said switch means opens said energizing circuit to thereby close said motor-operated valve and prevent actuation of said pump.

8. An apparatus as defined in claim 7 wherein said circuit means includes a starting circuit by-passes said energizing circuit and including a motor timer means for pulsing said pump, said pulsing device de-energizing said motor timer means upon flow of said first fluid therethrough.

9. An apparatus for incrementally adding a mercaptan odorizing agent in a predetermined ratio to a flowing stream of liquefied petroleum gas which comprises conduit means through which the liquefied petroleum gas flows, said conduit means being provided with metering means having an output responsive to the volume of fluid flow through the conduit and a motor operated valve having a normally open position and operable to closed position for closing fluid communication through the conduit means, a first closed liquid-filled reservoir containing a liquid of a specific gravity less than mercury and having an outlet at its lower end and an inlet, said inlet being provided with a positive displacement pump having a predetermined displacement per stroke for introducing the liquid into the first reservoir in known quantities, a second closed reservoir for the mercaptan odorizing agent having an inlet at its lower end and an outlet, a mercury filled trap communicating at one side thereof with the outlet of said first reservoir and communicating at the other side thereof with the inlet of said second reservoir whereby introduction of the known quantity of liquid into the first reservoir displaces an equivalent amount of mercaptan odorizing agent from said second reservoir, the outlet from the second reservoir communicating with said conduit means through a pulse means having an output responsive to a pulse of fluid flow through the outlet, a control circuit for said pump and said motor valve, said output from said metering means including means for energizing said control circuit, the output from the control circuit being connected as an input to said pump effective to activate the pump and displace a known quantity of mercaptan odorizing agent, and the output from the pulse means being connected as an input to the control circuit to close said motor valve when the pulse means does not indicate injection of a predetermined volume of ethyl mercaptan, thereby preventing further flow of liquefied petroleum gas, whereby a known quantity of mercaptan odorizing agent is injected into the flowing stream of liquefied petroleum gas in proportion to the liquefied petroleum gas each time a predetermined volume of liquefied petroleum gas is detected by the metering means.

10. An apparatus as defined in claim 9 wherein said control circuit includes a starting circuit having a motor timer means for pulsing said pump, said pulse means upon flow of fluid therethrough de-energizing said motor timer means.

11. An apparatus as defined in claim 9 including timer means actuated by the output of said pulse means for closing said motor operated valve when said pulsing device is not actuated at a predetermined rate.

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