Aug. 20, 1957 W. L. BEWLEY ET AL 2,803,379

CONTROLLED LIQUID DISPENSING SYSTEM

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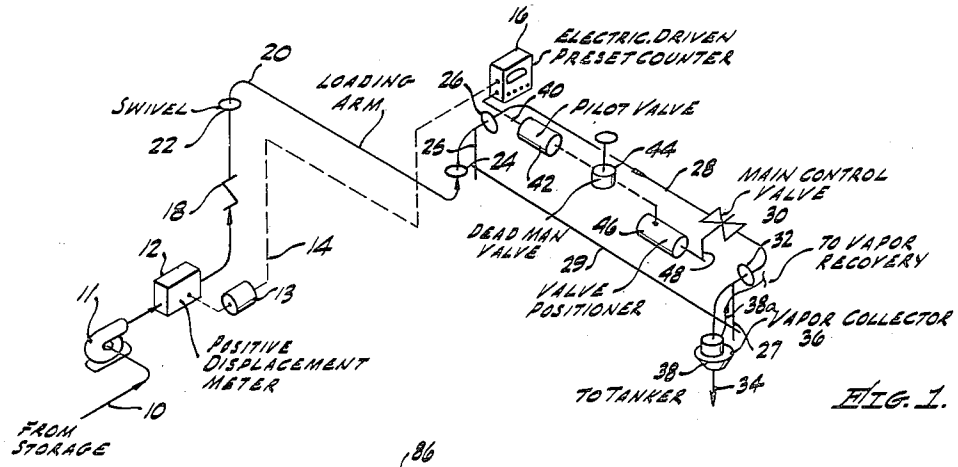

FIG. 1.

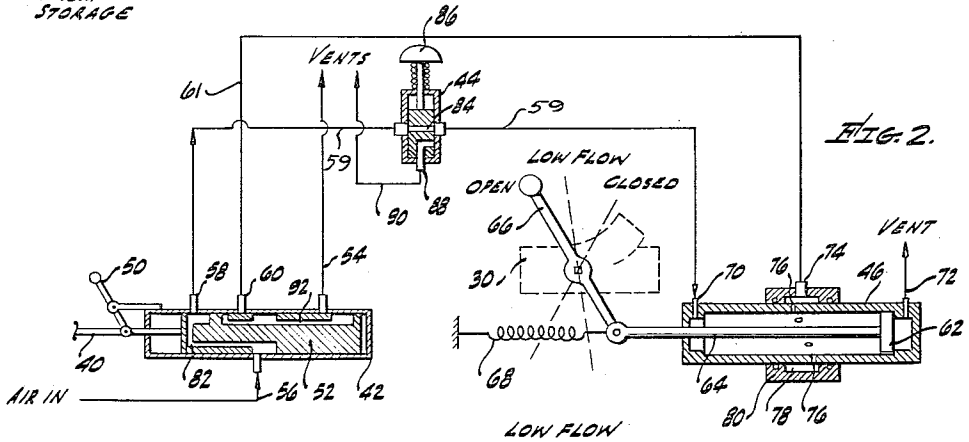

FIG. 2.

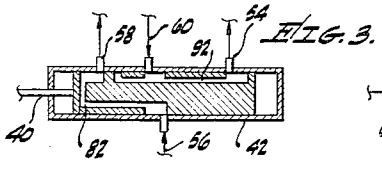

FIG. 3.

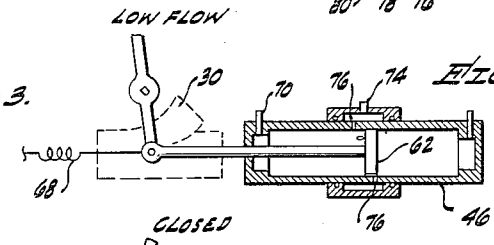

FIG. 4.

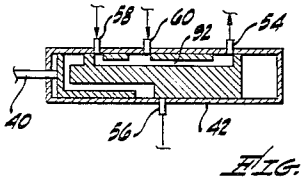

FIG. 5.

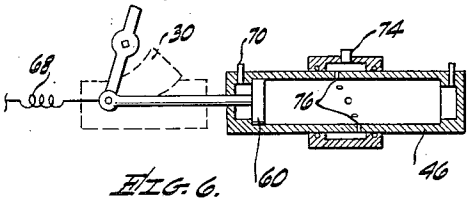

FIG. 6.

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CONTROLLED LIQUID DISPENSING SYSTEM

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Application October 24, 1955, Serial No. 542,207

10 Claims. (Cl. 222—20)

This invention relates to the dispensing of liquids and particularly to an apparatus for the controlled dispensing of liquids at high volumetric rates in combination with simultaneous vapor recovery.

More specifically the present invention relates to an improved process and apparatus for the transfer of volatile liquids having relatively low boiling points, such as gasoline and light solvents as in the filling of vessels at very high rates wherein relatively large quantities of vapor are generated or displaced from the vessel.

Light, low boiling liquids present problems from air pollution and fire explosion hazard standpoints during the transfer thereof from one vessel to another. Such liquids comprise solvents including the low molecular weight alcohols, ketones, and esters, and including the light hydrocarbon solvents such as naphtha, and the relatively low boiling internal combustion engine fuels such as gasoline. These liquids have relatively high vapor pressures under normal temperature condition and evaporate very readily, especially during agitation. The vaporization occurs at substantial rates from vessels open to the atmosphere and occurs at considerably higher rates when the liquid is in motion such as during the introduction of liquid into the vessel. Exceedingly high rates of vaporization occur when the liquid is introduced into the vessel under conditions which cause it to splash either against the bottom or walls of the vessel or against the liquid level therein.

Under these conditions of liquid transfer where vaporization takes place, serious hazards due to possibility of fire and/or explosion, fume generation, and air pollution present themselves. Furthermore, these light solvents are frequently very expensive and any vaporization loss is expensive and wasteful of materials. Often local regulations govern the type and amount of such vaporized materials which can be handled in the open air in order to minimize the possibility of air pollution or the damage from fire or explosion.

One particular illustrative application of this invention, which is not to be considered as limiting the invention, is in the loading of gasoline tank trucks and trailers at high volumetric rates. These trucks and trailers have liquid capacities of as high as about 4,000 to 8,000 gallons and will load at rates as high as 1500 to 2000 gallons per minute. In the case of railroad tank cars, these capacities are of the order of 30,000 to 50,000 gallons and the loading rates may be increased if desired to as high as 2000 to 4000 gallons per minute. The quantity of displaced vapor laden air evolved from such operations is at least equal to and frequently greater than the volume of the vessel because of the agitation induced vaporization. It has been found that gasoline losses may range as high as about 35,000 gallons per month at an active gasoline loading station in which about 24 million gallons per month are handled. This amounts to a 0.15% volumetric liquid loss and is economically undesirable as well as involving a fire hazard.

Coupled with the vapor recovery problem is the problem of controlling the flow rate of liquid when the flow rate is very high. Particularly the problem of "hammering" is difficult to avoid in those cases where vessels are being filled under circumstances wherein the operator is unable to detect the position of the liquid level within the tank visually as is the case when the operator's vision through the loading hatch is necessarily obstructed by the presence of vapor recovery equipment. A further problem in automatic shut off systems lies in insuring a constant flow rate during the shut off so that a definite metered amount of fluid will be delivered during the valve closure. Still further, ebullition of liquid caused by filling at high rates can constitute a spillage and fire hazard when the tank is nearly full.

Accordingly the present invention is directed to an improved apparatus for the transfer of volatile liquids at very high flow rates which incorporates an efficient mechanism for recovering the displaced or generated vapors and which includes a specific mechanism for terminating the flow after a preset volume has been delivered. This control apparatus includes a specially designed device which operates the main flow control valve so as to reduce the flow from the maximum loading rate to a value between about 10% and about 50% during the period at which the last few gallons of the preset volume of liquid are delivered. This simultaneously permits accurate dispensing of the liquid, complete and safe recovery of often hazardous vapors, and the avoidance of the hammering and ebullition phenomena which are manifested when the rapid flow of liquid is terminated.

It is a primary object of this invention to provide an improved apparatus for the controlled dispensing of volatile liquids which permits vapor recovery, accurate volumetric dispensing, and controlled termination of high rate liquid flows.

It is a more specific invention to provide in a segmented tubular loading arm a pneumatic control system which serves to deliver a preset volume of volatile liquid while recovering evolved or generated vapors and for the gradual and automatic reduction in flow rate during the period just prior to the completion of delivery of the desired volume.

It is a more specific object of this invention to provide a pneumatically operated control device including a pneumatic cylinder provided with a specially designed vent system intermediate the ends thereof which permits the pneumatic piston to throttle at an intermediate position and to control mechanical equipment such as liquid flow control valves at a partly open position.

Other objects and advantages of this invention will become apparent to those skilled in the art as the description thereof proceeds.

Briefly, the present invention comprises an improved apparatus for the transfer of volatile liquids at high rates and incorporates means for receiving and preventing the loss of displaced gases, such as air, which are laden with evolved vapors of the liquid being handled. The apparatus comprises a jointed tubular loading arm provided with tubular swivels between each section. The loading arm consists of three essential conduit or pipe sections. These include a first section which is movable in a horizontal plane and is connected at its upstream end through an elbow and a vertical swivel to a source of liquid to be loaded, a second or intermediate section connected at its upstream end by means of a pair of elbows and a horizontal and a vertical swivel to the downstream end of the first section whereby the second section is movable in vertical planes at any angle to the first section, and a third or vertical section connected by means of an elbow and a horizontal swivel to the downstream end of the second section.

The designation of swivels as being "horizontal" or

"vertical" refers to the direction of their longitudinal axis around which the movable parts rotate.

A novel mechanical means is provided in conjunction with the second and third conduit sections whereby the third section, constituting the delivery end of the loading arm, is maintained at all times parallel to a given axis. In the loading of gasoline tank trucks for example having hatches which open through their upper surfaces, this mechanical means is adjusted to maintain the third section in a vertical position at all times regardless of the movements of the first and second sections. This vertical positioning is effected by connecting the second and third conduit sections to a long rod which is parallel to and below the second section, and to a short vertical lever which extends down from the downstream end of the first conduit section so as to form a parallelogram. All four connections are pivoted except that between the vertical lever and the first conduit section.

The third section is provided with an integrally attached vapor collecting cap or hood which is adapted to seal against the inner edge of the loading hatch and prevent the direct escape therethrough of the vapors displaced when liquid is introduced into the vessel through the serially connected conduit sections of the loading arm. A flexible conduit opens from the cap or hood and extends back along the segmented tubular loading arm whereby the displaced vapors are carried from the loading site. The maintenance of the third conduit section in a vertical position by the means above indicated is exceedingly important as it permits maintenance of this vapor-tight seal in spite of the settling of the tank truck or car during loading and which normally causes misalignment of the seal.

The equipment briefly described above is physically supported through a rigid connection at the upstream end of the first conduit section and is usually operated in conjunction with a loading rack consisting essentially of elevated horizontal walkway or platform which extend along the side of the truck loading driveway at a height of about 8 to 12 feet. The truck and trailer are positioned on the driveway parallel to the loading platform, the hatches are opened, and the loading arm is swung out over the truck. The third section is extended downwardly into each hatchway, and the vapor recovery head is seated in and sealed against the hatch. The introduction of liquid is begun and the displaced vapors flow upwardly through the hatch, into the vapor collecting head which prevents their escape to the atmosphere, and then through the flexible vapor conduit to a suitable recovery system of the general types outlined below.

The usual liquid storage or transportation vessels, herein exemplified by gasoline trucks and trailers specifically, are not designed to withstand high operating pressures. The usual maximum pressure for these particular vessels is about 4.0 p. s. i. g. (pounds per square inch gauge). To prevent the buildup of undue pressures within the vessels being loaded, a novel apparatus is provided for automatically relieving any excess pressure during the loading and for fixing a desired maximum vessel pressure which cannot be exceeded.

The second and third conduit sections of the loading arm are supported from the downstream end of the first conduit section and are varied in position by means of a pneumatic cylinder which serves to raise and lower these sections of the arm. The pressure of air maintained on each side of the piston within this pneumatic cylinder is selected from a consideration of the weight of these loading arm sections, the area of the tank loading hatch, the maximum tank pressure, and the area of the piston in the pneumatic cylinder so as to maintain a predetermined downwardly acting weight of the second and third arm sections against the vessel hatch. This net downward weight is controlled, by controlling the cylinder air pressures as described, so that the net downward weight in pounds divided by the area of the hatch opening in square

inches does not exceed the maximum allowable pressure in pounds per square inch of the vessel being loaded. For gasoline tank trucks as stated above this pressure is usually about 4.0 p. s. i. g. In such a truck having a 10-inch diameter hatchway the open area of the hatch is 78.5 square inches. The pneumatic cylinder is therefore loaded so as to leave a net downward weight of the loading arm of no greater than 314 pounds exerted through the vapor collecting head and against the vessel hatchway. In the event of a pressure build-up to 4.0 p. s. i. g. within the vessel, a force of 314 pounds is exerted through the vapor collecting head upwardly against the loading arm causing it to lift. This opens the hatchway to the atmosphere, permits vapors to escape from the vessel, and prevents the pressure from raising to a value greater than the allowable limit. In actual operation with gasoline trucks, this net downward weight is preferably adjusted to about 200 pounds whereby a vessel build-up in pressure to 2.5 p. s. i. g. will lift the vapor collecting head from the hatchway and provide a safety factor with respect to any pressure build-up.

This control of the net weight at the outer or downstream end of the loading arm is controlled within narrow limits by controlling the air pressure which exists within the pneumatic cylinder on each side or both sides of the piston. The upper end of the cylinder is attached to a vertical stanchion or davit which in turn is supported from the downstream end of the first conduit section. The piston is connected through a piston rod by means of a pivot to the second conduit section so that by increasing the air pressure on the lower side of the cylinder causes the second and third sections to be lifted. Obviously releasing this pressure will permit gravity to move the second and third section downwardly so as to set the vapor recovery head against the truck hatch. By maintaining a predetermined air pressure at all times in the lower part of the pneumatic cylinder with heavy loading arms, all but the desired net weight may be suspended by means of the cylinder. With lighter loading arms, as in the following example, a residual pressure is maintained above the piston to fix the desired net downwardly acting force. In these ways the vapor relief valve provision is obtained.

The loading arm briefly described above is provided with a main control and shut-off valve disposed adjacent the downstream end of the second conduit section. This valve may be manually operated and is provided with a valve positioner comprising a novel pneumatic or air cylinder which is connected into the control system hereinafter more fully described. At one extreme position of the valve positioner piston the valve is wide open, and at the other extreme position this control valve is closed. The valve positioner cylinder is provided with an intermediate vent consisting of a series of close spaced small holes drilled through the cylinder wall along a helical path, with each hole being spaced along this helical path from the adjacent holes by a distance of between about ½ and 5 hole diameters. The length of the perforated section along the cylinder is always less than the length of the piston head seal so as to avoid air by-passing around the piston through the holes and manifold. These holes or apertures are manifolded within a collecting ring surrounding the cylinder barrel and are provided with suitable seals to prevent the leakage of gas. By means hereinafter described the piston may be made to throttle the main liquid control valve at an intermediate flow which is substantially reduced from the wide open flow rate and it is through this device that the hammering action is totally prevented during the shut-off at the end of the delivery of the predetermined liquid volume.

This air cylinder valve positioner is connected through a dead man valve to a pilot valve which controls the instrument or control air flow to the valve positioner air cylinder. The pilot valve in turn is actuated through a direct mechanical linkage to an electrically driven

preset counter. The electric motor driven counter is in turn electrically connected to the generator turned by the positive displacement meters by means of which the quantity of liquid delivered through the loading arm during any loading period is measured.

In operation of the present device, after the loading arm has been placed into position for liquid dispensing, the preset counter is adjusted to show the liquid volume to be delivered, the dead man valve is opened thereby permitting the valve positioner to open the main liquid control valve to the wide open position. As flow continues the preset counter, electrically actuated by the positive displacement meter, continuously determines the degree to which the desired volume has been delivered. At a time when all but 100 gallons or so of this volume has been dispensed, the preset counter actuates the pilot valve which in turn actuates the air cylinder valve positioner so as to reduce the delivery rate by partially closing the main control valve. This automatic reduction in delivery rate reduces the liquid velocity in the loading arm to a value such that it may be completely shut off by closing of the main control valve without undue build-up of liquid pressures upstream from the valve due to liquid momentum within the loading arm. It has been found that with gasoline loading for example at rates approximating 1200 gallons per minute, complete elimination of hammering is obtained when this preliminary reduction is from 1200 gallons per minute full flow rate to a value of about 400 to 500 gallons per minute for a period of about 5 to 15 seconds before complete shut-off.

The apparatus briefly described above will be more readily understood by reference to the accompanying drawings in which:

Figure 1 is an isometric view showing schematically the segmented loading arm to which the improved control equipment has been added according to this invention;

Figure 2 is a combination instrumentation drawing showing the pilot valve, the dead man valve, and the air cylinder valve positioner in vertical cross section, the pilot valve and valve positioner being shown in the full liquid flow positions;

Figures 3 and 4 show the pilot valve and valve positioner cylinders in the throttling or low flow position; and

Figures 5 and 6 show the pilot valve and valve positioner air cylinders in the closed position.

Referring now more particularly to Figure 1 the elements of the segmented tubular loading arm of this invention are shown. The description will be conducted in terms of the application of this device to the loading of volatile gasoline into tank trucks, but obviously the loading of other volatile liquids into any container is contemplated.

Gasoline from storage is pumped by means of a pump **11** through line **10** and into and through a positive displacement meter **12** wherein a total flow during any given loading period is determined. Meter **12** rotates during liquid flow and drives an electric generator **13** which is connected by means of electrical connection **14** to an electric motor contained within electrically driven preset liquid volume counter **16** subsequently described. The liquid flows upwardly through check valve **18** and into first conduit section **20** of the segmented loading arm. This is connected through a vertical swivel **22** so that the first conduit section may be moved in a horizontal plane.

The gasoline flow continues through tubular swivels **24** and **26** which connect the downstream end of first conduit section **20** to second conduit section **28**. Because the two swivels **24** and **26** are separated by an elbow, second conduit section **28** may be positioned in any vertical or horizontal direction necessary. Mechanically attached to the upstream end of second conduit section **28** is an electrically driven preset counter **16** which is actuated by the positive displacement meter with respect to the amount of liquid pumped through the meters in relation to the preset volume to which the counter has been adjusted. The main control valve **30** is disposed adjacent the downstream end of second conduit section **28**, and it is connected by means of two elbows and swivel **32** to third or vertical conduit section **34** through which the gasoline is delivered to the tank truck. Vapor collector **36** provided with an external sealing surface **38** is supported on third conduit section **34**. Displaced vapors from the tank truck flow around third conduit section **34** upwardly into vapor collector **36** from which they are removed through a flexible conduit **38***a*. This flexible conduit is disposed along the lower side of the segmented loading arm and is connected through a spring loaded check valve to suitable vapor recovery equipment. The latter may comprise a charcoal absorption system, a compression and condensation system, or a liquid absorption system which serves to separate the volatile materials from the displaced air. Third section **34** is kept vertical regardless of the slope of second section **28** by vertical levers **25** and **27** pivoted to connecting rod **29** forming a parallelogram.

In Figure 1 the counter **16** is connected by a mechanical linkage **40** to pilot valve **42**. This pilot valve is directly actuated by a counter **16** and serves to control the flow of instrument air through dead man valve **44** to the air cylinder valve positioner **46**. The latter element is directly connected by linkage **48** to the control handle of the main control valve **30**.

Dead man valve **44** is provided so as to interrupt the flow of air to valve positioner **46** and close the main control valve **30** in the event of casualty with respect to the loading operator, or if for any reason the operator leaves his post.

Valve positioner **46** is a specially designed air cylinder having intermediate vent ports which permit the cylinder to adjust the main control valve to a partially closed position so as to reduce the liquid flow from the full flow rate in response to a signal generated by the preset counter **16** when all but a certain small quantity of the desired liquid volume has been delivered. In this way the "hammering," ebullition, and the other problems of rapid liquid flow rate reductions are eliminated entirely.

The preset counter **16**, which serves to detect the delivery of a portion of preset volume of liquid and to activate the pilot valve in two steps when this desired quantity of liquid has been delivered, is an article of commerce. It is directly connected by means of linkage **40** to pilot valve **42**. The pilot valve movements induced thereby and the valve positioner air cylinder **46** responses thereto are more clearly shown in Figures 2 through 6.

Referring now more particularly to Figure 2 cross sectional elevation views of pilot valve **42**, dead man valve **44**, and valve positioner air cylinder **46** are shown. Linkage **40** together with a manual operator **50** are shown connecting the preset counter **16**, not shown, with the pilot valve **42**. The pilot valve is provided with a movable member **52** which serves to connect vent line **54** and air inlet line **56** with control ports **58** and **60** which are connected to the valve positioner by means of first and second control conduits **59** and **61**.

Valve positioner air cylinder **46** is provided with piston **62**, piston rod **64**, manual operator **66**, a loading spring **68**, and control ports **70** and **72**. This valve positioner is a conventional air cylinder modified to provide the intermediate venting port **74** shown. Around the periphery of the cylinder barrel is drilled a series of apertures **76**. These apertures are spaced apart from one another between about 0.5 and about 5 aperture diameters and extend around the periphery of the barrel in a helical path whose longitudinal or axial length is less than the length of piston head **62** so as to avoid control air by-passing around the piston head to vent port **72**. All

of these apertures open into fluid manifold annulus 78 contained within collecting ring 80, from which outlet or intermediate port 74 opens.

The pilot valve 42, the valve positioner 46, and dead man valve 44 are shown in Figure 2 in their wide open or full flow positions. In this position instrument air enters pilot valve 42 through port 56 and passes through channel 82 in the valve, through port 58 and first control conduit 59 through channel 84 in dead man valve 44 so long as the handle 86 thereof is manually depressed. This air continues into valve positioner 46 through port 70 and forces piston 62 into the position shown and keeps the main control valve 30, outlined by dotted lines, in a wide open position. In the event the dead man valve is released, spring loaded handle 86 rises isolating pilot valve 42 from valve positioner 46, the instrument air flowing from port 58 being cut-off, and air from port 70 of positioner 46 is vented through channel 88 through vent line 90. With the supply of instrument air cut off and port 70 vented, the loading spring 68 throws control valve 30 into the closed position, as indicated in Figure 6.

In the wide open or full flow position shown in Figure 2, the pilot valve is in a position so that inlet port 56 is open and connected to control port 58 while control port 60 and vent port 54 are sealed.

When all but the small remaining portion of the predetermined volume of liquid has been delivered, the preset counter 16 reacts through linkage 40 and moves the pilot valve 42 from the position shown in Figure 2 into the position shown in Figure 3 in which inlet port 56 remains connected through channel 82 to control port 58, but in which control port 60 is now opened and connected to vent port 54. With this change, the instrument air supplied continues from port 56 through port 58 into port 70 of valve positioner 46 shown in Figure 4, but since intermediate port 74 of the valve positioner is now connected through port 60 to vent line 54, the instrument air is permitted to leak through at least some of the apertures 76 previously described. This flow through the small apertures generates a pressure drop and permits loading spring 68 to move piston 62 to an intermediate position covering some of the apertures 76. The actual intermediate position is determined by the tension of loading spring 68 in relation to the pressure of the instrument air supplied through port 56.

By bringing piston 62 to the intermediate position shown the main control valve 30 is thus partially closed to reduce the liquid flow rate to the desired value for a short period before it is thrown into the completely closed position.

Shortly following this first impulse from the preset counter 16 and during which time the completion of delivery of the volume of liquid desired occurs, a second signal from the counter throws the pilot valve into the position shown in Figure 5. Here inlet air port 56 is sealed and both control ports 58 and 60 are connected through channel 92 to vent port 54. Because of the connections of control ports 58 and 60 to ports 70 and 74 of valve positioner 46, this position of the pilot valve prevents any flow of instrument air and vents any high pressure air from cylinder 46 through ports 70 and 74. With no high pressure instrument air present in valve positioner 46, piston 62 is returned by means of loading spring 68 to the position indicated in Figure 6, which completely closes main control valve 30 and terminates the liquid delivery.

As indicated briefly above the position of piston 62 in the valve positioner air cylinder and therefore the degree to which the main control valve is closed is determined by the adjustment of loading spring 68 and the pressure of the instrument air supplied through inlet port 56. It is also to some extent determined by the longitudinal distance of the perforated central section in the valve positioner air cylinder barrel. By means of the loading spring adjustment and the inlet air pressure the degree of reduction in liquid flow during the last stage of liquid delivery may be determined. It has been found preferable to reduce the flow rate at least to below the 50% point and prferably to a value between about 10% and about 30% of the maximum flow rate in order to avoid hammering effects during flow termination.

Although the centrally perforated valve positioner air cylinder shown and described above has been found to be highly suited to the service herein described it is not intended that this device be limited to these uses. There are many applications in which valve positioning is required and of course this valve positioner consisting of an air cylinder with an intermediate perforate section surrounded by a sealed collector ring may be employed. Such services are well known to those skilled in the art. The use of this device is of course not necessarily restricted to positioning valve elements, but can be used in the adjustment of other mechanical devices wherein an intermediate position is desirable between two extreme positions.

The present invention was applied in the preset volumetric metering of automotive gasoline in Los Angeles, California at a loading station in which approximately 24 million gallons of gasoline per month were loaded into tank trucks. The loading arms were fabricated of 4-inch diameter conduit, each of the first and second conduit sections being approximately 5 feet in length. The loading rates through these devices were held at about 1200 gallons per minute and the vapors displaced from tank trucks were collected and conducted from the loading site. The pilot valves employed in this device were as illustrated in Figures 2, 3, and 5 and were directly actuated by the electrically driven preset counter described above. The pilot valve operated in conjunction with a dead man valve as indicated in Figure 2 which controlled the flow of instrument air to the air cylinder valve positioner shown in Figures 2, 4, and 6. This air cylinder had a 2-inch bore and a 6-inch stroke, was provided with a helical row of holes through the air cylinder barrel at an intermediate point along the length of the cylinder. These holes were drilled with a No. 50 wire drill and were spaced 1.5 hole diameters center-to-center apart from one another along a 45° helical path around the cylinder. The air cylinder piston was directly connected to the main flow control valve and was spring loaded to bias this valve into the normally closed position.

Extensive testing of the above described device at the loading terminal indicated has proved it to be a highly successful and reliable control system.

A particular embodiment of the present invention has been hereinabove described in considerable detail by way of illustration. It should be understood that various other modifications and adaptations thereof may be made by those skilled in this particular art without departing from the spirit and scope of the invention as set forth in the appended claims.

We claim:

1. In an apparatus for transferring volatile liquids into a container and collecting evolved vapor therefrom without loss to the atmosphere which comprises a segmented loading arm conduit including a first, a second, and a third conduit section serially connected by means of conduit swivels, said second and third conduit sections being adapted thereby to be raised and lowered, a vapor collecting head surrounding said third conduit section and adapted to be sealed against the opening of said container, a flexible conduit for vapor opening from said head and extending back along said segmented loading arm, and a main flow control valve connected in said second conduit section, the improvement in combination therewith which comprises a pneumatic cylinder having a piston and piston rod disposed adjacent said control valve, said piston rod being connected so as to actuate said control valve, a loading spring biasing said piston into an extreme position

in said cylinder at which said control valve is closed, said cylinder having a fluid manifold disposed around an intermediate portion thereof which opens through at least one port into said cylinder, a preset counter connected to a meter which is actuated by the volume of liquid delivered through said loading arm, a pilot valve connected to and actuated by said preset counter, an inlet conduit for a control fluid under pressure opening into said pilot valve, a vent conduit opening therefrom, a first control conduit connecting said pilot valve to an end port of said cylinder, a second control conduit connecting said pilot valve to said fluid manifold, and a vent port conduit opening from the other end port of said cylinder, said preset counter being adapted to actuate said pilot valve so as to supply air to said cylinder and open said control valve until all but a minor amount of a preset liquid volume has been delivered, then vent said intermediate port so as to permit said loading spring to bring said piston into an intermediate position adjacent said port so as to close partially said main control valve while said minor amount of liquid is delivered at a reduced rate, and then vent all cylinder ports to spring close said control valve.

2. An apparatus according to claim 1 in combination with a spring closing "dead man" valve connected in said first control conduit, said valve being manually operated to supply control fluid from said pilot valve to said air cylinder.

3. An apparatus according to claim 1 in combination with a positive displacement meter connected upstream from said segmented loading arm, an electric generator driven thereby, an electric motor which drives said preset counter, and an electrical connection between said motor and said generator.

4. An apparatus according to claim 1 wherein said manifold surrounds a plurality of apertures opening through the wall of said cylinder, said apertures being spaced apart from one another between about 0.5 and about 5.0 aperture diameters, the length of the thus perforated section of said cylinder being less than the length of the head seal on said piston.

5. An apparatus according to claim 4 wherein said apertures are disposed along a helical path on the wall of said cylinder.

6. An apparatus for transferring a predetermined volume of liquid at a high flow rate into a container without adverse effects of ebullition and line hammering which comprises, in combination with a delivery conduit opening from a source of liquid into a container to be filled, a pump in said conduit, a liquid delivery meter in said conduit, a spring-loaded normally closed flow control valve in said conduit, a valve positioner cylinder disposed adjacent said valve and provided with a piston and a piston rod connected to actuate said valve, a fluid manifold surrounding and communicating with said positioner cylinder at an intermediate point, a preset liquid volume counter connected to and actuated by said liquid delivery meter, a pilot valve directly actuated by said counter so as to be retained in a full flow position until all but a minor part of the preset volume of liquid has been delivered, then be moved into a throttled flow position during delivery of said minor part, and then be moved into a closed position, a first and a second control conduit connecting said pilot valve to said positioner cylinder, a vent conduit opening from and a supply conduit into said pilot valve for control fluid under pressure, said full flow position of said pilot valve being one in which the control fluid is supplied therethrough to move said piston against the spring load to an extreme position at which said control valve is wide open and in which said manifold is sealed, said throttled flow position being one in which the control fluid is supplied as in the full flow position and in which said manifold is vented whereby said piston rests at equilibrium between the control fluid force and the spring load force at an intermediate position in said cylinder with said control valve partially closed, and said closed position being one in which said supply conduit is sealed and said control conduits are vented to permit said loading spring to close said control valve completely.

7. An apparatus according to claim 6 in combination with a spring-loaded normally closed and vented "dead man" valve connected in one of said control conduits between said pilot valve and said positioner cylinder whereby manual actuation thereof is required to supply control fluid to said positioner cylinder.

8. A valve positioner apparatus which comprises in combination with a control valve to be operated, a pilot valve having an inlet port for control fluid and a vent port and a first and second control port, a pneumatic cylinder having two end ports and disposed adjacent said control valve, a piston disposed within said cylinder and sealed against the cylinder walls, a piston rod connecting said piston with said control valve, a spring biasing said piston toward one end of said pneumatic cylinder, a first control conduit connecting said first control port with one end port, a second control conduit connecting said second control port with a manifold, said manifold surrounding said cylinder at an intermediate position and enclosing at least one opening through the wall thereof, a vent conduit from the other end port of said cylinder, said pilot valve adapted to seal said second control conduit and supply control fluid via said first control conduit to move said piston against said spring to one extreme position at which said control valve is open, and adapted to vent said second control conduit so as to permit said spring to move said piston to an intermediate point adjacent said manifold to close said control valve partially, and to vent both control conduits so as to permit said spring to move said piston to the other extreme position at which said control valve is closed.

9. An apparatus according to claim 8 in combination with a spring-loaded manually operated three-way venting "dead man" valve connected in said first control conduit, said pneumatic cylinder being vented through said "dead man" valve and isolated from said pilot valve except when said "dead man" valve is manually actuated.

10. An apparatus according to claim 8 wherein said manifold encloses a plurality of apertures through the cylinder wall, said apertures being disposed along a helical path having a longitudinal extent which is less than the sealed length of the piston.

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