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[54] **LIQUID PROPORTIONING SYSTEM**

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[73] Assignee: **said Meister, by said Kelley and Holmes**

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[51] **Int. Cl.** **B67d 5/56**

[58] **Field of Search** 222/129.2, 249, 129.4, 222/190, 189, 309; 259/4

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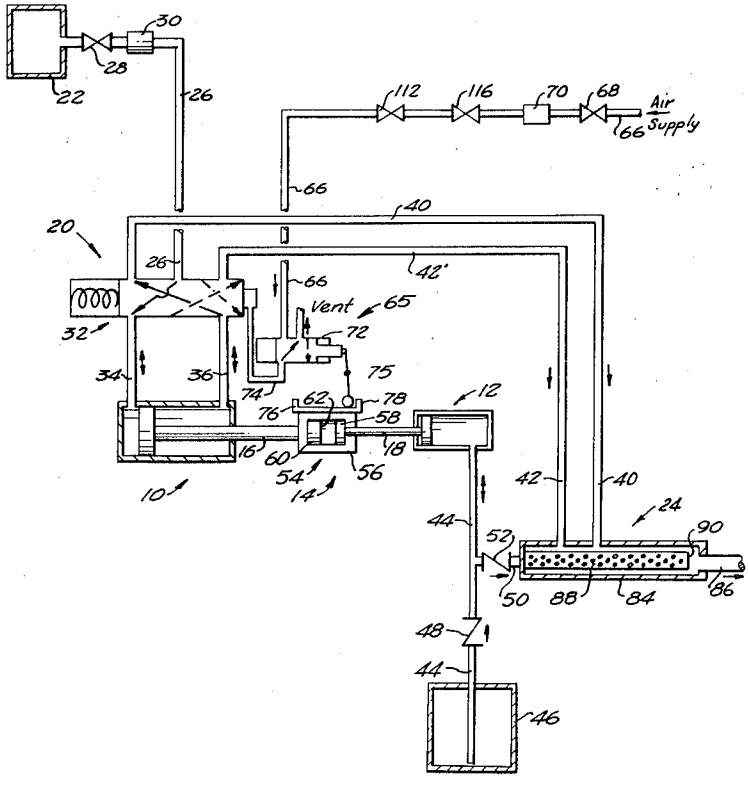
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[57] **ABSTRACT**

The specification and drawings disclose embodiments of a liquid proportioning apparatus which provides an exactly proportioned mixture of two liquids. The disclosed apparatus uses a pair of pistons which are interconnected such that one serves to drive the other. The driving piston is actuated by one of the liquids under pressure. The other piston acts to pump the second liquid. An adjustable lost motion connection between the two pistons allows the relative length of stroke of the two pistons to be varied.

13 Claims, 3 Drawing Figures



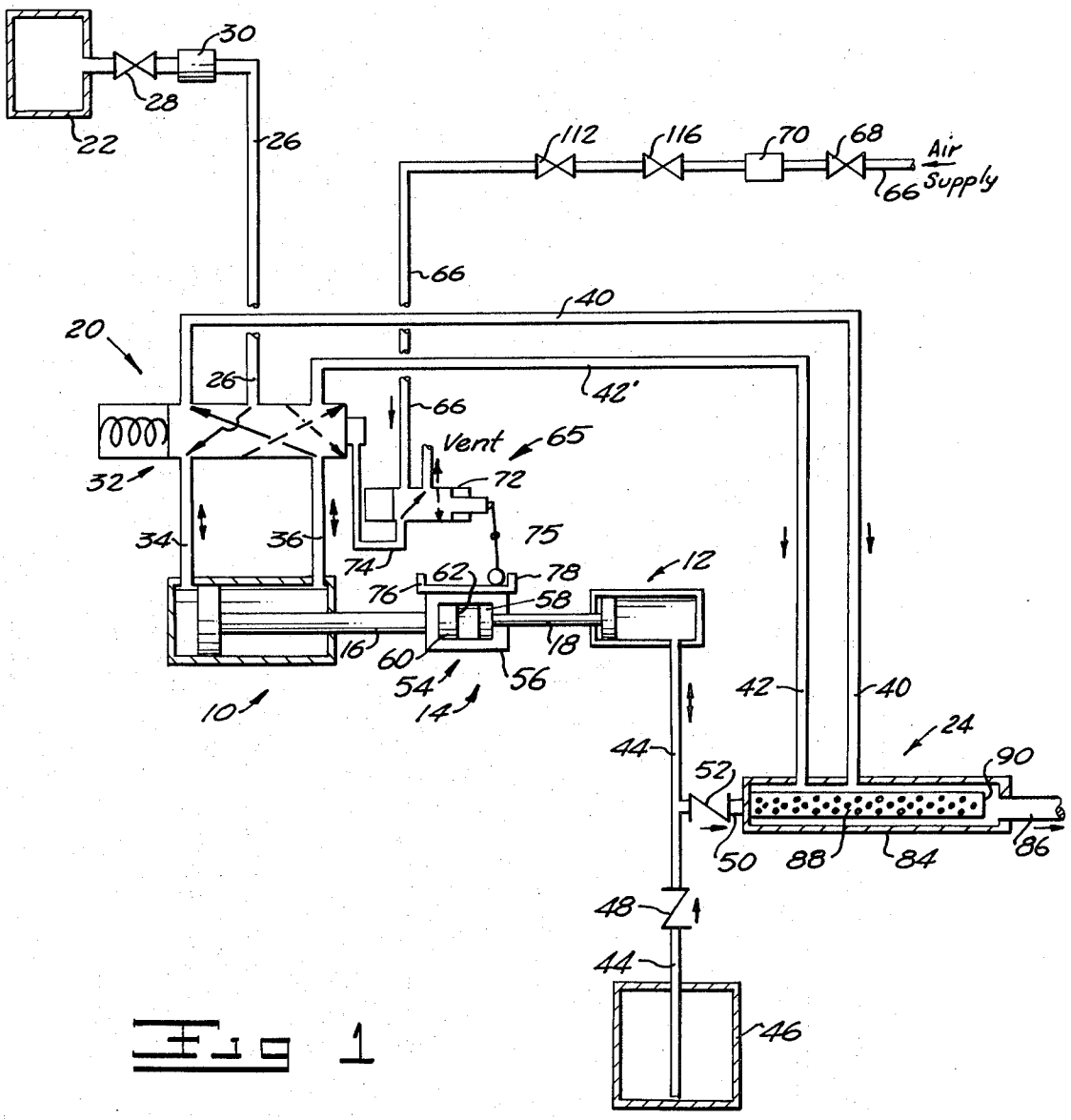

30
28
22
26
112
116
70
68
Air
Supply
66
66
40
20
26
42'
66
Vent
65
72
32
34
36
75
74
62
78
12
76
58
16
60
18
54
56
42
40
10
14
24
44
52
90
50
88
84
86
48
44
46

Fig. 1

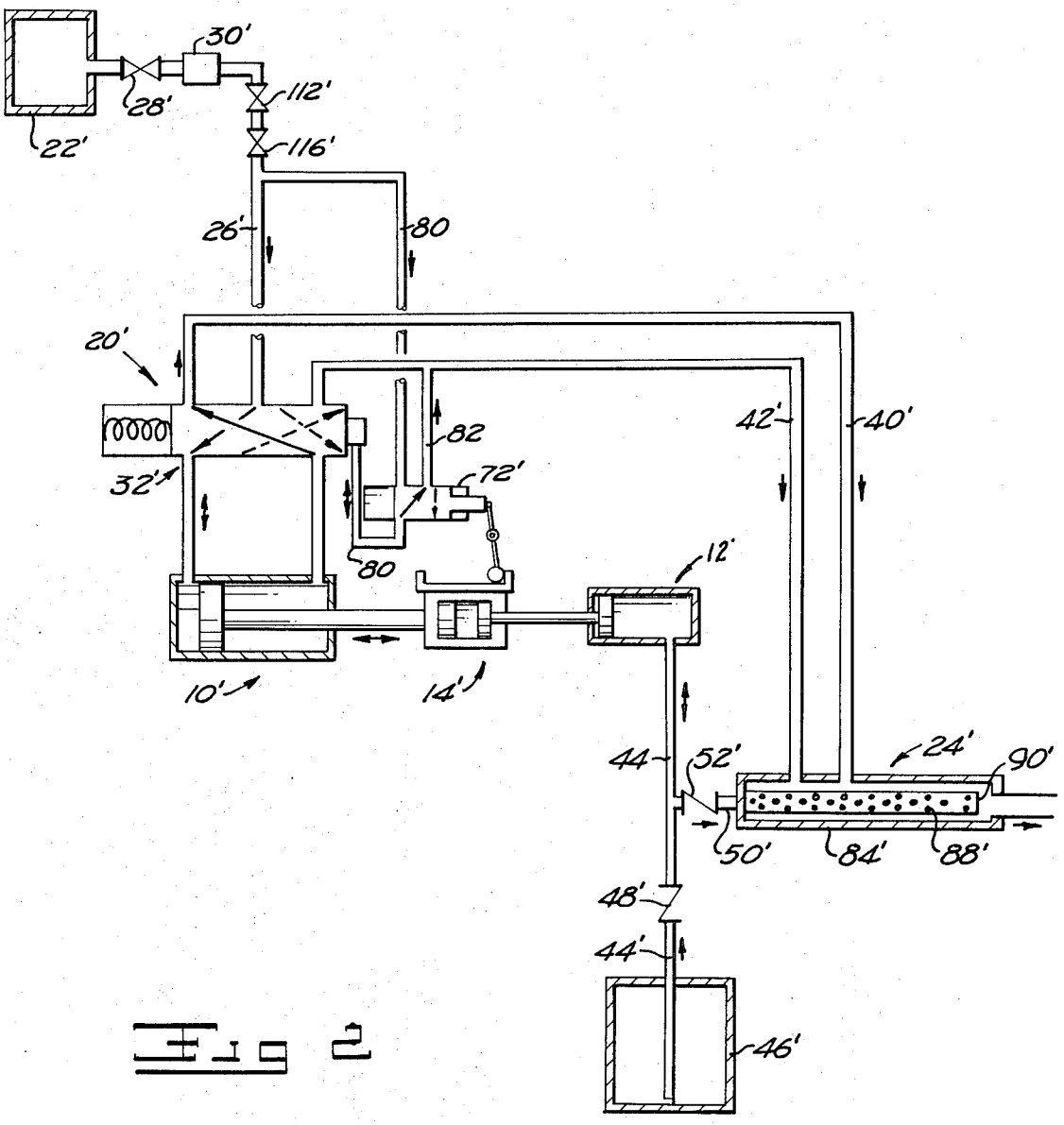

30'
28'
112'
22'
116'
26'
80
20'
42'
40'
82
32'
72'
80
12'
10'
14'
44'
52'
24'
90'
50'
84'
88'
48'
44'
46'

Fig 2

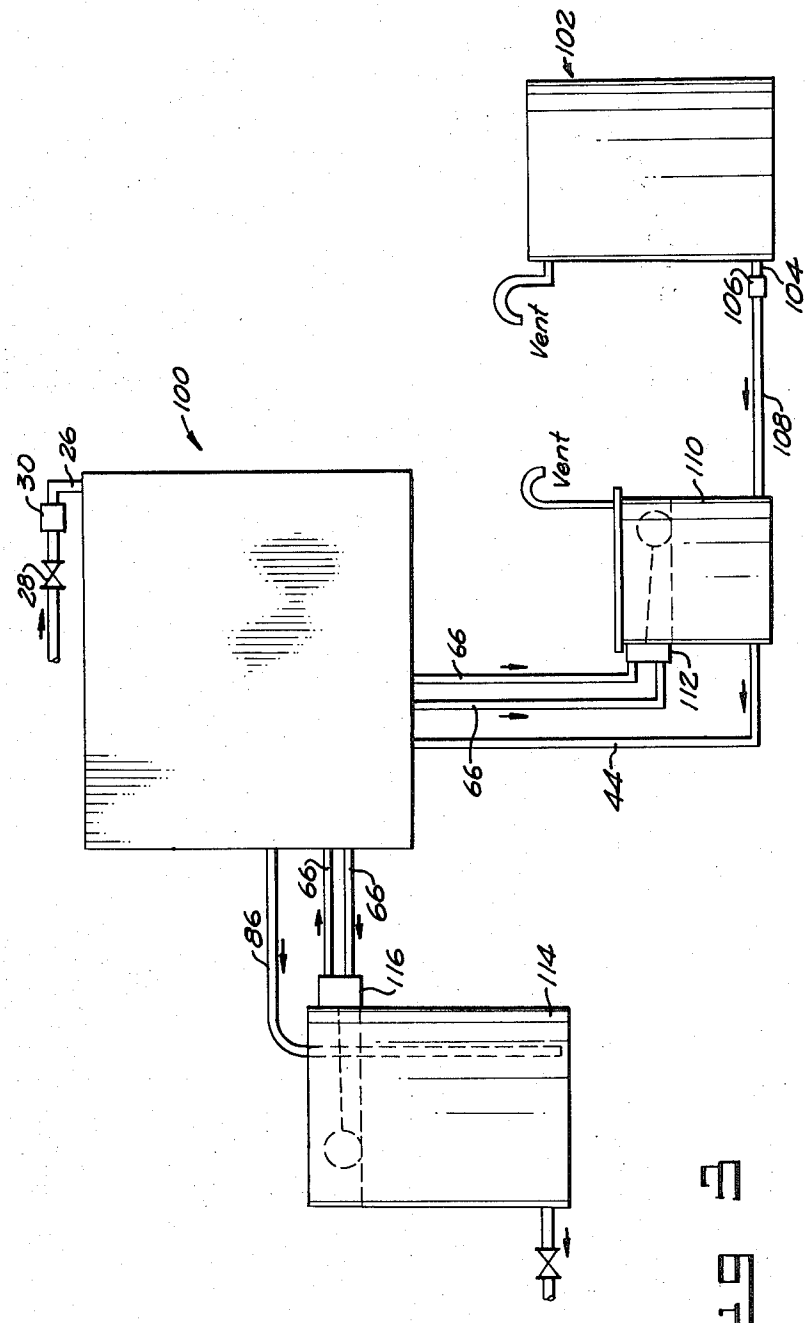

102
Vent
106
104
108
100
Vent
110
26
30
28
66
112
66
44
66
66
86
116
114

FIG 9

LIQUID PROPORTIONING SYSTEM

BACKGROUND OF THE INVENTION

The subject invention is directed toward the art of proportioning devices and, more particularly, to an improved apparatus for producing exactly proportioned fluid mixtures.

The invention is particularly suited for proportioning mixtures of water and release agents in the casting industry and will be described with particular reference thereto; however, as will become apparent, the invention is capable of much broader application and can be used whenever it is desired to provide an exactly proportioned fluid mixture.

Generally, prior to the present invention, fluid mixtures of the type under consideration were proportioned through the use of venturi-type fluid mixing and proportioning systems. The problem with the prior art proportioning devices was, primarily, that small changes in the pressure of the fluids supplied to the proportioning device would produce substantial variations in relative proportions. Additionally, the devices were sometimes impossible and, at best, difficult to readjust for varying the relative proportions of the fluids. Often, to change proportions required a completely new mixing assembly or a removal and replacement of orifice plates or the like. Consequently, as can readily be appreciated, there has been a distinct need for a positive, simple and reliable fluid proportioning device which assures exact relative proportions irrespective of the fluid supply pressures. Moreover, there has been a need for a device of this type which can be readily adjusted to produce varying mixture proportions without complex readjustments or substitution of major components.

BRIEF STATEMENT OF THE INVENTION

In general, the invention contemplates an apparatus for closely proportioning at least a first and a second liquid through the use of a first double acting cylinder which is drivingly connected with a second cylinder, preferably a single acting cylinder. The first fluid is supplied under pressure to the first cylinder. Control means are associated with the assembly so that the first fluid is alternately supplied to opposite sides of the piston of the first cylinder to produce reciprocation thereof. Simultaneously, the fluid on the opposite side of the piston of the first cylinder is discharged. The second cylinder is connected through suitable supply and discharge lines with a source of second fluid. The supply and discharge lines for the second cylinder are arranged to permit the second cylinder to act as a pump. As can be appreciated, the first fluid serves as the power fluid for pumping the second fluid. Because the double acting cylinder has a positive displacement, and, because the second cylinder likewise has a positive displacement, movement of the first cylinder produces fixed relative proportions of discharge of first and second fluid from the first and second cylinders. Preferrably, the discharged fluids are supplied to mixing means wherein they are intermixed.

It is also preferred that the connecting means between the first cylinder and the second cylinder comprise an adjustable means wherein the length of the reciprocation of the second cylinder can be varied relative to the length of the reciprocation of the second cylinder. This provides an adjustable relative proportion of the two fluids since a full stroke of the first cylinder can be arranged to produce only a partial stroke of the second cylinder. In a desirable form of the device, the adjusting means are a relatively simple, lost motion connection.

The invention also contemplates that the means used to control the supply of first fluid to the first cylinder will include a pilot valve which is controlled by a second valve alternately opened and closed by movement of the first piston.

In accordance with a somewhat more limited aspect of the invention, the pilot valve is a fluid actuated valve which is actuated by air or by the first fluid. This arrangement permits all controls for the assembly to be simple fluid actuated controls without the necessity of any electrical connections which could be dangerous in certain environments. However, it should be appreciated that electrical controls could be used in connection with certain applications, and the invention is therefor to be limited only by the language of the claims.

OBJECTS OF THE INVENTION

Accordingly, a primary object of the invention is the provision of a highly accurate and adjustable fluid proportioning apparatus which is simple to construct and highly reliable in operation.

A somewhat more limited object of the invention is the provision of a system of the general type described in which one of the liquids being proportioned serves as the power and control fluid for the apparatus.

A still further object of the invention is the provision of a system of the general type described wherein the fluids or liquids are proportioned through the use of positive displacement cylinders adjustably interconnected so as to permit variations in the relative quantities discharged from each of the cylinders.

A still further object of the invention is the provision of a liquid proportioning system in which all controls and actuating units for the system can be fluid actuated.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects and advantages will become apparent from the following description when read in conjunction with the accompanying drawings wherein:

FIG. 1 is a somewhat diagrammatic showing of the preferred embodiment of the invention;

FIG. 2 is a diagrammatic showing of a second embodiment of the invention; and

FIG. 3 shows a typical installation utilizing a proportioning apparatus formed in accordance with the subject invention.

Referring more particularly to FIG. 1 of the drawings the overall arrangement of the invention can be readily understood. In general, the apparatus of FIG. 1 includes a first double acting fluid cylinder **10** which is drivingly interconnected with a second cylinder **12** by adjustable interconnecting means **14.** Cylinder **10** serves as a power means for the unit and has its piston rod **16** drivingly connected to the piston rod **18** of cylinder **12.** Cylinder **12** acts as a positive displacement pump for pumping and discharging exact quantities of one of the liquids being proportioned.

Referring more specially to the first double acting cylinder **10**, it will be noted that supply and discharge means **20** connect cylinder **10** with a pressurized source **22** of a first fluid, as well as, connecting it with a mixing means **24**. Although the first fluid could be of many types, in the subject embodiment, it is water and the supply means **22** can simply be a pressurized water line. The water is supplied through a line **26** including a shutoff valve **28** and a filter **30** to a pilot or control valve **32**. Valve **32** is a standard spool-type control valve which is adapted to be moved in one direction by a spring and in the opposite direction by fluid pressure. It serves to direct the supply of pressurized water from line **26** to opposite sides of the piston of cylinder **10** by shifting the water supply between lines **34** and **36**. In the solid line position shown in FIG. **1**, water is being supplied from line **26** to line **34** to thereby produce movement of cylinder **10**'s piston to the right. Simultaneously therewith, line **36** is connected with line **40** which leads to the mixing means **24**. Consequently, as can be seen, during the period the fluid is being supplied through line **34** to cylinder **10**, the fluid on the opposite side of the piston is being discharged to the mixing means. Upon shifting of the pilot valve **32** in the opposite direction (to the left as viewed in FIG. **1**) the fluid from line **26** is directed to line **36** causing the piston to move to the left. Simultaneously therewith fluid from the left hand side of the piston is directed from line **34** to line **42** which also leads to the mixing means **24**. Although shown as separate lines, lines **40** and **42** could be connected as a common line if desired.

Referring more specifically to the single acting cylinder **12** it will be noted that it has a single line **44** which is connected to a source **46** of a second liquid such as, for example, a release agent which needs to be mixed in a predetermined relative proportion with water. The line **44** includes a check valve **48** arranged to permit flow only in the direction of the arrow. Between check valve **48** and the cylinder **12** is a branch line **50** which leads to the mixing means **24**. Branch line **50** is provided with a check valve **52** which permits fluid to flow only in the direction of the arrow (i.e., into the mixing means).

As can be appreciated, during reciprocation to the left of the piston of cylinder **10** causes the piston of cylinder **12** to likewise move to the left and to withdraw liquid from the supply **46** through line **44** to the cylinder **12**. Thereafter, movement of the piston of cylinder **10** to the right causes simultaneous movement of piston **12** which in turn pumps a fixed quantity of the second fluid through line **50** to the mixing means **24**.

As can be understood, by properly sizing the cylinders **10** and **12** any relative proportions of the first and second fluids could be supplied to the mixing means **24**. In the subject embodiment, however, an adjustable means is provided in the connecting means **14** so that the length of the stroke or piston movement of cylinder **12** can be readily adjusted relative to the length of stroke of the piston of cylinder **10**. These means could take many forms but as shown comprise a lost motion connection **54**. Connection **54** includes a housing or body **56** which is positively connected to the end of piston rod **16**. Piston rod **18** is slidably received through the outer end of housing **56** and, at its end has a disc or enlargement **58**. A removable plate **60** is positioned within the housing **56**. As is apparent, during movement of piston rod **16** to the right member **58** is not engaged until piston rod **16** has moved a substantial distance to the right to bring surface **62** of plate **60** into engagement with member **58**. Thereafter, piston **12** will move to the right with piston rod **16**. By varying the thickness of plate **60** the amount of movement undergone by the piston of cylinder **12** can be readily varied to vary the relative quantities of the two liquids. Note, for example, that by reducing the thickness of plate **60** the length of movement of piston rod **18** will be substantially reduced relative to that of piston rod **16**. Correspondingly, increasing the thickness of plate **60** will increase the movement of piston rod **18** relative to piston rod **16**. If plate **60** is of a thickness to completely fill the inner chamber of housng **56** the movement of piston rod **18** will be exactly equal to the movement of piston rod **60**. Thus, merely by supplying a number of plates **60** of varying thickness the relative proportions of the fluids can be quickly changed without any major change in the overall system.

As will become apparent, many types of controls could be used for the system.

In the subject embodiment, the pilot valve **32** is a fluid actuated type and is arranged to be shifted in timed relationship with the movement of piston **16** by an air controlled assembly **65**. The air control assembly **65** includes a line **66** which is connected to a source of compressed air through a standard air shutoff valve **68** and air filter **70** to a small, mechanically operable valve **72** having a discharge line **74** connected to the operator of the pilot valve **32**. In a first position of movement of valve **72** air is directed from line **66** through the valve to line **74** to shift the pilot valve **32** to the left as in the solid line position. Movement of the valve **72** in the opposite direction connects the line **74** through the vent outlet with the atmosphere. In the subject embodiment the valve **72** is shifted between its two positions by having its operator **75** positioned between a pair of upwardly extending tabs or the like **76** and **78** carried on the connecting means **14**. It should be understood that the valve **72** could be operated in other ways so long as it is operated in proper time relationship with the movement of piston rod **16**.

FIG. **2** illustrates an embodiment which differs only slightly from that described with reference to FIG. **1**. Accordingly, like reference numerals differentiated from the FIG. **1** embodiment by the addition of a prime suffix have been used to identify the same components. The description of one such FIG. **1** element is to be taken as equally applicable to the corresponding FIG. **2** element unless otherwise noted. In particular, FIG. **2** differs from the FIG. **1** embodiment primarily in the method of controlling the pilot valve **32'**. In this embodiment, pilot valve **32'** is a fluid actuated valve but is controlled by the first fluid which is tapped off from supply line **26'** through a line **80** which connects through valve **72'** with line **81** leading to the operating end of pilot valve **32'**. Line **82** is, however, connected directly to the mixing chamber **13**. Thus, the small portion of the first fluid which is utilized to actuate the pilot valve **32'** is directed to the mixing chamber **24'** upon reversal of valve **72'**. This must be taken into account when adjusting the relative proportions of the two fluids.

Although not previously discussed, the mixing means **24'** is a relatively simple unit. In particular, as shown in FIG. **1**, it comprises an outer housing **84** having a discharge line **86** extending therefrom. Lines **40** and **42**

discharge into the housing **84.** Extending longitudinally within the housing **84** is an internal tube **88** having an extensively perforated wall. The end **90** of tube **88** is plugged and the opposite end is connected to receive the discharge of the second fluid coming through line **50.** As can be appreciated, the perforated wall or baffle provided by tube **88** causes the second fluid to be dispersed throughout the interior of housing **84** and provides good mixing with the first fluid entering from lines **40** and **42** to assure that the mixture leaving line **86** is fully and completely mixed.

FIG. **3** illustrates a typical installation in which the proportioning systems of FIGS. **1** and **2** could be used. The major components of the proportioning system of FIG. **1** are indicated as being enclosed in a housing identified by the reference numeral **100.** The water supply line **26** is shown extending to the proportioning system. Associated with the system is a drum **102** of the second fluid. The outlet **104** of drum **102** is preferably connected through a quick release connection **106** with a line **108** leading to a tank **110.** Tank **110** serves as source **46** and is connected to line **44** as shown. A float controlled valve **112** is arranged to interrupt flow through line **26** (see FIG. **1**) whenever the level of fluid within tank **110** drops below a predetermined level. This will shut down the entire proportioning system by stopping the flow of compressed air to the pilot valve **32.** Similarly, in FIG. **2,** valve **112'** is closed by low level to stop the flow of water to the unit and thereby shut it down. The discharge line **86** through which the proportioned mixture exits from the proportioning unit **100** is directed to a mixture holding tank **114.** Tank **114** provides a storage tank for the proportioned fluid mixture and can be connected directly to other process lines or merely drawn off manually as needed. Carried within tank **114** is a float which serves to control a valve **116.** Referring to FIG. **1** it will be noted that valve **116** is located in line **66** and closes upon reaching a maximum level within tank **114.** This similarly shuts down the proportioning system by topping the flow of compressed air to the pilot valve **32.** Similarly, in the FIG. **2** embodiment valve **116'** closes to shut off the flow of water thereby shutting the system down upon reaching a high level in tank **114.**

The invention has been described in great detail sufficient to enable one of ordinary skill in the art to make and use the same. Obviously, modifications and alterations of the preferred embodiment will occur to others upon a reading and understanding of the specification and it is my intention to include all such modifications and alterations as part of my invention insofar as they come within the scope of the appended claims.

What is claimed is:

1. An apparatus for providing a closely proportioned mixture of at least a first and a second liquid comprising:

a first double acting fluid cylinder having a first piston and a piston rod;

a positive displacement piston pump;

interconnecting means connecting said piston rod with said piston pump whereby movement of said first piston produces pumping movement of said pump;

supply and discharge means for supplying said first fluid under pressure to said first cylinder and discharging it therefrom, said supply and discharge means including control means for shifting the supply of said first fluid between opposite sides of said first piston to produce continuous reciprocation of said piston;

means for connecting a source of said fluid to said pump;

fluid mixing means receiving the discharges from said first fluid cylinder and said pump; and,

wherein said interconnecting means include an adjustable lost motion connection between said piston rod and said pump.

2. An apparatus for providing a closely proportioned mixture of at least a first and second liquid comprising:

a double acting fluid cylinder having a piston mounted for reciprocation therein and a piston rod extending outwardly from at least one end thereof;

a second fluid cylinder having a piston mounted therein and a piston rod extending outwardly from at least one end thereof;

means interconnecting the piston rods of said first and second cylinders for producing movement of said second cylinder in response to movement of said first cylinder;

first supply and discharge means for supplying said first fluid under pressure to said first cylinder and discharging it therefrom, said supply means including control means responsive to movement of at least one of said piston rods for causing said first fluid to be alternately supplied to opposite sides of the piston of said first cylinder and discharged from the other side thereof;

second supply and discharge means connected with said second cylinder for connecting said second cylinder with a source of said second fluid and permitting discharge of said second fluid from said second cylinder to a discharge line, said supply and discharge means including valve means whereby reciprocatory movement of said piston of said second cylinder withdraws said second fluid from the source thereof and pumps it to said discharge line;

a fluid mixer means;

fluid lines connecting the discharge from both said first and second cylinders to said fluid mixer means; and,

said interconnecting means comprising an adjustable means for permitting the length of reciprocation of said piston in said second cylinder to be varied relative to the length of the reciprocation of said piston in said first cylinder to thereby vary the relative proportions of said first and second fluids discharged to said fluid mixer.

3. The apparatus as defined in claim **2** wherein said adjustable means comprise an adjustable lost motion connection.

4. The apparatus as defined in claim **2** wherein said mixer means comprises a chamber having a perforated baffle plate and wherein said discharges from said first and second cylinders are separately supplied to opposite sides of said baffle plate.

5. The apparatus as defined in claim **2** wherein said control means include a pilot valve adapted to shift the supply of said first fluid between opposite sides of said piston of said first cylinder.

6. The apparatus of claim **5** wherein said pilot valve is fluid actuated.

7. The apparatus as defined in claim 6 wherein said pilot valve is actuated by said first fluid.

8. The apparatus as defined in claim 6 wherein a supply of actuating fluid to said pilot valve is controlled by a valve operated from at least one of said piston rods.

9. The apparatus as defined in claim 1 wherein said control means include a pilot valve adapted to shift the supply of said first fluid between opposite sides of said piston of said first cylinder.

10. The apparatus of claim 1 wherein said pilot valve is fluid actuated.

11. The apparatus as defined in claim 10 wherein said pilot valve is actuated by said first fluid.

12. The apparatus as defined in claim 10 wherein a supply of actuating fluid to said pilot valve is controlled by a valve operated from at least one of said piston rods.

13. The apparatus as defined in claim 2 wherein the piston in said first cylinder reciprocates a constant distance irrespective of the setting of said adjustable means and wherein said adjustable means varies only the length of reciprocation of said piston in said second cylinder.

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