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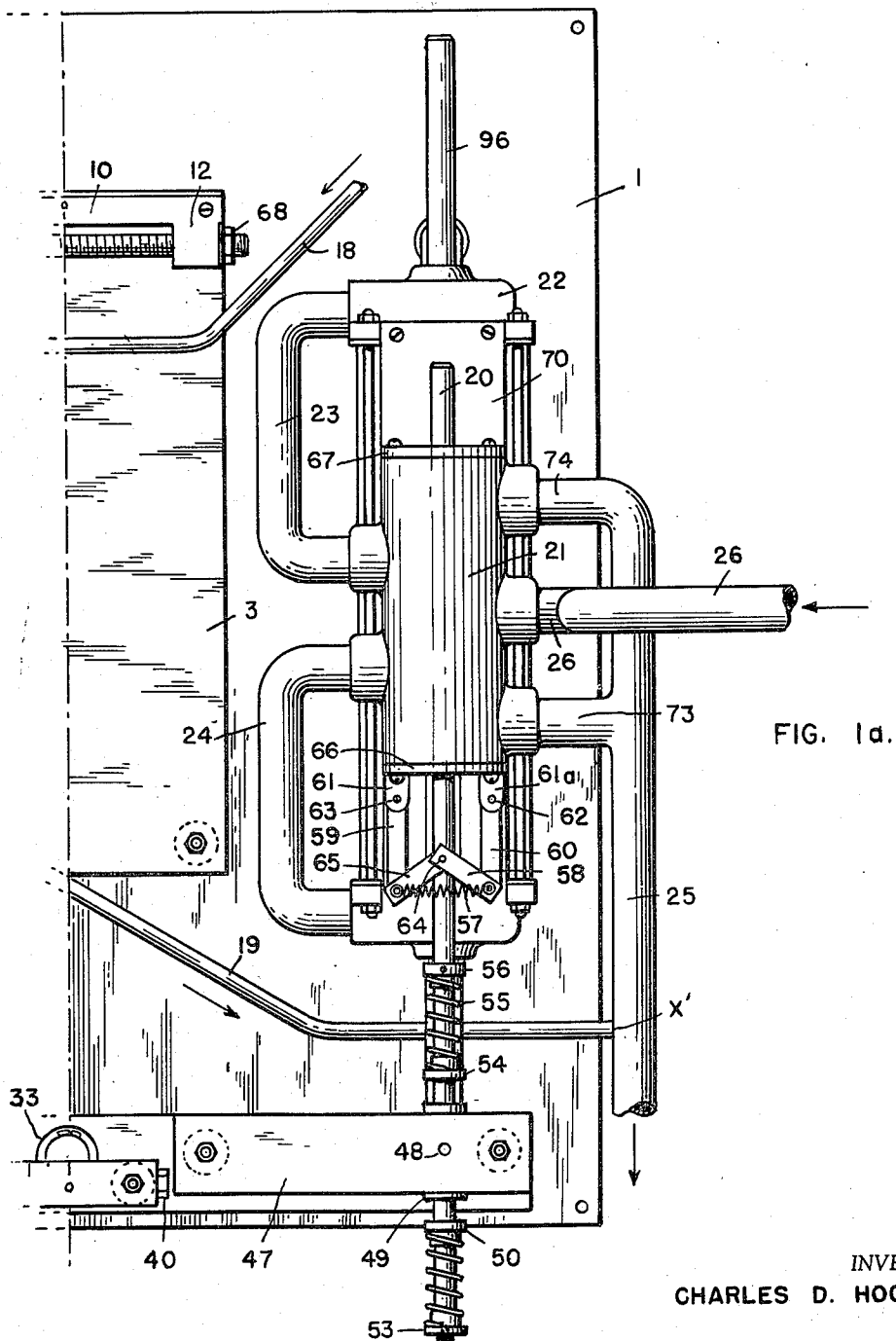
C. D. HOOVER

2,954,737

ADJUSTABLE PUMP AND LIQUID PROPORTIONING DEVICE

Filed April 19, 1954

6 Sheets-Sheet 1



INVENTOR
CHARLES D. HOOVER

BY

William H. Parrot, Jr.

ATTORNEY

Oct. 4, 1960

C. D. HOOVER

2,954,737

ADJUSTABLE PUMP AND LIQUID PROPORTIONING DEVICE

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6 Sheets-Sheet 2

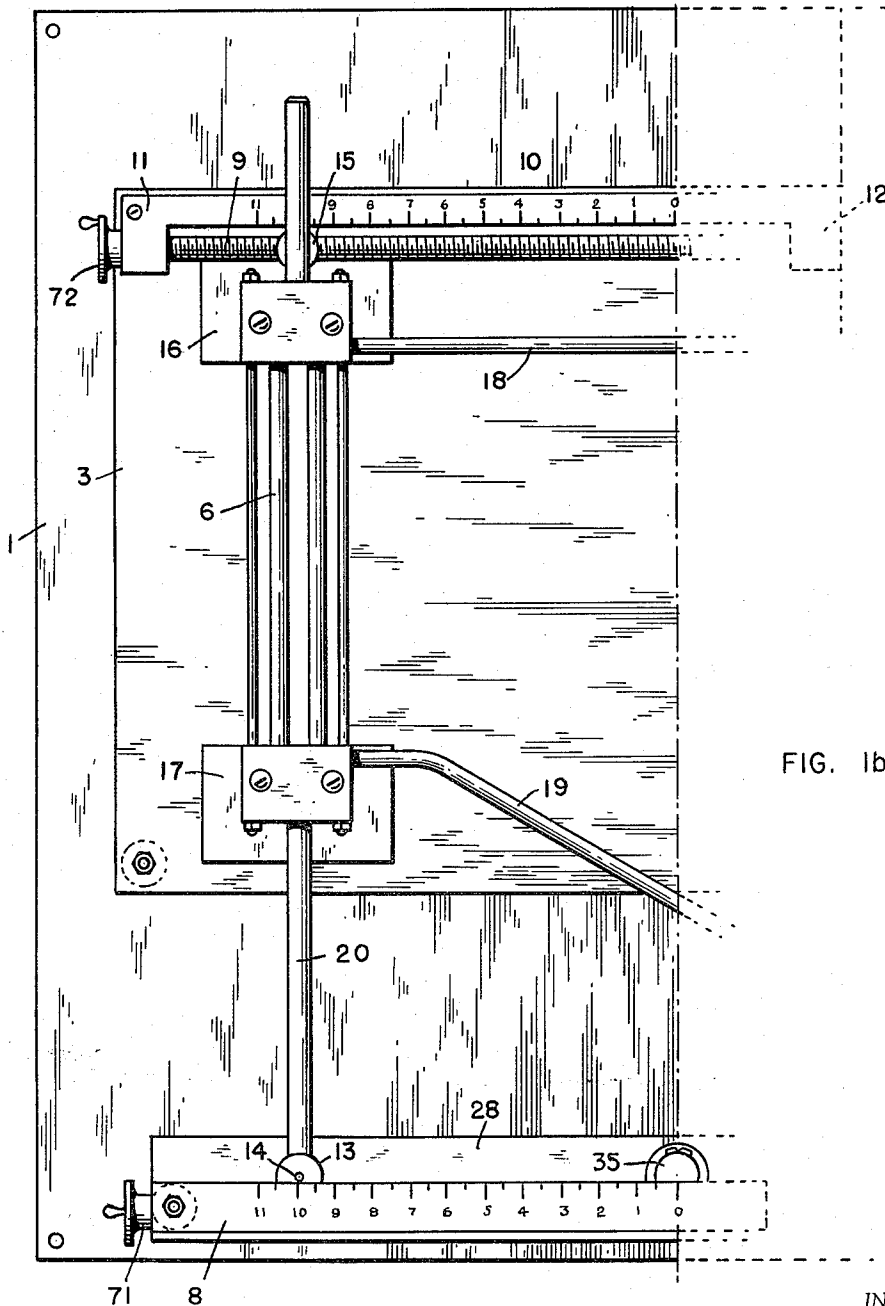


FIG. 1b.

INVENTOR
CHARLES D. HOOVER

BY *William R. Parrott Jr.*
ATTORNEY

Oct. 4, 1960

C. D. HOOVER

2,954,737

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FIG. 2.

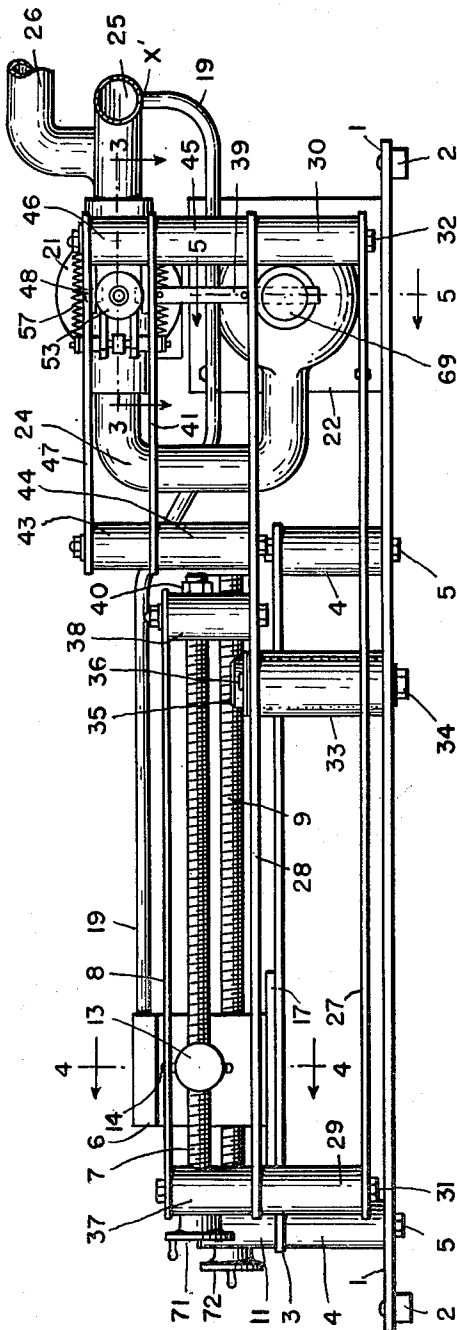
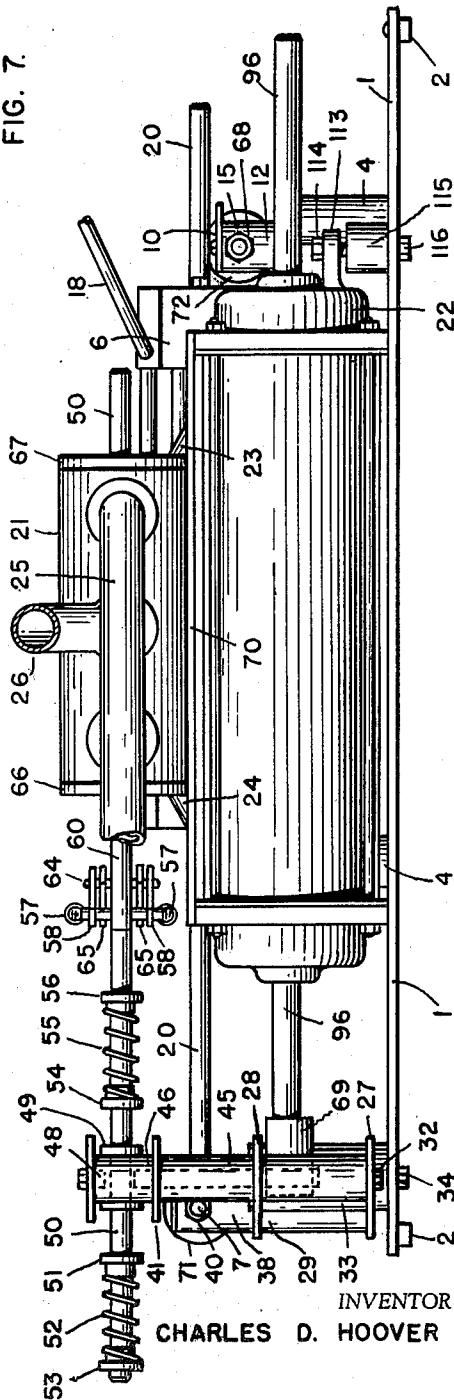


FIG. 7.



INVENTOR
CHARLES D. HOOVER

BY

William H. Bent

ATTORNEY

Oct. 4, 1960

C. D. HOOVER

2,954,737

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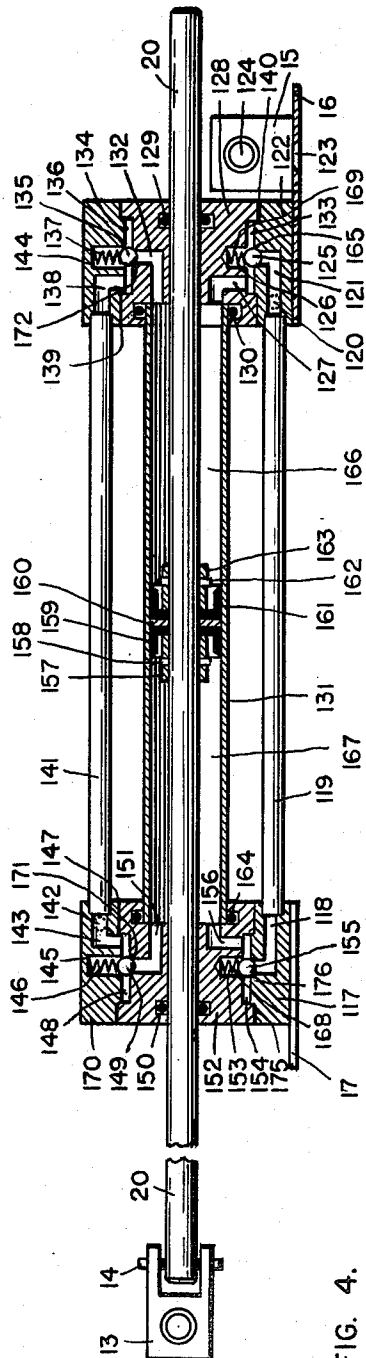


FIG. 4.

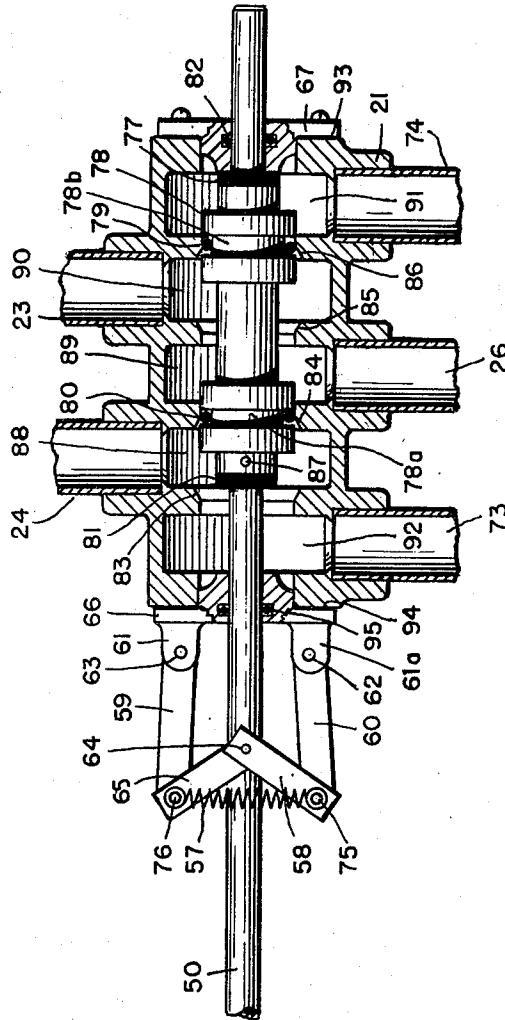


FIG. 3.

INVENTOR
CHARLES D. HOOVER

BY

William A. Davis Jr.

ATTORNEY

Oct. 4, 1960

C. D. HOOVER

2,954,737

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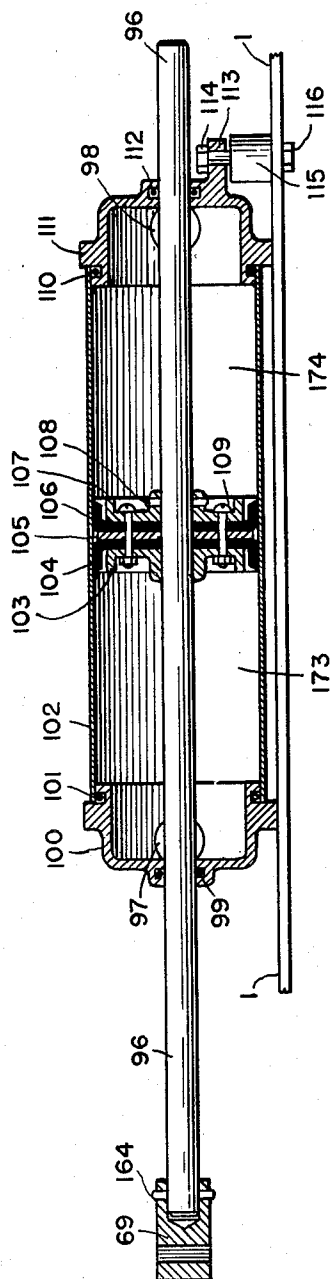


FIG. 5.

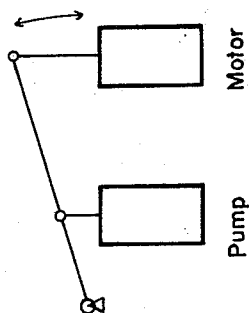


FIG. 9

INVENTOR
CHARLES D. HOOVER

BY *William D. Hoover Jr.*

ATTORNEY

Oct. 4, 1960

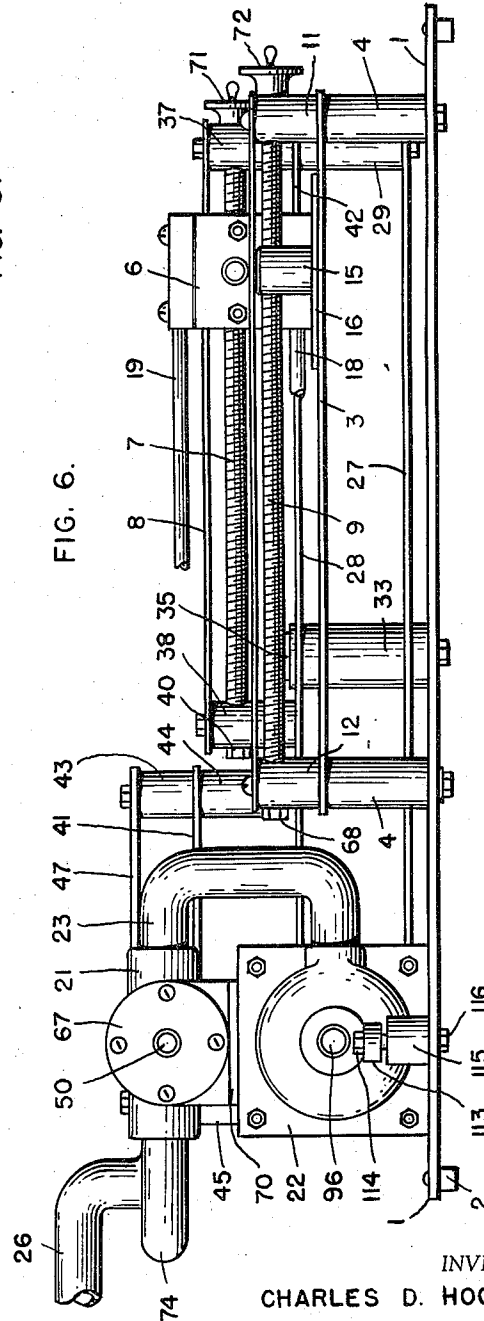
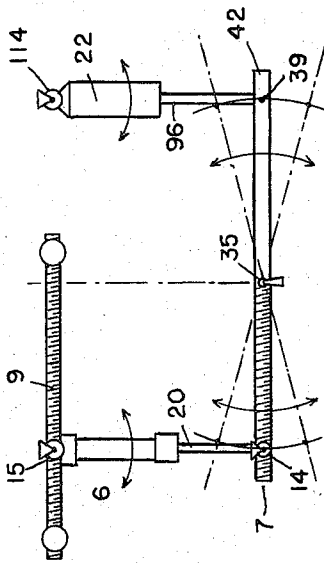
C. D. HOOVER

2,954,737

ADJUSTABLE PUMP AND LIQUID PROPORTIONING DEVICE

Filed April 19, 1954

6 Sheets-Sheet 6



INVENTOR

CHARLES D. HOOVER

BY

William H. Parry Jr.

ATTORNEY

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2,954,737

ADJUSTABLE PUMP AND LIQUID PROPORTIONING DEVICE

Charles D. Hoover, Upperco, Md., assignor, by mesne assignments, to Liqua-Mix, Inc., Indianapolis, Ind., a corporation of Indiana

Filed Apr. 19, 1954, Ser. No. 423,886

5 Claims. (Cl. 103—38)

This invention relates to liquid proportioning devices in general, and specifically relates to a proportioning device which employs a reciprocating pump or motor to effect proportioning in accordance with a predetermined setting of the stroke of the pump or motor.

In many physical and chemical processes and operations it is necessary to mix or intermingle two or more fluids in fixed relative proportion at varying rates of flow and at varying pressures. It is further desirable to be able to change these ratios quickly and simply by manipulating controls on the device and without having to change component parts of the device or to interrupt the flow of the various fluids.

It is an object of this invention to provide improved means whereby two or more liquids may be accurately proportioned each to the other, the proportioning ratios being readily variable by adjusting controls on the apparatus.

It is a further object to provide improved means whereby the proportioned liquids may be kept segregated one from the other until they are ready to be mixed internally of the device, or they may be kept segregated at all times, such as might be necessary in the case of two or more chemicals which are packaged separately and mixed by the ultimate user.

It is a still further object of this invention to control the sequence of the addition of the various proportioned liquids one to the other so as to avoid possibly dangerous reactions, precipitation of materials from the liquids, or harmful corrosion of unprotected parts of the device, or deposit of precipitated materials from the liquids which might cause binding of moving parts due to reduction in clearances within the device or accelerated wear.

A further object of this invention is to provide improved proportioning means whereby the two or more proportioned liquids may be kept isolated, as for example, when liquids must have physical or chemical changes performed upon them prior to mixing with one or more other proportioned liquids.

A still further object of this invention is to provide a device which may be added to an already existing positive displacement pump, positive displacement liquid motor, or positive displacement liquid meter.

The foregoing and other apparent objects are accomplished in the preferred embodiment of my novel arrangement in which a lever arm is caused to oscillate through an arc by means of an hydraulic motor or any other suitable power source, said lever arm being pivotally connected to drive one or more reciprocating pumps or motors, and calibrated means being provided to vary the position from the fulcrum of the lever to which at least one of the reciprocating pumps or motors are connected to said lever. In this manner the strokes of the several reciprocating pumps and motors connected to the lever arm, and hence the quantity of fluid delivered thereby, may be varied. The outputs of the several hydraulic pumps and motors connected to the lever arm

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will thus be in definitely predetermined proportions, the exact quantities dispensed depending chiefly upon the distances of each pump from the fulcrum of the lever arm to which each is connected and the effective hydraulic area of each pump, as well as the stroke of the piston.

My invention is more fully described hereinafter in this specification with reference to the annexed drawings, in which:

Figure 1a is the right hand half of a plan view of the preferred embodiment of my apparatus;

Figure 1b is the left hand half of said plan view, these two figures when placed side by side, developing the complete plan;

Figure 2 is a side elevation of the apparatus of Figure 1, viewed from the lower edges of both Figures 1a and 1b;

Figure 3 is an enlarged sectional view of the liquid motor valve taken on the line 3—3 of Figure 2;

Figure 4 is an enlarged sectional view of the liquid pump taken on the line 4—4 of Figure 2;

Figure 5 is a slightly shortened sectional view of the liquid motor taken on the line 5—5 of Figure 2;

Figure 6 is a side elevation of the apparatus of Figures 1a and 1b, viewed down from the top edge thereof;

Figure 7 is a side elevation of the apparatus of Figures 1a and 1b viewed from the right side of Figure 1a;

Figure 8 is a diagrammatic representation of the relative motion of the pump and motor of Figures 1a and 1b; and

Figure 9 is a schematic view of an alternative embodiment of my invention.

Referring specifically to Figures 1, 1a, 2, 6 and 7, my novel proportioner includes a base 1 resting desirably on suitable feet 2. A pump sub-base 3 is fastened to base 1 by means of spacer columns 4 and through-bolts 5. A lever pivot pin 35 is fastened to base 1 by means of a bolt 34 or other suitable fastener. Mounted on pin 35 and secured thereto by pin 36, an arm assembly 42 is free to rotate about the axis of pin 35 in the bearing 33 at the end of which are mounted the arms 27 and 28 which are separated by spacers 29, 30, and fastened by bolts 31, 32. On one side of arm 28 is mounted a drive screw 7 held free to rotate in journal spacers 37 and 38 and actuated by a hand crank 71 and retainer nut 40. Mounted on screw 7 and free to move along the axis of 7 as crank 71 is turned, is the pump drive yoke 13 suitably threaded to accommodate drive screw 7. Pump shaft 20 is freely pivoted to the drive yoke 13 by means of pin 14. This pin 14 further acts as a pump shaft position indicator pointer against the calibrated scale 8 mounted on top of the journal spacers 37 and 38. On the right hand side of arm 28 are mounted drive plates 41 and 47 separated by spacers 44, 45, 43 and 46. A drive pin 39 passes through pump drive bushing 69 freely at one end. Pin 48 and the top end of pin 39 enter into valve drive sleeve 49 sufficiently to form a free pivot for sleeve 49 but not deep enough to interfere with the sliding free motion of sleeve 49 on rod 50.

Pump 6 (better seen in Fig. 4), is fixed to the base plate 16. A pump pivot 15 with pivot pin 123 allows pump 6 to swing freely back and forth as drive arms 27 and 28 move through an arc about pivot 35. Pump pivot 15 is suitably threaded at 124 to accommodate parallel adjusting screw 9 so that, as hand crank 72 is turned in journals 11 and 12, pump pivot 15 and base plate 16 are free to move along the axis of screw 9. Screw 9 is maintained in place by the face of crank 72 and the retainer nut 68. As pump 6 swings, bases 16 and 17 serve as bearing surfaces.

Scale 10 is calibrated to coincide with scale 8. While this second screw arrangement and scale might be dis-

pensed with, I prefer to employ it to give greater accuracy in setting and adjusting of the proportions of fluid to be dispensed.

Supply line 18 conducts fluid to be proportioned to pump 6, and the fluid is discharged through discharge line 19. Proportioning drive motor 22 is pivotally secured directly to the base 1, better shown in Figs. 5, 6, and 7, by a free fitting pin 114 extending through lug journal 113 mounted on spacer 115 and secured by nut 116. Valve 21 is mounted on base 70, and this in turn is fastened to proportioning drive motor 22. Inlet liquid enters through conduit 26, and is distributed to the motor 22 through valve 21 and conduits 23 and 24, therefrom. Discharge from the motor 22 takes place also through the valve 21 and conduits 73 and 74. If desired, liquid from the pump 6, discharged through the conduit 19, may be brought into and mixed with liquid in conduit 25 at point X' in manifold 25. Valve rod 50 has secured to it the drive collars 53 and 56 onto which are tightly fitted springs 52 and 55, respectively (Fig. 7). Collars 51 and 54 are slidably free on rod 50 and are pressed onto and tightly fitted to springs 52 and 55, respectively. A valve lock, better seen in Figs. 3 and 7, has two lock arms 59 and 60 attached to lug pivots 61 and 61a by means of pins 63 and 62, respectively, about which the said arms are rotatably free to pivot. Balanced lever arms 65 and 58 on both sides of rod 50 are freely attached to rod 50 by pin 64 at one end, and to the lock arms 59 and 60 by free fitting pins 76 and 75, respectively. Balanced springs 57 on both sides of rod 50 span between pins 75 and 76 to pull the axes of these pins together.

The valve proper, Fig. 3, consists of a body 21 into which the conduits 23, 24, 26, 73 and 74 are sealed. Annular cavities 92, 88, 89, 90 and 91 are disposed about a common axis and are interconnected therealong by chamfered valve seats 83, 84, 85 and 86. The valve rod 50 is guided by the heads 66 and 67 which form a slidably free bearing for the rod. The glands 95 and 82 form a liquid seal around the rod 50. Valve heads 66 and 67 are sealed to the body 21 by means of gaskets 94 and 93, respectively. A specially cut double-headed piston 78 with annular grooves 78a, 78b, is fixed to rod 50 by means of a fastener 87. This piston 78 is free to move with the rod 50 in a reciprocating fashion within the cavities 92, 88, 89, 90 and 91 in valve body 21. Seal member 80 in groove 78a seals at seats 83 and 84 depending upon the position of piston 78, while seal member 79 in groove 78b seals at seats 85 and 86, respectively. Shock absorber washers 81 and 77 are mounted on rod 50 at each end of piston 78.

Referring next to the vertical section of the pump 6 shown in Fig. 4, the piston rod 20 is moved in a reciprocating fashion by force applied by arm 28 through the connection of the pump drive yoke 13 to the rod 20 at pin 14. A piston comprising sliding seal members 159 and 161, separated by the back-washer 160, is secured to the rod 20 by inner follower sleeves 157 and 163 and means 158 and 162. The piston thus formed is slidably free in the cylinder 131 and makes a positive liquid seal with the inner wall thereof. The rod 20 is guided by pump cylinder heads 152 and 128 which act as a slidably free journal for rod 20. A liquid seal is maintained between rod 20 and the pump cylinder heads 152 and 128 by the gland members 150 and 129, respectively. The seal between the cylinder 131 and the pump cylinder heads 152 and 128 is maintained by means of gaskets 164 and 130, respectively. The seal between members 170, 117 with member 152 is maintained by gaskets 147, 175, respectively, and between members 136, 122 with member 128, by gaskets 139, 140 respectively. Liquid supply conduit 18 enters the member 122 at 120 and connects with the cylinder chamber 166 through the passages 121, 133 and 127. Conduit 18 further connects with the cylinder chamber 167 through the passages 120, the conduit 119 to member 117 and the passages 118, 154, and 156.

A spherical ball 125 is seated over passage 121 at valve seat 165, held on its seat by spring 169, and guided in its opening and closing action by the cavity 126 in which ball 125 makes a free fit. Similarly, spherical ball 155 is seated over passage 118 at valve seat 176, held on its seat by spring 168 and guided in its opening and closing action by the cavity 153 in which the ball 155 makes a free fit. Liquid is discharged from the pump through conduit 19 connected to member 170 at 142, and with cylinder chamber 167 through the passages 143, 148 and 151. Conduit 19 further connects with the cylinder chamber 166 through the passage 142, the conduit 141 to members 136 and the passages 138, 134 and 132. A spherical ball 149 is seated over passages 151 at valve seat 171, held on its seat by spring 146 and guided in its opening and closing action by the cavity 145 in which ball 149 makes a free fit. Similarly, spherical ball 135 is seated over passage 132 at valve seat 172, held on its seat by spring 137 and guided in its opening and closing action by the cavity 144 in which ball 135 makes a free fit.

In Figure 5 where the motor cylinder 22 is shown in section, conduit 24 is in direct communication with cylinder chamber 173 through passage 97 in cylinder head 100. Conduit 23 is in direct communication with cylinder chamber 174 through passage 98 in cylinder head 111. The rod 96 is guided in reciprocating motion by the journals formed in cylinder heads 100 and 111 in which journals the rod 96 is slidably free. Liquid seal between the rod 96 and the cylinder heads 100 and 111 is maintained by the glands 99 and 112, respectively. A cylinder 102 is sealed at heads 100 and 111 by means of gaskets 101 and 110, respectively. Mounted and fastened to rod 96 by fastener 108 are piston members consisting of sliding seals 104 and 106 fixed to the rods 96 by means of inner back-up members 103 and 107 separated by washer 105. These elements 104, 106, 103, 107 and 105 are secured together on rod 96 by bolts 109 and thus form a slidably free seal between the chambers 173 and 174.

In operation liquid enters valve 21 through conduit 26 where it passes into annular cavity 89 and then moves through passage 85 into cavity 90. From the latter it is transferred via conduit 23 into cylinder chamber 174. In this process the liquid is prevented from entering chambers 88 and 91 by means of the sealing action of the piston seals 80 against seat 84, and 79 against seat 86, respectively. When a differential in pressure exists between conduit 26 and manifold 25, such that liquid must flow in the hydraulic circuit, this differential in pressure is manifested in a substantially higher pressure in chamber 174 than in chamber 173. This unit pressure differential acting on the effective piston area will produce a force tending to move the piston 103-108 along with its rod toward the area of lesser pressure. In this case, the rod 96 of the motor in Fig. 5 will tend to move to the left, with the volume of the chamber 174 increasing as the volume of chamber 173 decreases. The liquid in chamber 173 will be forced through passage 97, through conduit 24, into the valve cavity 88, from which it passes through passage 83 into cavity 92 and thence into discharge conduit 73 and manifold 25. Here also the seal 80 against seat 84 prevents liquid communication between chambers 88 and 89. Since conduits 73 and 74 are manifolded together in 25 the seal 79 against seat 86 prevents liquid communication between chambers 90 and 91. The valve in its operation is hydraulically balanced by its inherent construction and will cause no movement of the piston 78 along with rod 50 due to hydraulic pressure in the valve chambers.

As the piston rod 96 is forced downwardly, the arms 27 and 28, connected to the rod 96 through 39 and 69 (Figs. 1 and 7), along with arms 41 and 47 will swing in an arc about pivot 35. Valve actuator 49 connected to arms 41 and 47 through 39 and 48 will follow this movement in an arc, sliding on rod 50 until it engages spring collar 51. The lock springs 57 acting through

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lock arms 58 and 65 counteract the force exerted on the rod 50 through the spring 52 acting on collar 53, itself secured to the rod 50, until the further compression of spring 52 exerts a greater force on rod 50 than the combined locking force of springs 57 and the static friction of the valve assembly 21. At this point the valve rod 50 along with piston 78 is forced downwardly. If the locking load on the valve is greater than the force exerted by the spring 52, collar 51 will be forcibly brought against collar 53 by actuator 49, thus applying full arm force to the movement of the valve. The choice of springs 52 along with spring 55 and lock springs 57 depends upon the arbitrary valve action desired and the limits of travel of the liquid motor 22. Projecting the valve 21 (as shown in Fig. 3), to its left hand position with member 81 pressing against the inner face of head 66, the hydraulic action is reversed. In this position liquid flows through conduit 26 into chamber 89 through passage 84, cavity 88, and thence through conduit 24 into cylinder chamber 173. Liquid in chamber 174 is forced through conduit 23 into chamber 90, through passage 86, cavity 91 and thence via conduit 74 into manifold 25. The piston combination 103—108 (Fig. 5) is then forced to the right carrying with it rod 96. The result of the action of valve 21 and motor 22 is the application of a reciprocating force to arms 27, 28 while simultaneously a predetermined quantity of liquid is passed through valve 21—motor 22 combination in a metering manner.

To prevent or reduce undesirable hydraulic surge pressures due to rapid reversals of flow within the device, conduits 23 and 24 may be constructed of a resilient material such as rubber hose, and line conduit connections to conduits 25 and 26 may be similarly fabricated. Other suitable surge suppressing devices well known to the art may be employed as desired, for example, a multiplicity of cylinders.

As the arms 27 and 28 oscillate in an arc due to the reciprocating force applied by liquid motor 22, pump rod 20, slidably connected at the opposite side of fulcrum pivot 35 is likewise caused to reciprocate.

Referring to Fig. 4, as the rod 20 moves to the left with the piston elements 157, 158, 159, and 160, 161, 162, 163, the increased volume of chamber 166 causes a reduction of pressure in that volume sufficient to lift ball 125 from its seat 165 and cause flow of liquid from supply conduit 18 through passages 120, 121, 133 and 127 into cylinder portion 166. At the same time, the volume of cylinder portion 167 decreases an amount equal to the increase in the volume of portion 166, causing an increase in pressure in 167 such that the ball 149 is lifted from its seat 171 and liquid is forced from 167 through passages 151, 148, 143, 142, and thence into discharge conduit 19. Conversely, as the rod moves to the right liquid is drawn into chamber 167 from supply conduit 18 through passage 120, conduit 119, passage 118, around ball 155, which will be lifted from its seat 176, and into chamber 167 via passages 154, 156. Liquid is simultaneously discharged in equal amount from cylinder portion 166 through passage 132 around ball 135, forced from its seat 172, thence through passages 134 and 138, conduit 141, and into discharge conduit 19 via passage 142.

From the foregoing description of the preferred embodiment of my apparatus and its operation, it will be seen that the extent of the stroke of the pump 6 can be varied in relation to the stroke of the hydraulic motor 22 simply by turning the cranks 71, 72, thereby disposing the pump piston rod 20 at different distances on arm 42 from the pivot point or fulcrum 35. By pre-selecting the distance between pump rod 20 and fulcrum 35 in relation to the distance between fulcrum 35 and pins 48 and 39, where motor rod 96 connects 69 with arm assembly 42, the stroke of pump 6 may be made to bear a direct predetermined relation to the stroke of motor

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22, in accordance with well known principles of physics. Depending further only upon the effective piston areas of motor 22 and pump 6, the exact proportion of liquid which will be dispensed by pump 6 for a given stroke of motor 22 and quantity of liquid passed therethrough may be calculated, or determined by direct measurement. Such calculated or determined quantities may then be marked on the scales 8 and 10, either in absolute amounts or in terms of proportions relative to the amount of liquid passed on each stroke by the valve motor combination 21, 22. The manner in which calculations are made is well understood by physicists and engineers, and need not be further amplified here.

Figure 8 illustrates diagrammatically the reciprocating pivoting action of the motor 22 and pump 6. Pivot pin 114 is firmly secured to the base 1 and cannot move relative thereto. Likewise, pivot 35 is secured to base 1 and is incapable of movement relative to the base. Therefore, as rod 96 moves in and out of the cylinder of motor 22, and reciprocates lever 42, the connection of rod 96 with the lever 42 at 39 must and does swing back and forth over a small arc of the lever, and motor 22 pivots about pin 114 to follow the locus of the intersection of the two straight lines (namely, lever 42 with motor 22 and its rod 96), each pivoted at one of its extremities about a fixed point (namely, 35 and 114).

On the other side of the pivot 35, which is fixed as previously stated, the connection between lever 42 and rod 20 of pump 6 is fixed at pin 14. Therefore, when these two straight lines move with their intersections in an arc, the base at point 15 must pivot relative to base 1 to track the movement in arc of pin 14 located on lever 42.

While I have shown as my preferred embodiment, apparatus which is actuated by a reciprocating hydraulic motor and valve arrangement, connected to one extremity of a lever while the proportioning pump is connected to the extent of the lever on the other side of the fulcrum, it should be appreciated that the principles of proportioning devices herein taught may be applied to numerous different arrangements. For example, in Figure 9, there is shown schematically a possible arrangement in which both the pump and the motor are disposed on the same side of the fulcrum.

I claim:

1. Liquid proportioning apparatus comprising in combination a positive displacement pump, said pump having an inlet, an outlet, valve means for said inlet and said outlet, and a piston rod, a first source of liquid to be pumped, means conducting liquid from said first source to the inlet of said pump, lever means disposed transversely of the direction of movement of said piston rod substantially in the plane thereof, said lever means being pivotally secured at a fulcrum point to move pivotally thereabout, means connecting said rod to said lever means, the said connecting means being adapted to maintain connection between said rod and said lever means in the vicinity of a preselected point on the lever means throughout the movement of said lever means about its fulcrum point, means to vary the position, along a line substantially parallel with the lever means, of the said preselected point in the vicinity of which connection of the piston rod to the lever means is maintained, thereby to vary the stroke of said piston rod and the quantity of liquid dispensed through its outlet by said pump on each stroke, a second source of liquid for supplying liquid under pressure, a liquid metering device, said device including a hydraulic motor having a reciprocating driven member, and a valve arrangement connected to control said motor, said valve arrangement being operative in response to operation of said motor to supply operating liquid to said motor, means conducting liquid under pressure from said second source to supply pump-operating liquid to said valve arrangement, means connecting said motor driven member to said lever means to pivotally

oscillate the same about its fulcrum, said motor acting in response to flow from said second source to drive said lever and thereby drive said pump to pump liquid from said first source, and means to conduct the liquids passed by said pump and motor into admixture with each other.

2. Liquid proportioning apparatus comprising in combination a positive displacement pump, said pump having an inlet, an outlet, valve means for said inlet and said outlet, and a piston rod, a first source of liquid to be pumped, means conducting liquid from said first source to the inlet of said pump, lever means disposed transversely of the direction of movement of said piston rod substantially in the plane thereof, said lever means being pivotally secured at a fulcrum point to move pivotally thereabout, means connecting said rod to said lever means, the said connecting means being adapted to maintain connection between said rod and said lever means in the vicinity of a preselected point on the lever means throughout the movement of said lever means about its fulcrum point, means to vary the position of the preselected point along said lever means thereby to vary the stroke of said piston rod and the quantity of liquid dispensed through its outlet by said pump on each stroke, a second source of liquid for supplying liquid under pressure, a liquid metering device including a hydraulic motor having a power output member reciprocated thereby through successive opposite strokes, valve means connected between said second liquid source and said hydraulic motor and operative in response to completion of one stroke of said member to supply liquid under pressure from said second source to said motor to reciprocate said member through a successive stroke, said output member being connected to an eccentric point on said lever to pivotally oscillate the same about its fulcrum, said motor acting through said lever to drive said pump through successive pumping strokes of variable length depending on the selected position of said preselected point along said lever means, and means to conduct the liquids passed by said pump and motor into admixture with each other.

3. A self-contained proportional mixing device for liquids, comprising a hydraulic motor having a positive-displacement chamber, means to connect said motor to a source of a first liquid under pressure to drive said motor, valve means connected to control said meter, said valve means being responsive to motor movements and alternately connecting said chamber to be filled by said driving liquid and connecting said chamber to discharge said liquid therefrom, said motor and valve means being constructed and arranged to operate automatically in continuous cycles in response to flow of said first liquid, a pump having a similar positive-displacement chamber, a driving connection connecting said pump to said motor to operate in synchronism therewith with said pump chamber discharging concurrently with the discharge from said motor chamber, means to vary the driving connection between said motor and pump to adjust the pump displacement relative to the motor displacement, whereby to vary the proportion between the motor discharge rate and the pump discharge rate, means to connect said pump to a source of second liquid, and means to conduct the discharge streams from said motor and pump chambers into

admixture with each other in a common discharge conduit.

4. A liquid proportioning device, comprising a lever pivotally movable about a supporting fulcrum, a reciprocating hydraulic piston and cylinder motor having opposed displacement chambers, means mechanically connecting said motor to said lever to oscillate the same about said fulcrum, means to connect the motor to a source of a first liquid under pressure for driving the motor, valve means connected to control said motor, said valve means being responsive to movement of the motor for controlling liquid supply thereto and constructed and arranged to operate said motor automatically in continuous cycles in response to flow of said first liquid, and a reciprocating piston and cylinder pump operatively connected to the lever to be driven thereby for pumping a small amount of a second liquid at a fractional rate proportional to the rate of flow of said driving liquid through the motor, means to adjust the connection between the lever and one of said motor and pump to vary the stroke length of one with respect to the other, means to connect the pump to a source of second fluid, and means to conduct the liquids discharged by the motor and pump into admixture.

5. A self-contained proportional mixing device for liquids, comprising a hydraulic motor having a pair of oppositely-acting positive-displacement chambers, means to connect said motor to a source of a first liquid under pressure to drive said motor, valve means connected to control said motor, said valve means alternately connecting said chambers to be filled by said driving liquid and connecting said chambers to discharge said liquid therefrom in continuous automatic operation, a lever connected to said motor to be oscillated thereby, a pump connected to said lever to be reciprocated thereby, the connection between said lever and one of said motor and pump being selectively adjustable along the lever to vary the relative stroke length of the pump with respect to the motor, said pump having a pair of similar oppositely-acting positive-displacement chambers which respectively discharge concurrently with said motor chambers, means to connect said pump to a source of second liquid, and means to conduct the discharge from said motor and the discharge from said pump into admixture with each other in a common discharge conduit, whereby said pump continuously admixes with the discharged first liquid a substantially constant but adjustable proportion of said second liquid.

References Cited in the file of this patent

UNITED STATES PATENTS

536,430	Higgins	Mar. 26, 1895
552,386	Moffatt	Dec. 31, 1895
1,072,718	Heindl	Sept. 9, 1913
2,203,832	Malburg	June 11, 1940
2,369,365	Nichols	Feb. 13, 1945
2,552,762	Baker	May 15, 1951
2,627,813	Gilmore	Feb. 10, 1953
2,666,392	Martin	Jan. 19, 1954

FOREIGN PATENTS

498,078	Great Britain	Jan. 3, 1939
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