

Aug. 3, 1965

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3,198,123

PUMP AND VALVE ASSEMBLY

Original Filed July 16, 1963

4 Sheets-Sheet 1

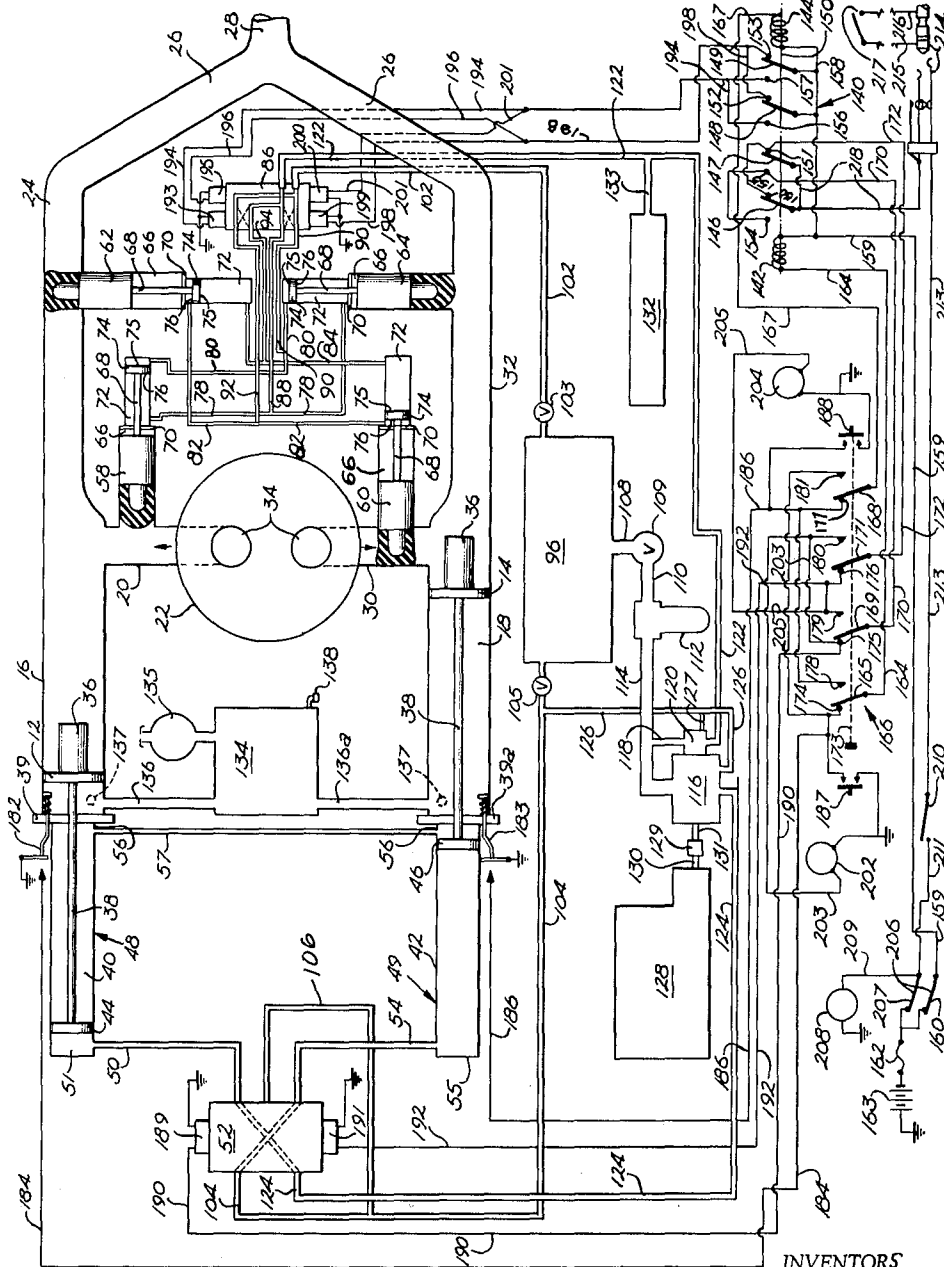


FIG. 1



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4 Sheets-Sheet 2

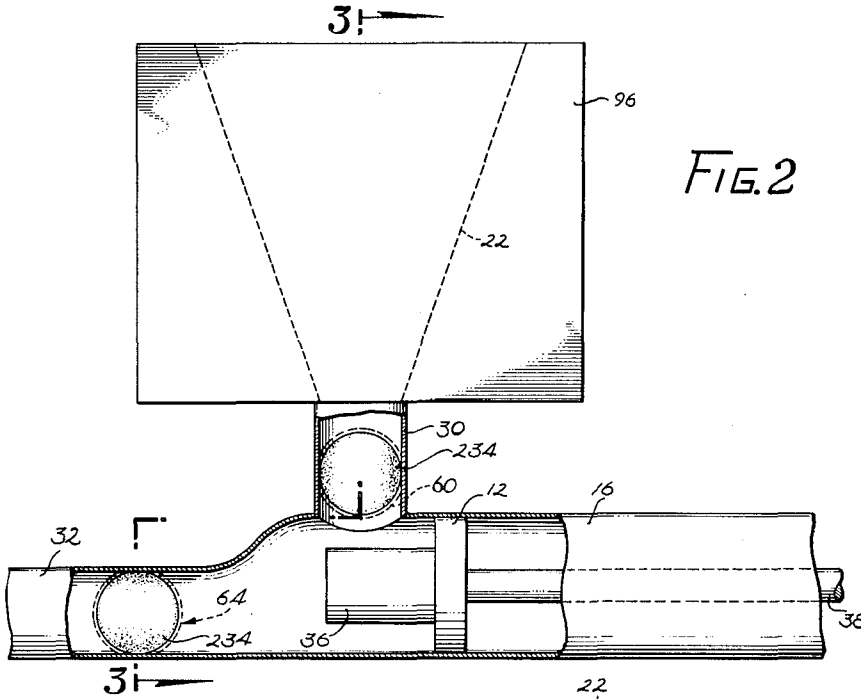


FIG. 2

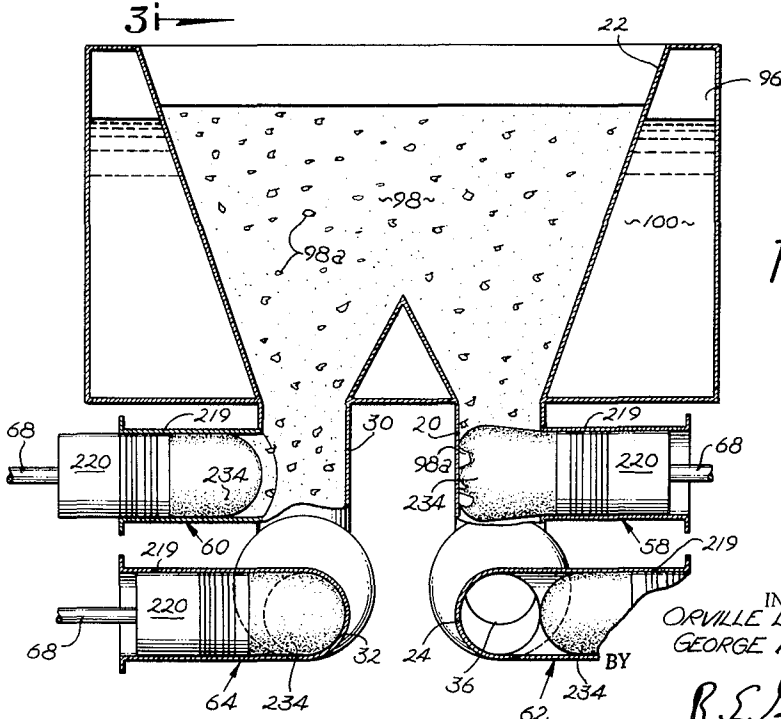


FIG. 3

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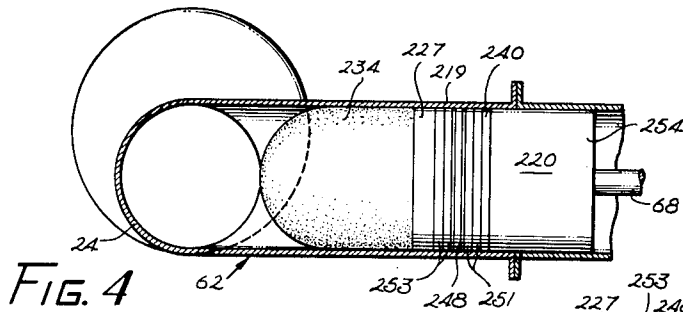


FIG. 4

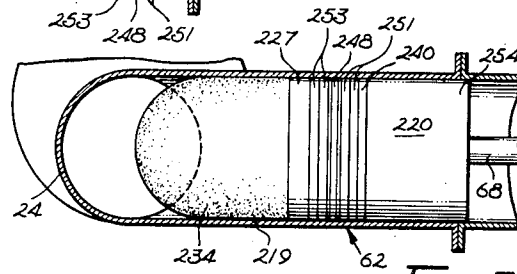


FIG. 5

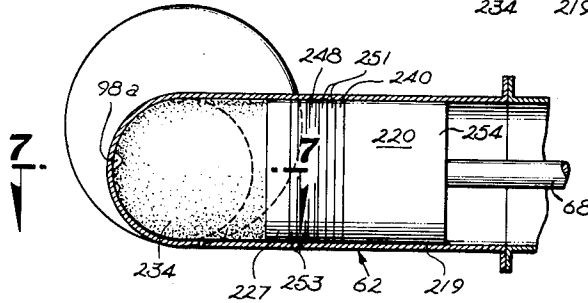


FIG. 6

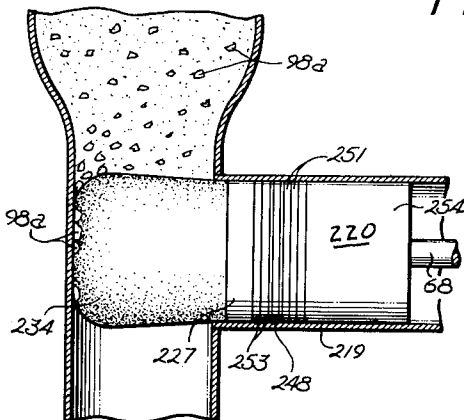


FIG. 7

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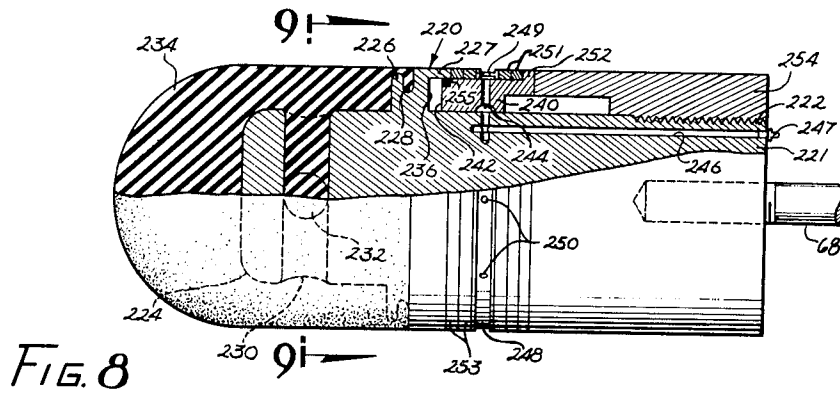
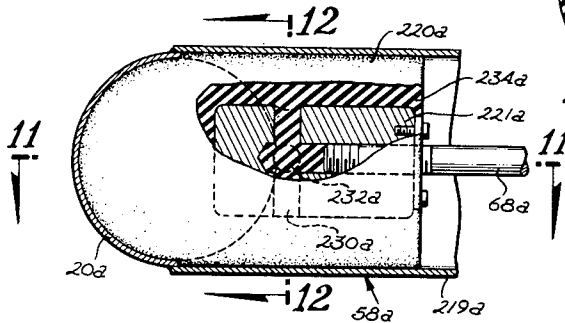


FIG. 8

FIG. 10



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FIG. 11

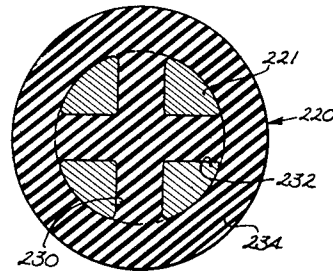


FIG. 9

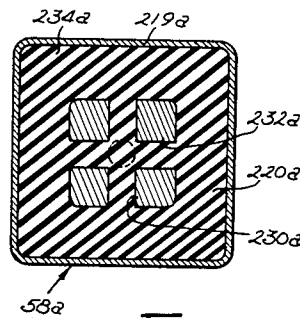
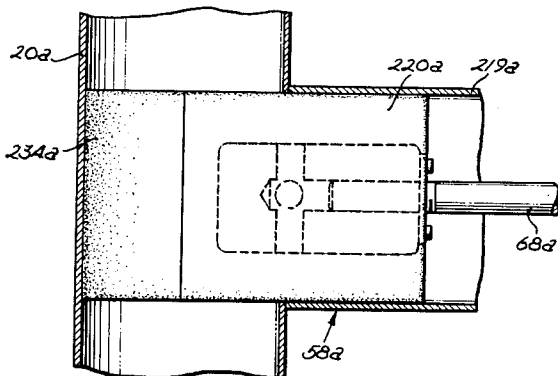


FIG. 12



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3,198,123

**PUMP AND VALVE ASSEMBLY**

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Original application July 16, 1963, Ser. No. 295,334. Divided and this application Nov. 13, 1964, Ser. No. 412,042

5 Claims. (Cl. 103-49)

This application is a division of application Serial No. 295,334, filed July 16, 1963, by Orville L. Wilkinson et al. and entitled Pump and Valve Assembly.

This invention relates to a pump and valve assembly and more particularly to a new and useful concrete pump employing a new and useful valve for controlling the flow of concrete and the like having large aggregate composition.

Prior art concrete pumps are available wherein concrete is pumped by pistons reciprocating within large cylinders in such a manner that, as one piston discharges its contents, the other piston draws material from a hopper to be pumped during the next half cycle. Valving is provided between each cylinder, its material supply source and its discharge line to control flow. While generally satisfactory, such concrete pumps do have certain disadvantages.

One disadvantage resides in the fact that the valves employed can only seat by crushing any aggregate which may be in the path of the valve gate as it closes on its seat. This prevents satisfactory sealing and permits separation of concrete "fines" and liquid from the aggregate. Separation of the fines and liquid from the aggregate leaves the aggregate in a mass to block the machine and interrupt the pumping cycle.

Another disadvantage resides in the fact that air sometimes leaks past the delivery piston on the suction stroke causing some separation of fines and liquid from the aggregate.

Yet another disadvantage resides in the fact that prior art portable concrete pumps cannot handle a satisfactory quantity of inch minus rock which necessitates using a lower strength, higher cost mix.

In view of the foregoing factors and conditions characteristic of pumps employed for pumping concrete, it is a primary object of the present invention to provide a new and useful concrete pump not subject to the disadvantages enumerated above and having a unique valving arrangement which satisfactorily seals aggregate-containing concrete efficiently, safely and expeditiously.

Another object of the present invention is to provide a pump for pumping concrete which incorporates a unique valving arrangement to control the flow of concrete from a hopper to a pair of discharge lines discharging into a common manifold.

Still another object of the present invention is to provide an improved valve for controlling the flow of concrete in a conduit.

A further object of the present invention is to provide a portable concrete pump which can pump concrete mixes having larger aggregate, less sand, less water and less cement than can be pumped with prior art portable devices.

A still further object of the present invention is to provide a valve for controlling the flow of concrete in a conduit wherein the valve includes a resilient nose portion which is adapted to close upon and encompass aggregate

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or other material upon which it seats without damaging the valve or the material while effecting a satisfactory seal.

According to the present invention, a portable concrete pump employs a pair of pistons which reciprocate in large cylinders. As one cylinder is discharging its contents, the other cylinder is being loaded with material to be pumped during the next half cycle. Appropriate valving is provided so that the outflow of material into a common manifold from each delivery cylinder is essentially continuous. Actuation of the pistons within the cylinders is accomplished by hydraulic rams. A common hopper is employed to supply the material to the cylinders through a unique valving arrangement of the present invention. When one cylinder is being loaded with material from the hopper, its discharge line to the manifold is closed and its line to the hopper is open. While the other cylinder is discharging, its line to the hopper is closed and its line to the manifold is open.

The hydraulic rams which actuate the pistons in the delivery cylinders are interconnected in such a manner that one ram extends as the other retracts and vice versa. Travel limit switches are employed to achieve cycling of the delivery pistons by having each piston actuate a switch when it reaches the end of its cylinder-filling or loading stroke. The travel limit switch completes an electrical circuit to one solenoid of a solenoid-actuated four-way hydraulic valve which responds to pressurize the hydraulic ram of a corresponding delivery piston and connect the opposite hydraulic ram to a hydraulic reservoir. When the opposite delivery piston reaches the end of its travel, it actuates its travel limit switch which, in turn, operates the other solenoid of the four-way hydraulic valve. The valve then responds to pressurize the hydraulic ram of the corresponding delivery piston and to connect the other ram to the hydraulic reservoir. Actuation of the travel limit switches also simultaneously operates the material loading and discharge control valves in the appropriate configuration to permit pumping into the common manifold as described above.

The material flow control valves are actuated by hydraulic, double-acting cylinders. A dual-stack, solenoid-actuated four-way hydraulic control valve is employed to actuate the four, double-acting hydraulic cylinders.

The valves which control flow from the material supply hopper to the common manifold each includes a rubber nose portion which envelopes large aggregate when the valve is seated thereby effectively sealing the flow conduits to provide a positive shut off.

A rinse tank is mounted between the pumping cylinders and is connected to the non-delivery or back side of the delivery cylinders to supply fluid, such as water or mineral oil, to the back side of the delivery cylinders to prevent air from leaking past the cylinders, to dilute any material passing behind the delivery pistons, to lubricate the seals on the delivery piston and to generally assist the seals on the back side of the delivery piston in their physical sealing during the fill stroke.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a diagrammatic view of a concrete pump of the present invention;

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FIGURE 2 is a partial elevational view of an enlarged scale, with parts shown in cross-section, of a portion of the device of FIGURE 1;

FIGURE 3 is a vertical cross-sectional view taken along line 3—3 of FIGURE 2;

FIGURE 4 is a transverse cross-sectional view, on an enlarged scale, of one of the valves of FIGURE 1 shown in a first operating position;

FIGURE 5 is a transverse cross-sectional view similar to FIGURE 4 showing the valve in transit to its seating position;

FIGURE 6 is a transverse cross-sectional view similar to FIGURE 4 showing the valve in a seated position;

FIGURE 7 is a transverse cross-sectional view taken along line 7—7 of FIGURE 6;

FIGURE 8 is an elevational view, with parts shown in cross-section, of the gate or plug portion of the valve of the present invention;

FIGURE 9 is a transverse cross-sectional view taken along line 9—9 of FIGURE 8;

FIGURE 10 is a transverse cross-sectional view of a modified valve of the present invention;

FIGURE 11 is a cross-sectional view, with parts shown in elevation, as taken along line 11—11 of FIGURE 10; and

FIGURE 12 is a transverse cross-sectional view taken along line 12—12 of FIGURE 10.

Referring again to the drawings, and more particularly to FIGURE 1, the pump and valve assembly constituting the present invention, generally designated 10, includes a pair of delivery pistons 12 and 14 which are reciprocally mounted in delivery cylinders 16 and 18, respectively. A first conduit 20 places the cylinder 16 in communication with a material supply hopper 22 and a second conduit 24 places the cylinder 16 in communication with a Y-connection 26 having a discharge manifold 28. A third conduit 30 places the cylinder 18 in communication with the hopper 22 and a fourth conduit 32 connects the cylinder 18 to the Y-connection 26. Thus, the pistons 12 and 14 both discharge material which is drawn from the hopper 22, in a manner to be hereinafter described, into the common manifold 28. A supply line, not shown, may be connected to the manifold 28 so that the material, such as concrete or the like, pumped from the hopper 22 may be discharged at a remote location. The pistons 12 and 14 are reciprocated within the cylinders 16 and 18, respectively, through means to be hereinafter described, in such a manner that, as one piston moves to the right, the other piston moves to the left, as viewed in FIGURE 1. As a piston moves to the left, it draws concrete or other material from the hopper 22 through a respective discharge port 34 into a respective cylinder. As a piston moves to the right, it discharges the material drawn from the hopper on a previous back stroke out of the Y-connection 26 and manifold 28. A scavenging horn 36 is connected to the front face of each piston to clear material from the junction of the lines from the hopper 22 and the discharge lines. A tail rod 38 is connected to the rear face of each piston. The tail rod 38 for the piston 12 extends through a partition 39 into a first cylinder 40 and the tail rod 38 for the piston 14 extends through a partition 39a into a second cylinder 42. The tail rods 38 are connected to pistons 44 and 46, respectively. The pistons 44 and 46 and the cylinders 40 and 42 comprise hydraulic rams 48 and 49, respectively. A first hydraulic supply line 50 connects the upstream end 51 of ram 48 to a solenoid-controlled four-way valve 52 and a second hydraulic supply line 54 connects the upstream end 55 of the ram 49 to the valve 52. The downstream ends 56 of the rams 48 and 49 are interconnected with a common hydraulic supply line 57.

A pair of inlet valves 58 and 60 control the flow of material from the hopper 22 to the pistons 12 and 14, respectively, and a pair of discharge valves 62 and 64

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control the flow of material through the discharge lines 24 and 32, respectively. The valves 58, 60, 62 and 64 each includes a tail-rod 68 which extends through an end cap 70 into a hydraulic cylinder 72. Each tail-rod 68 is connected to a piston 74 which is reciprocally mounted in its respective cylinder 72. Each piston 74 includes an upstream face 75 and downstream face 76. When the upstream faces 75 are pressurized with hydraulic fluid, their associated valves will seat in their respective conduits to interrupt the flow of material there-through. When a downstream face 76 is pressurized, its associated valve is opened. When piston 12 is moving to the left, as viewed in FIGURE 1, on its suction or fill stroke, valve 58, will be opened to permit flow of material from hopper 22 through a respective outlet 34 into the cylinder 16 and valve 62 will be closed in conduit 24. Simultaneously, piston 14 will be moving to the right, as viewed in FIGURE 1, on its discharge stroke and valve 60 will be seated in conduit 30 to prevent flow of material from cylinder 18 into the hopper 22 and valve 64 will be opened to permit material from cylinder 18 to discharge through the discharge conduit 32 into the manifold 28. Thus, valves 58 and 64 may be open at the same time and valves 60 and 62 may be seated at the same time and vice versa. This is accomplished by connecting the downstream faces 76 and upstream faces 75 of the valves 58 and 64 together with common hydraulic supply lines 78 and 80, respectively and by connecting the downstream faces 76 and the upstream faces 75 of valves 60 and 62 together with hydraulic supply lines 82 and 84, respectively. Flow of hydraulic fluid to the valves 58, 60, 62, and 64 is controlled with a solenoid-controlled, dual-stack, four-way valve 86. Hydraulic-fluid conducting lines 88, 90, 92 and 94 connect the common lines 78, 80, 82 and 84, respectively, to the valve 86.

A hydraulic reservoir 96 is provided to store the hydraulic fluid employed to actuate the pistons 12 and 14 and the valves 58, 60, 62 and 64. While the reservoir 96 is shown schematically in FIGURE 1 as being separated from the hopper 22, the reservoir 96 actually encompasses hopper 22, as shown in FIGURES 2 and 3, to conserve space and add rigidity to the hopper so that the concrete or other material 98 in the hopper 22 will cool the hydraulic fluid 100 in the reservoir 96. A first hydraulic-fluid return line 102 connects the valve 86 to the reservoir 96 through a control valve 103 and a second hydraulic-fluid return line 104 connects the valve 52 to the reservoir 96 through a control valve 105. A line 106 connects the control valve 52 to the return line 102 so that any internal leakage within the valve 52 will return to the reservoir 96. Hydraulic fluid is drawn from the reservoir 96 through a first conduit 108, a control valve 109, a second conduit 110, a filter 112, and a third conduit 114. The third conduit 114 discharges directly into the intake side of a hydraulic-fluid delivery pump 116 and a branch line 118 connects the third conduit 114 to the intake side of a control, hydraulic-fluid pump 120. A first hydraulic-fluid supply line 122 connects the discharge side of the control pump 120 to the valve 86 and a second hydraulic fluid supply line 124 connects the discharge side of the delivery pump 116 to the valve 52. A pump-case drain 126 connects the delivery pump 116 to the return line 104 and a branch pump-case drain 127 connects the control pump 120 to the pump-case drain 126.

A prime mover 128 supplies power to the pumps 116 and 120 through a flexible coupling 129 and shafts 130 and 131. A hydraulic accumulator 132 is connected in parallel with the control pump 120 through a line 133 and serves to supply hydraulic power to valve 86 at very high flow rates for short periods.

A rinse tank 134 is mounted between the delivery cylinders 16 and 18 and includes a surge chamber 135 which is vented to atmosphere. A pair of lines 136 and 136a place the tank 134 in fluid communication with the cylin-

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ders 16 and 18, respectively, so that the portion of the cylinders 16 and 18 between the rear faces of pistons 12 and 14 and the partitions 39 and 39a may be filled with liquid from the rinse tank 134. As the pistons reciprocate, the liquid will, of course, move back and forth between the tank 134 and the cylinders 16 and 18. A drain 137 is provided in the bottom of each cylinder adjacent the partitions 39 and 39a and a drain 138 is provided in the tank 134 so that the rinse liquid may be drained to waste when desired. The rinse liquid prevents air from leaking past the delivery pistons on their suction strokes and dilutes any material leaking past the delivery pistons. The fluid also lubricates the seals on the delivery pistons which is especially desirable during the filling or loading portion of the pumping cycle. The fluid used may be plain water or water having soluble oil added thereto. A mineral oil and like liquids may also be used. When operation of the pump 10 is terminated for any extended length of time, such as the end of a working day, the drains 137, 137a and 138 are preferably opened so that the fluid may flow out, thus removing any diluted materials which may have leaked past the delivery pistons 12 and 14.

The solenoids, to be hereinafter described, of valves 52 and 86 are controlled through an electrical switching system including a latching relay 140 having a pair of coils 142 and 144 and four, single-pole, double-throw switch blades 146, 147, 148 and 149. A soft iron rod or core 150 is connected to the blades 146-149 and extends into the coils 142 and 144. When the coil 144 is energized, the rod 150 will move to the right, as viewed in FIGURE 1, so that the blades will be closed on contacts 150, 151, 152 and 153, respectively, as shown in FIGURE 1. When the coil 142 is energized, the rod 150 is drawn to the left, as viewed in FIGURE 1, swinging the blades 146-149 into engagement with the contacts 154, 155, 146 and 157, respectively. A lead 158 connects the coil 144 to a lead 159 which, in turn, connects the coil 142 through a switch blade 160 and a fuse 162 to a source of power comprising a storage battery 163. A lead 164 connects coil 142 to a blade 165 of a reversing switch 166 and a lead 167 connects the coil 144 to a blade 168 of the reversing switch 166. A third blade 169 of reversing switch 166 is connected by a lead 170 to the contacts 154 and 155 in the latching relay 140. A fourth blade 171 of the reversing switch 166 is connected by a lead 172 to the contacts 150 and 151 of the latching relay 140. The blades 165, 169, 171 and 168 are connected to a rod 173 which may be positioned as shown in FIGURE 1 to close blades on contacts 174, 175, 176 and 177, respectively. The rod 173 may be moved to the right as viewed in FIGURE 1, to bring the blades 165, 169, 171 and 168 into engagement with contacts 178, 179, 180 and 181, respectively.

The latching relay 140 is controlled by a pair of delivery piston, travel limit switches 182 and 183 which are closed by the pistons 12 and 14, respectively, when they reach the end of their travel to the left, as viewed in FIGURE 1. A lead 184 connects the switch 182 to the contact 174 and a lead 186 connects the switch 183 to the contact 177.

A manually-operated push-button switch 187 is connected in the circuit with the switch 182 so that the switch 182 may be overridden manually when desired. A similar push-button switch 188 is connected in the circuit with the switch 183 for overriding it.

The latching relay 140 controls the operation of the valves 52 and 86 by actuating their respective solenoids through a number of different circuits which will now be described. A first solenoid 189 of valve 52 is connected by a lead 190 to the contact 175 in reversing switch 166 and a second solenoid 191 in switch 52 is connected by a lead 192 to the contacts 176 and 179. A first solenoid 193 in the switch 86 is connected by a lead 194 to the contacts 156 and 157 in the latching relay 140. A second solenoid 195 in switch 86 is connected by a lead 196 to a

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lead 198 which, in turn, connects a third solenoid 199 to the terminals 152 and 153 in the latching relay 140. A fourth solenoid 200 in the valve 86 is connected by a lead 201 to the lead 194.

A first indicating lamp 202 is connected by a lead 203 to the contacts 175 and 180 and a second indicating lamp 204 is connected by a lead 205 to the contacts 179 and 176. The indicating lamps 202 and 204, when energized, indicate which discharge line is supplying material to the manifold 28.

A master control switch 206 includes the blade 160 previously mentioned and a second blade 207. A third indicating lamp 208 is connected by a lead 209 to the switch 206 and indicates when the master switch is closed so that the system may be energized. A first "start-stop" switch 210 is connected by a lead 211 to the switch 206 and by a lead 213 to a jack 214 which, in turn, is connected by cables 215 and 216 to a second "start-stop" switch 217. The cables 215 and 216 may be of any desired length so that the switch 217 may be located at the discharge end of a line, not shown, discharging concrete from the manifold 28 to a point of application. Thus, the operator handling the discharge line can control the outflow of the material from the remote point of application. A circuit is completed through the jack 214 and the start-stop switch 210 by a lead 218 which connects the jack 214 to the blades 146 and 147 of the latching relay 140.

The control valves 58, 60, 62 and 64 are important features of the invention because they permit controlling the flow of a material, such as concrete, containing large particles, such as aggregate 98a (FIGURE 3), by forming an effective seal in a conduit without crushing the aggregate 98a or damaging the valve member. Referring now to FIGURES 2-9, these valves may be of identical construction and each includes a valve body 219 in which a plug or gate 220 is slidably mounted. Each plug or gate 220 includes a core 221 (FIGURES 8 and 9) having external threads 222 at one end, a rubber-gripping nose portion 224 at its other end and an annular dam 226 intermediate its ends. An annular skirt 227 is formed on core 221 adjacent the dam 226 and an annular groove 228 encompasses the core 221 intermediate the dam 226 and the skirt 227. The dam 226 prevents the nose plug 234 from becoming unseated from the groove 228 when the nose plug 234 is compressed by the seating of gate 220.

The nose portion 224 includes transverse bores 230 and 232 which lie at right angles to each other. A resilient nose plug 234, which may be made of gummed rubber or a suitable synthetic material such as polybutadiene, is molded to the core 221 in such a manner that the nose plug 234 firmly grips the annular groove 228 and the transverse bores 230 and 232. The skirt 227 forms a recess 236 with the core 221 to accommodate a pressure ring 240 which encompasses the core 221 with an end 242 slidably mounted in the recess 236. The pressure ring 240 includes a grease passageway 244 which communicates with a similar passageway 246 mounted in core 221. A grease fitting 247 is connected to the passageway 246 so that a suitable lubricant, such as water pump grease, may be supplied to the periphery of the gate 220. The grease is distributed about the periphery of plug or gate 220 by a lantern ring 248 which encompasses pressure ring 240 and has an annular channel 249 communicating with passageway 244. A plurality of apertures 250 are spaced about the periphery of ring 248 to admit the grease from channel 249 to the periphery of gate 220.

A first set of packing rings 251 encompasses the pressure ring 240 between the lantern ring 248 and an annular land 252 formed on the ring 240 and a second set of packing rings 253 encompasses the pressure ring 240 between the lantern ring 248 and the skirt 227. A nut 254 threadedly engages the threads 222 and bears against the pressure ring 240. The packing rings 251 and 253 prevent material, whose flow is to be controlled by the plug

220, from flowing past the plug 220, and are compressed between the skirt 227 and the land 252 by tightening the nut 254 against the pressure ring 240 causing it to slide further into the recesses 236. The material whose flow is being controlled and the lubricant are prevented from flowing into the recess 236 by an O-ring 255 which encompasses the end 242 and bears against the inner wall of the skirt 277. The nut 254 may be tightened to compensate for wear on the packing rings 251 and 253.

A modified valve 58a is shown in FIGURES 10-12 as controlling the flow of material through a conduit 20a and is substantially similar to the valve 58 previously described except that it is of a square configuration. The valve 58a includes a square body portion 219a in which a gate 220a is slidably mounted. The gate 220a includes a core 221a having transverse bores 230a and 232a. A tail rod 58a threadedly engages the core 221a. A resilient nose portion 234a is molded to the core 221a and is of sufficiently resiliency that it will seat against the conduit 20a and envelop any aggregate which may be trapped between the plug or gate 220a and the conduit 20a.

Operation of the device will be described in connection with FIGURE 1. Assuming that the hopper 22 is filled with a material, such as concrete, to be pumped by the pump 10 and that the prime mover 128 is energized to pressurize the hydraulic system, then switches 206 and 210 may be closed to energize the solenoids of valves 52 and 86. Assuming further that, when the electrical system is energized, the reversing switch 166 and the latching relay 140 are in the positions shown in FIGURE 1. When the electrical system is energized, current will flow from the battery 163 to the solenoid 191 through the fuse 162, the blade 207 of switch 206, lead 211, switch 210, lead 213, jack 214, lead 218, blades 146 and 147 of latching relay 140, lead 172, blade 171, contact 176 and lead 192. Current also flows from battery 163 to the solenoids 195 and 199 in valve 86 through fuse 162, blade 160, lead 159, lead 158, blades 148 and 149 and leads 198 and 196.

Energization of solenoid 191 positions valve 52 in such a manner that fluid under pressure from pump 116 flows from line 124 through valve 52, and line 54 into ram 49 pressurizing cylinder 42 causing piston 46 to move to the right, as viewed in FIGURE 1. Piston 46 forces hydraulic fluid out end 56 of cylinder 42, through line 57 and into the end 56 of cylinder 40. This pressurizes ram 48 causing piston 44 to move to the left, as viewed in FIGURE 1, exhausting hydraulic fluid out end 51 of cylinder 40 through line 50, valve 52, return line 104 and valve 105 into reservoir 96.

Energization of solenoids 195 and 199 positions valve 86 in such a manner that hydraulic fluid under pressure from line 122 flows through valve 86, line 94 and line 84 to pressurize faces 75 of valves 60 and 62 forcing the valves to seat in conduits 30 and 24, respectively. Fluid under pressure from line 122 also flows through valve 86, lines 88 and 78 into valves 58 and 64 pressurizing faces 76 of the respective pistons thereby opening the valves 58 and 64. The valve 86 is also positioned in such a manner that return fluid will flow from the faces 75 of pistons 74 in valves 58 and 64 through lines 80 and 90, valve 86, return line 102 and valve 103 into the reservoir 96. With the valves thus positioned, the movement of piston 12 to the left, as viewed in FIGURE 1, by ram 48 draws material from hopper 22 through outlet 34, conduit 20, and into cylinder 16 filling it. As piston 14 simultaneously moves to the right, as viewed in FIGURE 1, due to the force exerted by ram 49, material in cylinder 18 is forced through conduit 32 and Y-connection 26 into manifold 28. The scavenger horn 36 on piston 14 clears the material from the juncture of conduits 30 and 32. As delivery piston 12 moves to the left, it will also force rinse liquid from cylinder 16 through line 136, tank 134, line 136a and into cylinder 18 behind the piston 14 to prevent air from leaking past

pistons 12 and 14 and to dilute any material that might have leaked past the cylinder 14.

When piston 12 reaches the end of its travel to the left, it closes travel limit switch 182 completing a circuit through lead 184, contact 174, blade 165, lead 164, coil 142, lead 159, blade 160, fuse 162 and battery 163. This energizes coil 142 drawing the soft iron core 150 to the left, as viewed in FIGURE 1, to bring the blades 146, 147, 148 and 149 into engagement with the contacts 154, 155 and 156, and 157, respectively. This energizes solenoids 189 in valve 52 and solenoids 193 and 200 in valve 86 by placing the leads 190, 194, and 201 in a circuit with battery 163 through the latching relay 140.

Energization of solenoid 189 positions valve 52 in such a manner that fluid under pressure from line 124 will be directed through the valve 52 and line 50 into the end 51 of ram 48 pressurizing the piston 44 in such a manner that the ram 48 will cause delivery piston 12 to move to the right as viewed in FIGURE 1. The solenoid 189 will also position the valve 52 in such a manner that return fluid flowing from the ram 48 through line 57 pressurizes piston 46 causing it to move to the left, as viewed in FIGURE 1, exhausting the fluid from cylinder 42 through line 54, valve 52, line 104, and valve 105 into reservoir 96.

Energization of solenoid 193 will cause valve 85 to be positioned in such a manner that fluid under pressure in line 122 flows through valve 86, lines 92 and 82 pressurizing valves 60 and 62 on the faces 76 of their respective pistons to unseat the valves. The valve 86 is also positioned in said a manner that return fluid from the valves 60 and 62 flows through lines 84 and 94, valve 86, line 102, and valve 103 into the reservoir 96. Energization of the solenoid 200 positions valve 86 in such a manner that fluid under pressure in line 122 also flows through valve 86, lines 90 and 80, into cylinders 72 to pressurize faces 75 of valves 58 and 64 causing them to seat in their respective conduits and through valve 86, lines 92 and 82 into cylinders 72 to pressurize the faces 76 of valves 60 and 62 causing them to open. Thus, the valves 60 and 62 will open and valves 58 and 64 will be closed so that movement of the piston 12 to the right, as viewed in FIGURE 1, will force material previously drawn into the cylinder 16 out the cylinder 16 into conduit 24, Y-connection 26 and out manifold 28. Simultaneously, piston 14 moves to the left, as viewed in FIGURE 1, drawing material from hopper 22, through opening 34 and line 30 into the cylinder 18 filling it with material to be delivered on the next stroke. Movement of piston 14 to the left forces the rinse liquid behind the piston in cylinder 18 out cylinder 18 through line 136a, rinse tank 134, and line 136 into the cylinder 16 behind its piston keeping the area behind piston 12 in cylinder 16 filled with rinse liquid as the piston 12 moves to the right. When the piston 14 reaches the end of its travel to the left, as viewed in FIGURE 1, it closes its travel limit switch 183 completing a circuit through lead 186, contact 177, blade 168, lead 167, coil 144, lead 158, lead 159, blade 160, and fuse 162 to battery 163. This energizes coil 144 drawing soft iron core 150 to the right, as viewed in FIGURE 1, swinging blades 146, 147, 148 and 149 into engagement with the contacts 150, 151, 152 and 153 to again energize the solenoids 191, 195 and 199 preparing the pump 10 for its next one-half cycle of operation.

Should it be desired to reverse the above sequence of operation, the reversing switch 166 may be adjusted for such operation by sliding the rod 173 to the right, as viewed in FIGURE 1, to bring the blades 165, 169, 171, and 168 into engagement with the contacts 178, 179, 180 and 181, respectively. This reverses the circuits through the latching relay 140. The travel limit switch 182 may be manually overridden by depressing button 187 to bypass the circuit to coil 142. Similarly, the limit travel switch 183 may be manually overridden by depressing



the button 188 to by-pass the coil 144 in latching relay 140.

The accumulator 132 insures immediate hydraulic response through the valve 86 by making a high flow of fluid available at all times so that fluid will flow through the valve 86 the instant the solenoids therein are energized.

The above described cycle of operation will repeat itself continuously as long as the electrical circuit is energized. The circuit may be de-energized to interrupt the flow of material from hopper 22 from a remote location by assembling jack 214 and then opening switch 217 to interrupt the circuit from the battery 163.

While the particular concrete pump and valves herein shown and described in detail are fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that they are merely illustrative of the presently preferred embodiments of the invention and that no limitations are intended to the details of construction or design herein shown other than as defined in the appended claims.

What is claimed is:

1. A pump for pumping aggregate-containing concrete comprising:

- a first delivery piston reciprocally mounted in a first cylinder, said first delivery piston having an upstream face and a downstream face;
- a second delivery piston reciprocally mounted in a second cylinder, said second delivery piston having an upstream face and a downstream face;
- a concrete-supply hopper in fluid communication with each of said cylinders;
- a first concrete-delivery line having an upstream end in fluid communication with said first cylinder and a downstream end;
- a second concrete-delivery line having an upstream end in fluid communication with said second cylinder and a downstream end;
- a common concrete-delivery manifold in fluid communication with said downstream ends of said first and second delivery lines;
- a first valve controlling flow of materials from said hopper to said first cylinder;
- a second valve controlling flow of material from said hopper to said second cylinder;
- a third valve controlling flow of material through said first delivery line;
- a fourth valve controlling flow of material through said second delivery line;
- a valve-actuating piston connected to each of said valves for controlling the operation thereof, each of said valve-actuating pistons having an upstream face and a downstream face;
- a first transfer valve means for selectively placing said upstream faces of said valve-actuating pistons in fluid communication with a source of hydraulic fluid under pressure and with a reservoir, and for placing said downstream faces of said valve-actuating pistons in fluid communication with said source of hydraulic fluid under pressure and with said reservoir;
- a first hydraulic line placing the downstream faces of said second and third valves in fluid communication with said transfer valve;
- a second hydraulic line placing the downstream faces of said first and fourth valves in hydraulic communication with said transfer valve;
- a third hydraulic line placing the upstream faces of said first and fourth valves in fluid communication with said transfer valve;
- a fourth hydraulic line placing the upstream faces of said second and third valves in fluid communication with said transfer valve;
- a first solenoid connected to said transfer valve, actuation of said first solenoid placing said first and third hydraulic lines in communication with said reservoir;

- a second solenoid connected to said transfer valve, actuation of said second solenoid placing said first and third hydraulic lines in fluid communication with said source of hydraulic fluid under pressure;
- a third solenoid connected to said transfer valve, actuation of said third solenoid placing said second and fourth hydraulic lines in fluid communication with said source of hydraulic fluid under pressure;
- a fourth solenoid connected to said transfer valve, actuation of said fourth solenoid placing said second and fourth hydraulic lines in fluid communication with said reservoir;
- a latching relay connected to said solenoids, said latching relay having a first position completing an electrical circuit to said first and third solenoids and a second position completing a circuit to said second and fourth solenoids;
- said latching relay being moved to said first position by energization of a first coil and to said second position by energization of a second coil;
- a first limit switch connecting said first coil to said first cylinder for actuating by said first delivery piston to energize said first coil;
- a second limit switch connecting said second coil to said second cylinder for actuation by said second delivery piston to actuate said second coil; and
- means for reciprocating said delivery pistons in opposition to each other.

2. The pump of claim 1 including a liquid containing tank in fluid communication with the upstream faces of said delivery pistons for supplying a diluent to said upstream faces to dilute any concrete passing said delivery pistons.

3. The pump of claim 1 including a scavenger horn connected to the downstream face of each delivery piston.

4. The pump of claim 1 wherein said means for reciprocating said delivery pistons comprises:

- a hydraulic ram connected to each delivery piston, each hydraulic ram having an upstream face and a downstream face;
- a conduit interconnecting the downstream faces of said rams;
- a transfer valve connecting the upstream faces of said rams to a source of hydraulic fluid under pressure and to a reservoir, respectively;
- a fifth hydraulic line connecting the upstream face of said first ram with said second transfer valve;
- a sixth hydraulic line connecting the upstream faces of said second ram with said second transfer valve;
- a fifth solenoid connected to said second transfer valve, actuation of said fifth solenoid placing said sixth hydraulic line in communication with said reservoir; and
- a seventh solenoid connected to said second transfer valve, actuation of said seventh solenoid connecting said fifth hydraulic line to said source of hydraulic fluid under pressure, said second transfer valve normally connecting said fifth line to said reservoir and said sixth line to said source of hydraulic fluid under pressure.

5. A pump for pumping aggregate-containing concrete, comprising:

- a pair of delivery pistons each reciprocally mounted in a cylinder, each of said delivery pistons having an upstream face and a downstream face;
- a concrete supply line and a concrete delivery line in fluid communication with each cylinder;
- a common concrete delivery manifold connected to the discharge ends of said concrete delivery lines;
- separate inlet valves for controlling the flow of concrete from each supply line to its associated cylinder;
- separate outlet valves for controlling the flow of concrete from each cylinder to its associated delivery line;
- valve actuating means connected to each of said valves

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for simultaneously seating one inlet valve and one outlet valve and unseating another inlet valve and another outlet valve;  
 means for reciprocating said pistons in opposition to each other; and  
 a scavenger horn connected to the downstream face of each delivery piston for clearing concrete from the junction of each of said supply lines and its associated cylinder.

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## References Cited by the Examiner

## UNITED STATES PATENTS

1,991,342	2/35	Ball	-----	103—152
2,485,208	10/49	Longenecker	-----	103—204
2,998,781	9/61	Triebel	-----	103—227 X
3,068,806	12/62	Sherrod	-----	103—153

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