Aug. 16, 1966 E. SMITH 3,266,435

PUMP FOR SEMI-FLUID MATERIAL

Filed Dec. 9, 1963 3 Sheets-Sheet 1

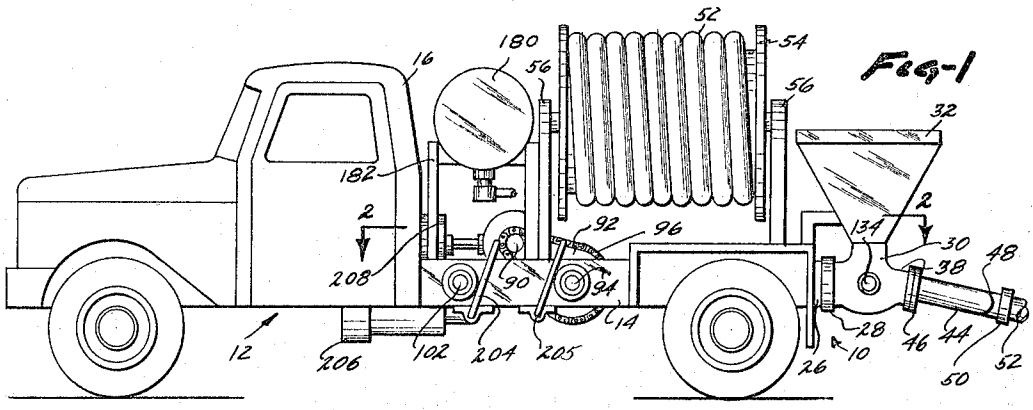


Fig-1

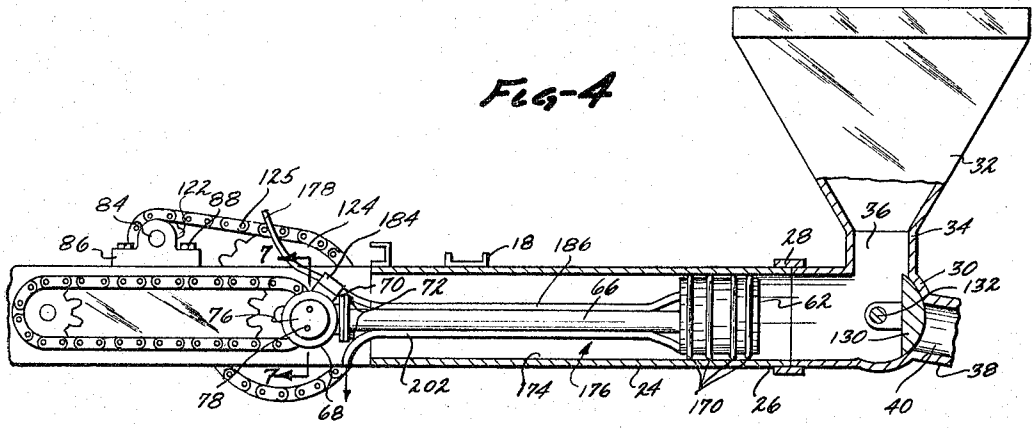


Fig-4

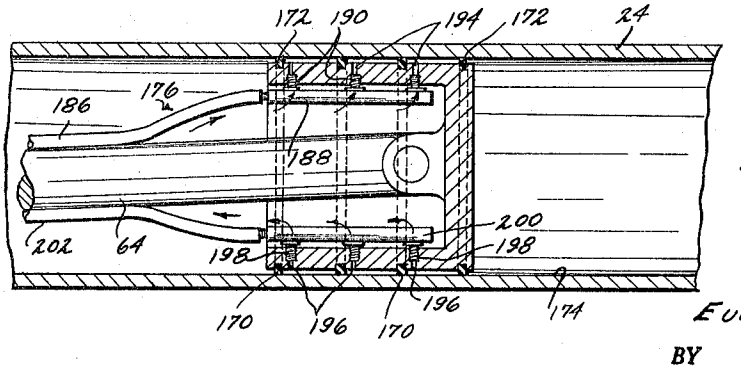


Fig-5

INVENTOR.
EUGENE SMITH

BY
Herzig + Walsh
ATTORNEYS

Aug. 16, 1966 E. SMITH 3,266,435

PUMP FOR SEMI-FLUID MATERIAL

Filed Dec. 9, 1963 3 Sheets-Sheet 2

Fig-2

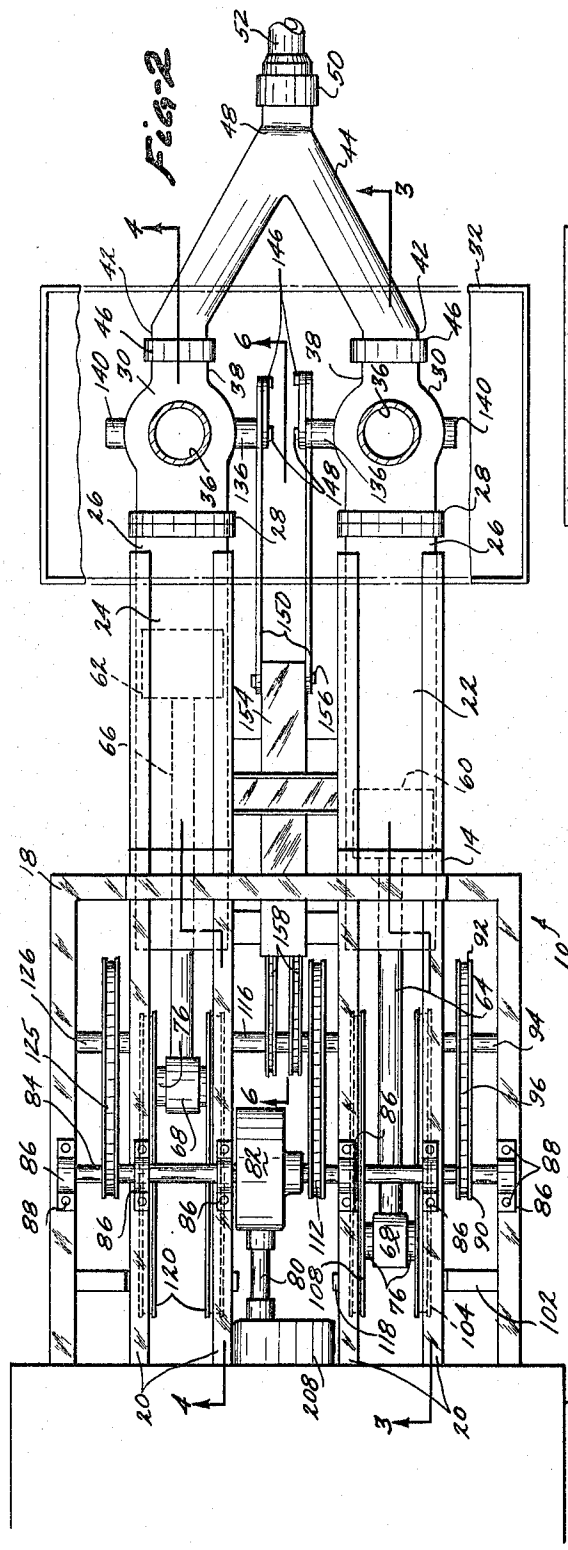
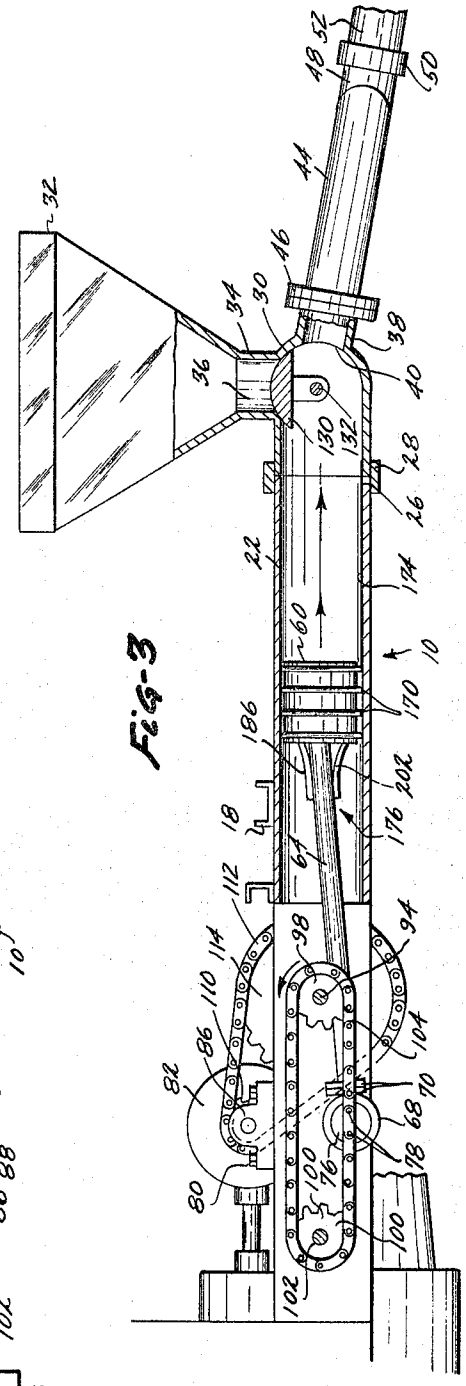


Fig-3



INVENTOR.
EUGENE SMITH
BY
Herzig & Walsh
ATTORNEYS

Aug. 16, 1966 E. SMITH 3,266,435

PUMP FOR SEMI-FLUID MATERIAL

Filed Dec. 9, 1963 3 Sheets-Sheet 3

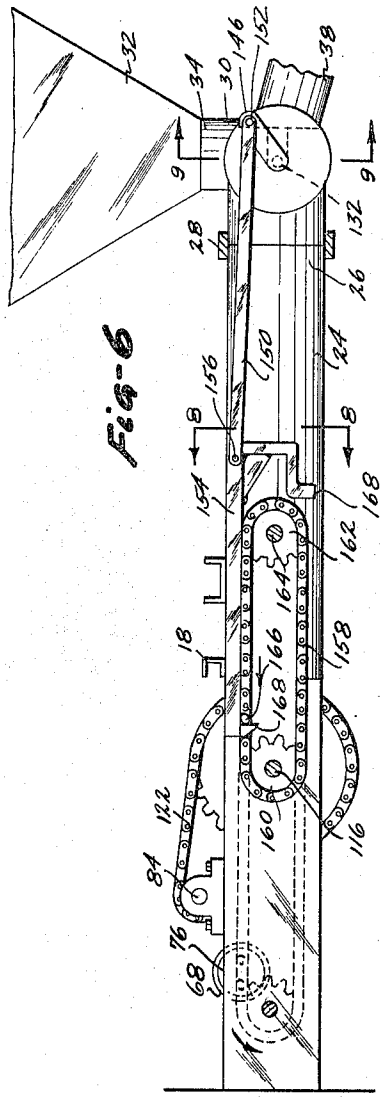


Fig-6

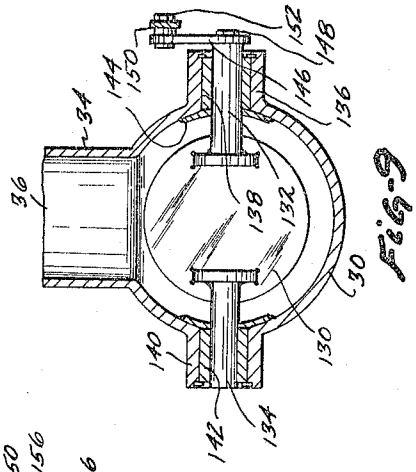


Fig-5

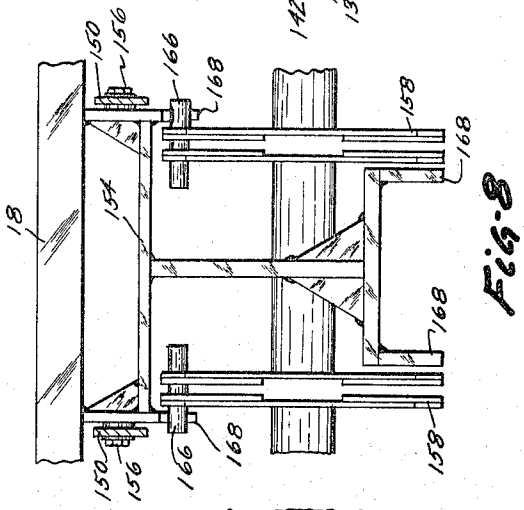


Fig-8

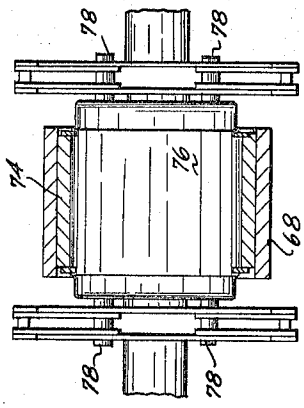


Fig-7

INVENTOR.
EUGENE SMITH

BY Herzig + Walsh
ATTORNEYS

United States Patent Office 3,266,435 Patented August 16, 1966

3,266,435

PUMP FOR SEMI-FLUID MATERIAL

Eugene Smith, 9648 Lemoran Ave., Downey, Calif.

Filed Dec. 9, 1963, Ser. No. 328,886
4 Claims. (Cl. 103—170)

This invention relates to a new and improved pump for semi-fluid material and more particularly to a concrete pump.

While a number of different types of concrete pumps are available, they do have certain disadvantages.

One disadvantages resides in the fact that the concrete pumps are usually mounted on trailers requiring one prime mover to operate the pump and another prime mover to tow the trailer.

Another disadvantage resides in the fact that prior art concrete pumps are relatively expensive and complicated to manufacture, having many parts that wear out rapidly in use.

Yet another disadvantage resides in the fact that the pistons and cylinders employed in such concrete pumps wear out rapidly due to the abrasive nature of the concrete being pumped.

A further disadvantage resides in the fact that, although the mechanisms for driving the pump pistons are complicated and expensive, they sometimes get out of adjustment causing the pistons to operate non-synchronously.

A still further disadvantage resides in the fact that the valves controlling the flow of concrete from the pump do not always effectively seal the lines being controlled.

In view of the foregoing factors and conditions characteristic of concrete pumps, it is a primary object of the present invention to provide a new and improved concrete pump not subject to the disadvantages enumerated above and having relatively simple and inexpensive component parts for pumping concrete efficiently, economically and expeditiously.

Another object of the present invention is to provide a truck-mounted concrete pump.

Yet another object of the present invention is to provide a concrete pump having parallel, reciprocating pistons which are reciprocated by a simple and inexpensive chain driven means.

Still another object of the present invention is to provide a new and improved valve for controlling the flow of concrete from a concrete pump.

A further object of the present invention is to provide means for minimizing the wear between the pistons and cylinders of a concrete pump.

A still further object of the present invention is to provide a new and useful lubricating system for the pistons of a concrete pump.

Another object of the present invention is to provide a new and improved valve actuating mechanism for the valves of a concrete pump.

According to the present invention, a concrete pump is mounted on a truck and includes a chain driven mechanism which is operated through the transmission of the truck to reciprocate in alternating fashion a pair of pistons. The drive mechanism also reciprocates a control bar which operates a pair of hemispherical valves controlling the flow of concrete from the pump. The concrete is fed from a hopper located above these two valves. On the back stroke of a piston, the associated valve is positioned so that concrete is drawn from the hopper into the cylinder in front of the piston. At the same time, the other piston is moving forward in the other cylinder and the valve associated with that other piston is in position to close the hopper and permit the concrete to be pushed forward toward a common outlet conduit.

Each piston is provided with a plurality of spaced,

resilient rings. A flexible water line feeds water to the piston between the rings. The water seeps around the piston and is discharged to waste. This provides a self-cleaning and lubricating action which minimizes wear between the piston and the cylinder and also minimizes wear on the piston rings. The water line is connected to a water tank mounted on the truck.

The chain drive mechanism includes a transverse shaft which is mounted generally above the level of the pistons and cylinders. The transverse shaft is rotated by suitable gearing and a drive shaft which is connected to the power take-off on the truck. A small gear on the transverse shaft drives a large center gear through a chain. The large center gear is fixed to a small center transverse shaft which drives, among other things, the control valve bar.

Each piston has a rod which is connected between a pair of spaced, parallel drive chains. This arrangement permits free movement of the piston rod both up and back and also up and down to some extent, as the end of the piston rod which is connected to the drive chain follows the path of the drive chain. The inwardly disposed drive chain of each pair is driven through the small center transverse shaft. The outwardly disposed chain of each pair is driven by an outer chain drive assembly which transmits rotation from the transverse shaft to the outer chain drive.

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 like reference characters refer to like elements in the several views.

In the drawings:

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

FIGURE 2 is a cross-sectional view taken along line 2—2 of FIGURE 1;

FIGURE 3 is a cross-sectional view, with parts shown in elevation, taken along line 3—3 of FIGURE 2;

FIGURE 4 is a cross-sectional view, with parts shown in elevation, taken along line 4—4 of FIGURE 2;

FIGURE 5 is an enlarged cross-sectional view showing details of a lubricating system employed in the concrete pump of the present invention;

FIGURE 6 is a cross-sectional view, with parts shown in elevation, taken along line 6—6 of FIGURE 2;

FIGURE 7 is an enlarged, cross-sectional view taken along line 7—7 of FIGURE 4;

FIGURE 8 is an enlarged, cross-sectional view taken along line 8—8 of FIGURE 6; and

FIGURE 9 is an enlarged, cross-sectional view taken along line 9—9 of FIGURE 6.

Referring again to the drawings, the concrete pump constituting the present invention, generally designated **10**, is shown in combination with a truck **12**. The truck **12** includes a chassis **14** and a cab **16**. The chassis **14** includes a box-like member **18** and a plurality of longitudinal, parallel rails **20**.

The concrete pump **10** includes a pair of pump cylinders **22**, **24** which are supported on chassis **14** by rails **20**. Each cylinder is lined with a thin, chromium plating, not shown, and includes an upstream end **26** which is connected by a flange **28** to a fitting **30** forming the lower portion of a concrete-supply hopper **32**. Each fitting **30** includes a cylindrical, upstanding neck portion **34** forming a circular outlet **36** through which concrete is free to discharge from the hopper **32** into an associated cylinder **22**, **24**. Each fitting **30** also includes an angular neck

portion 38 having a substantially circular upstream end 40 which is in fluid communication with an associated cylinder 22, 24. The upstream ends 42 of a Y-shaped discharge fitting 44 are connected to the angular neck 38 by flanges 46. The downstream end 48 of the fitting 44 is connected by a flange 50 to a flexible discharge line 52. The discharge line 52 is coiled about a powered winch 54 mounted on chassis 14 by upright members 56. The winch 54 may be powered by means, not shown, to play the discharge line 52 out to a point of application of the concrete being pumped by the pump 10.

Concrete is pumped from the hopper 32 to a point of use by a pair of pistons 60, 62 which are reciprocally mounted in cylinders 22 and 24, respectively. The pistons 60, 62 are pivotally connected to piston rods 64, 66, respectively. Each piston rod 64, 66 carries a journal 68 at its end remote from its associated piston. The journals 68 may be connected to their associated piston rods by a suitable plate and bolt arrangement, such as the plates 70 and bolts or cap screws 72 as shown in FIGURE 4. A bearing 74 is mounted in each journal 68 (FIGURE 7) and a motion transmitting device 76 is rotatably mounted in each bearing 74.

A pair of pins 78 extend from each end of the motion transmitting device 76.

Power to operate the concrete pump 10 is supplied by the truck 12 through a power take-off shaft 80 which drives a train of gears, not shown, in a gear box 82. A powered shaft 84 extends across the chassis 14 and is rotatably journaled in journals 86 which are affixed to the chassis 14 by bolts 88. The shaft 84 is driven by the gears, not shown, in gear box 82.

A first gear 90 (FIGURE 1) is rigidly affixed to the shaft 84. A second gear 92 is affixed to a shaft 94 which is rotatably mounted on chassis 14. An endless chain 96 is trained about the gears 90 and 92 and transmits power from the shaft 84 to the shaft 94. A gear 98 (FIGURE 3) is rigidly affixed to one end of the shaft 94 in alignment with a gear 100 which is affixed to a shaft 102 which, in turn, is rotatably mounted on the chassis 14. An endless chain 104 is trained about the gears 98 and 100 and is driven by the gear 98. It will be observed in FIGURE 3 that one pair of pins 78 passes through a link 106 in chain 104 so that one end of the motion transmitting device 76 will be carried by the chain 104 as it travels about gears 98 and 100. The other end of the motion transmitting device 76 is connected by pins 78 to an endless chain 108 which is also driven by the shaft 84 through a gear 110, an endless chain 112, a gear 114 (FIGURE 3), a shaft 116 (FIGURE 2), a gear, not shown, affixed to the end of shaft 116 and a gear, not shown, affixed to a shaft 118 which is rotatably mounted on chassis 14. The chains 104 and 108 constitute spaced, parallel driving means astraddle the piston rod 64 and reciprocate the piston 60 as the motion transmitting device 76 follows an orbital path defined by the chains 104 and 108 as they are moved by their associated gears.

This particular type of drive has particular and unexpected advantages in a cement pump. It is well known that the pressure or force acting on the piston is quite variable because the cement is abrasive and the friction encountered in the line varies bringing about this lack of uniformity and force However, the type of drive described herein combined with the cement pump cylinder produces a new result in that uniform force acting on the piston can be achieved. Any length of stroke can be obtained simply by lengthening the distance between the sprockets. Also the runs of chain are straight between the sprockets and as stated a steady uniform thrust is obtained. The relative sizes of the cement cylinder, the conduits of the fitting 44, and discharge line 52 are also of significance in connection with the drive of the pistons. The flexible discharge line 52 must be small enough so that it can be handled by an operator. On the other hand the piston cannot be made as small as this because if it were that size there would be required so many reciprocating strokes of the piston that the parts would quickly wear out. The design of this machine involves a piston of large size for a larger volume; a discharge fitting having conduits of smaller size and a flexible line of still smaller size. This means, of course, that the cement has to move at higher velocity in the discharge line than in the discharge fitting and in the cement cylinders. This combination has been tested and found to be successful.

The piston 62 is reciprocated in like manner by a pair of spaced, parallel endless chains 120 which are driven in a manner similar to the chains 104 and 108 by the shaft 116 and by the shaft 84 through a gear 122, a gear 124 and a chain 125 (FIGURE 4). The gear 124 is affixed to a shaft 126 which is rotatably mounted on the chassis 14.

The motion transmitting device 76 which is connected to the chains 120 is located with respect to the motion transmitting device which is connected to the chains 104 and 108 in such a manner that one piston will be nearing the end of its suction stroke while the other piston nears the end of its discharge stroke and vice versa.

Flow of concrete from the hopper 38 to each cylinder 22, 24 and from each cylinder into the discharge fitting 44 is controlled by a hemispherical valve 130 which is swingably mounted in each fitting 30 by a pair of shafts 132 and 134. Each valve 130 may be swung to a first position to close its associated opening 36 from hopper 32 and to a second position to close the associated upstream end 40 of outlet neck 38. Each shaft 132 is rotatably mounted in a boss 136 by a bushing 138 (FIGURE 9) and each shaft 134 is rotatably mounted in a boss 140 by a bushing 142. Seals 144 may be provided in the fitting 30 to prevent leakage past the shafts 132 and 134. A crank arm 146 is rigidly affixed to the exposed end of each shaft 132 by a cap screw 148 and one end of a link 150 is pivotally connected to each crank 146 by a pin 152. The other end of each link 150 is pivotally connected to a slide bar 154 by a pin 156. When the slide bar 154 is moved to the right, as viewed in FIGURE 2, to the limit of its travel, the valve 130 controlling flow of material in cylinder 24 will be seated in the opening 40 and the valve 130 controlling flow in the cylinder 22 will be seated in the opening 36. When the slide bar 154 is moved to the left to the limit of its travel, the valve controlling cylinder 22 is swung 90° in a clockwise direction, as viewed in FIGURE 3, to seat on the opening 40 and the valve 130 controlling cylinder 24 is swung in a counterclockwise direction, as viewed in FIGURE 4, to seat in the opening 36. The slide bar 134 is actuated by a pair of endless chains 158 which are each trained about a set of gears like the gears 160 and 162 shown in FIGURE 6. The gears 160 are affixed to the shaft 116 for rotation therewith and the gears 162 are affixed to a shaft 164 (FIGURE 6) which is rotatably mounted on chassis 14. A pin 166 (FIGURE 8) is affixed to each chain 158 and each pin engages a first lug 168 on bar 154, as the chains 158 travel counterclockwise, as viewed in FIGURE 6, to move the bar 154 to the left. As the chains 158 continue their counterclockwise travel, the pins 166 leave lug 168 and later strike a second pair of lugs 168 to move the bar 154 to the right. The action of the slide bar 154 is coordinated with the stroke of the pistons 60 and 62 in such a manner that each opening 40 is closed when its associated piston is on its intake stroke and each opening 36 is closed when its associated piston is on its compression stroke.

Leakage of concrete past the pistons 60 and 62 is minimized by a plurality of resilient piston rings 170 which are seated in ring grooves 172 (FIGURE 5) provided in the pistons. The rings 170 are in wiping arrangement with the inner wall 174 of an associated cylinder 22, 24. Wear between the pistons 60, 62 and the associated side wall 174 is minimized by providing a lubricating system 176 for each piston. The lubricating systems 176 each include a water supply line 178 which may be connected to a suitable source of water, such as a water tank 180

mounted on truck **12** on uprights **182**. The water supply lines **178** are of a flexible nature so that they will accommodate the reciprocation of the pistons and are connected to a suitable water pump for each piston **60**, **62**, such as the pump **184** shown for the piston **60** in FIGURE 4. Each pump **184** may be affixed to the journal **68** and discharges into a line **186**. Each line **186** discharges into a suitable manifold, such as the manifold **188** shown for the piston **62** in FIGURE 5. A plurality of nipples **190** are in fluid communication with each manifold **188**. Each nipple **190** discharges into an orifice **194** provided in its associated piston between a pair of piston rings **172**. The water thus supplied flushes any concrete leaking past the rings **172** from the space between the associated piston and the inner side wall **174** around to suitable discharge orifices, such as the orifices **196** shown in FIGURE 5 for the piston **62**. The flushed material flows through the orifices **196** into nipples **198** and a discharge manifold **200** from whence it flows through a discharge line **202** to waste. The lubricating system **176** is an important feature of the invention and has been found in actual practice to greatly extend the life of the piston rings **172**, the pistons **60**, **62** and the cylinders **22**, **24**. By observing the waste material discharging through line **202**, the amount of leakage of concrete past the associated pistons can be determined and the piston rings **172** may be replaced when substantial amounts of concrete appear in the discharge from the line **202**. But for the lubricating system **176**, concrete seeping past the rings **172** would harden between the pistons and the cylinders when the concrete pump **10** is taken out of operation for an extended period. Upon resuming operations, this hardened concrete would seriously damage the pistons and cylinders.

The concrete pump **10** is powered through the engine, not shown, of truck **12** by actuating a lever **204** to take the truck transmission (not shown) out of gear and by actuating a second lever **205** to shift a power take-off or divider **206** so that the shaft **84** is rotated through the gear box **82** and a gear box **208**. This places the chains **96**, **112** and **122** into operation. The chain **96** rotates the chain **104** through their associated gearing and shafts and the chain **112** rotates the chain **108** at the same speed as the chain **104** so that the motion transmitting device **76** follows the path of travel of the chain **104** and **108** causing the piston **70** to be reciprocated in cylinder **22**. In like manner, chain **112** also drives the inner chain of the pair **120** while the chain **122** is driving the outer chain of the pair **120** at the same speed to reciprocate piston **62**. The chain **112** also drives the pair of chains **158** which actuate the slide bar **154**. Assuming that the stage of operation is such that the piston **60** is moving to the right, as viewed in FIGURE 3, that the piston **62** is moving to the left, as viewed in FIGURE 4, and that the valves **130** are positioned as shown in FIGURES 3 and 4, then the piston **62** will be drawing concrete into cylinder **24** from hopper **32** through opening **36** and the piston **60** will be expelling concrete from the cylinder **22** through the opening **40** into the discharge fitting **44**. As the pistons **60**, **62** near the ends of their strokes, the pins **166** engage the lug **168** on bar **154** causing it to be carried to the left, as viewed in FIGURE 6. This turns the crank **146** for the cylinder **22** downwardly to seat the associated valve **130** in opening **40** to interrupt the flow from cylinder **22** through fitting **44** and pulls the crank **146** for the cylinder **26** upwardly to seat its associated valve **130** in the associated opening **36** to interrupt flow from the hopper **32** into cylinder **24** and to open the associated opening **40** so that at the beginning of the compression stroke for cylinder **62**, the concrete in cylinder **24** will be discharged through the fitting **44**. At all times during operation of the device, the pistons **60** and **62** are being lubricated with water supplied from tank **180** through the lubrication systems **176**.

While the particular concrete pump herein shown and described in detail is fully capable of attaining the objects and providing the advantages hereinbefore stated, it is to be understood that it is merely illustrative of the presently preferred embodiment 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 concrete pump comprising:

(a) a hopper for supplying concrete to be pumped, said hopper having a pair of substantially circular outlets;

(b) a pump cylinder in fluid communication with each of said outlets;

(c) a concrete discharge line in fluid communication with each pump cylinder, each of said discharge lines having a substantially circular upstream end mounted adjacent its associated outlet and a downstream end discharging into a common outlet conduit;

(d) a piston reciprocally mounted in each cylinder;

(e) a piston rod connected to each piston, each piston rod having a journal at its end remote from said piston;

(f) a hemispherically-shaped valve swingably mounted between each of said outlets and their associated upstream ends for selective engagement with said outlets and said upstream ends of said discharge lines;

(g) means for simultaneously seating one valve in its associated outlet and the other valve in its associated upstream end;

(h) a crank connected to each valve for swinging each valve to a seated position;

(i) a control bar connected to each crank, said control bar extending over an endless chain;

(j) means for connecting said endless chain to said control bar cyclically to slide said control bar and actuate said valves;

(k) a pair of endless chains mounted astraddle each piston rod; and

(l) means rotatably mounted in each journal for connecting said piston rods to said chains whereby said pistons are reciprocated thereby.

2. A concrete pump comprising:

(a) a hopper for supplying concrete to be pumped, said hopper having a pair of substantially circular outlets;

(b) a pump cylinder in fluid communication with each of said outlets;

(c) a concrete discharge conduit in fluid communication with each pump cylinder, each of said discharge conduits having a substantially circular upstream end mounted adjacent to its associated outlet, and a down stream end, a discharge line connected to said down stream ends, said discharge conduits being relatively smaller than said pump cylinders and said discharge line being relatively smaller than said discharge conduits;

(d) a piston reciprocally mounted in each cylinder;

(e) a piston rod connected to each piston, each piston rod having a journal at its end remote from said piston;

(f) a pair of endless chains mounted to straddle each piston rod;

(g) means rotatably mounted in each journal for connecting said piston rods to said chains whereby said pistons are reciprocated thereby;

(h) drive means for driving said chains;

(i) and valve means operable by said drive means for alternately closing one outlet and opening its associated discharge conduit while opening the other outlet and closing its associated discharge conduit.

3. A concrete pump comprising:

(a) a hopper for supplying concrete to be pumped,

said hopper having a pair of substantially circular outlets;

(b) a pump cylinder in fluid communication with each of said outlets;

(c) a concrete discharge line in fluid communication with each cylinder, each of said discharge lines having a substantially circular upstream end mounted adjacent to its associated outlet, and a downstream end, a common outlet conduit connected to said downstream ends, said discharge lines being reduced in diameter relative to the pump cylinders and said common outlet conduit being reduced in size relative to said discharge lines;

(d) a piston reciprocally mounted in each cylinder;

(e) a piston rod connected to each piston;

(f) a hemispherically-shaped valve swingably mounted between each of said outlets and their associated upstream ends for selective engagement with said outlets and said upstream ends of said discharge lines;

(g) means for simultaneously seating one valve in its associated outlet and the other valve in its associated upstream end;

(h) means connected to each valve for swinging each valve to a seated position;

(i) means having a straight line motion connected to the means for swinging the valve; and

(j) means having a straight line motion for actuating each of said pistons.

4. A concrete pump as in claim 3, including piston ring means encompassing each piston in wiping engagement with its associated cylinder and means connected to each piston for supplying a lubricant thereto and removing it therefrom.

References Cited by the Examiner

UNITED STATES PATENTS

1,021,296	3/1912	Ault	103—212 X
1,991,342	2/1935	Ball	103—153
2,001,661	5/1935	Ball	103—153
2,032,163	2/1936	Bagby.	
2,170,080	8/1939	Kaiser.	
2,455,084	11/1948	Neely	103—212 X
2,543,564	2/1951	Bakewell	103—218 X
2,796,032	6/1957	Ballert	103—170 X
3,077,204	2/1963	Bennett et al.	

FOREIGN PATENTS

895,070	4/1962	Great Britain.

MARK NEWMAN, *Primary Examiner.*

WARREN E. COLEMAN, *Examiner.*