A concrete pump having a pair of cylinders fed from a common hopper and pumping into a common outlet. An inlet valve in the hopper and an outlet valve in the outlet are actuated by piston and cylinder assemblies which in turn control the movement of the concrete pumping pistons in the cylinders. The piston construction includes cup shaped resilient discs backed by shaped rigid discs which enable the outer perimeter of the discs to flex or roll inwardly to eliminate grit when moving in the non-pumping direction.
PISTON CONSTRUCTION FOR CONCRETE PUMPS

This invention relates to new and useful improvements in concrete pumps which is a Divisional Application of application, Ser. No. 721, 343, filed Apr. 15, 1968 entitled “Concrete Pump” now U.S. Pat. No. 3,647,325.

The principal essence of the invention is to provide a device of the character herewithin described which enables concrete to be fed from a common hopper alternately into a pair of concrete pumping cylinders situated side by side, control being by novel feed valve assembly. The two concrete pumping cylinders feed into a common discharge conduit and a simple discharge valve assembly is also actuated to receive the concrete from the two cylinders alternately.

Another object of the invention together with the foregoing object is to provide a device of the character herewithin described which is fluid operated and which furthermore, utilizes the fluid pressure to change the length of the pumping stroke thus minimizing difficulties due to plugging or jamming of the concrete pump. A yet further object of the invention is to provide a device of the character herewithin described in which the head end of the assembly including the hopper, feed valve assembly, and discharge conduit with the discharge valve assembly, is pivotally mounted to the pumping portion so that it can be swung to one side thus enabling access to the interior of the pumping portion and to the valve assembly for clean-out and maintenance purposes. This eliminates the necessity of stripping down or dismantling the entire pump assembly which is usual with conventional concrete pumps.

A yet further object of the invention is to provide a device of the character herewithin described in which there is no possibility of contamination between the hydraulic fluid and the concrete, the two being separated by water carrying a lubricant for the pistons.

Still another object of the invention is to provide a device of the character herewithin described in which the construction of the concrete pumping piston reduces considerably any danger of grit or gravel remaining between the flexible seals of the walls of the cylinder thus reducing wear.

A further object of the invention is to provide a novel fluid operated intake valve assembly at the base of the hopper which is constructed in such a manner that jamming by gravel in the concrete is practically eliminated.

Still another object of the invention is to provide a device of the character herewithin described which is easy to maintain, which pumps concrete with the minimum change of direction of the concrete, and which is otherwise well suited to the purpose for which it is designed.

With the foregoing considerations in view, and such other objects, purposes or advantages as may become apparent from consideration of this disclosure and specification, the present invention consists of the inventive concept which embraces or includes the method, process, construction, arrangement of parts, or new use of any of the foregoing, as herein particularly exemplified in one or more specific embodiments of such concept, reference being had to the accompanying Figures in which:

FIG. 1 is an electrical schematic diagram of the operating portion of the device.

FIG. 2 is a schematic view of the fluid pressure portion of the device.

FIG. 3 is a fragmentary top plan view of the head end portion swung away from the pumping portion.

FIG. 4 is a view similar to FIG. 3, but with the head end portion clamped in operating position.

FIG. 5 is an end view of the head end portion per se, substantially along the line 5—5 of FIG. 3.

FIG. 6 is a side elevation of FIG. 4.

FIG. 7 is a top plan view of the device segmented in part to show the interior thereof.

FIG. 8 is a side elevation of the device.

FIG. 9 is a top plan view of the concrete pumping components section in part.

FIG. 10 is an enlarged fragmentary view of one portion of the concrete piston.

In the drawings like characters of reference indicate corresponding parts in the different figures.

Proceeding therefore to describe the invention in detail, reference should first be made to FIGS. 7 & 8 in which reference character 10 illustrates generally, supporting framework taking the form of a pair of spaced and parallel longitudinally extending frame members. The device collectively designated 11 is situated between these frame members 10 and consists generally of a pair of concrete pumping components collectively designated 12 and 13 situated in side by side relationship and being fed from a common concrete supply hopper 14 extending upwardly from the forward ends thereof. These concrete pumping components feed concrete to a common discharge conduit 15 situated upon the other side of the hopper 14, it being understood that concrete may then be conveyed by conduit to the location where it is needed.

An hydraulic fluid reservoir 16 is supported upon the framework above the concrete pumping components together with a water tank 17 and fluid reservoirs 18 and 19 are secured one to each of the longitudinal side members 10.

Each of the concrete pumping components consists of a concrete pumping cylinder 20, 20A consisting of sleeves held between a common rear plate 21 and a front plate 22 in the usual manner and having main seals 23 provided, said main seals also being conventional.

Extending concentrically upon the other side of rear plate 21 are actuating cylinders 24, 24A connected to a source of fluid pressure, the details of which are shown in FIG. 2 and which will subsequently be described.

Piston rods 25, 25A are provided for each of the pairs of cylinders 20, 24 and 20A and 24A, it being understood that these pairs of cylinders are concentrically located on a common axis. Inasmuch as the construction of the two piston and cylinder assemblies are similar, similar reference characters have been given, but are distinguished by the fact that all of the components of concrete pumping components 13 are followed by the letter “A”.

On the forward end of piston rod 25A, there is provided a piston collectively designated 26A, the details for which are shown in FIGS. 9 and 10.

Thread 27A of the piston rod 25A is screw-threaded and receives an anchor nut 28A. Next, a rear or back plate 29A is screwed onto the end of 27A with nut 30A secured thereto, to facilitate this screw-threading action. Following this disc 29A is a rear flexible disc or cup 31A, then a spacer disc 32A, a further spacer disc 33A, and a front flexible disc or cup 34A held in place
by a front disc 35A all of which is clamped by means of front nut 36A screw-threadably engaging the end 27A. This nut 36A clamps the entire assembly together against the anchor portion 28A. Also of note is the piston ring 37A held by spacer disc 32A.

The flexible discs or cups 31A and 34A are preferably made of synthetic rubber or the like and are provided with an annular recess 38A on the rear side thereof adapted to receive the annular rim 39A formed on the front sides of the spacer discs 32A and 33A respectively. Also of note is the rear side rim 40A of the discs 29A and 35A clearly shown in FIG. 10.

This configuration of importance inasmuch as when the piston is on the return stroke (to the left with reference to FIG. 9) the flexible disc 34A is permitted to roll in towards the axis of the cylinder as shown in phantom in FIG. 10, around the perimeter of disc 35A, thus allowing particles of sand or the like to dislodge. The opposite action takes place with the flexible cup or disc 31A when the piston is moving in the opposite direction. This means that the only cleaning action required is the metal piston ring 37A situated around the spacer 32A. These spacers serve to align and contain the piston ring 37A and back up the flexible discs 31A and 34A. Furthermore, the disc 35A acts as a piston front plate and a threaded cover 41A is screwed onto the extremity of the screw-threaded portion 27A to protect the thread from damage while in contact with concrete during the pumping operation.

Any sediment that does pass this piston and is cleared by the action of the flexible cup or disc 31A will be carried to the lubricating fluid reservoir 19 to settle out and this sediment together with any hydraulic oil which may have leaked from the actuating cylinders 24 and 24A can be drained off periodically.

Conduits 42 and 42A connect the reservoirs 18 and 19 to the concrete pumping cylinders 20 and 20A respectively as shown in FIGS. 7 and 8, it being understood that these conduits connect to the cylinders on the rear side of the pistons 26, and 26A, the rear side being defined as the sides to the left of the pistons with reference to FIG. 9.

The piston rods 25, 25A pass through apertures in the rear plate 21 and into the cylinders 24 and 24A respectively, hydraulic seals 43A preventing the passage of hydraulic fluid past these rods and into the concrete cylinders.

Conventional hydraulic pistons 44 and 44A are secured to the ends of these piston rods within the cylinders 24 and 24A respectively, these pistons being shown schematically in FIG. 2.

The portions of the concrete pumping components consisting of the front plate 22, the cylinders 20 and 20A, cylinders 24 and 24A, and the piston and piston rod assembly therewithin, form what is defined as the pumping portion of the concrete pumping components. Reference to FIGS. 3 and 4 show the head end portion collectively designated 45 of the concrete pumping components. This head end portion includes a mounting plate 46 pivotally secured by vertical pivot pin 47, to one side of the front plate 22 spanning the concrete cylinders 20 and 20A. This head end portion is normally clamped into the position shown in FIG. 4 by means of bolt 48 situated opposite to pivot pin 47 as shown clearly in FIG. 4.

This head end portion includes the aforementioned hopper 14, a feed valve assembly collectively designated 49, a discharge valve assembly collectively designated 50, and the common discharge conduit 15 together with the means to actuate the feed valve assembly 49 and discharge valve assembly 50.

This hinging attachment of the head end with the majority of the functional components therein, permits the head end to be swung away from the pumping portion so that the interiors of both may be cleaned out after use or made accessible for easy servicing if desired.

The hopper is conventional in configuration having sloping sides 51 converging to a base opening 52 and communicating with a base 53. This base in turn communicates with a concrete intake area 54 separated into two portions by a dividing barrier and valve stop wall 55 extending upwardly from the base 56 thereof and shown in FIG. 5. This divides the intake area 54 into two areas 57 and 57A which align with the aforementioned concrete cylinders 20, 20A respectively through corresponding apertures (not illustrated) in the front plate 22 of these components.

Situated within the base 53 is the aforementioned feed valve assembly 49.

It consists of a horizontally situated mounting spindle 58 extending through the walls 59 of the base 53. Secured to the spindle or shaft 58 is an apex boss 60 of a valve element 61 said valve element being defined by a pair of walls 62 extending from the apex or boss 60 at an angle from one another just less than 90°. A curved base wall 63 extends between the two walls 62, but inwardly from the ends 64 thereof as clearly shown in FIG. 5.

When in the position shown in FIG. 5, the upper wall 62 engages the side wall 59 of the base 53 and the lower wall 62 engages the stepped recess 65 on the outer end of the barrier or valve stop 55 so that concrete within hopper 51 can only flow by gravity to the intake area 57 and thus into the concrete cylinder 20.

However, when the valve element is moved through almost 90°, the lower wall 62 now engages the opposite wall 59 of the base 53 and the end 64 of the upper wall 62, in turn engages the stepped upper side 65' of the barrier or valve stop 55 so that concrete can now only flow from the hopper 14, to the intake area 57A and thence to the concrete cylinder 20A.

It will be noticed that the base or lower wall 63 of the valve element is spaced from the upper side 66 of the barrier 55 by an amount defining the maximum size of aggregate or stone in the concrete. This prevents any stones or gravel from jamming when the valve is operating thus ensuring that the valve can operate fully from one position to the other without interference.

An hydraulic piston and cylinder assembly 67 extends between a crank arm 68 secured to spindle or shaft 58 and supporting structure (not illustrated), said assembly 67 being connected to the hydraulic system for actuation as will hereinafter be described.

Situated within the discharge conduit 15, is the aforementioned discharge valve assembly 50. This consists of a vertically situated spindle or shaft 69 situated centrally within the discharge conduit and in alignment with the barrier or divider 55. A vertically situated guiding plate 70 (FIG. 4) is secured to the shaft 69 and moves from a position shown in FIG. 4 through the arc indicated by reference character 71. When in the position shown in FIG. 4, concrete can only flow from the concrete cylinder 20, but when moved through the de-
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3

gree of movement defined by arc 71, concrete can only flow from concrete cylinder 20A.

An hydraulic piston and cylinder assembly 72 extends operatively between a crank arm 73 secured to shaft 69 and a point of anchorage 74. This piston and cylinder assembly 72 is also connected to the hydraulic system as will hereinafter be described, with reference to FIG. 2.

The hydraulic schematic is shown in FIG. 2 and consists of a pump 75 driven from the power take-off 76 connected to the source of power indicated by reference character 77.

Fluid is driven by the pump from the reservoir 16, through filters 78 and conduits 79, to outlet conduit 80. Conduit 80 connects to cross conduit 81, one branch of which connects to a four-way directional double solenoid valve 82 which is conventional in construction and is operated by means of solenoids 83 and 84.

A return conduit 85 extends from the valve 82, back to return conduit 86, and thence to reservoir 16.

A conduit 87 extends from the valve to a cross conduit 88 which in turn extends between one end of each of the piston and cylinder assemblies 67 and 72 as clearly shown. Another conduit 89 also extends from the valve to a cross conduit 90 which in turn extends between the other ends of the piston and cylinder assemblies 67 and 72 so that by switching the valve 92, both of the pistons of the assemblies 67 and 72 can be moved in the same direction at the same time and then reversed in direction at the same time.

A cross conduit 91 extends between the inner ends 92, 92A of the cylinders 24, 24A respectively and a conduit 93 extends from this cross conduit 91, firstly to return conduit 94 and thence, through conduit 95 and one-way valve 96, to conduit 97 which in turn communicates with by-pass release valve 98. A further conduit 99 extends from this release valve back to the return conduit 86 and a further conduit 100 extends from this release valve to the aforementioned main conduit 80 from pump 75.

A four-way directional valve 101 is provided with a single acting solenoid 102 and the other branch 81A of conduit 81 communicates with this valve together with a return branch conduit 86A which in turn communicates with return conduit 86.

A conduit 103 extends also from the valve to one end 104A of the cylinder 24A and a further conduit 105 extends from the valve to one end 104 of the cylinder 24.

Solenoid 102 is normally in the "off" position under which circumstances the valve 101 is closed.

Valve 82 is normally in the position in which conduit 81 is connected to conduit 85 so that the pump, which is idling under these conditions, circulates fluid from the reservoir, through conduit 81, through valve 82, to conduit 85 and thence back to the reservoir via return conduit 86.

When the pump is to be used, actuation is commenced by the main switch 106 (FIG. 1) or a remote switch 106A. This actuates a 12-volt D.C. power supply and increases the motor's speed of the source of power by picking up the relay 107 and coil 108 through pressure switch 109, relay 110, ratchet relay 111, so that relay 111A actuates the hydraulic solenoid 84. This switch valve 82 so that conduit 81 connects with conduit 89 and conduit 87 connects with conduit 85 as indicated by the double-headed arrows within the valve box.

This means that oil under pressure flows from the pump, through conduit 81, to conduit 89 and thence to cross conduit 90 thus moving the pistons in cylinders 67 and 72 upwardly with respect to FIG. 2. This moves the discharge valve 70 to the position shown in FIG. 2 and also moves the feed valve to the position shown in FIG. 2. At the same time, a cam 112 secured to shaft 58, operates a limit switch 113 which is connected to solenoid valve 102 which in turn actuates valve 101.

The limit switch is set to operate solenoid 102 only when the piston of cylinder 67 is half-way along the stroke thereof. This means that the majority of the movement of the feed valve 49 and the discharge valve 70 is taking place while the pistons 26, 26A are stationary thus letting them move with the minimum of interference from the concrete under pressure.

When valve 101 is actuated, conduit 81A connects to conduit 103 and conduit 105 connects to conduit 86A as indicated by the double-headed arrow within valve 101.

Fluid under pressure flows through conduit 103 to one end 104A of cylinder 24A thus moving piston 44A to the right with respect to FIG. 2 or in the direction of arrow 114. This, at the same time, of course, moves piston 26A in the same direction thus forcing any concrete within concrete cylinder 20A towards the discharge. As this piston 26A moves in the direction of arrow 114, the discharge valve 70 is in the position opposite to that shown in FIG. 4 thus closing off the concrete cylinder 20 and opening the discharge to concrete cylinder 20A. As piston 44A moves forwardly, fluid in front thereof passes through conduit 91 into the end 92 of cylinder 24 thus driving piston 44 to the left with respect to FIG. 2 or in the direction of arrow 115. This, of course, moves piston 26 in the direction of arrow 115 thus creating a vacuum on the side thereof remote to piston 44. As this movement commences, the feed valve is in the position shown in FIG. 5 thus opening the hopper 14 to the intake area 57 and thence to concrete cylinder 20 which fills with concrete from a combination of gravity and suction feed.

As mentioned, fluid flowing through conduit 91 will move piston 44 in the direction of arrow 115 as fluid is kept in line 93 due to the valves 94 and 96 being closed. Fluid will continue to flow through conduits 81 and 89 until pistons are at the end of the stroke within cylinders 67 and 72. From a point half-way along the stroke, this movement has been facilitated by concrete completely filling the respective concrete cylinder 20 or 20A.

Should piston 44A reach the end of its stroke before piston 44, one-way valve 96 will open allowing a small quantity of fluid to flow from line 97 to line 93. At the same time, fluid in cylinder 24 will return to the reservoir 16 by way of line 105, valve 101 and conduit 86A to 86. The cause of this small amount of fluid loss would be leakage of the front hydraulic cylinder seals or hydraulic lines. A leak in the hydraulic lines or conduits would be detected by visual inspection, but leakage due to seals could be carried off by the lubricating fluid within cylinders 20 or 20A to the lubricating fluid reservoirs 18 and 19 so that the hydraulic fluid would not contaminate the concrete within the cylinders.

Should the piston 44 reach the end of its stroke before piston 44A, one-way valve 94 will open and allow a small quantity of fluid to escape through line or conduit 93, one-way valve 94 and thence to the reservoir.
through conduit 86. This condition would be caused by hydraulic fluid passing worn piston rings in the main pistons 44 or 44A or by a stoppage of the concrete being pumped, said stoppage commonly being called a plug.

Pressure in the system would increase causing one-way valve 96 to open momentarily thus allowing oil pressure or fluid pressure to build up and at the same time pressure switch 109 would open and close contact in the ratchet solenoid 111A or 111B thus causing a rapid change of hydraulic fluid flow. This allows the operator time to shut off the main switch 106 or 106A before damage occurs to the machine.

However, if this is not done, by-pass release valve 98 will open and combined with one-way valves 94 and 96, will allow hydraulic fluid to circulate back to the reservoir 16 through conduits 100, 97, valve 96, conduit 95, valve 94, conduit 99 and thence to 86 to the reservoir.

After the plug or stoppage has been removed or has freed itself, the length of the stroke of the piston 44A of 44 would increase automatically due to the one-way valve 94 allowing fluid to escape as mentioned above until the two pistons are in sequence once again.

With the use of pressure as the method of changing strokes, most of the plugging in the pump outlet or main delivery line is eliminated due to the fact that the pumping pistons 26 and 26A advancing do not have to reach the end of the stroke before hydraulic pressure alternately increases or decreases to free a formation of cross rock or any foreign object.

Once the pistons have reached the end of the stroke as aforesaid, the cycle is reversed by ratchet relay switch 111 switching from 11A to 11B. Reversing switch 116 is used only to change cam operated limit switch 113 from normally open to normally closed so that concrete in line can be returned to hopper which is done manually on toggle switch 116 moving from 116A to 116B. This places solenoid 11B in sequence thus actuating hydraulic solenoid valve 83 which causes fluid to flow from conduit 85, through conduit 87 to above the pistons within cylinders 67 and 72 and to move them downwardly in a direction opposite to that shown in FIG. 2.

Pilot lights 83 and 84 are in circuit with solenoid valves 83 and 84 respectively so that the operator can ascertain the situation at all times.

Various modifications can be made within the scope of the inventive concept which is herein disclosed and/or claimed.

What is claimed to be the present invention is:

1. In a concrete pump, the combination of a cylinder, a piston rod reciprocable in said cylinder and having a screw-threaded end portion, and a double-acting piston assembly mounted on the screwthreaded end portion of said rod, said piston assembly comprising a pair of cup-shaped backing plates positioned back-to-back and facing in opposite directions, a pair of resilient pumping cups juxtaposed to the respective backing plates and also facing in opposite directions, said pumping cups being provided at the back thereof with marginal recesses accommodating marginal portions of the backing plates therein, a pair of keeper discs positioned within the respective pumping cups, and nut means provided at the outside of said keeper discs for clamping the piston assembly in position on said screw-threaded end portion of the piston rod, the device being characterized in that said keeper discs have marginal edges which are curved inwardly toward said pumping cups so that the marginal edge portions of the pumping cups may deflect radially inwardly from the wall of said cylinder when the respective cups are moving in the non-pumping direction.

2. The device as defined in claim 1 wherein one of said backing plates is provided in its marginal edge with an annular groove, and a piston ring positioned in said groove to engage the cylinder wall.

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