May 4, 1965 K. E. SCHUMANN 3,181,469

CONCRETE PUMPING APPARATUS

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Fig. 1

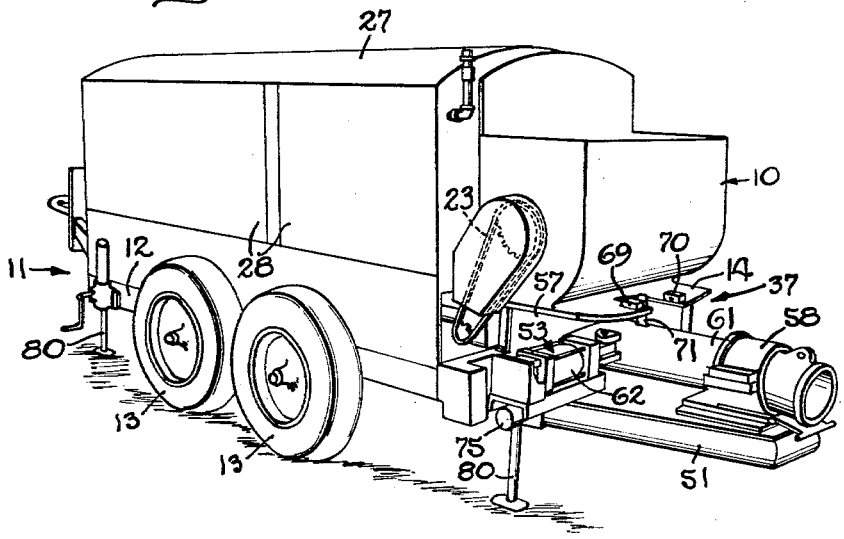
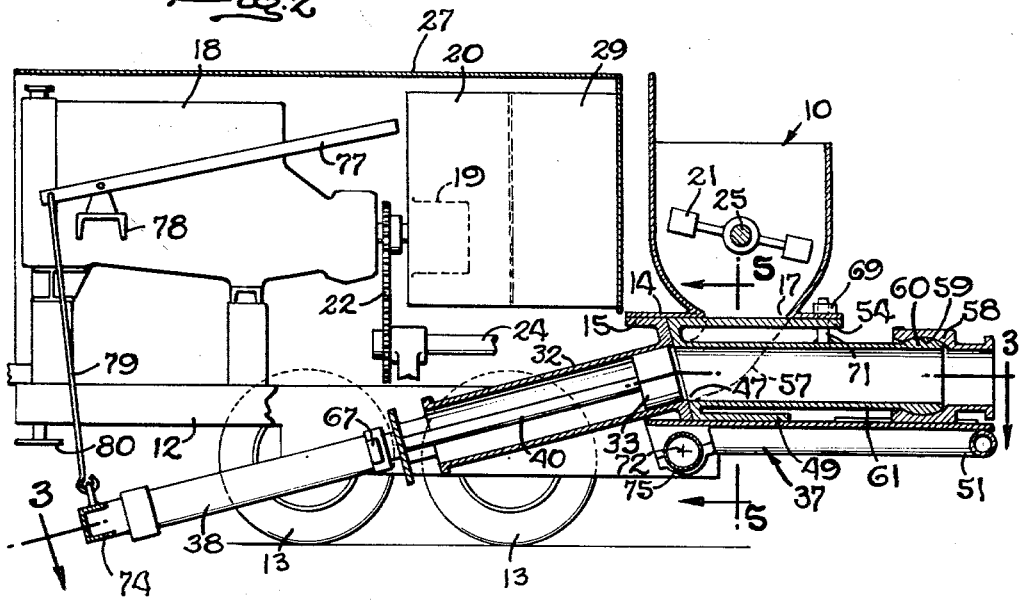


Fig. 2



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CONCRETE PUMPING APPARATUS

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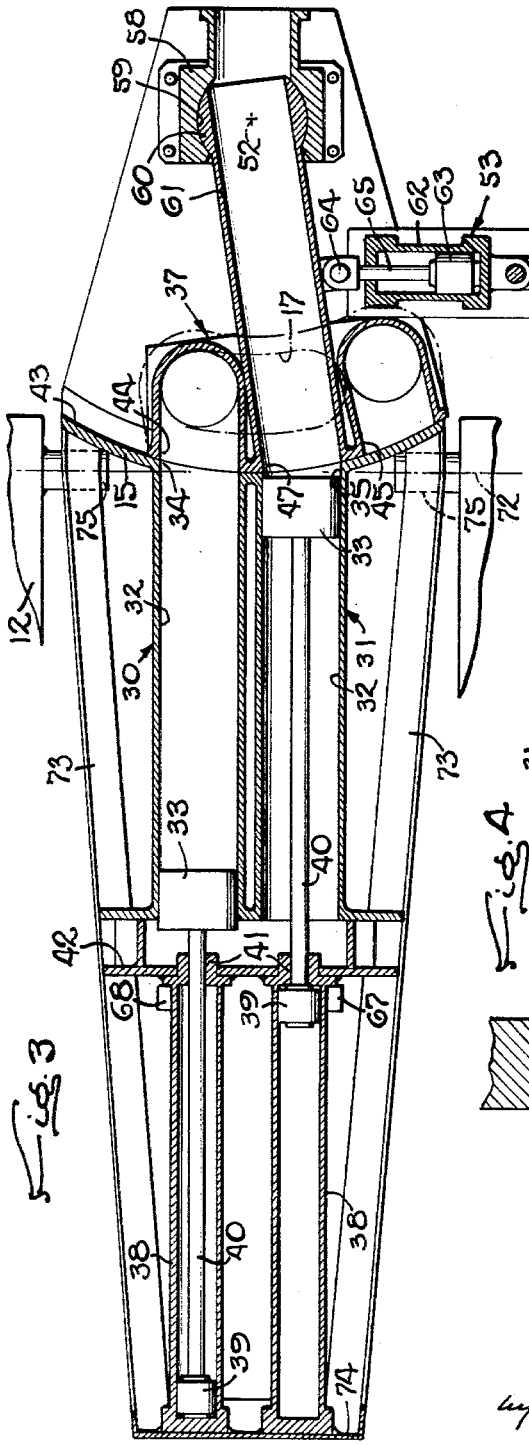

Fig. 3

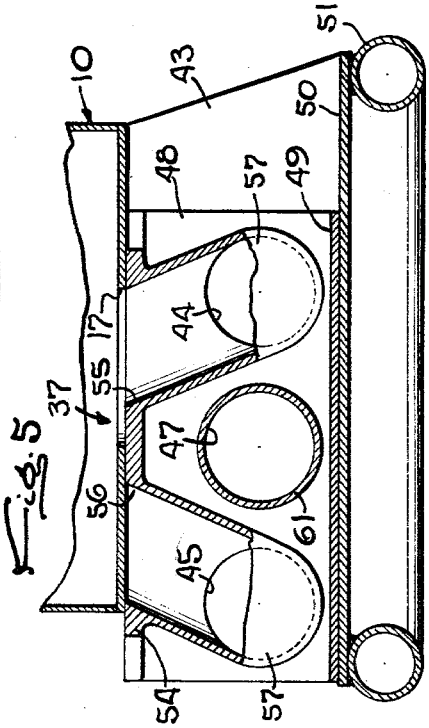

Fig. 5

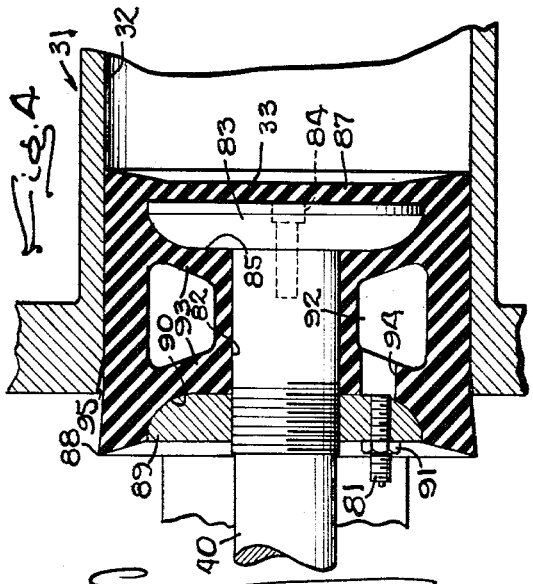

Fig. 4

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CONCRETE PUMPING APPARATUS

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9 Claims. (Cl. 103—49)

This invention relates to concrete pumping apparatus of the type with which fluent concrete from trucks or a mixer is pumped through a delivery pipe to a point inaccessible to trucks. For this purpose, the apparatus includes generally a hopper for receiving the concrete, a pair of reciprocating pumps, mechanism for operating the pumps in alternating relation whereby one pumps concrete during the intake stroke of the other, and valving for establishing communication between the respective pumps and the delivery pipe and the hopper at the appropriate times.

The general object of the present invention is to provide a pump of the above character which is of improved and simplified construction and is sturdier, more trouble-free, and more efficient in service use than has been the case with prior pumps for this purpose.

Another object is to simplify and improve the valving for alternately connecting the pumps to the delivery pipe and the hopper.

A more specific object is to utilize only one moving valve member to control the flow of concrete into and out of the pumps, and to form the valve in a novel manner such that the concrete is sheared with a positive scissoring action.

Another object is to improve the efficiency of the pump by avoiding the necessity of cutting or moving substantial quantities of concrete that has remained in place long enough to begin to stiffen.

A further object is to reduce the time, effort, and equipment required for setting up the pump in service use.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a perspective view of a concrete pumping apparatus embodying the novel features of the present invention.

FIG. 2 is an enlarged fragmentary sectional view taken in a vertical plane extending longitudinally of the apparatus shown in FIG. 1.

FIG. 3 is an enlarged fragmentary sectional view taken along the line 3—3 of FIG. 2.

FIG. 4 is an enlarged fragmentary cross-section taken along the axis of one of the pump pistons.

FIG. 5 is an enlarged fragmentary cross-section taken substantially along the line 5—5 of FIG. 2.

As shown in the drawings for purposes of illustration, the invention is incorporated in a concrete placement apparatus of the type in which fluent concrete dumped into a hopped 10 by a mixer or trucks is pumped through a delivery pipe (not shown) to a point inaccessible to trucks. A common application of such apparatus is the pumping of concrete to above-ground levels such as the upper stories of buildings under construction.

In this instance, the unit is mounted on a trailer 11 comprising a horizontal rectangular frame 12 supported on four wheels 13 journaled on the frame, the hopper 10 being mounted on a horizontal platform 14 disposed above the forward end of the frame and projecting cantilever fashion forwardly from a pedestal 15 extending across most of the width of the frame. Concrete flows to the pumping mechanism through an opening 17 through the underside of the hopper and the pedestal.

Mounted on the rear portion of the frame is a suitable actuator 18 such as a gasoline-powered motor driving a pump 19 disposed in an oil tank 20 and operable to supply oil under pressure to the concrete pumping mechanism. The motor also drives an agitator 21 in the hopper 10 through sprocket driven chains 22 and 23 (FIGS. 1 and 2) rotating a connecting shaft 24 and the agitator shaft 25. Preferably, the motor, the oil tank, and the associated parts are enclosed in a housing 27 having openings on each side normally covered by doors 28. Usually, a water tank 29 is provided for a readily available supply of water for cleaning purposes.

The concrete pumping mechanism includes a pair of side-by-side pumps 30 and 31 comprising cylinders 32 mounted adjacent the forward end of the frame 12 and extending longitudinally thereof with pistons 33 fitted in the cylinders for back and forth sliding. The forward or output end of each cylinder opens through an outlet port 34, 35 in the pedestal 15 and, through a valve 37, alternately communicates with the hopper 10 and the delivery pipe, first to receive a charge of concrete from the hopper as the associated piston slides rearwardly and then to pump the charge into the delivery pipe as the piston slides forwardly. The forward strokes of the pistons alternate so that one pumps while the other is sucking in a charge of concrete. Accordingly, the apparatus pumps a substantially continuous flow of concrete into the delivery pipe.

To operate the pumps 30 and 31, a second pair of cylinders 38 are mounted behind the cylinders 32 in coaxial relation with the latter with two pistons 39 fitted in the rear cylinders and connected to the pistons 33 by rods 40 slidably guided in bushings 41 in the forward end wall 42 of the rear cylinders. Thus, as oil under pressure is supplied alternately to the opposite ends of each cylinder 38 by the oil pump 19, the pistons 33, 39 of each pump are slid back and forth in unison.

The present invention contemplates the provision of a novel valve 37 which is of improved and simplified construction and is sturdier and more efficient and trouble-free in service use than has been the case with prior valves for this purpose. To these ends, the valve comprises a single oscillating valve member mounted on the frame 12 to slide back and forth in contact with a valve seat 43 and control the flow of concrete both into and out of the pumps 30 and 31, the valve member having two inlet ports 44, 45 communicating with the hopper and alternating the concrete flow from the hopper between the two pumps, and having a central outlet port 47 communicating with the delivery pipe and alternating between the two pump outlets to receive the output of the pumps.

As shown in the drawings, the valve seat 32 is formed by the front side of the pedestal 15 which is arcuately curved in horizontal cross-section, the open ends of the cylinders 32 being angularly spaced apart across the seat. The valve 37 includes an arcuately curved plate 48 (see FIG. 5) shorter than and fitted against the seat with three angularly spaced openings level with the cylinder ports 34, 35 and forming the ports 44, 45 and 47, the spacing of adjacent valve ports being the same as the spacing of the cylinder ports.

Projecting forwardly from the bottom edge of the curved valve plate 48 is a flat plate 49 which is slidably supported on a horizontal platform 50 on a U-shaped tubular frame 51 mounted on and projecting forwardly from the front end of the main frame 12. The valve is swingable back and forth relative to the seat 43 along an arcuate path defined by the seat and about an axis 52 (FIG. 3) spaced forwardly from the seat, such swinging in this instance being between two positions in which the cylinder ports are alined alternately with the central

valve port 47. Power operated mechanisms 53 (FIGS. 1 and 3) is provided to oscillate the valve back and forth between these two positions in timed relation with the operation of the pumps 30 and 31.

Projecting horizontally forwardly from the upper edge of the curved plate 48 and paralleling the lower plate 49 is a second flat plate 54 which fits snugly against the underside of the hopper platform 14 and is formed with two intake ports 55 and 56 angularly spaced to communicate alternately with the hopper opening 17 in the two positions of the valve to receive concrete from the hopper. These two ports are connected by curved pipe sections 57 to the two inlet ports 44 and 45 in the valve plate 48.

The pivotal axis 52 of the valve 37 is defined by a sleeve 58 fast on the forward portion of the platform 50 with an internal socket 59 rotatably receiving a ball segment 60 formed on the forward end of a forwardly extending pipe 61 fast at its rear end on the arcuate plate 48 and communicating with the outlet port 47 therein. The forward end of the sleeve is adapted to be connected to the delivery pipe.

It will be seen, therefore, that in one position of the valve 37 (see FIGS. 3 and 5), concrete flows from the hopper 10 through the opening 17, the ports 55, 44 and 34, and thence into the alined cylinder 32 of the pump 30 during the intake stroke of the associated piston 33. At the same time, the cylinder of the other pump 31 is in communication with the pipe 61 and the delivery pipe through the outlet port 35 and the central port 47 so that concrete pumped out of the cylinder flows into the delivery pipe. Upon completion of the strokes of the respective cylinders, the valve 37 is swung to the opposite position where the pump 30 feeds concrete into the delivery pipe through its outlet and the pump 31 is charged with concerte flowing from the hopper 10.

The power mechanism 53 for swinging the valve 37 back and forth in timed relation with the operation of the pumps 30 and 31 comprises a double-acting reciprocating actuator formed by a cylinder 62 (FIGS. 1 and 3) disposed on one side of the valve with a piston 63 (FIG. 3) slidable back and forth transversely of the frame 12 and pivotally connected to the pipe 61 at 64 by a rod 65. Pressure fluid is delivered alternately to opposite ends of the cylinder to slide the piston back and forth and thereby swing the valve back and forth about the axis 52, the stroke of the piston being such that the central port 47 is alined with one of the two cylinder ports 34, 35 when the piston is in its extreme positions.

Timing of the pumping mechanism is controlled by four switches 67 through 70, two disposed adjacent the forward ends of the cylinders 38 to be actuated by the pistons 39 when the latter reach the forward ends of the cylinders, and two disposed above the valve pipe 61 and spaced apart on opposite sides of an actuator arm 71 projecting upwardly from the pipe and movable therewith. When the lower piston 39, as viewed in FIG. 3, reaches the forward end of its cylinder, it actuates the switch 67 which controls suitable valving (not shown) to stop the flow of fluid to the cylinders 38 and deliver fluid to the head end of the cylinder 62 thereby swinging the valve 37 into its opposite position where the arm 71 engages the switch 70 to initiate the forward stroke of the pump 30 and the intake stroke of the pump 31. When the piston 39 in the upper cylinder 38 (FIG. 3) engages the switch 68, the valve 37 is swung to the opposite side where the arm 71 engages the switch 69 and initiates the forward stroke of the pump 31.

Thus, it will be seen that one movable valve member 37 and one double-acting actuator 53 are effective to connect the pumping cylinder to the delivery pipe and the other cylinder to the hopper 10. The opposed edges forming the ports in the seat 43 and the plate 49 coact to shear the concrete in the ports with a positive scissoring action which is more effective than has been the case with prior devices for alternating the flow into and out of reciprocating concrete pumps.

It should be noted that with this valve arrangement there is no cutting or slicing of concrete that has been permitted to remain in place long enough to begin to stiffen. Moreover, the forward stroke of the pistons 33 as shown in FIG. 3 may be long enough to avoid leaving any substantial quantity of concrete in place in the apparatus long enough to begin to stiffen. Concrete stands in the pipe 61 and the delivery pipe only during the short interval during swinging of the valve into a new position. Thus, losses in efficiency due to cutting or moving substantial quantities of stiffening concrete are eliminated.

To insure the complete filling of each pump cylinder 33 during the intake strokes thereof, it is desirable to incline the pump cylinders downwardly and rearwardly as shown in FIG. 2 thereby to obtain a gravity flow of concrete which supplements the sucking action of the pumps. Heretofore, it has been the practice to jack up the front end of the trailer 11 and support it on stands while the apparatus is in operation. In addition to requiring additional set-up equipment, such practices affect the stability of the apparatus during operation and require a substantial amount of set-up time.

In accordance with another aspect of the invention, the apparatus is constructed in a novel manner to avoid these problems. For this purpose, the pumps 30, 31 are disposed at a suitable angle with and rigidly mounted on the assembly comprising the hopper 10 and the forward platform 50 and frame 51, and the entire unit thus formed is fulcrumed on the main frame 12 for rocking about a horizontal transverse axis 72 (FIG. 3) to swing the pumps downwardly into an operating position (FIG. 2) and upwardly into a transport position (not shown) in which the rear ends of the cylinders 38 are well above the ground. Of course, the platform 50 is inclined downwardly and forwardly in the transport position but, due to the shorter length of the platform as compared to the length of the pumps, remains well above ground level.

As shown most clearly in FIG. 3, two rails 73 are disposed on opposite sides of the pumps 30, 31 and are secured at their forward ends to the pedestal 15. These rails project rearwardly and converge toward the pumps, and are connected across the rear ends of the pumps by a channel shaped rail 74 fast on the rear ends of the pumps. Trunnions 75 (FIG. 3) projecting inwardly from the side frame members and through the forward ends of the rails 73 pivot the rigid framework formed by the platform 50 and the rails on the forward end of the main frame.

To facilitate swinging of the unit between operating and transport positions, a lever 77 (FIG. 2) is pivoted on a bracket 78 projecting laterally from the motor 18 above the rear ends of the pumps and is connected to the bar 74 by a rod 79. A latch (not shown) is provided inside the housing 27 to hold the forward end of the lever in a lowered position and thereby hold the pump and valve unit in its transport position.

With this arrangement, setting up of the apparatus for operation is accomplished simply by releasing the lever 77 to lower the pumps to the position shown in FIG. 2. Braces 80 (FIG. 1) may be positioned beneath the frame and the platform 50 to hold the trailer securely in its horizontal operating position. Where the delivery pipe has been assembled with its intake end at a predetermined level, setting up time is reduced with this apparatus from as much as an hour or more to a matter of minutes.

Due to the abrasive property of concrete, wear on the pistons 33 is a problem with concrete pumps. Moreover, it is necessary to remove the pistons frequently for cleaning of the cylinders 32. To facilitate removal and reassembly of the pistons, and also to make it possible to maintain a tight fit between the pistons and the cylinders even after substantial wear has occurred in service use, the

pistons are composed of a flexible material such as rubber and are made hollow as shown in FIG. 4 so as to be inflatable inside the cylinders by air under pressure introduced into the pistons through air valves 81. Thus, when a piston is to be removed from a cylinder, the air pressure is relieved until the piston slides freely out of the cylinder. After the cylinder is cleaned, the piston slides freely into the cylinder and, when inflated, expands into tight contact with the cylinder wall despite any reduction in its normal or relaxed outside diameter that has occurred due to wearing away of the rubber.

Specifically, the pistons 33 comprise rubber sleeves having cylindrical interiors 82 (FIG. 4) sized to telescope snugly over the ends of the piston rods 40. A disc 83 larger than the rod is held thereon by a machine screw 84 (FIG. 4) and embedded in a circular hollow 85 adjacent the inner end wall 87 of the sleeve. The outer diameter intermediate the ends of the sleeve is approximately the same size as the cylinder bore and increases slightly adjacent each end as shown at 88 in FIG. 4 thereby forming a resiliently yieldable annular flange encircling each end of the sleeve and larger than the cylinder bore. A circular nut 89 is threaded onto the piston rod at a point spaced from the inner end thereof and tightened against the rearwardly facing end of the sleeve, seating in an annular recess 90 in the sleeve end. The valve 81 is threaded into the nut 89 and held in place by a lock nut 91.

The air-holding hollow 92 is formed between two annular webs 93 integral with the rest of the sleeve, the rear web having at least one hole 94 therethrough adapted to be alined with the inner end of the valve 81 to carry air from the valve into the hollow 92.

Around the open rear end of the cylinder bore is a bevel 95 (FIG. 4) which facilitates the insertion of the piston in the cylinder in its relaxed condition, the flanges 88 being deformed inwardly to the diameter of the bore during insertion and subsequently pressing resiliently against the same. When the piston is inflated, a tight sliding fit with the bore is obtained. It will be seen that little concrete can work its way past the forward scraping edge 97 of the piston and any that does will be scraped rearwardly by the rear scraping edge 98 and carried past the open rear end of the cylinder to drop to the ground upon completion of each intake stroke.

I claim as my invention:

1. In a concrete pump, the combination of, a frame, a hopper on said frame having an opening in its lower side, a member disposed below said hopper and including two angularly spaced intake ports, mechanism for swinging said member back and forth relative to said hopper between two positions in which alternate ones of said intake ports communicate with said opening to receive a gravity flow of concrete from said hopper, said member having an arcuately curved side, a seat of arcuate cross-section fitted closely against said curved side, said seat being formed with two angularly spaced outlet ports, two reciprocating pumps on said frame each communicating with one of said outlet ports, means defining two angularly spaced inlet ports in said curved side continuously communicating with said intake ports, a central port disposed between said inlet ports and alternately communicating with said outlet ports in said two positions, said central port being spaced from said inlet ports a distance equal to the spacing of said outlet ports whereby one inlet port communicates with one outlet port in each of said positions to carry concrete to the pump not in communication with the central port, mechanism for operating said pumps in timed relation with the swinging of said member and in unison but in opposite directions whereby each pump draws concrete through the inlet port and then pumps the concrete out through said central port.

2. Apparatus for pumping fluent concrete including,

in combination, a frame adapted to be supported in a horizontal position, a valve seat of arcuate cross-section mounted on said frame and having two angularly spaced outlet ports therein, first and second cylinders on said frame each having an end communicating with one of said outlet ports, a valve member having an arcuately curved side fitted against said seat to slide in close engagement therewith, said member being formed with two angularly spaced inlet ports therein and a central port disposed between said inlet ports, the spacing of adjacent valve ports being the same as the spacing of said outlet ports, means mounting said member on said frame for back and forth swinging relative to said seat about an axis spaced outwardly from the seat between two positions in which said central port communicates alternately with said outlet ports, one of said inlet ports communicating with the outlet port not in communication with the central port in each of said positions, mechanism for oscillating said member back and forth between said positions, a hopper for supplying fluent concrete to said inlet ports when the latter are in communication with the respective cylinders, a piston fitted in each of said cylinders for back and forth reciprocation, and mechanism for reciprocating said pistons in timed relation with the oscillation of said member whereby one piston pumps concrete out of its cylinder through its outlet port and said central port as the other piston draws concrete into its cylinder through its outlet port and the registering inlet port.

3. Pumping apparatus as defined in claim 2 in which said cylinders are inclined downwardly and away from said valve seat to induce a gravity flow of concrete during the intake strokes of said pistons, and said cylinders and hopper are rigid with the valve seat, the pumping unit thus formed being pivoted on said frame for rocking about a horizontal axis to raise the lower ends of said cylinders to a transport position.

4. Pumping apparatus as defined in claim 2 in which said pistons comprise sleeves composed of resiliently flexible material and sized to telescope into said cylinders, said sleeves having air-tight hollow interiors communicating with air valves mounted on the ends of the sleeves whereby the pistons are inflatable to expand into tight engagement with said cylinders.

5. In a concrete pump, the combination of, a frame, a seat having two spaced outlet ports therein, first and second reciprocating pumps on said frame each communicating with one of said ports, a valve member fitted closely against said seat and slidable back and forth across said seat between two predetermined positions, said member being formed with two spaced inlet ports therein and a central port disposed between said inlet ports, said central port communicating with opposite ones of said outlet ports in said two positions and being spaced from each of said inlet ports a distance equal to the spacing of said outlet ports whereby the inlet ports alternately communicate with the outlet ports not in communication with the central port, means for operating said pumps alternately whereby one delivers concrete to its outlet port as the other is charged, mechanism for sliding said member back and forth in timed relation with the operation of said pumps to aline said central port with each pump during its output stroke, and means for supplying concrete to the inlet ports when the latter are in communication with the respective pumps thereby to charge the latter.

6. In a concrete pump, the combination of, a frame, a seat of arcuate cross-section on said frame having two angularly spaced outlet ports therein, a valve member having an arcuately curved side fitted against said seat to oscillate back and forth in close engagement therewith between two angularly spaced positions and about an axis spaced outwardly from said seat, an outlet pipe mounted on the opposite side of said member for oscillating movement therewith and opening at one end through said

curved side, said pipe end being positioned to communicate with opposite ones of said outlet ports in said two positions, and two inlet pipes movable with said member and having ends opening through said member on opposite sides of said outlet pipe end and angularly spaced therefrom a distance equal to the spacing of said outlet ports to communicate with the outlet port not in communication with the outlet pipe in each of said positions.

7. A pump as defined in claim 6 further including a hopper stationarily mounted on said frame above said member with an opening in its underside and positioned to communicate said inlet pipes when the latter are in communication with said outlet ports thereby to deliver an alternating gravity flow of concrete to said outlet ports.

8. In a concrete pump, the combination of, a frame adapted to be supported in a generally horizontal position, two elongated reciprocating pumps disposed adjacent the underside of said frame with the output ends of said pumps adjacent one end of the frame, mechanism on said frame for operating said pumps in alternating relation whereby each pumps during the intake stroke of the other, a hopper on said one frame end above the level of said output ends and having an opening in its underside, an outlet pipe projecting outwardly from said one frame end generally level with said output ends, valve means beneath said hopper for establishing communication between said outlet pipe and each of said pumps during the output strokes thereof while establishing communication between said hopper opening and the pumps during the intake strokes, said pumps being inclined downwardly away from said output ends and said hopper whereby gravity supplements the sucking action of the pumps during said intake strokes, said pumps, said hopper, and said outlet pipe being rigidly secured together to form a unit with the pumps downwardly inclined relative to the outlet pipe, and a generally horizontal pivot mounting said unit on said frame adjacent said pump ends whereby the unit is tiltable relative to the frame to raise the lower ends of said pumps into a transport position.

9. In a concrete pump, the combination of, a frame

adapted to be supported in a generally horizontal position above the ground; and power mechanism on said frame; and a pumping unit mounted on said frame adjacent one end of the latter, said pumping unit including an outlet pipe projecting outwardly from said one end, a pair of elongated reciprocating pumps disposed side by side with the output ends of said pumps adjacent the inner ends of said delivery pipe and with the opposite end portions of said pumps inclined downwardly away from said output ends at a predetermined angle to lie generally beneath said power mechanism, said power mechanism operating said pumps in timed relation with each other with each pumping during the intake strokes of the other, an upwardly opening hopper disposed above said output ends to hold a supply of fluent concrete and having an opening in its underside, valve means for delivering concrete from said hopper to the pumps during their intake strokes and delivering the output of the pumps to said outlet pipe, said pumps, said outlet pipe, said hopper, and said valve means being mounted on a rigid framework adjacent said one frame end, and a generally horizontal transverse pivot between said frame and said framework adjacent said pump output ends supporting the framework on the frame for rocking relative thereto between an operating position in which said pumps are inclined downwardly at said predetermined angle, and a transport position in which the lower ends of said pumps are raised substantially.

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