Aug. 3, 1954

C. I. LONGENECKER

2,685,259

VALVE CHAMBER FOR CONCRETE PUMPS

Filed Oct. 2, 1950

4 Sheets-Sheet 2

Fig. 2.

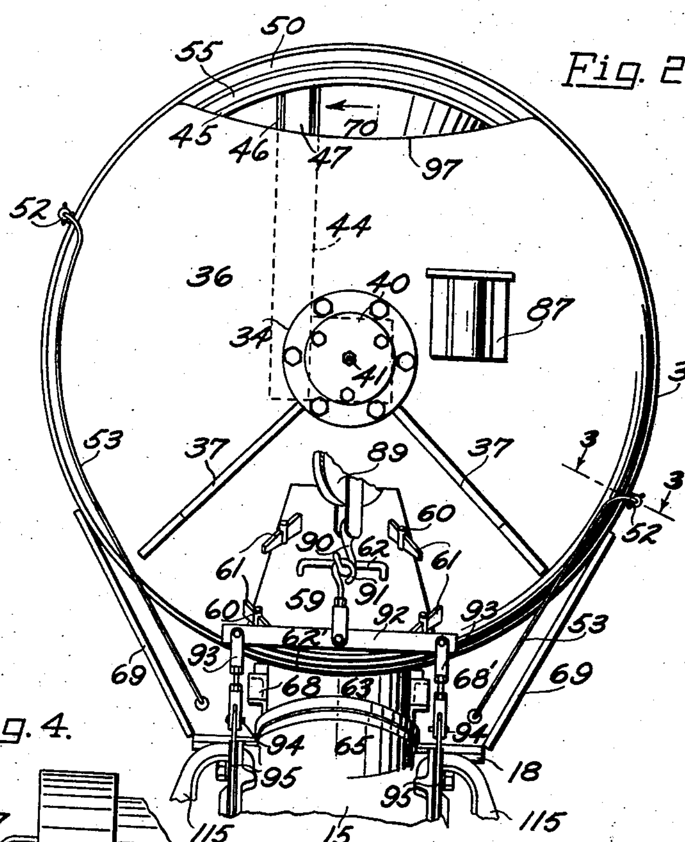

Fig. 4.

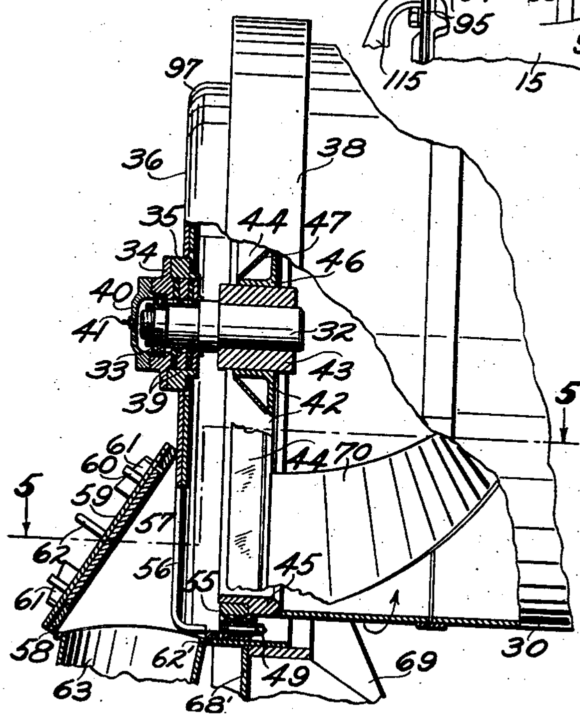

Fig. 3.

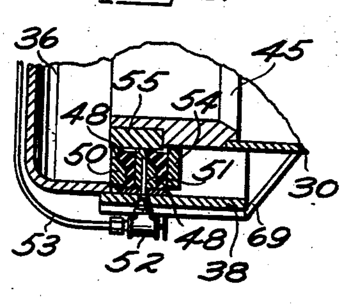

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Fig. 5.

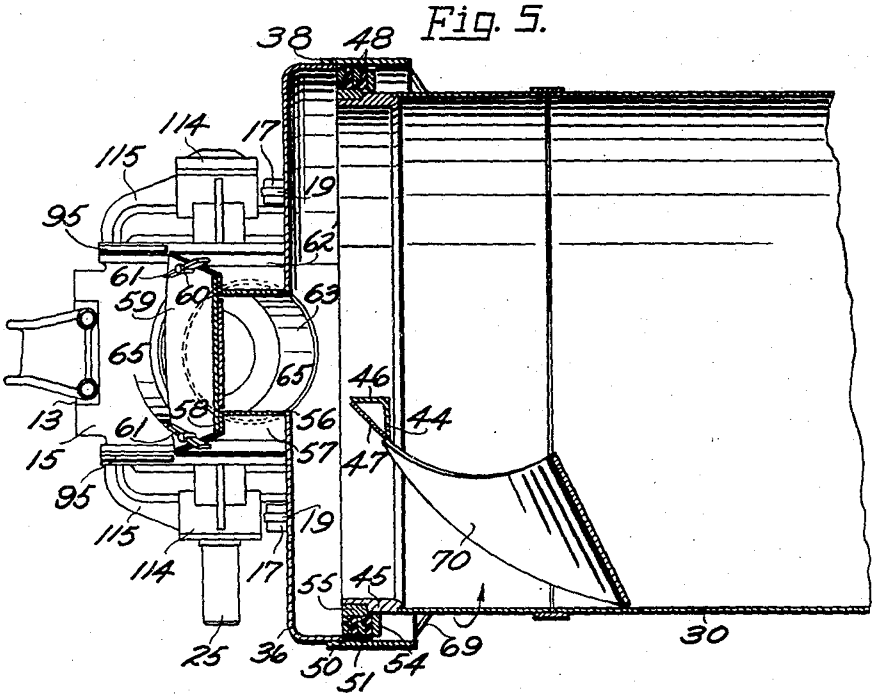

Fig. 7.

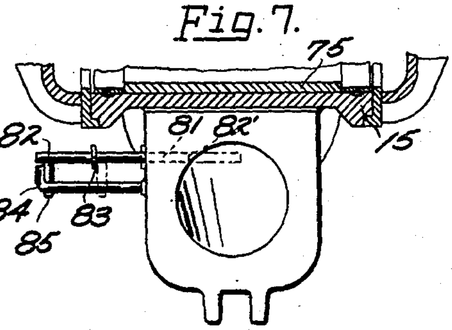

Fig. 6.

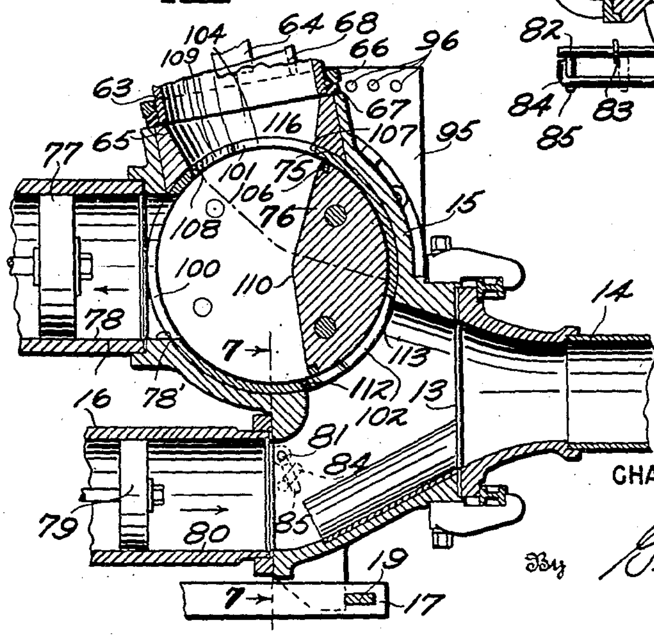

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Fig. 8.

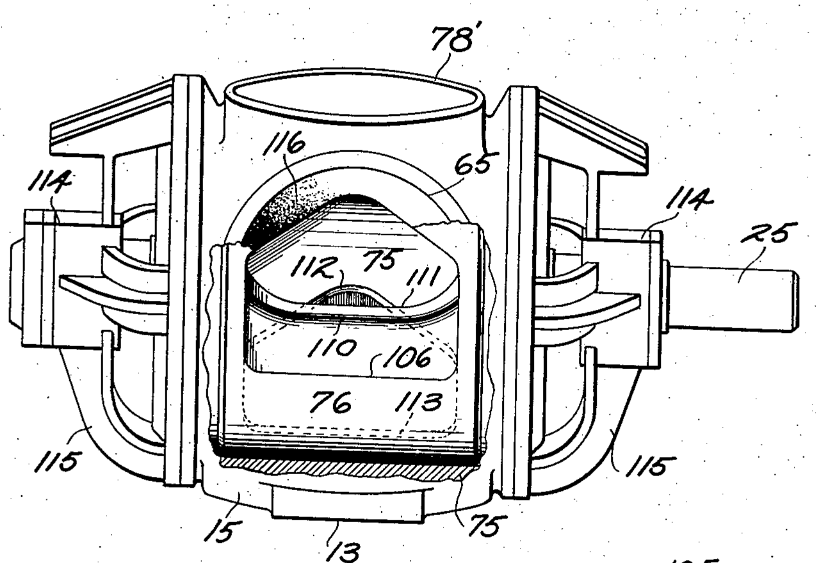
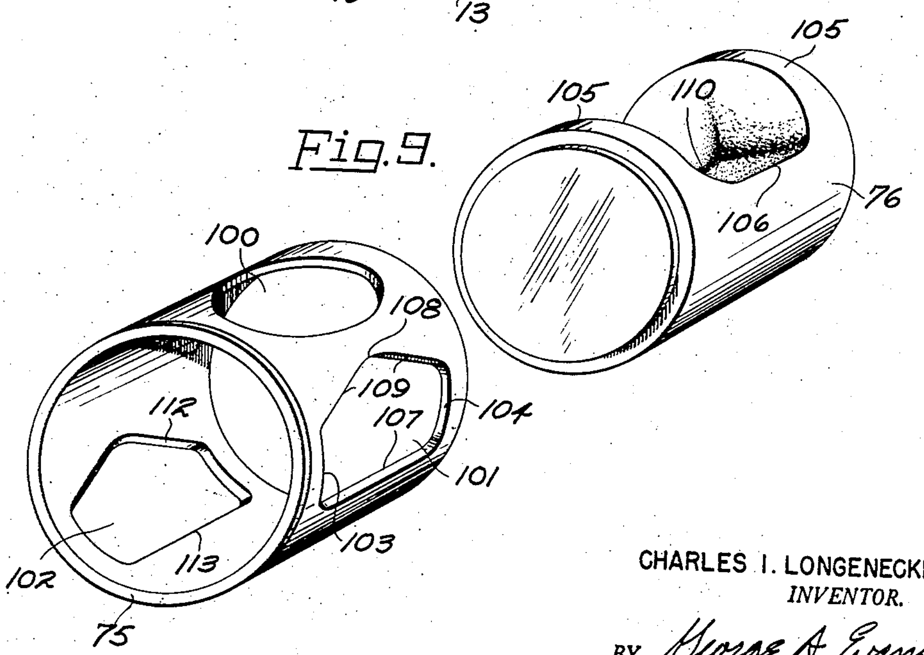


Fig. 9.



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Patented Aug. 3, 1954 2,685,259

UNITED STATES PATENT OFFICE

2,685,259

VALVE CHAMBER FOR CONCRETE PUMPS

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Application October 2, 1950, Serial No. 187,917

6 Claims. (Cl. 103—227)

This invention relates to concrete pumps and particularly to the valve chambers thereof and provides means for increasing the efficiency of the pump by changing the contour of the orifices leading into the valve chamber. The invention has other objects, relating to the improved performance of the pump and resides in the novel disposition and combination of parts as hereinafter set forth.

The valve used in the present embodiment of the invention is of the oscillating plug type and controls the admission and expulsion of concrete from the working chamber of the piston or other propulsive means employed in pumping. One of the principal characteristics of these valves, as used in the past, has been the fact that the valves are not completely closed in shutoff position. Instead, stowing of the concrete at the restriction is relied upon to complete the shutoff action.

The provision of clearance between the valve and its orifices has the advantage that the valve does not have to shear through stones and other concrete ingredients which lie in its path, and hence the life of the valve is greatly prolonged. The tendency of concrete to stow under the pressures developed by the pump is utilized to close the opening and maintain the pressure essential for pumping the mixture through the pipeline.

While the foregoing considerations have been successfully utilized in the design of concrete pumps, the action is not perfect and the valves allow some loss of pressure, which diminishes the efficiency of the pump. This results in reducing the distance concrete can be pumped with an engine or motor of specified horsepower.

In general the amount of clearance provided between the valve and the inlet and outlet openings has been of the order of the largest dimension of the maximum size of aggregate that is included in the concrete mixture. Thus, if the largest stone is say two and one-half to three inches in its longest dimension, the clearance is of the same order, i. e., about three inches between the leading edge of the valve in closed position and the adjacent edge of the opening.

It is an object of the present invention to reduce backflow through the valves of concrete pumps, thereby increasing their pumping efficiency.

A further object of the invention is to provide an improved design of opening for valves of the character discussed which while still avoiding the necessity of the valve crushing aggregates in its path, reduces the amount of clearance and hence the possibility of backflow and loss of efficiency.

The objects of the invention are accomplished by making utilization of the fact that the aggregates in the concrete mixture readjust themselves while stowing in the clearance provided at the valve, and thus if enough space is left for only one aggregate of the maximum permissible dimension, the clearance may be reduced and the valve may be moved to its closed position without having to shear or crush aggregates.

It is another object of this invention to provide means for removing air which may be in the working chamber at the start of operation of the concrete pump.

This application is a continuation in part of my copending application, Serial No. 771,276, filed August 29, 1947, entitled "Apparatus for Pumping Concrete," now Patent No. 2,548,733 issued April 10, 1951.

One embodiment of the invention is illustrated in the accompanying drawings wherein:

Fig. 1 is a side elevation of a concrete pump with its supporting framework and an agitating receptacle mounted thereon;

Fig. 2 is an end view of the upper portion of the apparatus shown in Fig. 1;

Fig. 3 is a section taken on the line 3—3 of Fig. 2;

Fig. 4 is an enlarged side elevation partly in section showing the discharge end of the agitating receptacle and the inlet end of the pump;

Fig. 5 is a section taken on line 5—5 of Fig. 4;

Fig. 6 is a vertical section taken through the center of the valve of the pump showing the disposition of the valve and piston chambers;

Fig. 7 is a section taken on the line 7—7 of Fig. 6;

Fig. 8 is a view of the valve chamber, with parts broken away, looking down through the inlet opening; and

Fig. 9 is an exploded view of the valve liner and valve plug which operates in the valve housing.

The concrete pump illustrated in the drawings is of the differential piston type, such as is disclosed in U. S. Patent No. 2,448,104 which issued August 31, 1948, from an application filed December 6, 1945, entitled "Differential Concrete Pump." Its valve construction is disclosed in my copending application Serial No. 763,328, filed July 24, 1947, now Patent No. 2,589,012, entitled "Valve For Plastic Concrete Pressure Pump." It will be appreciated, however, that many of the features of this invention are not restricted in their application to use with pumps of that particular construction and can be operated with pumps of different types of construction.

The pump illustrated in Fig. 1 of the drawings is mounted on a skid base 11 at one end of which is mounted the engine 12, and at the opposite end of which is located the discharge 13 of the pump to which the pipeline 14 is connected. The valve body 15 is arranged to register with the ends of the piston chambers 16, and said body is detachably supported by forwardly extending brackets 17 which are mounted on a front pedestal 18 through which the piston chambers 16 extend. It will be observed that the valve body 15 is held in position by wedges 19 which are driven through slots in the brackets 17 and which exert force on abutments of the valve body, thereby effecting sealing engagement of the body with the ends of the piston chamber.

The transmission for operating the pistons is enclosed in a housing 20 from one side of which there extends a shaft 21 for operating the oscillating pump valve. The operating means for accomplishing the latter consists of a cam 21′ mounted on the crank shaft 21, cam lever 22, connecting rod 23 and valve operating arm 24. The arm 24 is keyed to a trunnion 25 which extends from one side of the valve plug.

At the rearward end of the skid base 11 and on each side thereof are upstanding frame members 26, the upper portions of which are connected by a cross member 27 on which is mounted a pair of laterally spaced brackets 28 each of which supports a bearing for a roller 29. Rollers 29 form a bed for supporting the charging end of the agitating receptacle 30 and cooperate with a track 31 which surrounds the circumferential body of that receptacle.

The forward end of the agitating receptacle 30 is supported as best illustrated in Figs. 2 and 4 by an axially disposed shaft 32 mounted in a bearing 33. Bearing 33 is housed by a collar 34 bolted to a hub 35 located at the center of the stationary dished head 36. Reinforcing members 37 are welded to the outside of said head to strengthen the same while a rim member 38 secured to the periphery of the head and extending rearwardly of the agitating receptacle 30 constitutes an enclosure for the forward end of the receptacle. Bearing 33 is protected from the concrete in the agitating receptacle by annular sealing members 39 which are mounted in the hub 35 and which bear against shaft 32. A cap 40 fitting on the collar 34 and equipped with a grease fitting 41 encloses the outer end of the shaft 32.

The inner end of shaft 32 is secured to a spider 42 which is connected to the forward end of the agitating drum 30. The spider 42 is of welded construction and consists of a hub 43 having a square periphery to which there are secured the spokes 44 which are connected to the ring member 45 at the end of the receptacle 30. Each spoke 44 comprises an angle member 46, the ends of which are connected by the diagonal plate 47, the function of which will be later explained. The distance between the forward end of the spokes 44 and the head 36 is just sufficient to accommodate the largest stones which the pump is designed to handle, and hence any such stones in the mix may be forced against the head and the receptacle can continue to rotate and clear the stones without danger of breakage or the imposition of excessive power demands.

The diameter of the ring 45 is somewhat smaller than the diameter of the stationary rim 38 in order that a seal may be accommodated between them. This seal, which is of very similar construction to the seal 39 for the shaft 32, comprises a pair of annular deformable members 48 of rubber or other suitable material held in place by a series of circumferentially spaced bolts 49 which are threaded into a backing ring 50 which is welded or otherwise secured to the rim 38. This construction is best illustrated in Fig. 3. Two sealing members 48 are spaced apart by an annular member 51 which is provided with radial apertures at suitable points in its periphery to enable lubricant to be supplied thereto through fittings 52 fed by means of pipes 53 from a source of lubricant supply. The outer of the two rings 48 is retained by the washer 54 against which the heads of the bolts 49 bear. The inner ends of the sealing members 48 have elongated tip portions which bear against an annular insert 55 mounted on the ring 45, and the tip portions of the members 48 are deformed to provide an increased sealing surface against the insert 55.

The head 36 is provided with an aperture 56 directly below the hub 35 which extends from the periphery of the head a distance roughly equal to one-half the radius of said head. The radial sides of the slot 56 taper inwardly toward the center of the head, and on either side thereof and extending forwardly are triangular shaped plates 57 defining the upper sides of a conduit for the concrete passing from the agitating receptacle to the pump. The forward ends of the plates 57 are enclosed by a frame 58 against which a cover plate 59 is fitted. Bolts 60 extending through the frame 58 and the cover plate 59 are slotted so that wedges 61 may be driven therethrough to force the plate into sealed engagement with the frame and prevent passage of air into the pump. When the wedges 61 are removed the plate 59 may be lifted from the frame 58, handle 62 being provided to facilitate such removal.

The disposition of the cover plate 57 as provided herein, enables the operator in some instances to discharge the contents of vessel 30 without the latter passing into the pump. This would be done if perchance a bad batch of concrete should be delivered to the agitator and not detected until the agitator was charged. The pressure which the blades 70 exert is sufficient to force the concrete through the lateral opening provided in the conduit by removal of the cover plate 59.

The bottom edges of the triangular plates 57 are welded to a horizontal plate 62′ having a circular aperture registering with a cylindrical member 63 which leads to the pump inlet. Mounted on either side of the cylindrical member 63 are angle shaped brackets 64. As illustrated in Fig. 6 the end of the cylindrical member 63 is spaced slightly from the inlet end 65 of the valve body of the pump, and surrounding the end of the cylindrical member 63 is a loosely fitting metal ring 66 which rests on a rubber washer 67 which fits tightly around the lower end of the pipe 63. The annular rubber member 67 abuts the edges of the opening 65 and has a tapered upper surface arranged to mate with the complementary tapered surface of the ring 66. A tight seal is maintained by driving wedges 68 between the brackets 64 and the ring 66, the outer portion of the rubber member being pressed downwardly against the inlet 65 and the inner surface gripping the conduit 63. The use of rubber in the seal compensates for tolerances that might occur in manufacture which would make it difficult to align the surfaces, since both the valve body and the feeding apparatus are separately mounted on the pump frame.

The head 36 is supported by a vertical plate 68′ and by the side plates 69 which are mounted on the frame pedestal 18. This structure not only carries the weight of the forward end of the agitating receptacle 30, but also takes the end thrust which the spiral blades 70 in the receptacle exert on material being forced against the end plate 36.

As illustrated in Fig. 5, the spiral blade 70 joins the forward side of the spoke 44 and is securely fastened thereto. The diagonal face 47 of the spoke has a propulsive effect similar to that of the blade and forces the concrete under considerable pressure through the slot 56 and hence into the pump. The receptacle illustrated is provided with two spiral blades set 180° apart connected to two of the four spokes in the spider 42. When the drum is rotated in the direction indicated by the arrow shown in the drawings, blades 70 which extend for the full length of the drum 30 are arranged to propel the concrete which is introduced at the rearward end of the drum to the forward end. The height of the blades 70 adjacent the discharge opening is substantially the same as the height of the opening 56 in order that pressure may be exerted on the concrete across the full cross sectional area of the opening as the drum is rotated and the end of the blade passes the opening. A chute 71 mounted at the rear end of the drum facilitates transfer into the drum, and the drum is rotated by a chain 72 meshing with a sprocket 73 mounted on the drum a slight distance forwardly of the track 31. The power to drive the chain may be derived from a sprocket 74 driven by the same source of power as is used to operate the concrete pump.

As previously mentioned the concrete may be charged into the receptacle 30 faster than the pump can take it away, and in this event the concrete will pile up at the discharge end of the receptacle, assuming it be constantly rotated, until the level of concrete at the head 36 may be above the shaft 32. Should there be an interruption in pumping which is not unduly long, the concrete in the receptacle is continuously agitated and maintained in a plastic condition.

No agitation is provided within the conduit leading from the agitating receptacle to the pump. Should the material in this conduit become unpumpable for any reason, it may be removed from the conduit by removal of the cover plate 59. In most instances, however, upon resumption of pumping operations, the suction of the pump augmented by the pressure of the blades 70 is sufficient to move into the pump the concrete which has not been stagnant too long in the conduit leading from the agitator to the pump.

A section through the valve body 15 is illustrated in Fig. 6 according to which the inlet 65 communicates through a port in the valve liner 75 with the valve chamber. The segmental plug valve 76 having a substantially V-shaped channel therein is arranged to oscillate from the full line position shown in Fig. 6 to the dotted line position shown in said figure. In the full line position shown the piston 77 in the cylinder 78 is exerting suction and drawing concrete through the inlet 65 from the agitating receptacle. The aggregates are heaped high at the discharge end of the agitating drum 30 and, as previously pointed out, the blades 70 are assisting in forcing concrete into the cylinder 78. At the end of the

suction stroke of the piston 77, the valve shifts to the dotted line position shutting off the inlet and exposing the port in the liner 75 which leads to the outlet. The piston 77 now expels the concrete through this port, but instead of all of the concrete going into the pipeline 14, the use of the smaller piston 79 provides for a portion of this concrete entering the chamber 80 in which the smaller piston operates. During the propulsion stroke of the larger piston 77 the smaller piston draws concrete into its chamber, which it expels into the pipeline when the valve returns to its original, full line position.

At the start of operations with the concrete pump, whatever air is in the valve appears to collect in the upper portion of the smaller piston chamber 80 instead of being expelled into the pipeline. This results in the smaller piston chamber not being filled with concrete and the full advantages of the differential piston arrangement are not obtained. To get the original air out of the valve an aperture or air-exhaust port 81 is formed in the side wall of the valve body just in front of the lower piston cylinder 80 and near the top thereof. A rod 82 which fits snugly in this port is arranged to extend, when fully inserted, so that its inner end 82′ is approximately in line with the vertical axis of the piston 79. A washer 83 limits the extent to which this rod may be inserted into the working chamber of the pump. The rod 82 is prevented from being forced out of the chamber by a keeper 84 which engages a handle 85 on the rod. At the start of operation, however, and in order to get the air out of the chamber the rod may be turned, thus freeing the handle 85 from the keeper 84 and permitting removal of the rod. Often concrete may cover the inner end of the port 81 and hence it is provided that the rod may be moved inwardly to the dotted line position shown in Fig. 7 in order to provide a channel through the obstructing concrete between the air pocket and the port through which the air may escape when the rod is removed. It requires only a short time to remove the air from the cylinder, after which the rod is relocated in the aperture 81 and pumping may proceed without air trouble.

In large concrete pumping jobs it is desirable to be able to pump practically continuously because any shutdown necessitates cleaning out the pump and pipeline, or else the concrete will set. The present pump is designed so that in case some portions of the valve become worn or need repair, the entire valve body can be removed and a stand-by valve body which is on hand substituted without requiring a clean-out of the pipeline. This latter operation is facilitated by the provision of a boom 86 pivotally mounted for horizontal movement in a bearing housed in a bracket 87 mounted on the end plate 36 of the storage receptacle. A carriage 88 which may traverse the boom 86 carries a block and tackle designated 89, the hook 90 of which can be inserted in a hook 91 mounted on the upper portion of the valve body to permit the lifting and removal of the valve body from the pump. To balance the weight of the valve body on the hook 90, the hook 91 is secured to a cross bar 92, the ends of which are pivotally connected through turnbuckles 93 and bolts 94 to upstanding members 95 on either side of the valve body, as illustrated in Fig. 2. In Fig. 1, members 95 are illustrated as provided with a plurality of apertures 96 affording choice in the selection of holes through which the bolts 94 are inserted. As a result the yoke formed by the cross bar 92 and the turnbuckles 93 may be set at a slight angle to the axis of the valve, so that the bar may intersect the center of gravity of the valve body. This facilitates aligning the body with ends of the piston chambers.

The upper portion of the head 36 is cut away at 97, as illustrated in Fig. 2, in order that the pumpability of the concrete being fed into the pump may be observed. The cover plate 59 may likewise be removed, as previously explained, to facilitate clean-out or loosening of any obstructions that may occur in the inlet portion of the pump.

Referring now to Figs. 8 and 9, the cylindrical liner sleeve 75 (best illustrated in Fig. 8) is provided with three ports, port 100 being circular in shape and in line with the opening 78' to which the piston cylinder 78 communicates. Port 101 is the inlet port which receives concrete from the valve chamber inlet 65, and port 102 is the liner outlet port which permits discharge of concrete from the valve into the lower portion of the valve body and through the outlet 13 which communicates with the pipeline 14, as previously described.

As illustrated in Fig. 9, ports 101 and 102 of the liner plate are of like size and contour, the port 101 having side edges 103 and 104 which are circumferential and spaced apart approximately equal to the width of the opening provided between the cylindrical end portion 105 of the valve plug 76. The side faces of the channel through the plug 76 are therefore in registry with the side edges 103 and 104 of the liner opening. When the inlet port is fully open, the cutoff edge 106 of the plug is approximately in registry with the rearward edge 107 of the liner port, both of such edges being axial of the plug. The valve is shown in this position in Fig. 8 with the full area of the inlet port 101 open so that concrete may pass therethrough and through the channel of the valve into the piston chamber 78.

When the valve is swung to close the inlet port, the edge 106 of the valve plug moves across the opening in the liner until the edge approaches the apex 108 of the V-shaped forward edge 109 of the liner plate. The plug does not completely close the inlet, but the edge 106 overlaps the lateral extremities of the converging sides of the edge 109. The opening which is left is roughly triangular in shape, is substantially narrower than the width of the edge 107, and is of a dimension such that the largest aggregate in the concrete mixture can be stowed therein without the valve having to shear such aggregate.

As shown in Fig. 6, the section through the valve plug 76 shows the plug is segmental. This is also illustrated in Fig. 8, the apex of the segment 110 being slightly rearward of the lower cutoff edge 111. Fig. 8 also illustrates the amount of clearance between the cutoff edge 111 of the valve plug and the forward V-shaped edge 112 of the outlet liner port. It will be understood that this clearance is substantially the same as that provided in the inlet port 101 when the valve is moved to approximately close that port. When the valve is moved to close the inlet port, the outlet port is fully opened, the edge 111 then registering with the rearward edge 113 of the outlet port 102 to permit unobstructed passage of concrete from the valve.

The plug 76 illustrated in Fig. 9 is shown separate from the trunnion 25 to which it is welded or otherwise secured. Suitable bearings located in housings 114 are mounted by spiders 115 on the valve housing 15, said bearings journalling the trunnions 25 which enable oscillation of the valve in the manner described.

Hardened inserts as shown in Fig. 6, and as described in detail in my aforementioned application, Serial No. 763,328, now Patent No. 2,589,012, may be provided in the cutoff edges 106 and 111 of the valve plug to resist wear at these points. The liner material should also be chosen with a view to resisting wear and prolonging the life of this part of the pump.

Naturally the faces, such as the inlet face 116, of the openings which communicate with the liner openings should merge gradually with the notched edges 109 and 112 of the liner ports so as to provide no sharp corners around which the concrete must pass.

The invention having been described what is claimed is:

1. In apparatus for pumping concrete, a valve body having an inlet and an outlet and an air-expulsion port, means for feeding and maintaining a supply of concrete to the valve chamber whereby the inlet is constantly covered with concrete serving as a seal to prevent entrance of air to the pump, and means for removing initial air from an air pocket within the valve chamber comprising a member normally disposed within said port and closing the same, said member being arranged for movement within said chamber to provide a channel through the concrete between the air pocket and the port prior to removal of the member for the purpose of exhausting air from the chamber.

2. In apparatus for pumping concrete, a valve chamber having an inlet and an outlet and an air-expulsion port, means for feeding and maintaining a supply of concrete to the valve chamber whereby the inlet is constantly covered with concrete serving as a seal to prevent entrance of air to the pump, and means for removing such air as might be in the valve chamber comprising a rod-like member normally disposed within said port and closing the same, said member being arranged for axial movement in said port, either for removal of said member or for displacement of concrete within said body which might block said port, and means for limiting axial movement of said member when it is closing the port.

3. In a pump for pumping concrete or the like, a valve chamber, a conduit presenting an opening into said chamber, said opening being of generally rectangular shape except for one side which is notched to increase the size of the opening, and a valve operable in said chamber having a substantially U-shaped channel extending therethrough, the sides and bottom of said channel generally conforming to the unnotched sides of said opening to provide an unrestricted passage through the valve when it is opened, the notched side of said opening cooperating with the bottom of said channel when the valve is moved to closed position to center large aggregate in the center of the notch while the smaller aggregate and grout is stowed in the corners to prevent loss of pressure even though the opening is not completely closed when the valve is moved to closed position.

4. In a pump for pumping concrete or the like, a valve chamber having inlet and outlet openings, a cylindrical valve liner disposed within said chamber having openings registering with said inlet and outlet, one of said openings having

substantially straight edges except for one edge which is V-shaped to increase the size of the opening, and an oscillatory plug valve disposed within said liner having a substantially U-shaped channel therein, the sides and bottom of which register with the straight edges of the aforesaid opening when the valve is fully opened, the V shaped edge of the opening cooperating with the bottom of the channel when the valve is moved toward closed position to center large aggregate at the apex of said edge while finer aggregate and grout is stowed at either side, thereby enabling the valve to hold pressure when in closed position even though the opening is not fully closed.

5. In apparatus for pumping concrete, a working chamber through which the concrete is moved, a conduit having an opening communicating with said chamber, a movable valve member cooperating with said opening and having a substantially U shaped channel therein with flat sides and a flat bottom to provide maximum area for passage of concrete, said opening being rectangular in shape with three edges arranged to correspond to the sides and bottom of the aforesaid channel when the valve is fully open, the fourth edge of the opening having a V shaped notch to enlarge the opening, said fourth edge cooperating with the bottom of the valve channel to center large aggregate in the notch and promote showing of concrete when the valve is moved to closed position, whereby pressure may be maintained in the chamber even though the opening is not fully closed.

6. A valve liner for concrete pump valves of the oscillatory plug type having a substantially U shaped channel extending therethrough with flat sides and a flat bottom to provide maximum passage space, said liner having an opening with three generally flat edges registering with the sides of the aforesaid channel when the valve is fully opened, the fourth edge of said opening having a V shaped notch to increase the size of the opening and promote centering of aggregate in the notch when the bottom of the channel is moved to close the opening, whereby because of stowage of concrete in the opening, the valve need not be fully closed to maintain pressure in the pump.

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