Nov. 24, 1936. C. F. BALL 2,062,200

TANDEM VALVE CONCRETE PUMP

Filed Oct. 12, 1935 2 Sheets-Sheet 1

Fig. 1.

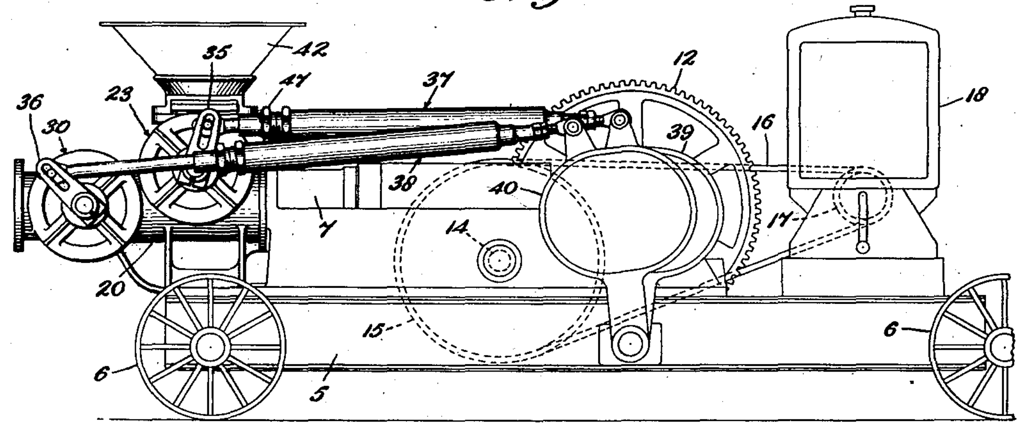


Fig. 3.

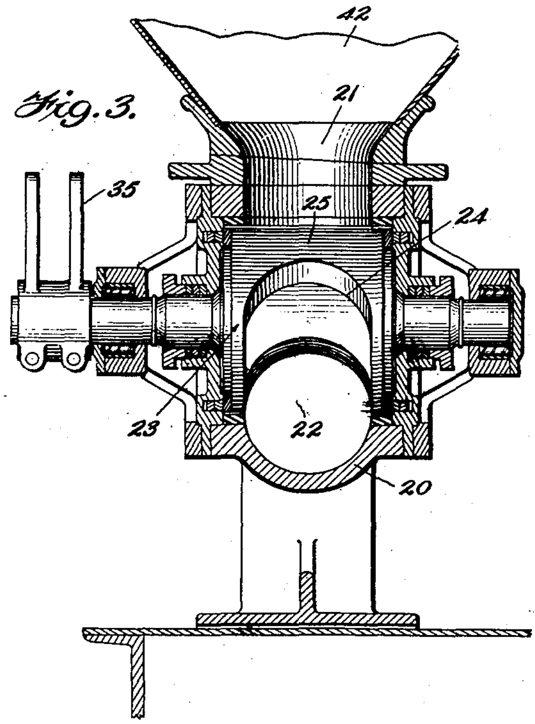
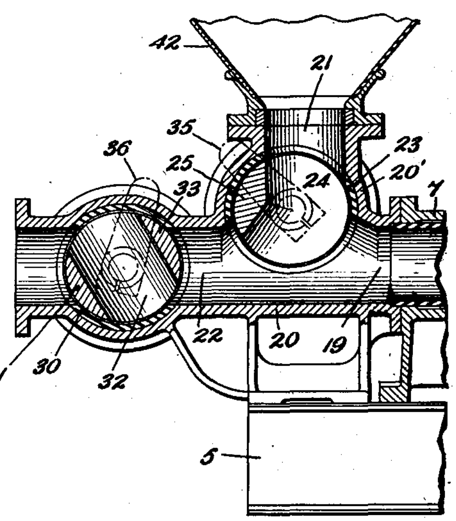


Fig. 4.



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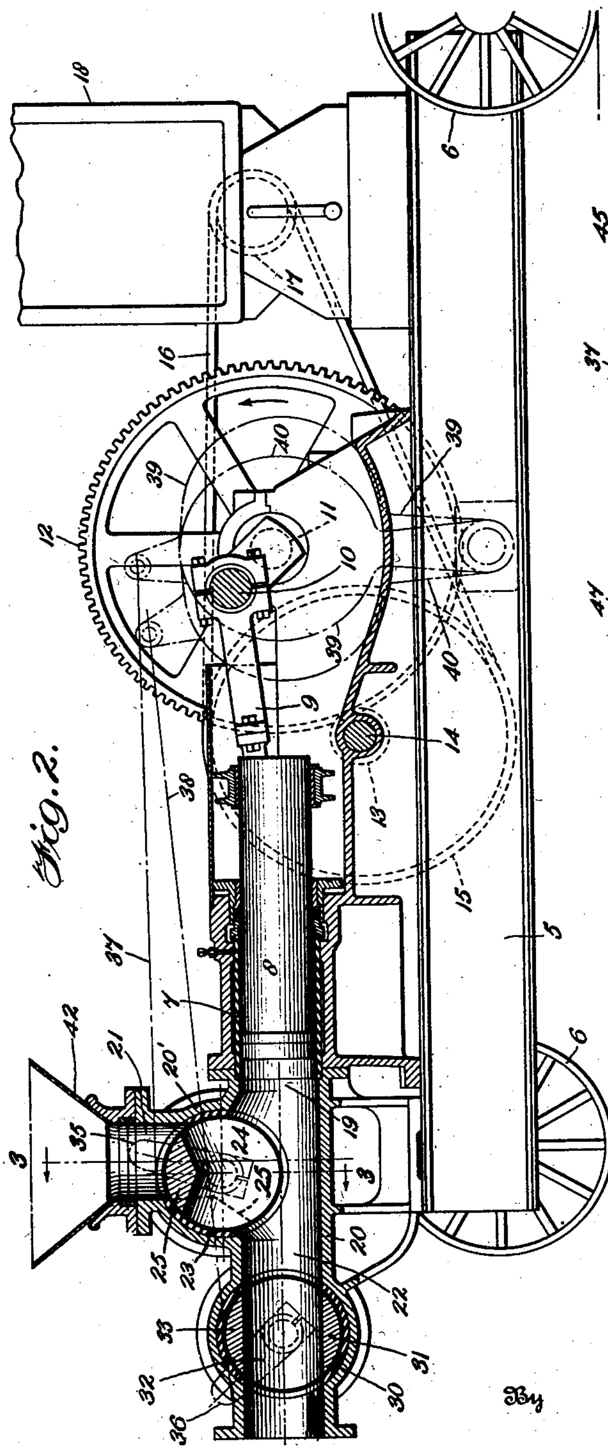

Fig. 2.

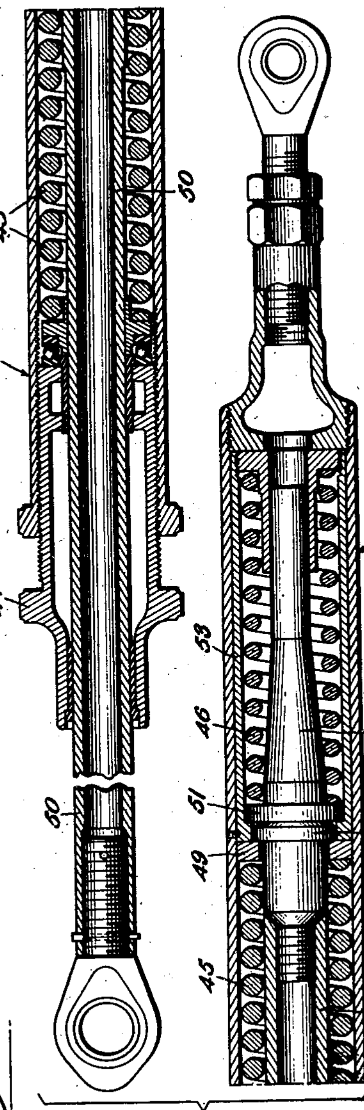

Fig. 5.

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Patented Nov. 24, 1936 2,062,200

UNITED STATES PATENT OFFICE

2,062,200

TANDEM VALVE CONCRETE PUMP

Charles F. Ball, Wauwatosa, Wis., assignor to Chain Belt Company, Milwaukee, Wis., a corporation of Wisconsin

Application October 12, 1935, Serial No. 44,793

16 Claims. (Cl. 103—227)

My invention relates to concrete pumps, for pumping plastic concrete mixtures through an associated pipe-line from the pump's convenient station on the job into the erection-forms in which the mixture will be compacted and allowed to set or harden.

Pumps for this purpose, of substantially the specific construction shown in Patent No. 2,017,-975, granted October 22, 1935, to Jacobus C. Kooyman, (on his application co-pending herewith, Serial No. 652,077, filed January 16, 1933) have been in extensive commercial use for several years past; and in one of its aspects my invention directly improves on such Kooyman pump, for I desirably use in the embodiment of my invention various features set forth in said patent, as will hereinafter more fully appear.

Field experience has shown that for many important concrete structures the mixture best suited to the job, to give desired strength and quality to the finished work and as well to minimize cost of the concrete, is of the sort commonly referred to as a "small slump mixture" containing a high percentage of graded coarse aggregates. Also, such mixtures,—being relatively very dry, dense and difficultly workable at best—generally have been extremely hard to handle by pump and pipe-line with entire satisfaction, prior to my invention.

In a more general aspect, one important object of my invention is to provide an improved pump of the reciprocating-piston type so organized that it will handle a very wide range of concrete mixtures including the very difficult ones last mentioned, and will handle the latter with a reliability that avoids troubles and shut-downs, with an efficiency that insures steady delivery of a very high percentage of the pump's theoretical delivery-capacity, and with an over-all economy, due to savings of labor, time and waste, that will excel in each stated respect the performance characteristics of any previously existing or proposed concrete pump of which I am aware.

Other and further objects of my invention will become apparent hereinafter, and success in attainment of my objects has been fully demonstrated in the quite extensive commercial use to which my improved pump, substantially as shown in the drawings hereof, has already been put.

The commercially desirable small slump mixtures above referred to are commonly characterized as follows: The larger aggregates, of over .25 inch screening size, generally preponderate over the finer aggregates. The graded coarse aggregates are made up of a number of different screening sizes, in due proportions of each, with the coarsest pieces sometimes being notably large in proportion to the cylinder-bore of the pump to be used—say of 3 inch screening size, to be handled by a pump of say 8 inch bore and 12 inch stroke and a pipe line of the same or slightly less internal diameter. The fine aggregates as well are also preferably graded, from nearly .25 inch size to fine sand, and under the proper mixing these finer particles mingle so densely with the coarser pieces as to leave an approximate minimum of voids. For this reason, and because of the coarseness of the largest pieces, the requirement of cement-and-water paste requisite to coat all pieces and particles of the aggregates and to fill the voids is substantially minimized, with resultant economy in cement requirement, and with advantage in reduction of the heat of hydration consistent with such reduction in cement content; while the comparative smallness of the fluid content enhances early high strength of the placed concrete.

As affecting the somewhat obscure conditions of inter-action between different ingredients of the mixture, and between the mixture and the pump and its pipe-line, under the varying forces that act upon the mixture in the pumping operation, the inherent resistivity of such mixtures to successful, reliable pumping is unquestionably aggravated greatly by the "dryness" and what I may call the "solid density" thereof. The "lubricating effect" of the paste and the fines, as between pieces of the aggregates themselves and as between them and the internal surfaces of the pump and pipe line, is lessened by the meagerness of moisture; the resultant small slump or steep angle of repose militates against passing of the mixture through the mouth or open end of the cylinder to charge the cylinder under conditions of gravity-and-suction feed; and the solid density and consequent minimization of voids makes it particularly difficult for the coarser aggregates to change relative position for accommodation of direction-changes within the pump or pipe-line when being propelled by the piston's working stroke. Such density and meagerness of "lubrication", together with the heightened pressure that must be exerted by the pump on its working stroke to propel a given line-pipeful of concrete, all enhance the tendencies of the concrete to "stow" at restrictions within the pumping system and to pack solidly and self-sustainingly in passages and passage-enlargements.

In accommodating these difficult characteristics of this class of concrete mixtures with the stated reliability, efficiency and economy, and as well in improving over prior pumps in general serviceability, I find the valving arrangement and particular constructions hereinafter described to give excellent results.

In the accompanying drawings, in which like reference characters designate like parts in all views:

Figure 1 is a side elevational view, partly diagrammatic, of a pump of the same general type as said Kooyman pump, modified to embody the present invention; the inlet and outlet valves being shown in the positions they occupy during the working stroke of the piston;

Figure 2 is a longitudinal sectional view, partly in elevation and partly diagrammatic, and upon a somewhat larger scale, of the pump illustrated in Figure 1, with the parts in the same relative positions, in which the piston has substantially completed its working stroke;

Figure 3 is an enlarged transverse sectional view through the inlet valve structure, taken approximately on the plane indicated by line 3—3 of Fig. 2, looking in the direction of the arrows;

Figure 4 is a fragmentary view, similar to Fig. 2, showing the valves in the positions they occupy during the suction stroke of the piston; and

Figure 5 is a detailed longitudinal sectional view of the valve connecting rod which connects the inlet valve to its actuating mechanism.

Referring to Figs. 1 and 2, a chassis 5 and ground-wheels 6 carry the pump and its power plant, for convenience in moving the equipment to the desired station on the job.

In general, the pump cylinder 7, piston 8 and power plant for the pump are preferably substantially the same as employed in the Kooyman pump of said patent; 9 representing the piston rod connected to crank 10 of the crank-shaft 11, which is driven by reducing gearing, including large gear 12 on said shaft, driving pinion 13 on main drive shaft 14, pulley 15 on said shaft 14, and belt 16 from a smaller pulley 17 on the crank shaft of an internal combustion engine or other source of power mounted within the housing 18.

The open end or mouth of cylinder 7 communicates with a passage 19, of a valve housing structure 20, which also provides an inlet passage 21 extending upward into connection with the gravity supply-hopper 42, and an outlet passage 22, coaxial with the cylinder and passage 19, and communicating at its outer end with the line pipe (not shown), which, of course, leads to the location of the erection-forms to be served. In best practice the internal diameters of the inlet and outlet passages are the same as, or slightly larger, or only slightly less than the bore of the pump cylinder, and in like manner, the cross sectional area of the pipe line which conducts the mixture to the point of placement is not materially greater or less than that of the pump cylinder and passages. For example, with an 8 inch pump, i. e., one having an approximate 8 inch cylinder and passage diameter, it is preferable to employ for heavy duty, long distance, difficult-material jobs, a so-called 8 inch pipe, having an inside diameter of about 7.625 inches. In some instances, as where the material is to be pumped only a relatively short distance, a nominal 7 inch pipe, having an inside diameter of about 6.625 inches, may be used with an 8 inch pump but where any change of the substantially-uniform diameter relationship is made, the tapering of the diameter-reducing part is very gradual.

Passage 21 is provided with a restricting valve 23 and passage 22 is provided with a restricting valve 30. These valves are of the oscillating plug type, horizontally traversing the respective passages they control, and the valves are power-operated from the drive shaft 14, in proper timing for best performance; of which more will be said later.

Each of said valves, 23 and 30, desirably involves features disclosed in said Kooyman patent, in the generalities of having its own passageway 24 and 32, of a size not less than sufficient to fully open the passage it controls when the valve is moved to open position; in providing clearance with respect to its housing in the ported zone of the latter, suitable for circulation of the paste-flowable constituents of the mixture; and in being settable to move, in its passage-closing direction, to adequately restrict the passage it controls. The outlet valve is herein shown as substantially identical with the Kooyman construction; plug 31 having a cylindrical passageway 32 through it which is of the same diameter as the outlet passageway 22, so that in open position the valve passageway 32 aligns with and forms a smooth continuation of said outlet passage. In the "cut-off" position the passageway 32 is angularly disposed, as in Figure 4, with the segments 33 at least partially closing off the passage 22.

According to my invention the inlet valve 23 is constructed differently from, and is novelly arranged with respect to, said outlet valve; so that when the valve 23 is in its closed or inlet-restricting cut-off position at least a portion of its non-cylindrical passageway 24 is in tandem with the outlet passage 22 and its then-open valve 31, thus to have at least a portion of the concrete that is propelled by the working stroke of the piston 8 sweep through the inlet valve's said passageway; as would happen under the conditions shown in Figures 1 and 2, were the system loaded, since the piston 8 is there shown as nearing completion of its working stroke, with the inlet valve 22 in cut-off position and the outlet valve 30 fully open. Upon reversal of positions of both valves, as shown in Fig. 4,—i. e., during the suction stroke of the piston 8,—the "cut-off" positioning of outlet valve 30 effectually relieves the inlet passage from back-slipping of concrete there-through under back-pressure of the concrete in the pipe-line, and facilitates the advantageous performances of the inlet valve involved in the feeding of a fresh charge of the concrete mixture to the pump cylinder.

I have found it to be highly desirable, especially for the handling of the "dry", dense mixtures of large aggregates heretofore referred to, that the inlet valve shall be located substantially as close to the open mouth of the pump cylinder as size requirements of its plug and other mechanical conditions will permit; also that its actuation from "cut-off" position to open position with respect to the inlet passageway 21 shall act to "liven up" the concrete in and adjacent to its own passageway 24 and shall have a tendency to push concrete into the mouth of the cylinder at commencement of the suction stroke, thereby permitting the concrete mixture in supply hopper 42 to slump into the inlet passageway, quickly establishing uninterrupted movement of the concrete from the hopper to the cylinder; and also that the transverse axis of such inlet valve shall be located high enough above the longitudinal axis of the outlet passage to have the passageway 24 of the inlet valve, together with the internally-exposed portion of its housing, afford a substantial-sized arched recess, opening at its bottom, where its horizontal section is of about the greatest area, into the horizontal passageway 22, so that the amount of concrete it will hold, when the valve 23 is in "cut-off" position, is quite substantial, and such concrete is advantageously positioned for the functionings of the valve, to be described later. Each of these desiderata has advantage in itself, and they interact advantageously, and also in conjunction with the outlet valve operation, in attaining the desired and stated results of satisfactory operation, especially on the stated difficult mixtures.

In the specific construction here shown, the parti-cylindrical enlargement 20' of housing 20, in which said inlet-valve plug 23 works, is located very close to the joint of the housing with the cylinder casing 7 of the pump; its transverse axis is located well above the horizontal axis common to the pump cylinder and outlet passage, preferably at a height to bring the bottom arc of the inlet-valve plug substantially in alignment with the pump-cylinder axis. The vertical axis of the inlet passage 21 is offset rearwardly, toward the pump cylinder, as compared with the transverse axis of the inlet valve.

Further, in the preferred specific construction of said inlet valve 23, the passageway through it is of a width (as shown in Fig. 3) corresponding to the diameter of the inlet or outlet passages but is cut through a major lower part of the perimeter of the plug, leaving the end disc of the valve united by a rather shallow segment 25, the peripheral extent of which is somewhat greater than that of the inlet passage 21, and the bluntly-diverging inner walls of which substantially correspond, in sectional curvature, lengthwise of the plug, with that of the inlet passage.

It will be observed that when the valve segment 25 is in cut-off position, it will restrict the inlet passage to any adjusted extent for which its actuating mechanism may be set, which, with some easily pumpable mixtures, may be an adjustment for full closure of the inlet passage, and with more difficult mixtures may be an adjustment for only enough restriction to assure "stowing" of the concrete within its ported zone adequately to complete the virtual closure of said passage; and that in its movement thence toward passage-opening position, the descending forward wall of the segment will sweep the concrete below it downwardly and rearwardly toward the mouth of the pump cylinder. This movement tends to loosen and "liven-up" the affected concrete and produce a pushing thereof backwardly toward the cylinder mouth. With the valve located above and adjacent the axis of the cylinder, this sweep of the valve has effect quite deep in the mixture below it, and movement of the directly affected concrete doubtless aids materially in clearing the rear part of the valve passageway very effectually, the resultant inflow of concrete from the hopper under gravity head and suction created by the piston movement being notably prompt and ample.

It will also be noted that by offsetting the inlet passage 21 with respect to the valve axis, the effective distance from the valve to the mouth of the cylinder is lessened, to aid in the desired action, and at the same time the arcuate length of the upper, forward portion of the valve housing is increased so as to substantially coincide with the sweep of the valve segment 25, for the avoidance of protruding it materially into said passage and for benefits in easing the valve operation.

Concerning the effectual handling of the "dry", dense mixtures in question, the arched pocket above the the outlet-passage, which is presented by the passageway of the inlet valve when the latter is turned to cut-off position, is an additional safeguard against the clogging of the inlet passageway; for although experience has shown that densely-packable concrete tends exasperatingly to pack self-sustainingly within any pocket in the pumping system under the high pressures necessary to propel the concrete to distant delivery points, the large-mouthed, arched shaping referred to, combined with the "pushing" action of the valve plug segment 25 on the concrete as the same moves to open position, is largely frustrative of such occurrence and doubtless aids materially in the effective performance of my pump on such concrete.

Further, it will be noted that with the inlet valve thus placed substantially in the juncture of the inlet passage with the outlet passage, the level at which the supply hopper 42 may be mounted is kept advantageously low, to facilitate loading, decrease head-room requirement, etc.

Since the outlet valve of my pump is identical with the Kooyman outlet valve construction, its valving action will also be the same; in that, since plug 31 has a central cylindrical passageway 32 through it of the same diameter as outlet passageway 22, the side walls thereof will encompass a cylinder-like section of concrete which in the closing action of the valve, is quickly and, in a sense, bodily displaced from the rest of the column contained in the passageway leading from the pump cylinder to the valve or from the valve to the pipe line, as the case may be, and in the valve's opening action is quickly replaced bodily into the concrete column. Only a double shearing action of the concrete column by the segments 33, and such friction as may be encountered in the turning of the valve plug, are involved in such revolving action and only a minimum power expenditure is necessary. On the other hand, in the valving action of my new inlet valve, the valve segment 25 acts, in its movement, as a gate and must needs force and cut its way through the concrete in the valve passageway. It is this cutting or forcing action of the segment 25, when the inlet valve is opening to admit concrete from the feed hopper, that is responsible for the "livening-up" of the concrete in the valve passageway and forcing the same toward the cylinder mouth, and such action of the segment 25 when the valve is moving to open position, necessitates a greater expenditure of power than that required for moving the outlet valve, especially when pumping "dry" dense concrete, and more particularly after a long stoppage of the pump.

The valves 23 and 30 may be actuated by means of valve arms 35 and 36 respectively, which arms in turn are connected by means of pitman or connecting rods 37 and 38, with oscillating levers 39 and 40, which levers are moved by suitable cams on the crank shaft 11, all in precisely the same manner as described in the said Kooyman patent.

To secure best efficiency, it is common practice in concrete pumps of the Kooyman type, to have the valve actuation take place somewhat in advance of the piston movement. For example, before the end of the pressure stroke, the outlet valve starts to close and when the piston reaches the end of its stroke, the valve has been closed a substantial amount. The inlet valve will start to open very shortly after the movement of the outlet valve to closing position is started; but its initial movement is well in advance of the piston reaching stroke end. In pumping densely packable concrete mixtures, this advance movement of the inlet valve while the concrete is still subject to high pump pressure, involves a further increase of power to effect the valve plug movement. At times there are extreme cases where the concrete is not of a uniform mixture, or a segregated mass of coarse aggregate concrete pieces enters the pump chamber, with the effect that the power required to actuate the inlet valve may be sufficient to actually stop the pump's operation.

To insure reliably continuous operation in spite of the above recited difficult conditions, I have found it advantageous to novelly combine the inlet valve with a special type of valve connecting rod for actuating it, the rod being so constructed and arranged as to provide an overload relief in either direction of valve movement. This pressure relief is secured by means of pre-loaded springs; that is to say, springs which will not yield in the course of valve-actuation unless the force required to move the valve plug is greater than the predetermined spring loading. When moving the inlet valve in closing direction, the relief-spring action is usually brought into play only in case the valve segment pinches a piece of aggregate between its edge and the inlet port so squarely that the piece will not squeeze out of its way, notwithstanding that conditions are quite favorable to the escape of pieces of aggregate from such a pinching action. In a pump of the size herein suggested, I have found that the spring giving relief to this closing action of the valve may be desirably pre-loaded to about 1700 pounds, with capacity for pressure-increase to about 4800 pounds. In the valve opening movement, the spring relief becomes effective whenever the power required to push the valve sector 25 to Fig. 4 position, against the resistance of the concrete below it, is excessive. The spring used in affording this relief has sufficient yield-range to permit the valve plug, on occasion, to remain stationary until the pump piston has reached the end of its propulsion stroke, at which time the valve connecting rod is well started on its valve-opening travel; and in existing pumps I have found good results to flow from the use of a spring pre-loaded to about 1800 pounds pressure, with a capacity for pressure increase to about 2900 pounds before the spring reaches "solid length"—which condition it reaches quite early in the valve-opening travel of the valve connecting rod, if the valve is offering sufficient resistance. It will be understood that at the time the piston reaches the end of its propulsion stroke and ceases to apply pressure to the concrete that lies below the inlet valve, the outlet valve 33 has partly closed, thereby reducing back-pressure on said concrete that underlies the inlet valve, and under these conditions the action of the compressed relief spring is usually sufficient—if the inlet valve has remained this long in cut-off position—to start the inlet valve plug in rapid movement, so that the latter "catches up" to its fully-open position at the same point in the piston's suction stroke as it would if positively actuated without spring relief. Should the resistance to the opening movement of the inlet valve be excessively high, the valve connecting rod will actuate it positively to overcome such resistance, after the relief spring is compressed to solid length.

One form of my novel connecting rod for use in the stated combination with the inlet valve, which is shown in detail in Figure 5, has incorporated therein a coiled spring 45 which may be compressed when the valve rod is lengthened in the course of moving the valve to cut-off position, a coiled spring 46 which is compressed whenever the valve rod is shortened in opening the valve; each of said springs being appropriately pre-loaded, as above indicated. The pre-loading compression of spring 45 can be changed by turning the adjusting nut 47.

Whenever unusual resistance is encountered in the closing of the inlet valve 23, spring 45 is further compressed by outward movement of rod 50; the load being applied to the spring through rod head 48 and washer 49; and whenever unusual resistance is encountered in the opening of the valve, spring 46 is compressed by inward movement of rod 50; the load being applied to the spring through rod head 48, pressing against head 51 of spring retainer 52.

Normally washer 49 is seated against the end of the shouldered lining member 53 of the spring 45 and head 51 is seated against the interior shoulder of the lining member 53 by spring 46. My construction of the valve-connecting rod is such that each loaded spring, 45 or 46, is further compressed independently of the other.

In résumé, I have found that troubles in feeding the pump by gravity and suction, and other obscure difficulties in reliably maintaining adequate output of the pump, are greatly lessened and the general performance of the pump is bettered to a marked degree, in the handling of such difficult mixtures as have been referred to, and as well in the handling of the more easily pumpable mixtures under adverse conditions (such as frequent stoppage of the pump for a substantial time because of conditions which may be met in the placement of the concrete into the forms) by a suitable inlet valve positioned in appropriate relation to the juncture of the pump inlet and outlet passages, close to the point where said passages jointly open to the mouth of the pump-cylinder, and arranging the inlet valve to cooperate with a suitable outlet valve located beyond said juncture, so that during the working stroke of the pump a part, at least, of the outgoing mixture is propelled through the passageway of the "closed" inlet valve before reaching the open outlet valve, which for this purpose is arranged in tandem with the inlet valve. By operating the rocking inlet valve, and a suitable outlet valve, each for quick change of position and in suitable relation to the time-cycle of the piston-travel, said suitable outlet valve (of which the particular construction shown is a very efficacious one) which serves to block return of concrete from the pipe line to the cylinder on the suction stroke of the piston, also assures that the inlet valve is relieved of back-slip there-through of concrete seeking to return from beyond said inlet valve under the back-pressure of the concrete in the line-pipe (which pressure may be very considerable, particularly when the concrete mixture is being pumped to an elevation scores of feet above the pumping station), and the effective operation of the inlet valve herein shown (to which various features of its construction and arrangement contribute) serves very effectively to insure free and ample flow of fresh mixture-charges into the adjacent cylinder-mouth under gravity and suction conditions; notwithstanding that, as compared with a similar pump having its inlet valve wholly above the juncture of the inlet passage with the outlet passage, the theoretical gravity head of the mixture has been lessened, by a lowering of the supply hopper nearer to the axis of the pump-cylinder. And I have found that the advantages of the tandem valve arrangement are augmented by the employment of an oscillating-plug type of inlet valve of substantially minimum practical diameter, which is an inverted U-section in side view and which has its axis of oscillation located about half the plug's diameter above the axis of the outlet passage, and which further has its cut-off segment coacting with an inlet passage that is offset on the valve housing in a direction toward the pump mouth; each of these factors, and as well the arched, wide-bottomed shaping of the pocket which the inlet valve presents toward the outlet passage during the working stroke of the piston, contributing to the efficacy of the pumping operation and to the mechanical simplicity, low cost, and durability of the machine itself. Also, the use of my safety double-acting valve-connecting rod aids in assuring continuous operation of my concrete pump on long runs without stoppage for repairs or replacement of damaged parts.

I claim:

1. In a pump for plastic concrete mixtures, having a working chamber, a pressure member working therein, and inlet and outlet passages communicating therewith, the combination of inlet and outlet valves controlling said inlet and outlet passages respectively, said valves being arranged in tandem with respect to said chamber and outlet passage, whereby the mixture moved along the outlet passage on the working stroke of said pressure member passes through both said valves.

2. In a pump for plastic concrete mixtures, having a working chamber, a pressure member working therein, and inlet and outlet passages communicating therewith at a common point, the combination of an inlet valve positioned at the junction of said passages in close proximity to said chamber, arranged to control the flow of the mixture from the inlet passage to the chamber; and an outlet valve in said outlet passage beyond said inlet valve, said valves being so arranged that the mixture moved along the outlet passage on the working stroke of said pressure member passes through both of them.

3. In a pump for plastic concrete mixtures, having a working chamber, a pressure member working therein, and inlet and outlet passages communicating therewith and with each other, an inlet valve positioned at the juncture of said passages, arranged to control the flow of the mixture from the inlet passage to the chamber, said valve having a mixture flow passage affording constant communication between said working chamber and outlet passage, and being subject to back-slip of the mixture therethrough when not in cut-off position; and an outlet valve in said outlet passage beyond said juncture, arranged to prevent back-slip through said inlet valve.

4. In a pump for plastic concrete mixtures, having a working chamber, a pressure member working therein, and inlet and outlet passages communicating therewith and with each other, an inlet valve positioned at the juncture of said passages for controlling the flow of mixture from the inlet passage to said chamber, said valve being arranged to afford in both its open and closed positions communication therethrough between said chamber and outlet passage, a feed hopper surmounting said valve close to the low level of the top of the valve, and an outlet valve in said outlet passage, arranged to prevent back-slip of the mixture through said inlet valve.

5. In a pump for plastic concrete mixtures, having a working chamber, a pressure member working therein, and inlet and outlet passages communicating therewith and communicating with each other close to the mouth of said chamber, an oscillatory inlet valve positioned to extend into the juncture of said passages, having a segment which in one position at least partially restricts said inlet passage to control the flow of mixture to said chamber, said valve having a passageway which in either position of the segment affords communication between said chamber and said outlet passage and in the open position of said valve affords communication between said chamber and the inlet passage; and an outlet valve in the outlet passage movable between respective positions in one of which it opens the outlet passage and in the other of which it restricts said passage at least sufficiently to produce stowing of the mixture and prevent back-slip thereof through said inlet valve.

6. A concrete pump effective to handle small slump concrete mixtures of graded coarse aggregate, having a cylinder open at one end; a piston working therein; inlet and outlet passages communicating in common with the open mouth of said cylinder and with each other close to said mouth; a U-section oscillatory inlet valve positioned at the juncture of said passages, having a valving-segment coacting with the inlet passage to control the flow of mixture from said passage to said cylinder mouth and having part of its own passageway coinciding with the outlet passage in either position of said valve; and an outlet valve controlling the opening and closing of the outlet passage beyond said juncture.

7. A concrete pump effective to handle small slump concrete mixtures of graded coarse aggregate, having a cylinder open at one end; a piston working therein; inlet and outlet passages communicating in common with the open mouth of said cylinder and with each other close to said mouth; a U-section oscillatory inlet valve positioned at the juncture of said passages, having a valving-segment coacting with the inlet passage to control the flow of mixture from said passage to said cylinder mouth and having part of its own passageway coinciding with the outlet passage in either position of said valve, said valving-segment being arranged to urge the concrete mixture adjacent thereto toward the open end of said cylinder during the opening movement of the valve; and an outlet valve controlling the opening and closing of the outlet passage beyond said juncture.

8. A concrete pump effective to handle small slump concrete mixtures embodying graded coarse aggregates, having a cylinder open at its end; a piston working therein; inlet and outlet passages communicating in common with the open end of said cylinder, and with each other close to said end; a U-section oscillatory inlet valve positioned at the juncture of said passages, having a valving-segment arranged to control the flow of mixture from said inlet passage to said open cylinder end, and having part of its own passageway coinciding with the outlet passage in either

position of said valve, the oscillatory axis of said valve being transverse to and above the axis of said outlet passage; and an outlet valve controlling said outlet passage beyond said juncture.

9. A concrete pump effective to handle small slump concrete mixtures embodying graded coarse aggregates, having a cylinder open at its end; a piston working therein; inlet and outlet passages communicating in common with the open end of said cylinder, and with each other adjacent said end; a U-section oscillatory inlet valve positioned at the juncture of said passages, having a valving-segment arranged to control the flow of mixture from said inlet passage to said open cylinder end, and having part of its own passageway coinciding with the outlet passage in either position of said valve; the axis of said inlet passage being offset toward said open cylinder end, relative to the axis of oscillation of said inlet valve; and an outlet valve controlling said outlet passage beyond said juncture.

10. A concrete pump effective to handle small slump concrete mixtures embodying graded coarse aggregates, having a cylinder open at its end; a piston working therein; inlet and outlet passages communicating in common with the open end of said cylinder, and with each other adjacent said end; a U-section oscillatory inlet valve positioned at the juncture of said passages, having a valving-segment arranged to control the flow of mixture from said inlet passage to said open cylinder end, and having part of its own passageway coinciding with the outlet passage in either position of said valve, the axis of oscillation of said valve being transverse to and above the axis of said outlet passage, and the axis of said inlet passage being offset relative to said valve-oscillation axis toward said open cylinder end, said valving-segment being movable from inlet-passage-restricting position to open position without substantially entering said outlet passage; and an outlet valve controlling said outlet passage beyond said juncture.

11. A concrete pump effective to handle small slump concrete mixtures embodying graded coarse aggregates, having a cylinder open at its end; a piston working therein; inlet and outlet passages of substantially equal diameter communicating in common with the open end of said cylinder, and with each other adjacent said end; a U-section oscillatory inlet valve positioned at the juncture of said passages, having a valving-segment arranged to control the flow of mixture from said inlet passage to said open cylinder end, and having part of its own passageway coinciding with the outlet passage in either position of said valve, the width of said valve passageway being substantially equal to the diameters of said inlet and outlet passages, whereby there is provided a wide-mouthed arched chamber beneath said valving segment when the valve is in closing position; an oscillatory outlet valve controlling said outlet passage beyond said juncture, arranged to at least partially restrict said outlet passage when in closing position, and to provide a smooth continuation of said passage when in open position; said inlet and outlet valves being of approximately the same diameter; and a low height feed hopper surmounting said inlet valve.

12. In a pump for plastic concrete mixtures, a working chamber; a pressure member working in said chamber; inlet and outlet passages communicating with said chamber and with each other; an oscillatory inlet valve positioned at the juncture of said passages, having a segment which in one position at least partially restricts said inlet passage to control the flow of mixture to said chamber, said valve having a passageway which in either the open or "closed" position of the valve segment affords communication between said chamber and said outlet passage, and in the open position of the segment also affords communication between said chamber and the inlet passage; means including an overload release device for moving said valve from one position to the other, said device being arranged to function differentially during movements of the valve to and from inlet "closing" position; and a valve controlling said outlet passage.

13. In a pump for plastic concrete mixtures, a working chamber; a pressure member working in said chamber; inlet and outlet passages communicating with said chamber and with each other; an oscillatory inlet valve positioned at the juncture of said passages, having a segment which in one position at least partially restricts said inlet passage to control the flow of mixture to said chamber, said valve having a passageway which in either the open or "closed" position of the valve segment affords communication between said chamber and said outlet passage, and in the open position of the segment also affords communication between said chamber and the inlet passage; means including an overload release device for moving said valve from one position to the other, said device having a plurality of resilient elements pre-loaded to different degrees and arranged to function differentially during movements of the valve to and from inlet "closing" position; and a valve controlling said outlet passage.

14. In a pump for plastic concrete mixtures, a working chamber; a pressure member working in said chamber; inlet and outlet passages communicating with said chamber and with each other; an oscillatory inlet valve positioned at the juncture of said passages, having a segment which one position at least partially restricts said inlet passage to control the flow of mixture to said chamber, said valve having a passageway which in either the open or "closed" position of the valve segment affords communication between said chamber and said outlet passage, and in the open position of the segment also affords communication between said chamber and the inlet passage; means including an overload release device for moving said valve from one position to the other, said device having a plurality of resilient elements pre-loaded to different degrees and arranged to function differentially during movements of the valve to and from inlet "closing" position, the element which functions during movement to "closing" position being pre-loaded less than the element which functions during movement to open position; and a valve controlling said outlet passage.

15. In a pump for plastic concrete mixtures, a working chamber; a pressure member working in said chamber; inlet and outlet passages communicating with said chamber and with each other; an oscillatory inlet valve positioned at the juncture of said passages, having a segment which in one position at least partially restricts said inlet passage to control the flow of mixture to said chamber, said valve having a passageway which in either the open or "closed" position of the valve segment affords communication between said chamber and said outlet passage, and in the open position of the segment also affords com-

munication between said chamber and the inlet passage; means including an overload release device for moving said valve from one position to the other, said device having a plurality of resilient elements pre-loaded to different degrees and arranged to function differentially during movements of the valve to and from inlet "closing" position, the element which functions during movement to "closing" position being pre-loaded less and having greater pressure-increase capacity than the element which functions during movement to open position; and a valve controlling said outlet passage.

16. In a pump for plastic concrete mixtures, a working chamber; a pressure member working therein; inlet and outlet passages communicating with said chamber and with each other; an inlet valve positioned at the juncture of said passages, having an oscillatory plug, U-shaped in axial section, providing a valving segment arranged to coact with the inlet passage to control the flow of mixture therefrom to said chamber, and a passageway adapted to afford communication with said outlet passage in either the open or "closed" position of the segment, said segment being of flattened V-shape in transverse section and arranged to urge the concrete mixture adjacent thereto toward said working chamber during the opening movement of the valve; and a second valve, controlling said outlet passage beyond said juncture.

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