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CONCRETE PUMPING SYSTEM

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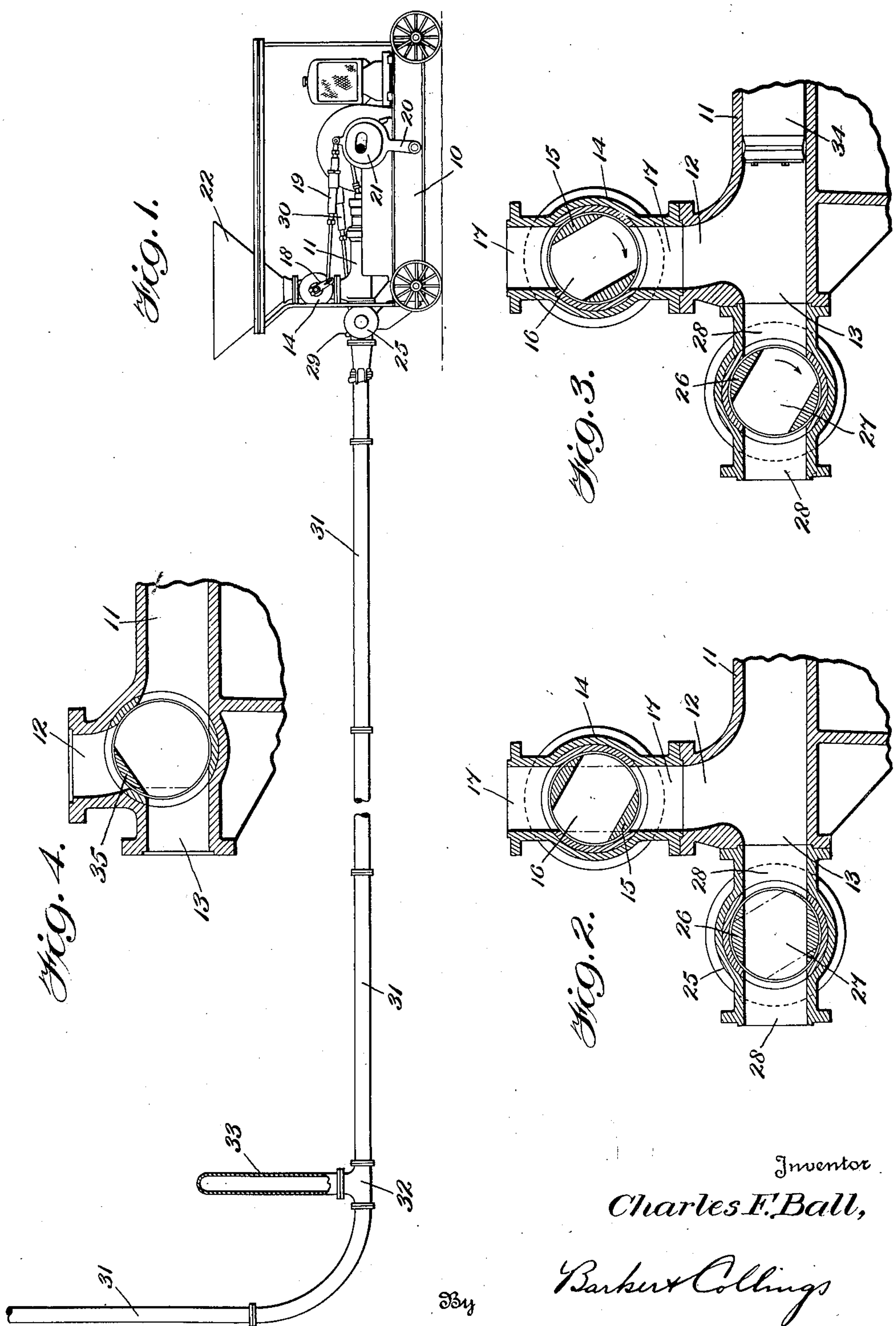

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CONCRETE PUMPING SYSTEM

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This invention relates to pumping systems, and more particularly to one including a recently developed type of pressure pump especially adapted for handling concrete and plastic mixtures having characteristics similar thereto, and has for its principal object to improve the operation and efficiency of such systems.

In order that the precise nature of the invention may be clearly understood, it may be said that the pressure pumps above referred to are usually, although not necessarily, single cylinder machines having single acting pistons, i. e. pistons which suck the plastic mixture into the cylinder upon one stroke and force it therefrom upon the succeeding stroke. Because of the size of certain of the constituents of the commonly used concrete mixtures—the large aggregate may range from one quarter inch up to two and one-half or three inches in greatest diimension—the valves of these pumps are not designed to seat tightly so as to completely close off the passages controlled thereby, but are moved in proper sequence from their fully open positions to positions in which they partially restrict but do not fully close their respective passages, advantage being taken of the peculiar packing or "stowing" property of such mixtures at such restrictions to substantially completely prevent movement of the mixture in a direction opposite to that in which it is being pumped.

These pumps usually operate at from 40 to 50 pressure strokes per minute, there of course being an equal number of suction strokes during which the outlet valve is in its most restricting position and the mixture in the discharge conduit beyond said valve is not being pushed forwardly. This results in an intermittent forward movement of the mixture in the discharge pipe, and a pulsating discharge therefrom. Under many conditions such pulsating discharge is objectionable, and it has been proposed to smooth out and substantially eliminate the pulsations through the use of air chambers or other pulsation damping devices, as is common practice in liquid pumps.

Notwithstanding the fact that the valves of these pumps are substantially simultaneously actuated—usually by cams to insure positive and relatively rapid movement from one position to the other—there is a certain interval during each valve movement when both valves may be completely or nearly completely open, and the length of this interval may in some instance be increased if one of the valves has a lead over the other. Because of this condition, it has been found that with the use of air domes or other pulsation damping devices located in the usual position on or immediately adjacent the pump, the back pressure set up by such damping devices is sufficient to force portions of the mixture back through the valves while thus open, resulting in what is termed "black-slip" and lowering the efficiency of the system.

On the other hand, I have found that if the pulsation damping device be so located as to communicate with the discharge line at a distance of say from 25 to 100 feet from the pump—dependent upon the consistency of the mixture being handled and other factors—the inertia of the portion of the mixture in the conduit between the damping device and the pump, together with the friction between the mixture and the walls of the conduit, will be sufficient to overcome the back pressure set up by the damping device and prevent reverse movement of the mixture through the valves during the intervals when they are simultaneously fully or nearly fully open.

The invention therefore resides specifically in locating the air dome or other pulsation damping device at a point in the discharge conduit sufficiently removed from the pump that the inertia and friction of that portion of the mixture lying within the conduit between the pump and the damping device is great enough to resist the back pressure exerted by the latter to the extent necessary to prevent the objectionable "back-slip" of the mixture through the simultaneously open valves, all as will be more fully hereinafter described and particularly pointed out in the appended claims.

Referring to the accompanying drawing, forming a part of this specification, in which like reference characters designate like parts in all the views:—

Figure 1 is a more or less diagrammatic side elevational view of a concrete pump of the type above mentioned, a discharge conduit therefore, and a pulsation damping device in the form of an air dome communicating therewith and located in accordance with the present invention:

Fig. 2 is an enlarged fragmentary sectional view through the inlet and outlet valves of the pump illustrated in Fig. 1, showing the positions they occupy during the pressure stroke of the piston;

Fig. 3 is a view similar to Fig. 2, but illustrating the valves in the course of their movements at the end of the pressure stroke of the piston, and showing how they may simultaneously occupy nearly fully open positions; and

Fig. 4 is a view similar to Fig. 2, of a somewhat modified form of pump, in which a single valve controls both the inlet and the outlet passages.

In the said drawing, 10 indicates generally a concrete pump having a cylinder 11 provided with an inlet passage 12 and an outlet passage 13. The inlet passage 12 communicates with a valve housing 14 in which is mounted a plug member 15, constituting the inlet valve, and which is provided with a passage 16 adapted in the open position of the valve (indicated in broken lines in Fig. 2) to aline with the passages 17 of the valve housing 14. The valve plug 15 is arranged to be oscillated from its restrictive full-line position illustrated in Fig. 2 to its open broken-line position and back again by means of a valve arm 18, a connecting rod assembly 19, and a rocker arm 20, which is actuated by suitable cams within a housing 21. A feed hopper 22 surmounts the valve housing 14 and receives the plastic concrete from any appropriate mixer.

In similar manner the outlet passage 13 communicates with a valve housing 25 in which is mounted the outlet valve plug 26, having the passage 27 arranged to aline with the passages 28 of the housing 25, and to be moved back and forth between its full- and broken-line positions, illustrated in Fig. 2, by an arm 29, connecting rod 30, and a rocker arm and cams located on the far side of the machine. The discharge pipe or conduit 31 is connected to the outlet valve housing 25, and at a point sufficiently removed from the pump may be provided with a fitting 32, upon which may be mounted the air dome or other pulsation damping device 33.

During the pressure stroke of the pump piston 34, the valves 15 and 26 occupy the positions shown in Fig. 2, with the inlet valve 15 in its most restrictive position, and the outlet valve 26 in its fully open position. As the piston 34 reaches the end of its pressure stroke, as indicated in Fig. 3, the cams actuate the respective rocker arms such as 20, the connecting rods 19 and 30, and the valve arms 18 and 29, to move the valve plugs 15 and 26 in a clockwise direction from the full-line positions of Fig. 2 to the broken line positions shown therein. At some time during this operation the valves may occupy substantially the positions illustrated in Fig. 3, in which it will be observed that neither valve imposes much restriction in the passages controlled by it; and it is during the interval that the valves are approaching and leaving these positions that "back-slip" may occur if the pulsation damper be located in its usual place on or immediately adjacent the pump. On the other hand, if it be located a suitable distance from the pump, as indicated in Fig. 1, the inertia of the mixture within that portion of the conduit 31 between the outlet valve 26 and fitting 32 will be sufficient to resist the pressure built up in the air dome 33, and which would tend to force the mixture back toward the pump on the suction stroke of the piston.

Obviously, the same condition permitting of "back-slip" will be present in the modified type of pump illustrated in Fig. 4, wherein a single valve 35 controls both the inlet passage 12 and the outlet passage 13, since as the said valve moves from the full line position to the broken line position shown therein, and vice versa, the two passages may be simultaneously open a sufficient time to allow the objectionable backward movement of the material being pumped. The present invention is therefore of value in connection with this form of pump.

As above stated, the exact distance the damper is located from the pump may vary, depending upon the character of the mixture being handled; however, I have found that distances ranging from 25 to 100 feet give satisfactory results with all concrete mixtures now in common use when pumping through a five inch discharge line.

It is obvious therefore that those skilled in the art may vary the precise arrangement of the various instrumentalities without departing from the spirit of the invention, and it is not wished to be limited to the details of the above disclosure, except as may be required by the claims.

What is claimed is:—

1. The combination with a pump for concrete and similar plastic materials having valve controlled inlet and outlet passages which at certain times in the operation of the pump may be simultaneously open, and a pulsation damping device, of longitudinally extended connections between said pump and device arranged to contain a quantity of the material being pumped sufficient that the inertia thereof and the friction between said material and the walls of said connections may over-come the back pressure exerted by said damping device and prevent back-slip of said material in said passages when they are simultaneously open.

2. A pumping system for concrete and plastic materials having characteristics similar thereto, comprising a pump having valve controlled inlet and outlet passages which at certain times in the operation of the pump may be simultaneously open an amount sufficient to permit of the plastic material flowing backward therethrough; a discharge conduit leading from said pump; and a pulsation damping device communicating with said conduit at a distance from said pump sufficient that the inertia and friction of the plastic material in said conduit between the pump and the damping device may resist the back pressure exerted by the lattter to the extent necessary to prevent back-slip of the material through said passages when they are simultaneously open.

3. In a pumping system for concrete and plastic materials having characteristics similar thereto, a pump having valve controlled passages which at certain times in the operation of the pump may be simultaneously open; a discharge conduit leading from said pump; and a pulsation damping device communicating with said conduit at a distance of at least twenty five feet from said pump, whereby the inertia and friction of the mixture in said conduit between the pump and the damping device may overcome the back pressure set up by the latter and prevent back-slip of the mixture through said pump passages when they are simultaneously open.

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