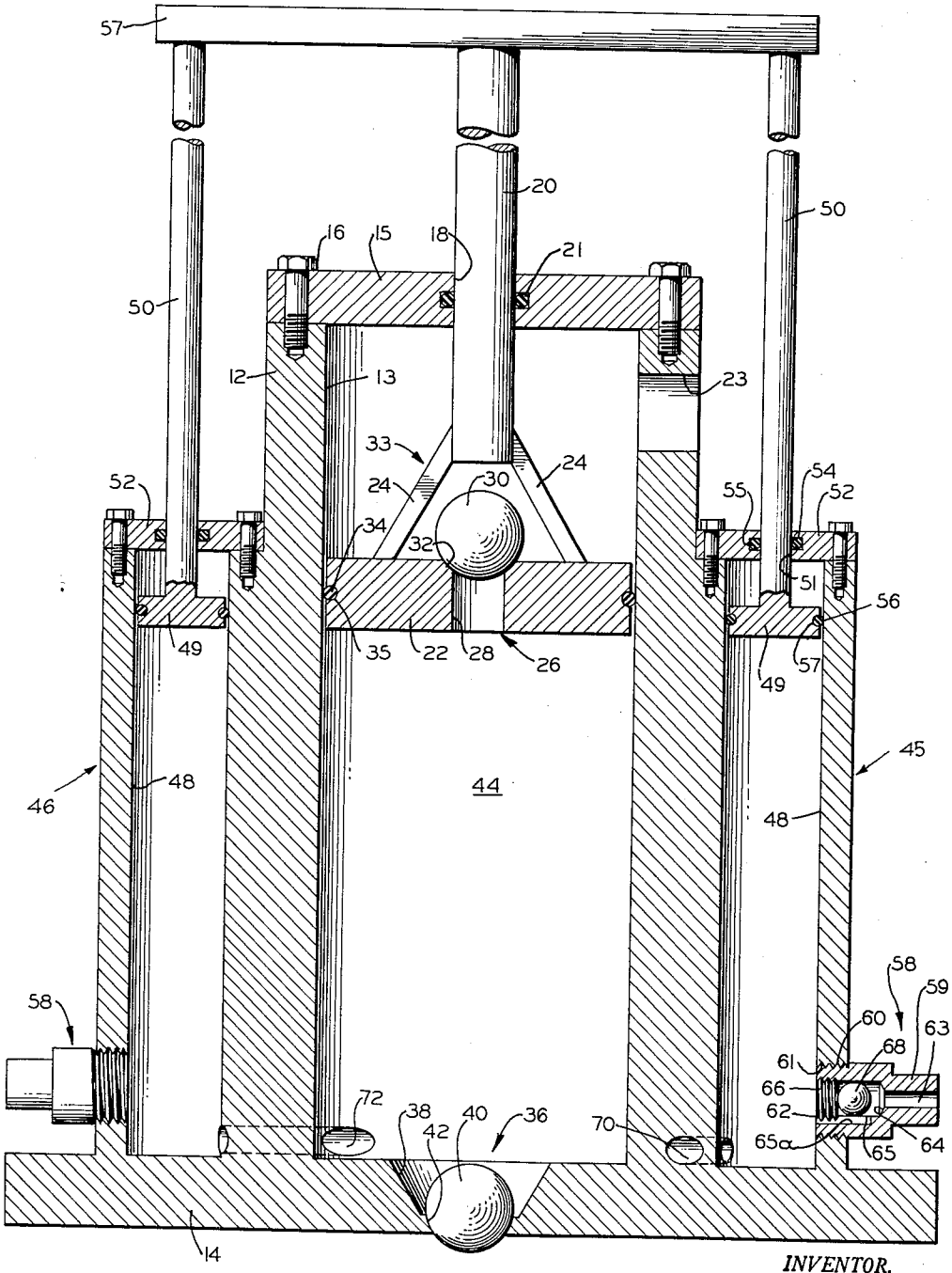
Aug. 21, 1962 P. H. HARRIS 3,050,002

PUMP

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INVENTOR.
PHILIP H. HARRIS

BY
Christie, Parker & Hale
ATTORNEYS

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PUMP

Philip H. Harris, Monrovia, Calif.

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This invention relates to pumps, and more particularly to reciprocating type pumps used in pumping fluids having settleable particles suspended in them.

Although the pump is useful in moving many types of liquids containing settleable particles, it is described with particular reference to its use as a submerged mortar pump.

In pumping fluids such as mortar, the problem often arises of solid particles tending to settle in the pump, particularly when the pump is of the reciprocating piston or diaphragm type. For example, in a typical prior art mortar pump, during the "compression" portion of the cycle in which fluid is being forced upwardly through a check valve in a piston moving down into a pumping chamber, there is a tendency for the solid particles in the mortar to settle around an inlet check valve located in the lower portion of the pumping chamber, permitting segregation of the mortar and interference with the proper operation of the inlet check valve.

This invention provides a pumping system in which fluid is injected into the pumping chamber during the compression portion of the cycle so that the fluid in the pumping chamber is agitated to reduce the tendency of solid particles to segregate or settle. Thus, the mixture of fluid and solid particles is kept more uniform, and the tendency for solid particles to pack around the inlet check valve is substantially reduced.

In the preferred form of the invention, the injection of the fluid into the pumping chamber is achieved with one or more auxiliary injection pumps which force fluid into the pumping chamber during the compression stroke of the primary pump. Moreover, the fluid is injected into the pumping chamber tangentially around the inlet check valve in the pumping chamber so that a swirling motion is set up around the inlet check valve, creating centrifugal force which tends to carry heavier and larger particles away from the check valve.

These and other aspects of the invention will be more fully understood from the following detailed description and the accompanying drawing which is a schematic representation (sectioned in parts) of the preferred embodiment of this invention.

Referring to the drawing, a primary pump 10 includes an upright primary housing 12 having a relatively large cylindrical bore 13 extending through it. The primary housing is mounted on a horizontal base 14 so the lower end of the large bore is closed by the base. The other end of the large bore is closed by a circular head 15 secured by bolts 16 to the upper end of the primary housing. A smaller vertical cylindrical bore 18 opens through the head, and a primary pump piston rod 20 is disposed to slide in it, an O-ring 21 being mounted in the smaller bore to make a sliding seal around piston rod 20. The upper portion of the primary housing includes an exit opening 23 to which is connected a discharge hose (not shown) for delivering the pumped fluid to the desired location.

A primary pump piston 22 is disposed to slide in the large cylindrical bore, and is attached by downwardly and outwardly extending radially spaced arms 24 to the lower end of the primary pump piston rod. An outlet check valve 26 in the piston includes a vertical bore 28 opening through the piston, and an outlet check valve ball 30 adapted to seal in a seat 32 formed around the upper end of the bore 28 in the piston. The arms 24 connecting the piston to the piston rod form an open cage 33 which

prevents the escape of the ball 30 as the piston reciprocates in the large bore 13.

An O-ring 34 fits in an annular groove 35 around the periphery of the piston to make a sliding seal against the wall of the large cylindrical bore.

An inlet check valve 36 at the lower end of the primary pump includes a downwardly converging tapered bore 38 in the central portion of the base, and an inlet check valve ball 40 adapted to seal in a seat 42 formed in the lower portion of the tapered bore 38. As can be seen from the drawing, the top portion of the inlet ball lies below the upper surface of the base when the ball is seated so the ball does not prevent the piston from contacting the base.

With the arrangement shown in the drawing, a pumping chamber 44 is defined by the lower portion of the cylindrical bore 13, the central portion of the base, and the piston.

First and second injection pumps 45, 46, respectively, are disposed in diametrically opposed positions on opposite sides of the primary housing. Each injection pump includes an upright housing 47 having a vertical cylindrical bore 48, a slidable piston 49 disposed in the bore 48, a vertical piston rod 50 attached to the upper side of the piston and making a sliding seal through a bore 51 in a top 52 secured by bolts 53 to the upper end of the cylinder 48. A separate O-ring 54 in an annular groove 55 in each bore 51 makes a sliding seal against a respective piston rod 50. Each of the injection pump pistons includes an O-ring 56 mounted in an annular groove 57 around the piston to make a sliding seal against the respective injection pump cylinder wall. The upper ends of the injection pump piston rods are connected by a cross bar 57 to the primary pump piston rod 20.

Each injection pump includes an inlet check valve 58 adapted to be connected to a source of water (not shown) such as a water main. The two injection pump inlet check valves are identical, and for simplicity only the first injection pump check valve is described in detail. The valve 58 includes a first fitting 59 having external threads 60 at one end which screw into internal threads 61 in a horizontal bore 62 through the lower portion of the first injection pump housing. The first fitting includes a first horizontal bore 63 beginning at the right end (as viewed in the drawing) of the fitting and terminating in a tapered seat 64 which connects to a second bore 65 of larger diameter, and which has a longitudinal slot 65*a* for the flow of liquid into the first injection pump housing. The bore 65 is threaded internally at its left end to receive an externally threaded retaining plug 66. The retaining plug 66 confines a check ball 68 disposed in the bore 65 and adapted to make a seal against seat 64 during the compression stroke of the injection pump piston 49.

The lower end of the first injection pump cylinder is connected to the lower portion of the pumping chamber by a horizontal passageway 70 which opens tangentially into the pumping chamber to inject fluid in a clockwise direction (as viewed from above). The lower portion of the second injection pump cylinder is connected to the lower part of the pumping chamber by a horizontal passageway 72 which opens tangentially into the pumping chamber to inject water so that it swirls in a clockwise direction (as viewed from above).

The inlet check valve 58 of the second injection pump 46 is of a construction identical to that of the first injection pump check valve and is not described in detail. The second injection pump check valve is also connected to a suitable source of water.

The primary and injection pumps can be constructed and assembled in any of a variety of ways, but for simplicity of illustration, the pump housings are shown as cast integrally with each other and the base.

The operation of the pumping system shown in the drawing is relatively simple. The system is mounted to be submerged in the fluid to be pumped, say mortar, care being taken to have it spaced from the bottom of the mortar container (not shown) so that fluid can flow freely in the pumping chamber through the inlet valve **36**, and so the valve can shut properly during the compression stroke of the primary pump. The injection pumps are supplied water by hoses (not shown) connected to suitable water source through the inlet valves on the injection pumps.

The cross bar is connected to a crank (not shown) which is driven by suitable source of power (not shown) so that the piston rods and their respective pistons are moved up and down in their respective cylinders. As the pistons move up together, the outlet valve **62** is forced closed and the inlet valve in the primary pump is forced open, atmospheric pressure driving mortar into the pumping chamber **44**. Simultaneously, each of the inlet check valves on the injection pumps opens, permitting the injection pump cylinders to fill with water. On the down stroke, or "compression" part of the cycle, the inlet valve in the primary pump is forced shut, and the outlet valve **26** opens, permitting mortar to flow from the pumping chamber through bore **28** into the space above the piston **22**. Simultaneously during this compression stroke, water is injected tangentially into the pumping chamber from the injection pumps, causing the fluid in the pumping chamber to swirl in a clockwise direction as viewed from above. This swirling movement creates a centrifugal force which tends to carry the larger and heavier solid particles in the mortar toward the periphery of the pumping chamber. The respective volumes of the pumping chamber and the injection pump cylinders are such that there is not excessive or undesirable dilution of the mortar.

On the succeeding upstroke of the pistons, the mortar above the primary pump piston is forced out of the exit and through the discharge hose. At the same time, the pumping chamber is recharged with mortar, and the injection pump cylinders are refilled with water.

Thus, with the pumping system of this invention, the fluid in the pumping chamber is agitated during the "compression" cycle, thereby reducing the tendency for solid particles to settle out and interfere with the operation of the inlet valve for the pumping chamber.

It will be apparent from the foregoing description, that this invention is applicable to embodiments equivalent to the specific one shown in the drawing. For example, the reciprocating piston in the primary pump may be replaced by a reciprocating diaphragm having a check valve in it, and the injection pumps may be replaced by valves in a line containing water under pressure, the valves being opened and closed in response to the actuation of the primary pump so that the valves are open during the compression stroke to inject water into the pumping chamber, and are closed during the intake stroke of the primary pump. With this arrangement, it is necessary to have water under pressure greater than the maximum developed in the pumping chamber.

I claim:

1. A pump for pumping fluids having settleable particles comprising means defining an elongate upright cylinder, a reciprocatable main piston disposed in the cylinder for up and down reciprocations within the cylinder and defining together with the sidewall of the cylinder a discharge chamber between the upper side of the main piston and the top of the cylinder, and an inlet chamber between the lower side of the main piston and the bottom of the cylinder, an outlet providing flow communication between the discharge chamber and a point of discharge, an inlet providing flow communication between the inlet chamber and a source of a first fluid, a passage in the main piston providing flow communication between the discharge chamber and the inlet chamber, first valve means associated with the inlet to permit flow only into the inlet chamber, second valve means associated with the passage in the main piston to permit flow only from the inlet chamber into the discharge chamber, injection apertures peripherally spaced apart in the sidewall of the inlet chamber near the bottom of said chamber adjacent the first valve means, the injection apertures arranged to open into the inlet chamber tangentially to the sidewall of said chamber to inject a second fluid into the inlet chamber and around the first valve means, an elongate injection cylinder, the injection apertures providing flow communication between the inlet chamber and the injection cylinder, a reciprocatable injection piston disposed in the injection cylinder, a fluid inlet providing flow communication between the injection cylinder and a source of the second fluid, and means for reciprocating the main piston and the injection piston to inject the second fluid into the inlet chamber as the first fluid is discharged through the passage in the main piston.

2. Apparatus in accordance with claim 1 wherein the main piston and the injection piston are connected to be reciprocated together.

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CERTIFICATE OF CORRECTION

Patent No. 3,050,002 August 21, 1962

Philip H. Harris

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

In the grant, lines 1 to 3, for "Philip H. Harris, of Monrovia, California," read -- Philip H. Harris, of Monrovia, California, assignor to American Cement Corporation, of Los Angeles, California, a corporation of Delaware, --; line 12, for "Philip H. Harris, his heirs" read -- American Cement Corporation, its successors --; in the heading to the printed specification, line 3, for "Philip H. Harris, Monrovia, Calif." read -- Philip H. Harris, Monrovia, Calif., assignor to American Cement Corporation, Los Angeles, Calif., a corporation of Delaware --.

Signed and sealed this 26th day of February 1963.

(SEAL)
Attest:

ESTON G. JOHNSON
Attesting Officer

DAVID L. LADD
Commissioner of Patents