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(54) Suction and force plunger pump.

(57) The suction and force plunger pump has at least one pumping chamber (31) in which a suction and force plunger (18), actuated by a cross-head crank system (14), is inserted at a packing-gland sealing device (32, 33). While said plunger is connected to said cross-head by means of a quick coupling (19), the packing-gland device is mounted so as to be extractable from said pumping chamber through an opening (23) thereof opposite to said cross-head and, at the same opening, its casing (35) is axially but not tangentially engaged by a ring (37) which is normally adapted to ensure the sealing lock between said chamber (31), said casing (35) and said ring (37) and vice versa to determine the extraction of the packing-gland device and, if said coupling is open, of the related plunger.

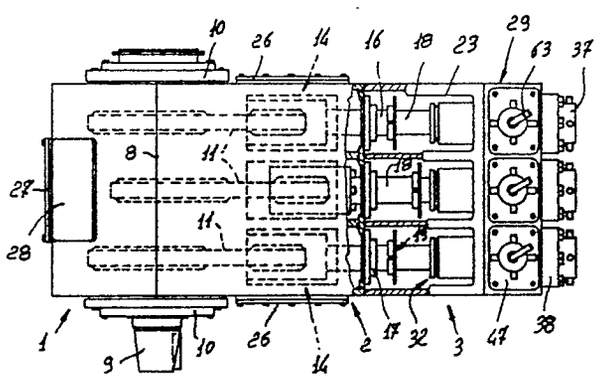

FIG.1

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SUCTION AND FORCE PLUNGER PUMP

The present invention relates to a hydraulic suction and force plunger pump adapted to operate at high pressures particularly for injecting cement mixtures to improve the mechanical and hydraulic characteristics of the soil.

Reciprocating pumps with multiple cylinders arranged side by side in a line, with a respective single-action suction and force plunger sliding in each cylinder, are already used in consolidating or waterproofing the soil by means of high pressure cement injection. The plungers are actuated by a single crankshaft by means of respective cross-head connecting rods.

The mechanism hitherto used for such pumps causes various disadvantages, and in particular it makes them expensive to operate and to be manufactured.

The aim of the present invention is therefore to improve the structure of plunger pumps so as to make their manufacture and their use more economical and facilitate and speed the replacement of worn parts and the restoration of the best efficiency and durability conditions.

This aim is achieved by a hydraulic pump having at least one pumping chamber in which a suction and force plunger actuated by a cross-head crank system is inserted at a packing-gland sealing device, characterized in that said plunger is connected to said cross-head by means of a quick coupling and said packing-gland device is mounted so as to be extractable from said pumping chamber through an opening thereof opposite to said cross-head, at said opening the packing-gland casing being axially but not tangentially engaged by a ring which is normally adapted to ensure the sealing lock between said chamber, said casing and said ring, said ring being also adapted to unlock said chamber and said casing for extracting the packaging-gland device and, if said coupling is open, the related plunger.

Further characteristics and advantages of the invention will become apparent from the detailed description of a preferred embodiment of the pump, illustrated only by way of non-limitative example in the accompanying drawings, wherein:

figure 1 is a partially cutout overall plan view of the pump;

figure 2 is a longitudinal vertical sectional view of the pump;

figure 3 is a view similar to figure 2, illustrating the detail of a pumping chamber.

With reference to the above described figures, the pump has a body which is longitudinally separated into three box-like parts 1, 2 and 3, removably associated for example by means of screw elements 4 and 5.

The body rests on the ground directly with the part 1 and with elements 6 protruding downwards from the part 3 which is the least high of the three abovementioned parts. The interior of part 1 is connected to the interior of the central part 2 by means of wide vertical openings 7 and, starting from the related wall which is transverse to the pump, is downwardly tapered. The axis of the horizontal crankshaft 9, having in particular three cranks keyed at 120 degrees to one another, is arranged in the transverse plane 8 which separates parts 1 and 2. The end supports 10 of the shaft 9 are applied both to the end part 1 and to the central one 2, at the co-planer faces thereof which are vertical and longitudinal to the pump and also at openings which affect, in said lateral faces, part 1 for half of their extension and part 2 for the other half; similarly, half of the main bearings, not illustrated, correspond to part 1 and the other half to part 2.

Each of the big ends of connecting rods 11 is articulated to the respective crank of the crankshaft 9; by means of a pin 12, the small end of each connecting rod 11 is then articulated to the body 13 of a cross-head 14 having skids, the guides 15 whereof are mounted within the central part 2 of the pump body. A respective stem 16 is fixed to the body 13 of each cross-head and penetrates into the other end part 3, passing through a gasketed ring 17 which is applied to the wall dividing parts 2 and 3. Each stem 16 has a plunger 18 of the suction and force and single-action type. The stems and the respective plungers, which extend longitudinally with respect to the pump, are connected to one another by quick couplings 19 of the collar type. The contiguous ends 16a and 18a of each stem 16 and of each plunger 18 have a truncated-cone configuration, diverging towards each other, and are closed and locked by two-collar elements 20 which have an inner groove 20a with a configuration which is complementary to that of said ends. Proximate to their separation plane, the two half-collars 20 furthermore have superimposed tabs which, mutually hinged at pivot 21 and are furthermore locked at the opposite position by a screw element 22. Access to the couplings 19 is gained through openings 23 with which the upper face of part 3 of the body is provided: naturally, in order to rapidly open the couplings and release the stems 16 from the plungers 18, the elements 22 should be conveniently positioned upwards, as shown in the figures. The openings 23 are normally

closed by a cover 24 which is pivoted to the central part 2 at pivot 25. The respective openings of the lateral faces of said part 2 are closed by hatches 26; the front openings of the end part 1 are closed by hatches 27 and 28.

A block 29 is rigidly associated with the front of part 3, and as many pump chambers 31 as there are plungers 18 are defined therein side by side and in a row at respective longitudinal through seats 30; each of said plungers enters its respective pumping chambers at a sealing device 32 with packing gland 33, the gasket element and casing whereof are respectively indicated at 34 and 35. The casing 35 is largely external to the block 29 and protrudes towards the coupling 19; inside said block it practically lines the pumping chamber 31 and, in the region opposite to the coupling 10, it forms a sort of dome 35a and ends with an external protrusion which has a groove 36. A ring 37, screwed into the threaded hole of a respective part 38, is axially but not tangentially engaged hereat with the casing, and is fixed to the block 29, by means of screw elements 39, and at the opening which is opposite to the coupling 19 in the respective seat 30. For its actuation, the ring 37 is conveniently provided with a series of external radial pins 40; the ring and the groove 36 are coaxial to their respective seat 30. For said engagement, the bottom 41 of the ring is configured, in its plane, in the shape of a fork, defining the radial slot 41a which is sufficiently wide and long to allow the extraction of the casing 35 from the ring when the latter is moved eccentrically with respect to the former. In fact if the ring 37 is unscrewed it pulls the respective sealing device 32 along and out of the block 29 and the respective plunger 18, if the coupling 19 is open. In this manner a rapid replacement of said entire device and of said plunger and therefore a rapid and safe restoration of the efficiency of the pump are possible even at the work site, leaving to specialized workshops the execution of the maintenance and the restoration of the elements (in particular the gaskets 34 and the plunger 18) which have worn out due to the heavy stresses to which they are subject. On the other hand the ring 37 normally ensures the locking of the respective pumping chamber 31 and therefore of the respective casing 35 in the block 29; the ring, acting on the dome 35a, in fact locks the shoulder 35b of the casing 35 against a related shoulder of the seat 30, with gaskets 42 and 43 interposed.

The suction valve 44 and the delivery valve 45 of a pumping chamber 31 are substantially configured according to a common alignment which is perpendicular to the axis of the respective plunger 18: in practice this alignment is vertical and the two valves are respectively above and below the block 29 and are arranged in related small blocks 46 and 37 fixed to said block with screw elements 48. According to this alignment, the small blocks are traversed by a hole with a threaded outward portion for the coupling of a respective ring connection 40 and 50 which has actuation pins 51 and is then connected to the chamber 31 by a respective passage 52 and 53 which corresponds to a port of the casing 35. Both valves comprise a shutter which is generally indicated at 54 and has a stem 54a and a terminal pointed expansion 54b which has a groove for the accommodation of a gasket 55 for sealing and shock-absorption against the seat 56. Both valves also comprise a guide 57, with bushes 58 interposed, for the sliding of the shutter stem 54a; a sleeve 59 surrounds the guide and is connected thereto by means of spoke elements 60. A retention spring 61 is interposed between the spokes 60 and the expansion 54b of the respective shutter. With reference to the valve 44, the seat 56, which is outwardly conical, is provided in a recess of the ring-like connection 49; with reference to the valve 45, said seat is instead provided in a recess of the small block 47. Both connections 49 and 50 lock an end shoulder of the respective sleeve 59 against a shoulder of the respective blocks 46 and 47, with a gasket 62 interposed. The portion 63 of the delivery duct, leading out of the connection 50 and connected thereto with a screw coupling, is substantially flexible and has a wide radius of curvature; the various portions 63 then converge into a single duct. Each connection 44 has a flanged inlet removably connected to a respective branching of the suction duct 64. The adopted solution allows to achieve a cement-mixture circuit which has no deviations or tortuous paths; this yields an improved volumetric efficiency of the pump and a simplification of the delivery and suction valves; the problems of degradation of the pumped mixtures which occur due to sharp flow variations are avoided. The rapidity of the replacement of said valves should also be noted.

The division into parts which has been studied for the body of the pump and the differentiation of the elements which constitute the various operating components allow a greater automation of the pump manufacturing operations and a concentration of the most valuable materials in the more highly stressed points.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. Suction and force plunger pump having at least one pumping chamber (31) in which a suction and force plunger (18) actuated by a cross-head (14) crank system is inserted at a packing-gland sealing device (32, 33), characterized in that said plunger is connected to said cross-head (14) by means of a quick coupling (19) and said packing-gland device is mounted so as to be extractable from said pumping chamber through an opening (23) thereof opposite to said cross-head, at said opening the packing-gland casing (35) being axially but not tangentially engaged by a ring (37) which is normally adapted to ensure the sealing lock between said chamber, said casing (35) and said ring (37), said ring being also adapted to unlock said chamber and said casing for extracting the packing-gland device (32, 33) and, if said coupling is open, the related plunger.

2. Pump, according to claim 1, characterized in that said casing (35) lines said respective pumping chamber (31) said extends towards said opening (23) with a sort of dome (35a) and ends thereat with an external protrusion which is concentrical to said opening and has a groove (36), while said ring (37) has a bottom (41) in the shape of a fork for axially engaging said casing at said groove.

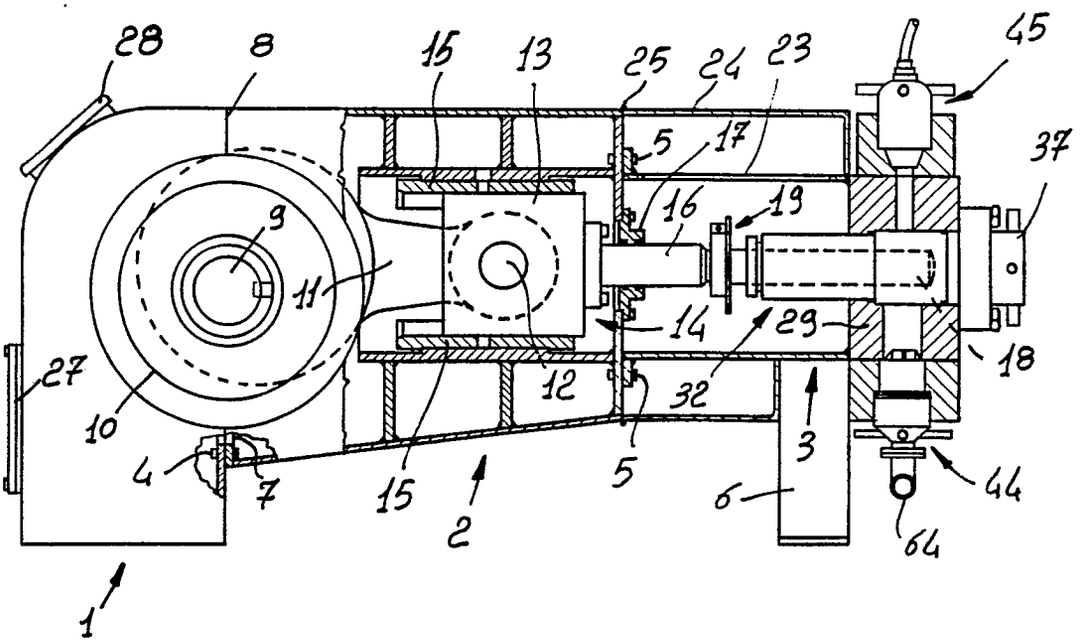
3. Pump, according to claim 1, characterized in that the passages between said respective pumping chamber (31) and the related suction (44) and delivery (45) valves, said valves (44, 45) and the connections (49, 50) of the suction (64) and delivery (63) ducts thereto are according to a common alignment which is perpendicular to the axis of said plunger and is preferably vertical.

4. Pump, according to claim 3, characterized in that said corresponding duct (63) connects to said delivery valve (45), located in the upper region of said respective pumping chamber, by means of a substantially flexible portion (63) having a wide radius of curvature.

5. Pump, according to claim 3, characterized in that each of said valves (44, 45) comprises, coaxial to said alignment: a shutter (54), a sliding guide (57) for said shutter, a sleeve (59) surrounding said guide and connected thereto by means of spoke elements (60), a seat on which said shutter abuts, closing it, a ring connection (49) for said respective duct, which connection is also adapted to provide a seal between said chamber and said sleeve.

6. Pump, according to claim 1, having a plurality of said pumping chambers (31) arranged side by side in a row and a single horizontal crankshaft (9) for the actuation, through respective cross-head connecting rods (11), of respective horizontal plungers (18), and characterized in that its body is longitudinally divided into three removably joined box-like parts (1, 2, 3) and, while said shaft is mounted at the separation plane between the central part (2) of said three parts and an end part (1), said cross-heads (14) and said quick couplings (19) are respectively accommodated in said central part (2) and in the other end part (3), said quick couplings being accessible through openings (23) of said end part which are normally closed by a cover (24).

FIG. 2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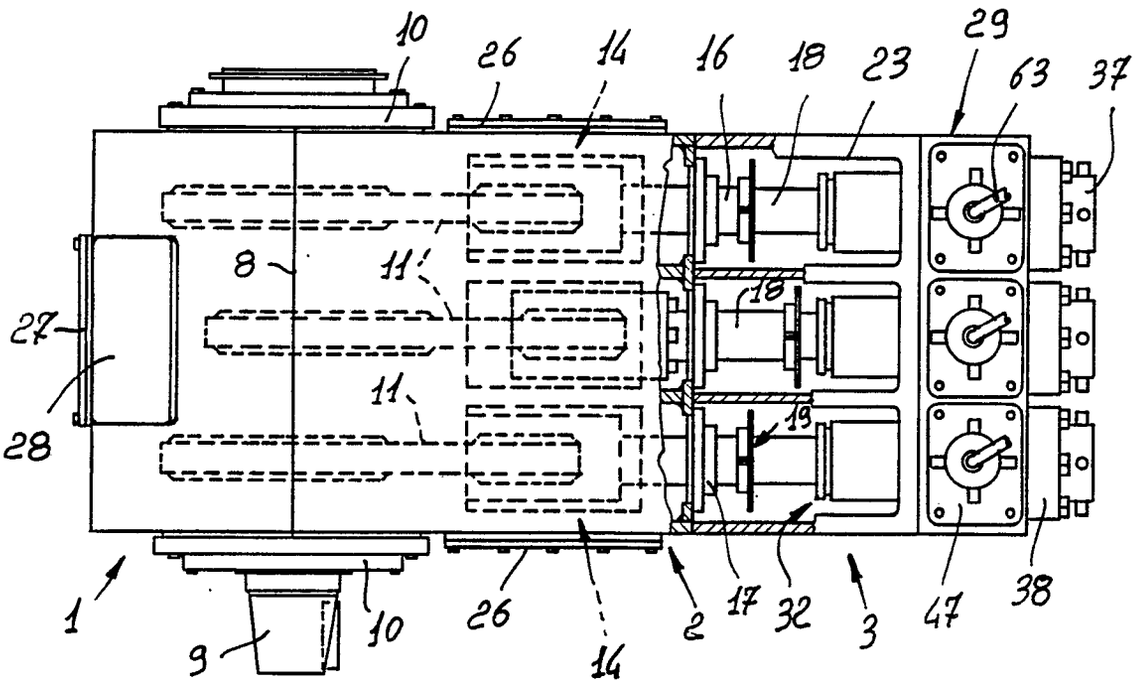
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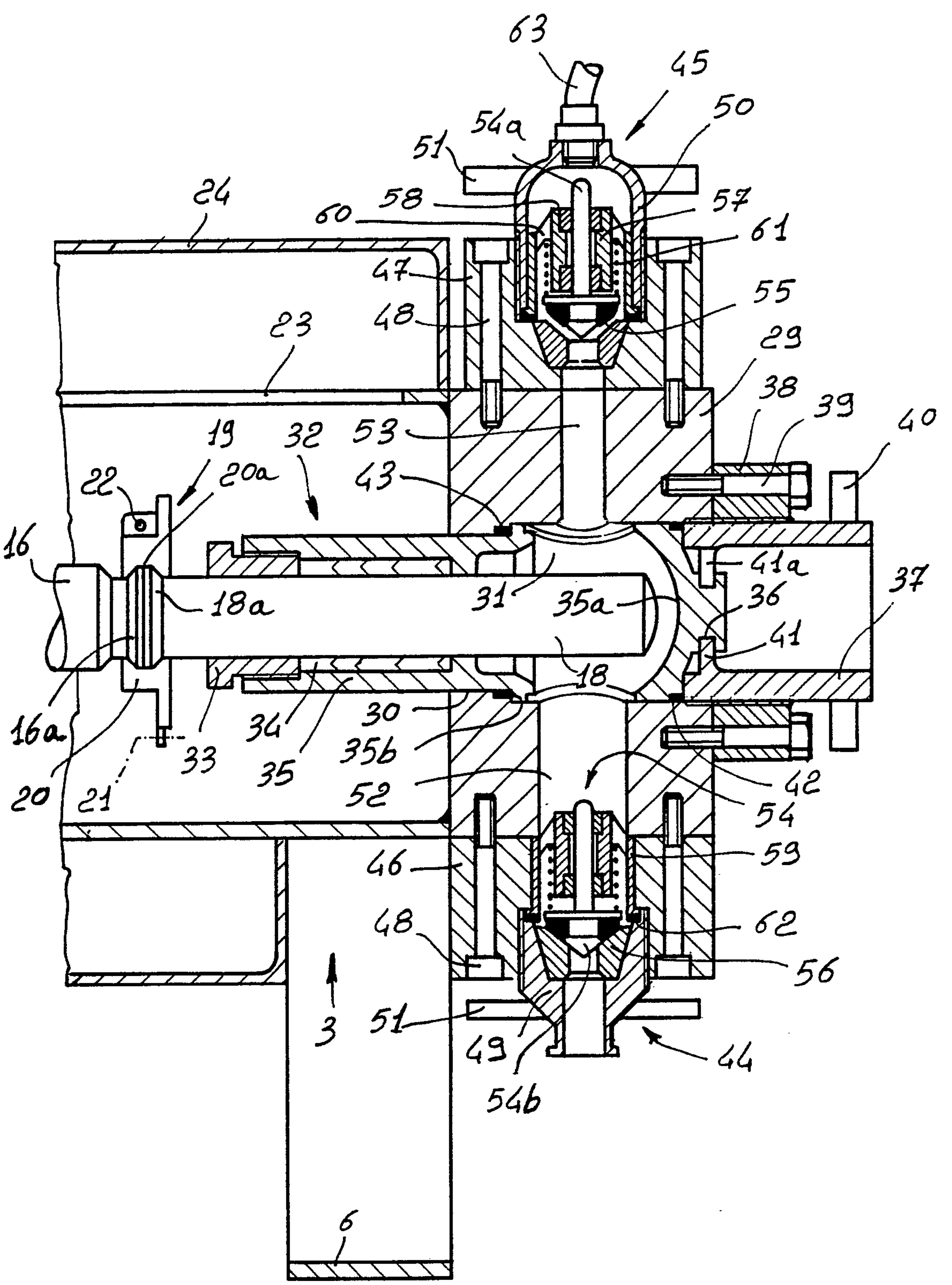
FIG.1

FIG.3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