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(54) **Pump.**

(57) In a pump capable of pumping water containing sand at a rate of 10 m^3/h a piston (8) is mechanically reciprocated within a flexible sleeve (4) sealingly connected between a movable member (3) carrying the piston (8) and a fixed member (2) provided with an inlet port (11) and an outlet port (12), each having non-return valves. The sleeve (4) is of polymeric material, preferably rubber or a fluorocarbon, is capable of withstanding an internal pressure of at least 0.5 MPa, and has a life of at least 20 million cycles. The pump can be used for de-watering foundations in building construction.

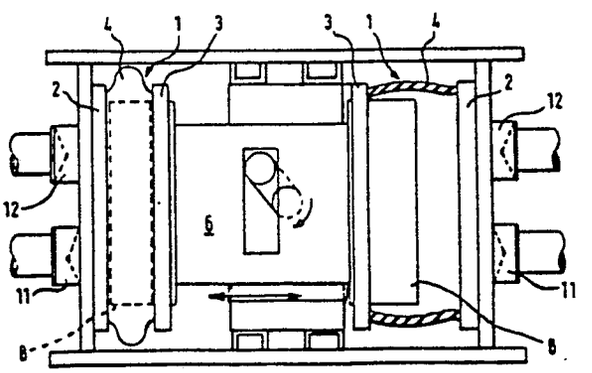

FIG.I.

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PUMP

This invention relates to pumps capable of pumping at the rate of 10 m^3/h water containing solid particles such as sand. In the de-watering of foundations in the constructions of buildings, large quantities of water containing solid impurities often have to be raised through considerable heights for extended periods of time (e.g. several months). What is desired is a pump which can perform this function, which is robust in construction, and is not liable to damage by the solids. Heavy duty pumps commonly have a reciprocating piston or rotary member moving in a metal casing. However, serious problems of wear and sealing arise because of the abrasive effect of the solid particles and the pressure differentials required to raise the water. Diaphragm pumps might solve the problems of wear and sealing but would in general provide an insufficiently high pumping rate.

In order to overcome these difficulties the present invention provides a pump capable of pumping at a rate of 10 m^3/h water containing solid particles such as sand, the pump comprising a pump chamber of variable volume defined by a fixed end-member, an end-member movable towards and away from the fixed end-member, a flexible sleeve sealingly connected between the end-members, and a piston fixed to the movable end-member and projecting towards the fixed end-member, the fixed end-member having an inlet port and an outlet port each provided with a non-return valve, and mechanical reciprocating means for moving the movable end-member to and from a position at which the volume of the pump chamber is at a minimum and the sleeve is convoluted with at least one outward bulge, the sleeve being of polymeric material, being capable of withstanding an internal pressure of at least 0.5 MPa, and having a life of at least 20 million cycles of reciprocation before failure.

The use of a piston reciprocating within a strong flexible polymeric sleeve avoids the necessity for mutually sliding surfaces and thus avoids the problem of abrasion by solid particles. An advantage of polymeric material is its resistance to corrosion.

The preferred sleeve is of natural or synthetic rubber or a fluorocarbon (e.g. polytetrafluoroethylene). Although the pump is primarily intended for pumping water containing solid particles such as sand, which may be in the form of a slurry (usually containing air), this does not preclude the use of the pump for pumping other fluids. The choice of polymeric material for the sleeve will depend on the range of fluids it is desired to pump. Preferably the sleeve is circumferentially reinforced externally (e.g. by rings of metal or plastics material) and/or internally (e.g. by fabric or rings of metal or plastics material).

The preferred sleeve is substantially barrel-shaped when the movable end-member is in the second extreme position. However, in order to reduce the maximum/minimum volume ratio of the pump chamber, the sleeve may have more than one convolution; this also limits the extent to which the sleeve bulges out at the minimum volume of the pump chamber.

The distance between the extreme positions of the movable end-member is preferably substantially half the distance between the end-members when the movable one is at its maximum distance from the fixed one. It is preferable for the length of the piston to be substantially equal to the minimum distance between the end-members. This makes the minimum volume of the pump chamber approach zero, thus providing a high ratio of maximum to minimum volume, comparable to that of a conventional piston pump.

Preferably, the pump includes guide means for preventing rocking of the movable end-member during reciprocation, in order to reduce wear of the sleeve.

The pump chamber is preferably one of a pair of similar pump chambers whose movable end-members are driven by the reciprocating means in such a way that the volume of one chamber increases as that of the other decreases.

The invention will be described further, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 schematically shows a pump, having two pump chambers, capable of pumping solids-contaminated water at a rate of at least 20 m^3/h; and

Figure 2 is a part-sectioned detail of a practical embodiment of the pump.

The pump illustrated has a pair of variable-volume pump chambers 1. Each chamber 1 is defined by a fixed end-plate 2, a movable end-plate 3, and a resilient synthetic-rubber sleeve 4 circumferentially reinforced with nylon fabric and sealingly connected to the plates 2,3 by clamping means (not shown). The movable plates 3 are rigidly connected by a longitudinal frame 6 which is reciprocated by a reciprocating mechanism which is only shown diagrammatically in Figure 1 and which may be of any convenient conventional type (preferably comprising a crank and a connecting rod).

Each movable plate 3 carries a closed, hollow, cylindrical piston 8 which reduces the minimum volume of the pump chamber and thus increases the ratio of maximum to minimum volume. Each fixed plate 2 has an inlet port 11 and an outlet port 12, each provided with a non-return valve (shown diagrammatically) which may be

of any convenient conventional type. In Figure 1 the left-hand chamber 1 is at its minimum volume and the right-hand chamber 1 is at its maximum volume. The sleeve 4 of the right-hand chamber 1 is at its natural length (i.e. unstressed).

As shown in Figure 2, each movable plate 3 is provided with upper and lower bearing bosses 13 which run on respective guide bars 14 fixed to the corresponding plate 2. The frame 6 comprises longitudinal bars 7 welded to the movable plates 3. Reciprocation of the frame 6 is caused by a connecting rod 16 whose "big end" 17 is connected to a crankshaft 18 driven by a motor (not shown) and whose "little end" 19 is connected to a pivot pin 20 mounted in the piston 8. In Figure 2 the piston 8 is midway between its extreme positions.

By way of example, a pump as described above may be designed to provide a flow of 6000 gal/h (27 m^3/h), with a suction lift of 9 m and a delivery head of 30 m (equivalent to a pressure of about 0.3 MPa or about 50 p.s.i.), for the purpose of de-watering foundations. In operation the sleeve 4 has to be able to withstand pressures up to at least 0.5 MPa (about 80 p.s.i.) may have a diameter of 150 to 200 mm (in its unstressed state) and a thickness of about 10 mm. In order to be able to function for several months without interruption, the sleeve has to have a life expectancy of at least 20 million cycles of reciprocation without failure. The maximum spacing of the plates 2,3 may be 130 mm, and the minimum spacing may be 60 to 70 mm, the reciprocating mechanism being driven by, say, a 6 hp (4.5 kW) motor.

1. A pump capable of pumping at a rate of 10 m^3/h water containing solid particles such as sand, the pump comprising a pump chamber (1) of variable volume defined by a fixed end-member (2), an end-member (3) movable towards and away from the fixed end-member (2), a flexible sleeve (4) sealingly connected between the end-members (2,3), and a piston (8) fixed to the movable end-member (3) and projecting towards the fixed end-member (2), the fixed end-member (2) having an inlet port (11) and an outlet port (12) each provided with a non-return valve, and mechanical reciprocating means (16 to 20) for moving the movable end-member (3) to and from a position at which the volume of the pump chamber (1) is at a maximum and the sleeve (4) is convoluted with at least one outward bulge, the sleeve (4) being of polymeric material, being capable of withstanding an internal pressure of at least 0.5 MPa, and having a life of at least 20 million cycles of reciprocation before failure.

2. A pump as claimed in claim 1, in which the sleeve (4) is of rubber.

3. A pump as claimed in claim 1 or 2, in which the sleeve (4) is circumferentially reinforced.

4. A pump as claimed in any of claims 1 to 3, including guide means (13,14) for preventing rocking of the movable end-member (3) during reciprocation.

5. A pump as claimed in any of claims 1 to 4, in which the pump chamber (1) is one of a pair of similar pump chambers (1) whose movable end-members (3) are driven by the reciprocating means (16 to 20) in such a way that the volume of one chamber increases as that of the other decreases.

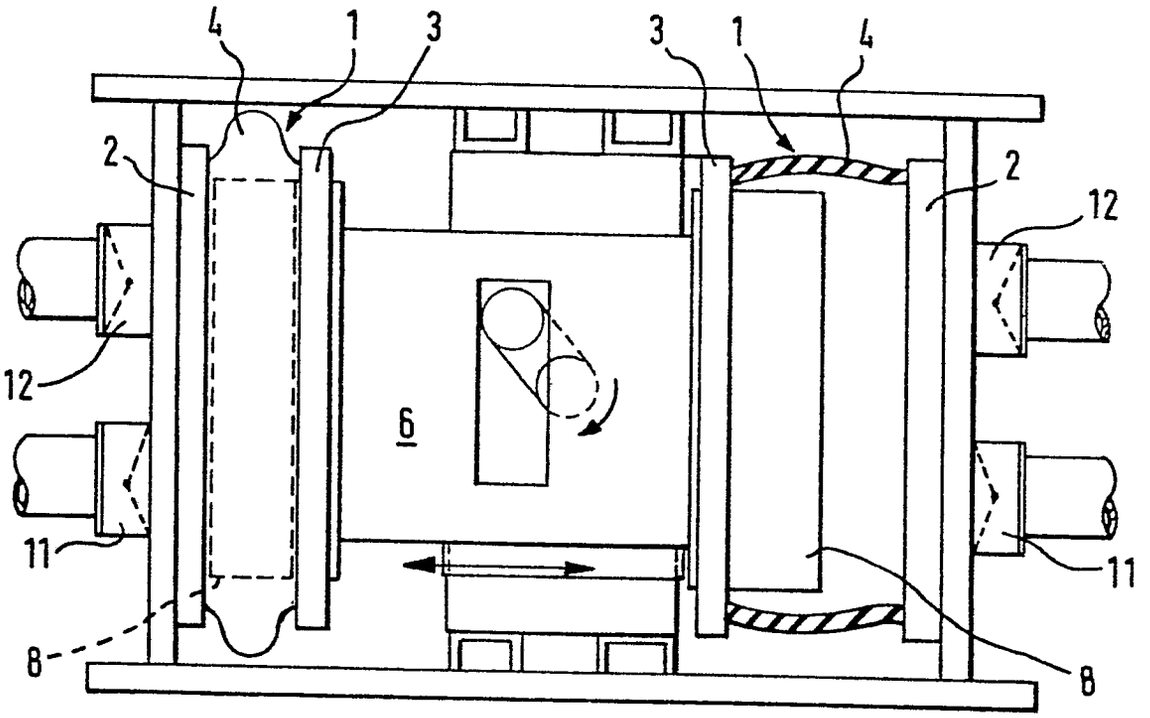

FIG.I.

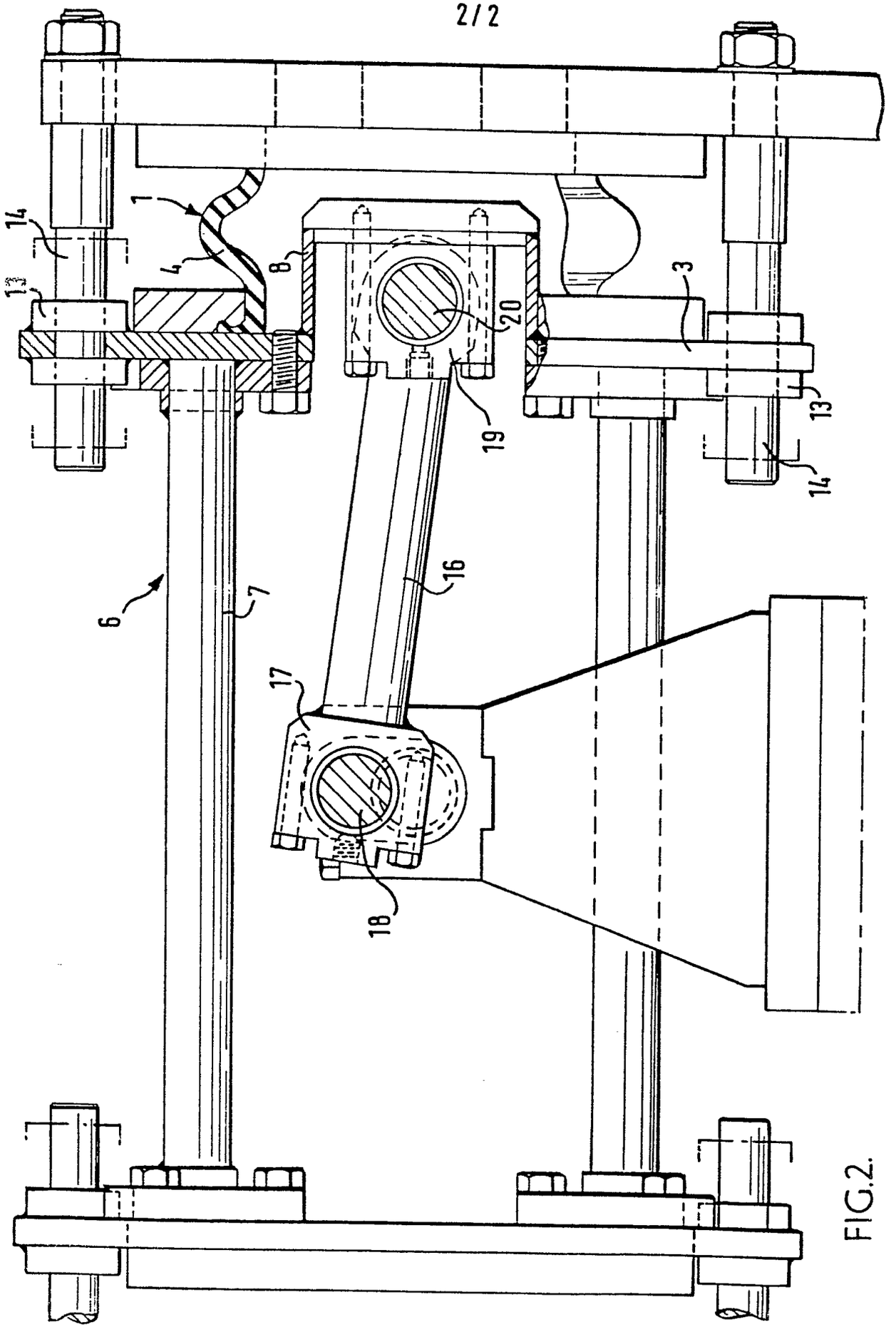

FIG.2.

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 79 30 2505

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	US - A - 2 902 944 (ETTEN) * Column 1, lines 48-52; column 2, lines 29-71; column 3, lines 1-23; figure 1 *	1-4
X	GB - A - 498 403 (STANCLIFFE) * Page 3, lines 22-69, 104-124; page 4, lines 34-55; figures 1-3 *	1-5
	FR - A - 1 328 970 (C.E.A.) * Page 2, left-hand column, paragraphs 2-6; figure *	1,5
	US - A - 2 431 007 (WOOD) * Column 2, lines 18-55; column 3, lines 1-21; figures 5 and 6 *	1,4,5

CLASSIFICATION OF THE APPLICATION (Int. Cl.³)

F 04 B 43/08

TECHNICAL FIELDS SEARCHED (Int.Cl.³)

F 04 B

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	05-02-1980	HEINLEIN

EPO Form 1503.1 06.78