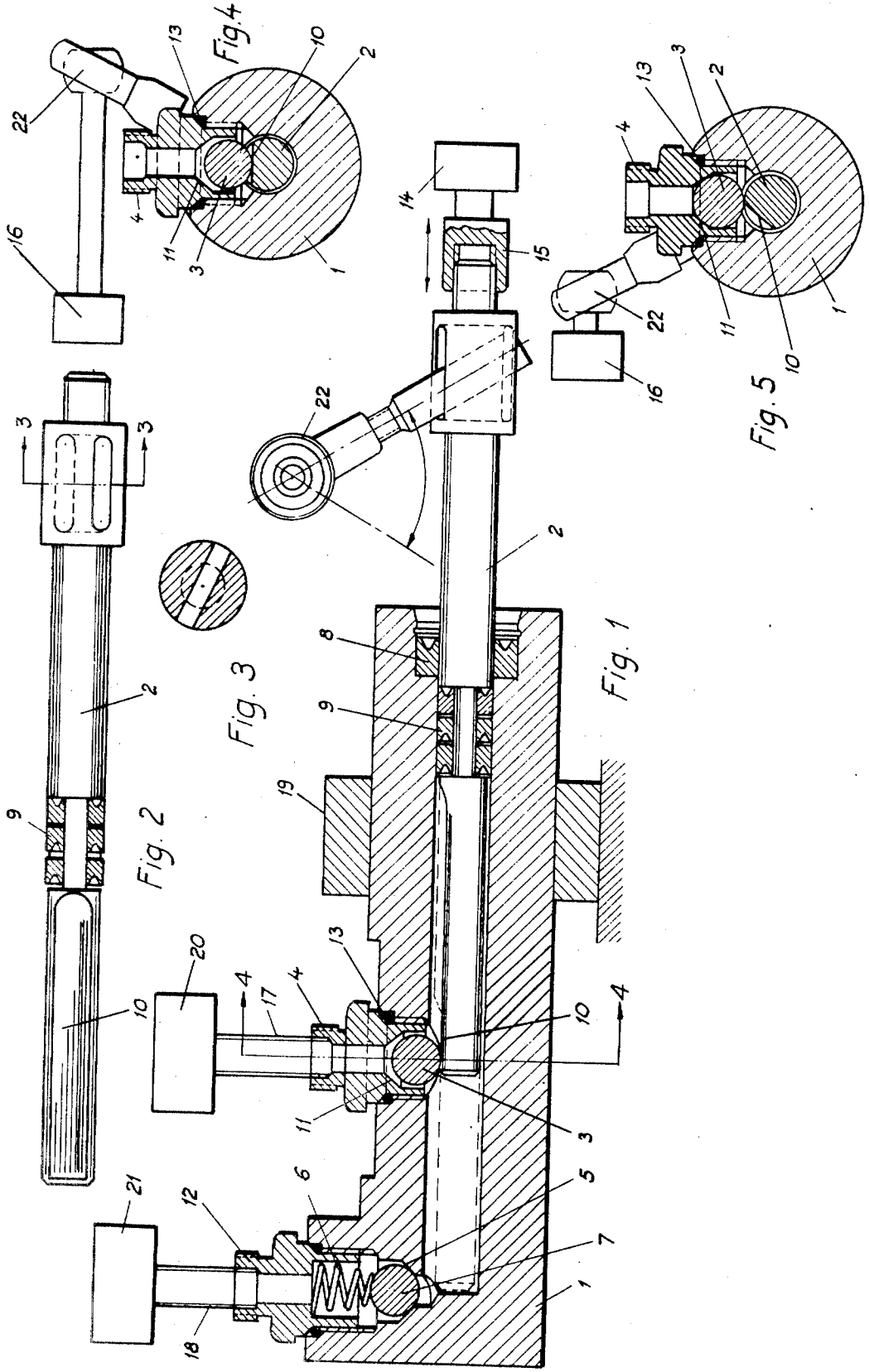
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PROPORTIONING PUMP

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PROPORTIONING PUMP

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ABSTRACT OF THE DISCLOSURE

A reciprocating plunger pump for proportioning or dispensing a fluid, wherein a section of the plunger has been removed so that the quantity of fluid drawn into the pump and portioned out therefrom may be controlled by the rotative position of the pump plunger and by the stroke of the latter in conjunction.

BACKGROUND OF THE INVENTION

Field of the invention

This invention refers to a reciprocating plunger pump that may be utilized for proportioning or dispensing controlled amounts of gases or liquids.

Description of the prior art

In pumps for proportioning gases or liquids, i.e. fluids, the pump generally comprises a pump housing surrounding a plunger and being provided with inlet and discharge valves. In these pumps the valves are opened and closed, respectively, by the flow of the passing fluid. The valve seats of these valves may consist of steel with a valve plug, generally a ball, also made of steel, engaging the valve seat and being urged against the latter by means of a spring. In order to achieve satisfactory sealing of the valve it is necessary to manufacture both the valve seat and the ball with great precision. If inappropriate materials are used in the valve seat and the ball, respectively, the seat and the ball may be subjected to heavy wear by fluids containing a substantial amount of erosive filling material, which will cause leaks in the valve. There will also be a danger of solid particles becoming positioned between the seat and the ball, which will cause permanent leaks in the valve. Moreover, as the ball has to be actuated by a spring for holding the valve closed, the fluid that is drawn in will have to overcome the spring force, thereby causing a delay in time in opening the valve. Furthermore, in fluids having high viscosities, the valve plug may not return rapidly enough, thereby giving the plunger time to begin its pressure stroke before the valve has closed, with the result that fluid is urged back into the suction line.

SUMMARY OF THE INVENTION

This invention proposes to eliminate the disadvantages set forth above in a pump for proportioning or metering a fluid in predetermined quantities. The pump in accordance with the invention comprises a pump housing having an inlet valve and discharge valve, respectively, in communication with an elongated cylindrical cavity in said housing, a fluid supply lead connected to said inlet valve, a fluid expelling lead connected to said discharge valve, a rotatable and reciprocable and substantially cylindrical pump plunger having a longitudinal segment removed therefrom, and driving means for providing said plunger with a predetermined rotation and a predetermined displacement, respectively, in said cavity. A predetermined quantity of fluid may be drawn into said cavity by said driving means setting said plunger in such rotative position that during the suction stroke of the reciprocable plunger the valve plug of the inlet valve will engage the portion of the plunger from which the longitudinal segment has been removed. Furthermore, said predetermined

quantity of fluid may be expelled through the discharge valve by said driving means setting said plunger in such rotative position that during the discharge stroke of the plunger the valve plug of the inlet valve will be urged against its valve seat by the remaining cylindrical surface of the plunger.

BRIEF DESCRIPTION OF THE DRAWING

The invention will now be described with reference to the accompanying drawing, in which FIG. 1 shows a longitudinal cross-section of the pump including the inlet and discharge valves, respectively, with the pump plunger illustrated in one of its end positions in solid lines and in its other end position in dashed lines, FIG. 2 is a plan view of the pump plunger. FIG. 3 is a cross-section of the plunger taken along the line 3—3 of FIG. 2, FIG. 4 is a cross-section of the pump including the inlet valve and is taken along the line 4—4 of FIG. 1 with the plunger in a rotative position corresponding to the inlet valve being open, and FIG. 5 is a cross-section similar to that of FIG. 4 but with the plunger in a rotative position corresponding to the inlet valve being closed.

With reference to the drawing, FIG. 1 shows a longitudinal cross-section of a pump housing **1** with a pump plunger **2** introduced therein but not illustrated in cross-section. The housing **1** may be supported by appropriate clamping means **19** or in any other suitable manner. A packing **8** is provided at the end of the housing **1** where the plunger **2** is introduced into said housing for effectively sealing off the plunger from the housing, and a set of packings **9** is positioned in the plunger for sealing off the front end of the plunger from the housing, irrespective of the temporary position of said front end. A discharge valve **12** comprising a valve plug illustrated in the form of a ball **7** which which may be resilient and which may be made of rubber or of any other suitable material including steel, and a spring **6** for actuating said ball are located at the opposite end of the housing. The ball **7** is urged by the spring **6** against the valve seat **5** so as to achieve effective sealing with respect to the latter. An inlet valve or suction valve **4** having a valve plug comprising a resilient ball **3** of for example rubber or some plastic material or of steel is situated in the wall of the housing **1**, and the ball **3** may be urged against the valve seat **11** of the inlet valve by means of the plunger **2** in manner to be described below. The valve seat **11** may be of resilient material for cooperation with a ball **3** of resilient material surrounded by steel, or else said valve seat may be of steel. Furthermore, a fluid supply lead **17** from a fluid supply **20** is connected to the inlet valve **4**, and a fluid discharge lead **18** is connected from the discharge valve **12** to a point designated as a block **21**, which generally comprises a nozzle, for utilizing the predetermined quantity of fluid proportioned from the pump.

A cylinder segment has been removed from the front end of the plunger **2** in the elongated direction thereof, so as to leave a flat longitudinal surface **10**. However, the plunger **2** will always be in engagement with the valve plug **3**, either with the flat surface **10** remaining after removal of the cylinder segment or with the cylindrical surface of the plunger. The axial or longitudinal extension of the removed segment corresponds to the full stroke of the plunger. Thus the radial cross-section of the portion of the plunger **2** where the cylinder segment has been removed will form a sort of cam, which engages the plug of the inlet valve. This is illustrated in FIG. 4 which shows a cross-section 4—4 through plunger **2**, housing **1** and inlet valve **4**. FIG. 4 shows the ball **3** removed from the valve seat **11** and engaging the flat surface **10** of the plunger **2**, thereby leaving the valve in open position.

FIG. 5 is substantially the same as FIG. 4, but shows the ball 3 engaging the valve seat 11 as the result of the plunger 2 having been rotated in such manner that the cylindrical outer surface of the plunger urges the ball into said position. The rotative position of plunger 2 may be controlled by means of a linkage mechanism 22 cooperating with appropriate driving means illustrated as a block 16. When the plunger 2 has been rotated sufficiently the flat surface thereof will have passed the valve plug, i.e. the ball, and the latter will be engaged by the cylindrical surface of plunger 2 instead, thereby closing the valve inlet completely. In FIG. 5 the plunger has been rotated by approximately 50° with respect to the housing.

The longitudinal stroke of the plunger is provided by appropriate driving means of any suitable known type and illustrated as a block 14 connected to the plunger 2 over coupling means 15.

The solid lines of FIG. 1 illustrate the plunger 2 in its end position after the suction stroke, with the portion 10 of the plunger surface from which a cylinder segment has been removed engaging the valve plug in the inlet valve and leaving the valve inlet open as illustrated in FIGS. 1 and 4, respectively. For proportioning a predetermined quantity of fluid from the pump, the plunger 2 is now rotated to the position illustrated in FIG. 5 by the driving means of the block 16, thereby closing the inlet valve by urging the ball 3 against its seat 11, and thereafter the plunger 2 is displaced longitudinally to the left, as illustrated in FIG. 1, for its discharging stroke by the driving means of the block 14 so as to urge the valve plug or ball 7 of the discharge valve 12 away from its valve seat against the force of spring 6, thereby expelling the fluid from the interior of the pump housing through the discharge valve. After the plunger has reached its final discharge position (illustrated by dashed lines in FIG. 1), the valve plug 7 of the discharge valve will be urged against its valve seat 5 again by the spring 6 and the plunger will be rotated by 50° in the reverse direction to the previous rotation by the driving means 16 so as to open the inlet valve 4 and thereafter will be displaced to the right, as illustrated in FIG. 1, by the driving means 14, so as to perform its suction stroke. During this stroke discharge valve 12 is maintained closed by the valve plug 7 of this valve being urged against valve seat 5 by spring 6. During the suction stroke fluid will again flow in through the open inlet valve 14 so as to fill the pump housing. When the plunger has reached its right end position the cylinder is rerotated by 50° so as to close the valve 4, whereafter the proportioning movement of the plunger is reinitiated. Thus the amount of fluid proportioned by the pump will be determined by the dimensions of the elongated cavity in which the plunger is displaced and by the stroke of the plunger 2, which in turn may be controlled by an appropriate setting of the known driving means 14.

Also, the opening and closing of the inlet valve 4 is always positively controlled by plunger 2 in such manner that the valve is not opened until after completion of the discharge stroke of the plunger and is not closed until after completion of the suction stroke of the plunger. If the quantity of fluid proportioned is to be varied, it is only necessary to vary the stroke of the plunger to a corresponding extent.

As mentioned hereinbefore, the movements of plunger 2 may be provided by means of any appropriate device, mechanical or other, known in the prior art for providing a rotative movement and a reciprocating movement, respectively. Such device may for instance be controlled by means of electric pulses according to a predetermined program.

The portion of the pump plunger 2 from which a cylinder segment has been removed has a flat surface in the illustrated embodiment. However, this surface might also be curved, depending on the desired opening characteristic of the flow through the inlet valve.

In consequence of the design of the plunger and of the inlet valve the valve will open and close with great precision. As no additional resistance in the form of a spring force urging the valve plug against the valve seat exists there will be no lag in the movement of the valve plug. Furthermore, the valve provides improved suction and is independent of the viscosity of the fluid, thereby eliminating the danger of clogging in the valve.

A nipple of standard design may be utilized for the inlet valve 4 if it is bored to a diameter that is appropriate to the ball serving as the valve plug. The valve housing may be made of brass or steel, for example, and the ball may appropriately be made of rubber or of any other suitable elastic material and it may be provided with an outer shell of steel, metal or plastic that is joined to said material. As the ball is made of resilient material, effective sealing against the valve seat is always attained when the ball is urged against the same by the plunger. The pressure of the valve plug against the seat may be adjusted by screwing inlet valve 4 inwards or outwards, and a resilient sealing ring 13 will provide the necessary sealing between the inlet valve and the pump cylinder within the adjusting range. As the plunger is not only longitudinally displaced during its movement but also is rotated back and forth, the ball will rotate, so that different areas thereof will always engage the valve seat, thereby avoiding any unevenly distributed wear on the ball.

As will be seen from the above disclosure, the invention provides a simple and compact pump which not only requires little space but also provides short and straight flow therethrough and proportions precise amounts of gaseous or liquid fluid.

The embodiment described above primarily refers to a pump for proportioning a fluid. However, the device of the invention may also be embodied as a flow regulating valve. In such case the plunger is made to perform only a rotative movement but no longitudinal movement. The flow-through quantity is determined by the extent to which the plunger is rotated with respect to the housing. This rotation may be provided either automatically or manually by selection of an appropriate device for block 16.

I claim:

1. A pump for proportioning a fluid in predetermined quantities, comprising a pump housing (1) having an inlet valve (4) and a discharge valve (12), respectively, in communication with an elongated cylindrical cavity in said housing, a fluid supply lead (17) connected to said inlet valve (4), a fluid expelling lead (18) connected to said discharge valve (12), a rotatable and reciprocable and substantially cylindrical pump plunger (2) having a longitudinal segment removed therefrom, and driving means (16, 14) for providing said plunger (2) with a predetermined rotation and a predetermined displacement, respectively, in said cavity, wherein a predetermined quantity of fluid will be drawn into said cavity by said driving means (16) setting said plunger (2) in such rotative postion that during the suction stroke of the reciprocable plunger (2) the valve plug (3) of the inlet valve will engage the portion of the plunger (2) from which the longitudinal segment has been removed and wherein said predetermined quantity of fluid will be expelled through the discharge valve (12) by said driving means (16) setting said plunger (2) in such rotative position that during the discharge stroke of the plunger (2) the valve plug (3) of the inlet valve (4) will be urged against its valve seat (11) by the remaining cylindrical surface of the plunger (2).

2. A pump in accordance with claim 1, wherein said valve plug (3) comprises a ball of resilient material.

3. A pump in accordance with claim 2, wherein said ball of resilient material is provided with an outer shell of steel, metal or plastic.

4. A pump in accordance with claim 1, wherein said valve plug (3) comprises a ball of resilient material surrounded by steel and adapted to engage a valve seat (11) of resilient material.

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