United States Patent

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[31] **P 18 05 972.8**

[54] **VALVE AND PUMP**
10 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **417/519,** 417/900
[51] **Int. Cl.** **F04b 7/00,** F04b 15/02
[50] **Field of Search** 417/515, 519, 900

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ABSTRACT: A pump and a valve therefor, the valve having an inlet conduit, an outlet and an opening connected to the pump cylinder, and a rotary part rotatable selectively to connect the opening to the inlet conduit and the outlet. The passage formed in the valve when the rotary part is in the position to connect the inlet conduit to the opening has the form of a pipe bend.

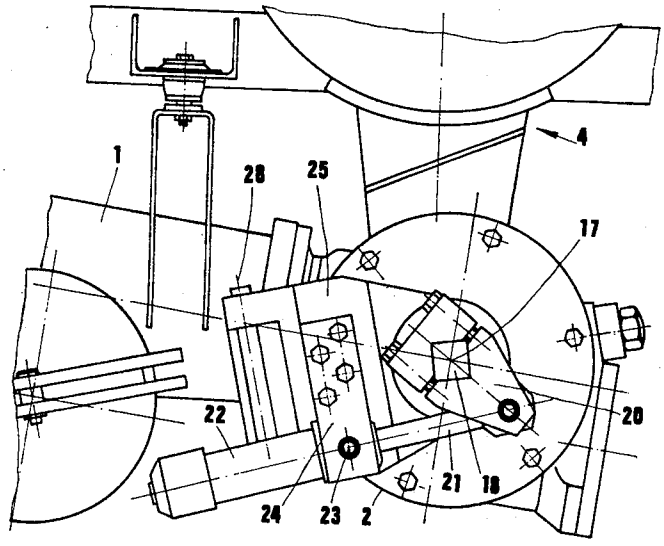
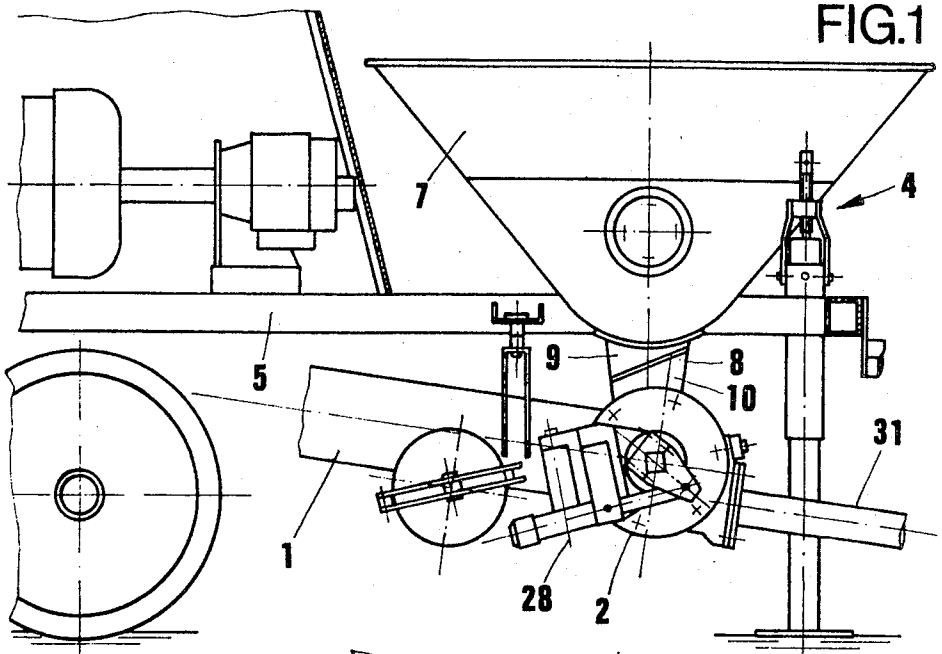


FIG.1



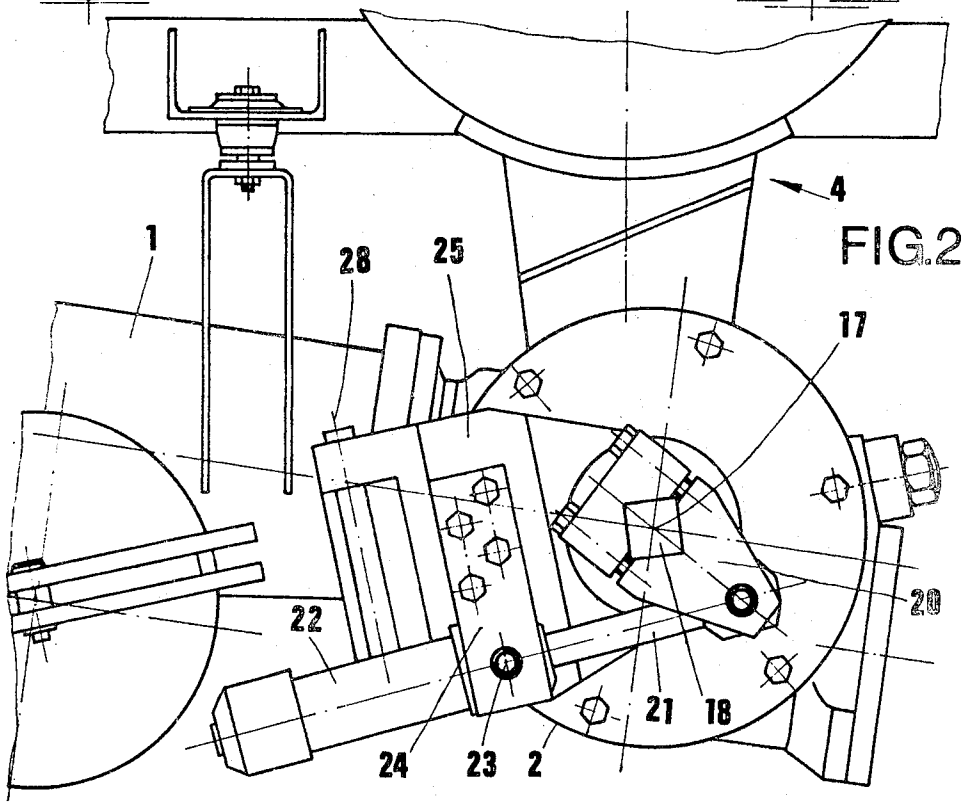


FIG.2

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FIG.3

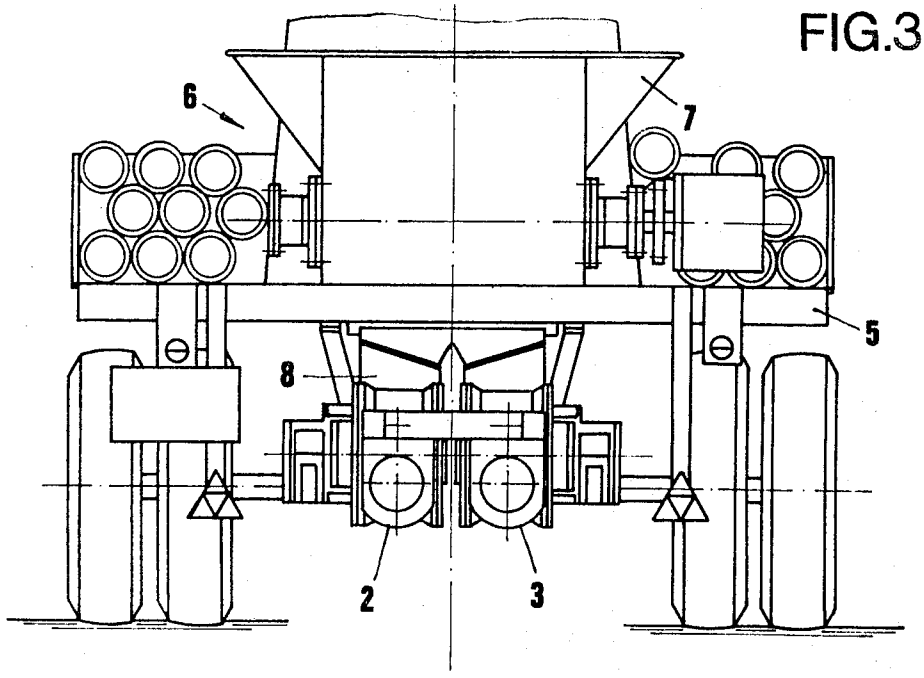
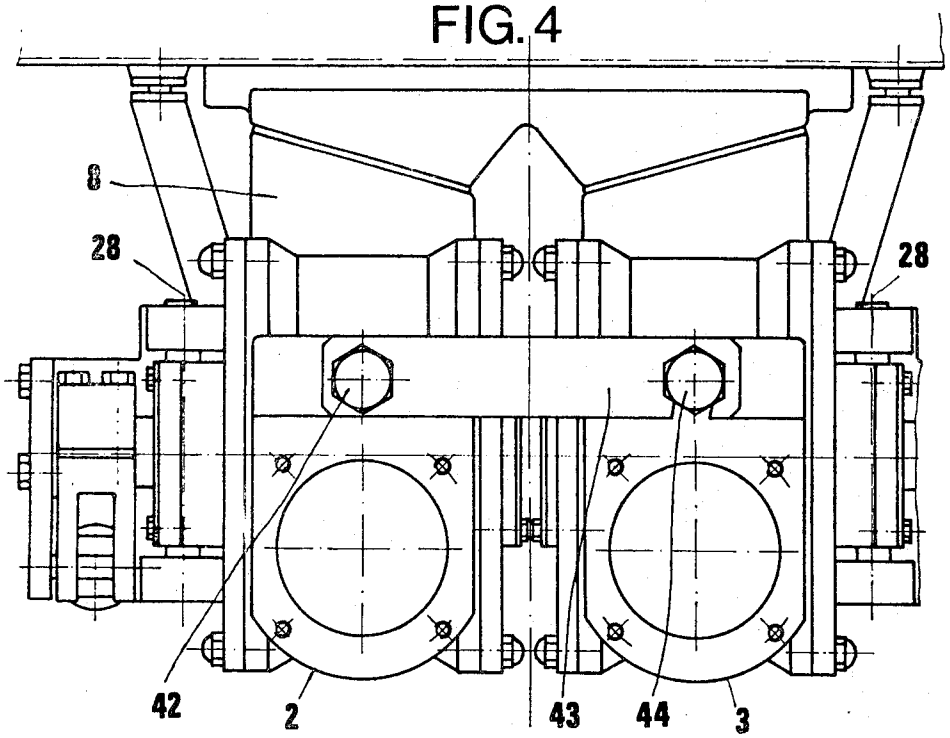


FIG.4



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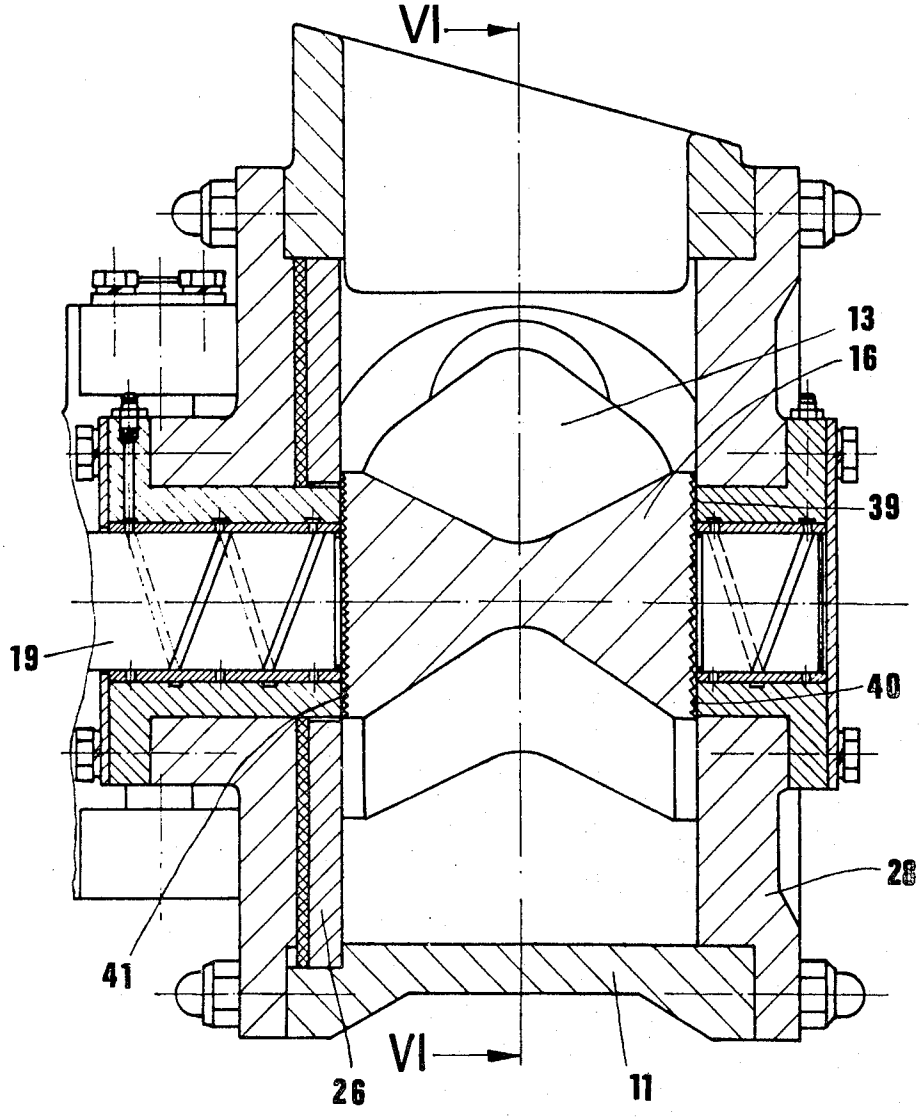

FIG. 5

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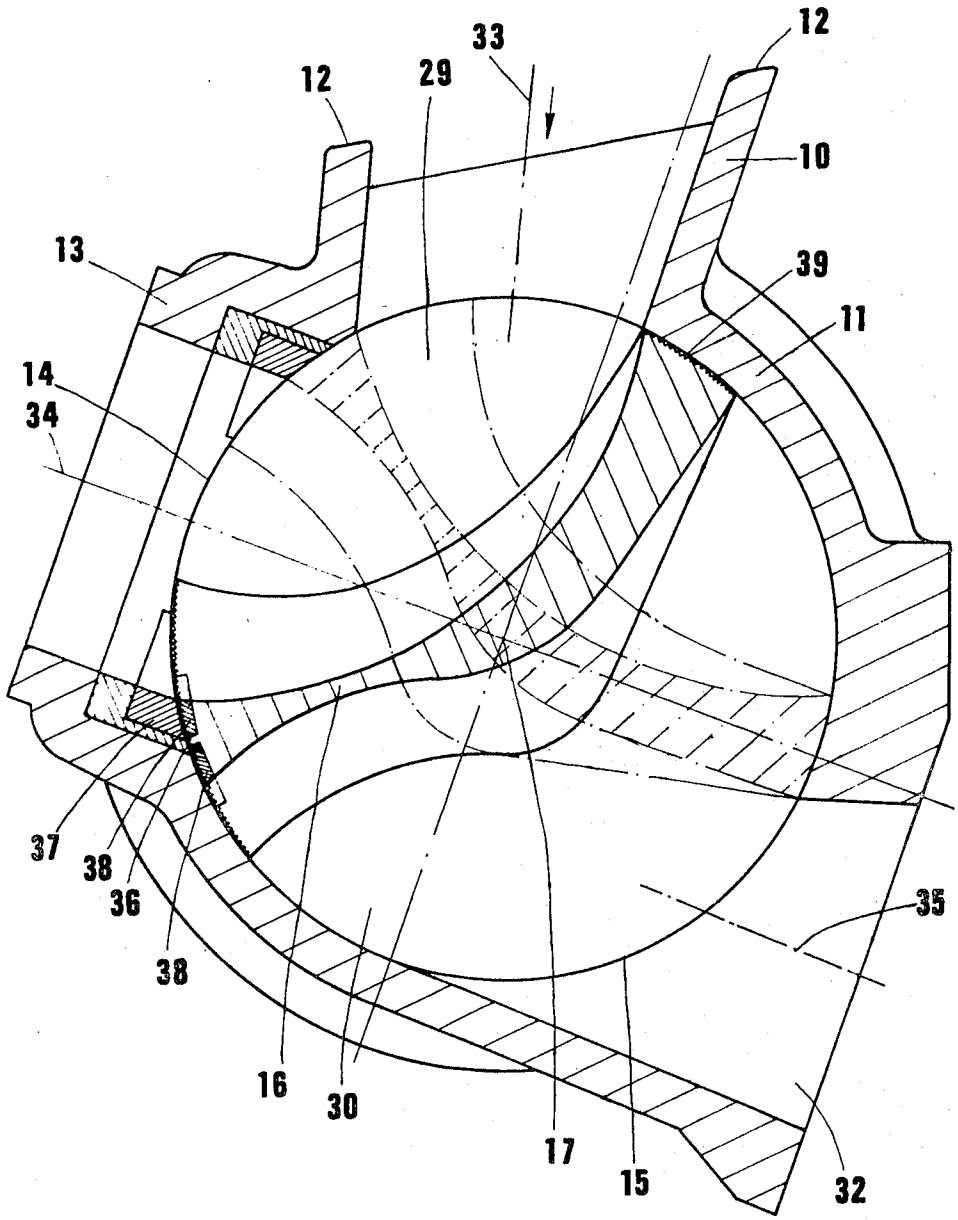

FIG. 6

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VALVE AND PUMP

The invention relates to a valve for a pump, and a pump including the valve.

In particular the invention relates to a valve and a pump for concrete or the like.

Hydraulically driven piston pumps for conveying concrete, mortar or similar substances are known. In these pumps material is drawn into a cylinder and then forced out by a piston into a delivery pipe. During the suction stroke, the piston draws the material to be pumped from an inlet arrangement into a cylinder. The piston pump is generally arranged with its axis horizontal so that if, as is usual, the material comes from a hopper above the pump, it must be deflected through a right angle.

In order to achieve an approximately uniform delivery of material, it is common to provide at least two pump cylinders, the pistons of which operate in opposition. This means that the stream of material from the hopper is divided into two separate streams, which are rejoined in the delivery pipe, and means that the material must be deflected further. All deflections in the path of material flow lead to wear in the pump and valve parts, can cause clogging, and require apparatus which is often difficult to clean and service. In addition the valve is often arranged at some distance from the cylinder, so that a portion of material is continually pushed back and forth without being delivered, thus reducing the efficiency.

Concrete pumps of this type are generally arranged on vehicles, which limits the possible height of the hopper, and means that the amount of material drawn into the cylinder on the suction stroke may not be very large compared with the space available in the cylinder.

According to one aspect of the present invention there is provided a valve for a pump, said valve including a housing having an inlet conduit, an outlet and an opening connectable to the cylinder of a pump, and a rotary part having its axis of rotation perpendicular to the axes of the inlet conduit and the opening, and being rotatable to form a part of either a passage between the opening and the inlet conduit or a passage between the opening and the outlet, the passage between the opening and the inlet conduit having the form of a pipe bend.

According to another aspect of the present invention the valve is included in a pump having a cylinder with a piston movable therein which cylinder is connected to the valve opening, a delivery pipe connected to the valve outlet, the valve inlet conduit being connectable to a source of material to be pumped.

The invention is based on the fact that deflection to the stream of material in its passage into the pump is unavoidable. However, if it is passed through a passage which has the form of a pipe bend, which is arranged in the immediate vicinity of the pump cylinder, the quantity of material which is now moved backwards and forwards but is not pumped out can be reduced to a minimum. If in addition, the pipe bend is combined with a valve such as that of the invention, the distance between the inlet and the cylinder is greatly reduced, and the efficiency of the pump is increased.

Since the invention avoids intermediate tubular elements between the valve and the pipe bend or between these parts and the cylinder, cleaning is also simplified and the number of components to be cleaned is reduced. Thus, when the valve housing is dismantled, the cylinder and the inlet arrangement are directly accessible. This also allows easy replacement of components.

It is possible to adapt the ends of the passages to fit a particular connection; so that the most suitable passage cross sections and flow conditions can be used.

It is to be noted that whereas the passage from the valve inlet to the opening connectable to the cylinder is curved, that between the opening and the outlet may be substantially straight, at least to the extent that the cylinder and outlet may be parallel and slightly offset.

In general the cylinder will be substantially horizontal, while the material will pass substantially vertically into the inlet conduit of the valve. Material will be deflected through a right angle in the suction stroke, and conveyed almost straight in the other stroke when the valve is switched to its other position.

It has been found that particularly good results are obtained with the pump of the invention if pipe bend encloses an angle of less than 90°, 70° being preferred, this is partly because in this arrangement the rotary part of the valve need rotate through less than 90° to form the respective passages. If this feature is combined with the feature of having the cylinder tilted downwards towards the outlet at a small angle, the material can pass into the valve inlet conduit in a substantially vertical direction, and in addition the moving parts associated with the pump can be raised, this being an advantage if it is connected to a vehicle. Also, the feature of having the valve set low down with respect to the vehicle, has the effect of increasing the head of material above the inlet conduit of the valve.

The rotary part of the valve is advantageously constructed like a shutter. The two possible passages in the valve are therefore defined by the rotary part and the valve housing. This construction has advantages in manufacture, it also means that the number of moving surfaces subject to wear is small and that the valve can be cleaned easily.

The opening in the valve housing to which is attached the cylinder may have a rhombic cross section, and the ends of the two valve passages which cooperate with this connection may also have this form. If the rotary part is, as it may be, of rhombic shape, it offers the advantage that a passage is closed by a quick reduction in cross-sectional area at first, followed by an increasingly slow reduction. This closing action is suitable in the case of concrete pumps, because the initial quick closing means that few stones and lumps will get wedged in the valve, and those which do will be broken during the later, slow closing.

Iron cladding may be provided at the rhombic corners of the rotary part and the valve housing, particularly as it is in the vicinity of the corners that the greatest stresses are set up during closing of a passage. Iron cladding may not otherwise be required.

The edges of the rotary part which sealingly engage the housing may have a plurality of concentric or parallel grooves. These grooves will be quickly filled with fine concrete during operation, so that the coacting surfaces of the control slide valve and of the housing are protected from metallic wear. In addition, a good sealing action is obtained, since the concrete in the notches acts as packing.

When setting up the pump with the valve, it is useful to support the valve on a pivot so that it may be pivoted, preferably about the vertical to make the cylinder and the valve accessible for cleaning purposes.

Although a pump of the invention may be used on its own, it is preferable to have two or more pumps arranged together, with their pistons pumping in turn. If two pumps are provided, their pistons may be driven from a single drive means. It is advantageous to feed material directly from a hopper to each valve inlet conduit, rather than to divide a single feed member. If the valves are pivoted, it is advantageous to have a separate valve drive for each.

In order that the invention may be more clearly understood, the following description is given by way of example with reference to the accompanying drawings in which:

FIG. 1 is a side elevation of the essential parts of a pump according to the invention including a valve according to the invention,

FIG. 2 is an enlarged view of a part of FIG. 1,

FIG. 3 is a rear view of a road vehicle with a pump according to the invention fixed thereto,

FIG. 4 is an enlarged view of a part of FIG. 3,

FIG. 5 is a longitudinal section through a rotary slide valve according to the invention, and

FIG. 6 is a cross-sectional view taken on the line VI—VI of FIG. 5.

It can be seen in FIGS. 1 to 4 that the pump consists essentially of the cylinders 1, the valves 2 and 3 and the inlet or supply arrangement 4. Only one cylinder 1 is visible in FIGS. 1 and 2 of the drawing, said cylinder being associated with the control valve 2. The valve 3, however, is associated with a similar pump cylinder, which is arranged parallel to the pump cylinder 1. The pump is fixed on the frame 5 of the vehicle 6, so that the essential parts of the pump which require maintenance are easily accessible.

The supply arrangement 4 consists essentially of a storage container 7 and inlet hoppers 8.

The inlet hoppers 8 are made of two parts. The upper part 9 is connected fast to the container 7, while the lower part 10 is constructed as an inlet conduit fitted to the appropriate valve housing 11. The joints 12 between parts 9 and 10 are inclined, which is an advantage when the valves are pivoted out of position. The sealing at 12 is advantageously a rubber packing or the like.

The part 13 of the valve housing 11 which leads to the cylinder is kept very short. The opening 14 into the cylindrical chamber 15 has a rhombic form. The piston in the cylinder is not shown in detail. Its stroke extends as far as the joint between the cylinder 1 and valve housing 11.

The rotary part 16 of the valve has the form of a shutter, and is adapted to turn about the pivot 17. To control the part, the crank 20 is clamped on to the square end 18 of the valve shaft 19, the piston rod 21 of the control cylinder 22 acting on the said crank. This control cylinder is adapted to pivot about joint 23 and the pivot bearing 24 is supported on the support element 25, which is adapted to pivot about the shaft 28 together with the valve housing. By this pivoting movement, both the opening 14 and also the inlet conduit 10 are made accessible, as are also the cylinder and the piston and the part 9 of the hopper. If necessary, the piston packing can be replaced, clogging material can be removed and it is also possible to check the cylinder journal, the rotary part of the valve and the internal surface of the valve housing.

In the operating position, the plate 43 which is pivotable about the bolt 42 (FIG. 4) on the valve 2 is engaged over the bolt 24 of the valve 3.

As shown, in FIG. 6, the rotary part 16 of the valve forms a wall thereby causing the passages 29, 30, to be formed in the valve housing. Passage 29 is the passage from the inlet to the cylinder opening, and is formed as a pipe bend which is used during the suction stroke, in which the inlet passage 10 is connected to the cylinder. When the rotary part is in its other position, the passage 30 forms part of the passage from the outlet 32 to the opening to the cylinder. This is the case during the compression stroke, when material is delivered into and through pipe 31. The center line 33 of inlet conduit 10 with the center line 34 of opening 14 enclose an angle of about 70°, the passage formed from inlet conduit to opening being curved. The center lines of the inlet conduit 10, the opening 14 and outlet 32 are substantially coplanar. The passage formed for use during the compression stroke of the piston is only slightly curved, the center line 35 of outlet 32 being slightly offset with respect to center line 34 of opening 14, but parallel thereto.

The interior of the valve housing which cooperates with the edge 36 of the rotary part is adapted to the rhombic shape thereof. This can be seen in FIG. 5.

Cladding 38 is provided on the rotary part, and cooperating cladding 37 is disposed in the opening 14 and in the valve housing. The rotary part has on all its external edges grooves 39, which extend parallel to the pivot axis 17. The grooves which are arranged in the surfaces 40 and 41 (FIG. 5), either extend straight or are curved in such a manner that a seal of the labyrinth packing type is obtained.

I claim:

1. A valve assembly for a pump, said valve assembly comprising in combination:

a. a housing defining a chamber;

b. an inlet conduit to said housing;

c. means defining an outlet from said housing and having a center line;

d. means defining an opening in said housing for communication with the chamber of said pump, and having a center line;

e. a rotary valve disposed within said chamber and having an axis of rotation;

f. said rotary valve forming a wall transverse to said axis of rotation defining, within said chamber, two passages;

g. the first of said passages being curved in the form of a pipe bend; and

h. the second of said passages being substantially straight;

said rotary valve being rotatable to a first position effective to allow communication between said inlet conduit and said opening through said first passage, and to a second position effective to allow communication between said opening and said outlet through said second passages, said axis of rotation being perpendicular to said passage; whereby said rotary valve is in said first position during the suction stroke of said pump and in said second position during the compression stroke of said pump.

2. A valve as specified in claim 1 wherein said passage having the form of a pipe bend includes an angle of less than 90°.

3. A valve as specified in claim 2 wherein said passage having the form of a pipe bend includes an angle of 70°.

4. A valve as specified in claim 1 wherein center lines of said inlet conduit, outlet means and opening means are substantially coplanar, and said center lines of said opening means and said outlet means are substantially straight and substantially parallel.

5. A valve as specified in claim 1 wherein said opening means is rhombic in cross section.

6. A valve as specified in claim 1 wherein said rotary part includes edges sealingly engaging said housing and wherein said edges are formed with a plurality of parallel grooves.

7. A pump comprising in combination:

1. a valve assembly comprising in combination:

a. a housing defining a chamber;

b. an inlet conduit to said housing;

c. means defining an outlet from said housing and having a center line;

d. means defining an opening in said housing for communication with the chamber of said pump, and having a center line;

e. a rotary valve disposed within said chamber and having an axis of rotation;

f. said rotary valve forming a wall transverse to said axis of rotation defining, within said chamber, two passages;

g. the first of said passages being curved in the form os a pipe bend; and

h. the second of said passages being substantially straight;

said rotary valve being rotatable to a first position effective to allow communication between said inlet conduit and said opening through said first passage, and to a second position effective to allow communication between said opening and said outlet through said second passage, said axis of rotation being perpendicular to said passages;

2. a chamber in the form of a cylinder having an open end connected to said opening means of said valve at said open end;

3. a piston movable within said cylinder to a first position, representing the suction stroke of said pump, and movable to a second position representing the compression stroke of said pump;

4. a delivery pipe connected to said outlet means of said valve; and

5. said inlet conduit of said valve being connectable to a source of material to be pumped;

whereby said rotary valve is in said first position during said suction stroke of said pump and in said second position during said compression stroke of said pump.

8. A pump as specified in claim 7 wherein a piston is movable in said cylinder substantially to the open end of said cylinder.

9. A pump as specified in claim 8 and further comprising pivot means, said valve being pivotable about said pivot means.

10. A pump comprising in combination:

1. two valves, each valve comprising in combination:
   a. a housing defining a chamber;
   b. an inlet conduit to said housing;
   c. means defining an outlet from said housing and having a centerline;
   d. means defining an opening in said housing for communication with the chamber of said pump, and having a centerline;
   e. a rotary valve disposed within said chamber and having an axis of rotation;
   f. said rotary valve forming a wall transverse to said axis of rotation defining, within said chamber, two passages;
   g. the first of said passages being curved in the form of a pipe bend; and
   h. the second of said passages being substantially straight; said rotary valve being rotatable to a first position effective to allow communication between said inlet conduit and said opening through said first passage, and to a second position effective to allow communication between said opening and said outlet through said second passage, said axis of rotation being perpendicular to said passages;
2. two chambers, each of said chambers in the form of a cylinder, each of said cylinders having an open end connected to said opening means of one of said valves respectively at said open end;
3. two pistons, each piston being movable within one of said cylinders, respectively, to a first position defining a suction stroke, and movable to a second position defining a compression stroke;
4. two delivery pipes, each pipe being connected to said outlet means of one of said valves respectively; and
5. said inlet conduits of said valves being connectable to a source of material to be pumped; whereby each of said rotary valves is in said first position during the suction stroke of its respective cylinder and in said second position during the compression stroke of said cylinder.

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