

PATENT SPECIFICATION

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(54) A VALVE MEANS FOR USE IN A CONCRETE MATERIAL PUMP

(71) We, NIIGATA ENGINEERING COMPANY LIMITED, a Japanese Company of No. 4-1, Kasumigaseki 1-chome, Chiyoda-Ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to a fluid passage change over valve means, and more particularly to a valve means for use in a concrete pump having stationary double cylinders and pistons for taking in and discharging the concrete material alternatively.

Recently, crude concrete having low slump and including large gravel therein has been used in civil engineering works. Such tendency is expected to increase in the future. In case of the employment of such kind of concrete material, it is necessary to reduce any resistive force exerted on discharge and intake passages, and switching of the flowing direction of the concrete should be easily made by reducing disadvantageous power or energy loss.

Conventionally, there has been a change-over-valve means for discharging crude concrete material, in which pistons are provided in double concrete cylinders, respectively, and alternately reciprocated therein, and simultaneously, intake and discharge ports are alternately opened and closed by flap valves disposed in the respective cylinders. However, such concrete pump may not have good concrete intake and discharge properties, since the part to be sealed also functions as a fluid passage, and further, excellent durability may not be obtained.

Another type of concrete pump has been proposed in which double cylinders having pistons therein respectively are provided in a hopper, and a discharge pipe is pivotably provided to alternatively communicate with the intake and discharge ports in response to the reciprocating movement of the piston. However, in such device, though intake and

discharge properties may be improved, large resistive force is applied to the discharge pipe in switching operation of the pipe, particularly when using a crude concrete having low slump and including large gravel, since large power is required to shove aside the crude concrete material in order to move the pipe in the hopper. Further, the total rigidity of the structure *per se* would be lowered and mechanical reliability may thus be reduced.

It is therefore an object of the present invention to eliminate the above mentioned drawbacks and disadvantages and to provide an improved fluid change-over valve means adapted to be used with crude concrete materials.

According to the present invention, there is provided a valve means for use in a concrete material pump having stationary double cylinders and pistons for taking in and discharging the concrete material alternatively, comprising a valve body mounted in a hopper, said valve body having a substantial frusto-conical shape and being steppingly rotatable about its major axis, at least one concrete material intake passage formed in said valve body, and having one end open at a frusto-conical surface of said valve body to form a first intake opening and having the other end open at a bottom of said valve body to form a second intake opening, said second intake opening being selectively communicable with an open end of one of said cylinders at one of the stationary positions of said valve body, and a concrete material discharge passage formed in said valve body, and having one end open at a top of said valve body to form a first discharge opening and having the other end open at the bottom of said valve body to form a second discharge opening, said second discharge opening being selectively communicable with an open end of the other of said cylinders at the said one stationary position of said valve body, whereby the concrete material contained in said hopper, in use, is taken into said one of

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said cylinders through said intake passage with a retracting movement of one of said pistons, and the concrete material contained in the other of said cylinders is discharged outside of said hopper through said discharge passage with extending movement of the other of said pistons.

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

Figure 1 is a side view showing one embodiment of the present invention;

Figures 2 and 3 are transverse sectional views of the embodiment of Figure 1;

Figure 4 is a perspective view of the valve body of Figures 1 to 3, and

Figure 5 is a perspective view showing another embodiment of a valve body according to the present invention.

A first embodiment of the invention will now be described in detail with reference to Figures 1 to 4, wherein double concrete cylinders 1 and 2 are provided with pistons 3 and 4 therein, respectively. Ports 1a and 2a of the cylinders 1 and 2 for intaking and discharging the concrete materials open into a hopper 5. A change-over valve body 6 is provided in the hopper 5 and is rotatably connected to the cylinders 1 and 2 through a hopper frame 7 and a seal member 8 which prevents the concrete materials from leakage.

The valve body 6 is generally frusto-conical in shape, having a discharge passage 9 and an intake passage 10 provided therein. One end of the discharge passage 9 is positioned at the top portion of the valve body to form a circular discharge opening 9a. The centre of the opening 9a is at the central axis of the frusto-conical valve body 6. The other end of the discharge passage 9 is opened at the bottom of the valve body 6 to form a discharge opening 9b. One end of the intake passage 10 is opened at the conical surface of the valve body 6 to form an intake opening 10a, while the other end of the intake passage 10 is opened at the bottom of the valve body 6 to form an intake opening 10b. The intake and discharge openings 10 and 9 each have a diameter of uniform cross-section throughout their length, and the discharge opening 9b and the intake opening 10b are symmetrically positioned with respect to a diameter of the bottom of the valve body 6. These openings 9b and 10b communicate with the intake and discharge ports 1a and 2a of the cylinders 1 and 2 in the position shown in Figure 2. Since the curvature of the passages 9 and 10 is gentle, and since the cross-sectional shape of these passages is circular, an excellent fluid discharging property can be obtained. Further, since the crude concrete material is directly introduced into the intake passage 10 from the hopper 5, and since the curvature of the passage 10 is gentle, and the diameter of the passage is uniform throughout its length, excellent fluid intaking property can be

obtained. Furthermore, since the valve body 6 is of truncated frusto-conical shape and is rotatable about its axis, exertion of the external resistance caused by the crude concrete material to the valve body can be reduced, and high rigidity of the valve body can be obtained.

Reference numeral 11 designates a shaft for rotating the valve body 6, one end of which is embedded into the bottom of the valve body 6 in an axial alignment with the central axis of the valve body. The shaft 11 is passed through the hopper frame 7 and the seal member 8 and extends to the central space defined between the cylinders 1 and 2. The free end of the shaft 11 is connected to an actuator 13 such as an hydraulic cylinder and hydraulic motor for rotating the valve body 6 through an operation arm 12. The actuator 13 also permits the valve body 6 to be urged toward the cylinders. Since the valve body 6 is positioned in the hopper 5, even if concrete material were to leak out through the sealed portion, such concrete material would still be in the hopper, thereby avoiding disadvantageous loss thereof.

The discharge opening 9a is rotatably connected to a pipe 15 through a tapered pipe 14. Agitating or stirring plates 16 which are also called paddles are provided at the outer peripheral surface of the valve body 6 in order to stir the concrete material and prevent it from solidification in the hopper 5 and also to promote intaking action of the concrete material into the intake opening 10a. The paddles 16 can be eliminated if desired.

In operation, as shown in Figures 1 and 2, in the state where the ports 1a and 2a of the cylinders 1 and 2 are in communication with the discharge openings 9b and the intake opening 10b, respectively, if the piston 3 is moved rightwardly, and simultaneously, the piston 4 is moved leftwardly, the concrete material in the cylinder 1 is transferred to the pipe 15 through the discharge opening 9b, discharge passage 9, discharge opening 9a and the tapered pipe 14, while the concrete material in the hopper 5 is introduced into the cylinder 2 through the intake opening 10a, intake passage 10 and intake opening 10b. Then the valve body 6 is rotated through 180° by the rotation of the shaft 11 by means of switching operation of the actuator 13, so that the port 1a of the cylinder 1 and the port 2a of the cylinder 2 then communicate with the intake opening 10b and the discharge opening 9b, respectively, as shown in Figure 3. Thereafter, the piston 3 is moved leftwardly to introduce the concrete material into the cylinder 1 through the intake opening 10a, intake passage 10, intake opening 10b, and port 1a, while the piston 4 is moved rightwardly to transfer the concrete material contained in the cylinder 2 to the pipe 15 through the port 2a, discharge opening 9b, discharge passage 9, discharge opening 9a and the tapered pipe 14. Next, the valve body 6 is rotated by the switching

operation of the actuator 13, so that once again the port 1a of the cylinder 1 and the port 2a of the cylinder 2 communicate with the discharge opening 9b and the intake opening 10b, respectively as shown in Figure 2. Such operation is repeatedly carried out to continuously discharge the concrete material.

A second embodiment of the invention is shown in Figure 5, wherein like parts and components are designated by the same reference numerals and character as those shown in Figures 1 to 4. The revolvable valve body 6 is in truncated frusto-conical shape identical to that of the first embodiment. The interior of the valve body is provided with two intake passages 10 and 10' and the discharge passage 9. Openings of these passages at the bottom surface of the valve body 6, namely, the discharge opening 9b, and intake openings 10b and 10b' are so positioned that the each of the distances in the radial direction between the centre of the bottom of the valve body and the centre of each of the openings are equal with each other, and the discharge opening 9b is positioned between the openings 10b and 10b'. The distance between the centre of the opening 9b and the centre of the opening 10b is equal to the distance between the centre of the opening 9b and the centre of the opening 10b'.

With this structure, the rotation angle of the valve body 6 can be reduced. For example, if the angle defined by the line connected between the centre of the bottom of the valve body and the centre of the opening 9b and the line connected between the centre of the bottom of the valve body and the centre of the opening 10b is 60°, and the angle defined by the line connected between the centre of the bottom of the valve body and the centre of the opening 9b and the line connected between the centre of the bottom of the valve body and the centre of the opening 10b' is 60°, the swithing operation can be achieved by rotating the valve body 6 by only 60°.

The dimension of the sealing part i.e. sliding part can be selected dependent upon the hopper frame. The sealing member 8 is easily exchanged by a new seal member by using wear-resistant steel, such as wear plate or float seal when the seal member is worn out. Further, it is possible to urge the valve body toward the cylinders 1 and 2 to reduce accidental clearance at the seal portion. It is also possible to eliminate the hopper frame to directly connect the cylinders 1 and 2 with the valve body 6.

Furthermore, in the above two embodiments, the discharge passage 9 can be modified to be tapered to have a reducing diameter in cross section along the flowing direction, to thereby directly connect the opening 9a with the pipe 15 without the employment of the tapered pipe 14. This may reduce pressure loss of the passageway from the hydrodynamics standpoint. Moreover, since the present

invention is of simple and compact structure, it is easy to load the valve means on a truck chassis.

Alternatively, pipes may be employed as the intake and discharge passages and metal plate used to form the frusto-conical shaped valve body. In such case, the weight of the valve means can be reduced.

WHAT WE CLAIM IS:

1. A valve means for use in a concrete material pump having stationary double cylinders and pistons for taking in and discharging the concrete materials alternatively comprising a valve body mounted in a hopper, said valve body having a substantial frusto-conical shape and being steppingly rotatable about its major axis, at least one concrete material intake passage formed in said valve body, and having one end open at a frusto-conical surface of said valve body to form a first intake opening and having the other end open at a bottom of said valve body to form a second intake opening, said second intake opening being selectively communicable with an open end of one of said cylinders at one of the stationary positions of said valve body, and a concrete material discharge passage formed in said valve body, and having one end open at a top of said valve body to form a first discharge opening and having the other end open at the bottom of said valve body to form a second discharge opening, said second discharge opening being selectively communicable with an open end of the other of said cylinders at the said one stationary position of said valve body, whereby the concrete material contained in said hopper, in use, is taken into said one of said cylinders through said intake passage with a retracting movement of one of said pistons, and the concrete material contained in the other of said cylinders is discharged outside of said hopper through said discharge passage with extending movement of the other of said pistons.

2. A valve means as claimed in claim 1, wherein a plurality of concrete material intake passages are provided in said valve body.

3. A valve means as claimed in claim 1 or claim 2, wherein said concrete material passages are of curved cylindrical shape.

4. A valve means as claimed in any one of claims 1 to 3, further comprising a plurality of stirring plates provided at the frusto-conical surface of said valve body.

5. A valve means as claimed in any one of the preceding claims, wherein said discharge passage is tapered to have a reducing diameter in cross section along the flowing direction of the concrete material.

6. A valve means as claimed in any one of the preceding claims, further comprising a hopper frame interposed between said cylinders and said bottom of said valve body.

7. A valve means as claimed in any one of the preceding claims, further comprising an

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operation of the actuator 13, so that once again the port 1a of the cylinder 1 and the port 2a of the cylinder 2 communicate with the discharge opening 9b and the intake opening 10b, respectively as shown in Figure 2. Such operation is repeatedly carried out to continuously discharge the concrete material.

A second embodiment of the invention is shown in Figure 5, wherein like parts and components are designated by the same reference numerals and character as those shown in Figures 1 to 4. The revoluble valve body 6 is in truncated frusto-conical shape identical to that of the first embodiment. The interior of the valve body is provided with two intake passages 10 and 10' and the discharge passage 9. Openings of these passages at the bottom surface of the valve body 6, namely, the discharge opening 9b, and intake openings 10b and 10b' are so positioned that the each of the distances in the radial direction between the centre of the bottom of the valve body and the centre of each of the openings are equal with each other, and the discharge opening 9b is positioned between the openings 10b and 10b'. The distance between the centre of the opening 9b and the centre of the opening 10b is equal to the distance between the centre of the opening 9b and the centre of the opening 10b'.

With this structure, the rotation angle of the valve body 6 can be reduced. For example, if the angle defined by the line connected between the centre of the bottom of the valve body and the centre of the opening 9b and the line connected between the centre of the bottom of the valve body and the centre of the opening 10b is 60°, and the angle defined by the line connected between the centre of the bottom of the valve body and the centre of the opening 9b and the line connected between the centre of the bottom of the valve body and the centre of the opening 10b' is 60°, the swithing operation can be achieved by rotating the valve body 6 by only 60°.

The dimension of the sealing part i.e. sliding part can be selected dependent upon the hopper frame. The sealing member 8 is easily exchanged by a new seal member by using wear-resistant steel, such as wear plate or float seal when the seal member is worn out. Further, it is possible to urge the valve body toward the cylinders 1 and 2 to reduce accidental clearance at the seal portion. It is also possible to eliminate the hopper frame to directly connect the cylinders 1 and 2 with the valve body 6.

Furthermore, in the above two embodiments, the discharge passage 9 can be modified to be tapered to have a reducing diameter in cross section along the flowing direction, to thereby directly connect the opening 9a with the pipe 15 without the employment of the tapered pipe 14. This may reduce pressureless of the passageway from the hydrodynamics standpoint. Moreover, since the present

invention is of simple and compact structure, it is easy to load the valve means on a truck chassis.

Alternatively, pipes may be employed as the intake and discharge passages and metal plate used to form the frusto-conical shaped valve body. In such case, the weight of the valve means can be reduced.

WHAT WE CLAIM IS -

1. A valve means for use in a concrete material pump having stationary double cylinders and pistons for taking in and discharging the concrete materials alternatively comprising a valve body mounted in a hopper, said valve body having a substantial frusto-conical shape and being steppingly rotatable about its major axis, at least one concrete material intake passage formed in said valve body, and having one end open at a frusto-conical surface of said valve body to form a first intake opening and having the other end open at a bottom of said valve body to form a second intake opening, said second intake opening being selectively communicable with an open end of one of said cylinders at one of the stationary positions of said valve body, and a concrete material discharge passage formed in said valve body, and having one end open at a top of said valve body to form a first discharge opening and having the other end open at the bottom of said valve body to form a second discharge opening, said second discharge opening being selectively communicable with an open end of the other of said cylinders at the said one stationary position of said valve body, whereby the concrete material contained in said hopper, in use, is taken into said one of said cylinders through said intake passage with a retracting movement of one of said pistons, and the concrete material contained in the other of said cylinders is discharged outside of said hopper through said discharge passage with extending movement of the other of said pistons.

2. A valve means as claimed in claim 1, wherein a plurality of concrete material intake passages are provided in said valve body.

3. A valve means as claimed in claim 1 or claim 2, wherein said concrete material passages are of curved cylindrical shape.

4. A valve means as claimed in any one of claims 1 to 3, further comprising a plurality of stirring plates provided at the frusto-conical surface of said valve body.

5. A valve means as claimed in any one of the preceding claims, wherein said discharge passage is tapered to have a reducing diameter in cross section along the flowing direction of the concrete material.

6. A valve means as claimed in any one of the preceding claims, further comprising a hopper frame interposed between said cylinders and said bottom of said valve body.

7. A valve means as claimed in any one of the preceding claims, further comprising an

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exchangeable sealing member provided at said bottom of said valve body.

5 8. A valve means as claimed in any one of the preceding claims, wherein said valve body is urged to press toward said cylinders to eliminate gaps between said bottom of the valve body and said openings of said cylinders.

10 9. A valve means as claimed in any one of the preceding claims, wherein said intake and discharge passages are pipes and said valve body is formed by a metal plate.

10. A valve means for use in a concrete

material pump substantially as hereinbefore described with reference to and as shown in Figures 1 to 4 of the accompanying drawings.

11. A valve means for use in a concrete material pump substantially as hereinbefore described with reference to and as shown in Figure 5 of the accompanying drawings.

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