VALVE SEALS FOR DRY SOLID PUMPS

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The present invention relates to an apparatus for providing a seal during the handling and transfer of solids from one zone to another zone. It is particularly related to a sealing arrangement provided for dry solid pumps during the transfer of solids from a low pressure zone to a zone of higher pressure in processes requiring the use of such pumps.

In the operation of processes involving the handling of finely divided solids, it is often necessary to transfer these solids from one pressure zone to a zone of higher pressure. Various systems have heretofore been employed for such purposes as, for example, star feeders, multiple high pressure lock hoppers or blow cases and other comparable mechanical means. The disadvantages of these devices however have been pointed out in U.S. 2,667,280 which also discloses a method and apparatus for the transfer of finely divided solids from one pressure zone to a zone of higher pressure. In these devices and whenever it is necessary to pump solid materials from one pressure zone to a zone of higher pressure it is necessary that the solids be fed to the suction side of the pump through a port which must be sufficiently large to permit flow by gravity of solid materials from a storage vessel such as a bin or a hopper to the cylinder of the pump. The suction port of the pump must however be effectively sealed by a valve during the discharge stroke of the pump so as to prevent any solids from flowing from the high pressure zone to the zone of lower pressure which could otherwise have severe erosive effects upon the valve parts.

The sealing arrangements which have heretofore been employed fail to provide a leak-tight and positive seal. Frequently such seals depend upon metal-to-metal contact such as, for example, metal ball poppets and plates used in combination with a metal seat. The solid particles tend to be lodged in the seat thus preventing an effective metal-to-metal seal. Consequently leakage will occur from the high pressure zone to the zone of lower pressure. Furthermore, leakage of the solid particles will have an erosive effect which will cause the seat to be damaged and thus fails to provide the necessary positive sealing action between the two pressure zones.

It is therefore an object of this invention to provide a valve seal for the so-called dry solid pumps, namely, pump-type apparatus used for the transfer of finely divided solids from one pressure zone to a zone of higher pressure. It is a further object of this invention to provide a sealing arrangement for positively and effectively sealing one pressure zone from a second zone during transfer of solids from a low pressure zone to a zone of higher pressure. These and other objects of this invention will be more clearly understood from the following description taken in conjunction with the accompanying drawings which illustrates the valve seal and the sealing arrangement of this invention schematically and partly in elevation.

Referring now to the drawing, the numeral 1 designates a storage means such as a bin or a conical hopper which is suitably mounted on a housing 3 such as a cylinder or some other suitable container. The housing 3 contains a passage 5 which preferably extends axially therethrough. A reciprocating member 7 such as a piston or a rod is closely fitted within passage 5 and is adapted to move therethrough along its principal axis. The reciprocating member can be biased by an externally connected mechanical or electrical means which is not shown in the drawing. A discharge port means 9 extends laterally from the passage 5 above the reciprocating member. This discharge port means communicates with the zone of higher pressure (not shown) to which the solid particles must be transferred.

Extending centrally through the storage means is a cylindrical body 11 such as a piston having an upper end 12 connected to an external source (not shown) for vertically biasing its motion, and a lower end which is in a position indicated by dotted line 13 when the cylindrical body is at its downstroke position and at the solid line 15 when it is in the upstroke position. The cylindrical body 11 is surrounded by a sleeve member 17 which coaxially surrounds the valve body and which contains an opening 19 adapted to permit the passage of the solid particles from the storage vessel into a chamber 23 and thus into passage 5. Chamber 23 is defined by the walls of the sleeve member 17 and the lower end of the cylindrical body 11 when the latter is in its upstroke position.

A sealing element 21 encircles the cylindrical body 11 at its lower end and provides a seal between the storage vessel and passage 5 when the valve is at the end of its downstroke position. The sealing element 21 can be an elastomeric material such as neoprene, teflon or some other suitable resilient plastic or metallic material.

In operation, when the cylindrical body 11 is at the end of its upstroke position, the solid particles flow by gravity from the storage vessel through opening 19 into chamber 23 and thus into passage 5. The solid particles in the storage vessel are advantageously maintained under fluidized condition. During this cycle, the reciprocating member 7 is in a retracted position and the pressure in passage 5 is substantially the same as the pressure in storage vessel 1. When the cylindrical body 11 is at the end of its downstroke position opening 19 is obstructed so that the solid particles will flow from the storage vessel into passage 5. The sealing element 21 will be compressed by sleeve member 17 between the outer walls of the cylindrical body and the housing 3 so as to provide a tight seal between the storage vessel and passage 5. The reciprocating member 7 moves upwardly within passage 5 and thus increases the pressure therein to any desired level which is usually slightly greater than the pressure in the zone to which the solid particles are to be transferred, i.e., the zone of higher pressure. The solid particles are thus transferred from passage 5 through discharge port means 9 into the zone of higher pressure. The reciprocating member 7 is then retracted and the cylindrical body 11 withdrawn to its upstroke position as indicated by solid line 15 and the cycle is thus repeated.

During the transfer of the solid particles from passage 5 to the zone of higher pressure, the sealing element 21 provides an effective and positive seal between the storage vessel and passage 5 without any damage to or erosive effect upon the sealing element itself. There is thus no tendency for the solid particles to flow back to the storage vessel and to be lodged within the seal.

The sleeve member 17 coaxes with the cylindrical body 11 so that when the latter is at the end of its downstroke position, the sleeve member is lowered (by mechanical or hydraulic means not shown) so as to apply a compressive force necessary for the sealing action. The sleeve member is raised during the upstroke movement of the cylindrical body so as to remove the forces of compression against the sealing element.

The operation of the cylindrical body 11 and sleeve member 17 are automatically coordinated with the motion of reciprocating member 7 so as to achieve the desired oper-
tion. Thus when the reciprocating member is in its retractive motion, both the cylindrical body and the sleeve member are moving upwardly and vice versa.

Although the present invention has heretofore been described with a certain degree of particularity it should be understood that many modifications and revisions can be made both in the construction of the apparatus and in its mode of application and operation but which are nevertheless suggested from the present description and which therefore fall within the spirit and scope of this invention.

What is claimed is:

1. A sealing arrangement for providing a seal between two zones which comprises, in combination, a storage means for solid particles constituting the first zone suitably mounted on a housing having a passage means therethrough which passage means constitutes a second zone, a reciprocating member within said passage means adapted to move therethrough along its principal axis, a discharge port means extending laterally from said passage means above said reciprocating member, a cylindrical body extending centrally through said solid storage means, said cylindrical body having an upper end and a lower end, said upper end being connected to a means for vertical blasing the motion of said cylindrical body between a first position and a second position, said first position corresponding to the end of the upstroke motion and said second position corresponding to the end of the downstroke motion of said cylindrical body, a sleeve member coaxially surrounding said cylindrical body, said sleeve member having an opening adapted to permit the passage of solid particles from said storage means into said passage means when said cylindrical body is at said first position, a sealing element encircling the lower end of said cylindrical body and adapted to be compressed between said cylindrical body and said housing when said cylindrical body is in the second position.

2. The sealing arrangement as in claim 1 wherein said housing is a cylinder having a passage means extending substantially centrally therethrough.

3. The sealing arrangement as in claim 1 wherein said cylindrical body and said sleeve member are adapted to move upwardly when said reciprocating member is retracted within said passage means and downwardly when said reciprocating member is moving upwardly within said passage means.

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