MECHANISM FOR FEEDING GRANULAR OR POWDERED MATERIAL
FROM A RELATIVELY LOW PRESSURE TO A HIGHER PRESSURE

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This invention has reference to improvements in mechanism for feeding granular or powdered material from a relatively low pressure to a higher pressure and is particularly applicable for feeding granular or finely powdered material from atmospheric pressure into a system maintained above atmospheric pressure, where the material to be fed is of an abrasive character as is the case, for example, with pulverised fuels. It is usual with such mechanism to feed the material into the low pressure side of a pump direct from a storage hopper, the flow of powder when necessary being assisted by a conventional conveying device and the pump itself conveying the material to a high pressure gaseous blast port where the powder is removed by the high pressure blast from the pump body to a delivery manifold. With such a design it is difficult to maintain an effective seal between the high and low pressure sides of the pump where the material being handled is of an abrasive character since the sealing surfaces deteriorate rapidly due to the penetration between them of the abrasive particles.

The present invention has for its object to provide a mechanism in which the high pressure delivery port is isolated from the low pressure or atmospheric feed point and wherein the sealing system is such that it will accommodate itself to any wear due to abrasion between the working surfaces so as to automatically maintain a seal between the working surfaces differentials and further to provide means for readily dissassembling and replacing the working surfaces when necessary.

The invention consists of a mechanism for feeding granular or powdered material from a relatively low pressure to a higher pressure characterised in the provision of a number of geared carrier plate each wherein powder is brought successively during the rotation of each carrier plate, into a position to receive a charge of material at relatively low pressure and then into a position so as to form a connection between two ports one of which is adapted to receive a blast of gas at high pressure and the other of which is connected to the high pressure system to which the material is to be fed. The invention further resides in the manner of the construction of the mechanism to be described hereinafter.

In order that the invention may be clearly understood and readily carried into practice reference may be had to the appended explanatory drawings in which:

Fig. 1 illustrates the mechanism in vertical section elevation and

Fig. 2 is a plan view with certain parts removed for clarity.

According to a convenient embodiment of the present invention the mechanism comprises a rotatable carrier plate mounted for rotation about a vertical axis being keyed to the vertical shaft and housed within a casing. The shaft is coupled to a motor driven variable speed gear, not shown, and preferably at a high speed. In the carrier plate is a number of pockets or other section, see particularly Fig. 2, which act as carriers for conveying the powdered or granular material from atmospheric pressure at the feeding point of the mechanism to the high pressure delivery manifold $d$, see particularly Fig. 2.

The material to be fed to the pockets $a$ in the carrier plate $a$ may be fed by gravity from a vibrating feeder in turn receiving the material from a hopper, not shown, so as to give a continuous or semi-continuous feed to the mechanism at $d$. This feeding system can if required function as a metering device in which case the carrier plate $a$ is rotated at a constant speed such that the potential rate of feed of the mechanism is in excess of the rate of feed therein by the vibrating feeder. The vibrating feeder incorporates a calibrated infinitely variable control permitting any predetermined quantity of material to be fed to the mechanism so that adjustment of this control gives rapid change in the quantity of material being fed into the high pressure system and since the control is calibrated the delivery of material is at a definite feeding rate to an accuracy of within plus or minus 2%. If a more accurate control of feed rate is desired then a continuous type of weighing machine may be introduced between the hopper and the vibrating feeder. Alternatively the mechanism itself will function as a less accurate meter by varying the speed of rotation of the carrier plate $a$, having first adjusted the primary feeding device (i.e. the vibrating feeder and/or a continuous type of weighing machine) to ensure that the pockets in the plate are filled to capacity.

The pocket $a$ in the carrier plate $a$ are in the form of ports passing vertically through the plate as illustrated but each is closed at its lower end by a lightly spring loaded poppet valve, the spring being so disposed as to hold the valve closed during the filling and conveying period. Since the valve operates at a very low pressure difference it is, therefore, to be preferred to a porous filter which may be used and which serves to retain the material in the pocket $a$.

As the carrier plate $a$ rotates the pockets $a$ are successively charged with material from the feeding point $d$ and may then pass under a series of scrapers which are adapted to remove any superfluous material deposited around the edges of the pockets. Each of the scrapers the pockets $a$ pass between two sealing pads $e$ and $f$ held in contact with the carrier plate by spring $e$ or pneumatic or other pressurised loading; one of these pads $e$ being disposed above the plate and the other $f$ below. The two pads are provided each with one of a pair of aligned ports $e$ forming part of the high pressure system of the mechanism and of a size and section to correspond to the section of the pockets $a$ in the main carrier plate $a$, the pockets being so designed as to provide whatever lap or lead may be necessary to ensure efficient evacuation of the material from the pocket by upward blast from the pipe and with due regard to the size of the particles and characteristics of the material to be fed. Both sealing pads, $e$ and $f$, which are preferably circular, are designed to cover three or more pockets $a$ in the carrier plate $a$ at one time and the port $e$ in the upper pad $e$ is connected to the main delivery line $h$ to the high pressure system to be fed, whilst the port $f$ in the lower pad is connected to the high pressure source from which the gaseous blast is received. As each pocket $a$ passes between the aligned ports $e$ and $f$ the high pressure blast enters the pocket through the poppet valve and carries the material into the main delivery line $h$ to where it is piped to the required point of the high pressure system. The gaseous blast is always maintained at a pressure in excess of the pressure of the receiving system so as to effect rapid and complete evacuation of the material from the pockets. As a pocket $a$ continues its rotation from the delivery point between the sealing pads $m$ and $n$ enters
a scavenging section $j$, see particularly Fig. 2, where clean air is blown or drawn through the pocket $a$ to expel any condensate remaining as the result of the blast, this being especially important where steam is utilised for the blast. Where the scavenging section is connected to a vacuum pump then the ports controlling the scavenging are so disposed that cut off on the atmospheric port occurs before cut off from the vacuum port so as to ensure that there is a negative pressure in the pocket as it enters the filling position, thereby assuring the filling operation and preventing blow back.

As previously mentioned, the sealing pads $c$ and $f$ are held against the carrier plate $a$ by spring or pneumatic or other pressurised loading. With the spring system, varying pressures may be applied to correspond to the high pressure side of the plant by means of an adjusting screw, and furthermore the spring loading has to be adjusted to correspond with the delivery and blast pressure. On the other hand, when the discs are loaded pneumatically or hydraulically, the pressure of the sealing pad on the carrier plate is automatically maintained at the correct proportionate sealing pressure.

The sealing pads which are located in a suitable housing containing the blast and delivery pipes are flexibly mounted so as to accommodate any misalignment.

The actual sealing surface of the pads $c$ and $f$ may be plain or fitted with such lubricating and/or exhaust ports as may be required. The exhaust ports when used are so placed as to relieve instantaneously the blast pressure remaining in the pockets after the powder has been evacuated, and are connected by pipes as indicated at $i$ to atmosphere. Where a dry blast is used then these pipes can be connected to the main powder storage hopper to deposit any entrained powder contained therein.

The sealing pads $c$ and $f$ are adapted to be rotated slowly about the central axes of their ports, by an internally or externally mounted gear drive $k$ and $l$ during the rotation of the carrier plate. This slow rotation ensures that the discs wear evenly and lap themselves in with the carrier plate.

Hard material is chosen for the carrier plate $a$ for example, hard chromium plating, nitriding, or special alloy steels. On the other hand the sealing pads are constructed with materials having softer properties; for example, bronze or aluminium lignum vitae. Wear, therefore, is confined only on the sealing pads, such wear being automatically accommodated by the spring or other loading system so as to maintain the seal at its normal working efficiency. The sealing pad and methods of housing are so designed as to permit rapid replacement of the sealing pads, if and when necessary.

In addition to the sealing pads $c$ and $f$ in contact with the main carrier plate $a$ there are two stationary cast iron or bearing metal discs $m$ and $n$ which are held from the main housing $c$. These secondary sealing discs serve as an additional seal surrounding the sealing pads $c$ and $f$ as a precaution against blow-back in the event of any break-down of the sealing pads. The pressure of the secondary sealing discs upon the upper and lower sides of the carrier $a$ is adjustable by means of threaded caps $p$ which may be screwed inwardly or outwardly to more or less compress springs $q$. The cap at the scavenging section $f$ shown in Fig. 2 has an opening through its top to permit the exit of a scavenging blast as each pocket passes a hole in the disc $m$ directly beneath the cap.

The housing $c$ of the mechanism is fitted with a material feeding duct $o$ located immediately above the pockets of the carrier plate at the feeding point and extending in the same radius and concentrically for such length as is essential to ensure that the pockets are completely filled and in order that the powder shall be directed to the centre of the pockets, the width of the feeding duct is less than the radial dimension of the pockets. The feeder port is a vertically sliding fit in the housing and is spring loaded to maintain contact with the carrier plate.

As an alternative to the mechanism described, the pockets in the carrier plate may be of U form in which case the blast inlet port and the pockets formed around the periphery thereof, in this case the sealing pad is in the form of an annular shoe resiliently pressed against the periphery of the carrier plate and may contain both inlet and outlet ports to register respectively with opposite limbs of U-shaped pockets in the periphery of the carrier plate or the shoe form of pad may contain either one of the inlet or outlet ports the other of which is contained in a second pad bearing against the face of the carrier plate in a similar manner to that described in the first embodiment described, in this latter case the pocket in the carrier disc would be L shape.

I claim:

1. Mechanism for feeding granular or powdered material from low pressure environment into high pressure environment comprising a rotatable carrier, a sealing member having a surface slantingly engaging a surface of said carrier, said carrier having a series of pockets, each of said pockets having means to admit a gaseous blast while preventing loss of such material by supplying such material to said pockets in low pressure environment, said sealing member having a blast inlet port located to register successively with said blast admitting means as said carrier is rotated, and means for moving said sealing member about an axis passing through said blast inlet port.

2. Mechanism for feeding granular or powdered material from low pressure environment into high pressure environment comprising a rotatable carrier, a sealing member having a surface slantingly engaging a surface of said carrier, said carrier having a series of pockets, each of said pockets having an opening to receive said material and from which such material can be discharged, each of said pockets also having a blast inlet valve, means for supplying such material to said pockets in low pressure environment, said sealing member having a blast inlet port located to register successively with said blast inlet valves as said carrier is rotated, means for moving said sealing member about an axis passing through said blast inlet port, and a second sealing member having an outlet port located to register successively with the openings of said pockets as said carrier is rotated.

3. Mechanism for feeding granular or powdered material from low pressure environment into high pressure environment comprising a rotatable carrier, a sealing member having a surface slantingly engaging a surface of said carrier, said carrier having a series of pockets, each of said pockets having an opening to receive such material and from which such material can be discharged, each of said pockets also having a blast inlet valve, means for supplying such material to said pockets in low pressure environment, said sealing member having a blast inlet port located to register successively with said blast inlet valves as said carrier is rotated, means for moving said sealing member about an axis passing through said blast inlet port, a second sealing member having an outlet port located to register successively with the openings of said pockets as said carrier is rotated and means for moving said second sealing member about an axis passing through said outlet port.

4. Mechanism for feeding granular or powdered material from low pressure environment into high pressure environment comprising a rotatable carrier, a sealing member having a surface slantingly engaging a surface of said carrier, said carrier having a series of pockets, each of said pockets having an opening to receive such material and from which such material can be discharged, each of said pockets also having a blast inlet valve, means for supplying such material to said pockets in low pressure environment comprising a rotatable carrier, a sealing member having a surface slantingly engaging a surface of said carrier, said carrier having a series of pockets, each of said pockets having an opening to receive such material and from which such material can be discharged, each of said pockets also having a blast inlet valve, means for supplying such material to said pockets in low pressure environment.
sure environment, said sealing member having a blast inlet port located to register successively with said blast inlet valves as said carrier is rotated, means for moving said sealing member about an axis passing through said blast inlet port, a second sealing member having an outlet port located to register successively with the openings of said pockets as said carrier is rotated, means for moving said second sealing member about an axis passing through said outlet port, and means for pressing the engaging surfaces of said carrier, and sealing members together to prevent the egress of high pressure fluid therebetween.

5. Mechanism for feeding granular or powdered material from low pressure environment into high pressure environment comprising a rotatable carrier, a sealing member having a surface slidingly engaging a surface of said carrier, said carrier having a series of pockets, each of said pockets having an opening to receive such material and from which such material can be discharged, each of said pockets also having blast admitting means, means for supplying such material to said pockets in low pressure environment, said sealing member having a blast inlet port located to register successively with the blast admitting means of said pockets as said carrier is rotated, means for moving said sealing member about an axis passing through said inlet port, and a stationary pad surrounding said sealing member and said inlet port and also having a surface engaging a surface of said carrier.

6. Mechanism for feeding granular or powdered material from low pressure environment into high pressure environment comprising a rotatable carrier, a sealing member having a surface slidingly engaging a surface of said carrier, said carrier having a series of pockets, each of said pockets having an opening to receive such material and from which such material can be discharged, each of said pockets also having blast admitting means, means for supplying such material to said pockets in low pressure environment, said sealing member having a blast inlet port located to register successively with the blast admitting means of said pockets as said carrier is rotated, means for moving said sealing member about an axis passing through said inlet port, and a stationary pad surrounding said sealing member and said inlet port and also having a surface engaging a surface of said carrier.

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