Fig. 5.

Fig. 7.

Fig. 8.

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This invention relates to improvements in a rotary valve designed to transfer separate masses of flowable pulverulent material from a region at one pressure to a second region at another pressure. More particularly it relates to improved means for providing a more perfect air seal between parts of the rotor and the housing of the valve and to an improved method and means for displacing from the valve chambers air acquired during a period of discharging pulverulent material into a region of higher pressure.

In processes involving the solvent extraction of oils from pulverized vegetable matter or the milling of cereal grains, continuous vacuum dryers are used for driving off the adsorbed solvent or the contained moisture, as the case may be. The material to be dried is admitted from a region at ordinary pressures into one end of a heated chamber, which is under a pressure less than atmospheric, and after being dried, is removed from the other end of the chamber into a region usually at ordinary atmospheric pressure. The drying process is most economically carried out in a continuous manner and in order not to raise the air pressure unduly within the vacuum chamber it is desirable to effect the entrance of the material into the chamber and the removal after treatment with the admission of as little air as possible.

This problem has been met heretofore by the use of a rotary transfer valve having a number of blades dividing the rotor into a plurality of distinct compartments. Since different chambers are exposed to the air and to the vacuum chamber at any one time there is no continuous passage which would enable the outside atmosphere to leak into the vacuum chamber.

It will be readily seen from their general construction, however, that these rotary valves do not normally provide a perfect means of preventing ingress of outside air to the vacuum chamber during the transfer process. One objection to the valves as formerly constructed is that the rotor blades did not make air tight contact with the valve housing and the contact became increasingly poor as the valve became worn in operation. This not only resulted in undesirable quantities of air leaking from the atmosphere into the vacuum chamber but allowed outside dust to be swept in as well.

Another inherent fault has been that every time a compartment comes into register with the opening leading to the region of higher pressure, i.e., the atmosphere, air rushes in filling the compartment, then is carried around as the rotor continues to turn and is discharged into the vacuum chamber. Each puff of air entering the vacuum chamber not only causes added strain on the pumps striving to maintain the reduced pressure therein but raises a cloud of dust particles, as well, if the pulverulent material has a large proportion of fines. These fines may be sucked out of the chamber into the vacuum pump instead of being normally discharged through the rotary valve and will quickly clog any filter placed in the vacuum line to intercept them.

The primary object of my present invention is to provide an improved rotary valve of the type under consideration which will be free from the above noted and other similar disadvantages inherent in prior art valves of this type. More particularly, it is an object of the present invention to provide an improved sealing means adapted to be placed on the transverse ends of the rotor blades of a rotary transfer valve.

Another object of the invention is to provide an improved holder for said sealing means.

Another object of the invention is to provide an improved air sealing means positioned between the end plates forming part of the rotor and attached to the lateral ends of the radial blades of a rotary transfer valve, and the interior cylindrical wall of the valve housing.

Another object of the invention is to provide an improved method of expelling the air by displacement from a compartment of a rotary transfer valve placed at the discharge side of a vacuum drying chamber which air the said compartment has acquired while discharging a load of material to a region under higher pressure.

Still another object of the invention is to provide means for admitting steam into successive compartments of a rotary transfer valve for the purpose of driving out contained air.

Other objects and advantages will be apparent and the invention will be better understood from the following description and reference to the accompanying drawings of which Fig. 1 is a side elevation view of one form of rotary valve structure constructed in accordance with my present invention.

Fig. 2 is a sectional view, partly broken away, taken along the line II—II of Fig. 1.

Fig. 3a is a fragmentary sectional view of the discharge end of a preferred form of rotary valve housing in accordance with my present invention.

Fig. 3b is an enlarged elevation, partly in section, of the steam discharging nozzle of Fig. 3a.

Fig. 4 is a sectional view of a double closure
ring which may be used to form an improved air seal between the end plates of the rotor and the valve housing.

Fig. 6 is a longitudinal section view of the end of a rotor blade and a portion of the associated end plates together with a part of the valve housing.

Fig. 7 is an end view of the embodiment illustrated in Fig. 6, and

Fig. 8 is an end view of one of the rotor end plates used in the embodiment illustrated in Figs. 6 and 7.

Referring more particularly to Figs. 1, 2, and 5, the improved valve structure of the present invention there shown comprises a rotor 2 fixed to a shaft 4 and enclosed in a cylindrical housing 9 so as to rotate therein about a horizontal axis. The rotor 2 has a number of blades 8 to which are bolted end plates 10 and 12 which, together with the blades 8, provide the rotor with a series of compartments 14. When the valve is in operation, the compartments move successively into mesh with an inlet port 11 at the top of the housing 9 to receive a charge of material and then move into register with a discharge passage 18 in the bottom of the housing to discharge the material from the compartments.

When the valve is located at the discharge end of a vacuum drying chamber, for example, the inlet passage 16 leads into a hopper 20 which in turn, communicates with the interior of the chamber, not shown. The outlet passage 18 communicates with a region of higher pressure, such as the outside atmosphere. One of the principal functions of the blades 8 is to make sliding contact with the cylindrical inner wall of the housing 9 while maintaining a seal which is as tight as is practically possible. This is to prevent the passage of atmospheric air through the valve from the discharge passage 18 to the inlet 16.

Improved means for maintaining the air-tight seal are a part of the present invention. As shown in Fig. 2, seal holders 22 are fitted over the transverse ends of rotor blades 8, these ends of the blades being preferably fitted into recesses 24 cut in the holder as illustrated. The outer side portions of the blades 8 which are received in the recesses 24 and the interior side walls of the recesses 24, themselves, are made to fit each other exactly by grinding and polishing in order to help minimize air leaks at these points. The ends of the seal holders 22 which are intended to face the interior walls of the housing 9 are also recessed and into the recesses thereof are fitted means for providing a renewable wearing surface. These means may be fiber strips 26 which may be impregnated with graphite to reduce friction.

As shown in Fig. 5, the wearing surfaces of the strips 26 are resiliently pressed against the interior housing wall in a direction radially outwardly from the center of rotation of the rotor by means of springs 28 inserted in recesses 30 formed in the ends of the rotor blades 8. The springs exert their force against the lower contacting surfaces of seal holders 22 which, in turn, transmit the force to the strips 26. Through this arrangement, there is maintained a constant, tight fit between the sealing means and the housing wall even though the fiber strips may become constantly thinner through frictional wear.

A channel 32 is provided between the ends of each of the rotor blades 8 and the bottoms of the recesses 24 in the seal holders 22. Alemite or other suitable fittings 34 in the end plates 10 and 12 supply lubricant to the channels 32 for the purpose of lubricating and sealing the bearing surfaces between the holders 22 and the rotor blades 8. These fittings also lubricate and seal the space between end plates 10 and 12 and seal holders 22.

Alemite or like fittings 38 supply lubricant to oil grooves 36 at the points where the end plates 10 and 12 have a running fit against the inside bore of valve housing 9. Other fittings 40 supply lubricant to the double closure sealing rings 42 which are included to provide additional improved means of forming an airtight seal between the end plates and the valve housing. The sealing rings 42 are made of flexible fiber material. They are attached to the stepped portion 44 of the valve housing by means of a channeled metal holder 46. A resilient cushion 47, made of felt, for example, may be mounted between the closure ring 42 and the adjacent wall portion of the housing 9, as shown in Fig. 4, for the purpose of lubricant and keeping out dust.

Other forms of sealing means may be used in place of the fiber strips 26 held in the seal holders 22. The seal holders, themselves, may be made of brass or other soft metal and their outer contact surfaces may be machined and ground so as to provide a tight fit against the interior surface of the valve housing.

It is also possible, although less preferable, to use other sealing means in place of the double closure rings 42. Recessed metal rings and flexible ring packings can be substituted if desired.

Although illustrated in connection with a transfer valve located at the discharge end of a vacuum drying chamber, the improved air sealing means are obviously not limited to valves used in this manner. The sealing means may be used in any rotary or transfer valve located at a point between regions of two different pressures in a vacuum drying system or any other system using varied pressures in different parts.

The present invention includes certain other improvements relating to rotary valves of the character described through the discharge passage 18, designed to discharge material from a vacuum drying chamber. These improvements have to do with methods and means of preventing air from being carried into the vacuum drying chamber.

As shown in Fig. 2, during the normal operation of a rotary valve connected to the discharge end of a vacuum dryer, each compartment 14, as it discharges its contained pulverulent material into the discharge passage 18, becomes filled with air. This air is carried around with the blades and, if nothing is done to remove it, enters the vacuum chamber through the passage 18. Most of this air can be driven out of the compartment by the improved method, one embodiment of which is illustrated in Fig. 3a. This comprises one or more steam jets 48 having control valves 50 and 52 and a nozzle 54 placed just within the entrance to the discharge passage 18. As one of the revolving compartments 14 empties itself of material into the passage 18, the jet 48 is made to inject a quantity of steam into the said compartment expanding the air therein and driving most of it out through the passage 18. Although steam is perhaps the cheapest and
most convenient substance to use in driving out the air, other easily condensable gaseous media, heated or unheated, may be used. For example, ethylene glycol or carbon tetrachloride or other similar organic materials may be used in the vapor state since they can be made to condense to relatively small liquid volumes with relative ease by quickly lowering their temperature. The action of the gaseous material is largely in the handling of displacement of the air in the compartment. The purged compartment then comes to revolve and eventually reaches a position out of register with the discharge passage. The steam, which is preferably dry and may be superheated, or other easily condensable gaseous medium which may be used, will not condense appreciably on the rotor blades since the blades are heated by the material being discharged from the hot drying chamber. The relatively small amount of air remaining in the compartment and the steam enter the vacuum chamber when the compartment again comes into register with the passage 16 but the quantity of each is so small that the vacuum system can easily handle it.

Another embodiment of this feature is illustrated in the improved form of apparatus of Figs. 5, 6, 7, and 8 wherein the compartments is accomplished in a more positive and automatic manner. In this form of my invention, one of the end plates 26 is provided with an additional hub portion 55 having a number of ports 50 drilled therethrough. Each port connects with a separate compartment 14 of the rotor.

There is also provided a stationary port ring 62 which rides freely on the rotor shaft 8. This ring is held firmly against the face of hub 56 by means of a spring 44 backed by a bushing 66. The portion of the end plate 55 has been provided with a number of ports 65 as shown in the sectional view 70. A yoke 74 attached to an end bearing 76 with cap screws 78 also engages steam line 70 by means of a forked portion 89 and since the end of the steam line is rigidly connected to the port ring 62, the ring is turned from turning on the rotor shaft 8. Slotted screw holes 82 provided for the cap screws 78 which attach the yoke 74 to the bearing 76 permit some adjustment so that port ring 62 can be turned slightly on its axis.

By the above arrangement, steam is admitted successively to each compartment 14 through its entrance port 60 as that port comes into alignment with the port 68 in the port ring. The port 68 is positioned so that steam is admitted automatically to each valve compartment in turn just after its contained material has been discharged and before its following rotor blade has cut the compartment off from the discharge passage 18. The valve turns slowly, at but a few revolutions per minute, so that by the time the compartment is cut off from the passage 18, air has been expelled from it and the compartment has been filled with steam. The slotted screw holes 82 permit the timing of the steam entrance to be suitably adjusted for different speeds or different loads of pulverulent material.

In my invention are useful in connection with transfer valves used in general to conduct pulverulent or other material between regions at different pressures and are susceptible of numerous modifications and embodiments illustrated. For example, in the handling of some types of materials, the rotary valve placed at the inlet side of a vacuum drying chamber may also be fitted with steam entrance ports similar to those described in connection with a rotary valve placed at the discharge side of a drying chamber. In this case, the steam is preferably injected into each valve compartment just before it comes into register with the inlet passage and, consequently, before it has received a charge of material to be carried around to the vacuum chamber. In this embodiment, the function of the steam is not to drive out air from the compartment but rather to neutralize the suction effect caused by the difference in pressure between the evacuated valve compartment and the normal atmospheric conditions at the inlet passage. The steam also mixes with the material entering the valve compartment and tends to prevent air from being trapped between the particles and then being carried around to the vacuum chamber. In the and 8 wherein the discharge valves, however, it will be seen that the function of the steam in the compartments is essentially the same. In each instance, it acts to prevent an undue amount of air from being carried from the high pressure side to the low pressure side of the valve.

I claim:

1. A rotary transfer valve comprising a rotor having a plurality of compartments, means providing an inlet passage for communicating with a region under low pressure, means providing an outlet passage for communicating with a region under high pressure, and means connected to said outlet passage providing means for injecting steam successively into each of said compartments through said outlet passage.

2. A rotary valve mechanism having a rotor divided into a plurality of compartments, said rotor being adapted to receive and to discharge pulverulent material at different points along the outer circumference of its path of rotation, and means independent of said rotor for injecting steam into each of said compartments through said point of discharge while each said compartment is passing said point of discharge.

3. A rotary valve for transferring material from one station to another station comprising a housing having a cylindrical inner wall, a bushing external to said housing, a shaft rotatably carried in said bushing, a rotor having a plurality of radial blades and a pair of endplates secured thereto, said rotor being connected to said shaft and being mounted within said housing, closure rings of resilient material mounted on said cylindrical inner wall and making airtight contact with the circumferential edges of each of said endplates, and retaining members for said closure rings interposed between said cylindrical inner wall and said closure rings, said closure rings and retaining members being separate from said bushing and said shaft.

4. A rotary valve for transferring material from one station to another station comprising a housing having an inner wall, a bushing external to said housing, a shaft rotatably carried in said bushing, a rotor having a plurality of radial blades and a pair of endplates secured thereto, said rotor being connected to said shaft and
being mounted within said housing, closure rings of resilient material mounted on said inner wall and making airtight contact with a surface of each of said endplates, and retaining members for said closure rings interposed between said inner wall and said closure rings, said closure rings and retaining members being separate from said bushing and said shaft.

5. A valve mechanism for transferring material from one station to another station which comprises a housing having an inlet for communication with said one station and an outlet for communication with said other station, means within said housing providing a plurality of material transferring compartments, said means being movably mounted for movement of said compartments alternately to and from said inlet and said outlet and having fluid tight engagement with said housing, and means connected to said housing at said outlet for introducing into each one of said compartments through said outlet while said compartments are successively at said outlet an easily condensable, gaseous medium for displacing the air therein as said first means moves to advance each said compartment from said outlet to said inlet.

6. A valve mechanism according to claim 5 in which said housing is cylindrical in shape and in which said first named means provides a plurality of circumferentially arranged compartments rotatably mounted on the axis of said housing.

7. A valve mechanism according to claim 5 in which said housing is cylindrical in shape and in which said first named means includes (1) a plurality of blades which extend radially outwardly from a common center and (2) a pair of endplates secured thereto.

8. A valve mechanism for transferring material from a station at low pressure to a station at high pressure which comprises a housing having an inlet for communication with said station at low pressure and an outlet for communication with said station at high pressure, means within said housing providing a plurality of material transferring compartments, said means being movably mounted for movement of said compartments alternately to and from said inlet and said outlet, air sealing means having a renewable wearing surface mounted between said first men-

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