This invention relates to conveyors for pulverulent materials, such as cement, flour, and the like, of the type comprising a plurality of containers from which the material is fed successively in order that the quantity of material discharged may be accurately measured. It is the principal object of the invention to provide a conveying apparatus of this type which will function automatically to deliver the material in a substantially continuous flow and which is simple and inexpensive to construct and economical to operate.

It is a more specific object of the invention to provide conveying apparatus for pulverulent materials employing compressed air for discharging the material alternately from two containers, one of which is receiving a fresh charge of material while the other is being discharged. It is a feature of the invention that the air supply for the discharging container is automatically interrupted when the container is emptied, the mechanism for controlling the air supply functioning to interrupt the air flow independently of the mechanism which effects successive filling of the containers. It will be appreciated that under these conditions it is possible to allow a greater period of time for the filling of the containers than for the discharge thereof without unnecessarily wasting compressed air, a feature which is highly desirable inasmuch as it is exceedingly difficult to control the filling and discharge operations so that they will be completed in equal intervals of time under varying conditions of the material, for instance moisture content, size, and so forth.

Further objects and features of the invention will be apparent from the following description taken in connection with the accompanying drawings, in which

The single figure is a diagrammatic representation in elevation of a conveying apparatus constructed in accordance with the invention and illustrating two containers, together with the automatic control mechanism therefor.

The containers 1 and 2 which are alternately filled and emptied in succession are provided respectively with the associated supply conduits or hoppers 3 and 4, communication between the conduits and the containers being controlled by means of valves 5 and 6. It will be observed from the drawing that these valves are connected by a linkage mechanism, of which the rods 7 and 8 form a part, in such manner that when one valve is closed the other is open. A piston 9 operating in a closed cylinder is interposed between and connected with the rods 7 and 8, this piston being reciprocable by means of fluid, such as air under pressure, to effect operation of the linkage mechanism and consequent opening and closing of the valves 5 and 6.

If the nature of the material being conveyed requires some means for effecting propulsion of the material to facilitate discharge thereof, distributing devices 10 and 11 may be employed, these devices being located in discharge conduits 43 and 44 associated with the lower end of the containers 1 and 2 respectively and being selectively operable by the motors 12 and 13. These distributing devices may comprise compartment wheels or other conventional mechanism for discharging pulverulent material and are preferably so controlled as to operate only during actual discharge of the material from the respective containers.

Conduits 14 and 15 to which air under pressure may be introduced are provided, these conduits communicating respectively with the discharge conduits 43 and 44 and serving to force the discharging material through the conduits 16 and 17 into a common discharge pipe, the conduits 16 and 17 being selectively placed in communication with the discharge pipe by means of a two-way valve 40 which is operated in a manner hereinafter described. The supply of air under pressure through the conduits 14 and 15 is controlled by valves 18 and 19 respectively.

It will be observed that a circuit closing switch 22 is located in the upper portion of the container 1 and a similar switch 23 is associated with the container 2, these switches being so constructed as to be actuated by the material when the latter rises to the proper height in the respective containers to close an electric circuit. Thus the switch 22 is connected in series with a solenoid 31 across a source of supply 41, 42 and the switch 23 is similarly connected in series with the solenoid 30. The solenoids 30 and 31 are utilized to control the position of the rotating element of a valve 26, the solenoid 31 serving...
to rotate this element in a clockwise direction to the position shown in the drawing and the solenoid 30 serving to rotate the element in a counter-clockwise direction through substantially 90°. A pipe 45 into which air under pressure may be supplied is connected by a pipe 46 with the rotary valve 26 and a pipe 48 with the rotary valve affords communication with the atmosphere. The pipes 32 and 33 also communicate with the valve and on rotation of the movable element of the valve are alternately placed in communication with the pressure pipe 46 and the discharge pipe 48 as will be apparent from an inspection of the figure. Thus in the position which the parts occupy in this figure air under pressure is being supplied to the pipe 33, whereas the pipe 32 is in communication with the atmosphere; on rotation of the movable element of the valve 26 in a counterclockwise direction through substantially 90°, the pressure in the pipes 32 and 33 will be reversed, the pipe 32 being supplied with air under pressure and the pipe 33 being placed in communication with the atmosphere. It will be observed that the pipes 30 and 39 are in communication with the pipes 32 and 33 and also communicate with the two-way valve 40 in such manner that when the valve 26 occupies the position shown in the drawing, the conduit 16 is in communication with the discharge pipe whereas the conduit 17 is blocked. On rotation of the movable member of the valve 26 through 90° in a counterclockwise direction, the position of the valve 40 will be reversed so that material may flow through the conduit 17 to the discharge pipe, whereas the conduit 16 is blocked.

The pipe 32 communicates with the left hand end of the cylinder and the pipe 33 with the right hand end of the cylinder in which the piston 9 reciprocates. Thus in the position in which the parts are shown in the drawing the piston 9 has been moved toward the left hand end of the cylinder by means of the pressure in the pipe 33, whereby the valve 5 is closed and the valve 6 is opened, so that material is being supplied through the conduit 4 to the container 2. At the same time material is being discharged from the container 1 through the two-way valve 40, discharge from the container 2 being blocked by this valve. As soon as the level of the material in container 1 drops below the switch 22, the latter will be opened, thus de-energizing the solenoid 31, but the rotary valve 26 will not be operated and will remain in the position in which it is shown in the drawing. When, however, the level of the material in the container 2 rises to an extent sufficient to close the switch 23, the solenoid 30 will be energized and the valve 26 will be reversed in position to reverse the pressures in the pipes 32 and 33, thus effecting reversal of the valve 40 to interrupt movement of the material through the conduit 16. At the same time the piston 9 will be moved to the right so that the valve 6 will be closed and the valve 5 opened to the container 1 wherefore the air pressure in the conduit 17 will force the material out of the container into the pipe 47 and through the air pressure supply pipe 45 and through the pipe 49 with the atmosphere. The construction of this valve is similar to that of the valve 26, the movable element of the valve being rotatable in opposite directions by the solenoids 28 and 29. In the position in which the valve is shown in the drawing the solenoid 29 has rotated the valve in a clockwise direction and if this solenoid is de-energized and the solenoid 29 is energized the movable element of the valve will be rotated through substantially 90° in a counterclockwise direction. The solenoid 28 is in series with a switch 28 across the source of supply 41, 42 and the solenoid 29 is similarly in series with air under pressure 24, the switches 24 and 25 being associated with the respective containers 1 and 2 and are similar in construction. Each of these switches is pressure operated, that is to say, when an abnormally low pressure is established in the associated container the switch will close and affect energization of the corresponding solenoid. It will be appreciated by an examination of the drawing that the closing of the switch 25 will serve to position the valve as shown and will apply air under pressure to the pipe 36, whereas the pipe 37 will be placed in communication with the atmosphere. Pipes 36 and 37 are connected respectively with the outer ends of larger surface area of the differential pistons 21 and 20, the inner ends of smaller area of the pistons 21 and 20 being connected respectively with the pipes 35 and 34. The pipe 34 is connected through one end of the cylinder in which the piston 9 reciprocates to the pipe 33 and the pipe 35 is similarly connected through the opposite end of the cylinder with the pipe 32. Thus in the position in which the parts are shown in the drawing air under pressure is supplied through the pipes 33 and 34 to the inner smaller end of the differential piston 20, whereas the inner end of the differential piston 21 communicates with the atmosphere through the pipes 35 and 36. The pistons 20 and 21 are operatively connected with the valves 18 and 19 respectively in such manner that inward movement of these pistons in response to pressure applied to the outer larger end thereof serves to close the respective valves, whereas outward movement of the pistons serves to open the valves. Thus the valve 18 is shown as open by reason of the fact that the piston 20 occupies its outer position as the result of the air pressure applied to the inner end thereof only, whereas the valve 19 is closed as the result of reverse pressure conditions applied to the piston 21.

The motors 12 and 13 are preferably respectively connected with the pistons 20 and 21 in such manner that when either piston occupies its outer position the corresponding motor is operated whereas movement of the corresponding piston to its inner position will terminate operation of the associated motor. These connections are omitted from the drawing to simplify the same, but it will be appreciated that operation of the motor associated with either container is desired only once the air required to discharge the material from the container is flowing through the corresponding control valve 18 or 19.

It will now be understood that in addition to the means for controlling the admission of material to the containers 1 and 2, a separately functioning means for terminating the operation of the material discharging devices, including the compressed air supply, when the associated container is emptied. Thus with the
In apparatus for conveying pulverulent material, the combination with a pair of containers, of reversible means for supplying pulverulent material to each container, separate control devices associated with each container and operable by the material on completion of filling of the container for interrupting operation of the respective supply means, separate means associated with each container for effecting discharge of material therefrom, and mechanism responsive to the emptying of said container and operable on completion of such discharge and acting independently of said control devices for rendering said last named means inoperative.

2. In apparatus for conveying pulverulent material, the combination with a pair of containers, of separate means for supplying pulverulent material to each container, separate control devices associated with each container and operable by the material on completion of filling of the container for interrupting operation of the respective supply means, separate means including a fluid pressure device associated with each container for effecting discharge of material therefrom, and mechanism operable by pressure conditions in the discharging container on completion of such discharge and acting independently of said control devices for rendering said last named means inoperative.

3. In apparatus for conveying pulverulent material, the combination with a pair of containers, of reversible means for supplying the material alternately to said containers, control devices, one associated with each container and operable by the material on completion of filling of one container for reversing said means to effect supply of material to the other container, means operable to discharge material alternately from said containers, and mechanism associated with said discharge means and functioning independently of said reversible supply means in response to the emptying of a container to render said discharge means inoperative on completion of discharge from the container.

4. In apparatus for conveying pulverulent material, the combination with a pair of containers, of reversible means for supplying the material alternately to said containers, control devices, one associated with each container and operable by the material on completion of filling of one container for reversing said means to effect supply of material to the other container, means operable to discharge material alternately from said containers, said last named means including a fluid pressure device exerting a discharging pressure within the container, and a plurality of members, one associated with each container, and responsive to reduction of pressure therein on completion of discharge for rendering the associated fluid pressure device inoperative.

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