

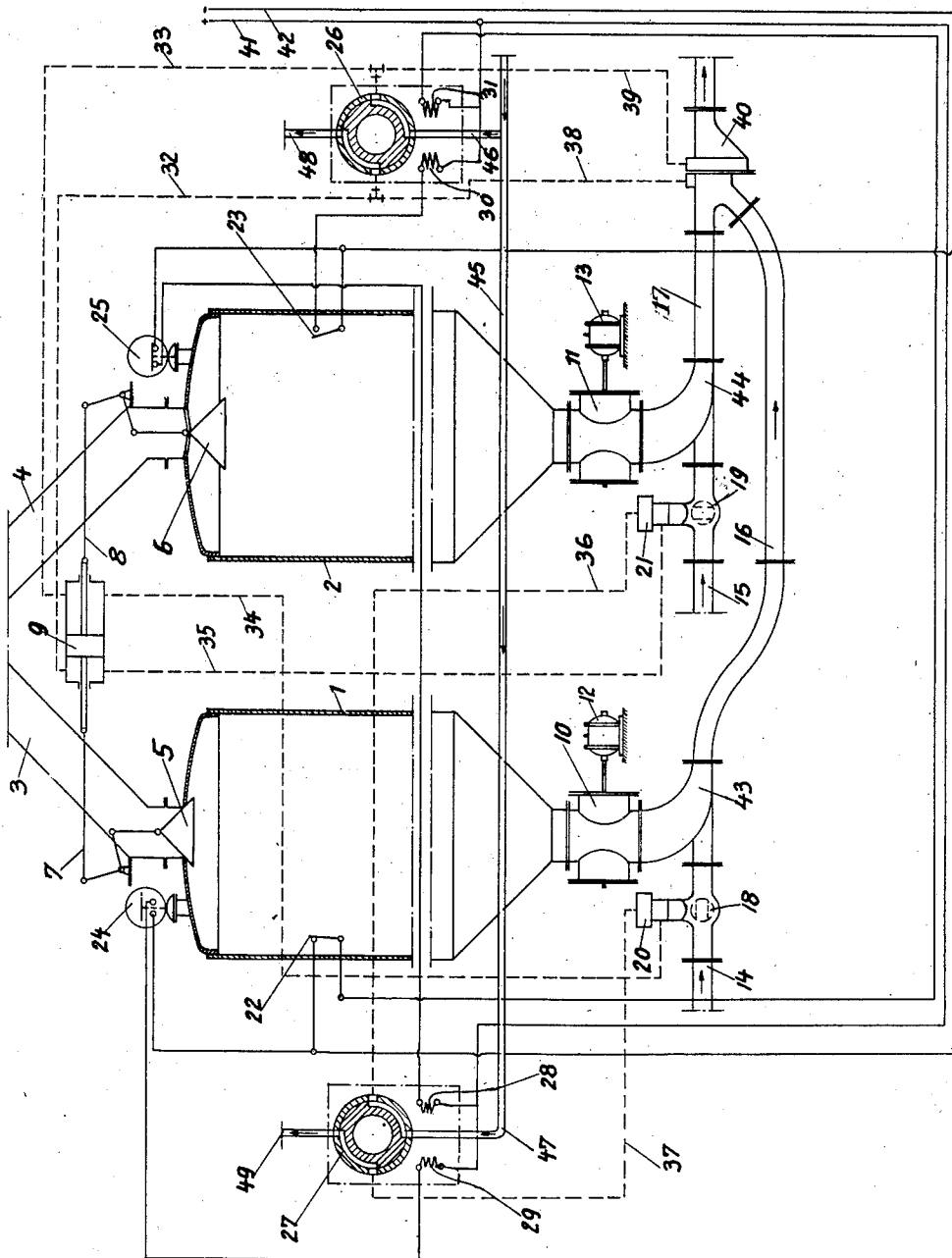
Nov. 21, 1933.

P. GOEBELS

1,935,843

APPARATUS FOR CONVEYING PULVERULENT MATERIAL

Filed Oct. 21, 1929



Paul Goebel
Inventor
H. J. Menden
Attorney

by

UNITED STATES PATENT OFFICE

1,935,843

APPARATUS FOR CONVEYING PULVERULENT MATERIAL

Paul Goebels, Dessau, Germany, assignor to G. Polysius Aktiengesellschaft, Dessau, Germany

Application October 21, 1929, Serial No. 401,260,
and in Germany October 26, 1928

4 Claims. (Cl. 302—39)

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.

A further object of the invention is the provision in apparatus for conveying pulverulent material of a pair of containers provided with separate control devices operable by the material on the completion of filling of one container for interrupting the supply of material thereto, and separate mechanism associated with each container and operable on completion of the emptying of a container for terminating the operation of the discharge means associated with that container, this mechanism operating independently of the control devices for supplying the material to the respective containers.

Further objects and features of the invention will be apparent from the following description taken in connection with the accompanying drawing, 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 respectively 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 connected 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 38 and 39 are in communication respectively 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 and the container 1 will commence filling.

It will be appreciated from the structure so far described that automatic means has been provided for ensuring successive filling of the containers 1 and 2 and for placing these containers alternately in communication with a discharge pipe so that while one container is filling the other may be discharging.

A second rotary valve 27 is provided, this valve communicating through the pipe 47 with 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 28 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 25 across the source of supply 41, 42 and the solenoid 29 is similarly in series with a switch 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 32. 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 ends 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 when the air pressure which serves 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, I have provided 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

parts in the position which they occupy in the drawing, the container 1 will discharge, this action being facilitated by the flow of air through the pressure conduit 14, until the container is entirely emptied. While the container is discharging there is a certain amount of back pressure as the result of the supply of compressed air but when the conduits 43 and 44, 16 and 17 are freed of material the aspirating effect of the air passing through the conduit 14 will result in the establishment of a subnormal pressure in the container 1 sufficient to close the switch 24. On the closing of this switch the solenoid 29 will be energized, and since the solenoid 28 has already been de-energized by the reestablishment of normal conditions in the container 2, the valve 27 will be rotated in a counterclockwise direction through substantially 90°. Thus pressure will be applied through the pipe 37 to the outer larger end of the piston 20 and by reason of the differential action of this piston it will move inwardly to close the valve 18, thus interrupting the supply of air under pressure through the pipe 14. At the same time the outer end of the piston 21 will be placed in communication with the atmosphere through the pipe 36 and the valve 19 will remain closed, both sides of the piston being subjected to atmospheric pressure.

When the container 2 is substantially filled to an extent sufficient to close the switch 23 and to rotate the movable element of the valve 26 in a counterclockwise direction through 90°, air under pressure will be supplied to the pipe 32 and the pipe 33 will communicate with the atmosphere and the piston 9 will move to the right, opening the valve 5 and closing the valve 6. At the same time air under pressure will be admitted through the pipe 35 to the inner end of the piston 21 and since the outer end of the piston 21 is under atmospheric pressure through the pipe 36 the piston will move outwardly and the valve 19 will be opened, thus admitting air to facilitate discharge of material from the filled container 2, the motor 13 being simultaneously rendered operative.

The sequence of operations will now be apparent from the foregoing description, it being obvious that the complete cycle will be repeated automatically, filling of the container ceasing as soon as a predetermined level has been reached and the supply of discharging air being terminated as soon as the associated container is emptied and without reference to the extent to which the other container has been filled. In this manner a measured quantity of material is delivered and complete filling and discharge of each container on each cycle of operations is ensured.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. 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 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.

PAUL GOEBELS.