

May 11, 1954

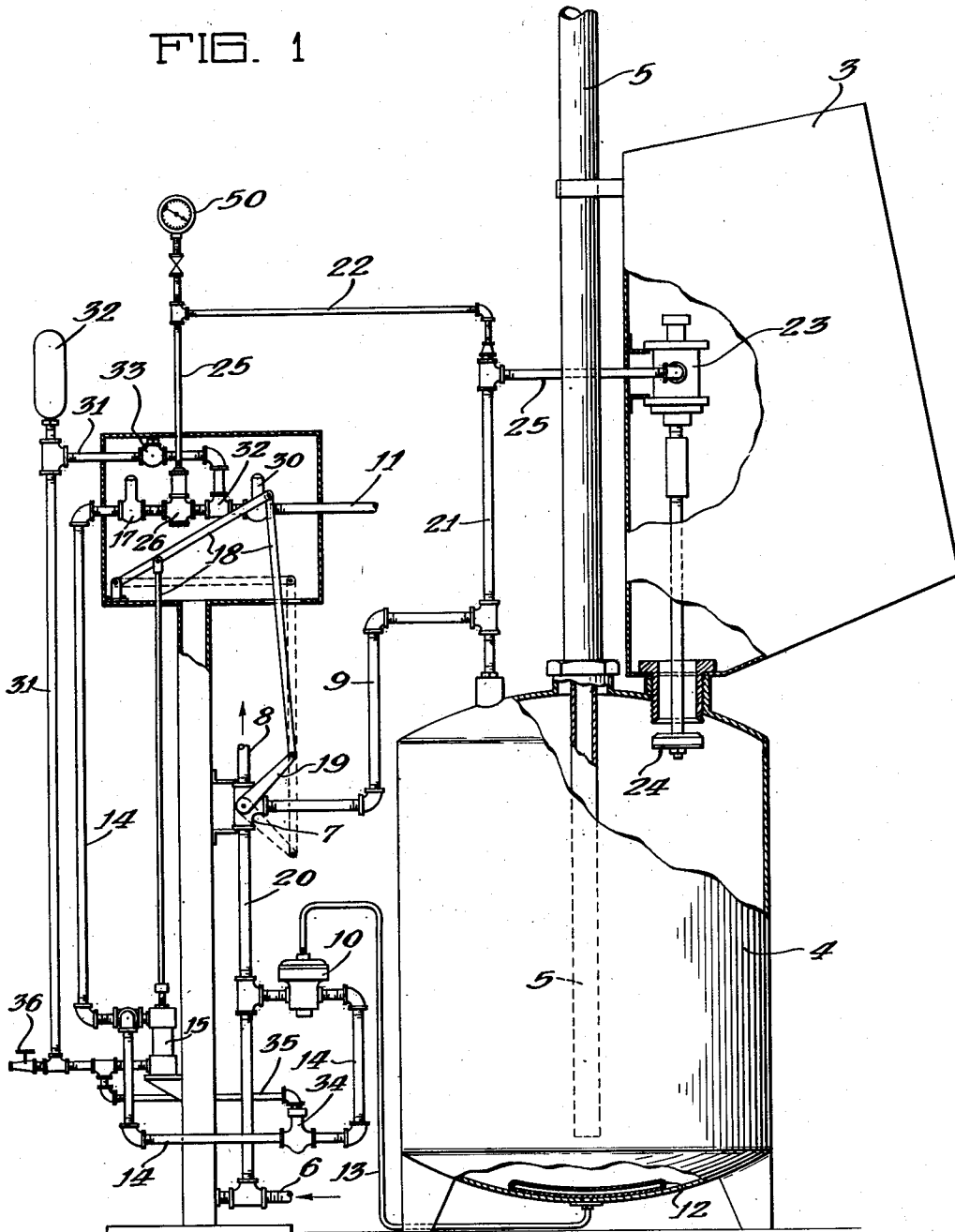
B. S. SNOW
AUTOMATIC CONTROL SYSTEM FOR GRANULAR
MATERIAL HANDLING DRUMS

2,678,240

Filed Nov. 14, 1950

2 Sheets-Sheet 1

FIG. 1



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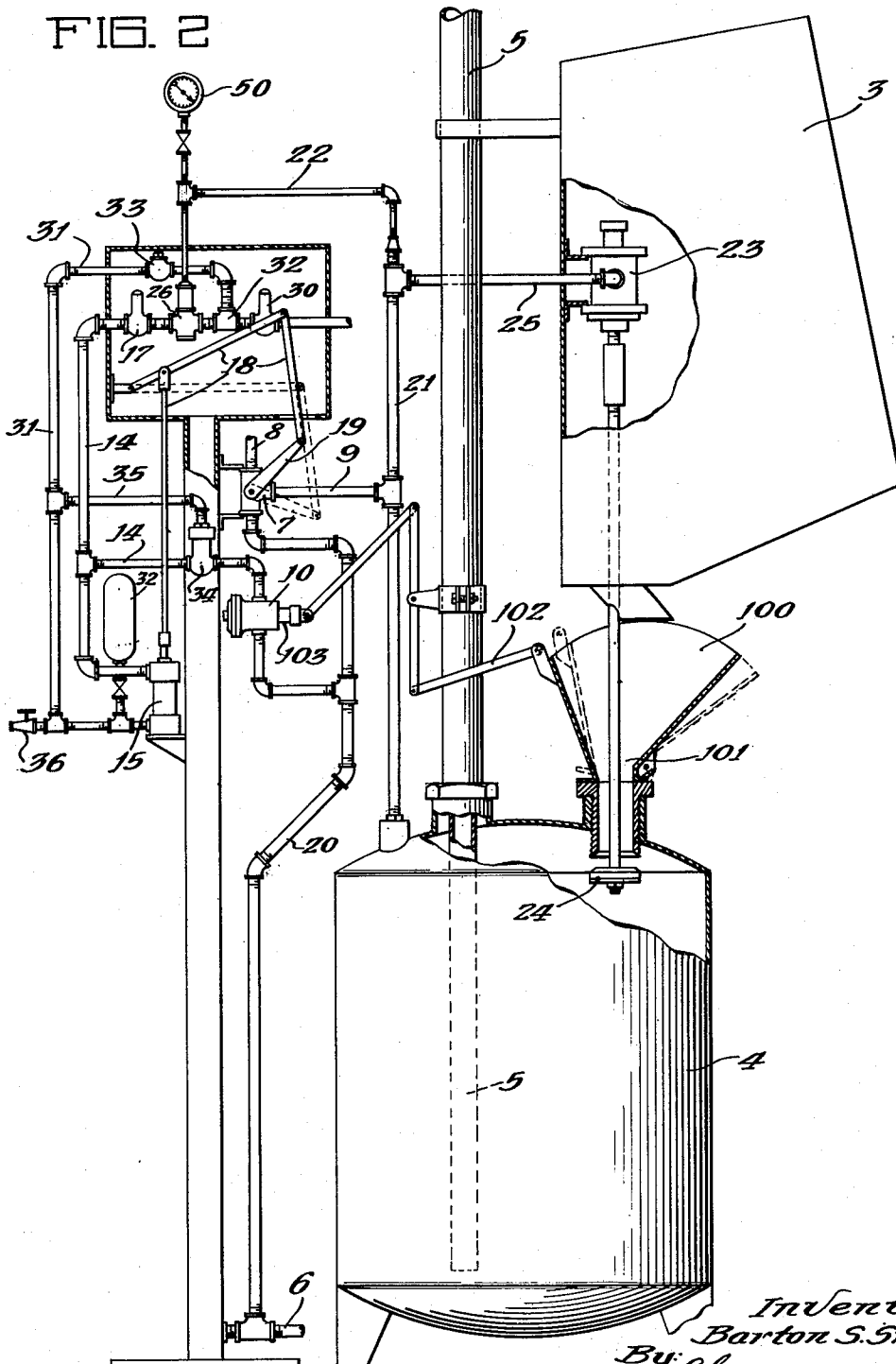
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2 Sheets-Sheet 2

FIG. 2



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UNITED STATES PATENT OFFICE

2,678,240

AUTOMATIC CONTROL SYSTEM FOR GRANULAR MATERIAL HANDLING DRUMS

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Application November 14, 1950, Serial No. 195,616

15 Claims. (Cl. 302—53)

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This invention relates to an apparatus for handling granular material by air pressure and more particularly to an automatic system for a pressure drum to intermittently deliver determined amounts of granular material to a pipeline by air pressure.

The primary object of this invention is to provide a fully automatic control system associated with a pressure drum which will not require manual operation.

Another object is to provide a control of the character described which will reduce scouring of equipment to a minimum.

A further object is the provision of a control of the character described which will automatically operate the drum to deliver a quantity of granular material as many times as that quantity is placed in the drum.

The invention is illustrated in exemplary embodiments in the accompanying drawings, in which:

Fig. 1 is a side elevation, partly broken away and partly in section, of a sand drum and the control system embodying the invention; Fig. 2 is a view similar to Fig. 1 illustrating another embodiment of the invention.

The embodiments of the present invention will be described in connection with an installation suitable for handling dry sand such as disclosed in my co-pending application Serial No. 125,908, filed November 7, 1949, now Patent No. 2,614,002 issued October 14, 1952. Thus, in the figures, sand may be placed in a receptacle 3 from which it is conveyed by gravity to a drum 4 adapted to hold approximately one ton. The sand is blown from the drum 4 by compressed air through a pipeline 5, either to a point of use or to a storage facility. Prior to this invention, a drum 4 has been used with manual controls resulting in waste of compressed air and also excessive scouring and pitting of the equipment, each time the operator failed to shut off the air supply reasonably soon after all the sand was blown from the drum. This invention contemplates replacing all prior manual operations with a completely automatic control system. The embodiments of Figs. 1 and 2 vary only in the particular structure or mechanism used to start the cycle operation, thus like reference numerals will be used in both figures.

In each of the figures the drum is shown in condition to receive sand from the receptacle 3, the air supply from line 6 being shut off from the drum by the drum pressure control valve 7. The drum 4 is vented through a port in the drum

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pressure control valve 7, to an exhaust 8 by means of a blowing line 9. Also in the condition shown, no air is present in the control system other than atmospheric air. A starting valve 10 controls admission of air to the control system and is normally closed. The control system has an exhaust 11 which is open in the condition illustrated in the figures of the drawings.

As the drum (Fig. 1) fills with sand, its weight exerts pressure on a bag 12 placed in the bottom of the drum 4. The bag is filled with a fluid which will not freeze and the interior of the bag is connected with the starting valve through a hydraulic line 13. The sand employed is generally dry and weighs approximately 100 pounds per cubic foot so that each vertical foot of sand exerts a pressure of approximately 0.69 pound per square inch on the bag 12. When the drum is full of sand, the pressure on the bag due to the weight of sand forces the fluid through line 13 into the top of the starting valve 10 and causes that valve to open, thus admitting air from the source 6 into the control system. Thus, air is lead through air motor supply line 14 to one side of an air piston motor 15 and up to a sequence valve 17. When the air in line 14 strikes the sequence valve 17, this valve closes and remains closed for a short period of time until the pressure within the valve on both sides of its gate is equalized. The sequence valve is available commercially. This time delay is sufficient to allow the pressure in line 14 to move the piston within the air motor 15 downwardly, with reference to the drawings, to shift a linkage 18 connected with the operating arm 19 of the drum pressure control valve 7. Upon this shift, the lever 19 of valve 7 is thrown to the dotted line position and connects an inlet port in the valve with blowing line 9 to allow air from the source 6 to enter through the high pressure supply line 20 and blowing line 9 to the drum 4. Air is also admitted to portions 21 and 22 of the blowing line and to an air ram 23 through air ram line 25. The air ram closes valve 24 which previously admitted sand to the drum. Generally the air pressure used is between 80 and 100 pounds per square inch and the first puff of air admitted to the drum 4 will generally clear the valve seat of the valve 24 permitting a positive tight seal between the valve body and the seat. The portion 22 of blowing line 9 leads to a blocking valve 26 which closes in response to the pressure built up within the drum. Valve 26 is generally closed in response to the drum pressure prior to the time that sequence valve 17 opens.

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As thus far described, the drum is full of sand; air has been admitted to the drum to blow the sand into the pipeline 5; and a portion of the control system has been filled with compressed air from the source 6. Compressed air now fills the air motor supply line which extends from starting valve 10 to sequence valve 17; the high pressure supply line between source 6 and valve 7; and the blowing line from valve 7 to the drum and to the blocking valve 26, plus line 25 to the air ram.

The drum is of a size to contain approximately 1 ton of sand which may be blown into the pipeline 5 in approximately 30 seconds, the air taking an additional 15 seconds to permeate through the sand. If the air supply is of the pressure of 100 pounds per square inch, the drum pressure while blowing the sand into the pipeline 5 will be substantially 100 pounds minus a small amount for friction loss and head loss in the piping. The loss in pressure, however, is small and may be disregarded in this application.

Also while the sand is being blown from the drum the starting valve 10 is held open and the air piston in the motor 15 is held in its lowermost position maintaining the drum pressure control valve 7 in position to admit air to the drum. The blocking valve 26, being sensitive to the drum air pressure, remains closed to exclude compressed air from the remainder of the control system. A pressure gauge 50 provides visible indication of drum air pressure.

The condition described in the above paragraph remains until substantially all the sand is blown from the drum. The air pressure in the drum drops rapidly as the lower end of the pipe line 5 is cleared of sand, since the delivery end of the pipe is usually open. In using 100 pounds per square inch air supply, the pressure in the drum will generally drop to as low as 25 pounds per square inch. This pressure drop affects the pressure in blowing line portions 21 and 22 and is sufficiently low to allow the blocking valve 26 to open, permitting air from line 14 to advance past the blocking valve to a second sequence valve 30. This sequence valve is substantially the same as sequence valve 17 and immediately closes upon air coming in contact with it. An air motor reversing line or branch line 31 is connected to a T 32 placed between the blocking valve 26 and sequence valve 30 and communicates with the lower end of the air piston motor 15. An accumulator 32 is provided in the line 31 with a check valve 33 positioned to admit air to the branch line 31. The sequence valve 30 remains closed sufficiently long for the air pressure to build up in the branch line 31 to a point approximately equal to the pressure of the air supply. A stopping valve 34, positioned between the air motor 15 and the starting valve 10 in line 14, is sensitive to the pressure in the branch line 31 by means of a connecting line 35. When the pressure builds up in the branch line, valve 34 closes in response to that pressure, shutting off further supply of air to parts of the system beyond the valve. At approximately this same time, sequence valve 30 opens and exhausts line 14 through the exhaust 11. However, the pressure in branch line 31 remains because of the check valve 33 and reverses the position of the piston in the air motor 15. This moves the drum pressure control valve to connect line 9 leading to the drum 4 with the exhaust port 3, thus venting the drum 4 of any air pressure left therein. The air ram 23 is also relieved to atmospheric

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pressure permitting the valve 24 to open by virtue of its own weight or by spring pressure as desired.

This system and the condition described in the above paragraph is now substantially the same as that shown in the drawings and first described with the exception that air pressure remains in the branch line 31. A bleed 36 is set to exhaust the branch line 31 at a predetermined rate so that this line will be reduced to atmospheric pressure before the drum is again filled with sand. Of course, exhausting the branch line 31 permits the stopping valve 34 to open and remain open until pressure is again built up in the branch line.

The embodiment of Fig. 2 is provided with the same system as that shown in Fig. 1. The difference in these embodiments lies merely in the manner of operating the starting valve 10 to introduce air into the control system. In Fig. 2 the drum 4 is provided with a hopper 100 pivotally mounted on the top of the drum at 101. Sand flows from receptacle 3 into the hopper and then by gravity through valve 24 into the drum. Sand backs up into the hopper 100 when the drum is full, and causes the hopper to tilt toward the dotted line position by reason of the weight of the sand alone. The hopper is constructed to have its center of gravity to the right of the pivot 101 so that when filled with sand it will readily move to its dotted line position. A link system 102 connects the upper edge of the hopper with the plunger 103 of the starting valve 10. Movement of the hopper opens the starting valve 10 to admit air to the control system. The operations of the two embodiments shown are identical from the opening of the starting valve 10. The air lines and valves are also the same.

While I have shown and described certain embodiments of my invention, it is to be understood that it is capable of many modifications. Changes, therefore, in the construction and arrangement may be made without departing from the spirit and scope of the invention as disclosed in the appended claims.

I claim:

1. An automatic control system for a lift drum used to deliver granular material to a pipe line by air pressure, comprising: a two position drum pressure control valve having an inlet port for admitting compressed air to the drum, and a vent port for venting the drum; a starting valve for admitting compressed air into said system; valve actuating mechanism connected to said drum to open said starting valve in response to the amount of granular material contained in said drum; an air motor connected to an air supply line in the control system for shifting the drum pressure control valve to open said inlet port after air pressure is admitted through said starting valve; a branch line in said control system for reversing said motor to return the drum pressure control valve to venting position and to shut off further air admission to the drum; and said system including automatic valves for cutting off air from said branch line until a predetermined amount of the granular material has been delivered from the drum, said starting valve actuating mechanism holding the starting valve open until pressure in the drum is reduced.

2. An automatic control system for a lift drum used to deliver granular material to a pipe line by air pressure, comprising: a two position drum pressure control valve having an inlet port for admitting compressed air to the drum, and

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a vent port for venting the drum; a starting valve for admitting air into said system; valve actuating mechanism connected to said drum to open said starting valve in response to the amount of granular material contained in said drum; an air motor connected to an air supply line in the control system for shifting the drum pressure control valve to open said inlet port; a branch line in said control system for reversing said motor to return the drum pressure control valve to venting position; a stopping valve in the air motor supply line, said stopping valve being controlled by the air pressure in the branch line; and said system including automatic valves for cutting off air from said branch line until a determined amount of the granular material has been delivered from the drum.

3. An automatic control system for a lift drum used to deliver granular material to a pipe line by air pressure, comprising: a two position drum pressure control valve having an inlet port for admitting compressed air to the drum, and a vent port for venting the drum; a starting valve for admitting air into said system; valve actuating mechanism connected to said drum to open said starting valve in response to the amount of granular material contained in said drum; an air motor connected to an air supply line in the control system for shifting the drum pressure control valve to open said inlet port; a branch line in said control system for reversing said motor to return the drum pressure control valve to venting position; and automatic valves in said system including a primary sequence valve, a blocking valve controlled by air pressure in the drum, and a secondary sequence valve, said valves being in series with the branch line being connected between the blocking valve and the secondary sequence valve, said valves cutting off air from said branch line until a predetermined amount of the granular material has been delivered from the drum.

4. A control system as specified in claim 1, in which the drum is provided with a port for admitting granular material, said port having a gate, and an air ram is provided to close said gate, said ram being operated by air from the control system admitted to the system through said drum pressure control valve.

5. An automatic control system for a lift drum used to deliver granular material to a pipe line by air pressure, comprising: a two position drum pressure control valve having an inlet port for admitting compressed air to the drum, and a vent port for venting the drum; a starting valve for admitting air into said system; a pressure responsive unit in the bottom of said drum having a connection with said starting valve to open said valve in response to pressure exerted on the unit by weight of material in the drum; an air motor connected to an air-supply line in the control system for shifting the drum pressure control valve to open said inlet port; a branch line in said control system for reversing said motor to return the drum pressure control valve to venting position; a check valve and a blocking valve in said branch line, said blocking valve being controlled by air in the drum; and said system including automatic valves for cutting off air from said branch line until a determined amount of the granular material has been delivered from the drum.

6. A control system as specified in claim 5, in which, a stopping valve is provided in the air-mo-

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tor supply line, said stopping valve being controlled by the air pressure in the branch line.

7. A control system as specified in claim 5, in which, the drum is provided with a port for admitting granular material, said port having a gate, and an air ram is provided to close said gate, said ram being operated by air from the control system admitted to the system through said drum pressure control valve.

8. A control as specified in claim 5, in which, the air motor supply line is provided with an exhaust port, and the branch line is connected to the air-motor supply line, said branch line being provided with an air pressure accumulator and a check valve to retain pressure in said line after said exhaust port is vented to atmosphere, and a bleed nozzle to slowly reduce air pressure in the branch line to atmospheric.

9. An automatic control system for a lift drum used to deliver granular material to a pipe line by air pressure, comprising: a two position drum pressure control valve having an inlet port for admitting compressed air to the drum, and a vent port for venting the drum; a starting valve for admitting air into said system; a pivotally mounted hopper on the drum for directing material into the drum, and having a connection with said starting valve to open said valve when said hopper is tilted about its pivot by weight of material backed up into the hopper; an air motor connected to an air-supply line in the control system for shifting the drum pressure control valve to open said inlet port; a branch line in said control system for reversing said motor to return the drum pressure control valve to venting position; and said system including automatic valves for cutting off air from said branch line until a determined amount of the granular material has been delivered from the drum.

10. A control system as specified in claim 9, in which said automatic valves include a sequence valve and a blocking valve in series, said sequence valve being adapted to close upon admission of air to said system and to open after full pressure is built up in said system, and said blocking valve is controlled by air pressure in the drum.

11. A control system as specified in claim 9, in which, a stopping valve is provided in the air motor supply line, said stopping valve being controlled by air pressure in the branch line.

12. A control system for a lift drum used to deliver granular material to a pipe line by air pressure, comprising: a high pressure air supply line; a two position drum pressure control valve having an inlet port for admitting compressed air from said supply line through a blowing line to the drum, and a vent port for venting the drum; an air motor supply line connected to the high pressure air supply line; a starting valve for admitting air into said air motor supply line; valve actuating mechanism connected to said drum to open said starting valve in response to the amount of granular material contained in said drum; an air motor connected to said motor supply line for shifting the drum pressure control valve to open said inlet port; an air motor reversing line for reversing said motor to return the drum pressure control valve to venting position; and said system including automatic valves positioned between said air motor supply line and said air motor reversing line for cutting off air from said reversing line until a determined amount of granular material has been delivered from the drum, at least one of said automatic valves being responsive to air pressure in the

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drum to open and admit air to the motor reversing line upon lowering of drum air pressure to below blowing pressure.

13. A control system as specified in claim 12, in which the drum is provided with a port for admitting granular material, said port having a gate, an air ram is provided to close said gate, and an air ram line connects said ram with said blowing line.

14. A control system for a lift drum used to deliver granular material to a pipe line by air pressure, comprising: a high pressure air supply line; a two position drum pressure control valve having an inlet port for admitting compressed air from said supply line through a blowing line to the drum, and a vent port for venting the drum; an air motor supply line connected to the high pressure air supply line; a starting valve for admitting air into said air motor supply line; valve actuating mechanism connected to said drum to open said starting valve in response to the amount of granular material contained in said drum; an air motor connected to said motor supply line for shifting the drum pressure control valve to open said inlet port; an air motor reversing line for reversing said motor to return the drum pressure control valve to venting position; automatic valves positioned between said air motor supply line and said air motor reversing line including a primary sequence valve, a blocking valve controlled by air pressure in the drum, and a secondary sequence valve, said air motor reversing line being connected to said air motor supply line between said blocking valve and said secondary sequence valve, said valves cutting off air from said reversing line until a predetermined amount of granular material has been delivered from the drum.

15. A control system for a lift drum used to deliver granular material to a pipe line by air

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pressure, comprising: a high pressure air supply line; a two position drum pressure control valve having an inlet port for admitting compressed air from said supply line through a blowing line to the drum, and a vent port for venting the drum; an air motor supply line connected to the high pressure air supply line; a starting valve for admitting air into said air motor supply line; valve actuating mechanism connected to said drum to open said starting valve in response to the amount of granular material contained in said drum; an air motor connected to said motor supply line for shifting the drum pressure control valve to open said inlet port; an air motor reversing line for reversing said motor to return the drum pressure control valve to venting position; a stopping valve in the air motor supply line being controlled by air pressure in said air motor reversing line; and said system including automatic valves positioned between said air motor supply line and said air motor reversing line for cutting off air from said reversing line until a determined amount of granular material has been delivered from the drum.

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