July 19, 1938. M. VOGEL-JORGENSEN 2,124,018

CONVEYER CONTROL

Filed Aug. 3, 1936 2 Sheets-Sheet 1

Fig. 1.

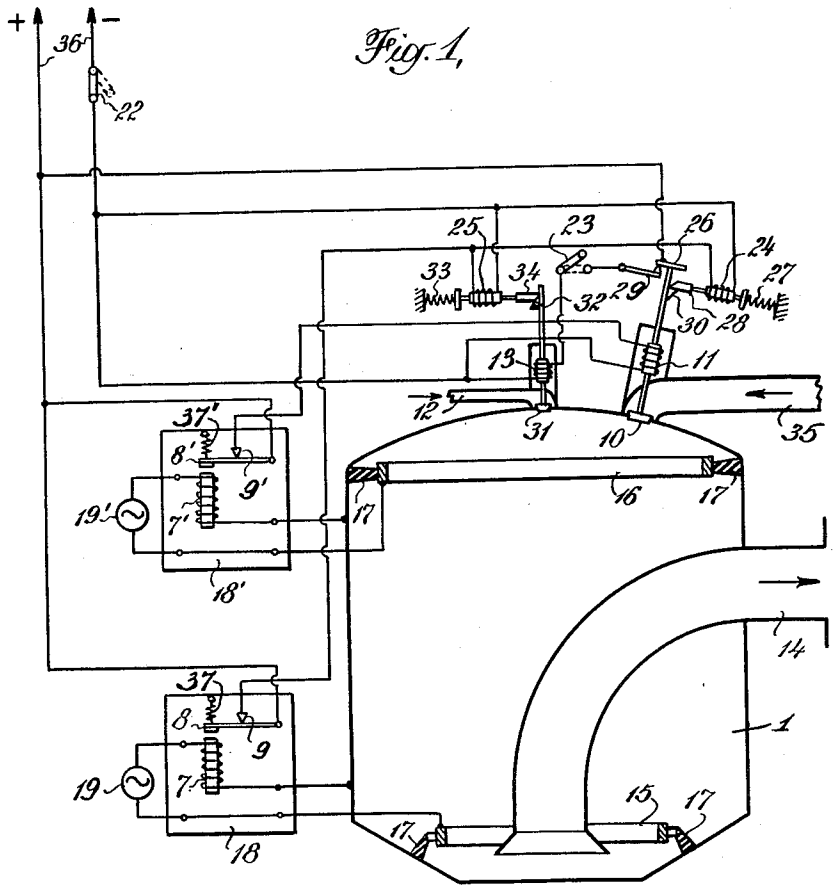
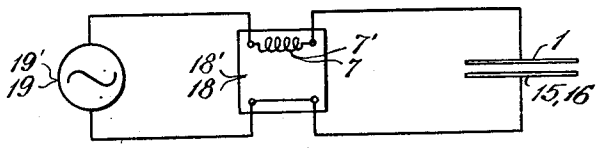


Fig. 2.



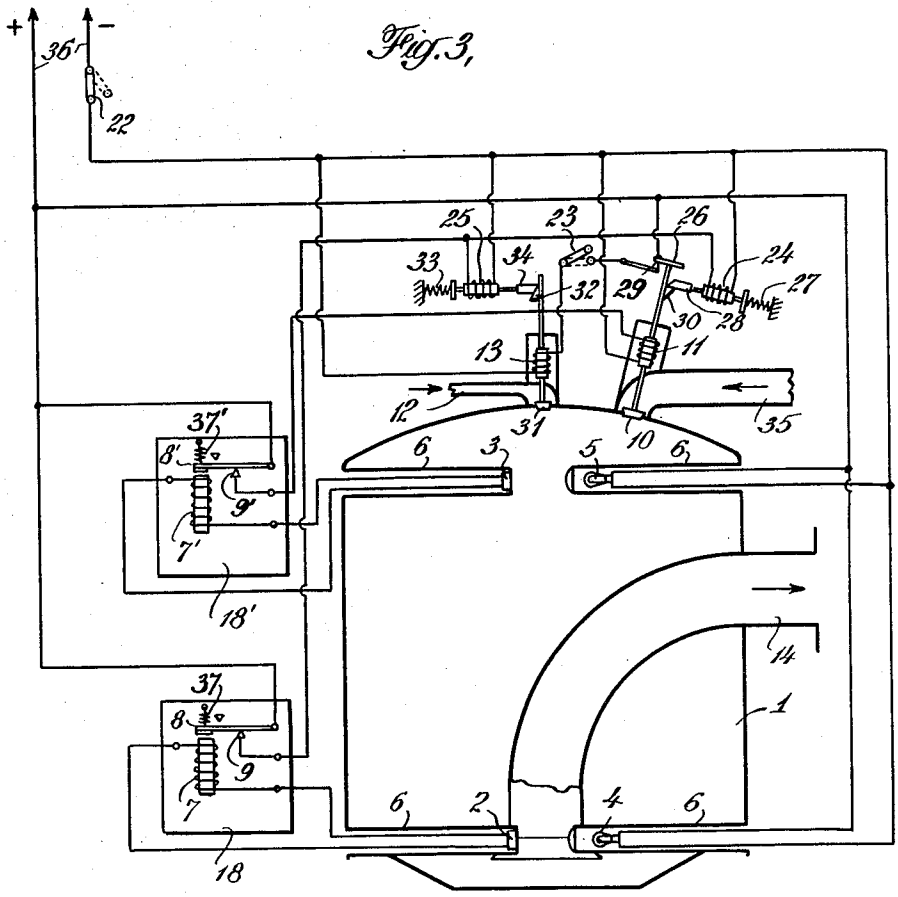
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Fig. 3,



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2,124,018

CONVEYER CONTROL

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2 Claims. (Cl. 302—53)

This invention relates to mechanism for controlling the conveyance of pulverulent or quasi-liquid material to and from a container such as a tank. More specifically, the invention is concerned with improved means for controlling automatically the valves of such a tank in accordance with the height of the material therein.

In accordance with the invention the valves which control the charging of the tank with the material, and with compressed air, are actuated by electrical impulses produced when the material in the tank reaches a predetermined high, low or intermediate level. These impulses result when the change in level of the material varies the dielectric constant of an electric condenser or changes the illumination incident on a photo-electric cell. The preferred mechanism includes certain locking devices by which the valves are constrained to operate in the correct sequence.

Heretofore it has been customary to control the valves of storage tanks either directly through mechanical linkage or indirectly through electric or pneumatic mechanism operated by the movement of a float or lever which follows the level of the material in the tank. In some installations where electrically conductive materials were stored in the tanks the material has been caused to bridge electrical contacts at the low and high levels on rising and to break the circuits on falling, and in this way to actuate electrically controlled valves. If the control mechanism were actuated pneumatically, instead of electrically, diaphragm-operated valves were substituted for magnetically-operated valves.

These previously known mechanisms introduced several disadvantages some of which were due to the fact that the specific gravity of the material usually varies from day to day and therefore any control which depends on the specific gravity of the material is unreliable. Furtheremore if the material is inclined to adhere to the walls of the tank the float or lever which actuates the control mechanism will operate too late.

In systems in which the change of pressure in the tank is employed to operate the control, dust from the material to be conveyed usually lodges in the diaphragm valve causing sluggish movement and sometime even stopping the movement altogether, so that it does not shut off the compressed air at the right time. Furthermore, an accumulation of material in the conveying pipe causes the pressure in the tank to be not always the same for the same level of material, from which it follows that the operation of the controls will not be in strict accordance with the level of the material.

All of the foregoing, as well as additional disadvantages of prior control arrangements are avoided by the present invention which provides greatly increased accuracy and reliability of operation, because in accordance therewith the operation of the necessary valves is controlled entirely by the actual level of the material in the tank and is independent of the conductivity of the material and its physical characteristics. Furthermore, the operation is entirely independent of the pressure in the tank within the range customarily used.

In order that the invention may be more clearly understood and carried into effect, two examples of arrangements in accordance therewith will now be described with reference to the accompanying drawings, in which:

Fig. 1 illustrates an embodiment of the invention in which the controlling impulses are initiated by the change of dielectric constant and electrostatic capacity of condensers;

Fig. 2 shows details associated with the arrangement of Fig. 1;

Fig. 3 is a modification of Fig. 1 in which photo-electric cells are substituted for the condensers.

Referring first to Fig: 1, the container comprising a tank 1 is provided with two pipes 35, 14 for conveying the required material to and from the tank. In operation the material may be fed to the tank through the pipe 35 under control of valve 10 until the tank is nearly full, when the valve 10 must be closed and the valve 31 opened. This allows compressed air to be introduced into the tank through pipe 12 forcing the material out through the delivery pipe 14.

The present invention contemplates the automatic control of the conveyance of material to and from the tank so that the tank will be filled to the proper height, then discharged and automatically refilled again. In general, the mechanism controlling the valves to secure this operation is as follows: Rings 15 and 16 mounted on insulators 17 each form one electrode of electrostatic condensers, the metal tank 1 forming the other electrode. These electrode rings may be of any suitable metal such as iron. When the material to be stored comes between the electrodes 15 and 16 and the tank, respectively, the dielectric constant of the condenser dielectric is changed and the relay circuits connected to the condensers are operated. Each of these condensers is connected respectively in a series circuit comprising electromagnet 7 or 7' of relay 18 or 18' and an

alternating current source 19 or 19'. This connection is diagrammatically illustrated in Fig. 2. The frequency chosen for energizing sources 19 and 19' will depend upon the design of the relays 18 and 18' and to some degree upon the nature (such as the dielectric constant) of the material in the tank. It will be seen that when the material enters or leaves the dielectric spaces between the ring electrodes 15 and 16 and the tank itself, the electrostatic capacity and therefore the capacitive reactance of the corresponding condensers will change, thus affecting the current flowing through the electromagnet 7 or 7' and causing the armature 8 or 8' of the relay to be attracted or released as the case may be. The initial impulse thus established will therefore control the associated electromagnets to open and close the valves in the correct sequence.

The operation of the system is as follows: Upon closure of the main switch 22 the electric power supply 36 is connected to solenoids 24, 25 energizing them and causing the latches 28, 34 to be drawn clear of the detents 30 and 32 of the valves 10 and 31, respectively. If there is no material between the tank and the condenser rings 15 and 16 the current flowing through the windings of the relays 18, 18' will be very small, allowing the springs 37, 37' to close contacts 8, 9, and 8', 9'. Closing of the contact 9' permits the solenoid 11 to be energized so that the valve 10 is opened to permit the material to enter the tank 1 through the supply pipe 35. Under these conditions the simultaneous closing of the contact 9 would cause the solenoid 13 to be energized thus also opening the compressed air line valve 31, were it not that switch 23 is initially open. Switch 23 should not be closed until a short time has elapsed to insure that the valve 10 has fully opened and in so doing has opened the contact between armature 26 and the contact 29 of valve 10. The opening of contact 29 breaks the circuit of the solenoid 13 so that air valve 31 will not open until the proper time, viz., after the tank is full. Valve 10 having been fully opened, the switch 23 may now be closed.

As the material accumulates in the bottom of the tank and reaches electrode 15 the electrostatic capacity of condenser 15 increases, thereby causing relay 18 to attract armature 8, breaking the circuit through contact 9 and releasing latches 28 and 34 to be pressed forward by compression springs 27 and 33, respectively. As the material further accumulates in the tank it will finally reach condenser 16 changing the electrostatic capacity thereof and causing armature 8' of relay 18' to be attracted, opening contact 9'. This deenergizes solenoid 11, and valve 10 closes by gravity augmented by the pressure of the incoming material upon the upper surface of the valve. The detent 30 in passing the latch 28 moves the latch to the right against the action of spring 27.

When valve 10 is fully closed and the contact 29 and armature 26 complete the circuit for solenoid 13, valve 31 opens, admitting compressed air to the tank.

It is evident that when valve 10 has closed, solenoid 11 will not be able to open the valve because detent 30 will bear upon latch 28. Similarly, valve 31 cannot close because detent 32 bears upon latch 34 which is urged against it by spring 33.

Inlet valve 10 being locked closed, and air valve 31 being locked open, the material in the tank is blown out through the pipe 14. This operation continues even when the level drops below the condenser ring 16 because valves 10 and 31 are locked. When the level of the material has fallen below the level of condenser ring 15 the original electrostatic capacity of this condenser is restored, releasing armature 8 of relay 18, which closes contact 9. This energizes solenoids 24, 25 causing latches 28, 34 to be drawn clear of detents 30, 32 permitting valve 10 to be opened by solenoid 11 and allowing valve 31 to close. The foregoing cycle of operation is then repeated automatically without the necessity of operating any switches or other manual controls. Obviously if the supply of material is to be continuous, or nearly so, two or more tanks may be operated side by side, one or more being filled while one or more are being emptied and the level of material in one tank may be caused to control the valves of another.

The embodiment illustrated in Fig. 3 is similar to that just described in connection with Figs. 1 and 2 except that in the system of Fig. 3 the initial impulse is not caused by a change in electrostatic capacity of a condenser. In this embodiment the initial impulse is effected by the diminution or interruption of light beams from light sources 4 and 5 which otherwise impinge upon photo-electric cells 2 and 3, respectively. The circuits from the photoelectric cells 2 and 3 control the relay circuits including windings 7 and 7' just as in the arrangement of Fig. 1 where the current in those windings is controlled by the change of reactance of the condensers 15 and 16. In this case, however, the action of the relays must be reversed because the presence of material at the level of the photo-electric cells causes a decrease, rather than an increase, in the current through the electromagnets 7 and 7'.

In employing photo-electric cells for the present purpose, it has been found especially convenient to accommodate the cells and their associated lamps in protective tubes 6, which permits removal of the photo-electric cells and the lamps when required, without the necessity of opening the tank.

I claim:

1. In a system for conveying pulverulent material, a tank, first and second control relays, first and second stationary control means secured at upper and lower portions of said tank, respectively, sensitive to the level of material in said tank and connected to said control relays to operate the same upon change of said level, a material-inlet valve actuated in response to said first control relay connected to said first stationary control means, an electrically-operated air-inlet valve actuated to open position in response to the operation of said material-inlet valve so that said material-inlet valve closes before said air-inlet valve opens, electrically-operated locking means associated with each of said valves serving to lock said material-inlet valve closed and said air-inlet valve open, and connections from said second control relay serving to release said locking means when the level of said material passes said second stationary control means.

2. A system according to claim 1, wherein said stationary control means comprises a photo-electric cell located on said tank and a source of light secured on said tank opposite to said photo-electric cell, said source of light and said photo-electric cell being enclosed within tubular members extending into said tank and opening on the exterior of said tank.

MIKAEL VOGEL-JORGENSEN.