

March 4, 1969

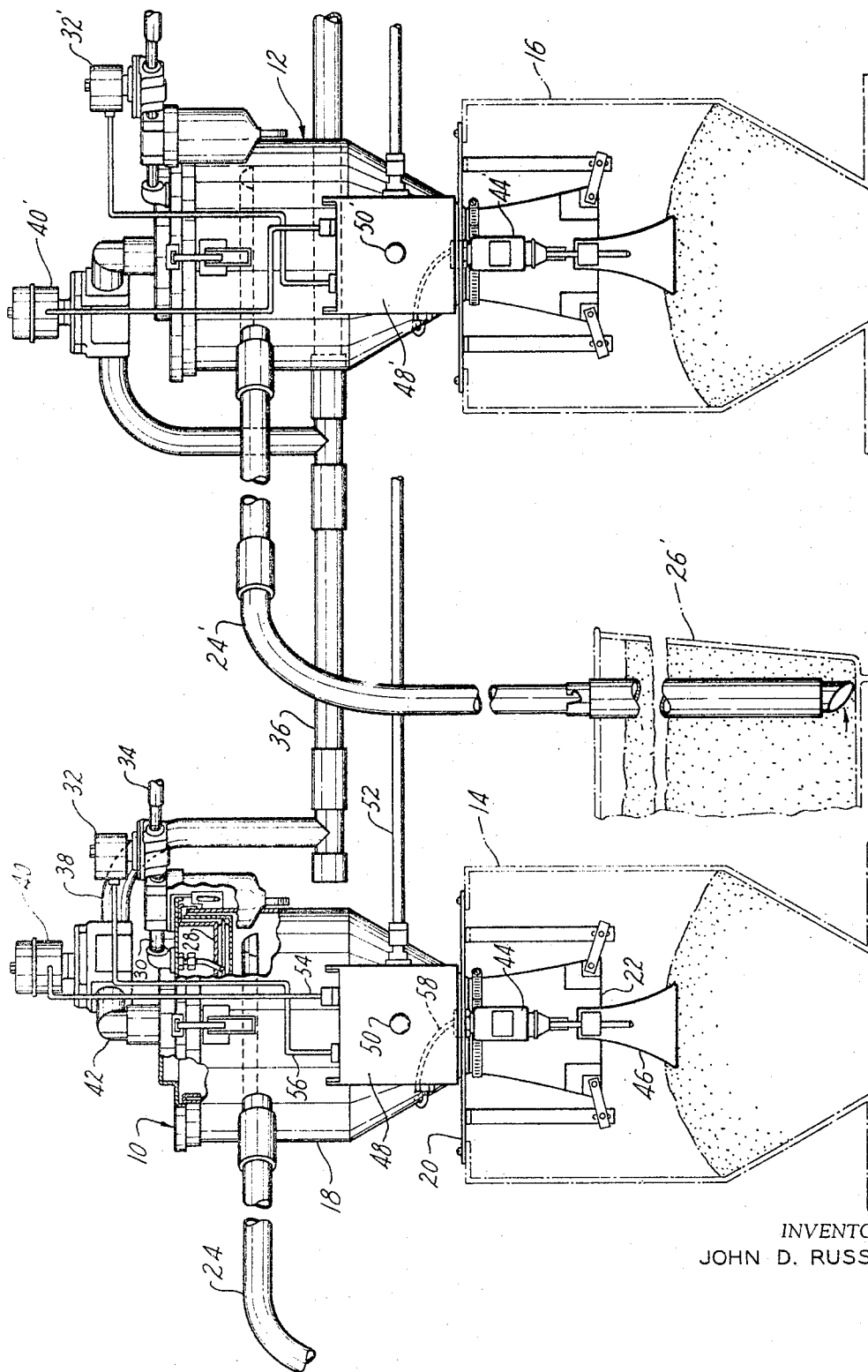
J. D. RUSSELL

3,431,026

MATERIAL TRANSPORTING DEVICE

Filed Nov. 30, 1966

Sheet 1 of 2



INVENTOR,
JOHN D. RUSSELL

March 4, 1969

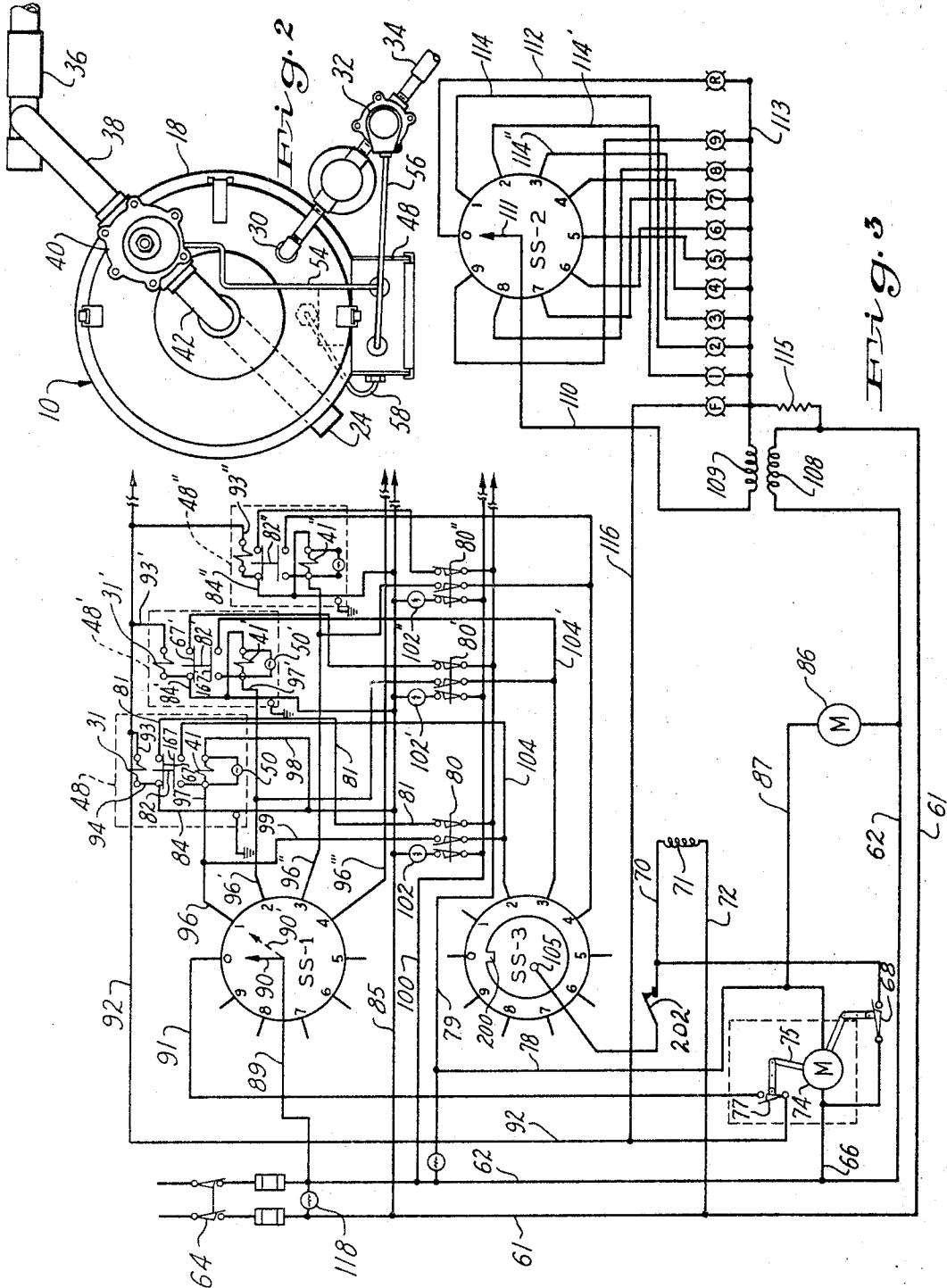
J. D. RUSSELL

3,431,026

MATERIAL TRANSPORTING DEVICE

Filed Nov. 30, 1966

Sheet 2 of 2



1

3,431,026

MATERIAL TRANSPORTING DEVICE

John D. Russell, 1361 Pittsburgh Road,
Franklin, Pa. 16323

Filed Nov. 30, 1966, Ser. No. 598,103

U.S. Cl. 302-27

10 Claims

Int. Cl. B65g 53/04, 53/28

ABSTRACT OF THE DISCLOSURE

A sequencing central vacuum loader system having a vacuum source and preferably a source of compressed air interconnected with multiple vacuum loaders so that the individual loaders are sequentially supplied with material followed by blow back air applied to the filters of all of the loaders simultaneously after which the sequential supplying of material recommences except that loaders with filled hoppers are by-passed in a fraction of a second with material being supplied only to those loaders not having filled hoppers.

This invention relates to a material transporting device and more particularly to a plurality of vacuum loaders for transporting finely divided or granular material from the storage bin or bins to hoppers of machines requiring a substantially constant supply of such material. The loaders are individually mounted on different machine hoppers and each loader unit is provided with a sensing device which is activated when the hopper becomes full. All of the hoppers are connected to a vacuum source through suitably controlled valves to provide a vacuum to each of the loaders in turn except when the hopper of a particular loader is full.

Such loaders are useful in many industries wherein it is common practice to transport finely divided, granular or pulverant material from a storage bin, through a feed pipe having an end embedded in the material to be transported, to a material receiving chamber by creating a vacuum in the receiving chamber so that the resultant air flow through the material in the feed pipe causes the material to be fluidized and entrained in the air stream. Since such transport is particularly necessary in the plastic industry, the following description will describe such application of the device of this invention but such description should not be taken as limiting the device of this invention to this field of use. Vacuum loaders of this type have nearly always been supplied with individual vacuum air flow producers usually of the fan type which are relatively inefficient and prone to various mechanical and electrical troubles because of the large number of separate units being operated. A positive displacement vacuum pump is much more efficient but relatively expensive and in the smallest practicable size is capable of conveying 1000 lbs. of material per hour of operation. It is difficult to justify the expense of individual positive displacement loaders on a number of low capacity machines. The problem thus posed for industries using vacuum loaders is that of finding a way to use the high capacity, efficient, positive displacement vacuum pump, without undue expense or inefficient utilization of its high capacity.

The material transporting device of this invention provides for using one or more high capacity, positive vacuum

2

pumps as a central source of vacuum air flow for a number of vacuum hoppers of relatively low capacity.

It is therefore an object of this invention to provide a control system for a plurality of vacuum loaders connected to a central source of vacuum air flow wherein the controls incorporate valves and control devices so interconnected that each hopper is provided with vacuum, for a predetermined length of time in sequence with all other loaders, in turn followed by renewed sequential vacuum application to each loader in turn excepting only that those loaders having filled hoppers are by-passed in favor of the next loader having an unfilled hopper.

These and other advantages and objects of this invention will become more readily apparent upon consideration of the following description and drawings in which:

FIG. 1 is a fragmentary side elevational view of two vacuum loaders constructed and interconnected according to the principles of this invention;

FIG. 2 is a top plan view of one of the vacuum loaders of FIG. 1; and

FIG. 3 is a schematic diagram of the electrical connections for a series of vacuum loaders interconnected according to the principles of this invention.

In FIG. 1 there is shown two vacuum loader units generally indicated at 10 and 12, respectively, of a type well known in the art and more completely described and illustrated in U.S. Patent 3,273,943, mounted on respective machine hoppers 14 and 16 which are in turn mounted on machines requiring a more or less continuous supply of finely divided material such as pulverized plastic. While only two vacuum loaders are shown in FIG. 1 the normal complement of loader units in the system of this invention is a total of nine although a greater or lesser number may be used without departing from the principles of this invention. All of the loader units in the system being alike, only the loader unit indicated at ten will be described in detail with reference numerals applied to the various parts. Where it is necessary to distinguish between the valves and switches of the various units the same reference numerals primed will be used on loader unit number 12 for analogous elements to those similarly numbered on unit 10 but unprimed. A third unit partially diagrammed in FIG. 3 has analogous elements double primed. The loader unit 10 comprises a hollow, generally cylindrical body 18 having a downwardly tapering, frusto conical, lower portion rigidly secured to a horizontally extending generally circular mounting plate 20 having a central opening through which the lower portion of body 18 extends in a hollow cylindrical lowermost portion. Rigidly secured about the outer surface of the lowermost portion is a resilient, tubular, downwardly, extending throat member 22 suitably shaped and mounted to remain closed whenever the pressure within the body 18 is lower than the ambient atmospheric pressure and to readily open whenever the pressure within the body 18 is equal to or greater than the ambient pressure.

The interior of the body 18 communicates through a suitable feed line 24 with a suitable feed tube having its lower end submerged in a body of finely divided, granular or pulverized solid material here shown as occupying the interior of a suitable material containing bin 26 partially shown as bin 26' in broken outline between the loader units 10 and 12.

The body 18 has an upward cylindrical portion within

which is located a generally disk shaped filter member 28 extending across the interior of the body member 18 and having a hollow interior communicating with a source of air (not shown) by way of tubular connections 30, a solenoid type air valve 32 and an air feed pipe 34 all as more completely described and shown in the above cited patent.

A vacuum manifold 36 communicating with a central source of vacuum (not shown) such as one or more high efficiency, high capacity positive displacement vacuum pumps, communicates with the upper portion of the interior of the body member 18 through a vacuum feed pipe 38, a solenoid type vacuum valve 40 and vacuum connections 42 suitably connected to the top of the body member 18 in air tight relation thereto.

Rigidly secured to the lowermost portion of the body member 18 and extending downwardly therefrom within the hopper 14 is a material level sensing switch 44, having a vertically adjustable material sensing element 46 mounted thereon and adjustable according to the height of material desired in the hopper 14 before the hopper 14 is considered to be full. The operation of such a vacuum loader is the same as that in the above cited patent and need be described here only as being characterized by application of vacuum through the connections 42 to the interior of the body 18 with air from within the body 18 traveling upwardly through the filter 28 to produce a subatmospheric pressure within the body 18 causing material to flow from the bin 26 through the feed line 24 into the body 18 in a manner well known in the art. After a suitable period of vacuum operation the vacuum is cut off and short blast of air through the connections 30 to the interior of the filter 28 performs the double function of removing dust from the filter 28 and raising the pressure within the body 18 at least to atmospheric pressure which causes the throat member 22 to open and allow granular material within the body 18 to flow downwardly into the hopper 14. After the material has flowed out of the body 18 vacuum is again applied to the connections 42 to the interior of the body 18. The cycle is repeated until the level of material in the hopper 14 rises to a predetermined level at which point the sensing member 46 is actuated to operate the level sensing switch 44 and interrupt the cycle of operation as will hereinafter more clearly appear.

Also mounted on a lower portion of the body 18 is a unit control box 48 within which are mounted control elements including switches and interconnections for control cables as well as a unit indicator lamp 50 to show when the unit is operating. Communicating with the box 48 and interconnected as will more fully hereinafter appear is a seven conductor cable 52 communicating with a control box (not shown), a two conductor cable 54 communicating with the vacuum solenoid valve 40, a two conductor cable 56 communicating with the solenoid air valve 32 and a two conductor cable 58 communicating with the level sensing switch 44.

FIG. 3 schematically illustrates the wiring and controls necessary to operate a total of nine loader units according to this invention. Suitable electrical energy is supplied through a pair of suitable fused conductors 61 and 62 having a disconnect 64 therein. The timing sequence of the control circuit is controlled by an electrical motor 74 having one side electrically connected by conductor 66 to the supply line 62 and the other side electrically connected to the other supply line 61 through a plurality of control functions as hereinafter described. Motor 74 rotates a pair of cams 75a and 75b in fixed relation with respect to each other and which respectively close normally open switches 68 and 77. Switch 68 when closed provides one manner for electrically energizing an operating coil 71 of a rotary stepper switch having 3 control decks SS-1, SS-2, and SS-3. Switch 68 is connected to conductor 66 and to a conductor 70 one end of which is electrically connected to one end of coil 71 with the

other end of coil 71 being connected to conductor 61. The stepper switch is of a known type of a construction that for each energization of coil 71 the rotating contacts will advance a single step and hold such position until after the solenoid has been deenergized, whereupon, reenergizing the solenoid will cause the switch to advance one more step. Each deck SS-1, SS-2, and SS-3, has ten contacts or positions.

The side of motor 74 opposite conductor 66 is electrically connected by a conductor 74 to a normally closed pole of a three pole manual switch 80, 80', 80" etc. on each of the nine loader unit connections. Since the controls and circuitry for each loader unit are connected in the same manner only the controls and circuitry for the first loader unit will be described and the same numbers primed will be used for the second loader and the same numbers double primed will be used for the third loader; it being realized that the same description applies to the remaining loaders although not shown or described. With the switch 80 in the normally closed or "on" position conductor 79 is connected via conductor 81 to one side of a normally closed pole 67 of a two pole double throw switch 82; the other side of pole 67 is connected to supply conductor 61 through conductors 84 and 85. The conductor 62 is also connected to one side of a vacuum pump motor 86 and the other side of motor 86 is connected to the conductor 78.

Conductor 62 via conductor 89 is electrically connected to a rotatable contactor 90 of deck SS-1. The zero position of deck SS-1 is electrically connected by a conductor 91 to one side of switch 77 and the other side of switch 77 is connected via a conductor 92 and a conductor 93 connected to one side of an operating coil 31 of the blow back solenoid valve 32. The other side of coil 31 is connected by conductor 94 to conductor 84. When the contactor 90 is stepped into the number one position as shown by the broken line representation 90' the conductor 62 is connected via a conductor 96 connected to the number 1 contact of deck SS-1 to one end of the operating coil 41 of the vacuum valve 40. The other side of coil 41 is electrically connected to conductor 84. An indicator lamp 50 is connected across coil 41 to indicate whenever coil 41 is energized and valve 40 open.

Contactor 90 steps in a clockwise direction to next energize the coil 41' and indicator lamp 50' through a conductor 96' connected to the number 2 position of deck SS-1 and thereafter on the next step contactor 90 energizes contact No. 3 of deck SS-1 to energize a coil 41" of the third loader through a conductor 96". Further units (not shown) are energized serially through contactor 90, contact No. 4 and line 96" for the first of such additional units while further additional units are thereafter similarly connected and similarly energized through contacts 5, 6, 7, 8, and 9 of the deck SS-1. In this manner loader units 1 through 9 are sequentially supplied with vacuum and the indicator lights thereof turned on to indicate the unit which is loading at a particular time. At the end of the complete cycle the contactor 90 again makes contact with the zero contact on deck SS-1 to provide simultaneous blow back of all filters of the nine units.

The conductor 62 is connected by a conductor 100 to another normally closed pole of all of the switches 80, 80', 80" etc., which poles are further connected to a lamp 102, 102' or 102" etc. respectively, with the other side of the lamp 102, and each analogous lamp is connected to the supply line 61 through conductor 85. Thus, when any of the switches 80, 80', 80" etc. is in the closed or "on" position its associated lamp will be energized to indicate that the unit associated therewith is connected for operation.

Level switch 44, as material reaches the desired height in the hopper 14 moves the switch 82 from the position shown in FIG. 3 to its other operating position to open

5

normally closed pole 67 and close a normally open pole 167 to connect a conductor 96 to a conductor 97 which is connected to the number 2 contact of a positive searching control deck SS-3. With the contactor 90 in the position 90' and the pole 167 closed, conductor 62 is connected to the number 2 contact of deck SS-3. Deck SS-3 has a common contact 105 connected to the wire 70 and thereafter to conductor 61 through coil 71 via conductor 72. Each electrical energization of the deenergized solenoid 71 advances the decks SS-1, -2 and -3 by one step. Deck SS-3 is provided with an insulating notch 200 which occupies the same step position on deck SS-3 as contactor 90 occupies in deck SS-1. The notch 200 insulates the contact of deck SS-3, with which it is juxtaposed, from the contact 105 to cause stepping of the decks SS-1, SS-2 and SS-3 as hereinafter described. The stepper switch has a normally closed reset switch 202 which is connected in conductor 70 ahead of the coil 71 which opens after each energization of the operating coil 71 to prevent energization of the coil 71 through the deck SS-3 so that the stepper switch is reset to receive an operating current pulse upon the subsequent closing of the switch 202.

The conductors 61 and 62 also connect opposite ends of a high voltage coil 108 of a step down transformer having a low voltage secondary coil 109 to provide electrical energy for a digital readout assembly of a type well known in the art having a display panel whereon any number, character or color associated with a single bulb will appear whenever that bulb is energized. Connected to one end of the low voltage coil 109 by a conductor 110 is a rotating contactor 111 of deck SS-2 of the rotary stepper switch. With the contactor 111 in the 0 contact position, as shown, the contactor 111' connects with a conductor 112 and through a bulb R to a line 113 connected to the other side of the coil 109.

When the contactor 111 is in position to connect with contact No. 1 of the deck SS-2 the contactor 111 is thereby connected to a conductor communicating through a bulb bearing the character 1 thereon to the line 113. In this manner the bulbs carrying the characters 1 through 9 are energized whenever the contactor 111 is in position to communicate with their respective contact and, since deck SS-2 is synchronized with decks SS-1 and SS-3, lights 1 through 9, when energized, show that the respective loader units 1 through 9 are connected as heretofore described with vacuum being applied thereto as long as the associated numeral appears on the display panel of the digital readout. A suitable voltage reducing resistance 115 is connected from the conductor 61 to lamp bearing a character F the other side of which lamp is connected by a conductor 116 to the conductor 92 to visually indicate blow back of the filters.

In operation (assuming all hoppers require material, all decks SS-1, SS-2 and SS-3 are in the number 0 position and that timer 74 has a 15 second cycle with switch 77 being closed for one second 10 seconds later than the closing of switch 68) the closing of the disconnect 64 energizes timer motor 74 and vacuum motor 86 through one pole of the normally closed switch 80 and the normally closed pole 67 of switch 82. Inasmuch as each loader control includes a normally closed switch 80', 80'' etc. corresponding to switch 80 connected to a common line 79 and a normally closed switch 82', 82'' etc. corresponding to switch 82 connected to common line 85, the timer 74 will be operative as long as any combination of switches 80, 80' etc., and 82, 82' etc. of a given single loader are in their normally closed position. If any switch 80, 80' etc. is open the associated loader will be removed from the circuit and if the switches 82, 82' etc. of all operating loaders are in engagement with contacts 167, 167' etc. the motors 74 and 86 will be deenergized since all controls 67, 67' etc. are open.

Energization of timer 74 for each cycle of rotation closes switch 68 for a period of one second and upon

6

the first closing of switch 68 coil 71 is energized and decks SS-1, SS-2 and SS-3 advance to the number 1 position, it being noted that insulating notch 200 also occupies the number 1 position. In the number 1 position the operating coil 41 of the first loader is energized through contact number 1 of deck SS-1 and the vacuum switch 40 is open to permit material to be loaded in the first loader until the deck SS-1 moves from the number 1 position due to stepping of the stepper switch occasioned by the timer motor 74. With the time cycle of timer 74 such loading will be for 15 seconds less the period of time required for operation of the various components of the controls. Although switch 77 is closed 10 seconds after switch 68 has closed since deck SS-1 is off of the zero position no control function occurs due to the closing of switch 77. In 15 seconds the stepping switch advances to position number 2 and the vacuum line of the second loader is opened and the second loader is provided with material. In this manner the stepper switch is advanced so that each loader receives material in sequence for the time period of the timer 74. As the stepper switch is indexed to the zero position the switch 77 is closed 10 seconds after the stepper switch has been indexed to the zero position and there are 5 seconds left for blow back of the filters. Thus, for the 10 second period the material in the last hopper which was receiving material has settled from being discharged into the hopper. When the switch 77 is closed under these conditions all the operating coils 31, 31', 31'' etc. are simultaneously energized due to their common energization from conductor 92 and their respective connections to the common conductor 85. The coils 31 are energized for approximately one second by the timer 74 so that after blow back of all the loaders has occurred substantially four seconds of time are left for the blow back material to settle in the hoppers. Thereafter the sequential loading will resume as before described.

It will be realized if the rate of consumption of material from the various hoppers varies the demand rate of the various hoppers will also vary. If it is assumed that at some time the first hopper is full and the stepper switch moves into the number 1 position the operating coil 41 of the vacuum switch 40 is not energized due to the by-pass path established by the closing of the normally open pole 167 by the level switch 44 engaging the material in the full first hopper. The closed pole 167 energizes the number 2 position contact of deck SS-3 and consequently operating coil 71 to cause the stepping switch to advance to the number 2 position to permit material to be supplied to the second loader. Since the by-pass circuit causes the stepper switch to operate 0.2 second after the closing of switch 68 there is no practical loss of material loading time. Inasmuch as each loader has a corresponding by-pass circuit any unit can be skipped when a by-pass circuit is energized by its corresponding level switch 44. Similarly if it is desired to remove the first loader from service switch 80 is opened and the first unit will be by-passed in the loading sequence by a by-pass conductor 99 connected through a normally open pole of the switch 80 to conductors 96 and 97. Such normally open pole of the switch 80 is closed when the switch 80 is opened to establish such by-pass circuit. Similarly each loader has a by-pass circuit so connected to its cooperating switch 80', 82' etc. In addition since the insulating notch 200 is always in the same position as contactor 90 no electrical feed back can occur. Thus, the stepper switch automatically by-passes any loader having a full hopper or which is removed from service by establishing the by-pass circuits; however, the advance of the stepper switch stops at the first loader requiring material to allow a full loading period for such loader after which the stepper switch moves to the next position at which a hopper requires material. With the control it is immaterial what loaders require material as the stepper switch will cycle through

all control positions to permit sequential loading of all loaders requiring material.

The foregoing description is of applicant's preferred embodiment; however, it is to be recognized that various control devices can be used which accomplish the same functions as those described.

One desirable modification is to provide the stepper switch with an additional synchronized deck having the same number of contacts with the respective contacts being connected directly to poles 167, 167' etc. respectively so that the vacuum solenoid circuit is isolated from the stepper by-pass circuit and thus present undesired pulsing of the coils 41, 41' etc. which can occur with the circuit described and shown. In the modification the connection between pole 162 and coil 41 is eliminated and a separate supply line connection is made to the extra deck.

Although the above control has been described as applied to a system having nine loader units, it is applicable to greater or lesser numbers of units without departing from the principles of this invention. In particular it will be noted that this invention provides a control system for a plurality of vacuum loaders in which: each loader has an equal loading time when all the loaders are in use and require material; any one of the loaders is selectively removable from use without interfering with the loading of any of the other loaders; each full loader is by-passed without interfering with the loading of any of the other loaders; each loader as it becomes full causes its loading cycle to be discontinued with material supplied to the next loader in sequence which requires material; a single vacuum source is used; a single filter cleaning cycle occurring after each loading cycle for all the loaders; and all such controlling occurring in a time cycle such that loaders not requiring material do not materially interfere with the loading of loaders requiring material. Further, if desired, other filter cleaning means can be energized during the portion of the cycle described as the blow back portion or, if desired, such filter cleaning portion can be eliminated and other filter cleaning methods employed. Although not shown, if desired, the coils 31, 31' etc. can be interconnected with switches 80, 80' etc. so that when a loader is removed from service by opening switch 80, 80' etc. no blow back of the filter of the associated loader occurs. Similarly, switch 82, 82' can be interconnected to the coils 31 to eliminate blow back of the filters of full loaders. In the control of this invention a common filter cleaning period is desired; however, it is recognized that filter cleaning of the individual filters can be obtained in sequence after the loading of individual hoppers or that filter cleaning of groups of filters can be provided.

What I claim is:

1. The method of supplying material comprising, conveying material to material receiving portions only of individual containers of a plurality of containers in a given repetitive sequence having substantially consecutive periods of time of the same duration,

discharging the material in said material receiving portions upon the completion of each conveying thereto into material retention portions of said individual containers, respectively,

discontinuing such conveying to particular material receiving portions of said plurality of containers when at least a desired amount of material is present within the respective associated material retention portions of said retention portions while continuing said conveying to the remaining material receiving portions of said plurality of containers for as long as the associated material retention portions of said retention portions have less than said desired amount of material present therein and which continued conveying is in a repetitive sequence which is the same as said first mentioned sequence except for the discontinued conveying to said particular material receiving portions,

and reestablishing such conveying to individual ones of

said particular material receiving portions when the associated material retention portions of said retention portions have less than said desired amount of material present in a repetitive sequence which is the same as said first mentioned sequence except for any herein defined discontinued conveying to particular material receiving portions.

2. The method as set forth in claim 1 in which said conveying is a pneumatic conveying from a common vacuum source.

3. The method as set forth in claim 1 in which cleaning of filter means associated with said material receiving portions, respectively, is done simultaneously and subsequent to the conclusion of each conveying sequence.

4. The method as set forth in claim 3 in which there is a lapse of time at the conclusion of each conveying sequence prior to said cleaning.

5. In the method as set forth in claim 1 additionally determining during each defined sequence which of said material receiving portions are said particular material receiving portions which determination is for a period of time substantially less than said periods of time of the same duration.

6. The method as set forth in claim 1 in which said periods of time are substantially less than the period of time required to supply at least said desired amount of material to any of said material retention portions.

7. In a system for supplying granular or pulverant material to a plurality of vacuum loaders each of which has a material receiving compartment communicating with a vacuum line which vacuum lines are connected to a single vacuum source and each of which lines has a normally closed valve therein with energizable means for obtaining opening thereof such that material is delivered into a receiving compartment when the valve associated therewith is open and each of which receiving compartments upon the completion of receiving material discharges the material received therein to an associated hopper and each of which hoppers has a material sensing means for de-energizing the energizable means of the valve associated therewith, the improvement comprising: control means connected to said energizable means to repetitively energize said energizable means in a given sequence having substantially consecutive periods of time of the same duration; said material sensing means being selectively operative in conjunction with portions of said control means, respectively, to prevent energization of an energizable means of said energizable means associated with a hopper having at least a desired amount of material therein and only for as long as at least said desired amount of material is therein; said control means including means for maintaining said repetitive energization of said energizable means in a sequence which is the same as said given sequence other than for the nonenergization of said energizable means the energization of which is prevented by a material sensing means of said material sensing means; said control means additionally being connected to energize a vacuum producing means only during said repetitive energizations of said energizable means; and said vacuum producing means constituting said single vacuum source.

8. In a system as set forth in claim 7 the further improvement in which said control means deenergizes said vacuum producing means when all of said material sensing means deenergize said energizable means of all of said valves.

9. In a system as set forth in claim 7 in which each of said receiving compartments has filter means for preventing material flow into the vacuum line associated therewith and means controlled by other energizable means for cleaning said filter means, the further improvement of connecting said control means to said other energizable means at the conclusion of each sequence of repetitive energization of said first mentioned energizable means.

10. In a system as set forth in claim 7 said means for

maintaining said repetitive energization being operable in a period of time substantially less than periods of time of the same duration.

References Cited

UNITED STATES PATENTS

3,099,492	7/1963	Mortimer	302—28
3,169,038	2/1965	Pendleton	302—59
3,219,394	11/1965	Moss et al.	302—59

3,273,943	9/1966	Russell	302—59
3,297,370	1/1967	Moriarity	302—59
2,861,840	11/1958	Powischill et al.	302—28 X

5

EVON C. BLUNK, *Primary Examiner*.
M. L. AJEMAN, *Assistant Examiner*.

U.S. Cl. X.R.

302—28, 59