United States Patent [19]

Hek

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[45] **Mar. 26, 1974**

[54] **MULTI-STATION LOADER FOR PARTICULATE MATERIAL**

[75] Inventor: **Homer C. Hek,** Alexandria, Va.

[73] Assignee: **Universal Dynamics Corporation,** Woodbridge, Va.

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[52] **U.S. Cl.** **302/28,** 302/59

[51] **Int. Cl.** **B65g 53/04**

[58] **Field of Search** 302/62, 28, 21, 59; 222/334

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Primary Examiner—Evon C. Blunk
Assistant Examiner—H. S. Lane
Attorney, Agent, or Firm—William D. Stokes

[57] **ABSTRACT**

A multi-station loader useful in the loading of particular solids entrained in a gaseous fluid is disclosed. During loading, a vacuum is drawn on a chamber which is connected to a source of material thus drawing the material into the chamber. During the blow back operation the direction of the air circuit which during the loading operation was drawing a vacuum on the chamber, is reversed thus cleaning the filter and chamber and allowing material to be discharged from its bottom into a material hopper. Loading is only allowed to occur when a level switch attached to the chamber indicates a need for material. The entire operation is controlled by a cylindrical array of switches and by a cam driven at two different speeds, dependent upon whether the loader is searching for a chamber calling for material or actually loading a chamber. Alternatively, the cam may be driven at the higher of the two speeds and stopped by magnetic braking.

10 Claims, 11 Drawing Figures

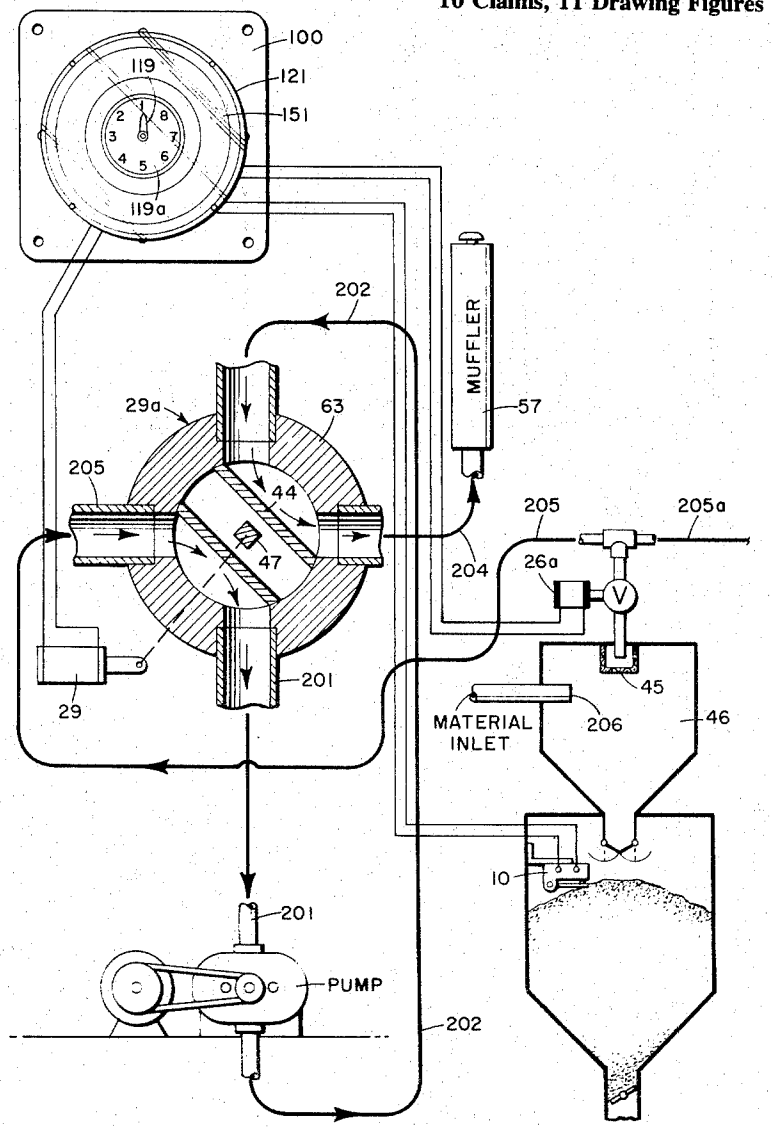


FIG. 1A

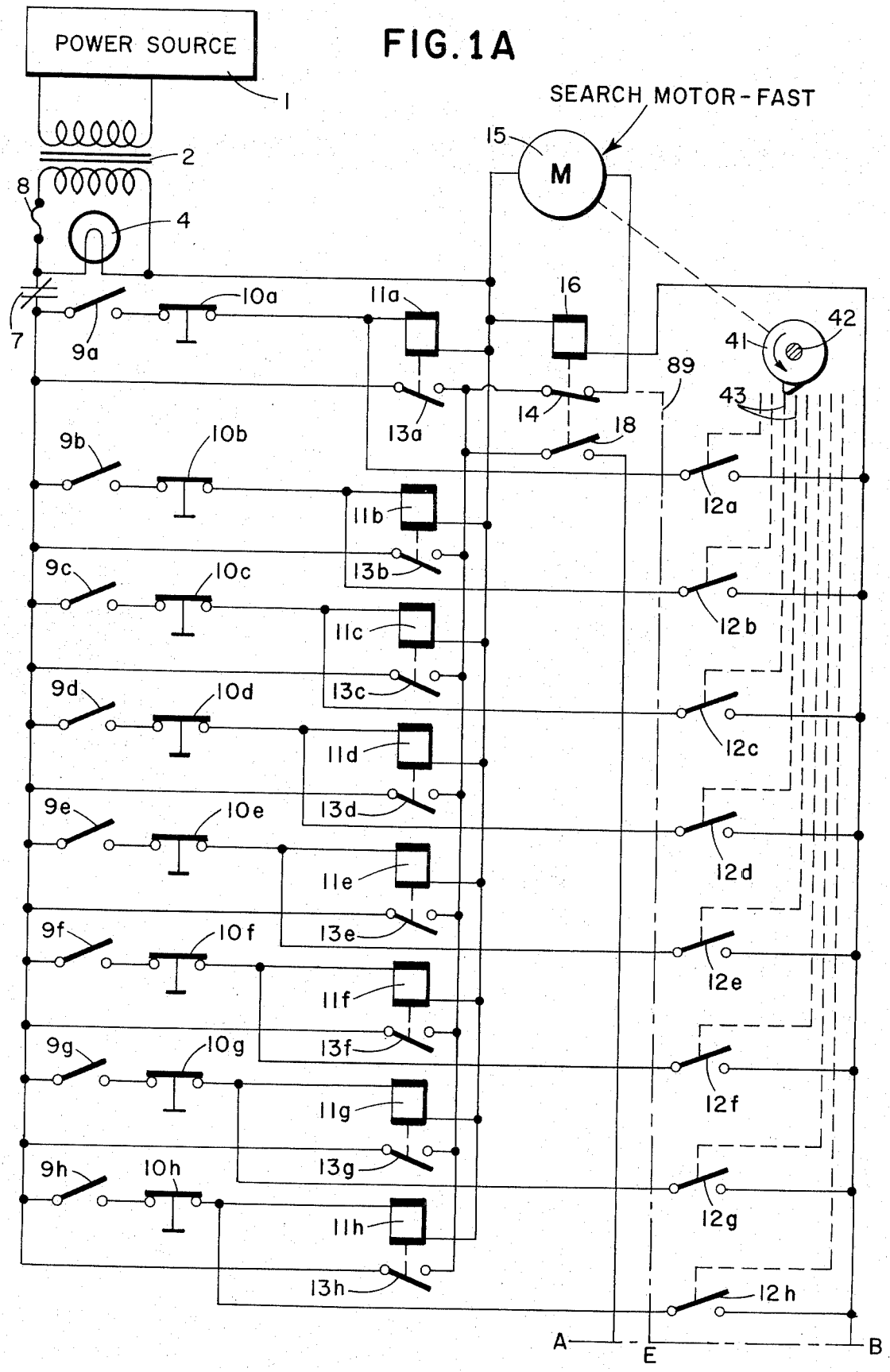

POWER SOURCE
1
2
8
4
7
9a
10a
11a
16
SEARCH MOTOR - FAST
15
M
42
41
89
43
14
18
13a
9b
10b
11b
12a
13b
9c
10c
11c
12b
13c
9d
10d
11d
12c
13d
9e
10e
11e
12d
13e
9f
10f
11f
12e
13f
9g
10g
11g
12f
13g
9h
10h
11h
12g
13h
12h
A
E
B

FIG. 1B

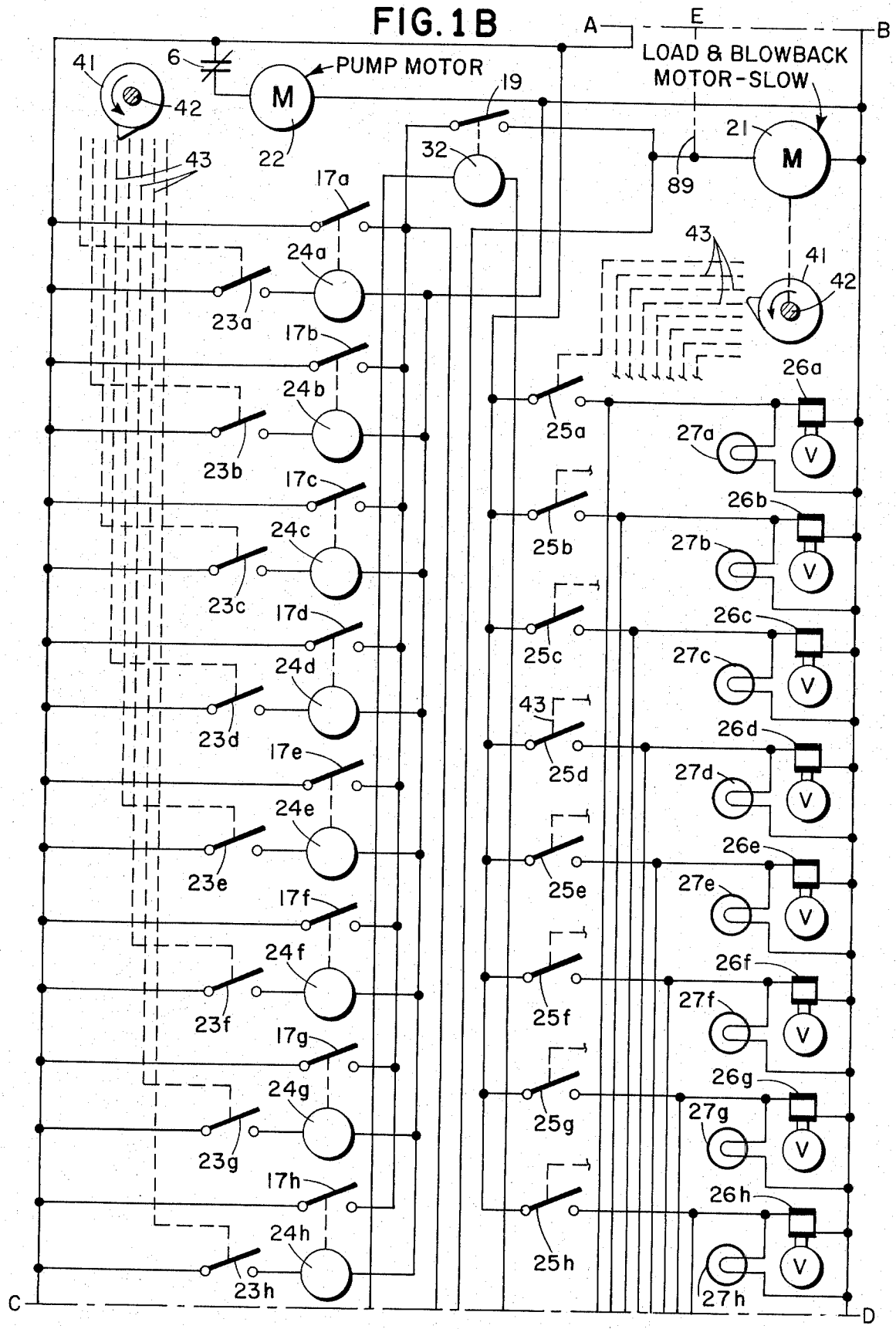

A
E
B
LOAD & BLOWBACK MOTOR-SLOW
PUMP MOTOR
M
41
42
6
22
19
32
89
21
43
17a
24a
23a
17b
24b
23b
17c
24c
23c
17d
24d
23d
17e
24e
23e
17f
24f
23f
17g
24g
23g
17h
24h
23h
25a
25b
25c
25d
25e
25f
25g
25h
26a
26b
26c
26d
26e
26f
26g
26h
27a
27b
27c
27d
27e
27f
27g
27h
V
C
D

FIG. 1C

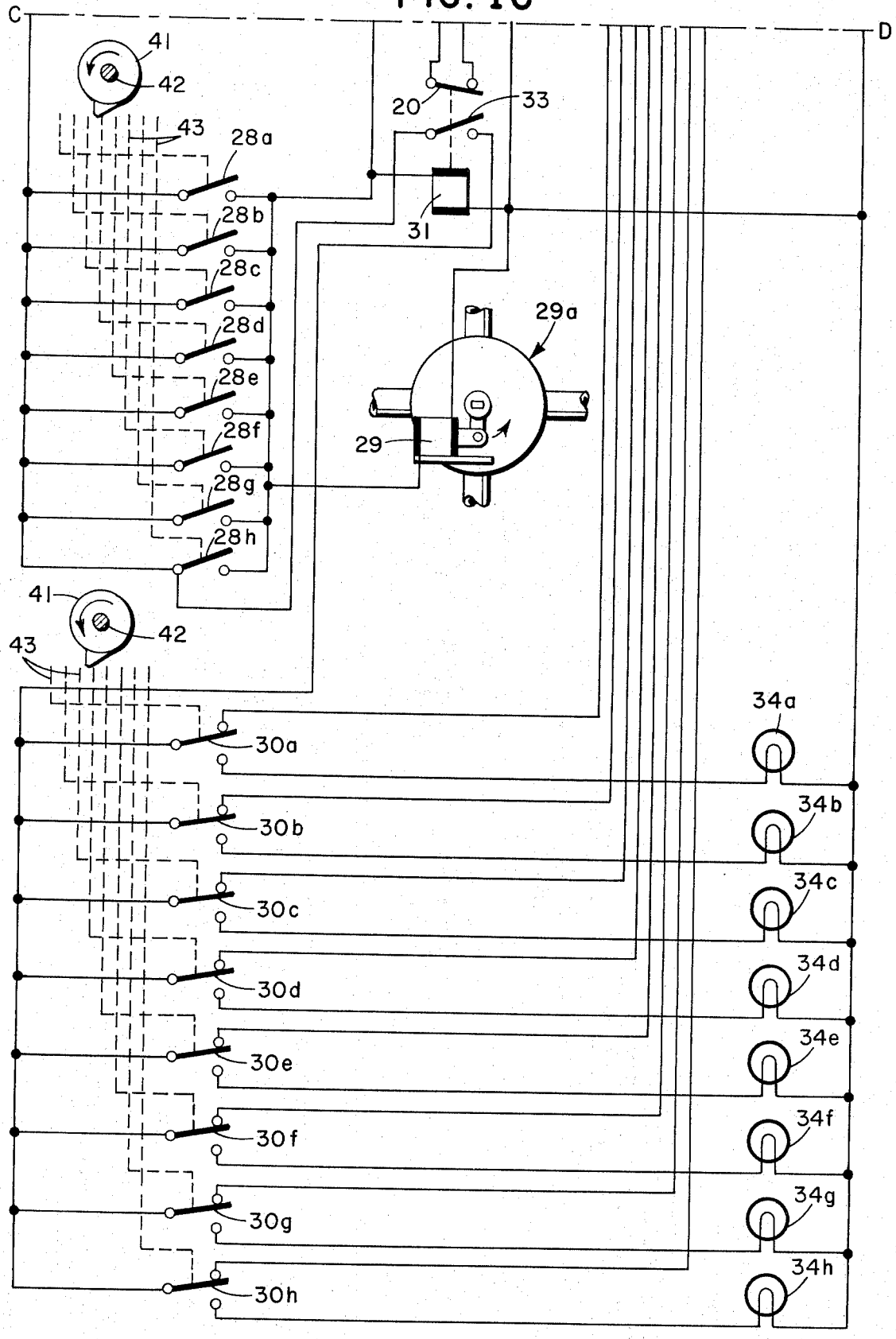

C
D
41
42
43
28a
28b
28c
28d
28e
28f
28g
28h
20
33
31
29a
29
41
42
43
30a
30b
30c
30d
30e
30f
30g
30h
34a
34b
34c
34d
34e
34f
34g
34h

FIG. 2

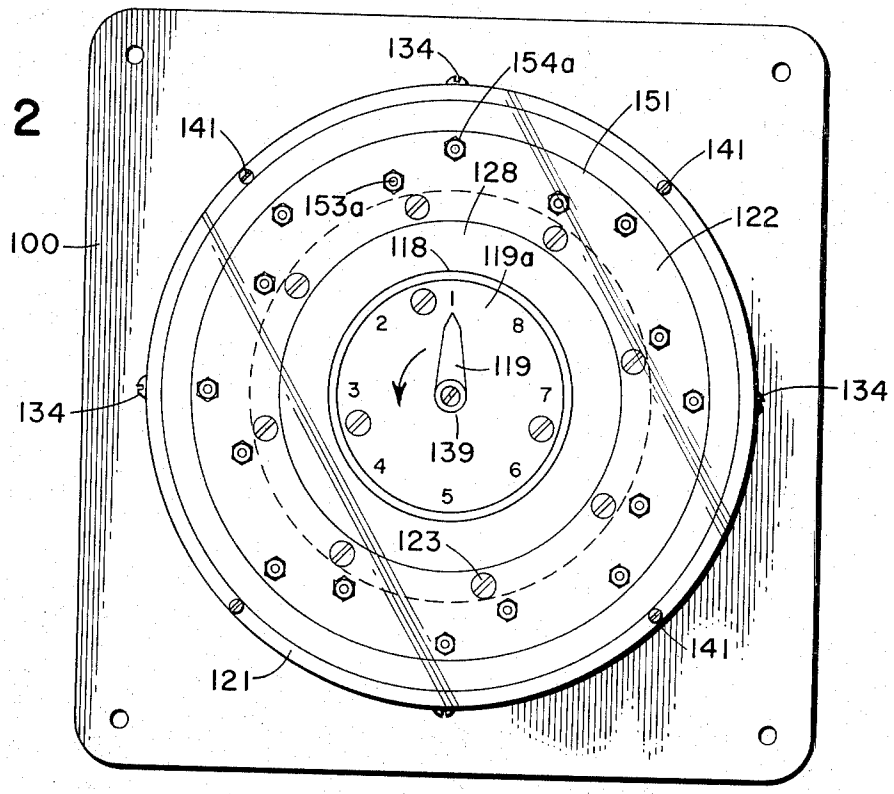
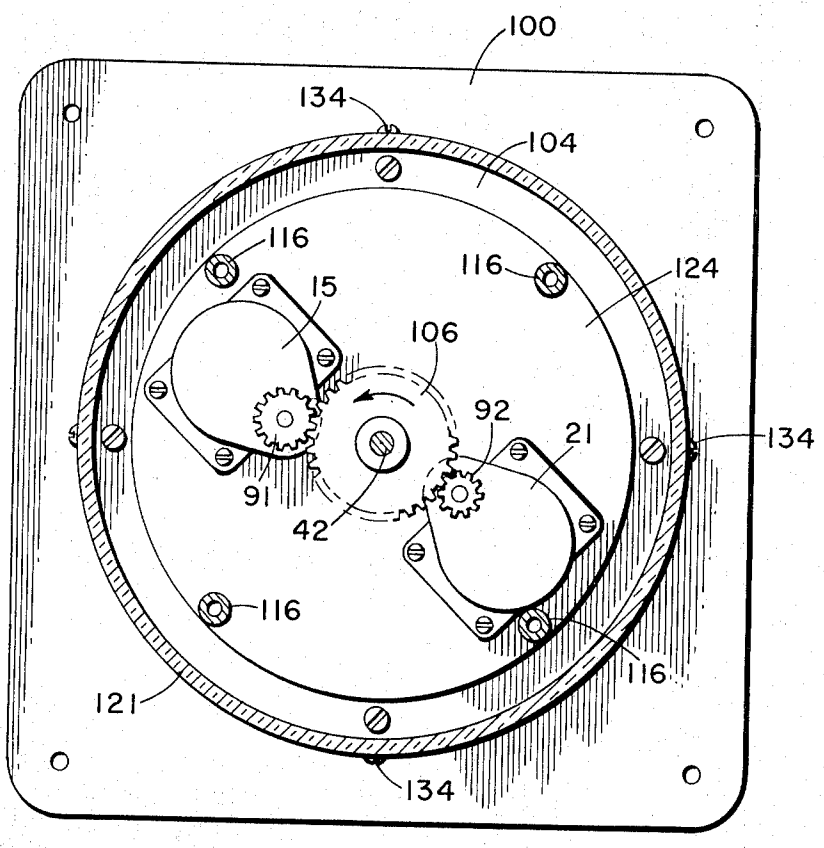

134
154a
151
141
141
128
153a
122
100
118
119a
1
2
8
119
3
7
134
134
139
4
6
5
123
141
121

FIG. 3


100
134
104
116
116
124
15
106
92
21
134
91
42
116
116
121
134

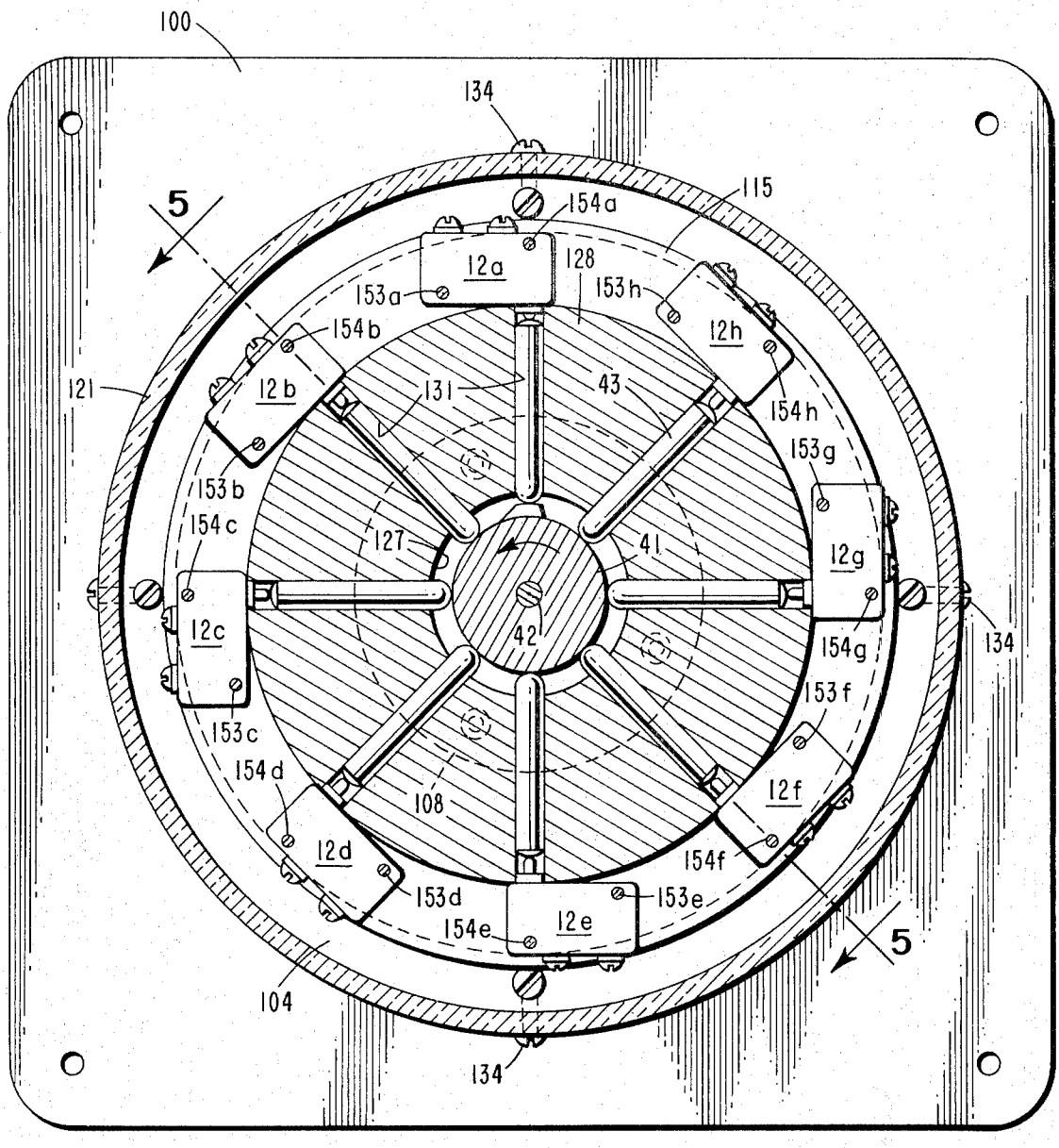

100
134
5
154a
115
12a
128
153a
153h
12h
154b
121
12b
131
43
154h
153g
153b
154c
127
41
12g
12c
42
154g
134
153f
153c
154d
108
12f
12d
154f
153d
153e
154e
12e
5
104
134

FIG. 4

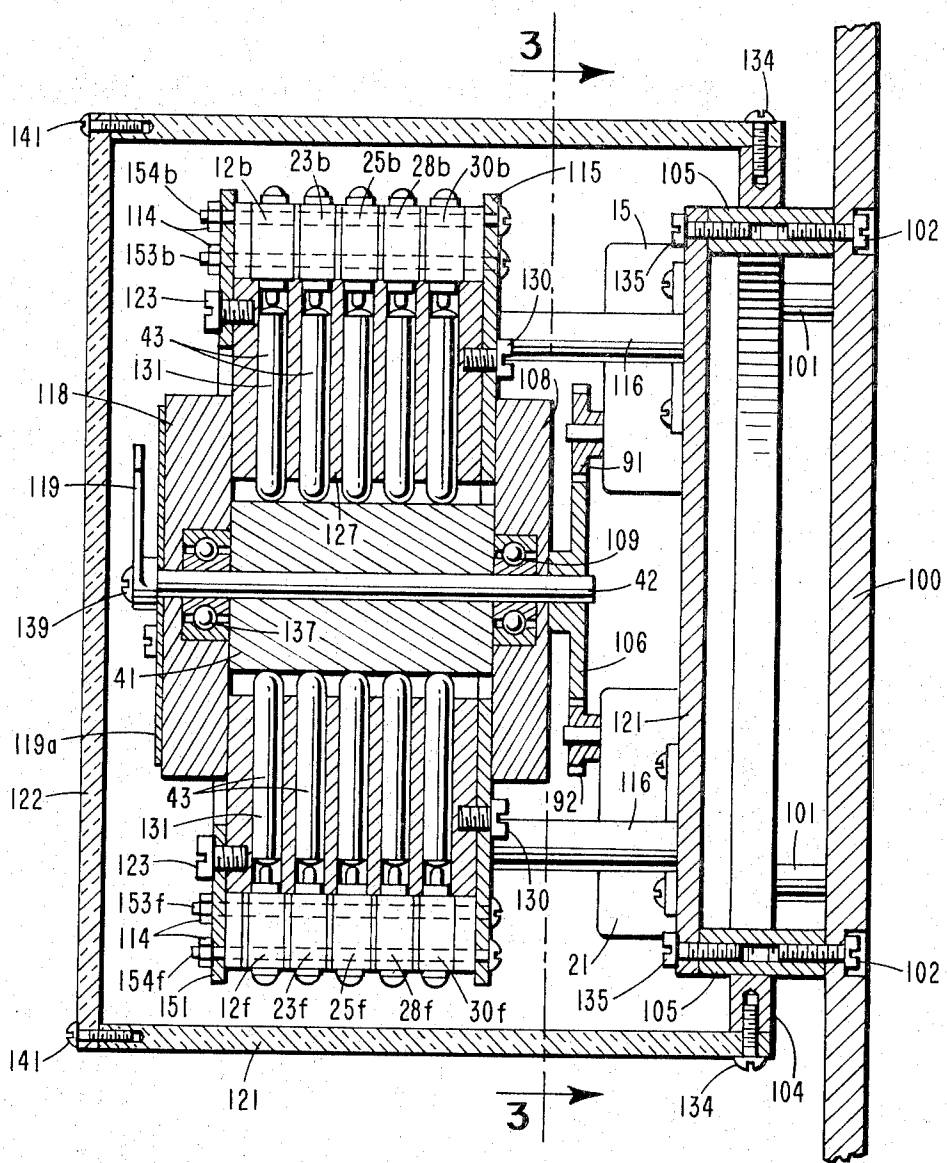

3
134
141
154b
12b
23b
25b
28b
30b
115
105
114
153b
15
102
123
130
135
43
131
101
118
108
116
91
119
127
109
42
100
139
137
106
41
121
119a
122
43
92
116
131
101
123
153f
130
114
21
102
154f
151
12f
23f
25f
28f
30f
135
105
141
121
3
134
104

FIG. 5

FIG. 7

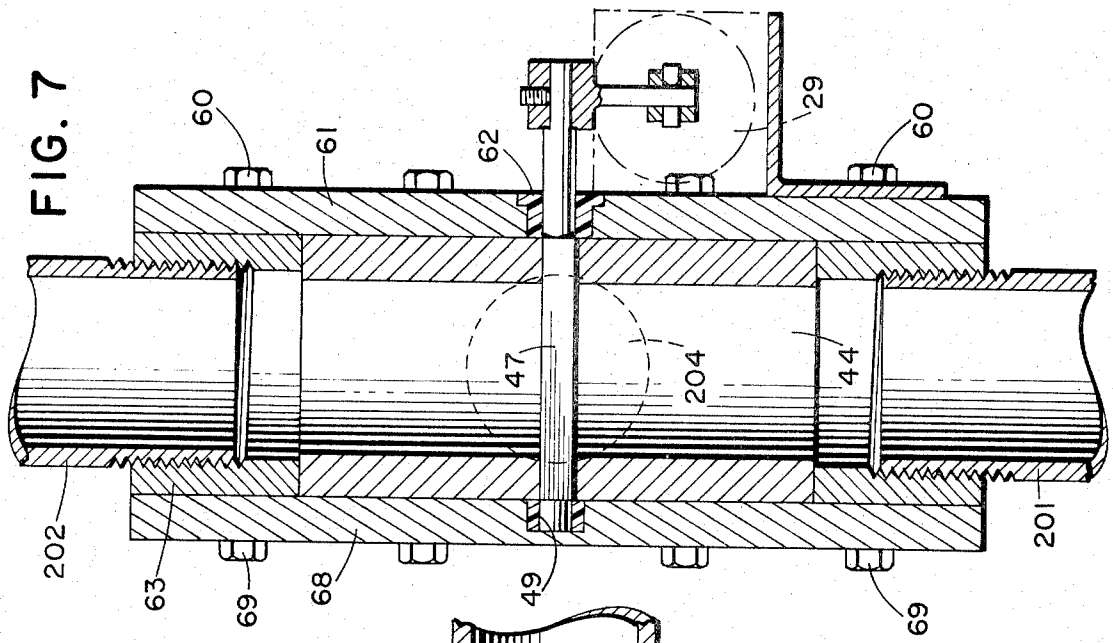

60
61
62
29
60
47
204
44
202
63
69
68
49
69
201

FIG. 6

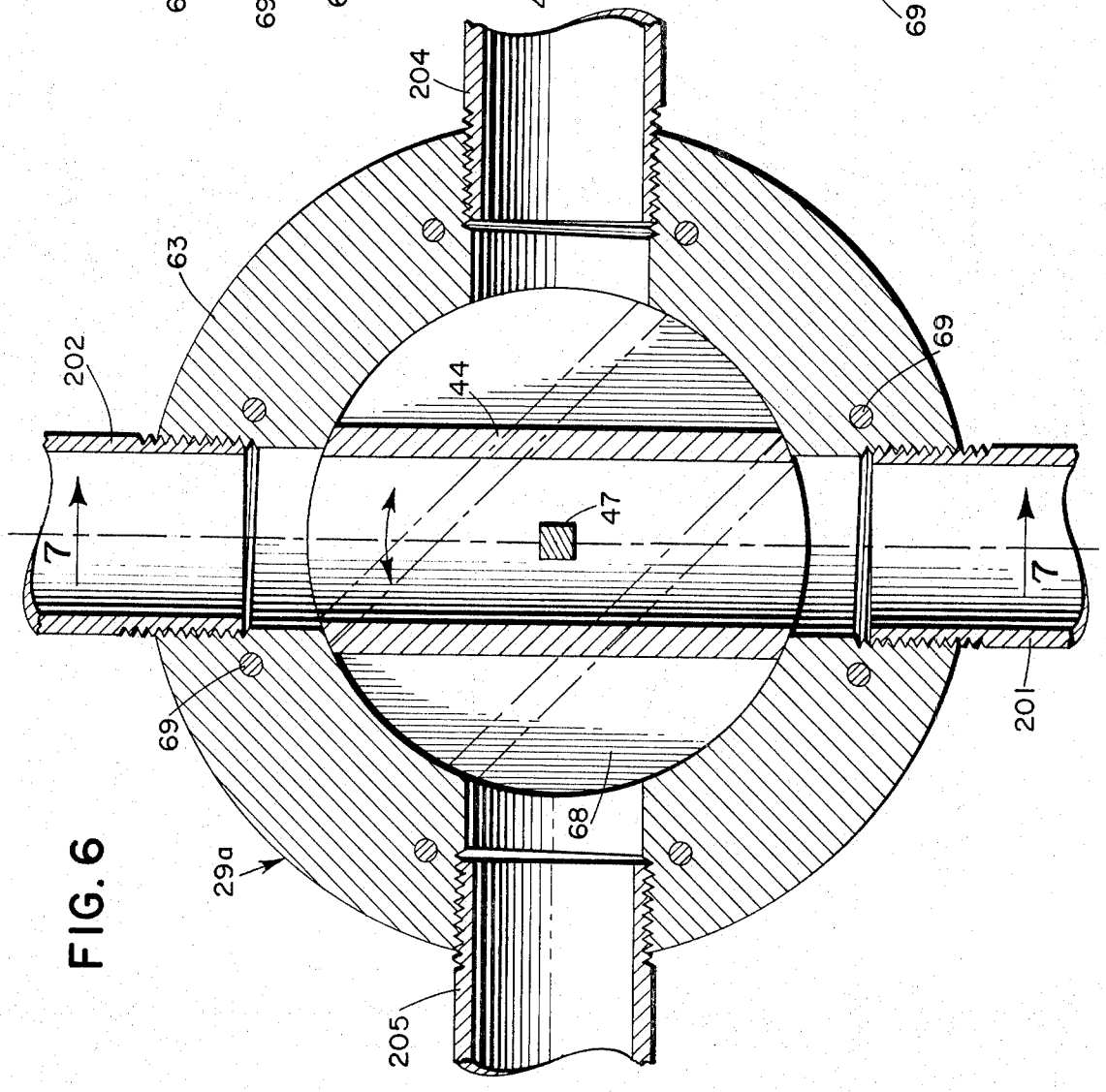
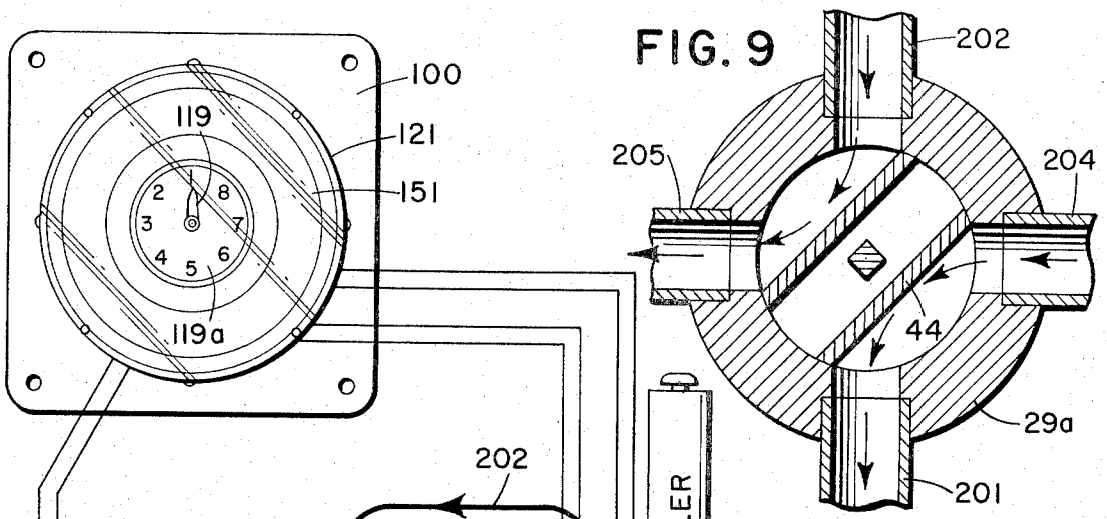

204
63
69
202
44
47
7
7
69
68
201
29a
205

FIG. 9


202
205
204
44
29a
201

100
119
121
151
2
8
3
7
4
5
6
119a
202
MUFFLER
57
29a
63
205
44
47
204
205
205a
26a
V
29
201
45
MATERIAL
INLET
206
46
10
201
PUMP
202

FIG. 8

MULTI-STATION LOADER FOR PARTICULATE MATERIAL

The present invention relates to an improved method and apparatus for the vacuum loading of particulate material and more specifically to a new and improved method and apparatus wherein the particulate material is sequentially fed to a plurality of stations where it is collected and unloaded into a hopper which feeds this material to a device which consumes the material at an uneven rate.

In conventional systems, material is moved pneumatically through a material line into a chamber. Pneumatic drive is provided by a vacuum pump which is connected to the chamber through a vacuum line. In order to prevent the material from entering the vacuum line, a filter is provided at the point where the vacuum line connects with the chamber.

When the vacuum is drawn, material is drawn into the material line, and travels to the chamber, where it enters near the top and falls by gravity to the bottom of the chamber. After a predetermined time period, the vacuum pump stops, causing the weight of the material to open the bottom of the chamber, thus allowing the collected material to drop out into a hopper from which the material is consumed at an uneven rate. Operation of this material dump function is thus actuated by the loss of vacuum in the chamber. Finally, it is necessary after each cycle to reverse the air flow and clear the filter by electrically reversing the pump and blowing back through the vacuum line.

This type of loader is commonly used to fill the hopper of a material user such as a drier. A level switch is used to start the loading operation when the level in the hopper reaches a predetermined low level.

A more sophisticated version of the loader employs a single vacuum pump and associated control to load, in sequence, several stations, each equipped with identical vacuum chambers and filters.

In such an arrangement, the loader selects a station and loads it for an adjustable period of time. The loading time is controlled by a timer and after the loading operation has been completed dumping occurs. It then automatically proceeds to the next station, and if the switch indicates a low level, loads it. After this station is loaded, it then proceeds to the next station, thus loading the various stations until the cycle is completed.

Upon completion of the entire cycle of stations, the vacuum pump is stopped. The pump is then run briefly in reverse, thereby blowing back all the filters at once. All these functions are controlled by a single timer motor driving a cam shaft with a cam for each function on each station.

Although it is possible to arrange for each station to be blown back immediately after filling, this would entail the use of an additional cam for each station, and would result in a great deal of lost time. Another disadvantage of separate blow-back of each station in this type of system is the additional wear and tear on the pump motor due to starting and stopping of the pump.

Multiple station systems of the type described above suffer from several distinct disadvantages. Effectiveness of the blow-back operation is hampered by the fact that the pump has to clean the filters by blowing back all of them at the same time. On the other hand, if each station is blown back separately, the additional

starting and stopping of the pump causes a severe deterioration of its useful life.

Another disadvantage of this type of system is the time wasted by the loader as it cycles through a station which does not need to be loaded.

Accordingly, it is an object of this invention to provide a vacuum loader with a plurality of loading stations which does not waste an excessive amount of time while cycling through a filled hopper. This is accomplished through the use of a two-speed timer to control the entire cycling operation. Alternatively, a single speed timer operating at the higher of the two speeds could be employed if it is used in conjunction with magnetic braking. The two speed timer operates at one speed while loading and blowing back on each station, and switches to a higher speed while it is searching for another station which needs loading. When it finds a station that needs loading, it then switches to the slow motor and proceeds in the loading operation. Thus, unlike conventional, single, slow speed timer systems, where, even when a station did not need to be loaded, the timer spent the equivalent period before going on to the next station, the new system searches at a much higher speed than can be used for loading and thus a station not needing to be loaded is passed very quickly resulting in a great saving of time.

Alternatively a single high speed motor can be used to move the cam at the higher of the speeds. It is still used to actuate the same switches. When a station is to be serviced, a magnetic brake is applied, thus allowing a station to be loaded or blown back. The motor is of the type with a built in brake, which is urged into braking contact with the armature of the motor by a spring. However, during operation of the motor, the magnetic field formed by the current flowing in the coils of the motor exerts a force on the brake and thus maintains it in its disengaged position, until the current is stopped, whereupon the motor is stopped immediately by the brake. A motor which would perform this purpose would be, for example, the 25 R.P.M. motor marketed under the tradename Dayton, stock number 3M257.

It is a further object of this invention to blow back each station separately without the necessity of starting and stopping the pump. This is accomplished by the use of a vacuum pressure diverter valve which reverses the air flow through the system. Thus the separate blow back of each station is accomplished without the attendant excessive wear and tear on the pump that would result from stopping and restarting it.

Reference is now made to the drawings accompanying the application.

FIGS. 1A, 1B and 1C, taken together are a schematic representation of the electrical control system of the present invention;

FIG. 2 is a front elevational view of the search module assembly of the present invention.

FIG. 3 is a transverse sectional view of the search module assembly, taken along lines 3—3 of FIG. 5;

FIG. 4 is a transverse sectional view of the search module assembly;

FIG. 5 is a longitudinal sectional view of the search module assembly along lines 5—5 of FIG. 4;

FIG. 6 is a transverse sectional view of the vacuum pressure diverter valve;

FIG. 7 is a longitudinal sectional view of the vacuum pressure diverter valve showing actuation of the valve by its operator solenoid;

FIG. 8 is a schematic representation of the system of the present invention;

FIG. 9 is a schematic representation of the air flow circuit within the vacuum pressure diverter valve during the blow back part of the cycle of the system illustrated in FIG. 8.

Referring now in greater detail to the drawings, FIGS. 1A, 1B and 1C taken together and joined at lines A–B, and C–D form a complete schematic diagram of the electrical control circuit of the search module.

In the single motor arrangement, the slow motor would be removed and the electrical connection shown as broken line 89 illustrated in FIG. 1A and B would be added.

Power to the machine is supplied by power source 1, connected to transformer 2 which supplies the system with a control voltage of 110 volts. Pilot light 4 indicates when the unit is energized. Control circuit protection is provided for by fuse 8. Overload protection is provided by circuit breakers 6 and 7.

A single pole switch, of which switch 9*a* is an example, performs the function of activating its corresponding station. If the switch is open, the station will be disabled and will not be loaded. When switch 9*a* is closed, however, the circuit is now connected to hopper fill switch 10*a*. If the hopper fill switch is closed, thus indicating a need for material, current is sent to the coil to relay 11*a*, closing its normally open contacts 13*a*. The coil of relay 11*a* is connected in parallel with the contacts of search switch 12*a*. When relay 11*a* is energized, its contacts 13*a* send current to normally closed contacts 14 of relay 16 thus passing the current to search motor 15.

Referring to FIGS. 1, 4 and 5, microswitches 12*a*–12*h*, 23*a*–23*h*, 25*a*–25*h*, 28*a*–28*h* and 30*a*–30*h*, are mounted on bolts 153*a*–153*h* and 154*a*–154*h* which are fastened to circular plates 151 and 115. The push buttons of the microswitches are depressed by push rods 43 situated in the guide bores 131 of body 128. Cam 41 is mounted on armature 42. push rods 43 are depressed by the cam-armature combination as it rotates inside a central bore 127 in body 128.

Search motor 15 drives the armature of the search module assembly, illustrated in FIGS. 3 and 5, at the faster of its two speeds. The higher speed is attained due to the fact that the driving gear 91 used by the search motor in driving the armature is larger than the corresponding timer motor gear 92.

When cam 41 mounted on armature 42 closes the normally open contacts of search switch 12*a* current is sent to the coil of relay 16. Relay 16 is then activated thus opening its normally closed contacts 14 and closing its normally open contacts 18. The opening of contacts, 14, stops the search motor 15. The closing of contacts 18 supplys the rest of the system with operating current.

Due to the cam's shape, normally open switches 23a and 25a are closed which is their position for loading. The pump is thus started and begins pulling a vacuum on the system.

When microswitch 23*a* is closed, current is sent to the coil of load timer 24*a*. The contacts 17*a*, of load timer 24*a* receive current from the closed contacts 18 of relay 16 which is activated during this part of the operation. Valve 26*a* must be open for loading to occur. Alternatively, it might be noted here that valve 26*a* may be put in the material line. During loading, therefor, switch 25*a* is closed, sending current to the coil of loading valve 26*a*, which may be a common diaphragm type valve, for example, the type manufactured under the trademark ASCO, No. X821580, and also its pilot light 27*a*. This pilot light is located at a remote point on the surface of the loader unit where it is easily visible to the operator of the unit.

When timer 24*a* is activated, its contacts 17*a* close and send current to the contacts 20 of relay 31. The contacts 20 apply current to the slow motor 21. It will be appreciated that motor 21 would not be used in the system of my invention where a single motor unit is utilized. This motor drives the armature slower due to the fact that its gear 92 is smaller than the corresponding gear 91 of the fast motor. The slow motor then moves the cam 41 a short distance into position for the second part of the operation. As the cam moves slowly forward, the predetermined cut in the cam allows the push rods 43 to open switch 25*a*. Thus, switch 25*a* denergizes the loading valve which was opened at the time the search motor 15 located mircoswitch 12*a* and activated switches 23*a* and 25*a*.

At the same time that switch 25*a* is opened, cam 41 closes switch 28*a* sending current to solenoid 29 which rotates the air diverter valve causing the air circuit to reverse, thus blowing back the filter 45 in the vacuum hopper 46. The same current which drives the solenoid 29 actuates relay 31, opening its normally closed contacts 20. This diverts the current to contacts 19 of timer 32. The coil of timer 32 is also fed current from switch 28 at this time. This causes the slow or timer motor 21 to wait till blow back has completed its job.

Due to the construction of the valves, it is necessary to have switch 20 energize all the valves of the load cycle except the one being blown back in order that they stay closed. When relay 31 is activated, its normally open contacts 33 are closed sending current to two-position microswitch 30*a*. In this position, blow back pilot 34*a* will light up. Contacts 33 of relay 31 send current on a parallel circuit to all station valves. This operation is necessary due to the fact that the valves used require current to remain closed while pressure is applied and also require current to open under a vacuum.

When timer 32 times out, its contacts 19 close, thus causing the slow motor 21 to rotate the armature 42 moving the cam 41 to a position allowing all microswitches to be open.

Assembly of the module is accomplished by mounting spacers 101 to the top side of base 100. The cover base ring 104 is then mounted on spacers 101. Spacers 105 are mounted on the base plate with bolts 102. Mounting plate 124 is mounted on spacers 105 with bolts 135. The relays, the motors and other parts of the electrical control circuit are mounted on plate 124. The motors are mounted allowing their gears 91 and 92 to engage the drive gear 106. Spacers 116 are then mounted on plate 124. Plate 115 is then mounted on spacers 116. Body 128 is then mounted on plate 115 with screws 130. Next, cam 41 is installed in armature 42. The two bearings 109 and 137 are mounted on armature 42. The cam and armature are then inserted in body 128. Gear 106 is mounted on armature 42 between plate 124 and plate 115. The bearing 109 and

holding plate **108** are installed on the armature before the gear goes on. Bearing **137** is then mounted on the armature along with top bearing holding plate **118.** Station indicator **119** is then secured by bolt **139** to the end of the armature which has a threaded hole at its end. A dial plate **119***a* is secured to the top surface of bearing bolder **118** for the purpose of visually indicating which loading station is operating.

To install push rods **43** you insert them into bores **131** drilled into body **128.** Microswitches **12***a*–**12***h*, **23***a*–**23***h*, **25***a*–**25***h*, **28***a*–**28***h* and **30***a*–**30***h* are then mounted on bolts **153***a*–**153***h* and **154***a*–**154***h* which are secured to plate **115** and ring **151.** When installing the microswitches, it is necessary to make sure that their activating pins are over the bores **131** in body **128,** thus insuring their activation by push rods **43.** Ring **151** is secured to body **128** by screws **123.** Bolts **153** and **154** are secured with nuts **114.** The assembly is now ready to be wired as illustrated in FIG. **1.** After being wired, transparent cover **121** is placed over the assembly and is secured by screws **134** which go into threaded holes in the module cover **104.** The top, module cover lid **122,** is then secured to module cover **121** by screws **141** which are screwed into threaded holes on the module cover **121.**

Referring now to FIGS. **6, 7, 8** and **9,** valve **29***a* is designed to allow selection of the direction in which air will flow in duct **203.**

During loading, the solenoid **29** which operates the valve **29** is not actuated and the air circuit is that indicated in FIG. **8.** Of course, it is understood that the air circuit shown in FIG. **8** shows connections to only one of the loading stations. Duct **205A** goes to the remaining stations. Electrical connections from the search module assembly to the various remaining stations are also made in the manner illustrated in FIG. **8.** A vacuum is created inside chamber **46** and material is drawn through duct **206.** The vacuum acts through duct **201,** valve **29***a,* duct **205,** actuated and open valve **26** and ducts **203** and **206.** Material is thus drawn into the chamber where it collects and is discharged upon command. When the material collects to a predetermined point, thus indicating that there is no need for material, air is drawn out of the system through duct **204** and valve **29***a* to muffler **57.**

When it is desired to reverse the flow of air in the system to blow back the filter **45,** the operator of the valve, solenoid **29,** is actuated. This causes valve rotor **44** to change position, thus altering the air circuit. The air is drawn into the air circuit through muffler **57** and goes to chamber **46,** where blow back is accomplished.

In order to assemble the valve, bushing **62** is inserted into front plate **61.** The front plate **61** is then fastened to the valve body **63** by screws **60.** Shaft **47** is then inserted through rotor **44.** The rotor **44,** in turn, is placed in valve body **63** so that the shaft **47** is protruding through front end plate **61.** Rear bushing **49** is then inserted into rear plate **68.** Screws **69** are then used to fasten plate **68** to valve body **63.**

The multi-station loader as hereinabove described exhibits several advantageous features not found in prior art devices. It has a rapid search feature and thus decreases time lost between stations. Also unlike conventional systems, very little time is lost if a station does not need filling. For example, if in an eight station system one station is not calling for material, the loader will behave as a seven station system with a consequent further reduction in total time required to service the remaining stations. Additionally, the system described above saves wear and tear on the pump in that the pump does not have to be reversed for the blow back part of the operation. This also results in an additional contributing economy to the overall time saving.

It is understood that the form and design of my invention, as shown and described herein, are to be taken merely as exemplary of the same and that various changes and modifications in the shape, size and arrangement of the components may be made without departing from the spirit and scope thereof as defined in the appended claims.

What is claimed is:

1. A multi-station loader for loading material from a material source comprising:

a. a plurality of loading stations;

b. means for coupling said plurality of loading stations to said material source;

c. means for providing pneumatic drive, said means having intake and exhaust ports;

d. valve means having a first port coupled to the intake of said pneumatic drive providing means, a second port coupled to the exhaust of said pneumatic drive providing means, a third port coupled to said plurality of loading stations, and a fourth port, said valve means further including rotor means rotatable to a first position coupling the first port to the third port and the second port to the fourth port for directing said pneumatic drive and loading said loading stations and rotatable to a second position coupling the first port to the fourth port and the second port to the third port for reversing the flow of said pneumatic drive within said loading station and cleaning the station;

e. a loading valve for each of said plurality of loading stations, each of said valves having an input coupled to said means for providing pneumatic drive and an output coupled to its respective station;

f. switch means for detecting a need for material at each of said plurality of stations;

g. variable speed electrical timing means; and

h. control means responsive to the detection of a need for material by said switch means for actuating said loading valves, for varying the speed of said electrical timing means and for controlling said valve means.

2. A multi-station loader according to claim **1,** wherein:

said electrical timing means includes a cam, and said control means comprises an array of switches sequentially actuated by said cam.

3. A multi-station loader according to claim **1,** wherein:

said valve is positionable by a solenoid actuated by said control means.

4. A multi-station loader according to claim **1** wherein said control means includes an electrical circuit.

5. A multi-station loader according to claim **1** wherein said variable speed electrical timing means has a first speed for searching for a station requiring material and a second lower speed for loading said station.

6. A multi-station loader for loading material from a material source comprising:

a plurality of loading stations having means for receiving material from said material source;

means for providing pneumatic drive;

loading means associated with each of said plurality of loading stations for coupling said loading stations with said pneumatic drive providing means;

valve means coupled to both said pneumatic drive providing means and said loading means for directing said provided pneumatic drive to said coupled loading stations and drawing material thereto from said material source through said means for receiving material;

filter means at said coupled loading stations for preventing said drawn material from entering said pneumatic drive providing means;

detection means associated with each of said plurality of loading stations for detecting a need for material at each of said plurality of loading stations;

multiple speed timing means operational at a first scanning speed for searching for one of said plurality of loading stations having a detected material need;

control means responsive to the said detection means for actuating said loading means associated with said detected one loading station, said control means also for reducing the speed of said multiple speed timing means to a second slower speed for a predetermined time period required for loading the detected loading station, said control means also for actuating said valve means at the end of said predetermined load period for reversing said provided pneumatic drive for blowing back said loaded loading station and cleaning said filter means.

7. A multi-station loader according to claim **6**, wherein:

said timing means includes a cam coupled thereto, and

said control means comprises an array of switches sequentially actuated by said cam

8. A multi-station loader according to claim **6**, wherein;

said loading means is positionable by a solenoid actuated by said control means.

9. A multi-station loader for loading material from a material source comprising:

a. a plurality of loading stations;

b. means for coupling said plurality of loading stations to said material source;

c. means for providing pneumatic drive, said means having intake and exhaust ports;

d. valve means having a first port coupled to the intake of said pneumatic drive providing means, a second port coupled to the exhaust of said pneumatic drive providing means, a third port coupled to said plurality of loading stations, and a fourth port, said valve means further including rotor means rotatable to a first position coupling the first port to the third port and the second port to the fourth port for directing said pneumatic drive and loading said loading stations and rotatable to a second position coupling the first port to the fourth port and the second port to the third port for reversing the flow of said pneumatic drive within said loading station and cleaning the station;

e. a loading valve for each of said plurality of loading stations, each of said valves having an input coupled to said source of material and an output coupled to its respective station;

f. switch means for detecting a need for material at each of said plurality of stations;

g. an electrical timer;

h. a magnetic brake operatively connected to said electrical timer; and

i. control circuit means scanned by said timer for actuating said loading valves and applying the brake in response to a detection of a need for material by said switch means.

10. A multi-station loader for loading material from a material source comprising:

a. a plurality of loading stations;

b. means for coupling said plurality of loading stations to said material source;

c. means for providing pneumatic drive and drawing said material from said source to one of said plurality of loading stations;

d. filter means at said one loading station for preventing said material from entering said means for providing pneumatic drive;

e. a loading valve for each of said plurality of loading stations, each of said loading valves having an input coupled to said source of material and an output coupled to its respective station;

f. switch means for detecting a need for material at each of said plurality of stations;

g. an electrical timer;

h. a magnetic brake operatively connected to said electrical timer; and

i. control circuit means scanned by said timer for actuating said loading valves and applying the brake in response to a detection of a need for material by said switch means.

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