United States Patent [19]

Wise

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[45] **Aug. 26, 1975**

[54] **MATERIAL DISTRIBUTING SYSTEM**

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[73] Assignee: **Fiber Controls Corporation**, Gastonia, N.C.

[22] Filed: **May 4, 1972**

[21] Appl. No.: **250,248**

Related U.S. Application Data

[60] Division of Ser. No. 848,133, July 9, 1969, Pat. No. 3,671,078, which is a continuation-in-part of Ser. No. 694,268, Dec. 28, 1967, abandoned, Continuation of Ser. No. 561,579, June 29, 1966, abandoned, which is a continuation-in-part of Ser. No. 538,437, March 3, 1966, abandoned, which is a continuation-in-part of Ser. No. 444,885, March 2, 1965, abandoned, which is a continuation-in-part of Ser. No. 217,154, July 15, 1962, abandoned.

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

[51] **Int. Cl.** **B65g 53/36**

[58] **Field of Search** 302/28, 49, 59; 19/105

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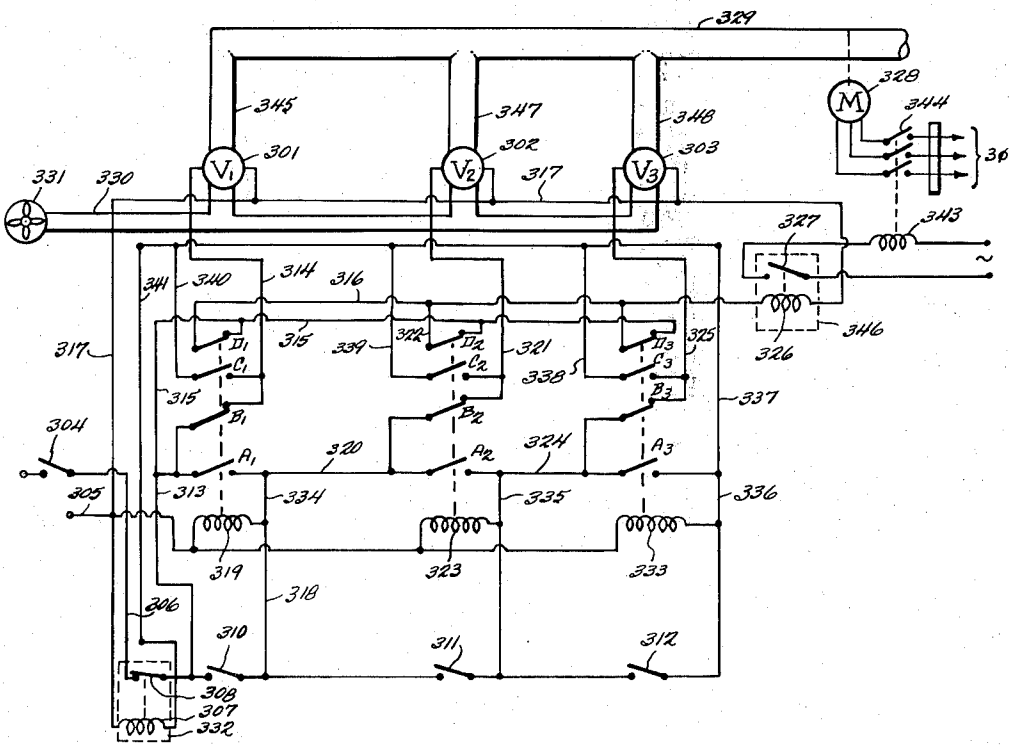
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Primary Examiner—Evon C. Blunk
Assistant Examiner—W. Scott Carson
Attorney, Agent, or Firm—Cushman, Darby & Cushman

[57] **ABSTRACT**

A system for distributing fibers pneumatically from a source to any of a plurality of distributors and electrical control circuitry for determining which distributors receive fibers in which order. Several electrical control circuits for sequentially checking each of the distributors in a system to determine which of them is demanding fibers and to sequentially satisfy the demands for fibers by opening valves associated with the distributors so that the air stream containing the fibers is drawn into a distributor, wherein the air stream and the fibers are separated, are disclosed. Also disclosed are a number of different distributors suitable for removing fibers from air streams.

4 Claims, 9 Drawing Figures



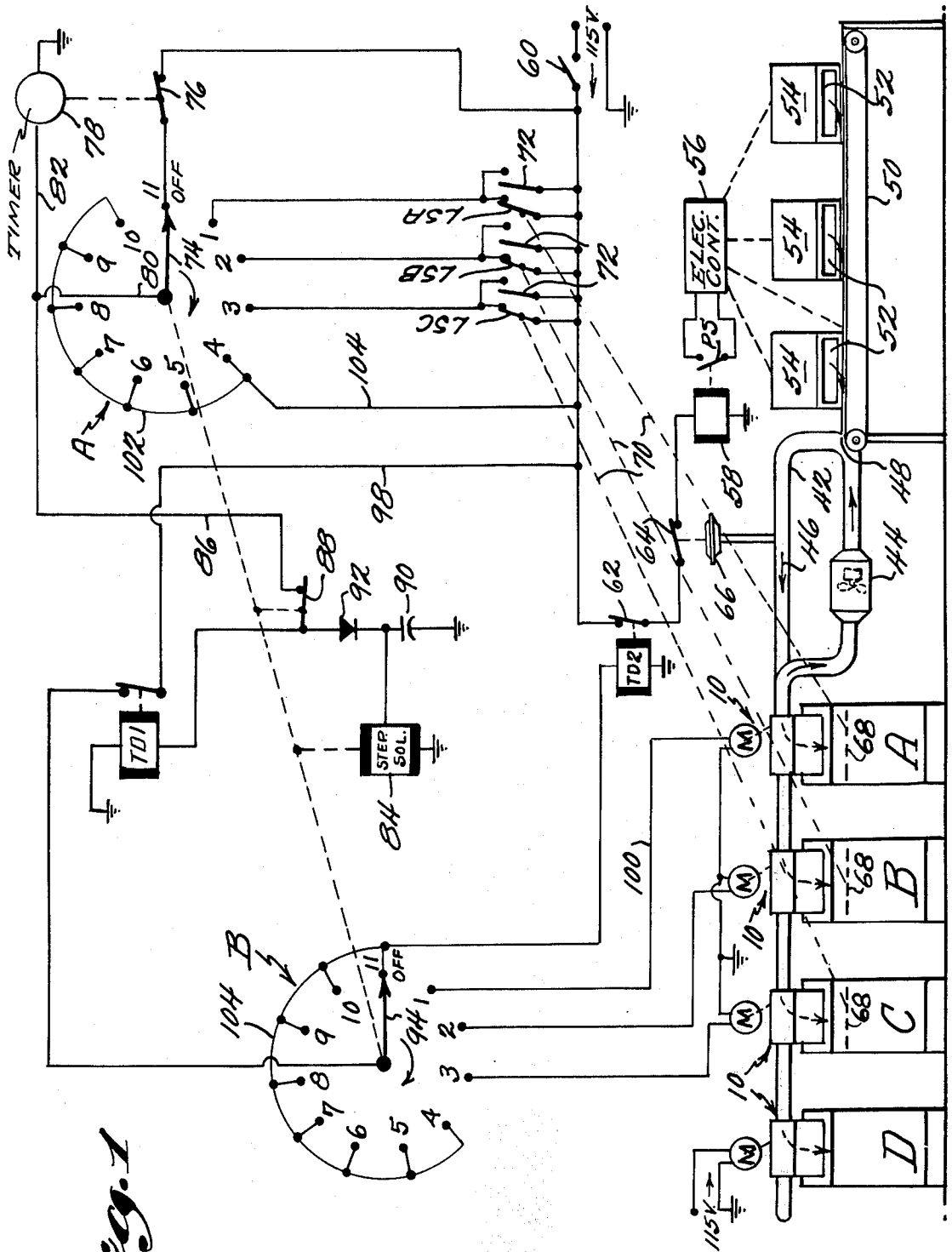
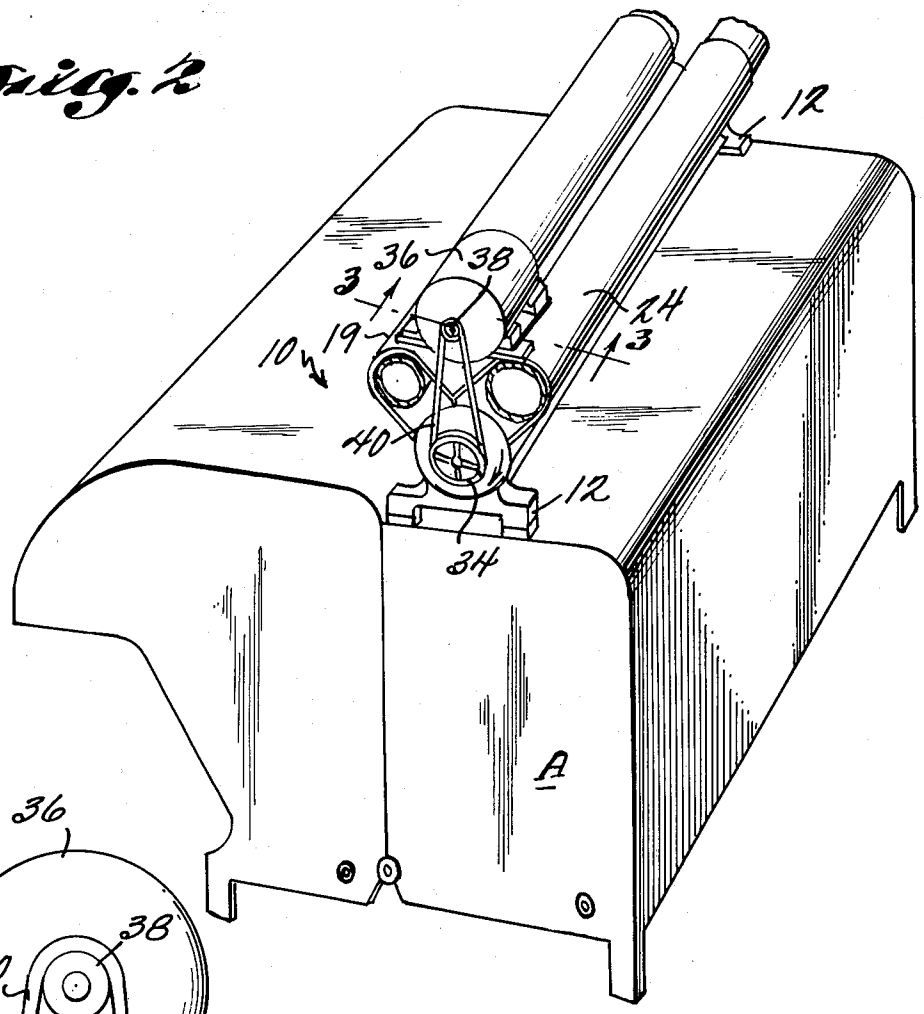

TIMER
OFF
A
B
TD1
TD2
STEP SOL.
ELEC. CONT.
PS
LSA
LSB
LSC
115V
A
B
C
D

Fig. 1

Fig. 2


12
36
38
34
24
13
10
19
40
12
34
A

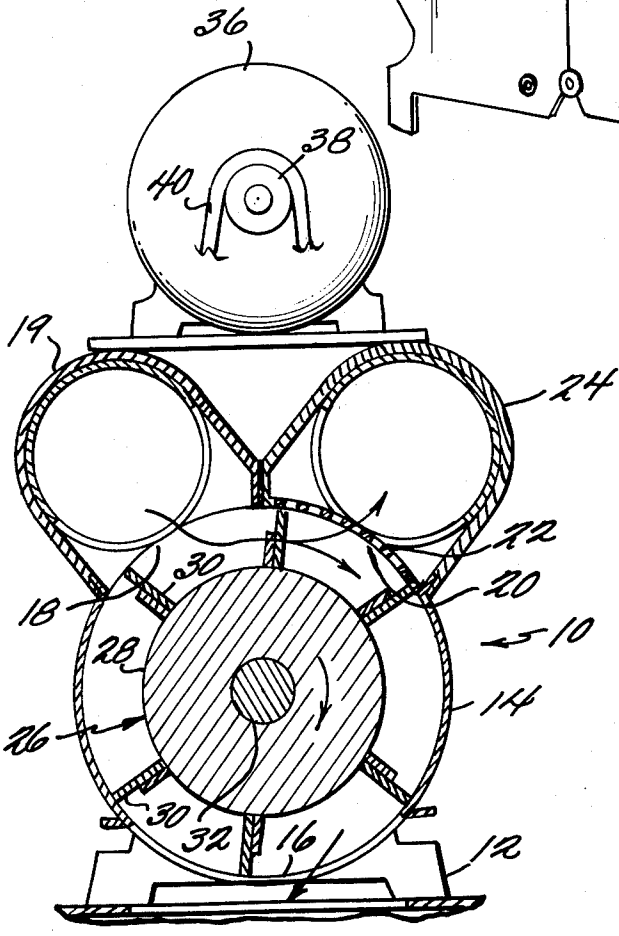

36
38
40
19
24
22
30
20
18
10
28
14
26
30
32
16
12

Fig. 3

FIG. 4

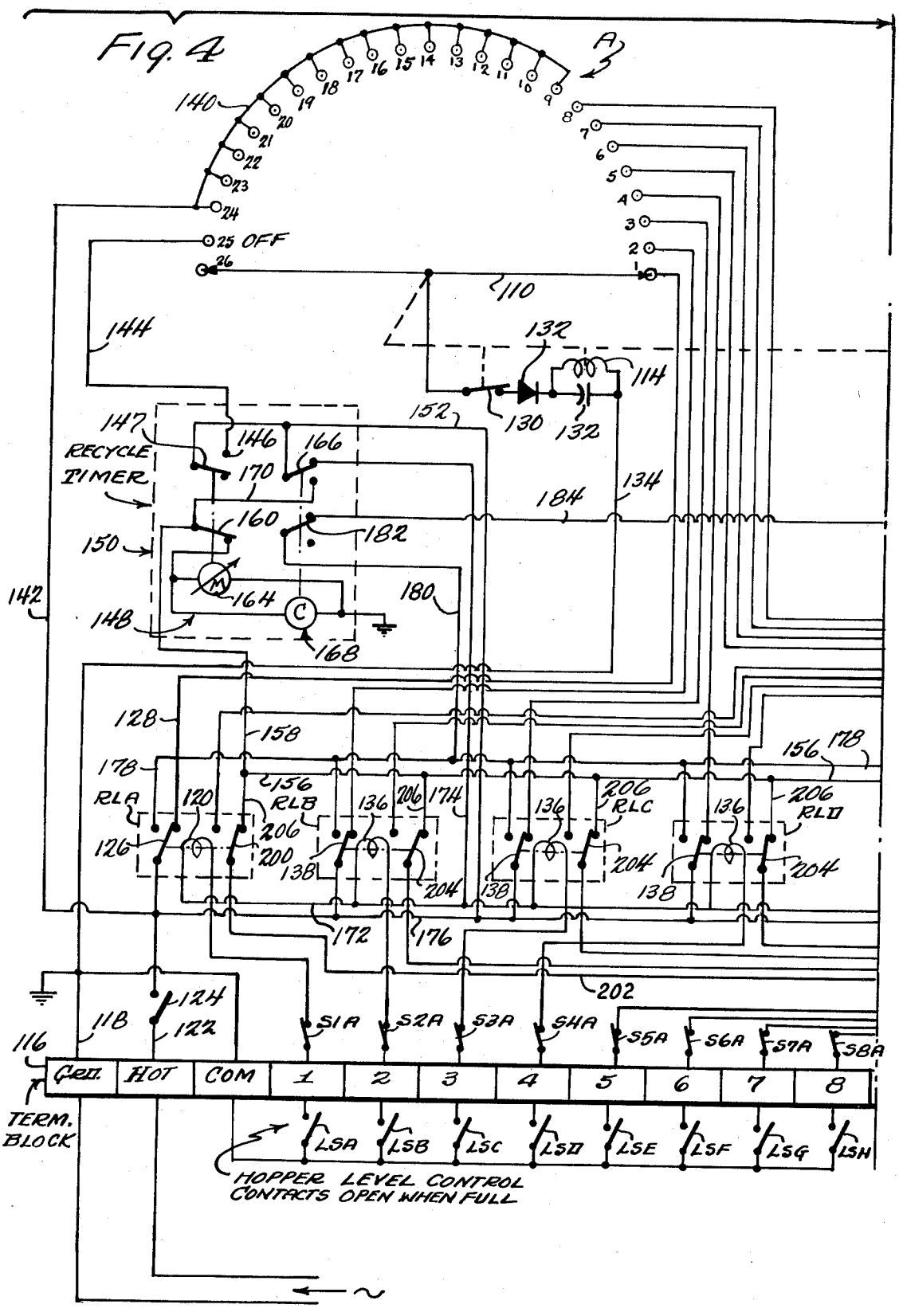

A
140
144
147
RECYCLE TIMER
146
166
170
160
182
150
142
148
164
168
180
184
134
110
132
114
152
130
128
158
178
156
RLA
120
RLB
126
206
200
136
206
174
138
204
RLC
RLD
172
176
202
124
118
122
116
S1A
S2A
S3A
S4A
S5A
S6A
S7A
S8A
GRD.
HOT
COM
1
2
3
4
5
6
7
8
TERM. BLOCK
LSA
LSB
LSC
LSD
LSE
LSF
LSG
LSH
HOPPER LEVEL CONTROL CONTACTS OPEN WHEN FULL
OFF
25
26

FIG. 4A

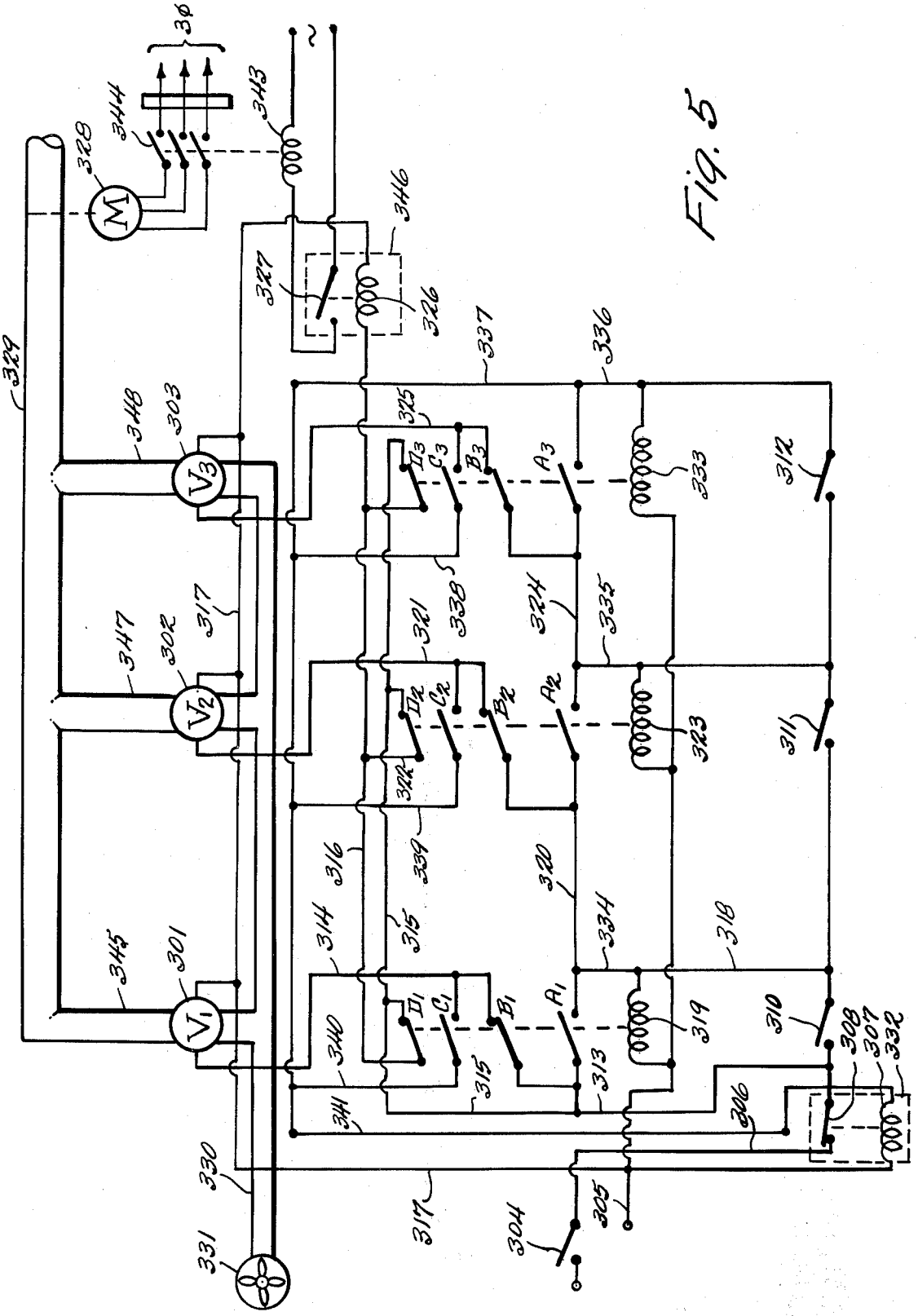


Fig. 5

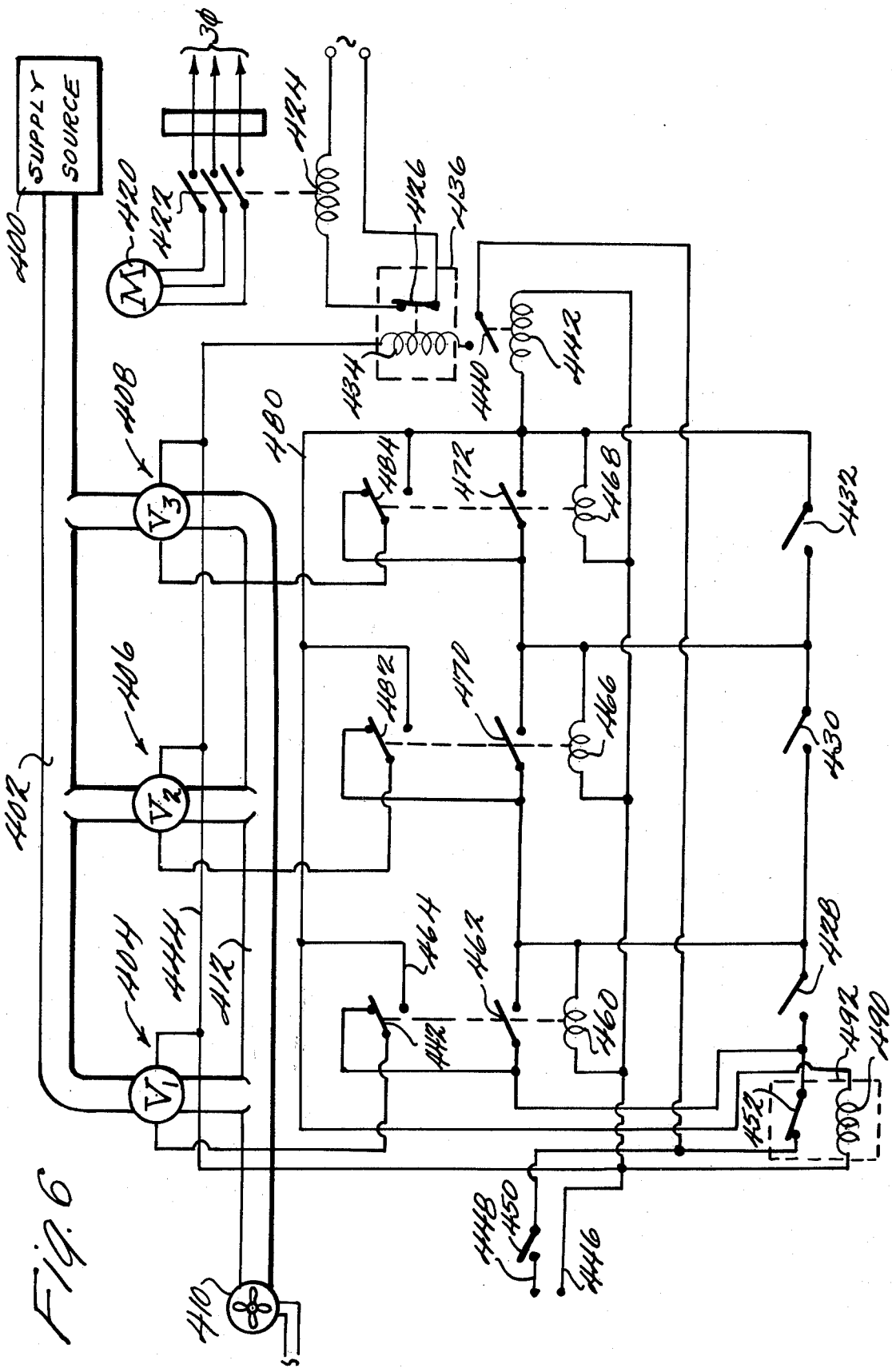

SUPPLY SOURCE
400
30
M
420
422
424
426
436
434
440
402
404
406
408
410
V1
V2
V3
S
460
462
464
466
468
470
472
474
476
478
480
482
484
486
488
490
492
494
496
498
430
432

Fig. 6

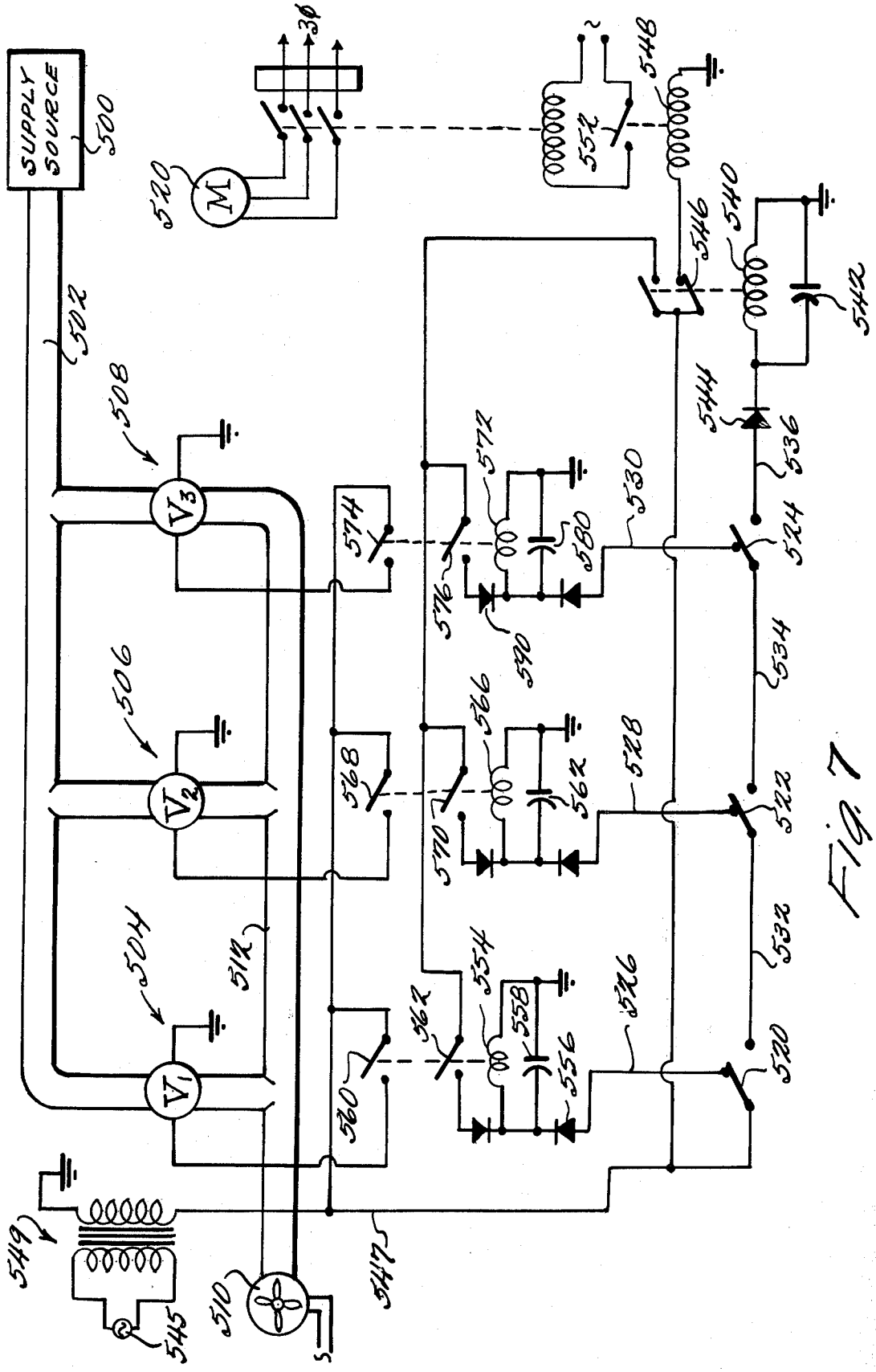

SUPPLY SOURCE
500
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570
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574
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578
580
M
30
V1
V2
V3

Fig. 7

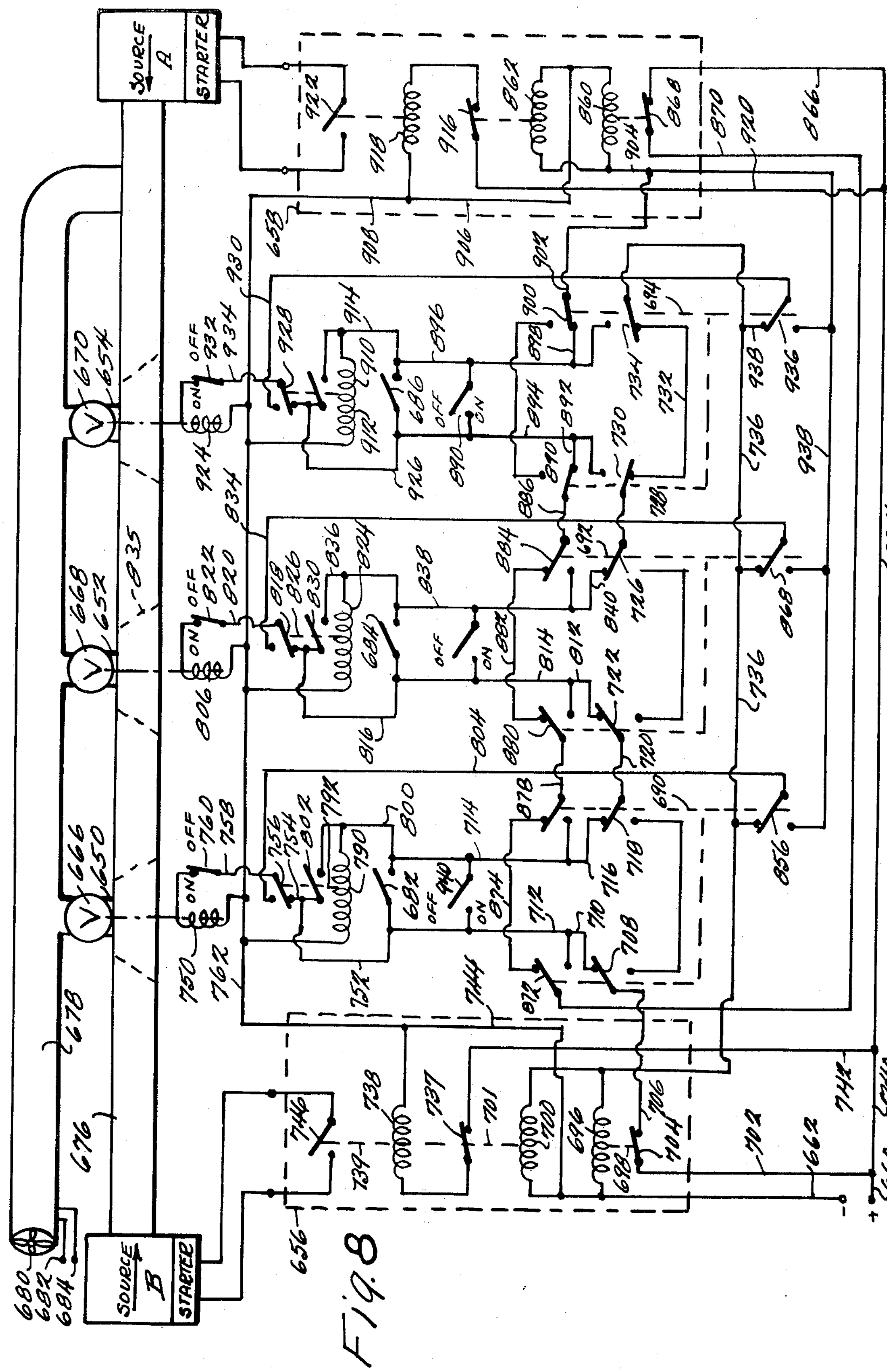


Fig. 8

MATERIAL DISTRIBUTING SYSTEM

This application is a division of application Ser. No. 848,133 filed July 9, 1969 and issued on June 20, 1972 as U.S. Pat. No. 3,671,078. U.S. Pat. No. 3,671,078 is a continuation-in-part of Ser. No. 694,268 filed Dec. 28. 1967, and abandoned Jan. 26, 1970. (A continuation of Ser. No. 694,268 — Ser. No. 5,981 — was filed on Jan. 26, 1970 and issued as U.S. Pat. No. 3,649,082 on Mar. 14, 1972). Ser. No. 694,268 is a continuation-in-part of Ser. No. 561,579 filed June 29, 1966 and abandoned Jan. 4, 1968. Ser. No. 561,579 is a continuation-in-part of Ser. No. 538,437 filed Mar. 3, 1966 and abandoned July 11, 1967. Ser. No. 538,437 is a continuation-in-part of Ser. No. 444,885 filed Mar. 2, 1965 and abandoned May 21, 1966. Ser. No. 444,885 is a continuation-in-part of Ser. No. 217,154 filed Aug. 15, 1962 and abandoned Mar. 29, 1965.

This invention relates to a distributor system, and, more particularly, to the electrical control system in a system for distributing material, for example, of the type that may be conveyed by a stream of fluid, such as air, to any one of a plurality of stations that demand the material.

The type of material with which this invention may conveniently be employed is such as may be found in textile mills, for example, any type of fiber or fibrous material, but no limitation to such material is necessarily intended. In textile mills, for example, there are many instances in which it is necessary to convey fibers from one processing system to another, and this is generally done by entraining the fibers in an air stream. In order to separate the fibers from the air stream at the point of delivery, an apparatus, conventionally termed a "fiber condenser" is employed. A condenser of this general type is described and claimed in the Lytton et al U.S. Pat. No. 3,039,149 and the disclosure of this patent is explicitly incorporated herein by reference. A plurality of such condensers, or of other types of material separators as in the Lytton et al U.S. Pat. No. 3,039,151, the disclosure of which is also explicitly incorporated herein by reference, may be disposed at respective receiving points or stations where it is desired to distribute the fibers in accordance with the needs of a particular station. In such a condenser or distributor, there is an air intake channel and a discharge channel, along with a fiber outlet to a hopper or the like at the respective receiving station, and a controllable doffer or valve for extracting the air and material from the intake channel and separating them to the air discharge channel and fiber outlet respectively when the particular station requires more material. The inlet and discharge channels of each of the distributors are connected in an air circulating system, and the arrangement in such that if the doffer or valve is not actuated the material in the stream of air as it arrives at unactuated station passes that station and proceeds to next. Each station includes a means for sensing the material requirements of that station, and stations are sequentilaly coupled to an electrical system which actuates the doffer or valve of the respective station or not in accordance with the instant determination of the sensing means thereat.

It is accordingly a primary object of this invention to convey material, for example in a fluid channel, from at least one source to any one of a plurality of different stations and distribute the material to the stations automatically in accordance with their respective requirements.

In order to effect this object, an electrical control system is employed to effect a sensing of the addition of the material sensing means at each station and actuate the distributor or not to cause the material to be deposited or to by-pass that station, and this electrical system, in one specific embodiment, includes stepping switches which operate automatically to deposit material at each station requiring same and to step to the next station to determine its requirements.

It is therefore another object of this invention, in conjunction with the preceding object, to provide an electrical control system of the nature just indicated.

These and other objects of the present invention will become more apparent during the course of the following detailed description and appended claims.

The invention may best be understood with reference to the accompaying drawings, in which:

FIG. **1** is a schematic and diagrammatic illustration of the system;

FIG. **2** is a perspective view of one of the stations to which material may be distributed;

FIG. **3** is a cross-sectional view of one of the distributors;

FIG. **4**, which consists of FIGS. **4A** and **4B** joined, is a schematic illustration of another embodiment of the electrical control system of this invention;

FIG. **5** is a schematic illustration of still another embodiment of the electrical control system of this invention;

FIG. **6** is yet another embodiment of the electrical control system of this invention; and

FIG. **7** is another embodiment of the electrical control system of this invention.

FIG. **8** is a schematic illustration of another embodiment of the electrical control system of this invention whereby material is distributed from two sources to a number of stations.

Before proceeding with a description of the electrical control system and overall pneumatic circulating system and supply therefor as shown in FIG. **1**, reference is first made to some of the details of the receiving stations A, B, C and D, particulary to the "condenser" or distributor thereof.

There is no limitation as to what each of the stations A, B, C and D may be, but generally each will include some sort of hopper or the like into which the material in question may be deposited, temporarily or for storage purposes. In other words, each of the A, B, C and D stations may be respective storage bin, or a feeder which feeds a carding machine, or delivers fibers to an adjacent storage bin, or each may be picked, or a combination of any or all such units.

As above indicated, there is disposed at each of such stations A, B, C and D, means for removing the fibers from the air stream. One such removing means as shown in detail in FIG. **2** for station A, is a distributor **10**, a traverse cross-sectional view of which is shown in FIG. **3**. Situated on end frame member or legs **12** is a doffer casing **14** which has a fiber discharge opening **16** around its bottom portion for a predetermined length between the legs **12**. This length is generally a considerable portion of the distance between the legs. At its upper right arcuate portion, the doffer casing has other arcuate openings extending substantially the same length as fiber discharge opening **16**. The upper left

opening **18** is longitudinally encompassed by an inverted U-shaped member **19** forming with casing **14** an air and material intake channel. The right hand opening **20** in casing **14** is covered with a screen **22** and an upstanding inverted U-shaped air discharge channel member **24.** Within casing **14** is a rotary member or doffer **26** which includes a rotatable cylinder **28** that carries a plurality of doffer blades **30.** These blades extend the full length of the intake channel opening **18** and discharge channel opening **20,** as well as the fiber outlet **16.** Cylinder **28** is disposed on shaft **32** to which is secured a pulley **34.** This pulley, and consequently doffer **26,** are driven clockwise as shown in FIGS. **2** and **3,** by a motor **36** to the shaft of which is connected a pulley **38** that is further coupled to pulley **34** by belt **40.**

In operation, any fibrous material or the like that is traveling with the air stream lengthwise in the intake channel defined by U-shaped member **19,** is diverted through the doffer casing opening **18** only if the doffer or member **26** is then rotating. In such a case, the air and material are both pulled into the doffer casing in a clockwise direction with the air being further pulled through screen **22** and out through the discharge channel defined by U-shaped member **24.** The material, however, cannot pass through screen **22,** but is conveyed by vanes or blades **30** into outlet **16.** If doffer **26** is not rotating, then any material and air present in the intake channel proceed straight through that channel without being diverted by the distributor into the doffer casing and separated.

When the doffer is not rotating, some of the material proceeding through the intake channel may drop by gravity into the distributor and be drawn against and clog the screen **22.** If this clogging causes difficulties, the two channels can simply be shifted about 45° counterclockwise from their illustrated positions so that the outlet channel is directly atop the distributor and the inlet channel along the side of the distributor, half way between the top and bottom.

As will be appreciated by reference to FIG. **1,** the intake channels of each distributor **10** are sequentially coupled, and in like manner the air discharge channels are sequentially coupled. For example, the outlet end of the intake channel of the distributor for station A is connected to the inlet end of the intake channel of the distributor for station B, the outlet of that intake channel is connected to the inlet of the intake channel of station D, the outlet of its intake channel is returned to the inlet of its air discharge channel, and at the opposite end of the pneumatic system, the inlet of the intake channel and outlet of the discharge channel of station A are interconnected by tubing **42** in which is disposed an air forcing system. Air is consequently continually circulated in pipe **42** in the direction of arrow **46** through each of the intake and discharge channels of each of the distributors.

Material to be distributed to stations A, B, C and D in FIG. **1** is supplied to the air circulating system at point **48,** for example, in any convenient manner and from any desired source of supply. The type of supply diagrammatically illustrated includes a conveyor **50** onto which is deposited proportioned layers of different fibers from respective weight pans **52** which are in turn supplied by feeders **54.** Such a system and its electrical controls **56** for automatically placing predetermined amounts of different fibers in continuous or interrupted stacks is fully disclosed and claimed in the co-pending application of Lytton et al Ser. No. 348,406, filed Apr. 13, 1953, now U.S. Pat. No. 3,071,202, and the disclosure of that patent is explicitly incorporated herein by reference.

In that patent, there is disclosed, in the upper left corner of FIG. **12** for example, a switch denoted PS, reference thereby being made to a "picker switch", which is closed when fibrous material should be supplied by the conveyor **50,** and opened when it should not be. In other words, switch PS operates the electrical controls of the apparatus to cause it to start and stop as required by other equipment. For purposes of the present disclosure, this switch is made a part of relay switch **52,** which when energized closes switch PS. Therefore, whenever start switch **60** is closed conveyor **50** will supply fibrous material as long as normally closed relay switch **62** and the normally closed pressure switch **64** are closed so as to energize relay **58** and close switch PS.

With the closing of start switch **60,** pressure switch **64** will be closed as long as fan **44** is operating and forcing air through the pneumatic circulating system sufficiently to cause the pressure differential element **66** to pull in switch **64.** Under such circumstances, fibrous material will be conveyed and drawn into the air circulating system and conveyed therethrough for distribution at stations A, B and C according to the demand of such stations, any residual or excess of fibrous material being automatically emptied into station D due to its motor being run constantly, so that no fiber will ever come to rest in the circulating system itself and tend to choke air circulation.

As has been previously indicated, each of the stations has a demand sensing means, and this may take any desired form, for example, a rake or other type level control **68** the height of which varies with the amount of material present at the station. When the station in question has a sufficient amount of material, then a limit switch is held closed by the level control **68.** On the other hand, when the station requires material, level control **68** holds the limit switch open until the demand is fulfilled, at which time the limit switch recloses. The respective limit switches are designated LSA, LSB, and LSC, with operation thereby in accordance with the respective level controls **68** being indicated by dash lines **70.** Each of the limit switches may be paralleled by a respective hand switch **72** for the purpose of by-passing any or all of the stations A, B and C when not needed, but for purposes of considering the operation of the remaining electrical system, it will be assumed that all switches **72** are open as illustrated.

Depression of start switch **60** applies current to the movable arm or wiper **74** of bank A of selfstepping rotary switch system having two banks A and B, via the normally closed contact **76** of timer **78** and the off or Number **11** position of bank A. This supplies current on line **80** to timer **78** via line **82,** thereby energizing the timer and causing its contact **76** to open until a predetermined time after wiper **74** returns to position Number **11** following its full stepping cycle around the switch bank. The stepping cycle is caused by supplying current from line **80** also to time delay relay TD1 and stepper relay **84** via line **86** and self-stepping contact **88.** Current proceeding from line **86** through contact **88** divides to energize relay TD1 and cause its normally closed contacts to open immediately, and to charge condenser **90** sufficiently through rectifier **92** to oper-

ate stepper relay **84** and cause stepping contact **88** to open and wiper arm **74** of bank A and wiper arm **94** of bank B to rotate clockwise one step to position Number **1**. The breaking of contact **88** de-energizes the coil of relay TD1 and allows its switch contact to close after a delay of one or two seconds, as desired.

The purpose of delaying the closing of relay TD1 contacts at this particular time is to prevent energization of wiper arm **94** on bank B with current from line **98**, and thereby present energization of the motor of distributor **10** at station A via line **100**, until it is determined by wiper **74** whether that station is calling for material to be separated from the air stream and deposited thereat. In other words, if limit switch LSA is closed so as to provide current to wiper arm **74** and thereby effect another and immediate stepping by the stepping relay **84**, the distributor motor at station A will not even be momentarily energized; nor will the motor at station B be immediately energized then (regardless of the position of limit switch LSB) since relay TD1 was reset to its full delay time by current from the closed LSA switch. On the other hand, if the level control **68** at station A causes limit switch LSA to be open, wiper arm **74** is not then energized and stepper relay **84** will not cause movement of the wiper arm to their next position. Instead, after a short delay, the contact of relay TD1 closes and supplies current to the distributor motor of station A via wiper arm **94** and line **100**. This motor continues to run and fill the station with material extracted by the distributor from the air stream, until level control **68** closes limit switch LSA and effects a stepping of wiper arms **74** and **94** to their respective Number **2** positions.

At this second station, the level control will be causing the limit switch LSB to be open or closed in accordance with the sensed requirements at station B, and accordingly the distributor motor at that station will operate or not to fulfill the requirements indicated. If there is no need for fibers at station B, the fibrous material in the air stream will continue in the pneumatic circulation system without any of the fibers being diverted into station B, and the stepping relay **84**, will automatically move wiper arms **74** and **94** to their respective Number **3** positions, in the same manner above indicated.

This same procedure automatically occurs for station C, but when wiper arms **74** and **94** are moved to their respective Number **4** positions, there is no sensing of demand at station D as long as the electrical system is connected as illustrated in FIG. **1**. As previously indicated, station D has its distributor motor connected continuously to a source of supply so as to operate continuously and extract from the circulating air any leftover fibrous material, to keep same from choking or tending to choke the pneumatic circulation system.

It will be noted that in the bank A stepping switch, positions **4–10** are interconnected by line **102**, which in turn is connected to the source of energy via line **104**. Accordingly, wiper arm **74** is continuously energized from position Numbers **4–10**, and consequently current results on lines **80**, **86**, and self-stepping contact **88** to stepper relay **84**, causing wiper arm **74** to move step-by-step from position Number **4** to position Number **11** automatically without delay. Of course, wiper arm **94** of bank B does likewise since it is also mechanically connected to relay stepper **84**. The interconnection of bank B positions or terminals Number **4–11** by line **104** has nothing to do with effecting the stepping itself, but causes relay TD2 to be immediately energized by current from line **98** through the TD1 contact and wiper arm **94**, while that wiper arm is at each of positions Number **4–11**, inclusive. Relay TD2 delays closing its contact after de-energization for a time comparable to the TD1 delay time, and renews its full delay time each time it is re-energized. This means the contact of relay TD2 opens beginning with position Number **4** and stays open until wiper arm **94** advances from position Number **11** to position Number **1** at the beginning of the next cycle, notwithstanding momenting cutoffs of current to the coil of relay TD2 by self-stepping contact **88** and the contact of relay TD1. Accordingly, while the stepping switches are at or between positions Numbers **4–11**, the electrical controls **56** are turned off by the resultant de-energization of relay **58** and opening of its switch PS.

Each step of wiper arm **74** on bank A, except the off or Number **11** position, eventually, if not immediately, supplies current to timer **78**. This timer, therefore, gets continually charged, and is not allowed to run out and close its contact **76** until wiper arm **74** returns to the off or Number **11** position, after which time the timer contacts close within a predetermined time, say 8 to 10 minutes. This delay in closing time contact **76** allows sufficient time for any one of the stations A to C to have any maximum requirement fulfilled by the fiber in the circulating air stream, and also allows time for the different stations A, B and C to utilize the material extracted from the air stream in accordance with the type of equipment thereat.

No limitation is intended by the number of receiving stations or number of rotary stepping switch positions utilized in the example discussed above, since with an **11** position switch any number of stations up through ten may be selectively coupled thereto and, of course, the number of switch positions may be increased to 100 or more to accommodate whatever number of receiving stations that need to be involved in any given situation. The same is true for the embodiment of FIG. **4** which is now described as operating with eight stations A . . . H (not shown).

Like the embodiment in FIG. **1**, the embodiment of FIG. **4** also employs two switch banks A and B, which have respective wiper arms **110** and **112** stepped in unison by the stepping solenoid **114** from each of **25** different positions, represented by switch contacts numbered through **25**, to the next.

The active contacts of switch banks A and B, i.e., contacts Number **1–8**, are connected between eight demand indicating or limit switches LSA . . . LSN and eight distributor actuators such as motors M_A . . . M_H. The limit switches LSA, etc. are any type of desired hopper level control contacts, for example, similar to those in FIG. **1** which are connected to the level indicating element in the hopper at each of the stations. Actuators M_A etc. may be condenser motors as in FIG. **1**, or they may be transition valves or the like by which material being conveyed by the conveyor means is directed, or not, into the hopper at the station where the actuator is located, according to whether the corresponding level indicating or limit switch is in a closed condition indicating the hopper demands material, or in an open position indicating the hopper is full. In FIG. **4**, the level switch LSA is associated with the same station as distributor actuator M_A, level switch LSB is as-

sociated with the same station as distributor actuator M_B, etc.

In a manner explained in more detail below, the eight level control switches LSA . . . LSH are connected through terminal block **116** and respectively by eight relays RLA . . . RLH to contacts Number **1–8** of switch bank A. In particular, level control switch LSA is connected at one side to the common ground line **118** and at its other side through one pole S1A of a double pole single throw switch which has its other pole, designated S1B, serially connected with motor M_A. Switch S1A, which is closed whenever station A is to benefit from the control system, is connected to the coil **120** of relay RLA. As long as level switch LSA is open, current from the "hot" line **122** passes through a system master switch **124** to relay contact **126** which in its deactuated (illustrated) position connects to line **128.** In turn, line **128** is connected to contact Number **1** of switch bank A. Consequently, when wiper arm **110** is on that contact, current passes through the wiper arm and the normally closed self-stepping solenoid contact **130,** diode **132,** and the solenoid coil **114,** with a slight delay in operation of the stepping solenoid being effected by a condenser **132.** Current returns to ground via line **134.** Solenoid **114** not only steps wiper arm **110** and **112** to a second position so as to be on contact Number **2,** but also opens the self-stepping contact **130,** thereby initially breaking the circuit and de-energizing coil **114.**

It is apparent from the foregoing description that as long as the other level control switches LSB . . . LSH are all open, the respective coil **136** of relays RLB . . . RLH will remain de-energized, and their left contacts will therefore remain in their rightward position so as to apply solenoid stepping current to the respective contacts Number **2–8** of switch bank A. Consequently, wiper arm **10** will, under the condition of all level switches LSA . . . LSH being open, automatically step from contact Number **1** to contact Number **2,** etc., until it arrives on contact Number **9** of switch bank A.

While it is not necessary for this invention to have a group of switch bank contacts unused, FIG. **4** illustrates how a switch bank with an excessive number of contacts, may still be employed nevertheless. Unused contacts Number **9–24** are connected together by conductor **140,** which in turn is connected to line **142** and thereby back to the current source on line **122.** Consequently, wiper arm **110** is continually energized from terminals Number **9–24** and stepper solenoid **114** steps the wiper arm from one to the next of these terminals automatically. At terminal **24,** it steps wiper arm to the "off" terminal Number **25.** This last terminal is similar to switch bank terminal **11** in FIG. **1,** in that the equipment is held in an off condition for a predetermined length of time before it is automatically recycled.

As may be noted in FIG. **4,** contact Number **25** of switch bank A is connected by line **144** to terminal **146** of a motorized delay relay **148** in a recycle timer **150.** Since terminal **146** is not initially connected to relay contact **147** and therefore cannot receive current from line **152,** it is apparent that the stepping solenoid **114** is not immediately energized via wiper arm **110** when it is on contact Number **25.**

To show how it is finally energized, reference is made to switch bank B, where it will be noted at contacts Number **9–23** are connected together by line **154,** which in turn connects to line **156.** At the far left end of line **156** in FIG. **4A,** line **158** connects line **156** to relay contact **160.** Wiper arm **112** of switch bank B is continuously energized by virtue of its connection via line **162** to the "hot" line **122.** Therefore, it is apparent that as soon as the wiper arm **112** makes contact with terminal Number **9** of switch bank B, current is conveyed thereby to line **156,** and further over line **158** to relay contact **160** of the delay motor **164.** This motorized delay relay **148** is of the variable delay type and does not actuate its contacts until the delay time manually set into the motor runs out. At the end of that time, which may be up to 12 seconds or so, relay contacts **147** and **160** shift over to their unillustrated positions, breaking the circuit to motor **164** and connecting wiper arm **110** at contact Number **25** to current on line **152** so as to cause stepper solenoid **144** to step wiper arm from contact Number **25** to contact Number **1.** This is done in one step since the opposite half of wiper arm **110** comes onto contact Number **1** immediately as the other half thereof moves off contact Number **25.**

Since contact Number **24** of switch bank B is not connected to the common line **154,** current over lines **156** and **158** ceases when wiper arm **112** steps onto contact Number **24.** This would de-energize motor **164,** if it were not for the fact that the clutch relay contact **166** was actuated when wiper arm **112** previously moved onto contact Number **9,** since then the current over lines **156** and **158** also energized the coil of clutch relay **168.** The relay immediately operates its contacts upon being energized or deenergized. When relay contact **166** was thereby pulled downwardly, the current on line **152** was transferred to line **170** so as to keep current continuously applied via relay contact **162,** the delay motor **164** and clutch relay **168,** thereby obviating any problem that might otherwise occur when wiper arm **112** steps onto a contact which is not connected to line **154.**

When the motorized delay relay **148** times out so as to move its contacts **147** and **160** upward, the circuit to the delay motor **164** and clutch coil **168** is broken, and the relay contacts of each immediately return to their illustrated positions and the delay motor is automatically reset. As previously indicated, wiper arms **110** and **112** then step from their respective contacts Number **25** to Number **1,** and the cycle beings all over again.

The foregoing describes a complete cycle of events when none of the level control switches LSA . . . LSH is closed. However, the cycle is interrupted whenever it is sensed, in the sequence of sensing the condition of these switches that one of them is closed. If the first station served by the system is demanding more material be distributed into its hopper, then the level control switch LSA is closed. This completes a circuit from ground through relay coil **120,** lines **172** and **174,** relay contact **166** and lines **152, 176** and **122.** Accordingly, contact **126** of relay RLA is operated to its leftward position so as to apply current to lines **178** and **180,** relay contact **182** and line **184** to the coil **186** of a delay timer **188.** This timer waits for about the time to complete one cycle, for example about 10 seconds, until it closes its contact **190.** This completes a circuit from a voltage source **192** through a manual feed switch **194** to a feed relay **196.** This relay has as its contact the picker switch PS of the FIG. **1** apparatus which feeds material to the conveying and distributing system through the feeder electrical control **56,** also shown in FIG. **1.**

At the same time, wiper arm **112** of switch bank B, while it is on contact Number **1**, feeds current from line **162** to line **198** back to relay RLA and therethrough via contact **200** which is not in its leftward position because of the energization of relay coil **120.** From relay contact **200,** current is conveyed by line **202** through the closed switch S1B and terminal **10** of block **116,** to distributor motor M_A. This motor, therefore, is actuated and causes the material that is being fed due to the closure of the feed relay contact PS, into the hopper at the first station A. The delay by timer **188** allows motor M_A to come up to full speed before the material is fed toward it for distribution in the hopper of station A.

As soon as the hopper of station A becomes full, its limit switch LSA opens, thereby de-energizing relay RLA. This turns off motor M_A since relay contact **200** moves to the right. The rightward movement of the other relay contact **126** causes current to be applied over line **128** to contact Number **1** of switch bank A. As before described, this causes the wiper arms to step to contact Number **2.**

From the above description, it is apparent that if any of the level control switches LSB . . . LSH is closed, the coil **136** of the respective relay RLB . . . RLH is energized to move its contacts **138** and **204** leftwardly so as to energize the respective motor M_B . . . $_{MH}$ and cause a feed of material by the closure of the picker switch PS.

After the condition of the last level switch LSH is sensed and material fed and distributed by motor M_H to station H, if required, wiper arms **110** and **112** move onto contacts Number **9.** As previously indicated, this energizes the delay relay **148** and clutch relay **168** to start the recycle delay time that is set into the delay motor **164.** During this time, the clutch relay contact **182** opens so as to prevent energization of the feed relay **196** until after the wiper arms return to their respective Number **1** contacts. Since line **156** from bank B is carrying current while wiper arm **112** is on contacts Numbers **9–23,** and since that line is connected by respective lines **206** into each of the relays RLA . . . RLH so as to deliver current through the right hand relay contact **200** in relay RLA and **204** in the others, all eight of the distributors M_A . . . M_H are thereby actuated during that time. This clears the material conveying line by adding any remaining material into the adjacent machine hoppers, readying the whole distributing system for another cycle.

FIG. **5** of the drawings discloses a further embodiment of the invention. Valves or "fiber condensers"indicated by numerals **301, 302** and **303** are transition valves which are normally closed but are opened when a demand is indicated by the station at which they are located. These valves or "fiber condensers" are used to separate the fibers of the material from the conveying air stream at the point of delivery. Apparatus of this general type is described and claimed in the Lytton et al U.S. Pat. No. 3,039,149. A plurality of such transition valves or condensers, or other types of material separators as in the Lytton et al U.S. Pat. No. 3,039,151 are disposed at respective receiving points or stations where the fibers are to be distributed in accordance with the demand of a particular station. The circuit diagram controlling these valves will now be explained.

With the system initially at rest, master control switch **304** will be closed and it will energize power line **306.** The pneumatic timer **307,** including switch **308,** which is normally closed, and coil **309,** will not effect the operation until the recycling sequence of the system is to become effective. This part of the operation will be discussed infra.

The level control switches **310, 311** and **312** are located within the respective receiving stations of the system. They are normally open and are closed only when the level of the material indicates the particular station is filled and no longer needs any material. Assuming for the moment that all the level control switches **310** through **312** are open, indicating a demand at all the stations, line **306** will be energized when switch **304** is closed. The open condition of level control switch **310,** as previously assumed, shows that the first station in line is demanding material. With the energization of line **306** and switch **310** being open, line **313** will be energized since switch **318** is normally closed. The power will be transmitted to transition valve **301** through lines **313** and **314** since relay contact B_1 is normally closed. The circuit is completed through return line **317.** Line **313** will concurrently also energize line **315** and **316** through normally closed relay contact D_1. With the energization of line **316,** coil **326** of feed timer **346** will be energized. This circuit is also completed by return line **317.** The delay timer will close switch **327** after a definite elapse of time, usually in the range of 5 seconds. When switch **327** closes, coil **343** is energized, which in turn will close three phase switch **344,** thereby powering motor **328** which will begin the flow of material to conduits **329** and **345.** Transition valve **301** being open, is now capable of transmitting the received supply of material to its respective station.

When this first station is filled, level control switch **310** will close, energizing thereby relay coil **319** through line **318.** With the energization of coil **319,** relay contacts B_1 and D_1, which normally were closed, are now open, and relay contacts A_1 and C_1, which were normally open, will now be closed. Coil **326** of course is not de-energized to stop feed motor **328** until all of the switches D_1 , D_2 and D_3 have been opened. With the closing of relay contact A_1, power from line **313** will be transmitted to line **320** and through relay contact B_2, which is normally closed, to line **321,** thereby opening transition valve **302.** Concurrently, power from line **313** will flow through line **315,** through normally closed relay contact D_2 to line **332** and **316.** The supply of material is thus continuously fed to conduits **329** and **347,** now being thereby deposited through transition valve **302** into its respective station.

When the level control switch **311** indicates that the station no longer needs any material, it will close, thereby completing a circuit through line **306** and **335,** energizing relay coil **323,** whereupon relay contacts D_2 and B_2, which were normally closed, are open, thereby closing transition valve **302.** Relay contacts A_2 and C_2, which were normally open are now closed. As we had previously assumed, level control switch **312** was open and remains open indicating a demand in its respective station. This demand will now be fulfilled since the closing of relay contact A_2 will transmit power to line **324,** through normally closed relay contact B_3 and line **325** to thereby open transition valve **303.** Power will now still be transmitted to the feed supply circuit through lines **313, 315,** normally closed relay contact D_3 to line **316.** This keeps energized the coil **326,** which in turn keeps closed coil **343** energized, three phase

switch **344** closed and feed motor **328**, which will feed the material through conduits **329** and **348** into the respective station which is fed by transition valve **303**, operating.

It will be noted from this specification that the contol valves **301, 302** and **303** are operably actuated when the level control switches **310, 311** and **312** are respectively open, indicating demand at each respective station. The station demand requirement was fulfilled in the system shown in FIG. **5**, by first filling the station furthest away from the supply line, then sequentially filling the remaining stations, from the furthest in the line to the nearest in the line relative to the supply source. This sequence is established so that the conduits **345, 347, 348** and **329** will be kept substantially clear of residue material during the operable distributing time of the system. Through the use of this sequence any material residue which may remain in conduit **329** during the filling of the first station will be used to fulfill the demand of the second station thereby limiting the amount of residue material remaining in the conduits which will be purged therefrom during the purging operation described infra.

Upon the completion of the filling operation, level control switch **312** will close thereby energizing relay coil **333**. The relay contacts B_3 and D_3, which normally are closed, are now open and relay contacts A_3 and C_3 which normally are open are now closed. With the closing of relay contact A_3, power will be transmitted to all the relays through lines **313, 320**, and **324** thereby assuring that relay windings will remain energized even though a level control switch may now be opened.

Concurrently with the closing of relay contact A_3 power will flow through line **337** which will transmit power to lines **338, 339** and **340** which because relay contacts C_1 and C_2 and C_3 are closed, will open all the transition valves connected thereto, shown as **301, 302**, and **303**.

In this operation all the transition valves are open. However, no supply is being fed into the conduits, therefore, the opening of all the transition valves at the present time will insure that any residue material which has remained in the conduits during the distribution operation will be cleared therefrom and drawn into the respective stations. The duration of this purging operation is controlled by the pneumatic timer **307** since with the energization of line **337**, line **341** will transmit power to coil **309** of the pneumatic timer. This will open switch **308**, which is normally closed after a predetermined time interval, thereby cutting off all power to the system.

The opening of the transition valves **301, 302**, and **303** during the purging operation which allows the residue material to be transmitted into the respective station is also a safety feature since the fan **331** is continuously drawing out, and if allowed to do so for an extended period of time it will eventually collapse the conduits. The feed motor **328** is stopped after completion of the feeding operation and it does not commence the feeding until the complete operation is recycled after the conduits are purged. It is during this interim that the conduits may collapse, however, the invention eliminates this detriment by opening the transition valves, thereby purging the conduits and preventing collapse. The fan **331** could be electrically connected to the primary circuit, so that when switch **308** opens, thereby closing the system, it could concurrently also stop the fan. In the embodiment shown in FIG. **5**, the fan **331** is shown to be independent of the main circuit, for purposes of clarity and is not considered a limiting feature.

Pneumatic timer **307** can be set to any specified length of time. This time is dependent upon the required distribution of the operation, since with the energization of coil **309**, switch **308** will once again assume its closed position thereby beginning the distribution cycle all over again. This embodiment, of course, is not limited as shown to three stations, since stations can be added to either side of the line without departing from the scope of the invention.

The number of stations can be changed, either increased or decreased, by any desired number at either end of the system. That is, stations can be added at the right end of FIG. **5** by merely removing line **337** and inserting the desired number of valve-relay combinations in parallel with those already existing. Line **337** would then be placed across the corresponding terminals of the last station. Other stations could be added at the left end of FIG. **5** by removing line **341** and inserting in parallel with the existing stations a desired number of additional stations with line **341** being replaced across the corresponding terminals of the left most near station. Reference is now made to FIG. **6** which shows another electrical control system similar to the circuitry illustrated in FIG. **5**. In the embodiment of FIG. **6**, as in the embodiment of FIG. **5**, fiber is supplied from a suitable source **400** to a pneumatic line **402** which carries the entrained fibers to each of the stations in the system and these stations, in the embodiment of FIG. **6** are stations **404, 406** and **408**. A fan **410** is connected to the pneumatic output line **412** to draw the entrained fibers through the line **402** and to a station to be supplied so that the entrained fibers are diverted through a station when valves V_1, V_2 or V_3 associated with a station is opened in the manner described above. As in the embodiment of FIG. **5**, an electrical motor **420** causes the supply source **400** to supply fibers to the line **402** and the energy to operate this motor **420** is supplied from a conventional three-phase source via ganged switches **422**. These normally open ganged switches **422** are closed together when current flows through a conventional relay coil **424** which is connected to a suitable alternating current source via a normally closed switch **426**, which is in turn controlled by relay coil **434** of relay **436**. Relay coil **434** is connected to an energy source via normally closed switch **440**, which is in turn controlled by relay coil **442**. Should any of the rake or demand switches **428, 430** or **432** associated with stations **404, 406**, and **408** respectively be open, indicating a demand for fibers at that station in the same manner as discussed above, then the relay coil **442** will be deactivated thereby allowing the normally closed switch **440** to return to its normally closed position permitting current to flow through coil **434**, closing switch **426** which in turn completes a current path through relay **424**, closing switches **422** and supplying the energy to the motor **420** which then supplies fibers to line **402** as described above.

If, for example, all of the rake switches **428, 430** and **432** are open, indicating a demand for fibers at each of these stations **404, 406** and **408**, then the circuitry will operate substantially in the manner described above causing each of the stations to be served in turn. The

stations are served in order starting with the one furthest from the source **400** and proceeding toward source **400.** Any stations not exhibiting demand are skipped and after being skipped if a station demands fiber it is not served until the cycle has been completed and line **402** purged.

Thus, if the switch **428** is open then current first flows from line **448** through closed on-off switch **450** and normally closed switch **452** through the switch **442,** which is a single pole, double throw switch replacing the switches B and C in the embodiment of FIG. **5,** through the valve V_1 to the line **444** and from line **444** back to the other side of the energy supply connected to line **446.** When the rake switch **428** subsequently closes indicating that demand has been temporarily satiated, a current path is completed through the coil **460** which responds by closing switch **462** and shifting the switch **442** into connection with line **464** in preparation for the purge. Similarly, if the stations **406** and **408** are demanding fibers, they are supplied in turn and the relays **466** and **468** are successively activated to shift the positions of the switches controlled thereby if no demand is indicated or after the demand has been satiated in the same manner as described above with regard to FIG. **5.**

After demand at all stations has been completely fullfilled, a current path is completed through the relay **442** via switches **462, 470** and **472.** The passage of current through coil **442** opens normally closed switch **440,** causing coil **434** to be deactivated thus opening switch **426.** The opening of switch **426** deactivates relay **424** which in turn opens switches **422** so that no more fibers are supplied to the line **402.**

In the same manner as with FIG. **5,** all of the valves V_1, V_2 and V_3 are now opened to purge the line **402** of fibers which have been dropped within the line **402** and which will eventually clog it if not periodically removed. The closing of all of the switches, **462, 470** and **472** completes a current path from line **448** to line **480** which is in turn connected to the line **444** through each of the switches **442, 482,** and **484,** which are shifted from their illustrated position, and valves V_1, V_2 and V_3 so that current passes through the valves V_1, V_2 and V_3 to cause them to open. Air then passes through each of these valves and to the fan **410** and the system is purged of fibers remaining in line **402.**

Current also passes from the line **444** through the coil **490** of the relay **492.** In the same manner as in FIG. **5,** coil **490** is of the time delay type which pauses briefly in opening its normally closed switch **452.** After a short time, the switch **452** is opened to interrupt the purging path through the valves V_1, V_2 and V_3 and to deactivate the coils **460, 466** and **468.** The system then returns to its initial state and again responds to demands at any of the stations **404, 406** or **408** as described above.

FIG. **7** illustrates another control system for controlling the supplying of fibers to a plurality of fiber stations connected to a supply source by a pneumatic tube. As in the embodiment of FIGS. **5** and **6,** the source **500** supplies entrained fibers to a line **502** to which are connected stations **504, 506** and **508,** having valves V_1, V_2 and V_3 respectively associated therewith for the removal of fibers in the same way as described above. Also, as in the embodiment of FIGS. **5** and **6,** a fan **510** or like device is attached to the return line **512** and the entrained fibers are drawn through the tube **502** toward the fan **510** and through the valves V_1, V_2 and V_3 which are successively opened to withdraw the fibers as described above.

In contrast to the other embodiments described above, the arrangement shown in FIG. **7** has a built-in priority. By this it is meant that the circuitry is designed to serve stations associated with a given pneumatic line set order and to interrupt the feeding of an unsatisfied station at any time in favor of another station having a higher priority that is demanding fibers. Further, the arrangement shown in FIG. **7** is designed to deal, at least partially, with the problem of overfeed which can result with the arrangement shown in FIGS. **5** and **6** if any of the stations attached to the line **502** is not removing the fibers which are deposited therein during each purge. Since the station closest to the fan **510** normally receives the bulk of the fibers which are purged at the end of each cycle, this station in particular is susceptible to being overloaded. The circuitry shown in FIG. **7** solves this problem by only opening the valve of the last station actually served during a cycle for purging the line **502.** Thus if a station does not receive fibers during a cycle, it cannot receive fibers during purging.

Like the embodiments of FIGS. **5** and **6,** the arrangement in FIG. **7** employs level control or rake switches **520, 522** and **524** which operate in the same manner as described above, connecting to the lines **526, 528** and **530,** respectively, when a demand condition and connecting to the lines **523, 534** and **536** when the station associated therewith does not want fibers. Thus, if any of the switches **520, 522** and **524** are in the illustrated demand positions, the feed relay **540** which has a capacitor **524** connected in parallel with it and a diode **544** connected in series with it to rectify the current from the alternating current source **545** which is coupled to line **547** by conventional transfer **549** is deactivated, permitting switch **546** which it controls to resume its normally closed and switch **580** its normally open position. The closing of switch **546** in turn activates relay **548** which in turn closes normally open switch **550** activating a feed motor **552** in the same manner as described in connection with FIGS. **5** and **6** to feed fibers to line **502** from source **500.**

In the arrangement of FIG. **7,** the priority of stations receiving fibers is from left to right with the station **504** having the highest priority, the station **506** having the second highest priority, and the station **508** having the lowest priority. It should be apparent that priority can be assigned any stations any way desired although stations are normally served beginning with those furthest from the source. Thus in this embodiment, assuming the station **504** is demanding fibers, it is served first as follows. The relay **554** is activated by the current flowing through the switch **520** and line **526** and rectified by the diode **556.** A capacitor **558** is connected in parallel with the relay **556** and is quickly charged to provide a D.C. voltage across relay **554** to close switches **560** and **562.** The closing of switch **560** completes a current path through the valve V_1 which then opens and diverts the entrained fibers in the line **502** through station **504** in the same manner described above. The closing of switch **562** is in preparation for the purge of the system as described below. When the demand of station **504** has been satiated, and assuming station **506** is demanding fibers, the rake or level control switch **520** shifts into connection with the line **532** and a current path is thus completed via switch **522** through the relay coil of the next station to receive fibers, namely

station **508.** Relay **566** then closes switches **568** and **570** in the same manner as relay coil **554,** completing a path through the valve V_2 and also preparing for the purge. When the station **506** has been satisfied, switch **522** shifts into connection with line **534** and the relay **572** of the station **508** is activated to close switches **574** and **576** and complete a current path through valve V_3 and prepare for a purge.

The system shown in FIG. **7** differs from the system shown in FIGS. **5** and **6** in that should a station having a higher priority exhibit a demand for fibers when another station is being served, the system will skip back to the higher station and satisfy its demands. For example, if the station **508** were being served but was not satisfied and the switch **520** returned to connection with the line **526** indicating a demand, the relay **572** after a very short time period during which the capacitor **580** discharged, would be deactivated, cutting off the current path through valve V_3 which then closes. At the same time, relay **554** would be reactivated closing switches **566** and **562** so that the valve V_1 is again opened to remove fibers. After the station **504** has again been satisfied switch **520** will shift again the into the connection with line **532** and once again the system serves the next station demanding fibers in priority.

Once the complete cycle has been finished with all of the rake or control level switches **520, 522** and **524** shifted to their satisfied condition in connection with line **532, 534,** and **536,** respectively, a current path is created through the relay **540** which charges a capacitor **542** and opens normally closed switch **546** which in turn cuts off the energy supplied to the motor **552.** The purging operation now takes place and the charged capacitor **542** will cause the relay **540** to remain activated for a short time sufficient for purging even should one of the rake or control switches **520, 522** or **524** shift during purging indicating a demand. The activation of relay **540** also closes the normally open switch **580,** completing a current path through the coil **554, 556** or **572** of the last station actually served. The values of the capacitors **558, 562** and **580** associated with the relays **554, 556** and **572** are carefully chosen so that the discharge rate will be usch to keep the coil with which it is associated activated for a shorter time after the current path is removed. The discharge time, however, is short enough so that by the time purging takes place all of the relays will be deactivated except the one which was served last. Of course, if the last station was served very quickly it is possible that more than one relay will be still activated during purging. However, a relay associated with a station which did not receive fibers during the cycle obviously could not still be activated. Thus, if station **508** was served last, which it normally would be, then the coil **572** will still be sufficiently charged to maintain relay **572** activated when switch **580** is closed completing a new path through relay **572** via switch **576** and diode **590.** Valve V_3 thus remains open during purging, and this valve will be the only one open during purging. Since the last station to be served during any cycle is the one through which purging takes place, the problem of over feeding is resolved.

Reference is now made to FIG. **8** which illustrates an embodiment of the invention in schematic whereby the distributing system has the ability to feed all of the stations from one of two sources or a predetermined number of stations from one supply and the rest from the other. Other embodiments employing more than one source are disclosed further in U.S. Pat. No. 3,649,082 filed Dec. 28, 1967. FIG. **8** however, clearly illustrates the scope of the invention of this application which covers multiple as well as single feed systems. The system illustrated in FIG. **8** is especially versatile and flexible in that the source which feeds a given station can be changed by throwing a ganged switch, inserting a single plug or manual cutoff valve into the conduit **676** through which the fiber passes and removing another plug. In this embodiment, two sources of fiber, source A and source B, are adapted to feed fibers, which are suspended in a moving air stream, in the same manner as described in connection with FIGS. **1–3** of the above mentioned U.S. Pat. No. 3,649,082 to stations **650, 652** and **654.** As will become apparent from the following detailed description of the operation of FIG. **8,** this embodiment is not limited to any particular number of stations, and it will become obvious how more stations can be added or deleted.

In this embodiment, as in the embodiments shown in FIGS. **2** and **3** of the above mentioned U.S. Pat. No. 3,649,082 a Master Control comprised of a number of relays which cause the source to feed fibers into the conduit **676** and which cause purging after all stations demanding fibers have been supplied is associated with each source. Master control **656** is associated with source B, and master control **658** with source A. The distribution system for both sources is energized by applying an electrical potential, for example 110 volts A.C., between lines **660** and **662.** For purposes of illustration, line **660** is shown connected to the positive pole of an alternating current source, and line **662** to the negative pole.

As in FIGS. **1, 2** and **3** of the above mentioned U.S. pat. No. 3,649,082, transition valves **666, 668** and **670** are associated with stations **650, 652,** and **654** so that when any of these valves are opened, fiber is extracted from the conduit **676** and air which was carrying the fiber passes on into the conduit **678,** drawn by the fan **680.** Fan **680** may be energized by applying an electrical potential between the lines **682** and **684,** or the fan may be energized only when fiber is being distributed or the system purged. Alternatively, each station may have an individual fan associated with it. The operation and structure of transition valves such as valves **666,** 668 and **670** are described more fully in connection with FIG. **5** of the above mentioned U.S. Pat. No. 3,649,082.

The distribution system of this embodiment is capable of supplying the fiber requirements of any of the stations **650, 652** and **654,** whenever any of the level control switches, **682, 684** or **686,** respectively associated with each of these stations, is opened, indicating thereby the need for additional fiber at that station. The position of each of the ganged switches **690, 692,** and **694,** each of which is comprised of five individual switches, determines from which source the station associated with that switch is to be fed. For example, when any of the ganged switches is positioned in the "up" position that ganged swtich **690** is shown in, then that station will be fed solely from source B. When any of the ganged switches is positioned in the "down" position that ganged switch **694** is shown in, then that station will be supplied solely from source A. This choice between "up" or "down" positions is of course arbitrary, and is made solely for the purpose of detailing the operation of this embodiment. This embodiment could

also be used with more than two sources by adding additional positions which the ganged switches can assume and additional circuitry in the same manner as the circuitry already present. Therefore, whenever the ganged switches are in the positions shown in FIG. 8, stations 650 and 652 will be supplied from the source B and station 654 will be supplied from source A. It is apparent that all three of the stations could be supplied from either source or two could be supplied from one and one from the other. Any of the stations can of course be removed from the system so that no fiber is supplied to it by throwing the appropriate on-off switches as described below.

In this embodiment, stations which are shown closest to each supply need not be supplied from that source. Furthermore, if two or more stations are demanding fiber from either supply, stations to the "left" receive fiber first. Neither of the conditions necessarily is indicative of the actual physical arrangement since the stations can be physically disposed in any location, regardless of their position in the schematic of FIG. 8, so that station 650, for example, could be just as easily located next to source A as source B. It should then be obvious that the arrangement of stations on FIG. 8 is not a limitation.

Assuming that the ganged switches 690, 692 and 694 are all in the position shown and that the level control switches 682, 684 and 686 are all open, calling for fiber, the operation of this embodiment will now be detailed. Whenever all of the level control switches of all of the stations to be fed from source B are closed, indicating no need for fiber at any of the stations, current passes through coil 696 of recycle timer relay 698 and coil 700 of relay 701, preventing the distribution system which distributes fiber from source B from operating, while also interrupting the circuit which supplies the electrical excitation to cause source B to supply fibers. When this emboidment is then operated with the ganged switches 690, 692 and 694 in the positions shown in FIG. 8 with stations 650 and 652 then supplied from source B and station 654 from source A, a current path leads through coils 696 and 700 via lines 660 and 702, normally closed switch 704, line 706, switch 708 of ganged switch 690, lines 710 and 712, closed level control switch 682, lines 714 and 716, switch 718 of ganged switch 690, line 720, switch 722 of ganged switch 692, lines 812 and 814, level control switch 684, lines 838 and 840, switch 726 of ganged switch 692, line 728, switch 730 of ganged switch 694, line 732, switch 734 of ganged switch 694, line 736, coils 696 and 700, and line 662.

The passage of current through coil 700 opens normally closed switch 737 immediately, cutting off the current which was flowing through coil 738 of feeder relay 739 via lines 660, 740 and 742, closed switch 737, and line 744. The normally closed switch 746 then opens immediately preventing source B from supplying fibers to conduit 676 in the same maner as in FIGS. 1–3 of the above mentioned application Ser. No. 694,269. However, the switch 746 delays for a short time in closing after current begins to flow through coil 738 so that the system will be fully prepared to receive fiber fed into the conduit 676 from source B.

The normally closed switch 704 delays for a period of a few seconds in opening so that purging can be accomplished as described below. Switch 704 then opens a predetermined time after current begins to flow through coil 690 and interrupts the flow of current through coils 696 and 700. The interruption of current through coil 700 closes switch 737 and the interruption of current through coil 690 closes switch 704 recompleting the current path through coils 690 and 700. Therefore current will flow through coils 690 and 700 except during momentary periodic intervals during which switch 704 briefly opens and switch 737 briefly closes. Switch 737 never closes however for a time sufficient to allow coil 738 to close the switch 746 which delays for a few seconds in closing.

However, when the passage of current through coils 690 and 700 is interrupted by the opening of either or both of the level control switches 682 and 684, switch 737 remains closed and current flows through coil 738 of feeder relay 739 until switch 746 closes causing source B to begin to supply fibers.

Between the time when a level control switch opens and when switch 746 closes, the transition valve of the station demanding fiber which is to be supplied first is opened so that fiber can be supplied to that station. For the purposes of explaining the operation of this embodiment, the switch 682 will be assumed to open first followed immediately by the opening of switch 684. It will of course be understood that should one level control switch 682 or 684 open, and not the other, the station associated with the open level control switch alone will be fed.

Since stations 650 and 652 are both supplied from source B, station 650 receives the fiber from source B first since it is furthest to the "left" in the drawing. As pointed out above, this does not necessarily mean that station 650 is physically nearest to source B or to the "left". Because the switch 682 is open, current flows through the relay coil 750, opening the valve 666. The positive pole of the potential connected to line 660 is then electrically linked to one side of the coil 750 via line 702, closed switch 704, line 706, switch 708 of ganged switch 690, lines 710, 712, 752 and 754, switch 756, line 758 and on-off switch 760. The negative pole attached to line 662 is attached to the other side of coil 750 via lines 762 and 744 so that the potential between line 660 and 662 appears across coil 750, opening valve 666.

The transition valve 666 remains open, supplying fibers to the station 650 until the level control switch 62 closes, indicating that the station has received a sufficient amount of fiber. The closing of switch 682 then completes a current path through the relay coil 790 of the relay 792. This path leads from the positive pole through lines 660 and 702, normally closed switch 704, line 706, switch 708 of the ganged switch 690, lines 710 and 712, switch 682, line 800, coil 790, and lines 762, 744 and 662 to the negative pole. The passage of current through coil 790 immediately closes switch 802 and shifts switch 756 from contact with line 754 to contact with line 804. This interrupts the current flowing through coil 750 and the transition valve 650 closes immediately. The closing of switch 802 provides a parallel path around switch 682 so that current will flow through coil 790 until all the stations which are to be fed from source B have received fiber, even if switch 682 opens indicating a need for additional fiber.

The closing of switches 682 and 802, which occurs when the fiber needs of station 652 have been completely satisfied, also completes a current path through the relay coil 806 which in turn opens the transition

valve 668 in the same manner as valve 666. This current path through coil 806 begins at line 660 and continues through line 702, closed switch 704, line 706, switch 708 of ganged switch 690, lines 710 and 712, level control switch 682 (or line 752, switch 802 and line 800) lines 714 and 716, switch 718 of ganged switch 690, line 720, switch 722 of ganged switch 692, lines 812, 814 and 816, switch 818, line 820, on-off switch 822, coil 806, and lines 762 and 744 to line 622. In the same manner as described in connection with the operation of station 652, valve 668 remains open as long as the level control switch 684 indicates a need for additional fibers by remaining open. The closing of switch 684 connects the coil 824 of relay 826 between lines 814 and 762 which are respectively at the potential of the lines 662 and 660. The passage of current through coil 824, which results from the closing of level control switch 684, closes switch 830 and shifts switch 818 from line 816 to line 834, interrupting thereby the passage of current through coil 806 and closing valve 668.

Since station 652 is the last station which is to be fed from source B, the system is now purged in a manner similar to that discussed in connection with FIGS. 1–7. The closing of switch 684 completes a current path through the coil 700, opening the switch 737. The opening of switch 737 interrupts the current path through coil 738 of the feeder relay 739, opening the switch 746 immediately. The opening of switch 746 then removes the excitation which causes the source B to supply fibers. This current path through coil 700 leads from line 660, through line 702, normally closed switch 704, line 706, switch 708 of ganged switch 690, lines 710, 712, and 752, closed switch 802, lines 800, 714 and 716, switch 718 of ganged switch 690, line 720, switch 722 of ganged switch 692, lines 812, 814 and 816, switch 830, lines 836, 838 and 840, switch 726 of ganged switch 692, lines 728, switch 730 of ganged switch 694, lines 732, switch 734 of ganged switch 694, line 736, coil 700 and line 662. Since coil 690 is connected in parallel with coil 700 a path also passes through coil 690. After current passes through the coil 690 for a predetermined length of time the switch 704 opens interrupting the paths through the coils 690 and 700.

The closing of the level control switch of the last station which is to be fed from source B, in this example switch 684, also completes a circuit through the relay coils associated with each of the transition valves of stations fed from source B so that purging occurs. The closing of switch 684 then connects coils 750 and 806 between lines 762 and 736, which are respectively at the potentials of lines 660 and 662. Current passes from line 762 through coil 750, on-off switch 760, switch 756, line 804, and switch 856 to line 736, and from line 762 through coil 806, on-off switch 822, line 820, switch 818, line 834, and switch to line 736.

Between the time when switch 746 opens and when switch 704 opens, the system is purged. All of the transition valves associated with source B, in this example transition valves 666 and 668, are open but no additional fiber is supplied from source B. The opening of switch 704 interrupts the current path through coils 790 and 824, opening switches 802 and 830 and shifting switch 756 from line 804 to 754 and switch 818 from line 834 to 816. The movement of switches 756 and 818 interrupts the current paths through coils 750 and 806, closing valves 666 and 668.

In addition, the opening of switch 704, also interrupts the current paths through coil 690 and 700 closing switch 737 and switch 704. The closing of switch 704 recompletes the current path through coils 690 and 700, opening switch 737 immediately and switch 704 after a predetermined time, as well as completing the path through coils 790, 824, 750 and 806. Therefore, the system will purge itself in the manner described each time switch 704 opens until a level control switch, in this example switch 682 or 684, opens, indicating a need for additional fiber at which time the system will supply fiber to the station in the manner described. Often, the number of stations fed will be sufficient so that a level control switch will usually be open after a single purging.

At the same time that station 650 is being fed, station 654 is being simultaneously and independently supplied from source A. A plug or manual cut-off valve 835 would of course have to be inserted in the conduit between the stations 652 ans 654 to insure that each station would be fed by just one source.

The distribution system associated with source A operates similar to the system associated with source B in that whenever all of the level control switches associated with source A are closed, source A is prevented from supplying fibers and the system is periodically purged. Since in this example only station 654 is supplied from source A, level control switch 686 when closed completes a circuit through coils 860 and 862 via lines 660, 740, 864, and 866, normally closed switch 868, line 870, switch 872 of ganged switch 690, line 874, switch 876 of ganged switch 690, line 878, switch 880 of ganged switch 692, line 882, switch 884 of ganged switch 692, line 886, switch 890 of ganged switch 694, lines 892 and 894, level control switch 686, lines 896, and 898, switch 900 of ganged switch 694, lines 902 and 904, coils 860 and 862, and lines 906, 908, 762, 744 and 622. When switch 686 is closed, current also flows through coil 910 of relay 912 from line 762 which is at the potential of line 660 to line 902 which is at the potential of line 662 via lines 914, 896 and 898, and switch 900 of ganged switch 894. As described in connection with master contol 656 switch 868 will periodically open and the system will repeatably purge itself until switch 686 opens, indicating a need for additional fibers.

When level control switch 686 opens, the current path through coils 862 and 860 is interrupted and the normally closed switch 916 closes. The closing of switch 916 connects coil 918 between line 762 which is at the potential of line 662 and line 864 which is at the potential of line 660, via line 920. The passage of current through coil 918 closes switch 922 which applies an excitation to the source A to cause fibers to be fed into the conduit 676. However, switch 922 delays a few seconds in closing so that the station will be fully ready to receive the fibers.

The opening of level control switch 686 also completes a current path through coil 924, opening valve 670 thereby, from line 886, which is at the potential of line 660, switch 890 of ganged switch 694, lines 892, 894 and 926, switch 928, on-off switch 932, line 934, and coil 924 to line 762 which is at the potential of line 662. When switch 686 closes indicating that enough fibers have been fed to station 654, a circuit is completed

through coil **910** from line **894** to line **762** and switch **928** shifts from line **926** to line **930.**

Since station **654** is the only station fed from source A, the system is purged after the fiber needs of station **654** have been satisfied. The closing of switch **686** completes a circuit through coils **860** and **862,** opening switch **916** and halting the feeding of fiber into the conduit from source A. The coil **924** is also connected between line **902** which is at the potential of line **662** and line **902** which is at the potential of line **660,** via the on-off switch **932,** line **934,** switch **928,** line **930,** swithc **936** of ganged switch **694** and line **938.**

This embodiment also has the further advantage that any of the stations can be wholly removed from the system. For example, station **650** can be removed by closing switch **940,** shorting switch **682,** and opening swtich **750,** preventing the opening of valve **666.** This feature could also be utilized with any of the other embodiments of the invention disclosed herein.

Thus, it is apparent that there has been described electrical control systems which provide for the stated objects and advantages of the invention. Other objects and advantages and even further modifications and embodiments of the invention will become apparent to those of ordinary skill in the art upon reading this disclosure. However, it is understood that this disclosure is intended to be illustrative and not limitative, the invention being described by the appended claims.

What is claimed is:

1. A method of distributing fibers from at least a single source to a plurality of stations, comprising the steps of:

checking, only after one of said stations indicates a demand for fibers, each of said stations in a fixed sequence to determine which of said stations is demanding fibers,

halting said checking whenever a given station is determined to be demanding fibers, and entraining said fibers from said source in an air stream connecting said source to a given station,

removing said fibers from said air stream at said station determined to be demanding fibers until said station is no longer demanding said fibers, and

continuing said checking until each of said stations in said fixed sequence has been checked.

2. A method as in claim **1,** including the step of preventing the removal of fibers from said air stream at stations which are not demanding fiber.

3. A method as in claim **1,** wherein said air stream is constrained in a pneumatic tube and including the step of purging said tube after all of said stations in said sequence have been checked.

4. A method as in claim **1,** including the step of delaying said entraining for a given time after said checking of all of said stations in said sequence is completed.

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