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Fuss

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[54] **AIR CONVEYANCE SYSTEM AND CONTROL**

[75] Inventor: **Gunter G. Fuss,** Daly City, Calif.

[73] Assignee: **Free-Flow Packaging Corporation,** Redwood City, Calif.

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[52] **U.S. Cl.** **302/28,** 141/67

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

[58] **Field of Search** 302/28, 59; 141/93, 141/67

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Primary Examiner—Evon C. Blunk
Assistant Examiner—H. S. Shane
Attorney—Paul D. Flehr et al.

[57] **ABSTRACT**

A system (method and apparatus) for effecting delivery of a predetermined quantity of lightweight subdivided material to a preselected distribution outlet in a pneumatic conveyance system having a plurality of distribution outlets or stations. The system operates in response to a demand signal from the preselected distribution outlet to initiate a timed sequence of operation of a conveyance blower, simultaneously with movement of flap means adjacent the preselected distribution outlet to divert the conveyance gas and entrained lightweight materials to said preselected distribution outlet. The flap means is held in diverted position by movement of a conveyance gas until such time as the timed blower sequence has been completed. The time period of operating the blower insures delivery of the desired quantity of the lightweight material to the preselected outlet. The control system also includes means to insure continuance of the timed blower sequence with respect to the selected distribution outlet and to prevent interruption of the timed sequence by operation of the control mechanisms at other distribution outlets. The system has utility in the intermittent distribution of subdivided materials (e.g., cushioning and packaging materials, dry cereals, etc.), only upon demand, to a particular filling or packaging outlet, with virtual elimination of blower noise except during the short interval of replenishing the supply at various localized distribution stations.

15 Claims, 5 Drawing Figures

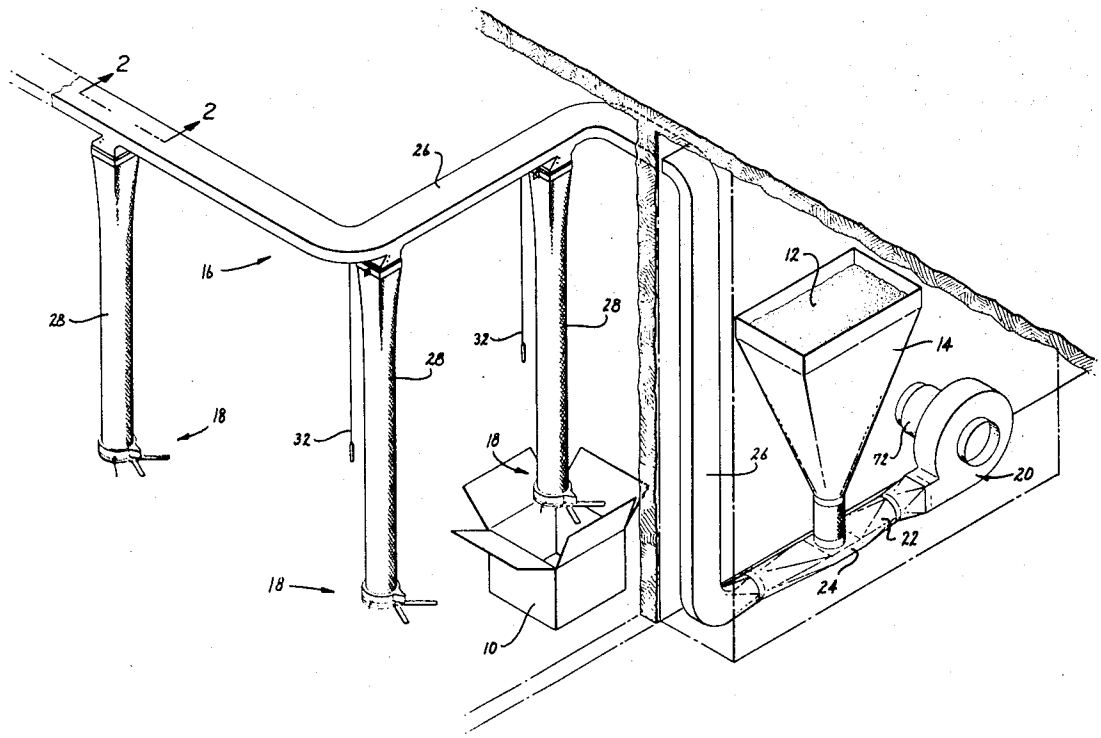
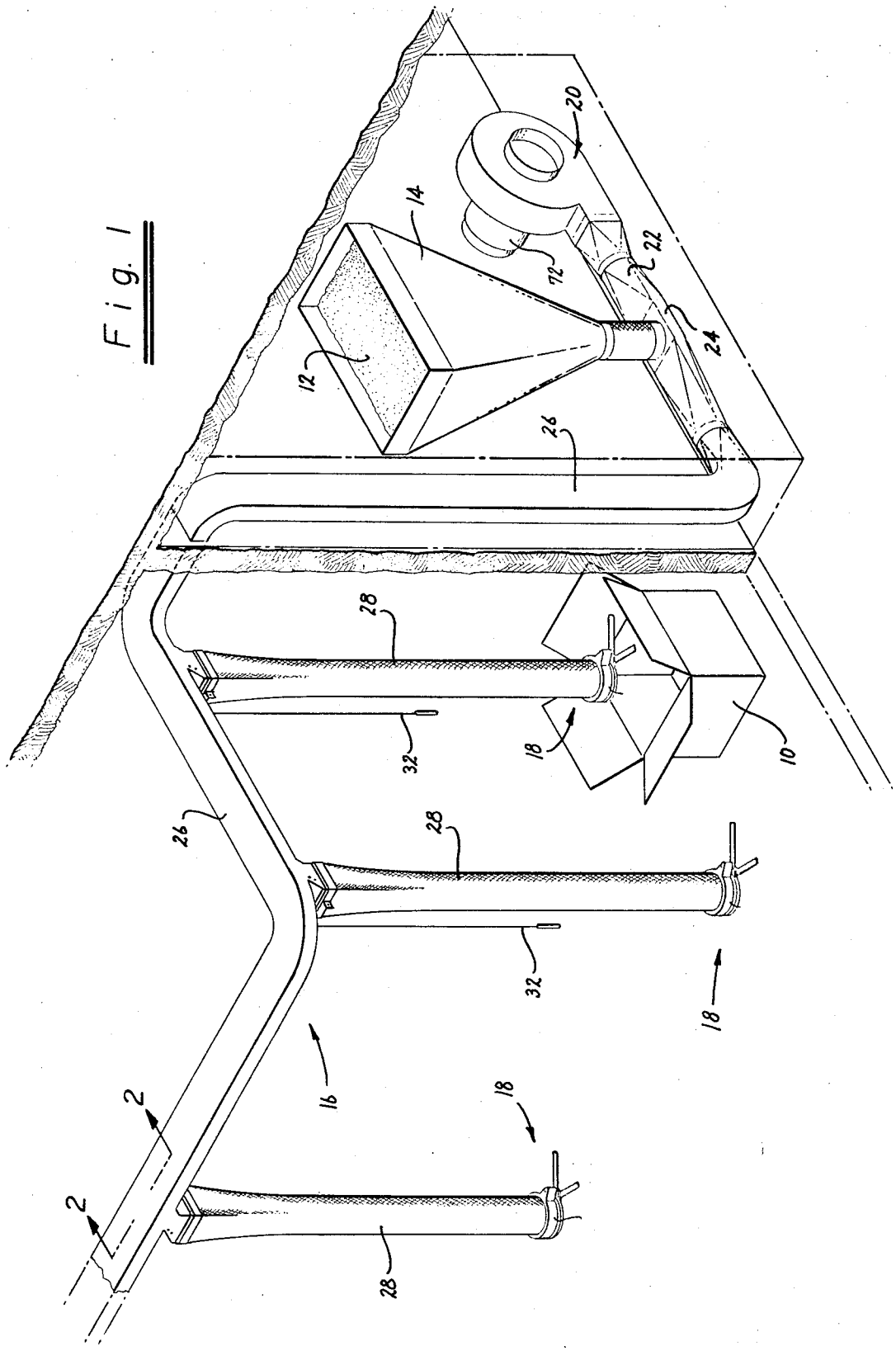


Fig. 1



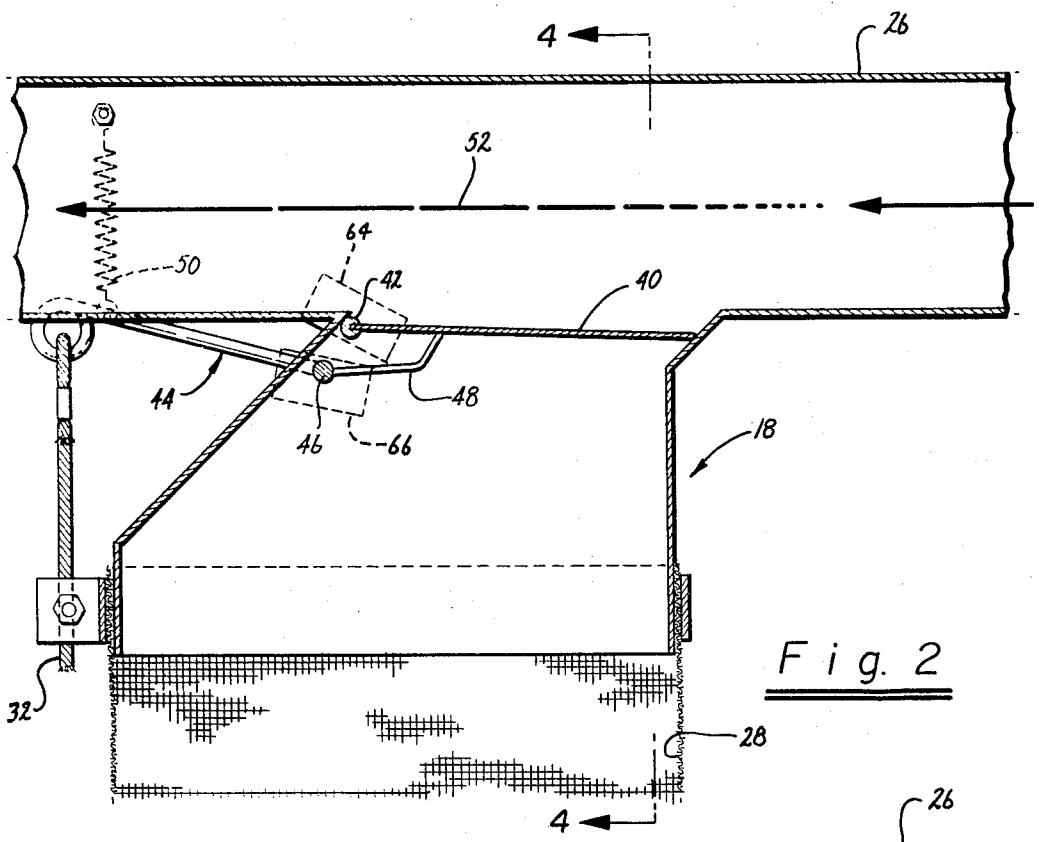

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Fig. 2

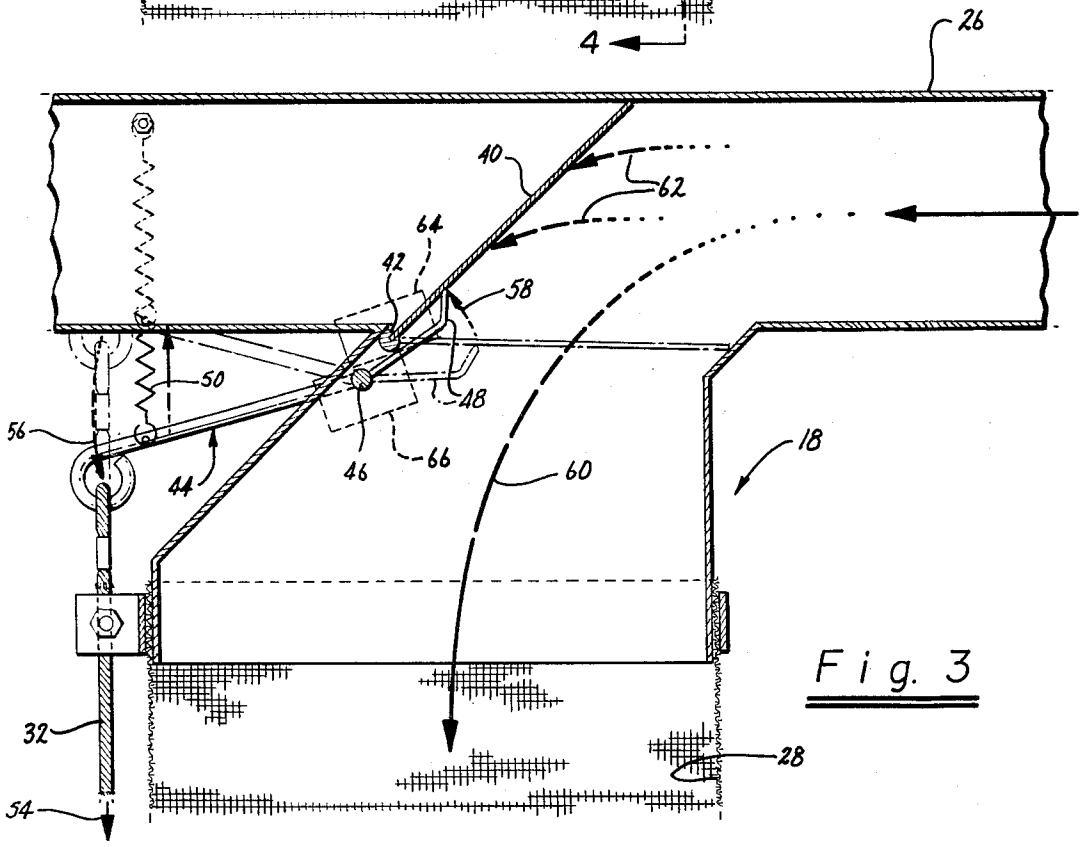
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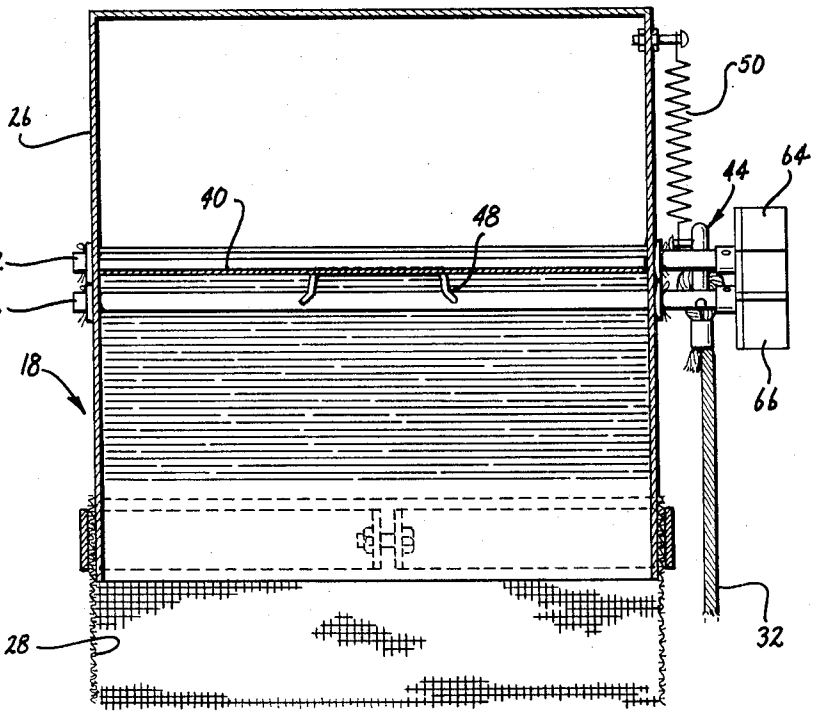
Fig. 3

Fig. 4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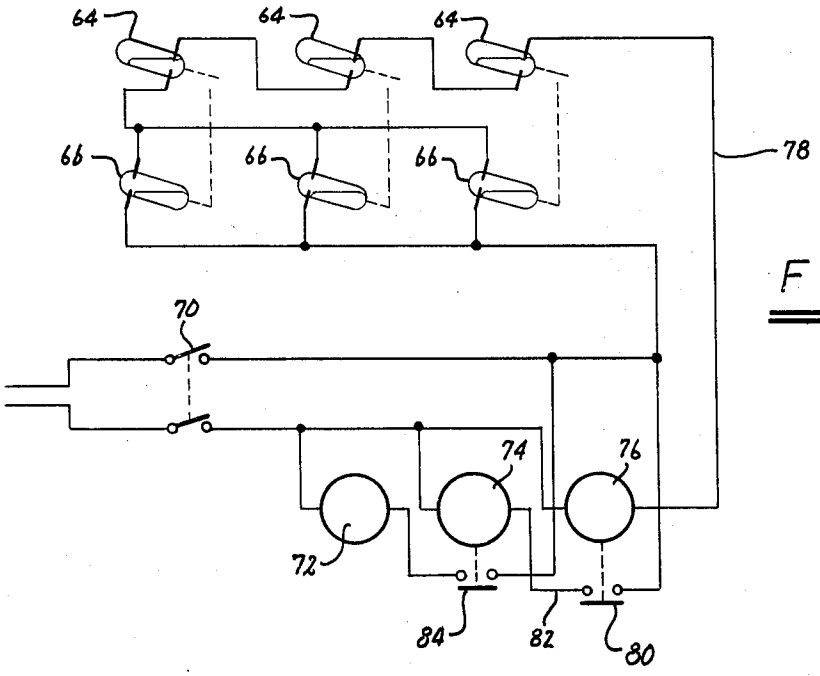
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Fig. 5

AIR CONVEYANCE SYSTEM AND CONTROL

SUMMARY OF THE INVENTION AND OBJECTS

This invention relates generally to systems for the rapid conveyance and selective distribution of subdivided lightweight materials of the type disclosed, for example, in Fuss U.S. application Ser. No. 861,112, filed Nov. 2, 1970.

In general, it is an object of the invention to improve upon the construction of systems of apparatus for such purpose, particularly with respect to control means making possible the rapid delivery of a predetermined quantity of lightweight material to a particular preselected distribution outlet, within a relatively short period of time.

It is another object of the invention to provide an improved system of apparatus of such character capable of effecting a timed delivery of a predetermined quantity of lightweight material to a single distribution outlet, selected from a plurality of such distribution outlets.

It is another object of the invention to provide an improved system of apparatus of such character wherein the delivery of lightweight material to the preselected distribution outlet can be locally controlled by an operator at such distribution outlet.

A further object of the invention is to provide an improved system of apparatus of such character making use of a blower to effect pneumatic conveyance, wherein the blower operates only during a short period of local demand, thus eliminating undesired noise.

A still further object of the invention is to provide an improved method for controlling the operation of a pneumatic conveyance system of the type described, to accomplish the desired result.

Additional objects and features of the invention will appear from the following detailed description of the same, and from the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in perspective of a system of apparatus embodying the present invention.

FIG. 2 is an enlarged fragmentary view in section, along the line 2—2, of a portion of the apparatus of FIG. 1.

FIG. 3 is a like view showing a different stage in the operation of the apparatus.

FIG. 4 is a view in transverse section along the line 4—4 of FIG. 2.

FIG. 5 is a schematic representation of an electrical control circuit for the system of apparatus shown in FIG. 1 through 4.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

In the drawings, the system of apparatus has been illustrated as primarily of metallic construction. It is to be understood, however, that any suitable material such as plastic, composition material, or like construction may be employed in particular embodiments.

Generally stated, the improved system of the present invention makes use of blower means in fluid communication with a substantially closed conveyance system and a source of subdivided lightweight material to be distributed. In accordance with the invention, the blower is operated in a timed sequence by control means, which insure the selective delivery of a predetermined amount of the lightweight material to a particular desired distribution outlet. The control means includes lever means at each distribution outlet for pivoting gas diverting flap means between positions sealing the outlets and positions interrupting the flow of conveyance gas in the closed system, whereby the latter can be diverted and dissipated through a particular preselected outlet. The control means additionally includes switch means to initiate a timer control for the blower and to simultaneously de-energize the control units at the other distribution outlets. The result is a timed conveyance delivery of a predetermined amount of lightweight material to the selected distribution outlet, based on a relatively short period of operation of the blower. Such operation has utility in the short interval replenishment of the supply of material at a particular distribution outlet, with consequent elimination of noise except during the short period of blower operation. A further advantage is that the system operates automatically in response to the demand of an operator at a particular remote distribution outlet.

Referring to the drawings in detail, FIG. 1 illustrates a particular system of apparatus in accordance with the present invention. Assuming a plant distribution operation involving the filling of cartons **10** with a lightweight packaging and cushioning material **12**, the system generally operates to feed material from a suitable supply hopper **14** through a closed conveyance system **16** to various distribution outlets, generally represented at **18**. A source of pressurized conveyance gas, such as the blower **20**, is positioned on the inlet side **22** of the closed conveyance system **16**. Upon demand, the blower **20** functions to continuously introduce air under pressure to the upstream side of the conveyance system **16**, causing lightweight subdivided material **12** in the hopper to be drawn into a sub-adjacent venturi section **24** and conveyed through the conduit **26** of the conveyance system. This operation is more specifically described in the aforementioned Fuss U.S. Pat. No. 3,708,208. As therein disclosed in detail, the blower functions in cooperation with a screened hopper outlet **27** to draw lightweight material from the bottom of the hopper **14** into the low pressure zone of the venturi restriction, where it is picked up and conveyed by the high volume air stream within the venturi restriction.

It is a feature of the present invention that the blower **20** operates to convey lightweight subdivided materials through the conveyance system **16**, only in response to an operator demand for such materials at a particular distribution outlet **18**. As particularly illustrated in FIG. **1**, the closed conveyance system **16** is proivded with a series of remote distribution outlets **18**, which may be formed of elongate conduits fabricated of screening material or like gas dissipating means **28**. The elongate screen sections **28** generally provide a visible reservoir from which lightweight materials (viz., foamed, expanded plastic cushioning units)may be selectively dispensed for use in packaging and cushioning operations, for example, by valve means **30**. At such time as the supply of packaging or other lightweight materials in the reservoir **28** approaches exhaustion, the operator can signify a demand to replenish the supply by pulling the lanyard or cord **32** to initiate a controlled operation of the blower. As hereinafter described, the blower then operates to convey a predetermined quantity of the lightweight material from the hopper **14** to the involved distribution outlet **18**.

Referring particularly to FIGS. 3, 4, and 5, each distribution outlet is provided with a gas diverting flap means 40. The flap means 40 is supported on a pivot shaft 42 and is free to pivot from a normal position (shown in FIG. 2) where it seals the top or inlet end of the distribution outlet 18, to a gas diverting position within the conduit 26 (shown in FIG. 3) where it diverts the conveyance gas downwardly into the distribution outlet. As illustrated, each distribution outlet is also provided with a lever means 44 mounted for pivotal movements on a pivot shaft 46 and carrying actuating means 48 slidably engaging the flap means 40. The lever 44 is normally biased upwardly by a spring or other suitable biasing means 50, causing the actuators 48 to assume the retracted position illustrated in FIG. 2. In this position of the flap means, conveyance gas is free to bypass the distribution outlet, as it moves through the closed conduit 26 in the direction of arrow 52. However, upon pulling the lanyard 32 in a downward direction (arrow 54), the lever 44 pivots downward (arrow 56) causing the actuators 48 to move upward in contact with the flap means 40 (arrow 58) so that the latter is pivoted to the gas diverting position shown in FIG. 3. In this position of the flap means, the conveyance gas is diverted downward into the distribution outlet 18 (arrow 60) where it is dissipated through the upper portions of the screened reservoir 28. Once the flap means 40 has been pivoted to a gas diverting position as in FIG. 3, the conveyance gas exerts sufficient pressure (arrow s 62) to hold the flap means in diverted position, that is, until the timed period of delivery of lightweight materials to the distribution outlet 18 has been completed. At such time, termination of the blower operation enables gravity and the biasing effect of spring 50 to return the flap means 40 to its normal or rest position, shown in FIG. 2.

It is desirable that the operator control the delivery of packaging materials or other lightweight materials to the distribution outlet 18. For this purpose, the lever 44 and the pull cord 32 can also form part of control means initiating a timed period of operation of the blower 20. Thus, referring again to FIGS. 2–4, gravity type switch means 64 and 66 are mounted, respectively, on each of the pivot shafts 42 and 46, with each switch means being keyed to its support shaft for simultaneous pivotal movements. Any suitable gravity type switch means, such as conventional mercury switches, can be utilized for such purpose. Due to the sliding contact between the actuators 48 and the flap means 40, the switch means 66 on the lever shaft 46 will shift slightly prior to the switch means 64 on the shaft 42 for the flap means. The mounting of the switch means thus provides a slight time delay in the operation of the switch means 66 and 64. This time delay is useful in initiating operation of the blower in response to a signal from the particular gas distribution outlet, just prior to locking out the switching means for such purpose at the other gas distribution outlets. Specifically, as hereinafter described, pulling the cord 32 initially shifts switch 66 to energize a timer control circuit for the blower 20, following which the switch 64 is de-energized to break or open the control circuits for the other distribution outlets 18.

FIG. 5 particularly illustrates a particular electrical control system to achieve the described control function. As illustrated, power is derived from a conventional power source under control of a main (on-off) toggle switch 70. Included in the circuit is a suitable motor for the blower, represented at 72, and starter and time delay relays 74 and 76, which control both the operation and the period of operation of the blower motor 20. Normally, during a rest condition of the control circuit (see FIG. 5), all of the switches 66 are in the open position so that the foregoing power components are de-energized. However, upon signifying a demand at a particular distribution outlet, by pulling cord 32, the associated lever 44 shifts switch 66 to initially close the circuit through the normally closed switch means 64 on line 78, to energize the time delay relay 76 to close switch 80. This in turn energizes the circuit in line 82 for the starter relay 74, actuating the starter switch 84 for the blower motor. The blower motor continues to operate thereafter for a timed cycle of operation determined by the time delay relay 76. In the meantime, the sliding contact of the actuators 48 with the flap means 40 causes the associated lockout switch 64 to open, thus breaking the circuit through switch 66 and line 78. All other circuits remain open because of the normally open position of the switches 66. The net effect on the time delay, obtained by the prior actuation of switch 66, is to permit the time delay relay 76 to take over the operation of the blower motor, so that the blower motor continues to operate throughout the timed cycle. Releasing the pull cord 32 (to return the lever 44 and actuators 48 to their normal positions) consequently has no effect on the continued operation of the blower motor through the timed cycle.

In general, the blower is operated by the time delay relay 76 for a period sufficient to convey an amount of lightweight materials from the hopper 14 to fill or replenish the capacity of the screened reservoir at the involved discharge outlet. Ordinarily, such period of operation may be of relatively short duration, ranging from a few seconds up to, perhaps, 30 seconds. The exact period of blower operation will depend, of course, upon the size and length of the screen section 28, the size and power of the blower, and the character and bulk density of the lightweight materials being conveyed. The indicated range generally relates to the conveyance and distribution of lightweight cellular packing materials (e.g., foamed, expanded polystyrene) and similar lightweight materials, in plant filling and/or packaging operations.

It will be appreciated that the blower motor operates only upon demand, as described above, and then only for the very brief period required to replenish the supply at a particular distribution outlet. As a consequence, the period of time during which noise of the blower is a disturbing element is substantially reduced, if not virtually eliminated. In a typical operation, for example, the blower operation may range to a few minutes of time in an entire day's operation. A further advantage is that each filling operation automatically occurs only with respect to a single column, upon demand of the operator, with no possibility of conflict through simultaneous demand from separate distribution stations.

The overall operation of the above described system of apparatus, in a typical filling or packaging operation, is briefly summarized below:

As noted, the conveyance system is normally at rest, with the blower motor off and each distribution column 28 filled with a supply of packaging material. In thid condition, the operators at the various packaging sta-

tions can dispense packaging materials through their respective valve outlets **30**, as needed. At such time as a particular distribution column becomes substantially empty, through continued use, the operator at such station can replenish the supply by the simple expedient of pulling the cord **32** to initiate the controlled delivery of a predetermined quantity of replacement material to his dispensing station. This operation results through pivoting of the lever **44** to initiate movement of the flap means **40** from its rest position shown in FIG. **2** to the gas diverting position shown in FIG. **3**. Pivoting of the lever **44** simultaneously causes switch **66** on pivot shaft **46** to close the timer contacts at **80**, through actuation of the time control relay **76**. This in turn starts the blower motor **72** through actuation of the starter relay **74**, thereby initiating and maintaining the timed delivery cycle for feeding lightweight material from the supply hopper **14** to the station indicating the exhausted supply. Sequentially, upward pivoting of the flap means **40** causes the normally closed switch **64** to open, thereby breaking the circuit through switch **66** and locking out all other circuits. Upon return of the lever **44** to its normal position (through release of the cord **32**) switch **66** again opens, maintaining the locked-out condition of the other circuits. At the end of the timed cycle of delivery by the blower **20**, the blower operation stops and the conveyance system reverts to its normal rest condition.

From the foregoing, it will be apparent that the system of apparatus and the method of the present invention make possible the rapid replenishment and delivery of a predetermined quantity of lightweight material to a particular distribution outlet, while avoiding the problems arising from simultaneous demand from different distribution outlets. The system thus effects a controlled delivery to a single distribution outlet, providing control over the amount delivered through a timed delivery cycle, in response to the demand of an operator at such outlet. The present invention also enable such results to be obtained with virtual elimination of noise from the blower motor, except during the very short interval of demand and replenishment at a particular distribution station. The system also lends itself to placement of the blower motor and supply hopper at a remote location with respect to the filling or discharge operations, for example, as in FIG. **1**, thus additionally reducing or virtually eliminating any noise problems associated with operation of the blower.

It will be understood that many variations are possible in the method and apparatus described, without departing from the scope of the invention. To illustrate, while an automatically timed period of operation of the blower has been described and illustrated, the invention is clearly not limited to such automatic timing, and manual timing could be substituted with equal facility. For example, the control circuit could be designed to operate by holding the pull cord in the depressed position throughout the replenishment cycle, the control cycle then being timed manually by the operator. To those skilled in the art to which this invention pertains, the foregoing and other similar variations are clearly within the scope of the invention, the disclosure herein being intended to be purely illustrative rather than limiting.

I claim:

1. In a system for the pneumatic conveyance and selective distribution of lightweight subdivided materials to a plurality of gas dissipating distribution outlets, control means operable upon demand to effect delivery of a predetermined quantity of said lightweight material to a preselected distribution outlet, said control means including gas diverting flap means mounted within substantially closed conduit means forming part of said conveyance system, blower means introducing conveyance gas to said closed conveyance system, said flap means being positioned adjacent each said gas dissipating distribution outlet to normally seal and close the same, lever means to pivot each said flap means to a position within said closed conduit means where it diverts conveyance gas for dissipation through the adjacent distribution outlet, said flap means being of a configuration to be held open in said gas diverting position by the movement and pressure of said conveyance gas, and means responsive to movement of the lever means at said preselected distribution outlet to initiate a controlled operation of said blower means to deliver light weight material and conveyance gas only to said preselected gas dissipating distribution outlet.

2. A system as in claim **1** including a timer control for said blower means, responsive to operation of said switch means.

3. A system as in claim **1** wherein biasing means are provided to normally hold said lever means in inoperative position.

4. A system as in claim **1** wherein said control means includes manually operable means at said preselected gas dissipating distribution outlet to actuate and shift said lever means.

5. A system as in claim **1** wherein each of said gas dissipating distribution outlets is in the form of an elongated conduit formed of screening means and having a volume sufficient to receive said predetermined quantity of lightweight material.

6. In a system for the pneumatic conveyance and selective distribution of lightweight subdivided materials to a plurality of gas dissipating distribution outlets, control means to effect delivery of a predetermined quantity of said lightweight material to a single distribution outlet preselected from a plurality of such distribution outlets, said control means including pivotally mounted flap means adjacent each of said gas dissipating distribution outlets, blower means adapted to introduce conveyance gas to said closed conveyance system, each of said flap means being positioned in said closed conveyance system immediately adjacent but downstream from a gas dissipating distribution outlet as respects a point of introduction of conveyance gas from said blower means, lever means to pivot each of said flap means from a normal position sealing a distribution outlet to an operable position diverting conveyance gas for dissipation and discharge through such distribution outlet, said flap means being of a configuration to be held open in said gas diverting position by the movement and pressure of said conveyance gas, first switch means at each distribution outlet for energizing a timer control for said blower means, second switch means at each gas dissipating distribution outlet for deenergizing the switch means at all other distribution outlets, and means interconnecting the lever means and switch means at each gas dissipating distribution outlet, whereby actuating the lever at a preselected gas dissipating distribution outlet serves to initiate a timed sequence of the blower means to convey a predetermined quantity of said lightweight material to said preselected

distribution outlet, while simultaneously preventing conveyance of said lightweight material to said other gas dissipating distribution outlets.

7. A system as in claim **6** wherein said control means includes circuit means interconnecting a power source for said blower means with each of said first and second switch means, and means to effect a sequential operation of the first and second switch means at each distribution outlet.

8. A system as in claim **7** wherein said means to effect sequential operation of said switch means includes mechanical means to effect a time delay in the operation thereof.

9. A system as in claim **6** wherein each of said lever means is provided with biasing means to hold the same in a normally inoperative position.

!0. A system as in claim **6** wherein said first switch means is normally in open position and each of said second switch means is normally in closed position.

11. A system as in claim **6** wherein each of said first and second switch means is mounted for actuation by pivotal movements of said lever means.

12. A system as in claim **11** wherein each of said switch means is gravity actuated, and said first and second switch means are mounted with respect to said lever means to provide a time delay between actuation of said first switch means and actuation of said second switch means.

13. In a system for the pneumatic conveyance and selective distribution of lightweight subdivided materials to plural distribution outlets, control means to effect delivery of a predetermined quantity of said lightweight material to a single distribution outlet preselected from a plurality of such distribution outlets, said control means including a pivotally mounted flap means adjacent each of said distribution outlets, blower means adapted to introduce conveyance gas to said closed conveyance system, each of said flap means being positioned in said closed conveyance system immediately adjacent but downstream from a distribution outlet as respects a point of introduction of conveyance gas from said blower means, lever means to pivot each of said flap means from a normal position sealing a distribution outlet to an operable position diverting conveyance gas to such distribution outlet, first gravity actuated switch means at each distribution outlet for energizing a timer control for said blower means, second gravity actuated switch means at each distribution outlet for de-energizing the switch means at all other distribution outlets, said first and second switch means being mounted with respect to said lever means to provide a time delay between actuation of said first switch means and actuation of said second switch means, said time delay being obtained by a sliding pivotal contact between said lever means and separate actuating means for said flap means, and means interconnecting the lever means and switch means at each distribution outlet, whereby actuating the lever at a preselected distribution outlet serves to initiate a timed sequence of the blower means to convey a predetermined quantity of said lightweight material to said preselected distribution outlet, while simultaneously preventing conveyance of said lightweight material to said other distribution outlets.

14. In a method for effecting delivery of a predetermined quantity of lightweight subdivided materials to a preselected gas dissipating outlet in a pneumatic conveyance system having a plurality of gas dissipating distribution outlets, the steps of providing a source of gas under pressure, introducing gas from said source to a generally closed conveyance system to provide a stream of conveyance gas in said system, diverting lightweight subdivided material from a source of such material into said stream of conveyance gas at a substantially uniform rate per unit of time, said conveyance gas being introduced to said generally closed conveyance system in response to a signal from a preselected distribution outlet, simultaneously diverting gas introduced from said source only through said preselected gas dissipating distribution outlet while preventing diversion of said gas through nonselected distribution outlets, and controlling the duration of a gas introduction on a timed cycle in response to said signal, whereby a quantity of said lightweight material determined by the period of said timed cycle is caused to be moved with said stream of conveyance gas and to be conveyed in said system to said preselected gas dissipating distribution outlet.

15. A method as in claim **14** wherein said diversion of gas from said pressurized source through said preselected distribution outlet is effected by a timed diversion of of substantially all of the gas flow through said preselected gas dissipating distribution outlet.

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