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PNEUMATIC FEEDING ARRANGEMENT FOR SUPPLYING FIBROUS MATERIALS

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2 Sheets-Sheet 1

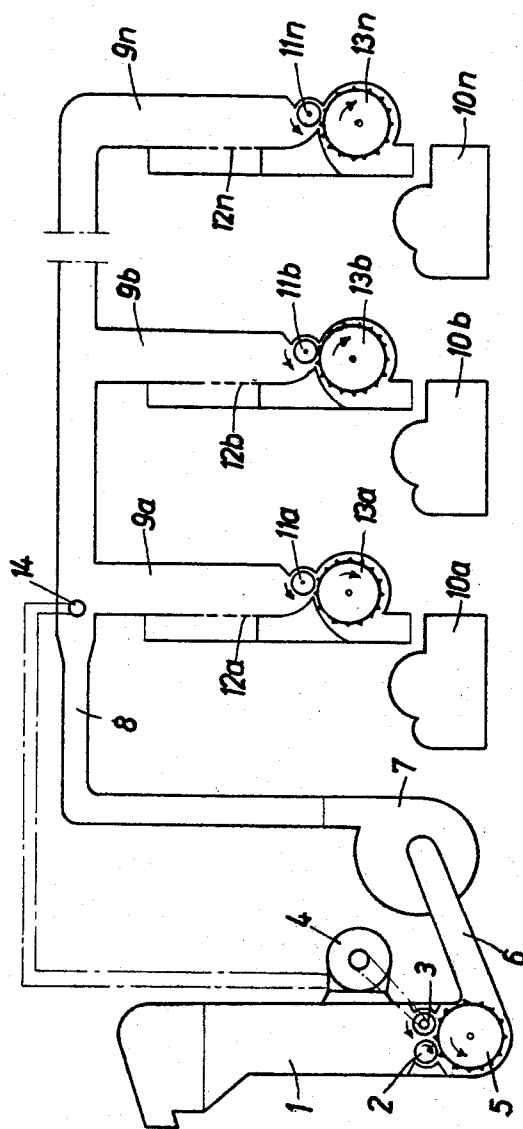


FIG. 1

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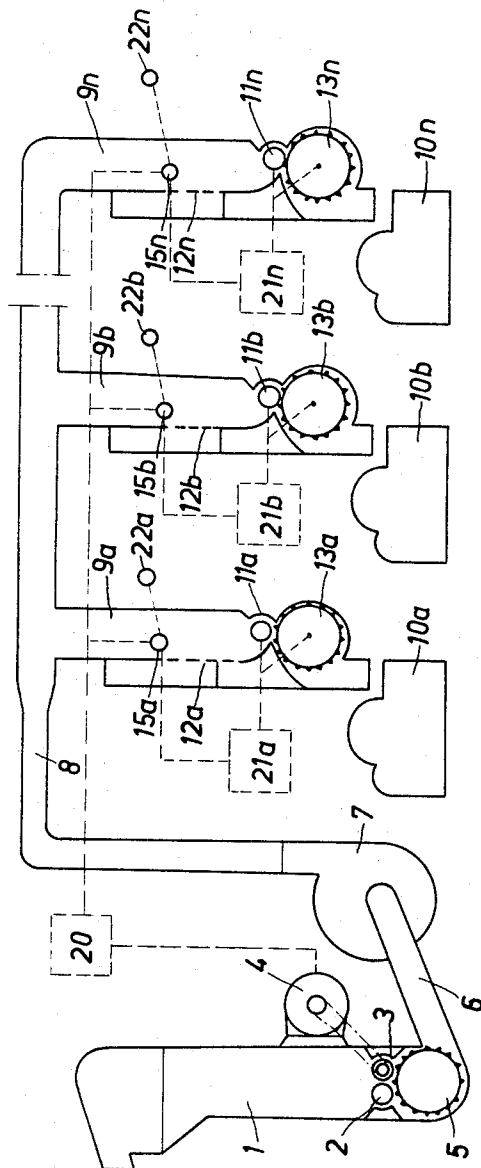
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PNEUMATIC FEEDING ARRANGEMENT FOR SUPPLYING FIBROUS MATERIALS

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ABSTRACT OF THE DISCLOSURE

A pneumatic feeding apparatus having a main supply duct, feeding means associated with such supply duct, a multiplicity of subsidiary ducts leading from said main duct, means for discharging the pneumatically fed material in such apparatus, wherein such subsidiary duct has a substantially air-tight discharge means and has an air discharge means spaced from the discharge means toward the main duct, and wherein the apparatus has a sensing device in the main duct operative to control the feeding of material to the main duct as required by the degree of filling of the subsidiary ducts.

This invention relates in general to equipment for handling materials, and more particularly to a pneumatic feeding arrangement for supplying fibrous materials to one or more receiving locations.

The pneumatic feeding arrangement of the instant invention basically provides a primary duct for guiding an airstream which conveys the fiber materials along a path extending by each receiving location, and a branch duct disposed at each receiving location for communication with the primary duct to receive fiber material conveyed therethrough and to deliver such material to the receiving location for withdrawal thereat. The fiber material is thus introduced into the primary duct by any suitable means, such as for example, a blower which creates the airstream in combination with a feeding device which delivers fibers from a source thereof into the blower for injection into the airstream.

Each of the branch ducts will accumulate fibers up to a limited quantity established by their internal dimensions, the amount of fibers accumulated in any particular duct at a given time being dependent upon the combined rates of fibers introduced into the primary duct airstream, and the rate of withdrawal at the receiving location from such branch duct.

Except for such outlets as are provided at the receiving location terminals of the branch ducts, the primary duct and all branch ducts define a closed system wherein only one-way air and fibrous material flow occurs, i.e. from the inlet of the primary duct to the individual branch ducts. With such a ducting arrangement, whenever one branch duct becomes filled with fibrous material, the resistance to air flow therethrough will increase and the primary duct airstream together with the fibrous material conveyed thereby will tend to seek the other branch ducts which are either empty, or filled to a lesser extent. Consequently, when one branch duct fills up, it is not absolutely necessary to reduce the rate of fibrous material injection into the airstream, although this can be done, because the airstream, which is under a pressure head, will automatically follow the paths of lesser resistance to such other branch ducts. However, when all branch ducts are filled, in the case of fibrous material, a certain small portion of the airstream will still permeate through the branch duct outlets, but the pressure in the primary duct will rise.

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In practical applications of the invention, it is not desirable to allow continued introduction of fibrous material into the primary duct airstream after the branch ducts have accumulated a predetermined quantity of fibrous material. For such purpose the invention provides a means responsive to the accumulation of fibrous material in the branch ducts which accumulation sensing means is connected to the fiber introducing means to regulate the operation thereof and hence, the rate at which fiber is injected into the primary duct, in accordance with the quantity of fiber accumulated in the branch ducts. Such regulation can be either an on-off type or a proportional type, as desired, but for simplicity, is preferably an on-off type, whereby at accumulation conditions below the limit quantity, fiber injection into the primary duct proceeds at a normal operating rate, and upon attaining limit quantity accumulation, fiber injection is interrupted until sufficient fiber withdrawal at one or more receiving locations removes such limit accumulation condition, upon which event, normal fiber injection is resumed.

According to one embodiment of the invention, a pressure sensor disposed to sense the airstream pressure in the primary duct is used to regulate fiber injection. The pressure sensor generates a signal, which can be either a change of switching state, an electrical voltage, or even a mechanical movement, whenever the primary duct airstream pressures reaches a value corresponding to the accumulation of a predetermined quantity of fiber in each branch duct.

Another embodiment of the invention provides for each branch duct, a photoelectric means disposed to sense the occurrence of a predetermined fiber accumulation in the duct, and generates a signal upon the occurrence of such accumulation condition to control the operation of the fiber injecting means. Consequently whenever the signals from all of such photoelectric devices indicate the simultaneous occurrence of limit accumulation conditions in their respectively associated branch ducts, injection of fiber into the primary duct is interrupted.

The use of such photoelectric devices affords control of fiber injection through sensing the physical presence of fibers accumulated up to a given length from the outlet end of each branch duct, the photoelectric devices being stationed at lengths from the branch duct outlets corresponding to the intended accumulation limits, such that the fiber upon accumulating to said limits interrupt the reception of light by a photoelectric sensor.

These pneumatic pressure and photoelectric techniques can be combined, if desired, to provide in the pneumatic fiber feeding arrangement of the invention either a redundant control of fiber injection wherein the branch duct fiber accumulations are verified both pneumatically and photoelectrically, or else a fiber feeding arrangement wherein the overall control of fiber injection is determined by primary duct pressure conditions, and the photoelectric devices are used to indicate which branch ducts are filled to capacity and/or to regulate the withdrawal of fibers from their associated branch ducts.

With regard to the prior art, it is known already to conduct fibers, for instance cotton flock, by compressed air through a conduit to a plurality of filling shafts branching off one behind the other from it, such filling shafts each being followed by a card. In this connection, the fibers are fed or injected by a device into the conveyance conduit in a quantity which is greater than the quantity which can be taken up by the filling shafts. The excess fibers are conveyed further through the conduit, as a rule back to the injecting device. Accordingly, a portion of the fibers are moved several times over the same path; this not only constitutes an uneconomical expense but

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frequently also results in undesired damage to the fibers.

The object of the present invention is a system for the conveying of fibers by compressed air to a plurality of filling shafts which branch off and from it one behind the other in which such recirculating multiple conveyance is avoided.

In accordance with the invention, the primary duct or conduit is closed at one end and the drive of the device for the continuous feeding of fibers into the primary duct can be controlled by a measuring device which is influenced by the extent to which the branch ducts or filling shafts are occupied by fibers.

The invention is particularly adapted for use in supplying cotton fibers to groups of carding machines located within a textile plant. It is therefore, an object of the invention to provide a pneumatic feeding arrangement for supplying fibers to one or more receiving locations for withdrawal thereat.

Another object of the invention is to provide a pneumatic feeding arrangement as aforesaid wherein the fibers are introduced into an airstream guided by a primary conduit and are carried thereby to communicating branch ducts at the individual receiving locations for limited quantity temporary storage in such branch ducts until withdrawal.

A further object of the invention is to provide a pneumatic feeding arrangement as aforesaid wherein the introduction of fiber into the primary duct is regulated in accordance with the quantities of fiber accumulated in the individual branch ducts.

A further object of the invention is to provide a pneumatic feeding arrangement as aforesaid wherein the introduction of fiber into the primary duct is interrupted whenever a predetermined fiber accumulation condition is reached in each branch duct.

A further object of the invention is to provide a pneumatic feeding arrangement as aforesaid wherein the sensing of the quantity of fiber accumulated in the branch ducts is accomplished by sensing the pneumatic pressure in the primary duct.

A further object of the invention is to provide a pneumatic feeding arrangement as aforesaid wherein the quantitative determination of fiber accumulation in the branch ducts is accomplished photoelectrically.

A further object of the invention is to provide a pneumatic feeding arrangement as aforesaid whereby such branch conduits wherein the fiber accumulation has reached a preset level can be identified, either at their respective receiving locations or remotely.

Still another and further object of the invention is to provide a pneumatic feeding arrangement as aforesaid which is adapted to supply cotton fiber to one or more carding machines stationed at separate locations.

Other and further objects and advantages of the invention will become apparent from the following detailed description and accompanying drawing wherein FIG. 1 illustrates schematically, and partially in section, a pneumatic feeding arrangement according to a preferred embodiment of the invention utilizing air pressure sensitive control means.

FIG. 2 is substantially identical to FIG. 1, showing a photoelectric control means in place of the air pressure meter of FIG. 1.

As exemplified by the drawing, the cotton or other fiber to be delivered to the card machines 10a, 10b and 10n is expediently held in a hopper 1, for example a charging hopper 1 which is provided at its lower end with a pair of feed rollers 2 and 3. These feed rollers 2 and 3 are rotatably driven by an electric motor 4, at a relatively slow peripheral speed, approximately 0.5 meters per second. Below the rollers 2 and 3 there is provided a receiving roller 5 which is provided with projecting pins or tooth members, and which rotates at a considerably higher peripheral speed to pass the fibers fed by the rollers 2 and 3 into a conduit 6. The roller 5 can be driven by

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the same motor 4 as used for driving rollers 2 and 3, by using a suitable transmission (not shown) to obtain the required speed for roller 5, or said roller 5 can be driven by an independent motor means (not shown) as desired.

The conduit 6 discharges into a radial blower 7, the outlet of which discharges into a primary duct 8 which leads to a plurality of communicating branch ducts 9a, 9b, 9n, one for each respective carding machine 10a, 10b, 10n to be supplied with fiber. The illustration of only three carding machines 10a, 10b, 10n should not be construed to indicate that the invention is limited to pneumatic feeding arrangements capable of delivering fiber to only three receiving locations, but rather as a typical example. In accordance with the invention, any number of carding machines, such as 8 to 16 cards, can be supplied at separate receiving locations simply by providing one branch duct for each location.

The primary duct 8 is preferably extended overhead past each card receiving location with the branch ducts 9a, 9b, 9n extending vertically downward so that the fiber accumulated therein will be aided by gravity in withdrawal.

At the lower, or outlet end of each duct 9a, 9b, 9n, a slowly rotating delivery roller, 11a, 11b, 11n respectively, is provided, and so arranged that, together with the fiber withdrawn by such rollers 11a, 11b, 11n out of ducts 9a, 9b, 9n, the rollers 11a, 11b, 11n provide a substantially hermetic sealing of their respective ducts 9a, 9b, 9n.

On one side, each branch duct 9a, 9b, 9n is provided with an air outlet opening, 12a, 12b, 12n respectively.

Below each delivery roller 11a, 11b, 11n there is provided a take-up roller 13a, 13b, 13n respectively, such rollers 13a, 13b, 13n having projecting pins or teeth and being driven for rotation at a considerably higher peripheral speed than the delivery rollers 11a, 11b, 11n. The take-up rollers 13a, 13b, 13n receive fiber fed to them out of ducts 9a, 9b, 9n by their corresponding delivery rollers 11a, 11b, 11n and in turn feed such fiber to corresponding carding machines 10a, 10b, 10n.

In the primary duct 8, there is installed a pressure sensing instrument 14 which responds to the pneumatic pressure within duct 8. This pressure sensor 14 can be expediently a switching type or one which provides any appropriate electrical or mechanical signal convertible into a switching state change. Pressure sensor 14 is so connected with the circuit of the electric motor 4 that the operation of said motor 4 is interrupted whenever, and for as long as the pneumatic pressure in duct 8 exceeds a predetermined value.

The pneumatic pressure in the primary duct 8 will remain relatively low as long as the air forced in (along with the fiber) by the blower 7 can escape practically unimpeded through the openings 12a, 12b, 12n. As soon, however, as all the branch ducts 9a, 9b, 9n are filled with fiber to a level above their openings 12a, 12b, 12n, the pneumatic pressure in duct 8 will increase above the predetermined value.

When such condition occurs, the pressure sensor 14 will provide a signal, i.e. open a switch to interrupt the operation of the motor 4 thereby interrupting the fiber feeding action of the rollers 2 and 3. When one of the ducts 9a, 9b, 9n has been emptied again by a delivery roller 11a, 11b, 11n to such extent that air can escape sufficiently from an opening 12a, 12b, 12n, the primary duct 8 pressure will drop and accordingly the pressure sensor 14 will revert to its normal state to allow motor 4 to resume operation, and fiber will be again injected into the air supplied by blower 7.

As compared with the previously known pneumatic fiber conveyance devices in which an excess quantity of fibers is always conveyed and the excess quantity returned to the starting point, the arrangement described has the advantage that all fibers are exposed to the conveyance stream only a single time. Aside from the fact that in this way damage to the fibers is avoided, the operating

expense is less and the plant is cheaper, due to the elimination of the return line, than the previously customary systems with continuous return of an excess amount conveyed.

The control of the electric motor 4, instead of being effected by a pressure measuring instrument, can, for instance also be controlled by photoelectric cells 15a, 15b, 15n in the manner that its operation is interrupted as long as all filling shafts 9a, 9b, 9n are filled with cotton to above the photoelectric cells 15a, 15b, 15n.

From the foregoing description, it can be noted that the invention basically provides for the regulation of the rate at which fiber is introduced into the primary duct 8 in accordance with the quantity of fiber accumulated in the branch ducts 9a, 9b, 9n. In the particular example illustrated in the drawing, this regulation is accomplished by an on-off control of the electric motor 4 which causes the feeding of fiber into the blower 7, which can continue to operate even though no fiber is being introduced into the primary duct 8.

Where photoelectric sensors 15a, 15b, 15n are used to detect the occurrence of limit fiber accumulation conditions in the branch ducts 9a, 9b, 9n, the same signal used for interrupting motor 4 operation can be used to regulate the operation of the blower 7, if desired. For example, where the blower 7 is operated by a variable speed electric motor (not shown) the photoelectric sensor signal can be used to reduce the speed of the blower 7 motor to the extent that sufficient pneumatic pressure is available within the primary duct 8 to push the accumulated fiber in the branch ducts 9a, 9b, 9n down against the outfeed rollers 11a, 11b, 11n for a more positive withdrawal thereby, and yet by reason of such blower 7 speed reduction, to allow a power saving during intervals when no fiber is introduced into the primary duct 8.

It should also be noted, that in accordance with the invention, the fiber accumulation sensing signal can be used to reduce the feed rate of fiber to blower 7 rather than to interrupt it entirely, such feed rate reduction being chosen so as to allow the outfeed means (rollers 11a, and 13a, 11b and 13b, 11n and 13n) to catch up with the fiber accumulations in branch ducts 9a, 9b, 9n and thereby reduce them to levels below the air escape outlets 12a, 12b, 12n while at the same time fiber accumulation in ducts 9a, 9b, 9n continues at a reduced rate. In general, the total fiber accumulation in branch ducts 9a, 9b, 9n will be at a rate equal to the difference between the rate at which fiber is introduced into the primary duct 8, and the sum of the rates at which fiber is withdrawn from branch ducts 9a, 9b, 9n. Whenever fiber is introduced faster into primary duct 8 than is withdrawn from branch ducts 9a, 9b, 9n, fiber will accumulate in said branch ducts 9a, 9b, 9n.

Accordingly, the use of photoelectric sensors 15a, 15b, 15n, can be for a dual purpose, to control the introduction of fiber into primary duct 8, and also to regulate the operation of the outfeed means associated with each individual branch duct 9a, 9b, 9n. For example, the signals from the individual photoelectric sensors 15a, 15b, 15n can be applied to a signal combining means 20, which can be an AND type logic circuit that interrupts or reduces motor 4 operation whenever all branch ducts 9a, 9b, 9n are filled with fiber to their intended capacity limits. The same individual photoelectric sensor signals can be applied to control the operation of drive means 21a, 21b, 21n which establish the fiber withdrawal rate of the respective roller combinations 11a, and 13a, 11b and 13b, 11n and 13n associated with branch ducts 9a, 9b, 9n. Thus, by using the individual photoelectric sensor signals to speed up the rate of fiber withdrawal from one or more branch ducts 9a, 9b, 9n, in cases where such fiber withdrawal rate increases are permissible, excess accumulation conditions in less than all of branch ducts 9a, 9b, 9n can be relieved as they arise, thereby minimiz-

ing the overall down time when the introduction of fiber must either be interrupted or reduced.

Of course, where it is not permissible to increase or otherwise vary the rate at which fibers are withdrawn from the branch ducts 9a, 9b, 9n, the photoelectric sensor signals need not be applied to the drive means 21a, 21b, 21n, but can be applied to individual indicator devices 22a, 22b, 22n, which can be located either in the vicinity of the branch ducts 9a, 9b, 9n and respective carding machines 10a, 10b, 10n, or at a centralized remote location, such as for example at the inlet end of primary duct 8. Thus, whenever fibers within any one or more of the branch ducts 9a, 9b, 9n, accumulate to the capacity limits as established by the positions of photoelectric sensors 15a, 15b, 15n, the interruption of light reception thereby will result in an electric signal generated thereby or derived therefrom, which signal is fed to the combining means 20 to await concurrent reception of similar signals from all other photoelectric sensors 15a, 15b, 15n, to regulate fiber introduction, and said signal is also fed to activate a corresponding indicator device 22a, 22b, 22n. This allows an attendant to discover which branch ducts 9a, 9b, 9n are filled to capacity levels, and if practical, to adjust the operating rate of particular carding machines 10a, 10b, 10n and/or outfeed drive means 21a, 21b, 21n to make such capacity fill conditions occur less frequently.

As can be appreciated by the artisan, the pneumatic fiber feeding arrangement of the invention has many potential diverse industrial applications, and is not necessarily restricted to use with carding machines 10a, 10b, 10n, or even to use with fibers per se, but can be adapted for general use to supply any material in physically divided form capable of pneumatic conveyance to one or more distinct receiving locations.

The invention offers a wide choice of means to regulate the introduction of the material to be pneumatically conveyed, as well as to regulate the material withdrawal rate at the various receiving locations, either independently, or in combination with the regulation of material introduction, and with or without indication of accumulation conditions at the receiving locations.

What is claimed is:

1. A pneumatic feeding arrangement for fibrous materials comprising a manifold duct closed at one end and operatively connected at the other end to means for supplying a fiber-air mixture to said duct under positive pressure, wherein said duct is adapted for conveyance therethrough of a mixture of fibers and air; a plurality of substantially vertical branch hoppers depending from said manifold duct in spaced relation to each other, which hoppers are adapted to receive said fibers; fiber discharge means at the lower end of each of said branch hoppers, which discharge means is substantially tight against the escape of air therethrough; openings in each of said branch hoppers for the escape of air therethrough, which openings are each positioned in said hoppers substantially below the upper end of said hoppers and control means adapted to sense the filling of all of said branch hoppers to a level at least as high as the top of said opening, which control means is adapted to regulate the operation of said mixture supplying means.

2. A pneumatic feeding arrangement according to claim 1, in which said means adapted to be influenced consists of an air pressure meter.

3. A pneumatic feeding arrangement as claimed in claim 2, wherein said air pressure meter is disposed in said manifold duct.

4. A pneumatic feeding arrangement according to claim 1, in which said means adapted to be influenced consists of a plurality of photoelectric cells, one of said cells being arranged in each of said shafts in a distance above said discharging means.

5. A pneumatic feeding arrangement according to claim 1, in which said discharge means comprise a driven roller.

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