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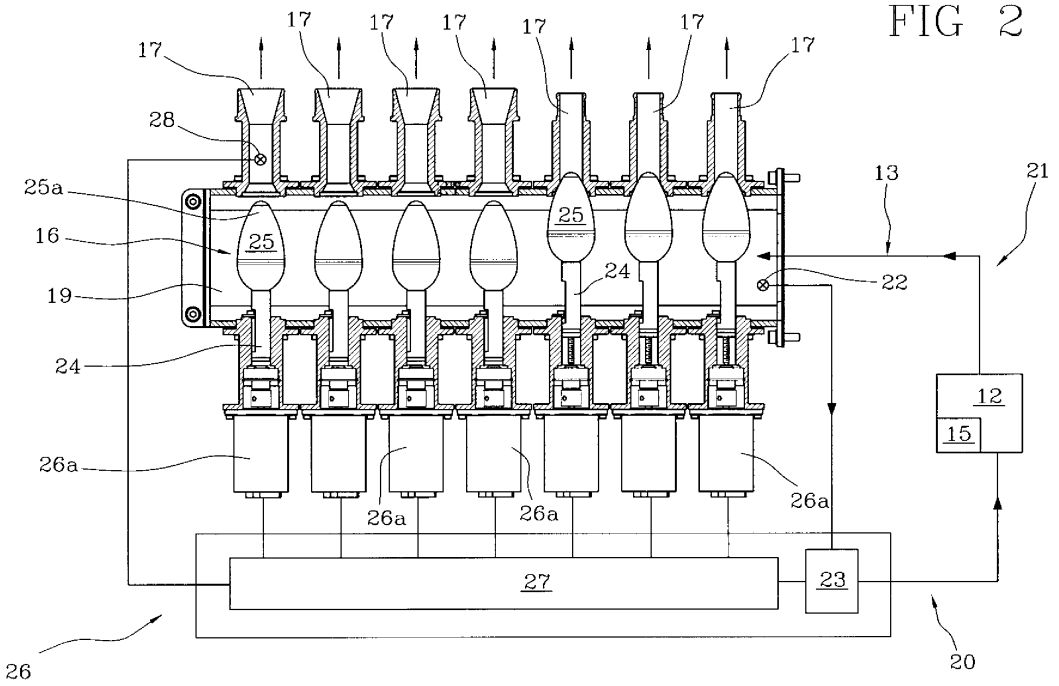
(54) A blower device for expanding continuous webs of filter material

(57) Compacted filter tow is drawn out initially into continuous webs (7) and then expanded by a blower device (1) comprising at least one blower unit (12) connected by way of an air delivery duct (13) to an air flow control system (14) equipped with at least two open/close valves (16) controlling relative air outlet ducts (17); also forming part of the air flow control system (14) is a plenum chamber (19), operating in conjunction with a pressure control circuit (20) in such a way as to maintain a steady equalizing pressure internally of the chamber (19).

FIG 2



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Description

[0001] The present invention relates to a blower device for expanding continuous webs of filter material.

[0002] In particular, the invention finds application in machines for manufacturing cigarette filters.

[0003] Conventionally, machines utilized in the tobacco industry include cigarette filter makers that operate by forming continuous rods or webs of filter material, drawn from compacted bales of fibrous tow held in magazines positioned upstream of the production line.

[0004] More exactly, one or more streams of the filter tow are pulled from the bale, advanced each along a respective mechanical and chemical treatment line, and subjected to a succession of steps resulting ultimately in the emergence of long continuous filter rods.

[0005] One of the steps performed typically on each stream of fibrous tow consists in expanding the material by blowing air at the fibres. The step in question is necessary in order to increase the volume of the tow, to convert the compacted stream drawn from the bale into a web of constant width, and to spread and separate the tow strands in such a way that a uniform and consistent distribution is obtained across the full width of the advancing material, and the density of the web thus rendered similarly constant.

[0006] Blower devices of conventional type installed in filter makers comprise a blower unit generating a flow of air, and a delivery duct by which the flow of air from the unit is conveyed toward a junction from which at least two outlet ducts are taken off, each terminating in a nozzle from which the air is jetted at the tow strands.

[0007] Such devices further comprise a plurality of open/close valves placed at the junction, typically butterfly valves, each located at the inlet of a relative outlet duct. The valves serve to regulate the force of the air flow along the ducts, hence the pressure of the jets impacting on the tow.

[0008] The valves are in general operated manually, as dictated by the specific requirements of the filter making process.

[0009] It can happen that one or more of the air outlet ducts will need to be closed for maintenance or cleaning purposes, or for whatever reason. In this instance, the corresponding valve is closed to shut off the particular outlet.

[0010] This causes pressure to vary in the remaining outlet ducts. In the particular case in point, pressure increases in the other outlet ducts: after an initial transient, the air pressure in the ducts will settle at a level higher than that registering prior to the closure of the aforementioned valve.

[0011] Similarly, when the operation of the previously closed duct is to be restored, the corresponding valve will be reopened. Self-evidently, this causes a further jump in pressure internally of the other ducts, and more exactly a drop in pressure.

[0012] It has been noticed that the structure of the tow exposed to the air jet is spoiled locally by such fluctuations in pressure. In practice, the effect of these unwanted changes in pressure of the air flow from the nozzles is to occasion localized inconsistencies in the distribution of the strands within the web of filter material, with the result that it becomes impossible for a constant density of the web to be maintained, likewise locally.

[0013] Owing to the notable drawbacks caused by closing and opening the air valves, machines commonly used in the tobacco industry are often operated in such a way as to avoid any disturbance whatever of these same valves. On the other hand, such an approach goes against the need for the jets to be set up in different ways to accommodate specific production requirements. Single users must be able to set the operating parameters to suit the type of filter being made, for example by adjusting the force of the jet, the pressure value, etc...

[0014] In practice, adjustments of this kind are not possible when the open and closed positions of the valves are selected manually by an operator, as the response is slow and relatively imprecise.

[0015] Clearly, control over the open/close valves is influenced by the human factor, in terms of the exact positioning of the valve and the speed with which the position can be altered.

[0016] Accordingly, the object of the present invention is to provide a blower device unaffected by the drawbacks mentioned above.

[0017] In particular, the object of the invention is to provide a blower device for expanding continuous webs of filter material, such as will allow the position of open/close valves controlling relative outlet ducts to be varied selectively without affecting the pressure of the flow delivered by other outlet ducts.

[0018] A further object of the invention is to provide a blower device for expanding continuous webs of filter tow in which the position of the open/close valves can be controlled automatically.

[0019] The stated objects are duly realized, according to the present invention, in a blower device for expanding continuous webs of filter material as characterized in any one or more of the appended claims.

[0020] The invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which:

- figure 1 is a schematic view of a cigarette filter maker, equipped with a blower device in accordance with the present invention;
- figure 2 is a schematic sectional view with elements omitted in part to give a clearer picture, showing a detail of the blower device according to the present invention, illustrated in a preferred embodiment;
- figure 3 is a perspective view of the blower device according to the present invention, shown cut away in part.

[0021] With reference to the accompanying drawings,

numeral 1 denotes a blower device for expanding webs of filter material, in its entirety, embodied in accordance with the present invention.

[0022] The device 1 is applicable preferably to a machine 2 for manufacturing cigarette filters.

[0023] As shown in the example of figure 1, a filter maker 2 of the type in question incorporates at least one garniture section 3 on which to form a continuous filter rod 4 from a material caused to advance along a respective mechanical and chemical treatment line 5.

[0024] The mechanical and chemical treatment line 5 is associated with a magazine 6, upstream, from which a respective continuous stream or web 7 of filter tow is drawn off over a guide bar 8. The mechanical and chemical treatment line 5 further comprises a plurality of rollers arranged in contrarotating pairs 9, each pair 9 operated by a relative drive unit to which at least one roller of the pair 9 is coupled. The function of the pairs 9 of rollers is to draw the web 7 of filter material forward and spread the constituent fibres longitudinally and transversely. Finally, the mechanical and chemical treatment line 5 includes a chemical treatment station 10 at which the web 7 of filter material is impregnated with selected substances such as plasticizers or the like.

[0025] The filter maker 2 further comprises a blower device 1 operating on the web of filter tow during its passage preferably through at least one blowing station 11.

[0026] In a preferred embodiment of the machine there will be three such stations 11, positioned one to coincide with the guide bar 8 over which the web 7 of filter material is drawn, another immediately preceding the pairs 9 of rollers, and another immediately preceding the aforementioned chemical treatment station 10.

[0027] To advantage, the cigarette filter maker 2 is a twin track type, with dual mechanical and chemical treatment lines 5.

[0028] The blower device 1 comprises at least one blower unit 12 connected by way of a delivery duct 13 to an air flow control system denoted 14.

[0029] The blower unit 12 comprises a rotor 15 internally, by which the flow of air is generated.

[0030] As illustrated in figure 2, the air flow control system 14 comprises at least two valves 16 serving to open and close respective air outlet ducts 17. Accordingly, the blower device 1 presents at least two air outlet ducts 17.

[0031] The outlet ducts 17 extend from the control system 14 to the mechanical and chemical treatment line 5 of the filter maker 2, each terminating with a relative nozzle 18 installed at a respective blowing station 11 located along the line. A jet is emitted from each nozzle 18 directly at the continuous web 7 of fibrous tow, serving to spread the fibres and distribute them more uniformly.

[0032] To advantage, the control system 14 further comprises a plenum chamber 19 connected both to the delivery duct 13 and to the air outlet ducts 17.

[0033] The plenum chamber 19 is filled from the delivery duct 13 with the flow of air generated by the blower unit 12. Thus, the chamber 19 functions as an air reservoir supplying the outlet ducts 17.

[0034] Generally considered, the plenum chamber 19 is of substantially prismatic appearance, as illustrated in figure 3, and able to house the aforementioned open/close valves 16. In a preferred embodiment, illustrated in figure 2, the valves are arranged one alongside the next and in alignment with the respective air outlet ducts 17, with which they are operationally associated.

[0035] Advantageously, the blower device 1 comprises pressure control means 20 operating in conjunction with the plenum chamber 19. Such pressure control means 20 comprise an auxiliary control circuit 21 by which the air pressure internally of the plenum chamber 19 is monitored through a feedback loop.

[0036] The auxiliary control circuit 21, illustrated schematically in figure 2, comprises at least one pressure transducer 22 positioned internally of the plenum chamber 19.

[0037] The transducer 22 senses the pressure inside the chamber 19 and relays a corresponding pressure signal to a processing and control unit 23.

[0038] Thus, the operation of the blower unit 12 can be governed by the processing and control unit 23 on the basis of the pressure detected in the plenum chamber 19 by the transducer 22, as will be explained shortly in greater detail.

[0039] As discernible in figure 2, the valves 16 are poppet valves preferably of tulip type design, that is to say consisting in a rectilinear stem 24 and a tulip head 25 of which a tapered end 25a registers in the outlet duct 17 and is able consequently to shut off the supply of air to the selfsame duct.

[0040] The valves 16 are capable of movement through a plurality of positions between fully closed, in which the corresponding air outlet duct 17 is shut off, and fully open, in which air can enter the selfsame duct 17. The valves 16 are therefore able to assume any intermediate position between the two limit positions mentioned, according to the pressure levels it is wished to maintain in the air outlet ducts 17. Self-evidently, the positioning of valves 16 will also determine the pressure at which air is jetted from the nozzles 18 positioned at the relative blowing stations 11.

[0041] The tulip head open/close valves 16 describe a linear stroke between the two limit positions, toward or away from the relative outlet duct 17.

[0042] The movement in question is controlled through the agency of positioning means denoted 26.

[0043] Such positioning means 26 might be manual, for example equipped with a knob, a setscrew or other hand-operated control mechanism.

[0044] Alternatively, and preferably, as illustrated in the example of figure 2, the positioning means 26 can be automatic.

[0045] The automatic positioning means 26 illustrated comprise actuators 26a located externally of the plenum chamber 19 and aligned with each valve 16.

[0046] In the example of figure 2, automatic positioning

means 26 further comprise a master control unit 27, managed advantageously by a software program, and a plurality of pressure sensors 28.

[0047] In particular, one such sensor 28 is positioned in each of the air outlet ducts 17 so as to monitor the pressure level internally of the respective duct 17, and connected electrically to the master control unit 27.

[0048] In the interests of simplicity, figure 2 shows just one pressure sensor 28 connected directly to the master control unit 27.

[0049] As will become clear in due course, the master control unit 27 operates in conjunction with the pressure sensors 28, piloting the operation of the actuators 26a in such a way as to position the open/close valves 16 in the appropriate manner.

[0050] In operation, the cigarette filter maker 2 forms continuous streams or webs 7 of filter material which, to reiterate, are drawn from a compact mass or bale of fibrous tow held in a magazine 6.

[0051] Each web 7 undergoes a series of mechanical and chemical treatments along a relative mechanical and chemical treatment line 5 forming part of the filter maker 2.

[0052] With reference in particular to the blowing stations 11, the web 7 is invested by the flow of air jetted from each nozzle 18 positioned at each of the stations 11, in such a way that the filter material will be spread to form a band of constant width, as far as possible, thereby redistributing the fibres of the web 7 across the full width of the band and maintaining the density of the web likewise constant.

[0053] As stated previously, a cigarette filter maker 2 will comprise preferably three blowing stations 11, at least. The pressure of the jet emitted by each nozzle 18 is not particularly high, normally just a few mBar above atmospheric pressure.

[0054] Generally speaking, typical values of the slight overpressure are in the order of 140 mBar at the outlet coinciding with the first blowing station 11 located at the passage of the web 7 over the guide bar 8 (see figure 1), 110 mBar at the outlet coinciding with the second blowing station 11 located immediately preceding the first of the pairs of rollers 9, and 50 mBar at the outlet coinciding with the third blowing station 11, preceding the chemical treatment station 10.

[0055] A cigarette filter maker 2 of the type described thus far will be equipped, preferably, with at least two mechanical and chemical treatment lines 5 so as to turn out at least two continuous filter rods 4.

[0056] A twin track machine 2 presenting two mechanical and chemical treatment lines 5 and three blowing stations 11 per line 5 will therefore require at least six air outlet ducts 17 connected to a single blower device 1.

[0057] In the example of figure 2, seven outlet ducts 17 are shown. In this instance, the blower device 1 is provided with at least one additional air outlet duct 17, for use in the event that one of the other outlet ducts 17 should happen to malfunction or need servicing, or as a spare outlet located directly in the machine.

[0058] For requirements connected with the production cycle, it may become necessary during operation of the machine to vary the pressure of the jet from at least one of the nozzles 18, though without altering the outlet pressure from the remaining nozzles 18.

[0059] It is well known that when a flow of air, or by analogy, an electric current of constant strength, arrives at a junction to which two or more outlet ducts or paths are connected, the flow of air or the current will be split uniformly between the various ducts or paths, other factors being equal.

[0060] Closing one or more of the air outlet ducts, the pressure of the outlet flow through the remaining ducts must inevitably vary.

[0061] The plenum chamber 19 replaces the ordinary junction in blower devices of the prior art and functions as an air reservoir, or equalizing chamber.

[0062] In effect, if there is a need to change the position of one or more valves 16, or in practical terms to adjust the pressure of the air directed through one or more ducts 17, the plenum chamber 19 is able to absorb the resulting variations in pressure and thus avoid excessive fluctuations in the pressure level of the air flow through the remaining outlet ducts 17.

[0063] This is achieved by maintaining the pressure in the plenum chamber 19 at a constant level.

[0064] More exactly, the interaction between the plenum chamber 19 and the pressure control means 20, and in particular the auxiliary control circuit 21, to which the chamber 19 is connected, establishes a feedback loop through which pressure in the selfsame chamber can be monitored and controlled, and maintained at a constant level.

[0065] To reiterate, pressure in the plenum chamber 19 is feedback-controlled by the auxiliary circuit 21. In short, the circuit 21 monitors the pressure level in the chamber 19 continuously, and regulates the output of the blower unit 12 according to the situation prevailing at any given moment.

[0066] In detail, the pressure transducer 22 forming part of the auxiliary control circuit 21 senses the level of pressure internally of the chamber 19 and relays a corresponding signal to the processing and control unit 23.

[0067] This input signal is processed by the unit 23 and compared with a reference signal entered previously by an operator; in the event that the pressure input signal received from the transducer 22 by the processing and control unit 23 is different to the reference value set by the operator, the unit 23 will respond by making the appropriate adjustment to the operation of the blower unit 12, and in particular to the speed of the rotor 15. A pressure level in the plenum chamber 19 lower than the reference value entered by the operator triggers an increase in the speed of the rotor 15 ; conversely, a higher level of pressure triggers a reduction in the speed of the rotor 15. In either case, the auxiliary control circuit 21 produces a corrective action on the blower unit 12 whereby the

pressure internally of the plenum chamber 19 is held at a constant level, and if necessary restored to the reference value entered by the operator.

[0068] The movement of the open/close valves 16 brought about by the automatic positioning means 26 is managed by the master control unit 27. The unit 27 in question can be used by the operator, with the aid of appropriate software, to set preferred parameters such as the requisite pressure through the air outlet ducts 17.

[0069] The pressure registering internally of each air outlet duct 17 is monitored by the sensor 28 installed in the selfsame duct.

[0070] The pressure sensors 28 are connected to the master control unit 27, which on receiving an input signal from the sensors 28 indicating a pressure different to the level selected by the user, will respond by generating an output signal to operate the actuators 26a.

[0071] Movement is thereupon induced in the relative open/close valves 16 by the actuators 26a, and continues until the pressure detected by the sensors 28 located in the outlet ducts 17 equals the reference value.

[0072] Normally, the processing and control unit 23 and the master control unit 27 will be wired one to another, combining thus in operation to maintain the air pressure at selected levels both in the plenum chamber 19 and in the air outlet ducts 17.

[0073] Advantageously, the two control units 23 and 27 could be incorporated physically into a single monitoring, processing and control unit such as a computer.

[0074] Thus, it will be appreciated that by automating the movement of the open/close valves 16, a greater versatility is achievable in the management of certain settings and operating parameters of the machine. With the master control unit 27, the user can select the appropriate parameters for a given type of filter, processed and treated in a certain way and exposed to air jets of greater or lesser force, according to production requirements.

[0075] Inevitably, following a change in position of the open/close valves 16, whether induced manually or automatically, there will be an interval of time before a response is produced through the auxiliary feedback control circuit 21, during which pressure internally of the remaining air outlet ducts 17 will undergo a slight variation. The inclusion of a reservoir provided by the plenum chamber 19 helps to minimize the adverse effects of the fluctuation in pressure that must necessarily occur. In effect, the flow of air from the delivery duct 13 is not supplied to the outlet ducts 17 direct, but first redistributed internally of the plenum chamber 19, so that any momentary rises or falls in pressure will be equalized.

[0076] The auxiliary control circuit 21 cuts in to restore the pressure to the reference value and ensure that the pressure level internally of the plenum chamber 19 remains constant.

[0077] The interaction between the plenum chamber 19 and the pressure control means 20 serves to safeguard the integrity of the web 7 of filter material, and prevent any risk that pressure fluctuations in the jets from the nozzles 18 of the various outlet ducts 17 might spoil the fibrous tow and jeopardize the quality of the filter.

Claims

1. A blower device for expanding continuous webs (7) of filter material, comprising at least one blower unit (12) connected by way of a delivery duct (13) to a system (14) controlling a flow of air generated by the blower unit (12), the air flow control system (14) in turn equipped with at least two valves (16) serving to open and close respective air outlet ducts (17),
characterized
in that the air flow control system (14) further comprises a plenum chamber (19) operating in conjunction with pressure control means (20) in such a way as to maintain a constant pressure in the selfsame plenum chamber (19).

2. A device as in claim 1, wherein pressure control means (20) comprise an auxiliary circuit (21) by way of which the level of pressure internally of the plenum chamber (19) is monitored and controlled through a feedback loop.

3. A device as in claim 2, wherein the auxiliary control circuit (21) comprises at least one pressure transducer (22) positioned internally of the plenum chamber (19) and serving to sense the pressure level in the selfsame chamber (19).

4. A device as in claim 3, wherein the auxiliary control circuit (21) further comprises a processing and control unit (23) connected operationally to the pressure transducer (22) in such a way as to process a pressure signal received from the transducer (22), compare the selfsame signal with a preset pressure reference value, and pilot the operation of the blower unit (12) on the basis of the comparison.

5. A device as in claims 1 to 4, wherein the plenum chamber (19) is an air reservoir supplied with air from the delivery duct (13), and air outlet ducts (17) are supplied with air from the reservoir.

6. A device as in claim 5, wherein the open/close valves (16) are housed internally of the plenum chamber (19).

7. A device as in claim 1, wherein the open/close valves (16) are capable of movement through a plurality of positions between a position in which the respective air outlet ducts (17) are fully open, and a position in which the outlet ducts (17) are fully closed.

8. A device as in claim 7, comprising means (26) by which to position the open/close valves (16), located

externally of the plenum chamber (19) and associated with each of the selfsame valves (16).

9. A device as in claim 8, wherein the positioning means (26) are operated manually.

10. A device as in claim 8, wherein the positioning means (26) are operated automatically.

11. A device as in claim 10, wherein automatic positioning means (26) comprise a master control unit (27).

12. A device as in claim 11, wherein automatic positioning means (26) further comprise a plurality of pressure sensors (28) connected operationally to the master control unit (27), each located in a respective air outlet duct (17) and serving each to monitor the pressure level in the selfsame outlet duct (17).

13. A blower device for expanding at least one continuous web (7) of filter material, comprising at least one blower unit (12) connected by way of a delivery duct (13) to a system (14) controlling a flow of air generated by the blower unit (12), the air flow control system (14) in turn equipped with at least one valve (16) serving to open and close a respective air outlet duct (17),
characterized
in that the open/close valve (16) is controlled by automatic positioning means (26).

14. A device as in claim 13, wherein automatic positioning means (26) comprise actuators (26a) aligned and associated with each of the open/close valves (16).

15. A device as in claim 13, wherein automatic positioning means (26) comprise a master control unit (27) piloting the operation of the actuators (26a).

16. A device as in claim 15, wherein the automatic positioning means (26) comprise a plurality of pressure sensors (28) connected operationally to the master control unit (27), each located in a respective air outlet duct (17) and serving each to monitor the pressure level in the selfsame outlet duct (17).

17. A device as in claim 16, wherein the open/close valves (16) are positioned by actuators (26a) in receipt of a control signal from the master control unit (27), generated in response to the pressure level detected by the pressure sensors (28) internally of the air outlet ducts (17) and consistently with a preset reference pressure value stored in the master control unit (27).

18. A device as in claim 13, wherein the air flow control system (14) comprises at least two open/close valves (16) and at least two relative air outlet ducts (17).

19. A device as in claim 18, wherein the air flow control system (14) comprises a plenum chamber (19) internally of which a constant level of pressure is maintained.

20. A device as in claim 19, wherein the plenum chamber (19) is connected both to the delivery duct (13), through which the selfsame chamber is supplied with the flow of air generated by the blower unit (12), and to the air outlet ducts (17), which in turn are supplied with air from the plenum chamber (19).

21. A device as in claim 19, wherein the open/close valves (16) are housed internally of the plenum chamber (19).

22. A machine for making cigarette filters, comprising at least one garniture section (3) along which to form a respective continuous filter rod (4), and at least one mechanical and chemical treatment line (5) processing a continuous web (7) of filter material, the mechanical and chemical treatment line (5) equipped in turn with at least one pair of contrarotating rollers (9) by which the web (7) is advanced longitudinally toward the garniture section (3), and a drive unit to which at least one roller of the pair (9) is coupled,
characterized
in that it comprises at least one blower device (1) as in claims 1 to 21.

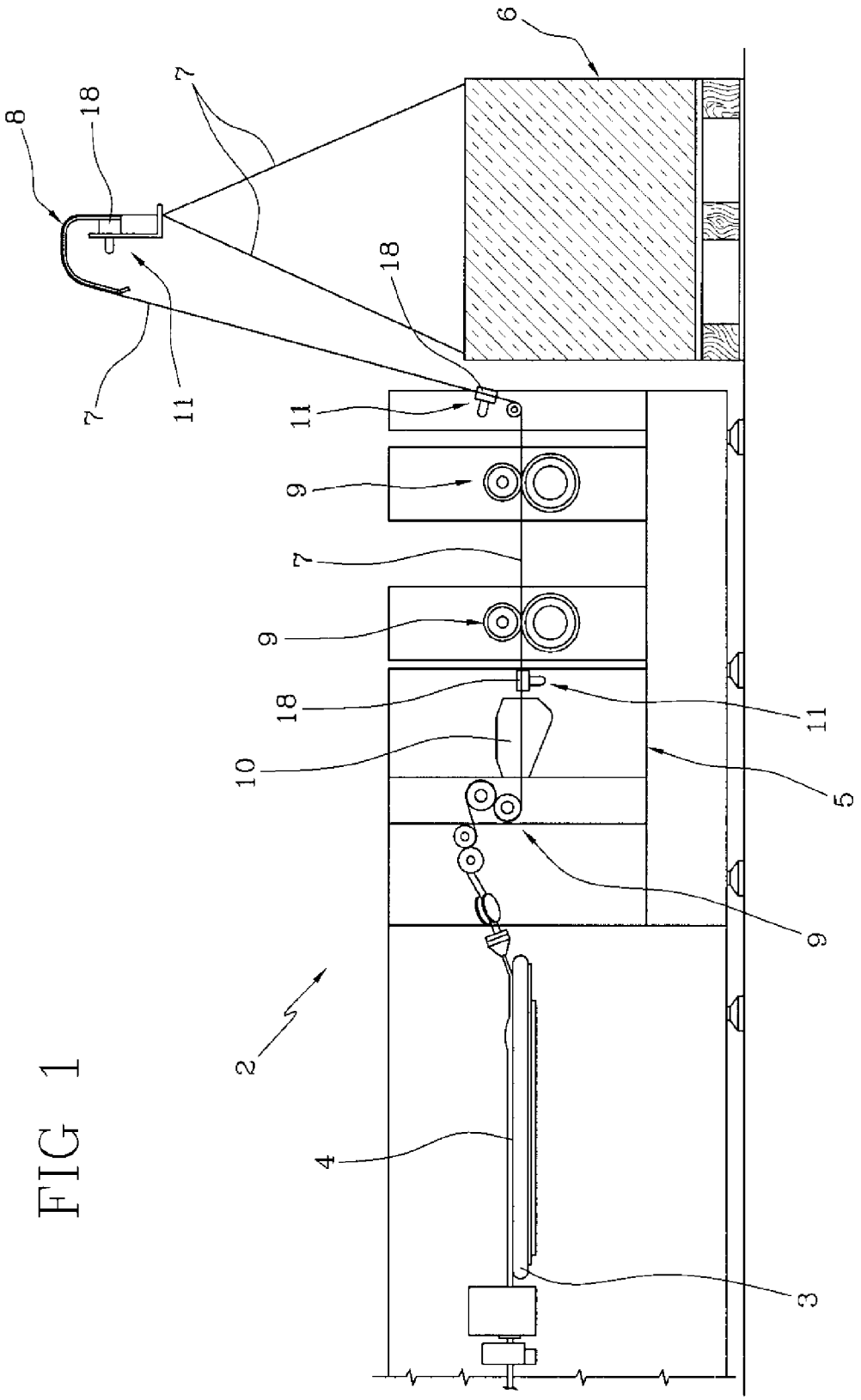

FIG 1

FIG 2

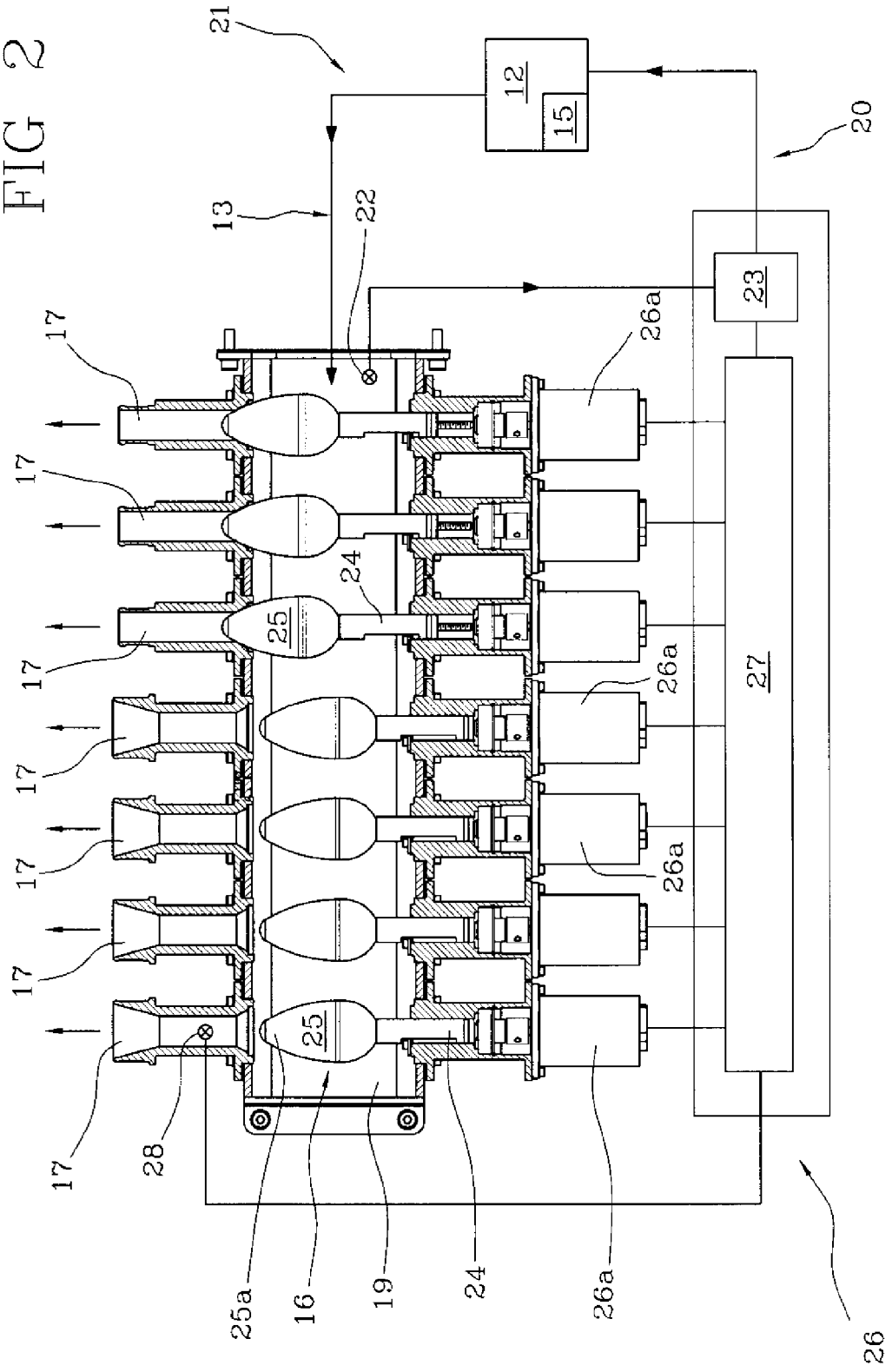

FIG 3