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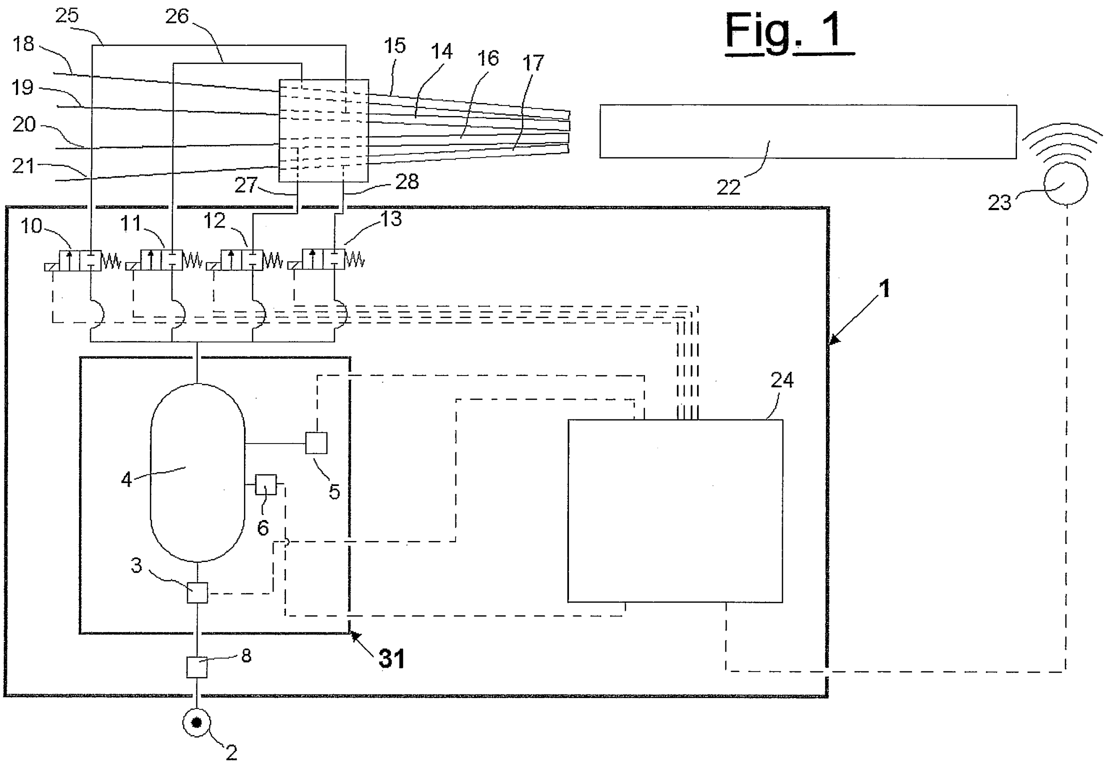
(54) Air feeding and control device for the pneumatic transporting of the weft in air-jet weaving machines

(57) Air feeding and control device for the pneumatic transporting of the weft (18-21) in air-jet weaving machines, comprising a control system (24), connected to air feeding means, which comprise a compressed air source (2) and a series of nozzles (14-17), driven by respective electrovalves (10-13) and which can be used for inserting the weft; the air feeding means also comprise at least one air feeding and accumulation system (31), suitable for allowing a pre-established quantity of air to be accumulated when the air is not flowing to the nozzles (14-17) and suitable for regulating the air flow-rate when it is flowing to the nozzles (14-17).

Fig. 1



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Description

[0001] The present invention relates to an air feeding and control device for the pneumatic transporting of the weft in air-jet weaving machines, such as looms, and, more specifically, it relates to a device suitable for regulating the air flow-rate to the nozzles during the insertion of the weft yarns.

[0002] Methods are known for feeding a series of nozzles in air-jet looms, in which the above nozzles transmit the compressed air energy to the weft yarns, as are also methods for controlling the insertion of the weft in the warp mouth, retroactively acting on the parameters that influence it, such as pressures, timing, etc., in order to make it stable with time.

[0003] The known methods make use of pressure control systems which feed a series of electrovalves of the ON/OFF type connected, by means of ducts, to the weft insertion nozzles.

[0004] In the functioning of the systems of the type described above, a certain time is necessary so that, once the electrovalve has been opened, the air can reach such a flow-rate inside the duct and nozzle as to allow an effective acceleration of the weft to be inserted. During this period of time, the weft is withheld, with a consequent energy waste. At the beginning of the insertion of the weft, it is then necessary to optimize the air flow-rate during the insertion more effectively than what is permitted by systems of the traditional type.

[0005] An objective of the present invention is therefore to overcome the above drawbacks and, in particular, to provide an air feeding and control device for the pneumatic transporting of the weft in air-jet weaving machines or looms, which allows an effective control of the air flow-rate for the insertion of the weft yarns.

[0006] A further objective of the invention is to provide an air feeding and control device for the pneumatic transporting of the weft in air-jet looms, which minimizes the waste of air in the environment during the insertion phases of the weft yarns.

[0007] Another objective of the present invention is to provide a reliable and effective air feeding and control device for the pneumatic transporting of the weft in air-jet looms and which at the same time is easy and economical with respect to the traditional systems.

[0008] These objectives are achieved by providing an air feeding and control device for the pneumatic transporting of the weft in air-jet weaving machines, according to the enclosed claim 1. Other detailed technical and functional characteristics are indicated in the subsequent claims.

[0009] Further objectives and advantages of an air feeding and control device for the pneumatic transporting of the weft in air-jet weaving machines, such as looms, according to the present invention, will appear more evident from the following description and enclosed drawings, provided for illustrative but non-limiting purposes, in which:

- figure 1 represents a block scheme of the air feeding device for the pneumatic transporting of the weft, which can be used in air-jet weaving machines (looms), according to the present invention;
- figure 2 shows a Cartesian graph relating to the airflow trend with time through a pipe which feeds one of the nozzles of the air feeding device, according to the present invention;
- figure 3 represents a possible functioning procedure of the air feeding device for the pneumatic transporting of the weft in air-jet looms, according to the present invention;
- figure 4 represents a second block scheme of the air feeding device for the pneumatic transporting of the weft, which can be used in air-jet weaving machines (looms), according to a possible variant embodiment of the present invention;
- figure 5 represents a third block scheme of the air feeding device for the pneumatic transporting of the weft, which can be used in air-jet weaving machines (looms), according to a further possible variant embodiment of the present invention.

[0010] With particular reference to figure 1 above, which refers to a particular illustrative and preferred but non-limiting embodiment of the present invention, an air feeding system for the pneumatic transporting of the weft is generically indicated with 1 and mainly consists of a control system 24, an air accumulation and feeding system 31, which requires a compressed air source 2 at a pressure stabilized by the pressure regulator 8, and a series of electrovalves 10, 11, 12, 13, which are present in a number equal to the number of wefts 18, 19, 20, 21 which can be inserted (in the pneumatic transporting device illustrated in figure 1 there are four electrovalves, as the system, described as an example, is capable of effecting the insertion of four wefts).

[0011] The air accumulation and feeding system 31 in turn consists of a flow regulator 3, a tank 4, an electrovalve 5 and a pressure sensor 6.

[0012] The operating cycle of the system can be divided into two fundamental phases: a first phase, during which the electrovalves 10, 11, 12, 13 are closed and consequently air does not flow to the nozzles 14, 15, 16, 17, and a second phase, during which at least one of these electrovalves 10, 11, 12, 13 feeds the corresponding nozzle 14, 15, 16, 17.

[0013] During the above first phase, the control system 24 regulates the quantity of air present in the tank 4 at a first pre-established reference value and calculated on the basis of data inserted by the operator and at weft insertion times 18-21 inside the channel 22, which are measured by means of the sensor device 23.

[0014] For this purpose, the control system 24 can introduce air into the tank 4 or discharge air from the tank 4, by means of the flow regulator 3 and electrovalve 5, respectively, on the basis of the signal coming from the pressure sensor 6, caused by the mass of air contained in the tank 4.

[0015] Subsequently, during the above second phase, the pre-established reference value of the quantity of air present in the tank 4 and the signal coming from the pressure sensor 6, are ignored and, with a pre-established phasing, one of the electrovalves 10-13 is opened and, in succession, the flow regulator 3 regulates the air flow-rate with which the tank 4 is fed and consequently the flow at the outlet of the nozzle fed, at a pre-established reference value on the basis of the data inserted by the operator and at the weft insertion times 18-21 in the channel 22, parameters revealed by means of the sensor device 23.

[0016] At a pre-established phase of the operating cycle, on the basis of the data inserted by the operator and on the basis of the insertion times revealed by the sensor 23 inside the channel 22, the flow regulator 3 is closed and, in succession, the electrovalve 10-13 which was open is closed, thus obtaining a fall in the air mass contained in the tank 4 and therefore preventing said air mass from being discharged, if necessary, by means of the electrovalve 5, during the subsequent first phase of the operating cycle. In this way, it is possible to optimally use the air energy for inserting the weft yarns 18-21.

[0017] The diagram of figure 3 represents a possible functioning procedure of the air feeding system object of the invention, in which the traces D symbolically represent the open/close movement of the warp yarns forming the so-called warp mouths, through which the weft yarns 18-21 are inserted.

[0018] In particular:

- the graph CH0 contains the trace O, which represents the trend of the quantity of air contained in the tank 4;
- the graph CH1 contains the trace E, which represents the trend of the air flow-rate through one (for example, duct 25) of the ducts 25, 26, 27, 28, which feed the respective nozzles 14, 15, 16, 17 (for example the nozzle 14), and the trace G, which represents the state of the electrovalve 10, 11, 12, 13 (electrovalve open: upper state; electrovalve closed: lower state - for example the electrovalve 10);
- the graph CH2 contains the trace H which represents the trend of the air flow-rate through one (for example, the duct 26) of the ducts 25, 26, 27, 28, which feed the respective nozzles 14, 15, 16, 17 (for example the nozzle 15), and the trace I, which represents the state of the electrovalve 10, 11, 12, 13 (electrovalve open: upper state; electrovalve closed: lower state - for example the electrovalve 11);
- the graph CH3 contains the trace L, which represents the trend of the air flow-rate through one (for example, the duct 27) of the ducts 25, 26, 27, 28, which feed the respective nozzles 14, 15, 16, 17 (for example the nozzle 16), and the trace N, which represents the state of the electrovalve 10, 11, 12, 13 (electrovalve open: upper state; electrovalve closed: lower state - for example the electrovalve 12).

[0019] The areas indicated with Q in the graph CH0 of figure 3 represent the first phases of the operating cycle, during which a pre-established quantity of air is accumulated inside the tank 4; the areas indicated with R and P in the graph CH0 of figure 3 represent the second phases of the operating cycle, during which one of the electrovalves 10-13 is opened. Upon the opening of one of the electrovalves 10-13 a sudden movement of the air is verified from the tank 4 to one of the ducts 25-28, with the consequent rapid regime establishment of the air flow at a value depending on the quantity of air accumulated in the tank 4 in the first phase; this value remains constant if the flow regulator 3 is opened so as to feed the tank 4 with an air flow-rate equal to the air flow which has been established at the end of the areas R, and which remains in the subsequent areas, indicated with P in the graph CH0 of figure 3, which represent the areas in which the wefts are accelerated.

[0020] In addition to the rapidity with which the flow-rate is brought to regime and the stability with which it can be maintained and regulated, it can be observed from the graphs of figure 3 that the drop in the quantity of air in the tank 4 (which inevitably takes place in correspondence with the areas indicated with R) is advantageous when there is a weft 18-21 inserted with a lower flow-rate than those suitable for the insertion of the other wefts (in the example of figure 3, when the electrovalve 10-13 represented by the trace N is active), as this reduces the quantity of air to be discharged from the tank 4 during the phase Q which precedes the insertion of the weft.

[0021] It is also easy to affirm the effect of the ratio between the pre-established value of the quantity of air present in the tank 4 in the first phase of the operating cycle and the air flow-rate value which feeds the tank 4 in the second phase of the operating cycle on the flow trend in the area indicated with P in figure 3; i.e. if the first pre-established value is substantially kept high with respect to the second value, the flow in the duct of interest 25-28 will first be high and will then tend to decrease and, vice versa, if the first pre-established value is low with respect to the second pre-established value, the flow will first be limited and will then tend to increase.

[0022] This confirms the considerable potentiality of the feeding device, object of the invention, which acts effectively and without limitations on the trend of the air flow-rate which feeds at least one nozzle, of the type 14-17, for the insertion of the weft on a weaving machine (loom) functioning with air-jet insertion of the weft.

[0023] Assuming that the compressed air source 2 supplies air, by means of the pressure regulator 8, at a much higher constant pressure with respect to the pressure necessary for transporting the weft in the channel 22, it can in fact be understood how air is stored at a high pressure in the tank 4 in the first phase of the operating cycle.

[0024] During the second phase of the operating cycle, once one of the electrovalves 10-13 has been opened, there will be a transitory phase during which, within a very short period of time, an air flow-rate will be established in the duct 25-28 depending on the quantity of air previously accumulated in the tank 4.

[0025] Said flow-rate can be maintained or varied by means of the flow regulator 3, in relation to the requirements of the yarn to be inserted and the weft insertion times requested.

[0026] In this way, as already shown in the graphs of figure 3, a much more rapid and stable slope of the air flow-rate is obtained (at least in the area in which the flow-rate is at regime) than that which can be obtained with the known systems.

[0027] The graph of figure 2 clearly illustrates the advantage of being able to obtain a rapid increase in the air flow-rate, which allows a considerable saving.

[0028] In the above graph, the ordinate corresponding to 90% of the maximum flow is, for example, the air flow necessary for initiating the transporting of the weft, the time t2 is the time required by a feeding device of the traditional type for reaching the air flow-rate required, whereas the time t1 is the time required by the feeding device object of the present invention.

[0029] It can be assumed and clearly verified from the graph of figure 2 that the area subtended by the curve C at the time t1 (the total area is equal to the sum of the areas A1+A3) is less than the area subtended by the curve B at the time t2 (the total area is equal to the sum of the areas A1+A2) and that the difference between the two total areas therefore represents the quantity of air that the feeding device according to the invention can save, with respect to the known techniques.

[0030] Finally, as already pointed out above, as the flow regulator 3 used is extremely reactive and does not suffer from the typical delays of a pneumatic circuit, since the geometry of a passage section of the air flow is regulated, it is possible to effectively manage the value and trend of the air flow-rate during the second phase of the operating cycle, in relation to the parameters for the weft insertion (overall timing, arrival times, coil unwinding times, characteristics of the weft, etc.) and the phase of the weaving machine cycle.

[0031] Figure 4 refers to a particular alternative embodiment, illustrative but non-limiting, of the feeding device according to the invention, wherein in the air accumulation and feeding system 31, the function of the pressure sensor 6 of figure 1 is substituted by two flow sensors 7 and 9, situated at the inlet and outlet respectively of the tank 4.

[0032] The function of these sensors is to allow the control 24 to determine the quantity of air to be accumulated in the tank 4 during the first phase described above.

[0033] Figure 5 relates to a further alternative embodiment, illustrative but non-limiting, of the feeding device according to the invention, wherein in the air accumulation and feeding system 31, the function of the pressure sensor 6 of figure 1 is substituted by a flow sensor 29, situated on the line of a discharge electrovalve 30.

[0034] An opening of said electrovalve 30 during the first phase creates a signal of the flow-rate sensor proportional to the quantity of air present in the tank 4; the opening of the electrovalve 30 must have a minimum duration and flow-rate, so that the quantity of air dispersed in the environment is insignificant.

[0035] The characteristics of the air feeding device for the pneumatic transporting of the weft in air-jet weaving machines or looms, object of the present invention, are clear from the above description as are also the advantages.

[0036] Finally, numerous other variants can obviously be applied to the feeding device in question, all included in the novelty principles inherent in the inventive idea. It is also evident that, in the practical embodiment of the invention, the materials, forms and dimensions of the details illustrated can vary according to the requirements and can be substituted with other technically equivalent alternatives.

Claims

1. An air feeding and control device for the pneumatic transporting of the weft (18-21) in air-jet weaving machines or looms, of the type comprising a control system (24), suitable for driving the activation of one or more electrovalves (10-13), which are connected, by means of relative ducts (25-28), to respective nozzles (14-17) which can be used for the insertion of weft yarns (18-21), said control system (24) also being suitable for piloting an air accumulation and feeding system (31) connected to at least one compressed air supplier (2), **characterized in that** said air accumulation and feeding system (31) allows the accumulation of a pre-established quantity of air, in a first phase of the operating cycle, when said first electrovalves (10-13) are closed and air is not flowing to the nozzles (14-17), and feeds air, by means of an adjustable passage section, in a second phase of the operating cycle, when at least one of said first electrovalves (10-13) is open and air is flowing to at least one of said nozzles (14-17).

2. The air feeding device according to claim 1, **characterized in that** said air accumulation and feeding system (31) comprises at least one flow regulator (3), at least a second electrovalve (5), at least one tank (4) and at least one pressure sensor (6) for the control of the air mass accumulated in said tank (4) during the first phase.

3. The air feeding device according to claim 1, **characterized in that** said air accumulation and feeding system (31) comprises at least one flow regulator (3), at least a second electrovalve (5), at least one tank (4) and at least two flow-rate sensors (7, 9) for

the control of the air mass accumulated in said tank (4).

4. The air feeding device according to claim 1, **characterized in that** said air accumulation and feeding system (31) comprises at least one flow regulator (3), at least a second electrovalve (5), at least one tank (4) and a flow-rate sensor (29), on the line of an electrovalve (30), for the control of the air mass accumulated in said tank (4).

5. The air feeding device according to claim 1, **characterized in that** said first electrovalves (10-13) are present in a number equal to the number of insertable wefts (18-21).

6. The air feeding device according to claim 1, **characterized in that**, during said first phase of the operating cycle, said control system (24), by means of said air feeding system (31), accumulates a pre-established quantity of air on the basis of the parameters inserted by the operator and at weft (18-21) insertion times, measured inside an insertion channel (22), by means of a sensor device (23).

7. The air feeding device according to claim 1, **characterized in that**, during said second phase of the operating cycle, said air accumulation and feeding system (31) regulates the feeding flow-rate at the reference value pre-established by the operator on the basis of the specific demands of the yarn to be inserted, the cycle phase of the machine and the weft (18-21) insertion times inside an insertion channel (22), which are revealed by means of at least one sensor device (23).

8. The air feeding device according to claim 1, **characterized in that** said compressed air supplier (2) supplies air, by means of at least one pressure regulator (8), at a higher constant pressure with respect to the pressure necessary for transporting the weft yarns (18-21) inside an insertion channel (22).

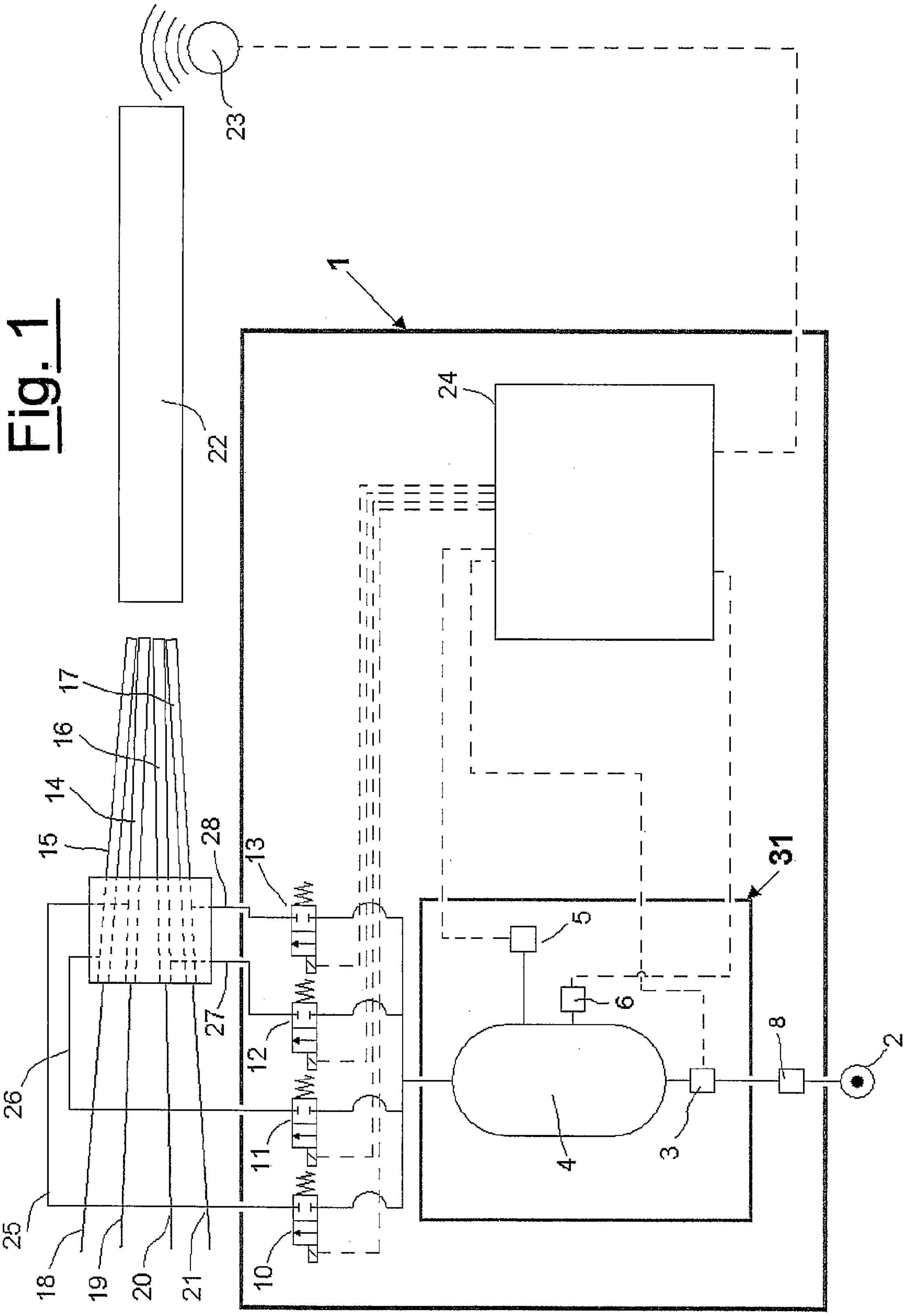
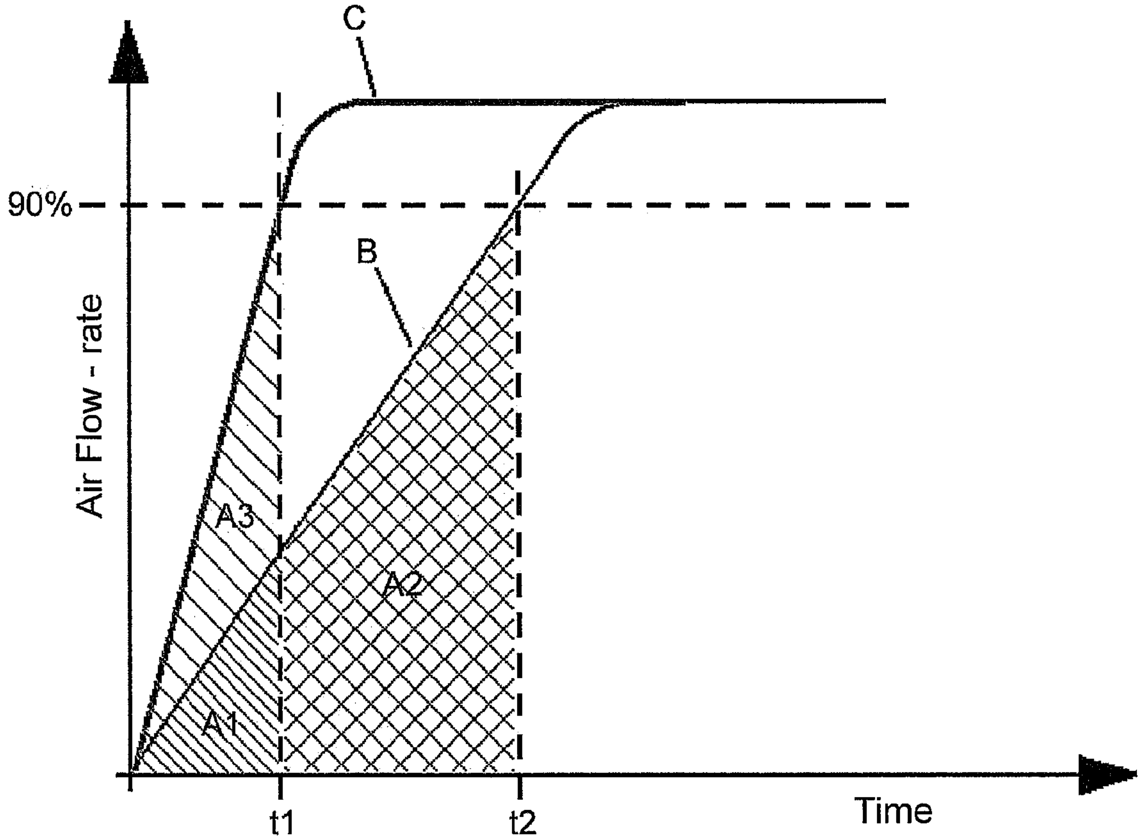


Fig. 1

Fig. 2



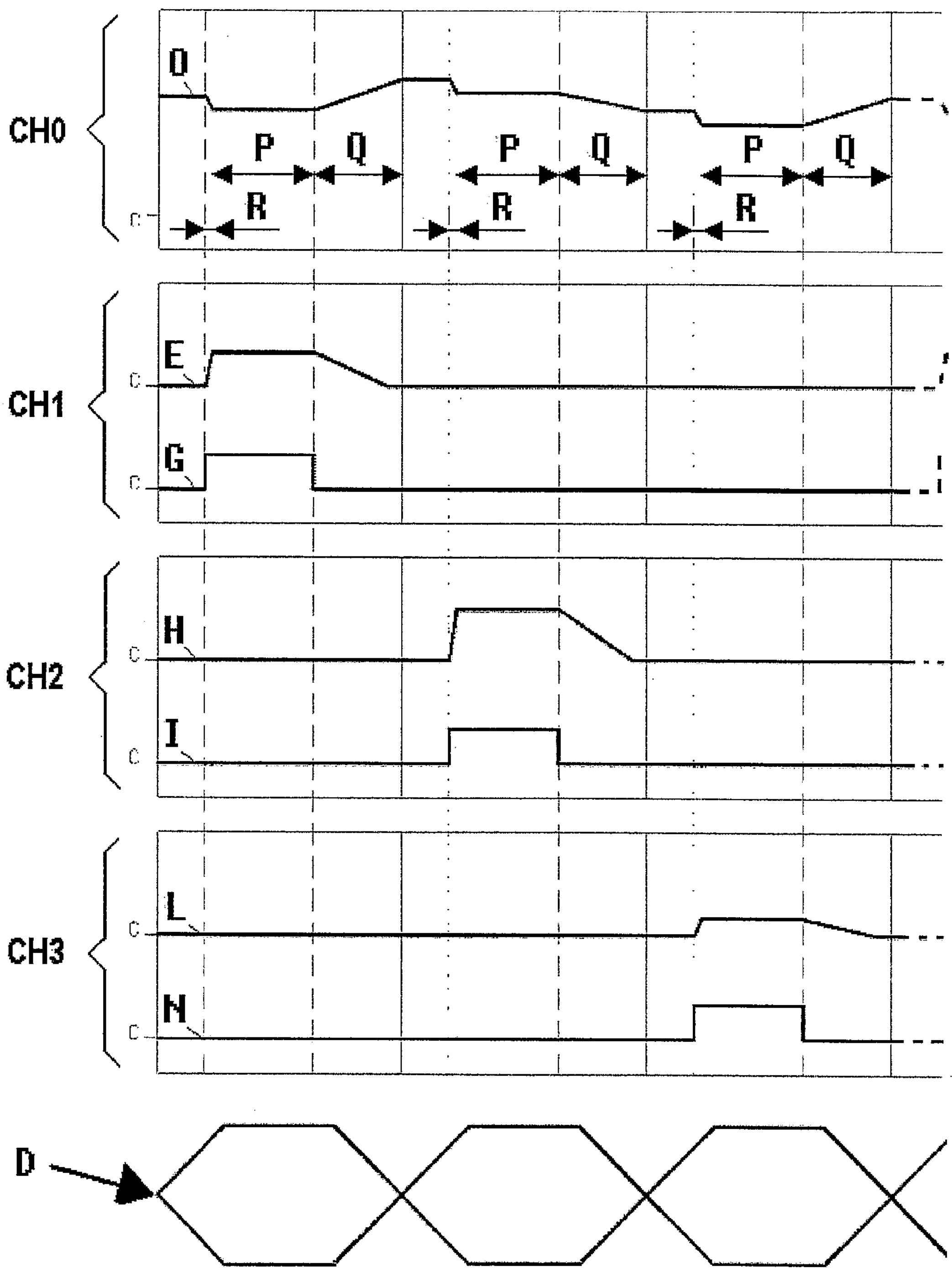


Fig. 3

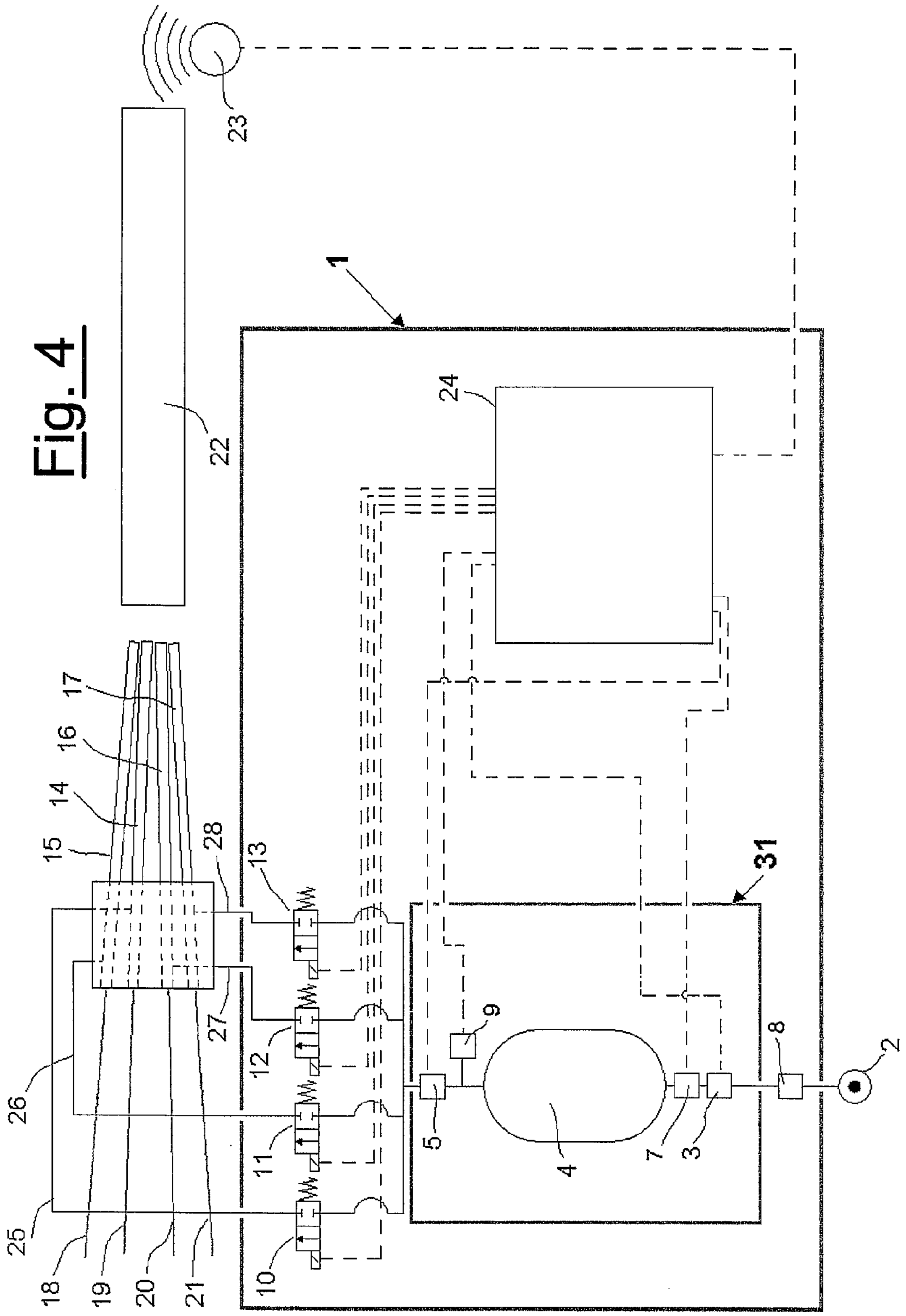


Fig. 4

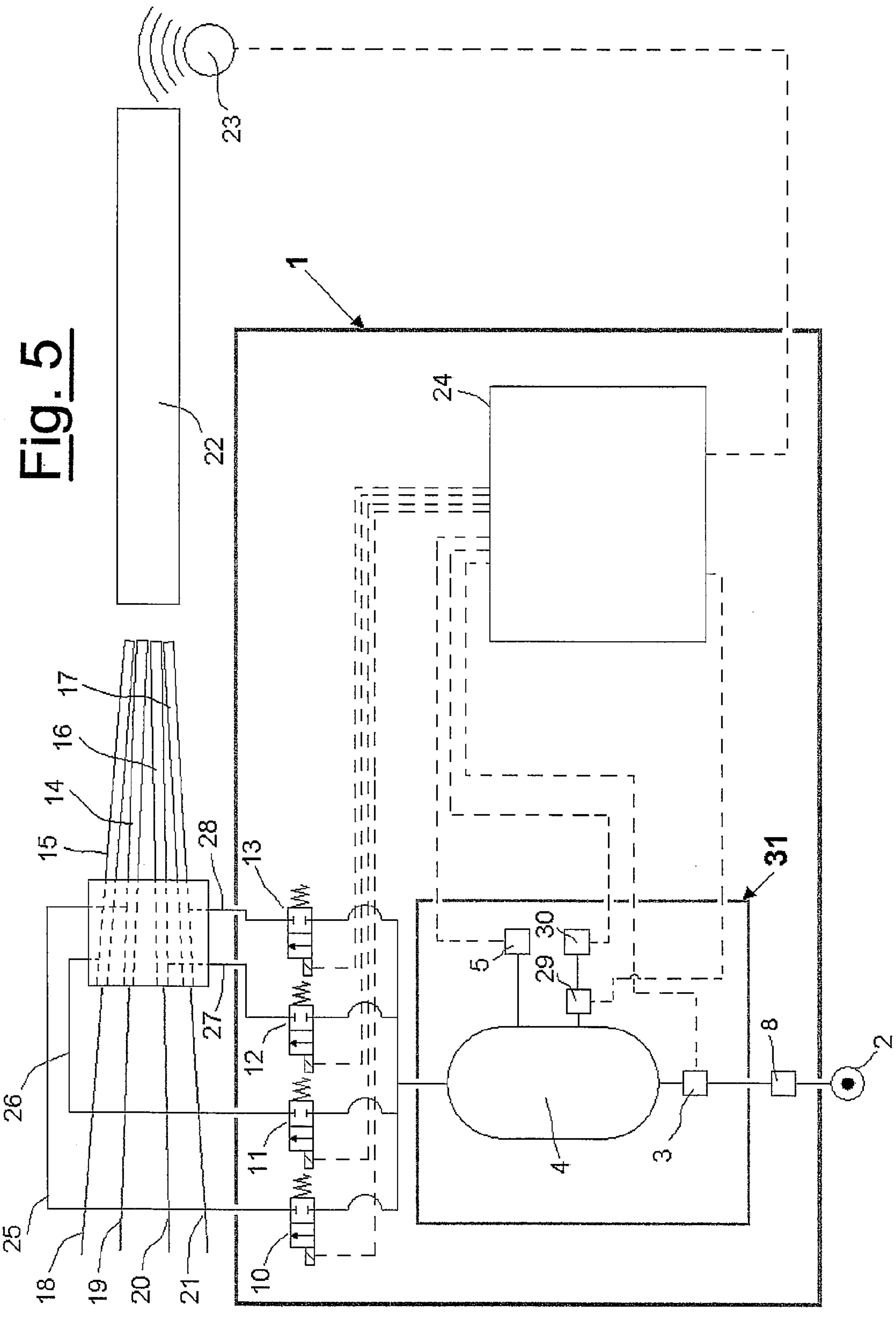

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Fig. 5