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(54) **Air control system for inserting a weft yarn in a pneumatic weaving loom**

Luftsteuerungssystem zum Eintragen einer Schussfaden in einen pneumatischen Webstuhl

Système de contrôle de l'air pour l'insertion de fil de trame dans une machine à tisser pneumatique

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Description

Field of the invention

[0001] The present invention concerns an improved air control system for the insertion of weft yarns into a air/pneumatic weaving loom.

BACKGROUND ART

[0002] As known, air weaving looms set themselves apart from other types of looms due to the fact that the weft yarns are inserted in the warp shed through an air jet ejected from a suitable nozzle. Typically, the pneumatic circuit used for the compressed air coming out of the jet nozzles also serves for the inlet vents of the tuck-in device and for the nozzles arranged along the warp shed and which make up air jet relays to better guide the weft yarn.

[0003] Each type of weft, different in terms of colour, count, texture and so on, is launched by a respective, specific nozzle. If a certain fabric provides the insertion of N different weft types, the loom is hence provided with N launch nozzles. Depending on the type of weft to be inserted, it is advantageous for the pressure of the air jet coming out of the respective launch nozzle to be correspondingly adjusted, for achieving an effective, prompt launch which uses as little compressed air as possible.

[0004] At the same time, between one weft yarn launch and the other, it must be possible to change the pressure of the same nozzle to allow adaptations to conditions which vary over time, for example due to the changes in environmental humidity or pre-supply (as the weft yarn reel runs out).

[0005] The prior art offers different architectures and operation methods to achieve the adjustment of the nozzle pressure.

[0006] In US 6062273, for example, it is taught to provide pressure sensors on the compressed air line between the pressure source and the nozzle, so as to have a retroaction signal by which to control the air supply at the optimal pressure for the specific yarn to launch. EP 1260622 discloses a system similar to the one just cited, wherein a pressure adjuster is used to maintain at the desired pressure level a lung or compensation chamber arranged immediately upstream of the valves of the on/off type which control the individual nozzles. EP1731645 discloses a similar arrangement; Similarly, documents EP189919 and EP 0279222, which represent the closest prior art, disclose similar configurations for air pressure control, wherein a compensation chamber, however, is provided for each nozzle. In these last ones, in particular, it is taught to provide detection sensors of the unwinding speed of the weft off the reel, to be able to provide a self-adjustment parameter for pressure.

[0007] However, this type of architecture is not completely satisfactory, mainly from the cost point of view, since the pressure adjustment valve, upstream of the compensation chamber, is decidedly expensive. In order to continuously keep good pressure adjustment by means of the choke/shutter valve, it is also necessary to have control sensors with good precision and resolution, which in turn are definitely expensive.

[0008] Moreover, it has been detected that it is very difficult to be able to keep a sufficiently constant delivery pressure at the nozzle as desired. The pressure fluctuations of the supply air, due both to the opening/closing of the nozzle, and to the movement of the choke valve (shutter) of the pressure adjuster upstream of the compensation chamber, impair yarn quality and produce misinsertions, with resulting defects in the fabric.

[0009] Moreover, it must be added that the solution envisaging a single compensation chamber for all the nozzles has unsatisfactory reaction times. As a matter of fact, since a single compensation chamber is provided, sufficiently large to be able to supply all the nozzles, it can be inefficient to handle marked, sudden pressure changes (for example above 4 ata), to adequately supply the nozzles of very different yarns, relying on the only vent valve located in the chamber.

[0010] For example, if a yarn A requires a launch pressure of 6 ata and yarn B a pressure of 2 ata, the supply sequence of yarn A and then of yarn B comprises a sudden pressure change of the compensation chamber of -4 ata which is discharged entirely through the vent valve.

[0011] The object of the present invention is hence that of prothrough the vent valve.

[0012] The object of the present invention is hence that of providing a supply system of the launch and relay nozzles which overcomes the drawbacks set forth above, allowing to obtain a control and an improved adjustment of the supply pressure, so as to be able to obtain a more constant launch pressure at a lower cost than the one currently provided.

BRIEF DESCRIPTION OF THE INVENTION

[0013] Such object is achieved through a system which has the innovative features set forth in their specific aspects in the accompanying claims.

[0014] According to a first aspect of the invention, it is provided an air supply system to launch or relay nozzle means for a weft yarn in a pneumatic weaving loom, comprising at least one outlet on/off valve controlling said nozzle means, further comprising only another inlet on/off valve means on the air supply conduit pertaining to said nozzle means upstream of said outlet on/off valve, and wherein between said outlet valve and inlet valve means there is arranged a storage tank of a volume suited to contain sufficient air for at least one weft yarn launch, and a pressure sensor apt to drive said inlet valve means so as to open when the pressure in the tank drops below a preset minimum threshold and to close when the pressure in the tank rises above a preset maximum threshold, said storage tank (Tk) is cylindrical and elongated, preferably with an aspect ratio greater than 10.

[0015] According to a preferred aspect of the invention, said pressure sensor is arranged so as to read the pressure inside said storage tank.

[0016] According to a further aspect, said pressure sensor is arranged so as to detect the pressure in a position as far as possible from a air charge port of the tank.

[0017] An additional aspect of the invention is that between the inlet valve means and the outlet valve, a vent device is further provided.

[0018] According to a further preferred aspect of the invention, the inlet valve means comprise at least two on/off valve units having respective different preset minimum opening thresholds.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Further features and advantages of the system according to the invention will in any case be more evident from the following detailed description of some preferred embodiments of the same, given by way of example and illustrated in the accompanying drawings, wherein:

fig. 1 is a diagrammatic, see-through view of a prior-art weaving loom, showing the position of nozzles and relays;

figs. 2-4 are diagrammatic views of the layout of three different embodiments of the system according to the invention applied to a weft-launching nozzle;

figs. 5-7 are diagrammatic views of the layout of other embodiments of the system according to the invention applied to a weft-launching nozzle; and

figs. 8-9 are diagrammatic views of the layout of other embodiments of the system according to the invention applied to relay nozzles.

DETAILED DESCRIPTION OF SOME PREFERRED EMBODIMENTS

[0020] Fig. 1 shows diagrammatically a prior-art pneumatic weaving loom. As one can detect, the devices to which compressed air is supplied for driving the launch of weft yarns are essentially the pre-nozzles and the launch nozzles referenced by numerals 10 and 11, respectively, by which the yarn is launched into the warp shed, and the relay nozzles (of which only one is shown, indicated by reference 6), by which the yarn is supported and pushed into the warp shed until it reaches the end opposite to the entry side.

[0021] The other devices and lines shown in fig. 1 are intended to adjust and distribute the compressed air coming from a source of compressed air of the weaving loom (shown by the arrow connecting to entry 2).

[0022] In particular, as visible in fig. 2, each nozzle 11 is connected, in a way known per se, to a supply line of compressed air M - specific for that individual nozzle or group of nozzles - wherefrom it is separated by an on/off outlet valve V_1, arranged in the proximity of an inlet port of the nozzle device. Line M is in turn connected to the general compressed air distribution conduit of the weaving loom. Valve V_1 opens and closes the nozzle entry, letting in and interrupting the flow of compressed air at each launch cycle, hence at a significant frequency, of the order of the weaving loom speed (generically speaking, if a weaving loom operates at a frequency of 800 strokes per minute and has two launch nozzles, on average each valve V_1 must operate at a frequency of about 800/4/60=6.6 Hz).

[0023] According to the invention, between supply M and valve V_1 an air storage tank Tk is further arranged, in turn separated from supply M by a second on/off inlet valve means V_2. According to an essential feature of the invention, tank Tk has a volume suited to contain the amount of air required for at least one launch of one weft yarn from nozzle 11. For example, the tank has a volume of 0.8 - 1.2 lt and typically operates at an operation pressure in the order of 2 - 6 bar.

[0024] For reasons of bulk and of behaviour regularity of the tank during the transient phases (i.e. when an airflow is established through one of the two on/off valves V_1 or V_2), tank Tk is cylindrical and elongated, in particular with an aspect ratio above 10.

[0025] This system is furthermore completed by a pressure sensor P, suited to provide an adjustment signal which controls the second on/off inlet valve means V_2.

[0026] Pressure sensor P is arranged in any one position between the two on/off valves V_1 and V_2, between which the circuit theoretically has the same pressure in static conditions. Sensor P can hence be, for example, also just upstream of the first on/off outlet valve V_1 (fig. 4).

[0027] It has been detected that the best adjustment behaviours are preferably obtained if the pressure sensor P is mounted so as to read the pressure inside tank Tk (figs. 2 and 3).

[0028] According to a preferred embodiment of the invention (fig. 2), sensor P is arranged at the bottom end of tank Tk, i.e. at the opposite end to the end wherein the inlet and charge port for the compressed air is provided. As a matter of fact, in these conditions it has been detected that the sensor is less sensitive to the pressure waves propagating in the tank during the transient phase and it hence supplies a signal more suited to obtain an effective adjustment free of instability.

[0029] As shown in fig. 2, tank Tk preferably has a single load/unload charge/discharge port, whereon a T-junction connection is installed which connects the circuit both to inlet valve means V_2 and to outlet valve V_1 to nozzle 11. Alternatively, the two charge and discharge ports of the tank are distinct but nevertheless arranged on the same bottom end of the tank.

[0030] Fig. 3 shows instead an embodiment wherein charge and discharge ports are located at the two opposite ends of the tank Tk: in such case, for adjustment regularity, it is preferable for pressure sensor P to be arranged so as to read the pressure inside tank Tk about halfway through its extension.

[0031] Operatively, the system is configured so as to work as follows. On/off inlet valve V_2 is open and tank Tk is charged with compressed air until it reaches an upper pressure threshold Psu detected by sensor P. At this point valve V_2 is closed and the system is ready for weft launch. At the moment established by the weaving loom control logic, outlet valve V_1 is opened and the compressed air available in tank Tk is used for performing the weft launch through nozzle 11. When outlet valve V_1 is again closed, should the probe P detects that the pressure inside tank Tk has dropped below a lower threshold Psl, inlet valve V_2 is re-opened, which enables the recharging of tank Tk. Typically, since tank Tk is sized so as to have a volume sufficient for at least one launch, the charging of tank Tk and the relative pressure fluctuations occur in a transient phase between one launch and the next one.

[0032] The two threshold pressures are defined by the control logic of the weaving loom, based on the specific yarn which must be launched from the nozzle; these thresholds can also be changed during operation upon varying the contour conditions, for example based on the weaving conditions of temperature and humidity.

[0033] The system set forth above, as it is conceived, has also an implicit downward pressure adjustment capability, because the same nozzle acts as venting valve to draw air out of the circuit and to lower the pressure between the two outlet/inlet valves V_1 and V_2. Should it be necessary to obtain a greater adjustment capability, it is possible to provide also a specific vent valve V_3, arranged between the two inlet valve means V_2 and outlet valve V_1. Vent valve V_3 can be provided on different embodiments, as shown in figs. 5-7. Preferably, as shown, vent valve V_3 is arranged upstream of the charge port to tank Tk.

[0034] Figs. 8-9 show an embodiment of the system applied to the relay nozzles. In fig. 8 there is a vent valve V_3 also provided.

[0035] In this specific embodiment, tank Tk is sized to be able to supply air to all the relays for an entire weft launch. Since the pressure required by the relays is substantially the same, a single tank Tk can supply simultaneously all the relays. In special conditions, it could be an advantage to provide two (or more) relay nozzle tanks in sequence (one for relay nozzle groups 1..n and one for relay nozzle groups n+l..m) which, from the point of view of operation and pressure charging, are equal.

[0036] In order to be able to control relays 6 at different times, adequately supporting the weft yarn as it progresses through the warp shed, multiple outlet valves V_{1a}-V_{1n} are provided, one for each relay nozzle or group of nozzles.

[0037] According to a further embodiment, said inlet valve means V_2 comprise more than one inlet valve units, due to the need to have more airflow, or a fastest pressure decreasing. In such an arrangement, tipically upon operation of a great number of relay nozzles, to provide a smooth pressure regulation and to reduce the total valve commutation, it is preferred not to open and close simultaneously the two valves together, but two slightly different opening thresholds (i.e. a difference of 0.1bar) for the two valves is provided. In such a case, the operation of the two valve units can be modulated. If, for example, the pressure decreases in the tank, a first valve unit is opened: in low air consumption condition, this is enough and, in steady conditions, only the first valve unit is opened and closed; if the air consumption is greater, the pressure decrease gradient is much more high and also the second valve unit will be activated: in such a condition, it can result that the first valve unit is kept continuously open and the second is commutating, depending on the pressure.

[0038] As can be evinced from the description reported above, the solution proposed here allows to achieve the desired objectives.

[0039] In particular, with the tank arranged between the two on/off inlet and outlet valves and the use of a single pressure sensor, it is possible to obtain the desired constant pressure adjustment without employing expensive pressure adjusters at nozzle entry. In substance, during the launch phase of the weft yarn, the pressure in nozzle 11 is kept sufficiently constant although no expensive shutter valve is provided which allows airflow even during the launch.

[0040] Due to the fact that tank Tk is of a volume suited to support at least one weft launch, sensor P can operate with low precision and resolution, for example between two threshold values Psu and Psl mutually separated by 0.1 bar: this positively affects the economy of the sensor.

[0041] However, it is understood that the invention is not limited to the particular configurations illustrated above, which represent only a non-limiting example of the scope of the invention, but that a number of variants are possible, all within the reach of a person skilled in the field, without departing from the scope of the invention as defined in the attached claims.

Claims

1. Air supply system to launch (10, 11) or relay (6) nozzle means for a weft yarn in a pneumatic weaving loom, comprising at least on outlet on/off valve (V_1) controlling said nozzle means, a storage tank (Tk) and a pressure sensor (P), **characterised in that** it further comprises only another inlet on/off valve means (V_2) on the air supply conduit pertaining to said nozzle means upstream of said outlet on/off valve (V_1), and **in that** between said outlet valve (V_1) and inlet valve means (V_2) there is arranged said storage tank (Tk), of a volume suited to contain sufficient air for at least one weft yarn launch, and said pressure sensor (P) which is apt to drive said inlet valve means (V_2) so as to open when the pressure in the tank (Tk) drops below a preset minimum threshold (Psl) and to close when

the pressure in the tank (Tk) rises above a preset maximum threshold (Psu), and **in that** said storage tank (Tk) is cylindrical and elongated, preferably with an aspect ratio greater than 10.

2. Air supply system as claimed in claim 1), wherein said pressure sensor (P) is arranged so as to read the pressure inside said storage tank (Tk).

3. Air supply system as claimed in claim 2), wherein said pressure sensor (P) is arranged so as to detect the pressure in a position as far as possible from a air charge port of the tank (Tk).

4. Air supply system as claimed in anyone of the preceding claims, wherein said storage tank (Tk) has a charge port and discharge port at the same end.

5. Air supply system as claimed in any one of the preceding claims, wherein between said inlet valve means (V_2) and said outlet valve (V_1) a vent device (V_3) is further provided.

6. Air supply system as claimed in claim 6), wherein said vent device (V_3) is arranged upstream of said storage tank (Tk).

7. Air supply system as claimed in any one of the preceding claims, wherein said inlet valve means (V_2) comprise at least two on/off valve units having respective different preset minimum thresholds (Ps1).

Patentansprüche

1. Luftversorgungssystem zum Starten (10, 11) oder Weiterschalten (6) einer Düseneinrichtung für einen Schussfaden in einem pneumatischen Webrahmen, mit wenigstens einem Ein/Aus-Auslassventil (V_1), das die Düseneinrichtung steuert, einem Speichertank (Tk) und einem Drucksensor (P), **dadurch gekennzeichnet, dass** es ferner nur eine weitere Ein/Aus-Einlassventileinrichtung an der Luftversorgungsleitung umfasst, welche stromaufwärts des Ein/Aus-Auslassventils (V_1) zu der Düsenanordnung gehört, und dass
zwischen dem Auslassventil (V_1) und der Einlassventileinrichtung (V_2) der Speichertank (Tk) angeordnet ist, wobei das Volumen des Speichertanks ausreichend Luft für wenigstens einen Schussfadenstart aufnehmen kann, und der Drucksensor (P_1) die Einlassventileinrichtung (V_2) ansteuern kann, so dass sie öffnet, wenn der Druck in dem Tank (Tk) unter einen eingestellten minimalen Schwellwert (Ps1) fällt, und schließt, wenn der Druck in dem Tank (Tk) über einen eingestellten maximalen Schwellwert (Psu) steigt, und dass
der Speichertank (Tk) zylindrisch und langgestreckt ist, vorzugsweise mit einem Seitenverhältnis von größer als 10.

2. Luftversorgungssystem nach Anspruch 1, wobei der Drucksensor (P) so angeordnet ist, dass er den Druck innerhalb des Speichertanks (Tk) liest.

3. Luftversorgungssystem nach Anspruch 2, wobei der Drucksensor (P) so angeordnet ist, dass er den Druck bei einer Position erfasst, die so nahe wie möglich bei einer Luftzuführöffnung des Tanks (Tk) liegt.

4. Luftversorgungssystem nach einem der vorangehenden Ansprüche, wobei der Speichertank (Tk) eine Zuführöffnung und eine Abgabeöffnung an demselben Ende aufweist.

5. Luftversorgungssystem nach einem der vorangehenden Ansprüche, wobei zwischen der Einlassventileinrichtung (V_2) und dem Auslassventil (V_1) ferner ein Ventilbauteil (V_3) vorgesehen ist.

6. Luftversorgungssystem nach Anspruch 6, wobei das Ventilbauteil (V_3) stromaufwärts des Speichertanks (Tk) angeordnet ist.

7. Luftversorgungssystem nach einem der vorangehenden Ansprüche, wobei die Einlassventileinrichtung (V_3) wenigstens zwei Ein/Aus-Ventileinheiten mit jeweils unterschiedlichen voreingestellten minimalen Schwellwerten (Ps1) aufweist.

Revendications

1. Système d'alimentation en air de moyens de buse de lancement (10, 11) ou de buse-relais (6) pour un fil de trame dans un métier à tisser pneumatique, comprenant au moins une soupape de marche/arrêt de sortie (V_1) contrôlant lesdits moyens de buse, un réservoir de stockage (Tk) et un capteur de pression (P), **caractérisé en ce que** :

il comprend en outre uniquement un autre moyen de soupape de marche/arrêt d'entrée (V_2) sur le conduit d'alimentation en air appartenant auxdits moyens de buse en amont de ladite soupape de marche/arrêt de sortie (V_1), et **en ce que** :

entre lesdits moyens de soupape de sortie (V_1) et de soupape d'entrée (V_2), on agence ledit réservoir de stockage (Tk) d'un volume approprié pour contenir l'air suffisant pour au moins un lancement de fil de trame, et ledit capteur de pression (P) qui est apte à entraîner lesdits moyens de soupape d'en-

trée (V_2) pour qu'ils s'ouvrent, lorsque la pression dans le réservoir (Tk) chute au-dessous d'un seuil minimum préréglé (Ps1), et pour qu'ils se ferment lorsque la pression dans le réservoir (Tk) monte au-dessus d'un seuil maximum préréglé (Psu) et **en ce que** ledit réservoir de stockage (Tk) est cylindrique et allongé, de préférence avec un rapport d'aspect supérieur à 10.

2. Système d'alimentation en air selon la revendication 1, dans lequel ledit capteur de pression (P) est agencé afin de lire la pression à l'intérieur dudit réservoir de stockage (Tk).

3. Système d'alimentation en air selon la revendication 2, dans lequel ledit capteur de pression (P) est agencé afin de détecter la pression dans une position située aussi loin que possible d'un orifice de chargement d'air du réservoir (Tk).

4. Système d'alimentation en air selon l'une quelconque des revendications précédentes, dans lequel ledit réservoir de stockage (Tk) a un orifice de chargement et un orifice de déchargement à la même extrémité.

5. Système d'alimentation en air selon l'une quelconque des revendications précédentes, dans lequel, entre lesdits moyens de soupape d'entrée (V_2) et ladite soupape de sortie (V_1), on prévoit en outre un dispositif d'évent (V_3).

6. Système d'alimentation en air selon la revendication 6, dans lequel ledit dispositif d'évent (V_3) est agencé en amont dudit réservoir de stockage (Tk).

7. Système d'alimentation en air selon l'une quelconque des revendications précédentes, dans lequel lesdits moyens de soupape d'entrée (V_2) comprennent au moins deux unités de soupape de marche/arrêt ayant des seuils minimums préréglés (Ps1) différents respectifs.

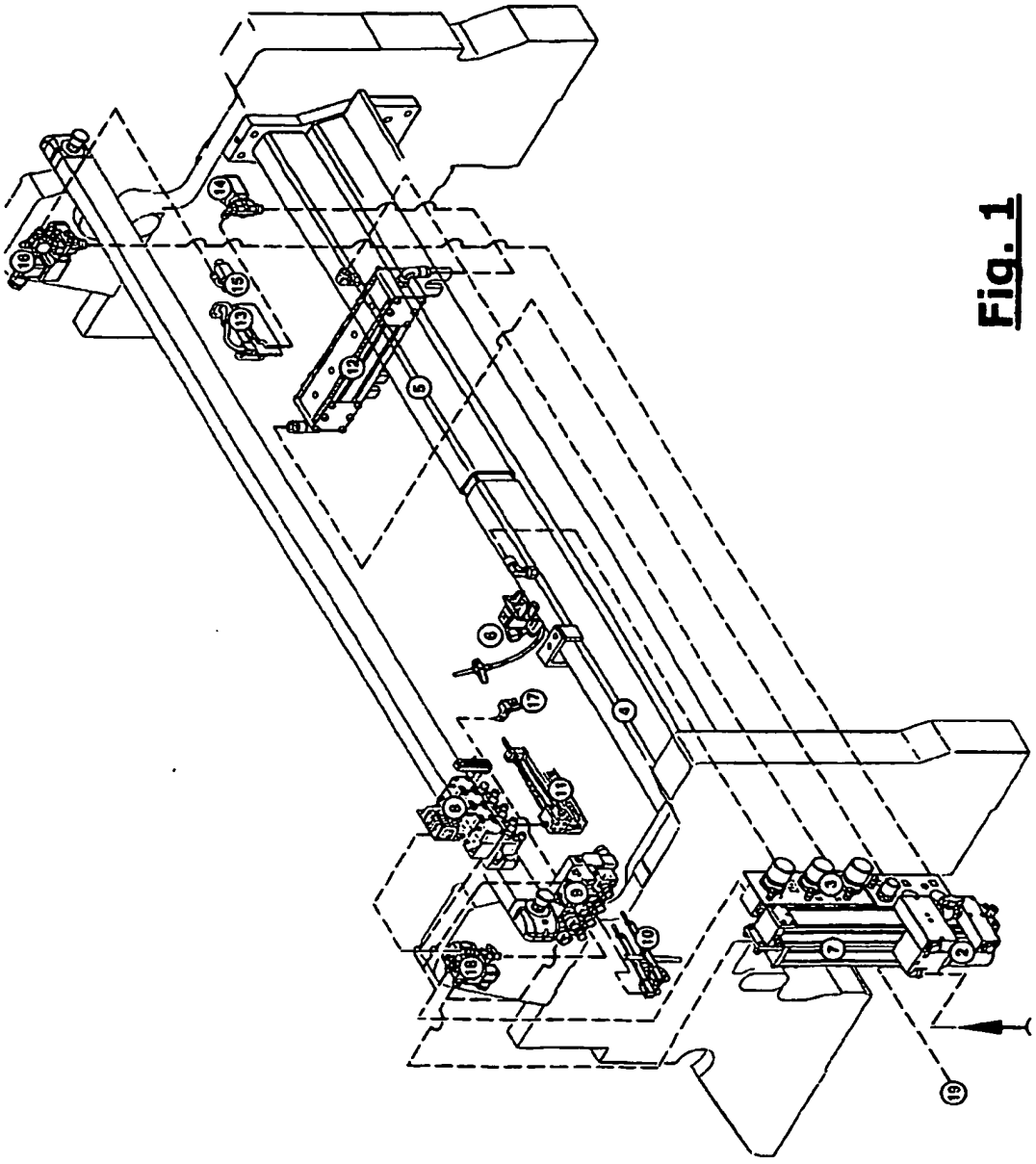


Fig. 1

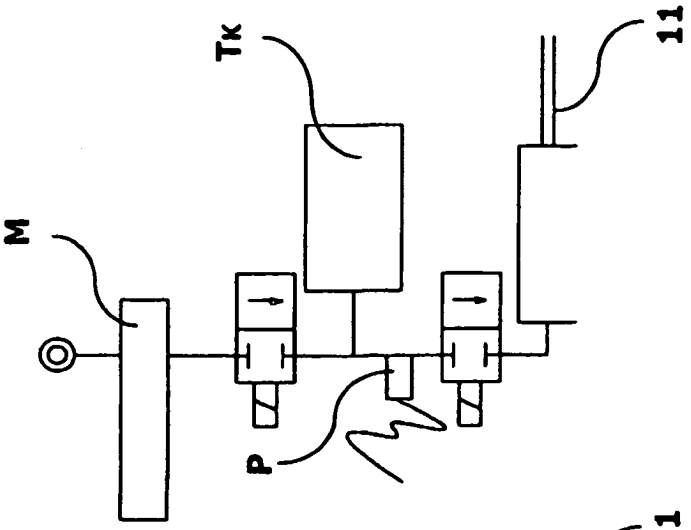


Fig. 4

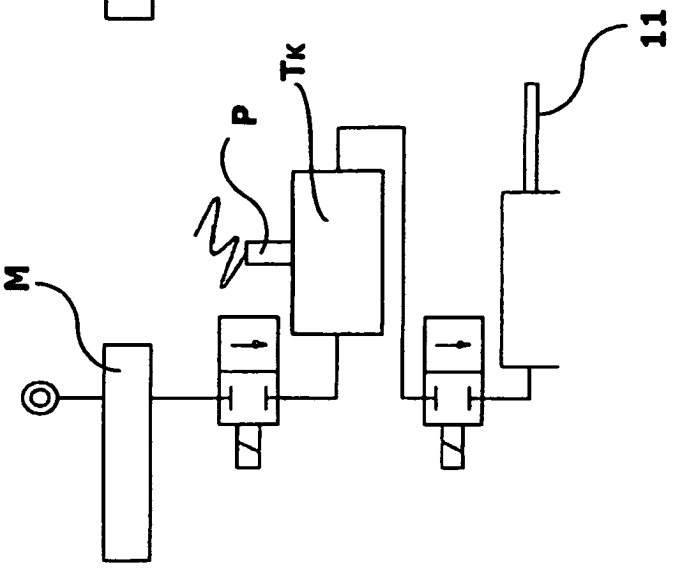


Fig. 3

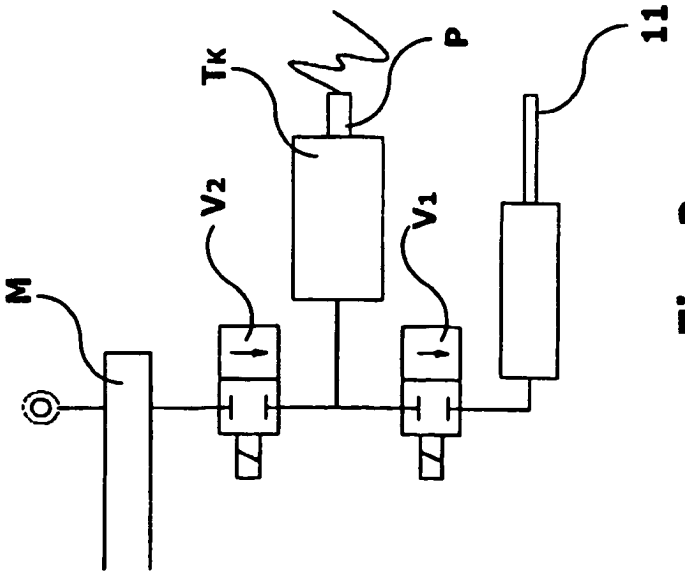


Fig. 2

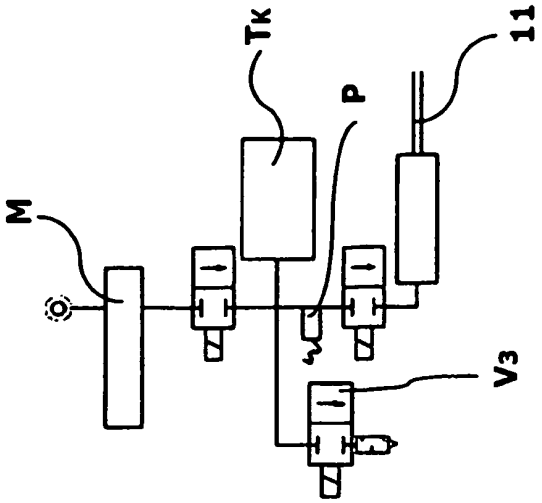


Fig. 7

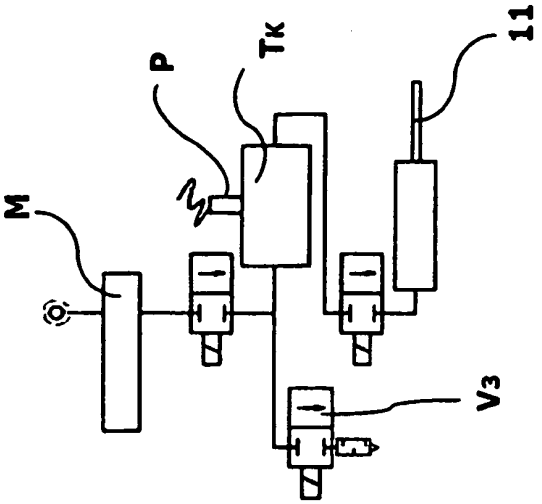


Fig. 6

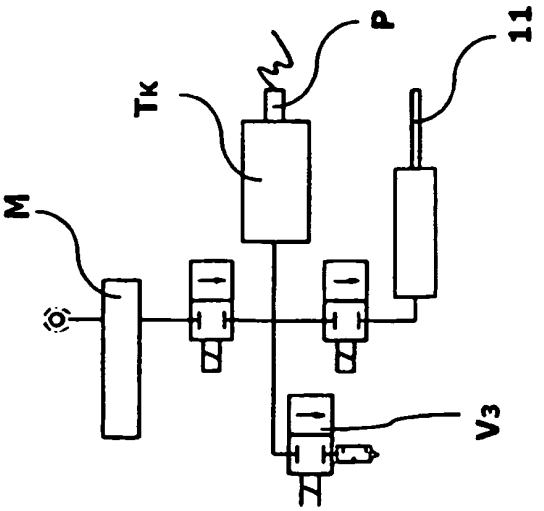


Fig. 5

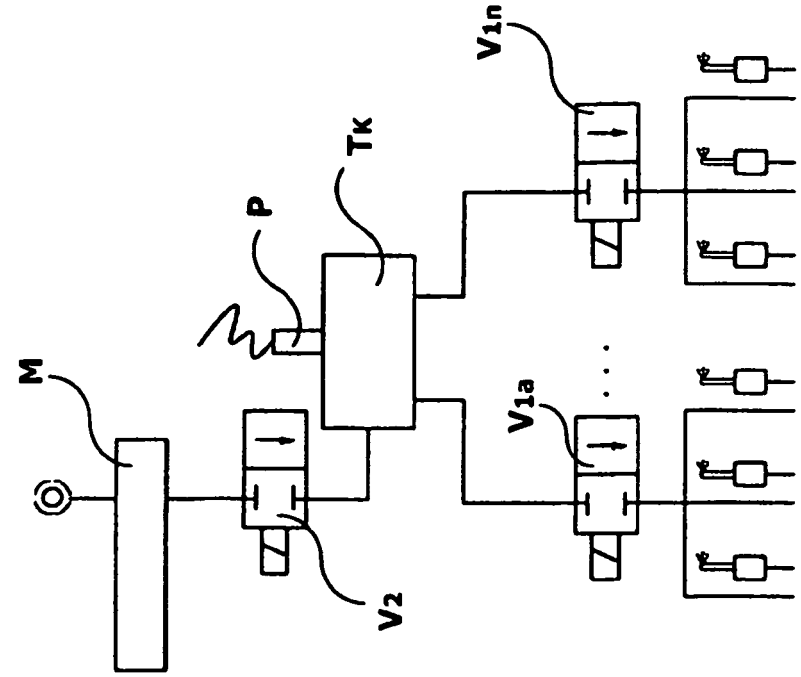


Fig. 9

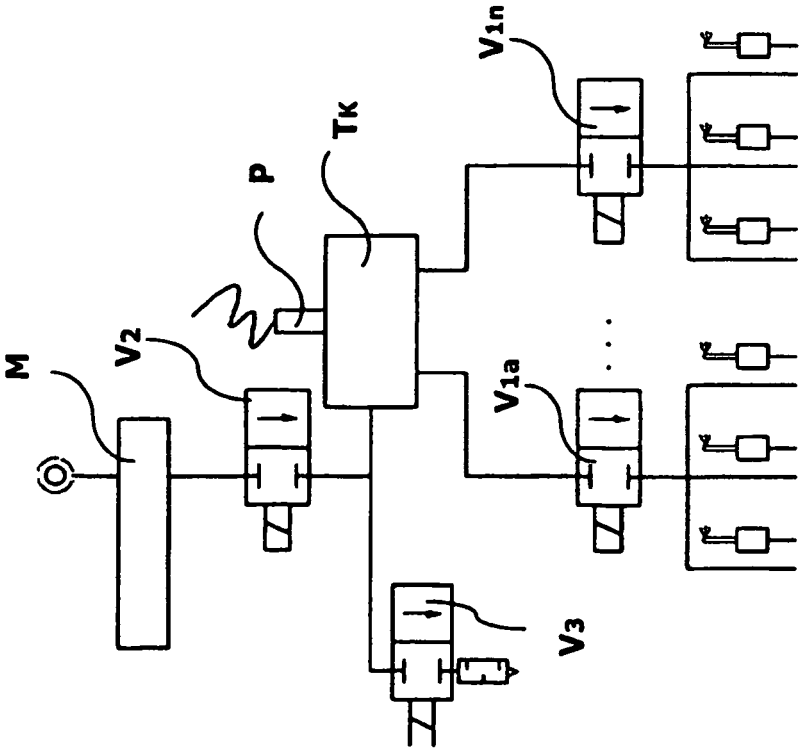


Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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