



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.06.2023 Bulletin 2023/25

(51) International Patent Classification (IPC):
B65H 67/08 (2006.01)

(21) Application number: **22202362.4**

(52) Cooperative Patent Classification (CPC):
B65H 67/083; B65H 2701/31

(22) Date of filing: **19.10.2022**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
KH MA MD TN

(72) Inventors:
• **ZANCAI, Dante**
I-33170 PORDENONE (IT)
• **VELLUDO, Massimo**
I-33170 PORDENONE (IT)
• **SINGH, Manpreet**
I-33170 PORDENONE (IT)
• **FLAIS, Gianluca**
I-33170 PORDENONE (IT)

(30) Priority: **14.12.2021 IT 202100031307**

(71) Applicant: **Savio Macchine Tessili S.p.A.**
33170 Pordenone (IT)

(74) Representative: **Mitola, Marco**
Jacobacci & Partners S.p.A.
Piazza Mario Saggin, 2
35131 Padova (IT)

(54) **WINDING UNIT WITH IMPROVED TUBE LOCKING PUSHER AND PLATE CENTRING PUSHER AND THE RELATIVE CONTROL METHOD**

(57) Winding unit (8) comprising a spool changing device (12), for changing spools (16) comprising yarn (20) wound on a tube (24) supported by a plate (26), the spool changing device (12) being provided with a tube locking pusher (28), provided with a locking stem (32) configured to pass from a retracted configuration, in which it does not interfere with the tube (24) of the spool (16), to an extracted configuration in which it obtains a constraint at a lower portion (36) of the tube (24) of the spool (16), facing said plate (26), a plate centring pusher (40) configured to influence, in an extracted configuration, the plate (26) abutting against a frame (44) of the spool changing device (12). The spool changing device (12) is provided with at least one nozzle (48) positioned and configured so as to direct, through at least one delivery hole (52), a jet of compressed air near said lower portion (36) of the tube (24) of the spool (16) influenced by the tube locking pusher (28), to prevent said tube locking pusher (28) from clamping a thread (56) of said yarn (20) wound on the tube (24).

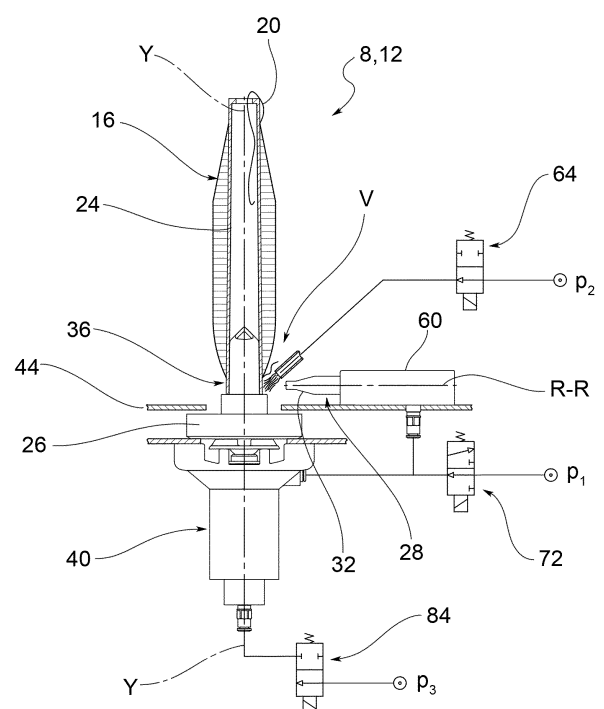


FIG.4

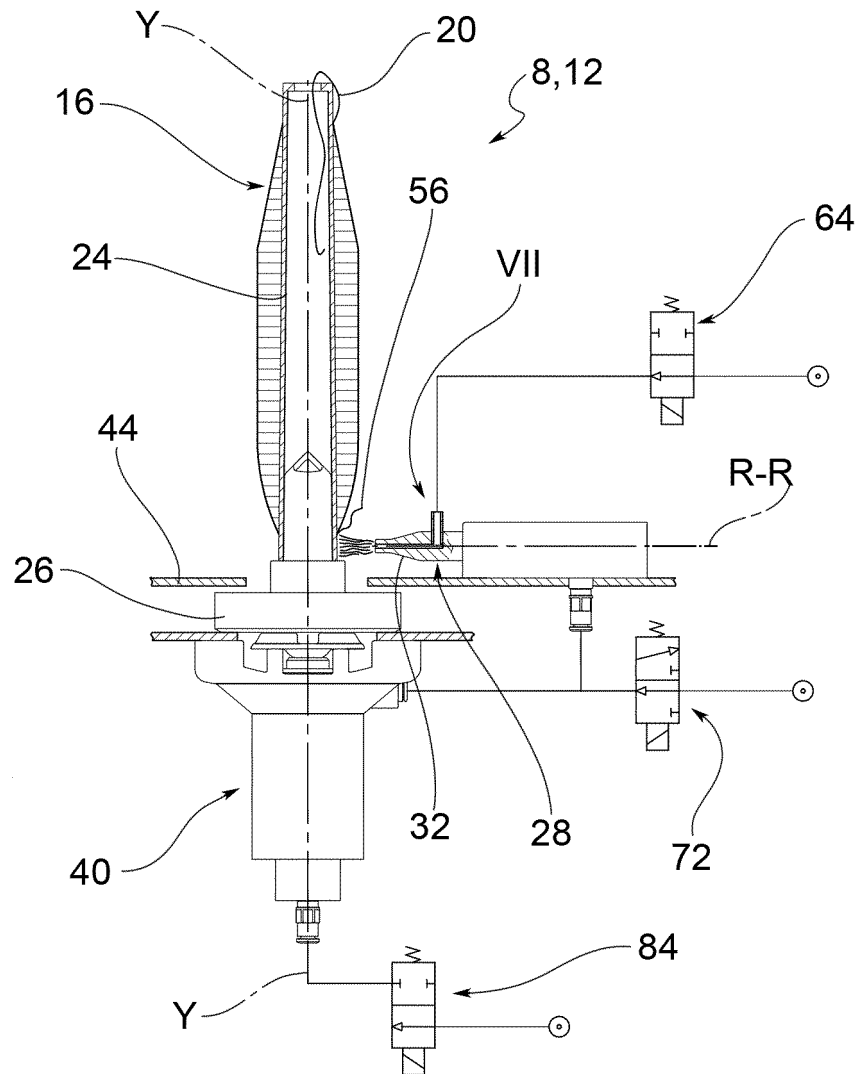


FIG.6

Description

FIELD OF APPLICATION

[0001] The present invention relates to a winding unit with improved tube locking pusher and plate centring pusher and the relative control method.

STATE OF THE ART

[0002] As is well known, in an automatic winding machine, both of the link type and of the free standing type, the spool of yarn which must be unravelled, after having been suitably prepared by the automation on board the machine, is conveyed to the winding unit by means of a spool-carrying plate which engages the tube. A special spool changing device, typically dedicated to each head, intercepts the individual spools, regulates the inflow thereof to the unravelling station and at the same time removes the empty tubes therefrom. All these steps are carried out in a known manner and will not be a specific object of the present invention.

[0003] In order for the spool to be processed without impediment by the winding unit, it is advisable that the plate and the tube are anchored in a fixed position during the entire unravelling step, to prevent the plate from moving and/or the spool from being dragged away by the rise of the coils of yarn, respectively, especially in the presence of tangles and/or irregularities in the deposit of the yarn. In this regard, it is customary to use:

a radial locking pusher, typically a single-acting pneumatic cylinder arranged horizontally, which radially intercepts the tube by exerting pressure on its base, where there is no yarn deposit;

an axial centring pusher, typically a single-acting pneumatic cylinder arranged vertically which, with the aid of a special tailstock, axially intercepts the spool holder plate making the upper surface adhere to the frame of the spool changing device.

[0004] Usually, both pushers are red by the same pneumatic solenoid valve, in order to lock the tube and centre the plate at substantially the same time. Finally, a spool unthreading function is envisaged, fed by a dedicated solenoid valve, which creates an air jet through the inner diameter of the tube, designed to facilitate the exit of the thread of yarn previously prepared by the automation on board the machine.

[0005] In such a context, a very frequent risk, which seriously compromises the functionality of the winding unit, is represented by the unwanted clamping of the free thread of yarn located at the base of the tube by the radial locking pusher. The immediate consequence is the breakage of the yarn in the final unravelling step, which forces the winding unit to start the conventional junction cycle to restore the continuity of the yarn. In doing so, the spool yarn nozzle must repeat (in vain) the drawing

of the thread several times based on an indication of false yarn presence, thus sending the head into alarm and generating a corresponding decrease in the overall productivity of the machine. Furthermore, the lack or incorrect processing of the locked thread of yarn leads to an increase in the amount of threads introduced into the textile working environment, with the consequent disadvantages associated with the dirtying of the winding units, the accumulation of yarn tangles and therefore the reduction of the machine's operational reliability.

[0006] Figure 1 shows a constructive and plant diagram of the device described above relating to the prior art, where it is possible to recognize the two pushers and the unthreading function with the two dedicated solenoid valves.

[0007] Furthermore, figure 2 shows the time trend of the corresponding supply pressures $p_1(t)$ and $p_3(t)$ of the two solenoid valves. It should be noted in particular that, when the spool is fed with the relative plate, the solenoid valve which controls the retraction of the two radial and axial pushers is switched at the initial instant t_0 , until the instant t_2 in which it is switched again with consequent locking and centring of the tube and plate (without, however, any possibility of controlling the thread). Subsequently, from the instant t_4 to the instant t_5 , the unthreading jet is operated independently by means of the dedicated solenoid valve.

[0008] The embodiments of the prior art described above, in order to move the thread away from the locking area, envisage that, at the end of unravelling, the pusher performs an alternating movement of unlocking and locking the tube for only the time necessary for the spool yarn nozzle to suck, without impediments, the thread at the end of the tube. However, this strategy leads to inefficiency, because it introduces additional times in the unravelling cycle, makes the cycle control logic more complex, reduces the number of life cycles of the pusher and, above all, does not always ensure full control of the spool.

PRESENTATION OF THE INVENTION

[0009] The need is therefore felt to resolve the drawbacks and limitations mentioned with reference to the prior art.

[0010] Such a need is met by a winding unit according to claim 1 and by a control method in accordance with claim 13.

DESCRIPTION OF THE DRAWINGS

[0011] Further features and advantages of the present invention will be more clearly comprehensible from the description given below of its preferred and nonlimiting embodiments, in which:

figure 1 depicts a constructive and plant diagram of a tube locking device and centring pusher relating to the prior art;

figure 2 depicts the time trend of the supply pressures $p_1(t)$ and $p_3(t)$ of the two solenoid valves of the prior art device of figure 1;

figure 3 depicts a winding machine comprising at least one winding unit in accordance with an embodiment of the present invention;

figure 4 depicts a partial view of a winding unit according to an embodiment of the present invention;

figure 5 depicts the enlarged detail V of figure 4;

figure 6 depicts a partial view of a winding unit according to an embodiment of the present invention;

figure 7 depicts the enlarged detail VII of figure 6;

figure 8 depicts a perspective view of a tube locking pusher according to a possible embodiment of the present invention;

figure 9 depicts a cross-section view of the tube locking pusher of figure 8;

figure 10 depicts a partial view of a winding unit comprising the locking pusher of figures 8-9;

figure 11 depicts the enlarged detail XI of figure 10;

figures 12-15 depict cross-section views of successive operating steps of the winding unit of figure 10; figure 16 depicts the time trend of the pressures in the solenoid valves of the winding unit of figure 10, during the operating steps illustrated in figures 12-15;

figure 17 depicts a partial view of a winding unit according to a further embodiment of the present invention;

figure 18 depicts a cross-section view of a plate centring pusher in accordance with the present invention, in an extracted configuration;

figure 19 depicts a cross-section view of the enlarged detail XIX of figure 18;

figure 20 depicts a cross-section view of the plate centring pusher of figures 18-19 in an extracted configuration;

figure 21 depicts the time trend of the pressures of the tube locking and plate centring pushers of the winding unit according to the embodiment of figures 17-20.

[0012] The elements or parts of elements common to the embodiments described below will be indicated using the same reference numerals.

DETAILED DESCRIPTION

[0013] With reference to the aforesaid figures, reference numeral 4 globally denotes a winding machine comprising a plurality of winding units 8.

[0014] At least one winding unit 8 comprises a spool changing device 12, for changing spools 16 comprising yarn 20 wound on a tube 24 supported by a plate 26. The tube 24 extends along a vertical axis Y-Y, preferably perpendicular to the plate 26.

[0015] It should be noted that the term thread or single thread or continuous thread refers to a single filament or

continuous filament (for example in the case of silk, artificial or synthetic fibres) while the term yarn refers to a group of fibrils of varying lengths which are paralleled and joined together by twisting. Hereinafter, one or the other term will be used indifferently, it being understood that the applications of the present invention are generic and all-encompassing, i.e., not limited to one or the other type/material.

[0016] The spool changing device 12 is provided with a tube locking pusher 28, provided with a locking stem 32 configured to pass from a retracted configuration, in which it does not interfere with the tube 24 of the spool 16, to an extracted configuration in which it obtains a constraint, preferably but not exclusively along a radial direction R-R, at a lower portion 36 of the tube 24 of the spool 16, facing said plate 26.

[0017] The radial direction R-R is preferably perpendicular and incident with respect to the vertical axis Y-Y of the tube 24.

[0018] The winding unit 8 further comprises a plate centring pusher 40 configured to influence, in an extracted configuration, the plate 26 abutting against a frame 44 of the spool changing device 12.

[0019] Advantageously, the spool changing device 12 is provided with at least one nozzle 48 positioned and configured so as to direct, through at least one delivery hole 52, a jet of compressed air near said lower portion 36 of the tube 24 of the spool 16 influenced by the tube locking pusher 28, to prevent said tube locking pusher 28 from clamping a thread 56 of said yarn 20 wound on the tube 24 and positioned near said lower portion 36.

[0020] In the following, reference will be made in particular to tube locking pushers 28 and plate centring pushers 40 of the pneumatically operated linear type (cylinders), meaning however that the invention is applicable to any other type of pushers, such as linear electric motors. Typically, said pushers slide axially inside relative cylinders 60.

[0021] In accordance with a possible embodiment (figures 4-5), said nozzle 48 is integral with the frame 44 of the spool changing device 12. In such an embodiment, the nozzle 48 does not move with the passage of the tube locking pusher 28 from the retracted configuration to the extracted configuration.

[0022] In accordance with a further possible embodiment (figures 6-7) said nozzle 48 is integrally fixed to said locking stem 32.

[0023] The nozzle 48 injects air at a delivery pressure p_2 , for example by means of a second pneumatic solenoid valve 64, through said at least one delivery hole 52 obtained at the tip of the locking stem near the contact area (lower portion 36) during the stroke of the tube locking pusher 28 to move the thread 56 away and prevent the latter from being accidentally clamped by the locking stem 32.

[0024] According to a particularly advantageous embodiment, the tube locking pusher 28 is configured as a pneumatic cylinder provided with a first chamber 68,

placed under pressure p_1 by a first solenoid valve 72, and a second chamber 76, placed under pressure p_2 by the second solenoid valve 64. Both chambers 68, 76 are in fluid communication with said locking stem 32 of the tube locking pusher 28.

[0025] Preferably, the second chamber 76 is hermetic and coaxial with respect to the first chamber 68.

[0026] For example, the second chamber 76 houses an elastic return element 80 of the locking stem 32 which elastically influences said locking stem 32 in said extracted position.

[0027] The tube locking pusher 28 is provided at the tip with a cylindrical delivery hole 52 coaxial with the locking stem 32 and fluidly connected to the second chamber 76. As will be better clarified below, the puff of air is integrated with the movement of the tube locking pusher 28 from both a constructive and a functional point of view, resulting in a greater compactness of the device and in a greater effectiveness of controlling the position of the thread 56, so that the latter is not accidentally clamped by the tube locking pusher 28.

[0028] For example, said at least one delivery hole 52 is arranged coaxial with respect to a main extension axis of the locking stem 32, arranged parallel to said radial direction R-R.

[0029] The delivery hole 52 of the nozzle 48 has a diameter between 0.2 mm and 1.2 mm, preferably equal to 0.5 mm.

[0030] The stroke of the tube locking pusher 28, equal to the distance between the retracted position and the extracted position, is between 5 mm and 15 mm, preferably 10 mm.

[0031] In accordance with an embodiment, the first solenoid valve 72, which controls the locking/unlocking of the tube locking pusher 28, is of the normally closed 3/2 type.

[0032] In accordance with an embodiment, the second solenoid valve 64, which controls the puff of air as well as the stroke of the locking stem 32, is of the normally closed 2/2 type.

[0033] For example, the winding unit 8 is provided with a spool unthreading jet fed by a third solenoid valve 84.

[0034] It should be noted that the supply pressures p_1 and p_2 can be distinct or equal to each other, and may or may not coincide with the line pressure of the plant. The same applies to the unthreading pressure p_3 .

[0035] In accordance with a particularly advantageous embodiment (figures 18-20), said plate centring pusher 40 comprises a centring stem 88 provided with a through hole 92 configured so that, when it is extracted in the locking position of the plate 26, it allows a jet of unthreading air to flow therein, through said through hole 92.

[0036] The jet of unthreading air exits through at least one circular sector-shaped slot 94 obtained on a sleeve 96 of the axial centring cylinder 98 which houses and guides said plate centring pusher 40.

[0037] For example, the plate centring pusher 40 is configured so that when the centring stem 88 retracts

disengaging the plate 26, it blocks the unthreading flow by occluding the at least one slot 94 with the centring stem 88 and pressing against a hermetic closing element 100.

[0038] In plate-locking conditions, the at least one slot 94 is kept open by the hermetic closing element 100, for example in the form of a rubber plug, coaxial to the centring stem 88, which abuts against a shoulder 104 of the axial centring cylinder 98, by virtue of the action of a spring 102, and thus creates a by-pass for the air.

[0039] With respect to the traditional cycle (figure 21), when at the initial instant t_0 the two pushers 28, 40 retract, the unthreading is plugged and therefore, when at the instant t_1 the second solenoid valve 64 is switched, only the puff of the tube locking pusher 28 is fed. At the instant t_2 the tube locking pusher 28 intercepts the tube 24. At the instant t_3 the first solenoid valve 72 is switched and thus also the plate centring pusher 40 centres the plate 26. Thereby, however, by virtue of the construction of the plate centring pusher 40, the unthreading jet is fed, being controlled by the same solenoid valve used for the puff of the pusher.

[0040] With respect to the previous case, then, the interval t_3-t_2 , which determines the delay of extinguishing the puff of the tube locking pusher 28, cannot be chosen arbitrarily, having to reconcile on the one hand the need to reach the tube 24 with certainty and on the other to prevent the undesired triggering of unthreading. Therefore, the duration of such an interval t_3-t_2 is assumed to be 20 ms. By virtue of this configuration, it will therefore be possible to perform the unthreading separately and independently during the interval t_5-t_4 with one less solenoid valve, certain of the fact that upon the unthreading the air will only exit from the stem of the plate centring pusher 40, the puff being plugged by the contact with the tube 24 itself.

[0041] The functioning of the winding unit in accordance with the present invention will now be described.

[0042] In particular, during the passage in the extracted configuration of the locking stem 32 of the tube locking pusher 28, a jet of compressed air is directed, through the delivery hole 52 of said nozzle 48 (whether it is separated or integrated in the tube locking pusher 28), near said lower portion 36 of the tube 24 of the spool 16, to prevent said tube locking pusher 28 from clamping a thread 56 of said yarn 20 wound on the tube 24.

[0043] More in detail (figure 12), at an initial instant t_0 , once the spool 16 has reached the plate 26, pressure is put on the first chamber 68 at pressure p_1 and the tube clamping pusher 28 and the plate 26 (being controlled by the same solenoid valve) are retracted with relative compression of the elastic return element 80 acting on the locking stem 32.

[0044] At an instant t_1 (figure 13), the operation continues with the step of switching the second solenoid valve 64 which allows the air to flow into the second chamber 76 and then through the delivery hole 52 at the tip of the tube locking pusher 28, with consequent deviation of

the thread 56 free of yarn from the tube 24.

[0045] Since during the filling step the air flow rate of the puff is significantly lower than the inlet flow rate to the second chamber 76, the latter is gradually pressurized, progressively overcoming the elastic load of the elastic return element 80 compressed by the first chamber 68 and gradually releasing the tube locking pusher 28 towards the tube 24 (figure 14).

[0046] At an instant t_2 (figure 15) the position of the first solenoid valve 72 is switched and the elastic return element 80 discharges the residual elastic load stored thereby onto the tube 24, which thus ensures the correct retention of the tube 24: in other words, the radial locking of the tube 24 in unravelling is provided by the cylinder spring.

[0047] Furthermore, the plate centring pusher 40 exits, pressing the plate 26 against the frame 44 of the spool changing device 12 to lock it in position.

[0048] The time interval t_2-t_1 is approximately 30 ms and coincides with the time necessary to achieve the nominal stroke of the tube locking stem 28.

[0049] The switching off of the second solenoid valve 64 is delayed to an instant t_3 to ensure that the locking stem 32 of the tube locking pusher 28 actually reaches the tube 24 and that at the same time the thread 56 continues to be deflected precisely at upon the locking (figure 16).

[0050] This solution, in addition to ensuring the puff in the approaching stroke of the tube locking pusher 28, also makes the movement of the tube locking pusher 28 slower, gradual and controllable, thus increasing the effectiveness of the puff diverting action.

[0051] The third solenoid valve 84, responsible for controlling the unthreading and independent of the other two solenoid valves 64, 72, is switched after the instant t_3 and feeds the air jet inside the tube at a pressure p_3 for a predefined interval t_5-t_4 .

[0052] The interval t_3-t_2 , which determines the delay of extinguishing the puff of the tube locking pusher 28, is chosen so as to reconcile, on the one hand, the need to reach the tube 24 with certainty and, on the other, the need to prevent the undesired triggering of unthreading.

[0053] The duration of said interval t_3-t_2 is between 18 ms and 22 ms, and preferably is 20 ms.

[0054] Starting from the embodiment described above, it is possible to obtain further advantages in terms of simplification of the pneumatic system at the service of the various functions, by exploiting the occlusion of the radial locking puff when the tube locking pusher 28 is in contact with the tube 24 and by appropriately modifying the design of the plate centring pusher 40, as described above. It is thereby possible to eliminate the third solenoid valve 84 dedicated to unthreading, feeding this last function with the same solenoid valve which controls the puff of the tube locking pusher 28 and configuring the plate centring pusher 40 so that, depending on the operating position of its stem, it can divert the air flow to perform the

following two functions:

in the locking position of the plate 26, the plate centring pusher 40 performs the unthreading of the thread 56;

in the plate release position 26, the air from the valve is diverted to the tube locking pusher 28 to move the thread 56.

[0055] As may be appreciated from the description, the present invention makes it possible to overcome the drawbacks mentioned of the prior art and to obtain considerable operational advantages.

[0056] First of all, the simplification of the unravelling cycle is achieved by reducing the number of operating cycles of the pushers and the consequent improvement of their operating performance in terms of useful life.

[0057] Furthermore, the risk of undesired clamping of the lower thread of the spool is eliminated and the consequent reduction in the number of alarms sounded by the spool thread nozzle.

[0058] Furthermore, the amount of threads introduced into the machine and the textile working environment is reduced, resulting in an overall improvement in the cleaning of the winding unit.

[0059] Furthermore, the sensorization on board the winding unit is reduced, as systems for controlling the presence of yarn at the end of the tube (e.g., photocells), with the consequent elimination of the risk of dirtying them.

[0060] By virtue of the substantial simultaneity of the puff and the advancement of the radial locking pusher, two steps are performed in one and therefore a better control of the thread dynamics.

[0061] Furthermore, it is possible to obtain a greater overall compactness of the device due to the integration of the puff inside the radial pusher.

[0062] The overall reduction in the number of solenoid valves necessary for operation leads to the simplification of the machine's pneumatic architecture.

[0063] Furthermore, an increase in the operating reliability and productivity of the winding unit, and therefore of the entire machine, is obtained.

[0064] Therefore, the fundamental concept underlying the invention relates to the juxtaposition of a pneumatic puff substantially simultaneous with the advancement stroke of the tube locking pusher. The adverb "substantially" is intended to protect also those embodiments in which the puff is not exactly simultaneous with the stroke of the tube locking pusher, but starts and ends respectively immediately before and/or immediately after the start and end of the stroke of the tube locking pusher. The impulsive action of the puff pushes the thread away during the stroke of the pusher, eliminating the undesired risk of clamping and allowing in particular the control of the thread only when really necessary, i.e., from the beginning of the stroke of the tube locking pusher until contact with the tube itself. In fact, if the puff were not oper-

ated simultaneously with the advancement of the tube locking pusher, there would be some considerable disadvantages (which are solved by the present invention), such as unnecessary and unsolicited air consumption, as well as a less reliable control of the thread due to the elastic return thereof in the interference position with the tube locking pusher for premature interruption of the puff.

[0065] A person skilled in the art may make numerous modifications and variations to the solutions described above so as to satisfy contingent and specific requirements.

[0066] The scope of protection of the present invention is defined by the following claims.

Claims

1. Winding unit (8) comprising a spool changing device (12), for changing spools (16) comprising yarn (20) wound on a tube (24) supported by a plate (26), the spool changing device (12) being provided with:

- a tube locking pusher (28), provided with a locking stem (32) configured to pass from a retracted configuration, in which it does not interfere with the tube (24) of the spool (16), to an extracted configuration in which it obtains a constraint at a lower portion (36) of the tube (24) of the spool (16), facing said plate (26),
- a plate centring pusher (40) configured to influence, in an extracted configuration, the plate (26) abutting against a frame (44) of the spool changing device (12),
- wherein the spool changing device (12) is provided with at least one nozzle (48) positioned and configured so as to direct, through at least one delivery hole (52), a jet of compressed air near said lower portion (36) of the tube (24) of the spool (16) influenced by the tube locking pusher (28), to prevent said tube locking pusher (28) from clamping a thread (56) of said yarn (20) wound on the tube (24).

2. Winding unit (8) according to claim 1, wherein said nozzle (48) is integral with a frame (44) of the spool changing device (12).
3. Winding unit (8) according to claim 1, 2 or 2, wherein said nozzle (48) is integrally fixed to said locking stem (32).
4. Winding unit (8) according to claim 1, 2 or 3, wherein the nozzle (48) injects air through said at least one delivery hole (52) obtained at the tip of the locking stem (32).
5. Winding unit (8) according to claim 4, wherein said at least one delivery hole (52) is arranged coaxial

with respect to a main extension axis of the locking stem (32).

6. Winding unit (8) according to any one of claims 1 to 5, wherein the tube locking pusher (28) is configured as a pneumatic cylinder (60) provided with a first chamber (68), placed under pressure p_1 by a first solenoid valve (72), and a second chamber (76), placed at a pressure p_2 by a second solenoid valve (64), both chambers (68,76) being in fluid communication with said locking stem (32) of the tube locking pusher (28).
7. Winding unit (8) according to claim 6, wherein the second chamber (76) is hermetic and coaxial with respect to the first chamber (68).
8. Winding unit (8) according to claim 6 or 7, wherein the second chamber (76) houses an elastic return element (80) of the locking stem (32) which elastically influences said locking stem (32) in said extracted position.
9. Winding unit (8) according to claim 6, 7, or 8, wherein the tube locking pusher (28) is provided at the tip with a cylindrical delivery hole (52) coaxial with the locking stem (32) and fluidically connected to the second chamber (76).
10. Winding unit (8) according to any one of claims 6 to 9, wherein the winding unit (8) is provided with a spool unthreading jet fed by a third solenoid valve (84).
11. Winding unit (8) according to any one of claims 6 to 10, wherein said plate centring pusher (40) comprises a centring stem (88) provided with an inner through hole (92) and is configured so that, when it is extracted in the plate locking position (26), it allows a jet of unthreading air to flow therein, through said inner through hole (92), wherein said jet of unthreading air exits through at least one circular sector-shaped slot (94) obtained on a sleeve (96) of the axial centring cylinder (98) which houses and guides said plate centring pusher (40).
12. Winding unit (8) according to claim 11, wherein said plate centring pusher (40) is configured so that when the centring stem (88) is retracted, disengaging the plate (26), it blocks the unthreading flow by occluding the at least one slot (94) with the centring stem (88) and pressing against a hermetic closing element (100), wherein the at least one slot (94) is kept open by said hermetic closing element (100), for example in the form of a rubber dowel, coaxial to the centring stem (88), which abuts against a shoulder (104) of the axial centring cylinder (98).

13. Control method of a winding machine (4) comprising the steps of:

- providing a winding unit (8) according to any one of claims 1 to 12; 5
- during the passage in the extracted configuration of the locking stem (32) of the tube locking pusher (28), directing a jet of compressed air, through the delivery hole (52) of said nozzle (48), near said lower portion (36) of the tube (24) of the spool (16), to prevent said tube locking pusher (28) from clamping a thread (56) of said yarn (20) wound on the tube (24). 10

sponsible for controlling the unthreading and independent of the other two solenoid valves (64,72), is switched after the instant t_3 and feeds the air jet inside the tube (24) at a pressure p_3 for a predefined interval t_5-t_4 .

14. Control method according to claim 13, comprising the steps of: 15

- providing a winding unit (8) according to any one of claims 8 to 18,
- at an initial instant t_0 , once the spool (16) has reached the plate (26), putting pressure on the first chamber (68) at pressure p_1 and retracting the tube locking pusher (28) with relative compression of the elastic return element (80) acting on the locking stem (32), 20 25
- at a time t_1 , switching the second solenoid valve (64) which allows air to flow into the second chamber (76) and then through the delivery hole (52) at the tip of the tube locking pusher (28), with consequent deviation of the thread (56) free of yarn (20) from the tube (24), 30
- wherein, since during the filling step the air flow rate of the puff is significantly lower than the inlet flow rate to the second chamber (76), the latter is gradually pressurized, progressively overcoming the elastic load of the elastic return element (80) compressed by the first chamber (68) and gradually releasing the tube locking pusher (28) towards the tube (24). 35 40

15. Control method according to claim 14, wherein

- at an instant t_2 the position of the first solenoid valve (72) is switched and the elastic return element (80) discharges the residual elastic load stored thereby onto the tube (24), which thus ensures the retention of the tube (24), wherein the plate centring pusher (40) exits, pressing the plate (26) against the frame (44) of the spool changing device (12) to lock it in place. 45 50

16. Control method according to claim 14 or 15, wherein the switching off of the second solenoid valve (64) is delayed to an instant t_3 to ensure that the locking stem (32) of the tube locking pusher (28) actually reaches the tube (24) and that at the same time the thread (56) continues to be deflected precisely upon the locking, wherein a third solenoid valve (84), re- 55

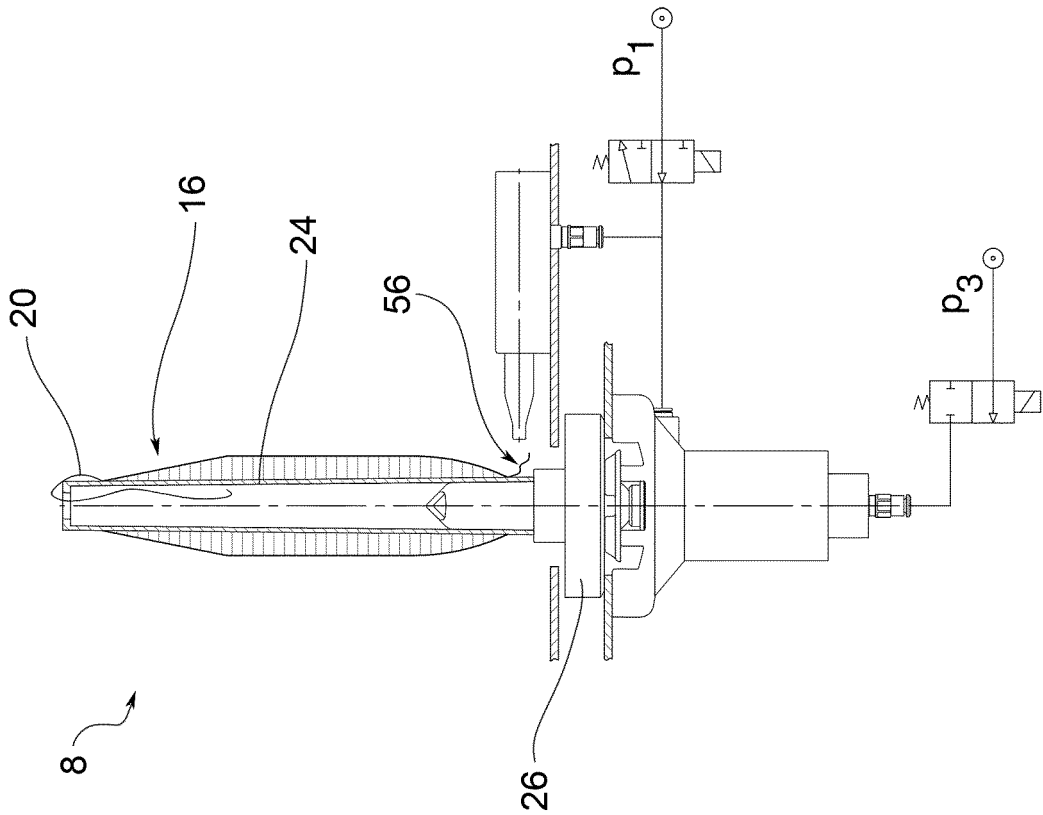


FIG.1 - Prior art

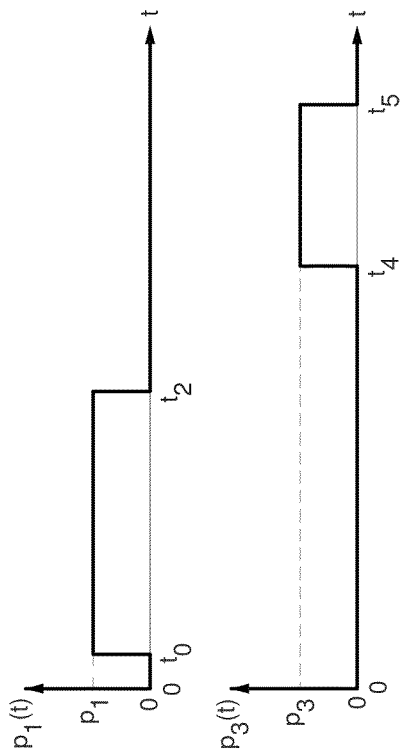


FIG.2 - Prior art

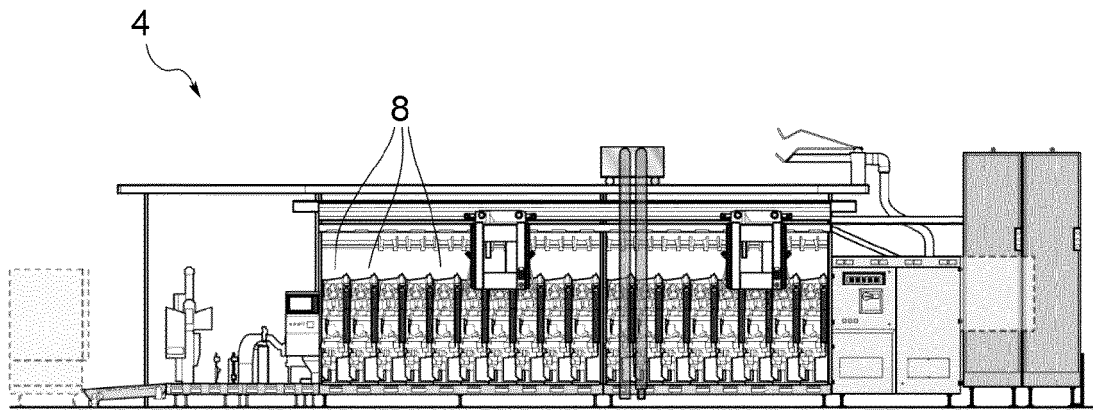


FIG. 3

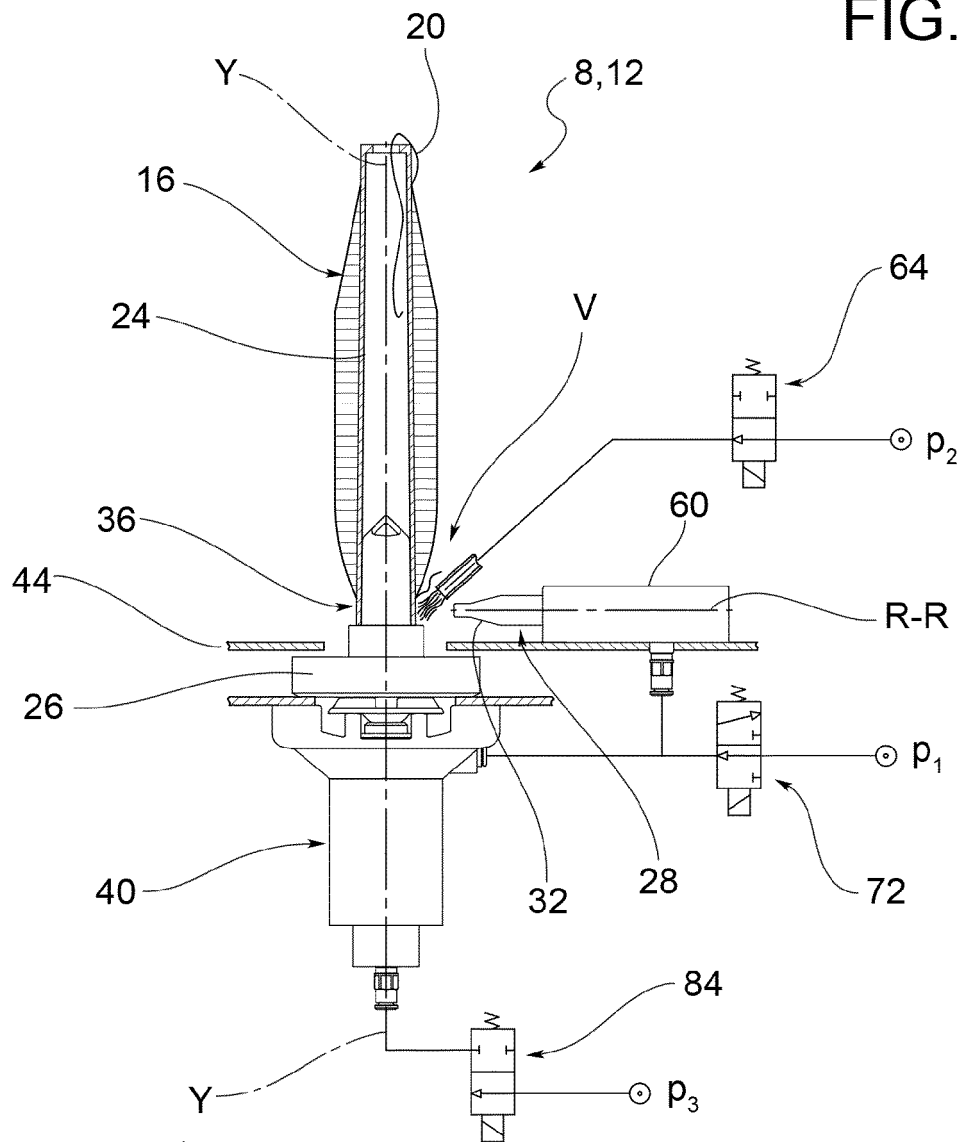


FIG. 4

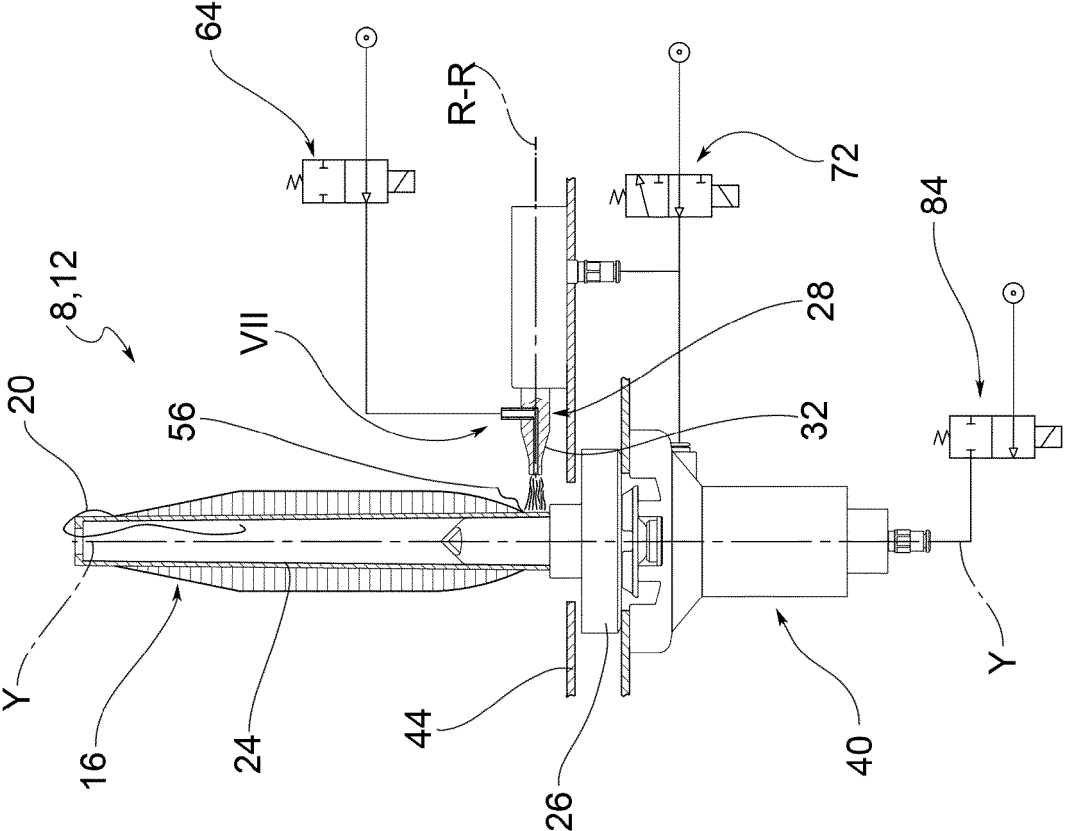


FIG. 5

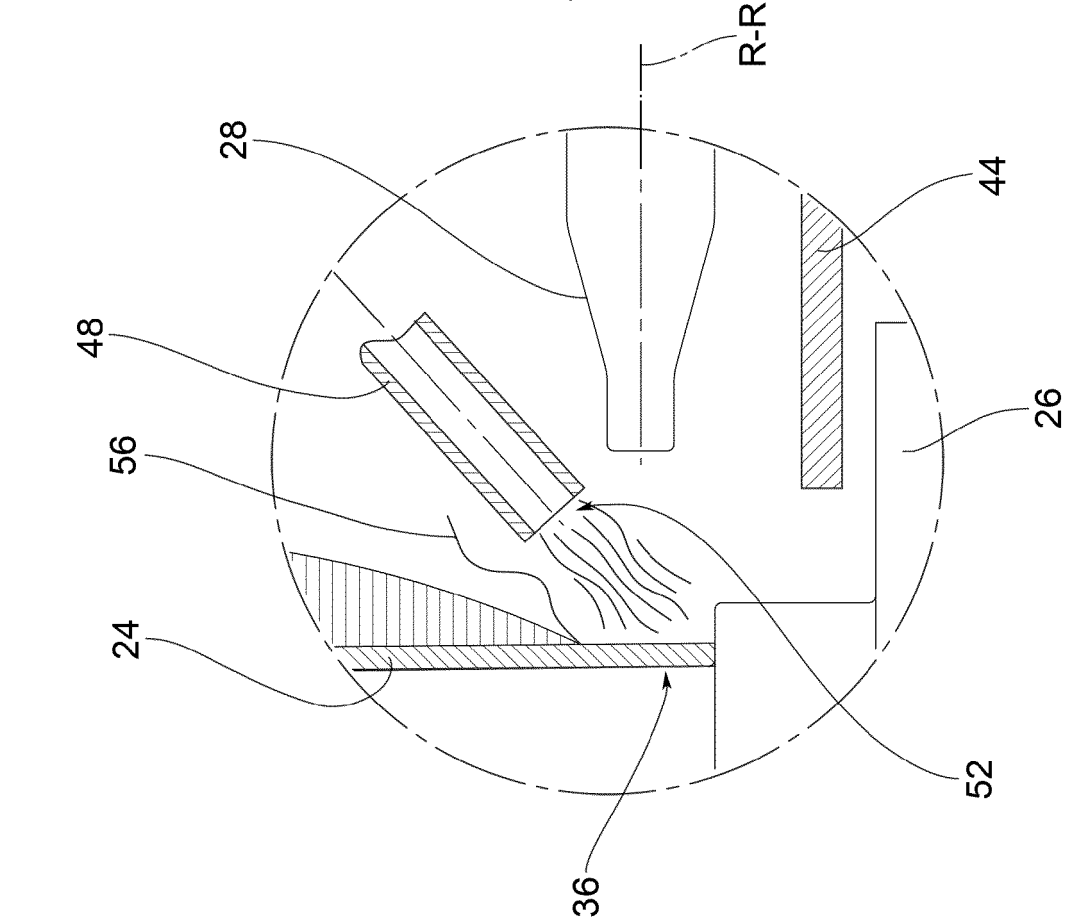


FIG. 6

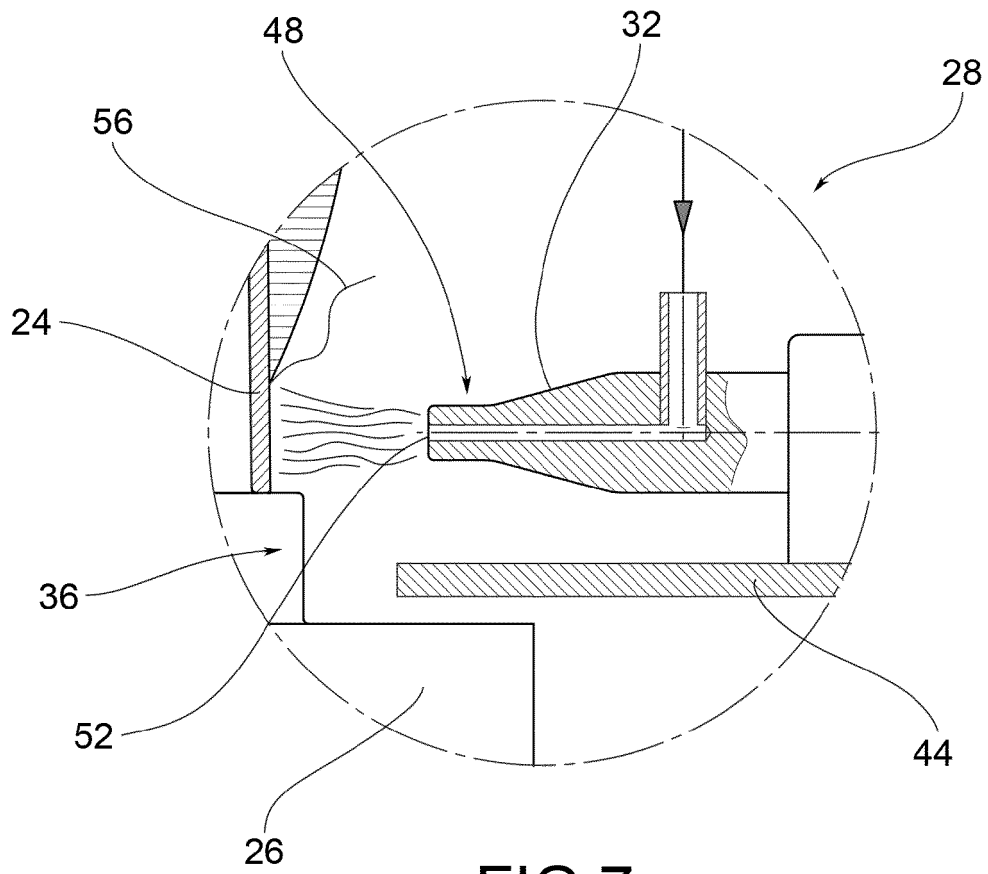


FIG. 7

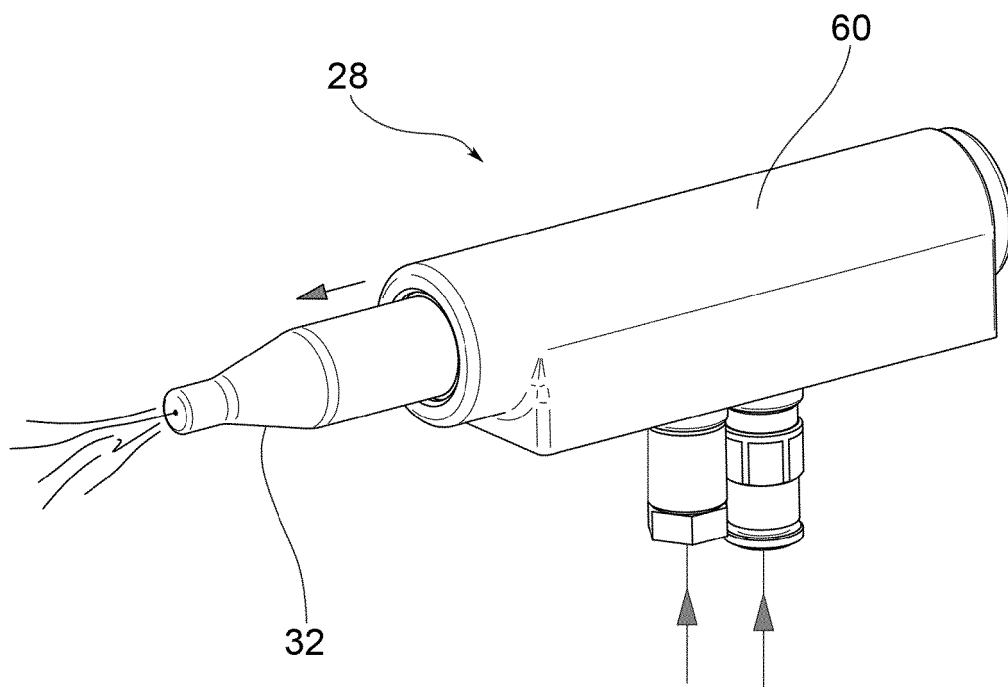


FIG. 8

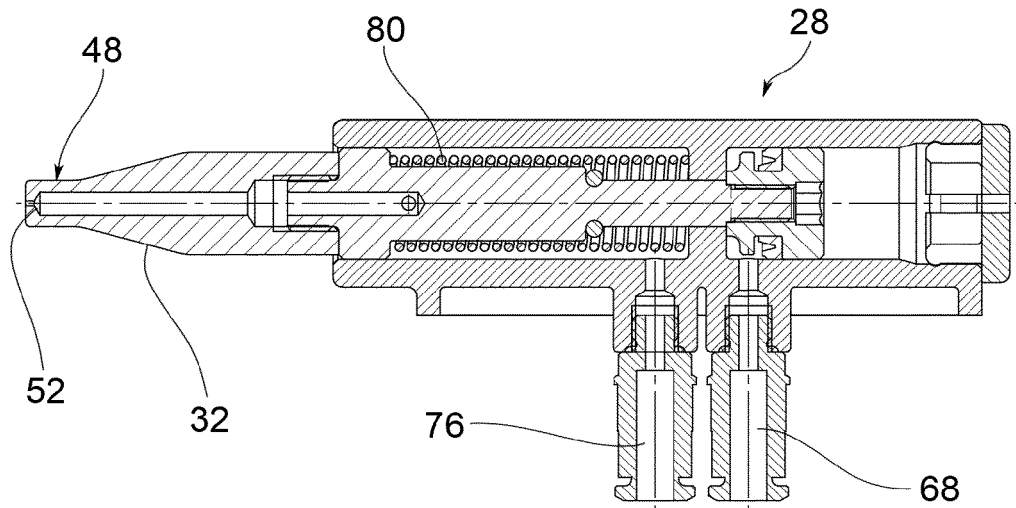


FIG. 9

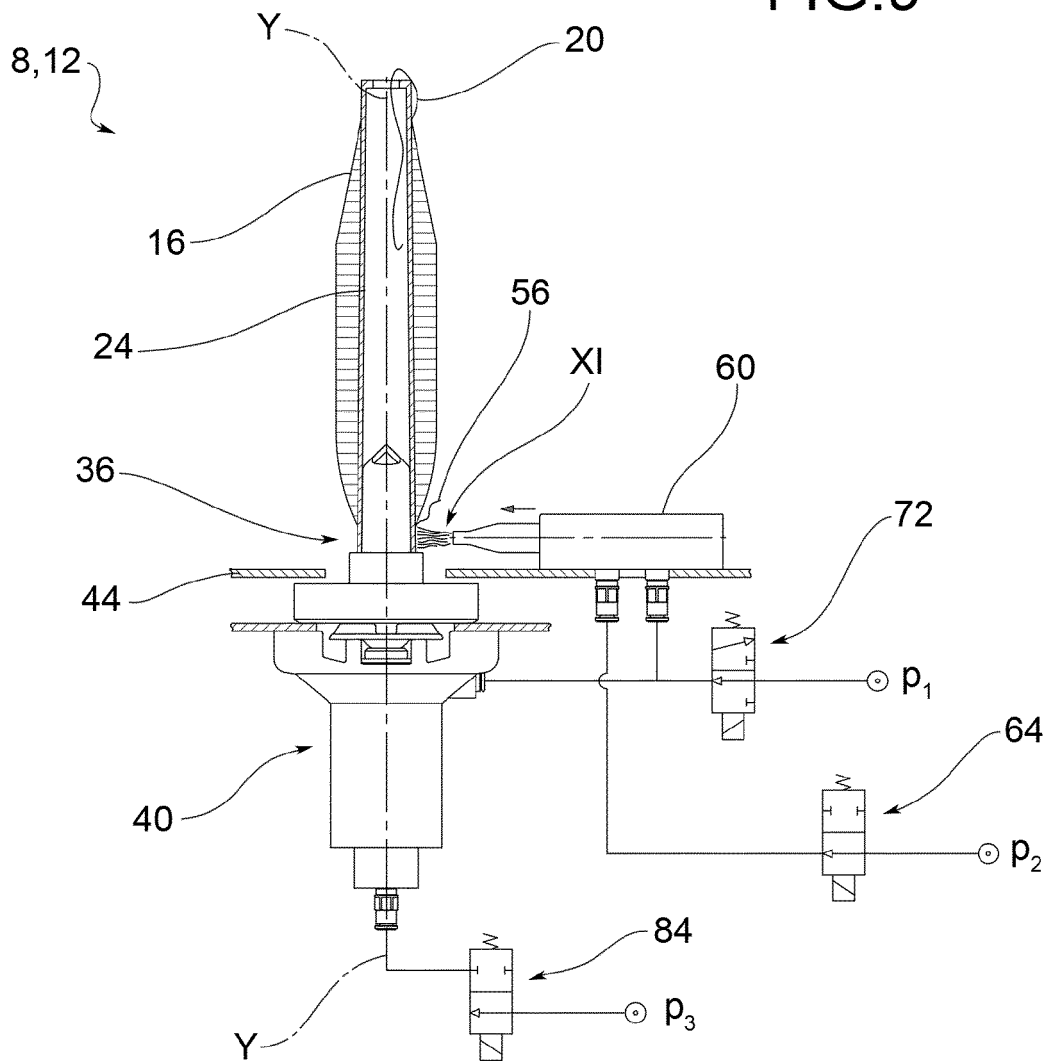


FIG. 10

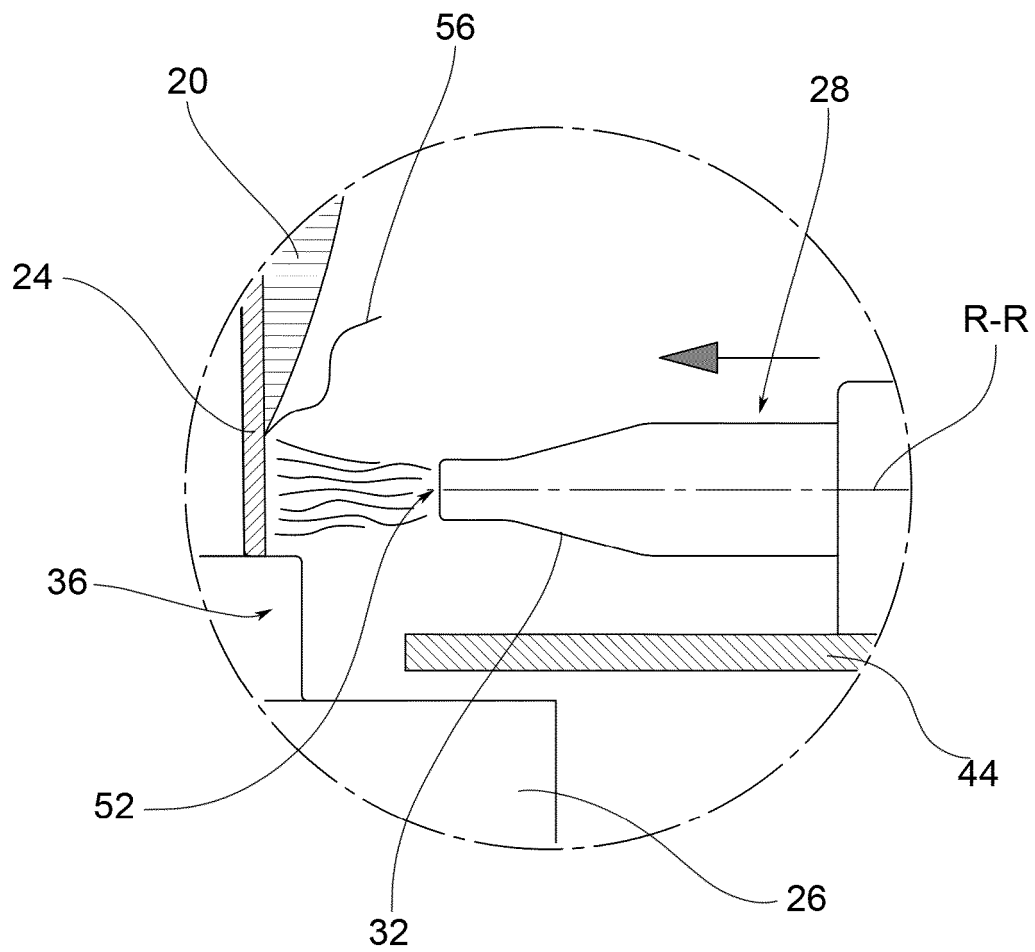


FIG.11

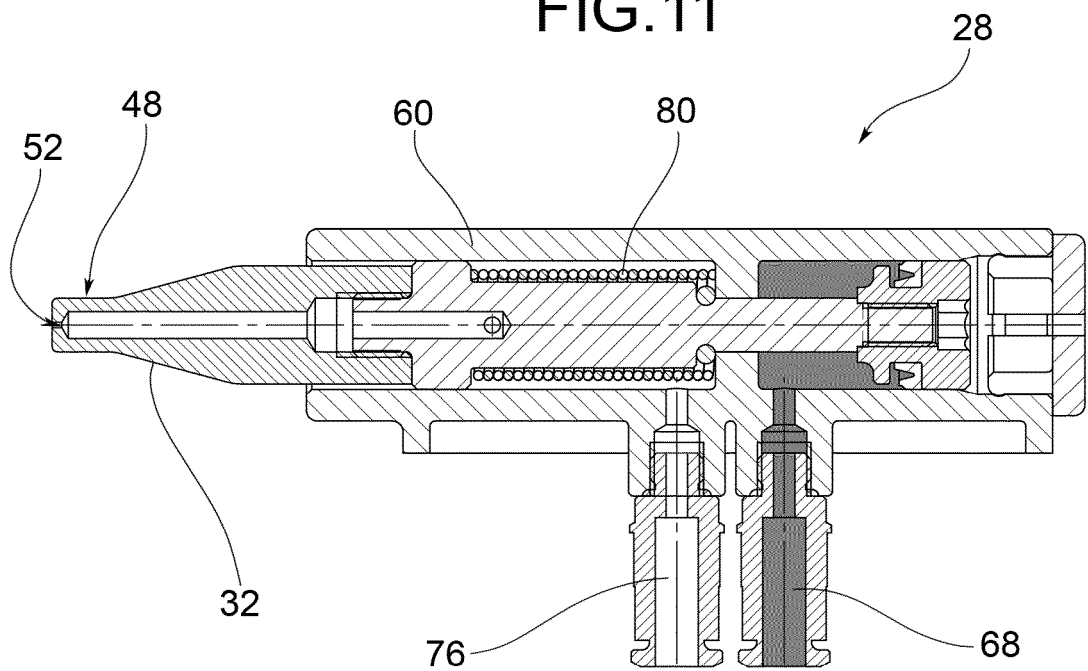


FIG.12

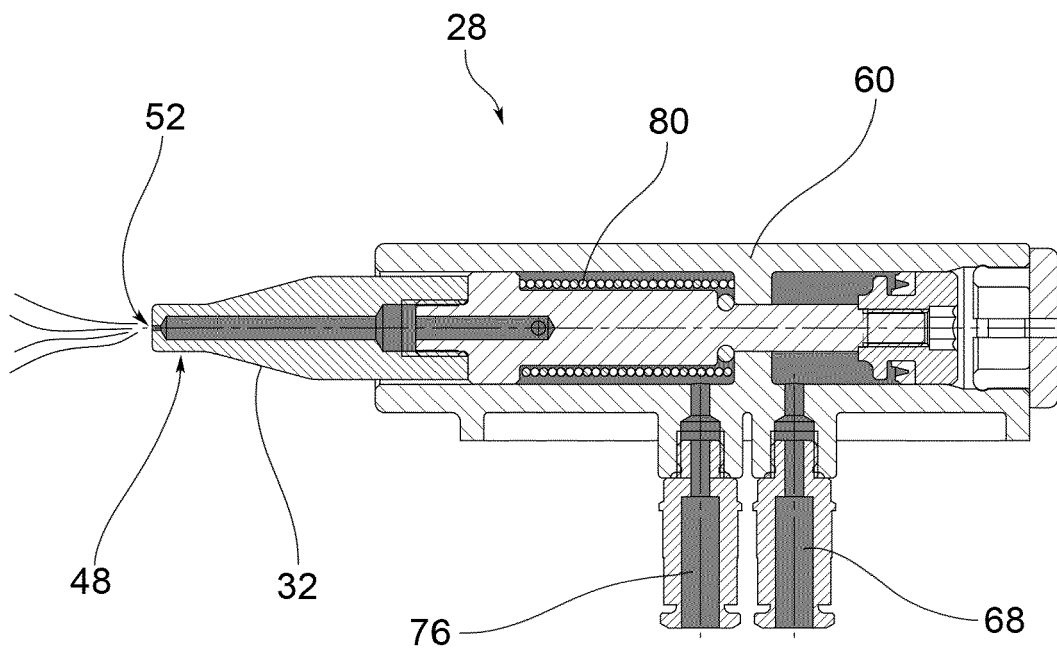


FIG.13

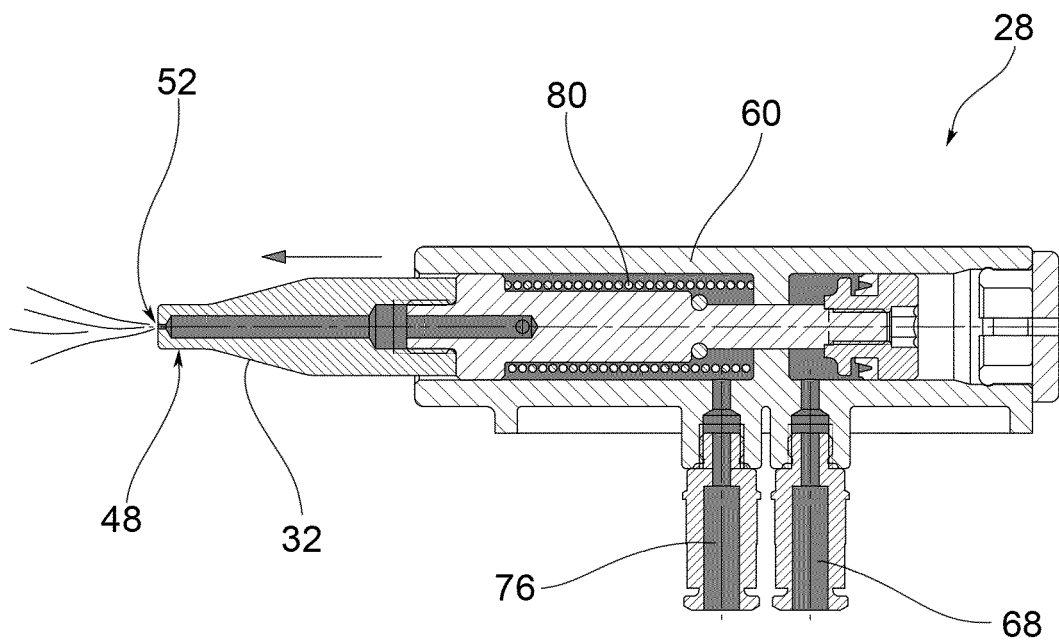


FIG.14

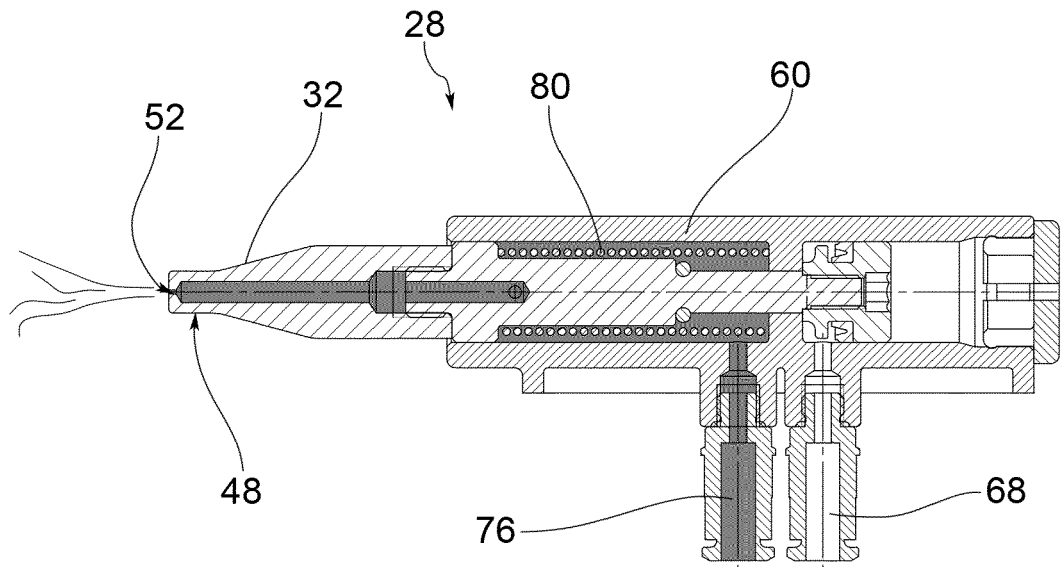


FIG.15

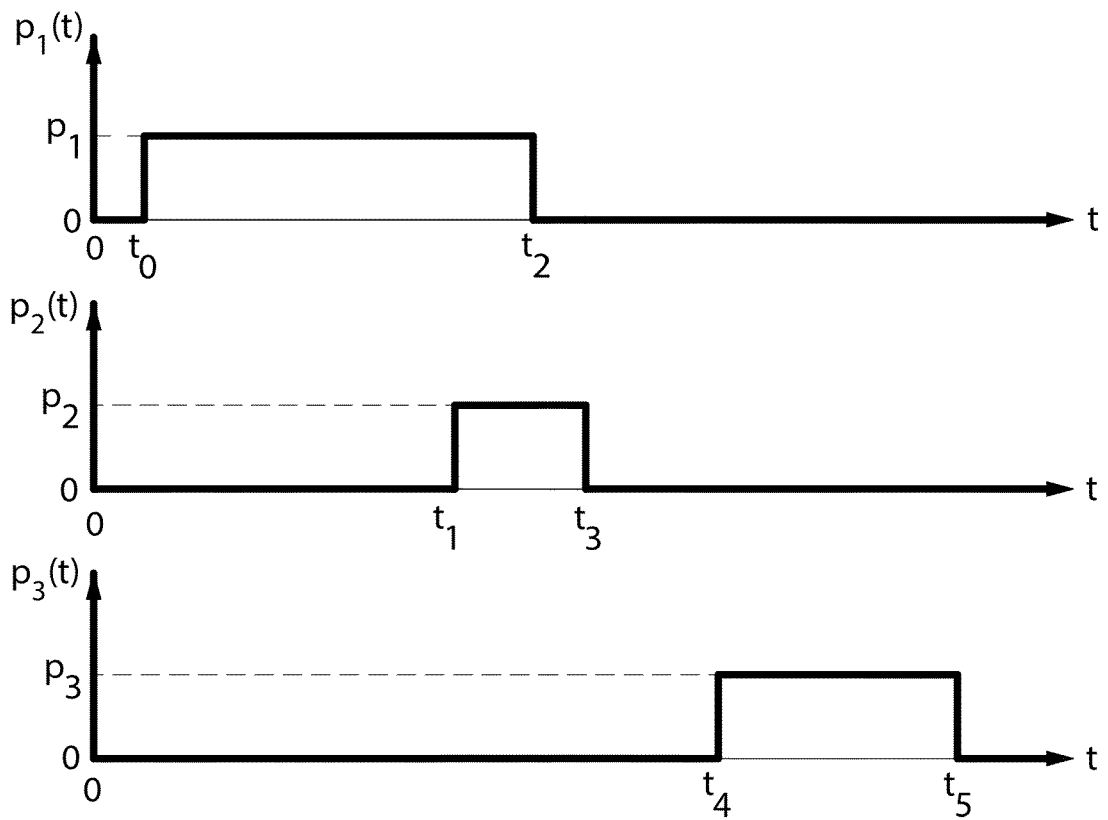


FIG.16

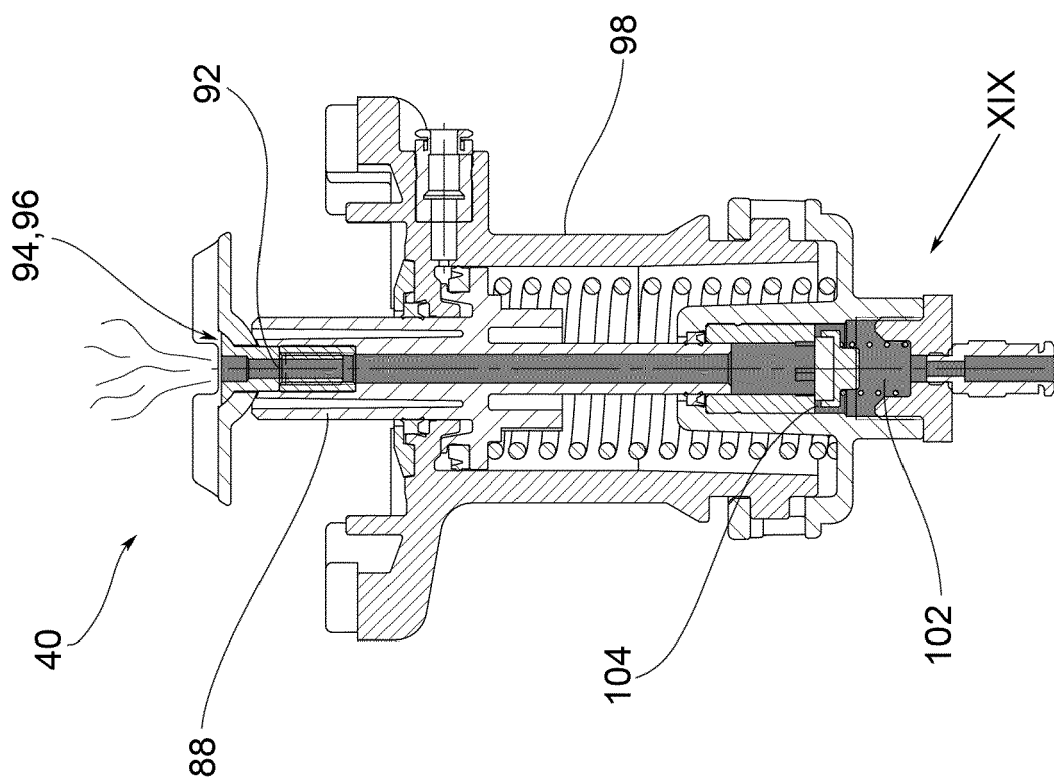


FIG. 18

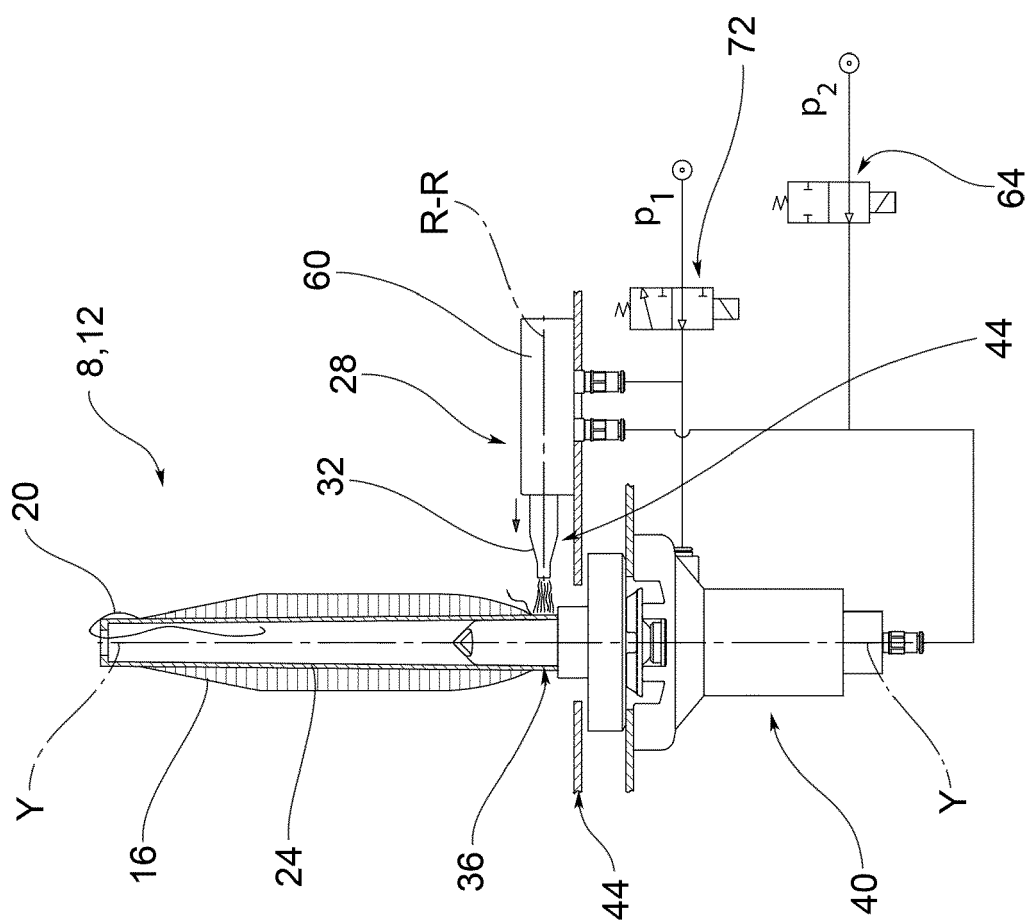


FIG. 17

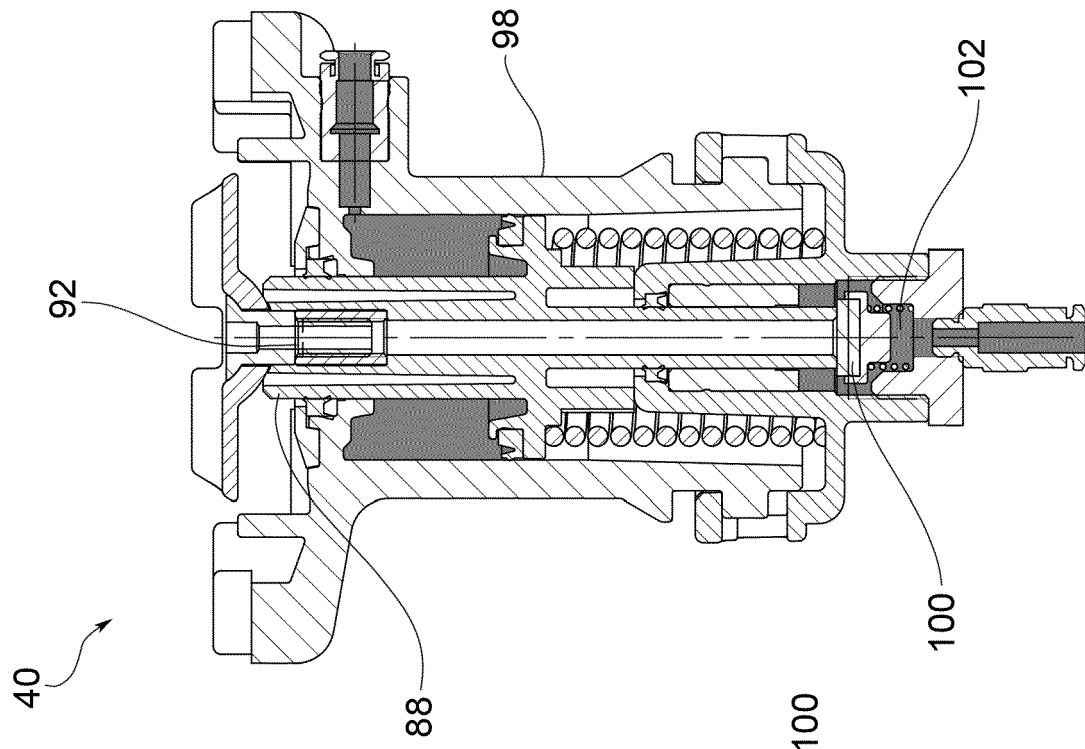


FIG.19

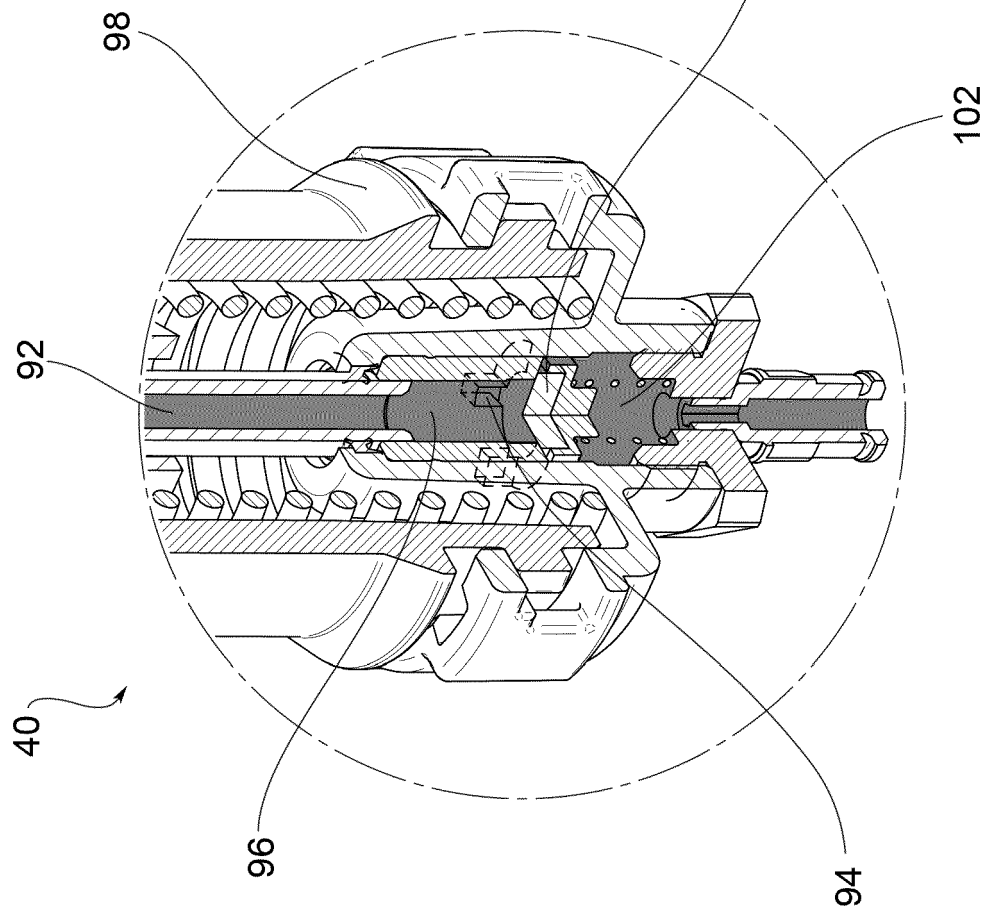


FIG.20

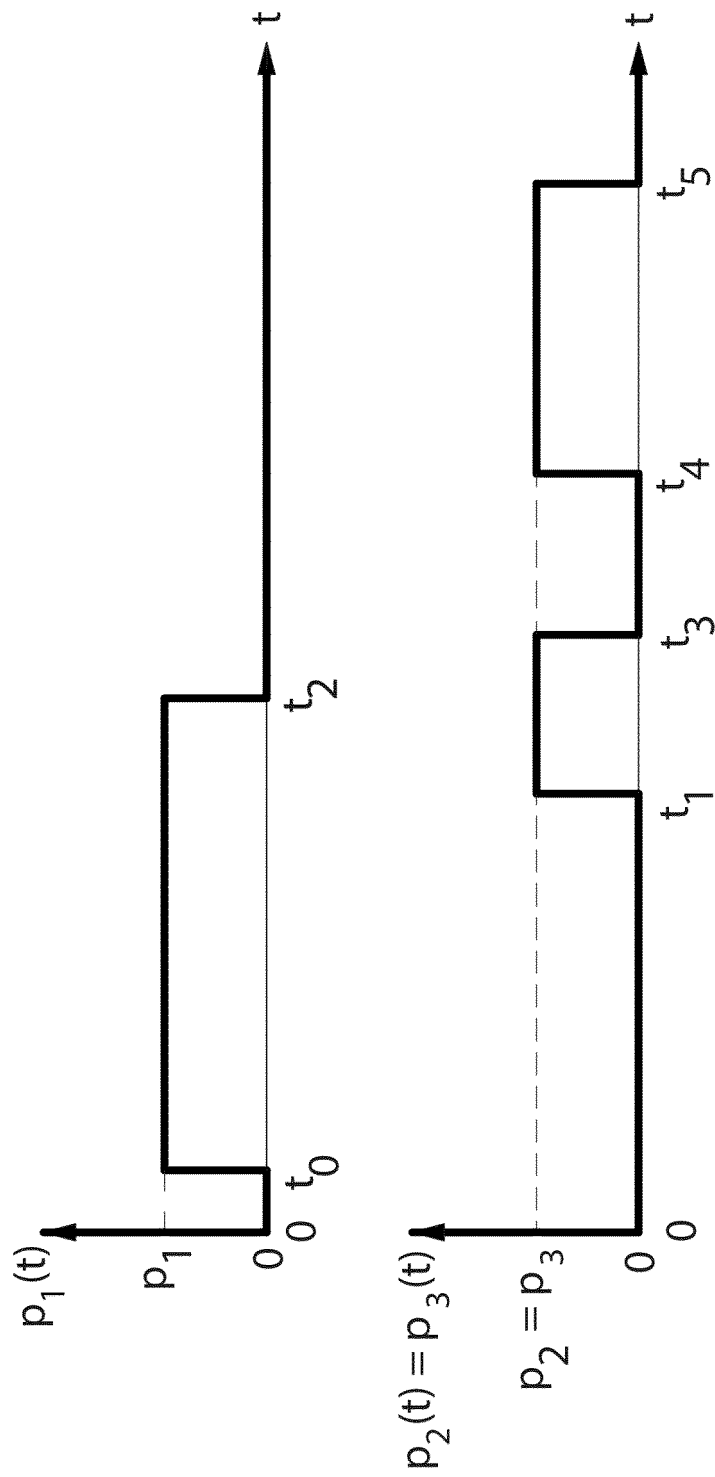


FIG.21



EUROPEAN SEARCH REPORT

Application Number

EP 22 20 2362

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X	US 5 590 845 A (NAKAGAWA TAKASHI [JP] ET AL) 7 January 1997 (1997-01-07)	1, 2, 6-8, 10-16	INV. B65H67/08
A	* column 3, lines 47-53 * * column 3, line 67 - column 4, line 9 * * column 4, lines 27-36; figures *	3-5, 9	
A	EP 1 950 163 A2 (SAVIO MACCHINE TESSILI SPA [IT]) 30 July 2008 (2008-07-30) * paragraphs [0016], [0020]; figures *	1-16	
A	US 4 619 416 A (MATSUI ISAMU [JP] ET AL) 28 October 1986 (1986-10-28) * column 3, lines 23-32 * * column 5, lines 20-26; figures *	1-16	
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			B65H
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 30 March 2023	Examiner Lemmen, René
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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