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(54) **INSERTING GUN WITH EXCHANGE VALVE**

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PISTOLET D'INSERTION AYANT UNE SOUPAPE D'ÉCHANGE

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Description

[0001] The present invention relates to a pneumohydraulic inserting gun.

[0002] In particular, the present invention falls in the technical field of inserting guns suitable to perform an action on a respective deformable threaded insert to be riveted, to lock it on one or more specific components, mutually locking them. In certain cases, inserting guns are known, in a very general manner, as "riveters" and the deformable threaded inserts to be riveted are known, in a very general manner, as "rivets". For reasons of practicality, since it is not the subject of the present invention as extensively described below, the term "rivet" will refer to the deformable threaded insert to be riveted, while since it is the subject of the present invention, the term inserting gun or pneumohydraulic inserting gun will always refer to the gun.

[0003] Specifically, the known inserting guns perform a series of actions on the rivet, by means of which the locking is obtained. Indeed, in a first moment, the inserter performs an action in which the rivet is housed in a housing, e.g. a hole, consisting of the coupling of two components, and is brought, with the head thereof, to abut on a wall of a first component; in a second moment, the inserter performs an action which plastically deforms the rivet so as to obtain the fastening of the threaded insert and/or the mutual fastening of the components.

[0004] In further detail, the present invention specifically relates to servo-assisted inserting guns. In particular, a known embodiment of inserting gun is that described in document EP2150378A2 which discloses the preamble of claim 1 to the same Applicant.

[0005] With particular reference to the aforesaid background, the inserting gun of the present invention forms part of that group of inserting guns in which engagement and disengagement actions on the rivet are provided by screwing and unscrewing.

[0006] Within the aforesaid background, the need is strongly felt to improve the known solutions, improving the efficiency thereof and making them more attractive on the market. In particular, such a need was also found for the inserting gun protected in document EP2150378 to the Applicant.

[0007] The inserting gun of the present invention aims at having improved features with respect to the features of the known inserting guns, with particular reference to the features of the inserting gun described in document EP2150378. Indeed, the inserting gun of the present invention is more efficient than the known solutions, for example being faster when moving the respective components and having smaller volumes.

[0008] Such an object is achieved by an inserting gun as claimed in claim 1.

[0009] The claims dependent thereon show preferred variants implying further advantageous aspects.

[0010] Further features and advantages of the invention will become apparent from the description provided

below of preferred embodiments thereof, given by way of nonlimiting examples, with reference to the accompanying drawings, in which:

- 5 - Figure 1 shows a diagrammatic view of an inserting gun according to the present invention, in a first configuration in which particular operations are not performed and the rivet is separated from the inserting gun;
- 10 - Figure 1a shows an enlargement of a portion of Figure 1;
- Figure 2 shows a diagrammatic view of an inserting gun according to the present invention, in a second configuration in which the rivet is in an engagement step by the inserting gun;
- 15 - Figure 2a shows an enlargement of a portion of Figure 2;
- Figure 3 shows a diagrammatic view of an inserting gun according to the present invention, in a third configuration in which the rivet abuts with the inserting gun;
- 20 - Figure 3a shows an enlargement of a portion of Figure 3;
- Figure 4 shows a diagrammatic view of an inserting gun according to the present invention, in a fourth configuration in which the rivet is plastically deformed by the inserting gun;
- 25 - Figure 4a shows an enlargement of a portion of Figure 4;
- 30 - Figure 5 shows a diagrammatic view of an inserting gun according to the present invention, in a fifth configuration in which the rivet is in a first disengagement step from the inserting gun;
- 35 - Figure 5a shows an enlargement of a portion of Figure 5;
- Figure 6 shows a diagrammatic view of an inserting gun according to the present invention, in a sixth configuration in which the rivet is in a second disengagement step from the inserting gun;
- 40 - Figure 6a shows an enlargement of a portion of Figure 6;
- Figure 7 shows a diagrammatic view of an inserting gun according to the present invention, in a seventh configuration in which the rivet is disengaged from the inserting gun and the trigger is in release;
- 45 - Figure 7a shows an enlargement of a portion of Figure 7;
- Figure 8 shows a diagrammatic view of an inserting gun according to the present invention, in an eighth configuration in which the emergency valve member is operating;
- 50 - Figure 8a shows an enlargement of a portion of Figure 8;
- 55 - Figures 9' and 9'' show two sectional views of a pneumatic tank body, according to a preferred embodiment, embedded in an inserting gun according to the present invention;
- Figures 10a and 10b show two perspective views of

a distribution flange embedded in the pneumatic tank body in Figures 9' and 9'';

- Figures 11, 11a and 11b show a bottom view and two side views of the distribution flange in Figures 10a and 10b;
- Figures 12a, 12b, 12c and 12d are sectional views with respect to the sectional planes A-A, B-B, H-H, and I-I in Figures 11a and 11b.

[0011] Reference numeral 1 in the accompanying drawings indicates an inserting gun according to the present invention. As extensively shown hereinafter, the inserting gun 1 is of the pneumohydraulic type.

[0012] The accompanying drawings also indicate a rivet with reference numeral 500. It should be noted that the present invention is not limited to the shape, physical nature, and geometry of rivet 500. Rivet 500 is a commercial component, comprising a threaded hole 550, a yielding portion 551 suitable to be plastically modified, as well as a head 552 suitable to abut on a wall of a component. Again in the accompanying drawings, reference numeral 551' indicates the collar obtained through the plastic modification to which said yielding portion 551 is subjected, by means of specific operations of the inserting gun 1.

[0013] According to present invention, the inserting gun 1 comprises a threaded tie rod 2. Such a threaded tie rod 2 extends along a working axis X-X and is suitable for engaging rivet 500. The threaded tie rod 2 preferably engages rivet 500 in the threaded axial hole 550 thereof.

[0014] According to the present invention, the threaded tie rod 2 is suitable for moving rivet 500 both rotationally and axially with respect to said working axis X-X.

[0015] According to a preferred embodiment, the threaded tie rod 2 has the shape, e.g. outline, such as to allow said interaction with the respective rivet 500.

[0016] At the beginning of the mutual engagement operations between rivet 500 and threaded tie rod 2 and respective component in which rivet 500 finds accommodation, the latter is preferably pushed and moved along axis X-X.

[0017] According to the present invention, the inserting gun 1 comprises a motor 3 operatively connected to the threaded tie rod 2 to command it in rotation clockwise or counterclockwise direction. According to the present invention, the rotation of the threaded tie rod 2 corresponds to the engagement or disengagement of rivet 500. The clockwise rotation (or, towards the right) of the threaded tie rod 2 preferably corresponds to the screwing of the threaded tie rod 2 to rivet 500; vice versa, the counterclockwise rotation (or, towards the left) of the threaded tie rod 2 corresponds to the unscrewing of the threaded tie rod 2 to rivet 500.

[0018] According to a preferred embodiment, motor 3 is of a pneumatic type.

[0019] Motor 3 is preferably positioned at the working axis X-X at an end of the threaded tie rod 2 opposite to the end suitable to engage rivet 500.

[0020] Moreover, according to the present invention, the inserting gun 1 comprises an oleodynamic system 4 suitable to move the threaded tie rod 2 and motor 3 along the working axis X-X. Rivet 500, previously engaged with the threaded tie rod 2 (by screwing), is plastically deformed by means of such a movement along axis X-X, in particular in the yielding portion 551 thereof, to be fastened and fasten the respective components.

[0021] Indeed, a thrust fluid F flows in the oleodynamic system 4. Said thrust fluid F preferably is a viscose fluid, e.g. an oil.

[0022] In particular, according to a preferred embodiment, two oil chambers fluidically connected to each other, in which there is thrust fluid, i.e. oil, are housed in the inserting gun 1; in which one of said chambers at least partially houses the threaded tie rod 2 and motor 3.

[0023] According to a preferred embodiment, the inserting gun 1 also comprises a pneumatic amplifier group 5 suitable to perform a compression action on the thrust fluid F, amplifying the thrust action thereof. Therefore, the pneumatic amplifier group 5 preferably is such as to amplify the action of the oleodynamic system 4. In particular, the action of the pneumatic amplifier group 5 is performed in an oil chamber and transmitted to the other oil chamber to be discharged onto threaded tie rod 2 and engine 3.

[0024] The pneumatic amplifier group 5 comprises a pneumatic chamber 50, a piston 51 and a plunger 52.

[0025] Preferably, piston 51 is entirely housed in the pneumatic chamber 50, while plunger 52 is integrally connected to said piston 51 and is at least partially housed in the pneumatic chamber 50. The protruding portion of plunger 52 preferably is the portion which engages the oleodynamic system 4, pushing it onto the thrust fluid F, preferably into the respective oil chamber.

[0026] Indeed, according to the invention, piston 51 and plunger 52 are axially movable along a thrust axis Y-Y. As a function of the axial position thereof, plunger 52 is suitable for performing a compression action on the thrust fluid F, thus amplifying the thrust action thereof.

[0027] Moreover, according to the present invention, the inserting gun 1 comprises a pneumatic system 6. Said pneumatic system 6 is fed by a source of compressed air. Said source of compressed air is preferably provided within the area of use of the inserting gun 1 supplied by a specific pneumatic plant. Preferably, the pneumatic system 6 aims at supplying and managing the supply of pressurized air to the air-fed components of the inserting gun 1, such as, for example, the motor 3 and the pneumatic amplifier group 5.

[0028] In particular, the pneumatic system 6 comprises a plurality of fluidic conduits which allow the fluidic connection between the various components, as hereinafter extensively described and extensively shown in the accompanying drawings.

[0029] The pneumatic system 6 indeed comprises a first conduit 64, a second conduit 65, a command conduit 66 and a management conduit 67.

[0030] It should be noted that the expression "conduit" means both a single fluidic segment in which a specific amount of air flows, and a fluidic passageway consisting of a plurality of branches in which specific amounts of air flow.

[0031] According to the present invention, the pneumatic system 6 comprises a trigger 60 which is operable by the user.

[0032] According to the present invention, the pneumatic system 6 further comprises an auxiliary valve 62 suitable to allow the supply of motor 3 to rotate it in a first direction of rotation (preferably in clockwise direction).

[0033] Said auxiliary valve 62 is actuated in opening by the threaded tie rod 2. In other words, the threaded tie rod 2 is pushed, with rivet 500, along the working axis X-X and the auxiliary valve 62 is moved in opening by means of a pressure action of the inserting gun 1, in particular of the threaded tie rod 2.

[0034] The air which flows through the (open) auxiliary valve 62 reaches motor 3, which in turn rotates the threaded tie rod 2 which screws rivet 500. Once rivet 500 abuts with the gun body 100 of the inserting gun 1, the thrust action on the threaded tie rod 2 ends and the auxiliary valve 62 is closed again, interrupting the rotation of motor 3.

[0035] According to the present invention, the auxiliary valve 62 is connectable to the compressed air source through the first conduit 64.

[0036] Additionally, according to the present invention, the pneumatic system 6 comprises a main valve 61 operatively connected to trigger 60. In particular, actuating trigger 60 results in opening the main valve 61.

[0037] According to the present invention, indeed, the main valve 61 is fluidically connected to the first conduit 64 and to the management conduit 67. The actuation of trigger 60 and the opening of the main valve 61 results in the fluidic connection of the first conduit 64 with the management conduit 67.

[0038] According to the present invention, the inserting gun 1 further comprises a hydropneumatic regulating valve 7. The hydropneumatic regulating valve 7 is fluidically connected to the oleodynamic system 4 and to the pneumatic system 6.

[0039] The hydropneumatic regulating valve 7 is fluidically connected to the second conduit 65, to the command conduit 66 and to the management conduit 67. In particular, first, the hydropneumatic regulating valve 7 is suitable for receiving the air which flows through the management conduit 67 as the main valve 61 opens. Moreover, the hydropneumatic regulating valve 7 is suitable for commanding the flow of air through the second conduit 65, i.e. towards motor 3, and/or through the command conduit 66, i.e. towards the pneumatic amplifier group 5.

[0040] Indeed, the hydropneumatic regulating valve 7 comprises first movable members 71 and second movable members 72 which are positionable along a hydropneumatic axis Z-Z in a:

- first configuration, or resting configuration, in which the supply of air to motor 3 is commanded through the first conduit 64; such a configuration indeed corresponds to the configuration in which the main valve 61 prevents the outflow to the management conduit 67; in other words, such a configuration corresponds to that in which trigger 60 is not actuated;
- a second configuration, or thrust configuration, in which air is supplied to the pneumatic amplifier group 5 through the command conduit 66 so that the pneumatic amplifier group 5 performs a thrust action on the oleodynamic system 4; the main valve 61 in such a configuration is open and the air flows through the management conduit 67, reaching the hydropneumatic valve 7; such a configuration of the hydropneumatic valve 7 is kept over time until the thrust action of the thrust fluid F exceeds a given pressure value;
- a third configuration, or discharge configuration, in which the hydropneumatic regulating valve 7 closes the flow through the command conduit 66 and directs the air to the pneumatic amplifier group 5 through the first conduit 64 so that the pneumatic amplifier group 5 performs a return action; moreover, in such a configuration, air is supplied to motor 3 through the second conduit 65 to rotate it in a second direction of rotation; such a configuration of the hydropneumatic valve 7 is due to a specific pressure value of the thrust fluid F being exceeded; such a third configuration results in a lowering of the thrust action of the pneumatic amplifier group 5 so as to lower the pressure of the thrust fluid F and bring back the hydropneumatic regulating valve 7 into the first position; moreover, in said third configuration, the rotary action of motor 3 results in the unscrewing of the threaded tie rod 2 from rivet 500.

[0041] Therefore, according to a preferred embodiment, the passage from the first to the third configuration results in the plastic modification or rivet 500, and the locking thereof. Once such an operation is complete, the inserting gun 1 passes from the third configuration to the first configuration.

[0042] According to a preferred embodiment, the thrust fluid F is suitable for reaching the hydropneumatic valve 7 through an oil conduit 45.

[0043] According to a preferred embodiment, the pneumatic system 6 further comprises an emergency valve member 63 fluidically connected to the first conduit 64 and to the second conduit 65, suitable to command and regulate the air flow flowing in the first conduit 64 and/or the air flow flowing in the second conduit 65 towards motor 3.

[0044] In particular, said emergency valve member 63 is suitable for commanding and regulating the air flow towards engine 3 so as to command the rotation of the threaded tie rod 2 to unscrew it from rivet 500. In particular, the unscrewing, by means of the emergency valve

member 63, is also performed in circumstances in which the overall working cycle of the inserting gun 1 is not successful and doesn't come to an end.

[0045] For example, the emergency valve member 63 is suitable for keeping active the supply of air to motor 3, even in a configuration in which trigger 60 is unexpectedly released.

[0046] Moreover, according to the present invention, the inserting gun 1 comprises an exchange valve 8 fluidically connected to the first conduit 64 and to the command conduit 66, and which is configurable in a plurality of configurations in which it regulates the flow or the discharge flowing in said conduits to and from the pneumatic chamber 50.

[0047] The exchange valve 8 extends along an exchange axis V-V. In particular, the exchange valve 8 is movable with respect to said exchange axis V-V.

[0048] According to a preferred embodiment, the exchange valve 8 is fluidically positioned between the hydropneumatic regulating valve 7 and the pneumatic amplifier group 5. Preferably, the hydropneumatic regulating valve 7 is fluidically connected to the pneumatic amplifier group 5 through the exchange valve 8. The air preferably flows into, or flows out of, the pneumatic amplifier group 5 through the exchange valve 8.

[0049] According to a preferred embodiment, the exchange valve 8 is positionable along the exchange axis V-V in a first exchange position and in a second exchange position.

[0050] The air flows to the pneumatic chamber 50 through the first conduit 64 in the first exchange position; in other words, the air flowing in the first conduit 64 supplies the pneumatic chamber 50. While the air flows to the pneumatic chamber 50 through the command conduit 66 in the second exchange position; in other words, the air flowing in the command conduit 66 supplies the pneumatic chamber 50.

[0051] In other words, the air flows to the exchange valve 8 through the first conduit 64 or through the command conduit 66 as a function of the positioning of the hydropneumatic regulating valve 7.

[0052] According to a preferred embodiment, the exchange valve 8 comprises an elastic bias member 80 suitable to keep the exchange valve 8 in the first exchange position. The action of pushing the air through the command conduit 66 preferably exceeds the elastic biasing action of the elastic bias member 80 in the second exchange position. In other words, the second exchange position is reached once the action of the elastic bias member 80 has been achieved.

[0053] The elastic bias member 80 preferably is a helical spring.

[0054] According to a preferred embodiment, the exchange valve 8 is fluidically connected to air discharge openings 84, 85 suitable to allow the discharge of the air of the pneumatic system 6 towards the ambient. As mentioned, indeed the discharge of the air in the air chamber 50 is also managed through the exchange valve 8.

[0055] According to a preferred embodiment, the already described pneumatic chamber 50 comprises a first pneumatic half-chamber 501 and a second pneumatic half-chamber 502 which are mutually separated by piston 51. Preferably, the exchange valve 8 is fluidically connected to both the first pneumatic half-chamber 501 and the second pneumatic half-chamber 502 so that the supply of air in one half-chamber and the discharge of air in the other half-chamber is commanded as a function of its positioning along the exchange axis V-V.

[0056] According to a preferred embodiment, the movement of piston 51 and simultaneously of plunger 52 in a first axial direction or in a second axial direction is obtained as a function of which pneumatic half-chamber is filled with air. In other words, the pneumatic amplifier group 5 has a dual effect. With the axial positioning thereof, the exchange valve 8 performs a thrust action on piston 51 in a first direction and in a second direction.

[0057] According to a preferred embodiment, the exchange valve 8 is fluidically connected to the first pneumatic half-chamber 501 by means of a first command conduit 81 through a first port 810. Preferably, the exchange valve 8 is fluidically connected to the second pneumatic half-chamber 502 by means of a second command conduit 82 through a second port 820.

[0058] According to a preferred embodiment, the first port 810 and the second port 820 are axially positioned spaced apart along the thrust axis Y-Y.

[0059] According to a preferred embodiment, the first exchange position of the exchange valve 8 corresponds to the supply of air to the second pneumatic half-chamber 502 by means of a second command conduit 82 through the second port 820, through the first conduit 64.

[0060] According to a preferred embodiment, the second exchange position of the exchange valve 8 corresponds to the supply of air to the first pneumatic half-chamber 501 by means of the first command conduit 81 through the first port 810, through the command conduit 66.

[0061] According to a preferred embodiment, the hydropneumatic regulating valve 7 comprises elastic means 79 suitable to carry out an axial action that keeps the first movable members 71 and the second movable members 72 in the first configuration, in which the third configuration is reached by the action of fluid F that passes the elastic means 79.

[0062] The elastic means 79 embedded in the hydropneumatic regulating valve 7 preferably are calibratable so as to regulate the respective elastic action as a function of the action of the thrust fluid F.

[0063] Moreover, according to a preferred embodiment, the hydropneumatic regulating valve 7 is in the shape of a cartridge, being insertable and extractable along the hydropneumatic axis Z-Z.

[0064] According to a preferred embodiment, the exchange valve 8 preferably is in the shape of a cartridge, being insertable and extractable along the exchange axis V-V.

[0065] According to a preferred embodiment, the inserting gun 1 comprises a gun body 100 and a pneumatic tank body 150 which is mountable to the gun body 100.

[0066] In particular, the gun body 100 is grippable by the user and contains the threaded tie rod 2, engine 3, and the oleodynamic system 4. The gun body 100 preferably comprises a handle 101 to which the pneumatic tank body 150 is preferably connected. Trigger 60 is preferably located at said handle.

[0067] According to a preferred embodiment, the pneumatic tank body 150 houses the pneumatic amplifier group 5 so that plunger 52 protrudes along the thrust axis Y-Y from said tank group 150 so that it is suitable for finding accommodation in the gun body 100 and thus engaging the oleodynamic system 4.

[0068] According to a preferred embodiment, the pneumatic tank body 150 comprises a distribution flange 151 which is mountable on the gun body 100 and a barrel body 152 which is mountable to said distribution flange 151; barrel body 152 and distribution flange 151 define said pneumatic chamber 50 in the mutual, preferably sealing, engagement.

[0069] According to a preferred embodiment, the exchange valve 8 is housed in the distribution flange 151. Indeed, the distribution flange 151 preferably comprises a specifically shaped housing for the exchange valve 8.

[0070] According to a preferred embodiment, the pneumatic regulating valve 7 is housed in the distribution flange 151. Indeed, the distribution flange 151 preferably comprises a specifically shaped housing for the pneumatic regulating valve 7.

[0071] According to a preferred embodiment, the emergency valve member 63 is housed in the distribution flange 151. Indeed, the distribution flange 151 preferably comprises a specifically shaped housing for the emergency valve member 156.

[0072] Indeed, in each of the aforesaid housings, the respective valve or valve member is insertable as a cartridge.

[0073] According to a preferred embodiment, the aforesaid fluidic connecting conduits between the components therein provided are obtained in the pneumatic tank body 150. In other words, fluidic conduits are obtained in the pneumatic tank body 150 which put into connection the exchange valve 8 and the thrust amplifier group 5, such as, for example the air discharge openings 84, 85 and the first command conduit 81 and the second command conduit 82. In particular, such fluidic conduits are preferably made in the distribution flange 151.

[0074] The connection with the source of compressed air is preferably performed on the distribution flange 151, through a connection port 640. Preferably, there are more than one connection port 640', 640" on the distribution flange 151, for example two on two opposite sides.

[0075] Except for the exchange valve 8, it should be noted that reference is first made to the disclosure in document EP2150378 for more details on the operating modes of the inserting gun 1 of the present invention.

Indeed, the method of operating the inserting gun 1 of the present invention is substantially similar to that described in such a document, with the exception of the modes of air supply and discharge to/from the pneumatic amplifier group 5 which, as described above, occur in a highly innovative manner by means of the exchange valve 8.

[0076] Innovatively, the inserting gun of the present invention fully achieves the preset object by solving the problems raised from the typical solutions of the prior art.

[0077] Indeed, advantageously, the inserting gun is quicker and more compact than the known solutions. Advantageously, the inserting gun is quicker and more compact than the inserting gun solution known from the teachings of document EP2150378.

[0078] Advantageously, the operating cycle of the inserting gun has been greatly speeded up, with particular reference to the plastic deforming operations of the rivet and the disengagement of the inserting gun therefrom.

[0079] Advantageously, the pneumatic amplifier group is pneumatically commanded in both directions.

[0080] Advantageously, the pneumatic amplifier group does not need elastic return elements.

[0081] It is apparent that, in order to meet contingent needs, a person skilled in the art may make changes to the inserting gun of the present invention, all contained within the scope of protection as defined by the following claims.

Claims

1. A pneumo-hydraulically driven inserting gun (1), comprising:

- i) a threaded tie rod (2) which extends along a working axis (X-X) suitable to engage a rivet (500), for example a threaded axial hole (550) thereof;
- ii) a motor (3), of a pneumatic type, operatively connected to the threaded tie rod (2) to command it in rotation clockwise or counterclockwise direction, preferably to engage or disengage the rivet (500);
- iii) an oleodynamic system (4), wherein a thrust fluid (F) flows, suitable to move the threaded tie rod (2) and the motor (3) along the working axis (X-X) to plastically deform a yielding portion (551) of the rivet (500);
- iv) a pneumatic amplifier group (5) comprising a pneumatic chamber (50), a piston (51) and a plunger (52), wherein the piston (51) and the plunger (52) are movable axially along a thrust axis (Y-Y) in such a way that, depending on its axial position, the plunger (52) performs a compression action on the thrust fluid (F), amplifying the action thereof;
- v) a pneumatic system (6), fed by a source of

compressed air, fluidically connected to the motor (3) and to the pneumatic amplifier group (5) comprising:

- a first conduit (64) connectable to the compressed air source;
- a second conduit (65);
- a command conduit (66) connectable to the pneumatic amplifier group (5);
- a management conduit (67);
- a trigger (60) operable by the user;
- an auxiliary valve (62) operated in opening by the tie rod (2) in such a way as to supply the motor (3) through the first conduit (64) and command it in rotation in a first direction of rotation;
- a main valve (61) operable in opening by actuating the trigger (60), being fluidically connected to the first conduit (64) and to the management conduit (67);

vi) a hydropneumatic regulating valve (7) fluidically connected to the oleodynamic system (4) to the pneumatic system (6), wherein the hydropneumatic regulating valve (7) is fluidically connected to the second conduit (65), to the command conduit (66) and to the management conduit (67), wherein the hydropneumatic regulating valve (7) comprises first movable members (71) and second movable members (72) positionable along a hydropneumatic axis (Z-Z) in a first configuration in which the flow of air to the hydropneumatic regulating valve (7) is prevented and the supply of air to the motor (3) is commanded, in a second configuration in which the hydropneumatic regulating valve (7) directs the air to the pneumatic amplifier group (5) through the command conduit (66) in such a way that the pneumatic amplifier group (5) carries out a thrust action on the oleodynamic system (4), and a third configuration in which the hydropneumatic regulating valve (7) closes the flow through the command conduit (66) and directs the air to the pneumatic amplifier group (5) through the first conduit (64) in such a way that it carries out a return action and in which air is supplied to the motor (3) through the second conduit (65) to rotate it in a second direction of rotation;

wherein the pneumo-hydraulically driven inserting gun (1) is **characterized by** the fact that it also comprises:

vii) an exchange valve (8) fluidically connected to the first conduit (64) and to the command conduit (66), being movable along an exchange axis (V-V), in a plurality of configurations wherein it regulates the flow or discharge of said conduits to the air in the

pneumatic chamber (50) .

2. Inserting gun (1) in accordance with claim 1, wherein said exchange valve (8) is positioned fluidically between the hydropneumatic regulating valve (7) and the pneumatic amplifier group (5), in such a way that the air flowing between the hydropneumatic regulating valve (7) and the pneumatic amplifier group (5) passes through the exchange valve (8).
3. Inserting gun (1) in accordance with any of the preceding claims, wherein the exchange valve (8) is positionable, along the exchange axis (V-V) in a first exchange position, in which the air flows to the pneumatic chamber (50) through the first conduit (64) supplying air, and a second exchange position, in which the air flows to the pneumatic chamber (50) through the command conduit (66).
4. Inserting gun (1) in accordance with claim 3, wherein the exchange valve (8) comprises an elastic bias member (80) suitable to keep the exchange valve (8) in the first exchange position, wherein in the second exchange position the action of pushing the air through the command conduit (66) exceeds the elastic biasing action of the elastic bias member (80).
5. Inserting gun (1) in accordance with any of the preceding claims, wherein the exchange valve (8) is fluidically connected to air discharge openings (84; 85) suitable to allow the discharge of the air of the pneumatic amplifier group (5).
6. Inserting gun (1) in accordance with any of the preceding claims, wherein the pneumatic chamber (50) comprises a first pneumatic half-chamber (501) and a second pneumatic half-chamber (502) mutually separated from the piston (51), wherein the exchange valve (8) is fluidically connected with the first pneumatic half-chamber (501) and with the second pneumatic half-chamber (502) in such a way that, as a function of its positioning along the exchange axis (V-V), the supply of air in one half-chamber and the discharge of air in the other half-chamber is commanded.
7. Inserting gun (1) in accordance with claim 6, wherein the exchange valve (8) is fluidically connected with the first pneumatic half-chamber (501) by means of a first command conduit (81) through a first port (810) and to the second pneumatic half-chamber (502) by means of a second command conduit (82) through a second port (820), wherein the first port (810) and second port (820) are positioned axially spaced along the thrust axis (Y-Y).
8. Inserting gun (1) in accordance with any of the preceding claims, wherein the hydropneumatic regulat-

ing valve (7) comprises elastic means (79) suitable to carry out an axial action that keeps the first movable members (71) and the second movable members (72) in the first configuration, wherein the third configuration is reached by the action of the fluid (F) that exceeds the action of said elastic means (79).

9. Inserting gun (1) in accordance with claim 8, wherein the elastic means (79) comprised in the hydropneumatic regulating valve (7) calibratable in such a way as to regulate the respective elastic action, as a function of the action of the thrust fluid (F). 10
10. Inserting gun (1) in accordance with any of the preceding claims, wherein the hydropneumatic regulating valve (7) has the shape of a cartridge being insertable and extractable along the hydropneumatic axis (Z-Z). 15
11. Inserting gun (1) in accordance with any of the preceding claims, wherein the exchange valve (8) has the shape of a cartridge being insertable and extractable along the exchange axis (V-V). 20
12. Inserting gun (1) in accordance with any of the preceding claims, wherein the pneumatic system (6) further comprises an emergency valve member (69) fluidically connected to the first conduit (64) and to the second conduit (65) suitable to command and regulate the air flow flowing in the first conduit (64) and/or the air flow flowing in the second conduit (65) towards the motor (3). 25
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13. Inserting gun (1) in accordance with any of the preceding claims, comprising a gun body (100) and a pneumatic tank body (150) mountable on the gun body (100), preferably on the handle (101) thereof, wherein the pneumatic tank body (150) comprises a distribution flange (151) mountable on the gun body (100) and a barrel body (152) mountable on said distribution flange (151) defining the pneumatic chamber (50), wherein the pneumatic tank body (150) houses the pneumatic amplifier group (5), so that the plunger (52) protrudes along the thrust axis (Y-Y) from said distribution flange (151) to find accommodation in the gun body (100). 35
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14. Inserting gun (1) in accordance with claim 13, wherein the hydropneumatic regulating valve (7) and the exchange valve (8) are housed in the distribution flange (151). 50
15. Inserting gun (1) in accordance with claim 14 and claim 12, wherein the emergency valve member (63) is also housed in the distribution flange (151). 55

Patentansprüche

1. Pneumohydraulisch angetriebene Einführungspistole (1), umfassend:

i) eine Gewindespurstange (2), welche sich entlang einer Arbeitsachse (X-X) erstreckt und dazu geeignet ist, mit einer Niete (500), beispielsweise einem axialen Gewindeloch (550) davon, in Eingriff zu treten;

ii) einen Motor (3) vom pneumatischen Typ, welcher betriebsbereit mit der Gewindespurstange (2) verbunden ist, um sie im Uhrzeigersinn oder gegen den Uhrzeigersinn in Rotation zu versetzen, vorzugsweise um mit der Niete (500) in Eingriff zu treten oder den Eingriff zu lösen;

iii) ein öldynamisches System (4), worin ein Druckfluid (F) strömt, welches dazu geeignet ist, die Gewindespurstange (2) und den Motor (3) entlang der Arbeitsachse (X-X) zu bewegen, um einen nachgiebigen Abschnitt (551) der Niete (500) plastisch zu verformen;

iv) eine pneumatische Verstärkergruppe (5), welche eine pneumatische Kammer (50), einen Kolben (51) und einen Stempel (52) umfasst, wobei der Kolben (51) und der Stempel (52) axial entlang einer Druckachse (Y-Y) derart bewegbar sind, dass der Stempel (52) abhängig von dessen axialer Position eine Kompression durchführt, welche auf das Druckfluid (F) wirkt, wodurch dessen Wirkung verstärkt wird;

v) ein pneumatisches System (6), welches durch eine Quelle aus komprimierter Luft gespeist wird und fluidisch mit dem Motor (3) und der pneumatischen Verstärkergruppe (5) verbunden ist, umfassend:

- eine erste Leitung (64), welche mit der Quelle aus komprimierter Luft verbindbar ist;
- eine zweite Leitung (65);
- eine Führungsleitung (66), welche mit der pneumatischen Verstärkergruppe (5) verbindbar ist;
- eine Steuerungsleitung (67);
- einen durch den Nutzer bedienbaren Auslöser (60);
- ein Hilfsventil (62), welches beim Öffnen durch die Spurstange (2) derart betätigt wird, dass der Motor (3) durch die erste Leitung (64) versorgt wird und in einer ersten Rotationsrichtung in Rotation versetzt wird;
- ein Hauptventil (61), welches beim Öffnen durch Betätigung des Auslösers (60) bedienbar ist und welches fluidisch mit der ersten Leitung (64) und der Steuerungsleitung (67) verbunden ist;

vi) ein hydropneumatisches Regelventil (7), welches fluidisch mit dem öldynamischen System (4) und dem pneumatischen System (6) verbunden ist, wobei das hydropneumatische Regelventil (7) fluidisch mit der zweiten Leitung (65), der Führungsleitung (66) und der Steuerungsleitung (67) verbunden ist, wobei das hydropneumatische Regelventil (7) erste bewegbare Elemente (71) und zweite bewegbare Elemente (72) umfasst, welche in einer ersten Konfiguration, in welcher das Strömen von Luft zu dem hydropneumatischen Regelventil (7) unterbunden ist und die Versorgung des Motors (3) mit Luft angeordnet ist, in einer zweiten Konfiguration, in welcher das hydropneumatische Regelventil (7) die Luft durch die Führungsleitung (66) derart zu der pneumatischen Verstärkergruppe (5) leitet, dass die pneumatische Verstärkergruppe (5) eine Druckwirkung auf das öldynamische System (4) ausübt, und in einer dritten Konfiguration entlang einer hydropneumatischen Achse (Z-Z) positionierbar sind, in welcher das hydropneumatische Regelventil (7) das Strömen durch die Führungsleitung (66) schließt und die Luft durch die erste Leitung (64) derart zu der pneumatischen Verstärkergruppe (5) leitet, dass es eine Rückwirkung ausübt, und in welcher der Motor durch die zweite Leitung (65) mit Luft versorgt wird, um ihn in einer zweiten Rotationsrichtung zu rotieren;

wobei die pneumohydraulisch angetriebene Einführpistole (1) **dadurch gekennzeichnet ist, dass** sie umfasst:

vii) ein Austauschventil (8), welches fluidisch mit der ersten Leitung (64) und der Führungsleitung (66) verbunden ist und in einer Mehrzahl von Konfigurationen entlang einer Austauschachse (V-V) bewegbar ist, wobei es den Strom oder Auslass der Leitungen zu der Luft in der pneumatischen Kammer (50) reguliert.

2. Einführpistole (1) nach Anspruch 1, wobei das Austauschventil (8) fluidisch derart zwischen dem hydropneumatischen Regelventil (7) und der pneumatischen Verstärkergruppe (5) positioniert ist, dass die Luft, welche zwischen dem hydropneumatischen Regelventil (7) und der pneumatischen Verstärkergruppe (5) strömt, durch das Austauschventil (8) passiert.
3. Einführpistole (1) nach einem der vorhergehenden Ansprüche, wobei das Austauschventil (8) entlang der Austauschachse (V-V) in einer ersten Austauschposition, in welcher die Luft durch die luftversorgende erste Leitung (64) zu der pneumatischen Kammer (50) strömt, und einer zweiten Austauschposition positionierbar ist, in welcher die Luft durch

die Führungsleitung (66) zu der pneumatischen Kammer (50) strömt.

4. Einführpistole (1) nach Anspruch 3, wobei das Austauschventil (8) ein elastisches Vorspannelement (80) umfasst, welches dazu geeignet ist, das Austauschventil (8) in der ersten Austauschposition zu halten, wobei die Wirkung des Drückens der Luft durch die Führungsleitung (66) in der zweiten Austauschposition die elastische Vorspannwirkung des elastischen Vorspannelements (80) übersteigt.
5. Einführpistole (1) nach einem der vorhergehenden Ansprüche, wobei das Austauschventil (8) fluidisch mit Luftauslassöffnungen (84; 85) verbunden ist, welche dazu geeignet sind, den Auslass der Luft der pneumatischen Verstärkergruppe (5) zu ermöglichen.
6. Einführpistole (1) nach einem der vorhergehenden Ansprüche, wobei die pneumatische Kammer (50) eine erste pneumatische Halbkammer (501) und eine zweite pneumatische Halbkammer (502) umfasst, welche voneinander von dem Kolben (51) getrennt sind, wobei das Austauschventil (8) fluidisch derart mit der ersten pneumatischen Halbkammer (501) und mit der zweiten pneumatischen Halbkammer (502) verbunden ist, dass die Versorgung von Luft in einer Halbkammer und der Auslass von Luft in der anderen Halbkammer als eine Funktion von dessen Positionierung entlang der Austauschachse (V-V) angeordnet wird.
7. Einführpistole (1) nach Anspruch 6, wobei das Austauschventil (8) mittels einer ersten Führungsleitung (81) durch einen ersten Anschluss (810) mit der ersten pneumatischen Halbkammer (501) und mittels einer zweiten Führungsleitung (82) durch einen zweiten Anschluss (820) mit der zweiten pneumatischen Halbkammer (502) fluidisch verbunden ist, wobei der erste Anschluss (810) und der zweite Anschluss (820) entlang der Druckachse (Y-Y) axial beabstandet positioniert sind.
8. Einführpistole (1) nach einem der vorhergehenden Ansprüche, wobei das hydropneumatische Regelventil (7) elastische Mittel (79) umfasst, welche dazu geeignet sind, eine axiale Wirkung auszuüben, welche die ersten bewegbaren Elemente (71) und die zweiten bewegbaren Elemente (72) in der ersten Konfiguration halten, wobei die dritte Konfiguration durch die Wirkung des Fluids (F) erreicht wird, welche die Wirkung der elastischen Mittel (79) übersteigt.
9. Einführpistole (1) nach Anspruch 8, wobei die in dem hydropneumatischen Regelventil (7) umfassten elastischen Mittel (79) derart kalibriert sind, dass sie

die jeweilige elastische Wirkung als eine Funktion der Wirkung des Druckfluids (F) regulieren.

10. Einführpistole (1) nach einem der vorhergehenden Ansprüche, wobei das hydropneumatische Regelventil (7) die Form einer entlang der hydropneumatischen Achse (Z-Z) einföhrbaren und extrahierbaren Kartusche aufweist. 5
11. Einföhrpistole (1) nach einem der vorhergehenden Ansprüche, wobei das Austauschventil (8) die Form einer entlang der Austauschachse (V-V) einföhrbaren und extrahierbaren Kartusche aufweist. 10
12. Einföhrpistole (1) nach einem der vorhergehenden Ansprüche, wobei das pneumatische System (6) ferner ein Notfallventilelement (69) umfasst, welches fluidisch mit der ersten Leitung (64) und mit der zweiten Leitung (65) verbunden ist und dazu geeignet ist, den in der ersten Leitung (64) strömenden Luftstrom und/oder den in der zweiten Leitung (65) strömenden Luftstrom in Richtung des Motors (3) anzuordnen und zu regulieren. 15 20
13. Einföhrpistole (1) nach einem der vorhergehenden Ansprüche, umfassend einen Pistolenkörper (100) und einen pneumatischen Behälterkörper (150), welcher an dem Pistolenkörper (100) befestigbar ist, vorzugsweise an dem Griff (101) davon, wobei der pneumatische Behälterkörper (150) einen Verteilungsflansch (151), welcher an dem Pistolenkörper (100) befestigbar ist, und einen Fasskörper (152) umfasst, welcher an dem Verteilungsflansch (151) befestigbar ist und die pneumatische Kammer (50) definiert, wobei der pneumatische Behälterkörper (150) die pneumatische Verstärkergruppe (5) aufnimmt, sodass der Stempel (52) entlang der Druckachse (Y-Y) von dem Verteilungsflansch (151) hervorsteht, um in dem Pistolenkörper (100) unterzukommen. 25 30 35 40
14. Einföhrpistole (1) nach Anspruch 13, wobei das hydropneumatische Regelventil (7) und das Austauschventil (8) in dem Verteilungsflansch (151) aufgenommen sind. 45
15. Einföhrpistole (1) nach Anspruch 14 und Anspruch 12, wobei das Notfallventilelement (63) ebenfalls in dem Verteilungsflansch (151) aufgenommen ist. 50

Revendications

1. Pistolet d'insertion à entraînement pneumo-hydraulique (1), comprenant : 55
 - i) une tige d'accouplement fileté (2) qui s'étend le long d'un axe de travail (X-X) adaptée pour

mettre en prise un rivet (500), par exemple un trou axial fileté (550) de celui-ci ;

ii) un moteur (3), d'un type pneumatique, fonctionnellement relié à la tige d'accouplement fileté (2) pour la commander en rotation dans le sens horaire ou anti-horaire, de préférence pour mettre en prise ou hors prise le rivet (500) ;

iii) un système oléodynamique (4), dans lequel circule un fluide de poussée (F), approprié pour déplacer la tige d'accouplement fileté (2) et le moteur (3) le long de l'axe de travail (X-X) pour déformer plastiquement une partie élastique (551) du rivet (500) ;

iv) un groupe amplificateur pneumatique (5) comprenant une chambre pneumatique (50), un piston (51) et un plongeur (52), dans lequel le piston (51) et le plongeur (52) sont mobiles axialement le long d'un axe de poussée (Y-Y) de telle sorte que, selon sa position axiale, le plongeur (52) exerce une action de compression sur le fluide de poussée (F), amplifiant l'action de celui-ci ;

v) un système pneumatique (6), alimenté par une source d'air comprimé, relié fluidiquement au moteur (3) et au groupe amplificateur pneumatique (5) comprenant :

- un premier conduit (64) raccordable à la source d'air comprimé ;
- un second conduit (65) ;
- un conduit de commande (66) raccordable au groupe amplificateur pneumatique (5) ;
- un conduit de gestion (67) ;
- un déclencheur (60) actionnable par l'utilisateur ;
- une soupape auxiliaire (62) actionnée en ouverture par la tige d'accouplement (2) de manière à alimenter le moteur (3) à travers le premier conduit (64) et à le commander en rotation dans un premier sens de rotation ;
- une soupape principale (61) actionnable en ouverture par actionnement du déclencheur (60), qui est relié fluidiquement au premier conduit (64) et au conduit de gestion (67) ;

vi) une soupape de régulation hydropneumatique (7) reliée fluidiquement au système oléodynamique (4) au système pneumatique (6), dans lequel la soupape de régulation hydropneumatique (7) est reliée fluidiquement au second conduit (65), au conduit de commande (66) et au conduit de gestion (67), dans lequel la soupape de régulation hydropneumatique (7) comprend des premiers éléments mobiles (71) et des seconds éléments mobiles (72) positionnables le long d'un axe hydropneumatique (Z-Z) dans une

première configuration dans laquelle l'écoulement d'air vers la soupape de régulation hydro-pneumatique (7) est empêché et l'alimentation en air du moteur (3) est commandée, dans une deuxième configuration dans laquelle la soupape de régulation hydropneumatique (7) dirige l'air vers le groupe amplificateur pneumatique (5) à travers le conduit de commande (66) de telle sorte que le groupe amplificateur pneumatique (5) effectue une action de poussée sur le système oléodynamique (4), et une troisième configuration dans laquelle la soupape de régulation hydropneumatique (7) ferme l'écoulement à travers le conduit de commande (66) et dirige l'air vers le groupe amplificateur pneumatique (5) à travers le premier conduit (64) de telle sorte qu'il effectue une action de retour et dans lequel de l'air est fourni au moteur (3) à travers le second conduit (65) pour le faire tourner dans un second sens de rotation ;

dans lequel le pistolet d'insertion à entraînement pneumo-hydraulique (1) est **caractérisé en ce qu'il** comprend :

- vii) une soupape d'échange (8) reliée fluidiquement au premier conduit (64) et au conduit de commande (66), qui est mobile le long d'un axe d'échange (V-V), dans une pluralité de configurations, celle-ci régulant l'écoulement ou l'évacuation desdits conduits vers l'air dans la chambre pneumatique (50).
- 2. Pistolet d'insertion (1) selon la revendication 1, dans lequel ladite soupape d'échange (8) est positionnée fluidiquement entre la soupape de régulation hydro-pneumatique (7) et le groupe amplificateur pneumatique (5), de telle sorte que l'air circulant entre la soupape de régulation hydropneumatique (7) et le groupe amplificateur pneumatique (5) passe à travers la soupape d'échange (8).
- 3. Pistolet d'insertion (1) selon l'une quelconque des revendications précédentes, dans lequel la soupape d'échange (8) est positionnable, le long de l'axe d'échange (V-V) dans une première position d'échange, dans laquelle l'air circule vers la chambre pneumatique (50) à travers le premier conduit (64) fournissant l'air, et une seconde position d'échange, dans laquelle l'air circule vers la chambre pneumatique (50) à travers le conduit de commande (66).
- 4. Pistolet d'insertion (1) selon la revendication 3, dans lequel la soupape d'échange (8) comprend un élément de sollicitation élastique (80) capable de maintenir la soupape d'échange (8) dans la première position d'échange, dans lequel dans la seconde position d'échange, l'action de pousser l'air à travers le conduit de commande (66) dépasse l'action de sollicitation élastique de l'élément de sollicitation élas-

tique (80).

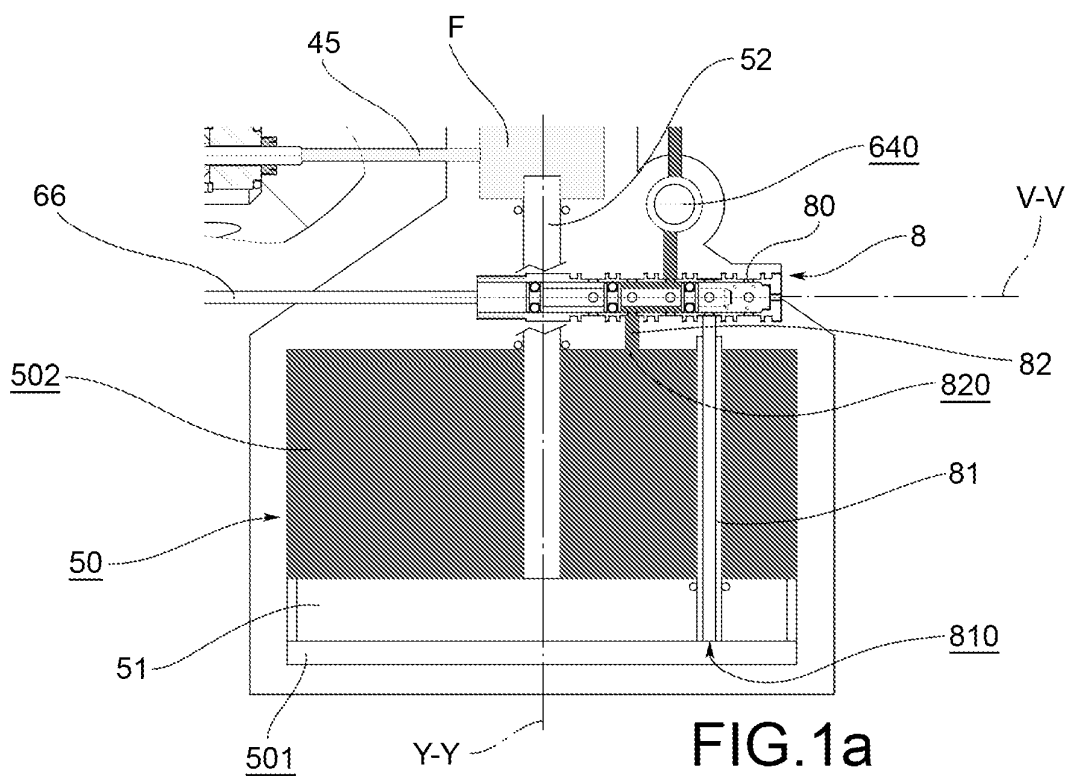
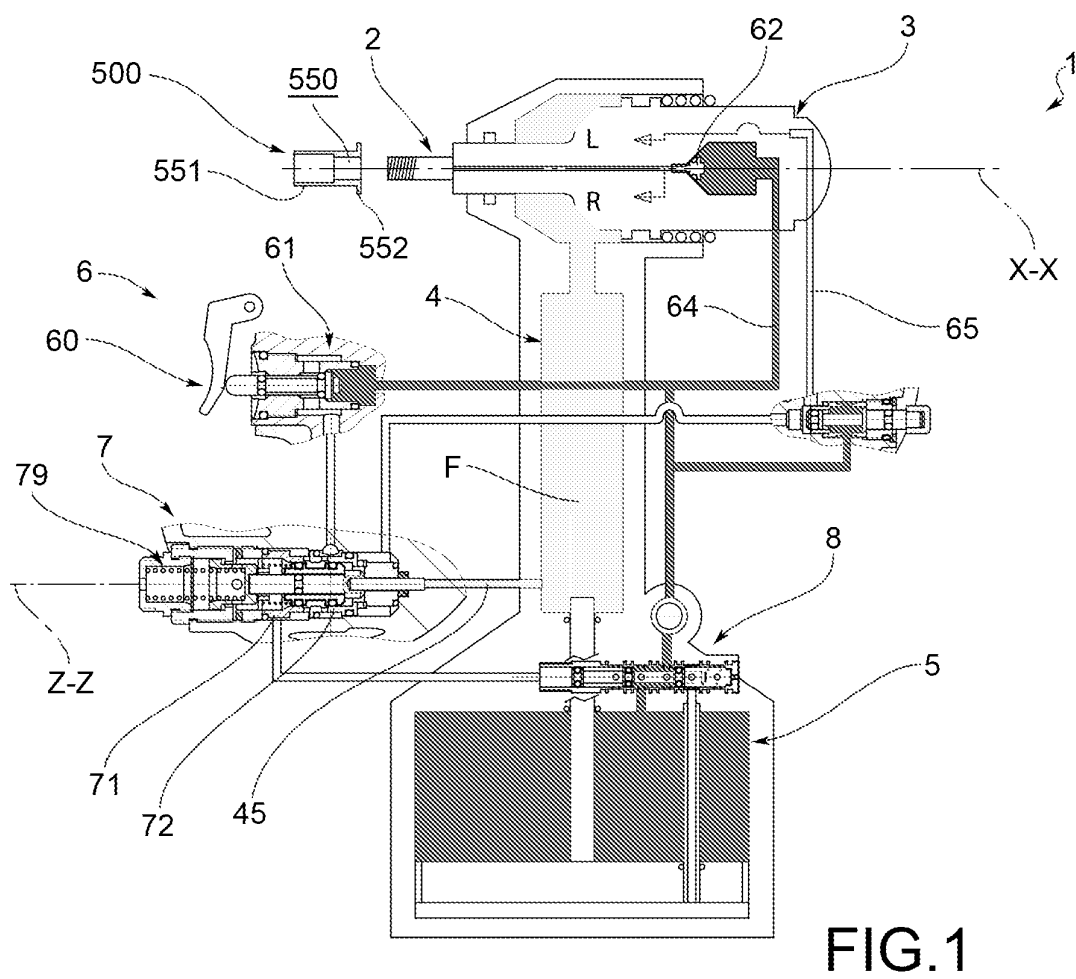
- 5. Pistolet d'insertion (1) selon l'une quelconque des revendications précédentes, dans lequel la soupape d'échange (8) est reliée fluidiquement à des ouvertures d'évacuation d'air (84 ; 85) appropriées pour permettre l'évacuation de l'air du groupe amplificateur pneumatique (5).
- 6. Pistolet d'insertion (1) selon l'une quelconque des revendications précédentes, dans lequel la chambre pneumatique (50) comprend une première demi-chambre pneumatique (501) et une seconde demi-chambre pneumatique (502) mutuellement séparées du piston (51), dans lequel la soupape d'échange (8) est reliée fluidiquement avec la première demi-chambre pneumatique (501) et avec la seconde demi-chambre pneumatique (502) de telle sorte que, en fonction de son positionnement le long de l'axe d'échange (V-V), la fourniture d'air dans une demi-chambre et l'évacuation d'air de l'autre demi-chambre sont commandées.
- 7. Pistolet d'insertion (1) selon la revendication 6, dans lequel la soupape d'échange (8) est reliée fluidiquement à la première demi-chambre pneumatique (501) au moyen d'un premier conduit de commande (81) à travers un premier orifice (810) et à la seconde demi-chambre pneumatique (502) au moyen d'un second conduit de commande (82) à travers un second orifice (820), dans lequel le premier orifice (810) et le second orifice (820) sont positionnés axialement en étant espacés le long de l'axe de poussée (Y-Y).
- 8. Pistolet d'insertion (1) selon l'une quelconque des revendications précédentes, dans lequel la soupape de régulation hydropneumatique (7) comprend des moyens élastiques (79) appropriés pour effectuer une action axiale qui maintient les premiers éléments mobiles (71) et les seconds éléments mobiles (72) dans la première configuration, dans lequel la troisième configuration est atteinte par l'action du fluide (F) qui dépasse l'action desdits moyens élastiques (79).
- 9. Pistolet d'insertion (1) selon la revendication 8, dans lequel les moyens élastiques (79) compris dans la soupape de régulation hydropneumatique (7) peuvent être étalonnés de telle manière à réguler l'action élastique respective, en fonction de l'action du fluide de poussée (F).
- 10. Pistolet d'insertion (1) selon l'une quelconque des revendications précédentes, dans lequel la soupape de régulation hydropneumatique (7) a la forme d'une cartouche pouvant être insérée et extraite le long de l'axe hydropneumatique (Z-Z).

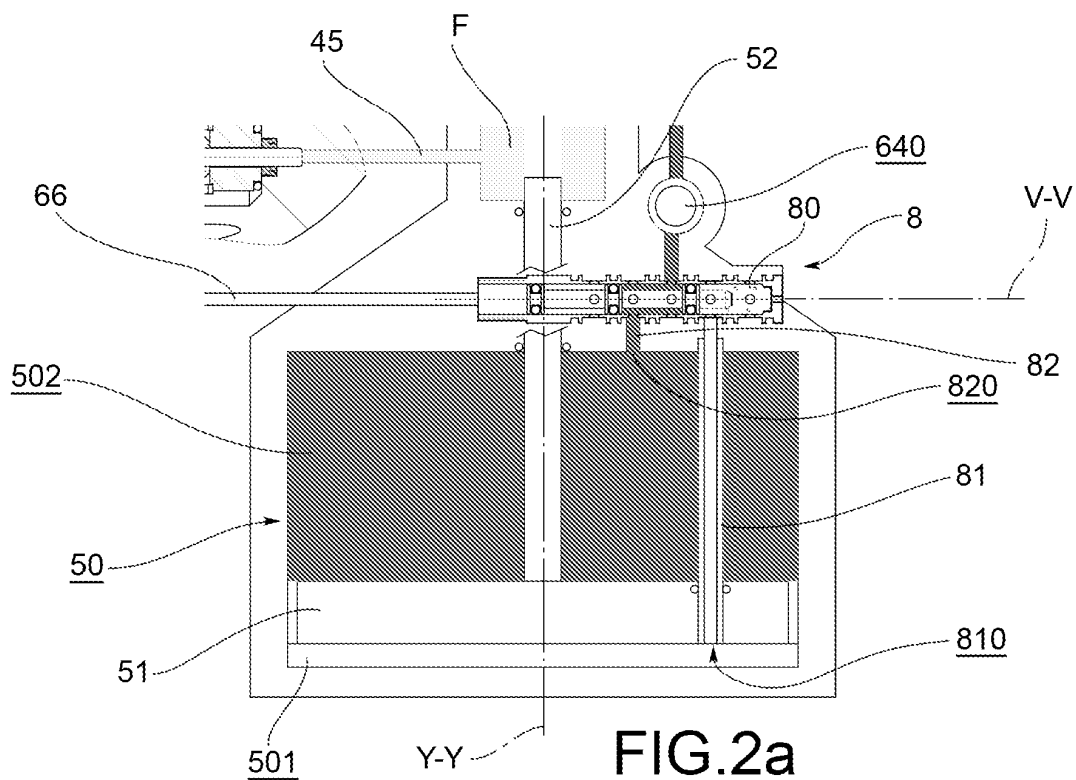
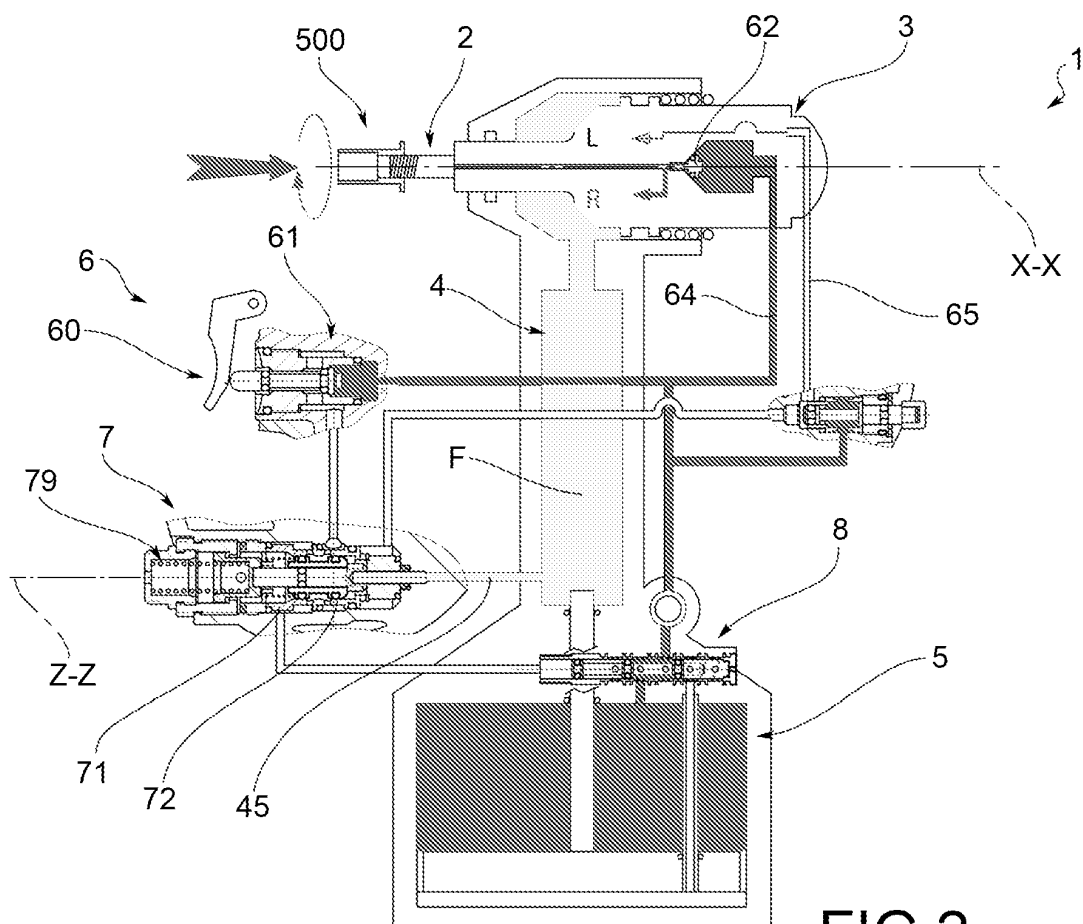
11. Pistolet d'insertion (1) selon l'une quelconque des revendications précédentes, dans lequel la soupape d'échange (8) a la forme d'une cartouche pouvant être insérée et extraite le long de l'axe d'échange (V-V). 5
12. Pistolet d'insertion (1) selon l'une quelconque des revendications précédentes, dans lequel le système pneumatique (6) comprend en outre un élément de soupape d'urgence (69) relié fluidiquement au premier conduit (64) et au second conduit (65) approprié pour commander et réguler l'écoulement d'air circulant dans le premier conduit (64) et/ou l'écoulement d'air circulant dans le second conduit (65) vers le moteur (3). 10 15
13. Pistolet d'insertion (1) selon l'une quelconque des revendications précédentes, comprenant un corps de pistolet (100) et un corps de réservoir pneumatique (150) pouvant être monté sur le corps de pistolet (100), de préférence sur la poignée (101) de celui-ci, dans lequel le corps de réservoir pneumatique (150) comprend une bride de distribution (151) pouvant être montée sur le corps de pistolet (100) et un corps de barillet (152) pouvant être monté sur ladite bride de distribution (151) définissant la chambre pneumatique (50), dans lequel le corps de réservoir pneumatique (150) loge le groupe amplificateur pneumatique (5), de sorte que le plongeur (52) fait saillie le long de l'axe de poussée (Y-Y) depuis ladite bride de distribution (151) pour trouver un hébergement dans le corps de pistolet (100). 20 25 30
14. Pistolet d'insertion (1) selon la revendication 13, dans lequel la soupape de régulation hydropneumatique (7) et la soupape d'échange (8) sont logées dans la bride de distribution (151). 35
15. Pistolet d'insertion (1) selon la revendication 14 et la revendication 12, dans lequel l'élément de soupape d'urgence (63) est également logé dans la bride de distribution (151). 40

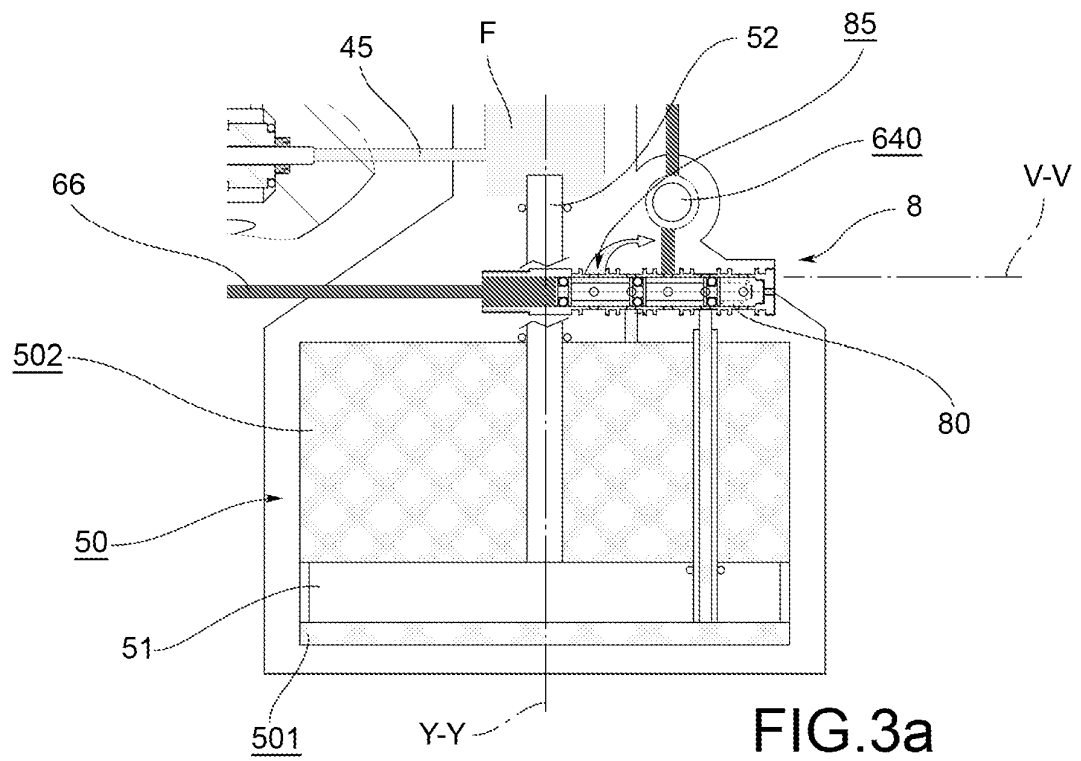
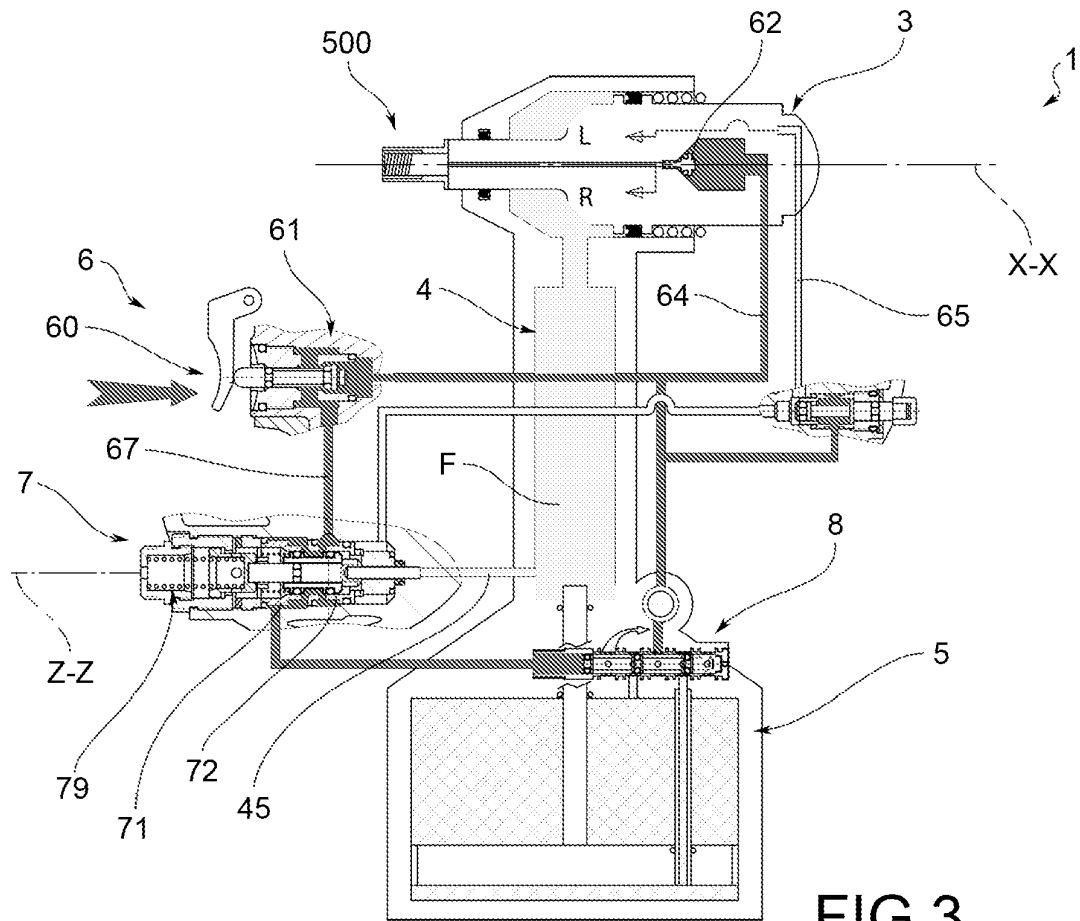
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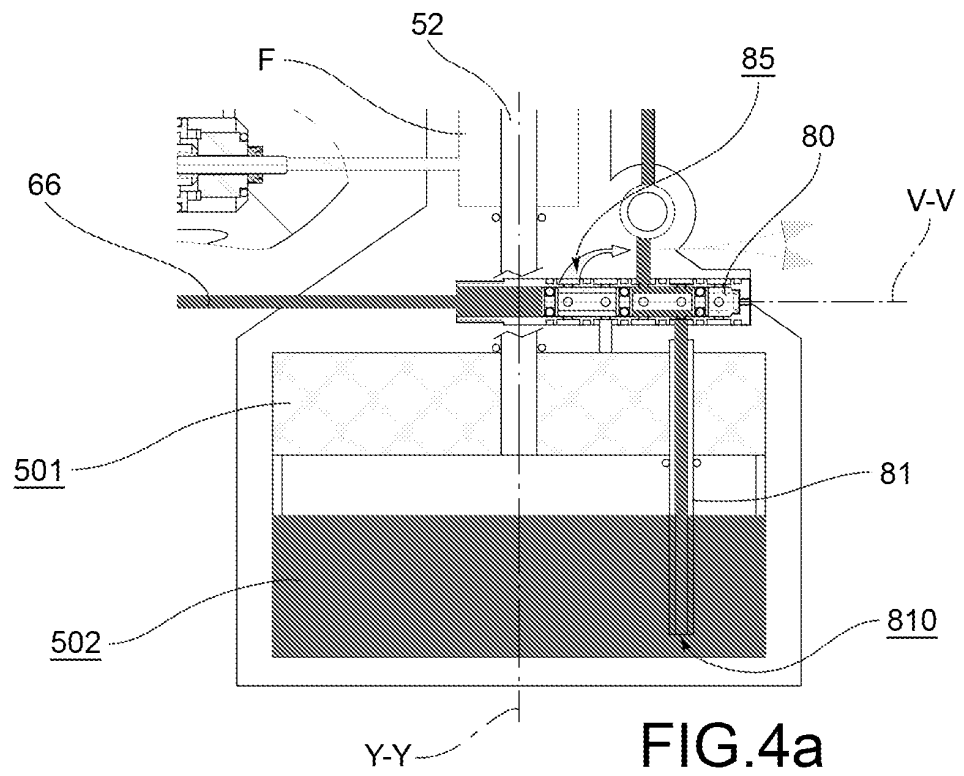
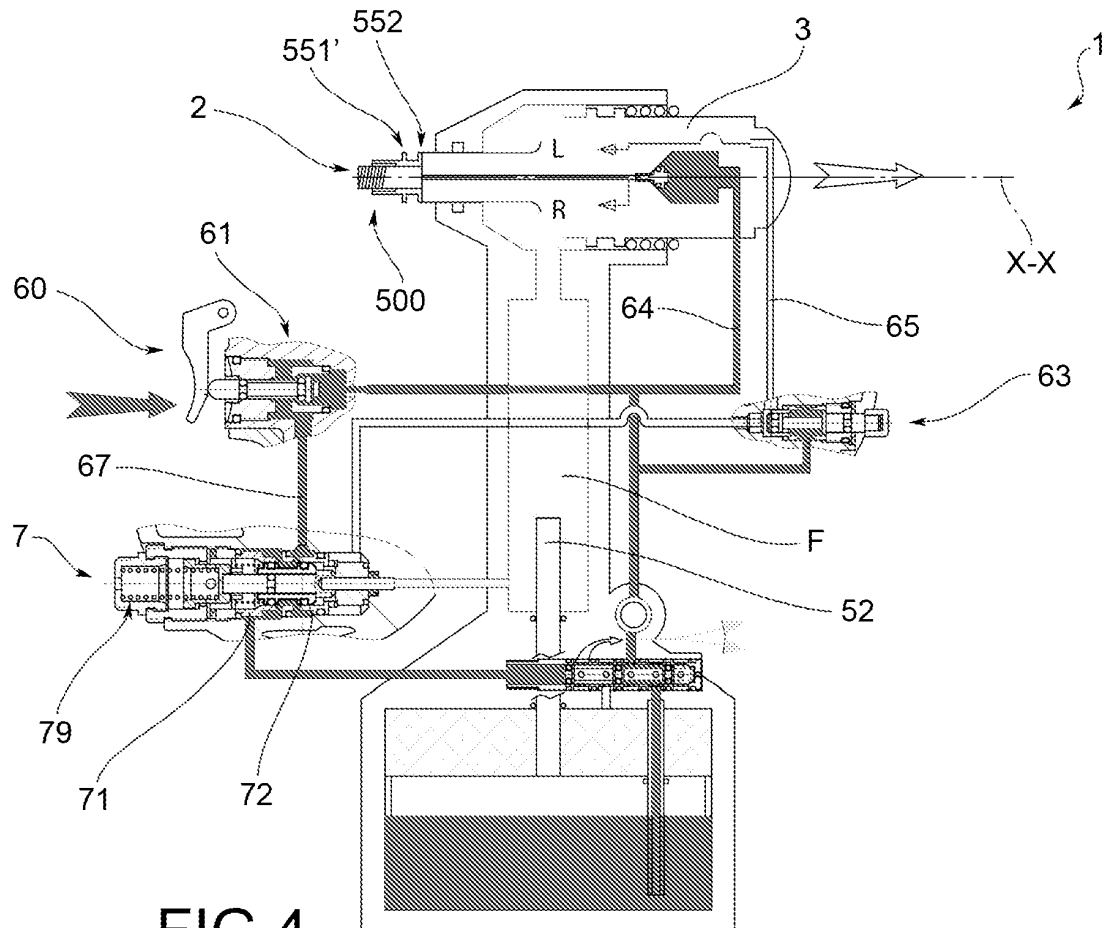
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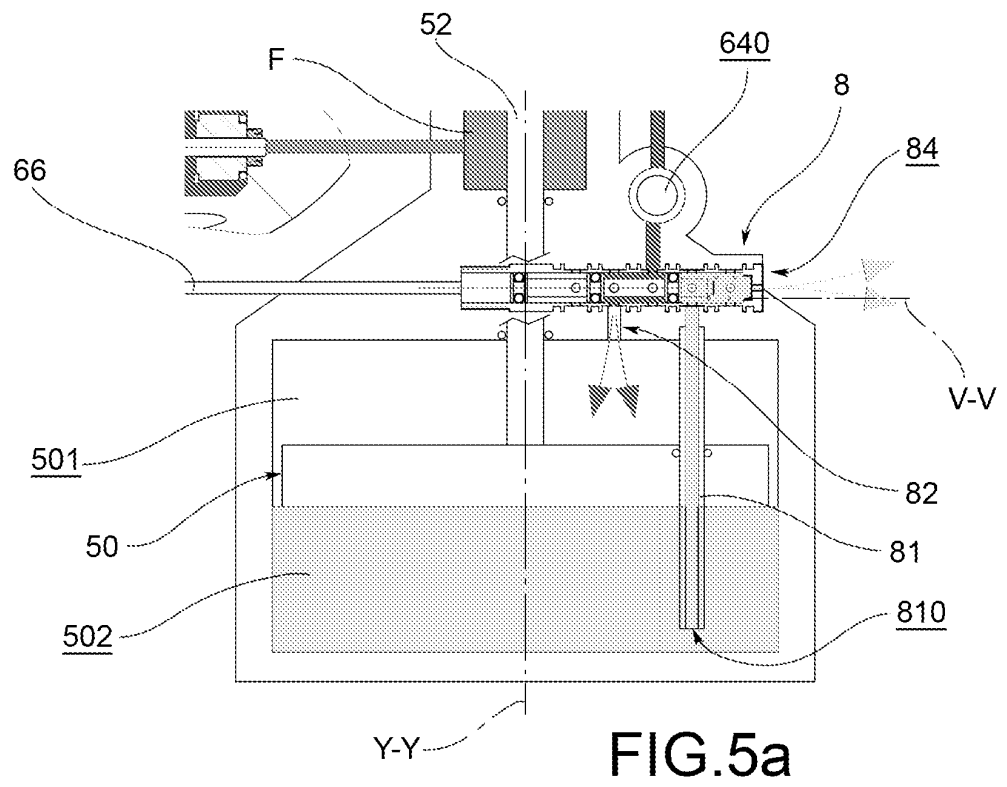
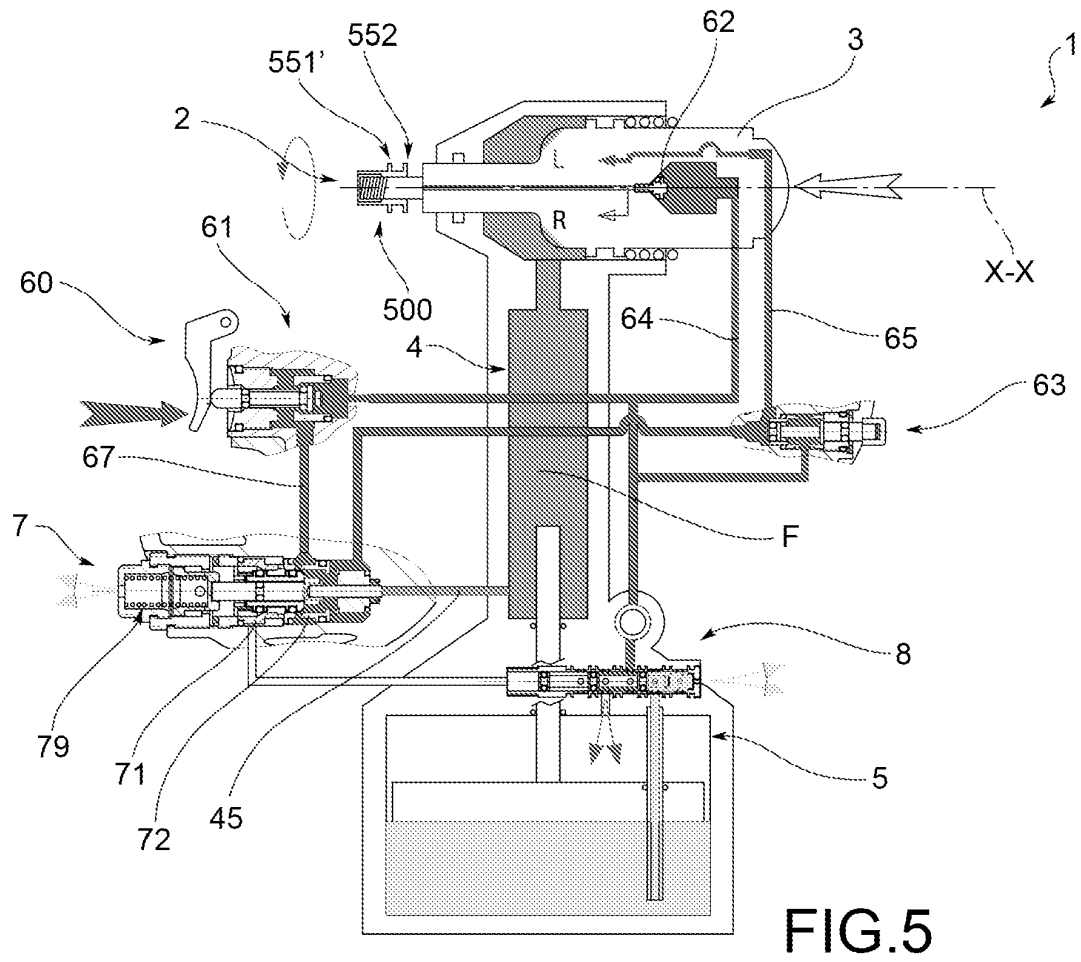
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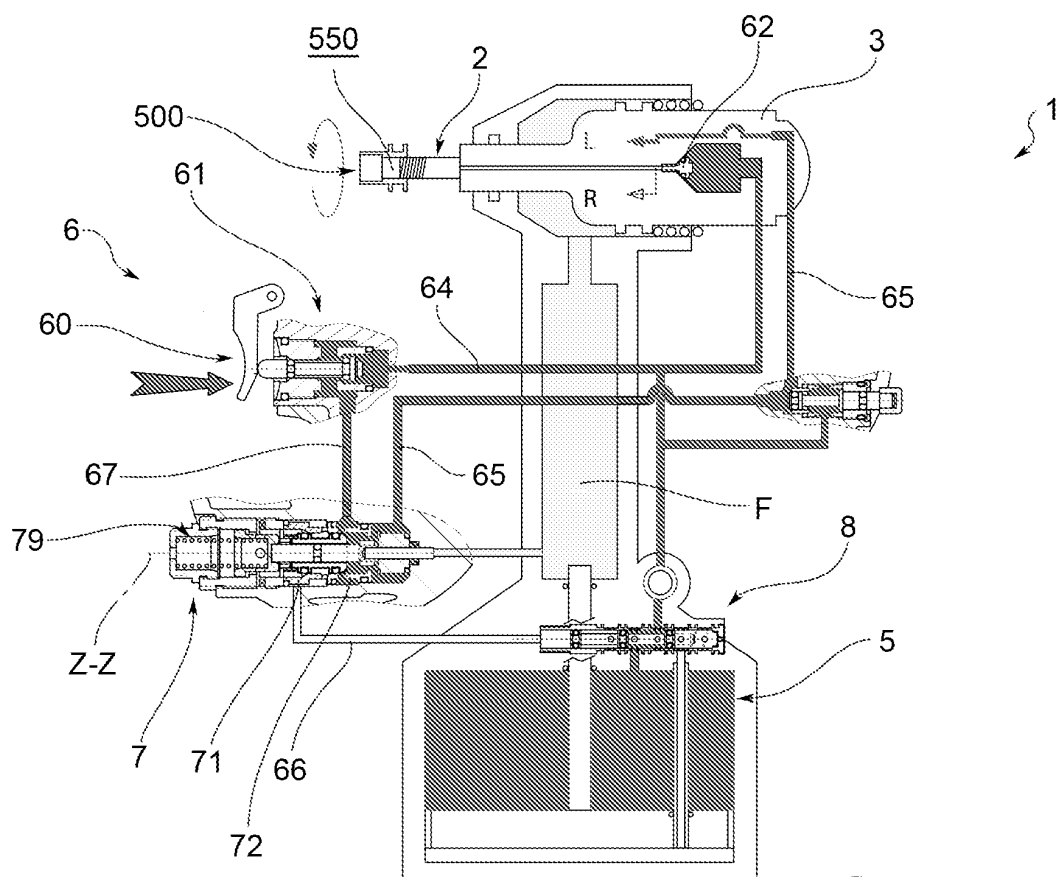


FIG.6

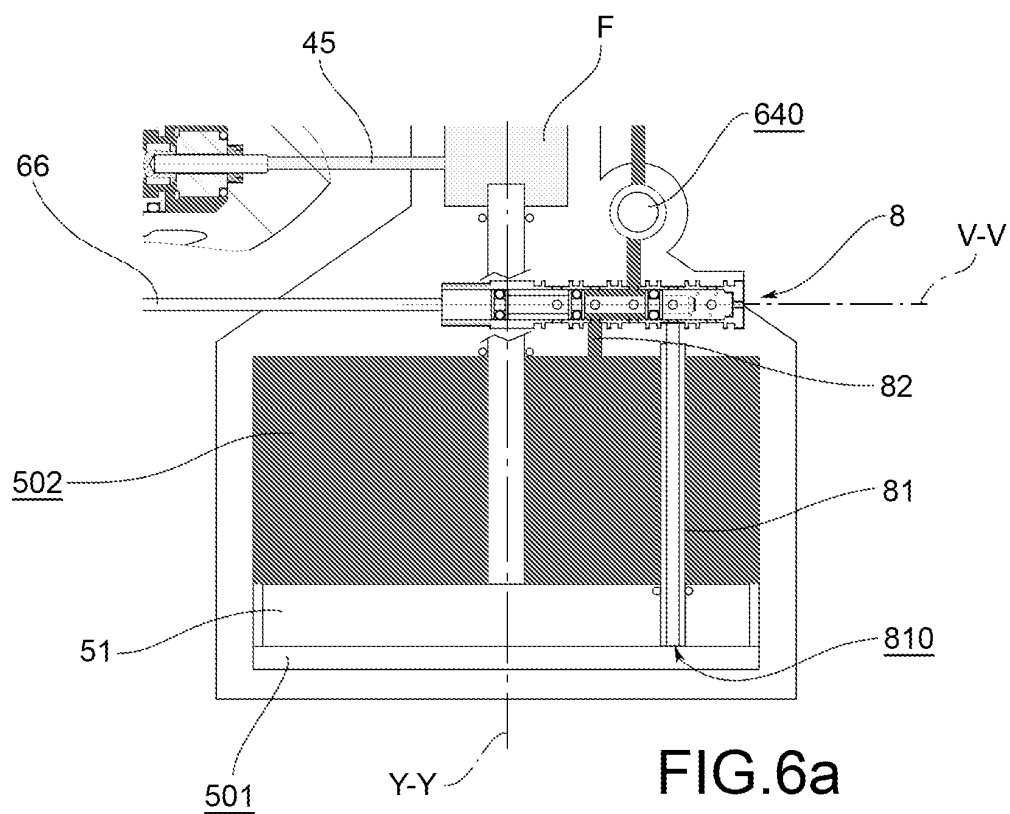


FIG. 6a

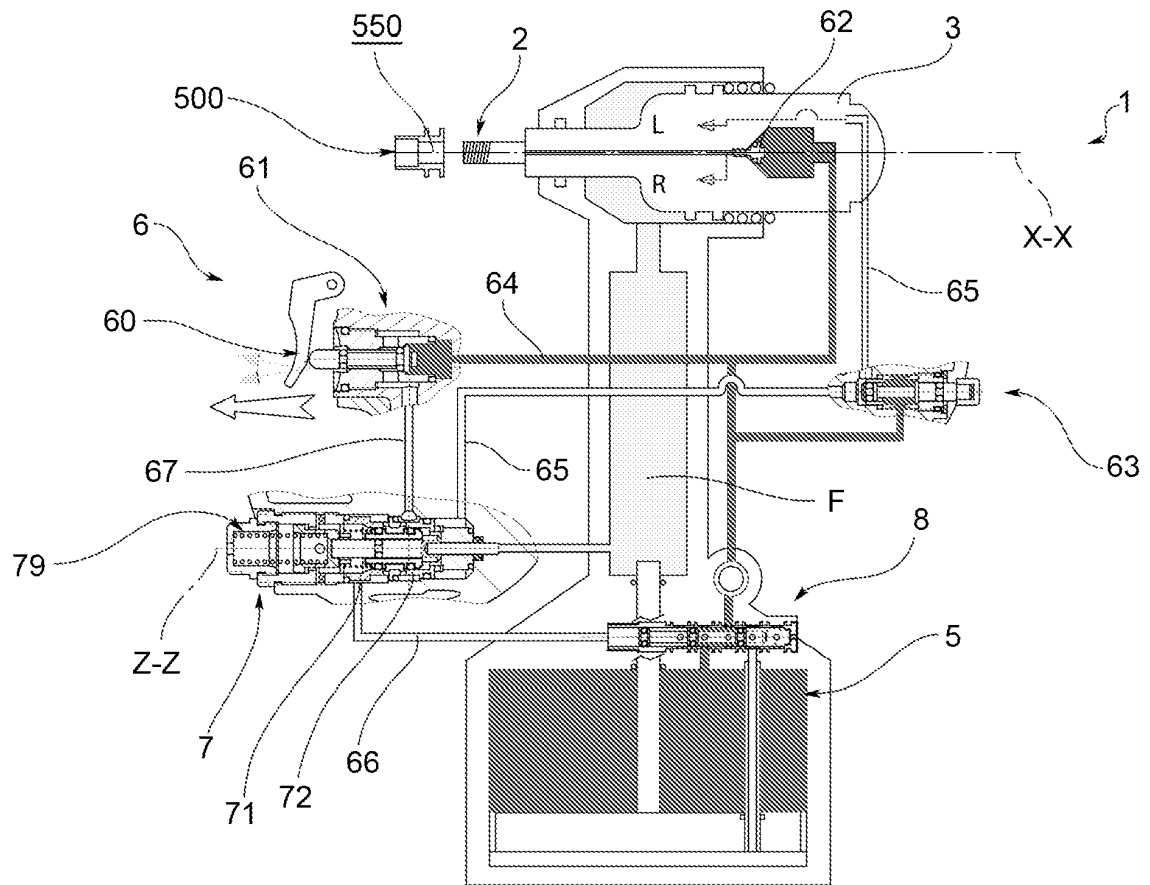


FIG. 7

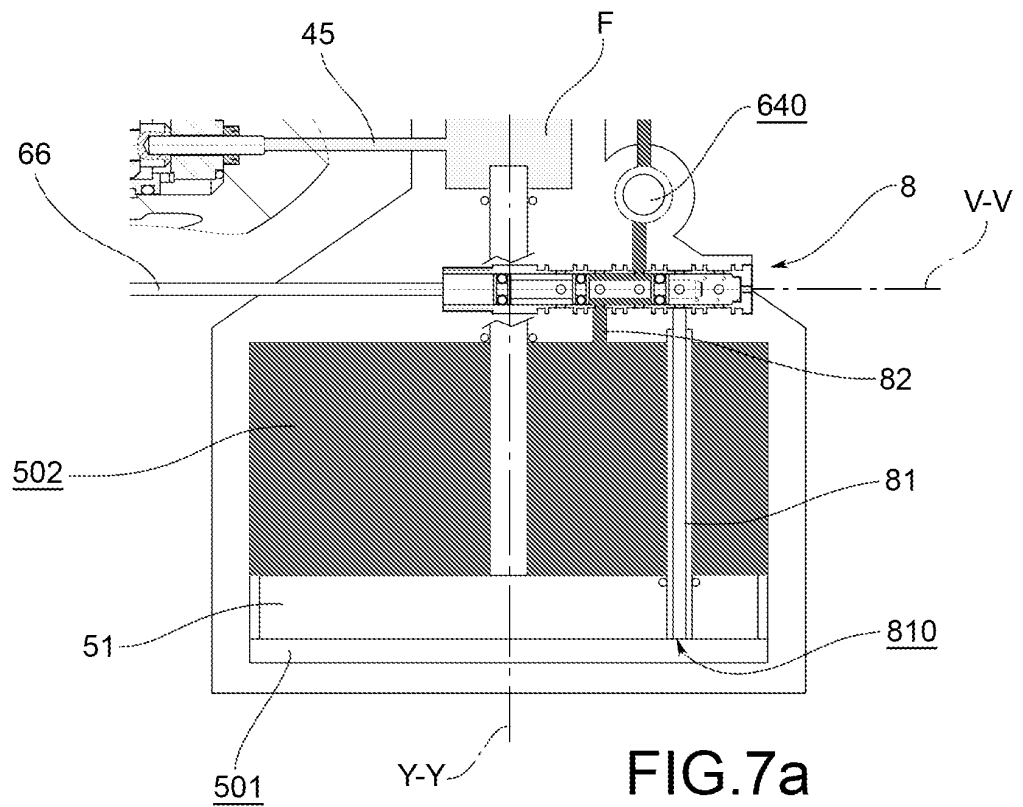


FIG. 7a

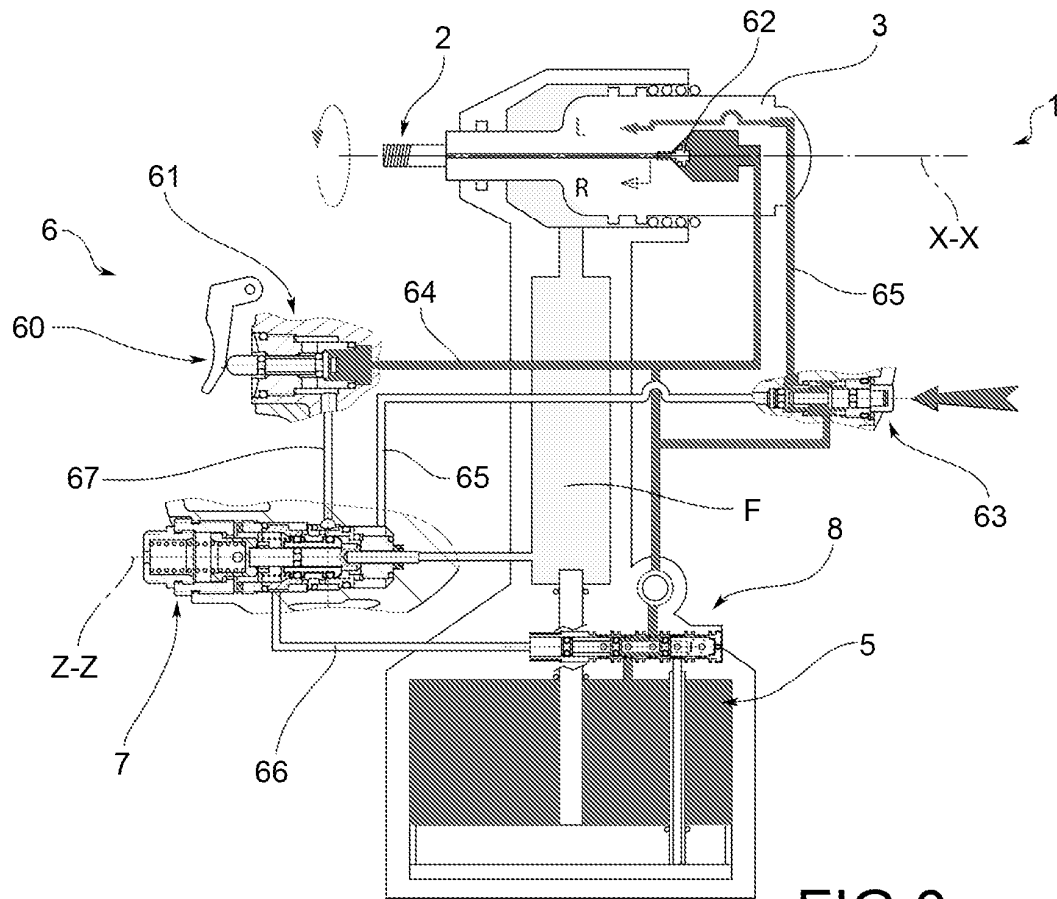


FIG. 8

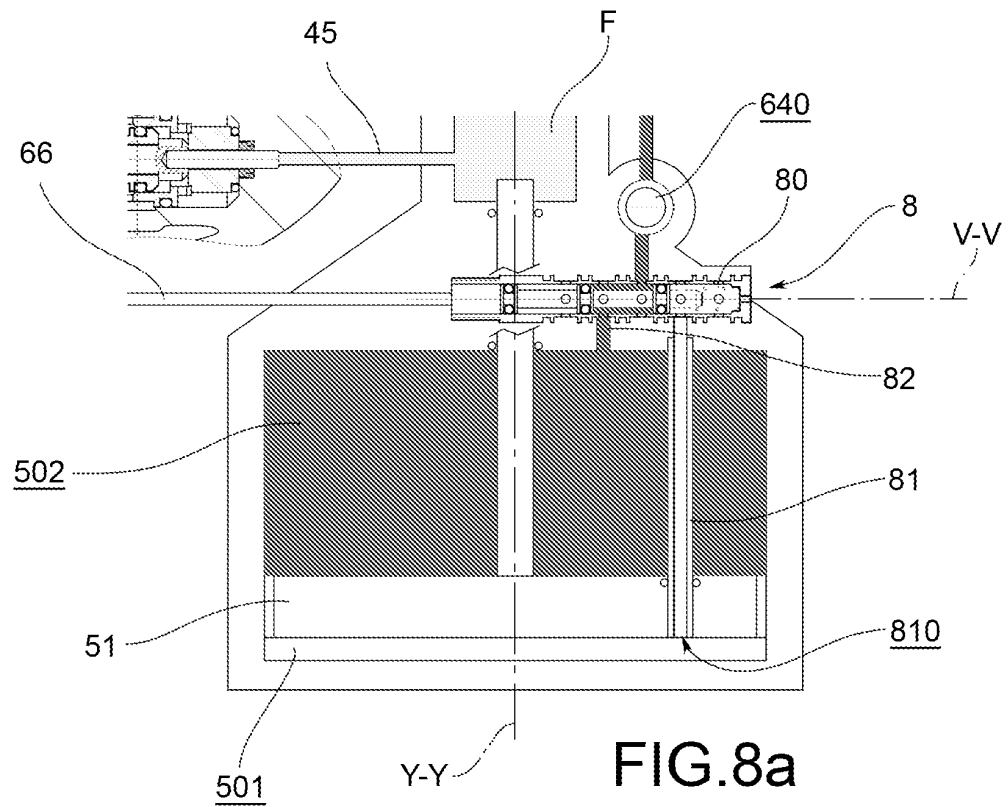


FIG. 8a

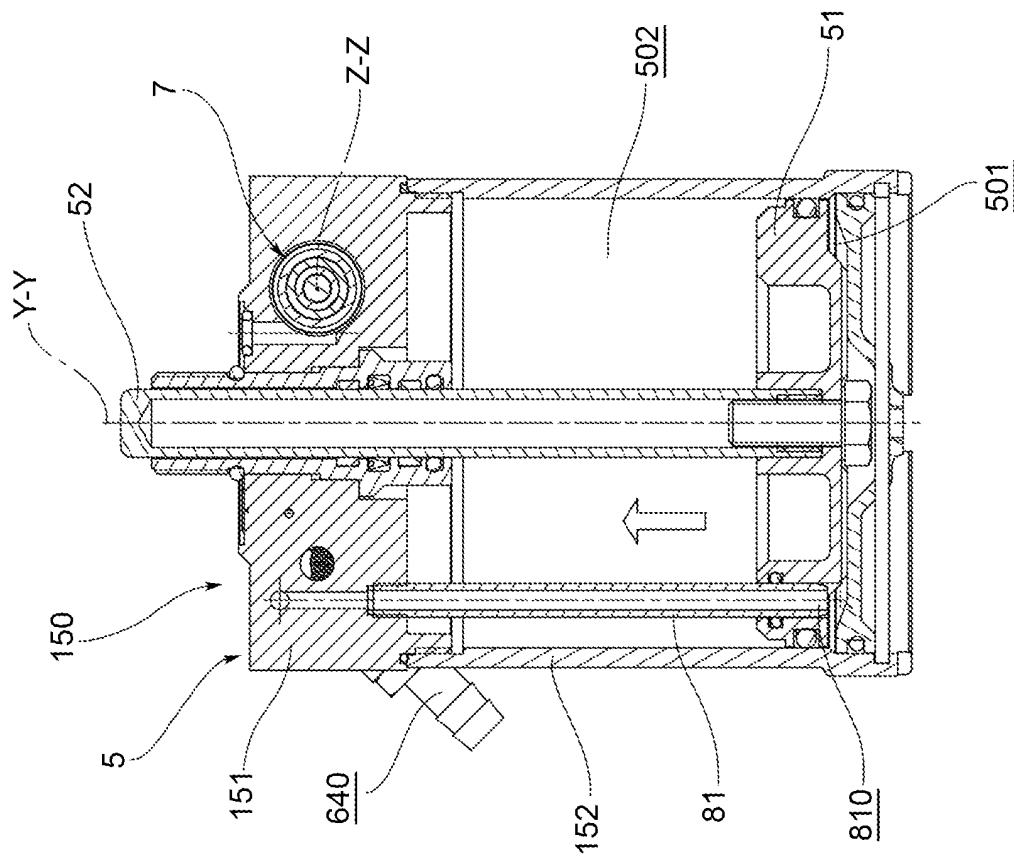


FIG. 9'

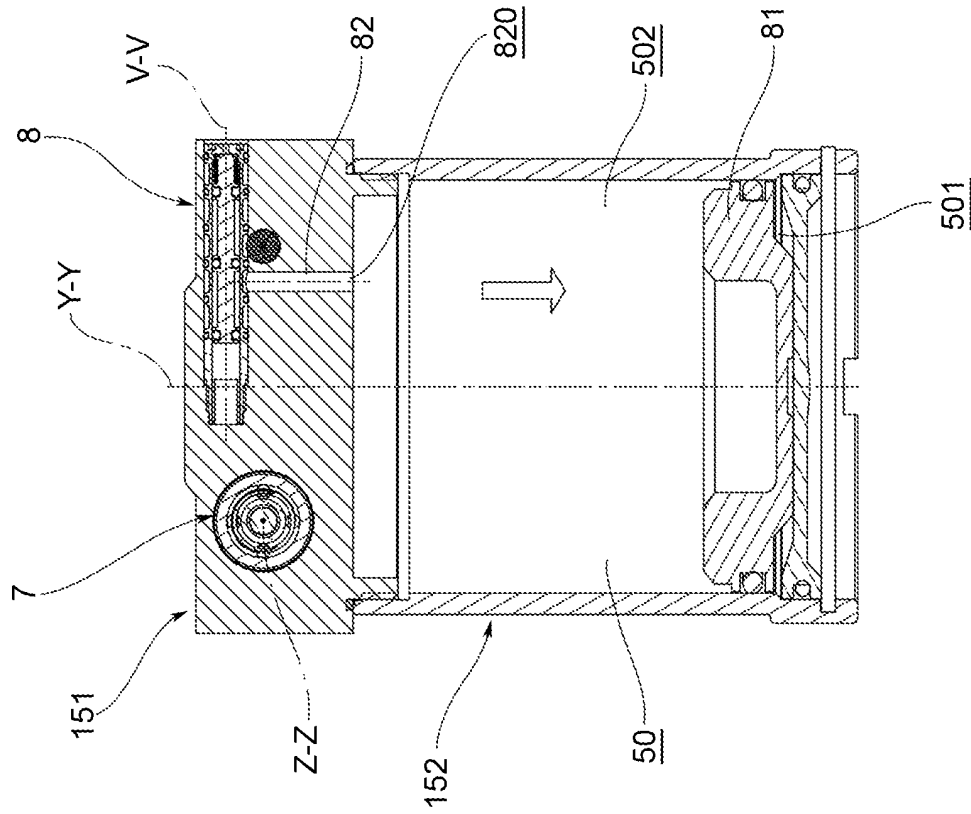


FIG. 9''

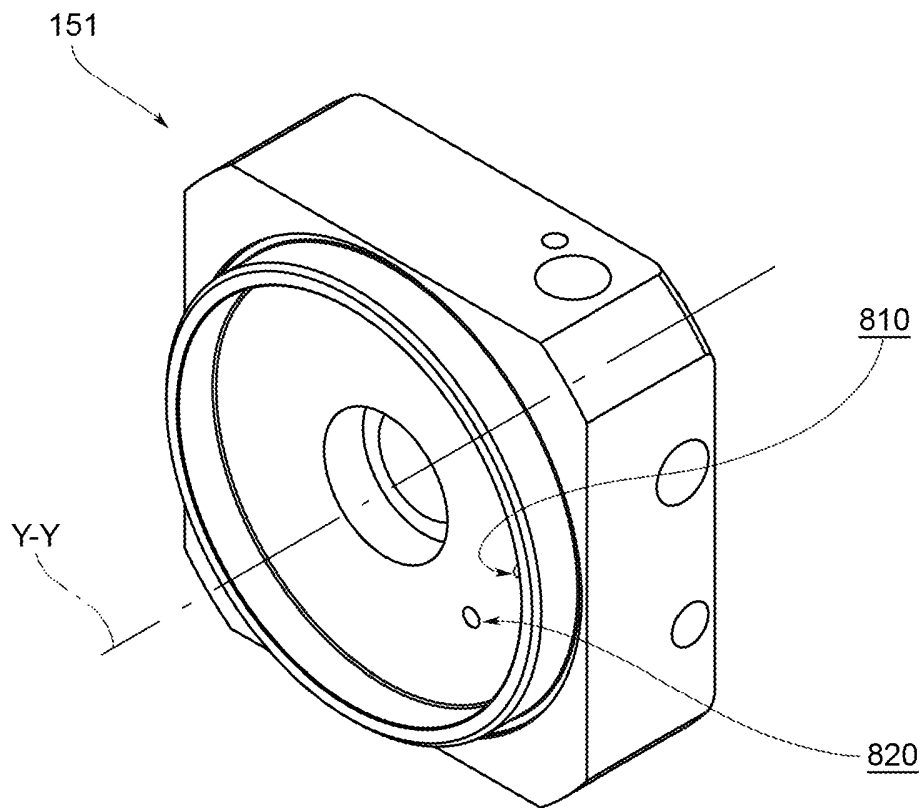


FIG.10a

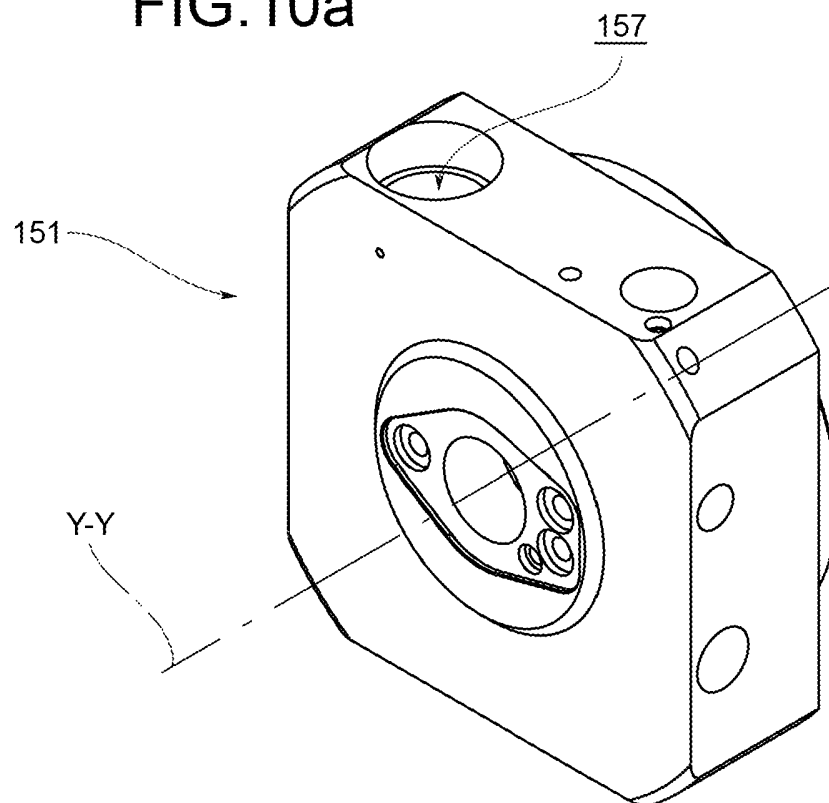


FIG.10b

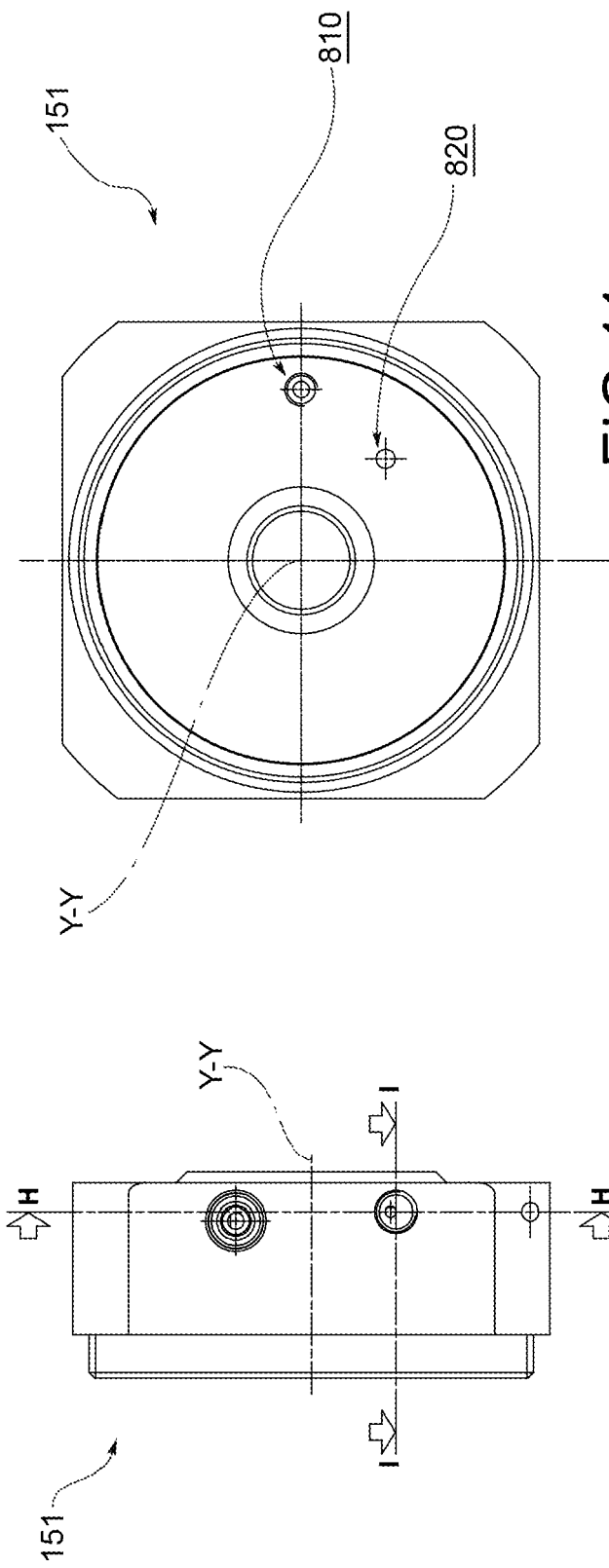


FIG.11

FIG.11a

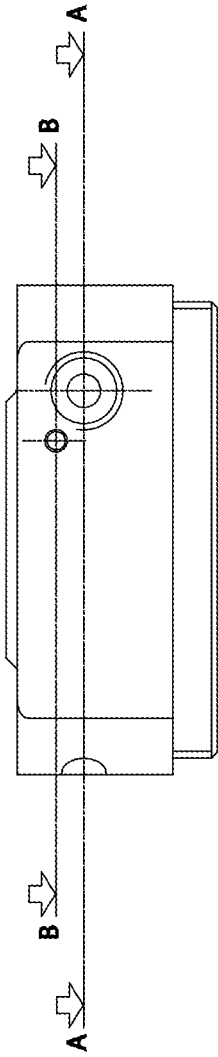
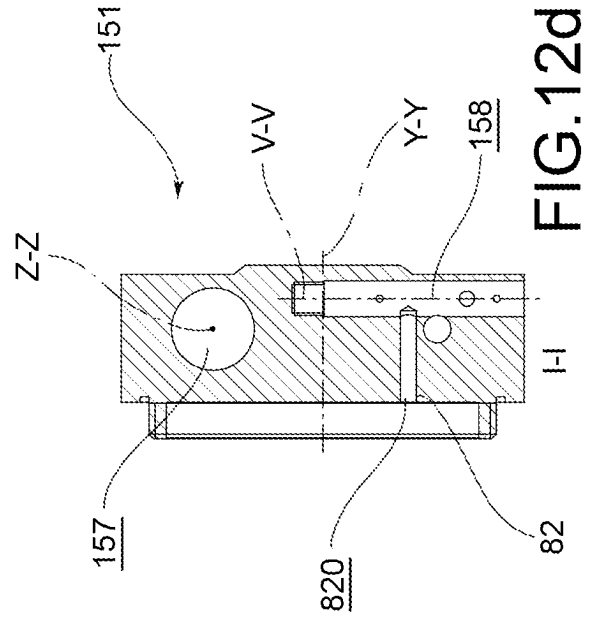
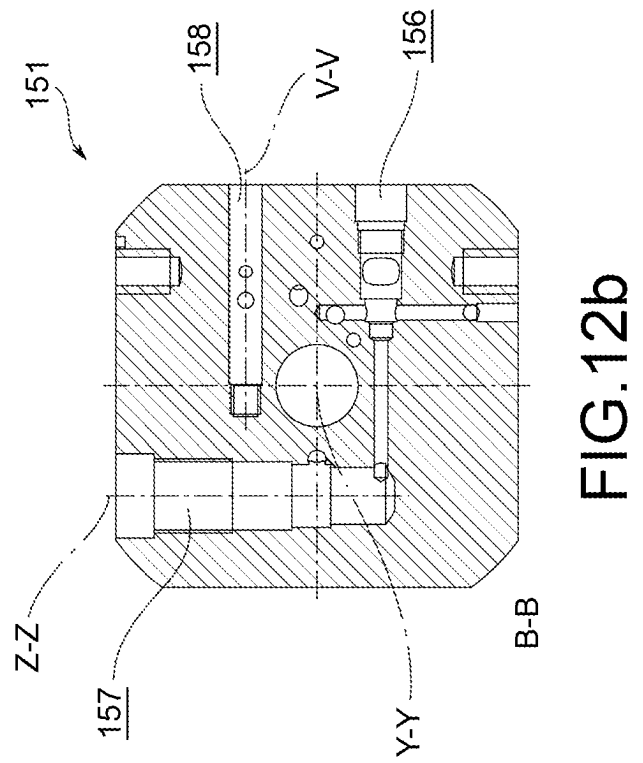
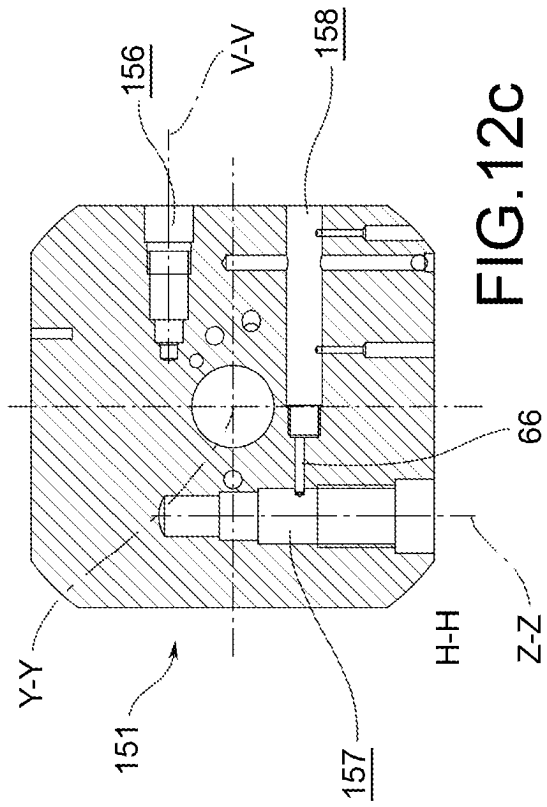
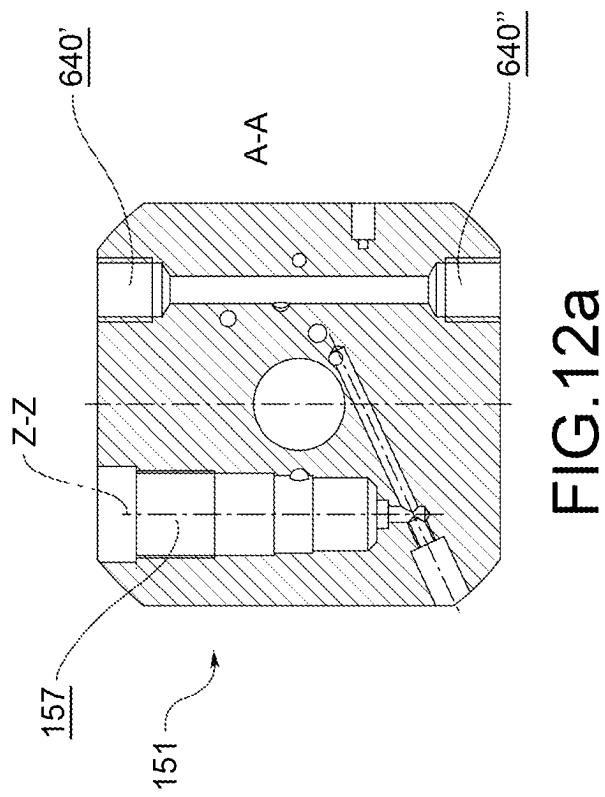


FIG.11b



REFERENCES CITED IN THE DESCRIPTION

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