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- (71) Applicant: ILLINOIS TOOL WORKS INC. [US/US];  
155 Harlem Avenue, Glenview, Illinois 60025 (US).
- (72) Inventors: WEIGMANN, Torsten; Glueck-auf-Strasse  
28, 30952 Ronnenberg (DE). VON SOEST, Klaus; Zum  
Apenteich 22, 31088 Winzenburg (DE). HAEHNDEL,  
Olaf; Hornfeld 6, 30982 Plattensen (DE).
- (74) Agent: HAUPTMAN, Benjamin J.; Lowe Hauptman &  
Ham, LLP, 2318 Mill Road, Suite 1400, Alexandria, Vir-  
ginia 22314 (US).

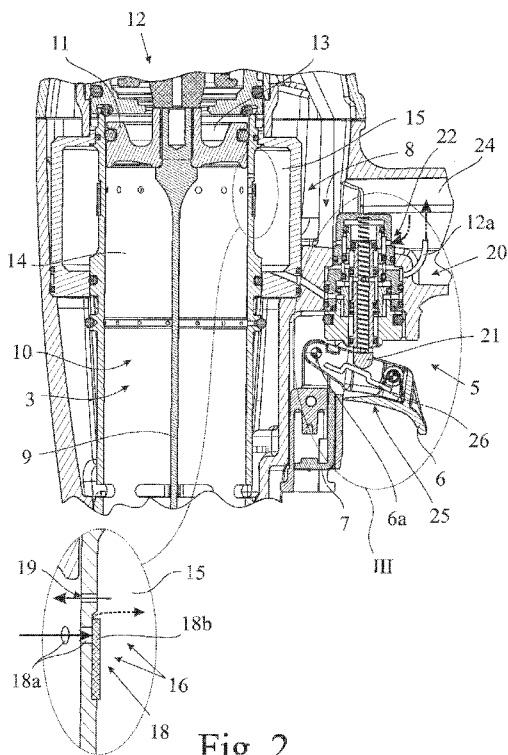
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(54) Title: DRIVING TOOL FOR DRIVING FASTENING MEANS INTO A WORKPIECE



(57) Abstract: The invention relates to a driving tool for driving fastening means (1), in particular nails or staples, into a workpiece (W), an actuator unit (3) being provided, by means of which the fastening means (1) can be driven into the workpiece (W) in driving-in cycles, a triggering assembly (5) being provided, by means of which the driving-in cycles of the actuator unit (3) can be triggered, the triggering assembly (5) having a trigger lever (6), which can be actuated manually, and a workpiece contact element (7), which can be actuated by placing the driving tool onto the workpiece, the driving tool being able to operate in a single shot mode, in which each individual sequence of an actuation of the workpiece contact element with subsequent actuation of the trigger lever (6) triggers a driving-in cycle, the driving tool being able to operate in a bump firing mode, in which, with the trigger lever (6) continuously actuated, each individual actuation of the workpiece contact element (7) triggers a driving-in cycle, a resetting assembly (8) being provided, which can be activated in the bump firing mode and, after a delay time starting from the activation, has the effect of transferring the driving tool from the bump firing mode into the single shot mode. It is proposed that the resetting assembly (8) is coupled to the actuator unit (3) in such a way that, in the bump firing mode, a driving-in cycle activates the resetting assembly (8).

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**DRIVING TOOL FOR DRIVING  
FASTENING MEANS INTO A WORKPIECE**

5 The present invention relates to a driving tool for driving fastening means into a workpiece according to the preamble of claim 1 and to a driving tool for driving in fastening means according to the preamble of claim 14.

10 The driving tool in question is used primarily as a handheld tool, for example for fastening particle boards on supporting structures. The term "fastening means" should be understood here in a broad sense and comprises not only nails and staples but also screws, pins or the  
15 like. The main focus of attention here is on the driving in of nails, which should not be understood as being restrictive.

The fastening means usually take the form of a magazine  
20 belt. Depending on the design, the magazine belt may for example have a carrier belt of plastic or metal, which carries the individual fastening means. Another variant is that of providing a series of parallel running fastening wires, which are tacked on to the individual fas-  
25 tening means.

The driving tool in question may be designed as a compressed-air-operated driving tool, as a combustion-powered driving tool or as an electrically operated  
30 driving tool or the like.

The known driving tool (US 6,604,664 B2), on which the invention is based, is designed as a compressed-air-operated driving tool. It is provided with a pneumatic  
35 actuator unit, which serves for driving in the fastening means in individual driving-in cycles.

For triggering the driving-in cycles of the actuator unit, a triggering assembly is provided, having a trigger lever that can be actuated manually and a workpiece contact element that can be actuated by placing the driving tool onto the workpiece.

What is advantageous about the known driving tool is the fact that it can be operated in two different operating modes. In the single shot mode, each individual sequence of an actuation of the workpiece contact element (from the unactuated state of the workpiece contact element) with subsequent actuation of the trigger lever (from the unactuated state of the trigger lever) triggers a driving-in cycle. In the bump firing mode, with the trigger lever continuously actuated, each individual actuation of the workpiece contact element (from the unactuated state of the workpiece contact element) triggers a driving-in cycle.

In the case of the known driving tool, a time-delayed, automatic resetting from the bump firing mode into the single shot mode is provided. For this, the driving tool has a resetting assembly with a control volume. The resetting assembly can be activated in the bump firing mode, by air at a working pressure being admitted into the control volume. The control volume is provided with an air-venting opening, which allows slow venting of the air. If the pressure goes below a limit value, this has the effect after a predetermined delay time of transferring the driving tool into the single shot mode. A separate valve, the valve piston of which is coupled to the workpiece contact element, is provided for the activation of the resetting assembly. An actuation of the workpiece contact element consequently leads to an activation of the resetting assembly. This is intended to achieve the effect that, when the driving tool is not used over a certain delay time, the driving tool is

transferred from the bump firing mode into the single shot mode.

5 The invention addresses the problem of designing and developing the known driving tool in such a way that the structure is simplified.

10 The above problem is solved in the case of a driving tool according to the preamble of claim 1 by the features of the characterizing part of claim 1.

15 Essential to this is the fundamental recognition that the driving-in cycle of the actuator unit itself can be used for the activation of the resetting assembly. That is also appropriate, since the delay time is in fact to be originally counted from the last firing actually performed. With the solution proposed, a malfunction of any kind, for example of the triggering assembly, cannot lead to an undesired activation of the resetting assembly.  
20

To be specific, a special coupling of the resetting assembly to the actuator unit is proposed, that is in such a way that, in the bump firing mode, a driving-in cycle  
25 activates the resetting assembly.

30 As it is proposed, the term "coupling" should be understood in a broad sense. It includes a pneumatic coupling, a mechanical coupling, an electrical coupling and a sensory coupling. A sensory coupling means that a change in state of the actuator unit, in particular an adjusting movement, is detected by means of a sensor.

35 With the solution proposed, the function of a resetting assembly can be realized without an additional valve being required. The reason for this is that the driving-in cycle that exists in any case is itself used to activate

the resetting assembly.

In the case of the particularly preferred design according to claim 3, the driving tool is designed as a compressed-air driving tool, in one variant the resetting  
5 assembly being pneumatically coupled to a working cylinder of the actuator unit. This coupling between the resetting assembly and the actuator unit can be implemented structurally in a most particularly simple way.

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In the case of the further preferred designs according to claims 4 to 13, the resetting assembly is provided with a control volume, to which a working pressure is applied for the activation of the resetting assembly.  
15 The venting of air from the control volume takes place by way of an air-venting assembly, which is dimensioned in such a way that, after the predetermined delay time, the pressure goes below the limit value (claim 6).

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In the case of the further preferred design according to claim 11, a pneumatically adjustable control element is pneumatically coupled to the control volume, the control element interacting with the triggering assembly in such a way that, when the pressure goes below the limit value,  
25 ue, there is a transfer of the driving tool from the bump firing mode into the single shot mode.

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A design that is structurally particularly compact is obtained according to claim 12, by the control element being designed as a control sleeve arranged concentrically in relation to the valve piston of the triggering valve of the triggering assembly.

35

According to a further teaching as claimed in claim 14, which is of independent significance, a driving tool for driving in fastening means is claimed. In principle, this is a driving tool of the kind described above,

without necessarily relying on the coupling of the re-setting assembly to the actuator unit in such a way that, in the bump firing mode, a driving-in cycle activates the resetting assembly.

5

Rather, what is essential according to the further teaching is that the resetting assembly has a control volume and a pneumatically adjustable control element, which is pneumatically coupled to the control volume. As proposed, when the pressure in the control volume goes below a limit value, the control element interacts with the triggering assembly in such a way that, with the trigger lever actuated, an actuation of the tool contact element is disengaged.

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What is essential according to this further teaching is therefore that, by an adjustment of the control element, the tool contact element is otherwise mechanically decoupled from the triggering assembly. Such an assembly with a control volume and a control element can be realized in a structurally simple and particularly compact way.

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All of the preferred features and advantages explained here in relation to the driving tool of the first-mentioned teaching can be applied to the full extent to the driving tool according to the second teaching, without relying on the resetting assembly being coupled to the actuator unit in such a way that, in the bump firing mode, a driving-in cycle activates the resetting assembly.

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The invention is explained in more detail below on the basis of a drawing that merely shows exemplary embodiments. In the drawing:

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Figure 1 shows a driving tool as proposed, in a side view,

5 Figure 2 shows the driving tool according to Figure 1, in the sectional view of a detail II,

10 Figures 3-5 show the triggering sequence of the driving tool according to Figure 2 from the single shot mode, in the sectional representation of a detail III,

15 Figure 6 shows the driving tool according to Figure 2 in the bump firing mode, in the sectional representation of a detail III,

20 Figure 7 shows the driving tool according to Figure 2 after the resetting from the situation represented in Figure 6, in the partially sectional view of a detail III,

25 Figure 8 shows the driving tool according to Figure 1 in a further embodiment, in the sectional view of a detail VIII,

30 Figures 9-11 show the triggering sequence of the driving tool according to Figure 8 from the single shot mode, in the sectional representation of a detail VIII and

Figure 12 shows the driving tool according to Figure 8 in the bump firing mode, in the sectional representation of a detail VIII and

35 Figure 13 shows the driving tool according to Figure 8 after the resetting from the situation represented in Figure 12, in the partially sectional view of a detail VIII.

The driving tool that is represented in the drawing serves for driving in fastening means 1 of a magazine belt 2 indicated in Figure 1, in particular nails, staples or the like. With regard to further interpretation of the term "fastening means", reference may be made to the introductory part of the description.

The driving in of nails is the main focus of attention in the description that follows, which should not be understood as being restrictive. All statements that are made with respect to nails apply correspondingly to all other types of fastening means that can be driven in.

The driving tool is provided with an actuator unit 3, by means of which the fastening means 1 can be driven into the workpiece W in driving-in cycles. Here and preferably, the actuator unit 3 is a pneumatic actuator unit 3, as still to be explained. In a driving-in cycle, the fastening means 1, driven by the actuator unit 3, pass through a driving channel 4 into the workpiece W.

The driving tool as proposed also has a triggering assembly 5, by means of which the driving-in cycles of the actuator unit 3 can be triggered. Correspondingly, the triggering assembly 5 first has a trigger lever 6, which can be actuated manually. The trigger lever 6 represented in the drawing can be pivoted about a trigger lever axis 6a for actuation.

In order to avoid unintentional triggering of driving-in cycles, the triggering assembly 5 is provided with a workpiece contact element 7, which can be actuated by the placing of the driving tool onto the workpiece W, that is to say by the placing of the workpiece contact element 7 onto the workpiece W. The workpiece contact element 7 can be resiliently deflected upward in Figure 1 for actuation.

The driving tool can be operated in different operating modes, depending on the application. Firstly, the driving tool can be operated in a single shot mode, in which  
5 each individual sequence of an actuation of the workpiece contact element 7 with subsequent actuation of the trigger lever 6 triggers a driving-in cycle. In the single shot mode, the user therefore first places the driving tool onto the workpiece W, thereby actuating the  
10 workpiece contact element 7, and subsequently actuates the trigger lever 6.

If the fastening means 1 are to be driven in at a multiplicity of driving-in locations lying next to one another, the driving tool can be advantageously operated in  
15 bump firing mode. In bump firing mode, with the trigger lever 6 continuously actuated, each individual actuation of the workpiece contact element 7 triggers a driving-in cycle. If the user keeps the trigger lever 6 actuated,  
20 the placing of the driving tool, and consequently the actuation of the workpiece contact element 7, is sufficient for the triggering of a driving-in cycle.

It is preferably the case that the completely unactuated  
25 driving tool is initially in the single shot mode. This means that, for triggering the first driving-in cycle, first the tool contact element 7 and then the trigger lever 6 must be actuated. After this first driving-in cycle, the driving tool is preferably in the bump firing  
30 mode. The user then correspondingly has the possibility of keeping the trigger lever 6 actuated and triggering a further driving-in cycle with each actuation of the workpiece contact element 7.

35 The handling of the driving tool as proposed is made particularly convenient by the provision of a time-based, automatic transfer of the driving tool from the

bump firing mode into the single shot mode. A resetting assembly 8, which can be activated in the bump firing mode and, after a delay time starting from the activation, has the effect of transferring the driving tool from the bump firing mode into the single shot mode, is specifically provided. The resetting assembly 8 therefore always determines the time that has elapsed since the activation. As soon as this time exceeds the predetermined delay time, the resetting assembly 8 initiates the transfer of the driving tool from the bump firing mode into the single shot mode. Here and preferably, the delay time lies in a range between approximately 2 s and approximately 4 s, preferably at approximately 3 s.

What is essential for the solution as proposed is that the resetting assembly 8 is coupled to the actuator unit 3 in such a way that, in the bump firing mode, a driving-in cycle activates the resetting assembly 8.

As explained further above, the solution as proposed can be used for all types of driving tools, as long as the activation of the resetting assembly 8 takes place by way of the coupling to the actuator unit by a driving-in cycle.

In the case of both exemplary embodiments that are represented, the actuator unit 3 has a driving punch 9, which during the driving-in cycle performs a linear driving-in movement, a movement from top to bottom in the drawing, and drives the respective fastening means 1 in. Subsequently, the driving punch 9 performs a return movement, a movement from bottom to top in the drawing. In principle, it may thus be provided that the resetting assembly 8 is coupled to the driving punch 9, or to a component connected thereto, for activation. Here and preferably, this coupling is however pneumatically provided, as explained below.

In the case of the exemplary embodiment that is represented and preferred to this extent, the actuator unit 3 has a working cylinder 10, in which a working piston 11  
5 connected to the driving punch 9 runs, the resetting assembly 8 being coupled to the working cylinder 10, here and preferably pneumatically, for activation. In other preferred exemplary embodiments, it may also be provided that the resetting assembly 8 is in turn coupled to the  
10 driving punch 9 or to the working piston 11.

As already indicated, the driving tool represented is designed as a compressed-air driving tool, the resetting assembly 8 being pneumatically coupled to the actuator  
15 unit 3, here and preferably to the working cylinder 10 of the actuator unit 3.

Preferably provided for the driving-in movement of the working piston 11 is a main valve 12, which, triggered  
20 by the triggering assembly 5, admits air at a working pressure to the driving volume 13 of the working cylinder 10 for triggering a driving-in cycle. The "driving volume 13" should be understood as meaning in each case the region of the working cylinder 10 that is bounded by  
25 the working piston 11 and to which a positive pressure is applied for producing the driving-in movement. "Working pressure" means a pressure lying above atmospheric pressure that is suitable for implementing the driving-in movement of the working piston 11.

30 After the driving-in movement of the driving punch 9, that is to say after the driving of the respective fastening means 1 into the workpiece W, air is vented from the driving volume 13 of the working cylinder 10, here  
35 and preferably against atmospheric pressure. At the same time, a certain driving pressure is applied to the portion 14 of the working cylinder 10 beyond the driving

volume 13, with respect to the working piston 11, thereby implementing the return movement of the working piston 11. The teaching as proposed does not specifically rely on the implementation of the driving-in movement and the return movement, and so to this extent there is  
5 no need for a detailed explanation.

Both in the first exemplary embodiment (Figures 2-7) and in the second exemplary embodiment (Figures 8-13), the  
10 resetting assembly 8 has a control volume 15, which is pneumatically coupled to the working cylinder 10 by way of a connection 16 and to the triggering assembly 5 by way of a connection 17. The term "connection" should be understood here in a broad sense in each case, and,  
15 apart from customary connecting lines, also comprises valves, nozzles or the like.

During the driving-in cycle, in particular during at least part of the driving-in movement of the driving  
20 punch 9, air at operating pressure is admitted to the control volume 15 by way of the working cylinder 10 and the connection 16. After the driving-in movement of the driving punch 9, air is vented from the control volume 15 against atmospheric pressure by way of the working  
25 cylinder 10.

For admitting air to the control volume 15, an air-admitting assembly 18 is provided in the wall of the working cylinder 10. The air-admitting assembly 18 can  
30 be seen best in the representation of a detail according to Figure 2. The air-admitting assembly 18 is designed as a simple check valve. What is essential in this respect is that the wall of the working cylinder 10 has openings 18a, which are closed by a compliant ring 18b.  
35 When a working pressure is applied to the driving volume 13, the ring 18b is pressed out of engagement with the openings 18a, and so the admission of air at the working

pressure to the control volume 15 can take place.

For the venting of air from the control volume 15, an air-venting assembly 19 is provided on the wall of the working cylinder 10, and is designed here as a simple opening. In principle, the air-venting assembly 19 may, however, also be designed as a valve, in particular as an adjustable needle valve or the like.

The design of the air-admitting assembly 18 on the one hand and of the air-venting assembly 19 on the other hand are of most particular importance in the present case. It should be taken into consideration in this respect that the admission of air 18 should take place with as little flow resistance as possible, while the venting of air should take place in such a way that the pressure in the control volume 15 only goes below the limit value, still to be explained, when the predetermined delay time has elapsed.

What is interesting about the exemplary embodiments represented is the fact that in any event the air-venting assembly 19 is flowed through in a first flow direction during the driving-in cycle and is flowed through in a second flow direction, opposite from the first flow direction, during the venting of air from the control volume 15. This ensures that contamination of the air-venting assembly 19 is largely avoided.

Advantageously, the air-admitting assembly 18 and the air-venting assembly 19 may also be combined in a single valve assembly. This leads to a structurally particularly simple embodiment.

The structural design of the control volume 15 is of most particular importance in the present case. Here and preferably, the control volume 15 is arranged annularly

around the working cylinder 10. This allows an arrangement that is optimized in terms of installation space to be achieved, as Figures 2 and 8 show. In principle, however, a different arrangement of the control volume 15 is also conceivable.

Among other influencing factors, the control volume 15 together with the air-venting assembly 19 are determinant for the resulting delay time of the resetting assembly 8. For this, the control volume 15 is assigned a pressure limit value, the driving tool remaining in the bump firing mode when the pressure is above the limit value, by way of the pneumatic coupling to the triggering assembly 5, and a fall in the pressure below the limit value defining the elapse of the delay time and having the effect of transferring the driving device into the single shot mode, by way of the pneumatic coupling to the triggering assembly 5. The pressure limit value may have a fixed value or else vary in dependence on various boundary conditions, such as the level of the working pressure.

Depending on the pressure prevailing in the control volume 15, the pneumatic coupling to the triggering assembly 5 therefore has the effect of keeping the driving device in the bump firing mode or transferring the driving device into the single shot mode. This is explained below on the basis of the two exemplary embodiments.

In the two exemplary embodiments represented, the triggering assembly 5 has a triggering valve 20 with a valve piston 21, which valve piston 21 can be actuated from a starting position (Figures 3 and 9) into an actuating position (Figures 5 and 11). The valve piston 21 is prestressed into the starting position by means of a valve piston spring 21a. The starting position corresponds to a certain extent to a rest position of the triggering

valve 20, in which no driving-in cycle is triggered by the triggering assembly 5. In the actuating position, the triggering valve 20 has the effect that air at working pressure is admitted to the driving volume 13 of the working cylinder 10, here and preferably by way of the main valve 12. The assembly comprising the main valve 12 and the triggering valve 20 is thus arranged in such a way that, as long as the triggering valve 20 switches through the working pressure to the main valve 12, the main valve 12 remains closed, that is to say air at operating pressure is not admitted to the driving volume 13. Only when the triggering valve 20 interrupts the application of working pressure to the main valve 12 does the main valve 12 admit air at working pressure to the driving volume 13 of the working cylinder 10.

For the above activation of the main valve 12, the triggering valve 20 is provided with an upper valve inlet 22, to which working pressure is applied. Working pressure is fed here to the upper valve inlet 22 of the triggering valve 20 by way of the connection 23 and the gripping portion 24.

What is essential in this context is that an adjustment of the valve piston 21 of the triggering valve 20 into the actuating position triggers an aforementioned driving-in cycle.

Depending on the respective operating mode of the driving tool, the valve piston 21 can be adjusted by a specific actuation of the trigger lever 6 on the one hand and the workpiece contact element 7 on the other hand into the actuating position. For this, the triggering assembly 5 is provided with a coupling assembly 25, which, with the trigger lever 6 actuated, provides a coupling or disengagement between the tool contact element 7 and the valve piston 21, depending on the posi-

tion of the valve piston 21.

What is essential here is firstly that, with the trigger lever 6 actuated, the coupling of the tool contact element 7 to the triggering assembly 5 otherwise depends on the position assumed by the valve piston 21 of the triggering valve 20. For example, in the case of the state that is represented in Figures 7 and 13, it is such that the valve piston 21 is in the starting position, and so, with the trigger lever 6 actuated, an actuation of the workpiece contact element 7 is disengaged. On the other hand, Figures 6 and 12 show that the valve piston 21 can be brought into an intermediate position, which is located between the starting position and the actuating position, in which, with the trigger lever 6 actuated, an actuation of the tool contact element 7 has the effect of adjusting the valve piston 21 into the actuating position.

Numerous structural variants are conceivable for the design of the coupling assembly 25. Here and preferably, the coupling assembly 25 is provided with a pivotable coupling element 26, which is pivotably mounted on the trigger lever 6. The coupling element 26 is preferably assigned a coupling element spring 26a, which prestresses the coupling element 26 onto the valve piston 21 of the triggering valve 20. This produces a coupling of movement between the valve piston 21 and the coupling element 26.

It is also preferably the case that, with the trigger lever 6 not actuated, the workpiece contact element 7 interacts with the coupling assembly 25, here and preferably with the coupling element 26 of the coupling assembly 25, in such a way that an actuation of the trigger lever 6 following the actuation of the workpiece contact element 7 has the effect of adjusting the valve

piston 21 into the actuating position. This is evident from the sequence of Figures 4 and 5.

5 What is interesting about the two exemplary embodiments represented is the fact that the resetting assembly 8 has a pneumatically adjustable control element 27, which is pneumatically coupled to the control volume 15. When the pressure in the control volume 15 is above the limit value, the control element 27 interacts with the valve  
10 piston 21 (Figures 2-7) or with the coupling assembly 25 (Figures 8-13) in such a way that, with the trigger lever 6 actuated, an actuation of the tool contact element 7 actuates the valve piston 21 into its actuating position (Figures 6 and 12). On the other hand, when the  
15 pressure in the control volume 15 goes below the limit value, the control element 27 interacts with the valve piston 21 (Figures 2-7) or the coupling assembly (Figures 8-13) in such a way that, with the trigger lever 6 actuated, an actuation of the tool contact element 7 is  
20 disengaged (Figures 7 and 13).

Numerous advantageous variants are conceivable for the structural design of the control element 27. In the case of the exemplary embodiment that is represented in Fig-  
25 ures 2-7, the control element 27 is designed as a pneumatically adjustable control sleeve, which is arranged concentrically in relation to the valve piston 21 of the triggering valve 20, the control sleeve 27 coming into engagement with the valve piston 21 and keeping the  
30 valve piston 21 in its intermediate position (Figure 6) when the pressure in the control volume 15 exceeds the limit value.

Alternatively, and shown in Figures 8-13, the control  
35 element 27 may be designed as a pneumatic drive piston, which runs in a drive cylinder 28 that is separate from the triggering valve 20. In the case of the exemplary

embodiment that is represented and to this extent preferred, arranged between the control element 27 and the coupling arrangement 25 is an intermediate lever 29, here and preferably an intermediate rocker 29, which is  
5 structurally simple and robust.

In the description that follows, the functioning principles of the two exemplary embodiments are explained on the basis of the single shot mode.

10

Figure 3 shows the completely unactuated state of the driving tool according to the first preferred embodiment. Working pressure is applied to the connection 12a, only indicated here, to the main valve 12, and so the  
15 main valve 12 is blocked as mentioned above.

As shown in Figure 4, an actuation of the workpiece contact element 7 leads to a pivoting of the coupling element. Operating pressure continues to be applied to the  
20 connection 12a to the main valve 12. A subsequent actuation of the trigger lever 6 brings about a further adjustment of the coupling element 26, with at the same time support on the workpiece contact element 7 in such a way that the valve piston 21 reaches its actuating position. In this position, the connection 12a to the main  
25 valve 12 is disconnected from the working pressure, which leads to the triggering of a driving-in cycle.

During the driving-in cycle, as explained above, working  
30 pressure is applied to the driving volume 13 of the working cylinder 10 by way of the main valve 12, and so the working piston 11 runs downward in Figure 2. As soon as the working piston 11 has passed the air-admitting assembly 18, the working pressure located in the driving  
35 volume 13 provides an admission of air to the control volume 15 by way of the air-admitting assembly 18. The working pressure is established in the lower valve inlet

30 of the triggering valve 20 by way of the connection 17 between the control volume 15 and the triggering assembly 5. Although working pressure is likewise applied to the upper valve inlet 21 of the triggering valve 20,  
5 the geometrical conditions of the surface areas of the control element 27 to which pressure is applied are such that the control element 27 runs upward in Figure 5 into its holding position.

10 Even if then, as shown in Figure 6, the workpiece contact element 7 assumes its unactuated position, the valve piston 21 is kept in the intermediate position shown in Figure 6 by the control element 27. For this, the control element 27 is provided with a snap ring 31  
15 and the valve piston 21 is provided with an offset 32.

In the state that is shown in Figure 6, the driving tool is in the bump firing mode, in which every actuation of the workpiece contact element 7 triggers a driving-in  
20 cycle, as long as the trigger lever 6 is actuated. With each driving-in cycle, air is newly admitted to the control volume 15, and so the control element 27 continuously keeps the valve piston 21 in the intermediate position that is shown in Figure 6.

25 Only when no driving-in cycle has been triggered over the predetermined delay time does the resetting assembly 8 transfer the driving tool into the single shot mode. This is the case when the pressure in the control volume  
30 15 goes below the pressure limit value on account of the venting of air from the control volume 15 by way of the air-venting assembly 19. In this case, the application of working pressure to the upper valve inlet 22 of the triggering valve 20 has the effect of adjusting the control element 27 into the resetting position that is represented in Figure 7. Correspondingly, the valve piston  
35 21 also falls into its starting position in a spring-

and pressure-driven manner. With the trigger lever 6 pulled, this means that the coupling assembly 25 otherwise decouples the workpiece contact element 7 from the triggering assembly 5. This can be seen from the representation according to Figure 7.

The functional principle of the second exemplary embodiment is similar in terms of effect. To this extent, only those aspects of the second exemplary embodiment that differ from the functional principle of the first exemplary embodiment are discussed below.

Like Figure 3, Figure 9 shows the completely unactuated state of the driving tool. An actuation of the workpiece contact element 7 leads to a slight adjustment of the coupling element 26 on the one hand and of the valve piston 21 of the triggering valve 20 on the other hand. Working pressure is applied to the connection 12a between the triggering valve 20 and the main valve 12, and so the main valve 12 is blocked. Only when the trigger lever 6 is additionally actuated is the working pressure no longer applied to the connection 12a to the main valve 12, which leads to a triggering of a driving-in cycle.

As in the case of the first exemplary embodiment, the driving-in cycle has the effect that air at operating pressure is admitted to the control volume 15, which results in the control element 27 being transferred from a resetting position into the holding position represented in Figure 11, by way of the connection 17. As long as the pressure in the control volume 15 is above the pressure limit value, the control element 27 is in the holding position, as shown in Figure 12. In this holding position, the control element 27 interacts by way of an intermediate lever 29, which is pre-stressed toward the control element 27 by means of an intermediate lever

spring 29a, with the coupling lever 26 in such a way that the coupling lever 26 otherwise couples the workpiece contact element 7 to the triggering assembly 5. Every actuation of the workpiece contact element 7 thus leads to the triggering of a driving-in cycle, as long as the trigger lever 6 is actuated.

Only when the pressure within the control volume 15 goes below the limit value due to the venting of air by way of the air-venting assembly 19 does the control element 27 go into its resetting position, as represented in Figure 13, in a spring- and pressure-driven manner. As a result, the intermediate lever 29 comes out of engagement with the coupling element 26, which falls into the position that is represented in Figure 13. This has the effect that the workpiece contact element 7 is otherwise decoupled from the triggering assembly 5, and so, with the trigger lever 6 actuated, an actuation of the workpiece contact element 7 is disengaged. The driving tool has thus been transferred by means of the resetting assembly 8 from the bump firing mode into the single shot mode.

According to a further teaching, which is likewise of independent significance, a driving tool for driving in fastening means 1 is claimed. An actuator unit 3 is provided, by means of which the fastening means 1 can be driven into the workpiece W in driving-in cycles, a triggering assembly 5 being provided, by means of which the driving-in cycles of the actuator unit 3 can be triggered. The triggering assembly 5 has a trigger lever 6, which can be actuated manually, and a workpiece contact element 7, which can be actuated by placing the driving tool onto the workpiece W.

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As explained above, the driving tool can be operated in a single shot mode and in a bump firing mode. Also pro-

vided is a resetting assembly 8, which can be activated in the bump firing mode and, after a delay time starting from the activation, has the effect of transferring the driving tool from the bump firing mode into the single  
5 shot mode.

What is essential according to this further teaching is that the resetting assembly 8 has a control volume 15, the resetting assembly 8 having a pneumatically adjustable control element 27, which is pneumatically coupled  
10 to the control volume 15, the control element 27 interacting with the triggering assembly 5 when the pressure in the control volume 15 goes below a limit value in such a way that, with the trigger lever 6 actuated, ac-  
15 tuation of the tool contact element 7 is disengaged.

Reference may be made to all statements that have been made, in particular the statements made in relation to the design of the control element 27, this further  
20 teaching not necessarily relying on the resetting assembly 8 being coupled to the actuator unit 3 in such a way that, in the bump firing mode, a driving-in cycle activates the resetting assembly 8.

**Patent claims**

1. A driving tool for driving fastening means (1), in particular nails or staples, into a workpiece (W), an actuator unit (3) being provided, by means of which the fastening means (1) can be driven into the workpiece (W) in driving-in cycles, a triggering assembly (5) being provided, by means of which the driving-in cycles of the actuator unit (3) can be triggered, the triggering assembly (5) having a trigger lever (6), which can be actuated manually, and a workpiece contact element (7), which can be actuated by placing the driving tool onto the workpiece (W) , the driving tool being able to operate in a single shot mode, in which each individual sequence of an actuation of the workpiece contact element (7) with subsequent actuation of the trigger lever (6) triggers a driving-in cycle, the driving tool being able to operate in a bump firing mode, in which, with the trigger lever (6) continuously actuated, each individual actuation of the workpiece contact element (7) triggers a driving-in cycle, a resetting assembly (8) being provided, which can be activated in the bump firing mode and, after a delay time starting from the activation, has the effect of transferring the driving tool from the bump firing mode into the single shot mode,

**characterized in that**

the resetting assembly (8) is coupled to the actuator unit (3) in such a way that, in the bump firing mode, a driving-in cycle activates the resetting assembly (8).

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2. The driving tool as claimed in claim 1, characterized in that the actuator unit (3) has a driving punch (9), which during the driving-in cycle performs a linear driving-in movement and drives the fastening means (1) in and subsequently performs a return movement and in that the resetting assembly (8) is coupled to the driv-

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ing punch (9), or to a component connected thereto, for activation and/or in that the actuator unit (3) has a working cylinder (10), in which a working piston (11) connected to the driving punch (9) runs, and in that the  
5 resetting assembly (8) is coupled to the working cylinder (10), the driving punch (9) or the working piston (11) for activation.

3. The driving tool as claimed in claim 1 or 2, characterized in that the driving tool is designed as a compressed-air driving tool and in that the resetting assembly (8) is pneumatically coupled to the actuator unit (3), in particular to a working cylinder (10) of the actuator unit (3), preferably in that a main valve (12) is  
10 provided, and in that the main valve (12), triggered by the triggering assembly (5), admits air at a working pressure to a driving volume (13) of the working cylinder (10) for triggering a driving-in cycle and, after the driving-in movement of the driving punch (9), air is  
15 vented from the driving volume (13) of the working cylinder (10), in particular against atmospheric pressure.  
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4. The driving tool as claimed in one of the preceding claims, characterized in that the resetting assembly (8) has a control volume (15), which is pneumatically coupled to the working cylinder (10) on the one hand and to the triggering assembly (5) on the other hand, preferably in that, during the driving-in cycle, in particular during at least part of the driving-in movement of the  
30 driving punch (9), air at working pressure is admitted to the control volume (15) by way of the working cylinder (10) and in that, after the driving-in movement of the driving punch (9), air is vented from the control volume (15) by way of the working cylinder (10), in particular  
35 against atmospheric pressure.

5. The driving tool as claimed in claim 4, character-

ized in that, for admitting air to the control volume (15), an air-admitting assembly (18) is provided in the wall of the working cylinder (10), preferably in that, for venting air from the control volume (15), an air-venting assembly (19) is provided in the wall of the working cylinder (10), more preferably in that at least the air-admitting assembly (18) is designed in the manner of a check valve.

6. The driving tool as claimed in claim 4 or 5, characterized in that the control volume (15) is assigned a pressure limit value, in that the driving tool remains in the bump firing mode when the pressure is above the limit value, by way of the pneumatic coupling to the triggering assembly (5), and in that a fall in the pressure below the limit value defines the elapse of the delay time and has the effect of transferring the driving device into the single shot mode, by way of the pneumatic coupling to the triggering assembly (5).

7. The driving device as claimed in one of the preceding claims, characterized in that the triggering assembly (5) has a triggering valve (20) with a valve piston (21), which can be actuated from a starting position into an actuating position, in which the triggering valve (20) has the effect of admitting air at working pressure to the driving volume (13) of the working cylinder (10), if appropriate by way of a main valve (12).

8. The driving tool as claimed in one of the preceding claims, characterized in that the triggering assembly (5) has a coupling assembly (25), which, with the trigger lever (6) actuated, provides a coupling or disengagement between the tool contact element (7) and the valve piston (21), depending on the position of the valve piston (21), preferably in that the valve piston (21) can be brought into an intermediate position, in

which, with the trigger lever (6) actuated, an actuation of the tool contact element (7) has the effect of adjusting the valve piston (21) into the actuating position.

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9. The driving tool as claimed in claim 8, characterized in that, with the trigger lever (6) not actuated, the workpiece contact element (7) interacts with the coupling assembly (25), in particular with the coupling element (26) of the coupling assembly (25), in such a way that an actuation of the trigger lever (6) following the actuation of the workpiece contact element (7) has the effect of adjusting the valve piston (21) into the actuating position.

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10. The driving tool as claimed in claim 8 or 9, characterized in that the coupling assembly (25) has a pivotable coupling element (26), which is pivotably mounted on the trigger lever (6).

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11. The driving tool as claimed in one of the preceding claims, characterized in that the resetting arrangement (8) has a pneumatically adjustable control element (27), which is pneumatically coupled to the control volume (15) and, when the pressure in the control volume (15) is above the limit value, interacts with the valve piston (21) and/or the coupling assembly (25) in such a way that, with the trigger lever (6) actuated, an actuation of the tool contact element (7) actuates the valve piston (21) into its actuating position and, when the pressure in the control volume (15) goes below a limit value, interacts with the valve piston (21) and/or the coupling assembly (25) in such a way that, with the trigger lever (6) actuated, an actuation of the tool contact element (7) is disengaged.

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12. The driving tool as claimed in one of the preceding

claims, characterized in that the control element (27) is designed as a pneumatically adjustable control sleeve (27), which is arranged concentrically in relation to the valve piston (21) of the triggering valve (20) and which comes into engagement with the valve piston (21) and keeps the valve piston (21) in its intermediate position when the pressure exceeds the limit value.

13. The driving tool as claimed in one of the preceding claims, characterized in that the control element (27) is designed as a pneumatic drive piston, which runs in a drive cylinder that is separate from the triggering valve (20), preferably in that arranged between the control element (27) and the coupling assembly (25) is an intermediate lever (29), in particular an intermediate rocker.

14. A driving tool for driving fastening means (1), in particular nails or staples, into a workpiece (W), an actuator unit (3) being provided, by means of which the fastening means (1) can be driven into the workpiece (W) in driving-in cycles, a triggering assembly (5) being provided, by means of which the driving-in cycles of the actuator unit (3) can be triggered, the triggering assembly (5) having a trigger lever (6), which can be actuated manually, and a workpiece contact element (7), which can be actuated by placing the driving tool onto the workpiece (W), the driving tool being able to operate in a single shot mode, in which each individual sequence of an actuation of the workpiece contact element (7) with subsequent actuation of the trigger lever (6) triggers a driving-in cycle, the driving tool being able to operate in a bump firing mode, in which, with the trigger lever (6) continuously actuated, each individual actuation of the workpiece contact element (7) triggers a driving-in cycle, a resetting assembly (8) being provided, which can be activated in the bump firing mode

and, after a delay time starting from the activation, has the effect of transferring the driving tool from the bump firing mode into the single shot mode,

**characterized in that**

5 the resetting assembly (8) has a control volume (15), in that the resetting assembly (8) has a pneumatically adjustable control element (27), which is pneumatically coupled to the control volume (15), and in that the control element (27) interacts with the triggering assembly  
10 when the pressure in the control volume (15) goes below a limit value in such a way that, with the trigger lever (6) actuated, actuation of the tool contact element (7) is disengaged.

15 15. The driving tool as claimed in claim 14, characterized in that the triggering assembly (5) has a triggering valve (20) with a valve piston (21), which can be actuated from a starting position into an actuating position, in which the triggering valve (20) admits air at  
20 working pressure to the driving volume (13) of the working cylinder (10), if appropriate by way of a main valve (12), preferably in that the control element is designed as a pneumatically adjustable control sleeve (27), which is arranged concentrically in relation to the valve piston (21) of the triggering valve (20) and comes into en-  
25 gagement with the valve piston and keeps the valve piston (21) in its intermediate position when the pressure goes below the limit value, or in that the control element (27) is designed as a pneumatic drive piston, which  
30 runs in a drive cylinder (28) that is separate from the triggering valve (20).

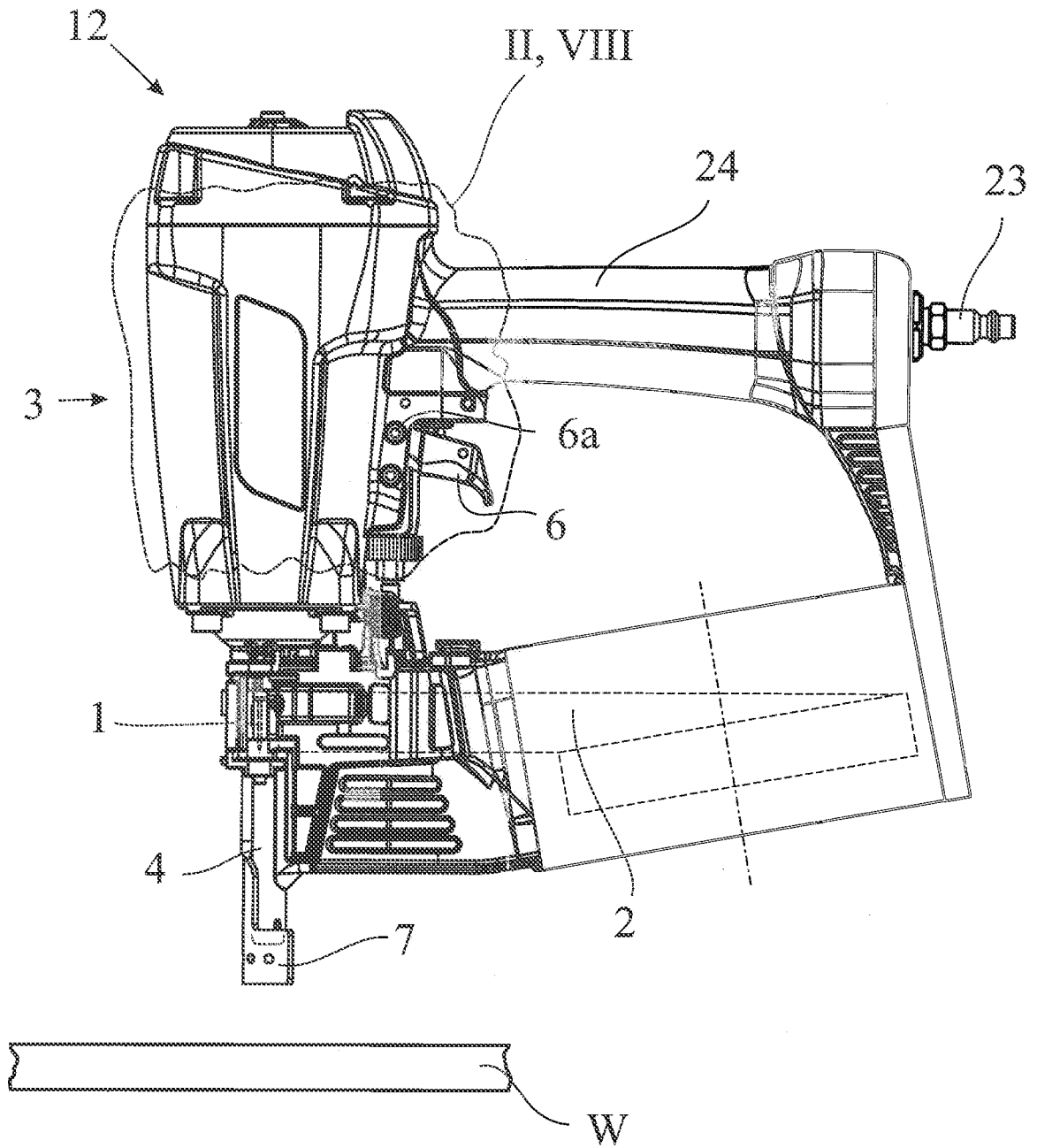
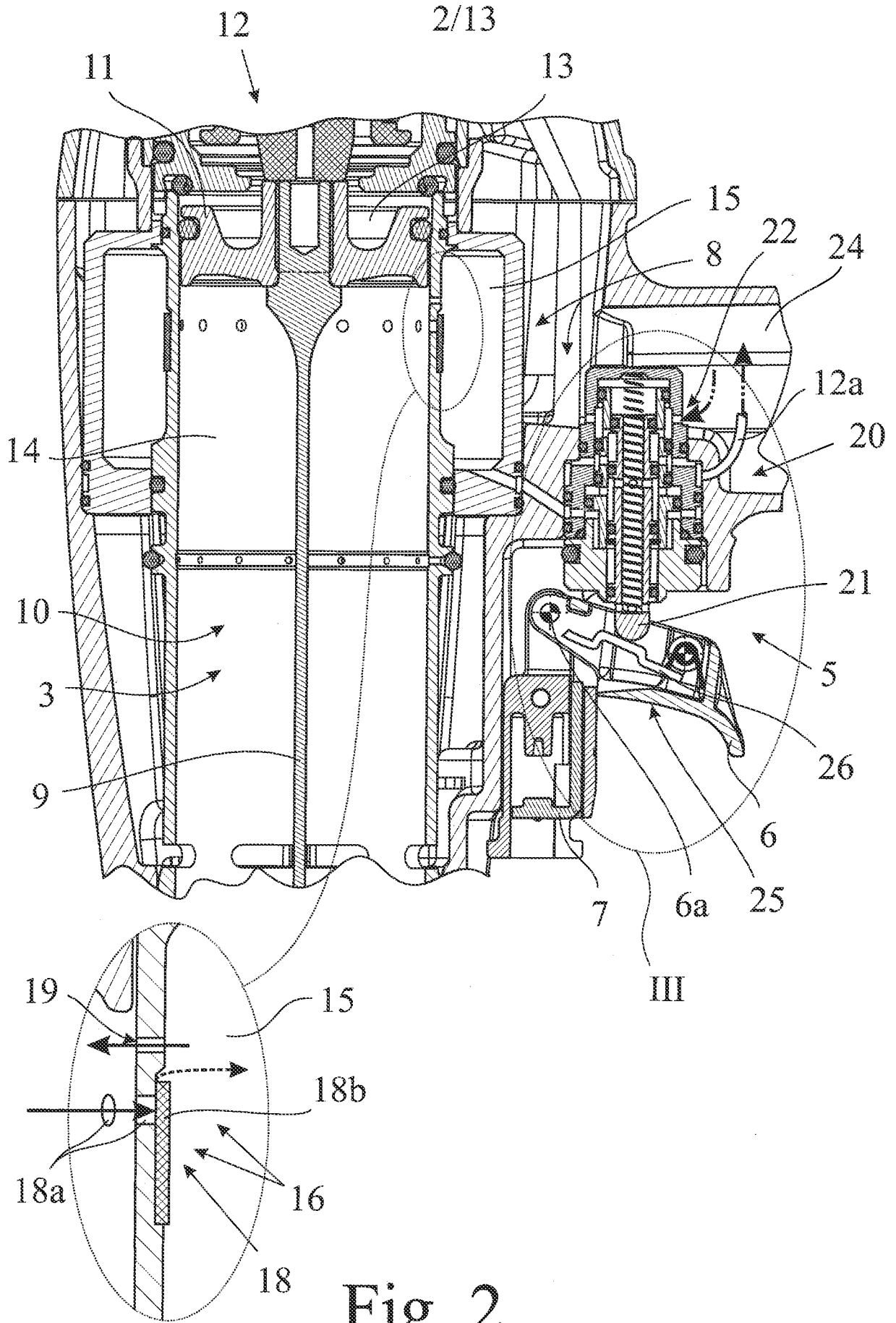


Fig. 1



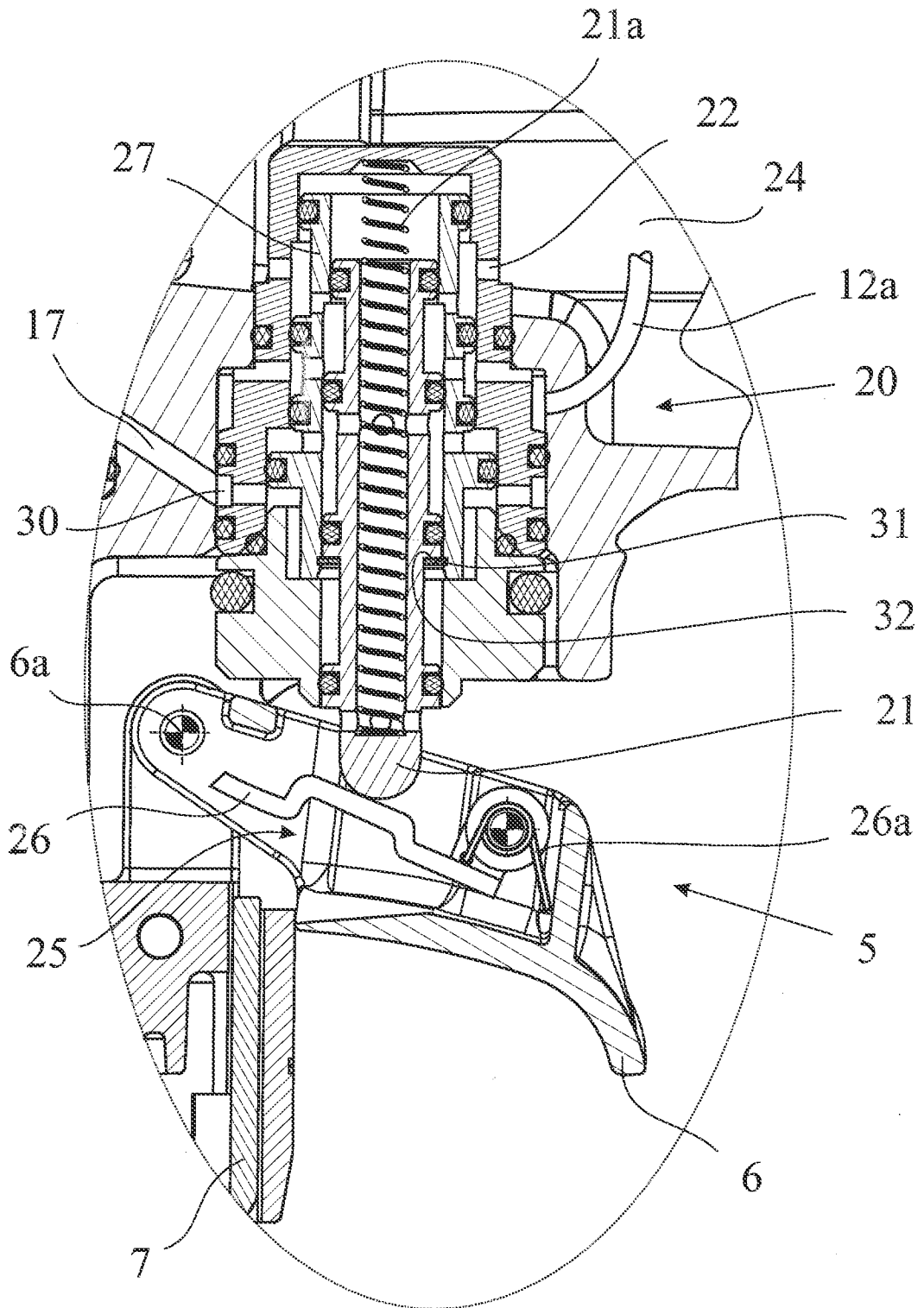


Fig. 3

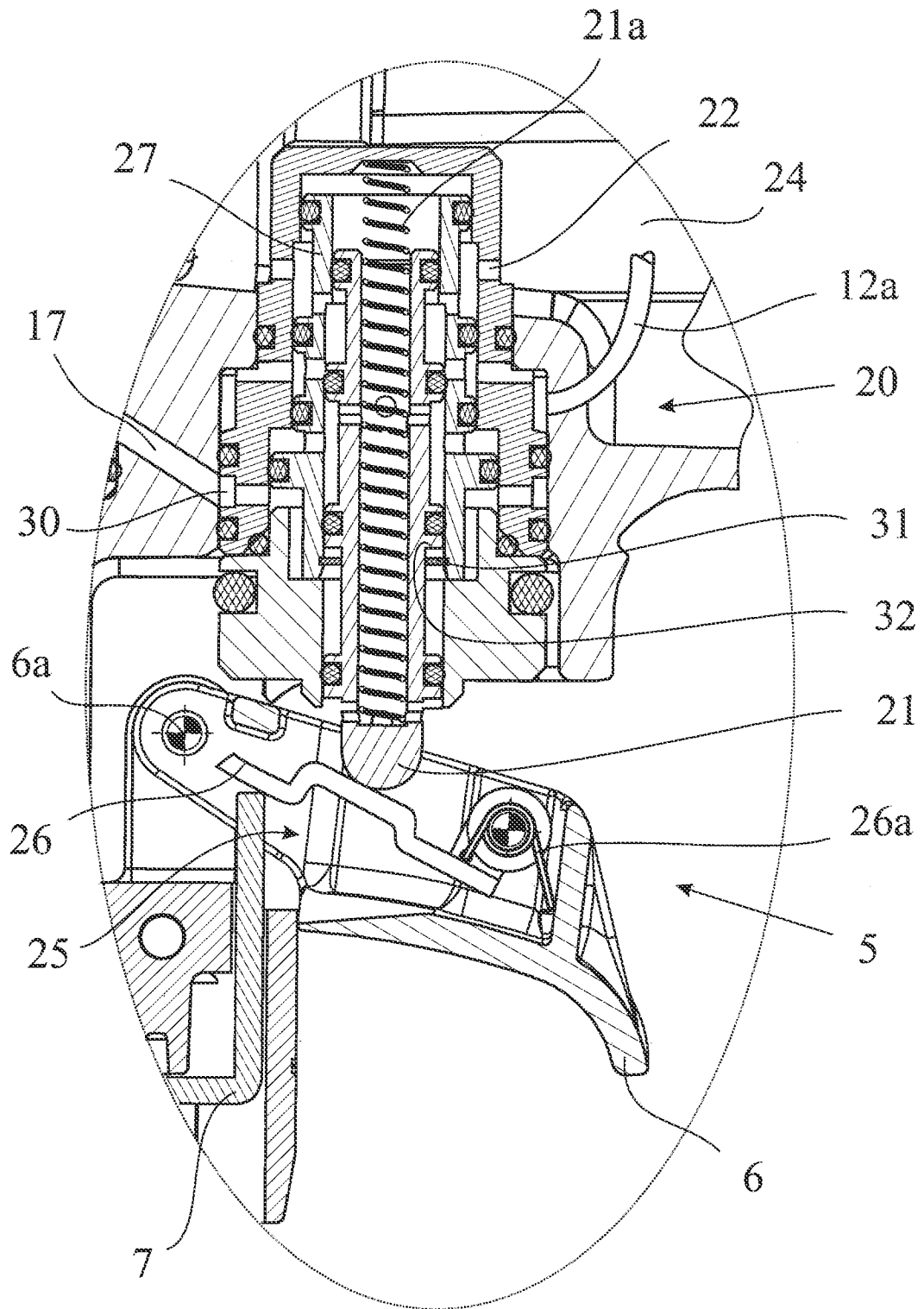


Fig. 4

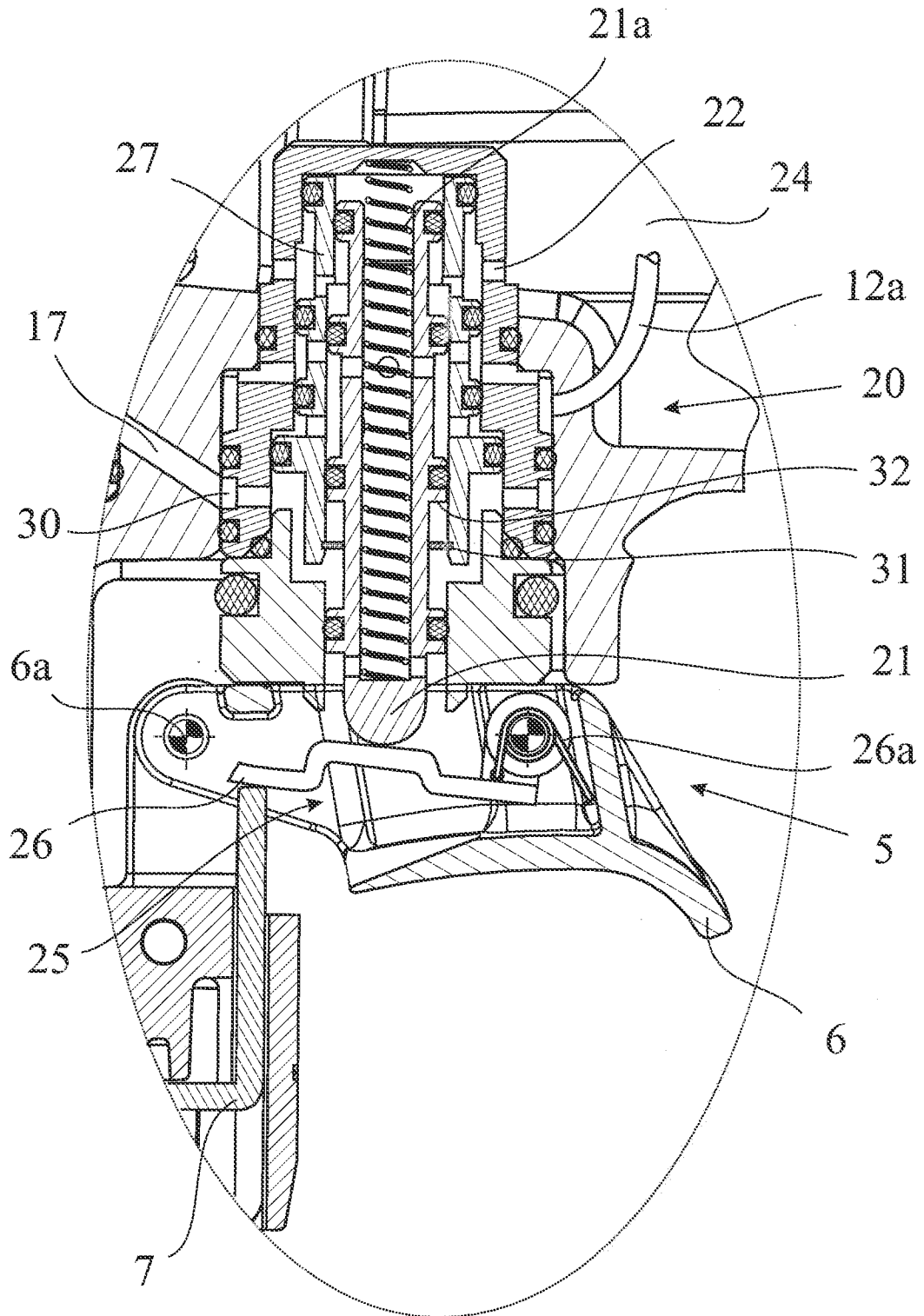


Fig. 5

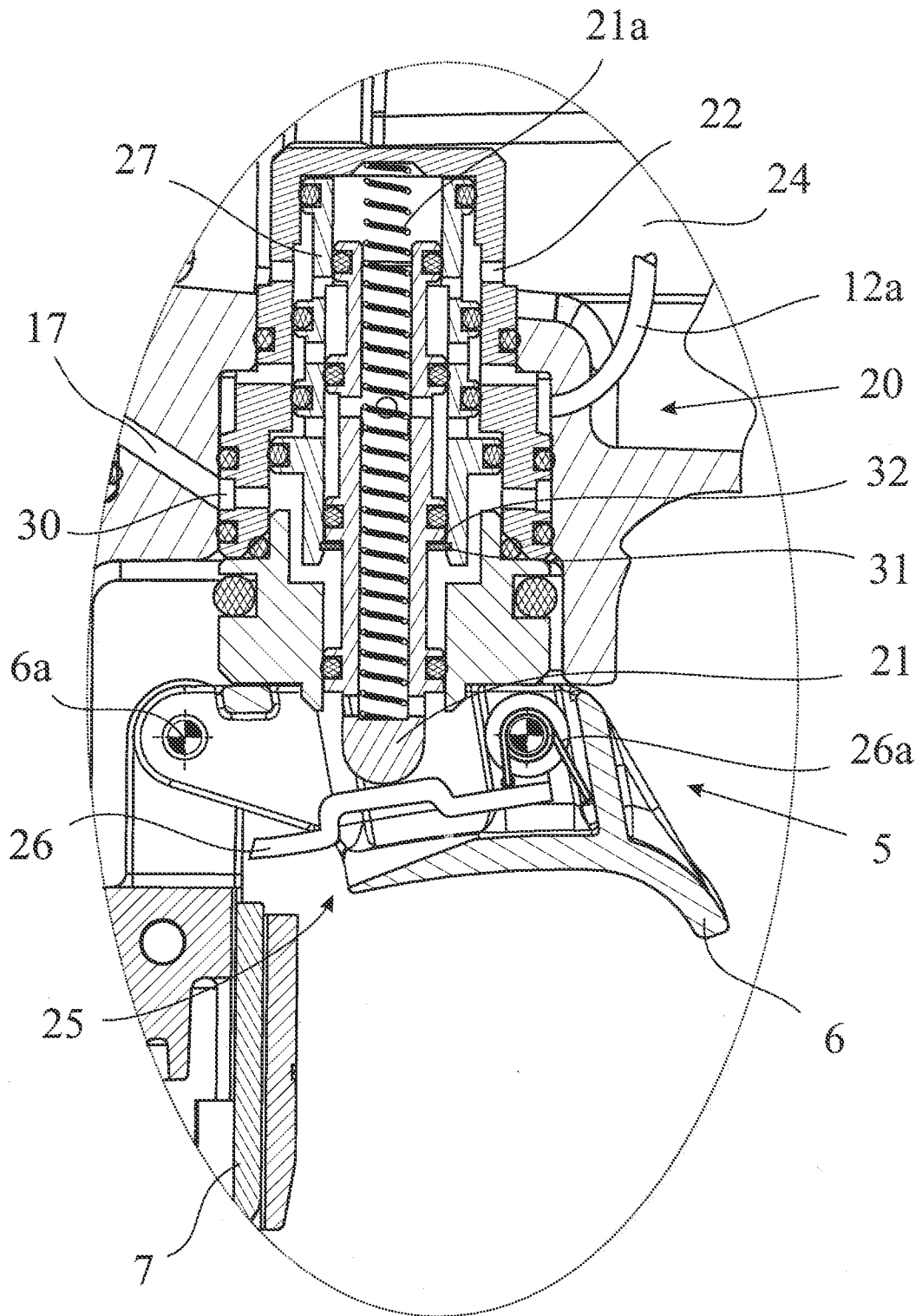


Fig. 6

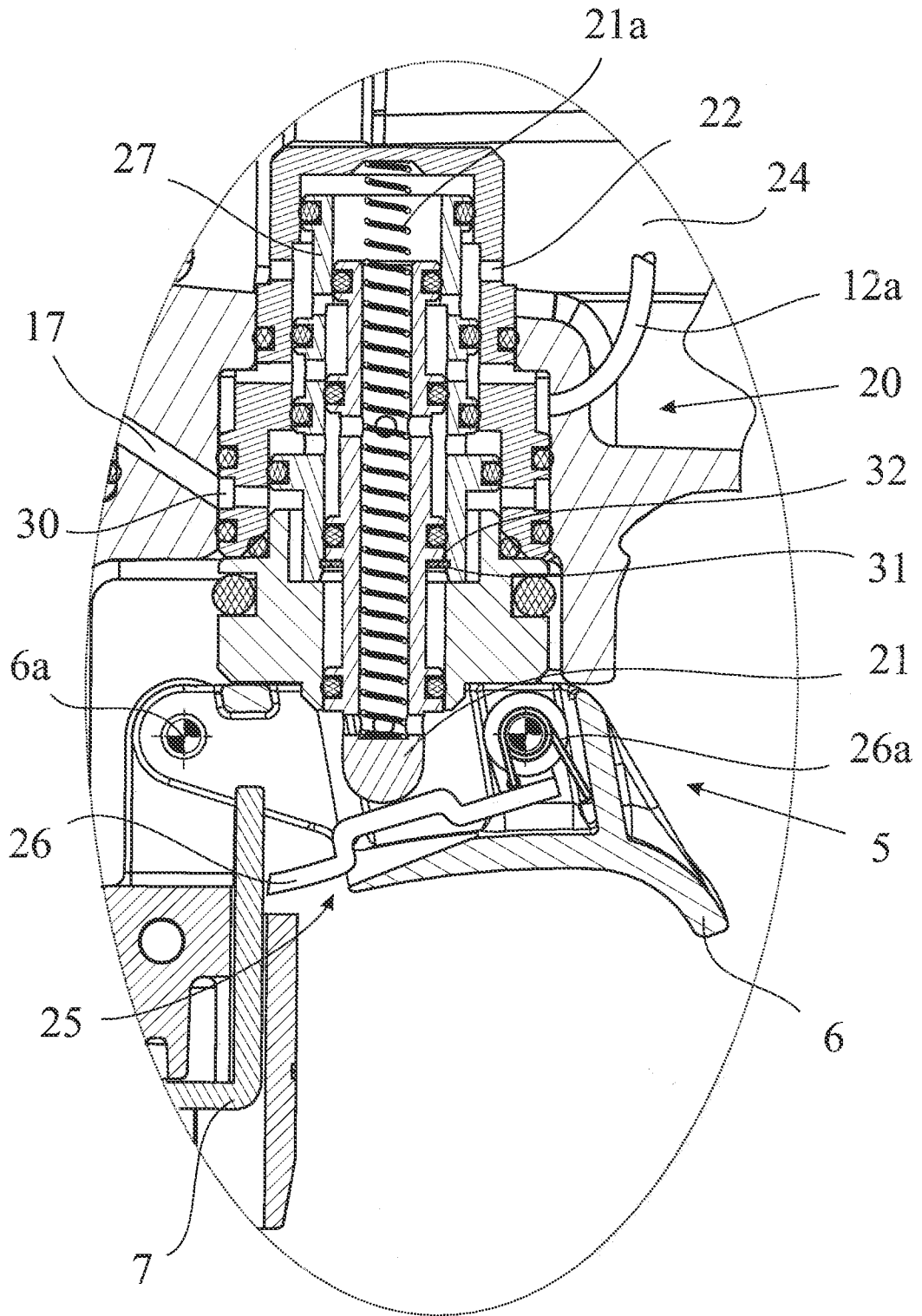


Fig. 7

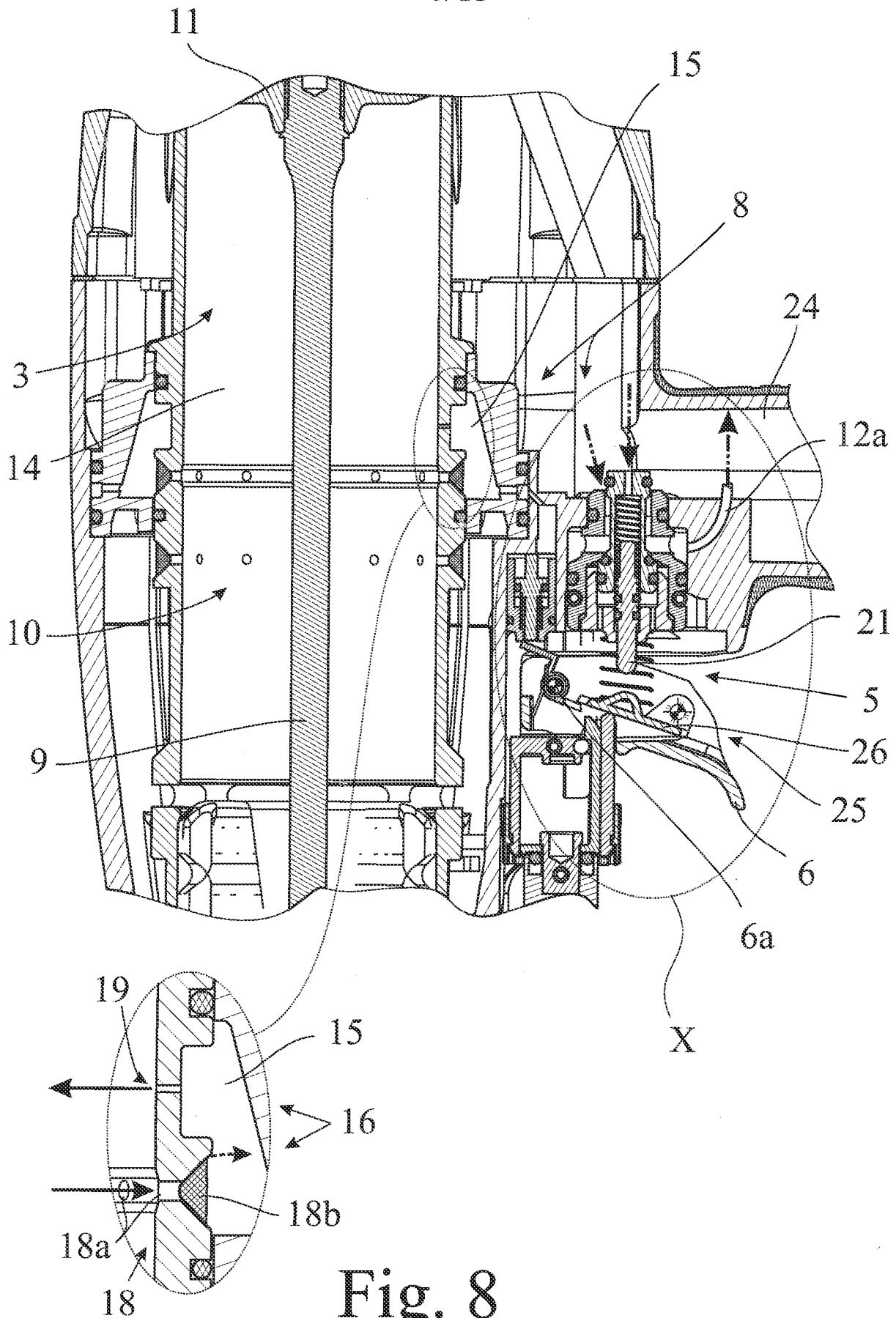


Fig. 8

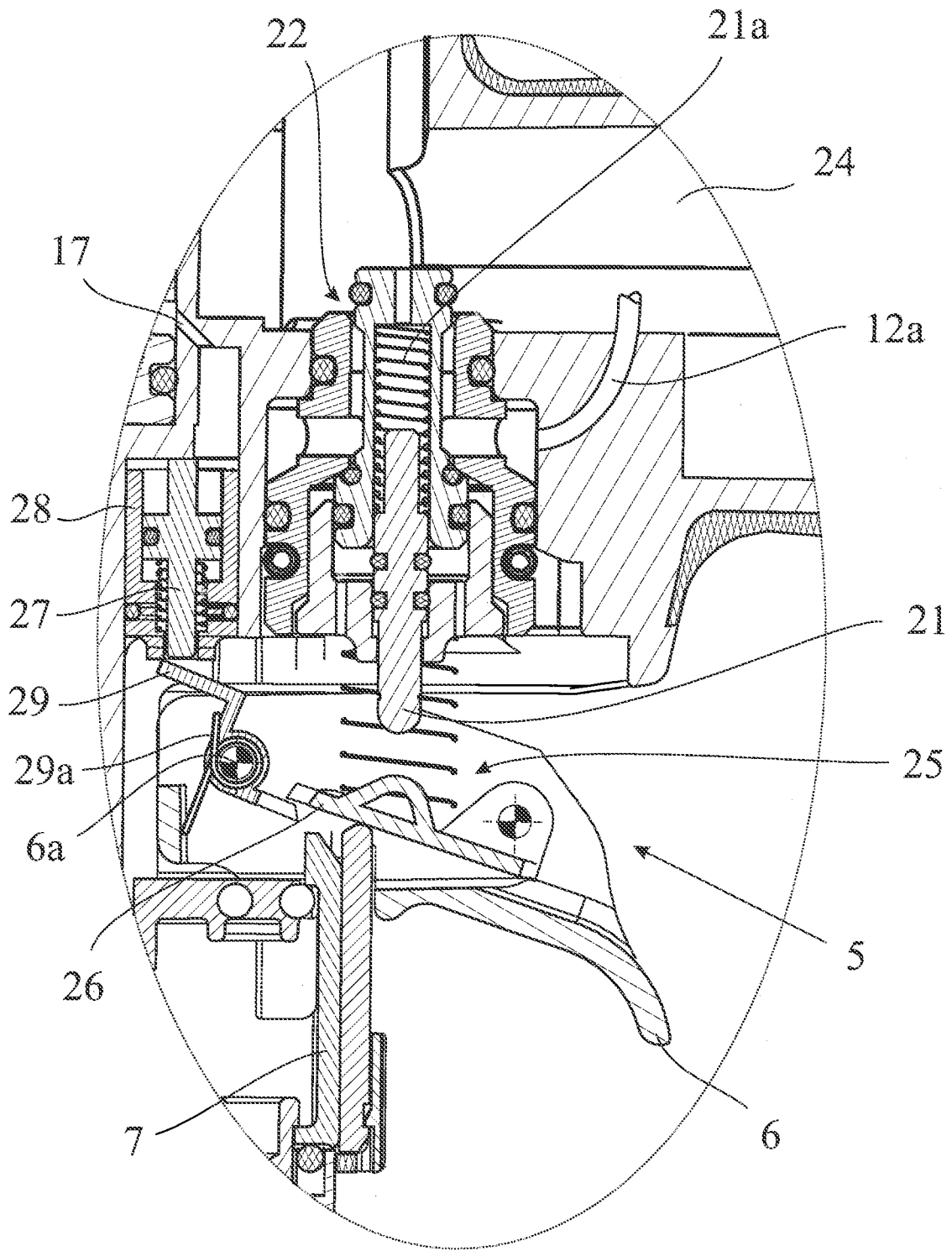


Fig. 9

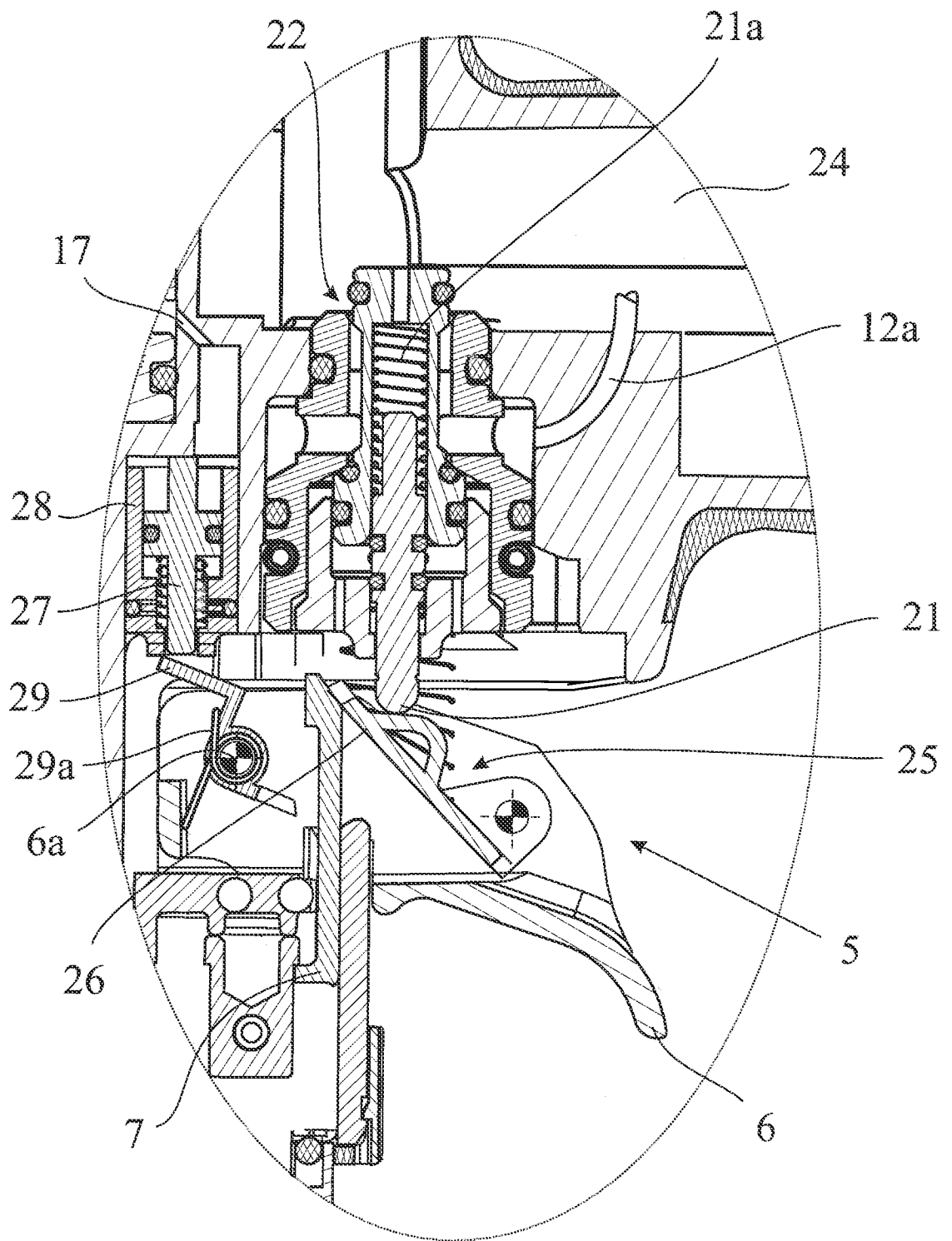


Fig. 10

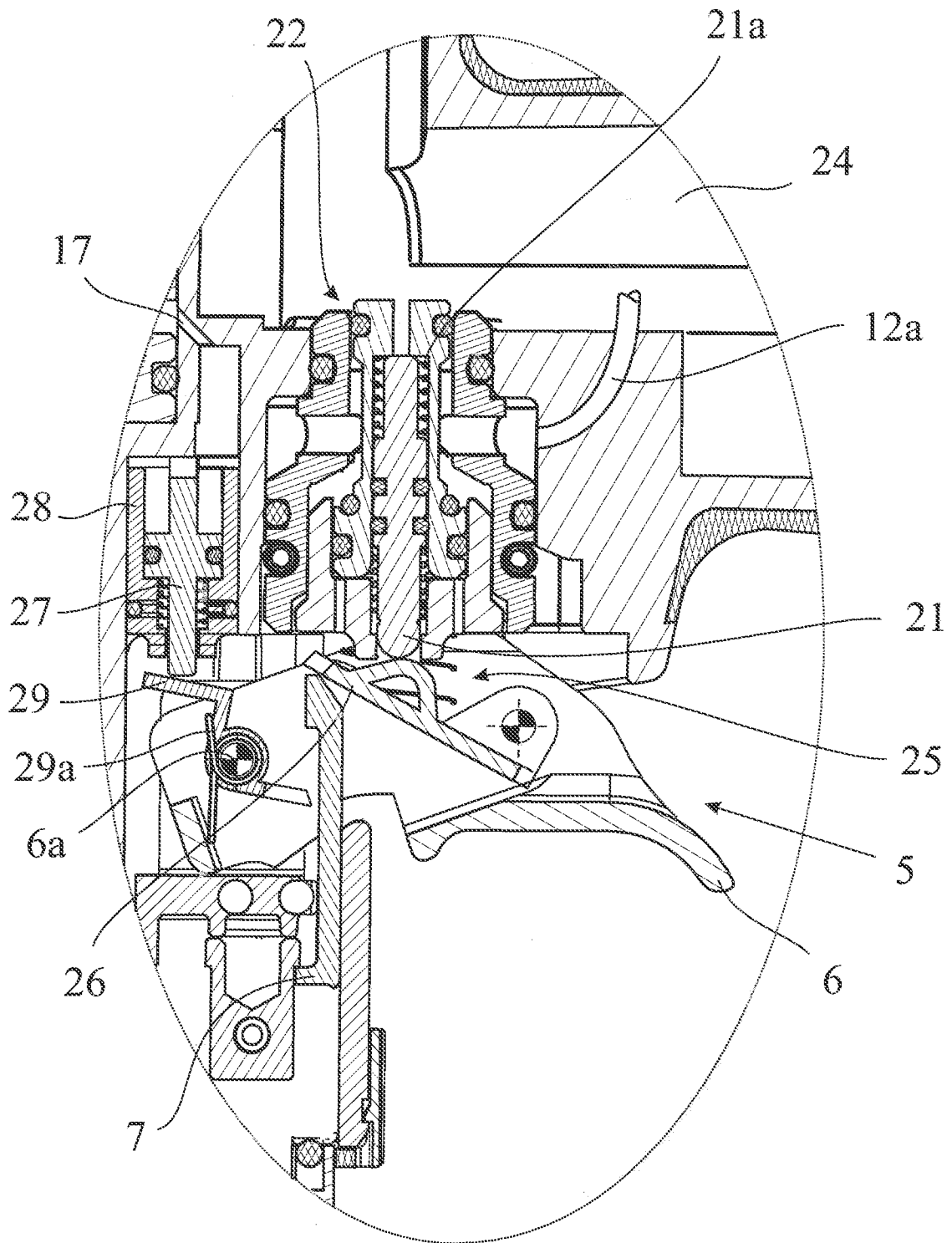


Fig. 11

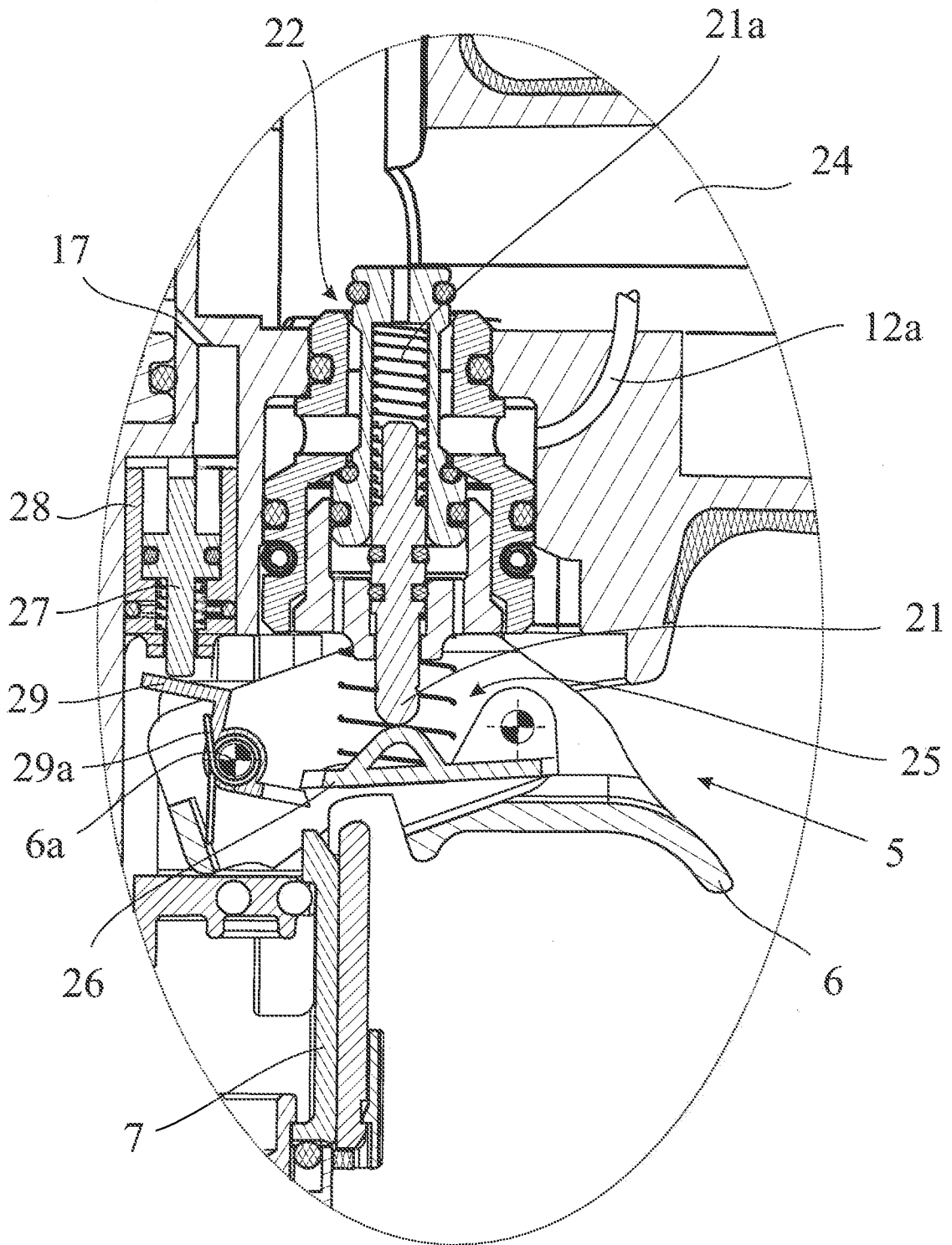


Fig. 12

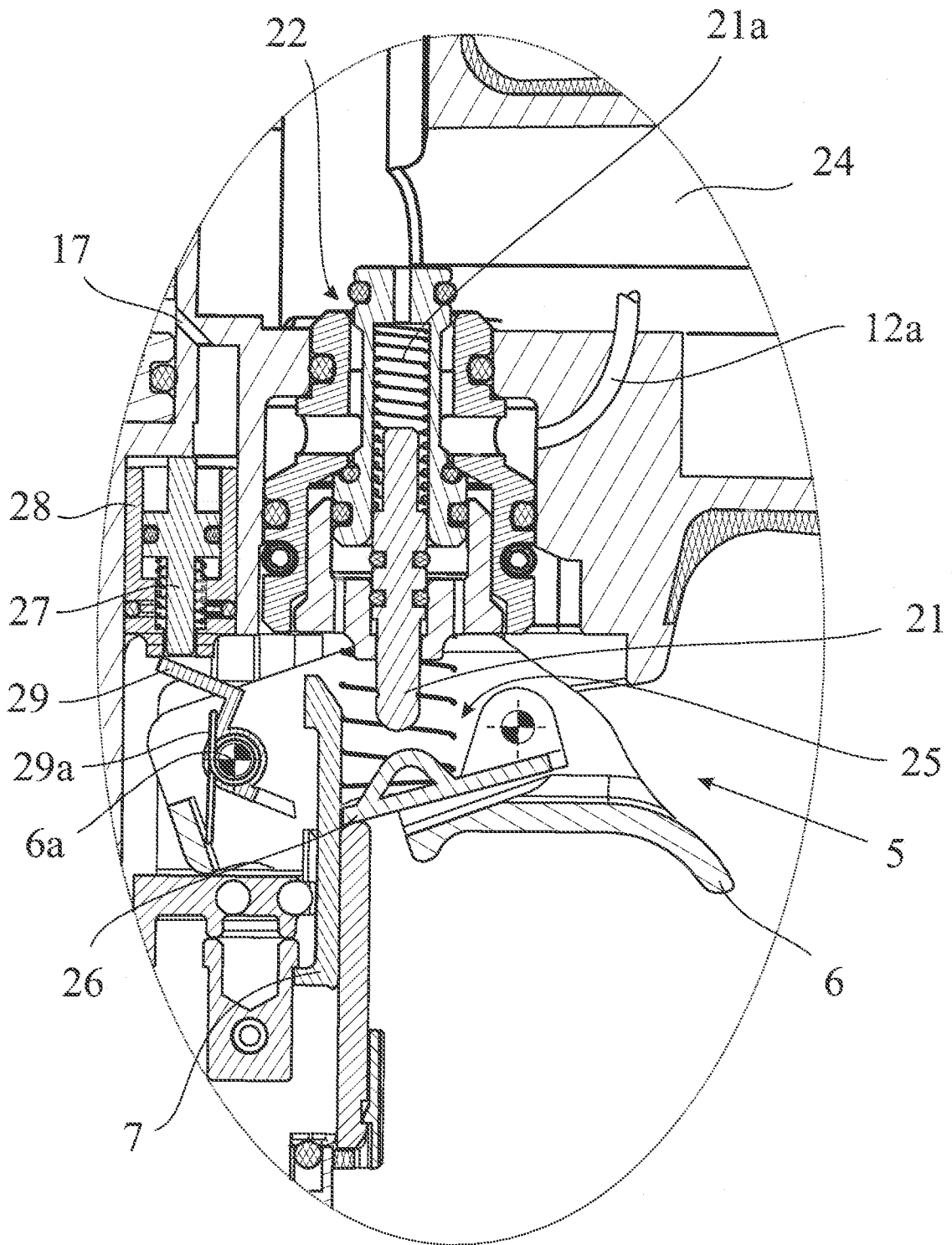


Fig. 13

**INTERNATIONAL SEARCH REPORT**

International application No  
PCT/US2014/035111

A. CLASSIFICATION OF SUBJECT MATTER  
INV. B25C1/00  
ADD.  
  
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED  
Minimum documentation searched (classification system followed by classification symbols)  
B25C B25F  
  
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
EPO-Internal, WPI Data

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 604 664 B2 (ROBINSON JAMES W [US]) 12 August 2003 (2003-08-12) cited in the application	14,15
A	the whole document	1-13
A	----- US 2005/217874 A1 (FORSTER MICHAEL [US] ET AL) 6 October 2005 (2005-10-06) the whole document	1,14
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Further documents are listed in the continuation of Box C.       See patent family annex.

\* Special categories of cited documents :

<p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p>	<p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&amp;" document member of the same patent family</p>
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Date of the actual completion of the international search  4 August 2014	Date of mailing of the international search report  11/08/2014
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer  Dewaele, Karl
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# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/035111

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6604664	B2	12-08-2003	
		AU 778985 B2	23-12-2004
		AU 9727701 A	18-07-2002
		CA 2364772 A1	16-07-2002
		EP 1223009 A2	17-07-2002
		JP 2002254348 A	10-09-2002
		NZ 516314 A	25-07-2003
		US 2002125290 A1	12-09-2002
-----			
US 2005217874	A1	06-10-2005	
		EP 1733408 A2	20-12-2006
		US 2005217874 A1	06-10-2005
		US 2009183888 A1	23-07-2009
		US 2013240229 A1	19-09-2013
		WO 2005098885 A2	20-10-2005
-----			