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(54) **CONNECTION APPARATUS FOR INTERCONNECTING AN ARM AND A TOOL OF A WORK MACHINE**

(57) A quick coupling (250) of a tool (U) to an arm of a heavy machine. The quick coupling (250) comprises a main body (252), substantially box-shaped, provided with an inner compartment (253) containing an actuator device (275) of at least one bolt element (270) adapted to engage with a complementary element (102) provided on an adapter (100) integral with the tool (U). The quick coupling (250) is characterized in that the bolt element

(270) is shaped so as to receive therein a double-acting hydraulic actuation system (275) adapted to move this bolt element (270) forward from a retracted disengaged position to an extended position engaged with an element (102) of the adapter (100), so that the thrust exerted by the hydraulic actuation system (275) has an operating axis substantially coincident with a longitudinal axis (X) of the bolt element (270). (Fig. 4)

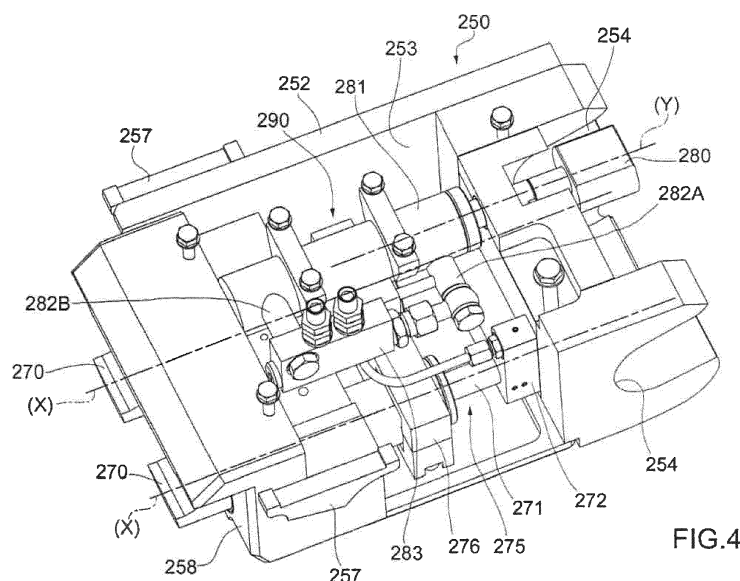


FIG.4

Description

[0001] The present invention concerns the field of mechanical connections and relates to a quick coupling, and to the related connection apparatus, of a tool to an operating arm. In general, connection apparatus of the type forming the subject matter of the present invention is adapted to connect mechanical elements of various kinds, and is particularly suitable to connect, mechanically and in a removable manner, a bucket, or another tool for demolition, for earth movement, for the care of green spaces and the like to an arm or to a support of a heavy machine, such as a tractor or a bulldozer.

DESCRIPTION OF THE STATE OF THE ART

[0002] There is known in the art apparatus destined to reversibly connect tools, such as buckets and impact hammers for demolition, to operating supports, such as the articulated arms of self-propelled machines for earth movement, demolition or the like.

[0003] This prior art connection apparatus is provided with a first member stably connected to the tool and with a second member stably connected to the mechanical arm.

[0004] In general, one side of a member is provided with a transverse pin for coupling a corresponding side of the other member.

[0005] It is thus possible to couple and release the hooks of one member to/from the pin of the other. In the coupled position, the two members can rotate mutually like a hinge. To block this rotation, preventing release and to produce the connection between the two members, one of these members is equipped with one or more bolts, which slide between a first released configuration and a second configuration locking the two members together.

[0006] Operation of the sliding bolts can be implemented through elastic elements (springs) or mechanical (actuator screws) or hydraulic actuators. However, each of the devices known in the art currently in use has drawbacks.

[0007] In fact, the use of elastic elements to block the moving member results in the need to use a further mechanism adapted to perform disengagement of the sliding bolts from the locking surfaces when wishing to disconnect the two elements. This mechanism can in turn be manually or hydraulically actuated.

[0008] However, in each of the current systems, the operating axis of the insertion and/or extraction forces is in any case offset relative to the operating axis of the bolts.

[0009] The presence of this offset between the axes, in apparatus currently available on the market, can cause binding during the steps of engagement or disengagement of the bolts. This binding can be very damaging to the operation of the connection device and could cause the tool to be with loss of stability of the connection if were

to occur during the step of engagement of the bolts; or, if were to occur during disengagement of the bolts, it could prevent disconnection of the tool from the arm.

[0010] Therefore, the main object of the present invention is the creation of a quick coupling with none of the problems described above and that is also easy and cost-effective to manufacture. A further object of the present invention is to provide a connection apparatus, comprising a quick coupling of the aforesaid type, which has none of the problems listed above.

[0011] Therefore, according to the present invention, there are provided a quick coupling and a connection apparatus as claimed in the independent claims or in any one of the dependent claims depending directly or indirectly on the independent claims.

[0012] In greater detail, it can be said that in the connection apparatus forming the subject matter of the present invention both the operating axis of the engagement forces and that of disengagement coincide with the movement axis of the bolts, as the hydraulic actuating cylinder has been incorporated inside at least one locking bolt.

[0013] Moreover, in order to increase the degree of safety of the connection device, further measures have been introduced, aimed at minimizing, or totally eliminating, the possibility of malfunction or breakage of any component of the device causing detachment of the tool from the operating arm. For this purpose, there has been inserted inside the quick coupling an auxiliary locking device provided with an operating axis parallel to that of the locking bolts, but which moves in the opposite direction.

[0014] In the case in hand, when the bolts for coupling and locking of the tool are operated simultaneously, the hydraulic cylinder of the aforesaid auxiliary locking device is operated to insert an auxiliary locking device capable of preventing disengagement of a transverse pin of the adapter from a slot of the quick coupling.

[0015] If, for any reason, the coupling bolts fail to produce safe locking of the tool, this latter would still be connected to the arm via the aforesaid auxiliary locking device and could not disengage and consequently create a hazard for the operators.

[0016] As will be more apparent below, the movement to make safe the auxiliary locking device is also favored by the presence of a spring inside the hydraulic cylinder thereof. This spring ensures extension of the auxiliary locking element in all conditions and therefore prevents disengagement of the slot from one of the transverse pins of the adapter, when, for any reason, the hydraulic supply to the cylinder is absent.

[0017] It should be noted that in the event of any malfunction that causes the loss of hydraulic pressure, even with the tool disconnected, the spring would in turn cause insertion of the auxiliary locking device, which, in this configuration, would prevent the transverse pin of the adapter from entering the slot of the quick coupling, making the malfunction evident and preventing use of the connection apparatus without the necessary safety.

[0018] Finally, between the hydraulic system of the quick coupling and the external hydraulic oil supply pipes there is interposed a check valve, pilot-operated to ensure that there are no uncontrolled movements inside the quick coupling in the event of breakage of or damage to the hydraulic oil supply line.

BRIEF DESCRIPTION OF THE FIGURES

[0019] For better understanding of the present invention, there are now described some preferred embodiments, provided purely by way of non-limiting example and with reference to the accompanying drawings, wherein:

- Fig. 1 illustrates a first three-dimensional configuration of a connection apparatus produced according to the dictates of the present invention;
- Fig. 2 shows a second three-dimensional configuration of the connection apparatus of Fig. 1;
- Fig. 3 illustrates a third and last three-dimensional configuration of the connection apparatus shown in Figs. 1 and 1; in this configuration the connection apparatus is fully inserted;
- Fig. 4 shows a three-dimensional view of a quick coupling, further subject matter of the present invention, which is a part of the connection apparatus illustrated in Figs. 1, 2 and 3;
- Fig. 5 illustrates an exploded view of the quick coupling of Fig. 4;
- Fig. 6 shows a partly sectional three-dimensional view of a bolt used in the quick coupling of Figs. 4 and 5;
- Fig. 7 illustrates a partly sectional three-dimensional view of an auxiliary locking device, which belongs to the quick coupling shown in Figs. 4, and 5; and
- Fig. 8 shows the hydraulic circuit that drives the various devices belonging to the quick coupling of Figs. 4 and 5.

DETAILED DESCRIPTION OF SOME EMBODIMENTS OF THE PRESENT INVENTION

[0020] With reference to Figs. 1 to 3, the numeral 100 indicates as a whole a connection apparatus between a tool (U) and an operating arm (not shown).

[0021] Incidentally, it must be stated that although in the present figures the tool (U) is a bucket, this tool (U) can be any other tool for demolition, for earth movement, for the care of green spaces and the like.

[0022] The connection apparatus 100 in turn comprises first coupling means 100 to the tool (U), and second coupling means 200 to the operating arm (not illustrated).

[0023] The first coupling means 100 to the tool (U) comprise two mutually parallel ribs 101.

[0024] At the ends of the two ribs 101 there are welded two transverse pins 102, each of which is provided with a respective groove 102A for engaging a respective bolt

(see below).

[0025] The assembly of the two ribs 101, of the two transverse pins 102 and of a base plate 103 form the aforesaid first coupling means 100, also referred to as "adapter".

[0026] For example, this adapter 100 is fastened to the tool (U) by welding.

[0027] As shown again in Figs. 1 to 3, the second coupling means 200 comprise, in turn, a quick coupling 250, to which there are fastened two ribs 260 having mechanical means that allow coupling thereof with the arm of the heavy machine.

[0028] We shall now describe in greater detail the quick coupling 250 that, as already stated, represents one of the subject matters of the present invention.

[0029] The quick coupling 250 is shown in particular in Figs. 4 and 5, and comprises a main body 252, substantially box-shaped, inside which there is produced an inner compartment 253 provided with specific seats for housing the devices required for its operation.

[0030] The main body 252 is substantially shaped as a hollow rectangular parallelepiped. On each of the lower sides of the parallelepiped there is provided a fork-shaped seat 254 adapted to couple, in use with one of the two transverse pins 102 of the adapter 100 (Figs. 1, 2 and 3).

[0031] As shown in Fig. 5, the inner compartment 253, in use, is closed at the top by an upper cover 255, which is sized to engage in a rectangular slot 255' produced in an upper face 252' of the main body 252; moreover, the inner compartment 253 is closed at the bottom by a lower cover 256, also sized to engage in a rectangular slot 256'.

[0032] On the two longer sides of the main body 252 there are fastened, with known methods, two lateral abutments 257 selected as a function of the width of the adapter 100 to which the quick coupling 250 is to be coupled. Two through holes 258A pass through a first lower side 258, while a single through hole 259A passes through a second lower side (opposite the first lower side 258).

[0033] As will be more apparent below, a related bolt 270 passes through each through hole 258A, while an auxiliary locking element 280, which is part of an auxiliary locking device 290, better described below, protrudes outward from the through hole 259. It is considered useful to specify that the auxiliary locking device 290 is an integral part of the quick coupling 250.

[0034] Advantageously, but not necessarily, the auxiliary locking element 280 has two flattened horizontal sides for the purpose of facilitating coupling thereof with one of the two pins 102 of the adapter 100.

[0035] As shown in greater detail in Figs. 4, and 5, in the inner compartment 253 there are housed (at least partly) the following devices:

- two rods 271 for operation of the bolts 270; the rods 271 are hydraulically connected to a hydraulic distribution board 272 and form with this latter a double-acting hydraulic actuator system 275 adapted to

move the bolts 270 forward from a retracted disengaged position to an extended position engaged with one of the two pins 102 of the adapter 100; in other words, each bolt 270 is shaped so as to receive therein at least a portion of a double-acting hydraulic drive system 275 so that the thrust exerted by the hydraulic system 275 has an operating axis substantially coincident with a longitudinal axis (X) of the bolt 270; the two bolts are supported by a specific support 276, also housed in the inner compartment 253 that allows each bolt 2370 to slide along the corresponding axis (X); and

- an auxiliary locking device 290, already mentioned above, which, as well as the auxiliary locking element 280 also comprises a hydraulic actuator cylinder 381, also positioned in the inner compartment 253; as illustrated in greater detail in Fig. 7, the hydraulic actuator cylinder 281 comprises, in turn, two chambers 281A, 281B, hydraulically separate from each other, each of which is fed with pressurized oil by means of a respective connector 282A, 282B (see also Fig. 4); moreover, the two connectors 282A, 282B are hydraulically coupled to a pilot-operated check valve 283 (Fig. 4). This pilot-operated check valve 283 has the function of preventing movement of the auxiliary locking device 290 and of the coupling pins 270 in the event of broken pipes, so that the auxiliary locking device 290 is not affected by any breakage of feed pipes external to the system. The chamber 281B contains therein a spring 284, which guarantees extension of the auxiliary locking element 280 in any condition and thus prevents the seat 254 from disengaging from one of the transverse pins 102 of the adapter 100, when, for any reason, the hydraulic supply to the hydraulic actuator cylinder 281 is interrupted.

[0036] Moreover, it should be noted that, while the bolts 270 are inserted in use under one of the pins 102, the auxiliary locking element 280 presses in a position above the other pin 102, clamping this pin 102 with the underlying part of each seat 254. With particular reference to Figs. 2 and 5, it can be noted that the main body 252 is delimited at the top on the opposite side to the through holes 258A by a protruding section 251, which extends to cover the auxiliary locking element 280 at the top in a manner substantially mating with a respective lower face 251', visible in Fig. 3.

[0037] This section 251 is adapted, in use, to oppose any transverse shifting (upward in Fig. 3) of the auxiliary locking device 280, and hence this section 251 is a safety member that contributes to strengthen the hold of the corresponding pin 102 inside the fork-shaped seats 254 produced by the auxiliary locking element 280, positioning it stably relative to the corresponding pin 102.

[0038] The auxiliary locking device 290 is arranged so that the auxiliary locking element 280 is arranged along a further longitudinal axis (Y) parallel to the operating

axes (X) of the bolts 270. Moreover, it is important to note that the axis Y is parallel to the axes X and at a level such that the lower edge of the locking element 280 is tangent to the pin 102.

[0039] With reference to Fig. 8, by supplying the coupling line LA with hydraulic fluid this causes simultaneous operation of the cylinder 281, which in turn causes operation of the locking element 280 and of the two bolts 270, which actuate locking of the quick coupling 250. Vice versa, again with reference to Fig. 8, by feeding a hydraulic fluid into the release line LS this causes return of the locking element 280, and consequently release of the corresponding pin 102, as well as return of the two bolts 270 to the unlocked position, also causing release of the corresponding pin 102. It should be noted that there is installed inside the cylinder 281 a spring 284, which is adapted to return the cylinder 281 to the locked position if the hydraulic supply is absent, producing another safety device associated with the quick coupling 250. Moreover, as can be noted (Figs. 6 and 8) the hydraulic supply of the bolts 270 takes place through passages produced in the respective rods 270. As already indicated, upstream of the whole hydraulic system there is installed a pilot-operated check valve 283 that prevents uncontrolled movements of the system if the hydraulic supply pipes are disconnected or damaged.

[0040] The main advantage of the quick coupling forming the main subject matter of the present invention consists in the fact of having eliminated the offsets between the axes of the bolts and related actuator systems, in this way overcoming the problem of binding of the bolts after insertion. Moreover, use of the auxiliary locking device allows the quick coupling to be made safe.

[0041] An embodiment of the invention can further relate to a quick coupling 250 of a tool U to an arm of a heavy machine, the quick coupling 250 comprising a main body 252, substantially box-shaped, provided with an inner compartment 253 containing actuator means 275 of at least one bolt element 270 adapted to engage with complementary means 102 provided on an adapter 100 integral with said tool U; said at least one bolt element 270 being shaped so as to receive therein at least a double-acting hydraulic actuation system 275 adapted to move said at least one bolt element 270 forward from a retracted disengaged position to an extended position engaged with a first element 102 of the adapter 100, so that the thrust exerted by said hydraulic actuation system 275 has an operating axis substantially coincident with a longitudinal axis X of said at least one bolt element 270; wherein the quick coupling 250 comprises an auxiliary locking device 290 comprising in turn at least one auxiliary locking element 280, and in that said at least one auxiliary locking element 280 can be moved forward from a retracted position to a forward position of engagement with a second corresponding element 102 of said adapter, and in that the direction of forward movement of said at least one locking element 280 is opposite that of said at least one bolt element 270.

[0042] In a further embodiment, said at least one bolt element 270 comprises a rod 271 and in that the hydraulic supply of the actuator takes place through appropriate passages produced inside the rod 271 that operates said at least one bolt element 270, this hydraulic supply being able to be conveyed inside said rod 271 through a hydraulic distribution board 272 that has been suitably machined internally for passage of the hydraulic fluid and to which there are fastened suitable hydraulic connectors.

[0043] In a further embodiment, said auxiliary locking device 290 comprises a hydraulic chamber 281B containing therein elastic means 284.

[0044] In a further embodiment, said auxiliary locking device 290 is hydraulically connected with a check valve 283.

[0045] In a further embodiment, said main body 252 has safety means 251 adapted to oppose transverse shifting of said auxiliary locking element 280 relative to the corresponding said second element 102.

[0046] In a further embodiment, said safety means 251 comprise a protruding section 251', which covers said auxiliary locking element 280 in a manner substantially mating with a respective lower face 251' to position it stably relative to said second element 102.

[0047] An embodiment of the invention can further relate to a connection apparatus 1000 which comprises at least one quick coupling 250 according to any of the previous embodiments.

Claims

1. Quick coupling (250) of a tool (U) to an arm of a heavy machine, the quick coupling (250) comprising a main body (252), substantially box-shaped, provided with an inner compartment (253), at least one bolt element (270) adapted to engage with complementary means (102) provided on an adapter (100) integral with said tool (U); a double-acting hydraulic actuation system (275) adapted to move said at least one bolt element (270) forward from a retracted disengaged position to an extended position engaged with said complementary means (102), **characterized by** an auxiliary locking device (290) comprising at least one auxiliary locking element (280), and in that said at least one auxiliary locking element (280) can be moved forward from a retracted position to a forward position of engagement with a corresponding element (102) of said adapter, and in that the direction of forward movement of said at least one locking element (280) is opposite that of said at least one bolt element (270).
2. Quick coupling (250) as claimed in claim 1, **characterized in that** said at least one bolt element (270) comprises a rod (271) and **in that** the hydraulic supply of the actuator takes place through appropriate passages produced inside the rod (271) that oper-

ates said at least one bolt element (270), this hydraulic supply being able to be conveyed inside said rod (271) through a hydraulic distribution board (272) that has been suitably machined internally for passage of the hydraulic fluid and to which there are fastened suitable hydraulic connectors.

3. Quick coupling (250) as claimed in claim 1 or claim 2, **characterized in that** said auxiliary locking device (290) comprises a hydraulic chamber (281B) containing therein elastic means (284).
4. Quick coupling (250) as claimed in any one of claims 1 to 3, **characterized in that** said auxiliary locking device (290) is hydraulically connected with a check valve (283).
5. Quick coupling (250) as claimed in any one of the preceding claims, **characterized in that** said main body (252) has safety means (251) adapted to oppose transverse shifting of said auxiliary locking element (280) relative to the corresponding said second element (102).
6. Quick coupling (250) as claimed in claim 5, **characterized in that** said safety means (251) comprise a protruding section (251'), which covers said auxiliary locking element (280) in a manner substantially mating with a respective lower face (251') to position it stably relative to said second element (102).
7. Connection apparatus (1000) **characterized in that** it comprises at least one quick coupling (250) as claimed in any one of claims 1-6.

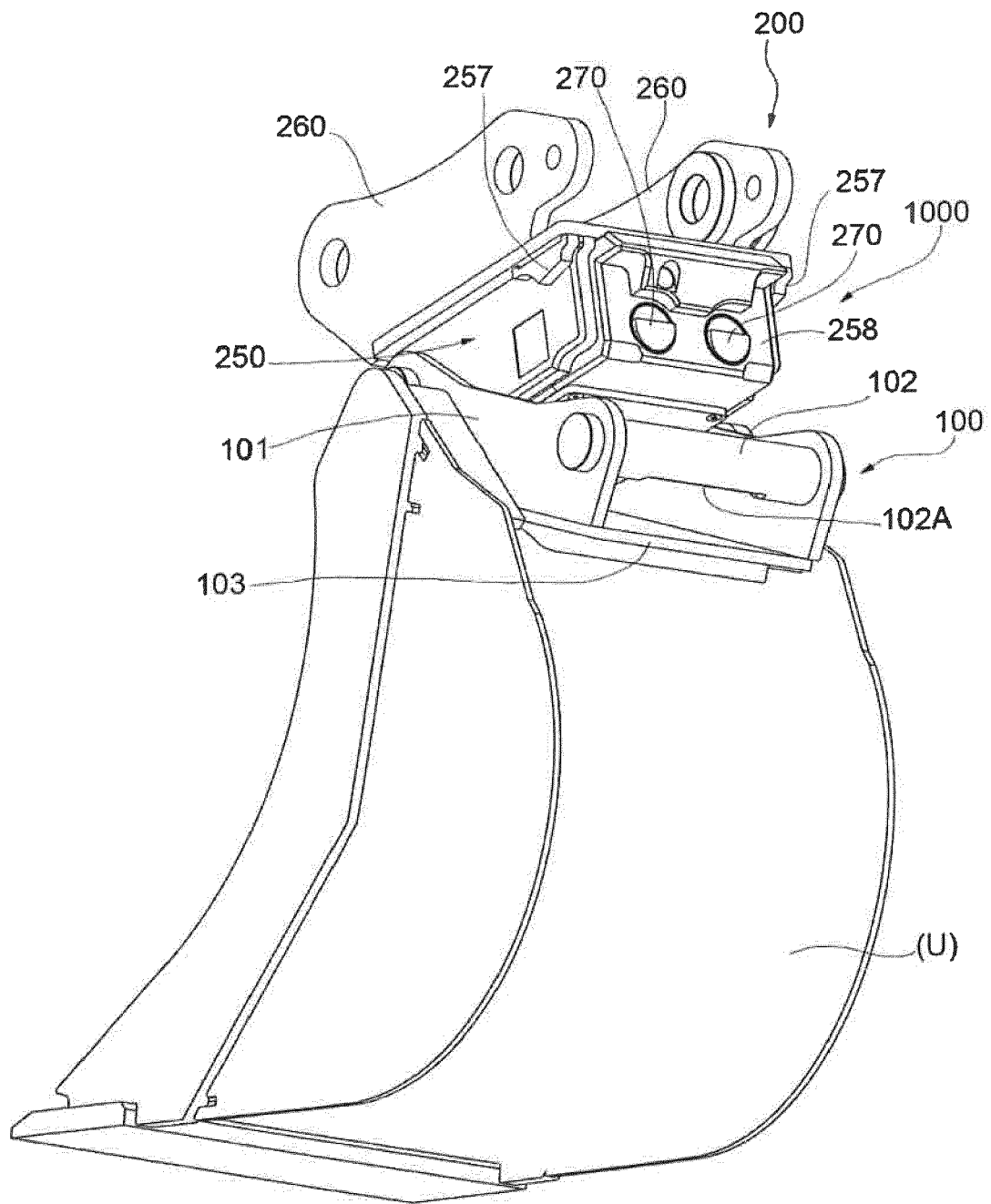


FIG.1

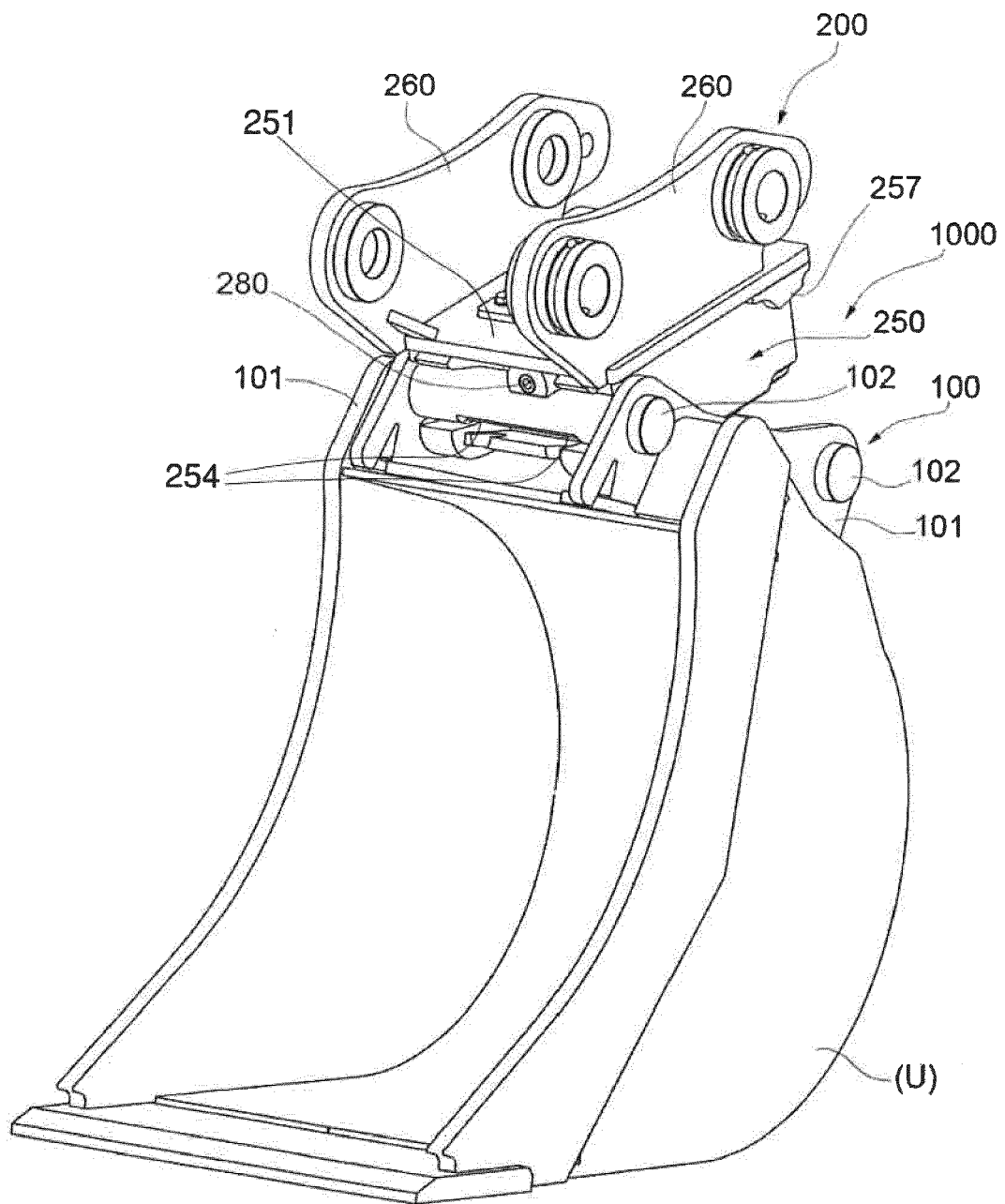


FIG.2

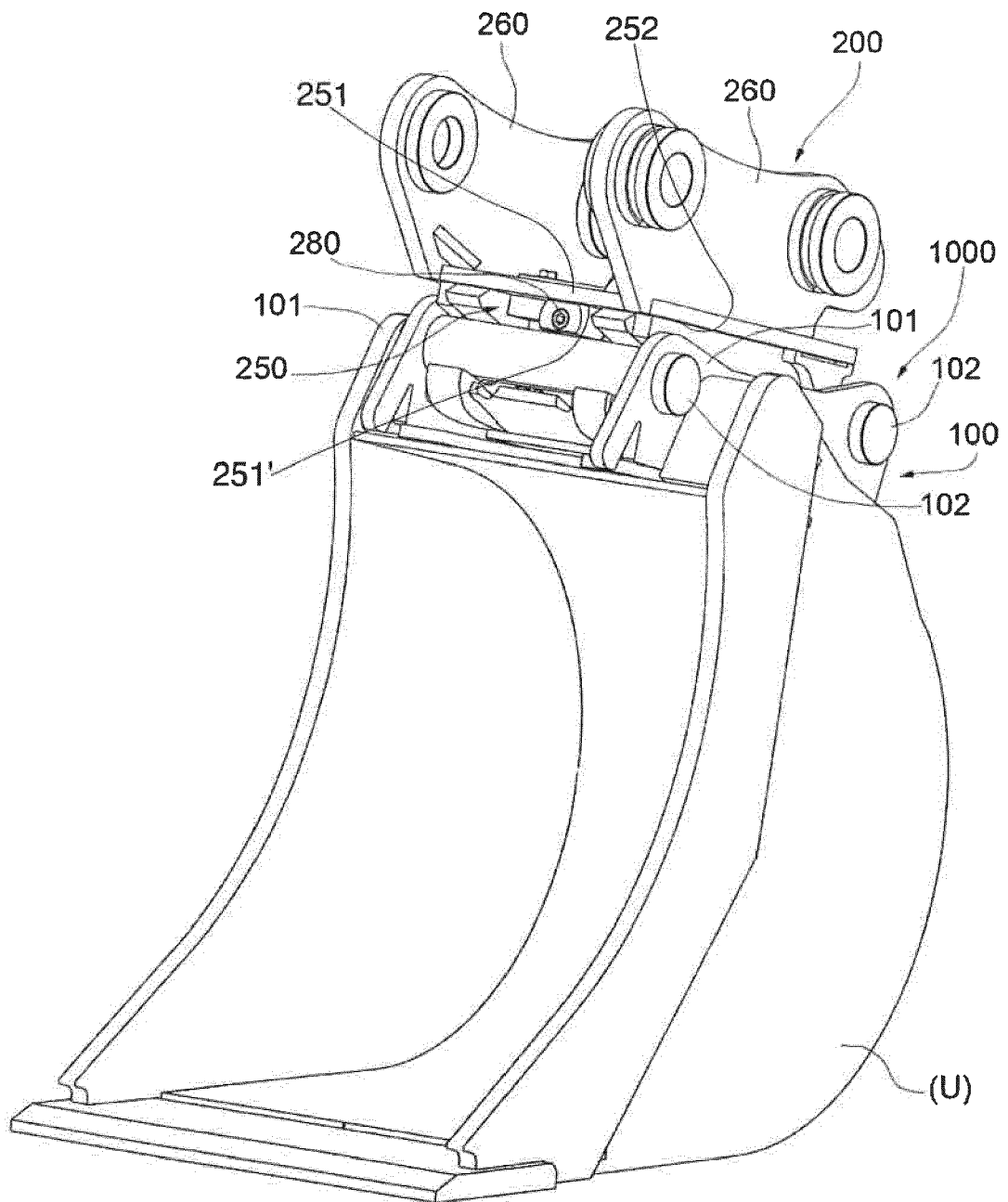
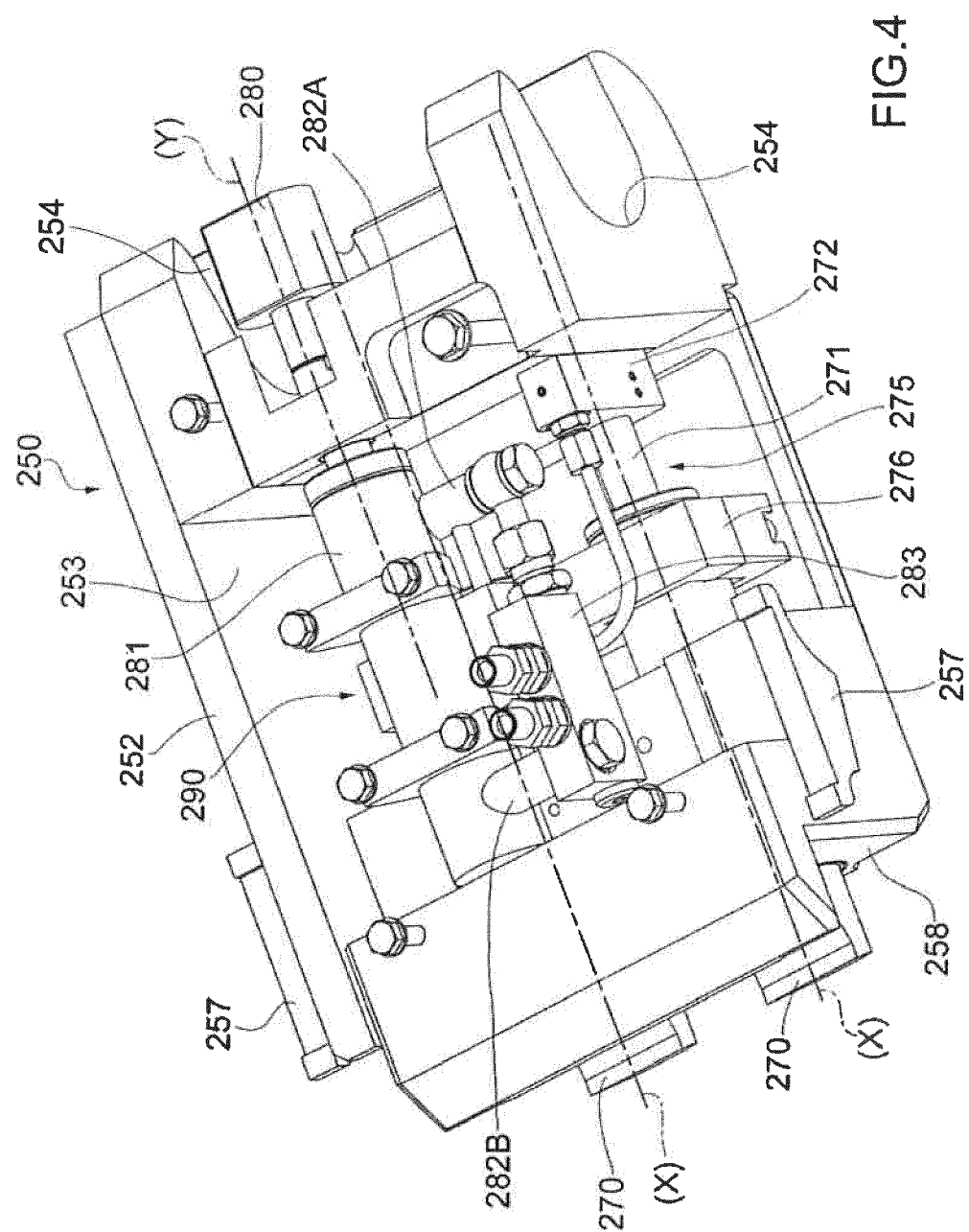


FIG.3



4. G. E.

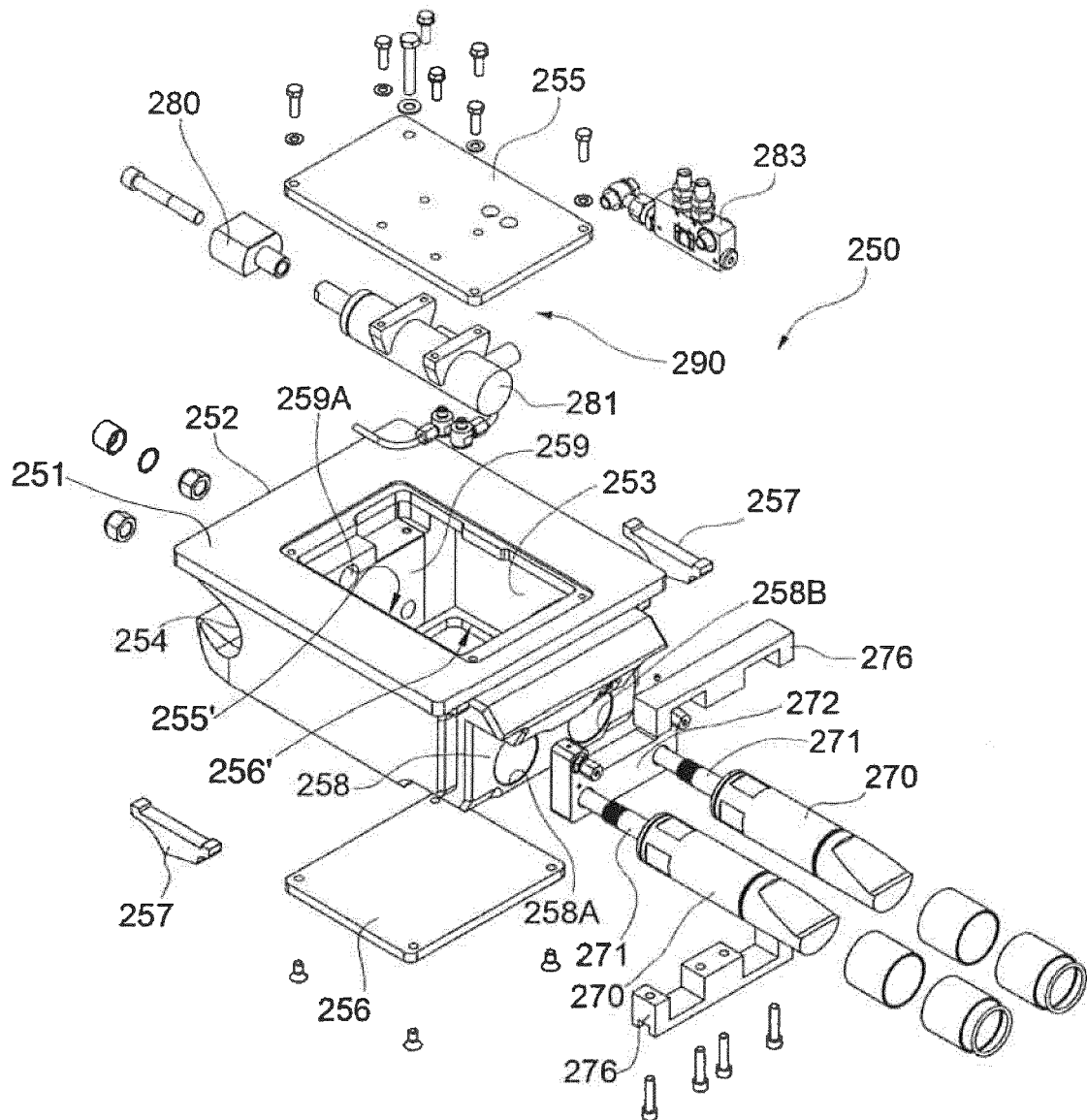
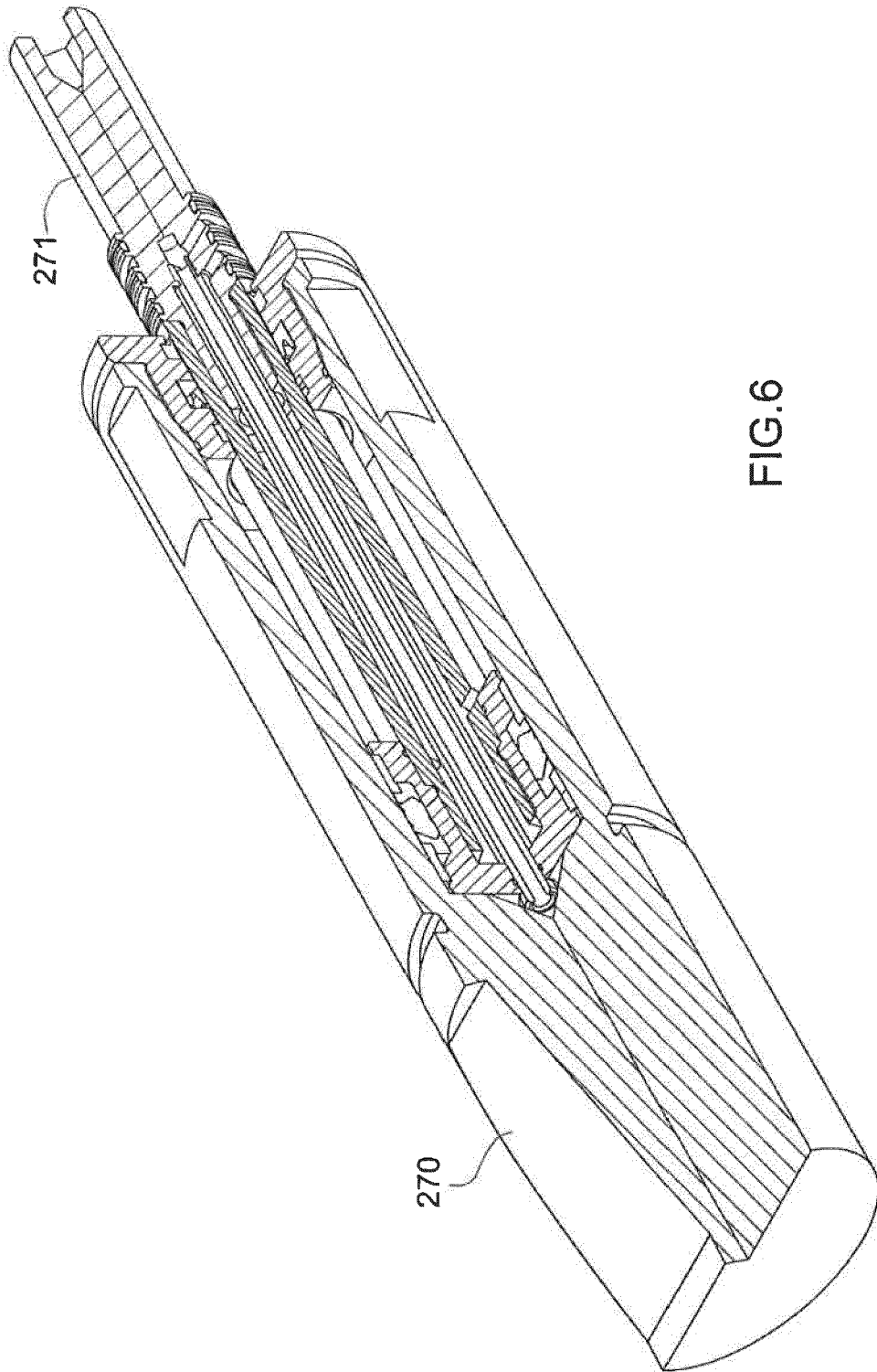
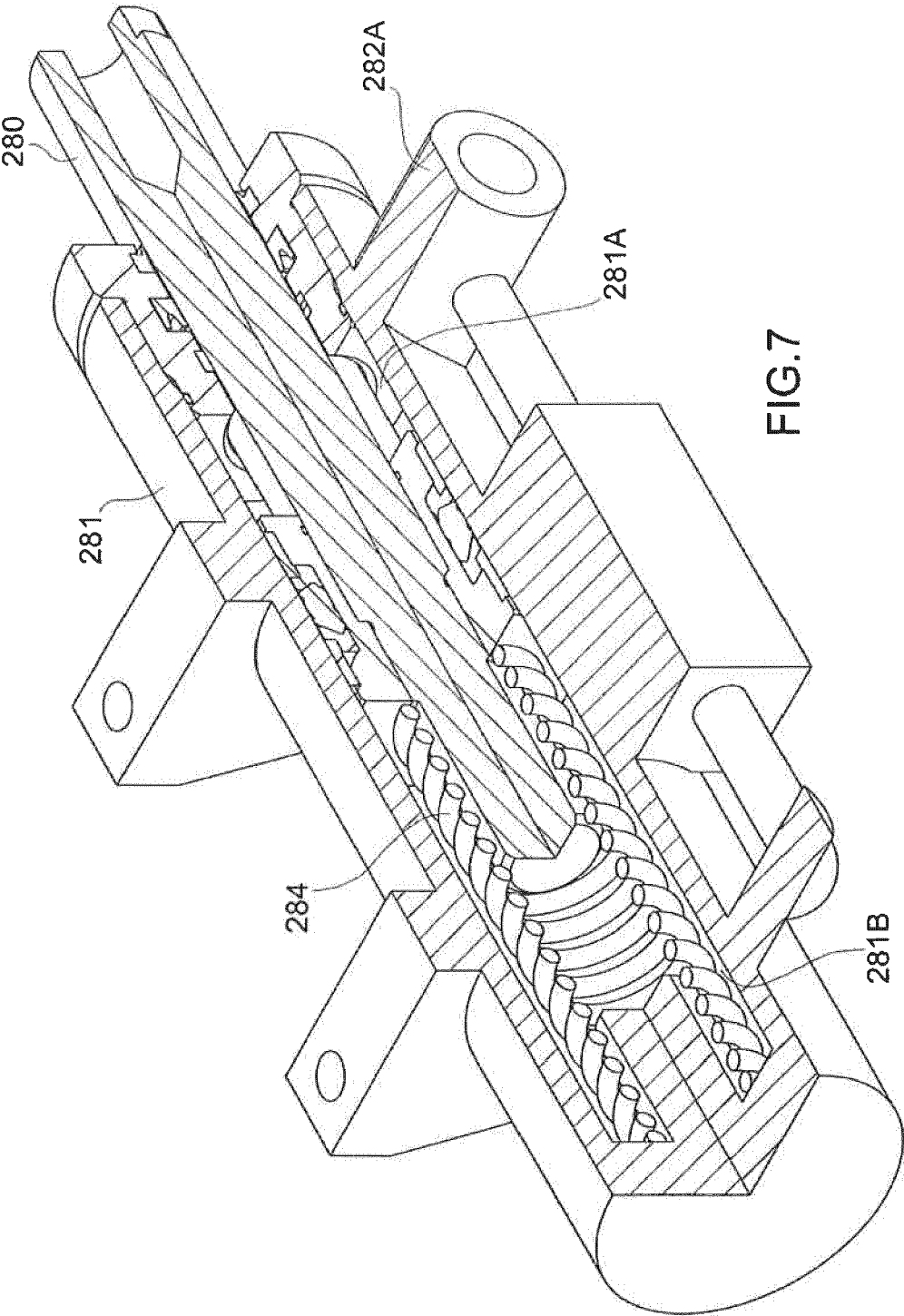


FIG.5





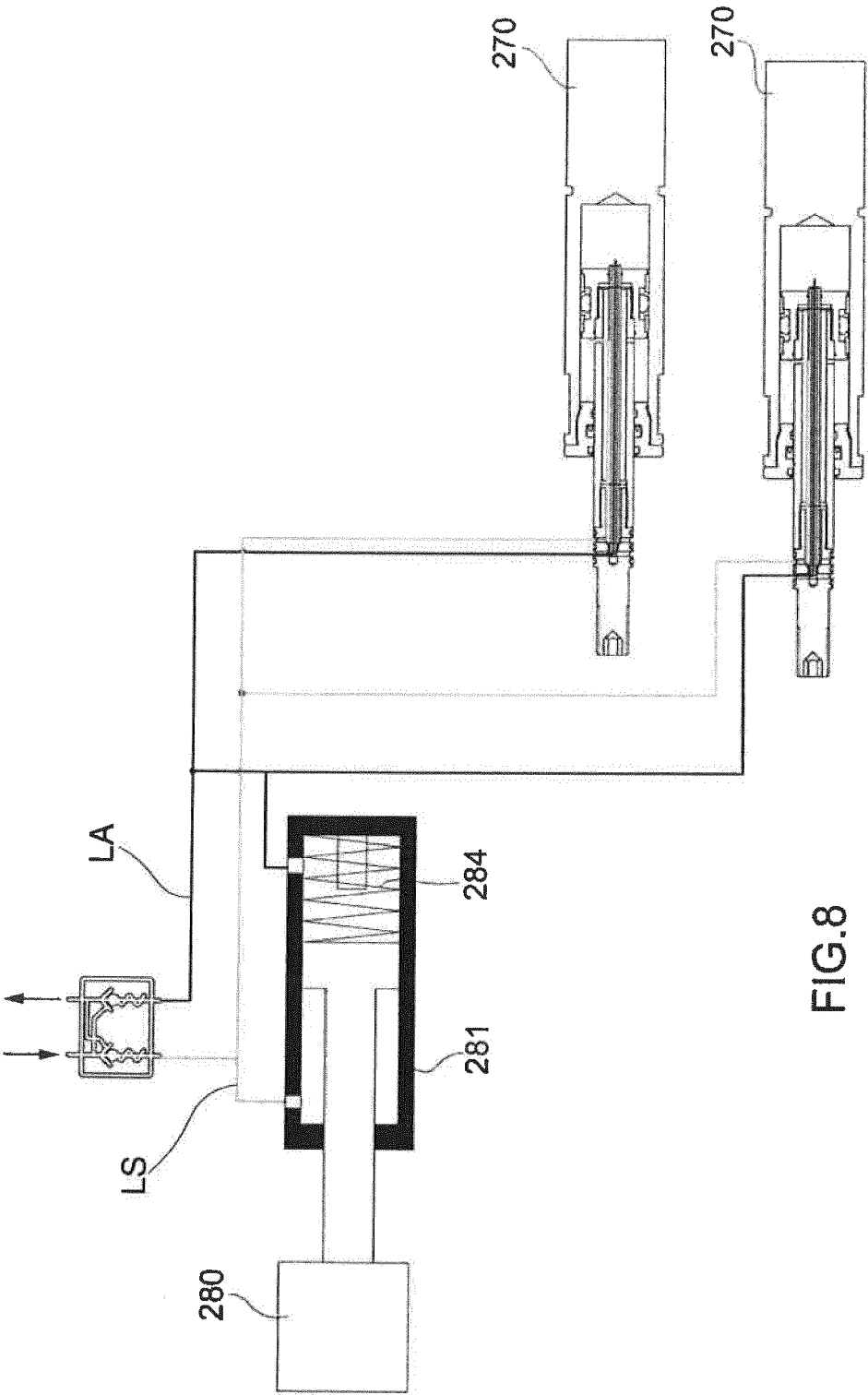


FIG.8



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**ANNEX TO THE EUROPEAN SEARCH REPORT
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