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(54) **Title:** FLUID TRANSMISSION COUPLING WITH INDEPENDENT MEMBER PRESSURE RELIEVING CAM

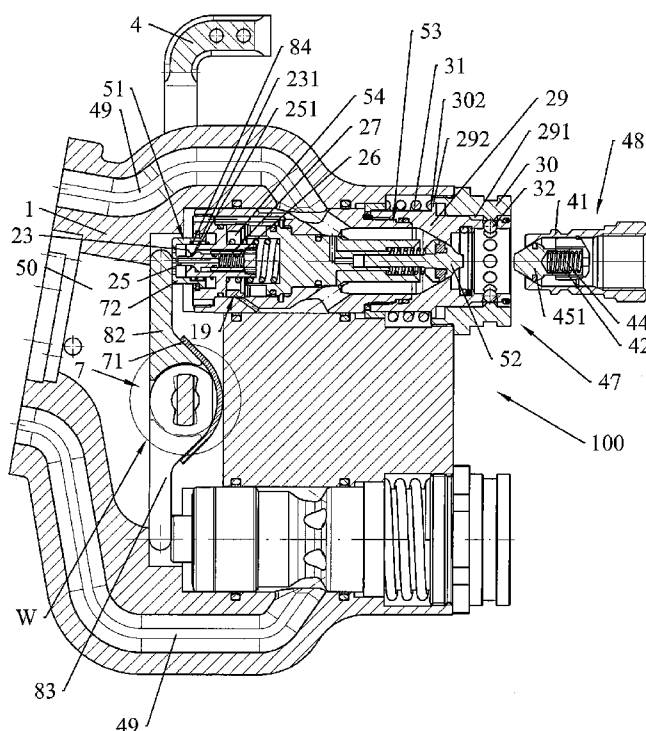


FIG.1

(57) **Abstract:** A fluid transmission fitting (100) is described comprising at least two female couplers (47) inserted within a hydraulic feeding block (1), and at least two respective male couplers (48), which can be coupled to said female couplers (47), said block (1) including at least two hydraulic lines (49) and at least one draining line (50), and a lever (4) integral with an independent member (82, 83) cam (7) adapted to relieve the pressure from a camera (54) inside each female coupler (47) and adapted to uncouple the male coupler (48) from the respective female coupler (47), each female coupler (47) including a pressure relief valve (51), which puts said chamber (54) into connection with said draining line (50).



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“Fluid transmission coupling with independent member pressure relieving cam”.

* * * *

DESCRIPTION

5 The present invention relates to a fluid transmission coupling with independent member pressure relieving cam.

 Fittings which may be rapidly coupled to one another to connect a fluid feed, by means of rigid pipes or flexible hoses, are frequently required for fluid transmission for example in operating machines and hydraulic
10 equipment.

 The known quick coupling fittings usually consist of two couplings, named male and female, which are fastened to respective pipes to be joined and which can be coupled together by screwing or by snapping.

 The aforesaid male and female couplers are formed by fixed parts and axially sliding parts, which at rest are arranged in a closing position of a
15 fluid passage gap and during the coupling between two members are displaced by engaging with corresponding parts of the other member to an opening position of said passage gap.

 The currently marketed fluid transmission solutions show that the coupling between the male coupler and the female coupler is not always
20 very easy with effort increasing incrementally as the residual pressure present in the circuit increases.

 Italian patent application MI2012A001254 by the present Applicant concerns a fluid transmission coupling connectable with constant effort
25 provided with a pressure compensation and relief system which is complex and not very cost-effective. Said known fitting further comprises a central locking system which is mechanically cumbersome and ineffective in some situations of accidental actuating by the user.

 US-2006/0273580 describes a pressurized fluid transmission fitting
30 with pressure relief cam having a first member which acts on a first female

coupler of a first hydraulic line, in one piece with the second member which acts on a second female coupler of a second hydraulic line. As said first and second members belong to one same piece, the approaching movement of the first member to the female coupler corresponds to the distancing of the second member from the second female coupler.

EP-0048822 shows a fluid transmission fitting with a cam with actuating members in one piece.

It is the object of the present invention to make a pipe fitting, in which the effort required for the coupling operation is minimum and independent from the residual pressure present in the circuit.

It is a further object of the present invention to make the fitting mechanically simpler and allow a suitable hydraulic control to guarantee user safety also in the event of accidental actuation.

It is a yet further object for said fitting to have a pressure relieving cam which allows the use of at least two pressurized lines in the same block of the fitting.

According to the present invention, such objects are reached by means of a fluid transmission fitting as described in claim 1.

The features of the present invention will be more apparent from the following detailed description of a non-limitative example thereof shown in the accompanying drawings, in which:

figure 1 shows a section view taken along line I-I in figure 26 of a fluid transmission fitting with uncoupled male and female coupler;

figure 2 shows a section view similar to the one in figure 1 of the fitting in a step of relieving the residual pressure of the hydraulic line before the coupling between male coupler and female coupler;

figure 3 shows a section view similar to the one in figure 1 of the fitting before the coupling between male coupler and female coupler without presence of residual pressure in the hydraulic line;

figure 4 shows a section view similar to the one in figure 1 of the

fitting in a first step of coupling between male coupler and female coupler, with contact of a valve of the male coupler and a valve of the female coupler;

5 figure 5 shows a section view similar to that in figure 1 of the fitting in a second step of coupling between male coupler and female coupler, with displacement of the inner part of the female coupler in the hydraulic feeding block and opening of the rear pressure relief;

10 figures 6 and 7 show two section views similar to the ones in figure 1 of the fitting in a third and a fourth step of coupling between male coupler and female coupler with radial displacement of the locking balls of the female coupler in the housing of a fixing ring nut;

figure 8 shows a similar view to the one in figure 1 of the fitting in a fifth step of coupling between male coupler and female coupler, with positioning of the locking balls within a recess present on the male body;

15 figure 9 shows a similar view to the one in figure 1 of the fitting in a sixth step of coupling between male coupler and female coupler, with displacement of the outer assembly with locking balls to the locking position of the male coupler;

20 figure 10 shows a section view similar to the one in figure 1 of the fitting in a seventh step of coupling between male coupler and female coupler, with opening of the male valve by effect of the hydraulic thrust caused by the feeding of the circuit;

25 figures 11 and 12 show section views similar to the ones in figure 1 of the fitting in a first and a second step of uncoupling between male coupler and female coupler, with pressure relief and closing of the male valve;

figure 13 shows a section view similar to the one in figure 1 of the fitting in a third step of uncoupling between male coupler and female coupler, with displacement of the inner parts until the locking balls are released;

30 figure 14 shows a section view similar to the one in figure 1 of the

fitting in a fourth step of uncoupling between male coupler and female coupler, with releasing of the male coupler;

figure 15 shows a section view similar to the one in figure 1 of the fitting, with male coupler and female coupler uncoupled;

5 figure 16 shows an enlarged detail of the content of circle W in figure 1;

figure 17 shows a section view taken along line XVII-XVII in figure 16;

10 figure 18 shows an enlarged detail of the content of circle U in figure 2;

figure 19 shows a section view taken along line XIX-XIX in figure 18;

figure 20 shows an enlarged detail of the content of circle Z in figure 13;

figure 21 shows a section view taken along line XXI-XXI in figure 20;

15 figure 22 shows an enlarged detail of the content of circle V in figure 27;

figure 23 shows a section view taken along line XXIII-XXIII in figure 22;

20 figure 24 is a section view similar to the one in figure 1, of a female coupler with a radial seal, also shown enlarged in circle B in accordance with a further embodiment;

figure 25 shows a section view similar to the one in figure 1, of a female coupler with a radial seal, also shown enlarged in circle C in accordance with a yet further embodiment;

25 figure 26 shows a front view of the fitting according to the present invention;

figure 27 shows a section view similar to the one in figure 1 of the fitting in a step of relieving of the residual pressure before the coupling between male coupler and female coupler of the lower hydraulic line.

30 Figure 1 shows a coupling fitting 100 comprising a female valve

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coupler 47 inserted in a hydraulic feeding block 1 and a male valve coupler 48 which can be coupled to said female coupler 47.

5 The block 1, which feeds the fluid, comprises at least one hydraulic line 49 and a draining line 50, both interfacing with one or more female couplers 47.

10 In the description of the operation, reference will be made to only one male-female line (the one shown on the top in the drawings), but the considerations are applicable to all lines of a same fitting. It is worth noting that in the drawings the male-female coupler in the lower line is not shown in section but only as a view, the section being identical to that of the upper line.

The block 1 further comprises a lever 4 integral with a cam 7 adapted to relieve the pressure from a chamber 54 inside the female coupler 47, and adapted to uncouple the male coupler 48 from the female coupler 47.

15 The cam 7 consists of two independent parts, an upper one 82, which acts on the coupling of the upper hydraulic line, and a lower one 83, which acts on the coupling of the lower hydraulic line (figure 1).

The cams 82, 83 have one disc-shaped attachment portion 821, 831 (figures 16-23) with a respective loop 822, 832 each.

20 Said attachment portions 821, 831 are associated with a central shaft 5 controlled by the rotation of the lever 4, by means of said loops 822, 832 in which said central shaft 5 is housed with clearance.

25 The central shaft 5 has a substantially rectangular section 501 with rounded short sides (figure 16) so as to allow the rotation of said shaft 5 in the loops 822, 832.

The shape of the loops 822, 832 is similar to that of the shaft 5, but broader so as to allow the shaft 5 to move inside if it is not meshing with either one loop 822, 832 or the other, as will be more apparent below.

30 In actual fact, said loops 822, 832 are superimposed in axis with the rotation axis of the shaft 5.

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The attachment portions 821, 831 may move one over the other, thus being reciprocally independent as their rotation is controlled only by the lever 4 by means of the shaft 5.

5 The rotation of the central shaft 5 is determined by applying stress to the lever 4, which moves the attachment portion 821 of the upper cam 82 clockwise, but being free in the second loop 832 it does not move the attachment portion 831 of the lower cam 83, and moves the attachment portion 831 of the lower cam 83 anticlockwise but by being free in the loop 822 it does not move the attachment portion 821 of the upper cam 82.

10 As already mentioned, the shape of said loops 822, 832 is substantially complementary to the shape of the central shaft 5, but their width is greater to allow a rotation clearance such to be able to move one cam 82 while maintaining the other 83 stationary, and vice versa, as will be more apparent below.

15 The cams 82, 83 are held in position by means of the spring 71, for example a C spring, but two compression springs may be provided. It is also possible to eliminate said spring 71 because said cams 82, 83 are stressed by the shutter 25 and in all cases a slight clearance, which determines a minimal distancing from the ideal initial resting position, is tolerated (figure 1).

20 The female coupler 47 comprises a pressure relief valve which puts said chamber 54 into communication with the draining line 50 (figure 1).

Said valve 51 comprises a valve body 23, which forms a housing for a sliding shutter 25, stressed by a spring 26, which reacts against a protrusion of the shutter 25 and a stop 27. Sealing is ensured by the contact between a conical surface 251 of the shutter 25 and an edge 231 of the valve body 23 (figure 1).

25 A cup 72 sliding in axial direction and pushed by said upper cam 82 against the opposite thrust of a spring 84 acts on said shutter 25. The upper cam 82 is always in contact with the cup 72, which is pushed by the spring 84 against the cam 82 in releasing position of the shutter 25. Said cup 72 is

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thus moveable between an engaging position and a releasing position with the shutter 25.

The shutter 25 has therein a hole 252 (figure 2) for venting the air and a hydraulic thrust section reduced to the minimum. Such a hydraulic thrust section is determined by the interface diameter between the conical surface 251 of the shutter 25 and the valve body 23, and by the diameter of slightly smaller size of a rear part 263 of the shutter 25 on which a seal 28 acts. The described configuration of the shutter 25 - valve body 23 coupling allows to minimize the actuation force of the shutter 25 itself in presence of residual pressure present inside the chamber 54.

The female coupler 47 further comprises a valve 52 axially sliding inside an outer assembly 53 of the female coupler 47 itself, and a seal 19 adapted to generate a pressure difference between the hydraulic line 49 and the chamber 54.

Said seal 19 is adapted to close a calibrated communication pipe 191 between the chamber 54 and the hydraulic line 49 contained in an inner body 13 (figure 2).

Said seal 19 is ring-shaped, determines a radial type sealing, i.e. orthogonal to the axis of the fitting 100, and comprises a non-deformable portion 192 and a deformable portion 193.

Said pipe 191 is external to the chamber 54 and the pressurized fluid flow inside it insists radially outwards from the inside of the chamber 54 at the outer surface of the seal 19.

When a given nominal pressure is reached, the deformable portion 193 bends towards the inside of the chamber 54 thus determining the introduction of pressurized fluid into the chamber 54 of the hydraulic line 49. When the pressure returns under said nominal pressure, the deformable portion 193 returns to its initial position thus obstructing the passage of fluid.

Said seal 19 can be used with identical operating principle also in case

of flat-faced male-female couplers.

The outer assembly 53 (figure 1) comprises a ring nut holder 29, a ring nut 30 and at least one locking ball 32 arranged inside a housing of the ring nut holder 29. A spring 31, by reacting against appropriate protrusions 292, 302, against the ring nut 30, the ring nut holder 29 and the block 1, constrains the outer assembly 53 in a central resting position which guarantees the locking of the male coupler 48 after the coupling.

A bottom 16 also slides inside the female coupler 47 and has two seals 14 and 17 (figure 9) on the side of the hydraulic line 49 and on that of the chamber 54, respectively. The zone comprised between the two seals 14, 17 is in contact with the draining line 50 by means of the pipe 56. The bottom is held in position by a spring 22.

The male coupler 48 is shown, in turn, in figure 1 and comprises a threaded male body 41 for connecting to a user (not shown), e.g. to a hydraulic equipment. There is a valve 451 held in position by a spring 44 which acts on a bottom 42 within the male body 41. Such a valve 451 guarantees the sealing of the male coupler 48 in uncoupled condition.

Residual pressure may be present in one or more of the hydraulic lines 49 in operation. Starting from the configuration in figure 1 in which the upper cam 82 and the lower cam 83 are in resting position, i.e. do not act on the couplings, the lever 4 moves rightwards and actuates the upper cam 82, which pushes the cup 72 towards the shutter 25 putting the hydraulic line 49 into connection with the draining line 50 and allowing to relieve the inner residual pressure (figure 2). During such a function, the seal 19 is radially deformed at the deformable portion 193 allowing the passage of fluid through the pipe 191.

During this step, the lower cam 83 does not move because the shaft 5 by rotating rightwards meets a side of the loop 822 of the upper cam 82 feeding it, while the loop 832 of the attachment portion 831 is sufficiently wide to make the shaft 5 rotate without touching any of its sides (figures 18-

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19). In practice, the attachment portion 821 of the upper cam 82 rotates on the attachment portion 831 of the lower cam 83. The upper cam 82 thus moves independently from the lower cam 83.

5 The force applied by the lever 4 must be such to overcome the resistance of the spring 71, which in all cases holds the lower cam 83 in position.

Having relieved the residual pressure inside the line 49, the system is ready for coupling.

10 The first coupling step (figure 4) consists in pushing the male coupler 48 into the female coupler 47. Residual pressure may be present in the chamber 57 upstream of the valve 451. The valve 451 comes into contact with the valve 52 by approaching the male coupler 48 to the female coupler 47. In absence of residual pressure in the chamber 57, the load of the springs 21 and 44 is equivalent and both valves 451, 52 are displaced. Only valve 52
15 is displaced in case of pressure in the chamber 57. By pushing the male coupler 48 into the female coupler 47, the male body 41 goes into contact with the balls 32, thus displacing the outer assembly 53 into the block 1 (figure 5). During the displacement, the shutter 25 goes into contact with the cup 72 and the upper cam 82, in turn, goes into contact with the block 1.
20 Thus, the shutter 25 opens and turns the hydraulic line 49 into an open circuit. This function allows to relieve the pressure during coupling even if the lever 4 is not operated in advance. The upper cam 82 is not free to move with the shutter 25 in the opening position.

25 Proceeding with the insertion of the male coupler 48 in the female coupler 47 (figures 6-7), the locking balls 32 enter into the seat 301 of the ring nut 30 thus allowing the entrance of the male coupler 48 until the locking balls 32 fall into the cavity 411 obtained in the male body 41 (figures 8-9).

30 In this position, the spring 31 returns the assembly consisting of the outer assembly 53 and the male coupler 48 to the coupled balanced position

by working on the shoulder 292 of the lock ring holder 29 (figure 9). In case of absence of pressure in the chamber 57, as mentioned above, the bottom 16 is not moved and is held in position by the spring 22, and the valve 451 is retracted; in this case the circuit is open and the coupler is coupled as shown in figure 10.

The bottom 16 retracts instead in case of pressure in the chamber 57.

The manual mechanical coupling operation is complete at this point; the male coupler 48 is mechanically coupled to the female coupler 47, but by virtue of the fact that the bottom 16 was moved towards the inside of the female coupler 47, the valve 451 which retains the residual pressure of the male coupler 48 is still not open. Thus, the effort required for the coupling operation is independent from the residual pressure present inside the male coupler 48 because it does not work on the valves which retain the residual pressure.

For opening the valve 451, in case of pressure in the chamber 57, it is necessary to send a pressure pulse from the hydraulic line 49, which by passing through the pipe 191 deforms the deformable portion 193 of the seal 19, fills the chamber 54 and pushes the bottom 16 which acts on the valve 52, which opens the valve 451, the thrust section of the bottom 16 being higher than that of the valve 451. During the movement of the bottom 16, the air contained in the zone comprised between the seals 14 and 17 may enter and exit through the pipe 56 (figure 10).

The circuit totally opens when the bottom 16 abuts on the inner body 13 (again in figure 10). In this position, the chamber 54 remains full of oil and pressurized, and no longer allows the movement of the bottom 16 except for a movement of the shutter 25 because the seal 19 does not allow the return of fluid towards the hydraulic line 49.

The uncoupling between male coupler 48 and female coupler 47 starts by acting on the lever 4 (figure 11) which moves the upper cam 82, according to the same methods as the initial relieving described above

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shown in figures 2, 18 and 19, which acts on the shutter 25 by means of the cup 72 putting the hydraulic line 49 into communication with the draining line 50, thus discharging the pressure inside them. In case of pressure and possible flow in the hydraulic line 49 (e.g. caused by a load applied upstream of the male coupler), by actuating the shutter 25 there is a drop of pressure in the chamber 54, while the presence of the seal 19 and of the calibrated pipe 191 causes a higher pressure in the hydraulic line 49, which acts on the seal 14 causing a thrust on the bottom 16, which overcomes the spring 22 and thus moves the bottom 16 itself, the valve 52 and the valve 451 which close (figure 12).

Continuing the movement, the upper cam 82 pushes the cup 72 to act on the valve body 23, which in turn moves the whole formed by female coupler 47 and male coupler 48 outwards the locking balls 32 with the recess 303 on the fixing ring nut 30. In such a position, the locking balls 32 exit from the recess 411 in the male body 41 and release it letting it out (figures 13-14).

It is worth noting that the loop 832 of the lower cam 83 is sufficiently wide to allow a double movement of the upper cam 82 at the end of the second movement, the shaft 5 nearly abutting onto a side of said loop 832 (figures 20-21). Thus, the upper cam 82 rotates by a predetermined angle according to the shape of the loop 832, and vice versa, as will be more apparent below, the lower cam 83 rotates in opposite sense by a predetermined angle according to the shape of the loop 822.

The unrestrained male coupler 48 is uncoupled by effect of the thrust of the inner springs. Having released the balls 32, the spring 31 returns the female coupler 47 to the resting position by working on the ring 37 (figures 15 and 1).

The system is ready for a new connection.

The female coupler 47 coupled by means of the locking balls 32 is fed outwards when coupled, if the male coupler 48 is pulled. When the locking

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balls 32 reach the recess 303 of the ring nut 30, the male coupler 48 is uncoupled (accidental uncoupling, "breakaway" function).

5 The engagement of the lower line is similar to that of the upper line, it being worth noting that the lever 4 moves leftwards in opposite sense (figure 27) starting from the central resting position shown in figure 16 (figure 27): the interaction between the shaft 5 and the attachment portion 831 of the lower cam 83 is similar to that described above for the attachment portion 821 of the upper cam 82, in which the loop 822 allows the rotation of the attachment portion 831 of the lower cam 83 without moving the upper cam 82.

10 Figures 24-25 show female couplers 47 with seals 19 according to two further embodiments.

The seal 19 in figure 24 is not placed directly on the mouth of the pipe 191, there being provided an annular gap 194 obtained on the valve body 23 which allows to limit the wear of the seal 19 itself, which again includes a non-deformable portion 192 and a deformable portion 193.

15 Said gap 194 allows to direct the pressurized flow exiting from the mouth of the pipe 191 firstly towards the non-deformable portion 192, then onto the deformable portion 193, on both sides of said mouth of the pipe 191.

20 Said deformable portion 193 has a reduced thickness with respect to the non-deformable portion 192, which is further reduced by moving away from the non-deformable portion 192. When there is pressure in the chamber 54, the deformable portion 193 presses on a conical surface 232 of the valve body 23. When there is no pressure in the chamber 54, the pressurized fluid in the hydraulic line 49 bends the deformable portion 193 inwards starting from the most distant part from the non-deformable portion 192.

25 The seal 19 in figure 25 instead includes the non-deformable portion 192 made of more rigid material directly on the mouth of the pipe 191.

30 Said non-deformable portion 192 has an L-shaped section and is

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adapted to direct the pressurized fluid coming from the pipe 191 towards the deformable portion 193 which does not face the mouth of the pipe 191 directly. As apparent in the enlargement shown in circle C, the L is rotated by 90° clockwise to form an annular gap 194 also in this case: the short part of the L closes an end of the mouth of the pipe 191, while the longer part of the L of the pipe 191, directs the pressurized fluid towards the deformable portion 193 of the seal 19.

Consequently, the wear of the seal 19 is limited also in this second embodiment which indeed derives from the direct interaction between the mouth of the pipe 191 and the deformable portion 193 of the seal 192, which is excluded in this manner.

CLAIMS

1. A fluid transmission fitting (100) comprising at least two female couplers (47) inserted in a hydraulic feeding block (1) belonging to said fitting (100), and two respective male couplers (48), which can be coupled to
5 said female coupler (47),

said block (1) including at least two hydraulic lines (49) and at least one draining line (50), and a lever (4) integral with a cam (7) adapted to relieve the pressure from a chamber (54) inside each female coupler (47) and adapted to uncouple the male coupler (48) from the female coupler (47),

10 each female coupler (47) comprising a pressure relief valve (51) which puts said chamber (54) into communication with the draining line (50),

said cam (7) comprising a first member (82), which acts on the female coupler (47) of a first hydraulic line, and a second member (83), which acts on the female coupler (47) of a second hydraulic line,

15 characterized in that

said first and second member (82, 83) are independent so that while said first member (82) is moved to act on said first hydraulic line by turning said lever (4) in one sense, said member (83) remains in resting position, and vice versa, by rotating said lever (4) in the opposite sense.

20 2. A fitting (100) according to claim 1, characterized in that said first and second member (82, 83) have a first and a second disc-shaped attachment portion (821, 831) with a first and a second loop (822, 832), respectively,

25 said attachment portions (821, 831) being associated with a central shaft (5) controlled by the rotation of the lever (4), by means of said loops (822, 832) in which said central shaft (5) is housed with clearance,

by applying stress to the lever (4) the rotation of the central shaft (5) is determined which, in one direction, moves the first attachment portion (821) of the first member (82) but being free in the second loop (832) of the
30 second attachment portion (831) it leaves the second attachment portion

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(831) of the second member (83) stationary, while, in the other direction, it moves the second attachment portion (831) of the second member (83) but being free in the first loop (822) it leaves the first attachment portion (821) of the first member (82) stationary.

5 3. A fitting (100) according to claim 2, characterized in that the shape of said loops (822, 832) is similar to that of the shaft (5) but broader to allow the shaft (5) to move inside if it is not meshing either one loop or the other (822, 832).

10 4. A fitting (100) according to claim 3, characterized in that said loops (822, 832) are superimposed in axis with the rotation axis of the shaft (5), the attachment portions (821, 831) being able to move on one another.

15 5. A connection (100) according to claim 4, characterized in that said central shaft (5) has a rectangular section with rounded short sides (501) so as to allow the rotation of said shaft (5) in the loops (822, 832).

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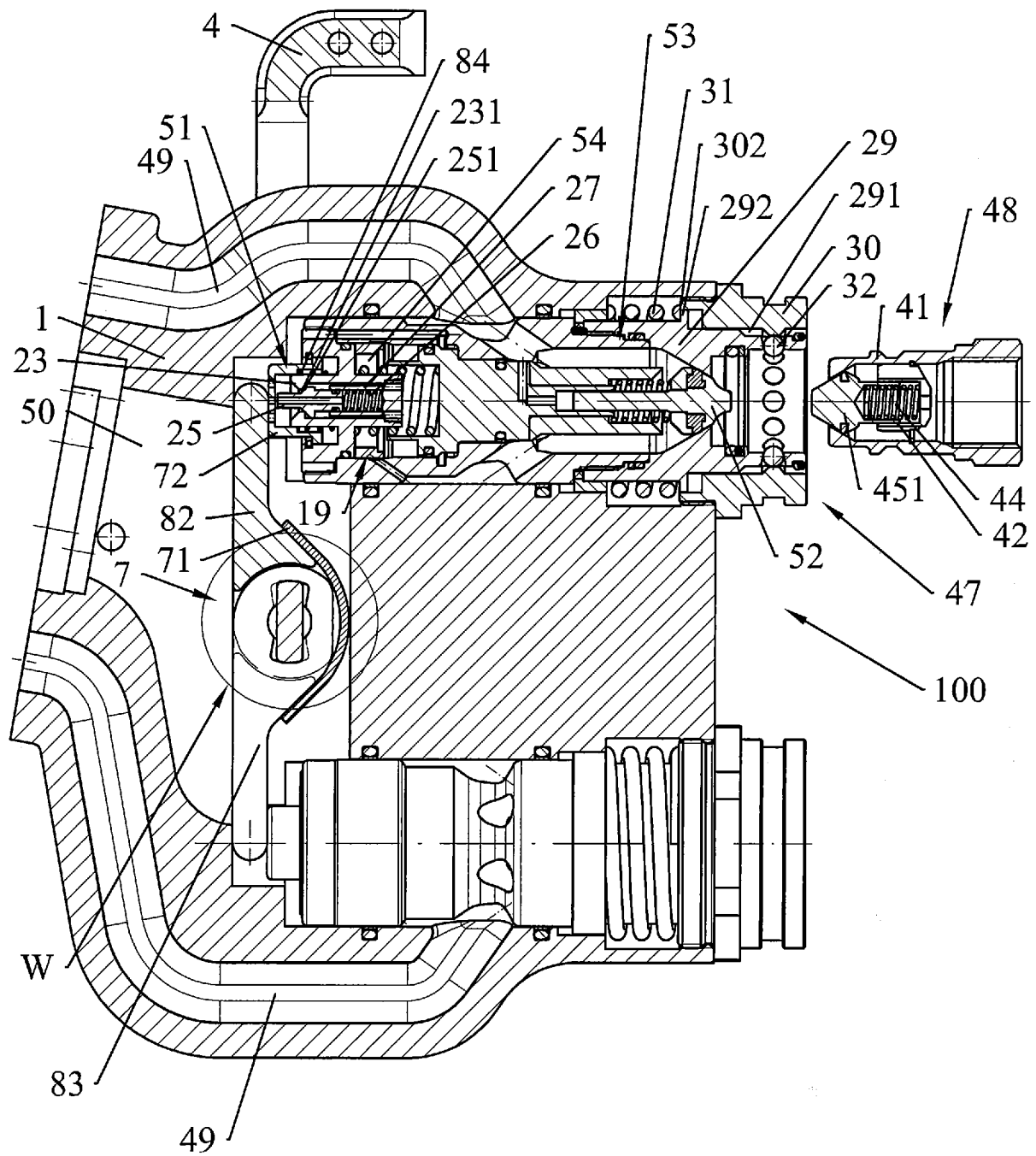


FIG.1

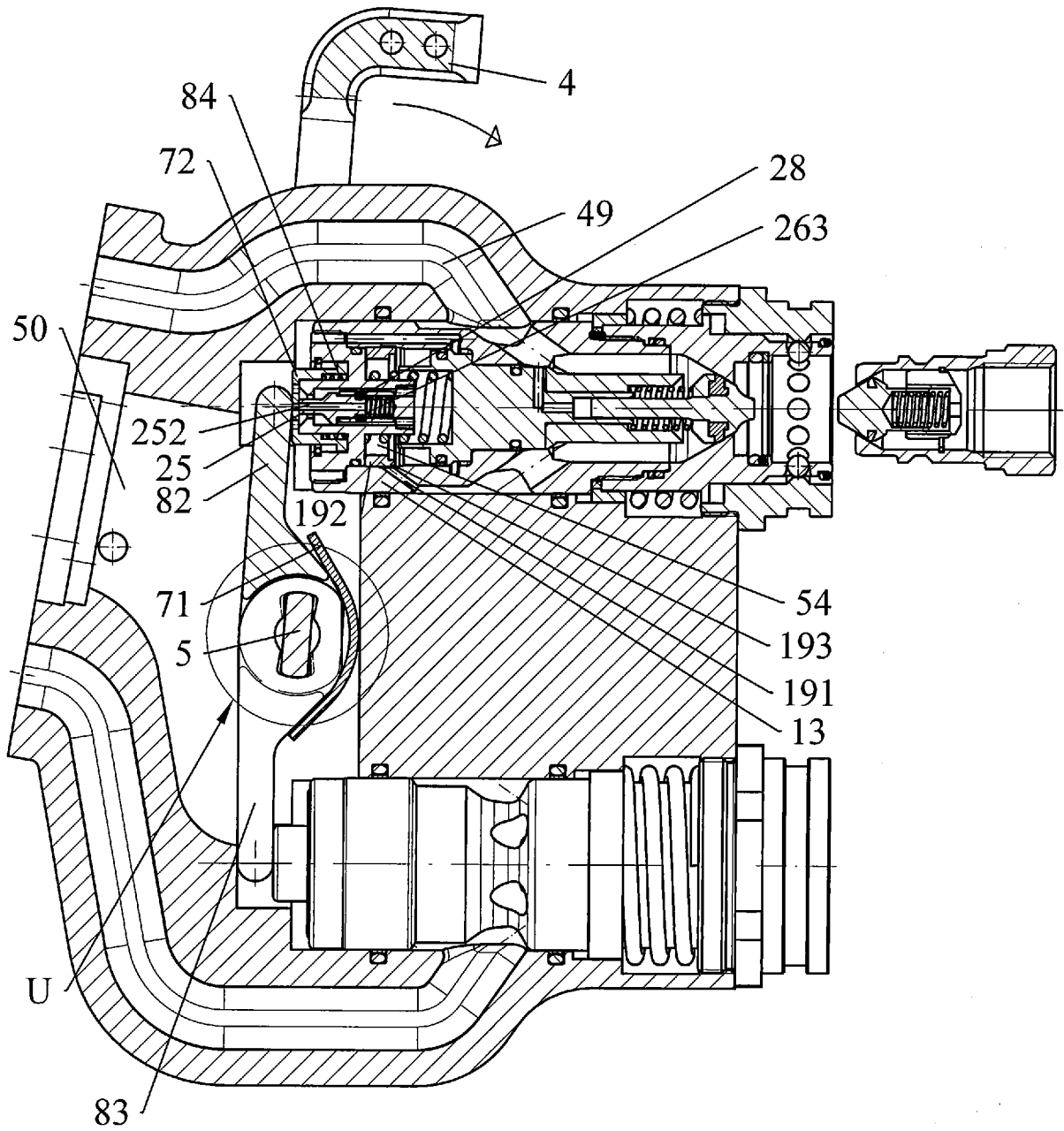


FIG.2

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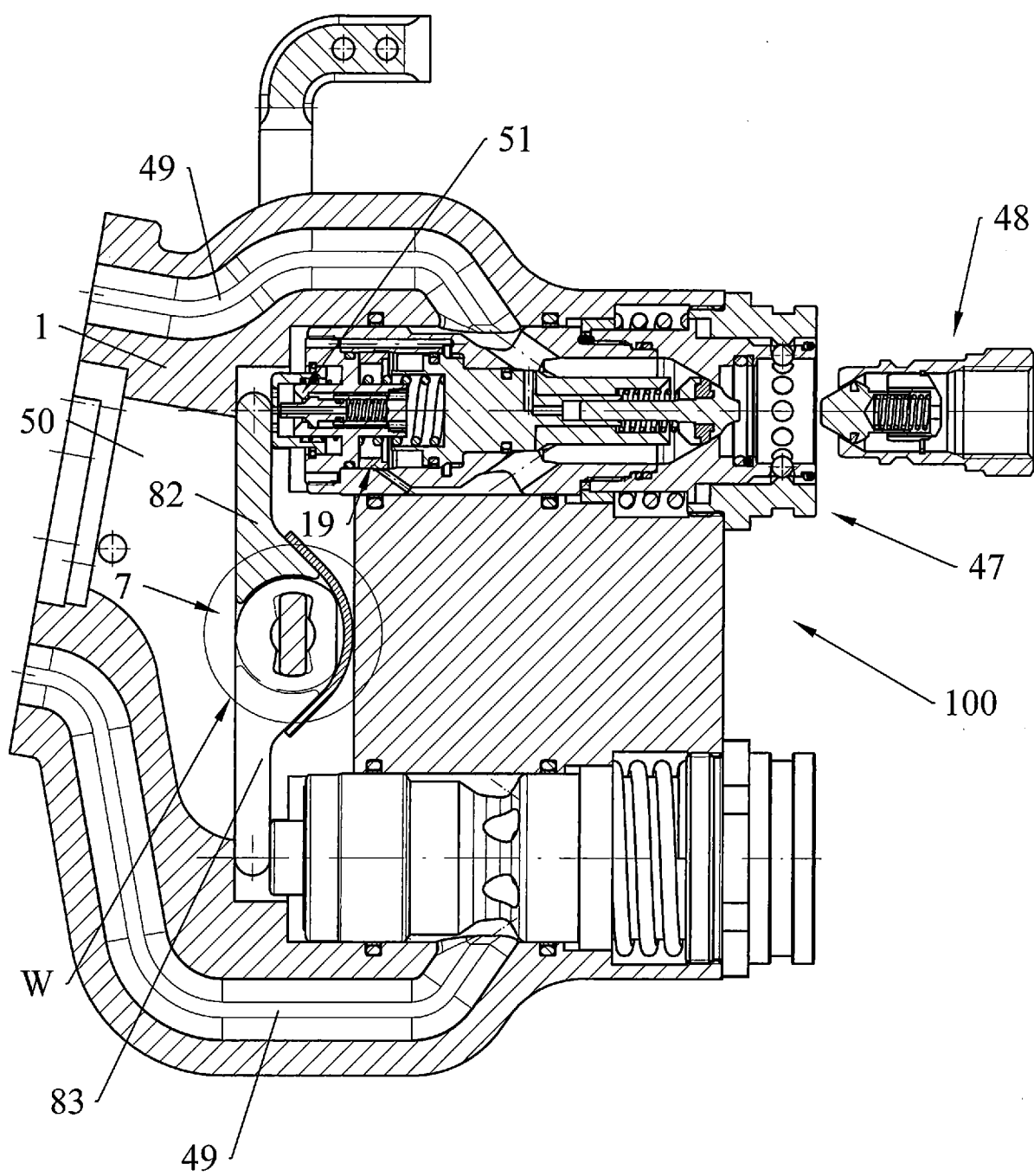


FIG.3

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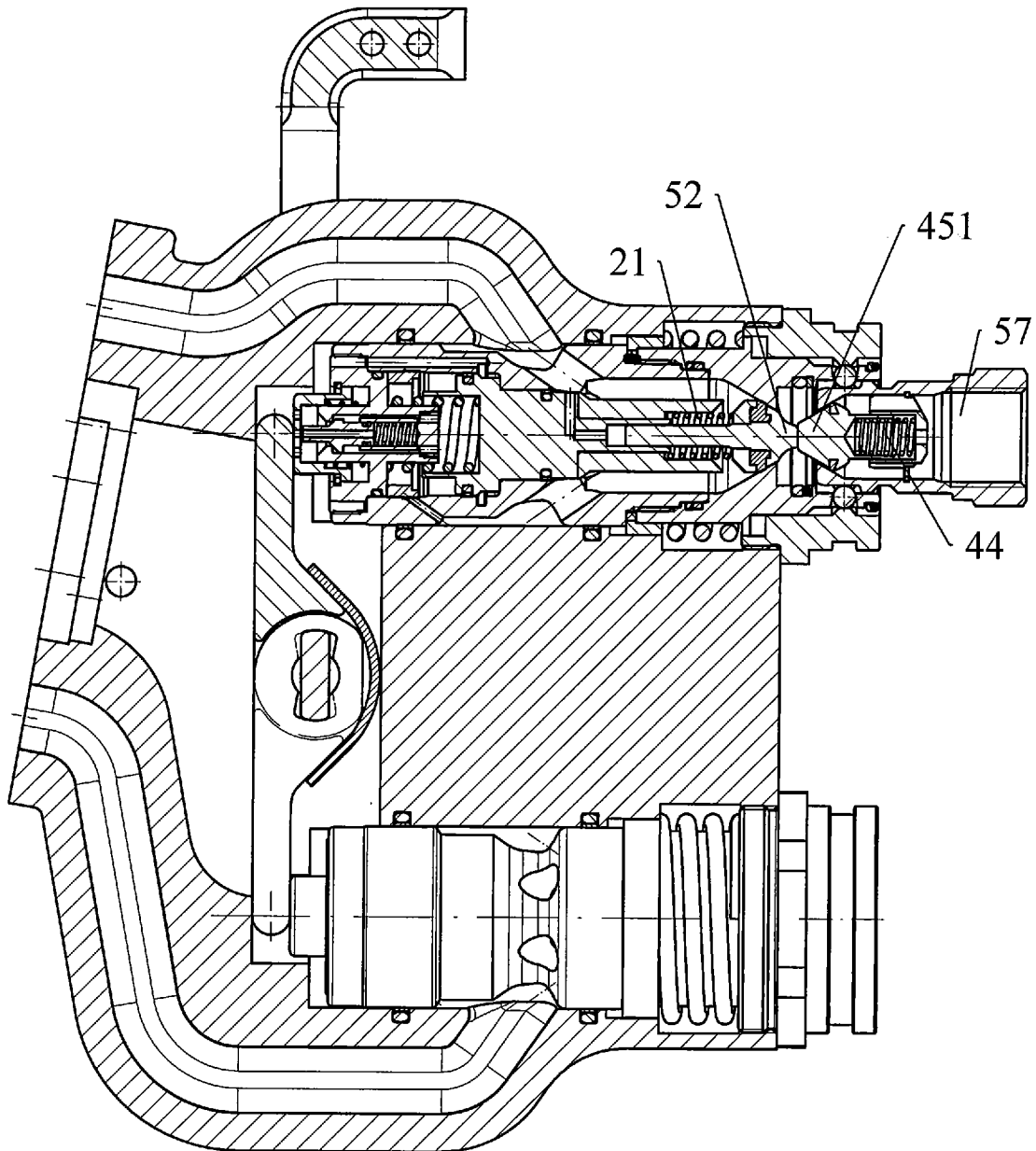


FIG.4

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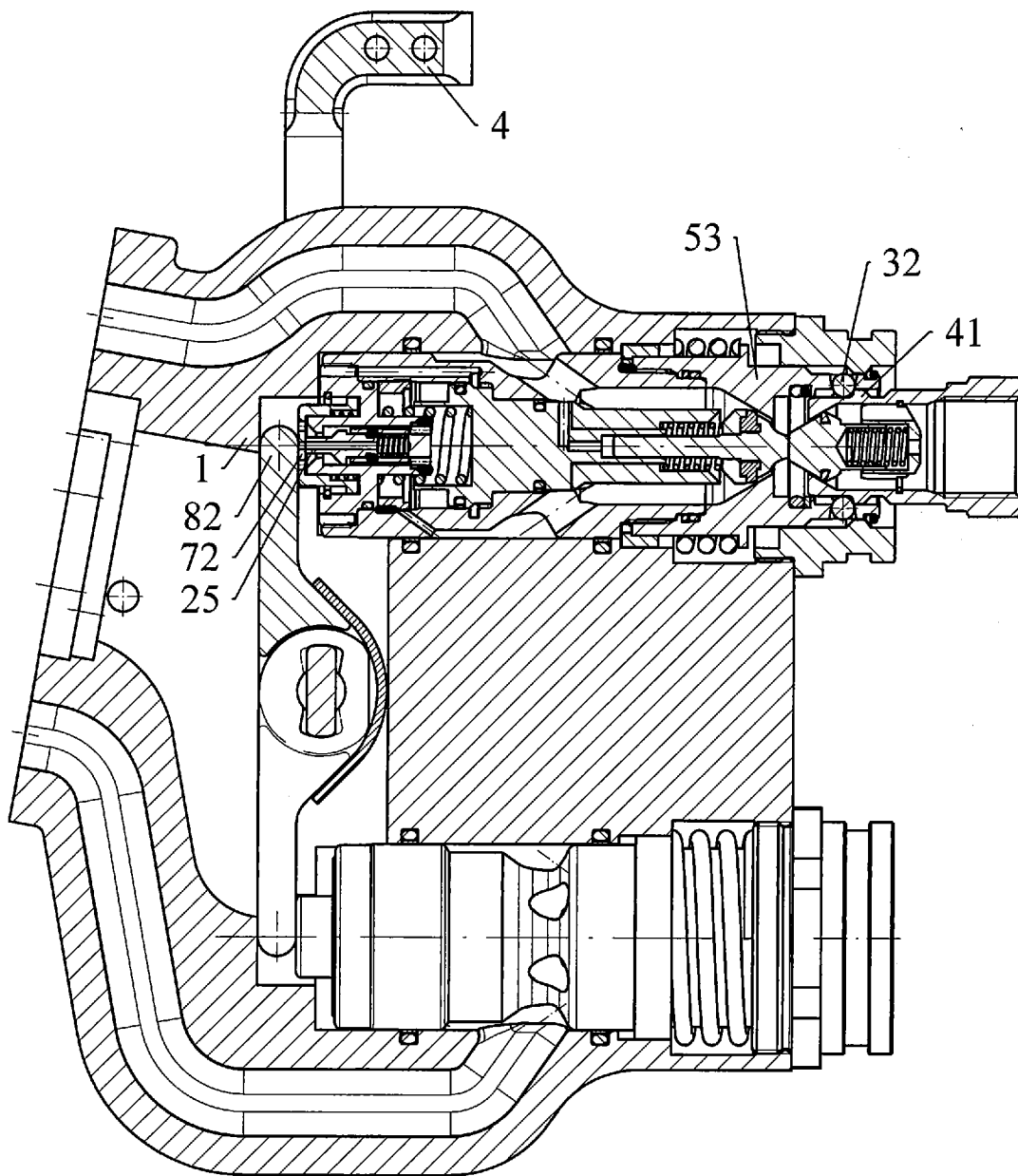


FIG.5

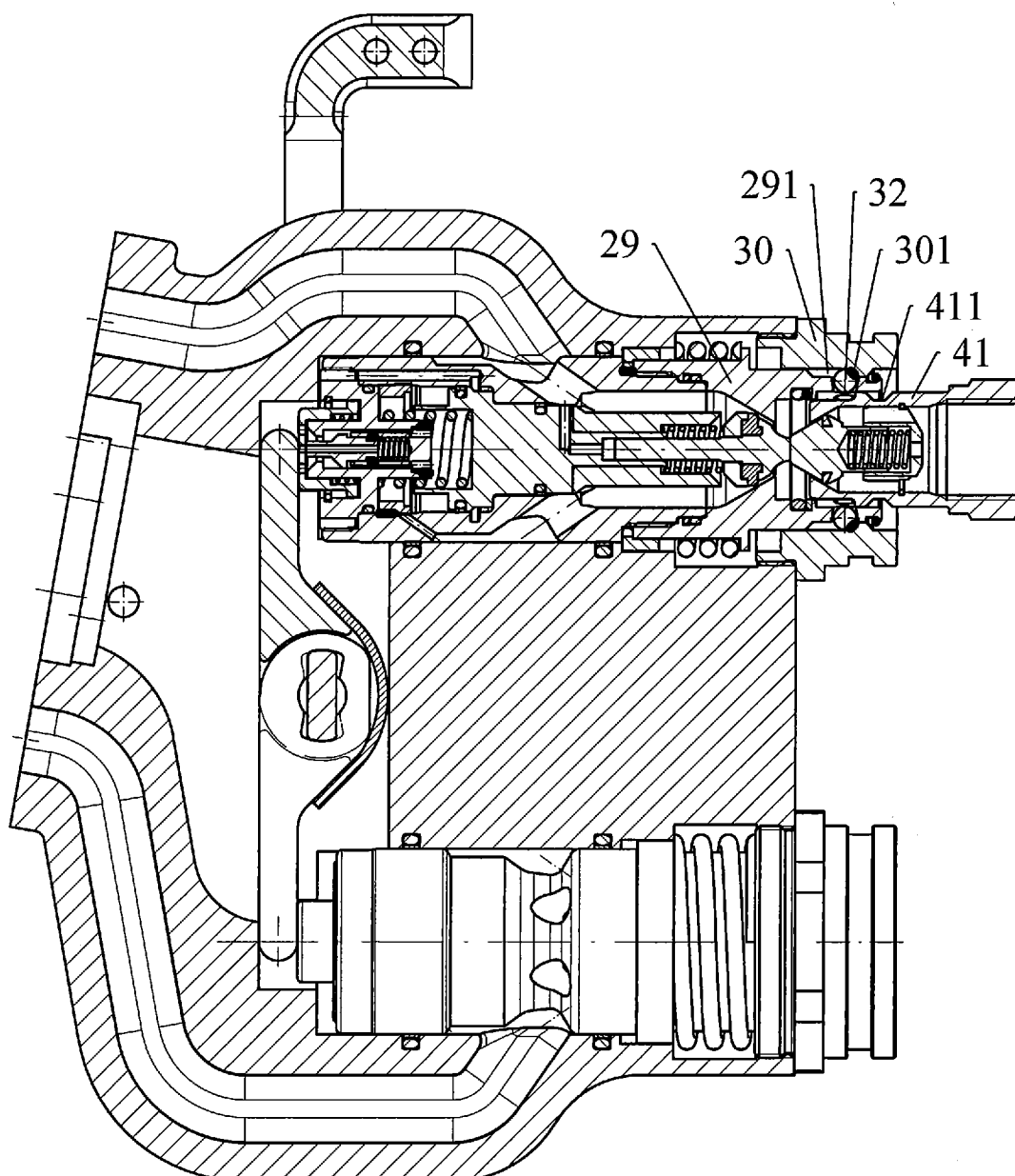


FIG.6

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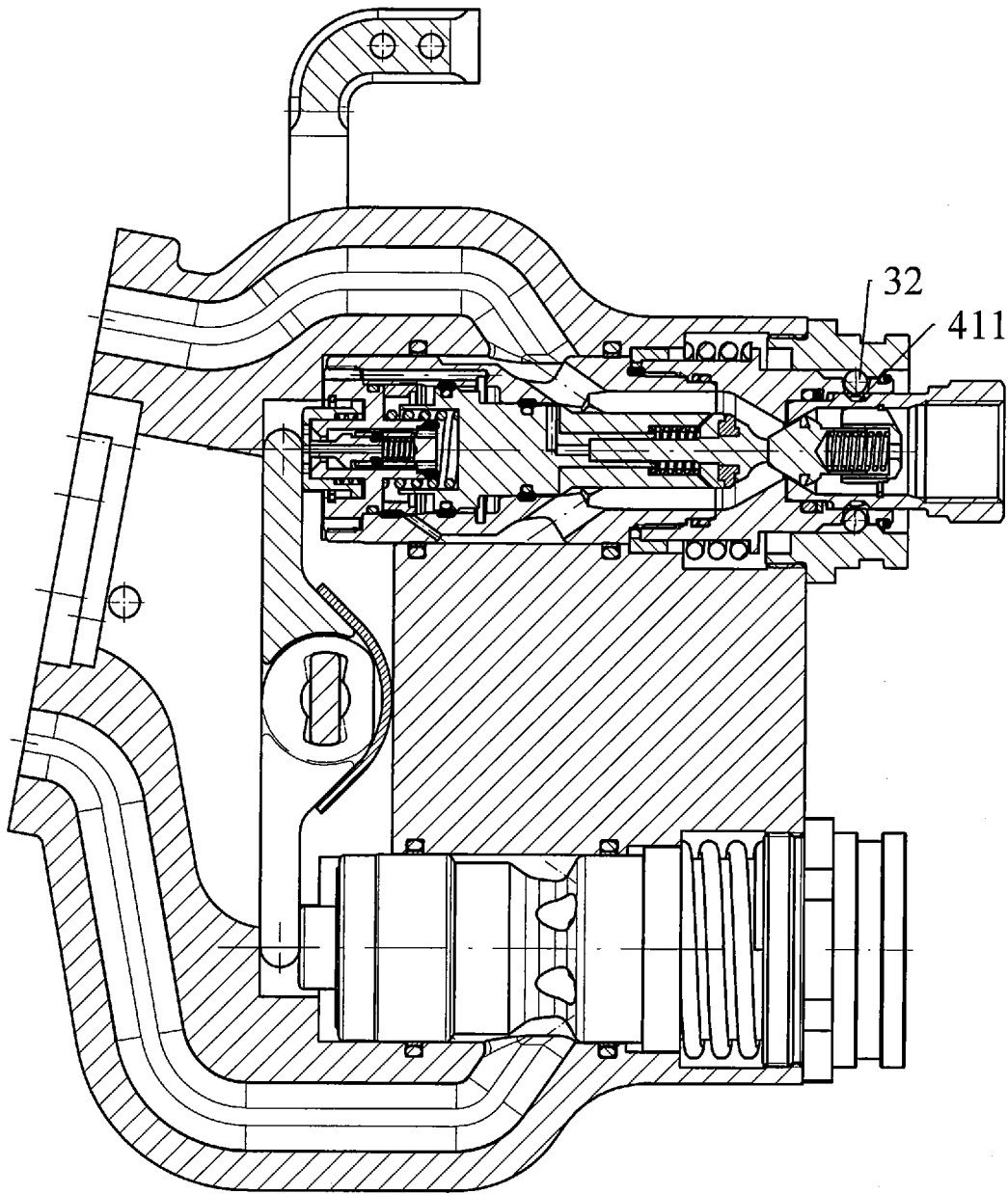


FIG.7

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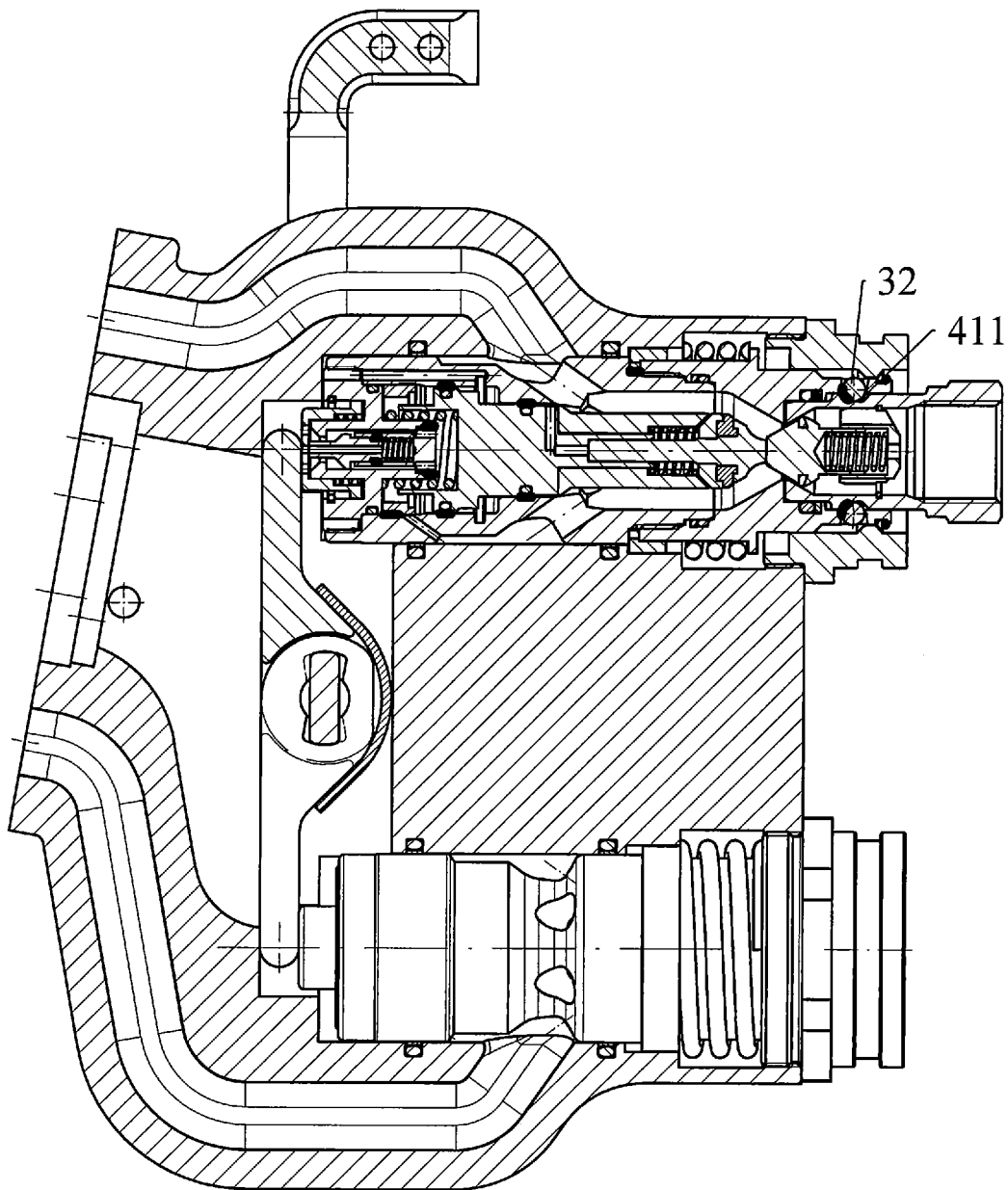


FIG.8

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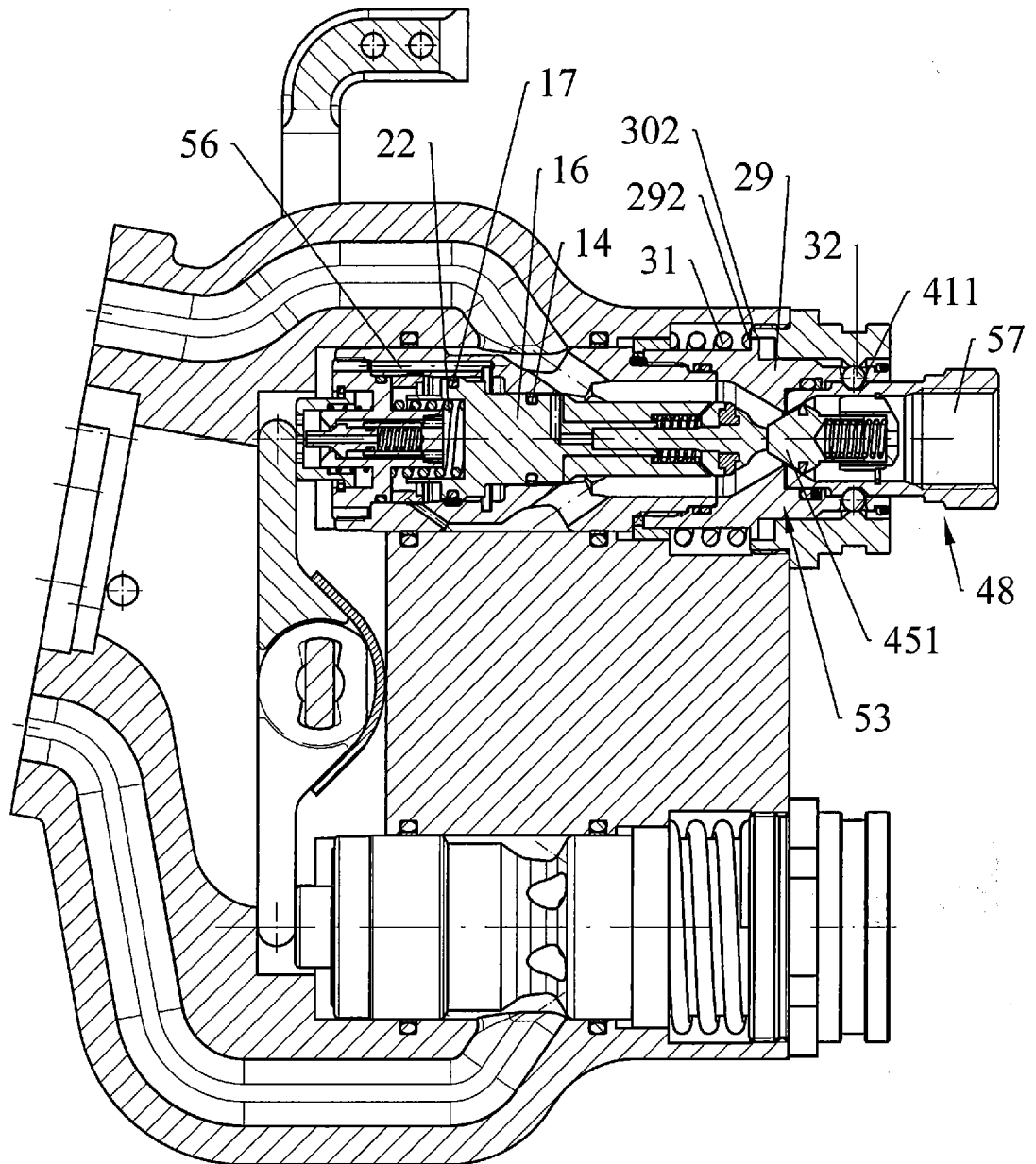


FIG.9

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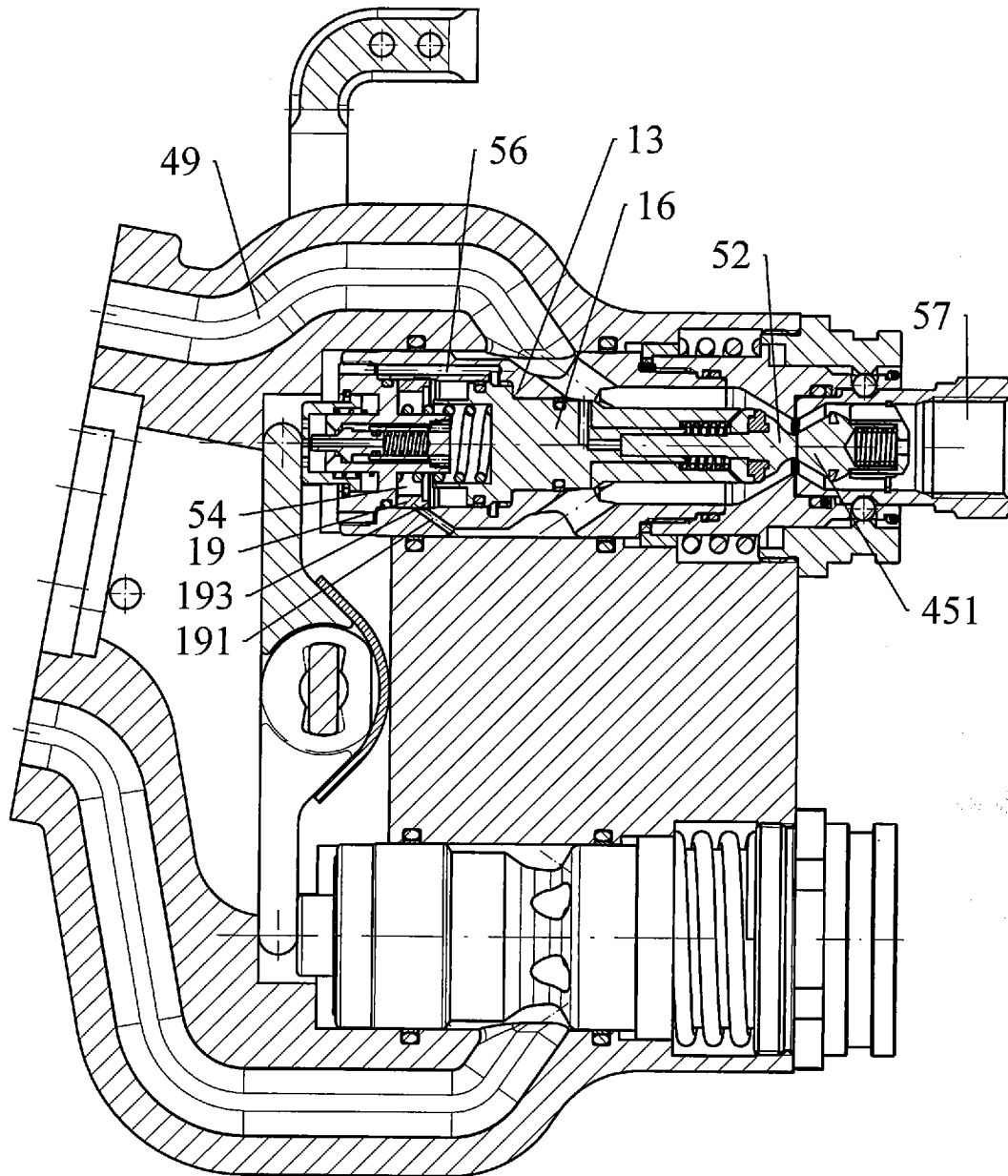


FIG.10

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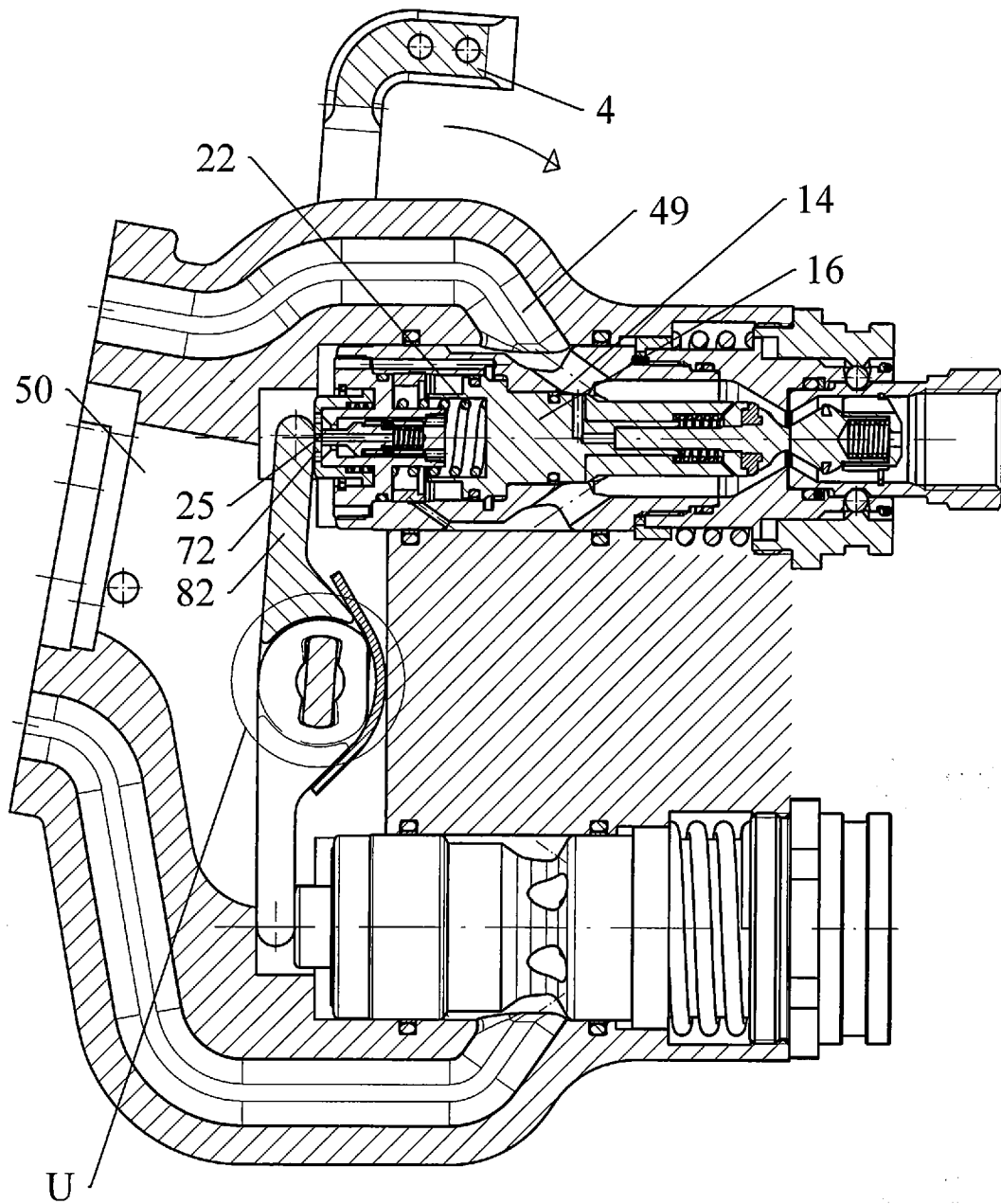


FIG.11

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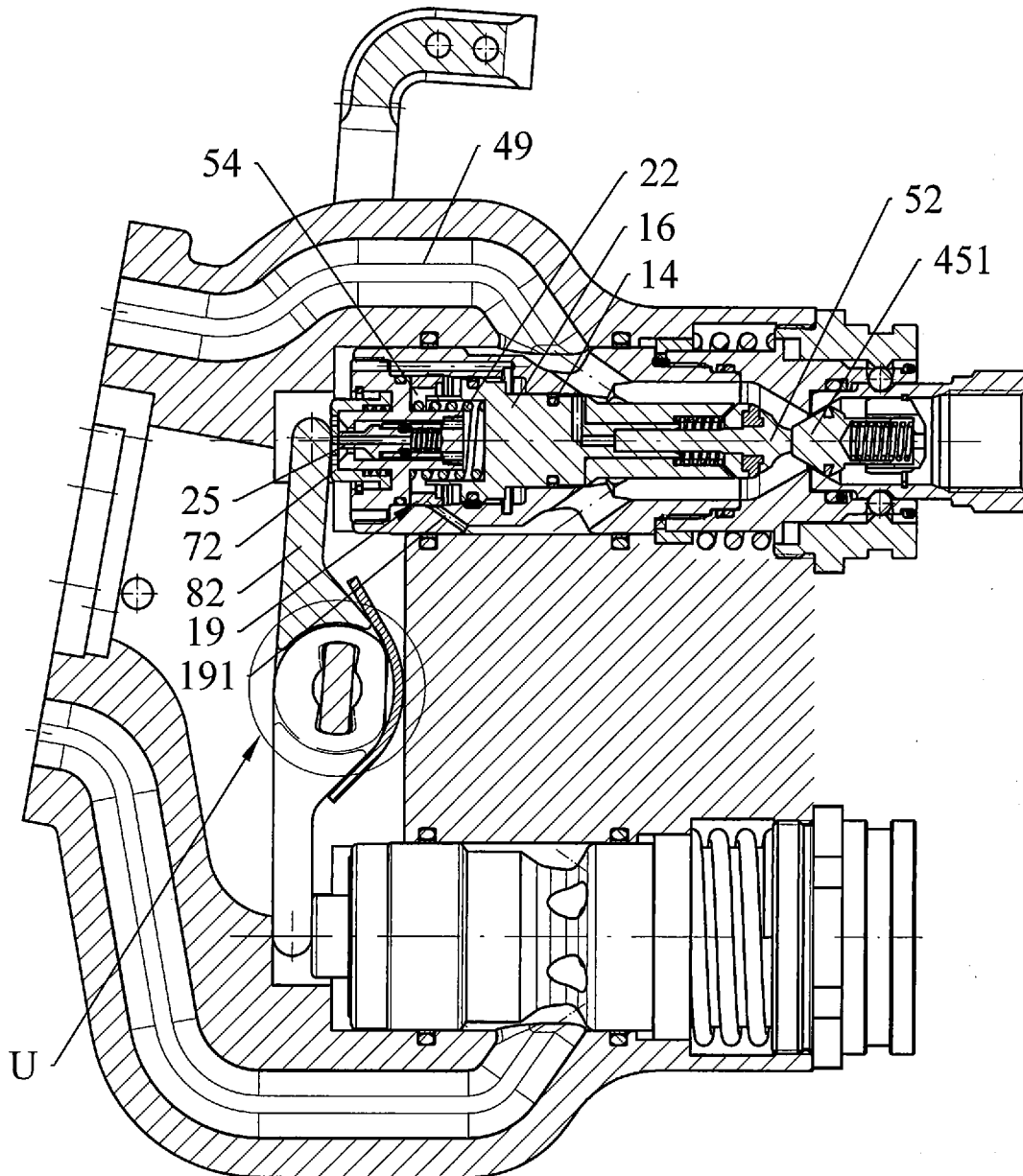


FIG.12

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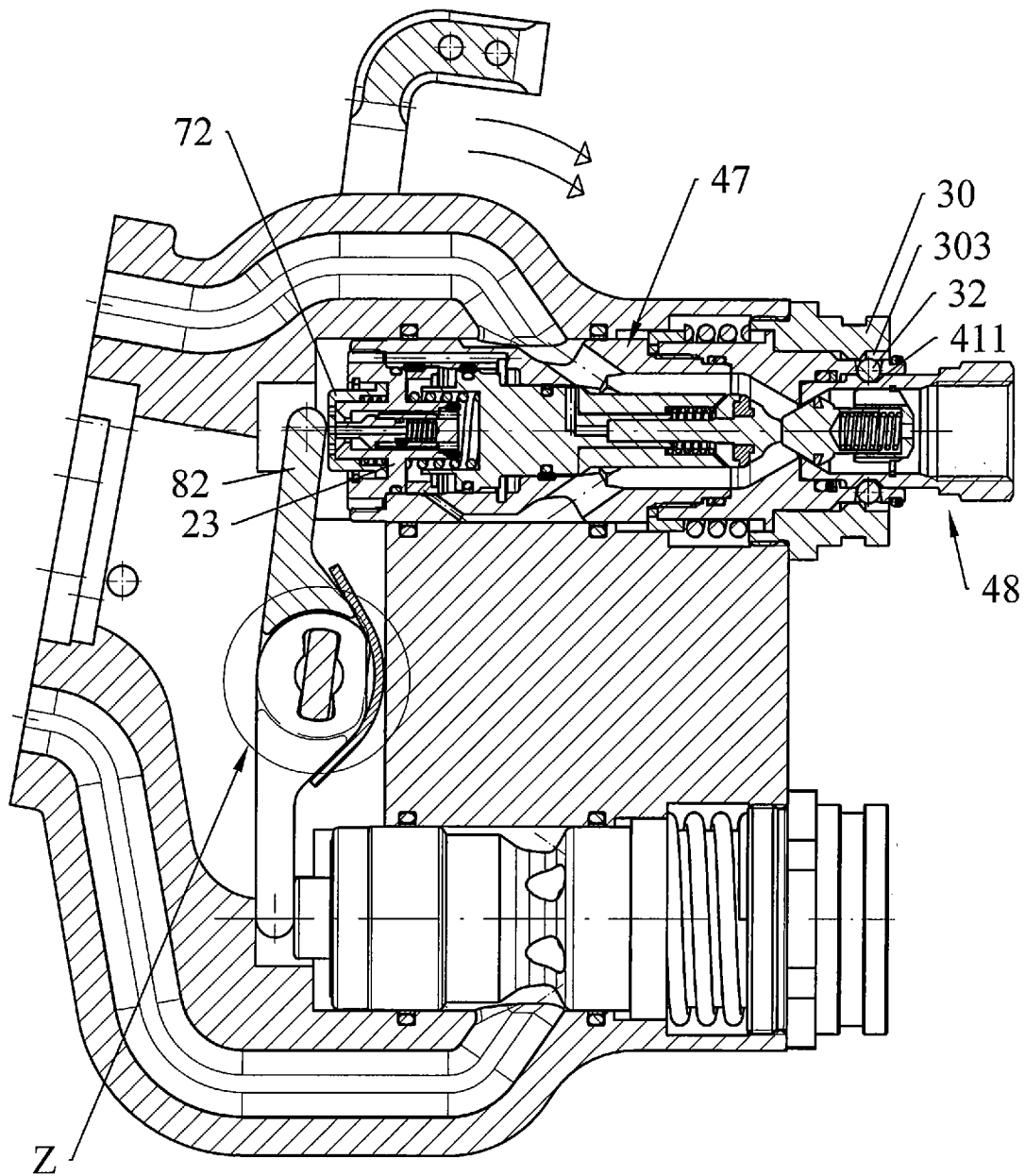


FIG.13

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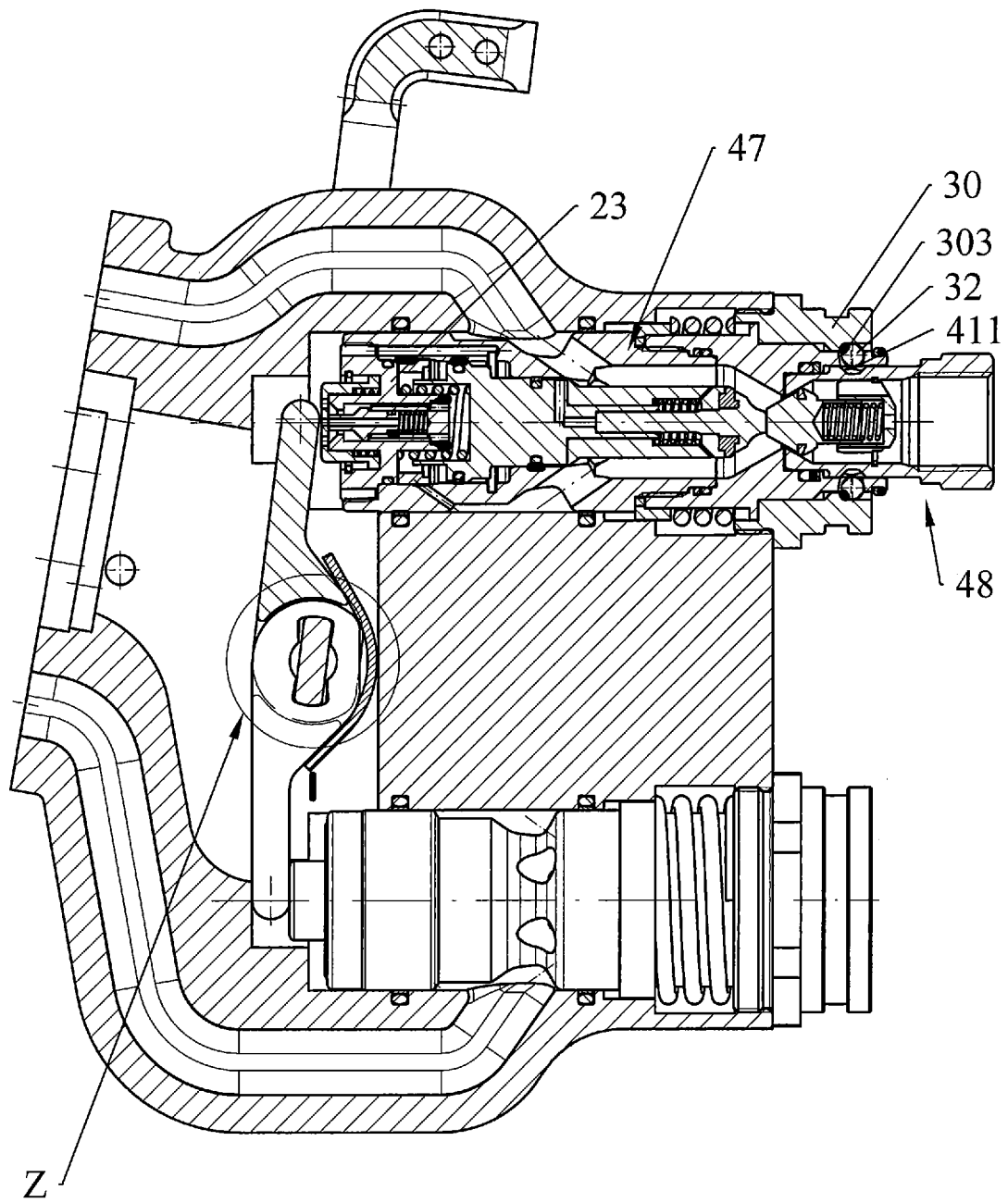


FIG.14

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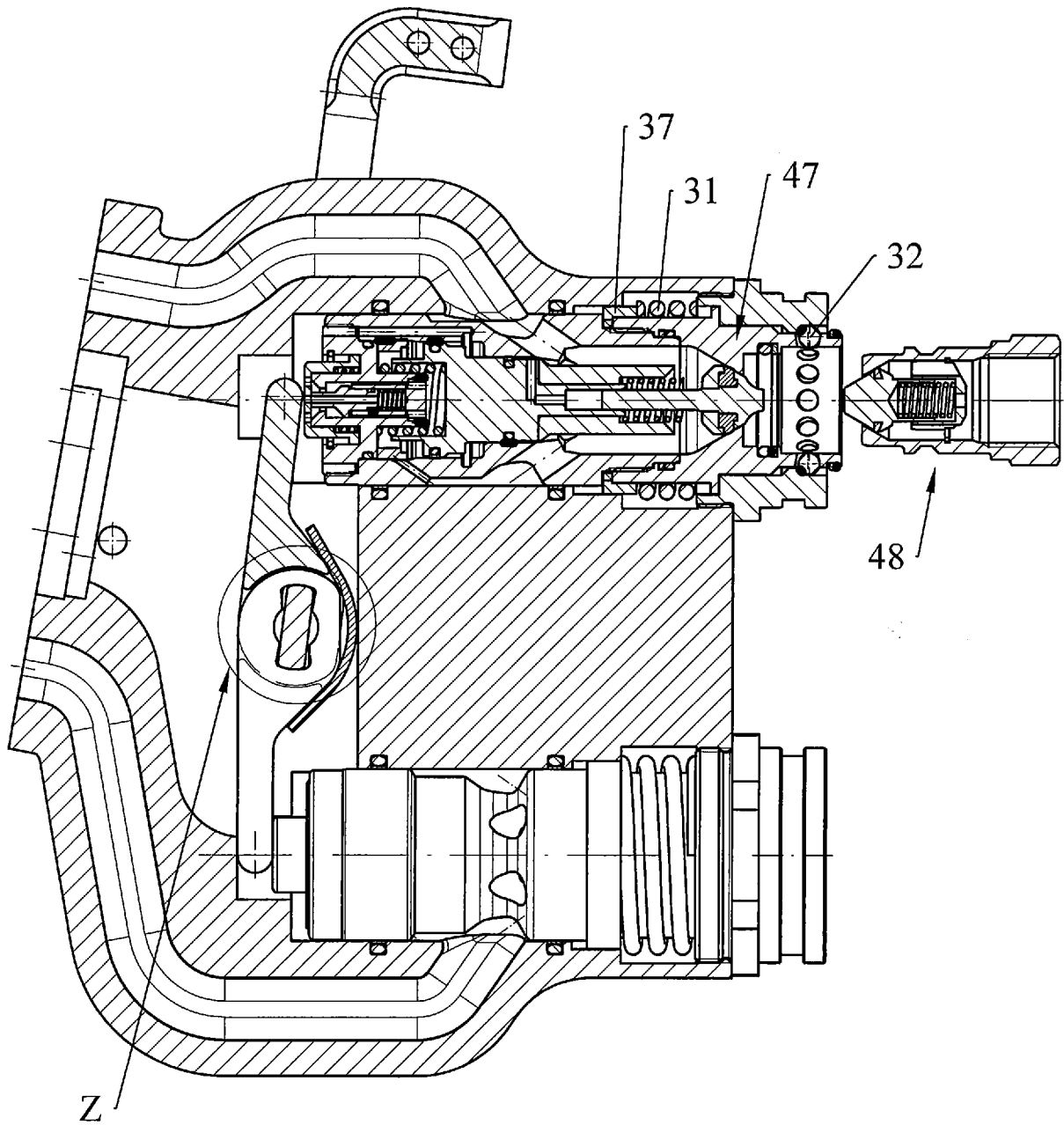


FIG.15

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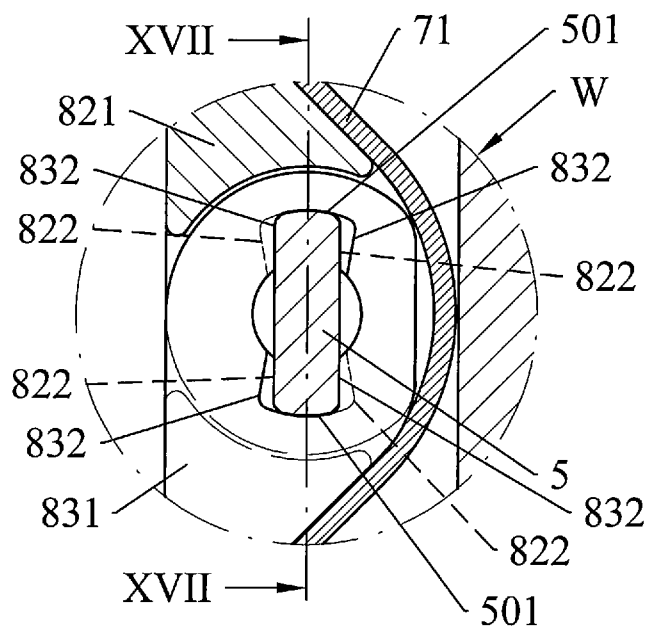


FIG.16

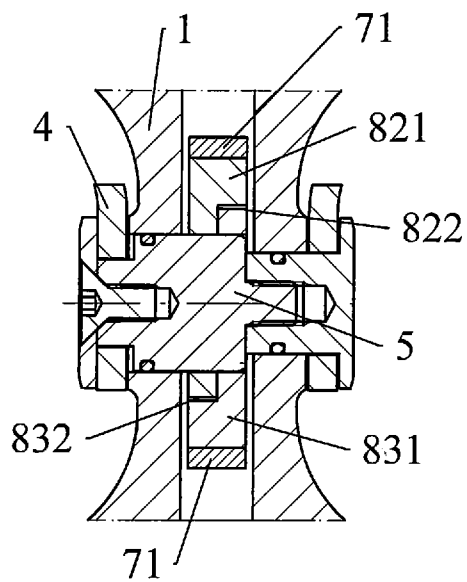


FIG.17

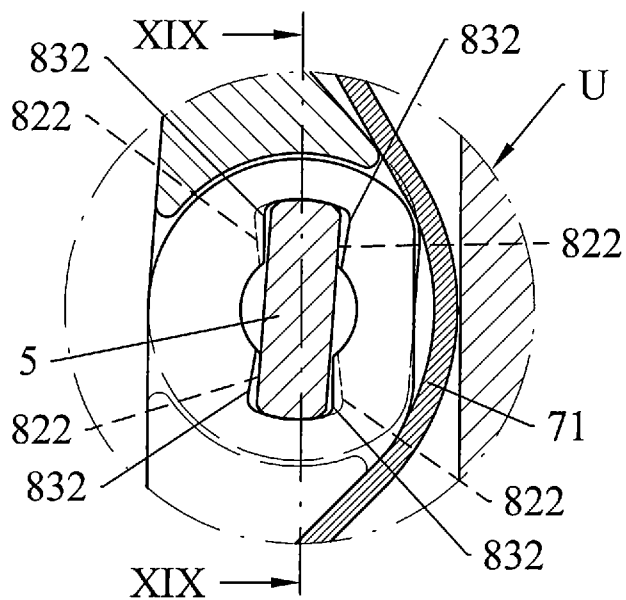


FIG.18

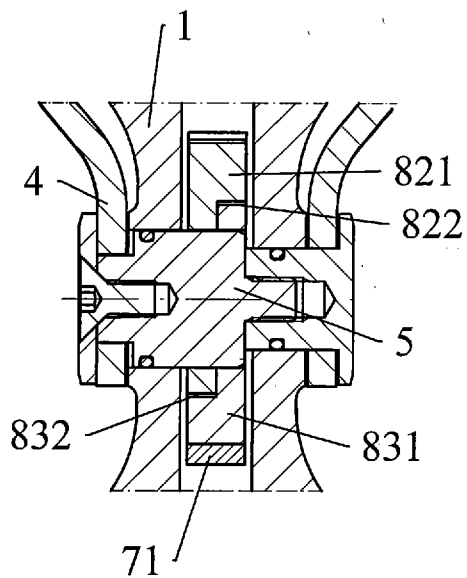


FIG.19

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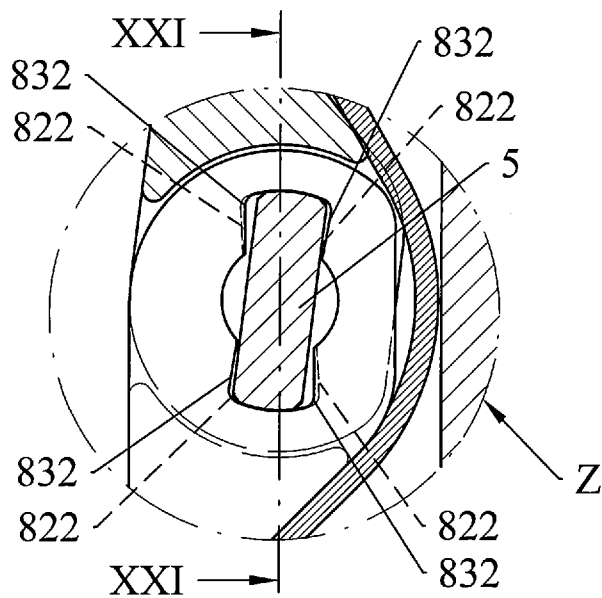


FIG. 20

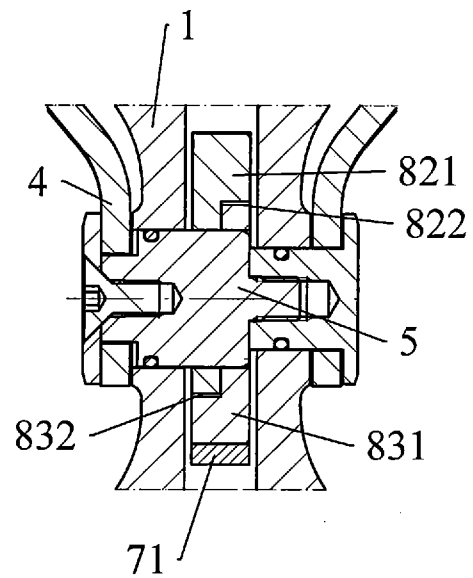


FIG. 21

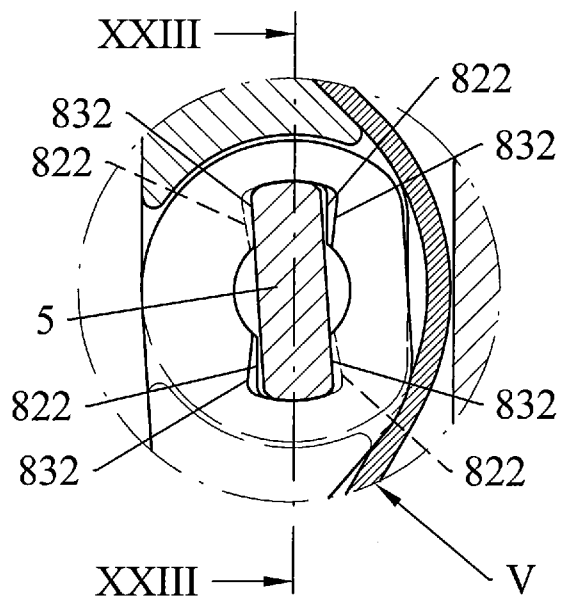


FIG. 22

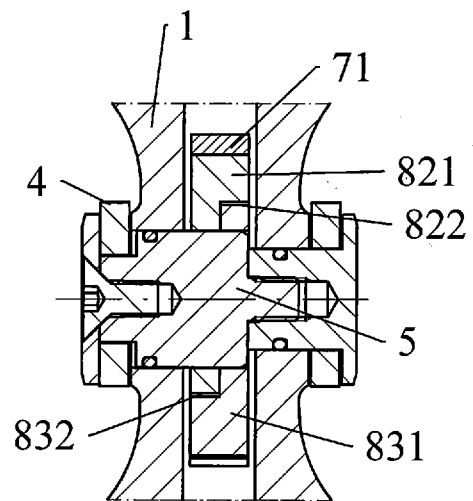
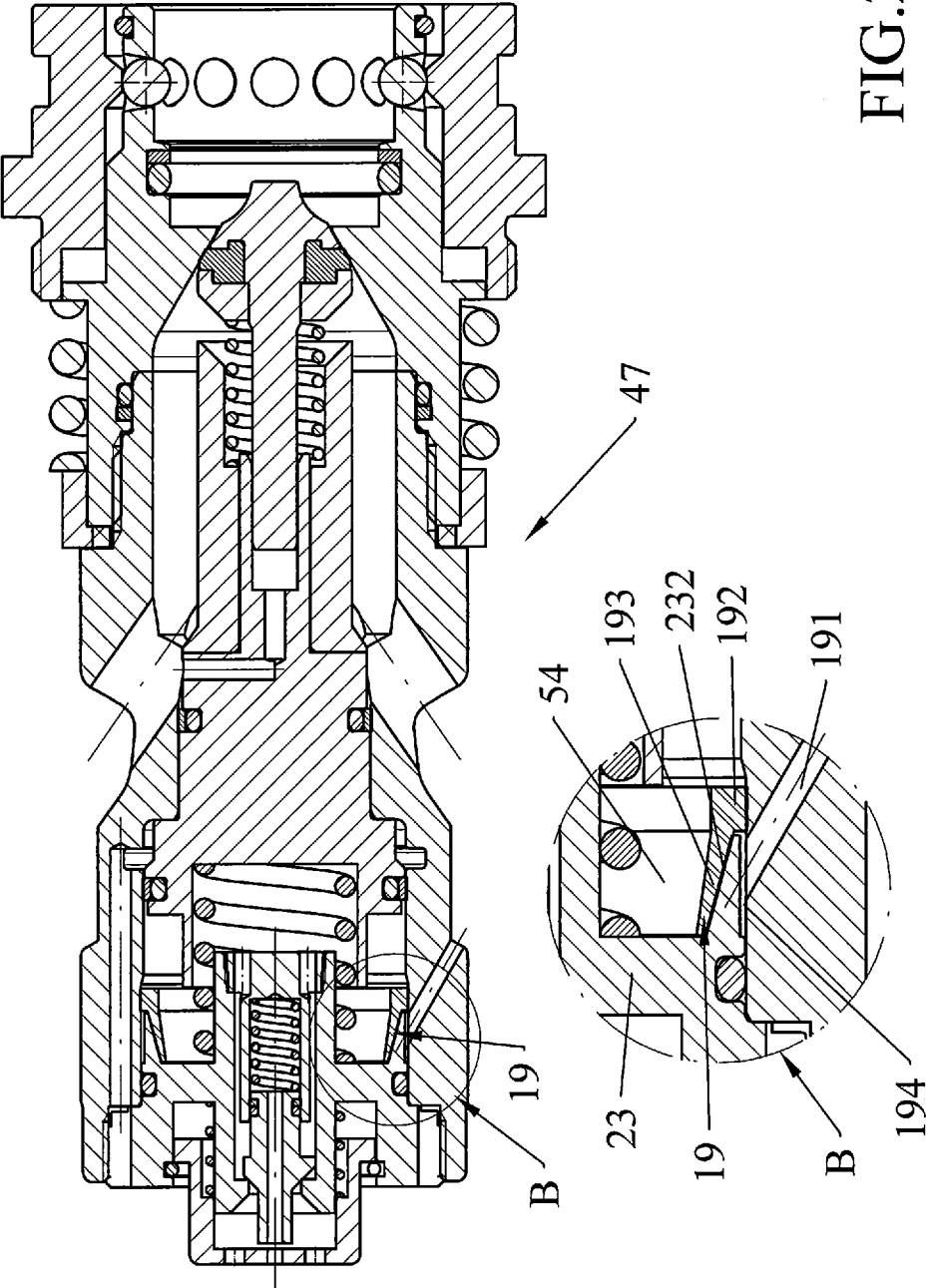
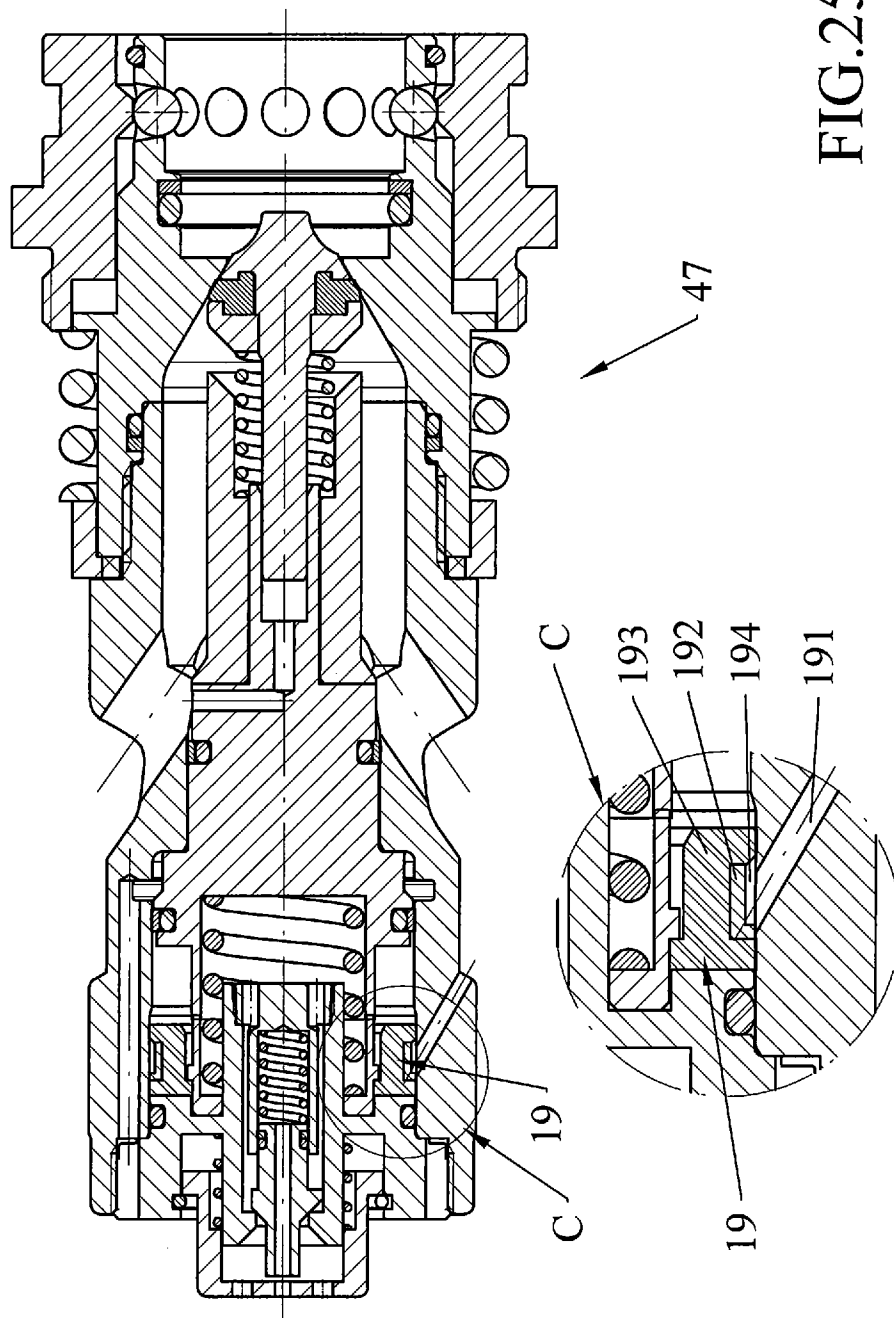


FIG. 23



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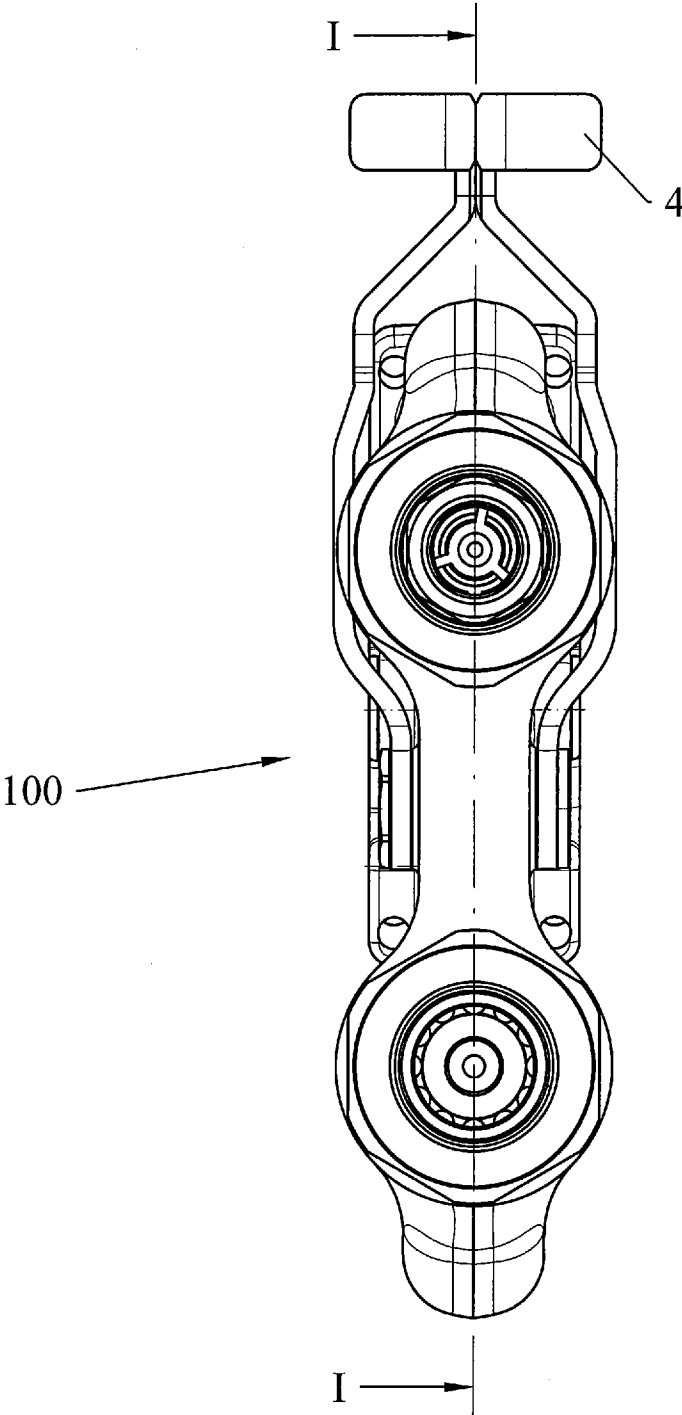


FIG.26

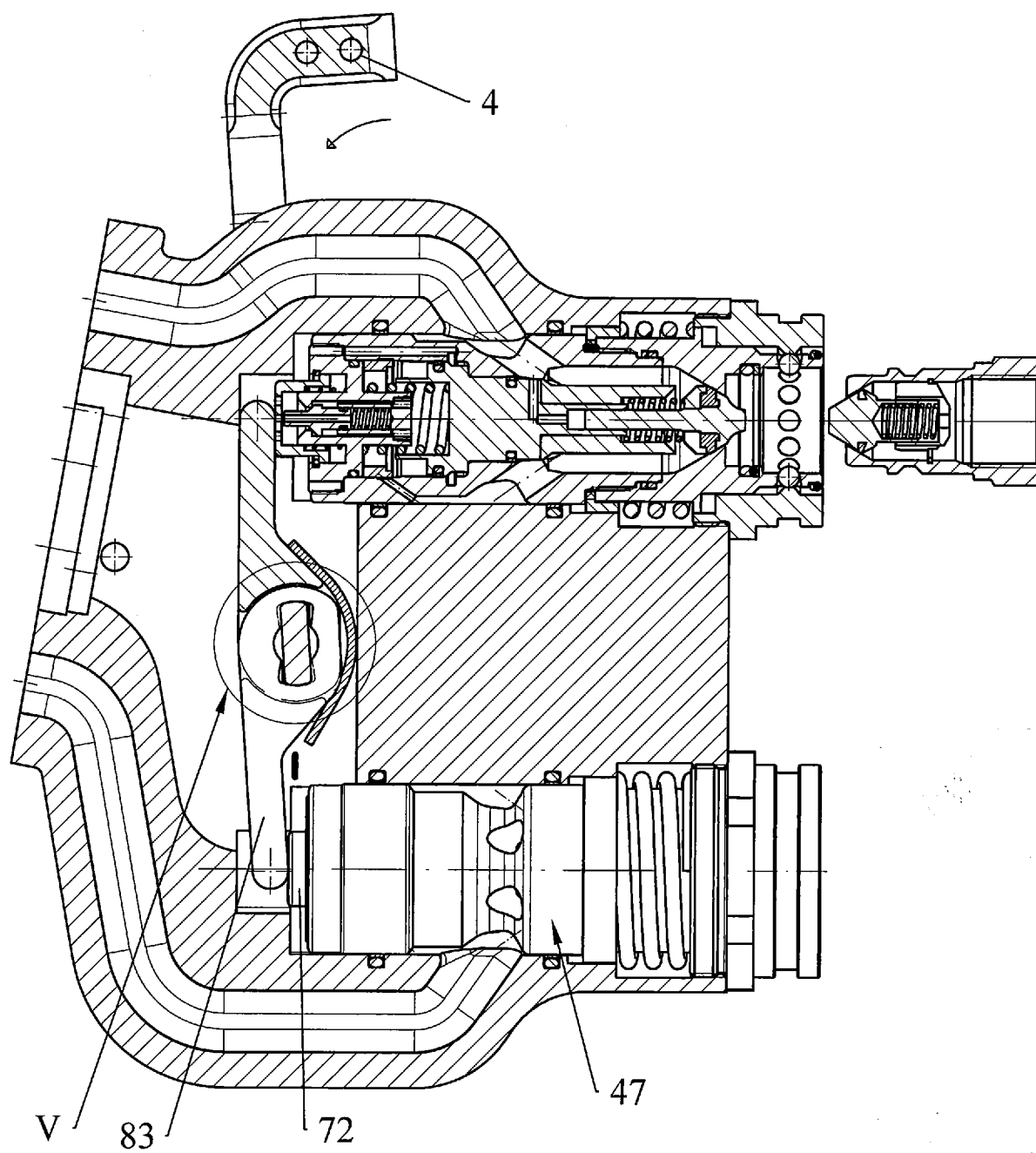


FIG.27

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2014/074119

A. CLASSIFICATION OF SUBJECT MATTER

INV. F16L37/23 F16L37/38 F16L37/56 F16K11/18
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)

F16L F16K

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 2006/273580 A1 (MARQUIS TIMOTHY T [US]) 7 December 2006 (2006-12-07)	1
Y	paragraph [0012] - paragraph [0038]; figures	2-4
X	EP 0 048 822 A2 (DEERE & CO [US]) 7 April 1982 (1982-04-07) page 4 - page 8; figures	1-5
Y	US 1 478 289 A (JOSEPH MAHONEY JOHN) 18 December 1923 (1923-12-18) the whole document	2-4
A	GB 555 181 A (ARTHUR LARUE PARKER) 9 August 1943 (1943-08-09) the whole document	1



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

5 February 2015

Date of mailing of the international search report

25/02/2015

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Popescu, Alexandru

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2014/074119

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