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(54) **Method for manufacturing an open/close element for balanced servo valves of a fuel injector.**

Verfahren zur Herstellung eines Öffnen/Schliessen-Elements für ausgeglichene Servoventile von Kraftstoffeinspritzdüsen

Procédé pour la fabrication d'un élément d'ouverture/fermeture pour servovalves équilibrées d'un injecteur de carburant

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Description

[0001] The present invention relates to a method for manufacturing an open/close element for balanced servo valves of a fuel injector, in which the open/close element comprises a bushing designed to move for a certain axial travel along a fixed stem for opening and closing the servo valve. The invention moreover relates to an open/close element manufactured applying the aforesaid method.

[0002] In servo valves of the type described, as for example shown in DE 102006021741 and US 2009/0032621, the discharge duct of the servo valve gives out onto a lateral surface of the stem, in such a way that, in the closing position, the bushing is subject to a substantially zero axial pressure. Consequently, the servo valve is of a balanced type and requires relatively small forces for its displacement. The bushing is brought into the closing position by a corresponding spring, and is controlled so as to be brought into the opening position of the servo valve, against the action of the spring, by a disk-shaped anchor, actuated by an electric actuator.

[0003] In order to reduce or eliminate the rebounds of the bushing when it is brought into the closing position, the need is felt to separate the anchor from the bushing and to displace the anchor axially for a travel greater than the travel of the bushing so as to strike against the latter when it rebounds.

[0004] The production of this type of servo valves presents the problem of providing two stop, or impact, elements for the travel of the anchor, which must be fixed with respect to the bushing and must be set on the latter with extreme precision. In addition, said type of production presents the problem of mounting the anchor in a slidable way on the bushing and of fixing thereon an intermediate body, on which the spring acts. Since said intermediate body has a flange that must be fixed in contact with an end edge of the bushing, fixing of the flange by means of welding, for example laser welding, presents various difficulties. In any case, the external profile of the anchor and of its housing must remain unaltered.

[0005] The aim of the invention is to provide a method for manufacturing an open/close element for balanced servo valves of the type described above, which will solve the problems referred to above and presents a high reliability and a limited cost.

[0006] According to the invention, the above purpose is achieved by a method for manufacturing an open/close element for balanced servo valves of a fuel injector, as defined in Claim 1.

[0007] For a better understanding of the invention described herein is a preferred embodiment, provided by way of example with the aid of the annexed drawings, wherein:

- Figure 1 is partial median section of a servo valve, the open/close element of which is manufactured with the method according to the invention;
- Figure 2 is a perspective view of a component of the open/close element;
- Figure 3 is a partial median section of the open/close element of Figure 1, in a production step;
- Figure 4 is a median section of a servo valve according to a variant of Figure 1;
- Figure 5 is a portion of Figure 4 at an enlarged scale; and
- Figure 6 is a partial median section of the open/close element of Figure 4, in a production step.

[0008] With reference to Figure 1, designated as a whole by 2 is a hollow body or casing of a fuel injector for an internal-combustion engine, in particular a diesel engine. The casing 2 extends along a longitudinal axis and terminates with a nozzle, or nebulizer (not visible in the figure) for injection of the fuel at a high pressure.

[0009] The casing 2 has an axial cavity 34, housed in which is a dosage servo valve 5, comprising a valve body 7 having an axial hole, in which a rod for control of injection (not visible in Figure 1 either) is able to slide. This rod is controlled by the pressure of the fuel in a control chamber, which is contained in the valve body 7 and is not visible in Figure 1 either. Housed in a portion of the cavity 34 is an electric actuator 15, comprising an electromagnet 16, designed to control an anchor 17 in the form of a notched disk. In particular, the electromagnet 16 comprises a magnetic core 19, which has a polar surface 20 perpendicular to the axis of the casing 2 and is held in position by a support or jacket 21.

[0010] The electric actuator 15 has an axial cavity 22 in communication with the discharge of the servo valve 5 towards the usual fuel tank. Housed in the cavity 22 is a helical compression spring 23, pre-loaded so as to exert an action of thrust on the anchor 17 in a direction opposite to the attraction exerted by the electromagnet 16. The spring 23 acts on the anchor 17 through an intermediate body, designated as a whole by 12a, which comprises a flange 24 made of a single piece with a pin 12 for guiding one end of the spring 23. Set between a plane top surface 17a of the anchor 17 and the polar surface 20 of the core 19 is a thin lamina 13 made of nonmagnetic material in order to guarantee a certain gap between the anchor 17 and the core 19.

[0011] The valve body 7 comprises a flange 33 housed in the cavity 34 and kept fixed, in a fluid-tight way, against a shoulder (not visible in the figure) by a threaded ring nut 36, screwed on an internal thread 37 of the cavity 34. The anchor 17 is associated to a bushing 41, guided axially by an axial stem 38, which is made of a single piece with the flange 33 of the valve body 7 and extends in cantilever fashion from the flange 33 itself towards the cavity 22. The stem 38 has a cylindrical lateral surface 39, which guides axial sliding of the bushing 41. In particular, the bushing 41 has a cylindrical internal surface 40, coupled to the lateral surface 39 of the stem 38 substantially in a fluid-tight way, for example with a diametral play of less than 4 μm, or else by means of interposition

of annular seal elements.

[0012] The control chamber of the body 7 has an outlet duct 43 for the fuel, made axially inside the flange 33 and the stem 38. The duct 43 is in communication with at least one substantially radial stretch of duct 44. Advantageously, two or more radial stretches 44 can be provided, set at constant angular distances apart, which give out into an annular chamber 46, formed by a groove of the lateral surface 39 of the stem 38. In Figure 1, two stretches 44 are provided, inclined in the direction of the anchor 17.

[0013] The annular chamber 46 is obtained in an axial position adjacent to the flange 33 and is opened/closed by a terminal portion of the bushing 41, which forms the open/close element 47 for said annular chamber 46 and hence also for the radial stretches of duct 44. The open/close element 47 is consequently made of a single piece with the bushing 41 and co-operates with a corresponding stop for closing the servo valve 5. In particular, the open/close element 47 terminates with a stretch having an internal surface shaped like a truncated cone 45 flared downwards and designed to stop against a connector shaped like a truncated cone 49 set between the flange 33 and the stem 38.

[0014] Advantageously, the connector 49 has two surface portions shaped like a truncated cone 49a and 49b, separated by an annular groove 50, which has a cross section shaped substantially like a right angle. The surface shaped like a truncated cone 45 of the open/close element 47 engages in a fluid-tight way the portion of surface shaped like a truncated cone 49a, against which it stops in the closing position. On account of the wear between these surfaces 45 and 49a, after a certain time the closing position of the open/close element 47 requires a greater travel of the bushing 41 towards the connector 49, always defining, as maximum diameter of the surface, the diameter of the cylindrical stretch of the annular groove 50.

[0015] The anchor 17 is made of a magnetic material and is formed by a distinct piece, i.e., a piece separate from the bushing 41. It has a central portion 56 having a plane bottom surface 57 and a notched annular portion 58, with cross section tapered outwards. The central portion 56 has an axial hole 59, by means of which the anchor 17 engages with a certain radial play along an axial portion of the bushing 41, formed by a collar 61 obtained on a flange 60 of the bushing 41. The collar 61 has a smaller diameter than the bushing 41 and hence also than the flange 60.

[0016] The flange 24 of the intermediate body 12a has a plane surface 65, designed to engage a surface 17a of the anchor 17 opposite to the surface 57. The bushing 41 is made of a single piece with a first stop element of the anchor 17, constituted by a shoulder 62, formed between the collar 61 and the flange 60 of the bushing 41. In addition, the intermediate body 12a comprises an axial pin 63 for connection of the bushing 41, which is made of a single piece with the flange 24 and must be fixed rigidly to the bushing 41 so that the surface 65 of the flange 24 of the intermediate body 12a is fixed with respect to the bushing 41. The connection pin 63 is designed to be housed in a corresponding seat 40a of the bushing 41. The seat 40a has a diameter slightly greater than the internal surface 40 of the bushing 41, in order to reduce the portion to be ground to ensure fluid tightness with the surface 39 of the stem 38.

[0017] Between the surface 39 of the stem 38 and the surface 40 of the bushing 41 there occurs in general a certain leakage of fuel, which leaks out into a compartment 48 between the end of the stem 39 and the connection pin 63. In order to enable discharge of the fuel leaking into the compartment 48 towards the cavity 22, the intermediate body 12a is provided with an axial hole 64.

[0018] The connection pin 63 extends axially from the plane surface 65 of the flange 24 in a direction opposite to the guide pin 12. In turn, the shoulder 62 is set in a position such as to create for the anchor 17 an axial play of a pre-set amount to enable a relative axial displacement between the anchor 17 and the bushing 41. The distance or space between the surface 65 of the flange 24 and the shoulder 62 of the bushing 41 constitutes the housing of the anchor 17. The plane surface 65 of the flange 24 bears upon an end surface or edge 66 of the collar 61 of the bushing 41 so that the housing of the anchor 17 is uniquely defined.

[0019] Normally, the anchor 17 rests against the shoulder 62 in the position indicated in Figure 1. The surface 65 of the flange 24 projects from the lamina 13 downwards by a distance equal to a certain travel, or lift, of the open/close element 47. The bushing 41 can be drawn axially by the anchor 17 upwards when the latter engages the flange 24. The anchor 17 can, however, perform a travel greater than the travel of the bushing 41; i.e., it can perform along the collar 61 an overtravel equal to the aforesaid play, between the two stop elements represented by the shoulder 62 of the bushing 41 and by the surface 65 of the flange 24.

[0020] When the electromagnet 16 is not energized, the open/close element 47 is held, by the spring 23 acting on the body 12a, resting with its surface shaped like a truncated cone 45 against the portion shaped like a truncated cone 49a of the connector 49 so that the servo valve 5 is closed. Normally, the anchor 17 is detached from the lamina 13 and rests against the shoulder 62. In the annular chamber 46 there is hence set up a pressure of the fuel, the value of which is equal to the supply pressure of the injector.

[0021] When the electromagnet 16 is energized to perform an opening stroke of the servo valve 5, the core 19 attracts the anchor 17, which at the start performs a loadless travel, until it is brought into contact with the surface 65 of the flange 24, without affecting the displacement of the bushing 41. Next, the action of the electromagnet 16 on the anchor 17 overcomes the force of the spring 23 and, via the flange 24 and the fixing pin 63, draws the

bushing 41 towards the core 19 so that the open/close element 47 opens the servo valve 5.

[0022] When energization of the electromagnet 16 ceases, the spring 23, via the body 12a, causes the bushing 41 to perform the travel towards the closing position of the servo valve 5. During a first stretch of this closing travel, the flange 24, with the surface 65, draws the anchor 17 along with it, which hence moves together with the bushing 41. At the end of its travel, the open/close element 47 impacts with its conical surface 45 against the portion of surface shaped like a truncated cone 49a of the connector 49 of the valve body 7.

[0023] On account of the type of stresses involved, the small area of contact, and the hardness of the open/close element 47 and of the valve 7, after impact, the open/close element 47 rebounds overcoming the action of the spring 23. Instead, the anchor 17 continues its travel towards the valve body 7, recovering the play that is formed between the plane surface 57 of the portion 56 of the anchor 17 and the shoulder 62 of the flange 60. After a certain time from the first impact of the open/close element 47, the anchor 17 continues its travel towards the valve body 7 until there is an impact of the plane surface 57 of the portion 56 against the shoulder 62 of the bushing 41. As a result of this impact, the rebounds of the bushing 41 are markedly reduced or even eliminated.

[0024] By appropriately sizing the weights of the anchor 17 and of the bushing 41, the travel of the anchor 17, and the travel of the open/close element 47, it is possible to obtain impact of the anchor 17 against the bushing 41 during the first rebound, immediately following upon de-energization of the electromagnet 16 so that both the first rebound and the rebounds subsequent to the first rebound are attenuated. The impact between the anchor 17 and the shoulder 62 of the bushing 61 can also occur upon return of the open/close element 47 into the closing position, following upon the first rebound. In this case, the rebounds of the open/close element 47 subsequent to the first rebound are completely blocked.

[0025] Advantageously, the intermediate body 12a is fixed on the bushing 41 by means of an appropriately shaped welding device 70, indicated by dashed lines in Figure 3. The weld is performed on the surface of the seat 40a along a circumference of continuous contact so that welding is carried out without any need for phasing between the device 70 and the intermediate body 12a. In particular, the circumference of continuous contact is constituted between a sharp edge 69 of an end surface 71 of the connection pin 63 and the seat 40a of the connection pin 63 itself, when the surface 65 of the flange 24 is brought into contact with the edge 66 of the bushing 41 so that the device 70 acts inside the bushing 41.

[0026] The method for manufacturing the open/close element 47 of the servo valve 5 of Figures 1-3 is performed as described in what follows.

[0027] First, the anchor 17 is provided with the central guide hole 59, and the bushing 41 is provided with a guide portion 61 and the shoulder 62. Then the intermediate body 12a is provided with the flange 24 for supporting the spring 23, and with the connection pin 63. Then the anchor 17 with the hole 59 is fitted on the collar 61 of the bushing 41, and the fixing pin 63 is inserted into the seat 40a on the bushing 41 so as to bring the surface 65 of the flange 24 into contact with the edge 66 of the bushing 41.

[0028] Finally, via the welding device 70 (see also Figure 3), the intermediate body 12a is welded to the bushing 41 along the circumference of contact between the sharp edge 69 of the end surface 71 of the connection pin 63 and the seat 40a of the bushing 41 that receives said pin 63. In this way, on the circumference of contact a weld bead 72 is formed, which does not modify the external profile of the bushing 41 of the intermediate body 12a, nor does it alter the surfaces 39, 40 of the stem 38 or of the bushing 41, in particular, nor is the profile of the housing for the anchor 17 altered.

[0029] In the variant of Figures 4 and 5, the parts that are similar to the ones of the embodiment illustrated in Figures 1-3 are designated by the same reference numbers and will not be described any further herein. In Figure 4, the anchor 17 has a constant thickness for the two portions 56 and 58, whilst the shoulder 62 is not made on a flange, but on the thickness of the bushing 41.

[0030] Removably inserted between the bottom surface 57 of the anchor 17 and the shoulder 62 of the bushing 41 is a ring of calibrated thickness, in particular a C-shaped ring 73 (see also Figure 5), which is housed in an annular groove 74 adjacent to the shoulder 62. Consequently, the stop element of the anchor 17 for closing the open/close element 47 is here constituted by a surface 75 of the C-shaped ring 73 opposite to the shoulder 62. Advantageously, the C-shaped ring 73 can have a thickness chosen from a series of modular classes of C-shaped rings of calibrated thicknesses in order to adjust the additional travel of the anchor 17, i.e., the relative play between the two stop elements 65 and 75.

[0031] As regards the corresponding manufacturing method, before the pin 63 of the intermediate body 12a is inserted into the seat 40a of the bushing 41, the anchor 17 with the hole 59 is fitted on the collar 61 so as to enable the anchor 17 itself to rest against the shoulder 62, remaining with the surface 17a set at a distance from the end edge 66 of the bushing 41.

[0032] Then the intermediate body 12a with the pin 63 is inserted into the seat 40a so as to bring the surface 65 of the flange 24 into contact with the edge 66 of the collar 61. Then, by means of an appropriately shaped welding device 77, indicated by dashed lines in Figure 6, the intermediate body 12a is welded to the collar 61 along a circumference of continuous contact between a sharp edge 76 of the edge 66 and the surface 65 of the flange 24. In this way, on the circumference of contact, a weld bead 78 is formed, in a position corresponding to which the hole 59 of the anchor 17 has a flaring 79 so that after welding the travel of the anchor 17 is not altered with respect to the travel before welding.

[0033] Finally, by displacing the anchor 17 towards the flange 24, the C-shaped ring 73 is inserted into the groove 74 so that the anchor 17 has, with the C-shaped ring 73, the desired play, corresponding to the difference between its travel and the travel of the open/close element 47 and hence also of the bushing 41.

[0034] The method for manufacturing the open/close element 47 of the servo valves 5, according to the variants of the invention described, is hence characterized by the following steps:

- the bushing 41 is provided with a guide portion 61 designed to engage the guide hole 59 for a relative displacement of the anchor 17 between two stop elements 62, 75 and 65, said bushing 41 being equipped with at least one 62, 75 of said stop elements 62, 65;
- an intermediate body 12a is provided, comprising a flange 24 for supporting said spring 23 and a connection pin 63 that can be inserted into a seat 40a arranged in said guide portion 61;
- said anchor 17 is fitted on said guide portion 61;
- said intermediate body 12a is inserted with said pin 63 into said seat 40a so as to bring said flange 24 into contact with an edge 66 of said guide portion 61; and
- by means of a welding device 70, 77, said intermediate body 12a is welded on said guide portion 61 along a circumference 69, 76 of continuous contact so that welding is carried out without any need for phasing of the intermediate body 12a with the welding device 70, 77.

[0035] From what has been seen above, the advantages of the manufacturing method according to the invention as compared to the known art emerge clearly. In particular, the welding can be performed without any discontinuity along the circumference 69, 76 and without any need for phasing between the intermediate body 12a and the welding device 70, 77. In addition, in the variant of Figure 1, the weld bead 72 does not cause any variation of the external profile of the bushing 41 and of the flange 24. In the variant of Figure 4, in a position corresponding to the bead 78, the anchor 17 has the flaring 79, which does not alter sliding between the anchor 17 and the collar 61.

[0036] It may be understood that various modifications and improvements may be made to the manufacturing method described above, without thereby departing from the scope of the claims. For example, in the variant of Figure 1, the stop 62 can be represented by a C-shaped ring mounted removably on the bushing 41. In addition, in the variant of Figures 4 and 5, between the anchor 17 and the C-shaped ring 73 there can be set an additional ring with modular calibrated thickness. Also the flaring 79 of the hole 59 of the anchor 17 can be replaced by a flaring of the end edge 66 of the collar 61. Finally, in the method for the production of the open/close element of Figure 6, using the same device 77, the C-shaped ring 73 can be welded on the collar 61 or on the shoulder of the bushing 41, immediately after fitting thereof on the bushing 41.

[0037] The weld beads 72 and 78 could be replaced by spot welds, once again along a circumference of continuous contact, and/or the terminal portion defined by the open/close element 47, during production, could be a separate piece fixed to the remaining part of the bushing 41.

Claims

1. A method for manufacturing an open/close element for a balanced servo valve (5) of a fuel injector, wherein the open/close element (47) is fixed with respect to a bushing (41) designed to move for a certain axial travel along a fixed stem (38) for opening/closing said servo valve (5); a discharge duct (43, 44) of the servo valve (5) giving out onto a lateral surface (39) of said stem (38), a spring (23) being designed to keep said bushing (41) in the closing position, where said bushing (41) is subject to a substantially zero axial pressure; said bushing (41) being movable under the control of an anchor (17) actuated by an electric actuator (15) against the action of said spring (23); said anchor (17) being provided with a central hole (59) and being axially movable for a travel greater than said certain travel;
said method comprising the following steps:

    - an intermediate body (12a) is provided, comprising a flange (24) for supporting said spring (23) and a connection pin (63) that can be inserted into a seat (40a) arranged in said bushing (41);
    - said anchor (17) is fitted on a guide portion (61) of said bushing (41);
    - said intermediate body (12a) is fitted on said bushing (41) so as to bring said flange (24) into contact with an edge (66) of said guide portion (61); and
    - said intermediate body (12a) is welded by means of a welding device (70, 77) on said guide portion (61) along a circumference of continuous contact (69, 76) so that welding is carried out without any need for phasing of the intermediate body (12a) with the welding device (70, 77).

2. The manufacturing method according to Claim 1, **characterized in that** said intermediate body (12a) is moreover provided with a guide pin (12) for guiding an end of said spring (23), said guide pin (12) being coaxial to said connection pin (63) and opposite to the latter.

3. The manufacturing method according to Claim 1 or

Claim 2, **characterized in that** said guide portion is formed by a collar (61) of said bushing (41) set between a shoulder (62) of said bushing and said edge (66).

4. The manufacturing method according to Claim 3, **characterized in that** one of said stop elements (62, 75; 65) is formed by a surface (65) of said flange (24).

5. The manufacturing method according to one of the preceding claims, **characterized in that** said circumference (69) of continuous contact is brought, by an end edge (71) of said connection pin (63), into contact with said seat (40a).

6. The manufacturing method according to Claims 3 and 5, **characterized in that** the other of said stop elements is constituted by said shoulder (62) of said bushing (41).

7. The manufacturing method according to any of Claims 1 to 4, **characterized in that** set between said shoulder (62) and said anchor (17) is a ring (73) of a thickness chosen from classes of a modular thickness.

8. The manufacturing method according to Claims 7 and 4, **characterized in that** said surface (65) of said flange (24) is designed to set itself in contact with said end edge (66), said circumference of continuous contact being constituted by a sharp edge (76) of said end edge (66) in contact with said surface (65).

9. The manufacturing method according to Claim 7 or Claim 8, **characterized in that** said ring of thickness is formed by a removable ring (73), designed to block said anchor (17) on said bushing (41), said removable ring (73) being fitted on said bushing (41) after said welding.

10. The manufacturing method according to Claim 9, **characterized in that** said removable ring is a C-shaped ring (73) set in an annular groove (74) of said bushing (41) adjacent to said guide portion (61).

11. The manufacturing method according to Claim 10, **characterized in that** the other of said stop elements (62, 75; 65) is formed by said C-shaped ring (73).

12. The manufacturing method according to Claim 9, **characterized in that** said ring of thickness is a C-shaped ring (73) and is in turn welded in a position corresponding to the surface (62) or the collar (61), after its insertion.

13. An open/close element for a balanced servo valve of a fuel injector, manufactured applying the method according to one of the preceding claims.

Patentansprüche

1. Verfahren zum Herstellen eines Öffnungs-/Schließelemtentes für ein Servoventil (5) mit Druckausgleich eines Kraftstoffinjektors, wobei das Öffnungs-/Schließelement (47) bezüglich einer Buchse (41) fixiert ist, die dazu ausgelegt ist, sich über eine vorbestimmte, axiale Strecke längs eines fixierten Schaftes (38) zu bewegen, um das Servoventil (5) zu öffnen bzw. zu schließen; wobei eine Auslassleitung (43, 44) des Servoventils (5) von einer Seitenwand (39) des Schaftes (38) ausgeht und eine Feder (23) vorgesehen ist, die dazu ausgelegt ist, die Buchse (41) in der Schließstellung zu halten, wobei die Buchse (41) einem axialen Druck von im wesentlichen Null ausgesetzt ist; wobei die Buchse (41) unter der Steuerung eines Ankers (17) bewegbar ist, der mit einem elektrischen Betätigungsorgan (15) gegen die Wirkung der Feder (23) betätigt wird; wobei der Anker (17) mit einem zentralen Loch (59) versehen ist und axial über eine Strecke bewegbar ist, die größer ist als die vorbestimmte Strecke;
wobei das Verfahren folgende Schritte aufweist:

- es wird ein Zwischenkörper (12a) vorgesehen, der einen Flansch (24) zum Abstützen der Feder (23), sowie einen Verbindungsstift (63) aufweist, der in einen Sitz (40a) eingesetzt werden kann, der in der Buchse (41) angeordnet ist;
- der Anker (17) wird an einem Führungsbereich (61) der Buchse (41) angebracht;
- der Zwischenkörper (12a) wird an der Buchse (41) angebracht, um den Flansch (24) mit einer Kante (66) des Führungsbereiches (61) in Kontakt zu bringen; und
- der Zwischenkörper (12) wird mit einer Schweißeinrichtung (70, 77) an dem Führungsbereich (61) längs eines Umfanges mit durchgehendem Kontakt (69, 76) angeschweißt, derart, dass die Schweißung durchgeführt wird, ohne dass ein Erfordernis zum Abstimmen des Zwischenkörpers (12a) mit der Schweißeinrichtung (70, 77) besteht.

2. Verfahren nach Anspruch 1,
dadurch gekennzeichnet,
dass der Zwischenkörper (12a) außerdem mit einem Führungsstift (12) versehen ist, um ein Ende der Feder (23) zu führen, wobei der Führungsstift (12) koaxial zu dem Verbindungsstift (63) ausgebildet ist und letzterem gegenüberliegt.

3. Verfahren nach Anspruch 1 oder 2,
dadurch gekennzeichnet,

dass der Führungsbereich von einem Bund (61) der Buchse (41) gebildet ist, der zwischen einer Schulter (62) der Buchse (41) und der Kante (66) angeordnet ist.

4. Verfahren nach Anspruch 3,
dadurch gekennzeichnet,
dass das eine von den Anschlagelementen (62, 75; 65) von einer Oberfläche (65) des Flansches (24) gebildet wird.

5. Verfahren nach einem der vorhergehenden Ansprüche,
dadurch gekennzeichnet,
dass der Umfang (69) des durchgehenden Kontaktes mittels einer Endkante (71) des Verbindungsstiftes (63) in Kontakt mit dem Sitz (40) gebracht wird.

6. Verfahren nach Anspruch 3 und 5,
dadurch gekennzeichnet,
dass das andere von den Anschlagelementen von der Schulter (65) der Buchse (41) gebildet wird.

7. Verfahren nach einem der Ansprüche 1 bis 4
dadurch gekennzeichnet,
dass zwischen der Schulter (62) und dem Anker (72) ein Ring (73) mit einer Dicke angeordnet wird, die aus den Klassen einer modularen Dicke gewählt wird.

8. Verfahren nach Anspruch 4 und 7,
dadurch gekennzeichnet,
dass die Oberfläche (65) des Flansches (24) so ausgebildet ist, dass sie sich selbst mit der Endkante (66) in Kontakt bringt, wobei der Umfang des durchgehenden Kontaktes von einer scharfen Kante (76) der Endkante (66) in Kontakt mit der Oberfläche (65) gebildet wird.

9. Verfahren nach Anspruch 7 oder 8,
dadurch gekennzeichnet,
dass der Ring mit seiner Dicke von einem lösbaren Ring (73) gebildet wird, der dazu ausgelegt ist, den Anker (17) auf der Buchse (41) zu arretieren, wobei der lösbare Ring (73) nach dem Schweißen an der Buchse (41) angebracht wird.

10. Verfahren nach Anspruch 9,
dadurch gekennzeichnet,
dass der lösbare Ring ein C-förmiger Ring (73) ist, der in eine ringförmige Nut (74) der Buchse (41) in der Nähe des Führungsbereiches (61) eingesetzt wird.

11. Verfahren nach Anspruch 10,
dadurch gekennzeichnet,
dass das andere von den Anschlagelementen (62, 75; 65) von dem C-förmigen Ring (73) gebildet wird.

12. Verfahren nach Anspruch 9,
dadurch gekennzeichnet,
dass der Ring mit seiner Dicke ein C-förmiger Ring (73) ist und seinerseits nach seinem Einsetzen in einer Position angeschweißt wird, die der Oberfläche (62) oder dem Bund (61) entspricht.

13. Öffnungs-/Schließelement für ein Servoventil mit Druckausgleich eines Kraftstoffinjektors, hergestellt durch Verwenden des Verfahrens nach einem der vorhergehenden Ansprüche.

Revendications

1. Méthode de fabrication d'un élément d'ouverture/fermeture pour une servo-soupape équilibrée (5) d'un injecteur de carburant, dans laquelle l'élément d'ouverture/fermeture (47) est fixe par rapport à une douille (41) conçue pour se déplacer selon un certain déplacement axial le long d'une tige fixe (38) pour ouvrir/fermer ladite servo-soupape (5) ; une conduite d'évacuation (43, 44) de la servo-soupape (5) donnant sur une surface latérale (39) de ladite tige (38), un ressort (23) étant conçu pour maintenir ladite douille (41) dans la position de fermeture, où ladite douille (41) est soumise à une pression axiale sensiblement nulle ; ladite douille (41) étant mobile sous la commande d'une ancre (17) actionnée par un actionneur électrique (15) contre l'action dudit ressort (23) ; ladite ancre (17) étant pourvue d'un orifice central (59) et étant axialement mobile selon un déplacement supérieur audit certain déplacement ;
ladite méthode comprenant les étapes suivantes :

- un corps intermédiaire (12a) est fourni, comprenant une bride (24) pour supporter ledit ressort (23) et une tige de liaison (63) qui peut être insérée dans un siège (40a) agencé dans ladite douille (41) ;
- ladite ancre (17) est installée sur une partie de guidage (61) de ladite douille (41) ;
- ledit corps intermédiaire (12a) est installé sur ladite douille (41) afin de mettre ladite bride (24) en contact avec un bord (66) de ladite partie de guidage (61) ; et
- ledit corps intermédiaire (12a) est soudé au moyen d'un dispositif de soudage (70, 77) sur ladite partie de guidage (61) le long d'une circonférence de contact continu (69, 76) pour que le soudage soit réalisé sans que le corps intermédiaire (12a) ne soit mis en phase avec le dispositif de soudage (70, 77).

2. Méthode de fabrication selon la revendication 1, **caractérisée en ce que** ledit corps intermédiaire (12a) est en outre pourvu d'une tige de guidage (12) pour guider une extrémité dudit ressort (23), ladite tige de

guidage (12) étant coaxiale par rapport à ladite tige de liaison (63) et opposée à cette dernière.

3. Méthode de fabrication selon la revendication 1 ou la revendication 2, **caractérisée en ce que** ladite partie de guidage est formée par un collier (61) de ladite douille (41) placé entre un épaulement (62) de ladite douille et ledit bord (66).

4. Méthode de fabrication selon la revendication 3, **caractérisée en ce qu'**un desdits éléments de butée (62, 75 ; 65) est formé par une surface (65) de ladite bride (24).

5. Méthode de fabrication selon l'une des revendications précédentes, **caractérisée en ce que** ladite circonférence (69) de contact continu est mise, par un bord d'extrémité (71) de ladite tige de liaison (63), en contact avec ledit siège (40a).

6. Méthode de fabrication selon les revendications 3 et 5, **caractérisée en ce que** l'autre desdits éléments de butée est constitué par ledit épaulement (62) de ladite douille (41).

7. Méthode de fabrication selon l'une quelconque des revendications 1 à 4, **caractérisée en ce que**, une bague (73), d'une épaisseur choisie parmi des classes d'une épaisseur modulaire, est placée entre ledit épaulement (62) et ladite ancre (17).

8. Méthode de fabrication selon les revendications 7 et 4, **caractérisée en ce que** ladite surface (65) de ladite bride (24) est conçue pour se placer en contact avec ledit bord d'extrémité (66), ladite circonférence de contact continu étant constituée par un arête vive (76) dudit bord d'extrémité (66) en contact avec ladite surface (65).

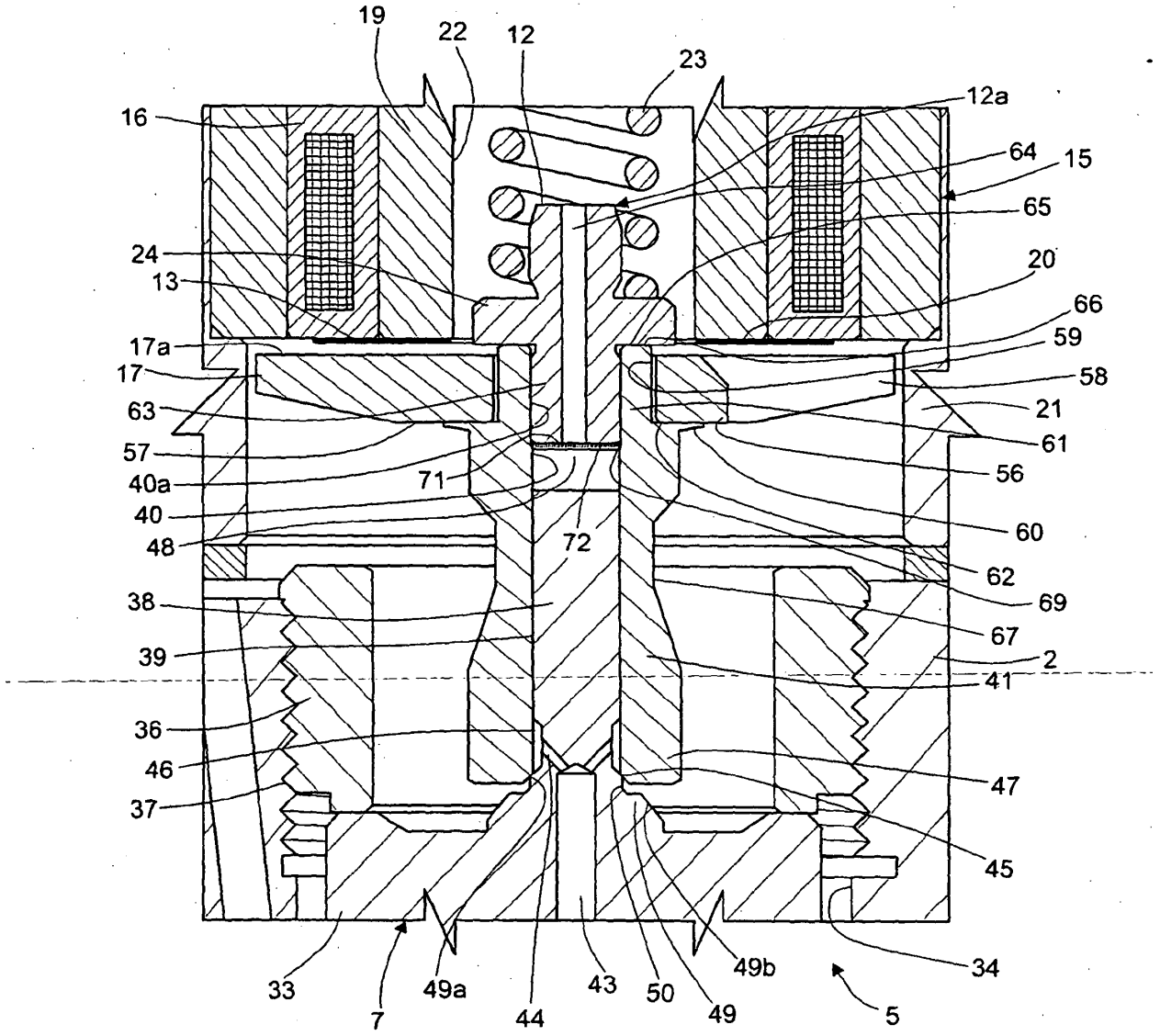
9. Méthode de fabrication selon la revendication 7 ou la revendication 8, **caractérisée en ce que** ladite bague d'épaisseur est formée par une bague amovible (73), conçue pour bloquer ladite ancre (17) sur ladite douille (41), ladite bague amovible (73) étant installée sur ladite douille (41) après ledit soudage.

10. Méthode de fabrication selon la revendication 9, **caractérisée en ce que** ladite bague amovible est une bague en forme de C (73) placée dans une rainure annulaire (74) de ladite douille (41) adjacente à ladite partie de guidage (61).

11. Méthode de fabrication selon la revendication 10, **caractérisée en ce que** l'autre desdits éléments de butée (62, 75 ; 65) est formé par ladite bague en forme de C (73).

12. Méthode de fabrication selon la revendication 9, **caractérisée en ce que** ladite bague d'épaisseur est une bague en forme de C (73) et est à son tour soudée dans une position correspondant à la surface (62) ou au collier (61), après son insertion.

13. Élément d'ouverture/fermeture pour une servo-soupape équilibrée d'un injecteur de carburant, fabriqué en appliquant la méthode selon une des revendications précédentes.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49a
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49b
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Fig.1

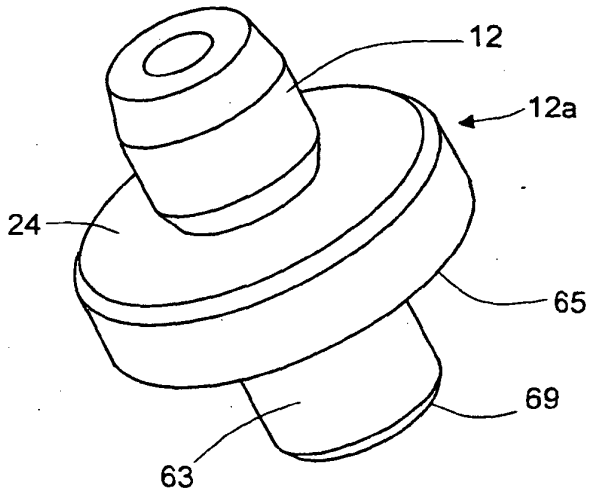

Fig.2

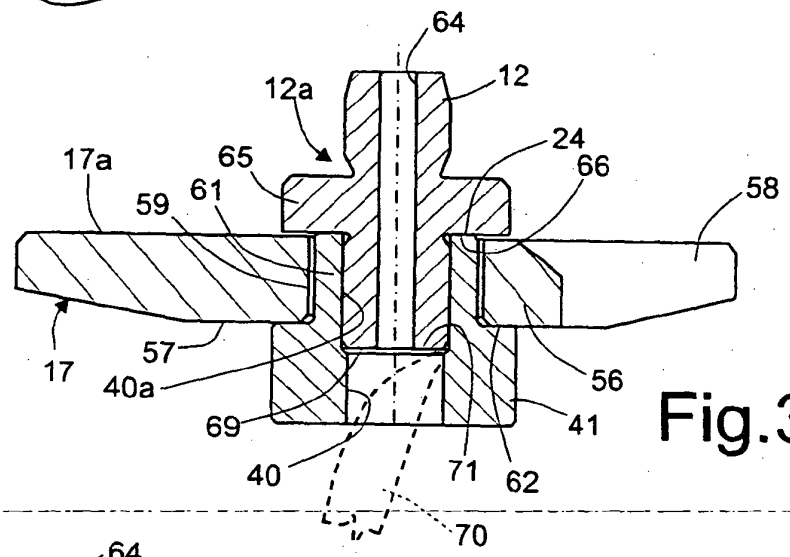

Fig.3

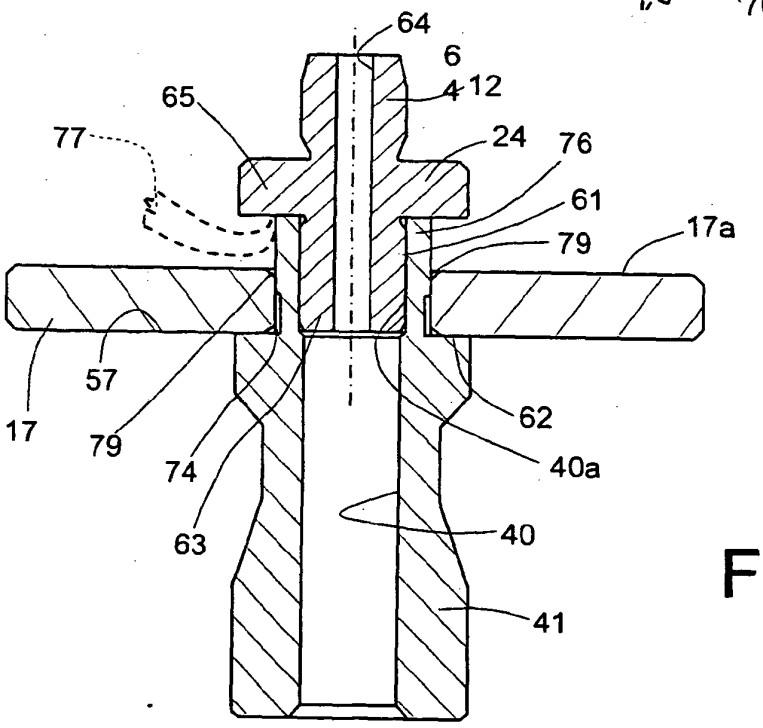

Fig.6

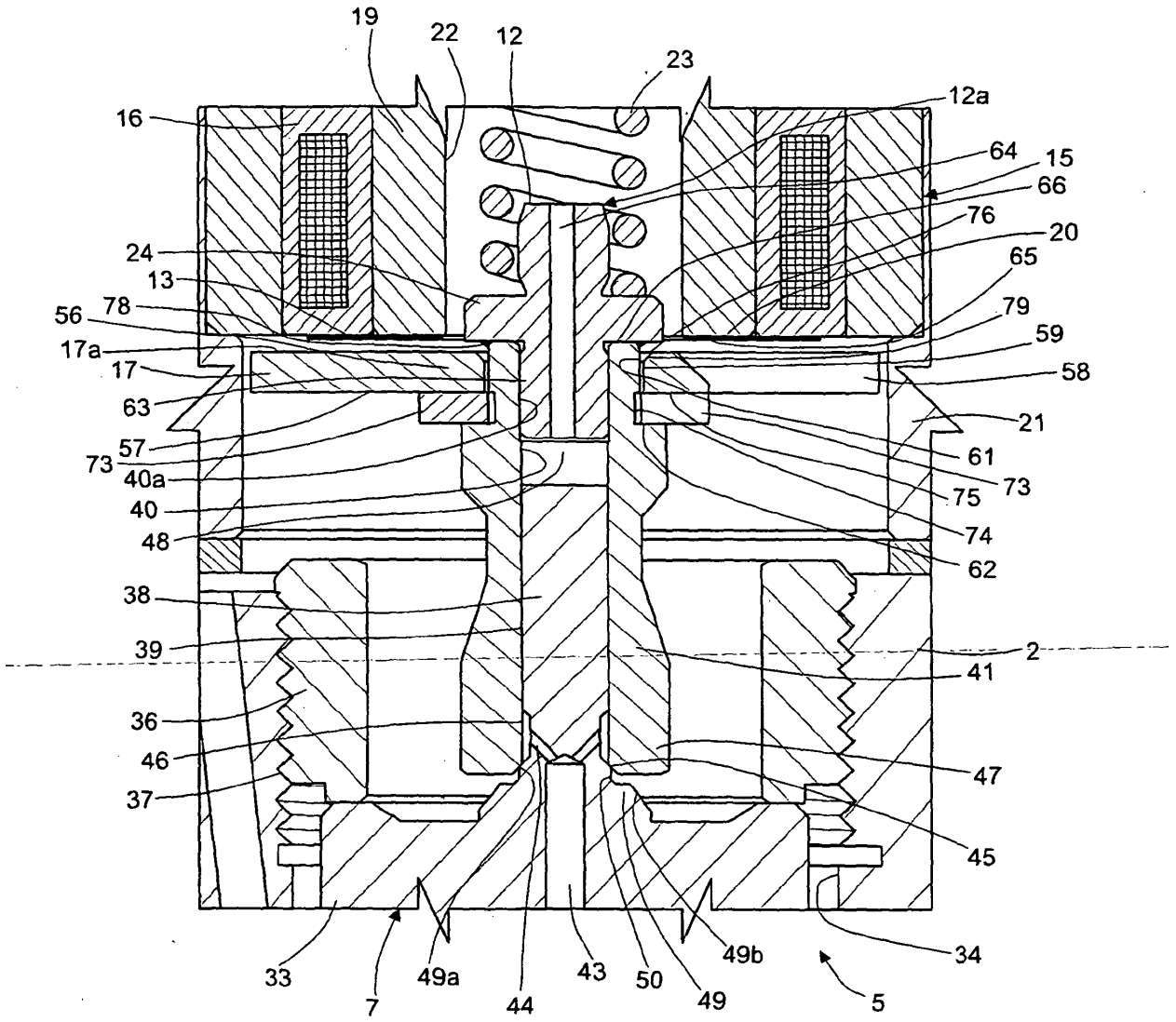
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Fig.4

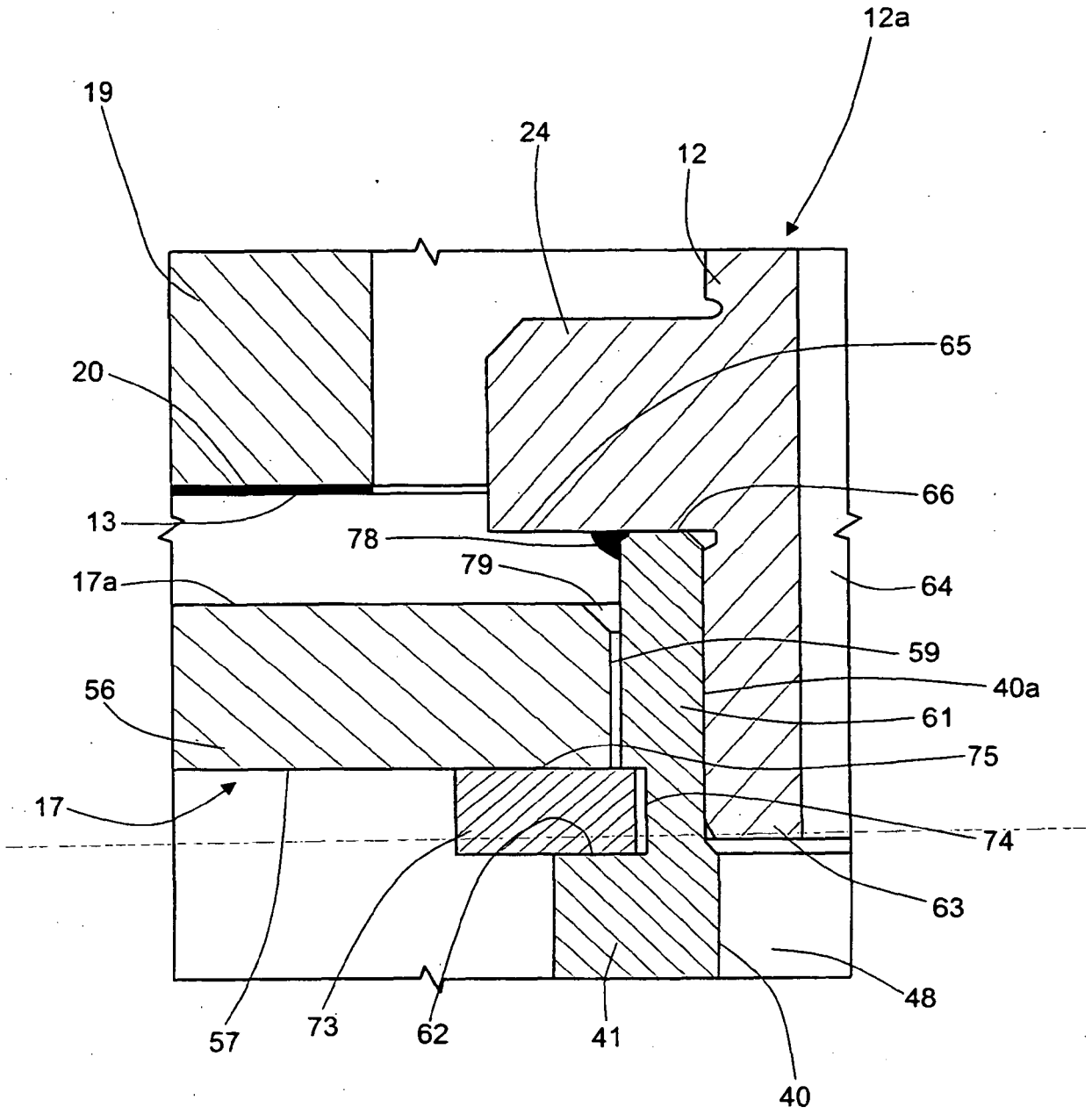
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Fig.5

REFERENCES CITED IN THE DESCRIPTION

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