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(54) Titre : SOUPAPE D'ARRET ET AGENCEMENT DE SOUPAPE DE PROTECTION DE ROUE CHAUDE
(54) Title: CUT-OFF VALVE AND HOT WHEEL PROTECTION VALVE ARRANGEMENT

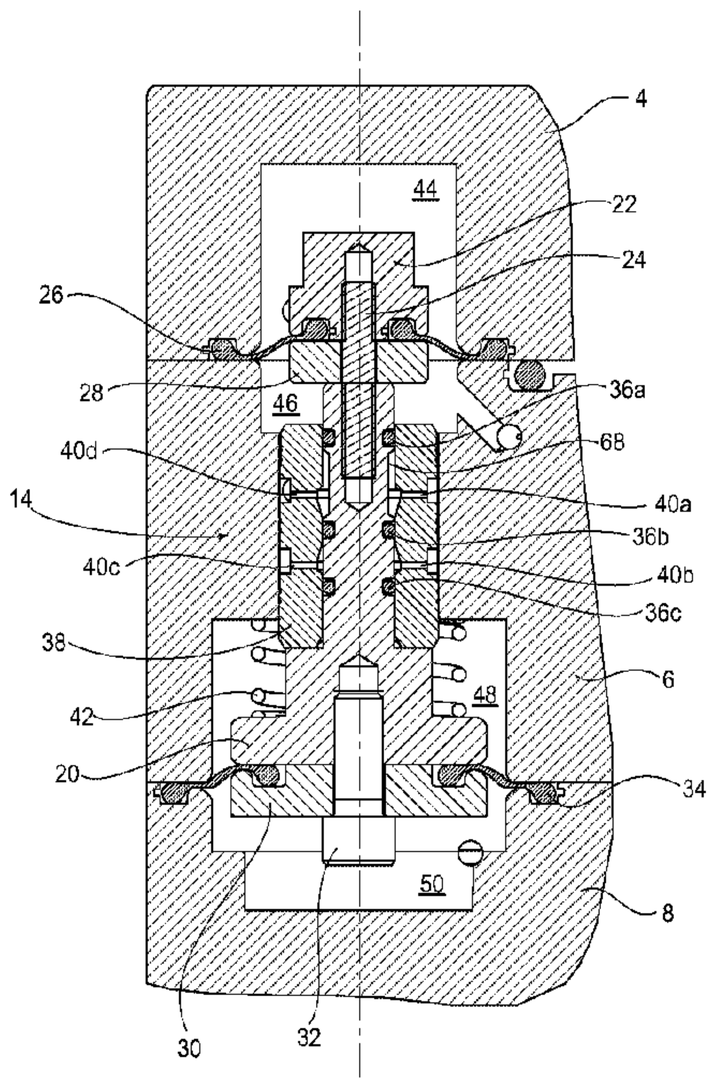


FIG. 6

(57) Abrégé/Abstract:
A hot wheel protection valve arrangement including a hot wheel protection valve, the hot wheel protection valve including a body defining a passageway, a piston slidably positioned within the passageway, a bushing positioned on the piston and within the passageway, a first diaphragm provided on a first end of the piston, the first diaphragm defining a first chamber in the passageway, a second diaphragm provided on a second end of the piston, the second diaphragm defining a second chamber in the passageway, a third chamber being defined between the first diaphragm and the second diaphragm, and an exhaust port defined in the body and in fluid communication with the third chamber, a brake cylinder line that establishes fluid communication between a brake cylinder, the first chamber, and the third chamber; and an emergency reservoir line that establishes fluid communication between an emergency reservoir and the second chamber.

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(54) Title: CUT-OFF VALVE AND HOT WHEEL PROTECTION VALVE ARRANGEMENT

(57) Abstract: A hot wheel protection valve arrangement including a hot wheel protection valve, the hot wheel protection valve including a body defining a passageway, a piston slidably positioned within the passageway, a bushing positioned on the piston and within the passageway, a first diaphragm provided on a first end of the piston, the first diaphragm defining a first chamber in the passageway, a second diaphragm provided on a second end of the piston, the second diaphragm defining a second chamber in the passageway, a third chamber being defined between the first diaphragm and the second diaphragm, and an exhaust port defined in the body and in fluid communication with the third chamber, a brake cylinder line that establishes fluid communication between a brake cylinder, the first chamber, and the third chamber; and an emergency reservoir line that establishes fluid communication between an emergency reservoir and the second chamber.

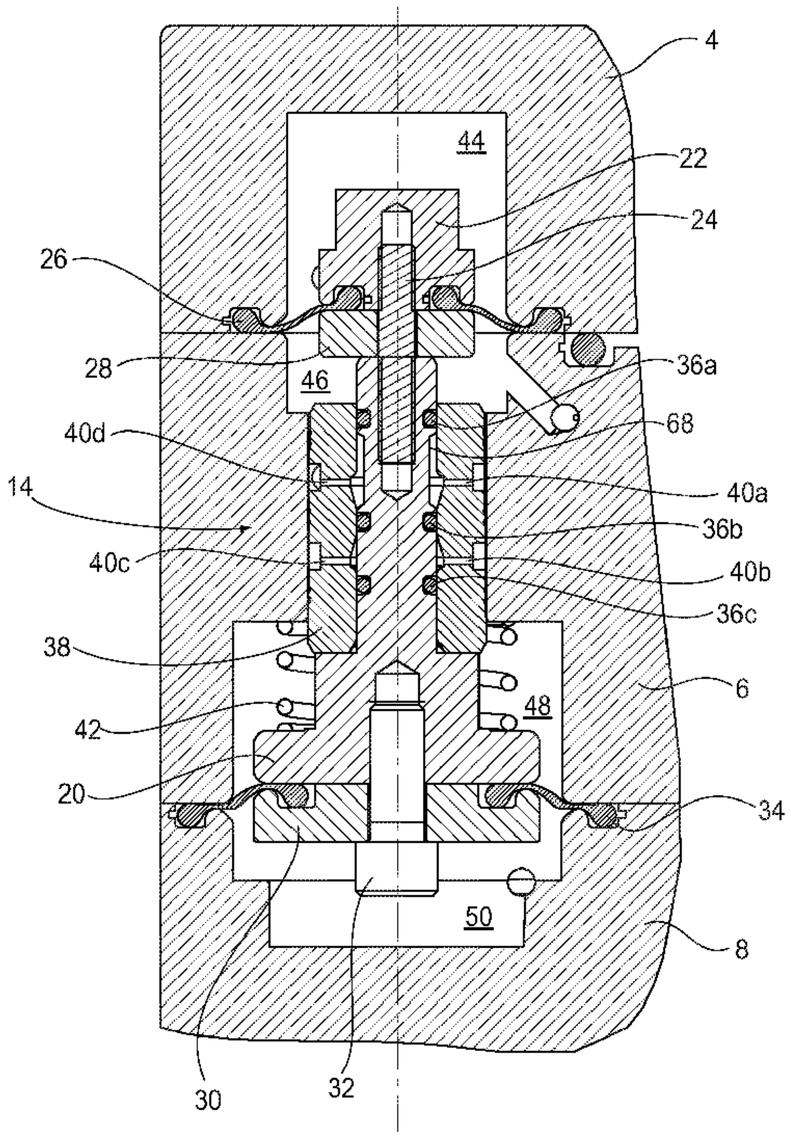


FIG. 6

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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

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CUT-OFF VALVE AND HOT WHEEL PROTECTION VALVE ARRANGEMENT

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims priority to United States Patent Application No. 15/062,721 filed March 7, 2016, the disclosure of which is hereby incorporated in its entirety by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present disclosure is directed to brake valve arrangements for railway cars and, more particularly, to a cut-off valve and hot wheel protection valve arrangement for a brake valve arrangement for a railway car.

Description of Related Art

[0003] Current brake systems for railway vehicles experience leakage of pressurized fluid into the brake cylinder of the brake system. The Association of American Railroads' specification for a single railway car specifies allowable leakage into/out of the brake cylinder at the rate of +/- 1 psi/min. At this rate, acceptable loss of brake cylinder pressure is permitted while still safely maintaining brake cylinder pressure levels for the operation of the railway vehicle's brake system. When operating a railway vehicle on a grade for an extended period of time, however, a minimal level of leakage into the brake cylinder in one minute can increase to a high enough pressure to cause excessive heat to be generated by the excessive pressure. This excessive pressure results in higher than desired shoe force creating a "hot wheel" condition in which forces within the brake cylinder cause the brake cylinder and the wheels of the railway vehicle to experience excessive heat. By venting pressure from the brake cylinder, this "hot wheel" condition is avoided.

[0004] An example of a preexisting brake cylinder pressure reducing valve is disclosed in U.S. Patent No. 5,083,843. The brake cylinder pressure reducing valve is used to control the release of brake cylinder pressure. Upon the graduated release of brake cylinder pressure, brake pipe pressure is restored by a locomotive brake valve. The control valve of the release valve is moved to its full release position and brake cylinder pressure is rapidly reduced. The reduction in brake cylinder pressure reduces a downward force exerted on a diaphragm by the brake cylinder pressure in a first chamber, allowing the graduating volume air pressure to move a stem upward. Thus, the first chamber is sealed and air is retained in the brake cylinder at a value equal to the remaining reduction in brake pipe pressure. Therefore, with

the graduating check valve seated, further exhaust of brake cylinder pressure is prevented and the valve remains at a stable position. Brake cylinder pressure can be reduced in a predetermined proportion to a brake pipe pressure increase. Therefore, this release valve is not configured to release brake cylinder pressure upon the brake cylinder exceeding a predetermined amount. The brake cylinder is released as a function of an increase in brake pipe pressure, not through an increase in the brake cylinder pressure.

[0005] Another example of a preexisting brake cylinder pressure reducing valve is disclosed in U.S. Patent No. 6,609,769. A pneumatically graduated brake pressure release valve for a freight train brake system is used to release pressure from a brake cylinder. The graduated release valve controls the exhaust of the brake cylinder pressure. A metering valve portion of the graduated release valve exhausts brake cylinder pressure generally proportional to an increase in brake pipe pressure. On one side, a graduating piston is held in position by pressure from an emergency reservoir. On an opposite side, pressure from the brake pipe and a brake cylinder exhaust urge against the piston. Once the brakes have been applied, if a reduction in brake cylinder pressure is desired, the brake pipe pressure must be increased. This increase in brake pipe pressure unbalances the pressures acting on the piston and causes the brake cylinder to be exhausted to atmosphere. The brake cylinder will only exhaust, however, until the brake cylinder pressure decreases proportionally to the brake pipe pressure increase. The pressure exhausted from the brake cylinder is generally a function of the increase in brake pipe pressure. This graduated release valve is not configured to reduce brake cylinder pressure upon an increase in brake cylinder pressure due to leakage of pressurized fluid into the brake cylinder.

SUMMARY OF THE INVENTION

[0006] Preexisting graduated brake cylinder release valves, some of which have been discussed hereinabove, are not configured to exhaust brake cylinder pressure upon leakage of pressurized fluid into the brake cylinder. Many of the preexisting graduated brake cylinder release valves release brake cylinder pressure in proportion to an increase in brake pipe pressure. Further, none of the preexisting brake cylinder release valves use a cut-off valve to isolate an exhausted pressurized fluid from the graduated brake cylinder release valves when a brake cylinder pressure exceeds a pre-determined pressure.

[0007] In one aspect of the disclosure, a hot wheel protection valve arrangement may include a hot wheel protection valve, the hot wheel protection valve may include a body defining a passageway, a piston slidably positioned within the passageway, a bushing

positioned on the piston and within the passageway, a first diaphragm provided on a first end of the piston, the first diaphragm may define a first chamber in the passageway, a second diaphragm may be provided on a second end of the piston, the second diaphragm may define a second chamber in the passageway, a third chamber may be defined between the first diaphragm and the second diaphragm, and an exhaust port may be defined in the body and in fluid communication with the third chamber, a brake cylinder line may establish fluid communication between a brake cylinder, the first chamber, and the third chamber; and an emergency reservoir line may establish fluid communication between an emergency reservoir and the second chamber. Pressurized fluid may be vented from the brake cylinder via the exhaust port upon a brake cylinder pressure exceeding a predetermined force exerted by an emergency reservoir pressure.

[0008] The bushing may define at least one bushing passageway in fluid communication with the brake cylinder line and the exhaust port. A choke may be provided in the brake cylinder line between the brake cylinder and an inlet port defined in the hot wheel protection valve configured to receive pressurized fluid from the brake cylinder. A fourth chamber may be defined between the first diaphragm and the second diaphragm. A brake pipe line may establish fluid communication between a brake pipe and the fourth chamber, or an auxiliary reservoir line establishes fluid communication between an auxiliary reservoir and the fourth chamber. The pressurized fluid may be vented from the brake cylinder via the exhaust port upon a brake cylinder pressure exceeding a predetermined force exerted against a differential of the emergence reservoir pressure and a brake pipe pressure or an auxiliary reservoir pressure. A biasing member may be provided in the fourth chamber. The biasing member may create a biasing force against the second diaphragm. A groove may be defined on an outer surface of the piston. As the piston slides within the passageway to a predetermined position, pressurized fluid from the brake cylinder line may be permitted to flow through the bushing, around the groove defined on the piston, through the bushing again, and through the exhaust port. An outer circumferential surface of the first diaphragm may be held within the body of the hot wheel protection valve and an inner circumferential surface of the first diaphragm may be held on the first end of the piston between a feedback follower and a spacer. An outer circumferential surface of the second diaphragm may be held within the body of the hot wheel protection valve and an inner circumferential surface of the second diaphragm may be held on the second end of the piston between the second end of the piston and a follower.

[0009] In another aspect of the disclosure, a hot wheel protection valve arrangement may include a cut-off valve in fluid communication with an exhaust port of a hot wheel protection valve and a brake cylinder line, the cut-off valve may include a piston positioned within a passageway, a bushing provided around the piston and within the passageway, and a biasing member provided on an end of the piston. The brake cylinder line may establish fluid communication between the cut-off valve and a brake cylinder. The cut-off valve may prevent pressurized fluid from being exhausted from the brake cylinder upon a brake cylinder pressure exceeding a predetermined force exerted by the cut-off valve. The biasing member may create the predetermined force against the piston to keep the cut-off valve in an open position.

[0010] The passageway of the cut-off valve may be in fluid communication with the exhaust port of the hot wheel protection valve, the brake cylinder line, and a line to atmosphere. A groove may be defined on an outer surface of the piston. As the piston slides within the passageway to a predetermined position, pressurized fluid from the exhaust port of the hot wheel protection valve may be permitted to flow through the bushing, around the groove defined on the piston, through the bushing again, and through an exhaust port on the cut-off valve. A plurality of grooves may be defined on an outer surface of the piston. An O-ring may be provided in each groove of the plurality of grooves.

[0011] In another aspect of the disclosure, a hot wheel protection valve arrangement may include a hot wheel protection valve, the hot wheel protection valve may include a body defining a passageway, a piston slidably positioned within the passageway, a bushing positioned on the piston and within the passageway, a first diaphragm provided on a first end of the piston, the first diaphragm defining a first chamber in the passageway, a second diaphragm provided on a second end of the piston, the second diaphragm may define a second chamber in the passageway, a third chamber may be defined between the first diaphragm and the second diaphragm, and an exhaust port defined in the body and in fluid communication with the third chamber, a cut-off valve in fluid communication with the exhaust port of the hot wheel protection valve, the cut-off valve may include a piston positioned within a passageway, a bushing provided around the piston and within the passageway, and a biasing member provided on an end of the piston, a brake cylinder line that establishes fluid communication with the first chamber, the third chamber, and the passageway of the cut-off valve, and an emergency reservoir line that establishes fluid communication between an emergency reservoir and the second chamber. Pressurized fluid

may be vented from the brake cylinder via the exhaust port upon a brake cylinder pressure exceeding a force exerted by an emergency reservoir pressure.

[0012] The cut-off valve may prevent pressurized fluid from being exhausted from the brake cylinder upon a brake cylinder pressure exceeding a predetermined force exerted by the cut-off valve. The biasing member may create the predetermined force against the piston of the cut-off valve to keep the cut-off valve in an open position. The bushing of the hot wheel protection valve may define at least one bushing passageway in fluid communication with the exhaust port of the hot wheel protection valve, the passageway of the cut-off valve, and an exhaust port defined by the cut-off valve. A choke may be provided in the brake cylinder line between the brake cylinder and an inlet port defined in the hot wheel protection valve configured to receive pressurized fluid from the brake cylinder. A fourth chamber may be defined between the first diaphragm of the hot wheel protection valve and the second diaphragm of the hot wheel protection valve. A brake pipe line may establish fluid communication between a brake pipe and the fourth chamber, or an auxiliary reservoir line establishes fluid communication between an auxiliary reservoir and the fourth chamber. The pressurized fluid may be vented from the brake cylinder via the exhaust port upon a brake cylinder pressure exceeding a predetermined force exerted against a differential of the emergence reservoir pressure and a brake pipe pressure or an auxiliary reservoir pressure. A biasing member may be provided in the fourth chamber. The biasing member may create a biasing force against the second diaphragm. A groove may be defined on an outer surface of the piston of the hot wheel protection valve. As the piston slides within the passageway to a predetermined position, pressurized fluid from the brake cylinder may be permitted to flow through the bushing of the hot wheel protection valve, around the groove defined on the piston of the hot wheel protection valve, through the bushing of the hot wheel protection valve again, and through the exhaust port of the hot wheel protection valve. An outer circumferential surface of the first diaphragm may be held within the body of the hot wheel protection valve and an inner circumferential surface of the first diaphragm may be held on the first end of the piston of the hot wheel protection valve between a feedback follower and a spacer. An outer circumferential surface of the second diaphragm may be held within the body of the hot wheel protection valve and an inner circumferential surface of the second diaphragm may be held on the second end of the piston of the hot wheel protection valve between the second end of the piston and a follower.

[0013] These and other features and characteristics of the cut-off valve hot wheel protection valve arrangement, as well as the methods of operation and functions of the related

elements of structures and the combination of parts and economies of manufacture, will become more apparent upon consideration of the following description and the appended claims with reference to the accompanying drawings, all of which form a part of this specification, wherein like reference numerals designate corresponding parts in the various figures. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only, and are not intended as a definition of the limits of the disclosure. As used in the specification and claims, the singular form of "a", "an", and "the" include plural referents unless the context clearly dictates otherwise.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] **FIG. 1** is a front perspective view of a brake valve that includes a cut-off valve and hot wheel protection valve arrangement in accordance with one aspect of this disclosure;

[0015] **FIG. 2** is a rear perspective view of the brake valve of **FIG. 1**;

[0016] **FIG. 3** is a top view of the brake valve of **FIG. 1**;

[0017] **FIG. 4** is an exploded assembly drawing of a central main body of the brake valve of **FIG. 1** that only depicts components of the hot wheel protection valve;

[0018] **FIG. 5A** is an exploded assembly drawing of a central main body of the brake valve of **FIG. 1** that only depicts components of the cut-off valve and the hot wheel protection valve;

[0019] **FIG. 5B** is an exploded assembly drawing showing a central main body of the brake valve of **FIG. 1** that depicts all of the components of the cut-off valve and the hot wheel protection valve;

[0020] **FIG. 6** is an isolated cross-sectional view of the brake valve along line A-A of **FIG. 3** depicting the hot wheel protection valve;

[0021] **FIG. 7** is an isolated cross-sectional view of the brake valve along line B-B of **FIG. 3** depicting the cut-off valve; and

[0022] **FIG. 8** is a schematic drawing of the cut-off valve and hot wheel protection valve arrangement provided in the brake valve of **FIG. 1**.

DESCRIPTION OF THE DISCLOSURE

[0023] For purposes of the description hereinafter, the terms "upper', "lower', "right", "left", "vertical", "horizontal", "top", "bottom", "lateral", "longitudinal", and derivatives thereof, shall relate to the invention as it is oriented in the drawing figures. However, it is to be understood that the invention may assume alternative variations and step sequences,

except where expressly specified to the contrary. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification, are simply exemplary embodiments of the invention. Hence, specific dimensions and other physical characteristics related to the embodiments disclosed herein are not to be considered as limiting.

[0024] Referring to the drawings in which like reference characters refer to like parts throughout the several views thereof, the present disclosure is generally directed to a cut-off valve and hot wheel protection valve arrangement for use with a railway vehicle to vent excess pressurized fluid that may leak into the brake cylinder of the railway vehicle.

[0025] Referring initially to **FIGS. 1-5B**, an aspect of a brake valve **2** for a railway vehicle is shown. The brake control valve **2**, as described herein, is intended for use in a brake system of a railway car, as will be readily apparent to those skilled in the rail vehicle art. In particular, brake control valve **2** may be provided in a service portion of a railway brake arrangement. The brake control valve **2** may be adapted for use in railway vehicles used for passenger and/or cargo transit. However, this use is intended to be non-limiting and the brake control valve **2** has applications in railway cars generally. Brake control valve **2** in the depicted aspect includes an upper main body **4**, a central main body **6**, and a lower main body **8**. In one aspect, upper main body **4**, central main body **6**, and lower main body **8** may be connected together using fasteners **10** to form brake control valve **2**. In another aspect, upper main body **4**, central main body **6**, and lower main body **8** may be formed as a monolithic structure. Brake control valve **2** may include, among other components, a cut-off valve **12** and a hot wheel protection valve **14**. It is to be understood that additional components may be included in brake control valve **2**, including a brake cylinder maintaining valve, a manual release shuttle and check valve, and/or an automated release spool, which are not shown or described in this disclosure. As shown in **FIGS. 4**, **5A**, and **5B**, central main body **6** may define a cavity **16** to receive cut-off valve **12** and a cavity **18** to receive hot wheel protection valve **14**. Cavity **16** may extend from an upper surface of central main body **6** to an intermediate position in central main body **6**. Cavity **18** may extend from an upper surface of central main body **6** to a lower surface of central main body **6**.

[0026] Referring to **FIGS. 4-6**, an aspect of hot wheel protection valve **14** is shown. Hot wheel protection valve **14** may include several components used for exhausting pressurized fluid from a brake cylinder of a railway vehicle. Hot wheel protection valve **14**, as described herein, is intended for use in a brake system of a railway car, as will be readily apparent to those skilled in the rail vehicle art. Hot wheel protection valve **14** is adapted for use in

railway vehicles used for passenger and/or cargo transit. However, this use is intended to be non-limiting and hot wheel protection valve **14** has applications in railway cars generally.

[0027] Hot wheel protection valve **14** may include piston **20** connected to a feedback follower **22** using a rod **24**, typically threaded. An upper portion of piston **20** and feedback follower **22** may each define a threaded cavity that is threadedly connected to a portion of threaded rod **24**. A feedback diaphragm **26** and a spacer **28** may also be provided on threaded rod **24** and positioned between the upper portion of piston **20** and feedback follower **22**. In one aspect, feedback diaphragm **26** may be a flexible member that is configured to flex or stretch upwardly or downwardly upon movement of piston **20** in an upward or downward direction within brake control valve **2**. In one aspect, an outer circumferential surface of feedback diaphragm **26** may be positioned between upper main body **4** and central main body **6** of brake control valve **2** so that feedback diaphragm **26** is "sandwiched" therebetween, and an inner circumferential surface of feedback diaphragm **26** may be "sandwiched" between feedback follower **22** and spacer **28**.

[0028] A bottom portion of piston **20** may be connected to a follower **30** via a fastener **32**. Fastener **32** may be inserted through follower **30** and threaded into a cavity defined in the bottom portion of piston **20**. Another diaphragm **34** may be positioned between the bottom portion of piston **20** and follower **30**. In one aspect, diaphragm **34** may be a flexible member that is configured to flex or stretch upwardly or downwardly upon movement of piston **20** in an upward or downward direction within brake control valve **2**. In one aspect, an outer circumferential surface of diaphragm **34** may be positioned between central main body **6** and lower main body **8** of brake control valve **2** so that diaphragm **34** is "sandwiched" therebetween, and an inner circumferential surface of diaphragm **34** may be "sandwiched" between piston **20** and follower **30**.

[0029] In one aspect, piston **20** may have a T-shaped vertical cross-section. An upper portion of piston **20** may have a reduced diameter compared to a lower portion of piston **20**. The upper portion of piston **20** may define a plurality of circumferential grooves in an outer surface of piston **20**. The grooves may be provided at different longitudinal positions along the upper portion of piston **20**. A plurality of O-rings **36a**, **36b**, **36c** may be positioned within the grooves defined in piston **20**. O-rings **36a**, **36b**, **36c** are provided to prevent leakage of pressurized fluid from hot wheel protection valve **14**. Although three grooves and three O-rings are shown in connection with piston **20**, it is to be understood that more or less grooves and/or O-rings may be provided to create a tighter seal between piston **20** and a bushing **38** provided around the upper portion of piston **20**.

[0030] Bushing **38** may be cylindrical in shape to fit around the upper portion of piston **20**. Bushing **38** may be slidable in relation to piston **20**. A plurality of bushing passageways **40a**, **40b**, **40c**, **40d** may be defined in bushing **38**. Bushing passageways **40a**, **40b**, **40c**, **40d** may permit pressurized fluid to pass through bushing **38** and, thereby, out of hot wheel protection valve **14**, as will be described in detail below. Although four bushing passageways **40a**, **40b**, **40c**, **40d** are shown in connection with bushing **38**, it is to be understood that more or less bushing passageways may be provided to more efficiently allow pressurized fluid to pass through bushing **38**. The bushing **38** may rest on a portion of piston **20**. A biasing member **42** may also be positioned around piston **20**. A lower end of biasing member **42** may rest on a portion of piston **20**, and an upper end of biasing member **42** may rest against a portion of central main body **6**. In one aspect, biasing member **42** may be a spring. However, it is to be understood that alternative biasing members may be used that provide a resilient member that may be compressed and expanded to provide a biasing force. Biasing member **42** may be configured to assert a biasing force against piston **20** and diaphragm **34** during operation of hot wheel protection valve **14**. It is also contemplated that biasing member **42** may not be used with hot wheel protection valve **2**. As shown in **FIG. 5B**, during assembly of the brake control valve **2** several components **22**, **26**, **28** of the hot wheel protection valve **14** may be inserted into the upper end of the cavity **18**, while the remaining components **20**, **24**, **30**, **32**, **34**, **36a-36c**, **42** of the hot wheel protection valve **14** may be inserted into the bottom end of the cavity **18**.

[0031] With reference to **FIG. 6**, a plurality of chambers may be established by hot wheel protection valve **14** within brake control valve **2**. A first chamber **44** may be established above feedback diaphragm **26**. A second chamber **46** may be established between flexible diaphragm **26** and bushing **38**. A third chamber **48** may be established between the portion of central main body **6** on which biasing member **42** rests, and diaphragm **34**. A fourth chamber **50** may be established below diaphragm **34**. Chambers **44-50** are configured to receive pressurized fluid from different parts of brake control valve **2**, which will be described below.

[0032] In one aspect, shown in **FIG. 8**, a brake cylinder **52** may be in fluid communication with first chamber **44** of hot wheel protection valve **2** via a brake cylinder line **54**. Through brake cylinder line **54**, brake cylinder **52** may supply pressurized fluid to first chamber **44**. A choke **56** may also be provided in brake cylinder line **54** to regulate the flow of pressurized fluid through brake cylinder line **54**. Choke **56** may be positioned between brake cylinder **52** and first chamber **44**. Brake cylinder line **54** may also be in fluid communication with bushing **38** and, in particular, bushing passageways **40a**, **40b**, **40c**, **40d**. As will be described

in greater detail below, pressurized fluid from brake cylinder **52** may be exhausted through bushing passageways **40a**, **40b**, **40c**, **40d** to reduce the volume of pressurized fluid in brake cylinder **52**. A brake pipe **58** may be in fluid communication with third chamber **48** of hot wheel protection valve **14** via a brake pipe line **60**. It is also contemplated that an auxiliary reservoir (not shown) may be in fluid communication with third chamber **48**, instead of brake pipe **58**. The auxiliary reservoir would supply pressurized fluid to third chamber **48** in a same manner as brake pipe **58**. In particular, the auxiliary reservoir would be in fluid communication with third chamber **48** via an auxiliary reservoir line. An emergency reservoir **62** may be in fluid communication with fourth chamber **50** of hot wheel protection valve **14** via an emergency reservoir line **64**. A hot wheel exhaust line **66** may be in fluid communication with bushing passageways **40a**, **40b**, **40c**, **40d**, cut-off valve **12**, and second chamber **46**. Details regarding cut-off valve **12** and its operation are provided below.

[0033] Operation of a hot wheel protection valve **14** to exhaust brake cylinder **52** pressure from a brake system of a railway vehicle is described below. As previously discussed, by using hot wheel protection valve **14**, any excess pressurized fluid that leaks into the brake cylinder **52** of the railway vehicle may be exhausted from the brake system, thereby avoiding a hot wheel situation for the railway vehicle.

[0034] With reference to **FIG. 8**, during use of hot wheel protection valve **14**, biasing member **42** may apply a predetermined downward force on piston **20**. The predetermined downward force may be provided based on the stiffness and resiliency of biasing member **42**. The downward force exerted by biasing member **42** on piston **20**, in turn, provides a downward force on diaphragm **34**. It is also contemplated that pressurized fluid in first chamber **44** from brake cylinder **52** may assert a downward force on feedback diaphragm **26** and thereby piston **20**. Pressurized fluid in third chamber **48** from brake pipe **58** (or, alternatively, an auxiliary reservoir) may also provide a downward force on diaphragm **34** and thereby piston **20**, which is connected to diaphragm **34**. Pressurized fluid in fourth chamber **50** from emergency reservoir **62** may assert an upward force on diaphragm **34** and thereby piston **20**. In this aspect, a pressure differential is developed between biasing member **42**, brake pipe **58**, and brake cylinder **52** on a first side of hot wheel protection valve **14**, and emergency reservoir **62** on a second opposing side of hot wheel protection valve **14**. Hot wheel protection valve **14** is positioned in a lap position when the opposing forces on the pressure differential are substantially equal. In this situation, bushing passageway **40b**, which leads to hot wheel exhaust line **66**, is closed off by an outer surface of piston **20**.

[0035] During operation of the railway vehicle, when brake cylinder **52** pressure is provided at a predetermined level, the hot wheel protection valve **14** remains in the lap position. In one aspect, when brake cylinder **52** pressure is less than 42 psi, hot wheel protection valve **14** is positioned in the lap position and does not vent excess pressurized fluid from hot wheel protection valve **14**. However, during operation of the railway vehicle, pressurized fluid may slowly leak into brake cylinder **52**, thereby bringing brake cylinder **52** pressure to an excessive pressure level. To avoid a hot wheel condition, this excessive pressure should be vented from brake cylinder **52**. As the pressure increases in brake cylinder **52**, the downward force from the pressurized fluid supplied to first chamber **44** is increased and unbalances the pressure differential in hot wheel protection valve **14**. Pressurized fluid in first chamber **44** pushes down on feedback diaphragm **26**, which pushes piston **20** downwardly. As piston **20** is moved downwardly, bushing passageway **40b** is opened and fluid communication is established between brake cylinder line **54** and hot wheel exhaust line **66**. A groove **68** on piston **20** allows for fluid communication from brake cylinder line **54** to hot wheel exhaust line **66**. Groove **68** allows for fluid communication from brake cylinder line **54**, through bushing passageway **40d**, through groove **68**, through bushing passageway **40b**, and through hot wheel exhaust line **66**. This fluid communication allows pressurized fluid from brake cylinder line **54** to vent through bushing passageway **40b** to exhaust through hot wheel exhaust line **66**. As pressurized fluid is vented from brake cylinder **52**, the downward pressure exerted on feedback diaphragm **26** and piston **20** by pressurized fluid in first chamber **44** is reduced accordingly. As the downward pressure exerted on piston **20** is reduced, the pressure differential is brought back to the lap position, wherein the downward pressure exerted by pressurized fluid in first chamber **44**, third chamber **48**, and biasing member **42** is substantially equal to the upward pressure applied by the pressurized fluid in fourth chamber **50**. Hot wheel protection valve **14** may be configured to reach the lap position when brake cylinder **52** pressure ceases to increase and pressure on piston **20** is reduced. Hot wheel protection valve **14** may "meter" or continually vent to match the leakage into brake cylinder **52** in order to prevent an increase above a predetermined pressure level in brake cylinder **52**.

[0036] While hot wheel protection valve **14** will ensure that any pressurized fluid that leaks into brake cylinder **52** will be vented from brake control valve **2** to maintain a desired brake cylinder **52** pressure level, it is also contemplated that there are situations during operation of the railway vehicle in which an operator intends to stop the railway vehicle and an excess pressure level in brake cylinder **52** is desired to apply a brake force to the railway vehicle. In

this situation, the venting of brake cylinder **52** is no longer appropriate since any and all brake cylinder **52** pressure should be available to control or stop the railway vehicle. Cut-off valve **12** provides the ability to nullify the exhaust feature of hot wheel protection valve **14** to allow pressurized fluid to build up in brake cylinder **52**. In one aspect, cut-off valve **12** prevents venting of hot wheel protection valve **14** when brake cylinder **52** pressure exceeds 42 psi. It is to be understood, however, that different brake cylinder **52** pressure levels which nullify the venting of hot wheel protection valve **14** are also contemplated.

[0037] Referring to **FIGS. 5A**, **5B**, and **7**, cut-off valve **12** is shown. Cut-off valve **12** may be in fluid communication with hot wheel protection valve **14** via hot wheel exhaust line **66**. Cut-off valve **12** may include a piston **70** positioned in a chamber **72** defined by central main body **6**. A plurality of grooves may be defined in an outer surface of piston **70**. An O-ring **74a**, **74b, 74c** may be positioned in each groove defined on piston **70**. O-rings **74a**, **74b, 74c** are provided to prevent leakage of pressurized fluid from cut-off valve **12**. Although three grooves and three O-rings are shown in connection with piston **70**, it is to be understood that more or less grooves and/or O-rings may be provided to create a tighter seal between piston **70** and bushing **76** provided around the piston **70**. Bushing **76** may be cylindrical in shape to fit around piston 7**0**. Bushing **76** may be slidable in conjunction with piston **70**. A plurality of bushing passageways **78a**, **78b**, **78c**, **78d** may be defined in bushing **76**. Bushing passageways **78a**, **78b**, **78c**, **78d** may permit pressurized fluid to pass through bushing **76** and, thereby, out of hot wheel protection valve **14**, through cut-off valve **12**, and out of cut-off valve **12**, as will be described in detail below. Although four bushing passageways **78a**, **78b**, **78c**, **78d** are shown in connection with bushing **76**, it is to be understood that more or less bushing passageways may be provided to more efficiently allow pressurized fluid to pass through bushing **76**. A biasing member **80** may be provided on an upper portion of piston **70**. In one aspect, biasing member **80** may be a spring. However, it is to be understood that alternative biasing members may be used to provide a resilient member that may be compressed and expanded to provide a biasing force. Biasing member **80** may be configured to assert a biasing downward force against piston **70** during operation of cut-off valve **12**. It is also contemplated that biasing member **80** may not be used with cut-off valve **12**. Biasing member **80** may be positioned in a chamber **82** defined by upper main body **4**. As shown in **FIG. 5B**, the components **70**, **74a-74c**, **80**, **86** may be inserted into an upper end of the cavity **16** of the brake control valve **2**.

[0038] As shown in **FIG. 8**, brake cylinder **52** may also be in fluid communication with chamber **72** cut-off valve **12** via brake cylinder line **54**. Pressurized fluid supplied to

chamber **72** from brake cylinder **52** asserts an upward force on piston **70**. Chamber **82** may be fluidly connected to atmosphere **84**. A pressure differential is established between the force exerted by biasing member **80** and atmospheric pressure on one side of piston **70**, and the force exerted by the pressurized fluid in chamber **72** from brake cylinder **52**. When these pressures are substantially equal, the piston **70** is positioned in a lap position.

[0039] In one aspect, when brake cylinder **52** is positioned in a release position, and brake cylinder **52** pressure is approximately zero psi, biasing member **80** exerts enough force on piston **70** to permit venting of hot wheel protection valve **14**. In this situation, however, since there is no brake cylinder **52** pressure, venting of brake cylinder **52** through hot wheel protection valve **14** is not needed. When brake cylinder **52** is in an applied position, brake cylinder **52** pressure is greater than zero but less than a predetermined excess pressure level. In the applied situation, the force exerted by the pressurized fluid in chamber **72** from brake cylinder **52** is insufficient to overcome the force exerted by biasing member **80**. Therefore, cut-off valve **12** remains open and permits venting of pressurized fluid from hot wheel protection valve **14**. As pressurized fluid is leaked into brake cylinder **52**, and hot wheel protection valve **14** is used to vent the excess pressurized fluid, the vented pressurized fluid is directed through hot wheel exhaust line **66** into cut-off valve **12**. The vented pressurized fluid is directed through bushing passageway **78a**, through a groove **86** defined in the outer surface of piston **70**, through bushing passageway **78c**, and through a cut-off valve exhaust line **88**. The vented pressurized fluid is vented out of the cut-off valve **12** through cut-off valve exhaust line **88** and is vented to atmosphere or, alternatively, another chamber (i.e., a retainer exhaust cavity) of hot wheel protection control valve **2**.

[0040] In another aspect, when brake cylinder **52** is in an applied position and excess pressurized fluid is supplied to brake cylinder **52**, cut-off valve **12** may be activated to prevent the excess pressurized fluid from being vented from hot wheel protection valve **14**. In one aspect, when the brake cylinder **52** pressure exceeds 42 psi, the cut-off valve **12** is activated. When the brake cylinder **52** is supplied with this excess pressurized fluid, the pressurized fluid is directed to chamber **72** of cut-off valve **12**. The pressurized fluid in chamber **72** exerts an upward force on piston **70** that is greater than and overcomes the downward force exerted by the biasing member **80** on piston **70**. In this situation, the piston **70** is moved upwards in cut-off valve **12**, which closes bushing passageways **78a**, **78c** to prevent pressurized fluid vented from hot wheel protection valve **14** from being vented through cut-off valve exhaust line **88**. Since bushing passageways **78a**, **78c** are closed to prevent venting through cut-off valve **12**, any pressurized fluid vented from hot wheel

protection valve **14** through hot wheel exhaust line **66** is directed to second chamber **46** of hot wheel protection valve **14** via hot wheel exhaust line **66**, as shown in **FIG. 8**. Since no pressurized fluid is permitted to exhaust from hot wheel protection valve **14**, substantially all of the pressurized fluid supplied to brake cylinder **52** can be used to apply the brakes on the railway vehicle. Choke **56** also assists in preventing the pressurized fluid from being vented through hot wheel protection valve **14** when an operator wants full brake cylinder **52** pressure to apply the brakes on the railway vehicle. Choke **56** regulates the flow of pressurized fluid into hot wheel protection valve **14** and ensures that a considerable amount of the pressurized fluid from brake cylinder **52** is directed to chamber **72** of cut-off valve **12** instead of hot wheel protection valve **14** to ensure that cut-off valve **12** nullifies the venting feature of hot wheel protection valve **14**.

[0041] While various aspects of cut-off valve **12** and hot wheel protection valve **14** were provided in the foregoing description, those skilled in the art may make modifications and alterations to these aspects without departing from the scope and spirit of the disclosure. For example, it is to be understood that this disclosure contemplates that, to the extent possible, one or more features of any aspect can be combined with one or more features of any other aspect. Accordingly, the foregoing description is intended to be illustrative rather than restrictive. The disclosure described hereinabove is defined by the appended claims and all changes to the invention that fall within the meaning and the range of equivalency of the claims are to be embraced by their scope.

THE INVENTION CLAIMED IS:

1. A hot wheel protection valve arrangement, comprising:

a hot wheel protection valve, comprising:

a body defining a passageway;

a piston slidably positioned within the passageway;

a bushing positioned on the piston and within the passageway;

a first diaphragm provided on a first end of the piston, the first diaphragm defining a first chamber in the passageway;

a second diaphragm provided on a second end of the piston, the second diaphragm defining a second chamber in the passageway, wherein a third chamber is defined between the first diaphragm and the second diaphragm; and

an exhaust port defined in the body and in fluid communication with the third chamber;

a brake cylinder line that establishes fluid communication between a brake cylinder, the first chamber, and the third chamber; and

an emergency reservoir line that establishes fluid communication between an emergency reservoir and the second chamber,

wherein pressurized fluid is vented from the brake cylinder via the exhaust port upon a brake cylinder pressure exceeding a predetermined force exerted by an emergency reservoir pressure.

2. The hot wheel protection valve arrangement as claimed in claim 1, wherein the bushing defines at least one bushing passageway in fluid communication with the brake cylinder line and the exhaust port.

3. The hot wheel protection valve arrangement as claimed in claim 1, further comprising a choke provided in the brake cylinder line between the brake cylinder and an inlet port defined in the hot wheel protection valve configured to receive pressurized fluid from the brake cylinder.

4. The hot wheel protection valve arrangement as claimed in claim 1,

wherein a fourth chamber is defined between the first diaphragm and the second diaphragm,

wherein a brake pipe line establishes fluid communication between a brake pipe and the fourth chamber, or an auxiliary reservoir line establishes fluid communication between an auxiliary reservoir and the fourth chamber, and

wherein the pressurized fluid is vented from the brake cylinder via the exhaust port upon a brake cylinder pressure exceeding a predetermined force exerted against a differential of the emergence reservoir pressure and a brake pipe pressure or an auxiliary reservoir pressure.

5. The hot wheel protection valve arrangement as claimed in claim 4, further comprising a biasing member provided in the fourth chamber, and

wherein the biasing member creates a biasing force against the second diaphragm.

6. The hot wheel protection valve arrangement as claimed in claim 1, wherein a groove is defined on an outer surface of the piston, and

wherein, as the piston slides within the passageway to a predetermined position, pressurized fluid from the brake cylinder line is permitted to flow through the bushing, around the groove defined on the piston, through the bushing again, and through the exhaust port.

7. The hot wheel protection valve arrangement as claimed in claim 1, wherein an outer circumferential surface of the first diaphragm is held within the body of the hot wheel protection valve and an inner circumferential surface of the first diaphragm is held on the first end of the piston between a feedback follower and a spacer, and

wherein an outer circumferential surface of the second diaphragm is held within the body of the hot wheel protection valve and an inner circumferential surface of the second diaphragm is held on the second end of the piston between the second end of the piston and a follower.

8. A hot wheel protection valve arrangement, comprising:

a cut-off valve in fluid communication with an exhaust port of a hot wheel protection valve and a brake cylinder line, the cut-off valve comprising:

a piston positioned within a passageway;

a bushing provided around the piston and within the passageway; and

a biasing member provided on an end of the piston;

wherein the brake cylinder line establishes fluid communication between the cut-off valve and a brake cylinder;

wherein the cut-off valve prevents pressurized fluid from being exhausted from the brake cylinder upon a brake cylinder pressure exceeding a predetermined force exerted by the cut-off valve; and

wherein the biasing member creates the predetermined force against the piston to keep the cut-off valve in an open position.

9. The hot wheel protection valve arrangement as claimed in claim 8, wherein the passageway of the cut-off valve is in fluid communication with the exhaust port of the hot wheel protection valve, the brake cylinder line, and a line to atmosphere.

10. The hot wheel protection valve arrangement as claimed in claim 8,

wherein a groove is defined on an outer surface of the piston; and

wherein, as the piston slides within the passageway to a predetermined position, pressurized fluid from the exhaust port of the hot wheel protection valve is permitted to flow through the bushing, around the groove defined on the piston, through the bushing again, and through an exhaust port on the cut-off valve.

11. The hot wheel protection valve arrangement as claimed in claim 8,

wherein a plurality of grooves are defined on an outer surface of the piston; and

wherein an O-ring is provided in each groove of the plurality of grooves.

12. A hot wheel protection valve arrangement, comprising:

a hot wheel protection valve, comprising:

a body defining a passageway;

a piston slidably positioned within the passageway;

a bushing positioned on the piston and within the passageway;

a first diaphragm provided on a first end of the piston, the first diaphragm defining a first chamber in the passageway;

a second diaphragm provided on a second end of the piston, the second diaphragm defining a second chamber in the passageway, wherein a third chamber is defined between the first diaphragm and the second diaphragm; and

an exhaust port defined in the body and in fluid communication with the third chamber;

a cut-off valve in fluid communication with the exhaust port of the hot wheel protection valve, the cut-off valve comprising:

a piston positioned within a passageway;

a bushing provided around the piston and within the passageway; and

a biasing member provided on an end of the piston;

a brake cylinder line that establishes fluid communication with the first chamber, the third chamber, and the passageway of the cut-off valve; and

an emergency reservoir line that establishes fluid communication between an emergency reservoir and the second chamber,

wherein pressurized fluid is vented from the brake cylinder via the exhaust port upon a brake cylinder pressure exceeding a force exerted by an emergency reservoir pressure.

13. The hot wheel protection valve arrangement as claimed in claim 12, wherein the cut-off valve prevents pressurized fluid from being exhausted from the brake cylinder upon a brake cylinder pressure exceeding a predetermined force exerted by the cut-off valve.

14. The hot wheel protection valve arrangement as claimed in claim 13, wherein the biasing member creates the predetermined force against the piston of the cut-off valve to keep the cut-off valve in an open position.

15. The hot wheel protection valve arrangement as claimed in claim 12, wherein the bushing of the hot wheel protection valve defines at least one bushing passageway in fluid communication with the exhaust port of the hot wheel protection valve, the passageway of the cut-off valve, and an exhaust port defined by the cut-off valve.

16. The hot wheel protection valve arrangement as claimed in claim 12, further comprising a choke provided in the brake cylinder line between the brake cylinder and

an inlet port defined in the hot wheel protection valve configured to receive pressurized fluid from the brake cylinder.

17. The hot wheel protection valve arrangement as claimed in claim 12, wherein a fourth chamber is defined between the first diaphragm of the hot wheel protection valve and the second diaphragm of the hot wheel protection valve, and

wherein a brake pipe line establishes fluid communication between a brake pipe and the fourth chamber, or an auxiliary reservoir line establishes fluid communication between an auxiliary reservoir and the fourth chamber, and

wherein the pressurized fluid is vented from the brake cylinder via the exhaust port upon a brake cylinder pressure exceeding a predetermined force exerted against a differential of the emergence reservoir pressure and a brake pipe pressure or an auxiliary reservoir pressure.

18. The hot wheel protection valve arrangement as claimed in claim 17, further comprising a biasing member provided in the fourth chamber,

wherein the biasing member creates a biasing force against the second diaphragm.

19. The hot wheel protection valve arrangement as claimed in claim 12,

wherein a groove is defined on an outer surface of the piston of the hot wheel protection valve, and

wherein, as the piston slides within the passageway to a predetermined position, pressurized fluid from the brake cylinder is permitted to flow through the bushing of the hot wheel protection valve, around the groove defined on the piston of the hot wheel protection valve, through the bushing of the hot wheel protection valve again, and through the exhaust port of the hot wheel protection valve.

20. The hot wheel protection valve arrangement as claimed in claim 12, wherein an outer circumferential surface of the first diaphragm is held within the body of the hot wheel protection valve and an inner circumferential surface of the first diaphragm is held on the first end of the piston of the hot wheel protection valve between a feedback follower and a spacer, and

wherein an outer circumferential surface of the second diaphragm is held within the body of the hot wheel protection valve and an inner circumferential surface of the second diaphragm is held on the second end of the piston of the hot wheel protection valve between the second end of the piston and a follower.

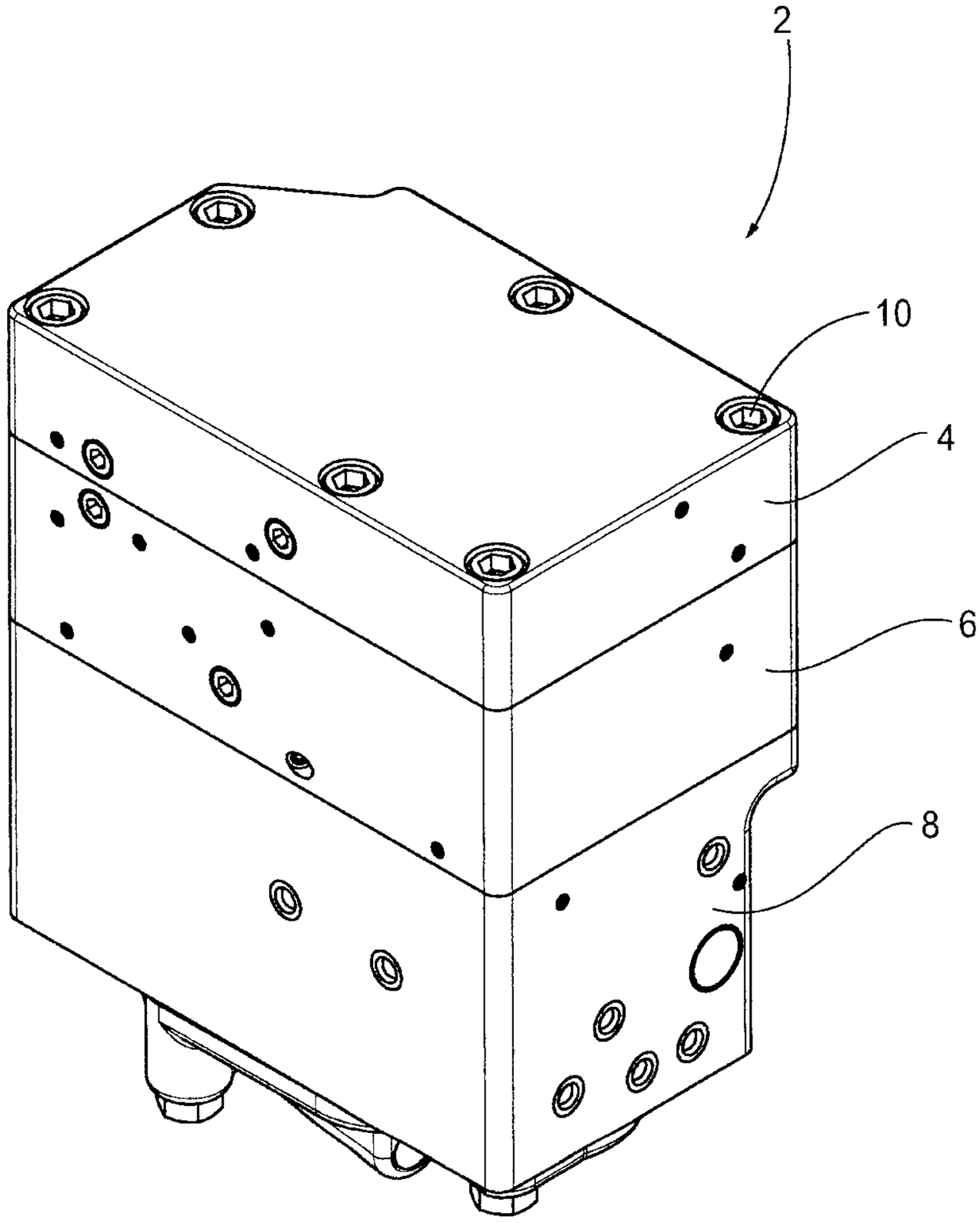


FIG. 1

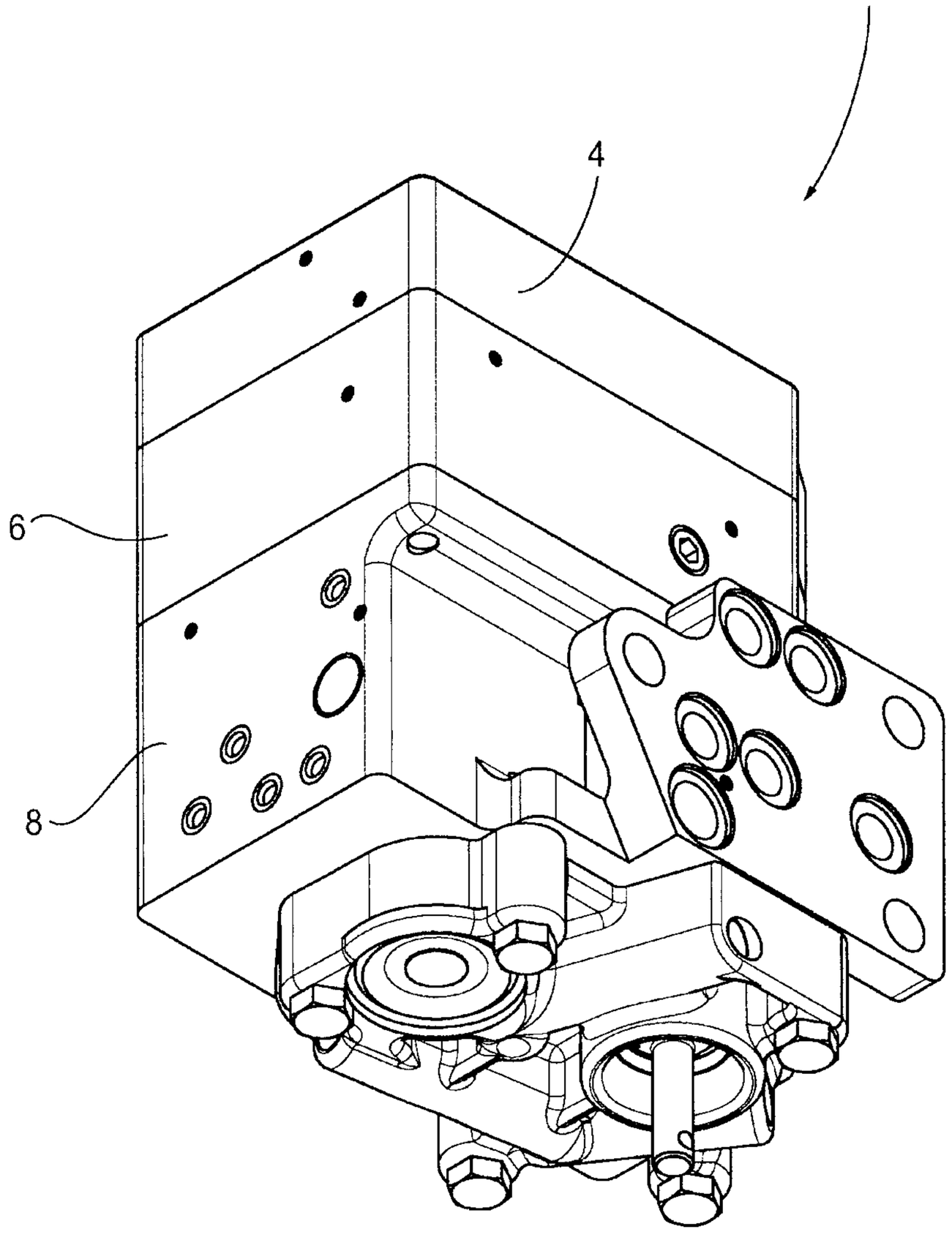


FIG. 2

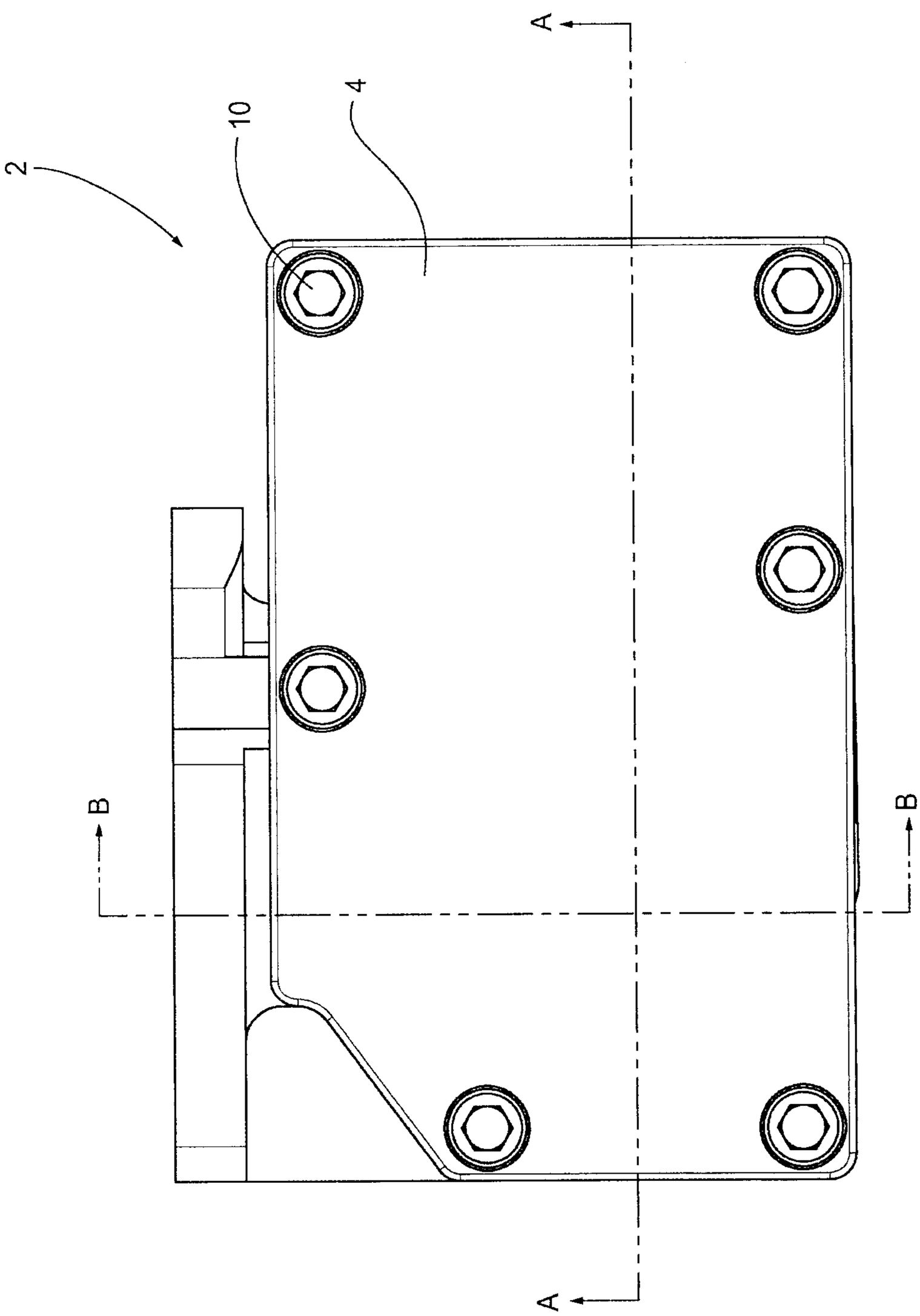


FIG. 3

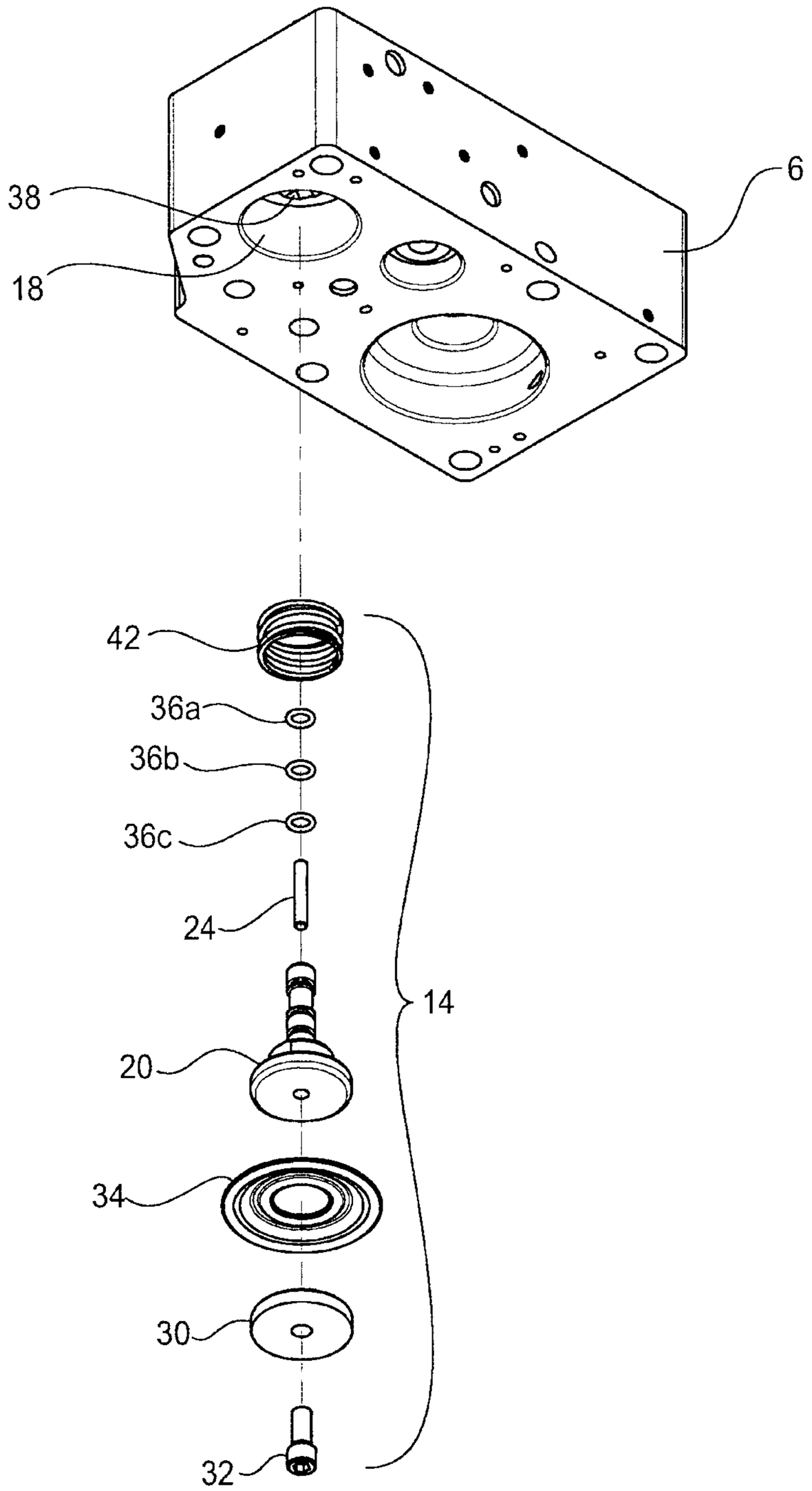


FIG. 4

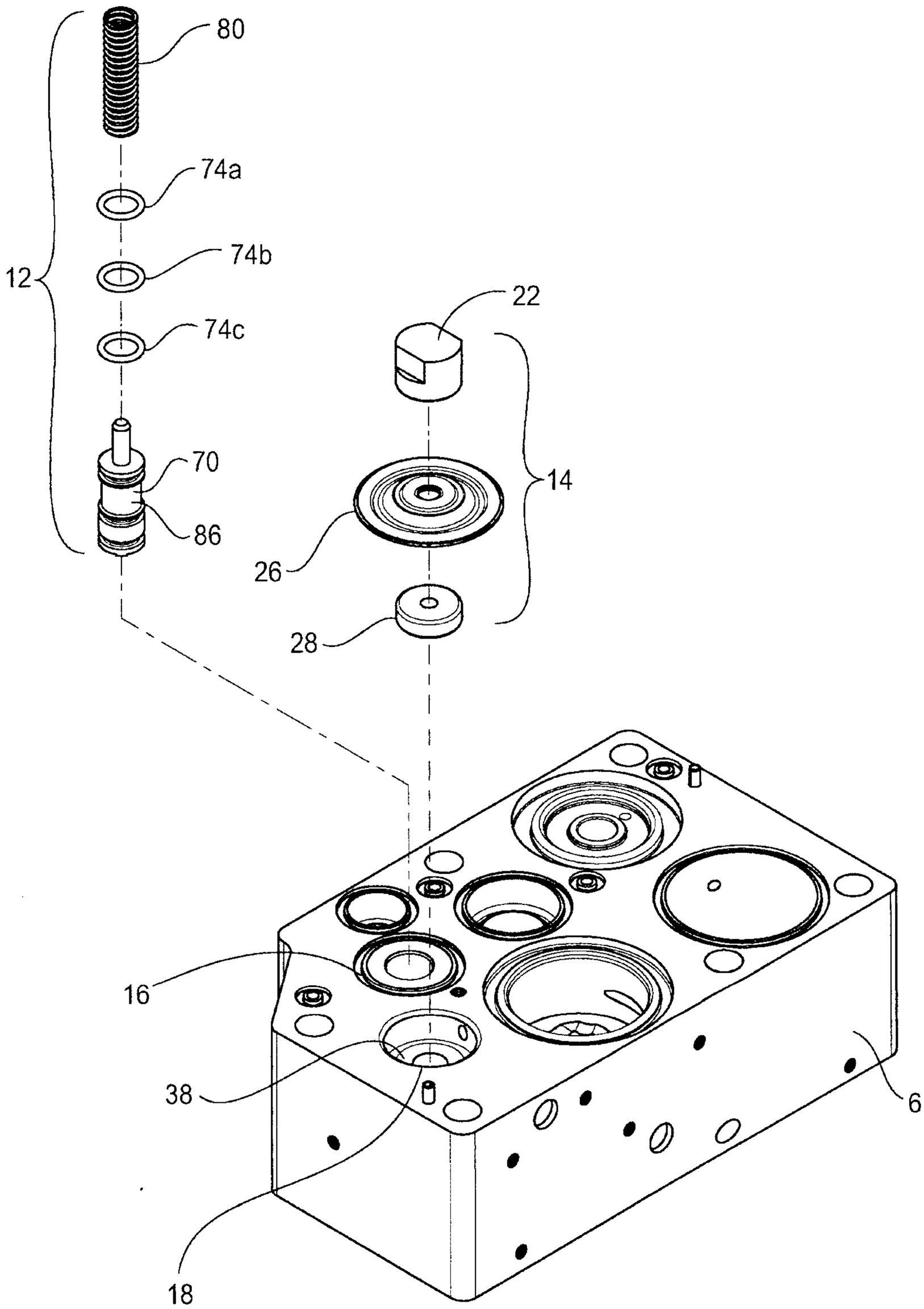


FIG. 5A

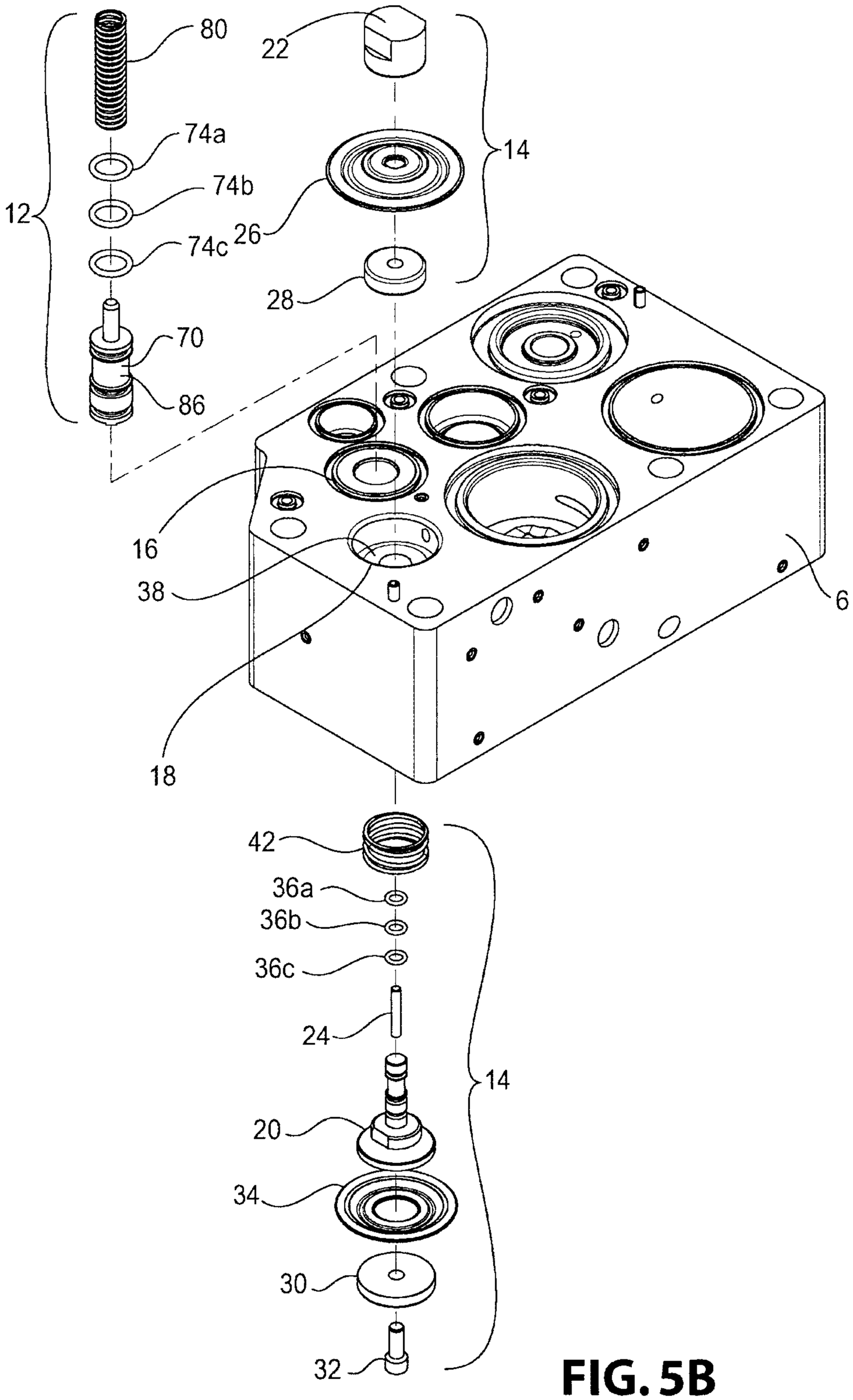

80
74a
74b
74c
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FIG. 5B

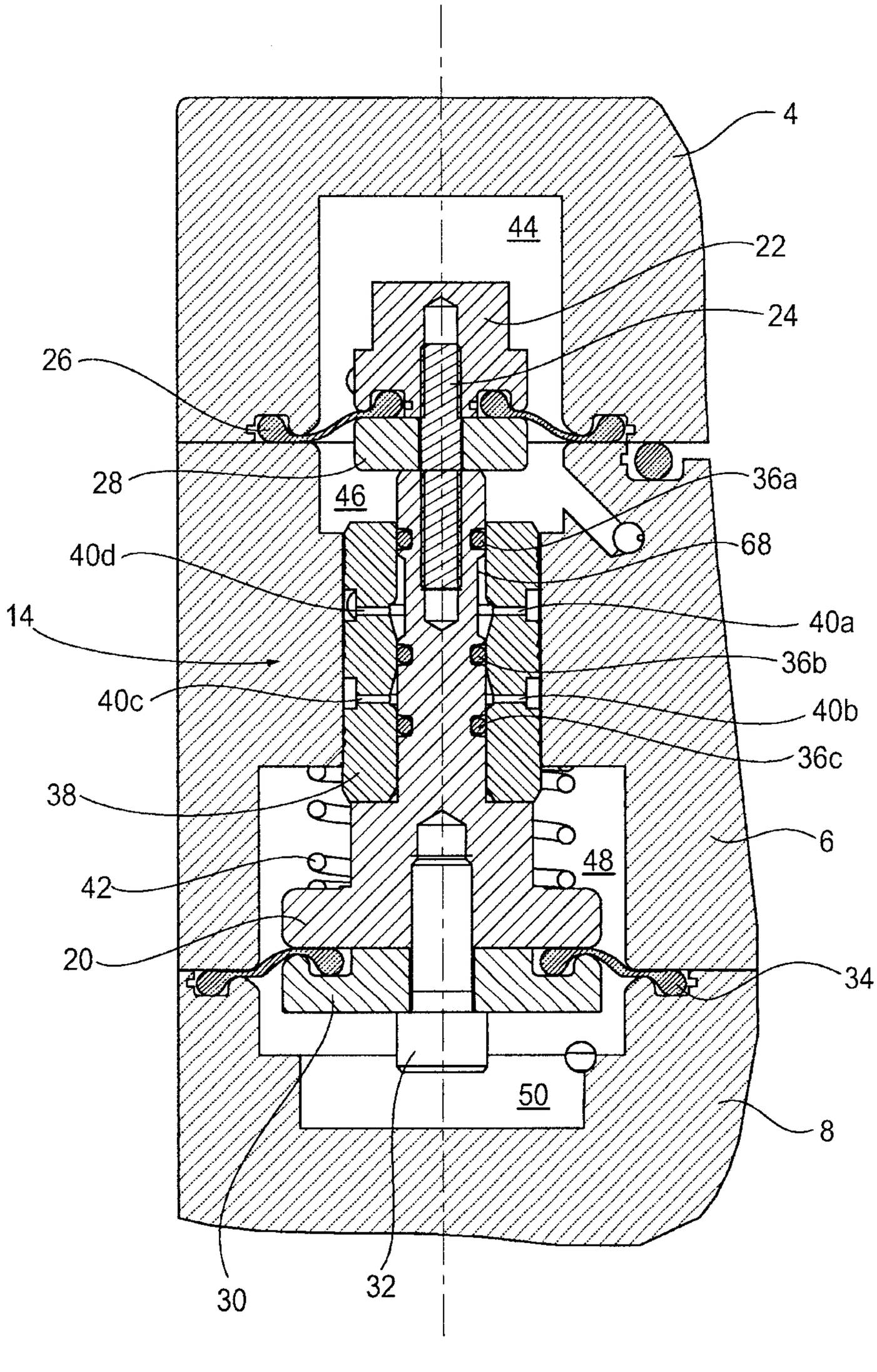

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36c
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FIG. 6

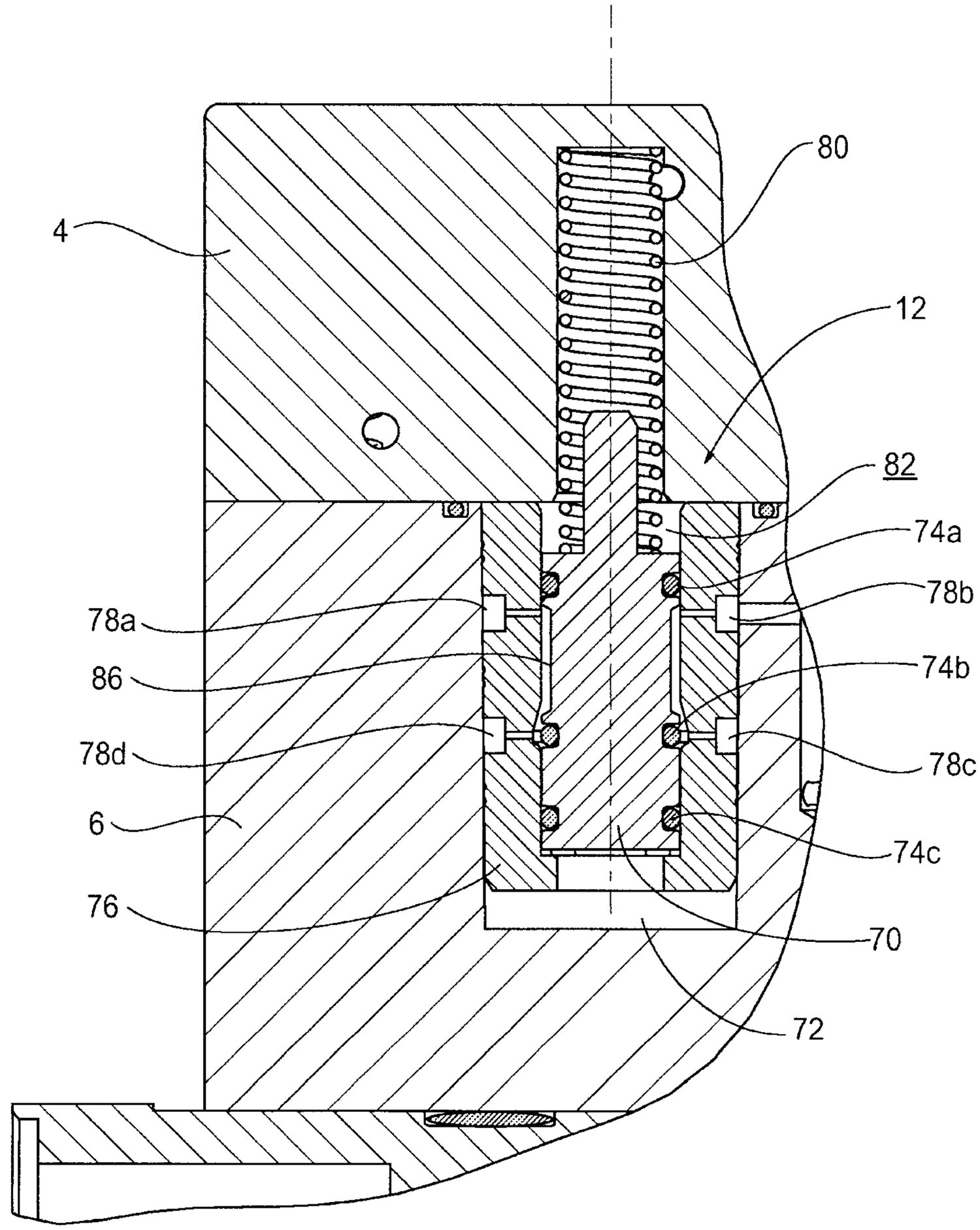


FIG. 7

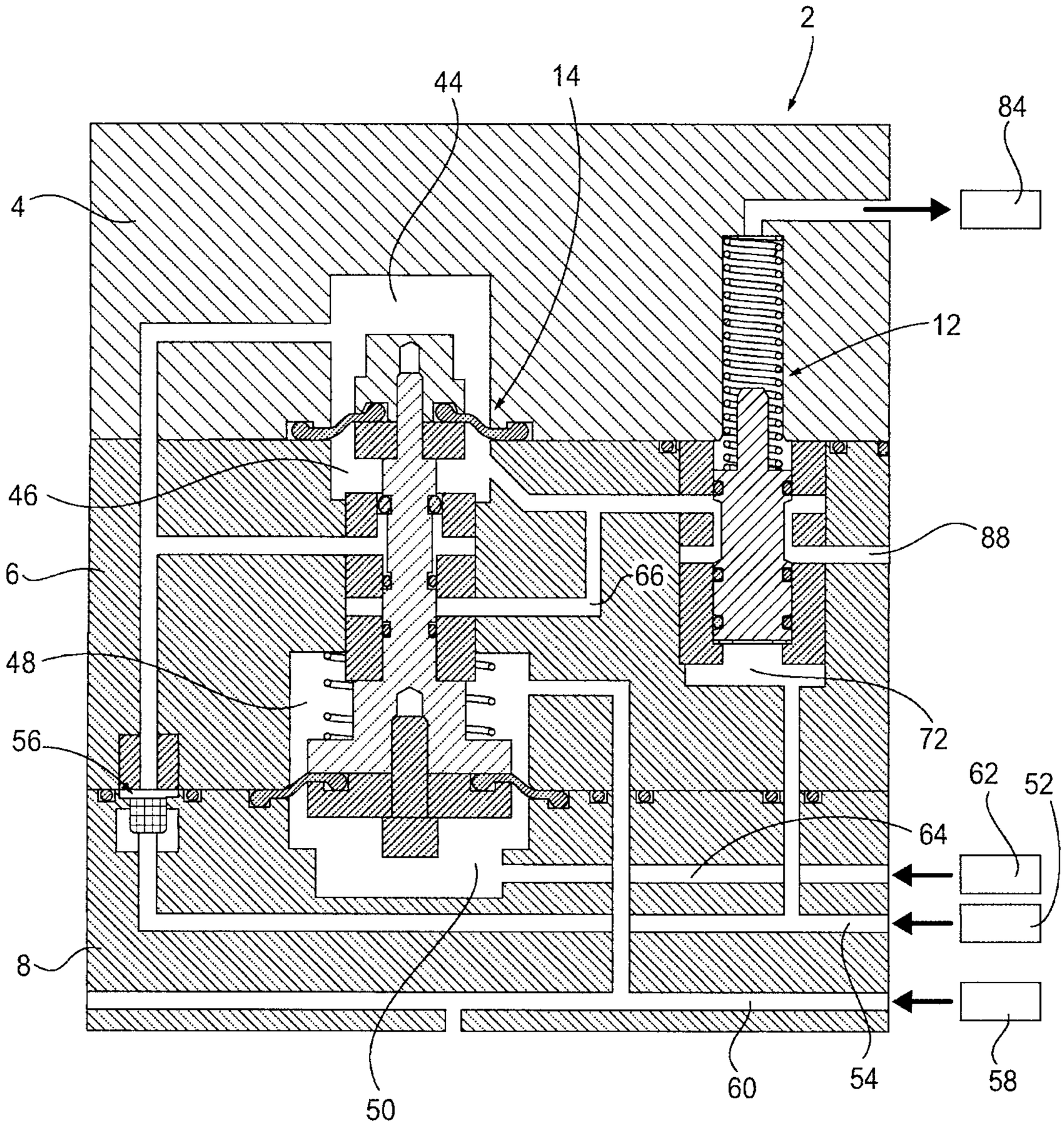


FIG. 8

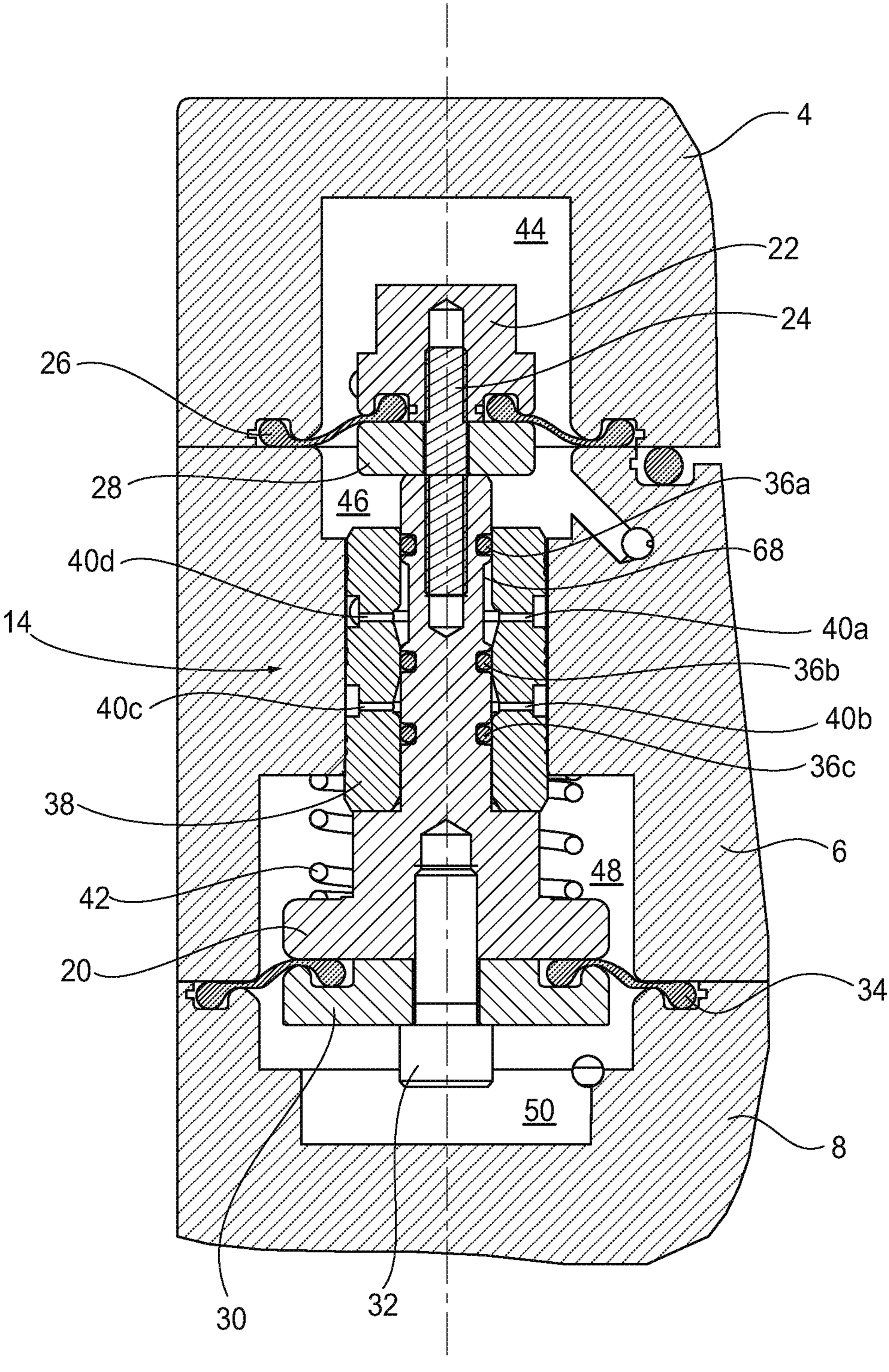

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40d
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36b
40c
40b
36c
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34
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FIG. 6