



- (51) **International Patent Classification:**
F16K 1/32 (2006.01) *F16K 1/12* (2006.01)
F16K 1/36 (2006.01)
- (21) **International Application Number:** PCT/US2015/010790
- (22) **International Filing Date:** 9 January 2015 (09.01.2015)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
61/930,095 22 January 2014 (22.01.2014) US
62/101,515 9 January 2015 (09.01.2015) US
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- (81) **Designated States** (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) **Designated States** (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) **Title:** POPPET VALVE STOP FEATURE

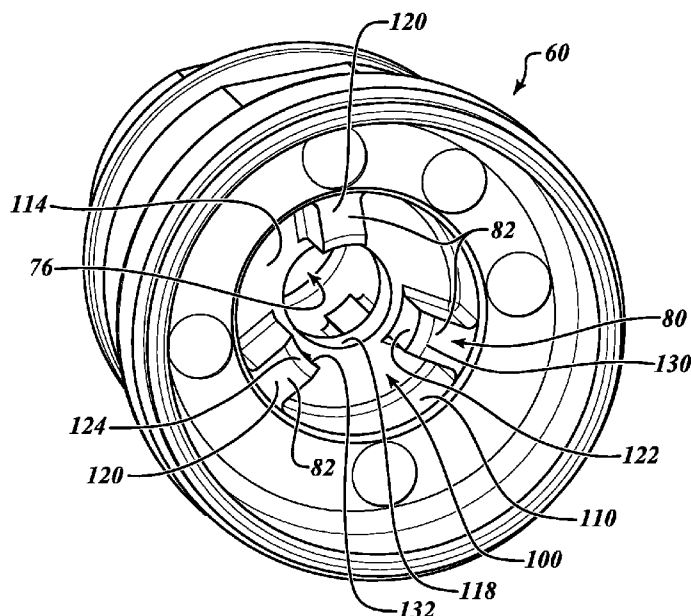


FIG. 2

(57) **Abstract:** An oil control valve constructed in accordance to one example of the present disclosure includes a valve body, a stem, a poppet, a regulator body and a poppet stop feature. The valve can have a valve seat. The stem can be configured to translate within the valve body. The poppet can be disposed at a distal end of the stem. The poppet can be configured to selectively engage the valve seat and inhibit oil from passing therebetween. The regulator body can define a regulation port. Oil can be configured to selectively flow through the regulation port when the poppet is offset from the valve seat. The poppet stop feature can be configured on the regulator body to engage the poppet upon dislocation of the poppet from the stem and permit flow of oil through the regulation port.

WO 2015/112349 A1



Published:

— *with international search report (Art. 21(3))*

POPPET VALVE STOP FEATURE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Patent Application No. 61/930,095 filed on January 22, 2014 and U.S. Patent Application No. 62/101,515 filed on January 9, 2015. The disclosures of the above applications are incorporated herein by reference.

FIELD

[0002] The present disclosure relates generally to oil control valves.

BACKGROUND

[0003] Oil control valves can be provided for various applications and in various configurations. In one application an oil control valve can be used in a cylinder deactivation system. Some oil control valves can include a poppet configured on a distal end of a stem in a regulator assembly.

[0004] The background description provided herein is for the purpose of generally presenting the context of the disclosure. Work of the presently named inventors, to the extent it is described in this background section, as well as aspects of the description that may not otherwise qualify as prior art at the time of filing, are neither expressly nor impliedly admitted as prior art against the present disclosure.

SUMMARY

[0005] An oil control valve constructed in accordance to one example of the present disclosure includes a valve body, a stem, a poppet, a regulator body and a poppet stop feature. The valve can have a valve seat. The stem can be configured to translate within the valve body. The poppet can be disposed at a distal end of the stem. The poppet can be configured to selectively engage the valve seat and inhibit oil from passing therebetween. The regulator body can define a regulation port. Oil can be configured to selectively flow through the regulation port when the poppet is offset from the valve seat. The poppet stop feature can be configured on the regulator body to engage the poppet

upon dislocation of the poppet from the stem and permit flow of oil through the regulation port.

[0006] According to additional features, the poppet stop feature can comprise a series of poppet stops. The poppet stops can be integrally formed with the regulator body. The series of poppet stops can comprise three poppet stops radially spaced 120 degrees relative to each other around the regulator body. Adjacent poppet stops can define an annular space therebetween. The annular space can accommodate oil flow therebetween.

[0007] In other features, each poppet stop of the series of poppet stops is connected to and extends from an inner cylindrical sidewall of the regulator body. Each poppet stop can extend from the cylindrical wall to a transverse wall of the regulator body. The transverse wall can extend generally transverse to an axis of the valve body and have an aperture therethrough. Each poppet stop can further include a poppet stop opposing wall portion, an axial wall portion and a connecting wall portion that connects the opposing wall portion and the axial wall portion.

[0008] According to other features, the axial wall portion can be concave corresponding to a geometry of the aperture of the transverse wall. The axial wall portions of the respective poppet stops can collectively define a diameter that is larger than a corresponding diameter of the transverse wall aperture. The connecting wall portion can be an angled transition wall having a first arcuate wall portion at the poppet stop opposing wall portion and a second arcuate wall portion at the axial wall portion. The first and second arcuate wall portion can be concentric with the regulation port. The regulator body can be formed of cast zinc-aluminum alloy.

[0009] An oil control valve constructed in accordance to another example of the present disclosure can include a valve body, a stem, a poppet, a regulator body and a series of poppet stops formed on the regulator body. The valve body can have a valve seat. The stem can be configured to translate within the valve body. The poppet can be disposed at a distal end of the stem. The poppet can be configured to selectively engage the valve seat and inhibit oil from passing therebetween. The regulator body can have an inner cylindrical sidewall and define a regulation port. Oil can be configured to selectively flow through the regulation port when the poppet is offset from the valve seat.

The series of poppets can be connected to and extend from the inner cylindrical sidewall of the regulator body. Adjacent poppet stops of the series of poppet stops can define annular space therebetween. The series of poppet stops can be configured to engage the poppet upon dislocation of the poppet from the stem and permit flow of oil through the annular space and through the regulation port.

[0010] According to other features, each poppet stop extends from the cylindrical wall to a transverse wall of the regulator body. The transverse wall can extend generally transverse to an axis of the valve body and have an aperture therethrough. Each poppet stop can further include a poppet stop opposing wall portion, an axial wall portion and a connecting wall portion that connects the opposing wall portion and the axial wall portion.

[0011] According to still other features, the axial wall portion can be concave and correspond to a geometry of the aperture of the transverse wall. The axial wall portions of the respective poppet stops collectively define a diameter that is larger than a corresponding diameter of the transverse wall aperture. The connecting wall portion can be an angled transition wall having a first arcuate wall portion at the poppet stop opposing wall portion and a second arcuate wall portion at the axial wall portion. The first and second arcuate wall portions can be concentric with the regulation port. The series of poppet stops can comprise three poppet stops radially spaced 120 degrees relative to each other around the regulator body.

[0012] An oil control valve constructed in accordance to another example of the present teachings can include a valve body, a stem, a poppet, a regulator body and a series of poppet stops formed on the regulator body. The valve body can extend along a valve axis and have a valve seat. The stem can be configured to translate within the valve body. The poppet can be disposed at a distal end of the stem. The poppet can have a first end configured to selectively engage the valve seat and inhibit oil from passing therebetween and a second end having a radial lip. The regulator body can define a regulation port. Oil can be configured to selectively flow through the regulation port when the poppet is offset from the valve seat. The regulator body can have an inner cylindrical wall and a transverse wall that define an aperture. The series of poppet stops can be connected to and extend from the inner cylindrical sidewall to the transverse wall of the regulator body. Adjacent poppet stops of the series of poppet stops define annular space

therebetween. The series of poppet stops can be configured to engage the radial lip of the poppet upon dislocation of the poppet from the stem and permit flow of oil through the annular space and through the regulation port.

[0013] According to other features, each poppet stop further includes a poppet stop opposing wall portion, an axial wall portion and a connecting wall portion that connects the opposing wall portion and the axial wall portion. The axial wall portion can be concave corresponding to a geometry of the aperture of the transverse wall. The axial wall portions of the respective poppet stops collectively define a diameter that is larger than a corresponding diameter of the transverse wall aperture. The connecting wall portion can be an angled transition wall having a first arcuate wall portion at the poppet stop opposing wall portion and a second arcuate wall portion at the axial wall portion. The first and second arcuate wall portions can be concentric with the regulation port.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present disclosure will become more fully understood from the detailed description and the accompanying drawings, wherein:

[0015] FIG. 1 is an oil control valve constructed in accordance to one example of the present disclosure;

[0016] FIG. 2 is an end perspective view of a regulator body configured in the oil control valve of FIG. 1 incorporating poppet stops according to one configuration;

[0017] FIG. 3 is a side view of a regulator body constructed in accordance to the present disclosure;

[0018] FIG. 4 is a cross-sectional view of the regulator body taken along lines 4-4 of FIG. 3;

[0019] FIG. 5 is an end view of the regulator body of FIG. 2;

[0020] FIG. 6 is a detail view of an o-ring groove of the regulator assembly of FIG. 1;

[0021] FIG. 7 is a cross-sectional view of the regulator body taken along lines 7-7 of FIG. 3; and

[0022] FIG. 8 is an end view of the regulator body of the present disclosure illustrating the poppet stops according to one example of the present disclosure.

DETAILED DESCRIPTION

[0023] As will become appreciated within, the following discussion will be directed toward an oil control valve configured for use in a cylinder deactivation valve. However, the configurations disclosed herein may be applicable to other valves configured for use with poppets.

[0024] With initial reference to FIG. 1, an oil control valve constructed according to the present disclosure is shown and identified at reference number 10. The oil control valve 10 can generally include a regulator assembly 20, a valve body 30, a core 36 and an armature 38. A stem 40 can include a distal threaded end 42. A poppet 44 can be threadably connected to the distal threaded end 42 of the stem 40. The valve body 30 can have a valve seat 48. When the core 36 is energized, the stem 40 can translate in a direction rightward as viewed in FIG. 1 until the poppet 44 engages the valve seat 48. When the poppet 44 engages the valve seat 48, oil is blocked from flowing between the poppet 44 and the valve seat 48.

[0025] The regulator assembly 20 can include a regulator body 60 that receives a check valve assembly 64. The check valve assembly 64 can include a check ball 70 and a biasing member 72. The regulator body 60 can define a regulation port 76. The regulator body 60 can further include a poppet stop feature 80. The poppet stop feature 80 can include a series of poppet stops 82 that are radially arranged around the regulator body 60. In one configuration the poppet stops 82 can be integrally formed with the regulator body 60. The regulator body 60 can be formed of cast zinc-aluminum alloy or other material. As will become appreciated herein, the poppet stops 82 are arranged such that if the poppet 44 separates from the stem 40, the poppet 44 will stop against the poppet stops 82 of the poppet stop feature 80 on the regulator body 60. In this regard, the poppet 44 will not be permitted to enter the regulation port 76 and obstruct oil flow. Additionally, the poppet stops 82 are positioned such that they will not contact the poppet 44 when the poppet 44 is properly attached to the stem 40 and normal function is not impacted.

[0026] FIG. 2 illustrates one configuration wherein the poppet stop feature 80 comprises three poppet stops 82. The poppet stops 82 are arranged in radial increments of 120 degrees. Adjacent poppet stops 82 define an annular space 100 therebetween.

The annular space 100 is provided for oil flow such as if the poppet 44 becomes separated from the stem 40 (explained further below). Other configurations are contemplated. In the example shown in FIG. 2, each poppet stop 82 is connected to and extends from an inner cylindrical sidewall 110 of the regulator body 60. Each poppet stop 82 extends from the inner cylindrical sidewall 110 to a transverse wall 114 of the regulator body 60. The transverse wall 114 extends generally transverse relative to an axis 116 of the regulator body 60. The transverse wall 114 defines an aperture 118 that cooperates to pass fluid through the regulation port 76.

[0027] Each poppet stop 82 can further include a poppet stop opposing wall portion 120, an axial wall portion 122 and a connecting wall portion 124. In one example, the axial wall portion 122 can be concave to generally match the geometry of the aperture 118. It will be appreciated however that the axial wall portions 122 can have other geometries such as planar or convex. In one example, the axial wall portions 122 can define a diameter D1 that is larger than a diameter D2 of the aperture 118 (see FIG. 8). The poppet stop opposing wall portion can be generally parallel to the transverse wall 114. The connecting wall portion 124 can be an angled transition wall having a first arcuate wall portion 130 at the poppet stop opposing wall portion 120 and a second arcuate wall portion 132 at the axial wall portion 122. Both of the first and second arcuate wall portions 130 and 132 can have a generally concave profile that is concentric or substantially concentric with the port 76 and the aperture 118.

[0028] FIGS. 3-8 illustrate various exemplary configurations of the regulator body 60. As identified above, the poppet stops 82 are arranged such that if the poppet 44 separates from the stem 40, the poppet 44 will stop against the poppet stops 82 of the poppet stop feature 80 on the regulator body 60. Specifically, the poppet 44 would engage the respective poppet stop opposing wall portions 120 (see FIG. 4) in a retained position. More particularly, the poppet 44 includes a poppet head portion 138 including a first end 140 configured to engage the valve seat 48 (FIG. 1) and a radial lip 142 provided on an opposite end. The radial lip 142 provided on the poppet 44 engages the respective poppet stop opposing wall portions 120 and is inhibited from travelling further into the port 76. In the retained position, fluid is still permitted to flow through the respective annular spaces 100 defined between adjacent stops 82. See also flow F shown in FIG. 7.

[0029] With particular reference now to FIGS. 3 and 6, additional features of the regulator body 60 will be described. The regulator body includes a central hub portion 144 and a collar 146. An annular groove 148 is formed between the central hub portion 144 and the collar 146. The annular groove 148 can be configured to receive a sealing member such as an o-ring 150 (FIG. 1).

[0030] The foregoing description of the examples has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular example are generally not limited to that particular example, but, where applicable, are interchangeable and can be used in a selected example, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

CLAIMS

What is claimed is:

1. An oil control valve comprising:
 - a valve body having a valve seat;
 - a stem configured to translate within the valve body;
 - a poppet disposed at a distal end of the stem, the poppet configured to selectively engage the valve seat and inhibit oil from passing therebetween;
 - a regulator body defining a regulation port, wherein oil is configured to selectively flow through the regulation port when the poppet is offset from the valve seat;
 - and
 - a poppet stop feature configured on the regulator body, the poppet stop feature configured to engage the poppet upon dislocation of the poppet from the stem and permit flow of oil through the regulation port.
2. The oil control valve of claim 1 wherein the poppet stop feature comprises a series of poppet stops.
3. The oil control valve of claim 2 wherein the poppet stops are integrally formed with the regulator body.
4. The oil control valve of claim 3 wherein the series of poppet stops comprise three poppet stops radially spaced 120 degrees relative to each other around the regulator body.
5. The oil control valve of claim 3 wherein adjacent poppet stops define an annular space therebetween, the annular space accommodating oil flow therethrough.
6. The oil control valve of claim 5 wherein each poppet stop of the series of poppet stops is connected to and extends from an inner cylindrical sidewall of the regulator body.

7. The oil control valve of claim 6 wherein each poppet stop extends from the cylindrical wall to a transverse wall of the regulator body, the transverse wall extending generally transverse to an axis of the valve body and having an aperture therethrough.

8. The oil control valve of claim 7 wherein each poppet stop further includes a poppet stop opposing wall portion, an axial wall portion and a connecting wall portion that connects the opposing wall portion and the axial wall portion.

9. The oil control valve of claim 8 wherein the axial wall portion is concave corresponding to a geometry of the aperture of the transverse wall, wherein the axial wall portions of the respective poppet stops collectively define a diameter that is larger than a corresponding diameter of the transverse wall aperture.

10. The oil control valve of claim 8 wherein the connecting wall portion is an angled transition wall having a first arcuate wall portion at the poppet stop opposing wall portion and a second arcuate wall portion at the axial wall portion, wherein the first and second arcuate wall portions are concentric with the regulation port.

11. The oil control valve of claim 4 wherein the regulator body is formed of cast zinc-aluminum alloy.

12. An oil control valve comprising:
 - a valve body having a valve seat;
 - a stem configured to translate within the valve body;
 - a poppet disposed at a distal end of the stem, the poppet configured to selectively engage the valve seat and inhibit oil from passing therebetween;
 - a regulator body having an inner cylindrical sidewall and defining a regulation port, wherein oil is configured to selectively flow through the regulation port when the poppet is offset from the valve seat; and
 - a series of poppet stops formed on the regulator body, the series of poppet stops connected to and extending from the inner cylindrical sidewall of the regulator body, wherein adjacent poppet stops of the series of poppet stops define annular space therebetween, the series of poppet stops configured to engage the poppet upon dislocation of the poppet from the stem and permit flow of oil through the annular space and through regulation port.
13. The oil control valve of claim 12 wherein each poppet stop extends from the cylindrical wall to a transverse wall of the regulator body, the transverse wall extending generally transverse to an axis of the valve body and having an aperture therethrough.
14. The oil control valve of claim 13 wherein each poppet stop further includes a poppet stop opposing wall portion, an axial wall portion and a connecting wall portion that connects the opposing wall portion and the axial wall portion.
15. The oil control valve of claim 14 wherein the axial wall portion is concave corresponding to a geometry of the aperture of the transverse wall, wherein the axial wall portions of the respective poppet stops collectively define a diameter that is larger than a corresponding diameter of the transverse wall aperture.

16. The oil control valve of claim 14 wherein the connecting wall portion is an angled transition wall having a first arcuate wall portion at the poppet stop opposing wall portion and a second arcuate wall portion at the axial wall portion, wherein the first and second arcuate wall portions are concentric with the regulation port.

17. The oil control valve of claim 12 wherein the series of poppet stops comprise three poppet stops radially spaced 120 degrees relative to each other around the regulator body.

18. An oil control valve comprising:

- a valve body extending along a valve axis and having a valve seat;
- a stem configured to translate within the valve body;
- a poppet disposed at a distal end of the stem, the poppet having a first end configured to selectively engage the valve seat and inhibit oil from passing therebetween and a second end having a radial lip;
- a regulator body that defines a regulation port, wherein oil is configured to selectively flow through the regulation port when the poppet is offset from the valve seat, the regulator body having an inner cylindrical wall and a transverse wall that defines an aperture; and
- a series of poppet stops formed on the regulator body, the series of poppet stops connected to and extending from the inner cylindrical sidewall to the transverse wall of the regulator body, wherein adjacent poppet stops of the series of poppet stops define annular space therebetween, the series of poppet stops configured to engage the radial lip of the poppet upon dislocation of the poppet from the stem and permit flow of oil through the annular space and through regulation port.

19. The oil control valve of claim 18 wherein each poppet stop further includes a poppet stop opposing wall portion, an axial wall portion and a connecting wall portion that connects the opposing wall portion and the axial wall portion, wherein the axial wall portion is concave corresponding to a geometry of the aperture of the transverse wall, wherein the axial wall portions of the respective poppet stops collectively define a diameter that is larger than a corresponding diameter of the transverse wall aperture.

20. The oil control valve of claim 18 wherein the connecting wall portion is an angled transition wall having a first arcuate wall portion at the poppet stop opposing wall portion and a second arcuate wall portion at the axial wall portion, wherein the first and second arcuate wall portions are concentric with the regulation port.

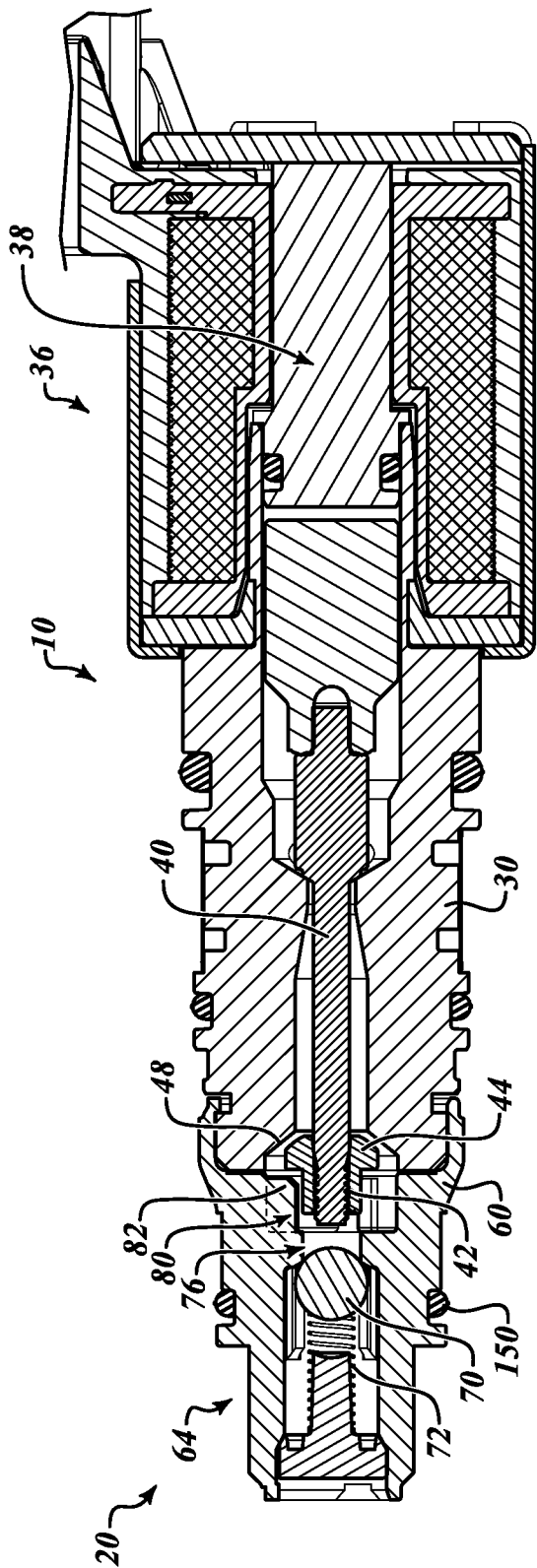


FIG. 1

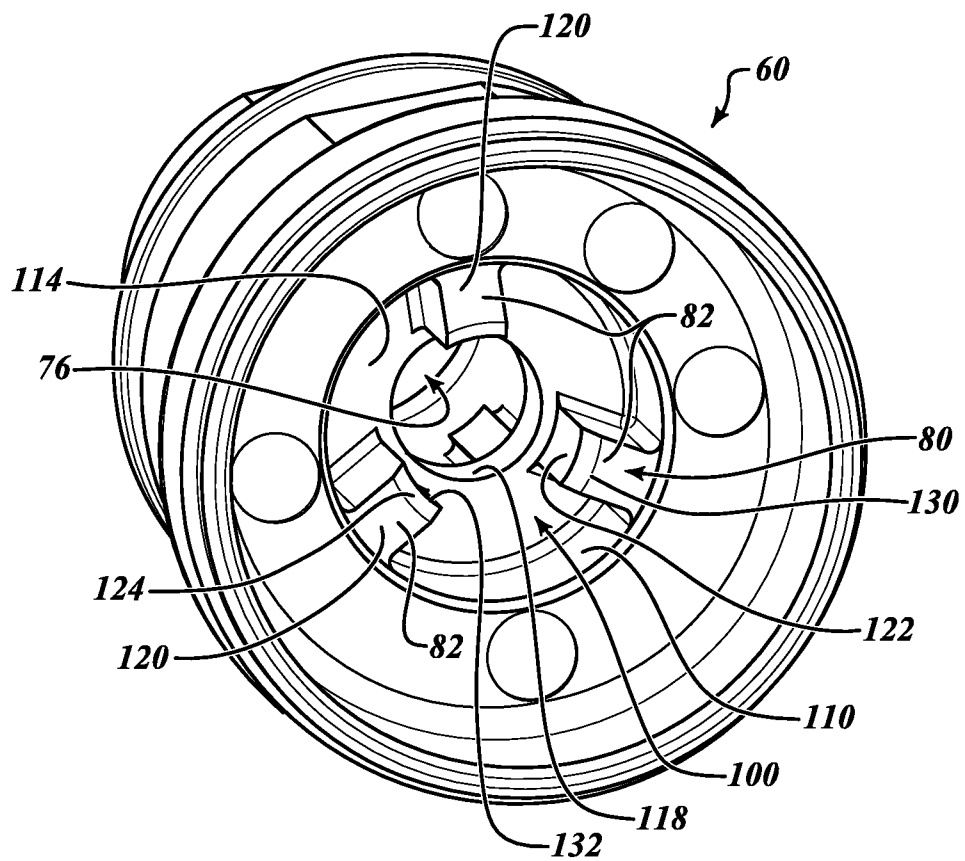


FIG. 2

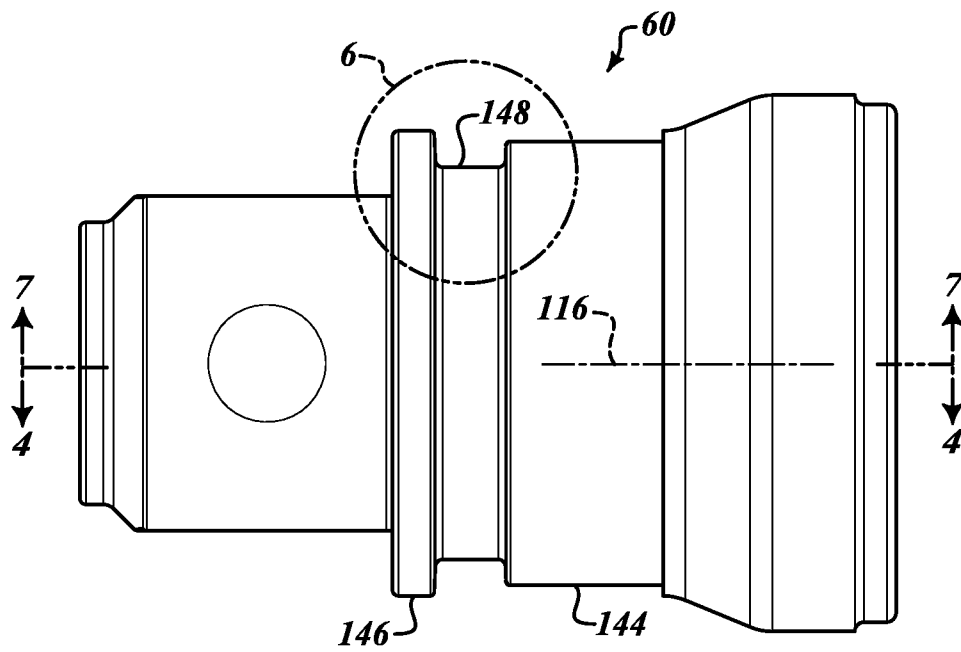


FIG. 3

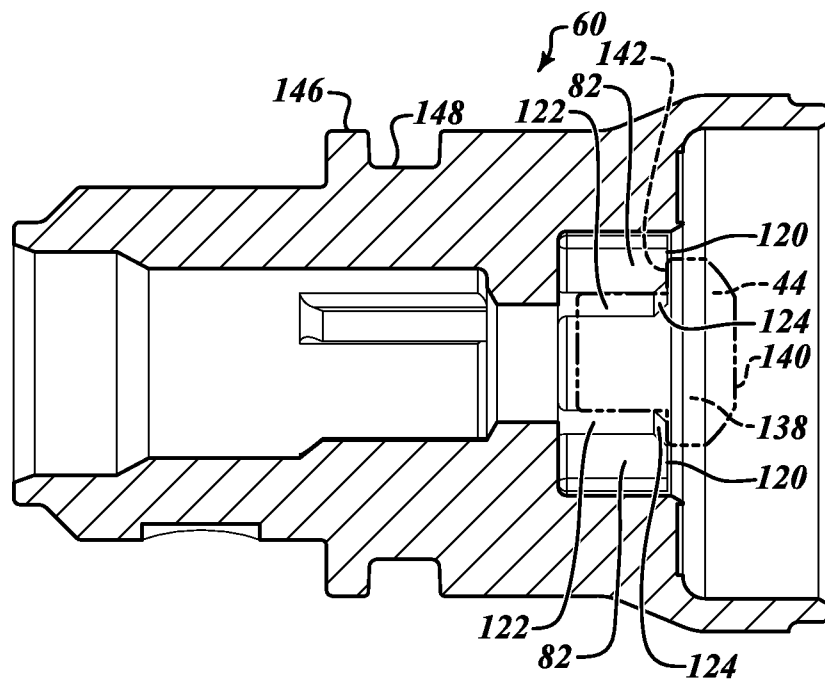


FIG. 4

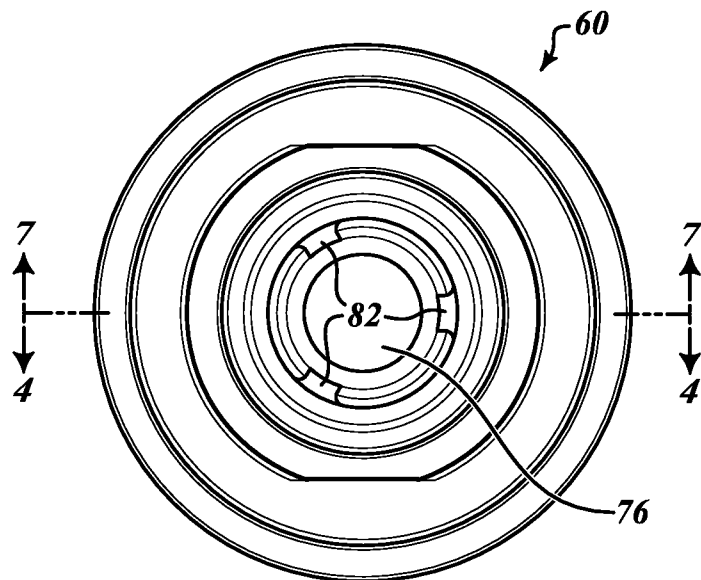


FIG. 5

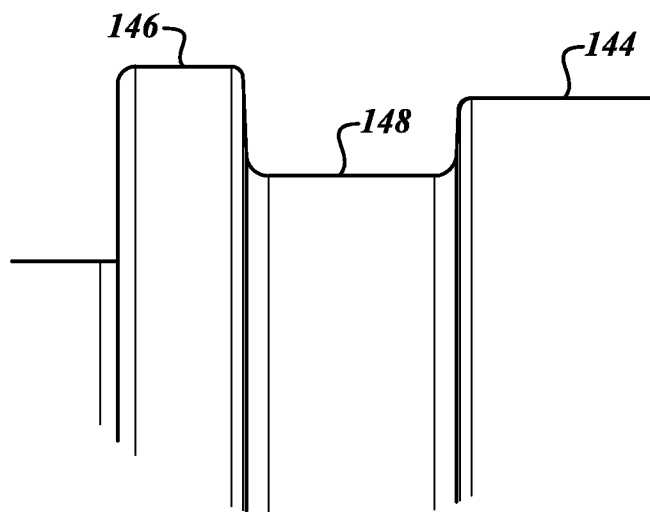


FIG. 6

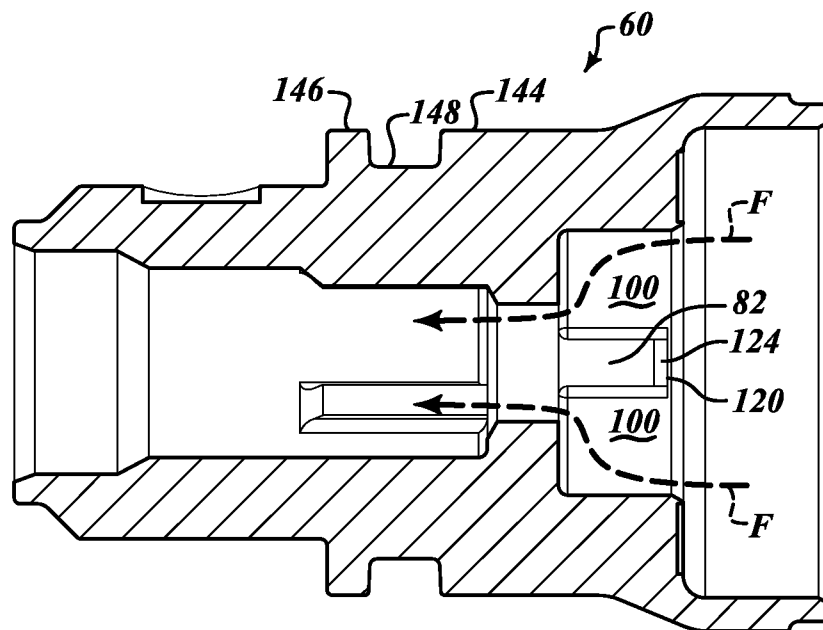


FIG. 7

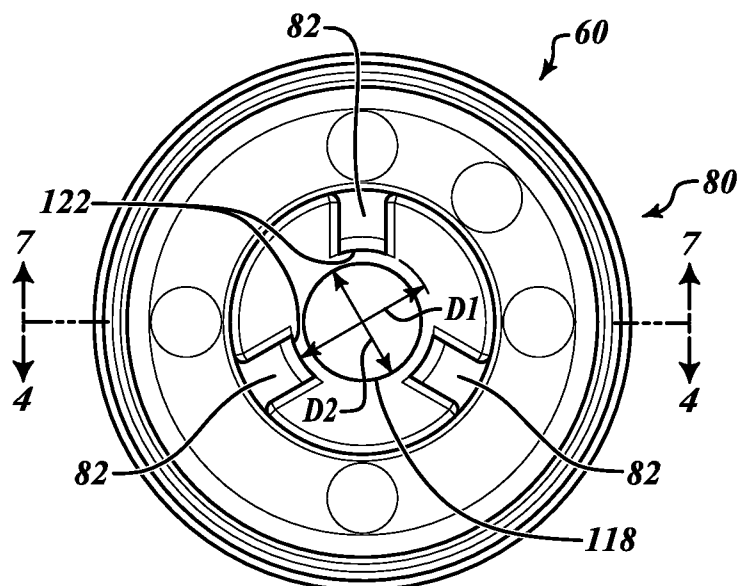


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2015/010790**A. CLASSIFICATION OF SUBJECT MATTER****F16K 1/32(2006.01)i, F16K 1/36(2006.01)i, F16K 1/12(2006.01)i**

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F16K 1/32; F02M 61/08; F16K 31/06; F16K 1/52; B67D 3/00; F16K 51/00; F16K 15/18; B23P 15/00; F16K 1/36; F16K 1/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords: oil control valve, valve body, stem, poppet, regulator body, poppet stop feature, and regulation port

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5715996 A (COOPER et al.) 10 February 1998	1-6, 11-12, 17
A	See column 1, line 34 - column 3, line 60 and figures 1-4C.	7-10, 13-16, 18-20
A	US 2005-0076955 A1 (BOEHLAND et al.) 14 April 2005 See paragraphs [0019], [0024] and figures 2, 4.	1-20
A	US 2006-0042702 A1 (BAUMANN, HANS D.) 02 March 2006 See paragraphs [0014]-[0017] and figures 1-2.	1-20
A	US 2009-0189104 A1 (BAMBER, DANIEL W.) 30 July 2009 See paragraphs [0013]-[0015] and figures 3-4.	1-20
A	US 2007-0267450 A1 (BOLYARD, JR. et al.) 22 November 2007 See paragraph [0015] and figure 2.	1-20



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

24 April 2015 (24.04.2015)

Date of mailing of the international search report

24 April 2015 (24.04.2015)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2015/010790

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5715996 A	10/02/1998	None	
US 2005-0076955 A1	14/04/2005	DE 10231135 A1 EP 1521930 A1 JP 2005-532501 A WO 2004-008010 A1	29/01/2004 13/04/2005 27/10/2005 22/01/2004
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US 2007-0267450 A1	22/11/2007	CN 101063493 A CN 101063493 B DE 102007018836 A1 DE 102007018836 B4 US 7614529 B2	31/10/2007 26/05/2010 15/11/2007 20/08/2009 10/11/2009