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(54) FLUID QUALITY CONTROL ASSEMBLY AND DEVICE

(57) A fluid quality control assembly for a fluid-filled container, e.g. an oil filled container, having a through-hole (1) within its container wall (3), wherein the through-hole comprises a seating section (31) is described. For reliable sealing the through-hole during quality control the assembly comprises a rod-like member (10) and a plug (20) separate from the rod-like member, the plug having an end surface configured to be adjacently arranged with regard to a first end tip (11a) of the rod-like member extending in a longitudinal direction between the first end (11) and a second end (12), wherein along its longitudinal direction the rod-like member comprises the first end tip (11a), a magnetic portion (13) and a fastening portion (14), wherein in a fixing position the rod-like member is removably fixed by its fastening portion within the through-hole of the container for sealing said through-hole, wherein the magnetic portion is located between the first end tip and the fastening portion, wherein in the fixing position the rod-like member is configured such that it extends in longitudinal direction beyond the seating section and that the magnetic portion is flowed around by fluid of the containers fluid filling, wherein the first end tip of the rod-like member and the end surface of the plug are coupled in the way that the plug is moved with the rod-like member and into a seating position at the seating section within the through-hole when the rod-like member is removed from its fixing position, wherein the plug is configured such that its outer surface fluid-tightly seals the through-hole in said seating position. Further a respective device comprising a tubular body and such assembly is described.

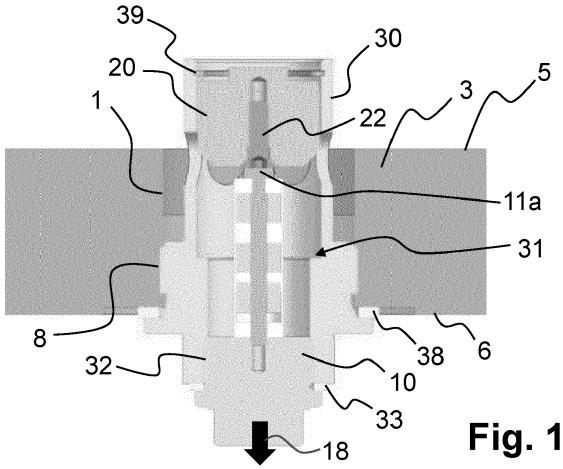

Fig. 1

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Description

[0001] The present disclosure relates to a fluid quality control assembly and device for a fluid-filled container, e.g. an oil-filled container, having a through-hole within its container wall, wherein the assembly comprises a magnetic portion.

BACKGROUND

[0002] The fluid, e.g. oil, quality of filled gear boxes and fuel tanks is often checked for metal residues using a magnetic stick that extends into the fluid from a drain hole of the box or tank wall. The magnetic stick adsorbs metal chips distributed within the fluid. The number, form and/or size of such metal residues helps to assess the status of the gear or other elements of the fluid system at an early stage. However, such magnetic stick cannot be pulled from the through-hole at the bottom of the gear box or tank without losing a lot of the liquid thereby causing environmental damage. This is why it was only possible to check the magnetic stick if the gear box or tank was completely emptied. This is very time consuming and costly.

[0003] Document CN 205797483 U describes an iron chip oil drain plug that can be screwed within an oil drain hole of a container having a cartridge and a magnetic core. The magnetic core comprises an oil filtering slotted hole that adsorbs iron chips distributed within the oil. When the iron chips adsorbed by the magnet core need to be removed, the magnet core can be rotated so that the magnet core can be moved within a cartridge bore hole along the longitudinal direction of the cartridge thereby disconnecting the magnet core from the cartridge. The removal of the magnet core allows a rubber buffer to move along the cartridge effected by a pressure spring supported by and accommodated within the cartridge into a position where it seals the magnetic core plug-in mounting hole such that oil cannot leak out from the oil drain hole.

[0004] Such iron chip oil drain plug does not reliably seal the drain hole of the container since iron chips may collect within the cartridge thereby hindering the spring driven movement of the buffer within the cartridge and correct accommodation of the buffer at the mounting hole.

[0005] Accordingly, it is an object of the present invention to provide a fluid quality control assembly and device that reliably seals a through-hole of a fluid container or tank and that can be easily removed and reassembled into the through-hole.

DESCRIPTION

[0006] The above problem is solved by a fluid quality control assembly having the features of claim 1 and a fluid quality control device having the features of claim 8.

[0007] In particular, the above problem is solved by a fluid quality control assembly for a fluid-filled container, i.e. an oil filled container, having a through-hole within its container wall, wherein the through-hole comprises a seating section. The assembly comprises a rod-like member and a plug separate from the rod-like member. The rod-like member provides collection of the metal scraps distributed within the liquid, wherein the plug facilitates sealing the through-hole when the rod-like member is removed for checking and/or cleaning. Further, the plug of the fluid quality control assembly has an end surface configured to be adjacently arranged with regard to a first end tip of the rod-like member extending in a longitudinal direction between the first end and a second end. Along its longitudinal direction the rod-like member comprises the first end tip, a magnetic portion and a fastening portion, wherein in a fixing position the rod-like member is removably fixed by its fastening portion within the through-hole of the container for sealing said through-hole. The magnetic portion is configured to magnetically attract metal scraps within the oil, wherein the magnetic portion is located between the first end tip and the fastening portion. In the fixing position the rod-like member is configured such that it extends in longitudinal direction beyond the seating section into the fluid and that the magnetic portion is flowed around by fluid of the container's fluid filling to collect metal scrap. The first end tip of the rod-like member and the end surface of the plug are coupled in the way that, when the rod-like member is removed from its fixing position (i.e. the rod-like member is pulled outwards), the plug is moved with the rod-like member and into a seating position at the seating section within the through-hole. The plug is thereby positioned in the seating position. The coupling of the rod-like member and the plug is described in more detail below. Furthermore, the plug is configured such that its outer surface fluid-tightly seals the through-hole in said seating position. In the seating position, the plug may be accommodated at and at least partly within the seating section. Accordingly, the plug is driven by the movement of the rod-like member and into its seating position when the rod-like member is detached from the through-hole and pulled out of it. Hence, the plug accommodation within its seating position is more reliable and may be provided with a greater initial contact pressure leading to a better sealing of the through-hole. After location of the plug in its seating position the internal pressure of the fluid keeps the plug pressed to its seating position. Hence, the through-hole may extend in horizontal or vertical direction or any direction angled with regard to the vertical direction and is still reliably sealed by the plug in its seating position.

[0008] The fluid may be a machine oil, a hydraulic oil or a gear oil, for example made from a biolubricant, a mineral oil and/or a synthetic oil.

[0009] The seating section may be a section within the trough hole with an enlarged or reduced inner diameter with regard to one neighboring section. The seating section may be provided by the through-hole itself or

another element (such as a tubular body) fixed within the through-hole as described below in detail.

[0010] In one embodiment, the seating section is configured for accommodation of the plug in its seating position, optionally it may provide an edge or bevel for accommodation of the plug.

[0011] For example, the rod-like member may comprise a thread at its fastening portion by means of which the rod-like member may be fastened to a corresponding thread within the through-hole of the container. Alternatively, the rod-like member may be removably fixed within the through-hole by a bayonet connection or another positive and/or frictional locking connection. When the rod-like member is fixed within the through-hole of the container, it takes its fixing position.

[0012] In one embodiment of the assembly, the first end tip comprises a first coupling element and the plug comprises a second coupling element at its end surface adjacent the first end tip for magnetic and/or mechanical coupling. For example, if the coupling between the first coupling element and the second coupling is a pure or predominantly magnetic coupling, i.e. the coupling of the elements is mechanically loose. For magnetic coupling the first coupling element and the second coupling element may be permanent magnets of opposite polarity. For example, the first and second coupling elements, each may have the form of a cylindrical or lenticular magnetic element that may be embedded within the plug or rod-like member, respectively. Alternatively, the magnetic material may be embedded within the material of the plug. In case of a mechanical coupling, each one of the first coupling element and the second coupling element may comprise a hook and/or a chain and/or a rope and/or a spring, wherein the first coupling element and the second coupling element may be unhooked or unlinked (i.e. uncoupled) for full removal and/or cleaning of the rod-like element, in particular for cleaning of its magnetic section. Further, the first coupling element and the second coupling element are configured such that for both coupling types they allow movement of the plug with the rod-like member when the rod-like member is removed from the through-hole. In other words: the rod-like member actively drives the plug into its seating position for sealing the through hole.

[0013] In one embodiment of the assembly, the plug comprises a plug body forming the end surface for accommodating adjacent the rod-like member, a recess within said end surface and a magnetic screw with a screw head, wherein said screw is fixed within said recess and said screw head forms the second coupling element. This embodiment provides a combination of magnetic and mechanical coupling, wherein the plug comprises magnetic material at or in close proximity to the recess. The rod-like member may comprise a pin-like and magnetic first end tip whose pin-form is complementary to the recess of the plug's end surface. Accordingly, in this embodiment, the first coupling element and the second coupling element form a positive locking connection, wherein other type of positive locking connection may be used, as well.

[0014] In one embodiment of the assembly, the magnetic portion of the rod-like member comprises at least two cylindrical permanent magnets having a pre-defined distance in longitudinal direction. In another example, the magnetic portion of the rod-like member comprises three or four such cylindrical permanent magnets. This is advantageous, because it is possible to adjust the magnetic field strength to the requirements of the intended purpose, e.g. the specific fluid, by the number and size of the permanent magnets. Additionally, the longitudinal design is a space-saving design.

[0015] In one embodiment of the assembly, the plug is configured such that it is movable from a first position to its seating position along a guiding channel, wherein the plug is located in its first position when the rod-like member is in its fixing position. The guiding channel provides a well-defined movement of the plug from its first position to the seating position. The guiding channel may be provided either by the through-hole itself or, as described below, by a tubular body that is arranged between the rod-like member and the through-hole.

[0016] In one embodiment of the assembly, the plug comprises or consist of a non-magnetic plastic material. The material is chosen such that it does not dissolve or swell in contact with the fluid, e.g. oil.

[0017] Further, the above problem is solved by a fluid quality control device comprising the assembly of any one of the previous claims and a tubular body encircling said assembly and being configured to be arranged between the rod-like member and the through-hole, wherein the outer surface of the tubular body having an outer fixation section being configured to directly and fluid-tightly fixing the tubular body to the inner surface of the through-hole, wherein the inner surface of the tubular body comprises the seating section (i.e. the seating section is formed by the inner surface of the tubular body) and an inner fixation section to directly and fluid-tightly fix or fluid-tightly accommodate at least a section of the fastening portion of the rod-like member within the through-hole, wherein the seating section is located closer to the inner surface of the container wall than the inner fixation section when the tubular body is fixed by its outer fixation section to the through-hole.

[0018] In one embodiment of the device, the inner surface of the tubular body is configured such that it guides the plug when it is moved by the rod-like member into its seating position. Accordingly, the outer diameter of the plug is dimensioned to allow it to move within the tubular body and along its longitudinal direction (i.e. along its longitudinal axis / length).

[0019] The tubular body provides a well-defined seating section as well as guidance of the plug between its first position and its seating position. Further, it delimits the distance between the plug and the rod-like member and partly covers and thereby protects the plug when the rod-like member is in its fixing position. Furthermore, the

tubular body provides the above-mentioned properties and advantages even if the through-hole is manufactured as a drillhole. Accordingly, in one embodiment the tubular body covers the plug when the rod-like member is in its fixing position. In one embodiment the wall of the tubular body comprises at least one opening preferably located between the position of a circlip and the seating section. The circlip is described below. The tubular body is configured such that, when the rod-like member is in its fixing position, the plug is in its first position and allows fluid to flow to the magnetic portion so that metal scraps are collected there. In its seating position, the plug allows fluid to flow to the front surface of the plug that is opposite the seating section and blocks fluid to flow further outwards. Optionally, the plug may in its first position and its seating position partly covers the at least one opening.

[0020] In one embodiment of the device, the inner diameter of the tubular body is greater than the outer diameterof the magnetic portion of the rod-like member. This difference between the inner diameter of the tubular body and the outer diameter of the magnetic portion, provides sufficient space for the metal chips / residues to be adsorbed at the surface of the magnetic portion.

[0021] In one embodiment of the device, wherein the wall of the tubular body comprises the at least one opening, the adjacent rim of each of the at least one opening has a distance from the seating section that is equal to or greater than ½ of the length of the plug determined in longitudinal direction. This distance of the seating section and the next rim of the at least one opening allows reliable positioning of the plug in its seating position since the plug is laterally limited by the side walls of the tubular body. Further, in one embodiment, the inner diameter of each of the at least one opening is smaller than the smallest one of the outer dimensions (e.g. the length or the diameter) of the plug to prevent the plug from getting lost through such opening and ensure its secure fit within the tubular body.

[0022] In one embodiment of the device, the tubular body comprises the circlip at its inner surface, wherein the inner diameter of the tubular body is greater than the inner diameter of the circlip, wherein the inner diameter of the circlip is smaller than the outer diameter of the plug. The circlip is provided at the end of the tubular body that is opposite the outer fixation section (with regard to the longitudinal direction of the tubular body along its longitudinal axis). The circlip prevents escaping the plug from the tubular body into the container and provides a stop position/surface for the plug.

[0023] In one embodiment of the device, the plug comprises a tapered section at its end surface, wherein the tapered section is configured to fit closely to the seating section at the inner surface of the tubular body when the plug is in its seating position. This design of the plug allows a reliable sealing of the through hole when the plug is in its seating position, e.g. by a form fit. Accordingly, the inner diameter of the seating section is equal to an outer diameter of the plug at its tapered section. Further, the slope of the tapering section allows smooth sliding of the plug into its seating position thereby providing a firm fit. The tapered section extends laterally from the end surface of the plug that is adjacent the rod-like member in the mounted state.

[0024] In one embodiment of the device, a first sealing ring is provided for fluid-tight fixation of the rod-like member within the tubular body and/or a second sealing ring is provided for fluid-tight fixation of the tubular body within the through-hole. The sealing rings provide another reliable sealing of the through hole of the container.

[0025] While embodiments of the present invention have been illustrated, and described, it will be understood that changes and modifications may be made therein without departing from the invention in its broader aspects.

[0026] The invention will now be described in further detail with reference to the accompanying schematic drawing, wherein

Fig. 1 shows an embodiment of a fluid quality control device in its fixing position within the through-hole of a container in an axial section,

Fig. 2 depicts the embodiment and axial section of Fig. 1 in an exploded view, and

Fig. 3 shows the embodiment of Fig. 1 where the plug is in a seating position in an axial section.

[0027] An embodiment of a fluid quality control device and assembly is shown in Fig. 1 and 2 screwed or otherwise mounted within a through-hole 1 of a container wall 3 with an inner surface 5 and an outer surface 6 of a container filled with gear oil. The device comprises a rod-like member 10, a plug 20 and a tubular body 30, wherein the rod-like member 10 and the plug 20 form the fluid quality control assembly according to the invention. The rod-like member 10 and the plug 20 are encircled or housed by the tubular body 30. The inner surface of the tubular body provides a guiding surface for the plug 20. The tubular body 30 extends into the gear oil that is located above the inner surface 5 of the container wall 3, wherein the gear oil level is usually above the projection of the tubular body 30 into the container.

[0028] The rod-like member 10 comprises a first end 11 with a pin-like first end tip 11a and a second end 12. Further, it comprises a magnetic portion 13 located between the first and 11 and the second end 12 but closer to the first end 11 / first end tip 11a. The rod-like member 10 further comprises a threaded section 14 and a cylindrical handle section 15, wherein the handle section 15 is provided at the second end 12 of the rod-like member 10. The user may grip the rod-like member 10 by its handle section 15 to screw the rod-like member 10 into the tubular body 30 or to remove it therefrom. When screwing, the thread of the threaded section 14 is screwed into a corresponding thread at an inner surface

threaded section 32 of the tubular body 30. Further, the rod-like member 10 comprises a stop surface 16 in longitudinal direction between the threaded section 14 and the handle section 15 defining how far the rod-like member 10 is screwed into the tubular body 30. The device further provides a sealing ring 33 at a recess in the opposite front surface of the tubular body 30 sealing the rod-like member 10 against the inner lumen of the tubular body 30.

[0029] The magnetic portion 13 comprises alternating magnetic sections 13a consisting of a permanent magnet and non-magnetic sections 13b. The magnetic portion 13 collects the metal chips / residues that are distributed within the gear oil. The outer diameter of the magnetic portion 13 is approximately half of the inner diameter of the tubular body 30 so that a lumen is provided between the magnetic portion 13 and the inner surface of the tubular body 30 for the gear oil and for metal chips adsorbed at the surface of the magnetic portion 13. The first end tip 11a of the rod-like member 10 consists of permanent magnetic material, as well.

[0030] The gear oil of the container flows into the tubular body 30 to the outer surface of the magnetic portion 13 through circular openings 35 within the tubular body wall. The inner surface of the tubular body comprises a seating section 31. The seating section 31 is formed in this embodiment as a step at the inner surface of the tubular body 30. The tubular body 30 further comprises an outer threaded section 36 for screwing the tubular body 30 into a corresponding threaded section 8 at the inner surface of the through-hole 1. Further, the tubular body 30 comprises a stop surface 37 defining how far the tubular body 30 is screwed into the through-hole 1 and providing a surface for another sealing ring 38 sealing the tubular body 30 against the through-hole 1. At the end of the tubular body 30 opposite the threaded section 36, the tubular body 30 further comprises a circlip 39 at its inner surface.

[0031] The plug 20 is accommodated at the first end 11 of the rod-like member 10 within the tubular body 30. The plug 20 has a basically cylindrical form and comprises a magnetic screw 22 within a respective recess 24 within its end surface 25. The head of the screw 22 that is adjacent the first end tip 11a and the first end tip 11a have opposite polarity so that they are attracted and that the plug 20 moves with the rod-like member 10.

[0032] In Fig. 1 the rod-like member 10 is shown in its fixing position, where it is screwed with its threaded section 36 into the corresponding threaded section 32 of the tubular body 30. At its first end 11 the plug 20 is located magnetically coupled using the magnetic first end tip 11a and the magnetic screw 22. The through-hole 1 of the container is reliably sealed by the tubular body 30 using the sealing ring 38 and the rod-like member 10 using the sealing ring 33. The metal residues distributed within the gear oil of the container are attracted by the magnetic portion 13 and flow with the gear oil along the container wall 3 into the through-hole 1 and through the openings 35 into the tubular body 30 to the magnetic portion 13. There, the metal residues are collected. The outer diameter of the tubular body 30 at its extending end is considerably smaller than the inner diameter of the through-hole 1 so that the gear oil can easily flow into the openings 35. The longitudinal movement of the plug 20 is limited by the circlip 39 because the inner diameter of the circlip 39 is smaller than the outer diameter of the plug 20 at its section adjacent the circlip 39. Further, the inner diameter of the tubular body 30 is greater than the inner diameter of the circlip 39. Additionally, the distance of the adjacent rim of the openings 35 from the seating section 31 (see arrow 35a in Fig. 2) is greater than the length of the plug 20 (length is the dimension in longitudinal direction) so that the plug is securely laterally limited by the tubular body 30 in its seating position (see Fig. 3).

[0033] For quality control of the gear oil, the rod-like member 10 is removed from the through-hole 1 by unscrewing it from the tubular body 30. For that, the user grips the rod-like member 10 at its handle section 15. When removing the rod-like member 10 by moving it into longitudinal direction (see arrow 18 in Fig. 1) the plug 20 is moved due to the magnetic coupling via the first end tip 11a and the screw 22 into the same direction. The plug 20 moves along and is guided by the inner surface of the tubular body 30 until it reaches the seating section 31. There it is driven into its seating position shown in Fig. 3 by its magnetic coupling to the moving rod-like member 10. In its seating position, the plug 20 seals the through-hole 1 reliably and tightly by its tapered section 26 whose outer diameter is equal to the inner diameter of the seating section 31. The compression force caused by the inner pressure of the container keeps the plug 20 in place, independently from the exact position of the through-hole 1. The through hole may run vertically as shown in Fig. 1 and 3 in the container wall but also horizontally or in any other direction.

[0034] The user may inspect the metal residues adsorbed at the surface of the magnetic portion 13 for quality control and clean the rod-like member 10 when the rod-like member 10 is removed from the through-hole 1. During this time, no gear oil will leak from the container through the through-hole 1 as it is tightly sealed by the plug 20.

[0035] After inspection and cleaning, the rod-like member 10 can be reused and screwed back into the tubular body so that it provides an adsorption place for metal residues within the gear oil again. Many further inspections of important informative value may be realized by this one assembly and device. Only little time is needed for such inspection as no fluid removal is necessary therefor.

[0036] The above-described embodiment uses a magnetic coupling between the plug 20 and the rod-like member 10. Alternatively, a mechanical coupling, for example comprising a hook, a chain, a rope and/or a spring may analogously be used, as well.

Claims

1. A fluid quality control assembly for a fluid-filled container, e.g. an oil filled container, having a through-hole (1) within its container wall (3), wherein the through-hole comprises a seating section (31), wherein the assembly comprises a rod-like member (10) and a plug (20) separate from the rod-like member,
the plug having an end surface configured to be adjacently arranged with regard to a first end tip (11a) of the rod-like member extending in a longitudinal direction between the first end (11) and a second end (12), wherein along its longitudinal direction the rod-like member comprises the first end tip (11a), a magnetic portion (13) and a fastening portion (14), wherein in a fixing position the rod-like member is removably fixed by its fastening portion within the through-hole of the container for sealing said through-hole, wherein the magnetic portion is located between the first end tip and the fastening portion, wherein in the fixing position the rod-like member is configured such that it extends in longitudinal direction beyond the seating section and that the magnetic portion is flowed around by fluid of the container's fluid filling, wherein the first end tip of the rod-like member and the end surface of the plug are coupled in the way that the plug is moved with the rod-like member and into a seating position at the seating section within the through-hole when the rod-like member is removed from its fixing position, wherein the plug is configured such that its outer surface fluid-tightly seals the through-hole in said seating position.

2. The assembly of claim 1, wherein the first end tip comprises a first coupling element and the plug comprises a second coupling element (22) at its end surface for magnetic and/or mechanical coupling.

3. The assembly of claim 2, wherein the plug (20) comprises a plug body forming the end surface, a recess (24) within said end surface (25) and a magnetic screw (22) with a screw head, wherein said screw is fixed within said recess and said screw head forms the second coupling element.

4. The assembly of any one of the claims 2 to 3, wherein the first coupling element and the second coupling element form a positive locking connection.

5. The assembly of any one of the previous claims, wherein the magnetic portion comprises at least two cylindrical permanent magnets (13a) having a predefined distance in longitudinal direction.

6. The assembly of any one of the previous claims, wherein the plug (20) is configured such that it is movable from a first position to its seating position along a guiding channel, wherein the plug is located in its first position when the rod-like member (10) is in its fixing position.

7. The assembly of any one of the previous claims, wherein the plug (20) comprises or consist of a non-magnetic plastic material.

8. A fluid quality control device comprising the assembly of any one of the previous claims, and a tubular body (30) encircling said assembly and being configured to be arranged between the rod-like member (10) and the through-hole (1), wherein the outer surface of the tubular body having an outer fixation section (36) being configured to directly and fluid-tightly fixing the tubular body to the inner surface of the through-hole,
wherein the inner surface of the tubular body comprises the seating section (31), and an inner fixation section (32) to directly and fluid-tightly fix or fluid-tightly accommodate at least a section of the fastening portion (14) of the rod-like member (10) within the through-hole (1), wherein the seating section (31) is located closer to the inner surface (5) of the container wall (3) than the inner fixation section (32) when the tubular body is fixed by its outer fixation section (36) to the through-hole.

9. The device of claim 8, wherein the tubular body (30) covers the plug (20) when the rod-like member (10) is in its fixing position and/or wherein the wall of the tubular body comprises at least one opening (35) located between the position of a circlip (39) and the seating section (31).

10. The device of any one of the claims 8 to 9, wherein the inner surface of the tubular body (30) is configured such that it guides the plug (20) when it is moved by the rod-like member (10) into its seating position.

11. The device of any one of the claims 8 and 10, wherein the inner diameter of the tubular body (30) is greater than the outer diameter of the magnetic portion (13) of the rod-like member (10).

12. The device of any one of the claims 9 to 11, wherein the adjacent rim of each the at least one opening (35) has a distance (35a) from the seating section (31) that is equal to or greater than ½ of the length of the plug determined in longitudinal direction.

13. The device of any one of the claims 8 to 12, wherein the tubular body (30) comprises the circlip (39) at its inner surface, wherein the inner diameter of the tubular body (30) is greater than the inner diameter of the circlip (39), wherein the inner diameter of the

circlip is smaller than the outer diameter of the plug (20).

14. The device of any one of the claims 8 to 13, wherein the plug (20) comprises a tapered section (26) at its end surface (25), wherein the tapered section is configured to fit closely to the seating section (31) at the inner surface of the tubular body when the plug is in its seating position.

15. The device of any one of the claims 8 to 14, wherein a first sealing ring (33) is provided for fluid-tight fixation of the rod-like member (10) within the tubular body (30) and/or a second sealing ring (38) is provided for fluid-tight fixation of the tubular body (30) within the through-hole (1).

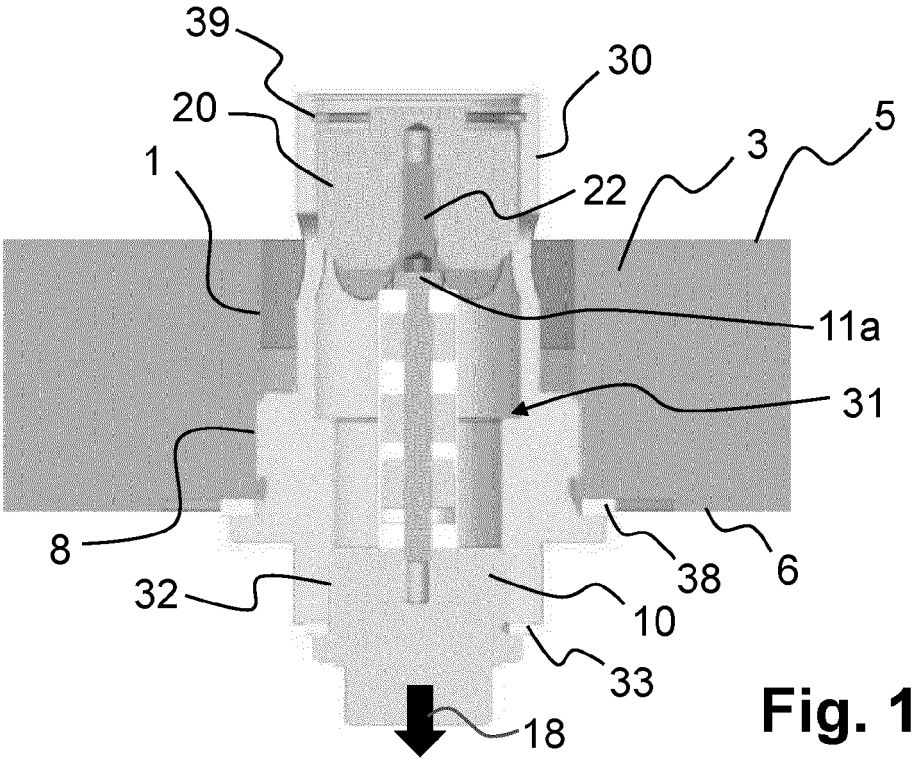

Fig. 1

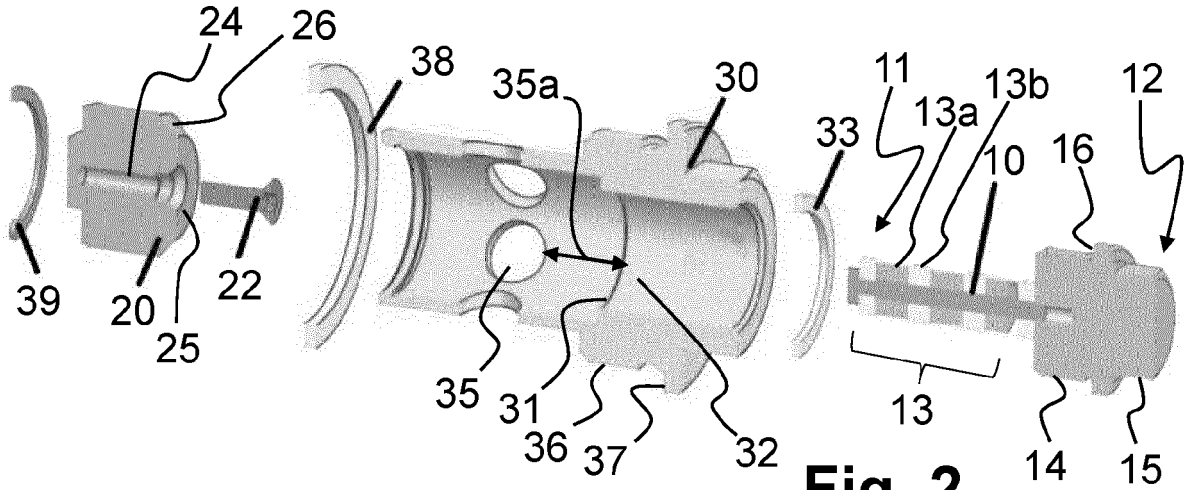

Fig. 2

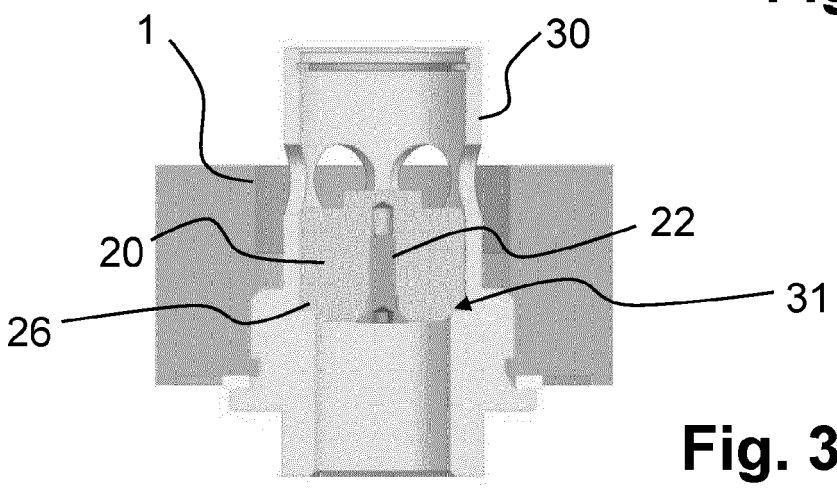

Fig. 3

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 23 20 0730

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2 704 156 A (BOTSTIBER DIETRICH W) 15 March 1955 (1955-03-15) * column 2, line 13 - column 5, line 45; figures 1-11 *	1-15	INV. B03C1/28 F01M11/04
X	US 2019/120731 A1 (MARCHAND ROGER L [CA] ET AL) 25 April 2019 (2019-04-25) * paragraph [0029] - paragraph [0037]; figures 1-19 *	1-15	
X	US 2007/262028 A1 (FLAHERTY JOSEPH R [US]) 15 November 2007 (2007-11-15) * paragraph [0026] - paragraph [0030]; figures 1-12 *	1-15	
A	US 2 358 612 A (ACKER GEORGE H) 19 September 1944 (1944-09-19) * the whole document *	1-15	

TECHNICAL FIELDS SEARCHED (IPC)

B03C
F01M

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	14 March 2024	Skaropoulos, N

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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E : earlier patent document, but published on, or after the filing date
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 20 0730

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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14-03-2024

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