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(54) **A FILTER PLUG ASSEMBLY**

(57) A filter plug assembly includes a plug body, a filter body and at least one sealing element. The plug body is received in and engages with a tubular element, the plug body formed by molding includes at least one sealing surface that is smooth and without any partition line. At least a portion of filter body is over molded on at least one sealing surface to configure at least one intermediate rib that forms multiple seating channels in conjunction with at least one of another adjacent intermediate rib, at least one lateral wall of the plug body and at least one lateral wall of the filter body. The at least one sealing element is received in seating channels for configuring sealing between tubular element and at least one of plug body and filter body received in tubular element.

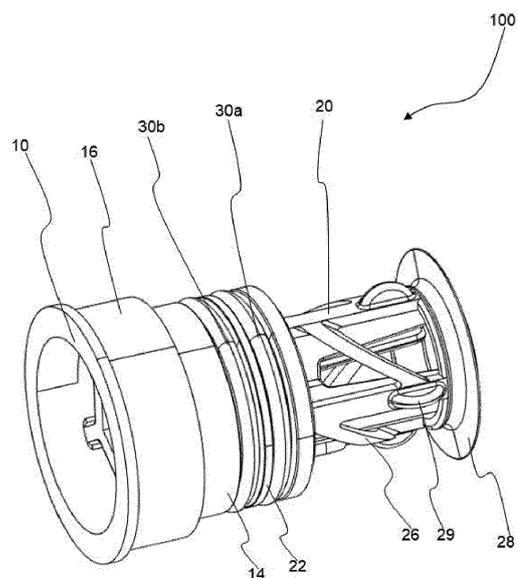


FIG. 1

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Description

[0001] The present disclosure relates to a receiver drier for a vehicle air conditioning system, particularly, the present disclosure relates to a filter plug assembly for a receiver drier for a vehicle air conditioning system.

[0002] Conventional air conditioning system for example for a vehicle cabin includes a condenser, an evaporator, an expansion device, a compressor and a heater. The compressor pumps refrigerant gas up to a high pressure and temperature. Thereafter, refrigerant gas enters the condenser, where refrigerant gas rejects heat energy to external ambient (through ambient air or a specific low temperature coolant circuit), gets cooled, and condenses into liquid phase. Thereafter, the expansion valve regulates refrigerant liquid to flow at proper rate, reducing its pressure due its expansion, and finally, the cooled liquid refrigerant flows to the evaporator, where the cooled liquid refrigerant is evaporated, reducing its temperature. As the liquid refrigerant evaporates, the refrigerant extracts or absorbs heat energy from air inside an enclosure to be conditioned, specifically, a vehicle cabin in case of a vehicle air conditioning system and returns to the compressor, and the above cycle repeats. In the process, the heat is extracted from inside the vehicle cabin and rejected to outside vehicle cabin, resulting in cooling of air inside the vehicle cabin.

[0003] The conventional air conditioning system configured with expansion valves are also configured with a receiver drier that is disposed in the high-pressure section of the air conditioning system, usually located between condenser and expansion valve in the air conditioning loop. The receiver drier is in form of an air tight container of a tubular configuration with an inlet for receiving - liquid refrigerant from a condenser and an outlet. The receiver drier acts as a temporary storage for refrigerant (and oil). The receiver drier receives a desiccant material to absorb moisture (water) that may have entered inside the air conditioning system. The receiver drier also includes a filter to trap debris that may be inside the air conditioning system. A filter plug assembly is generally configured on a bottom of the receiver drier and is connected thereto by a threaded connection. If the receiving dryer does not properly retain moisture and / or debris, the moisture and/or debris can reach critical elements of the air conditioning system, particularly the compressor, this can be detrimental to performance and can also cause damage. Specifically, in order to avoid refrigerant leakage, and also to prevent moisture from entering into the system, the receiver drier is required to be sealed and the connection between the filter plug assembly and the receiver drier is required to be air tight.

[0004] Generally, a single O-ring is disposed in a groove defined by at least one wall of a plug body and a filter body respectively when the plug body and the filter body are assembled to configure the filter plug assembly. However, with the increasing quality and durability requirements, the single O-ring solution has become inef-

ficient in proper sealing between the filter plug assembly and the receiver drier. In order to configure better sealing between the filter plug assembly and the receiver drier, configuring of a plurality of grooves on the filter plug assembly for receiving multiple O-rings is suggested. This adoption of a plurality of O-rings prevents correct construction of the grooves, where a mold parting line is inherently formed during molding.

[0005] The prior art suggests defining grooves in at least one of the plug body and the filter body to facilitate receipt of multiple O-rings. However, such a configuration of the multi-groove filter plug assembly to accommodate multiple O-rings is also ineffective in configuring effective seal arrangement between the filter plug assembly and the receiver dryer because of the inequality/unevenness in the seating regions for the O-rings or the O-ring grooves, caused by the inherently formed shaped parting line. The parting line is inherently formed during manufacture of the grooved engagement/ plug body and grooved filter body manufactured by molding. More specifically, this parting line creates a gap between the groove and the O-ring. Although the parting lines can be removed by machining, such a configuration of the filter plug assembly requires an additional machining step for manufacturing and is therefore not recommended.

[0006] Another option to create a solution with 2 O-rings without having this mold opening line, is using a three part configuration of the filter plug assembly for configuring multiple grooves, wherein one groove is formed between the plug body and an interconnecting element connecting the plug body to the filter body and another groove is formed between the filter body and the interconnecting element, when the plug body, the interconnecting element and the filter body are assembled together. However, such configuration is expensive, requires additional parts and additional steps for manufacturing of the filter plug assembly. Also, such configuration of the filter plug assembly increases inventory costs and manufacturing costs associated with manufacturing thereof.

[0007] Accordingly, there is a need for a filter plug assembly configured with multiple grooves for receiving multiple sealing O-rings to achieve improved and effective sealing between the filter plug assembly and the receiver drier, while still eliminating formation of the parting lines and problems arising due to such parting lines that are inherently formed in seating regions of the multiple grooves of the conventional multi-grooved filter plug assembly. Further, there is a need for a filter plug assembly that provides effective and full-proof sealing between the filter plug assembly and the receiver drier without requiring any additional process such as for example machining process to remove parting lines formed on the seating regions of the multiple grooves. Furthermore, there is a need for a filter plug assembly that provides effective and full-proof sealing between the filter plug assembly and the receiver drier without requiring any additional part for configuring multiple grooves. Still further, there is a need

for a filter plug assembly that is inexpensive, convenient to assemble and manufacture and that involves lower inventory and manufacturing costs associated with manufacturing thereof. Also, there is a need for a filter plug assembly that effectively performs its function of preventing moisture and debris from escaping from the receiver drier and reaching the critical elements of the air conditioning system, thereby improving performance of the air conditioning system.

[0008] An object of the present invention is to provide a filter plug assembly that achieves improved and effective sealing between the filter plug assembly and a receiver drier and obviates problems arising due to parting lines that are inherently formed in seating regions of multiple grooves of conventional filter plug assembly.

[0009] Another object of the present invention is to provide a filter plug assembly that provides effective and full-proof sealing between the filter plug assembly and the receiver drier without requiring any additional process such as for example machining process to remove parting lines.

[0010] Yet another object of the present invention is to provide a filter plug assembly that provides effective and full-proof sealing between the filter plug assembly and the receiver drier without requiring any additional part for configuring multiple grooves.

[0011] Still another object of the present invention is to provide a filter plug assembly that is simple in construction.

[0012] Yet another of the present invention is to provide a filter plug assembly that involves fewer parts and accordingly is inexpensive, reliable, and convenient to assemble and manufacture.

[0013] Another object of the present invention is to provide a filter plug assembly that involves comparatively lower inventory and manufacturing costs associated with manufacturing thereof as compared to inventory and manufacturing costs associated with manufacturing of conventional filter plug assembly.

[0014] Still another object of the present invention is to provide a filter plug assembly that effectively performs its function of preventing moisture and debris from reaching the critical elements of the air conditioning system, thereby improving efficiency and performance of the air conditioning system.

[0015] In the present description, some elements or parameters may be indexed, such as a first element and a second element. In this case, unless stated otherwise, this indexation is only meant to differentiate and name elements which are similar but not identical. No idea of priority should be inferred from such indexation, as these terms may be switched without betraying the invention. Additionally, this indexation does not imply any order in mounting or use of the elements of the invention.

[0016] A filter plug assembly is disclosed in accordance with an embodiment of the present disclosure. The filter plug assembly includes a plug body, a filter body and at least one sealing element. The plug body is re-

ceived in and engages with a tubular element, the plug body being formed by injection molding is configured with at least one sealing surface that is smooth. At least a portion of the filter body is over molded on the at least one sealing surface to configure at least one intermediate rib that forms multiple seating channels in conjunction with at least one of another adjacent intermediate rib, at least one lateral wall of the plug body and at least one lateral wall of the filter body. The at least one sealing element is received in the at least one seating channel for configuring sealing between the tubular element and at least one of the plug body and the filter body received in the tubular element.

[0017] In accordance with an embodiment of the invention, the plug body includes at least one stepped portion that configures the at least one lateral wall of the plug body, the at least one lateral wall of the plug body in conjunction with the at least one intermediate rib and at least a portion of the at least one sealing surface configures at least one seating channel of the multiple seating channels.

[0018] Also, is disclosed an assembly in accordance with an embodiment of the present invention. The assembly includes a tubular element and a filter plug assembly. The filter plug assembly in turn includes a plug body, a filter body and at least one sealing element. The plug body is received in and engaged with the tubular element, at least one of the plug body and the filter body being formed by molding is configured with at least one smooth sealing surface. Further, at least a portion of at least one of the plug body and the filter body is over molded on the at least one sealing surface of the other to configure at least one intermediate rib, wherein the at least one intermediate rib forms multiple seating channels in conjunction with at least one of another adjacent intermediate rib, at least one lateral wall of the plug body and at least one lateral wall of the filter body. The at least one sealing element is received in the at least one seating channel for configuring sealing between the tubular element and the plug body received in the tubular element. The plug body and the tubular element include complimentary engagement elements for facilitating engagement between the plug body and the tubular element.

[0019] Particularly, the complimentary engagement elements are complimentary threads configured on at least a portion of the plug body and the tubular element respectively for facilitating threaded engagement between the plug body and the tubular element.

[0020] Further, the plug body includes a locator element configured on the at least one sealing surface thereof to facilitate configuring and positioning of the at least one intermediate rib that is over molded over the at least one sealing surface.

[0021] Further, the locator element facilitates secure attachment of the filter body over the plug body and resists relative movement there between due to vacuum pressure.

[0022] Generally, the tubular element is a receiver drier

that receives condensed refrigerant from a condenser of a vehicle air conditioning unit, the receiver drier further receives a desiccant bag therein for absorbing moisture from the condensed refrigerant.

[0023] Generally, the filter body supports a filter mesh that in turn filters out impurities from the condensed refrigerant received by the receiver drier before delivering the condensed refrigerant.

[0024] In accordance with an embodiment, the filter body includes at least one additional rib that configures the at least one lateral wall of the filter body, the at least one lateral wall in conjunction with the at least one intermediate rib and at least a portion of the at least one sealing surface configures at least one seating channel of the multiple seating channels.

[0025] In accordance with an embodiment, the plug body includes a plurality of first shaped elements to facilitate additional internal interference between the plug body and the filter body that in turn facilitates over molding of the filter body over the plug body.

[0026] Also, the filter body includes a plurality of second shaped elements that provide structural support to the filter mesh.

[0027] Generally, the at least one sealing element is a deformable O-ring that seals the gap between the tubular element and at least one of the plug body and the filter body configuring the filter plug assembly.

[0028] Specifically, the plug body is configured of a loaded type rigid plastic material by injection molding, whereas the filter body is configured of an unloaded type relatively softer plastic material and is over molded over the plug body by injection molding.

[0029] Also is disclosed a method of configuring a filter plug assembly in accordance with an embodiment of the present invention. The method includes the step of molding a plug body of a loaded type rigid plastic material, thereafter over molding at least a portion of a filter body of an unloaded type relatively softer plastic material on at least one sealing surface of the plug body for configuring at least one intermediate rib that in turn forms multiple seating channels in conjunction with at least one of another adjacent intermediate rib, at least one lateral wall of the plug body and at least one lateral wall of the filter body and finally receiving at least one sealing element in the seating channels for configuring sealing between the tubular element and at least one of the plug body and the filter body received in the tubular element.

[0030] Other characteristics, details and advantages of the invention can be inferred from the description of the invention hereunder. A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying figures, wherein:

FIGURE 1 illustrates an isometric view of a filter plug assembly in accordance with an embodiment of the

present invention configured with a single intermediate rib;

FIGURE 2a illustrates an isometric view of the filter plug assembly of **FIGURE 1**, wherein seating channels are depicted without the at least one sealing element received therein;

FIGURE 2b illustrates an isometric view of the filter plug assembly of **FIGURE 2a**, wherein the seating channels are depicted with the at least one sealing element received therein;

FIGURE 2c illustrates an isometric view of a plug assembly in accordance with an embodiment of the present invention with one intermediate rib forming two seating channels and the seating channels are depicted without the at least one sealing element received therein;

FIGURE 3 illustrates an isometric view of a plug body of the filter plug assembly of **FIGURE 1** with a single locator element configured thereon;

FIGURE 4 illustrates an isometric view of a filter body of the filter plug assembly of **FIGURE 1** with the single intermediate rib configured by over molding at least a portion of the filter body on the plug body;

FIGURE 5 illustrates a sectional view depicting the assembly between the filter plug assembly of **FIGURE 1** and a tubular section of a receiver drier in accordance with an embodiment of the present invention;

FIGURE 6 illustrates an isometric view of a filter plug assembly in accordance with another embodiment of the present invention configured with two intermediate ribs and sealing elements received in the seating channels;

FIGURE 7a illustrates another isometric view of the filter plug assembly of **FIGURE 6**, wherein seating channels are depicted without the at least one sealing element received therein;

FIGURE 7b illustrates an isometric view of a plug assembly in accordance with an embodiment of the present invention with two intermediate ribs forming three seating channels and the seating channels are depicted without the at least one sealing element received therein;

FIGURE 8 illustrates an isometric view of a plug body of the filter plug assembly of **FIGURE 6** with two locator elements configured thereon;

FIGURE 9 illustrates an isometric view of a filter body

of the filter plug assembly of **FIGURE 6** with two intermediate ribs configured by over molding at least a portion of the filter body on the plug body; and

FIGURE 10 illustrates a sectional view depicting the assembly between the filter plug assembly of **FIGURE 6** and a tubular section of a receiver drier in accordance with an embodiment of the present invention.

[0031] It must be noted that the figures disclose the invention in a detailed enough way to be implemented, said figures helping to better define the invention if needs be. The invention should however not be limited to the embodiment disclosed in the description.

[0032] A filter plug assembly configured with multiple grooves to facilitate receiving of multiple sealing O-rings and achieving improved and effective sealing between the filter plug assembly and the receiver drier is disclosed, wherein the multiple grooves or seating channels are configured by at least one intermediate rib in conjunction with at least one of another adjacent intermediate rib, at least one lateral wall of the plug body and at least one lateral wall of the filter body. The at least one intermediate rib is formed by over molding at least a portion of a filter body on at least one smooth sealing surface of a plug body or over molding at least a portion of the plug body over at least one smooth sealing surface of the filter body. However, such configuration of the filter plug assembly is also applicable for configuring sealing plugs used for sealing ends of any tubular element that is not limited for use in vehicle cabin air conditioning only.

[0033] Referring to **FIGURE 1**, **FIGURES 2a, 2b** of the accompanying drawings, different views of a filter plug assembly **100**, particularly, an isometric view of the filter plug assembly **100** in accordance with an embodiment of the present invention configured with a single intermediate rib **22**, the filter plug assembly **100** without sealing elements **30a, 30b** received in seating channels **12a, 12b** and the filter plug assembly **100** with the sealing elements **30a, 30b** received in the seating channels **12a, 12b** are illustrated respectively in accordance with an embodiment of the present invention. **FIGURE 2c** illustrates an isometric view of a plug assembly in accordance with an embodiment of the present invention with one intermediate rib **22** forming two seating channels **12a, 12b** and the seating channels **12a, 12b** are depicted without the at least one sealing element received therein. More specifically, the plug assembly is similar to the filter plug assembly depicted in **FIGURE 1** and **FIGURES 2a, 2b**, except that instead of the filter body **20**, the plug assembly includes a terminal end body **20a** over molded over the plug body **10** for configuring the one intermediate rib **22** that in turn facilitates in forming two seating channels **12a, 12b**. **FIGURE 3** and **FIGURE 4** of the accompanying drawings respectively illustrate a plug body **10** and a filter body **20** configuring the filter plug assembly **100** in accordance with an embodiment of the present invention.

Specifically, the filter plug assembly **100** includes the plug body **10**, the filter body **20** and the at least one sealing element **30a, 30b**. The plug body **10** is received in and engages with a tubular element, for example, a receiver drier that receives condensed refrigerant from a condenser of a vehicle air conditioning unit. The receiver drier further receives a desiccant bag therein for absorbing moisture from the condensed refrigerant. However, the tubular element can be any element that can be a part of any vehicular non vehicular system and that requires to be sealed against ingress of moisture therein or egress of moisture there from and is not limited to being the receiver drier only. The plug body **10** formed by molding, preferably injection molding and is so configured with at least one sealing surface **12** that the at least one sealing surface **12** is smooth and without any partition line. At least a portion of the filter body **20** is over molded on the at least one sealing surface **12** to configure at least one intermediate rib **22** that in turn forms the multiple seating channels **12a, 12b** in conjunction with at least one of another adjacent intermediate rib **22**, at least one lateral wall **14a, 16a** of the plug body **10** and at least one lateral wall **24a** of the filter body **20**. Specifically, as illustrated in the **FIGURES 2a, 2b**, the intermediate rib **22** forms the seating channel **12a** in conjunction with the lateral wall **24a** of the filter body **20** and the same intermediate rib **22** forms the seating channel **12b** in conjunction with the lateral wall **14a** of the plug body **10**. The at least one sealing element **30a, 30b** is tightly received in the at least one seating channel **12a, 12b** for configuring sealing between the tubular element and at least one of the plug body **10** and the filter body **20** received in the tubular element.

[0034] With such configuration of the filter plug assembly **100**, the parting lines are eliminated and multiple O-rings are effectively seated in the multiple seating channels **12a, 12b** without forming any gaps, thereby providing effective and full-proof sealing between the filter plug assembly **100** and the tubular element, particularly, the receiver drier, that too without requiring any additional part for configuring multiple grooves or the seating channels **12a, 12b** for receiving the multiple O-rings and also without requiring any additional process such as for example machining process that is presently required for removing the parting lines that are inherently formed during the molding process. The portion of the filter body **20** is over molded over the at least one sealing surface **12** in such a way, so as to define the width of the at least one seating channel **12a, 12b** configured by the at least one of the intermediate rib **22** in conjunction with at least one of the another adjacent intermediate rib **22**, the at least one lateral wall **14a, 16a** of the plug body **10** and the at least one lateral wall **24a** of the filter body **20**. In some cases the width of the at least one the seating channel **12a, 12b** is wide enough to tightly hold a single O-ring. Else, the width of the at least one of the seating channel **12a, 12b** is wide enough to tightly hold multiple single O-rings. With the elimination of the addition proc-

ess and additional part for manufacturing of the filter plug assembly **100**, the filter plug assembly **100** is simple in construction, involves fewer parts and is inexpensive, reliable, and convenient to assembly and manufacture. Further, the manufacturing of the filter plug assembly **100** of the present invention involves comparatively lower inventory and manufacturing costs as compared to inventory and manufacturing costs associated with manufacturing of conventional filter plug assembly.

[0035] Referring to the **FIGURE 3** of the accompanying drawings, an isometric view of the plug body **10** of the filter plug assembly **100** with a single locator element **12d** configured thereon is illustrated. The locator element **12d** is also referred to as a plug body channel, wherein during the over molding process the plug body channel facilitates passage of softer material configuring the filter body **20** from flowing there through for configuring the teeth **31** and the intermediate rib **22**. The plug body **10** includes a proximal end forming a lid and a distal end, at least one stepped portion **14**, **16** configured between the proximal end and the distal end. The stepped portion **14**, **16** configures the at least one lateral wall **14a**, **16a** of the plug body **10**. The at least one lateral wall **14a**, **16a** in conjunction with the at least one intermediate rib **22** and at least a portion of the at least one sealing surface **12** configures at least one seating channel of the multiple seating channels. Furthermore, the plug body **10** includes the locator element **12d** configured on the at least one sealing surface **12** thereof to facilitate positioning of the at least one intermediate rib **22** that is over molded over the at least one sealing surface **12**. The locator element **12d** further facilitates secure attachment of the filter body **20** over the plug body **10** and resists relative movement there between due to vacuum pressure. The plug body **10** further includes a plurality of first shaped elements **18** that facilitates additional internal interference between the plug body **10** and the filter body **20** that in turn facilitates over molding of the filter body **20** over the plug body **10**. The plug body **10** is configured of a loaded type rigid plastic material. Specifically, the plug body **10** is of a relatively rigid plastic material, for example of the polyamide type, which is glass fiber or talc loaded. The filler used is advantageously talc. The use of such a loaded material imparts high mechanical resistance to the plug body **10**.

[0036] Referring to the **FIGURE 4** of the accompanying drawings, an isometric view of the filter body **20** of the filter plug assembly **100** is illustrated. The filter body **20** includes a proximal end and a distal end and is configured with the single intermediate rib **22**, wherein the proximal end of the filter body **20** and the single intermediate rib **22** in turn is configured by over molding at least a portion of the filter body **20** on the plug body **10**. The filter body **20** further includes a sealing element, preferably a seal **28** integrally formed on the distal end of the filter body **20** by molding. Generally, the seal **28** is in the form of an annular lip and is of the same material as of the filter body **20**, accordingly, the seal **28** is flexible and deformable.

The filter body **20** includes at least one additional rib **24** that configures the at least one lateral wall **24a** of the filter body **20**, the at least one lateral wall **24a** in conjunction with the at least one intermediate rib **22** and at least a portion of the at least one sealing surface **12** configures at least one seating channel of the multiple seating channels **12a**, **12b**. The filter body **20** supports a filter mesh that in turn filters out impurities from the condensed refrigerant received by the receiver drier before delivering the condensed refrigerant. However, the present invention is not limited to any particular configuration of the filter mesh as far as the filter mesh effectively filters out the debris and impurities and prevents the debris and impurities from escaping through the filter plug assembly and reaching other critical elements disposed downstream of the filter plug assembly. Specifically, the filter body **20** further includes a plurality of second shaped elements **26** that provide structural support to the filter mesh. Specifically, the proximal end and the distal end of the filter body **20** are connected by connecting arms, referred to as the second shaped elements **26**. In accordance with an embodiment of the present invention, the filter body **20** includes four connecting arms or second shaped elements **26** extending in the longitudinal direction. However, the present invention is not limited to any particular configuration, placement and number of the connecting arms or the second shaped elements **26** of the filter body **20**, as far as filter body **20** is able to structurally support to the filter mesh in such a configuration that the filter mesh is capable of effectively entrapping the debris. Each of the connecting arms or the second shaped elements **26** further includes at least one centering guide **29** in form of a rounded boss and elongated to facilitate guiding of the filter body **20** during assembly of the filter plug assembly **100** within a tubular element **40** for configuring the assembly **150** as illustrated in **FIGURE 5**. Generally, the filter body **20** is configured of an unloaded type plastic material that is relatively softer than the loaded type rigid plastic material of which the plug body **10** is configured of. The filter body **20** is of a softer plastic material, for example an unloaded polyamide material. Such a material to provide some flexibility to the filter body **20** to ensure tightness of the sealing. The proximal end of the filter body **20** delimits the lateral wall **24a** of the filter body **20**, as the lateral wall **24a** is formed at the end the same can be molded without burr or partition line. From the lateral wall **24a** extend a plurality of over molding teeth **31** that extend substantially in the axial direction and are intended to form connection between the filter body **20** and the plug body **10** by over molding. More specifically, during the over molding process, the soft material of the filter body **20** flows through the locator element **12d** or the plug body channel for configuring the teeth **31** and the intermediate rib **22**. Further, the over molding teeth **31** are housed in the locator element **12d** configured on the distal end of the plug body **10** to ensure proper connection between the filter body **20** over molded over the plug body **10**.

[0037] Further various provisions are provided for configuring better connection between the plug body **10** and the filter body **20**. More specifically, the distal end of the plug body **10** may include an additional form of attachment on which will over mold the proximal end of the filter body **20** for configuring a definite connection between the plug body **10** and the filter body **20**. Apart from the regular function of guiding and increasing the area of attachment of the filter body **20** over the plug body **10**, the first shaped elements **18** also functions as a weight relief. The shaped element **18** is generally having a hexagonal profile because such profile exhibits better torque resistance characteristics. However, the present invention is not limited to any particular profile of the shaped element **18** as far as the shaped element performs its function of guiding and increasing the area of attachment of the filter body **20** over the plug body **10** and also acting as weight relief. The connection so configured between the plug body **10** and the filter body **20** is such that the filter body **20** is an extension of the plug body **10**, thereby imparting a mono-block configuration to the filter plug assembly **100**.

[0038] The at least one sealing element **30a, 30b** is a deformable O-ring that seals the gap between the tubular element **40** and at least one of the plug body **10** and the filter body **20** configuring the filter plug assembly **100**.

[0039] Further referring to the **FIGURE 5** of the accompanying drawings, a cut section view depicting details of an assembly **150** between the filter plug assembly **100** and a tubular section of the tubular element **40**, such as for example, a receiver drier is illustrated. The assembly **150** includes the tubular element **40** and the filter plug assembly **100** that in turn includes the plug body **10**, the filter body **20** and the at least one sealing element **30a, 30b**. The plug body **10** is received in and engaged with the tubular element **40**. At least one of the plug body **10** and the filter body **20** being formed by molding, preferably injection molding is configured with the at least one smooth sealing surface **12**. Further, at least a portion of at least one of the plug body **10** and the filter body **20** is over molded on the at least one smooth sealing surface **12** of the other to configure the at least one intermediate rib **22**. More specifically, in one embodiment as illustrated in the accompanying drawings, the filter body **20** is over molded over the plug body **10** to form at least one intermediate rib **22** on the at least one smooth sealing surface **12** configured on the plug body **10**. In another embodiment, the plug body **10** is over molded over the filter body **20** to form at least one intermediate rib **22** on the at least one smooth sealing surface **12** configured on the filter body **20**. In accordance with still another embodiment, the filter body **20** and the plug body **10** are over molded over each other to configure at least one intermediate rib **22** on the at least one smooth sealing surface **12** configured on at least one of the plug body **10** and the filter body **20**. The at least one intermediate rib **22** in turn forms the multiple seating channels **12a, 12b** in conjunction with at least one of another adjacent intermediate rib **22**,

at least one lateral wall **14a, 16a** of the plug body **10** and at least one lateral wall **24a** of the filter body **20**. Specifically, the intermediate rib **22** forms the seating channel **12a** in conjunction with the lateral wall **24a** of the filter body **20** and the same intermediate rib **22** forms seating channel **12b** in conjunction with the lateral wall **14a** of the plug body **10**. More specifically, in the assembled configuration of the filter plug assembly **100**, the lateral wall **14a** of the plug body **10** and the lateral wall **24a** of the filter body are opposite each other and the intermediate rib **22** is disposed between the lateral wall **24a** of the filter body **20** and the lateral wall **14a** of the plug body **10** such that one side of the intermediate rib **22** is facing the lateral wall **14a** and the other side of the intermediate rib **22** is facing the lateral wall **24a**. The at least one sealing element **30a, 30b** is received in the at least one seating channel **12a, 12b** for configuring sealing between the tubular element **40** and the plug body **10** received in the tubular element **40**. More specifically, for configuring the sealing element **30a, 30b** in the seating channel **12a, 12b**, the sealing elements **30a, 30b** are widened radially and thereafter threaded axially, preferably by passing around the filter body **20** to bring around the seating channel **12a, 12b** in which the sealing element **30a, 30b** are housed by resuming the initial configuration thereof. The plug body **10** and the tubular element **40** include complimentary engagement elements for facilitating engagement between the plug body **10** and the tubular element **40**. Particularly, the complimentary engagement elements are complimentary threads **16b** and **40a** configured on at least a portion of the plug body **10** and the tubular element **40** respectively for facilitating threaded engagement between the plug body **10** and the tubular element **40**. The threaded portion **16b** is disposed between the proximal end and the distal end of the plug body **10** and facilitates mounting / assembly of the plug body **10** inside/ within the tubular element **40**.

[0040] **FIGURE 6** illustrates an isometric view of a filter plug assembly **200** in accordance with another embodiment of the present invention. The filter plug assembly **200** is configured with two intermediate ribs **22** instead of only one intermediate rib **22** in case of the filter plug assembly **100**. Referring to the **FIGURE 6**, the sealing elements **30a, 30b, 30c** are received in the seating channels **12a, 12b, 12c** respectively whereas in the **FIGURE 7a** the seating channels **12a, 12b, 12c** are depicted without the at least one sealing element **30a, 30b, 30c** received therein. **FIGURE 7b** illustrates an isometric view of a plug assembly in accordance with an embodiment of the present invention with two intermediate ribs **22** forming three seating channels **12a, 12b** and **12c** and the seating channels **12a, 12b** and **12c** are depicted without the at least one sealing element received therein. More specifically, the plug assembly is similar to the filter plug assembly depicted in **FIGURE 6**, except that instead of the filter body **20**, the plug assembly includes a terminal end body **20a** over molded over the plug body **10** for configuring the two intermediate ribs **22** that in turn facil-

itate in forming three seating channels **12a**, **12b** and **12c**. **FIGURE 8** illustrates an isometric view of a plug body **110** of the filter plug assembly **200** with two locator elements configured thereon. **FIGURE 9** illustrates an isometric view of a filter body **120** of the filter plug assembly **200** with two intermediate ribs **22** configured by over molding at least a portion of the filter body **120** on the plug body **110**. **FIGURE 10** illustrates a cut section view depicting an assembly **250** between the filter plug assembly **200** and a tubular section of the tubular element **40** such as for example the receiver drier in accordance with an embodiment of the present invention.

[0041] The filter plug assembly **200** is almost similar to the filter plug assembly **100**, except that the plug body **110** of the filter plug assembly **200** includes two locator elements **12d** for facilitating configuring of two intermediate ribs **22** on the sealing surface **12** of the plug body **110** instead of only one intermediate ribs **22** configured on the sealing surface **12** of the plug body **10** of the filter plug assembly **100**. The two intermediate ribs **22** are formed by over molding at least a portion of the filter body **120** on the at least one sealing surface **12** of the plug body **110**. The two intermediate ribs **22** in turn forms multiple seating channels **12a**, **12b**, **12c** in conjunction with at least one of another adjacent intermediate rib **22**, at least one lateral wall **14a**, **16a** of the plug body **110** and at least one lateral wall **24a** of the filter body **120**. Specifically, as illustrated in the **FIGURES 6, 7a, 7b**, one of the intermediate ribs **22**, referred to as first intermediate rib **22** forms seating channel **12a** in conjunction with the lateral wall **24a** of the filter body **120** or a terminal end body **20a**, the same first intermediate rib **22** forms seating channel **12b** in conjunction with adjacent intermediate rib **22**, also referred to as second intermediate rib **22** and the second intermediate rib **22** further forms seating channel **12c** with the lateral wall **14a** of the plug body **10**. With such configuration three seating channels **12a**, **12b**, **12c** are configured for receiving the three sealing elements **30a**, **30b**, **30c**. The number of the intermediate ribs **22** formed by over molding at least a portion of the filter body **120** on the at least one sealing surface **12** of the plug body **110** can be further increased to configure more seating channels and corresponding more sealing elements for achieving better sealing between the filter plug assembly **200** and the tubular element **40** such as the receiver drier. The present invention is not limited to particular number and spacing between the adjacent intermediate ribs **22** in case the filter plug assembly **200** is configured with the multiple intermediate ribs. Further, the assembly **250** is similar to the assembly **150**, except that the assembly **250** is between the filter plug assembly **200** and the tubular section of the tubular element **40** instead of assembly between the filter plug assembly **100** and the tubular section of the tubular element **40** as is the case with the assembly **150**.

[0042] Every embodiment disclosed for the filter plug assembly **100** and the elements configuring the filter plug assembly **100** may also applicable for the filter plug as-

sembly **200** and elements configuring the filter plug assembly **200**, also, every embodiment disclosed for the assembly **150** and the elements configuring the assembly **150** may also applicable for the assembly **250** and elements configuring the assembly **250**, for sake of brevity of present document, only Figures depicting the details of the filter plug assembly **200** and the assembly **250** are illustrated along with a description that is not as detailed as the description for the filter plug assembly **100** and the assembly **150**.

[0043] Also, is disclosed a method of configuring a filter plug assembly **100**, **200** in accordance with an embodiment of the present invention. The method includes the step of molding a plug body **10** of a loaded type rigid plastic material, thereafter over molding at least a portion of a filter body **20** of an unloaded type relatively softer plastic material on the at least one sealing surface **12** of the plug body **10** for configuring the at least one intermediate rib **22** that in turn forms the multiple seating channels **12a**, **12b**, **12c** in conjunction with at least one of another adjacent intermediate rib **22**, the at least one lateral wall **14a**, **16a** of the plug body **10** and the at least one lateral wall **24a** of the filter body **20** and finally receiving the at least one sealing element **30a**, **30b**, **30c** in the seating channels **12a**, **12b**, **12c** for configuring sealing between the tubular element **40** and at least one of the plug body **10** and the filter body **20** received in the tubular element **40**.

[0044] Several modifications and improvement might be applied by the person skilled in the art to the filter plug assembly as defined above, as long as it comprises a plug body, a filter body and at least one sealing element. The plug body is received in and engages with a tubular element, the plug body being formed by injection molding is configured with at least one sealing surface that is smooth and without any partition line. At least a portion of the filter body is over molded on the at least one sealing surface to configure at least one intermediate rib that forms multiple seating channels in conjunction with at least one of another adjacent intermediate rib, at least one lateral wall of the plug body and at least one lateral wall of the filter body. The at least one sealing element is received in the at least one seating channel for configuring sealing between the tubular element and at least one of the plug body and the filter body received in the tubular element.

[0045] In any case, the invention cannot and should not be limited to the embodiments specifically described in this document, as other embodiments might exist. The invention shall spread to any equivalent means and any technically operating combination of means.

Claims

1. A filter plug assembly (100, 200) comprising:
 - a plug body (10, 110) adapted to be received

in and engaged with a tubular element (40), the plug body (10, 110) being formed by molding is configured with at least one smooth sealing surface (12) ;

- a filter body (20, 120), wherein at least a portion of the filter body (20) is adapted to be over molded on the at least one smooth sealing surface (12) to configure at least one intermediate rib (22) that is adapted to form multiple seating channels (12a, 12b, 12c) in conjunction with at least one of another adjacent intermediate rib (22), at least one lateral wall (14a, 16a) of the plug body (10, 110) and at least one lateral wall (24a) of the filter body (20, 120); and
- at least one sealing element (30a, 30b, 30c) adapted to be received in the at least one seating channel (12a, 12b, 12c) for configuring sealing between the tubular element (40) and the plug body (10, 110) received in the tubular element (40).

2. The filter plug assembly (100, 200) according to the previous claim, wherein the plug body (10, 110) comprises at least one stepped portion (14, 16) adapted to configure the at least one lateral wall (14a, 16a) of the plug body (10, 110), the at least one lateral wall (14a, 16a) of the plug body (10, 110) in conjunction with the at least one intermediate rib (22) and at least a portion of the at least one smooth sealing surface (12) adapted to configure at least one seating channel of the multiple seating channels (12a, 12b, 12c).

3. An assembly (150, 250) comprising:

- a tubular element (40); and
- a filter plug assembly (100, 200) comprising:
 - a plug body (10, 110) adapted to be received in and engaged with the tubular element (40);
 - a filter body (20, 120),

wherein at least one of the plug body (10, 110) and the filter body (20, 120) being formed by molding is configured with at least one smooth sealing surface (12, 21), further at least a portion of at least one of the plug body (10, 110) and the filter body (20, 120) is adapted to be over molded on the at least one smooth sealing surface (12, 21) of the other to configure at least one intermediate rib (22),

wherein the at least one intermediate rib (22) is adapted to form multiple seating channels (12a, 12b, 12c) in conjunction with at least one of another ad-

jacent intermediate rib (22), at least one lateral wall (14a, 16a) of the plug body (10, 110) and at least one lateral wall (24a) of the filter body (20, 120); and

- at least one sealing element (30a, 30b, 30c) adapted to be received in the at least one seating channel (12a, 12b, 12c) for configuring sealing between the tubular element (40) and the plug body (10, 110) received in the tubular element (40),

wherein the plug body (10, 110) and the tubular element (40) comprises complimentary engagement elements for facilitating engagement between the plug body (10, 110) and the tubular element (40);

4. The assembly (150, 250) according to the previous claim, wherein the complimentary engagement elements are complimentary threads (16b) and (40a) configured on at least a portion of the plug body (10, 110) and the tubular element (40) respectively for facilitating threaded engagement between the plug body (10, 110) and the tubular element (40).

5. The filter plug assembly (100, 200) according to any of the preceding claims, wherein the plug body (10, 110) further comprises a locator element (12d) configured on the at least one sealing surface (12) thereof and adapted to facilitate configuring and positioning of the at least one intermediate rib (22) that is over molded over the at least one sealing surface (12).

6. The filter plug assembly (100, 200) according to the previous claim, wherein the locator element (12d) is adapted to facilitate secure attachment of the filter body (20, 120) over the plug body (10, 110) and resist relative movement there between due to vacuum pressure.

7. The filter plug assembly (100, 200) according to any of the preceding claims, wherein the tubular element (40) is a receiver drier adapted to receive condensed refrigerant from a condenser of a vehicle air conditioning unit, the receiver driver further adapted to receive a desiccant bag therein for absorbing moisture from the condensed refrigerant.

8. The filter plug assembly (100, 200) according to any of the preceding claims, wherein the filter body (20, 120) adapted to support a filter mesh that in turn is adapted to filter out impurities from the condensed refrigerant received by the receiver drier before delivering the condensed refrigerant.

9. The filter plug assembly (100, 200) according to any of the preceding claims, wherein the filter body

(20, 120) comprises at least one additional rib (24) adapted to configure the at least one lateral wall (24a) of the filter body (20, 120), the at least one lateral wall (24a) in conjunction with the at least one intermediate rib (22) and at least a portion of the at least one sealing surface (12) adapted to configure at least one seating channel of the multiple seating channels (12a, 12b, 12c).

in the tubular element (40).

11. The filter plug assembly (100, 200) according to any of the preceding claims, wherein the plug body (10, 110) comprises a plurality of first shaped elements (18) adapted to facilitate additional internal interference between the plug body (10, 110) and the filter body (20, 120) that in turn facilitates over molding of the filter body (20, 120) over the plug body (10, 110).

12. The filter plug assembly (100, 200) according to any of the preceding claims, wherein the filter body (20, 120) comprises a plurality of second shaped elements (26) adapted to provide structural support to the filter mesh.

13. The filter plug assembly (100, 200) as claimed in claim 1, wherein the at least one sealing element (30a, 30b, 30c) is a deformable O-seal that seals the gap between the tubular element (40) and at least one of the plug body (10, 110) and the filter body (20, 120) configuring the filter plug assembly (100).

14. The filter plug assembly (100, 200) according to any of the preceding claims, wherein the plug body (10, 110) is configured of a loaded type rigid plastic material by injection molding, whereas the filter body (20, 120) is configured of an unloaded type relatively softer plastic material and is over molded over the plug body (10, 110) by injection molding.

15. A method of configuring a filter plug assembly (100, 200) comprising the following steps:

- molding a plug body (10, 110) of a loaded type rigid plastic material;
- over molding at least a portion of a filter body (20, 120) of an unloaded type relatively softer plastic material on at least one sealing surface (12) of the plug body (10, 110) for configuring at least one intermediate rib (22) that in turn forms multiple seating channels (12a, 12b, 12c) in conjunction with at least one of adjacent intermediate rib (22), at least one lateral wall (14a, 16a) of the plug body (10, 110) and at least one lateral wall (24a) of the filter body (20, 120); and
- receiving at least one sealing element (30a, 30b, 30c) in the seating channels (12a, 12b, 12c) for configuring sealing between the tubular element (40) and the plug body (10, 110) received

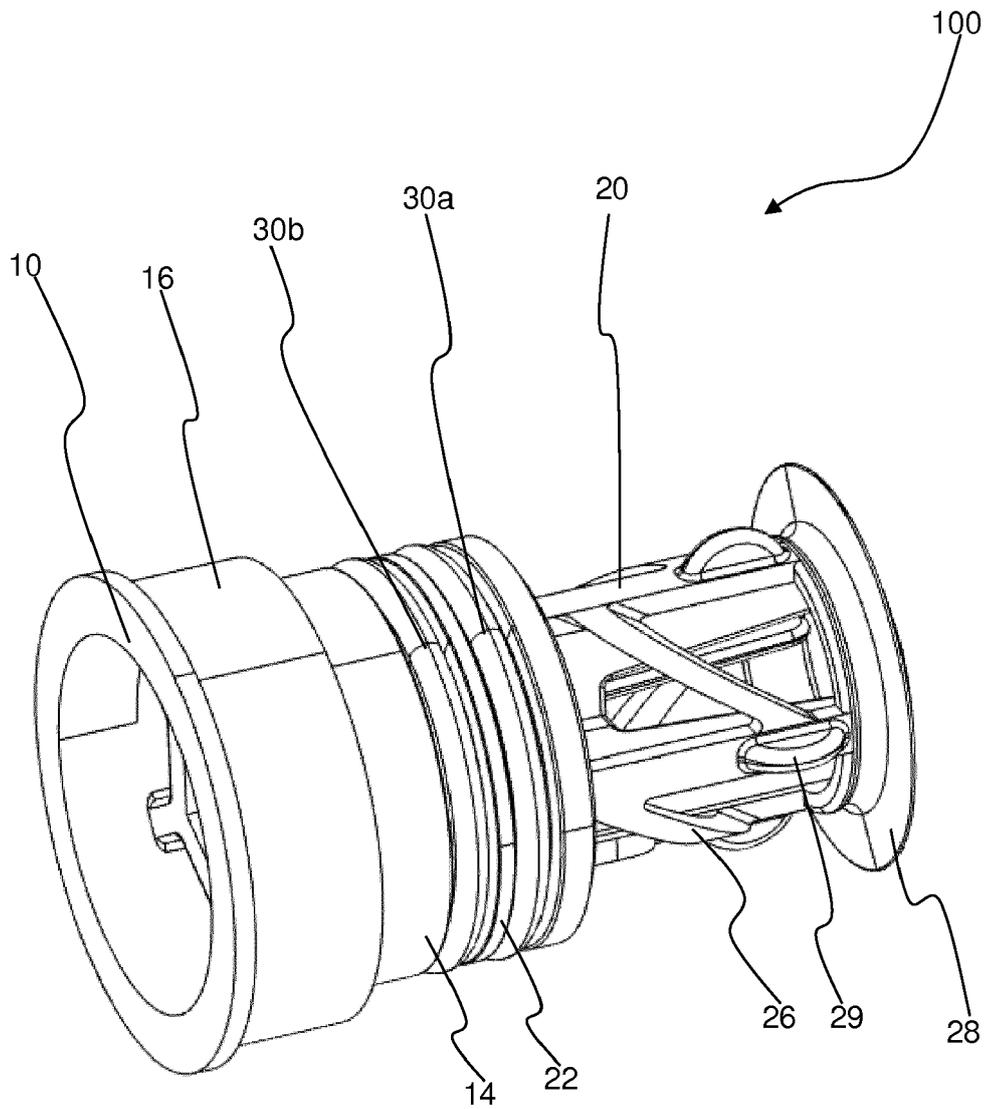


FIG. 1

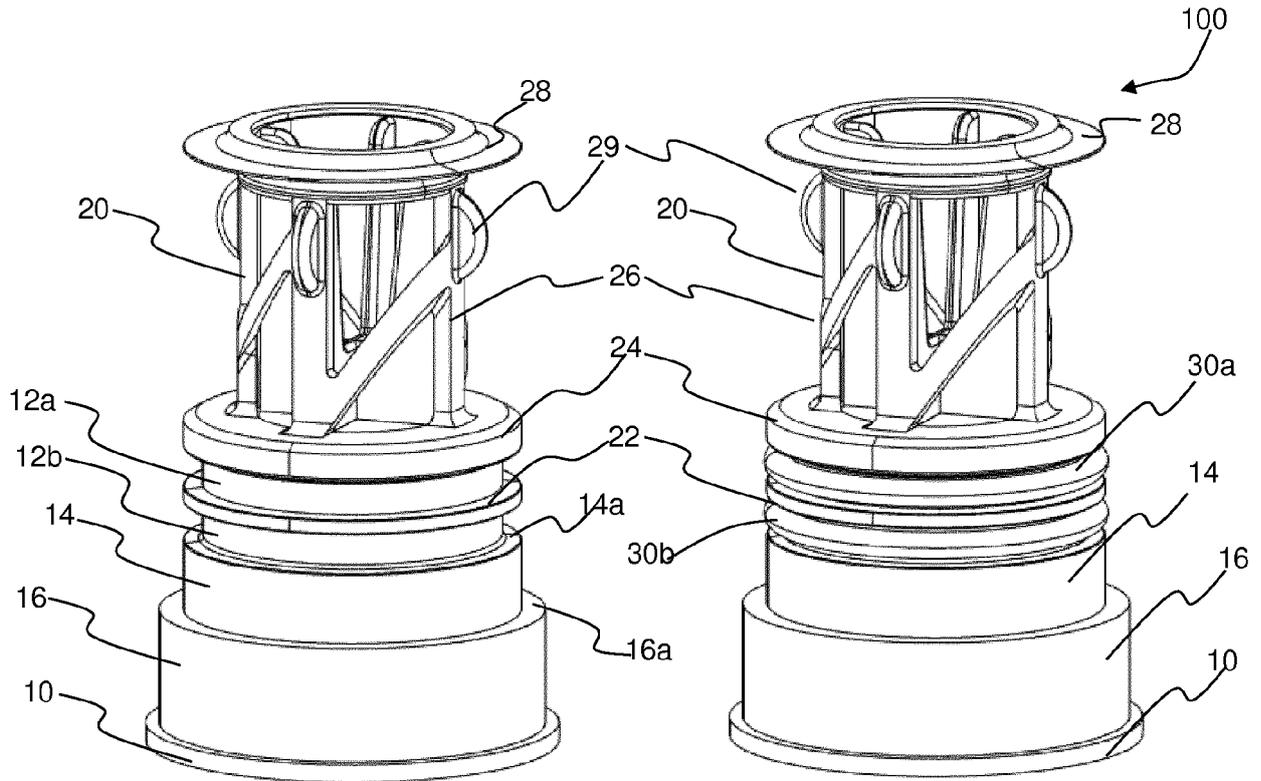


FIG. 2a

FIG. 2b

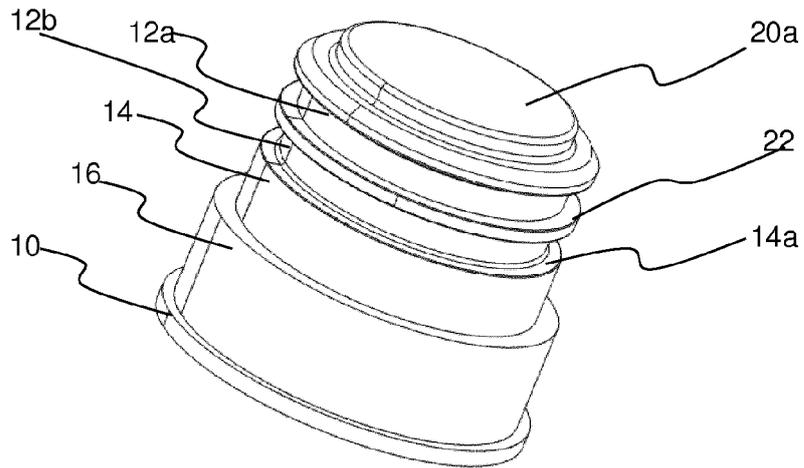


FIG. 2c

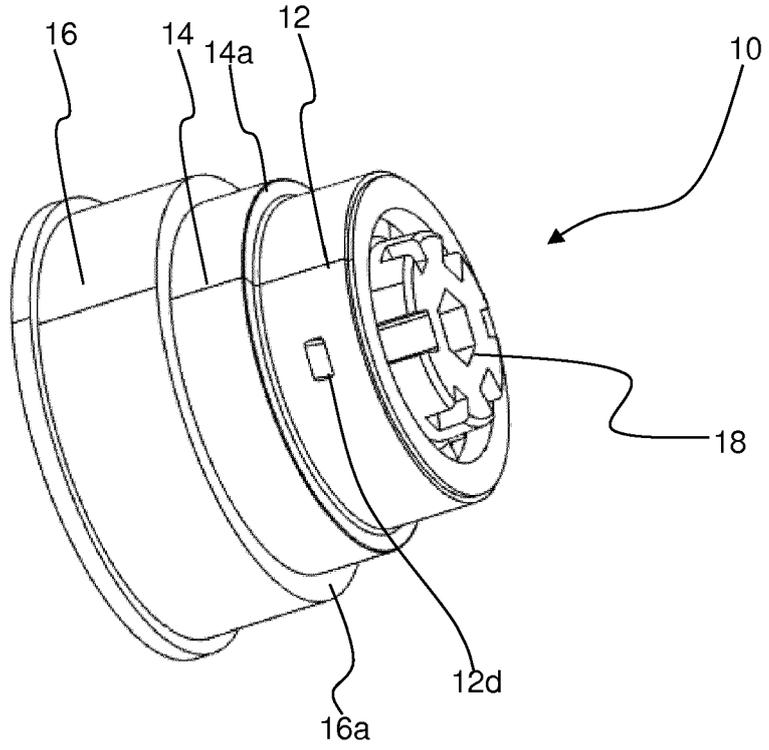


FIG. 3

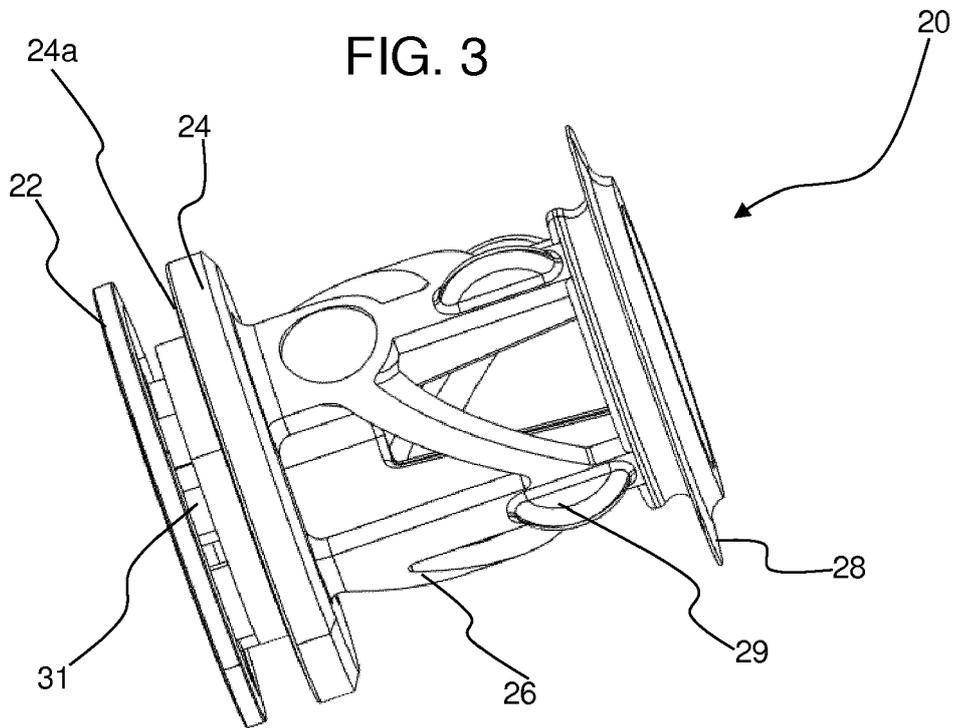


FIG. 4

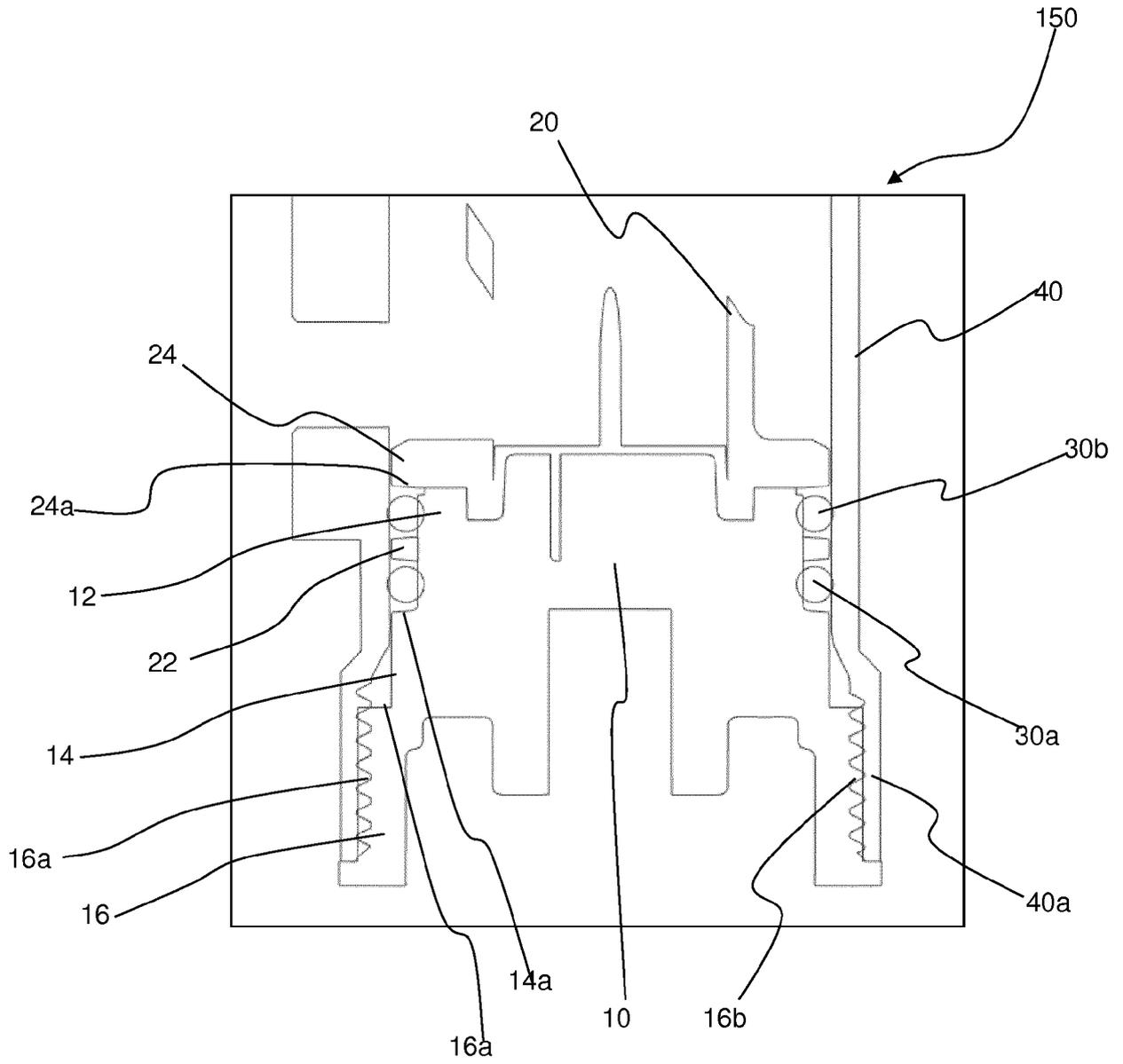


FIG. 5

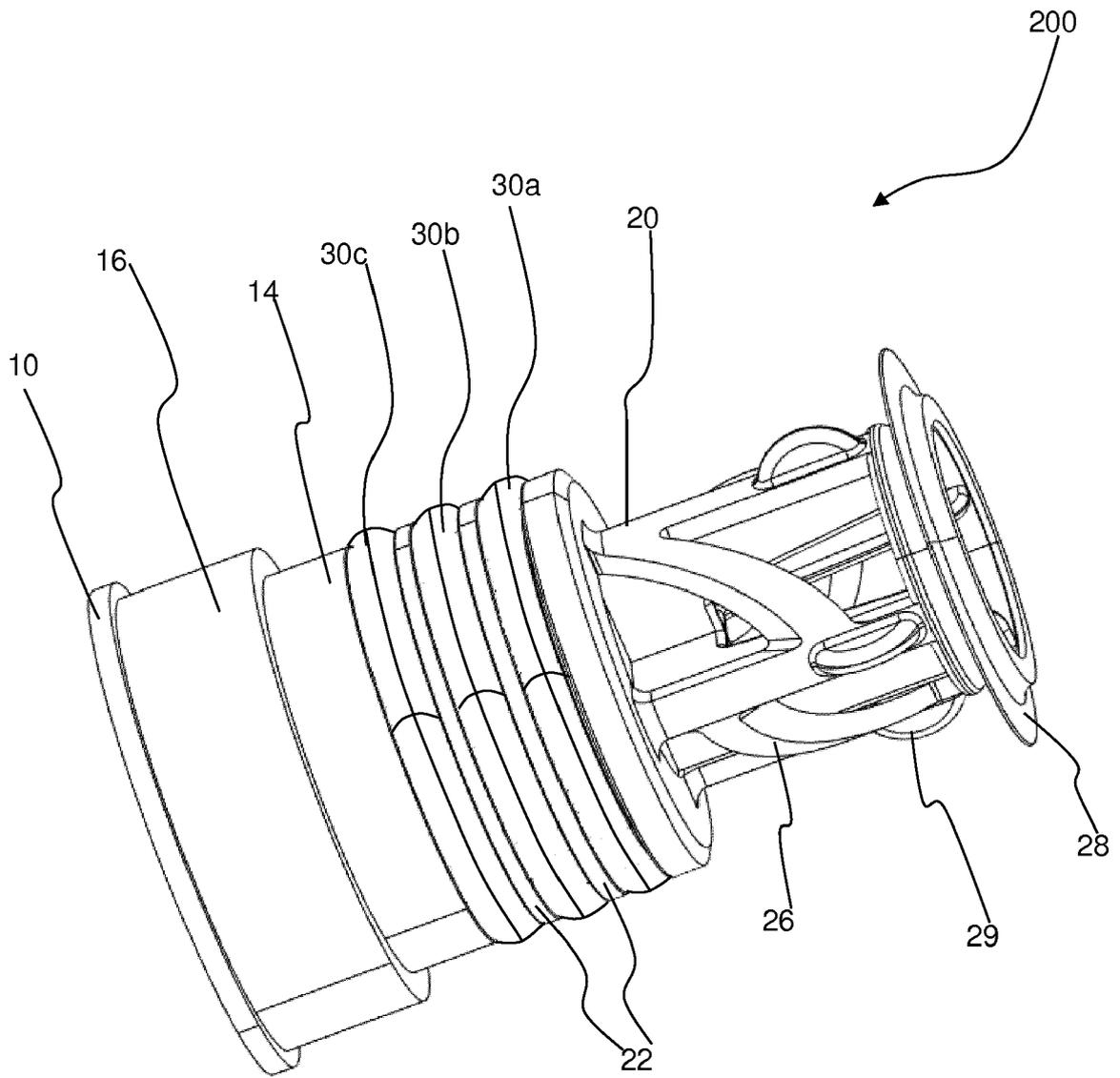


FIG. 6

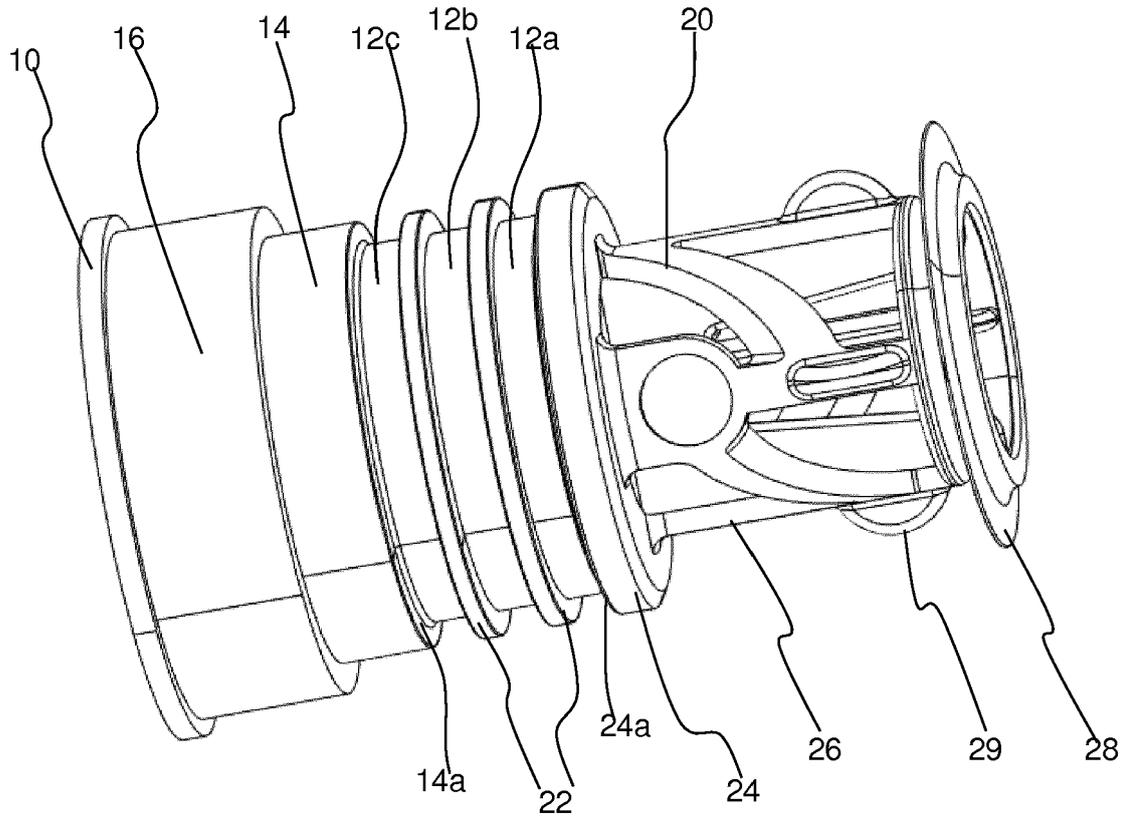


FIG. 7a

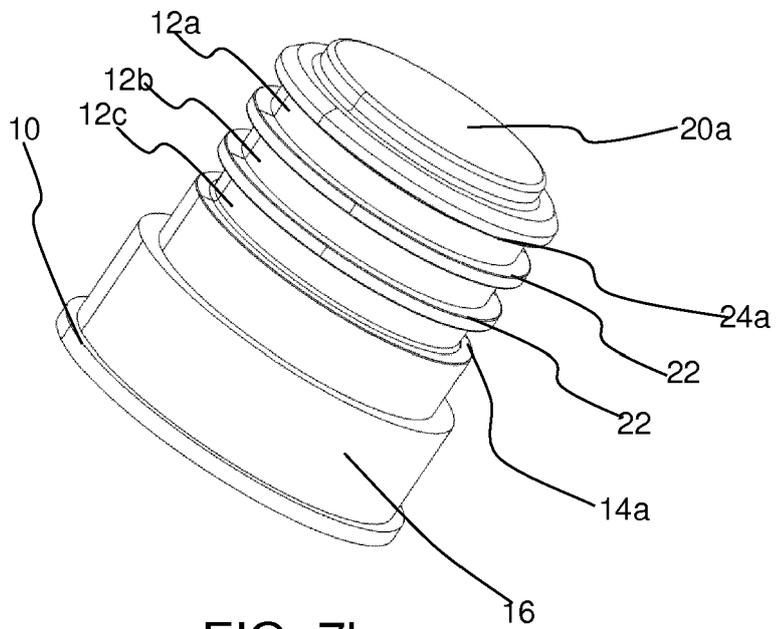


FIG. 7b

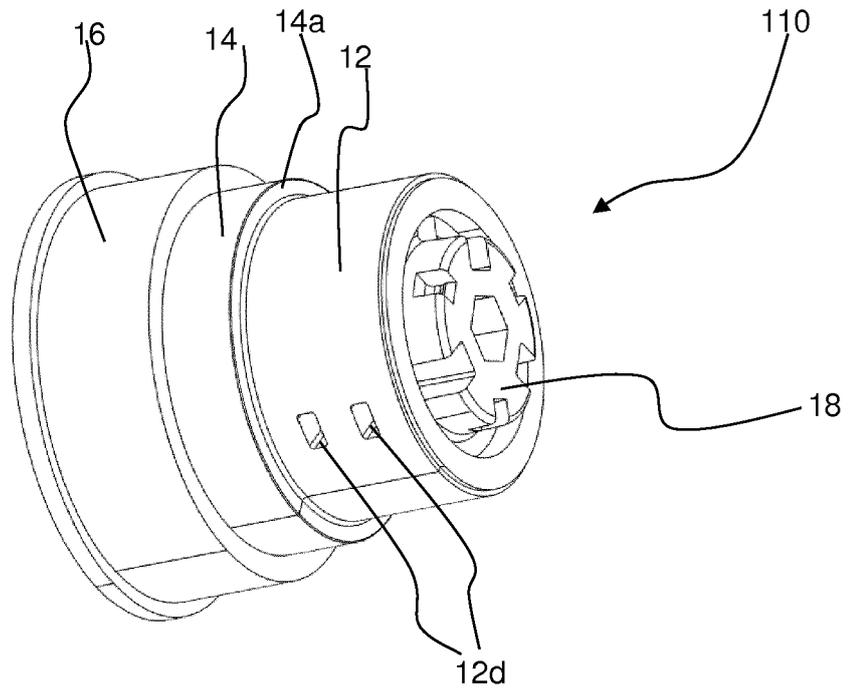


FIG. 8

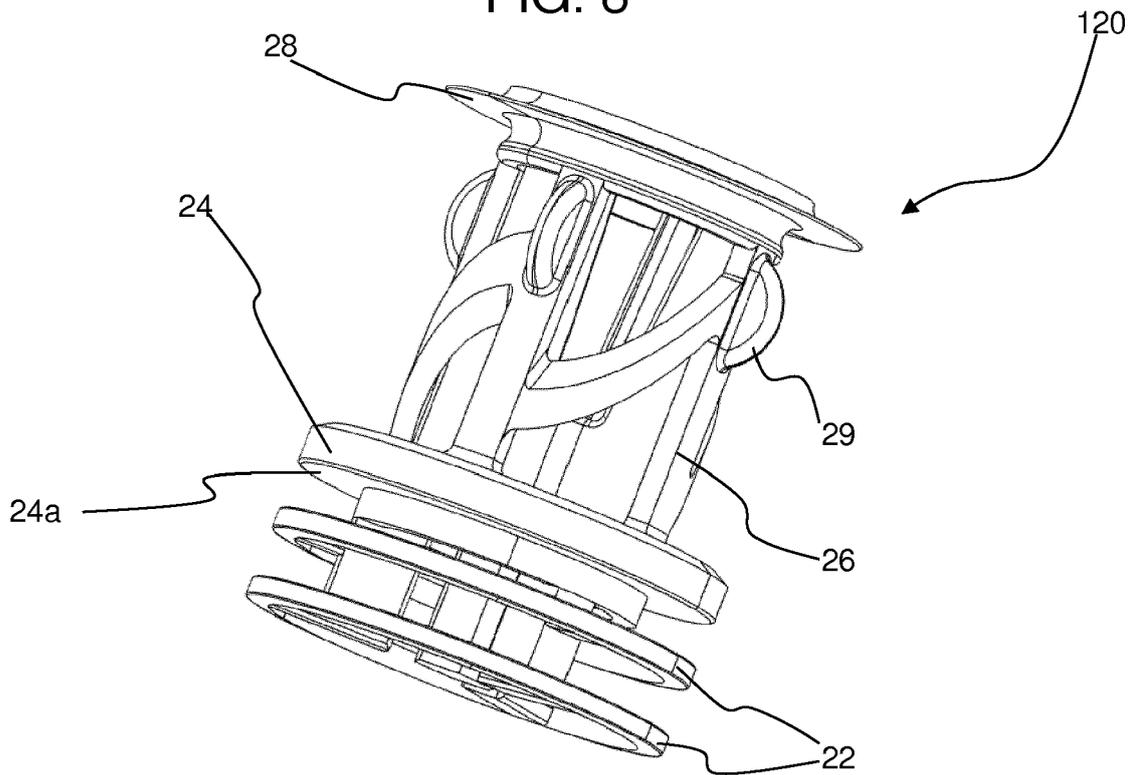


FIG. 9

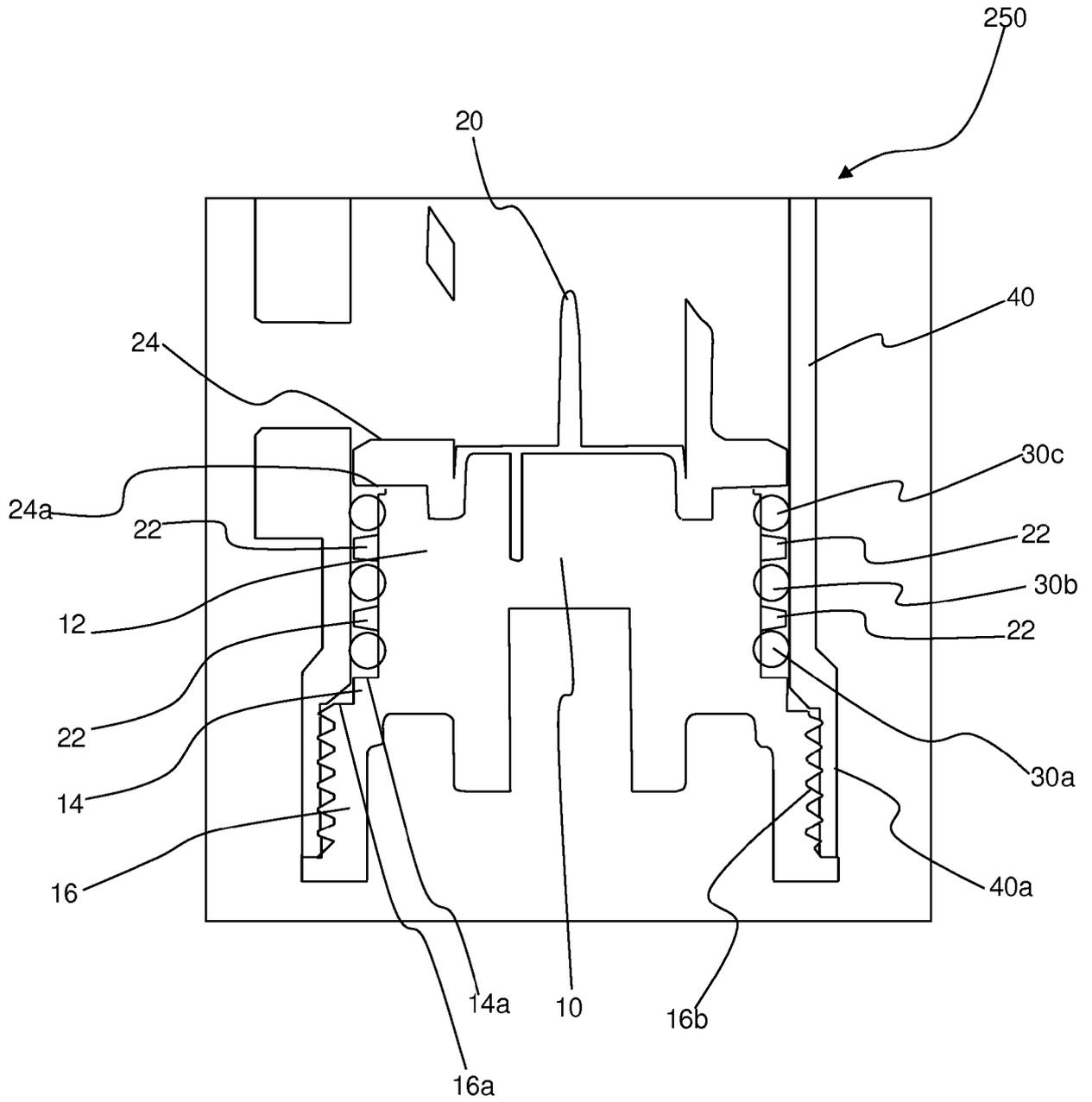


FIG. 10



EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 18 April 2019	Examiner Ritter, Christoph
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