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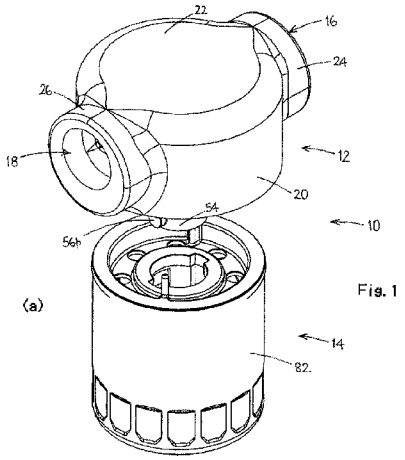

Fig. 1

(57) Abstract: A filter assembly has a head portion (12) comprising a housing (20) having inlet means (16) and outlet means (18) for inlet and outlet of fluid respectively and a filter (14) releasably connectable to the head portion and being adapted to receive a flow of fluid from the inlet means and return it to the outlet means. The assembly has valve means (28) within the housing displaceable between a first, closed position, and a second, open position. The filter portion (14) is engageable with the valve means (28), in which condition the filter portion is displaceable with respect to the housing (20) of the head portion between a first position in which the filter portion (14) is disconnected from the head portion and disengageable from the valve means (28) and a second position in which the filter portion (14) is connected to the head portion (12). Displacement of the filter portion (14) between the first and second portions causes the valve means (28) to be displaced between its closed and open positions.

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DESCRIPTION

FILTER ASSEMBLY

The present invention relates to filter assemblies, in particular, but not exclusively, to filter assemblies for use in central heating systems and the like.

During operation of a central heating system, unwanted deposits are produced which circulate in the fluid and which can potentially cause damage to the system.

Traditionally, this problem has been overcome by periodically draining the system and flushing it through with clean fluid and then refilling the system. However, this procedure is time-consuming and relatively expensive and suffers from the disadvantage that it allows unwanted material to circulate through the system until the system is drained and refilled.

An alternative approach is to insert a filter into the system. This retains unwanted particles and prevents them from circulating within the system, thereby reducing the likely damage. However, such filters must be cleaned and/or replaced regularly. This requires cut-off valves to be placed either side of the filter which increases the cost and complexity of the procedure.

It is an object of the present invention to provide a filter assembly which overcomes or alleviates the problems associated with the prior art.

In accordance with a first aspect of the present invention, there is provided a filter assembly comprising a head portion comprising a housing

having inlet means and outlet means for inlet and outlet of fluid respectively; and a filter portion releasably connectable to the head portion and being adapted to receive a flow of fluid from the inlet means and return it to the outlet means.

Preferably, the filter assembly further comprises valve means within the housing displaceable between a first, closed position, and a second, open position, the filter portion being engageable with the valve means, in which condition the filter portion is displaceable with respect to the housing of the head portion between a first position in which the filter portion is disconnected from the head portion and disengageable from the valve means and a second position in which the filter portion is connected to the head portion, the displacement of the filter portion between the first and second portions causing the valve means to be displaced between its closed and open positions.

With such an assembly, the filter portion can be removed and replaced when necessary without having to isolate the flow of fluid and/or disconnect it from the adjoining circuit and reconnect the new filter to the circuit.

With such an assembly, as the filter portion is removed, the valve in the head portion is closed, which prevents leakage of fluid from the system to which the head portion is connected. A new filter portion can then be connected, the acting of connecting automatically opening the valve within the valve head and thereby reconnecting the supply of fluid through the filter

portion. This provides a simple and quick method for replacing a filter, without the need for separate valves to isolate the fluid flow.

Preferably, each of the inlet means and outlet means comprises means for connecting to a pipe e.g. means for effecting a push-fit connection or a threaded connection with a pipe.

The valve means is preferably sealed with respect to the housing of the head portion.

The valve means may further comprise a bypass inlet port, a bypass outlet port and passage means interconnecting the bypass inlet and outlet ports, the bypass inlet and outlet ports being aligned with, and communicating with, the inlet means and outlet means respectively when the valve means is in the first, closed position.

This allows fluid to be diverted through the passage means when the filter portion is removed, with the result that the system to which the filter assembly is connected does not need to be shut down in order to replace the filter portion.

The passageway may be formed, for example, in an upper face of the valve means.

The valve means may comprise a valve closure member displaceable through a predetermined angle between its closed and open positions, e.g. through approximately 90°.

In one arrangement, the head portion further comprises support means on which the valve closure member is mounted.

The support means is preferably secured to the housing of the head portion.

The support means also preferably extends out of the housing of the head portion. In one embodiment, when the head portion and filter portion are connected, the support means extends into the filter portion.

Preferably, the support means is hollow.

The support means preferably communicates with the outlet means when the valve means is in the open position.

Preferably, when the head portion and filter portion are connected, the support means communicates with the interior of the filter portion.

The valve means may, alternatively, be displaceable linearly with respect to the housing between the first and second positions.

The filter assembly preferably further comprises interengaging means on the head portion and the filter portion for releasably connecting the head portion and filter portion.

The interengaging means may comprise one or more projections on one of the head portion and the filter portion receivable in one or more corresponding recesses on the other of the head portion and the filter portion.

The one or more projecting portions may be provided on the head portion.

Preferably, the interengaging means engage with a bayonet-type action.

Preferably, the head portion and the filter portion are releasably connectible in a sealing manner.

Preferably, the filter portion comprises one or more projections engageable with the valve means.

The filter means preferably comprises a filter housing.

There may be a plurality of filter components within the housing.

The filter assembly preferably comprises a mandrel on which the plurality of filter components are mounted.

Preferably the mandrel is hollow.

Preferably the mandrel communicates with the support means of the head portion.

The filter portion may comprise magnetic filtration means and/or cyclone means for inducing a helical motion in fluid and or filter screen means.

In accordance with a second aspect of the present invention, there is provided a filter assembly comprising an inlet and an outlet for inlet and outlet of fluid respectively and filter means adapted to receive a flow of fluid from the inlet means and return it to the outlet means, the filter means comprising means for inducing a helical motion of fluid flowing from the inlet to the outlet.

The helical motion of fluid causes a "cyclonic" action and results in solid particles being displaced outwardly and removed from the fluid flow.

Preferably, the means for inducing a helical motion of fluid interacts with the flowing fluid to induce the helical motion.

Preferably, the means for inducing a helical motion of fluid is static.

Preferably, the means for inducing a helical motion of fluid comprises a plurality of blades. Preferably, each of the blades is part-helical in shape. The filter assembly may further comprise a support from which the blades project radially. Preferably, the blades project radially outwardly.

Preferably, the blades decrease in width along the flow direction of the blades, causing an increase in fluid velocity.

The filter assembly may further comprising a housing in which the means for inducing helical motion of fluid is secured.

The housing preferably comprises sump means downstream of the means for inducing a helical motion of fluid.

The filter assembly may further comprise filter means located downstream of the means for inducing a helical motion of fluid.

The filter means located downstream of the means for inducing a helical flow of fluid may comprise barrier filter means.

The filter assembly may further comprise filter means secured in the housing upstream of the means for inducing a helical motion of fluid.

The filter assembly may further comprise magnetic filter means secured in the housing upstream of the means for inducing a helical motion of fluid.

The filter assembly may further comprise a head portion having inlet means and outlet means for inlet and outlet of fluid respectively. The housing is removably securable to the head portion.

In accordance with a third aspect of the invention, there is provided a a filter assembly comprising an inlet and an outlet for inlet and outlet of fluid respectively and filter means adapted to receive a flow of fluid from the inlet means and return it to the outlet means, the filter means comprising magnetic filtration means arranged in series with a barrier filtration means.

The magnetic filtration means is able to remove magnetisable particles from the fluid flow without restricting the flow-through of fluid, whereas the barrier filtration means retains non-magnetizable particles from the fluid, thereby resulting in a very efficient filtering process.

The filter assembly preferably further comprises a housing in which the filter means is secured.

The filter assembly may further comprise a head portion in which the inlet and outlet are provided. Preferably, the housing is releasably securable to the head portion.

By way of example only specific embodiments of the present invention will now be described with reference to the accompanying drawings, in which:

Figs. 1(a), (b) and (c) are, respectively, an exploded perspective view, an end view and a side view of an embodiment of filter assembly in accordance with the present invention;

Figs. 2(a), (b) and (c) are, respectively, an exploded perspective view, an end view and a side view of a head portion of the filter assembly of Fig. 1;

Figs. 3(a) and (b) are transverse cross-sections through the head portion of Fig. 2, showing an internal valve in open and closed positions, respectively and Figs. 3(c) is a perspective view from below of the valve closure member shown in Figs. 3(a) and 3(b).

Fig. 4 is a longitudinal cross-section through the filter head of Fig. 2, with the valve in a closed position;

Fig. 5 is a longitudinal cross-section through a filter bowl which forms part of the filter assembly of Fig. 1;

Fig. 6 is an an exploded perspective view of the filter bowl of Fig. 5;

Figs. 7(a) and (b) are, respectively, an exploded longitudinal cross-section and an exploded side view of the filter bowl of Fig. 5;

Figs. 8(a) and (b) are, respectively, a perspective view and a longitudinal cross-section through an annular strainer which forms part of the filter bowl of Fig. 5;

Figs. 9(a) and (b) are, respectively, a longitudinal cross-section and a side view of an annular cyclone component which forms part of the filter bowl of Fig. 5;

Figs. 10(a) and (b) are, respectively, a side view and a longitudinal cross-section through an alternative annular strainer which can be used in the filter bowl of Fig. 5;

Figs. 11(a) and 11(b) are transverse cross-sections through a variant of the head portion of the filter assembly of Fig. 2.

Figs. 12 is a transverse cross-section through an alternative construction of mandrel which forms part of the filter assembly;

Figs. 13(a) and 13(b) are an inverted plan view and a perspective view from below respectively of an alternative form of casing which forms part of the head 12;

Figs. 14(a) and 14(b) are detail cross-sections explaining the operation of the casing of Fig. 13;

Fig, 15 is an exploded perspective view from above of a modification to the embodiment of Fig. 1;

Fig. 16 is a perspective view from above of the upper portion of the filter bowl shown in the modification of Fig. 15; and

Fig. 17 is a perspective view from above of the annular valve closure member shown in the modification of Fig. 15.

With reference to Fig. 1, a filter assembly 10 comprises a head 12 to which a filter bowl 14 is releasably attachable. As will be explained in more setail hereafter, the head 12 is provided with inlet and outlet ports 16, 18, which are adapted to be a push-fit connection with two lengths of fluid conveying pipe (not shown), although other types of connection (e.g. threaded connections) could be used. In use, fluid to be filtered passes into the head 12 via the inlet port 16, is filtered in the filter bowl 14 and passes out of the head 12 via the outlet port 18.

The head 12 comprises an outer casing 20 in the general shape of a hollow cylinder closed off at one end by an end wall 22 and having short, diametrically-opposed tubular extensions 24, 26 in which the inlet and outlet ports 16, 18 are formed. An annular valve closure member 28 is rotatably received within the outer casing 20 and is sealed with respect to the inner cylindrical surface of the casing 20 by means of a cage-like seal 30. The seal 30 comprises upper and lower annular sealing members 32, received in corresponding annular recesses 34 in the outer face of the valve closure member 28, and four equally spaced connecting legs 36 extending perpendicularly between and connected to the annular sealing members 32, received in corresponding recesses 38 in the outer face of the valve closure member 28.

Fluid inlet and outlet ports 40, 42 are positioned diametrically opposite each other on the valve closure member. The inlet port 40 comprises a recess 40a which communicates with the undersurface of the valve closure member 28 via an arcuate channel 44 passing longitudinally through the valve closure member. The outlet port 44 extends between the radially inner and outer faces of the annular valve closure member. As will be explained, the valve closure member 28 is rotatable through approximately 90° from an "open" position shown in Fig. 3(a), in which the inlet and outlet ports 38, 40 of the valve closure member 28 are aligned with the inlet and outlet ports 16, 18 of the outer casing 20, to a "closed" position shown in Fig. 3(b), in which the inlet and outlet ports 40, 42 are angularly displaced by 90° from the inlet and

outlet ports 16, 18 of the outer casing 20. The base of the valve closure member is provided with two identical, diametrically-opposed blind recesses 46, for receipt of actuating pins for rotating the valve closure member, as will be explained.

The valve closure member 28 is rotatably mounted on the outer surface of a support collar 48. The support collar 48 has a hollow cylindrical upper portion 50, whose distal end is secured by ultrasonic welding to the undersurface of the end wall 22 of the casing 20, a shoulder portion 52 of larger outer diameter, and which the radially innermost portion of the valve closure member 28 rests and a lower neck portion 54 of smaller diameter than the upper portion 50, which projects, in use, into the filter bowl 14. Two diametrically opposed pairs of upper and lower 56a, 56b securing pegs project radially outwardly from the distal end of the neck portion 54 and a cylindrical passage 60 of constant cross-section passes through the collar, the upper end of the passage 60 communicating with a cross-bore 61 aligned with the outlet port 18.

A circular annular retaining ring 62 is positioned radially outwardly of the shoulder portion 52 of the support collar 48 and is secured to the radially outermost face 64 of the collar by means of two diametrically opposed radial extensions 66 extending between the shoulder portion 52 and the radially innermost face 68 of the ring 62. The radially outermost portion of the upper face of the retaining ring 62 seats against an undercut shoulder 70 in the wall of the outer casing 20. The retaining ring 62 is also provided with a

downwardly-depending skirt portion 72 which is shaped complementarily with the inner face of the longitudinally outermost portion of the casing 20 and is secured thereto by ultrasonic welding.

Referring now to Figs. 5 to 9, the filter bowl 14 comprises a casing 80 having a generally cylindrical side wall 82 which is closed off at its lower end by a domed end wall 84. Received within the casing are, in sequence, an annular mesh barrier strainer 88, an annular cyclone component 90, an annular magnetic filter assembly 92 and an apertured end cap 94, all of which are slidably received on the exterior cylindrical face of a hollow, generally cylindrical mandrel 96. As best seen in Fig. 5, the above components are assembled within the casing 80 and are retained in the casing by crimping or swaging the upper peripheral edge of the cylindrical side wall 82 of the casing into a peripheral groove 102 in the casing formed by the crimping/swaging operation, thus forming a groove in the cylindrical side wall 82 of the casing 80 to receive the seal 100. Part of the inner annular face of each of the components is provided with a flat portion which engages with a longitudinal flat face 97 of the mandrel 96, to prevent relative rotation of the components and the mandrel.

The annular strainer 88 comprises a circular planar disc 104 having a central annular collar 106 for receiving one end of the mandrel 96, an outer annular wall 108 of the same height as the central collar 106 located at the periphery of the disc 104 and an intermediate annular wall 110, taller than the central collar 106, located coaxially with the locating collar 106 between the

collar and the outer wall 108, all extending perpendicularly from the upper face of the disc 104. Three support feet 112 extend perpendicularly from the undersurface of the disc 104 and, in use, rest on the inner face of the domed end wall 84, in which position the peripheral edges of the disc 104 and outer annular wall are spaced very slightly from the inner face of the cylindrical side wall 82, as shown in Fig. 5. The annular collar 106 is provided with four identical rectangular, equally spaced rectangular apertures 113 separated by vertical spacers 114. Similarly, the outer and intermediate walls 108, 110 are each provided with four identical, equally spaced rectangular apertures or windows 115, separated by vertical spacers 116, the windows being covered with a sheet 118 of woven mesh filter material.

Immediately above the annular strainer 88 is the annular cyclone component 90. As can be seen from Fig. 9, the component 90 comprises a central cylindrical annular sleeve 120 which slides over the mandrel 96 and whose lower annular end abuts, when assembled, the upper annular end of the locating collar 106 of the disc 104. The upper end of the annular sleeve 120 is formed into a radially outwardly extending planar annular end wall 122 and a frusto-conical skirt 124 extends downwardly and outwardly from the periphery of the end wall 122. As best seen in Fig. 9, the outer face of the skirt 124 is provided with twelve identical, equally-spaced, overlapping, part-helical blades 126 (although a different number of blades could be used, if desired). Since the skirt flares outwardly away from the annular end wall

122, the width of the blades 124 decreases towards the lower end of the skirt 124.

Immediately above the annular cyclone component 90 is the annular magnetic filter assembly 92. The assembly 92 comprises a stack of three magnetic filter devices 128 of the type described in WO97/04873 and WO99/58247. Briefly, each magnetic filter device comprises an annular ferrite magnet 130 having two planar faces of opposite magnetic polarity, against each of which faces a respective one of two identical annular metal plates 132, 134 abuts. The peripheral edge of each of the plates 132, 134 is provided with a plurality of identical, evenly spaced recesses 138, between which are defined a plurality of identical pole pieces 140, the apertures 138 and the pole pieces 140 of the two plates 132, 134 being aligned with each other. The pole pieces 140 of each plate are also aligned slightly towards the pole pieces of the other plate and extend radially outwardly of the annular magnet 130.

Opposed pole pieces 140 of the plates 132, 134 define regions of magnetic attraction 142 into which magnitizable materials are attracted and retained. Thus, as fluid flows along the passageways defined between the aligned recesses 138 in the plates, magnetisable material is withdrawn from the fluid into the regions of magnetic attraction 142 and are retained in those regions.

Three such identical filter devices 128 are assembled on the mandrel 96 to form the annular magnetic filter assembly 92. It should be noted that

adjacent devices 128 are preferably (but not necessarily) arranged such that the adjacent poles of their magnets are of the same polarity, and that the recesses 138 and the pole pieces 140 of the devices are all aligned with one another.

The apertured end cap 94 comprises an annular base wall 148 whose inner periphery is reinforced to form a collar 150 which is slidable over the mandrel 96. The upper face of the peripheral edge of the base wall is formed into an upwardly extending peripheral annular wall 152 in whose outer face the exterior peripheral groove 98 is formed. Between the outer peripheral wall 152 and the collar 150, the base wall 148 is provided with a plurality of identical, equally angular spaced circular apertures 154. In addition, two diametrically opposed elongate pegs 156 extend perpendicularly from the upper face of the wall 148. The pegs are adapted to be releasably received in corresponding identical diametrically opposed recesses in the undersurface of the valve closure member 28. The central portion of the end cap 94 is also provided with a central aperture 158 for receipt of the neck portion 54 of the head 12. The aperture 158 has two diametrically opposed recesses 159 to allow the two pairs 56a, 56b of securing pegs to pass.

The upper annular end of the mandrel 96 is provided with a plurality of identical locating pegs 160 which are adapted to be received in corresponding recesses in the undersurface of the reinforced collar portion 150 of the end cap 94. The opposite end of the mandrel 96 is formed into four identical, equally angularly spaced, longitudinally extending feet 162

(although a different number of feet could be used) which, when assembled, abut the upper face of the planar disc 104 of the annular strainer 88, within the central annular collar 106 of the disc 104 and from apertures 162 at the base of the mandrel. The inner wall of the mandrel to also protected with two diametrically opposed, longitudinally extending straight guide recesses 164, aligned with the recesses 159 in the end cap 94, which are adapted to receive the securing pegs 56a, 56b slidably. A first horizontal arcuate recess 166 at the end of each recess 159 and a second recess 168 at a spacing equal to that of the securing pegs 56a, 56b extend perpendicularly from the longitudinal guide recess 164 for a quarter of the circumference of the mandrel.

In use, the components of the filter bowl 14 are assembled into a unit as shown in Fig. 5, with the annular strainer 88, annular cyclone component 90, annular magnetic filter assembly 92 and apertured end cap 94 being arranged in series on the mandrel and the whole sub-assembly being located in the casing 80 and securing in place by crimping/swaging the upper peripheral edge of the casing to form the external peripheral groove 98 of the end cap, the O-ring seal then being located in the exterior peripheral groove 98 in the casing formed by the crimping/swaging operation. The filter bowl 14 is then ready for connection to the head 12.

As explained previously, the head 12 is adapted to be connected to inlet and outlet pipes (not shown). At the time of installation, care should be taken to ensure that the valve closure member 28 is in the closed position

(shown in Fig. 3(b)) in order to prevent leakage when fluid flows through the pipes.

The upper end of the assembled filter bowl 14 is then offered to the undersurface of the head 12 and is adjusted so that the securing pegs 56a, 56b projecting from either side of the neck portion 54 of the head 12 are aligned with the recesses 159 in the central aperture 158 of the end cap 94. In this orientation, the pegs 156 projecting from the end of the filter bowl 14 are located one in each of the arcuate recesses between the support collar 48 and the annular retaining ring 62 of the head 12 and are aligned with, but not yet received in, the corresponding apertures 46 in the undersurface of the valve closure member 28. As the filter bowl is pushed further onto the head 12, the securing pegs 56a, 56b move along the respective vertical guide recesses 164 until the lowermost pegs 56a reach the lower end of the recesses, at which point the lower and upper pegs 56a, 56b are longitudinally aligned with the arcuate, part-circumferential securing recesses 166, 168 in the mandrel 96. At this point, the securing pegs 156 projecting from the end of the filter bowl 14 are received in the corresponding recesses 46 in the undersurface of the valve closure member 28. Consequently, as the filter bowl is rotated to engage the lower and upper pegs 56a, 56b with the securing recesses 166, 168 in the mandrel 96, and thereby secure the filter bowl 14 to the head 12, the valve closure member 28 is rorated form the closed position shown in Fig. 3(b) to the open position shown in Fig. 3(a). Attachment of the filter bowl 14 to the head 12 therefore automatically results

in the opening of the valve in the head 12. Conversely, removal of the filter bowl 14 from the head 12 by reversal of the above process ensures that the valve is closed before the filter bowl can be removed.

When the filter assembly 10 is assembled and connected to inlet and outlet pipes extending from the inlet and outlet ports 16, 18, fluid flowing through the inlet pipe will pass into the assembly 10, where it will be filtered before passing out of the filter assembly via the outlet 18 and thence into the outlet pipe. Filtering of the fluid takes place in several ways, as will be explained.

Fluid passing into the head 12 of the filter assembly passes through the inlet port 40 in the valve closure member 28 and passes downwardly through the valve closure member 28 via the arcuate channel 44. The fluid thereby reaches the aperture end cap 94 of the filter bowl and passes through the apertures 154 therein. The fluid then passes to the magnetic filter assembly 92 and flows generally longitudinally through the passageways defined between the aligned recesses in the plates 132, 134 of the filter devices 128. Magnetisable material is attracted from the flowing fluid into the regions of magnetic attraction between opposed pole pieces 140 of the plates 132, 134 of each filter device, where the magnetisable material is retained and thereby removed from circulation.

The fluid flows from the magnetic filter assembly 92 and passes to the annular cyclone component 90. The longitudinal flow of fluid passing from the magnetic filter assembly 92 is converted into a helical flow as it passes

over the blades 126. The flow is thereby provided with a radially outward flow component, which is enhanced by the narrowing of the blades 126 towards the lower end of the cyclone component 90.

Very fine particles are thereby displaced to the interior of the face of the casing 80 and then pass longitudinally between the outer upstanding wall 108 of the annular strainer 88 and collect in a sump region between the undersurface of the strainer 88 and the damed end wall 84 of the casing.

Larger particles are displaced towards, and retained by, the inner face of the sheets 118 of filter material forming part of the outer upstanding wall 108. The fluid flow then passes downwardly beyond the lower edge of the frusto-conical skirt 124. Larger particles are then trapped and retained by the sheets 118 of filter material forming part of the intermediate upstanding wall 110.

The fluid then flows through the apertures 113 in the central annular collar 106 and through the apertures 163 at the base of the mandrel 96. The fluid flow then continues upwardly through the hollow mandrel and out of the filter bowl via the central aperture 158. The neck portion 54 of the support collar 48 of the head portion 12 is received in the central aperture and thus the fluid flow continues through the cylindrical passage 60 of the support collar and thence through the cross-bore 61, through the aligned outlet port 42 of the valve closure member 28 and finally out of the filter assembly 10 via the outlet port 18 and into the outlet pipe connected to the outlet port 18.

The fluid passing through the filter assembly thereby undergoes a multi-stage filtering process. Moreover, in order to change the filter bowl 14, it is merely necessary to rotate the filter bowl through a quarter turn, as described previously, whereupon the valve closure member 28 will be rotated to its closed position (shown in Fig. 3(b)), thereby preventing fluid flow through the head 12, and the filter bowl will be disengaged from the head 12. A new filter bowl 14 can then be fitted, which will simultaneously attach the bowl to the head and rotate the valve closure member 28 to the open position (Fig. 3(a)), allowing fluid to flow through the head and thence through the filter bowl and back out through the head.

A modification to the above embodiment is shown in Fig. 10. The modification replaces the annular strainer 88 with an annular mesh filter 170. The mesh filter comprises an inner annular collar 172 which is received on the lower end of the mandrel 96. The collar 172 merges into a short radially-outwardly extended wall portion 174 which in turn merges with a tubular, annular inner wall 176. The tubular inner wall 176 merges into an upwardly and radially outwardly inclined intermediate wall 178 which reaches a height of approximately ⅔ of the inner wall 176 (although this height could be different) which in turn merges with a downwardly and radially outwardly directed intermediate wall 180 which in turn merges with a tubular outer wall 182. The construction is therefore of a trough between the inner and outer walls 176, 182 whose floor is not flat but forms a peak 186, whereby the cross-section of the profile is generally in the form of a "W".

The construction of the mesh filter 170 means that it is resiliently deformable and acts as a spring, which allows the component to deform and move when subjected to pressure.

In the event that the mesh filter 170 becomes full with filtered material, the differential pressure causes the inner annular collar 172 to be pushed downwards (as seen in Fig. 10) along the hollow mandrel 96, thereby uncovering the apertures 163 at the base of the mandrel 96, allowing fluid to bypass the blocked mesh filter 170.

As the collar 172 moves downwardly, the mesh filter 170 hinges at the two bases 184 of the trough and the peak 186.

Fig. 11 illustrates a variant of the head portion 12 of the filter assembly of Fig. 2. The construction is generally very similar to that of Fig. 2, and corresponding features are given the same reference numeral, with the addition of a dash. The main difference from the arrangement of Fig. 2 is that whereas the valve closure member 28' of the Fig. 2 embodiment is displaceable angularly between its open and closed positions, in the variant of Fig. 11, the valve closure member 28' is movable linearly, up and down as shown in Fig. 11, between the open and closed positions.

In particular, the valve closure member 28' in Fig. 11 is biased by means of spring S downwardly into the closed position in which the inlet and outlet ports 40', 42' are out of alignment with the inlet and outlet ports 16', 18' of the outer casing 20', as shown in Fig. 11(a). The valve closure member 28' is moved upwardly, into the position shown in Fig. 11(b) in which the inlet

and outlet ports 40', 42' are aligned with the inlet and outlet portions 16', 18' of the outer casing 20', as the filter bowl (not shown in Fig. 11) is inserted into the head 12'.

Fig. 12 is a transverse cross-section through an alternative construction of mandrel. In order to prevent unintentional removal of the filter bowl 14 (for example by a child or unauthorised person), which might result in release of hot water, the mandrel is provided with cut-out portions 190 in the horizontal arcuate recesses 166, 168, so that the pegs 56a, 56b positively engage the mandrel.

Figs. 13 and 14 illustrate a further variant and provides timed automatic bleeding of pressure in the filter bowl 14, on removal.

The inner face of the end wall 22 of the head 12 is provided with a ramped track 192 which varies in depth from a shallow end 192a to a deeper end 192b. A vent hole 194 is located at the deeper end of the track. As shown in Fig. 14, the upper face of the valve closure member 28 carries a ball bearing 196 which sits on an O-ring seal 198, the bearing 196 sitting in the ramped track.

When the filter bowl 14 is removed, thereby rotating the valve closure member 28, the ramping in the track either pushes the bearing onto the seal, thus sealing off the unit, or relieves the compression on the bearing, thus unloading the seal and allowing the filter to vent its pressure to atmosphere.

Figs. 15 to 17 illustrate a further modification of the arrangement shown in Fig. 1. Many of the features of the arrangement remain unchanged

as compared with the Fig. 1 arrangement and corresponding features are given the same reference numerals, with the addition of a double dash (“). For example, the outer casing 20 of the head 12 remains unchanged and therefore has not been illustrated, to allow the other components to be viewed.

The first significant difference is that the pins 156 projecting upwardly from the filter bowl 14 of Fig.1 and the corresponding recesses 46 in the undersurface of the valve closure member 28 have been omitted. In the modification shown in Figs. 15 to 17, the collar 150 of the filter bowl 14” is also replaced with a toothed or splined annular collar 200, formed into eighteen identical teeth 202. The toothed collar is releasably engageable with a complementarily-shaped recess 204 on the inner face of a downwardly-depending annular cylindrical skirt portion 205 of the valve closure member 28”. The valve closure member retains the lower neck portion 54” of the arrangement of Fig. 1 (omitted from Figs, 15 to 17, for clarity), which carries the securing pegs 56a”, 56b” by means of which the filter bowl 14” is releasably securable to the head 12, with the securing pegs being received in recesses 164” of the mandrel 96” of the filter bowl 14”. However, the toothed or splined interconnection 200, 202, 204 ensures that as the filter bowl 14” is rotated between its secured and unsecured positions, the valve closure member 28” is rotated between its open and closed positions as described previously. This arrangement uses less space and spreads the forces more widely as compared with the arrangement of Fig. 1.

It will also be observed that the upper face of the valve closure member 28" is provided with a semicircular groove 206, just inward of the periphery of the valve closure member. A first end 208 of the groove 206 communicates with a filter bypass inlet port 210 in the outer side wall of the valve closure member and the opposite end 212 of the groove 206 communicates with a filter bypass outlet port 214 in the valve closure member, diametrically opposed to the bypass inlet port 210. The inner and outer upper peripheries are also formed into annular ribs 216, 218 which sealingly engage the undersurface of the end wall 22" of the outer casing 20" (preferably by means of annular seal, not shown) and which thereby prevents fluid from entering or leaving the groove other then via the filter bypass inlet and outlet ports 210, 214.

The bypass inlet and outlet ports 210, 214 are positioned on the valve closure member 28" so that when the valve closure member 28" is rotated to its closed position as described previously, namely the position in which fluid flow to and from the filter bowl 14" is cut off, to allow the filter bowl to be replaced, the ports 210, 214 are aligned with the inlet port 16 and the outlet port 18 respectively of the head 12. In this position, fluid is allowed to continue to flow through the filter bypass inlet port 210, a passageway formed by the semicircular groove 206 in the upper face of the valve closure member 28" and the undersurface of the end wall 22" of the casing 20", and the filter bypass outlet port 214.

Consequently, when the filter bowl 14" is removed for replacement, fluid is still allowed to flow through the system to which the head 12" is attached and there is no need to shut down the system in order to replace the filter.

The invention is not restricted to the details of the foregoing embodiments. For example, the push-fit connections in the inlet and outlet port may be replaced with threaded connections, welded connections or other types of connections.

CLAIMS

1. A filter assembly comprising a head portion comprising a housing having inlet means and outlet means for inlet and outlet of fluid respectively; and a filter portion releasably connectable to the head portion and being adapted to receive a flow of fluid from the inlet means and return it to the outlet means.

2. A filter assembly as claimed in claim 1, further comprising valve means within the housing displaceable between a first, closed position, and a second, open position, the filter portion being engageable with the valve means, in which condition the filter portion is displaceable with respect to the housing of the head portion between a first position in which the filter portion is disconnected from the head portion and disengageable from the valve means and a second position in which the filter portion is connected to the head portion, the displacement of the filter portion between the first and second portions causing the valve means to be displaced between its closed and open positions.

3. A filter assembly as claimed in claim 1 or claim 2, wherein each of the inlet means and outlet means comprises means for connecting to a pipe.

4. A filter assembly as claimed in claim 3, wherein each of the inlet means and outlet means comprises means for effecting a push-fit connection with a pipe.

5. A filter assembly as claimed in claim 3, wherein each of the inlet means and the outlet means comprises means for effecting a screw-threaded connection with a pipe.

6. A filter assembly as claimed in any of the preceding claims, wherein the valve means is sealed with respect to the housing of the head portion.

7. A filter assembly as claimed in any of claims 2 to 6, wherein the valve means further comprises a bypass inlet port, a bypass outlet port and passage means interconnecting the bypass inlet and outlet ports, the bypass inlet and outlet ports being aligned with, and communicating with, the inlet means and outlet means respectively when the valve means is in the first, closed position.

8. A filter assembly as claimed in claim 7, wherein the passageway is formed in an upper face of the valve means.

9. A filter assembly as claimed in any of claims 2 to 8, wherein the valve means is displaceable angularly with respect to the housing between the first and second positions.

10. A filter assembly as claimed in claim 9, wherein the valve means comprises a valve closure member displaceable through a predetermined angle between its closed and open positions.

11. A filter assembly as claimed in claim 10, wherein the valve closure member is displaceable through approximately 90°.

12. A filter assembly as claimed in claim 10 or claim 11, wherein the head portion further comprises support means on which the valve closure member is mounted.

13. A filter assembly as claimed in claim 12, wherein the support means is secured to the housing of the head portion.

14. A filter assembly as claimed in claim 12 or claim 13, wherein the support means extends out of the housing of the head portion.

15. A filter assembly as claimed in claim 14, wherein when the head portion and filter portion are connected, the support means extends into the filter portion.

16. A filter assembly as claimed in any of claims 12 to 15, wherein the support means is hollow.

17. A filter assembly as claimed in claim 16, wherein the support means communicates with the outlet means when the valve means is in the open position.

18. A filter assembly as claimed in claim 16, wherein when the head portion and filter portion are connected, the support means communicates with the interior of the filter portion.

19. A filter assembly as claimed in any of claims 2 to 8, wherein the valve means is displaceable linearly with respect to the housing between the first and second positions.

20. A filter assembly as claimed in any of the preceding claims, comprising interengaging means on the head portion and the filter portion for releasably connecting the head portion and filter portion.

21. A filter assembly as claimed in claim 20, wherein the interengaging means comprises one or more projections on one of the head portion and the filter portion receivable in one or more corresponding recesses on the other of the head portion and the filter portion.

22. A filter assembly as claimed in claim 21, wherein the one or more projecting portions are provided on the head portion.

23. A filter assembly as claimed in any of claims 20 to 22, wherein the interengaging means engage with a bayonet-type action.

24. A filter assembly as claimed in any of the preceding claims, wherein the head portion and the filter portion are releasably connectible in a sealing manner.

25. A filter assembly as claimed in any of the preceding claims, wherein the filter portion comprises one or more projections engageable with the valve means.

26. A filter assembly as claimed in any of the preceding claims, wherein the filter means comprises a filter housing.

27. A filter assembly as claimed in claim 26, comprising a plurality of filter components within the housing.

28. A filter assembly as claimed in claim 27, comprising a mandrel on which the plurality of filter components are mounted.

29. A filter assembly as claimed in claim 28, wherein the mandrel is hollow.

30. A filter assembly as claimed in claim 29, wherein when the head portion and filter portion are connected, the mandrel communicates with the support means of the head portion.

31. A filter assembly as claimed in any of claims 26 to 30, comprising magnetic filtration means.

32. A filter assembly as claimed in any of claims 26 to 31, comprising cyclone means for inducing a helical motion in fluid.

33. A filter assembly as claimed in any of claims 26 to 32, comprising filter screen means.

34. A filter assembly comprising an inlet and an outlet for inlet and outlet of fluid respectively and filter means adapted to receive a flow of fluid from the inlet means and return it to the outlet means, the filter means comprising means for inducing a helical motion of fluid flowing from the inlet to the outlet.

35. A filter assembly as claimed in claim 34,wherein the means for inducing a helical motion of fluid interacts with the flowing fluid to induce the helical motion.

36. A filter assembly as claimed in claim 34 or claim 35, wherein the means for inducing a helical motion of fluid is static.

37. A filter assembly as claimed in any of claims 34 to 36, wherein the means for inducing a helical motion of fluid comprises a plurality of blades.

38. A filter assembly as claimed in claim 37, wherein each of the blades is part-helical in shape.

39. A filter assembly as claimed in claim 37 or claim 38, further comprising a support from which the blades project radially.

40. A filter assembly as claimed in claim 39, wherein the blades project radially outwardly.

41. A filter assembly as claimed in any of claims 37 to 41, wherein the blades decrease in width along the flow direction of the blades.

42. A filter assembly as claimed in any of claims 32 to 37, further comprising a housing in which the means for inducing helical motion of fluid is secured.

43. A filter assembly as claimed in claim 42, wherein the housing comprises sump means downstream of the means for inducing a helical motion of fluid.

44. A filter assembly as claimed in any of claims 34 to 43, further comprising filter means located downstream of the means for inducing a helical motion of fluid.

45. A filter assembly as claimed in claim 44, wherein the filter means located downstream of the means for inducing a helical flow of fluid comprises barrier filter means.

46. A filter assembly as claimed in any of claims 42 to 45, further comprising filter means secured in the housing upstream of the means for inducing a helical motion of fluid.

47. A filter assembly as claimed in claim 46, comprising magnetic filter means secured in the housing upstream of the means for inducing a helical motion of fluid.

48. A filter assembly as claimed in any of claims 42 to 47, further comprising a head portion having inlet means and outlet means for inlet and outlet of fluid respectively.

49. A filter assembly as claimed in claim 48, wherein the housing is removably securable to the head portion.

50. A filter assembly comprising an inlet and an outlet for inlet and outlet of fluid respectively and filter means adapted to receive a flow of fluid

from the inlet means and return it to the outlet means, the filter means comprising magnetic filtration means arranged in series with a barrier filtration means.

51. A filter assembly as claimed in claim 50, further comprising a housing in which the filter means is secured.

52. A filter assembly as claimed in claim 51, further comprising a head portion in which the inlet and outlet are provided.

53. A filter assembly as claimed in claim 52, wherein the housing is releasably securable to the head portion.

54. A filter assembly substantially as herein described, with reference to and as illustrated in the accompanying drawings.

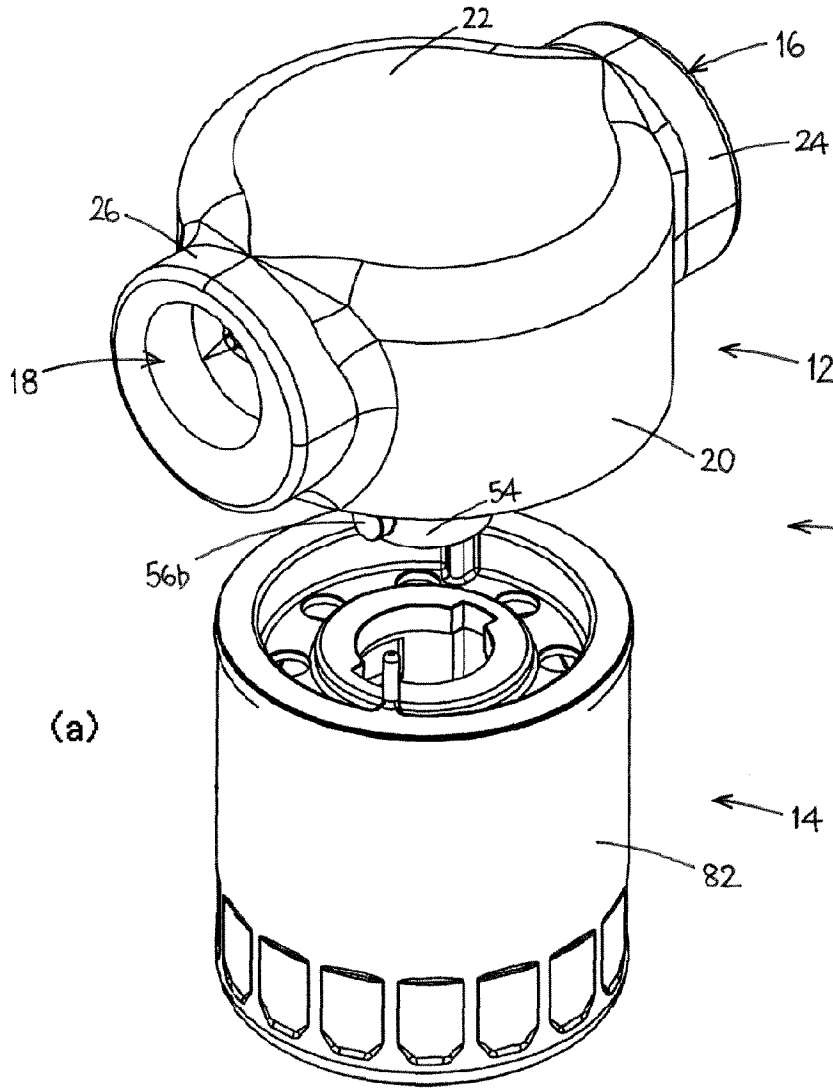
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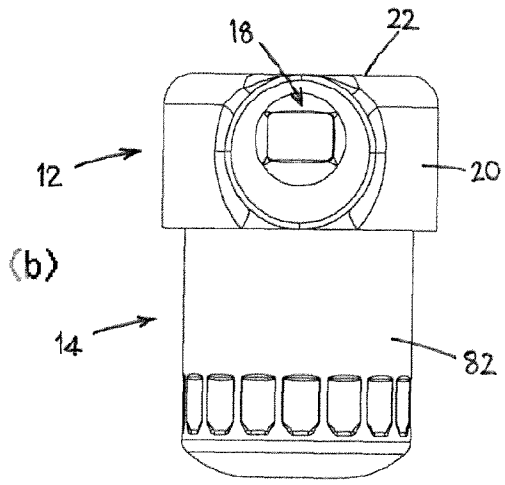
Fig. 1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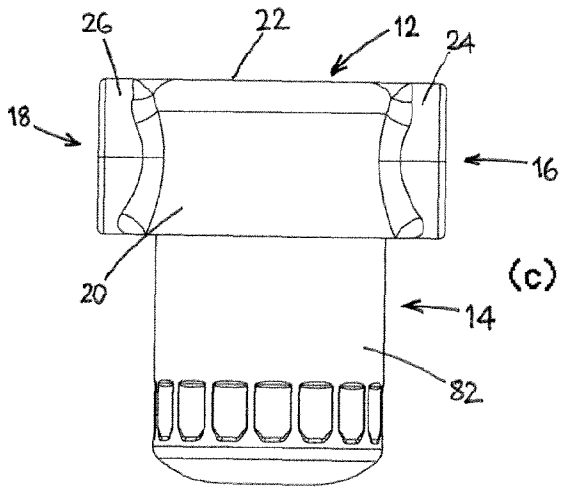
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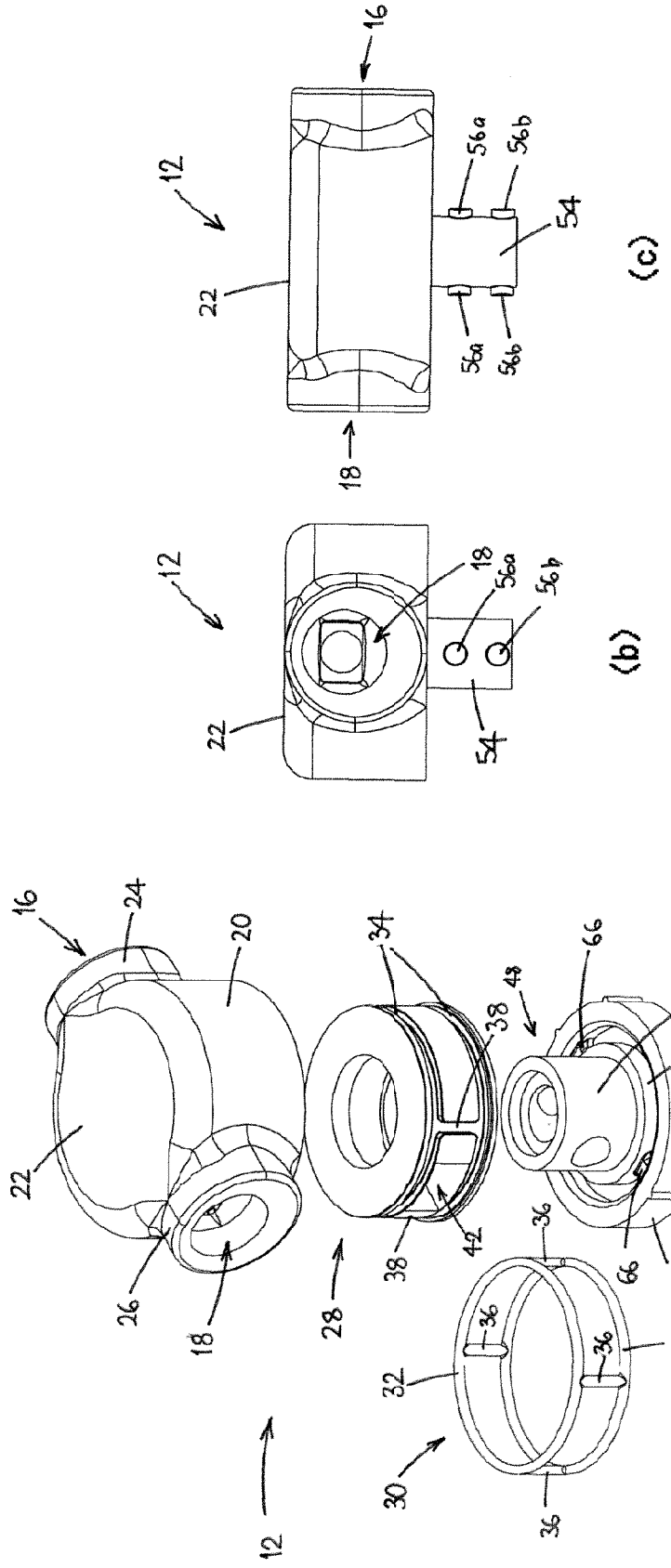
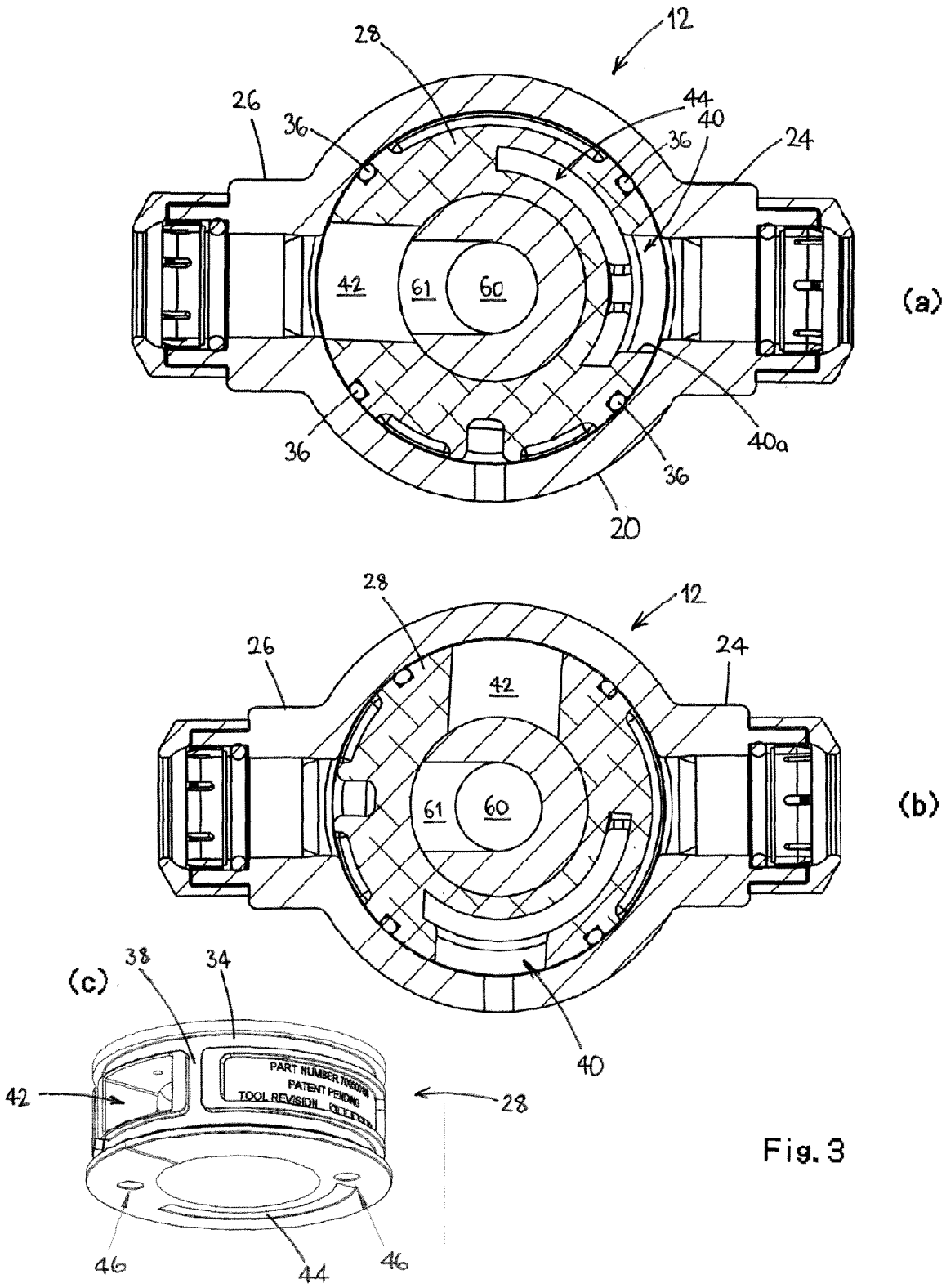


Fig. 2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PART NUMBER
PATENT PENDING
TOOL REVISION
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Fig. 3

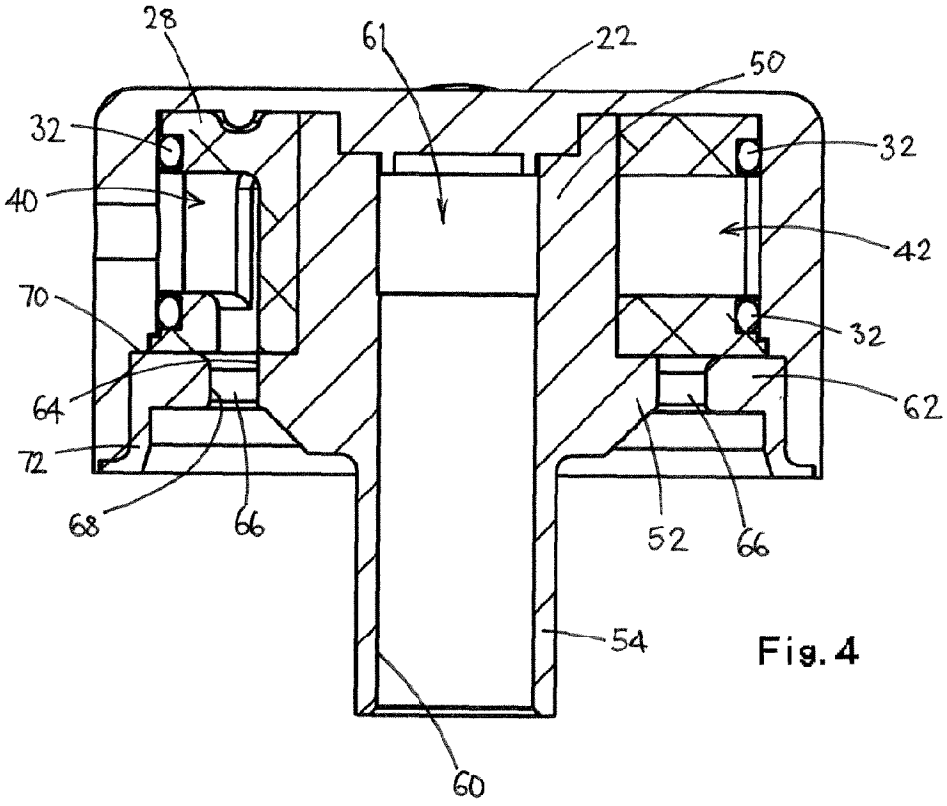
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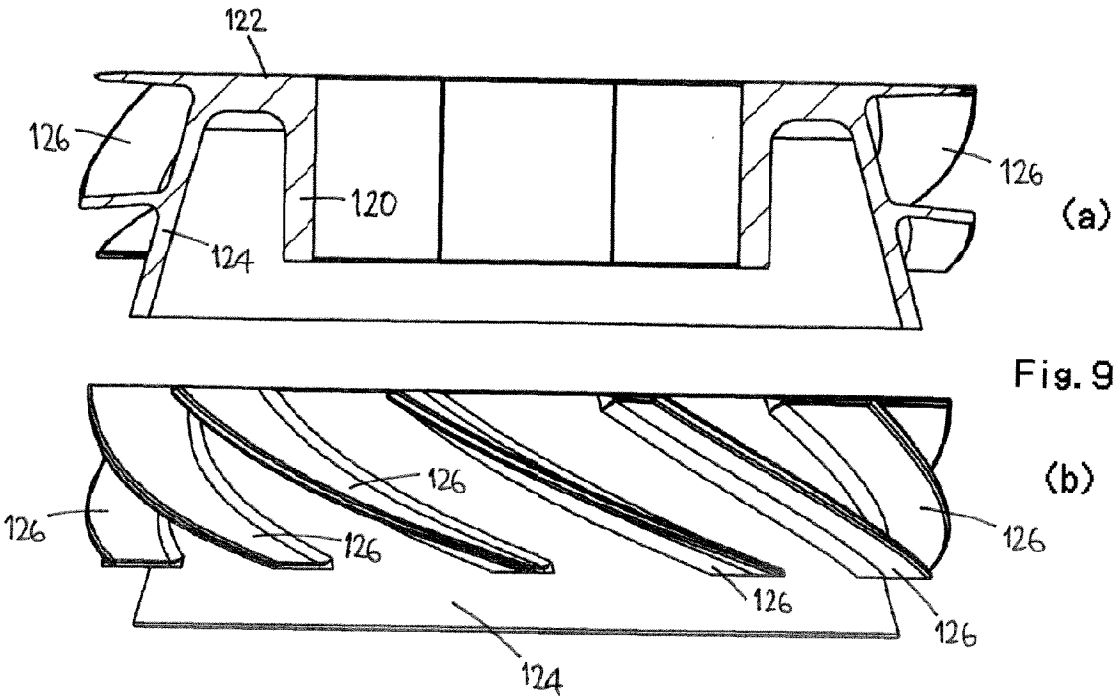
Fig. 4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(b)

Fig. 9

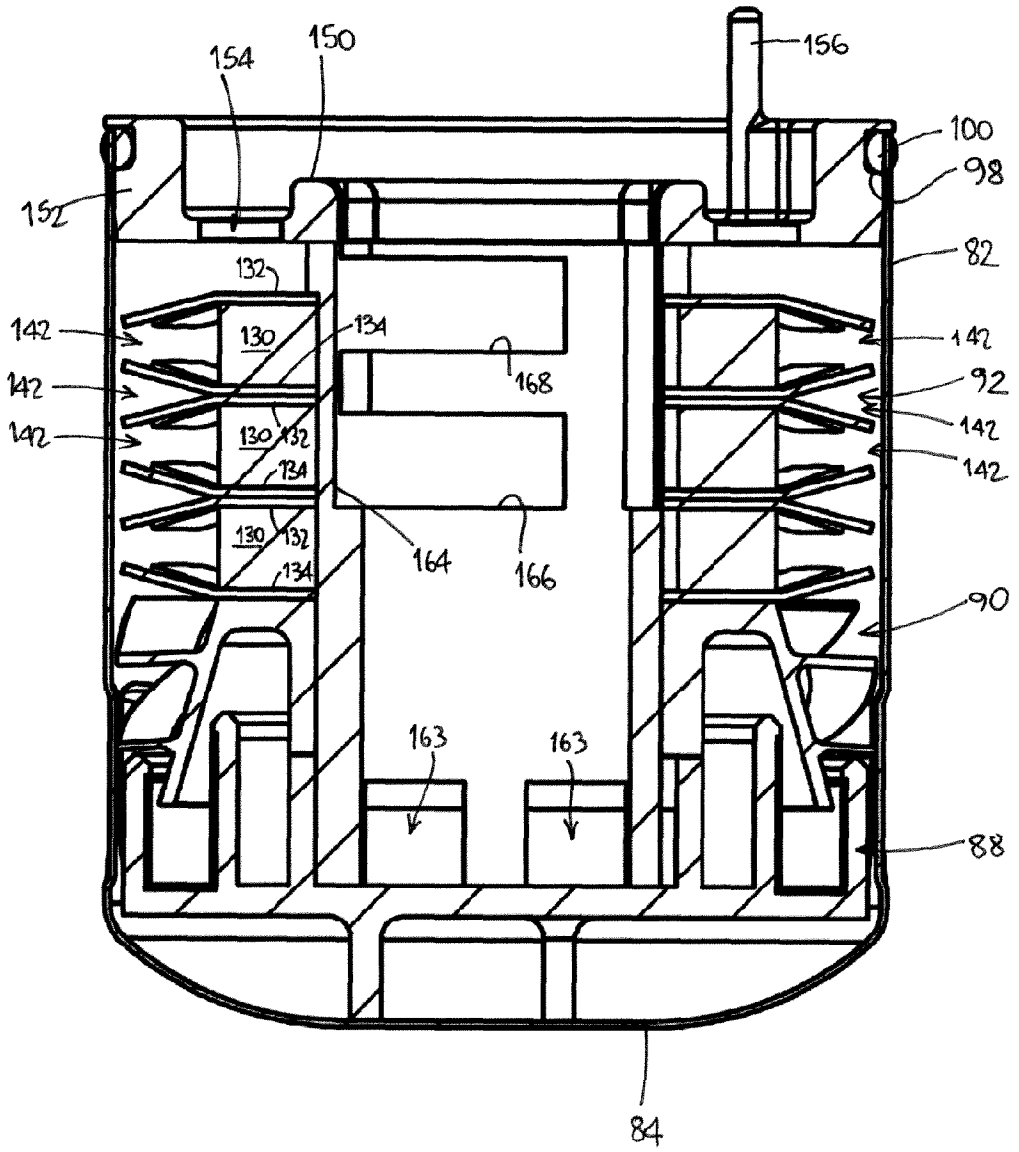
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Fig. 5

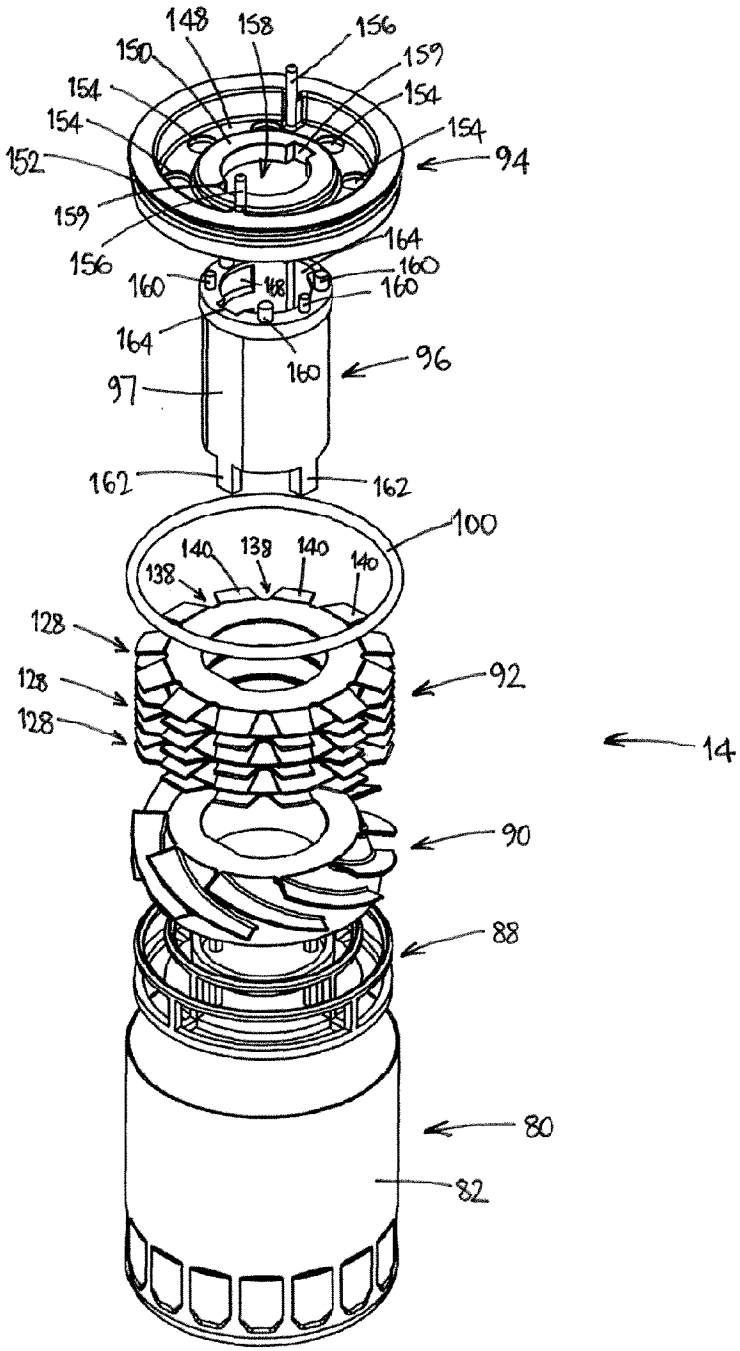
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Fig. 6

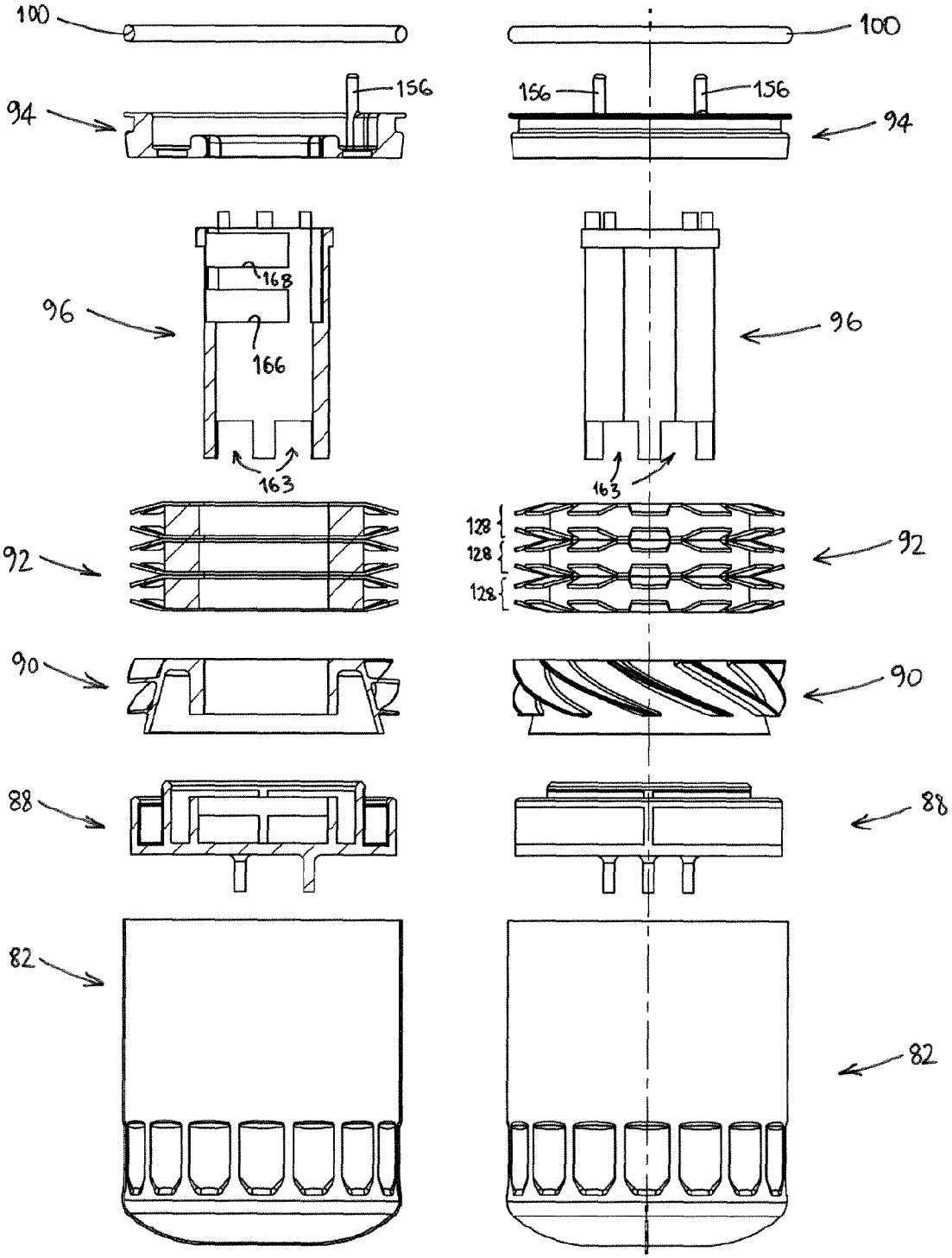
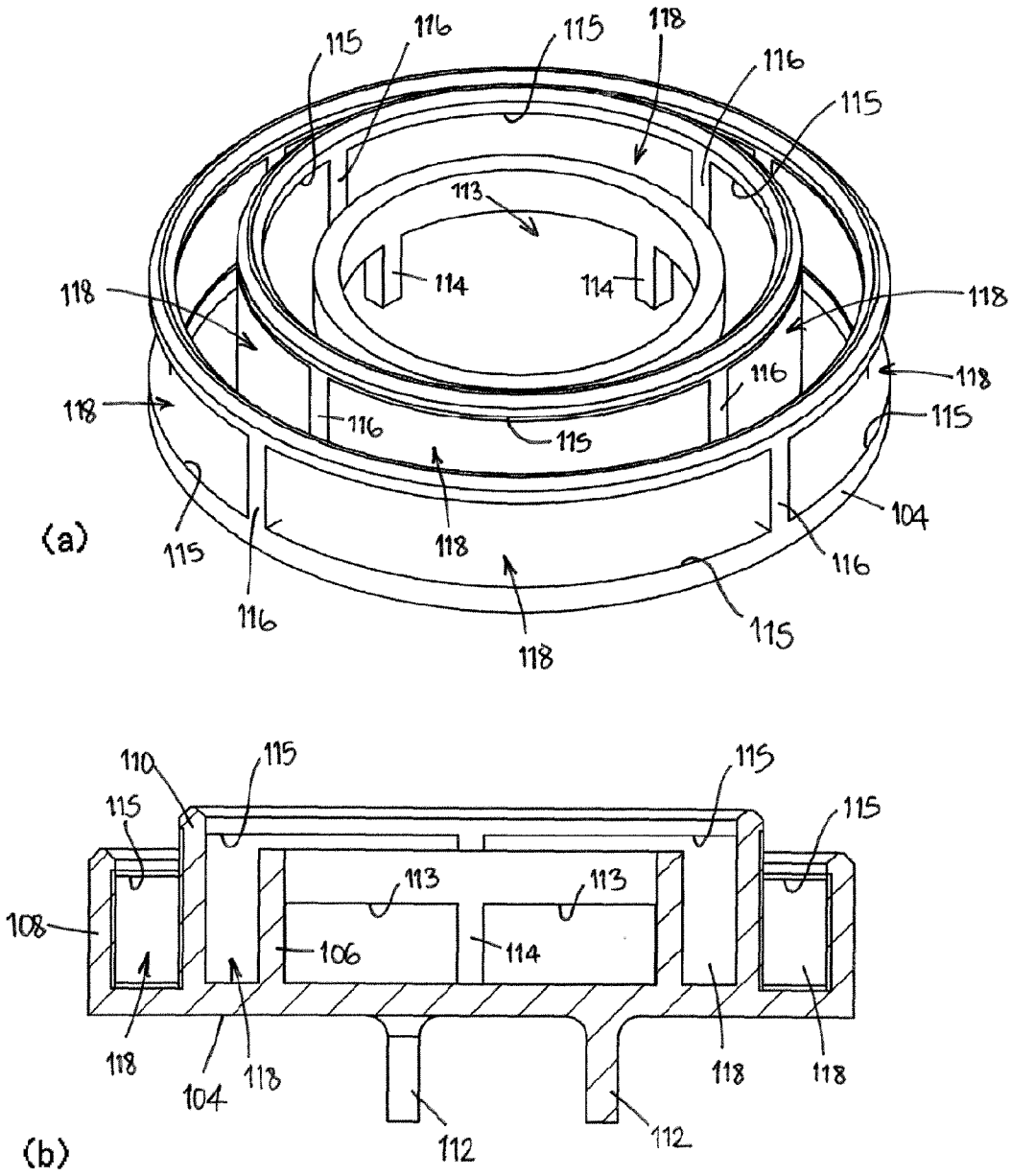


Fig. 7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(b)
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Fig. 8

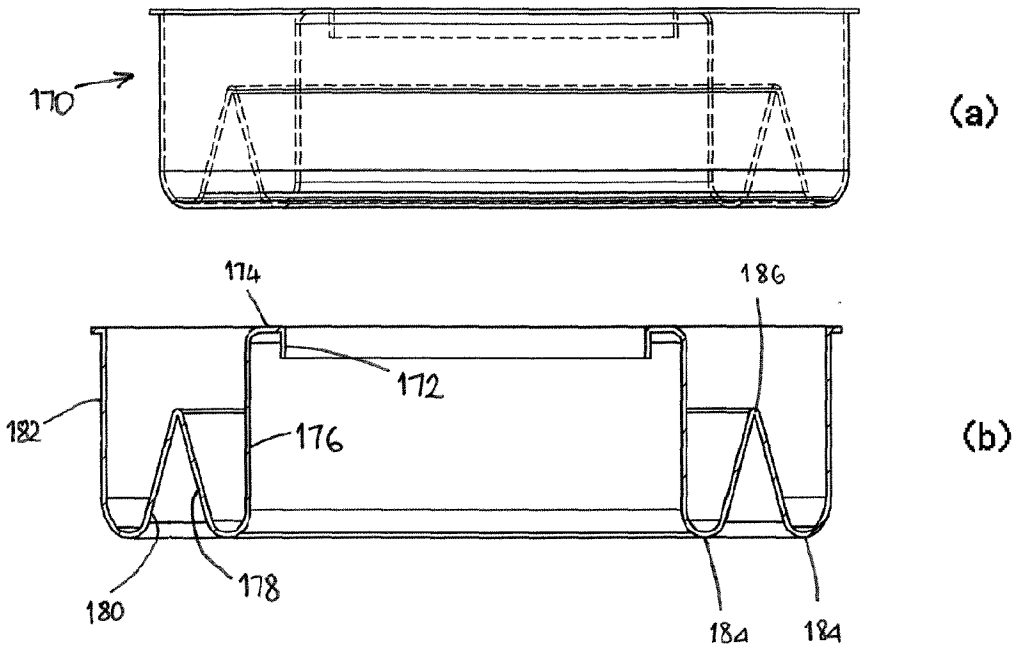
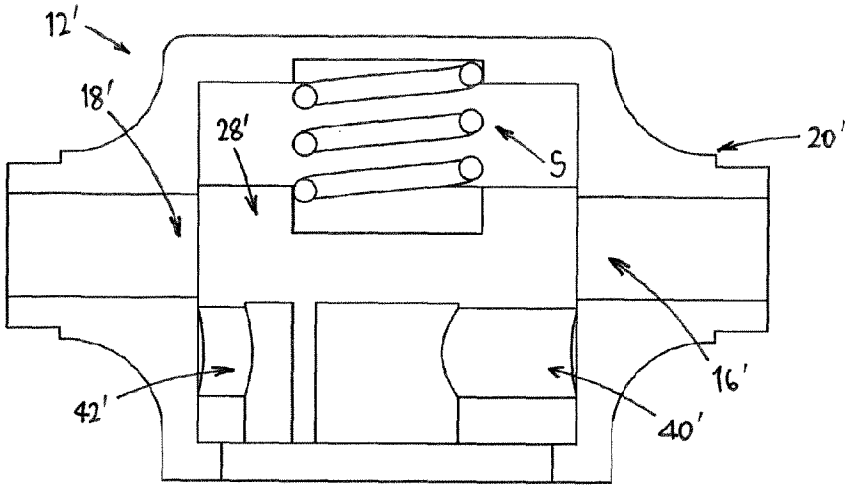
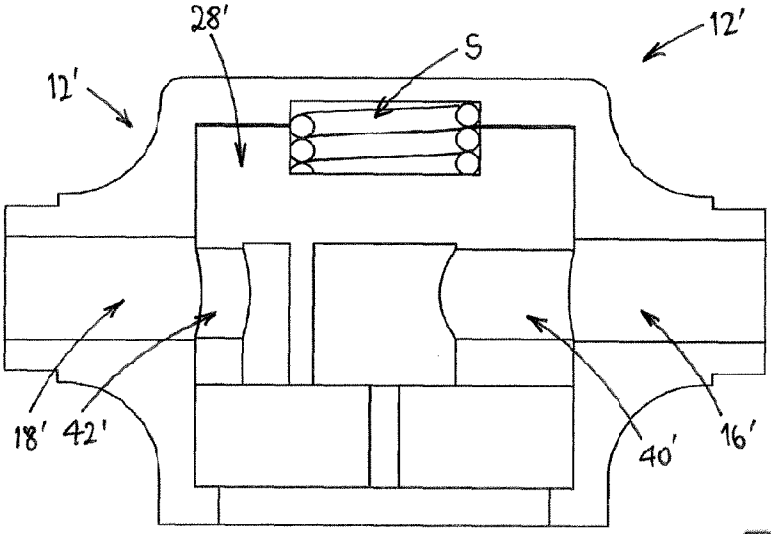


Fig. 10



(a)

Fig. 11



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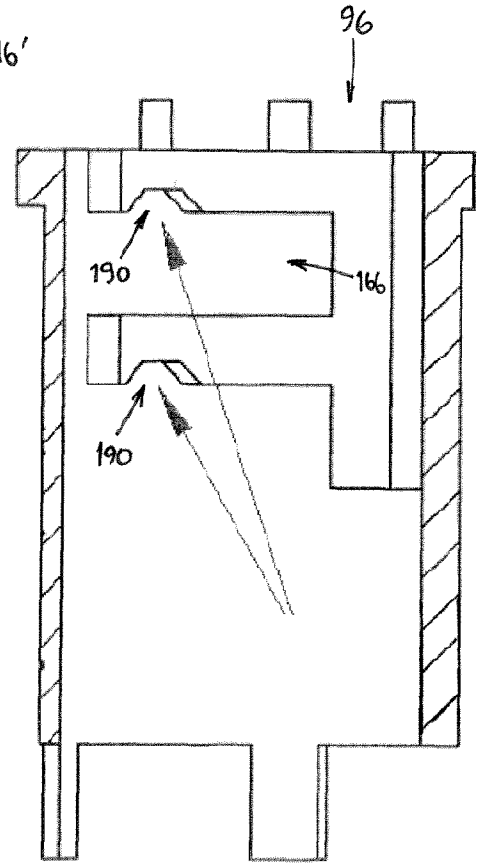
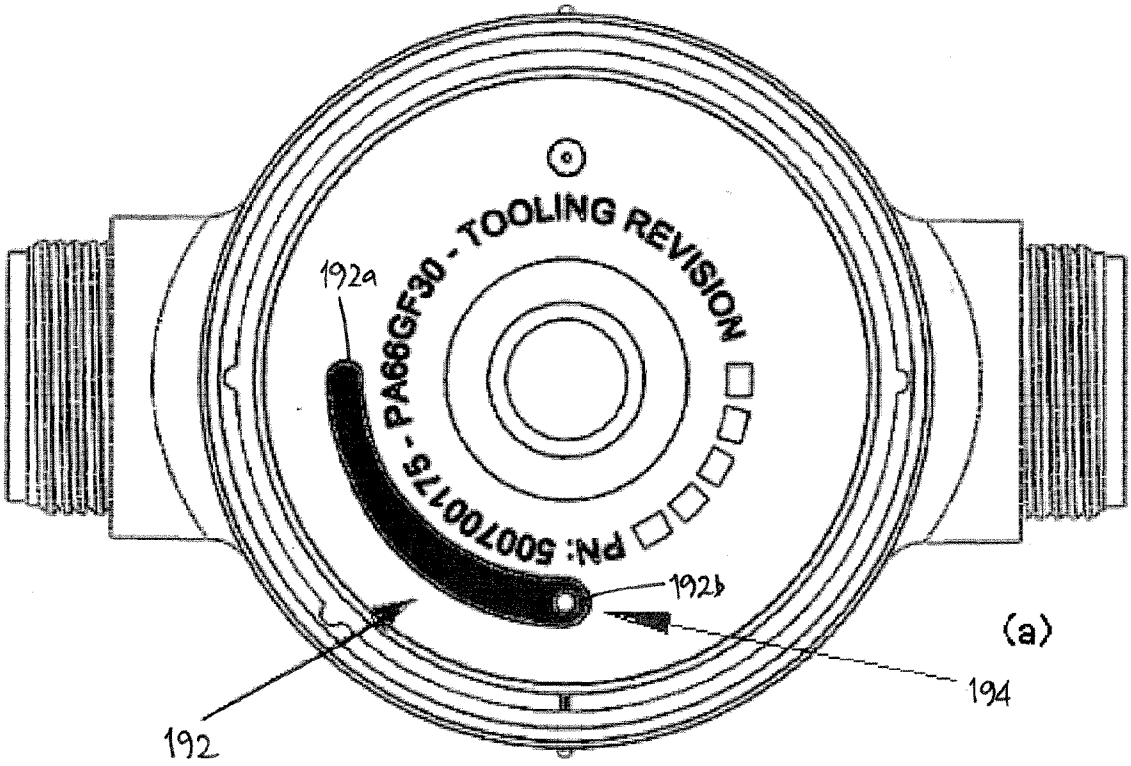


Fig. 12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(a)
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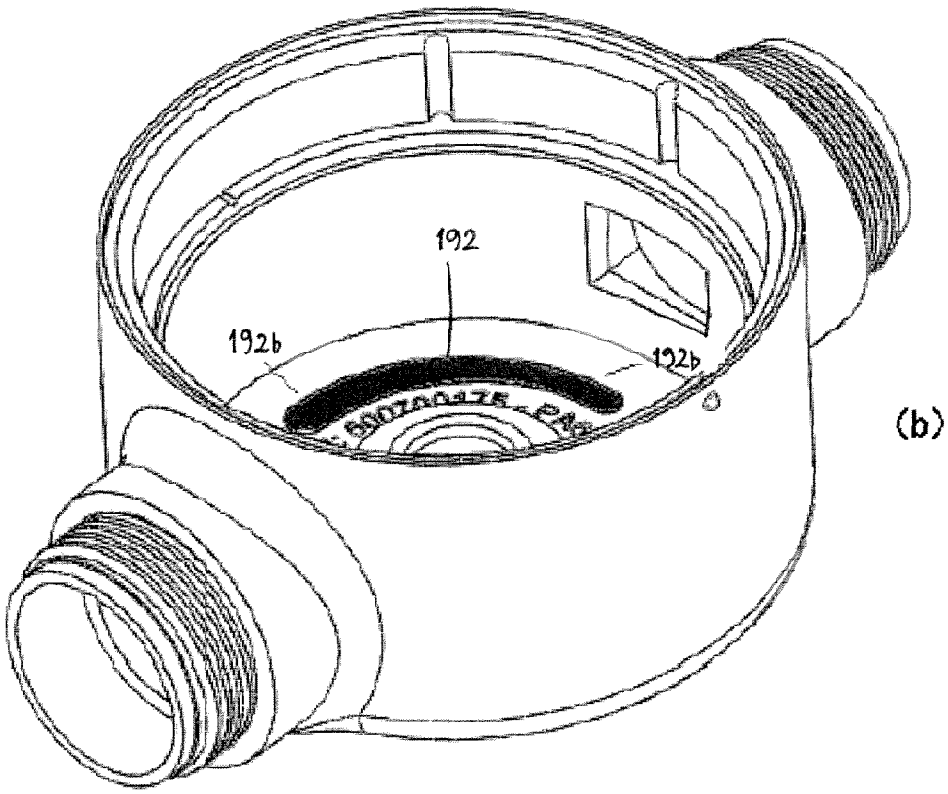
Fig. 13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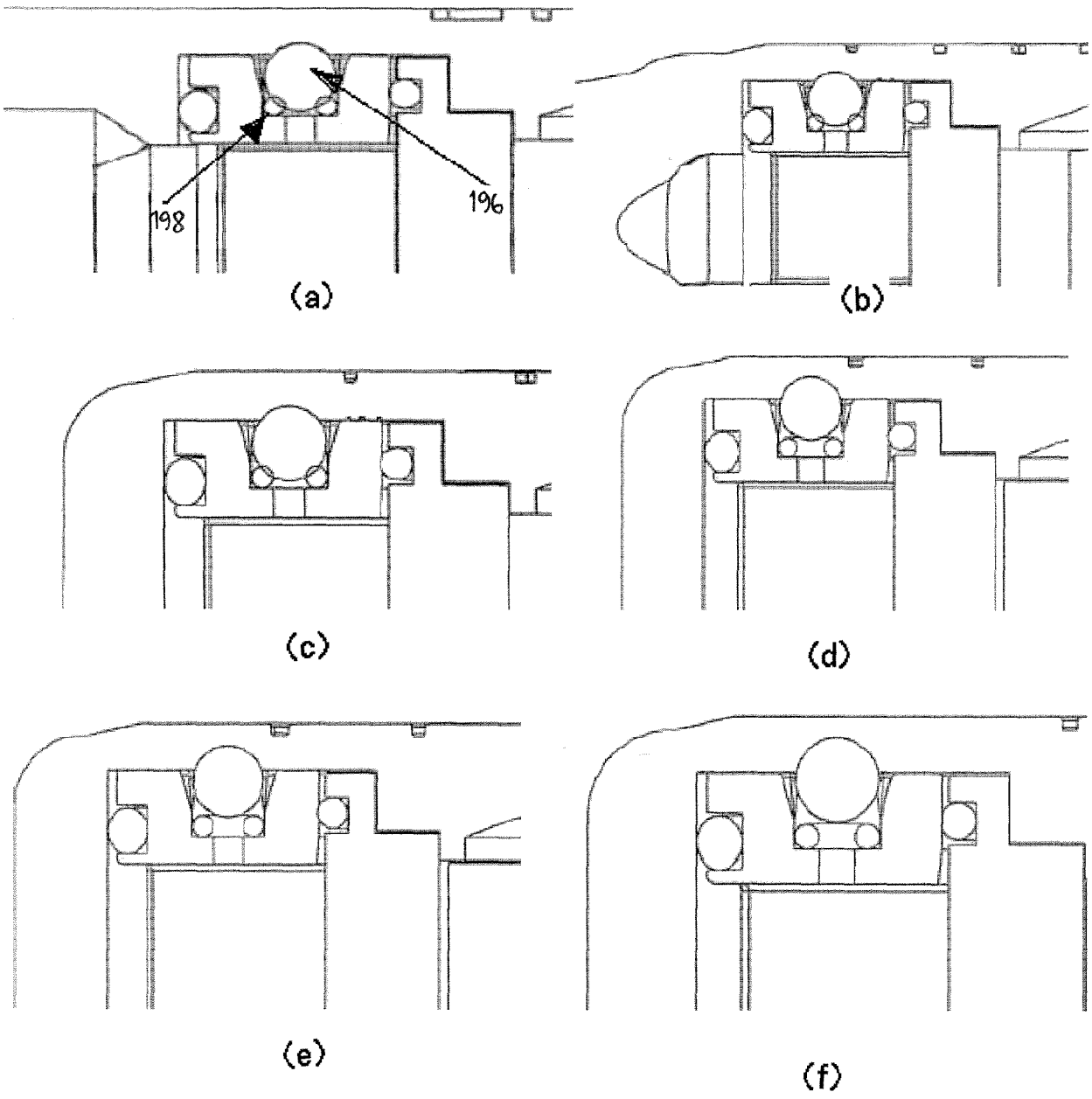

Fig. 14

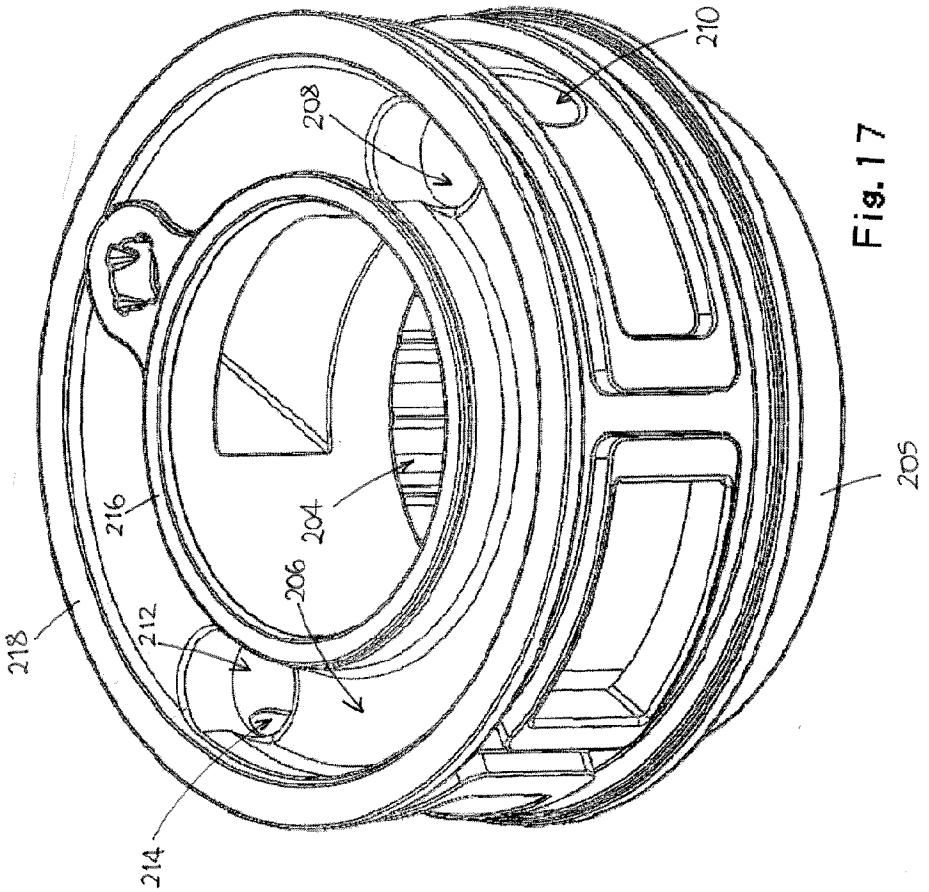

Fig. 17

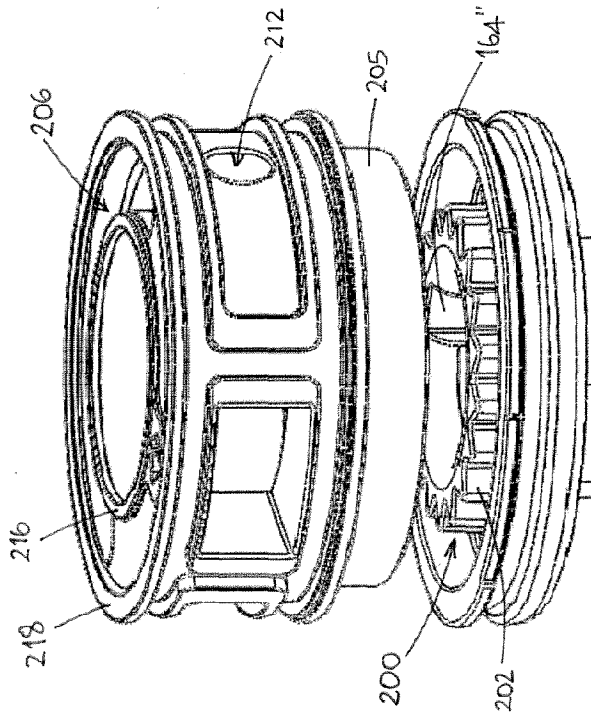

Fig. 15

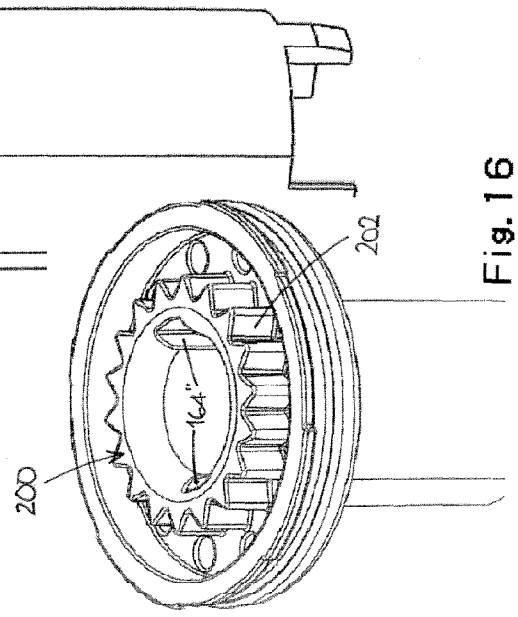

Fig. 16