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CA 2425287 A1 2002/04/18

(21) 2 425 287

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2001/10/11
(87) Date publication PCT/PCT Publication Date: 2002/04/18
(85) Entrée phase nationale/National Entry: 2003/04/10
(86) N° demande PCT/PCT Application No.: DE 2001/003861
(87) N° publication PCT/PCT Publication No.: 2002/031333
(30) Priorité/Priority: 2000/10/12 (100 50 393.4) DE

(51) Cl.Int.^{7}/Int.Cl.^{7} F02D 9/10, F16K 1/22
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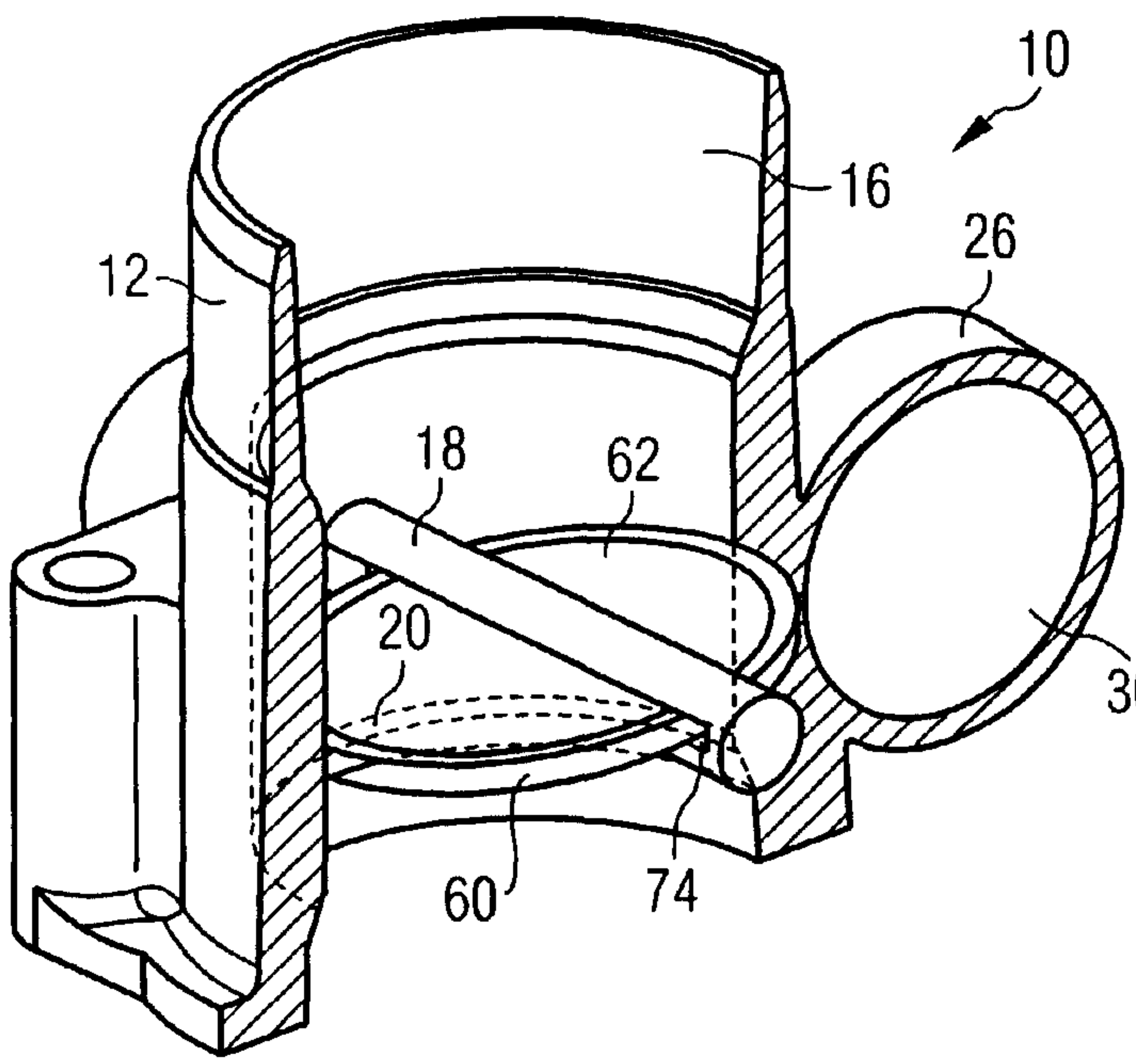
(54) Title: THROTTLE-VALVE



(57) Abrégé/Abstract:
The invention relates to a throttle-valve assembly (10) comprising a housing (12) that has a throttle opening, through which a gaseous medium (70) can flow in a main direction of flow (72) and which has an approximately cylindrical cross-section (16). According to the invention, a throttle-valve (20, 80), which is pivotally mounted on a throttle-valve shaft (18), is arranged inside the throttle opening (16), and the throttle-valve shaft (18) can be displaced by an actuator (30) arranged inside the housing (12). The inventive throttle-valve assembly should comprise a throttle-valve (20, 80), which has a particularly high degree of strength and a particularly low tendency towards wearing. To this end, the throttle-valve (20, 80) is provided with a ring-like first area (60), which radially encircles at least in part and which is comprised of a first material (66), and with a radial second area (62), which is approximately circular and which is comprised of a second material (68), whereby the first area (60) at least partially encircles the second area (62), and the first material (66) of the throttle-valve (20, 80) has a greater degree of strength than that of the material (68) of the throttle-valve (20, 80).

Abstract

Throttle valve assembly (10) comprising a housing (12), that has the throttle opening through which a gaseous medium (70) can flow in a main direction of flow (72) and which is of an approximately cylindrical cross section (16), a throttle valve (20, 80) that is pivotally mounted on a throttle valve shaft (18) being arranged inside the throttle opening (16), the throttle valve shaft (18) being adjustable by means of an actuator (30) that is arranged within the housing (12), should comprise a throttle of (20, 80) which has a particularly high degree of strength and a particularly low tendency towards wearing. To this end, the throttle valve (20, 80) is provided with a ring-like first area (60) which radially encircles at least in part and is of a first material (66) and with a radial second area (62), which is approximately circular and which is of a second material (68), the first area (60) encircling at least in part this second area (62), this first material (66) of throttle valve (20, 80) having a greater degree of strength than the second material (68) of the throttle valve (20, 80).

Figure 2

Throttle Valve Assembly

The present invention relates to a throttle valve assembly that comprises a housing that has a throttle opening through which a gaseous medium can flow in a main direction of flow and which has an approximately cylindrical cross section; a throttle valve that is secured to a throttle valve shaft so as to be able to pivot is arranged in the throttle opening, and this throttle valve shaft can be displaced by an actuator.

Throttle the valve assemblies are usually used to control the quantity of fresh gas that is supplied to a motor vehicle. Throttle valve assemblies comprise a housing with a throttle opening and a throttle element that is arranged within the throttle opening. The throttle element assumes a particular position within the throttle opening in order to permit passage of a specific quantity of fresh gas. To this end, the throttle element can be controlled either mechanically or electronically.

The housings for throttle valve assemblies are usually manufactured from plastic or metal. Throttle valve assembly housings that all of metal, for example, aluminum, can be manufactured very precisely and for this reason can be made to within very small tolerances. Such small tolerances are required for a throttle valve assembly, in particular, in the area of the throttle valve itself if the quantity of flow medium passing through the throttle opening of the throttle valve assembly is to be varied by a particularly small movement of the throttle valve. In the closed area of the throttle valve, these requirements are also referred to as leakage air requirements. However, metal housings for throttle valve assemblies entail the disadvantage that costly secondary processing of the housing is usually required once the housing has been manufactured, for example, by die casting. For example, secondary machining of housings that are of aluminum is required in order to ensure the functional requirements that are associated with the interior and the exterior of the housing. Such functional requirements are, in particular, the throttle opening, the receiver for the actuator, and the distances between the centres of the gearing. Precise machining of the bearing seat is usually required as well, since the correct operating (bearing) clearance in the needle roller bearing is arrived at by the press fit.

Throttle valve assembly housings that are of plastic weigh less than the housings for throttle valve assemblies that are manufactured essentially from metal, and in particular from aluminum. In addition, plastic can be matched very simply to the most varied geometrical forms of the housing. In the case of plastic housings that are manufactured by an injection molding process, inserts such as those used for the bearings that support the throttle valve shaft can be molded into the housing.

Throttle valves that are of a diameter of up to 90 mm or more are not as strong as those that are of a diameter of only up to 40 mm. For this reason, in the case of a throttle valve that is of a particularly large diameter, much more gaseous medium--so called leakage air--will pass through the throttle opening than is the case with a throttle valve that is of a diameter that is relatively small in comparison. Thus, the lesser strength of a throttle valve with a comparatively large diameter also means that the passage of gaseous medium through the throttle opening cannot be controlled as precisely as in the case of a throttle valve that is of a comparatively smaller diameter. In addition, throttle valves that are of a particularly large diameter tend to wear much quicker than throttle valves that are of a particularly small diameter, comparatively speaking, because they are not so strong.

For this reason, it is the objective of the present invention to describe a throttle valve assembly of the type described heretofore, the throttle valve of which is particularly strong and which, at the same time, displays a particularly small propensity to wear.

According to the present invention, this objective has been achieved in that the throttle valve has a ring-like area of a first material that encloses it radially, at least in part, and a second radial area that is of a second metal, that is approximately circular, the first area enclosing the second area, at least in part, the first material of the throttle valve being of greater strength than the second metal of the throttle valve.

The present invention proceeds from the idea that a throttle valve that is very strong and has a very low propensity to wear should be additionally reinforced. However, because of economic considerations, the throttle valve should be producable according to a standard. In order to permit additional stabilization without incurring any additional costs, one additional measure should be sufficient to impart the required additional rigidity to it. Calculations have shown that the throttle valve will have a particularly high degree of rigidity if it incorporates a first and a second area, the first area of the throttle valve being additionally reinforced. To this end, the first area of the throttle valve is of a first material that is more rigid than the material used for the second area of the throttle valve.

More advantageously, the first area is an outer area, and the second area is an inner area. An outer, first area can, for example, be additionally arranged on the throttle valve. Because of this outer and inner area of the throttle valve, it is particularly simple to produce areas that are of different strength .

The second area is more advantageously divided into a circular area and an edge area, the first area being arranged between the circular area and the edge area of the second area. Because of the approximately ring-shaped first area, the throttle valve is particularly rigid, even at particularly large diameters, the edge area of the throttle valve remaining unchanged.

It is advantageous that, in the first area, the throttle valve is not as thick as it is in the second area. With a comparatively lesser first thickness D1 in the first area, and a second thickness D2 in the second area of the throttle valve, proceeding from the closed position of the throttle valve, it is possible to influence the passage of gaseous medium through the throttle opening by a small movement of the throttle valve shaft and thus of the throttle valve. In a particularly reliable way, this ensures very finely graduated control of the quantity of gaseous medium passing through the throttle opening.

It is advantageous that the first area and the second area of the throttle valve be formed in one piece from one material, the first material of the throttle valve in the first area being compressed material and the second material of the throttle valve in the second area being uncompressed material. Compressed materials usually possess a higher degree of strength or rigidity than materials that are not compressed. In order to impart a higher level of strength to the first area than to the second area, the first area of the throttle valve is compressed in an additional step of the manufacturing process. The thickness D1 can then be impressed into the throttle valve. It is possible to guarantee particularly great strength for the first area of the throttle valve in a simple and economical manner by using an impressing method.

It is advantageous that the material used for the throttle valve be metal, in particular aluminum. Aluminum is easy to machine and can be well compressed because it is soft.

In order that the throttle valve shaft can be secured to the throttle valve shaft, the shaft incorporates a slot, the throttle valve that is installed through the slot then projecting from the throttle valve shaft on both sides of the slot, so that a subarea of the surface of the throttle valve is enclosed by the throttle valve shaft in the slot. It is advantageous if the first area is interrupted by the subarea. Because of this, the throttle valve is reliably secured in the slot of the throttle valve shaft, and thus has a first area that is of increased strength, which ensures an especially long service life for the throttle valve.

The advantages that can be gained by the present invention are such that as a result of the additional reinforcement of the first area of the throttle valve, the throttle valve will have a high degree of strength and will be particularly resistant to wear. This ensures that even during a particularly long service life of throttle valve assembly, its characteristic curve will remain unchanged for all intents and purposes.

One embodiment of the present invention will be described in greater detail below with reference to the drawings appended hereto. These drawings show the following:

Figure 1: A diagrammatic view of a throttle valve assembly in cross section;

Figure 2: A diagrammatic view of the throttle valve assembly as in Figure 1, in longitudinal section;

Figure 3: A diagrammatic view of a throttle valve assembly as in Figure 1, in a perspective longitudinal cross section;

Figure 4: A diagrammatic view of a throttle valve as shown in Figure 1, Figure 2, and Figure 3 as a first embodiment;

Figure 5: A diagrammatic view of a part of the throttle valve assembly as shown in Figure 1, Figure 2, Figure 3;

Figure 6: A diagrammatic view of a second embodiment of a throttle valve.

Those parts that correspond to each other are shown with the identical reference numbers in all of the drawings

The throttle valve assembly 10 that is shown in Figure 1 is used to supply air or air-fuel mixture to a consumer (not shown herein), for example, to a fuel injection device of a motor vehicle (not shown herein), the quantity of fresh gas that is supplied to the consumer being controlled by means of the throttle valve assembly 10. To this end, the throttle valve assembly 10 has a housing 12 that is manufactured from metal 14; in this embodiment, this is aluminum. Alternatively, the housing 10 can be manufactured from plastic, using an injection-molding process. The housing 12 includes a continuous throttle opening 16 which is of approximately cylindrical cross section 17. The consumer (not shown herein) can be supplied with air or an air-fuel mixture by way of the throttle opening 16.

A throttle valve 20 is arranged on the throttle shaft 18 so as to adjust the volume of fresh gas that is to be supplied to the consumer. The throttle valve 20 is of a material 22 that in this embodiment is a metal 24, more particularly aluminum. Rotation of the throttle valve shaft 18 simultaneously pivots the throttle valve 20 that is arranged on the throttle valve shaft 18, so that the active cross section of the throttle opening 16 is either enlarged or reduced. Regulation of the throughput of air or air-fuel mixture through the throttle opening 16 of the throttle valve assembly 10 is effected by enlarging or reducing the active cross section of the throttle opening 16 by means of the throttle valve.

The throttle valve shaft 18 can be connected to a pulley (not shown in greater detail herein) that is, in its turn, connected by a Bowden cable to device for adjusting the power requirement. The adjusting device can be the gas pedal of a motor vehicle, so that when the driver of the vehicle operates this adjusting device the throttle valve 20 can be moved from a minimally open position, in particular from a closed position, to a maximally open position, in particular an open position, so as to control the power output of the motor vehicle.

In contrast to the foregoing, the throttle valve shaft of the throttle valve assembly 10 can be adjusted either through part of its range by an actuator and additionally by way of the gas pedal, or else the throttle valve 20 can be adjustable over its whole adjustment range by an actuator. In the case of this so-called E-gas or drive-by-wire system, mechanical control of the power output , for example, pressure on the gas pedal, is converted into an electrical signal. This signal is passed to a control unit that then generates a triggering signal for the actuator. In this system, during normal operation there is no mechanical connection between the gas pedal and the throttle valve 20.

For this reason, in order to adjust the throttle valve shaft 18, and thereby the throttle valve 20, the throttle valve assembly 10 has a drive housing 26 and a gearing housing 28. The drive housing 26 and the gearing housing 28 are made in one piece with the housing 12 of the throttle valve assembly 10; they can also form a separate structural unit, or each of them alone can also be made in one piece. An actuator 30 that is in the form of an electric motor is arranged in the drive housing 26. Within the gearing housing 28 there is a position sensing device 32 and gearing 34. The actual position of the throttle valve shaft 18 can in each instance be detected by the position sensing device. The gearing 34 is in the form of a reduction gearing and is used to transfer the rotary movement of the actuator 30 that is in the form of an electric motor to the throttle valve shaft 18. The position sensing device and the gearing 34 are not shown in greater detail in the drawings.

The actuator 30 that is in the form of an electric motor is triggered by a control unit (not shown herein). The control unit sends a signal to the actuator 30 that is in the form of an electric motor, by means of which signal the gearing 34 that is configured as a reduction gearing adjusts the throttle valve shaft. The actual position of the throttle valve shaft 18 is detected by the position sensing device. The position sensing device is in the form of a potentiometer, the slide of which is connected to the throttle valve shaft.

The throttle valve shaft is supported in bearings that are arranged on both sides of the throttle opening 16, within the housing 12. The throttle valve shaft 18 ends at one end—in Figure 1, on the left-hand side—in a space 48 in which a spring system with so-called return springs and/or emergency running springs can be accommodated. Alternatively, the return springs and/or the emergency running springs can be accommodated in the area in which the return springs and/or the emergency running springs are arranged. The return springs and/or the emergency running springs of the spring system hold the throttle valve shaft 18 in the closed position, so that the actuator, in the form of an electric motor, works against the force of the return springs and/or of the emergency running springs. A so-called return spring and/or an emergency running spring functions in such a way that in the event that an actuator 30 that is in the form of an electric motor should fail, the throttle valve 20 will be moved into a defined position that is usually above the idling speed.

Alternatively, or in addition to this, the throttle valve shaft 18 can extend out of the housing 12 of the throttle valve assembly, beyond the space 48. It is then possible to install, for example, a pulley (not shown herein) on the end of the throttle valve shaft 18; this pulley is connected through a Bowden cable to the gas pedal, so that a mechanical nominal value can be preset. In an emergency situation, this mechanical coupling of the throttle valve shaft 18 to the gas pedal (not shown herein) can ensure operation of the throttle valve assembly 10 in the event that, for example, the actuator should fail. Additional elements can also be arranged on the housing 12, and these can be used to accommodate additional parts such as, for example, stub shafts for gear wheels or toothed gear quadrants of the gearing system (not shown herein) that is configured as a reduction gearing system. Other elements of the throttle valve assembly can also be arranged in the space 48.

The housing 12 of the throttle valve assembly 10 can be closed off by a housing cover 50. To this end, the housing 12 of the throttle valve assembly 10 has a peripheral stepped rim

52 in the direction of the housing cover 50, and this rim matches a peripheral edge 54 on the housing cover 50. The rim 52 and the edge 54 ensure that the housing cover is properly positioned on the housing 12. The housing cover 50 is cemented to the housing 12. Alternatively, the housing cover 50 can be snapped onto the housing 12 or securely attached to this in another way. In addition, the housing 12 incorporates flange lugs 12 for the attachment of elements that are arranged outside the throttle valve assembly 10; these lugs are made in one piece with the housing 12.

When the throttle valve assembly 10 is operated, the throttle valve shaft 18 is rotated by means of the actuator 30 that is in the form of an electric motor. When this happens, the throttle valve 20 that is secured to the throttle valve shaft 18 leaves more or less of the throttle opening unobstructed, which means that the quantity of fresh gas that is to be supplied to the internal combustion engine can be controlled. In order that the throttle valve 20 has a particularly high level of strength for this function, the throttle valve 20 is divided into a first area 60 that is at least approximately ring-shaped in part, and an approximately circular second area 62, as well as a subarea 64. The first area 60 encloses the second areas 62, at least in part.

The first area 60, the second area 62, and the subarea 64 are made in one piece and manufactured from the material 22 that is a metal 24. In this particular embodiment, the metal 24 is aluminum. The first area 60 is made of a first material 66 that is a compressed metal 24, which is to say compressed aluminum. The second area 62 is manufactured from a second material 68 that is uncompressed metal 24, which is to say uncompressed aluminum. This means that the first material 66 used for a throttle valve 20 is harder than this second material 68 used for the throttle valve 20. The subarea 64 is similarly manufactured from the second material 68. Because it is a section drawing, Figure 1 does not show the subarea 64.

During the manufacturing process, the throttle valve 20 is cut from a piece of aluminum, usually inclined at an angle relative to the piece of aluminum. Next, the first area 60 is impressed into the throttle valve 20 by a pressing process. Because of this, the second area 62 and the subarea 64 are of a material 22 that is uncompressed metal, and the first area 60 is of a material 22 that is compressed metal 24.

Figure 2 is a diagrammatic cross section through the throttle valve assembly 10 that is shown in Figure 1. A gaseous medium 70 can flow in a main flow direction 72 through the continuous throttle opening 16 of the throttle valve assembly 10. The amount of the throughput of gaseous medium 70 through the throttle opening 16 is controlled by the position of the throttle valve 20. In order that the throttle valve 20 has a particularly high degree of strength for this purpose, the throttle valve 20 is divided into a first area 60 that is at least in part approximately ring-like and is of a first material 66, and an approximately circular second area 62 that is of the second material 68. The first material 66 is compressed aluminum. For this reason, the first area 60 of the throttle valve 20 is of a lesser thickness D1 than the remaining area 66 of a throttle valve 20, which is of a thickness D2. The throttle valve 20 is particularly resistant to wear because of the compressed first area 60 that is impressed into the throttle valve 20.

As can be seen from the drawing of the throttle valve assembly 10 that is shown in Figure 3, the throttle valve 20 is installed through a slot 74 in the throttle valve shaft 18 and extends beyond the throttle valve shaft 18 on both sides, the subarea 64 of the throttle valve 20 being enclosed by the throttle valve shaft 18 within the slot 74. Because of the fact that the throttle valve 18 is sufficiently stablized in the subarea 64 that is enclosed by the throttle valve shaft 18, usually by the throttle valve shaft 18, the first area 16 that is of compressed material 22 is manufactured from uncompressed material 22. The first area 60 is thus interrupted by the subarea 64. The subarea 64 is covered by this slot 74 and for this reason it cannot be seen Figure 3.

The throttle valve 20 shown in Figure 4 is a single component and corresponds to the throttle valve 20 that the shown in Figure 1, Figure 2, and Figure 3. In this drawing, it can be seen that the subarea 64 of the throttle valve 20, which is to be arranged in the slot 74 of the throttle valve shaft 18 when the throttle valve 20 is being installed, is of almost the same thickness D2 as the second area 62 of the throttle valve 24.

Figure 5 is a diagrammatic viewof part of the throttle valve assembly 10 that is shown in Figure 1 and Figure 2. Because of the lesser thickness D1 of the first area 60 of the throttle valve 20, as compared to the throttle valve without a compressed first area 60, the throttle valve 20 now has the characteristic that, even when the throttle valve 20 is moved only slightly from its close position towards an open position, the throughput of the gaseous medium 70 through the approximately cylinder-shaped throttle opening 16 can be controlled. This is indicated by the dimensions Y and X + Y.

The dimension Y extends from the mid-point of the throttle valve shaft 18 as far as the point at which the throttle valve 20 would touch the wall of the throttle opening 16 with its lesser thickness D1. The dimension X + Y extends from the mid-point of the throttle valve shaft 18 as far as the imaginary point at which a throttle valve that is of a continuous thickness D2 would touch the wall of the throttle opening 16. Thus, the throttle valve 20 that is of thickness D2 in the first area influences the quantity of gaseous medium passing through the throttle opening 16 in the throttle valve 20's range of movement between Y and X + Y, in contrast to which the imaginary throttle valve that is of a continuous thickness D2 would first influence the quantity of gaseous medium passing through the throttle opening in a range of movement that is greater than X + Y.

Thus, the characteristic curve of a throttle valve assembly 10 with a throttle valve 20 that has a first lesser thickness D1 and a second, greater thickness D2 has a wider working range than the characteristic curve of an imaginary throttle valve assembly with an imaginary throttle valve that is of a continuous thickness D2. The characteristic curve of a throttle valve assembly describes the dependency of the angle of rotation of the throttle valve shaft on the mass of the gaseous medium that passes through the throttle opening at a specific angle of rotation of the throttle valve shaft or opening angle of the throttle valve. Because of this, the throughput of thegaseous medium 60 through the throttle opening 16 can be controlled more precisely than is the case with a conventional throttle valve.

Figure 6 is a diagrammatic view of a single throttle valve 18 that does not correspond to the throttle valves that the shown in Figures 1, 2, 3, 4, and 5. In the case of the throttle valve 18 as shown in Figure 6, the second area 62 is divided into a circular area 82 and an edge area 84, the first area 60 being arranged between the circular area 82 and the edge area 84 of the second area 62. In this embodiment, the throttle valve 80 has a particularly high degree of strength because of the first area 60 that is manufactured from a first material 66 that is stronger than the second material 68 of the second area 62. The throttle valve 80 also incorporates a subarea 64 that is of the second material 68. Such a throttle valve can be used, for example, in motor vehicles that require a throttle valve with a particularly large diameter because of a particularly great throughput of gaseous medium, but in which particularly fine graduation of the working range of the throttle valve assembly is not absolutely necessary.

Because of the high a level of strength that the first area 60 of the throttle valve 20 possesses in comparison to the second area 62 and the subarea 64, it can be particularly reliably ensured that the throttle valve 20 displays an especially small tendency to wear even at especially large diameters. Because of the strength of the edge area 60 of the throttle valve 20 is possible to ensure an especially small quantity of leakage air when the throttle valve 20 is in its closed position. By using a simple and additional step in the manufacturing process, the throttle valve 20 exhibits a particularly high level of strength and is thus especially resistant to wear. This ensures that the characteristic curve of the throttle valve assembly 10 remains more less unchanged throughout even a particularly long service life of the throttle valve assembly.

Patent Claims

1. Throttle valve assembly (10) comprising a housing (12) that has a throttle opening (16) through which a gaseous medium (70) can flow in a main direction of flow (72) and which has an approximately cylindrical cross section (16), a throttle valve (20, 80) that is pivotally mounted on a throttle valve shaft (18) being arranged inside the throttle opening (16), the throttle valve shaft (18) being adjustable by means of an actuator (30) that is arranged within the housing (12), characterized in that the throttle valve (20, 80) has a ring-like first area (60) that is of a first material (66) and radially encircling at least in part, and an approximately circular radial second area (62) that is of a second material (68), the first area (60) enclosing the second area (62) at least in part, the first material (66) of the throttle valve (20, 80) having a greater degree of strength than the second material (68) used for the throttle valve (20, 80).

2. Throttle valve assembly (10) as defined in Claim 1, characterized in the first area (60) is an outer area and the second area (62) is an inner area.

3. Throttle valve assembly (10) as defined in Claim 1, characterized in that the second area (62) is divided into a circular area (82) and an edge area (84), the first area (60) being arranged between the circular area (82) and the edge area (84) of the second area (62).

4. Throttle valve assembly (10) as defined in one of the Claims 1 to 3, characterized in that the throttle valve (20, 80) is of a lesser thickness in the first area (60) than in the second area (62).

5. Throttle valve assembly (10) as defined in one of the Claims 1 to 4, characterized in that the first area (60) and the second area (62) of throttle valve (20, 18) are formed in one piece from a material (22), the first material (66 in the first area (60) of the throttle valve (20, 80) being of compressed material (22) and in the second area (62) of the throttle valve (20, 80) the second material (68) is of uncompressed material (22).

6. Throttle valve assembly (10) as defined in Claim 5, characterized in that the material (22) of the throttle valve (20, 80) is a metal (24), in particular aluminum.

7. Throttle valve assembly as defined in one of the Claims 1 to 6, in which in order to secure the throttle valve (20, 80), the throttle valve shaft (18) incorporates a slot (74), the throttle valve (20, 80) which is inserted through the slot (74) protruding from the throttle valve shaft (18) on both sides of the slot (74) so that a subarea (64) of the throttle valve (20, 80) is enclosed by the throttle valve shaft (18) within the slot (74), characterized in that the first area (60) is interrupted by the subarea (64).

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FIG 1

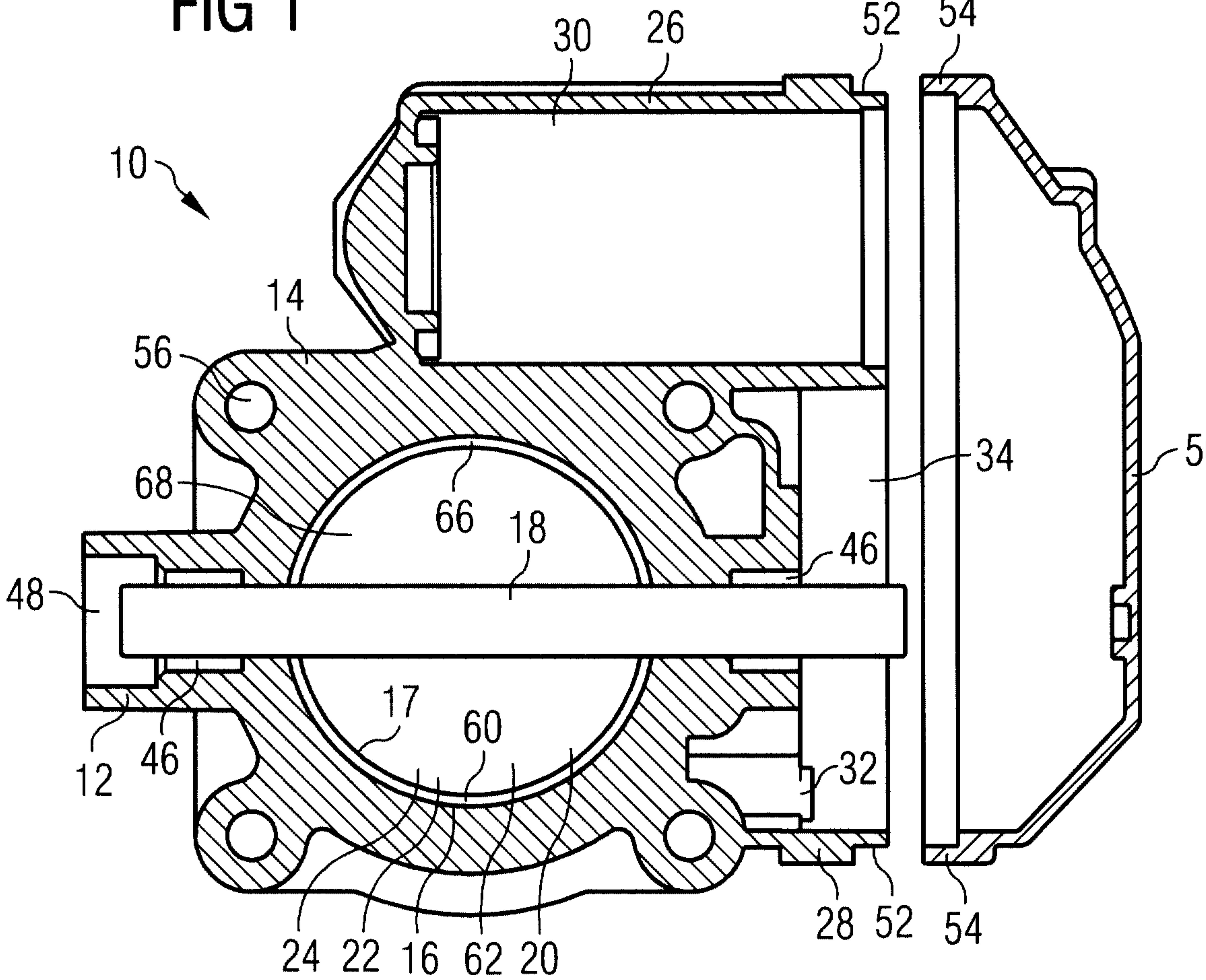

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FIG 2

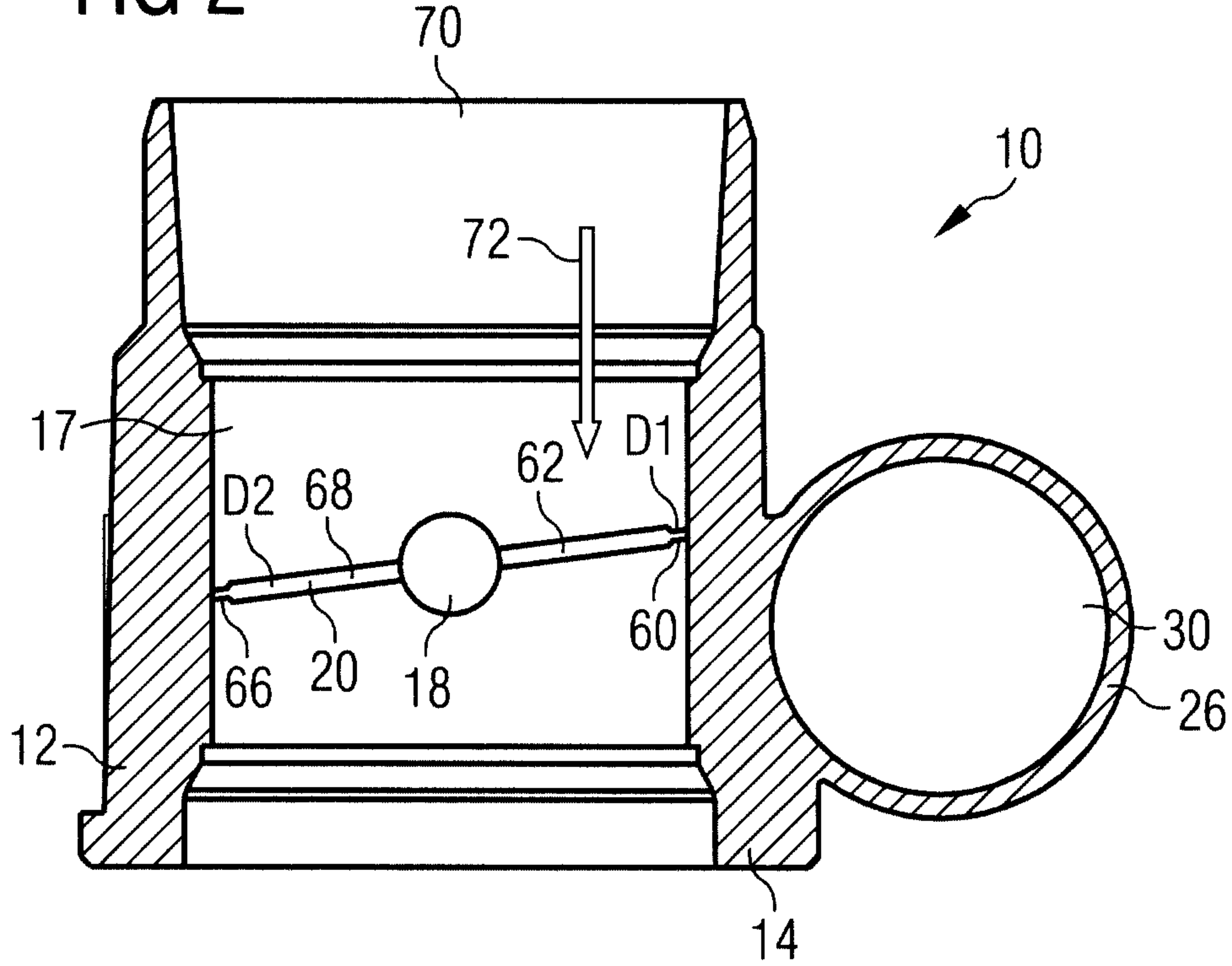

FIG 3

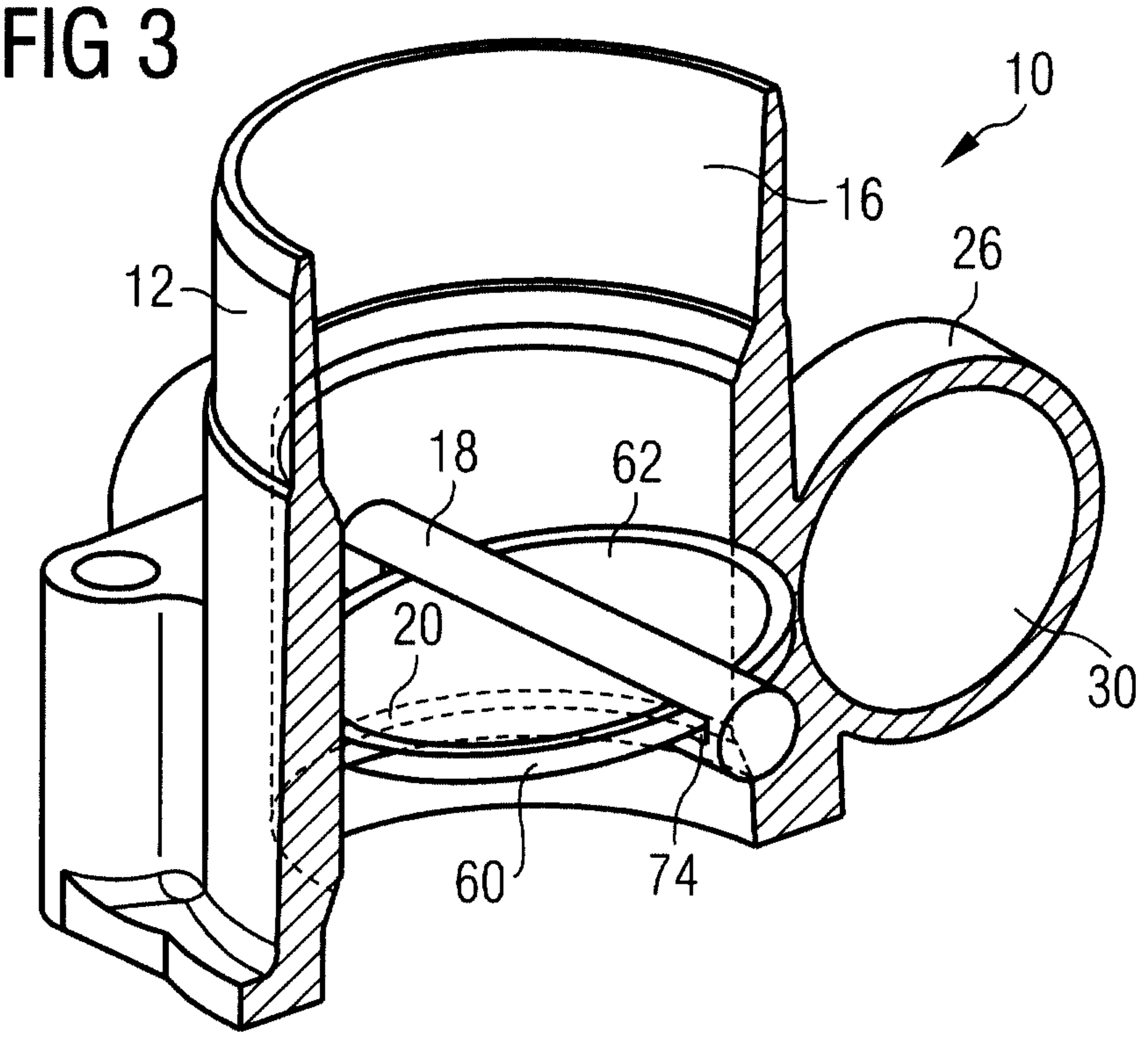

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FIG 4

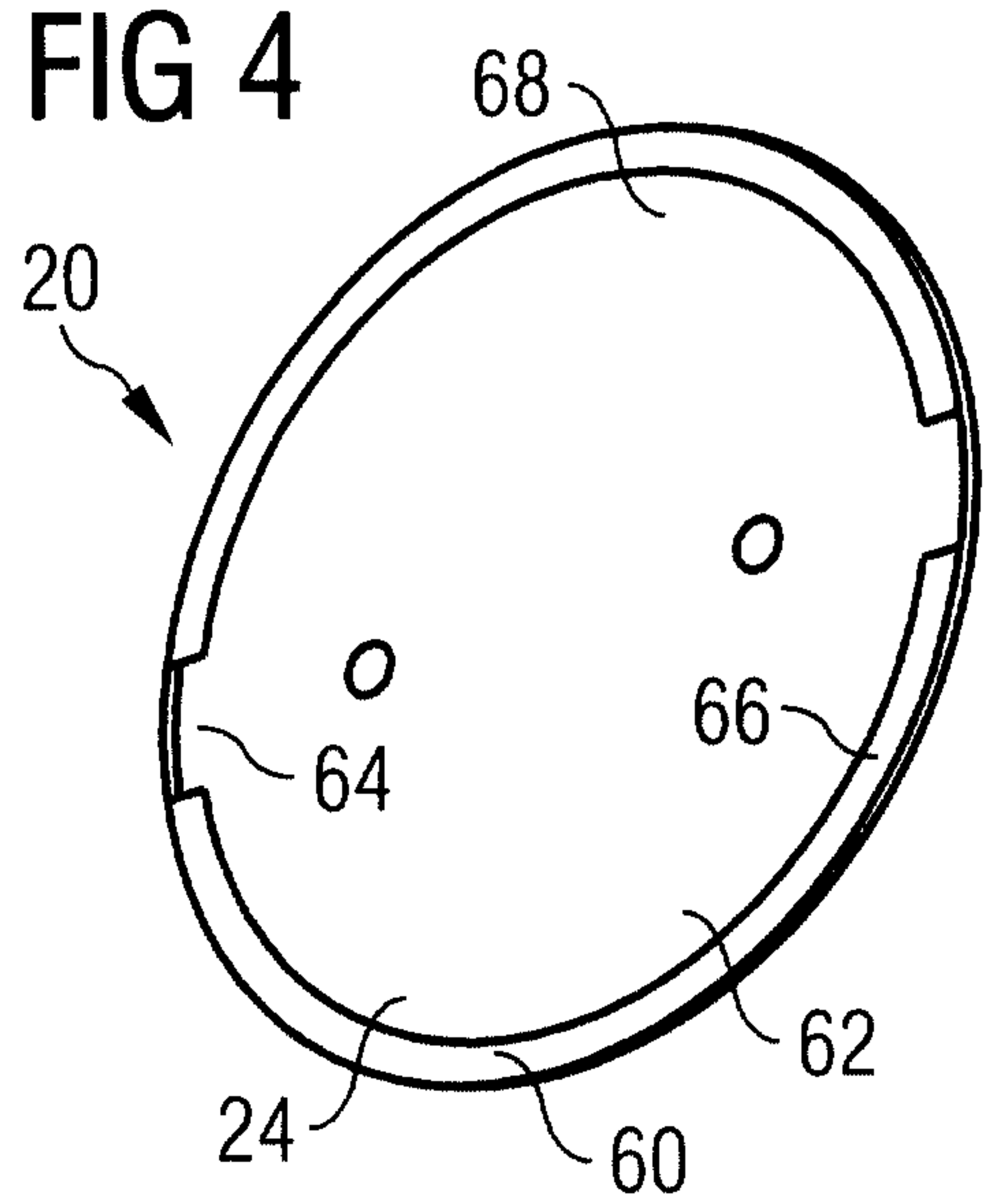


FIG 5

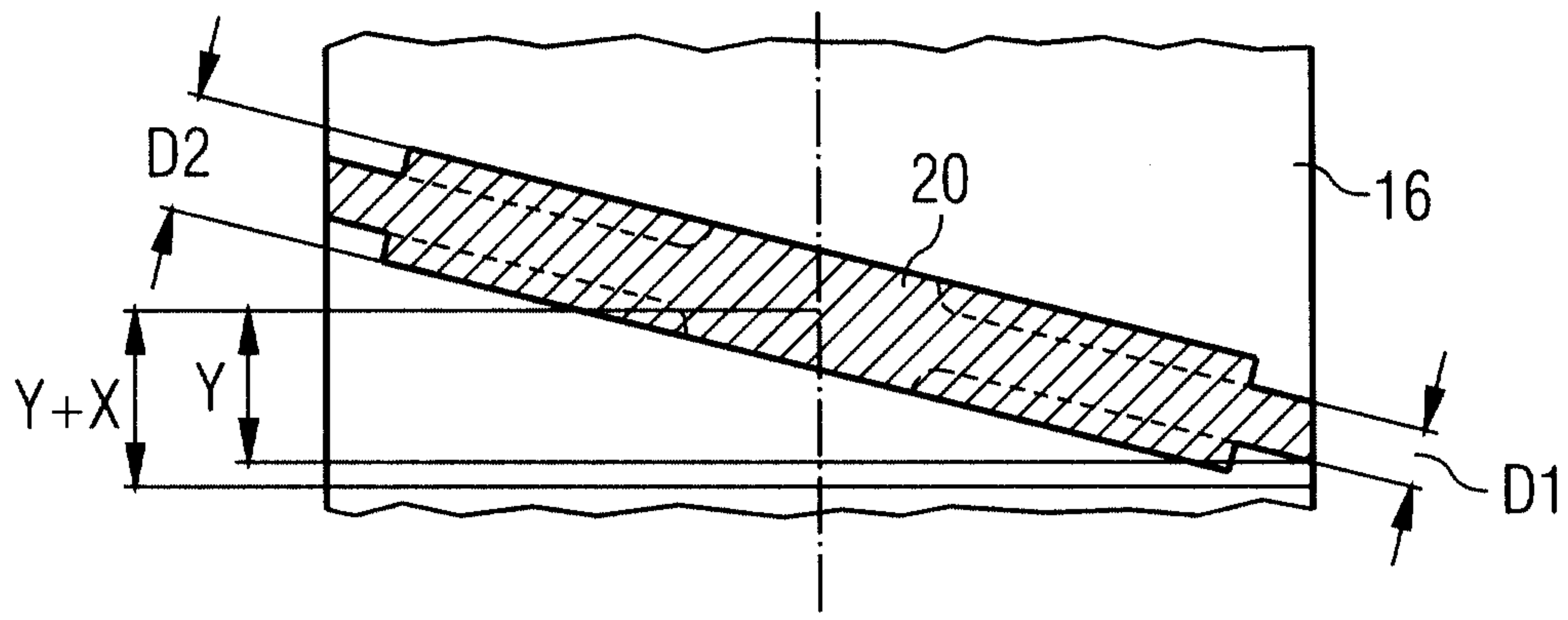
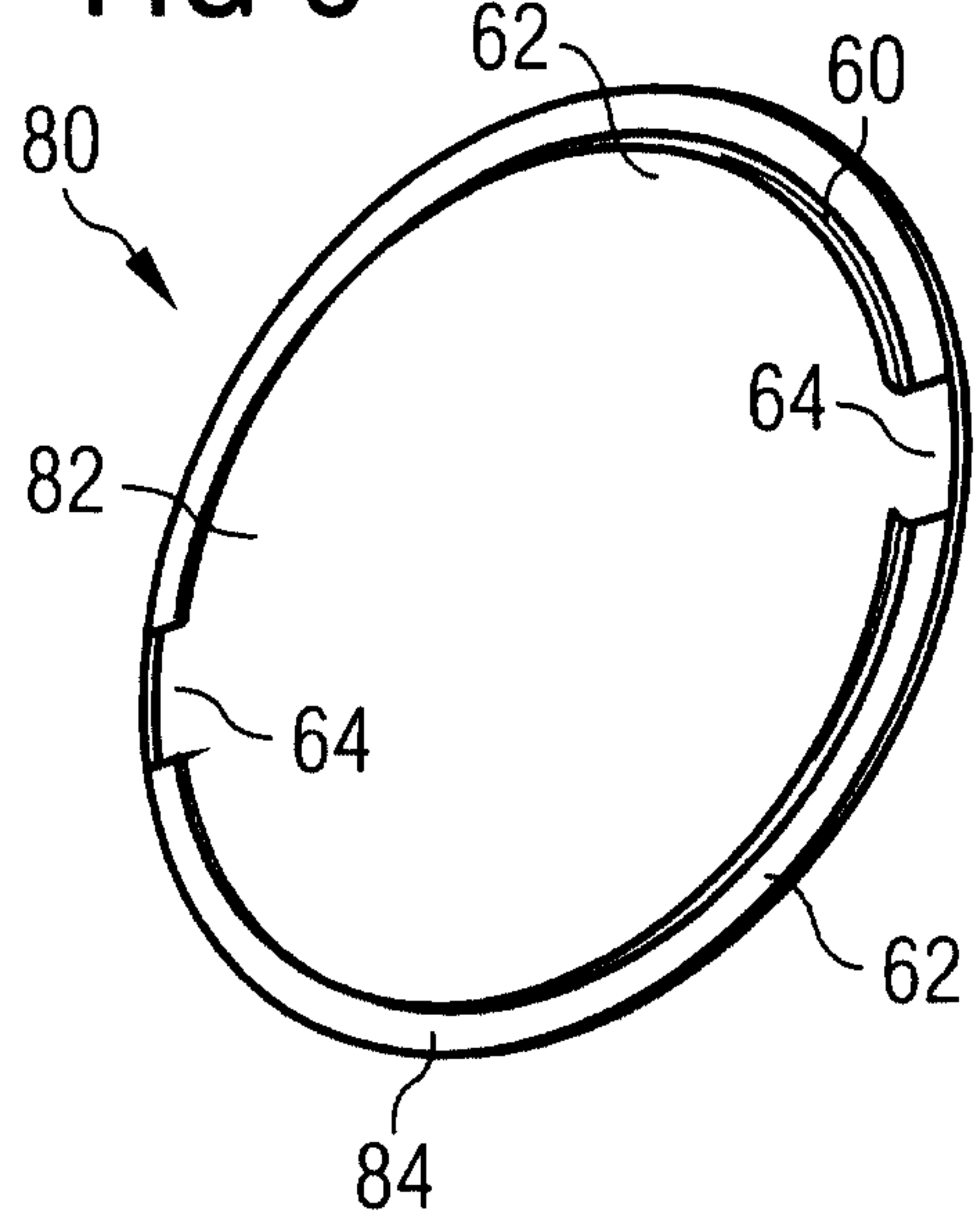
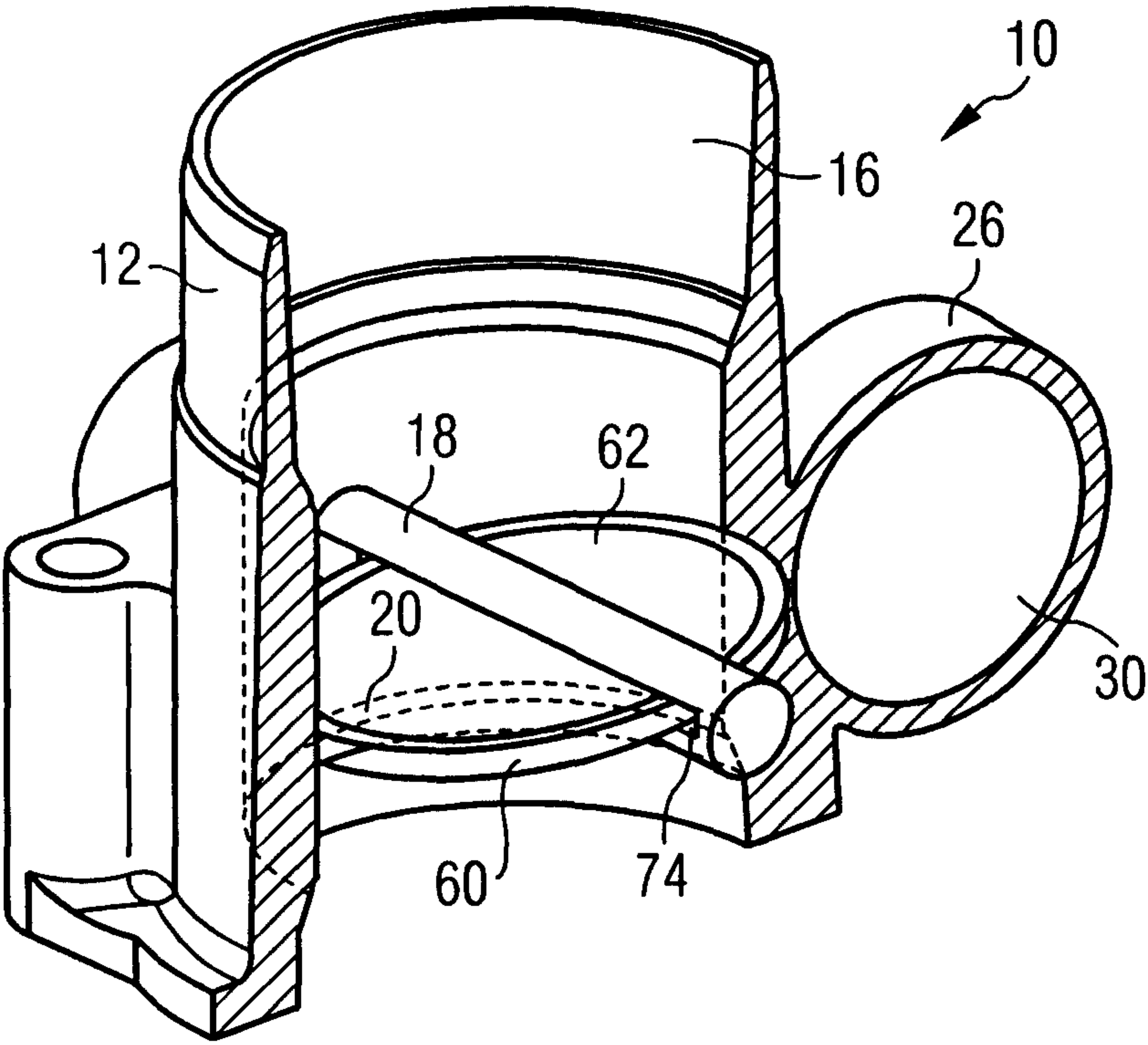


FIG 6

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