



(11) **EP 2 108 914 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
30.05.2018 Bulletin 2018/22

(51) Int Cl.:
F41G 7/32 (2006.01) F42B 15/04 (2006.01)

(21) Application number: **08425232.9**

(22) Date of filing: **08.04.2008**

(54) **Wire-guided torpedo propulsion assembly**

Drahtgeführte Torpedoabschussbaugruppe

Assemblage de propulsion de torpille filoguidée

(84) Designated Contracting States:
DE FR GB IT

(43) Date of publication of application:
14.10.2009 Bulletin 2009/42

(73) Proprietor: **LEONARDO S.p.A.**
00195 Roma (IT)

(72) Inventor: **Bottaini, Giancarlo**
57121 Livorno (IT)

(74) Representative: **Franzolin, Luigi et al**
Studio Torta S.p.A.
Via Viotti, 9
10121 Torino (IT)

(56) References cited:
EP-A- 0 504 049 DE-C1- 3 818 840
US-A- 3 706 293 US-A- 5 419 512
US-A- 5 637 825 US-A- 5 678 785

EP 2 108 914 B1

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

Description

[0001] The present invention relates to a wire-guided torpedo propulsion assembly.

[0002] A torpedo propulsion assembly normally comprises two counter-rotating propellers with respective hubs driven by coaxial shafts. The axially adjacent hubs are mounted between two axial covers - one front and one rear; and, to prevent water from entering between the parts in relative motion, sliding face seals are provided, normally comprising a graphite ring sliding on a tungsten carbide surface.

[0003] Wire-guidance systems are also known comprising an optical-fibre cable wound partly on a reel inside the torpedo, and partly on a reel integral with the launcher. The cable extends along a cable duct extending inside the innermost (rear) propeller shaft, to allow dialoging between the launcher and the torpedo. This system enables distancing of the torpedo and the launcher with no significant increase in load on the cable, which is therefore maintained below break load at all times.

[0004] The wire-guidance cable is unwound gradually as the torpedo advances. The wire-guidance cable is normally of slightly negative buoyancy (hydrostatic thrust - weight) and so tends to either remain stationary or sink very slowly.

[0005] In the event of the torpedo trajectory passing close to the unwinding cable, the rotating propellers may engage the cable and wind it onto the face seals; in which case, the cable may interpose itself between the graphite ring and the sealing surface, thus allowing water into the torpedo.

[0006] US-A- 5637825 discloses a propulsion assembly for a torpedo equipped with a wire-guidance cable, the assembly comprising at least two parts in relative rotational motion and protection means to guide the cable and avoid any interaction of the latter with the torpedo propeller. In particular, the protection means are constituted by a tubular protective shroud enclosing the propeller.

[0007] It is an object of the present invention to provide a wire-guided torpedo propulsion assembly designed to eliminate the above drawback.

[0008] According to the present invention, there is provided a wire-guided torpedo as claimed in Claim 1.

[0009] A preferred, non-limiting embodiment of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows an axial section of a propulsion assembly in accordance with the invention;

Figures 2, 3, 4 and 5 show views in perspective of component parts of the Figure 1 assembly.

[0010] Number 1 in Figure 1 indicates as a whole a propulsion assembly of a wire-guided torpedo 2 (only shown partly).

[0011] Assembly 1 comprises two propellers 3, 4

mounted on respective front and rear hubs 5, 6 fitted to respective coaxial, counter-rotating shafts 7, 8.

[0012] Shafts 7, 8 are driven by an electric motor (not shown) by means of a known drive, also not shown by not forming part of the present invention.

[0013] Shafts 7, 8 are hollow, and are fitted one inside the other by means of conventional radial bearings 9 and thrust bearings 10 not described in detail.

[0014] Front hub 5 is fitted to the outer shaft 7, and rear hub 6 is fitted to an end portion 11 of the inner shaft 8 projecting axially from shaft 7.

[0015] Inner shaft 8 houses a cable duct 12, along which unwinds a wire-guidance cable 14 wound into a reel (not shown) housed in the body of torpedo 2.

[0016] Hubs 5, 6 are axially adjacent and mounted between an annular front cover 15 fixed rigidly to the body of torpedo 2, and an annular rear cover 16 fixed to one end of cable duct 12. The two covers 15, 16 thus close propulsion assembly 1 axially.

[0017] An axial clearance defining a gap 17 is present between each two parts in relative motion (front cover 15 - front hub 5; front hub 5 - rear hub 6; rear hub 6 - rear cover 16). And, to prevent water entering the torpedo through gap 17, a known sliding face seal assembly 18 is provided between the parts in each pair.

[0018] More specifically, each seal assembly 18 comprises an annular seal 19 made of material with a low friction coefficient, e.g. graphite, and secured in known manner to one of the parts in the pair by an elastic device 20; and a ring 21 made of extremely hard, wear-resistant material, e.g. tungsten carbide, and fitted to the other of the parts in relative motion. Elastic device 20 - not described in detail as not forming part of the present invention - exerts axial thrust on seal 19 to hold it in contact with ring 21.

[0019] According to the present invention, to prevent wire-guidance cable 14 from penetrating gap 17 and interposing itself between seal 19 and ring 21, thus separating them and impairing sealing performance, protection means 22 defining a labyrinth 23 are provided on the outside of gaps 17.

[0020] Protection means 22 conveniently comprise a circumferential edge 24, which extends axially from one of the parts in relative motion (the front part, i.e. closer to the torpedo head), and extends flush with the outer profile of the torpedo, in the opposite direction to the travelling direction of the torpedo; and a corresponding inner circumferential projection 25, which extends axially from the other of the parts in relative motion (the rear part, i.e. closer to the rear of the torpedo), extends in the travelling direction of the torpedo, and is coaxial with and radially faces edge 24 to form labyrinth 23 with edge 24.

[0021] As opposed to being circumferentially continuous, inner projection 25 is preferably defined by a number of, e.g. four, sectors 26 equally spaced angularly to define an axially symmetrical structure.

[0022] Figure 2 shows front cover 15 with edge 24.

[0023] Figure 3 shows front hub 5, which, at the front,

has sectors 26 cooperating with edge 24 of front cover 15, and has edge 24 at the rear.

[0024] Figure 4 shows rear hub 6, which, at the front, has sectors 26 cooperating with edge 24 of front hub 5, and has edge 24 at the rear.

[0025] Figure 5 shows rear cover 16 with sectors 26 at the front cooperating with edge 24 of rear hub 6.

[0026] Sectors 26 prevent passage of cable 14.

[0027] To reach sealing assembly 18, wire-guidance cable 14 would have to change direction three times. That is, to negotiate labyrinth 23, it would have to move radially to penetrate, then continue in an axial direction, and, finally, move once more radially with respect to the axis of torpedo 2, and all this while propellers 3, 4 are rotating. The likelihood of this occurring is substantially zero.

[0028] Assuming the cable manages to slip inside the first portion of the path of labyrinth 23, sectors 26 act as a reel about which cable 14 can wind without compromising the seals.

[0029] The fact that projection 25 comprises a number of separate sectors 26, as opposed to being continuous, allows fresh water, when washing, to reach the seals, and does not affect the cooling and lubrication condition of the seals.

[0030] Being axially symmetrical, protection means 22 induce no static or dynamic unbalance of the rotating parts, and produce no noise during rotation. Edges 24, flush with the outer profile of torpedo 2, also assist in maintaining a low noise level.

[0031] Clearly, changes may be made to propulsion assembly 1 as described herein without, however, departing from the protective scope as defined in the accompanying Claims.

Claims

1. A propulsion assembly (1) for a torpedo (2) equipped with a wire-guidance cable (14), the assembly comprising at least two parts (15, 5; 5, 6; 6, 16) in relative rotational motion; face sealing means (18) interposed between said parts (15, 5; 5, 6; 6, 16); and protection means (22) for preventing access of said cable (14) to said face sealing means (18), said protection means (22) defining a labyrinth (23).
2. An assembly as claimed in Claim 1, **characterised in that** said protection means (22) comprise a circumferential edge (24) extending in a substantially axial direction from one of said at least two parts (15; 5; 6); and at least one circumferential projection (25) extending axially from the other part (5; 6; 16) and radially facing said edge (24).
3. An assembly as claimed in Claim 2, **characterised in that** said edge (24) is flush with an outer profile of said propulsion assembly (1) and faces the opposite way to the travelling direction of the torpedo (2).
4. An assembly as claimed in Claim 3, **characterised in that** the projection (25) is located radially inwards with respect to said edge (24), and extends axially in the travelling direction of the torpedo (2).
5. An assembly as claimed in one of Claims 2 to 4, **characterised in that** said projection (25) is defined by a number of angularly spaced sectors (26).
6. An assembly as claimed in Claim 5, **characterised in that** said sectors (26) are arranged axially symmetrically.
7. An assembly as claimed in any one of the foregoing Claims, **characterised in that** at least one of said parts (5; 6) is a hub of a propeller (3; 4).
8. An assembly as claimed in Claim 7, **characterised in that** at least one of said parts is an axial cover (15; 16) of said propulsion assembly (1).
9. An assembly as claimed in Claim 8, **characterised in that** said parts in relative rotational motion comprise two axially adjacent, counter-rotating hubs (5, 6), and two fixed covers (15, 16) located on axially opposite sides of said hubs (5, 6); said protection means (22) being provided between each two axially adjacent said parts (15, 5; 5, 6; 6, 16) in relative rotational motion.

Patentansprüche

1. Antriebsanordnung (1) für einen Torpedo (2), der mit einem Drahtlenkungskabel (14) ausgestattet ist, wobei die Anordnung mindestens zwei Teile (15, 5; 5, 6; 6, 16) in relativer Drehbewegung zueinander; Gleitringdichtungsmittel (18), die zwischen den Teilen (15, 5; 5, 6; 6, 16) eingefügt sind; und Schutzmittel (22) umfasst, um einen Zugang des Kabels (14) zu den Gleitringdichtungsmitteln (18) zu verhindern, wobei die Schutzmittel (22) ein Labyrinth (23) definieren.
2. Anordnung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Schutzmittel (22) einen umlaufenden Rand (24), der sich in einer im Wesentlichen axialen Richtung von einem der mindestens zwei Teile (15; 5; 6) aus erstreckt und mindestens einen umlaufenden Vorsprung (25) aufweisen, der sich axial von dem anderen Teil (5; 6; 16) erstreckt und dem Rand (24) radial gegenübersteht.
3. Anordnung nach Anspruch 2, **dadurch gekennzeichnet, dass** der Rand (24) mit einem äußeren Profil der Antriebsanordnung (1) bündig ist und der

Bewegungsrichtung des Torpedos (2) entgegen gerichtet ist.

4. Anordnung nach Anspruch 3, **dadurch gekennzeichnet, dass** der Vorsprung (25) in Bezug auf den Rand (24) radial innenliegend angeordnet ist und sich axial in Bewegungsrichtung des Torpedos (2) erstreckt.
5. Anordnung nach einem der Ansprüche 2 bis 4, **dadurch gekennzeichnet, dass** der Vorsprung (25) durch eine Anzahl von winkelbeabstandeten Sektoren (26) definiert ist.
6. Anordnung nach Anspruch 5, **dadurch gekennzeichnet, dass** die Sektoren (26) axialsymmetrisch angeordnet sind.
7. Anordnung nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** zumindest eines der Teile (5, 6) eine Nabe eines Propellers (3, 4) ist.
8. Anordnung nach Anspruch 7, **dadurch gekennzeichnet, dass** zumindest eines der Teile eine Axialabdeckung (15; 16) der Antriebsanordnung (1) ist.
9. Anordnung nach Anspruch 8, **dadurch gekennzeichnet, dass** die Teile in relativer Drehbewegung zueinander zwei axial benachbarte, gegenläufig rotierende Naben (5, 6) und zwei feststehende Abdeckungen (15, 16) umfassen, die auf axial entgegengesetzten Seiten der Naben (5, 6) angeordnet sind; wobei die Schutzmittel (22) zwischen jeweils zwei axial benachbarten Teilen (15, 5; 5, 6; 6, 16) in relativer Drehbewegung zueinander vorgesehen sind.

Revendications

1. Ensemble de propulsion (1) pour une torpille (2) équipée d'un câble de filoguidage (14), l'ensemble comprenant au moins deux parties (15, 5 ; 5, 6 ; 6, 16) dans un mouvement de rotation relatif ; des moyens d'étanchéification de face (18) interposés entre lesdites parties (15, 5 ; 5, 6 ; 6, 16) ; et des moyens de protection (22) pour empêcher l'accès dudit câble (14) auxdits moyens d'étanchéification de face (18), lesdits moyens de protection (22) définissant un labyrinthe (23).
2. Ensemble selon la revendication 1, **caractérisé en ce que** lesdits moyens de protection (22) comprennent un bord circonférentiel (24) s'étendant dans une direction sensiblement axiale à partir de l'une desdites au moins deux parties (15 ; 5 ; 6) ; et au moins une saillie circonférentielle (25) s'étendant axiale-

ment à partir de l'autre partie (5 ; 6 ; 16) et faisant face radialement audit bord (24).

3. Ensemble selon la revendication 2, **caractérisé en ce que** ledit bord (24) est de niveau avec un profil externe dudit ensemble de propulsion (1) et fait face au sens opposé à la direction de déplacement de la torpille (2).
4. Ensemble selon la revendication 3, **caractérisé en ce que** la saillie (25) est située radialement vers l'intérieur par rapport audit bord (24), et s'étend axialement dans la direction de déplacement de la torpille (2).
5. Ensemble selon l'une des revendications 2 à 4, **caractérisé en ce que** ladite saillie (25) est définie par un certain nombre de secteurs espacés angulairement (26).
6. Ensemble selon la revendication 5, **caractérisé en ce que** lesdits secteurs (26) sont agencés symétriquement de façon axiale.
7. Ensemble selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**au moins une desdites parties (5 ; 6) est un moyeu d'une hélice (3 ; 4).
8. Ensemble selon la revendication 7, **caractérisé en ce qu'**au moins une desdites parties est un couvercle axial (15 ; 16) dudit ensemble de propulsion (1).
9. Ensemble selon la revendication 8, **caractérisé en ce que** lesdites parties en mouvement de rotation relatif comprennent deux moyeux contrarotatifs adjacents axialement (5, 6), et deux couvercles fixes (15, 16) situés sur des côtés opposés axialement desdits moyeux (5, 6) ; lesdits moyens de protection (22) étant prévus entre chaque paire desdites parties (15, 5 ; 5, 6 ; 6, 16) adjacentes axialement en mouvement de rotation relatif.

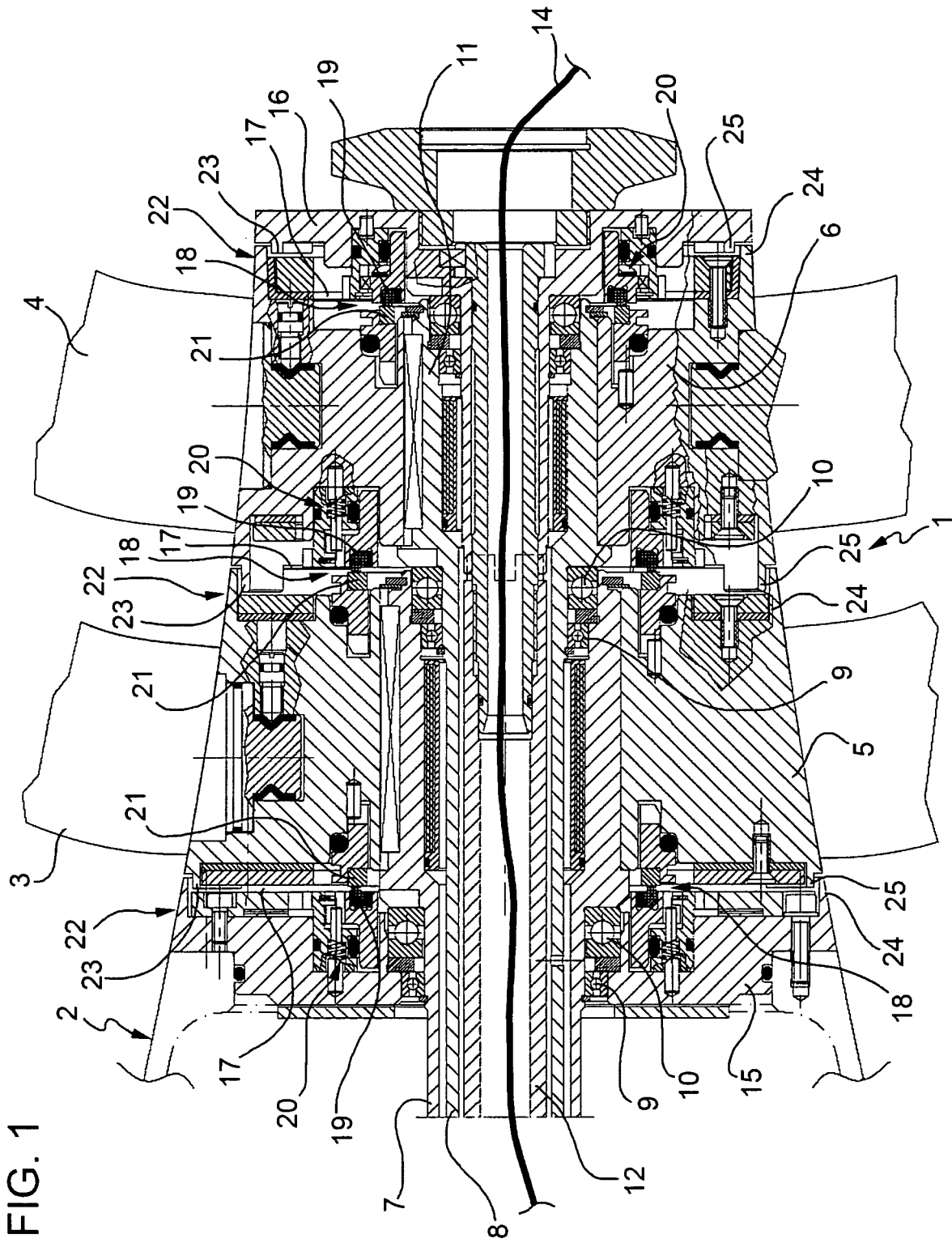


FIG. 1

FIG. 3

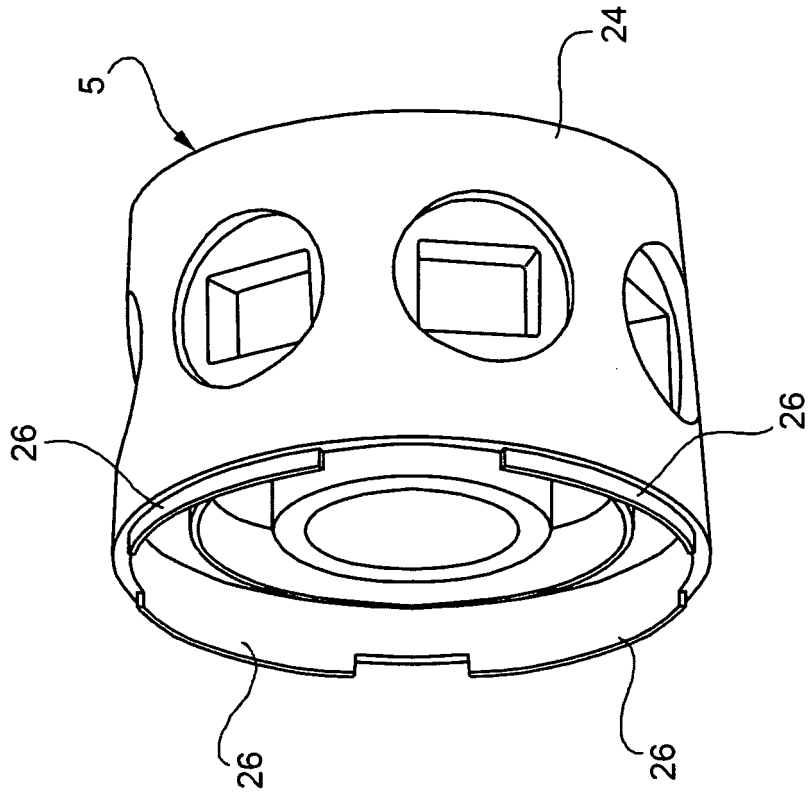


FIG. 2

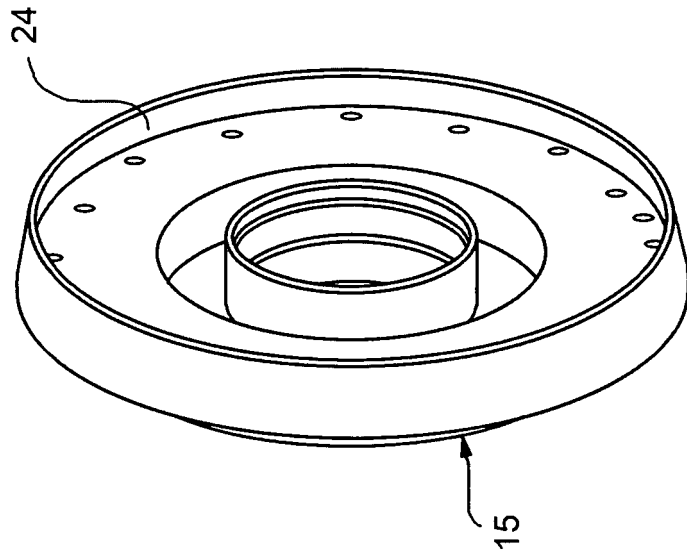


FIG. 5

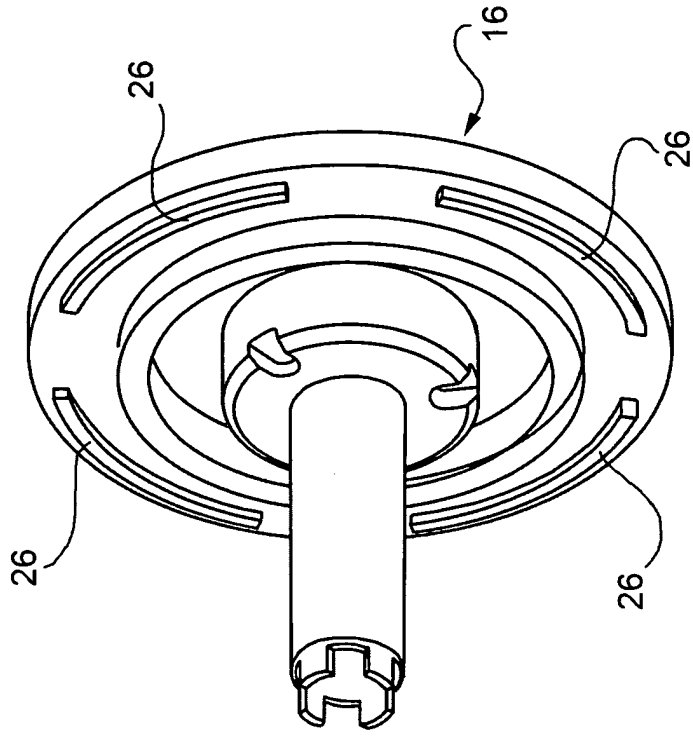
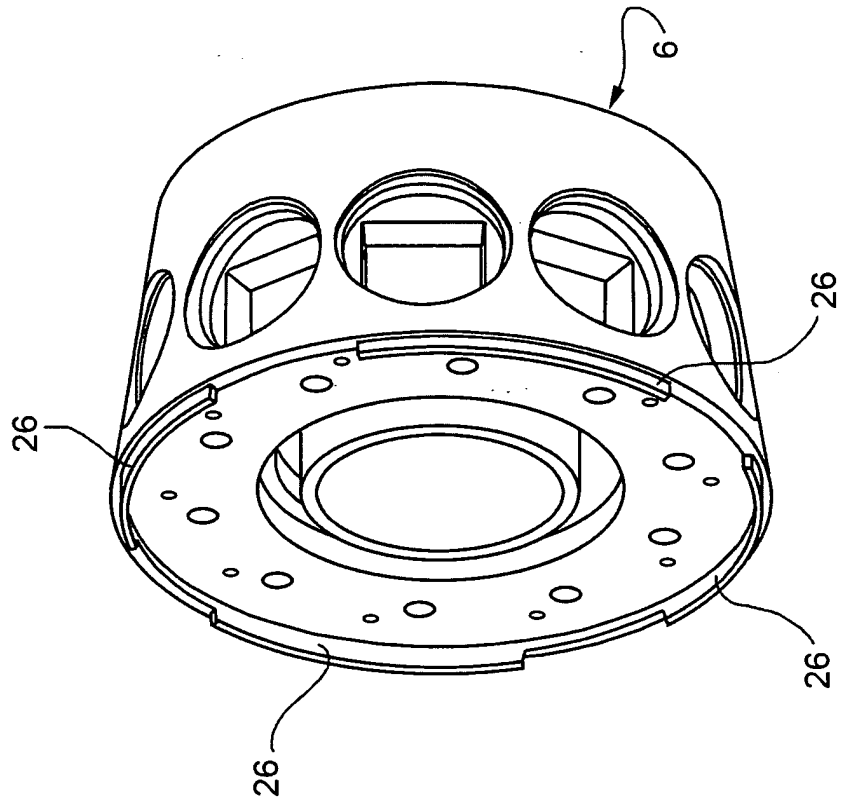


FIG. 4



REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 5637825 A [0006]