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### (54) COOLING ARRANGEMENT FOR VALVE SEAT

KÜHLANORDNUNG FÜR EINEN VENTILSITZ

AGENCEMENT DE REFROIDISSEMENT CONÇU POUR UN SIÈGE DE SOUPAPE

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## Description

### Technical field of the invention

**[0001]** The present invention relates to a cooling arrangement for a valve seat of a piston engine in accordance with the preamble of claim 1.

### Background of the invention

**[0002]** In a piston engine the task of the cylinder head is to close the upper end of the cylinder sleeve and form the upper part of the combustion chamber. The cylinder head accommodates inlet and exhaust passages for the gases of the combustion process and provides a base for the valve gear and in a diesel engine for the fuel injection valve. The cylinder head is also provided with cooling ducts for cooling the components that require cooling. One of the components in the cylinder head that needs to be cooled is the exhaust valve seat insert, i.e. the counter surface for the exhaust valve disc, which surface is subject to high thermal loading. If the seat insert heats up excessively, it may develop permanent deformations causing leakage in the exhaust valve.

**[0003]** Various solutions have been developed for cooling the exhaust valve seat insert. For instance the cooling ducts in the cylinder head may be arranged as close to the seat insert as possible, or a separate cooling duct for cooling liquid may be adapted in conjunction with the seat insert. Problems related to this kind of solutions include insufficient cooling effect and cooling liquid leakages. These problems have been solved for example by a valve seat insert disclosed in patent application FI 20065722 A. The valve seat insert comprises a cooling duct, an inlet port for conveying cooling liquid into the cooling duct, and an outlet port for discharging cooling liquid out of the cooling duct. The inlet port and the outlet port are arranged close to one another. In addition, the cooling duct is arranged between the inlet port and the outlet port so that it extends at least almost around the whole seat insert. With this kind of seat insert effective cooling of the seat insert can be achieved. However, a remaining problem is the sealing between the seat insert and the cooling ducts of the cylinder head. Leakages are normally prevented by applying liquid sealant to the joints between the cooling ducts of the cylinder head and the seat insert. When the sealant hardens, it seals the joints between the parts. The liquid sealant works for some time, but after longer use of the engine leakages often occur.

### Summary of the invention

**[0004]** The object of the present invention is to provide an improved cooling arrangement for a valve seat of a piston engine. The characterizing features of the cooling arrangement according to the present invention are given in the characterizing part of claim 1.

**[0005]** The cooling arrangement according to the invention comprises a cylinder head comprising an inlet duct and an outlet duct for cooling liquid, and a valve seat insert, which seat insert is arranged against the cylinder head and comprises a cooling duct, an inlet port that is arranged on the outer circumference of the seat insert and in fluid communication with the inlet duct of the cylinder head for conveying cooling liquid into the cooling duct, and an outlet port that is arranged on the outer circumference of the seat insert and in fluid communication with the outlet duct of the cylinder head for discharging cooling liquid out of the cooling duct. The arrangement further comprises at least one connecting pipe that is arranged inside the inlet duct or the outlet duct of the cylinder head and against the seat insert, and a seal that is arranged between the connecting pipe and the seat insert.

**[0006]** With the cooling arrangement according to the invention, leakages from the valve seat cooling system can be prevented. The arrangement is more reliable than conventional cooling systems, where joints between the cylinder head and the seat insert are sealed with liquid sealant. When the seal is damaged, it can be easily replaced. Also existing cooling arrangements can be upgraded with an arrangement according to the invention.

**[0007]** According to an embodiment of the invention, the arrangement comprises a second seal that is arranged between the connecting pipe and the inlet or outlet duct of the cylinder head. The second seal prevents leakages between the connecting pipe and the cylinder head. Alternatively, additional seals could be arranged between the connecting pipe and a separate locking pipe and between the locking pipe and the cylinder head.

**[0008]** According to another embodiment of the invention, the connecting pipe is provided with a screw thread on the outer surface of the pipe for fastening the connecting pipe to the inlet or outlet duct of the cylinder head. With the thread the connecting pipe can be easily fastened and removed.

**[0009]** According to another embodiment of the invention, the arrangement comprises a locking pipe that is provided with a screw thread on the outer surface of the pipe for fastening the locking pipe to the inlet or outlet duct of the cylinder head and for clamping the connecting pipe between the locking pipe and the seat insert. The locking pipe can replace the thread of the connecting pipe. However, it is beneficial to provide both pipes with threads. If the connecting pipe is provided with a screw thread, the screw thread of the locking pipe can be oriented in the opposite direction compared to the screw thread of the connecting pipe. A loosening connecting pipe thus tightens the locking pipe and both pipes are prevented from moving.

### 55 Brief description of the drawings

### [0010]

Fig. 1 shows a cylinder head of a piston engine.  
 Fig. 2 shows a cross-sectional view of part of the cylinder head of Fig. 1 taken along line A-A.  
 Fig. 3 shows a cross-sectional view of part of the cylinder head of Fig. 1 taken along line B-B.  
 Fig. 4 shows an enlarged view of detail C in Figs. 2 and 3.  
 Fig. 5 shows a valve seat insert.  
 Fig. 6 shows a connecting pipe for a cooling arrangement according to the invention.  
 Fig. 7 shows a locking pipe for a cooling arrangement according to the invention.

#### Detailed description of the invention

**[0011]** Embodiments of the invention are now described in more detail with reference to the accompanying drawings.

**[0012]** Figure 1 shows a cylinder head 1 of a large internal combustion engine. The engine is a four-stroke piston engine, which can be used, for instance, as a main or an auxiliary engine of a ship or an engine that is used at a power plant for producing electricity. The task of the cylinder head 1 is to close the upper end of the cylinder sleeve and form the upper part of the combustion chamber of the cylinder. In addition, the cylinder head 1 is provided with an inlet passage and an exhaust passage for the gases of the cylinder's combustion process. The gas flow through the inlet passage and the exhaust passage is controlled by valves that are arranged in conjunction with the passages. The cylinder head 1 also acts as a base for the valve gear and in a diesel engine for the fuel injection valve. Each cylinder of the engine is provided with two intake valves and two exhaust valves. The gas exchange valves comprise a valve stem and a valve disc that cooperates with a valve seat. The exhaust valve seats have a high thermal load and are therefore provided with a cooling arrangement. The cooling arrangement comprises a valve seat insert 2 shown in figure 5. The seat insert 2 comprises an annular cooling duct 10 (not shown in Fig. 5) that is arranged completely inside the seat insert 2. The cooling duct 10 is provided with an inlet port 11 for conveying cooling liquid into the cooling duct 10 and with an outlet port 12 for discharging the cooling liquid out of the cooling duct 10. The inlet port 11 and the outlet port 12 are arranged on the outer circumference of the seat insert 2. The cooling duct 10 is arranged between the inlet port 11 and the outlet port 12 so that it extends almost around the whole seat insert 2. The seat insert 2 is a one-piece part, for instance a one-piece cast, which is manufactured by casting. Alternatively, the seat insert 2 may be manufactured by using a powder metallurgical manufacturing method, for instance hot isostatic pressing (HIP). Cooling liquid is supplied through the inlet port 11 into the cooling duct 10. The cooling liquid circulates in the cooling duct 10 almost around the whole seat insert 2 and is then discharged from the cooling duct 10 through the outlet port 12.

**[0013]** The seat insert 2 is attached to the cylinder head 1 by a shrinkage fit. The cylinder head 1 is provided with an inlet duct 8 for supplying cooling liquid to the seat insert 2 and with an outlet duct 9 for discharging cooling liquid from the seat insert 2. The inlet duct 8 and the outlet duct 9 can be accessed by removing a plug 4 at the end of the duct 8, 9. The inlet port 11 of the seat insert 1 is aligned with the inlet duct 8 of the cylinder head 1 and the outlet port 12 of the seat insert 2 is aligned with the outlet duct of the cylinder head 1. Conventionally, the joints between the inlet and outlet ducts 8, 9 of the cylinder head 1 and the inlet and outlet ports 11, 12 of the seat insert 2 have been sealed by applying liquid sealant to the joints. When the liquid sealant hardens, it seals the joints. However, because of the harsh conditions in the cylinder head 1, leakages often occur in the joints after longer use of the engine.

**[0014]** For avoiding leakages, a connecting pipe 3 is used for improving sealing between the cylinder head 1 and the seat insert 2. The connecting pipe 3 is shown in figure 6. In figures 2 to 4 is shown a cross-sectional view of the connecting pipe 3. Both the inlet duct 8 and the outlet duct 9 of the cylinder head 1 are provided with a connecting pipe 3. A seal 6 is arranged between the inlet port 11 of the seat insert 2 and the connecting pipe 3. An identical seal 6 is arranged between the outlet port 12 of the seat insert 2 and the connecting pipe 3. The seal 6 is between the end of the connecting pipe 3 and the respective inlet or outlet port 11, 12. The seal 6 prevents leaking between the seat insert 2 and the connecting pipe 3. An annular groove 13 is arranged on the outer surface of the connecting pipe 3 for accommodating a sealing ring 7. The sealing ring 7 prevents leaking between the connecting pipe 3 and the cylinder head 1.

**[0015]** For fastening the connecting pipe 3 to the cylinder head 1, the connecting pipe 3 is provided with a screw thread 14 that is arranged on the outer surface of the pipe 3. A similar thread is arranged in the inlet or outlet duct 8, 9 of the cylinder head 1. The connecting pipe 3 is provided with a hexagon socket head 16. The connecting pipe 3 can thus be fastened and removed by using a hex wrench (Allen key). It is also possible to use other socket shapes. For securing the fastening of the connecting pipe 3, the arrangement can be provided with a locking pipe 5. The locking pipe 5 is similar to the connecting pipe 3 and is arranged in the inlet or outlet duct 8, 9 of the cylinder head 1. The connecting pipe 3 is clamped between the seat insert 2 and the locking pipe 5. A screw thread 15 is arranged on the outer surface of the locking pipe 5 for fastening the locking pipe 5 to the cylinder head 1. A similar thread is arranged in the inlet or outlet duct 8, 9 of the cylinder head 1. The thread 15 of the locking pipe 5 is oriented in the opposite direction compared to the thread 14 of the connecting pipe 3. Thus, if the connecting pipe 3 is provided with a right-hand thread, the locking pipe 5 is provided with a lefthand thread. If the connecting pipe 3 starts to turn open, it will tighten the locking pipe 5 and loosening of the pipes 3,

5 is prevented. Also the locking pipe 5 is provided with a hexagon socket head 17 for fastening the pipe 5.

[0016] It will be appreciated by a person skilled in the art that the invention is not limited to the embodiments described above, but may vary within the scope of the appended claims. For instance, if the cooling arrangement is provided with a locking pipe, it is not necessary to provide the connecting pipe with a sealing ring, but a sealing could be arranged between the connecting pipe and the locking pipe and around the locking pipe. Also, it is possible to provide only the locking pipe with a thread.

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## Claims

1. A cooling arrangement for a valve seat of a piston engine, which cooling arrangement comprises

- a cylinder head (1) comprising an inlet duct (8) and an outlet duct (9) for cooling liquid, and
- a valve seat insert (2), which seat insert (2) is arranged against the cylinder head (1) and comprises a cooling duct (10), an inlet port (11) that is arranged on the outer circumference of the seat insert (2) and in fluid communication with the inlet duct (8) of the cylinder head (1) for conveying cooling liquid into the cooling duct (10), and an outlet port (12) that is arranged on the outer circumference of the seat insert (2) and in fluid communication with the outlet duct (9) of the cylinder head (1) for discharging cooling liquid out of the cooling duct (10),

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**characterized in that** the arrangement further comprises

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- at least one connecting pipe (3) that is arranged inside the inlet duct (8) or the outlet duct (9) of the cylinder head (1) and against the seat insert (2), and
- a seal (6) that is arranged between the connecting pipe (3) and the seat insert (2).

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2. An arrangement according to claim 1, **characterized in that** the arrangement comprises a second seal (7) that is arranged between the connecting pipe (3) and the inlet or outlet duct (8, 9) of the cylinder head (1).

3. An arrangement according to claim 1 or 2, **characterized in that** the connecting pipe (3) is provided with a screw thread (14) on the outer surface of the pipe (3) for fastening the connecting pipe (3) to the inlet or outlet duct (8, 9) of the cylinder head (1).

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4. An arrangement according to any of claims 1-3, **characterized in that** the arrangement comprises a locking pipe (5) that is provided with a screw thread

(15) on the outer surface of the pipe (5) for fastening the locking pipe (5) to the inlet or outlet duct (8, 9) of the cylinder head (1) and for clamping the connecting pipe (3) between the locking pipe (5) and the seat insert (2).

5. An arrangement according to claim 4, **characterized in that** the screw thread (15) of the locking pipe (5) is oriented in the opposite direction compared to the screw thread (14) of the connecting pipe (3).

## Patentansprüche

15 1. Kühlanordnung für einen Ventilsitz eines Kolbenmotors, wobei die Kühlanordnung Folgendes umfasst:

- einen Zylinderkopf (1), der einen Einlasskanal (8) und einen Auslasskanal (9) zum Kühlen von Flüssigkeit umfasst, und
- einen Ventilsitzring (2), wobei der Sitzring (2) gegen den Zylinderkopf (1) angeordnet ist und einen Kühlkanal (10), eine Einlassöffnung (11), die am Außenumfang des Sitzrings (2) angeordnet ist und mit dem Einlasskanal (8) des Zylinderkopfs (1) in Fluidverbindung steht, um Kühlflüssigkeit in den Kühlkanal (10) zu befördern, und eine Auslassöffnung (12), die am Außenumfang des Sitzrings (2) angeordnet ist und mit dem Auslasskanal (9) des Zylinderkopfs (1) in Fluidverbindung steht, um Kühlflüssigkeit aus dem Kühlkanal (10) abzuführen, umfasst,

**dadurch gekennzeichnet, dass** die Anordnung ferne Folgendes umfasst

- mindestens ein Verbindungsrohr (3), das innerhalb des Einlasskanals (8) oder des Auslasskanals (9) des Zylinderkopfs (1) und gegen den Sitzring (2) angeordnet ist, und
- eine Dichtung (6), die zwischen dem Verbindungsrohr (3) und dem Sitzring (2) angeordnet ist.

45 2. Anordnung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Anordnung eine zweite Dichtung (7) umfasst, die zwischen dem Verbindungsrohr (3) und dem Einlass- oder Auslasskanal (8, 9) des Zylinderkopfs (1) angeordnet ist.

3. Anordnung nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Verbindungsrohr (3) auf der Außenfläche des Rohrs (3) mit einem Schraubgewinde (14) versehen ist, um das Verbindungsrohr (3) an dem Einlass- oder Auslasskanal (8, 9) des Zylinderkopfs (1) zu befestigen.

4. Anordnung nach einem der Ansprüche 1 - 3, **da-**

**durch gekennzeichnet, dass** die Anordnung ein Verriegelungsrohr (5) umfasst, das an der Außenfläche des Rohrs (5) mit einem Schraubgewinde (15) versehen ist, um das Verriegelungsrohr (5) an dem Einlass- oder Auslasskanal (8, 9) des Zylinderkopfs (1) zu befestigen und um das Verbindungsrohr (3) zwischen dem Verriegelungsrohr (5) und dem Sitzring (2) festzuklemmen.

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5. Anordnung nach Anspruch 4, **dadurch gekennzeichnet, dass** das Schraubgewinde (15) des Verriegelungsrohrs (5) im Vergleich zu dem Schraubgewinde (14) des Verbindungsrohrs (3) in der entgegengesetzte Richtung ausgerichtet ist.

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**Revendications**

1. Agencement de refroidissement pour un siège de soupape d'un moteur à piston, lequel agencement de refroidissement comprend :

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- une culasse (1) comprenant un conduit d'entrée (8) et un conduit de sortie (9) pour du liquide de refroidissement, et

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- un insert de siège de soupape (2), lequel insert de siège (2) est disposé contre la culasse (1) et comprend un conduit de refroidissement (10), un orifice d'entrée (11) qui est disposé sur la circonference extérieure de l'insert de siège (2) et en communication fluidique avec le conduit d'entrée(8) de la culasse (1) pour transporter du liquide de refroidissement à l'intérieur du conduit de refroidissement (10), et un orifice de sortie (12) qui est disposé sur la circonference extérieure de l'insert de siège (2) et en communication fluidique avec le conduit de sortie (9) de la culasse (1) pour déverser du liquide de refroidissement hors du conduit de refroidissement (10),

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**caractérisé en ce que** l'agencement comprend en outre :

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- au moins un tube de raccordement (3) qui est disposé à l'intérieur du conduit d'entrée (8) ou du conduit de sortie (9) de la culasse (1) et contre l'insert de siège (2), et

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- un joint d'étanchéité (6) qui est disposé entre le tube de raccordement (3) et l'insert de siège (2).

2. Agencement selon la revendication 1, **caractérisé en ce que** l'agencement comprend un deuxième joint d'étanchéité (7) qui est disposé entre le tube de raccordement (3) et le conduit d'entrée ou de sortie (8, 9) de la culasse (1).

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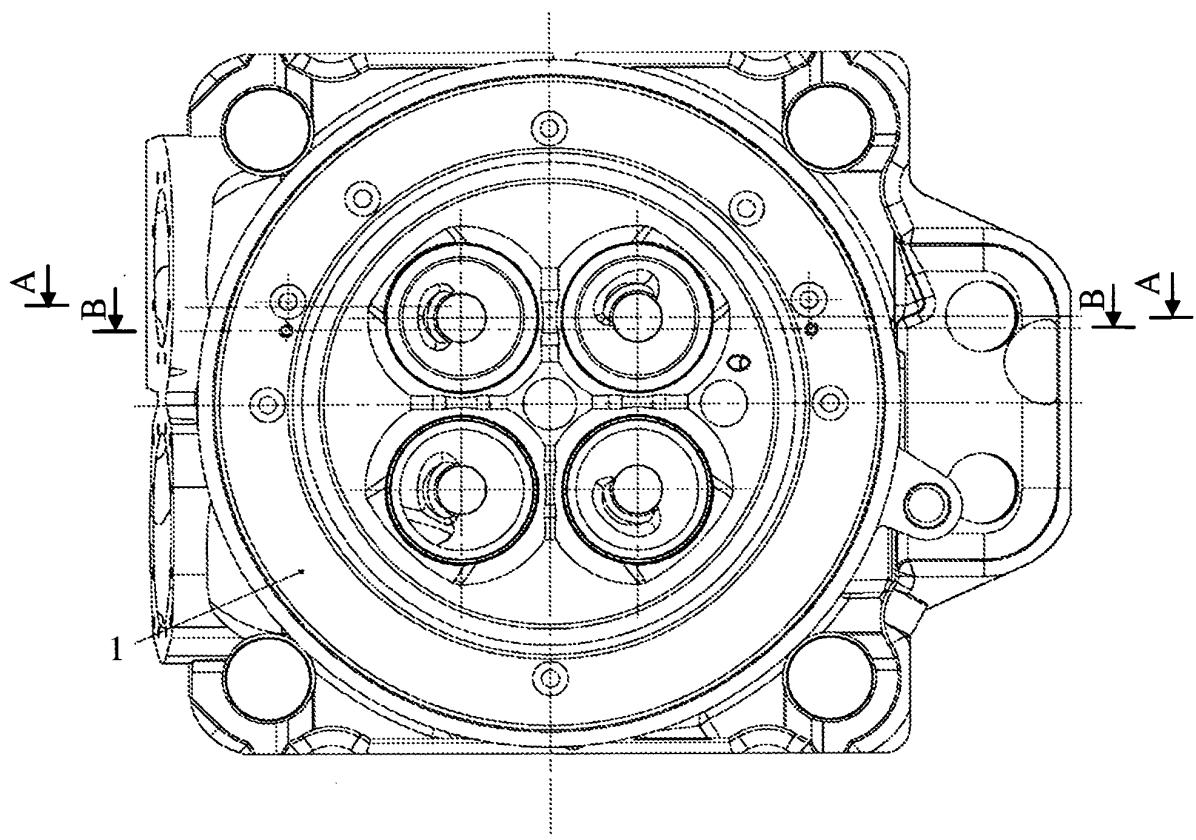


FIG. 1

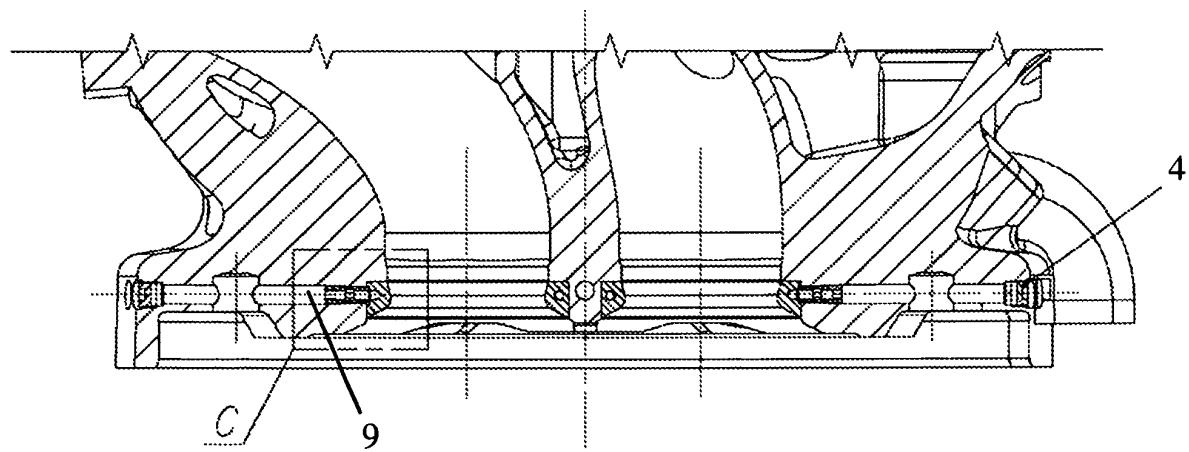


FIG. 2

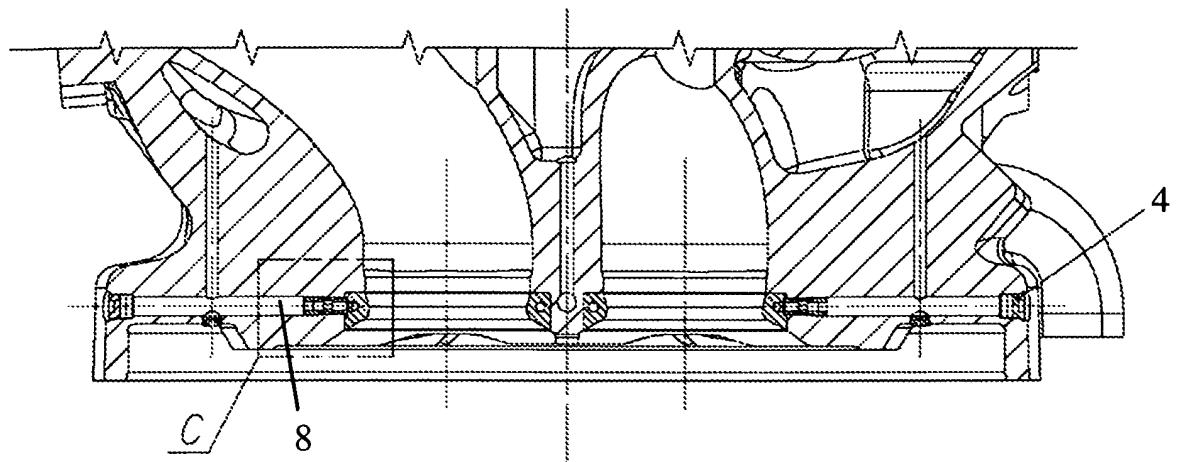


FIG. 3

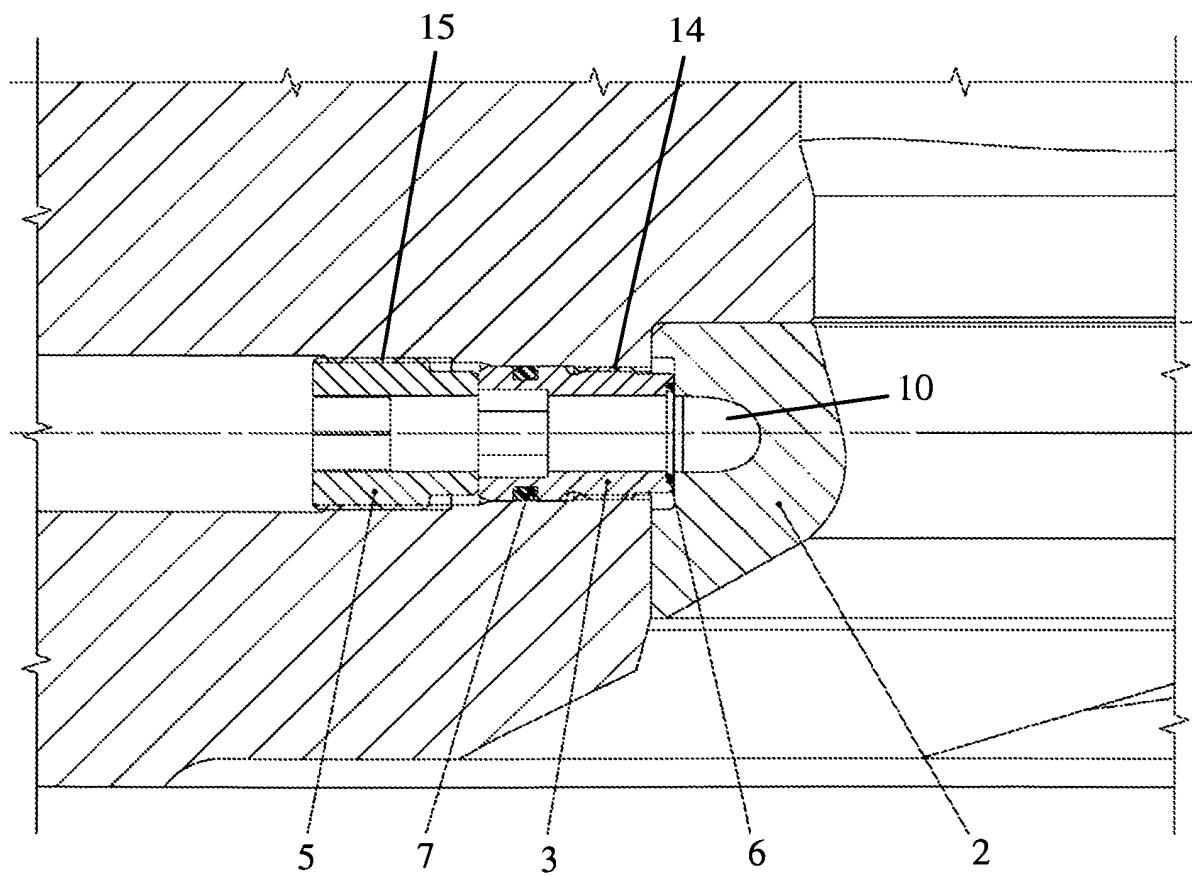


FIG. 4

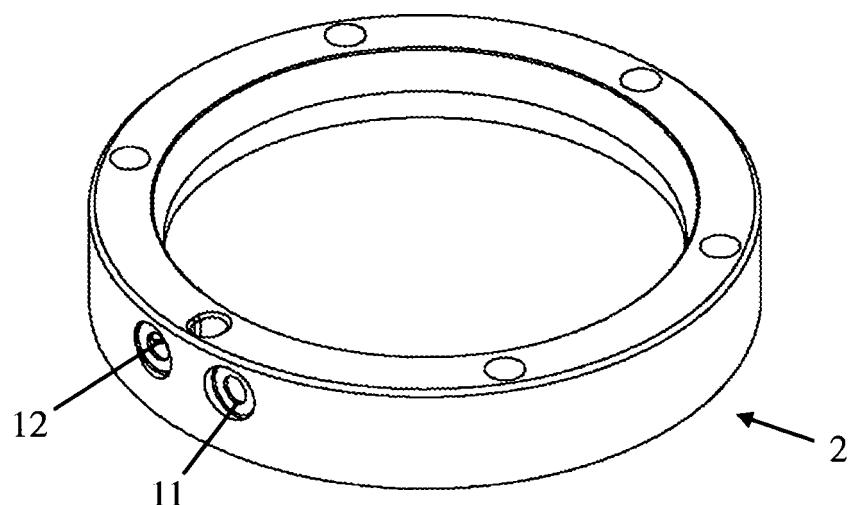


FIG. 5

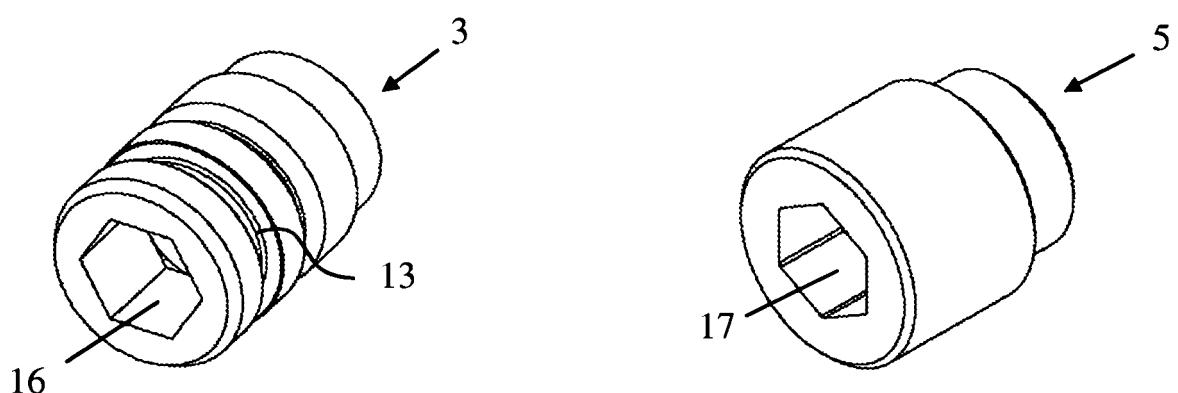


FIG. 6

FIG. 7

**REFERENCES CITED IN THE DESCRIPTION**

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