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(54) **Üzemanyag elosztó vezeték**

Fuel distributor pipe

The invention relates to a tubular fuel distributor pipe, which is closed at its ends with a plug which is inserted into the fuel distributor pipe and is soldered thereto.

Fuel is usually distributed to individual cylinders of an internal combustion engine through a tubular fuel distributor pipe which is arranged close to a cylinder head and is fastened thereto by means of fastening elements. Arranged at the same spacings as the cylinders, openings are provided on the fuel distributor pipe into which injection valves are inserted which inject the fuel into the combustion chamber of the respective cylinder. At its ends the fuel distributor pipe is closed off by plugs or stoppers. Either the fuel supply into one of these stoppers is also integrated in the fuel distributor pipe or the fuel distribution occursat another location on thefuel distributor pipe.

Usually either petrol or diesel is used as fuel. Nowadays,fuel is injected directly into the combustion chamber of the respective cylinder,both in diesel enginesand in modern petrol engines. However, the operating pressures in the fuel distributor pipe differ significantly between diesel and petrol. The pressure required for the direct injection of diesel is relatively high. In so-called common rail technology the pressure is about 1800 bar and increases to 2500 bar in so-called pump-nozzletechnology. In the case of petrol the usual working pressures are about 1 to 100 bar. Only in the case of a high pressure direct injection into a petrol motor does the fuel distributor pipe have to be designed for an operating pressure of 200 to 800 bar. This results in differences in the construction of the fuel distributor pipe depending on whether the fuel distributor pipe is used for a diesel engine, a petroiengine or a petroiengine with modern direct injection at relatively high pressure.

DE 10 2009 029 219 A1 discloses a fuel distributor pipe for a diesel combustion engine. This fuel distributor pipe is a solid fuel distributor pipe in which all the connections for the injection valves are moulded on in one piece. At the ends,plugs are screwed into the fuel distribution strip by means of screw threads. The wall thickness of the fuel distributor pipe is so great that a pipe wall of the

fuel distributor pipe is provided at its end with an internal recess and the plug engages with the recess,and the screw thread is introduced into the tube wall with the recess.

A similar construction of a fuel distributor pipe for diesel combustion engines is disclosed in DE 101 62 203 A1. In a one-piece forged pipe, a pipe wall of the fuel distributor pipe is provided at its end with an internal recess and a screw thread into which a plug is screwed.

Wall thicknesses of this magnitude are not available in fuel distributor pipes for petrol, because here the entire fuel distributor pipe is made of a relatively thin-walled tube due to the significantly lower operating pressures. At an injection pressure of less than 10 bar, a generic fuel distributor pipe is made,for example, of a stainless steel pipe with a wall thickness of less than 1 mm. Typically, end plugs are soldered to the fuel distributor pipe. This construction is not possible in a fuel distributor pipe for a high-pressure diesel application because it cannot withstand the operating pressure of more than 1800 bar.

DE 100 42 540 C1 discloses a thin-walled fuel distributor pipe, which is made of an inner tube and a reinforcement surrounding the inner tube. On its end face, the inner tube is closed off with a plug at one end, whileat the other end a plug is arranged into which a connecting line is inserted. The plugs are pushed into the inner tube and connected thereto by a material connection.

DE 10 2008 044 923 A1 also shows a fuel distributor pipe which is closed off by plugs at its ends. Both plugs are in the form of a cup-like deep-drawn or sheet metal component, inserted into the fuel distributor pipe and soldered thereto in the same way asother connection components.

Provided that the operating pressure in fuel distributor pipes for petrol motors is in a range of a few bar, the construction described above is operationally safe. However, problems arise when a fuel distributor pipe for petrol is required to safely withstand an operating pressure of 200 to 800 bar, but it still does not make sense to resort to the forging options conventional in the diesel sector as

the operating pressure is not high enough to warrant this. In particular, the joint between plug and fuel distributor pipe is subjected to different loads. The loads consist of a thrust force resulting from the inner pressure of the fuel on the inner surface of the plug, and a tensile force at the joint which results from the internal pressure in the pipe applied to the inner surface of the pipe. As a consequence, the force flow in the joint is deflected and thus causes increased tensions in the joint.

The problem of the present invention is thus to configure a generic tubular fuel distributor pipe, which is closed off at its endsby a plug which is inserted into the fuel distributor pipe and is soldered thereto, so as to withstand an operating pressure of 200 to 800 bar.

The invention solves this problem with the features of claim 1. According to this, in a tubular fuel distributor pipe which is closed off at its end by a plug inserted into the fuel distributor pipe and soldered to the fuel distributor pipe, a pipe wall of the fuel distributor pipe is provided with an internal recess at the end of the fuel distributor pipe and the plug engages with the recess. This means that the pipe wall of the fuel distributor pipe is machined at the ends that are to be closed off so that, after joining, the thickness of the pipe wall of the fuel distributor pipeis continued in the plug. For this, the plug has ashoulder on the endwhich is to be introduced into the fuel distributor pipe, so that an inner diameter of the plug at this pointis equal to an inner diameter of the fuel distributor pipe without the recess. In this way the shoulder of the plug ends flush with the pipe wall of the fuel distributor pipe. As a result the flow of force is not deflected. A similar distribution of tension is formed in the fuel distributor pipe and in the plug. In particular, there is nochange in stiffness and hence no notch effect at the joint. In one particular embodiment, the plugcomprises on its outer circumference a groove located inside the fuel distributor pipe for receiving a solder ring. The shoulder on the plug prevents the solder from flowing into the inside of the fuel distributor pipe. The solder remains in the region of the groove and the immediately adjacent flat regions of the plug, thereby ensuring that sufficient solder is available for a materially bonding connection of the plug and the fuel distributor pipe. In anotherpreferred embodiment, a passage for fuel is formed in

the plug, this passage having at least two different-sized diameters. For improved handling, the plugcomprises on its outer circumference a marking which is located outside the fuel distributor pipe. The plug and the fuel distributor pipe are designed for an operating pressure of 200 to 800 bar and are generally used for petrolas the fuel.

The invention is hereinafter described in more detail by reference to the Figures, wherein:

Fig. 1 is a plan view of a fuel distributor pipe(1) according to the invention,

Fig. 2 is a longitudinal section through the fuel distributor pipe (1) according to the invention,

Fig. 3 is a detailed view of the connection of the plug (5) of Fig. 2 with the fuel distributor pipe (1),

Fig. 4 shows the plug (5) of Fig. 3 on a larger scale with the length ratio indicated,

Fig. 5 shows an alternative plug (14) with the length ratio indicated.

Fig. 1 shows the fuel distributor pipe (1) according to the invention with a pipe wall (2), connection sockets (3) for injection valves and fasteners (4) for attaching to a combustion engine, in plan view. At its ends, the fuel distributor pipe (1) is closed off with two different plugs (5) and (6).

Fig. 2 shows a longitudinal section through the fuel distnbutor pipe (1) according to the invention. Fuel can be supplied through the plug (6) by way ofthe passage (12).An operating pressure of 200 to 800 bar is produced in the fuel distributor pipe (1) by means of a high-pressure pump (not shown). The passage (12) has different diameters, i.e., the diameter decreases in the direction of the fuel distributor pipe (1). This serves to slow down and calm the inflowing fuel.An opening (10) is provided in the plug (5), in which there is a pressure sensor (not shown) which monitors the pressure inside the fuel distributor pipe (1). The fuel is

supplied to cylinders (not shown) of the combustion engine via the connection sockets (3). Alternatively, both plugsmay have a passage for fuel.

Fig. 3 shows the plug (5) and the connection with the fuel distributor pipe (1) in detail. The plug (5) has a stop (13). The plug (5) is inserted into the fuel distributor pipe (1) up to this stop (3). At its end, the plug (5) has a shoulder (7), which is located inside the fuel distributor pipe (1). The fuel distributor pipe (1) has been machined in its end region so as to form a recess (11) in the pipe wall (2) of the fuel distributor pipe (1). The shoulder (7) of the plug (5) engages in this recess (11). The shoulder (7) ends flush with the pipe wall (2). In the region of the shoulder (7) the inner diameter of the plug (5) thus corresponds to the inner diameter of the fuel distributor pipe (1) without the recess (11). The plug therefore continues the wall thickness of the fuel distributor pipe (1). This shifts the site of the jointsaway from a relatively highly stressed region. On the outer circumference of the plug (5) a circumferential groove (8) for a solder ring is formed in the plug within the fuel distributor pipe (1). The shoulder (7) ensures that the solder remains in the region of the groove (8) and adjacent joints and does not migrate uncontrollably into the interior of the fuel distributor pipe (1) and thereby weaken the joint. The recess (11), the shoulder (7) and the circumferential groove (8) are also present on the plug (6). However, whereas in the passage (12) of the plug (6) the fuel is supplied into the fuel distributor pipe (1), a pressure sensor is arranged in the opening (10) of the plug (5). Consequently, the elements essential to the invention are provided in both plugs (5, 6) and at both ends of the fuel distributor pipe (1). Because the plugs (5, 6) are not completely identical in construction, however, the plug (5) has a marking (9) on its outer circumference located outside the fuel distributor pipe (1). The marking (9) enables a robot to distinguish between the two plugs (5) and (6) so that the plugs (5, 6) are not mixed up during the attachment of the fuel distributor pipe (1). Alternatively, a fuel distributor pipe according to the invention can also be closed off at both ends with identical plugsboth with and without passages for fuel.

Finally, the distribution of stress at the joint or at the joining seam is an important criterion for the durability of the fuel distributor pipe (1). Comprehensive strength

tests have shown that the ratio of lengths must not fall below a defined ratio between an inner length L_1 of the shoulder (7) and an outer length L_2 on the plug (5, 14). In this regard, Fig. 4 shows a magnified view of the plug of Fig. 3. One crucial factor is the inner length L_1 of the shoulder (7). L_1 is measured on the inner diameter of the plug (5), specifically from a shoulder end (15) of the shoulder (7) to a bottom (16) of the plug (5). L_2 is measured on the outer length of the plug (5). The plug (5) has a groove (8) which accommodates a solder ring (not shown in detail). The groove (8) weakens the plug (5). In addition, a soldering surface (17) from the groove (8) to the shoulder end (15) of the shoulder (7) forms the supporting connection for the joint. The strength of the connection results from this soldering surface (17). If the plug (5) is thus joined to the pipe wall (2) of the fuel distributor pipe (1) by means of a solder ring, L_2 is measured from the groove (8) to the shoulder end (15). When the outer length L_2 of the soldering surface (17) on the plug (5) thus determined is divided by the inner length L_1 of the shoulder (7), the ratio should be greater than or equal to 2, i.e., $L_2:L_1 \geq 2$.

As an alternative to the solder ring, however, the plug may also be pasted with a solder. In this case there is no need for a groove for receiving the solder ring. Such an embodiment is shown in Fig. 5. In the plug (14) shown here, a soldering surface (18) extends from the stop (13) to the shoulder end (15). In this case, L_2 is also measured from the stop(13) to the shoulder end (15) of the plug (14). As in the case of the plug (5), L_1 is measured from the shoulder end (15) to the bottom (16). Here, too, the optimum tension ratio in the joint is $L_2:L_1 \geq 2$.

In Figs. 3 to 5, D1 designates the inner diameter of the fuel distributor pipe (1) without the recess (11) and the inner diameter of the plug (5, 6). The inner diameter D1 of the plug (5, 6) in the region of the shoulder (7) corresponds to the inner diameter D1 of the fuel distributor pipe (1) without the recess (11). D2 designates the outer diameter of the shoulder (7) or the inner diameter of the pipe wall (2) of the fuel distributor pipe (1) in the region of the recess (11). D3 designates the outer diameter of the fuel distributor pipe (1).

LIST OF REFERENCE NUMERALS

1	fuel distributor pipe
2	pipe wall
3	connection socket
4	fastener
5	plug
6	plug
7	shoulder
8	groove
9	marking
10	opening
11	recess
12	passage
13	stop
14	plug
15	shoulder end
16	bottom
17	soldering surface
18	soldering surface
L_1	inner length
L_2	outer length

714370/DO

ÜZEMANYAG ELOSZTÓ VEZETÉK

SZABADALMI IGÉNYPONTOK

1. Csőszerű üzemanyag elosztó vezeték (1), amely a végoldalain egy dugasszal (5, 6) van lezárva, amely az üzemanyag elosztó vezetékbe (1) be van csúsztatva és forrasztva van, azzal jellemezve, hogy az üzemanyag elosztó vezeték (1) csőfala (2) a végoldalain egy visszaugrással (11) van ellátva és a dugasz (5, 6) a visszaugrással (11) kapcsolatban van, ahol a dugasz (5, 6) az üzemanyag elosztó vezetékbe (1) bevezetett oldalán egy kinyúlást (7) tartalmaz, úgy, hogy a dugasz (5, 6) belső átmérője azon a helyen azonos az üzemanyag elosztó vezeték (1) visszaugrás (11) nélküli belső átmérőjével, és hogy a dugasz (5, 6) kinyúlása (7) az üzemanyag elosztó vezeték (1) csőfalába (2) van süllyesztve.

2. Az előző igénypontok egyike szerinti üzemanyag elosztó vezeték (1) azzal jellemezve, hogy a dugasz (5, 6) külső kerületi oldalon egy, az üzemanyag elosztó vezetékben (1) lévő hornyot (8) tartalmaz egy tömítőgyűrű befogadására.

3 Az előző igénypontok egyike szerinti üzemanyag elosztó vezeték (1) azzal jellemezve, hogy a dugaszon (5, 14) egy L2 külső hossz, a dugasz (5) kinyúlásának egy L1 belső hossz aránya $L2:L1 \geq 2$.

4. Az előző igénypontok egyike szerinti üzemanyag elosztó vezeték (1) azzal jellemezve, hogy a dugaszban (6) az üzemanyag számára egy átfolyó nyílás (12) van kialakítva.

5. Az előző igénypontok egyike szerinti üzemanyag elosztó vezeték (1) azzal jellemezve, hogy az átfolyó nyílásának (12) legalább két különböző nagyságú átmérője van.

6. Az előző igénypontok egyike szerinti üzemanyag elosztó vezeték (1) azzal jellemezve, hogy a dugasz (5) a külső kerületi oldalon egy, az üzemanyag elosztó vezetéken (1) kívül fekvő bevágást (9) tartalmaz.

7. Az előző igénypontok egyike szerinti üzemanyag elosztó vezeték (1) azzal jellemezve, hogy a dugasz (5, 6) és az üzemanyag elosztó vezeték (1) 200-800 bár üzemi nyomásra van tervezve.

8 Az előző igénypontok egyike szerinti üzemanyag elosztó vezeték (1) azzal jellemezve, hogy az üzemanyag alatt benzint értünk.

A meghatalmazott:

Mészárosné Dénes Katalin
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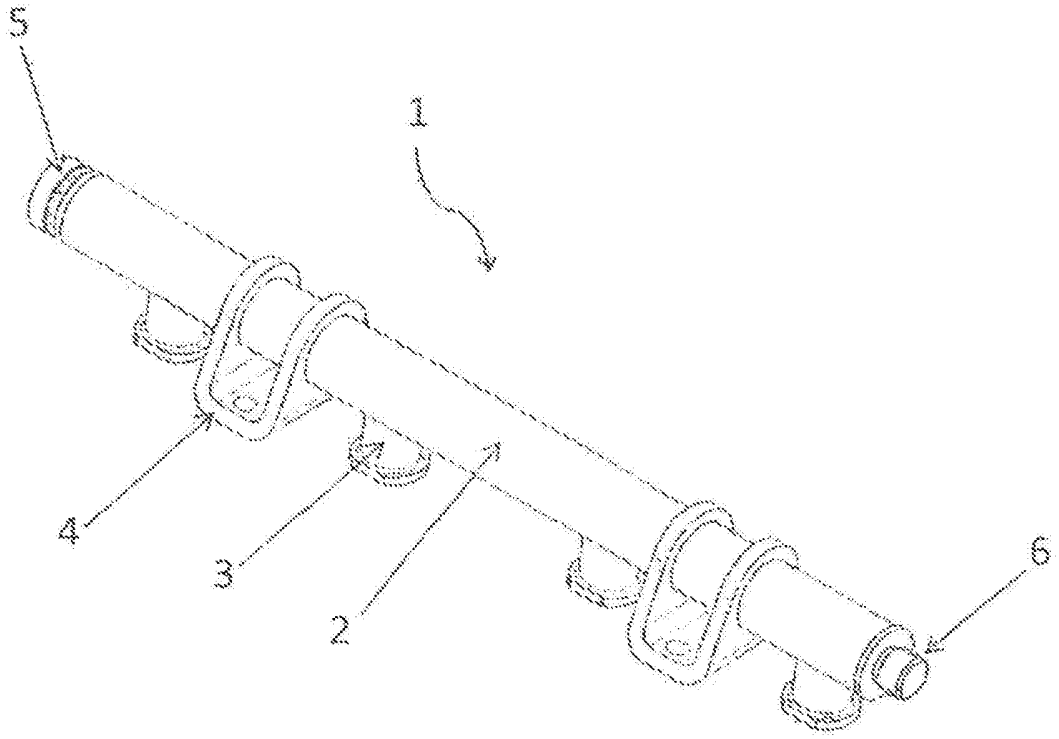
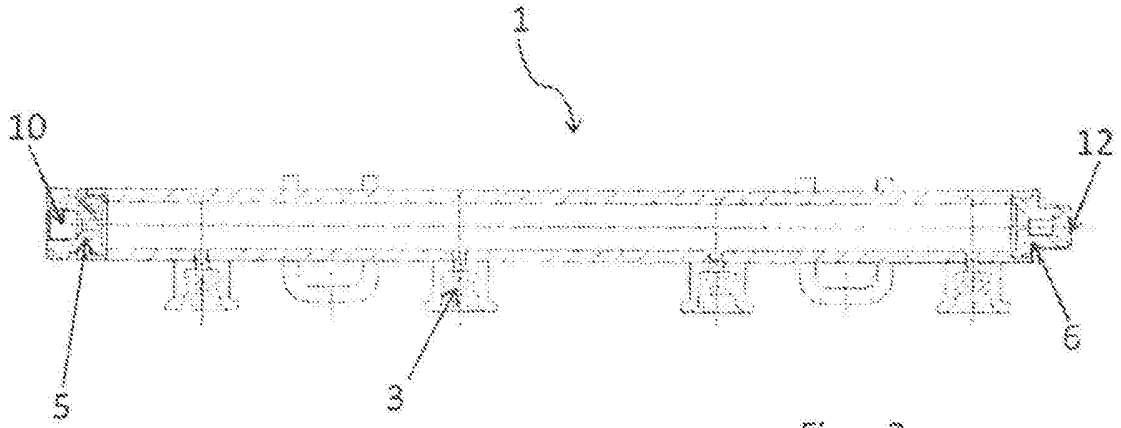
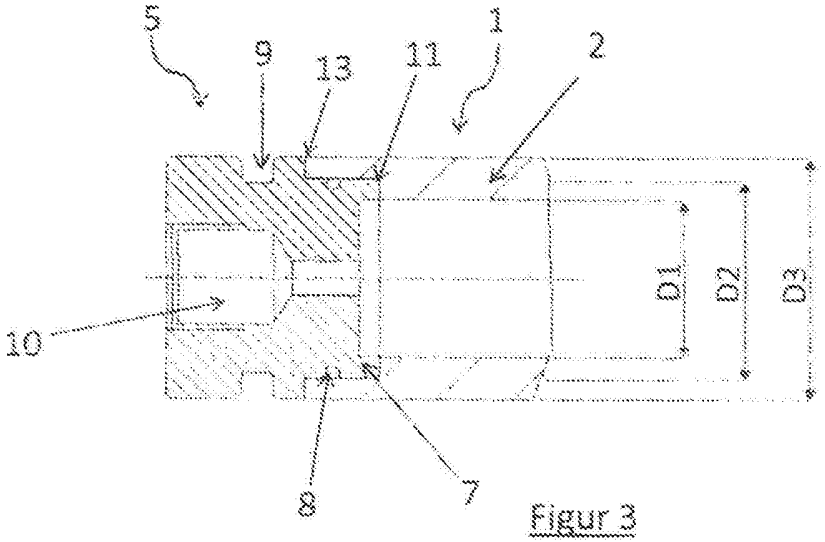


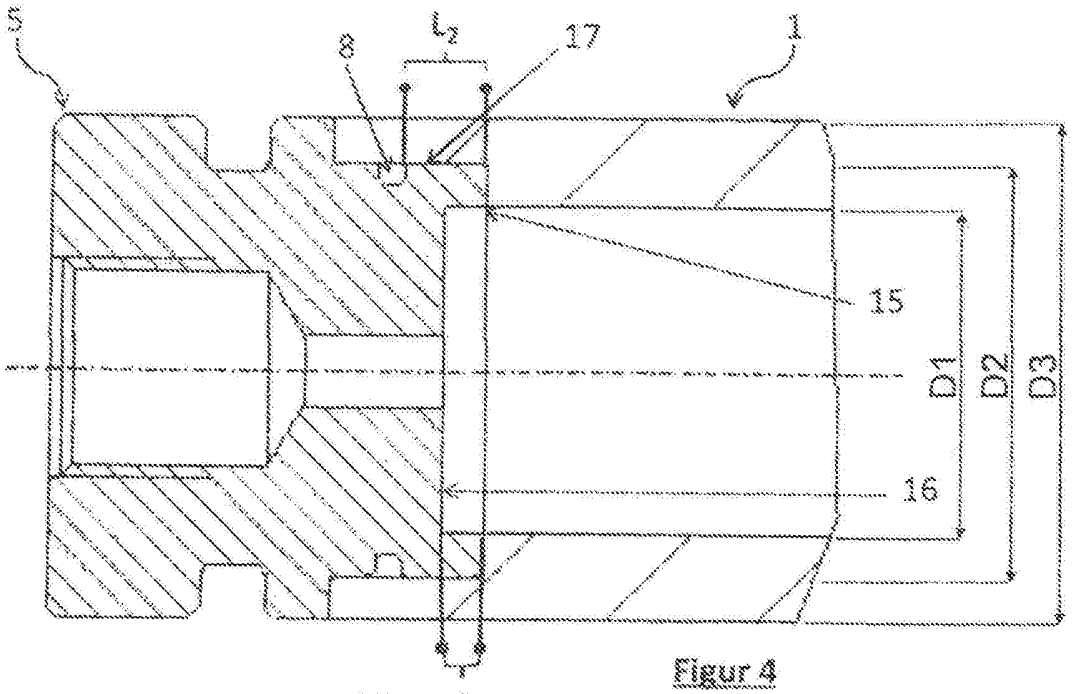
Figur 1



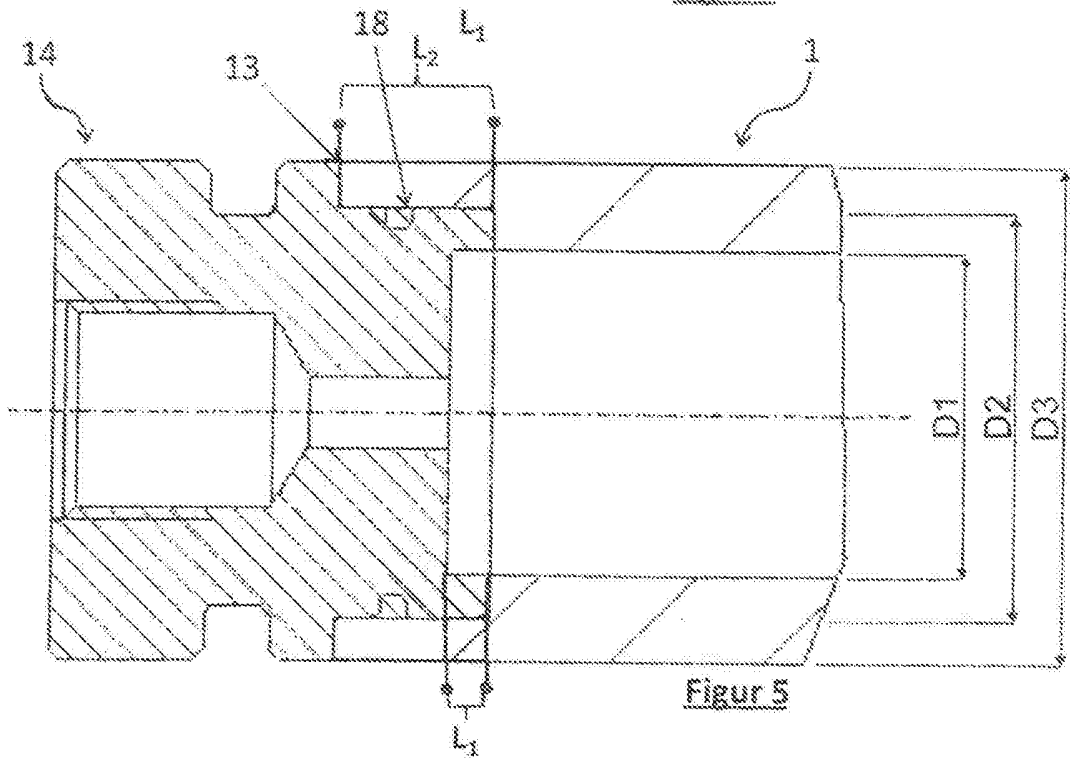
Figur 2



Figur 3



Figur 4



Figur 5