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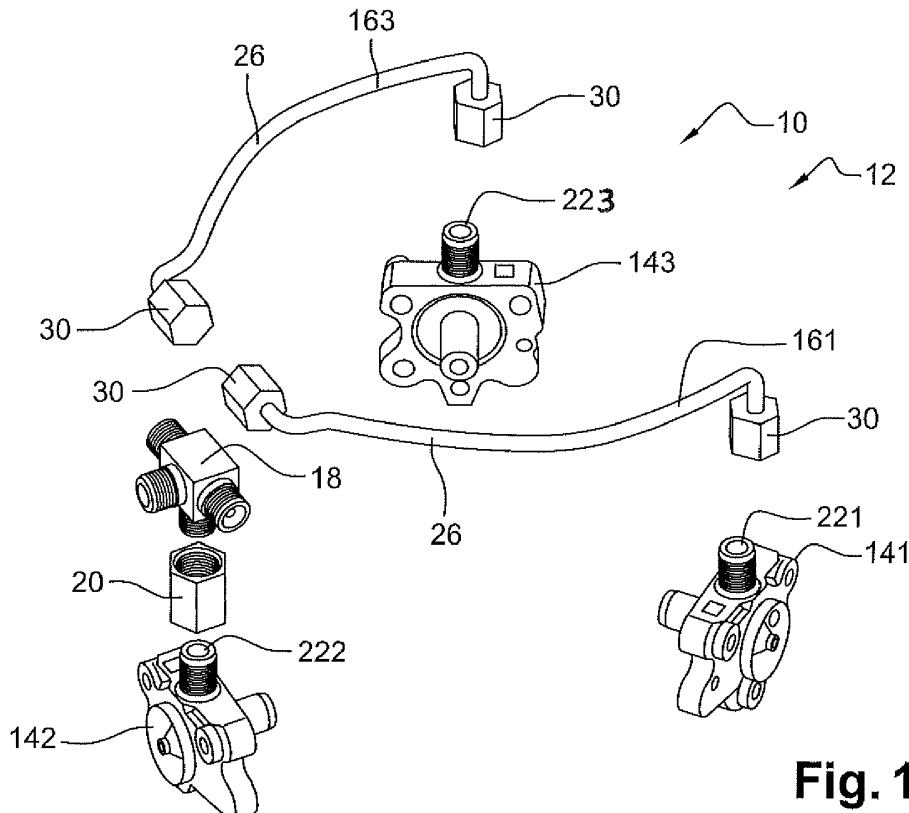
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Saint Michael (BB)(54) **HIGH PRESSURE PUMPING EQUIPMENT**

(57) A high pressure (HP) pumping equipment (10) comprising several HP pumping heads (141, 142, 143), each head having a fuel outlet (221, 222, 223), said fuel

equipment (10) further comprising a hydraulic collector member (18) for the high pressure fuel to be flown to a common rail via a single fluid communication.

**Fig. 1**

Description

TECHNICAL FIELD

[0001] The present invention relates to a high pressure fuel pumping equipment of a fuel injection equipment.

BACKGROUND OF THE INVENTION

[0002] High pressure pumps are limited by the space available in the engine bay. They are also limited by the drive torque required to rotate the pump. A further limitation is pump efficiency, affected by plunger leakage.

[0003] To increase the output of a pump, the stroke can be increased this requiring more space or, the plunger diameter can be increased, this creating more plunger leakage, lowering efficiency and increasing the peak torque required to drive the pump. Another option is to add another pumping head which helps with balancing packaging and output (capacity), and also with peak torque. The issue created is that more high pressure outlets are formed and they all need to feed the rail.

SUMMARY OF THE INVENTION

[0004] Accordingly, it is an object of the present invention to resolve the above mentioned problems in providing a high pressure (HP) pumping equipment of a fuel injection equipment comprising several HP pumping heads. Each head has a fuel inlet for fuel to enter a compression chamber and, a fuel outlet for pressurised fuel to be delivered to a common rail. The fuel equipment further comprises a hydraulic collector member provided with a plurality of inlets each one being connected to one fuel outlet and, a single outlet for the high pressure fuel to be flown to said common rail via a single fluid communication.

[0005] Said collector member may comprise a body wherefrom protrude said inlets and single outlet.

[0006] Each of said inlets and single outlet may define a cylinder extending from said body, said cylinder being externally threaded and internally provided with an axial drilling.

[0007] One of the collector's inlet may directly be tightened to a pumping head outlet, the other head's outlet, being connected to other collector's inlets, via individual high pressure pipes.

[0008] Said one collector's inlet may directly be tightened to a pumping outlet may comprise a conical male end protruding at the end of the cylinder, the axial drilling opening at the top of said conical male protrusion, said male conical protrusion defining a male seat adapted to be complementary sealingly engaged against a female conical seat provided on the head's outlet.

[0009] Said one collector's inlet and said a pumping head outlet may both define cylindrical extensions externally threaded to the same nominal diameter and same lead, the head's outlet being threaded in the right-hand

direction and the collector's inlet being threaded in the left-hand direction. Said collector's inlet and said head's outlet are tightened to one another by a nut internally threaded at the head's outlet end in the right-hand direction and, at the collector's inlet end in the left-hand direction.

[0010] The HP pumping equipment may further comprise a non-return check valve arranged in said single outlet, said valve opening when the fuel pressure exiting the pump heads exceeds a predetermined threshold.

[0011] In a particular embodiment, the HP pumping equipment comprises three pumping heads, the collector member having three inlets, and a single outlet.

[0012] Said collector member may have a parallelepiped body, each of the three inlets and the single outlet extending from a different face.

[0013] The invention further extends to a fuel injection equipment of an internal combustion engine, said equipment comprising a HP pumping equipment as described above.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention is now described by way of example with reference to the accompanying drawings in which:

Figure 1 is an exploded view of a fuel injection equipment as per the invention.

Figure 2 is the equipment of figure 1 after assembly. Figure 3 is a detailed of assembly of a pump outlet and a collector member.

Figures 4 and 5 and 3D views of said collector member.

Figure 6 is a partial detail of the equipment shown on figures 1 and 2.

Figure 7 is a section view of the part shown on figure 3.

Figure 8 and 9 are 3D sections of said collector member.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0015] In reference to figures 1 and 2 is presented a high pressure (HP) pumping equipment 10 of a fuel injection equipment 12 of an internal combustion engine, said pumping equipment 10 having three pumping heads 141, 142, 143 hydraulically interconnected via two HP pipes 161, 163, a hydraulic collector member 18 and a nut 20.

[0016] For clarity of the presentation, said three pumping heads 141, 142, 143 are shown substantially at 120° from one another while, in use on an engine, said heads 141, 142, 143 are coaxially arranged one behind the other. The head shown bottom right of figure 1 is referred as the first head 141, the head shown bottom left is the second head 142 and the head on top of figure 1 is the third head 143. Also the HP pipe joining the first head

141 to the second head 142 is the first pipe 161 and, the HP pipe joining the third head 143 to the second head 142 is the third pipe 163.

[0017] The example chosen for the description is a diesel HP pumping equipment comprising three aluminium pumping heads. In alternatives not shown the invention can easily be implemented in a system having two, four, five or more pumping heads.

[0018] Each of the heads 141, 142, 143 has a body housing a pressurising unit such as a rotating camshaft urging a piston to reciprocal displacement that vary the volume of a compression chamber, fuel at low pressure entering said chamber via an inlet and, after being pressurised, being expelled via an outlet.

[0019] In the fuel injection equipment 12, the fuel at low pressure stored in a tank is sucked by a feed pump, such as a vane pump, and is flown to the inlets of the pumping heads 141, 142, 143. After being pressurised the fuel exits said three heads via three outlets 221, 222, 223 and is delivered to a HP reservoir, known as a common rail, wherefrom HP fuel is distributed to fuel injectors.

[0020] Each head outlet 221, 222, 223 is a threaded male cylinder extending from the body and being externally threaded TM1 in the standard right-hand direction. Said head outlets are provided with an axial drilling defining the outlet channel enabling the HP fuel to flow off the compression chamber, said outlet channel opening at the top of the male cylinder and there enlarging to define a female conical seat 24. In other words, each outlet forms a right-hand-hollow-screw.

[0021] Each of the first 161 and third 163 HP pipes comprise a pipe 26, per se, which is shaped to the particular engine it is due to equip and also to the respective location of the heads 141, 142, 143 of the HP pumping equipment 10. Said pipe 26 extends between two opposite ends shaped to form a male conical seat 28 complementary received in the female conical seat 24 of the head outlets. Moreover, at each end of the pipe is arranged a nut 30 having a female thread TF1 complementary to the head male thread TM1, the tightening of said nut 30 enabling to sealingly press against one another the male 28 and the female cones 24.

[0022] The collector member 18 has a parallelepiped rectangle body 32 and is provided with a first inlet 341, a second inlet 342, a third inlet 343 and a single outlet 36, each of said three inlets and single outlet being a male cylinder externally threaded and provided with an axial drilling 38 forming channels that join each other inside the body 32.

[0023] The first inlet 341 extends from a body first face and is in fluid connection with the outlet 221 of the first pumping head via the connection of the first pipe 161. The second inlet 342 extends from a body second face and is directly connected to the outlet 222 of the second pumping head. The third inlet 343 extends from a body first face and is in fluid connection with the outlet 223 of the third pumping head via the connection of the third pipe 163. The outlet 36, extending from a body fourth

face is arranged to be connected to the common rail.

[0024] The outlet 36 and said first and third inlets are identical to the pumping heads outlets 221, 222, 223 as they are all male cylinders extending from their respective faces of the body 32, externally threaded in the right-hand direction TM1 and provided, on their end face, with a female conical seat 24 adapted to seal against the male conical seat 28 of a HP pipe.

[0025] The thread of the second inlet 342 has identical lead and pitch diameter as the threads TM1 of the other inlets but, it differs by a left-hand male thread TM2. Moreover, a male cone protrudes from the end face of said second inlet 342 there defining a male conical seat 28, particularly visible on figures 3 and 5, adapted to engage and seal against the female seat 24 of the outlet 222 of the second pumping head.

[0026] In other words, the outlet 36, the first 341 and the third inlets 343 are right-hand-hollow-screws and, the second inlet 342 is a left-hand-hollow-screw, all having same nominal diameter and same lead.

[0027] Said second inlet 342 of the collector member and the outlet 222 of the second pumping head directly connect to one another via the nut 20 that has externally an hexagonal shape for complementary engagement of a tightening tool and, is internally provided with a female right-hand thread TF1 on one half and with a female left-hand thread TF2 on the other half.

[0028] This arrangement of right-left opposed threads enables to assemble the collector member 18 onto the second pumping head 142 by only rotating and tightening the nut 20 keeping the collector member 18 in position. When the nut 20 makes one turn it engages on the outlet 222 of the second pumping head by a distance of one lead and, on the opposite end the collector member 18 also engages the nut 20 by one lead.

[0029] As shown on figure 7, the collector member 18 is internally provided with said drillings 38 extending between said conical seat face 24, 28 and a merging area 40 that, on the example shown is central to the parallelepiped body 32.

[0030] The collector member 18 may further be provided with a check valve 42 arranged in the outlet 36 and, as it is presented on figures 8 and 9, the outlet drilling 38 enlarges at a distance from the merging area 40 defining a valve seat 44 opening to an outer drilling 46. A ball, a spring and a tubular retailer are inserted in said outer drilling 46. The valve 42 is naturally in a closed position wherein a spring compressed between a tubular retailer and a ball urges said ball in sealing contact against the seat 44.

[0031] In use, the valve 42 opens enabling fuel to flow out of said outlet 36 when the pressure upstream the ball exceeds a predetermined threshold generating on the ball an opening force predominant over the spring closing force.

[0032] Thanks to said arrangement the pumping equipment 10 is hydraulically connected to the rail via a single pipe, which is a major advantage over the standard

multi-heads equipment requiring multi connection points on the rail. Moreover, by hydraulically merging all the pumping heads to a common collector member 18 that is the exit toward the common rail, the pressurised flow from one head does not disturb the outlet from another head.

LIST OF REFERENCES

[0033]

TM1 male thread in clockwise direction
TF1 female thread in clockwise direction
TM2 male thread in counter clockwise direction
TF2 female thread in counter clockwise direction

10 pumping equipment
12 fuel injection equipment
141 first pumping head
142 second pumping head
143 third pumping head
161 first pipe
163 third pipe
18 collector member
20 nut
221 outlet of the first pumping head
222 outlet of the second pumping head
223 outlet of the third pumping head
24 female conical seat
26 pipe
28 male conical seat
30 nut
32 body of the collector member
341 first inlet of the collector member
342 second inlet of the collector member
343 third inlet of the collector member
36 outlet of the collector member
38 drilling
40 merging point of the drillings
42 check valve
44 outer drilling

Claims

1. High pressure (HP) pumping equipment (10) of a fuel injection equipment comprising two or more HP pumping heads (141, 142, 143), each head having a fuel inlet, for fuel to enter a compression chamber and, a fuel outlet (221, 222, 223) for pressurised fuel to be delivered to a common rail, said fuel equipment (10) further comprising a hydraulic collector member (18) provided with a plurality of inlets (341, 342, 343) each one being connected to one fuel outlet (221, 222, 223) and, a single outlet (36) for the high pressure fuel to be flown to said common rail via a single fluid communication and, wherein said collector member (18) comprises a

body (32) wherefrom protrude said inlets (341, 342, 343) and single outlet (36).

2. HP pumping equipment (10) as claimed in claim 1 wherein each of said inlets (341, 342, 343) and single outlet (36) define a cylinder extending from said body (32), said cylinder being externally threaded (TM1, TM2) and internally provided with an axial drilling (38).
3. HP pumping equipment (10) as claimed in claim 2 wherein one of the collector's inlet (342) is directly tightened to a pumping head outlet (222), the other head's outlet (221, 223) being connected to other collector's inlets (341, 343) via individual high pressure pipes (161, 163).
4. HP pumping equipment (10) as claimed in claim 3 wherein said one collector's inlet (342) directly tightened to a pumping outlet (222) comprises a conical male end (28) protruding at the end of the cylinder, the axial drilling opening at the top of said conical male protrusion, said male conical protrusion defining a male seat adapted to be complementary sealingly engaged against a female conical seat (24) provided on the head's outlet (222).
5. HP pumping equipment (10) as claimed as in any of the claims 3 or 4 wherein said one collector's inlet (342) and said a pumping head outlet (222) both define cylindrical extensions externally threaded (TM1, TM2) to the same nominal diameter and same lead, the head's outlet (222) being threaded in the right-hand direction (TM1) and the collector's inlet (342) being threaded in the left-hand direction (TM2), said collector's inlet (341) and said head's outlet (222) being tightened to one another by a nut (20) internally threaded at the head's outlet end in the right-hand direction (TF1) and, at the collector's inlet end in the left-hand direction (TF2).
6. HP pumping equipment (10) as claimed in any one of the preceding claims further comprising a non-return check (42) valve arranged in said single outlet (36), said valve opening when the fuel pressure exiting the pump heads exceeds a predetermined threshold.
7. HP pumping equipment (10) as claimed in any one of the preceding claims comprising three pumping heads (141, 142, 143), the collector member (18) having three inlets (341, 342, 343) and a single outlet (36).
8. HP pumping equipment (10) as claimed in claim 7 wherein said collector member (18) has a parallelepiped body (32), each of the three inlets and the single outlet extending from a different face.

9. Fuel injection equipment (12) of an internal combustion engine, said equipment comprising a HP pumping equipment (10) as claimed as in any one of the preceding claims.

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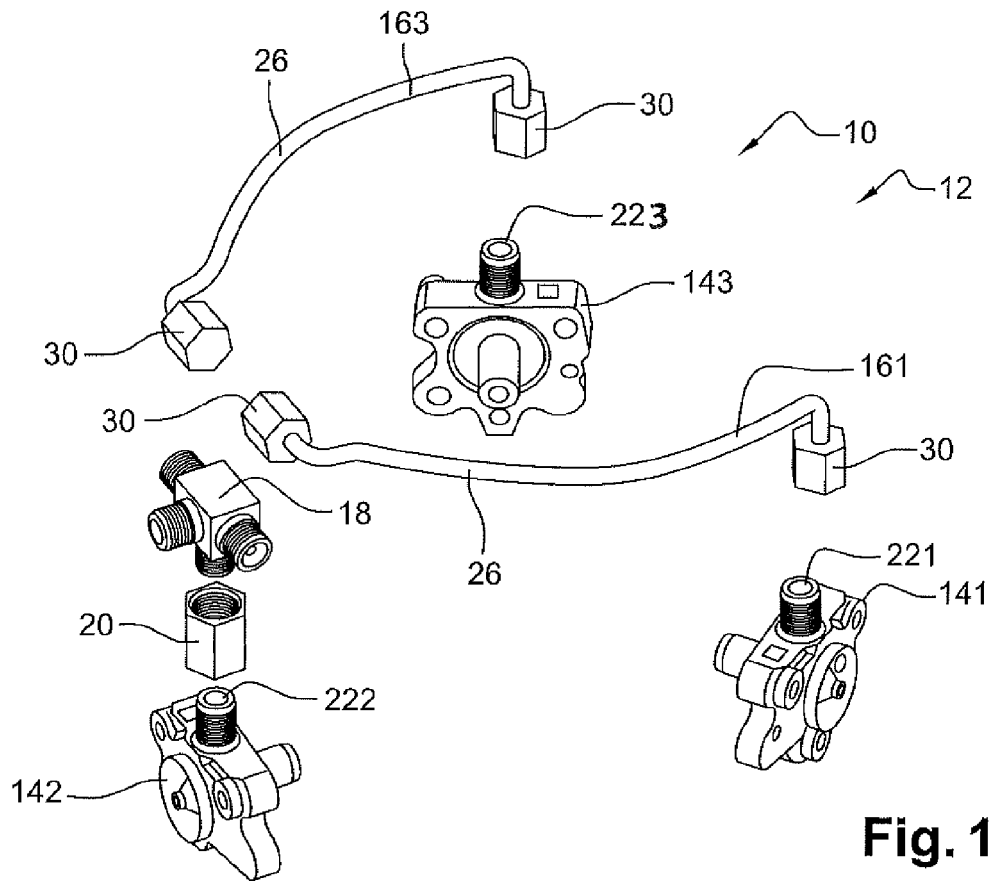


Fig. 1

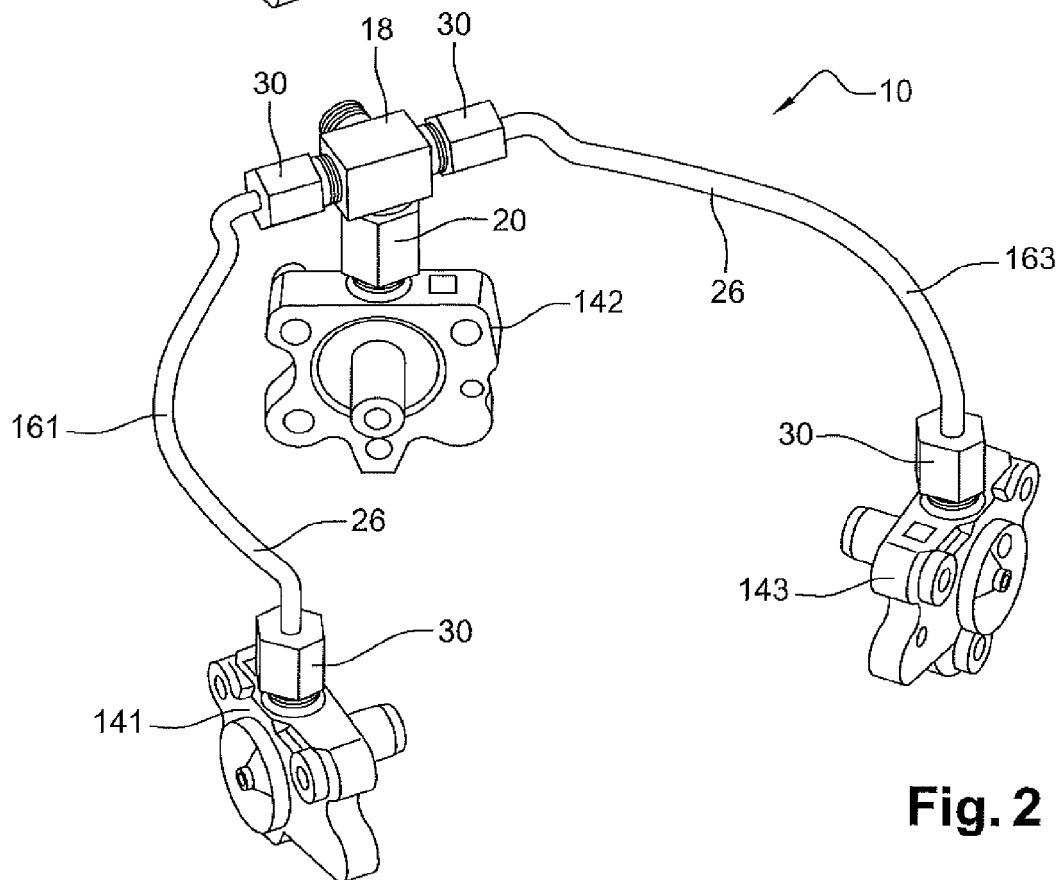


Fig. 2

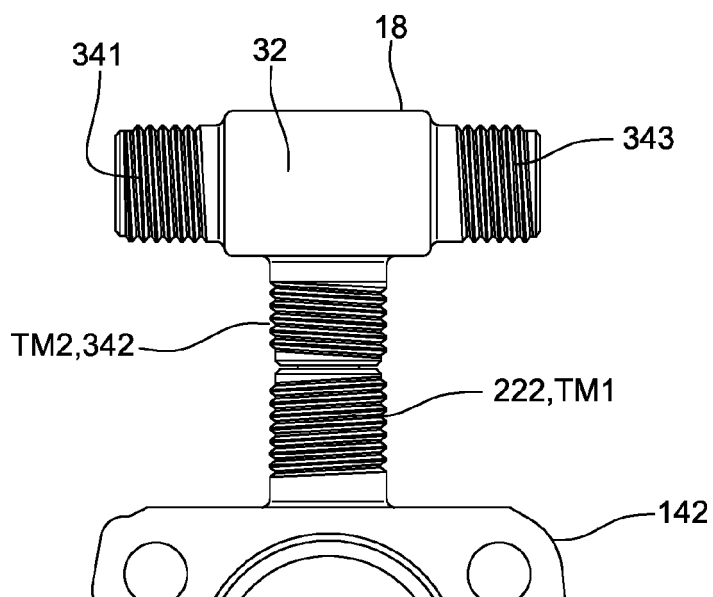


Fig. 3

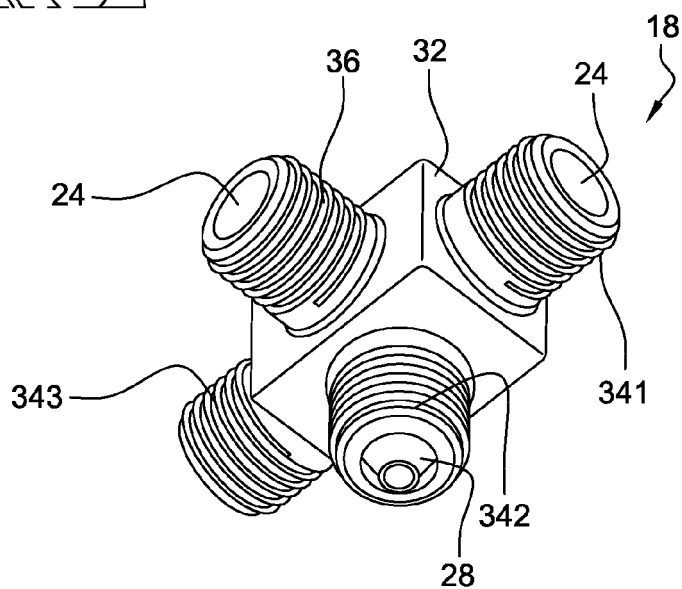


Fig. 4

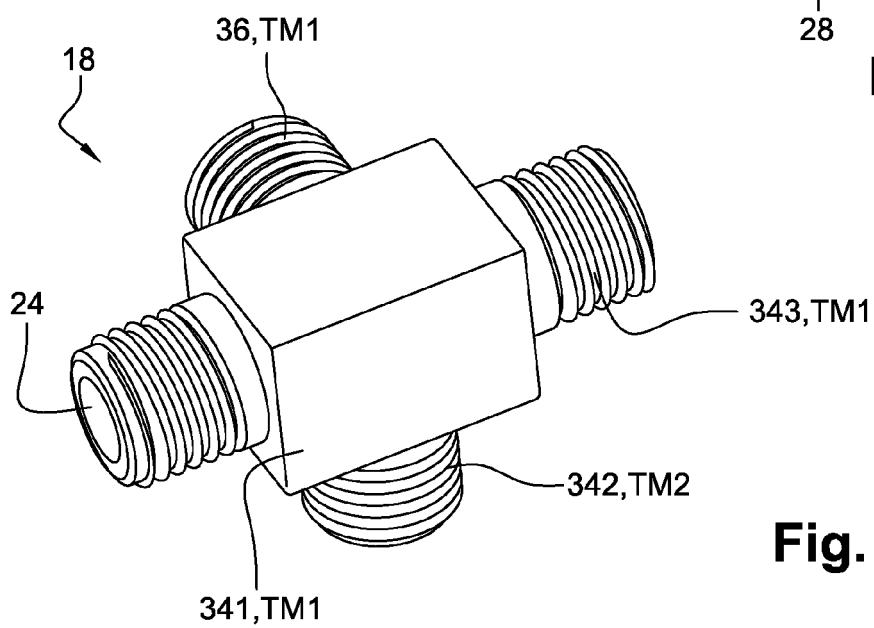


Fig. 5

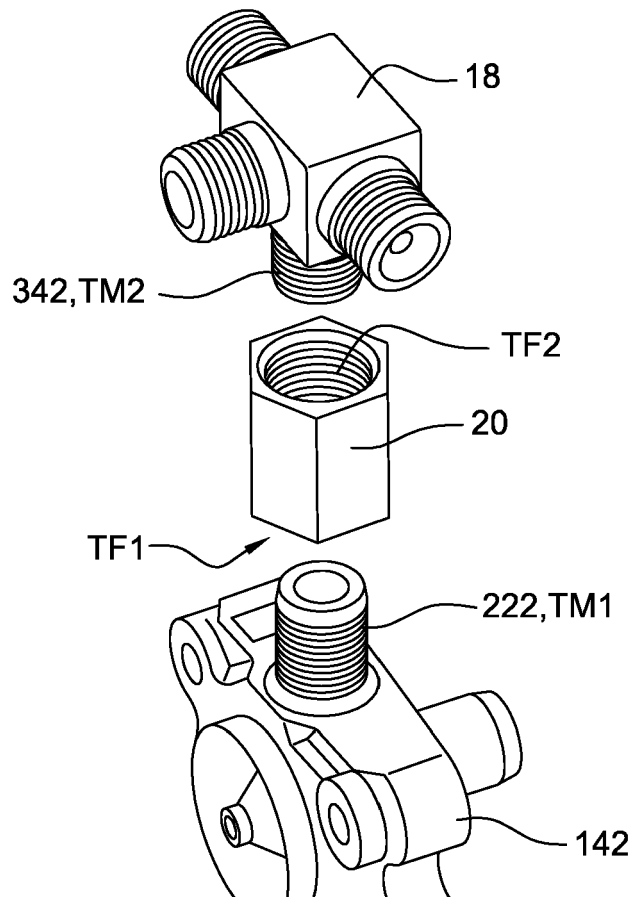


Fig. 6

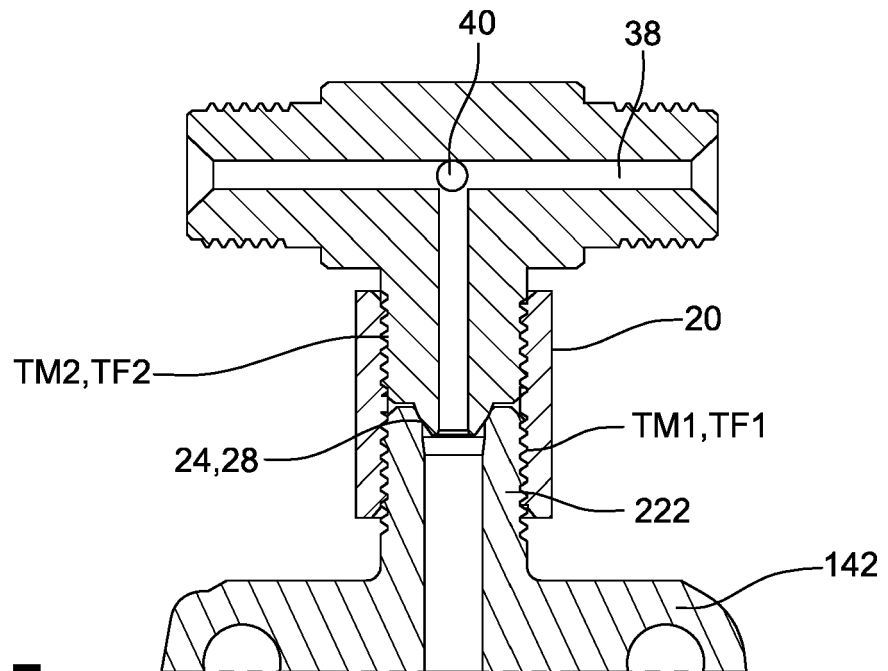


Fig. 7

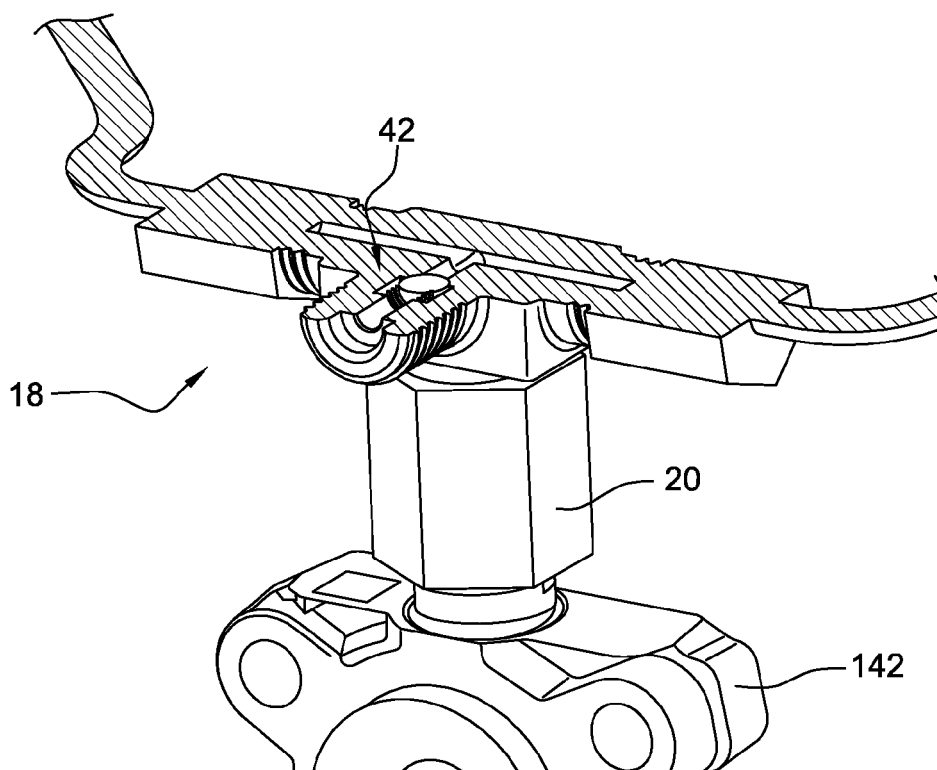


Fig. 8

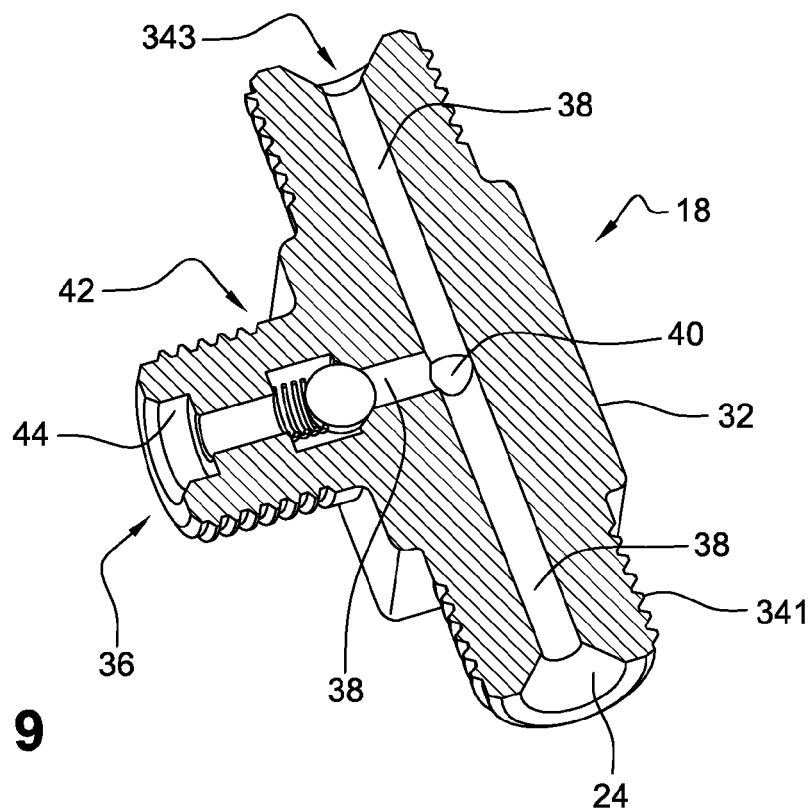


Fig. 9



EUROPEAN SEARCH REPORT

Application Number
EP 18 20 8966

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2010/060838 A1 (CONTINENTAL AUTOMOTIVE GMBH [DE]; VU NGOC-TAM [DE]) 3 June 2010 (2010-06-03) * figure 1 *	1-5,9	INV. F04B53/16 F02M63/02 F02M55/02 F02M59/06 F02M59/44 F04B53/00
X	US 5 035 221 A (MARTIN TIBY M [US]) 30 July 1991 (1991-07-30) * figures 1-7d *	1,6-9	
X	DE 100 00 981 A1 (TOYOTA MOTOR CO LTD [JP]) 27 July 2000 (2000-07-27) * figures 2-4 *	1,9	
			TECHNICAL FIELDS SEARCHED (IPC)
			F04B F02M
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 15 March 2019	Examiner Morales Gonzalez, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 18 20 8966

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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15-03-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2010060838 A1	03-06-2010	DE 102008059636 A1 WO 2010060838 A1	02-06-2010 03-06-2010
US 5035221 A	30-07-1991	US 5035221 A US 5311850 A US 5339786 A	30-07-1991 17-05-1994 23-08-1994
DE 10000981 A1	27-07-2000	DE 10000981 A1 FR 2793848 A1 JP 3813370 B2 JP 2000205116 A	27-07-2000 24-11-2000 23-08-2006 25-07-2000