(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 754 174 A1

(12) # EUROPEAN PATENT APPLICATION

(43) Date of publication:
23.12.2020 Bulletin 2020/52

(21) Application number: **19181354.2**

(22) Date of filing: **19.06.2019**

(51) Int Cl.:
F02M 55/02 *(2006.01)*
F02M 61/16 *(2006.01)*
F02M 55/00 *(2006.01)*
F16L 47/00 *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(71) Applicant: **Vitesco Technologies GmbH**
30165 Hannover (DE)

(72) Inventors:
- **Serra, Giandomenico**
  56010 Ghezzano - S.Giuliano Terme (PI) (IT)
- **Di Domizio, Gisella**
  56017 San Giuliano Terme (IT)
- **Lorenz, Ivo**
  09112 Chemnitz (DE)

(74) Representative: **Waldmann, Georg Alexander**
Continental Automotive GmbH
Patente und Lizenzen
Postfach 22 16 39
80506 München (DE)

(54) **FUEL RAIL ASSEMBLY FOR A FUEL INJECTION SYSTEM FOR AN INTERNAL COMBUSTION ENGINE AND METHOD FOR MANUFACTURING A FUEL RAIL ASSEMBLY**

(57) A fuel rail assembly (2) for a fuel injection system for a multi-cylinder internal combustion engine is provided. The fuel rail assembly comprising a fuel rail (4) comprising an elongate generally tubular body forming a fuel reservoir and having formed integrally therewith a fuel inlet port (6), and a plurality of fuel outlet ports (12) spaced along the fuel rail wherein each outlet port (12) comprises a fuel injector cup (10) adapted to receive a fuel injector. The fuel injector cup (10) is located on the fuel rail (4) by means of a connection device (14).

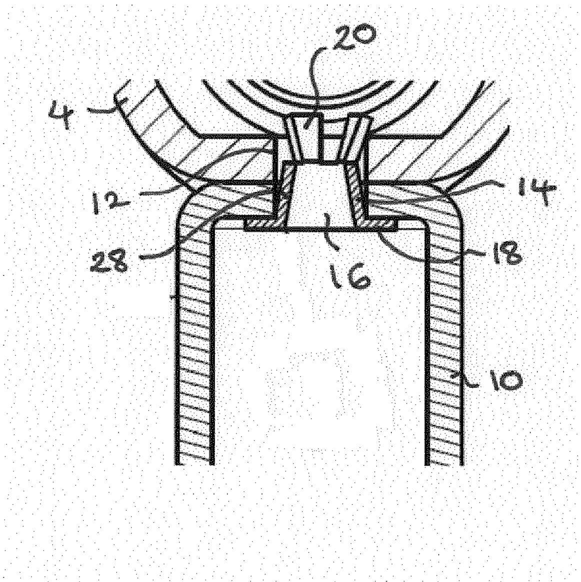

Fig. 2a

EP 3 754 174 A1

Description

[0001] The present disclosure relates to a fuel rail assembly for a fuel injection system for an internal combustion engine and particularly but not exclusively to a fuel rail assembly for incorporation in a gasoline fuel injection (GDI) system for a multicylinder internal combustion engine.

[0002] A fuel rail comprises an elongate reservoir for fuel. Fuel is supplied to a fuel inlet of the fuel rail by a high-pressure fuel pump and fuel outlets for supplying fuel to a fuel injector for injecting fuel directly into each cylinder of the engine are spaced along the length of the fuel rail. The fuel rail is typically a straight tubular fuel rail element formed of a metal such as stainless steel typically by forging, deep drawing or milling.

[0003] Further components such as the fuel inlet port, fuel outlet ports and mounting brackets are typically secured to the tubular element by brazing. An injector cup may secured to each outlet port, for example by brazing, the injector cup being adapted to receive a fuel injector through which fuel is injected into the associated combustion chamber.

[0004] EP 3 470 660 A discloses an example of a method for producing a brazed joint between components of a fuel rail. However, further improvements would be desirable.

[0005] According to the present disclosure there is provided a fuel rail assembly for a fuel injection system for a multi-cylinder internal combustion engine, having a fuel rail comprising an elongate generally tubular body forming a fuel reservoir and having formed integrally therewith a fuel inlet port and a plurality of fuel outlet ports spaced along the fuel rail, wherein each outlet port comprises a fuel injector cup adapted to receive a fuel injector, the fuel injector cup being located on the fuel rail by means of a connection device.

[0006] The connection device is provided as a separate part which is used to locate the fuel injector cup on the fuel rail, in particular to locate the injector cup on the outlet port. The connection device may be used to form a mechanical connection, for example a resilient connection, between the fuel injector cup and the outlet port which is also movable. The connection device may be used to initially and temporarily locate the fuel injector cup on the fuel rail before brazing is carried out to permanently attach the injector cup to the fuel rail and form the fuel rail assembly.

[0007] The connection device may be used to provide a temporary or adjustable connection between the main gallery and the cup for transportation and handling before the final brazing process by which the injector cup is firmly secured to the fuel rail. The connection device may be used in place of other attachment methods, such as spot welding, which may be used to weld the injector cup in position on the fuel rail with a temporary spot weld prior to the final brazing, but which are not always suitable. For example, spot welding may be unsuitable if the thickness of the components being welded is too small or the relative thickness of the two components is too different, or the materials are unsuitable for welding. Additionally, in contrast to a welded connection, the connection device allows the disassembly and reworking of the two components.

[0008] In some embodiments, the fuel injector cup is integrally incorporated in the outlet port, for example brazed to the outlet port.

[0009] In some embodiments, the connection device has a through bore forming part of the fuel passage between the fuel rail and the injector cup.

[0010] In some embodiments, the connection device comprises a body having a peripheral flange adapted to engage the inner face of the injector cup, the body projecting into the fuel rail in the installed condition. An end of the body opposite the peripheral flange has a plurality of resilient fingers biased outwardly into engagement with the fuel rail to retain the connection device in resilient contact with the fuel rail. This connection device can be considered to have a snap connection with the fuel rail.

[0011] In this way, the fuel injector cup is secured to the fuel rail for transportation but its precise position relative to the fuel rail can be adjusted before the final brazing stage without damaging either component.

[0012] The resilient fingers may be in resilient contact with the inner wall of the outlet port or with the inner wall of the main gallery formed by the fuel rail.

[0013] In some embodiments, the body of the connection device is generally cylindrical body. In some embodiments, the body of the connection device has a frustoconical shape.

[0014] In another embodiment, the connection device comprises a generally cylindrical body having a peripheral flange adapted to engage the inner face of the injector cup, the generally cylindrical body projecting into the fuel rail in the installed condition, wherein the end of the connection device opposite the flange is formed, or permanently deformed, to securely engage the inner face of fuel rail, for example the inner face of the main gallery.

[0015] The connection device is not limited to use with an injector cup and an outlet port and may also be used to locate other subcomponents of the fuel rail relative to one together, for example the inlet port or a sensor and the fuel rail.

[0016] By the use of this formed coupling device the two components can be secured together in their final position for transport to the final brazing station.

[0017] The present disclosure also provides a connection device for a fuel rail assembly for a fuel injection system for an internal combustion engine for securing two subcomponents of a fuel rail assembly. In some embodiments, one of said subcomponents comprising a fuel rail and the other subcomponent having a fuel passage in fluid communication with the fuel rail.

[0018] The present disclosure also provides a method of manufacturing a fuel rail assembly for a fuel injection system for an internal combustion engine for securing two sub-components of a fuel rail assembly, one of said sub-components may comprise a fuel rail and the other sub-component may have a fuel passage in fluid communication with the fuel rail. The other sub-component may comprise an injector cup.

[0019] The method comprises providing a connection device between the two sub-components, locating and securing the two sub-components with the connection device to secure the two sub-components relative to each other, for example in their final operational position, and then forming a fluid-tight seal for the fuel passage between the sub-components.

[0020] This method enables the two subcomponents to be secured together to form an intermediate product that can be further manufactured at a later stage to join the two sub-components together, in particular to form a fluid tight seal between the two sub-components, for example by brazing. A joining method such as spot welding is not used so that any deformation of one or more of the sub-components due to this joining technique is avoided. Thus the method described herein is useful for thin-walled parts which are more susceptible to deformation or even melting by spot welding depending on the material. The use of an additional separate connection device also enables the vertical displacement between the two subcomponents to be controlled and set. This may be useful in controlling and setting the width of a brazing seam, for example.

[0021] The fluid tight seal may be formed by a brazing technique. A brazing ring or brazing paste may be used.

[0022] In some embodiments, the connecting device is formed of a plastics material, in said further step, the plastics material melts. In these embodiments, the final fuel rail assembly including one or more brazed seams may not include the connection device.

[0023] In some embodiments, the connection device is made of a material that is thermally stable at the temperature used to from the fluid tight seal, for example typical brazing temperatures, and is present in the final fuel rail assembly.

[0024] In some embodiments, one of the sub-components comprises a fuel rail and the other sub-component is an injector cup. In other embodiments, one of the sub-components comprises an outlet port of the fuel rail and the other sub-component is an injector cup.

[0025] In some embodiments, the connection device comprises a through bore forming part of a fuel passage between the fuel rail and the other subcomponent, for example the injector cup. The connection device, in particular the wall of the connection device bounding the through bore, prevents braze material from entering the fuel passage. This embodiment enables the diameter of the through bore and fuel passage to be less than the diameter of the hole in the fuel rail to which the subcomponent is fitted and joined. This may be useful in providing mechanical strengthening of the joint between the fuel rail and the other subcomponent and for providing smaller diameter fuel passages, since the risk of the smaller diameter fuel passage being filled by brazing is reduced due to the intervening connection device.

[0026] In some embodiments, the connection device comprises a generally cylindrical body having a peripheral flange at a first end and a second end having a plurality of resilient fingers, the second end being opposite the first end. The connection device is inserted into the injector cup and into the fuel rail such that the peripheral flange engages the inner face of the injector cup, the generally cylindrical body projects into the fuel rail and the plurality of resilient fingers are biased outwardly into engagement with the fuel rail to retain the connection device in resilient contact with the fuel rail. The resilient fingers may be considered to provide a snap connection between the connection device and the fuel rail. This embodiment is particularly simple for attaching the subcomponent to the fuel rail.

[0027] In some embodiments, the connection device comprises a generally cylindrical body having a peripheral flange at a first end and a second end opposite the flange. The connection device is inserted into the injector cup and into the fuel rail such that the flange engages an inner face of the injector cup and the generally cylindrical body projects into the fuel rail in the installed condition. The second end of the connection device is deformed to engage the connection device and the injector cup to an inner face of fuel rail. This embodiment may be useful to provide a more secure connection since the deformation of the second end can prevent the connection device from changing position and even falling out. In some embodiments, in the undeformed state the connection device is a cone.

[0028] In some embodiments, a plurality of slots extend axially from the second end of the connection device to form a plurality of peripheral parts disposed about the periphery of the connection device. These plurality of parts may be deformable, i.e. resilient to form a snap fit connection, or permanently deformed, for example, by using a tool inserted into the through bore from the first end, to engage with the inner surface of the fuel rail.

[0029] Embodiments of the present disclosure will now be described by way of example with reference to the accompanying drawings in which:-

Figure 1	discloses a side view and a sectional view of a connection device located between an injector cup and a fuel rail,
Figure 2a	shows an enlarged view of the sectional view of Figure 1,
Figure 2b and 2c	show perspective views of the coupling device of Figure 1,
Figure 3	shows a sectional view of a formed device by which the injector cup is secured to the fuel rail,

Figure 4 shows the connection device partially formed, ready for insertion in the injector cup up prior to installation,

Figure 5 shows two views of the connection device in its deformed shape,

Figure 6 shows an alternative arrangement of a connection device secured in position by resilient deformation.

Figure 7 shows an alternative arrangement of a connection device secured in position by resilient deformation.

[0030] Referring now to Figure 1 there is shown part of a fuel rail assembly 2 comprising a fuel rail 4, a fuel inlet 6 and a fixing bracket 8 by which the fuel rail assembly is secured to an internal combustion engine. Figure 1 shows a side view, a top view and a cross-sectional view along the line A-A.

[0031] The fuel rail 4 has an outlet passage or port 12 to which an injector cup 10 is connected to provide a fuel flow passage from the fuel volume in the fuel rail 4 to the injector cup 10 and hence to a fuel injector (not illustrated) located in the fuel injector cup 10.

[0032] A connection device 14 is located between the fuel rail 4 and the injector cup 10 to secure the injector cup 10 to the fuel rail 4, the connection device 14 having a through flow bore forming part of the fuel passage though the outlet port 12.

[0033] The connection device 14 forms a coupling for securing the injector cup 10 to the fuel rail 4 in its final position, prior to the transmission of the assembly of the injector cup 10 and fuel rail 4 to a further workstation for the injector cup 10 to be brazed to the fuel rail 4 to provide a fluid tight connection between the fuel rail 4 and the injector cup 10 that is able to withstand the high pressure in the fuel rail 4.

[0034] Referring now to Figures 2a, 2b and 2c, there is shown greater detail of the connection device 14 of figure 1. The connection device 14 may be formed of stainless steel and may be formed by a pressing or deep drawing operation. In some embodiments, the connection device 14is formed of plastic. The connection device 14 has a body 28 that is generally cylindrical and has a bore forming part of the fuel flow passage. The connection device 14 has a flange 18 at a first end of the body 28 and a plurality of fingers 20 at a second opposing end of the body 28.

[0035] In operation, the connection device 14 is inserted in the injector cup 10 until the peripheral flange 18 abuts the inner face of the injector cup 10. At its other end remote from the flange 18, the connection device 14 has four upstanding resilient fingers 20 equi-distantly disposed about the periphery of the device 14. The fingers 20 are formed to be inclined outwardly as shown in Figures 2a and 2b in particular to encompass a diameter larger than the diameter of the bore 22 in the fuel rail. When the injector cup 10 is offered up to the fuel rail 4, the resilient fingers 20 are resiliently moved inwardly as the connection is pushed through the fuel passage bore 22 in the fuel rail 4. As the fingers 20 enter the fuel rail at the junction between the fuel bore 22 and the interior of the fuel rail 4, the resilient bias of the fingers 20 urges the fingers outwardly towards the inclined position to engage the exit of the fuel bore 22 to thereby ensure that the injector cup 10 is maintained in position held in contact with the fuel rail 4.

[0036] Referring now to Figure 3 there is shown an alternative embodiment, where like parts have like references, in which the connection device 14 is permanently deformed when the injector cup 10 is secured to the fuel rail 4. Figure 3 shows a side view, a top view and a cross-sectional view along the line A-A.

[0037] As shown in Figure 3, the connection device 14 is a generally cylindrical body having a through bore forming part of the fuel passage 16. At its first lower end, the connection device has a peripheral flange 18 which is adapted to engage the inner face of the injector cup 10 when the device inserted in the injector cup 10. In this embodiment, the other second end of the connection device 14 has four slots 26 extending axially to provide four equidistantly disposed peripheral parts 26.

[0038] When fully inserted, and the injector cup 10 is offered up to the fuel rail 4, the cylindrical part of the connection device enters the fuel rail 4 through the fuel passage bore 22. In this embodiment, in the installed condition, the four equidistantly disposed peripheral parts 26 are turned over outwardly to engage the inner face of the fuel rail 4, as shown in Figure 3, to secure the injector cup 10 to the fuel rail 4. The peripheral parts 26 are permanently deformed to engage the inner face of the fuel rail 4.

[0039] As shown in Figure 4, a connection device 14 according to a further embodiment is shown in a partially formed state with the peripheral flange 18 formed on the lower end. In this embodiment, the main body 28 of the connection device 14 is slightly frusto-conical with four slots 24 extending axially downwardly from its upper second free end. Figure 5 illustrates two perspective views of the connection device 14 in the installed and deformed position in which the peripheral parts 26 are bent over outwardly so as to engage the inner surface of the fuel rail 4. The provision of the slots 24 and the resultant four peripheral parts 26 greatly facilitates the forming of the ends of the peripheral parts 26 over onto the inner face of the rail 4 and their engagement with the inner surface of the fuel rail 4.

[0040] Figures 6 and 7 show a connection device 14 according to a further embodiment. Figure 6 shows a side view, a top view and a cross-sectional view along the line C-C and figure 7 shows an enlarged cross-sectional view and two perspective views of the connection device 14. In this embodiment, the connection device 14 has a frustoconical body 28 having a flange 18 at a first end and a plurality of fingers 20 at the opposing second end. The fingers 20 are equidistantly spaced about the smaller end of the frustoconical body 28 and extend outwardly such that the connection device 14 has a narrower portion or waist. In this embodiment, the tips of the fingers 20 engage with the inner face of the fuel rail 4 to provide a resilient connection between the connection device 14 and the fuel rail 4 and between the injector cup 10 and the fuel rail 4. The peripheral flange 18 engages the inner face of the injector cup 10 with the remainder of the connection device passing into the interior of the fuel rail 4. The fingers 20 are resiliently deformed in a similar manner to the embodiment described with reference to Figures 1 and 2 so that the fingers 20 of the connection device 14 engage inner face of the fuel rail 4 to secure the injector cup 10 and the fuel rail 4 together.

[0041] In this embodiment, the connection device 14 has a through bore 16 which is shaped to influence the flow of fluid into the injector cup 10 to assist in damping out oscillations in the flow of fluid into the injector cup.

[0042] The present disclosure shows a connection device for securing two fuel rail sub-components in which the components are secured together either with a resilient snap action or by a formed device which rigidly secures the two components together. The connection device may be formed of a metal such as stainless steel or a plastics material, which can melt away in the final brazing step. When formed of a metal, the connection device may be formed in stages by means of a pressing or drawing operation in which the body is formed, whereby the body may have a basic cylindrical profile, and the final stage of forming the connection is carried out when the device is assembled to the fuel rail. In a further improvement, the gap between the injector cup and the fuel rail can be controlled by means of the connection device to set the best value for an optimal brazing process.

[0043] An advantage of the formed device is that the positioning of the injector cup relative to the fuel rail can be accurately controlled prior to transport of the assembly to the final brazing station. With the use of resilient fingers, it is possible for the injector cup to move slightly relative to the fuel rail transportation but this adjustment can be corrected prior to the final brazing step. The use of resilient fingers has the advantage that should the injector cup, for example, be damaged during transit, it is relatively easy to remove the cup and the connection device for repair.

[0044] When the engagement of the two components is by means of the resilient snap action, the force of engagement can be adjusted by means of the size and thickness of the resilient fingers similarly, the parts of the connection device can be changed for example by removing material by means of holes or slots to increase the elasticity of the component. The profile of the fluid passage through the connection device can be varied along its length to control or dampen oscillations in the fuel pressure.

[0045] The fuel rail assembly may comprise the following features:

- A coupling between two fuel rail sub-components, for example a main gallery and injector cup as shown in the drawings, but also for other components such as cup adapter for example, with a snapping or formed device consisting in deformed and cut elements;
- In case of formed device, the deformation can be in two steps: the first, before assembling, from a simple shaped element such as a flat disc with a hole to a conical element with a flat base with some optional cuts, as shown in figure 4, and the second, after assembling, from the cone to the final formed shape, as shown in figure 5;
- The quantity and the dimension of the deformable elements can be any, depending on the application and on the force required for the assembly or disassembly;
- The gap between injector cup and main gallery can be controlled by means of the connection device height to set the best value in order to have an optimal brazing process;
- The thickness of the connecting device can vary according to the insertion and disassembly force requirements, higher the thickness higher the force;
- It is possible also to change the behaviour of the deformable elements by setting a bigger or smaller bending angle to the deformable part;
- The snapping or formed element can have not only the aim of keeping together the parts, but also structural tasks as to assume part of the stress in operating conditions;
- The central cylindrical part of the connection snapping device can be changed, for example removing material by means of holes or slots to increase the elasticity of the component;
- The snapping device can contain in the middle a lower diameter zone or orifice, including as a consequence the benefit of pressure oscillation reduction; in case of formed element, the orifice device can be only added afterwards as a separate part by means of press-fit or welding for example;
- The snapping and formed devices are represented in the drawings between two flat surfaces, but the same concept can be applied in case of curve surface and in case of presence of internal brazing ring instead of external brazing paste;

- The material of the connecting device can also change, for example it can be stainless steel contributing to the final structural resistance of the fuel rail, or can be a plastic material if not needed disappearing in this way during the brazing process;
- In case of formed device, there is the possibility to auto-centre the injector cup hole with respect the main gallery hole, since during the deformation there is an outward force applied in the holes cylindrical surface.

Claims

1. A fuel rail assembly (2) for a fuel injection system for a multi-cylinder internal combustion engine, the fuel rail assembly comprising a fuel rail (4) comprising an elongate generally tubular body forming a fuel reservoir and having formed integrally therewith a fuel inlet port (6), and a plurality of fuel outlet ports (12) spaced along the fuel rail wherein each outlet port (12) comprises a fuel injector cup (10) adapted to receive a fuel injector, **characterised in that** the fuel injector cup (10) is located on the fuel rail by means of a connection device (14).

2. A fuel rail assembly (2) according to claim 1, wherein the connection device (14) has a through bore forming part of the fuel passage between the fuel rail (4) and the injector cup (10).

3. A fuel rail assembly (2) according to claim 2, wherein the connection device (14) comprises a generally cylindrical body having a peripheral flange (18) adapted to engage the inner face of the injector cup (10), the generally cylindrical body projecting into the fuel rail (4) in the installed condition, wherein an end of the body opposite the peripheral flange (18) comprises a plurality of resilient fingers (20) biased outwardly into engagement with the passage in the fuel rail to retain the connection device (14) in resilient contact with the fuel rail (4).

4. A fuel rail assembly (2) for a fuel injection system according to claim 1 or 2, wherein the connection device (14) comprises a generally cylindrical body having a peripheral flange (18) adapted to engage the inner face of the injector cup, the generally cylindrical body projecting into the fuel rail (4) in the installed condition, wherein an end of the connection device opposite the flange (18) is formed to securely engage the inner face of fuel rail (4).

5. A fuel rail assembly (2) according to claim 4, wherein the connection device (14) comprises a plurality of slots (24) extending axially from the end of the connection device (14) to form a plurality of peripheral parts (26) disposed about the periphery of the connection device (14).

6. A fuel rail assembly (2) according any one of claims 1 to 5, wherein the connecting device is formed of a metal.

7. A fuel rail assembly (2) according to claim 6 wherein the metal is stainless steel.

8. A fuel rail assembly (2) according to any one of claims 1 to 5, wherein the connecting device is formed of a plastics material.

9. A method of manufacturing a fuel rail assembly (2) for a fuel injection system for an internal combustion engine for securing two sub-components (4, 10) of a fuel rail assembly, the method comprising:

providing a connection device (14) between the two sub-components (4, 10),
locating and securing the two sub-components (4, 10) with the connection device (14) to secure the two sub-components (4, 10) relative to each other in their final operational position, and then forming a fluid-tight seal for the fuel passage between the sub-components (4, 10).

10. A method according to claim 9, wherein, when the connecting device is formed of a plastics material, the plastics material melts when forming the fluid-tight seal.

11. A method according to claim 9 or claim 10, wherein the fluid tight seal is formed by a brazing technique.

12. A method according to claim 11, wherein one of the sub-components comprises a fuel rail (4) and the other sub-component is an injector cup (10), wherein the connection device (14) comprises a through bore forming part of a fuel passage (16) between the fuel rail (4) and the injector cup (10) and the connection device (14) prevents braze material from entering the fuel passage (10).

13. A method according to any one of claims 9 to 12, wherein the connection device (14) comprises a generally cylindrical body having a peripheral flange (18) at a first end and a second end having a plurality of resilient fingers (20), the second end being opposite the first end, wherein the connection device (14) is inserted into the injector cup and into the fuel rail such that the peripheral flange engages the inner face of the injector cup (10), the generally cylindrical body projects into the fuel rail (4) and the plurality of resilient fingers are biased outwardly into engagement with the fuel rail to retain the connection device (14) in resilient contact with the fuel rail (4).

14. A method according to any one of claims 9 to 12, wherein the connection device (14) comprises a generally cylindrical body having a peripheral flange (18) at a first end and a second end opposite the flange (18, wherein the connection device (14) is inserted into the injector cup and into the fuel rail such that the flange engages an inner face of the injector cup (10) and the generally cylindrical body projects into the fuel rail (4) in the installed condition, and the second end of the connection device is deformed to securely engage the connection device (14) and the injector cup to an inner face of fuel rail (4).

15. A method according to any one of claims 9 to 14, wherein a plurality of slots (20) extend axially from the second end of the connection device to form a plurality of peripheral parts (26) disposed about the periphery of the connection device (14).

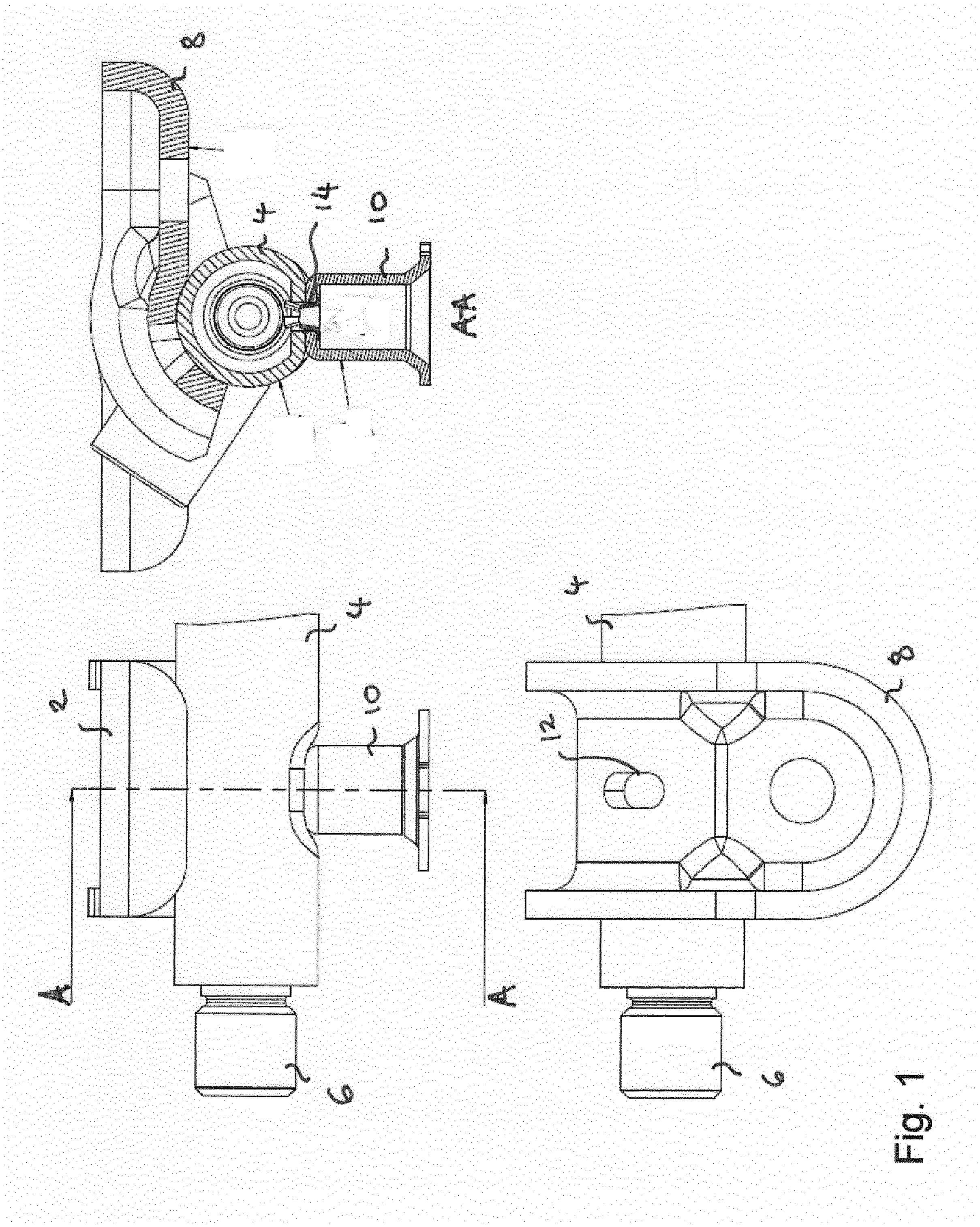

Fig. 1

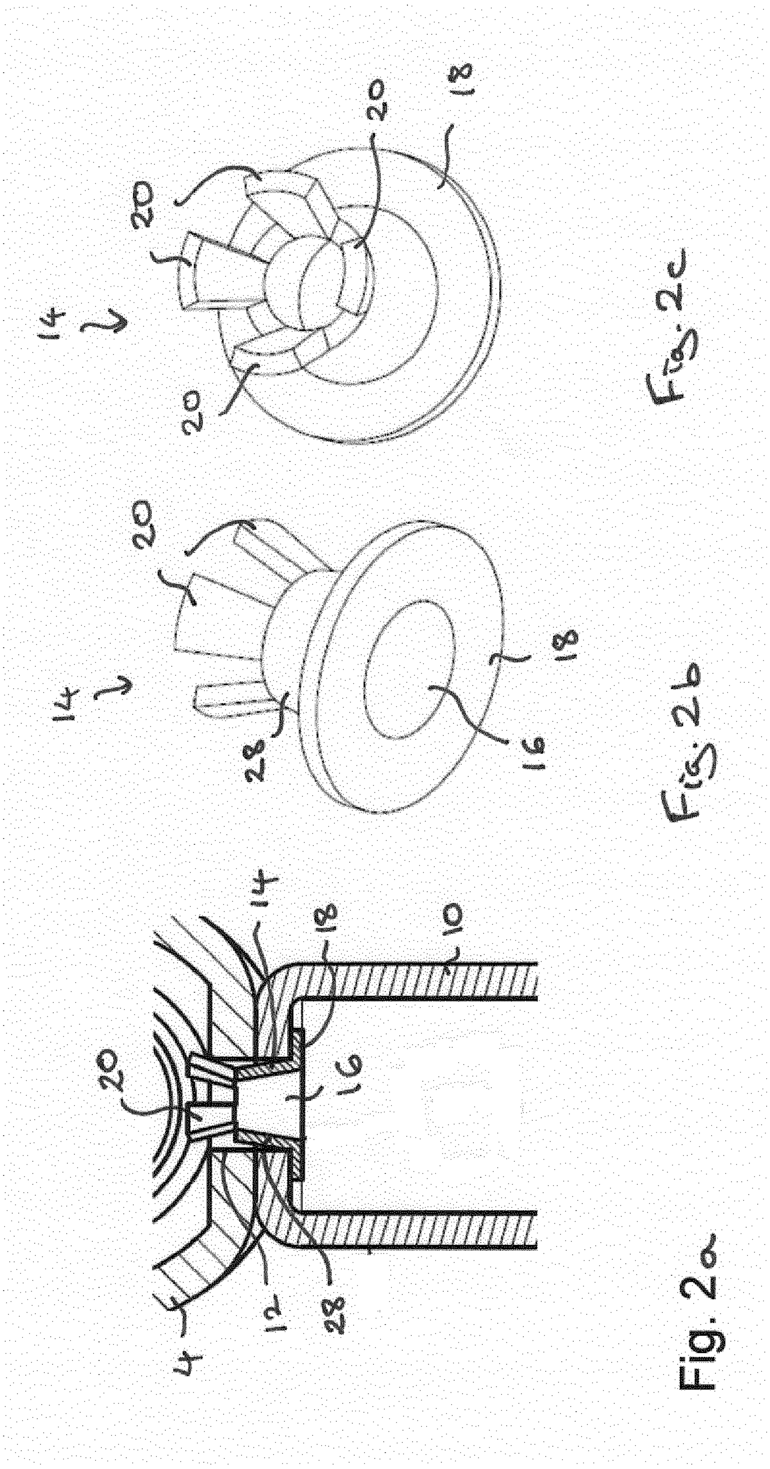

Fig. 2a

Fig. 2b

Fig. 2c

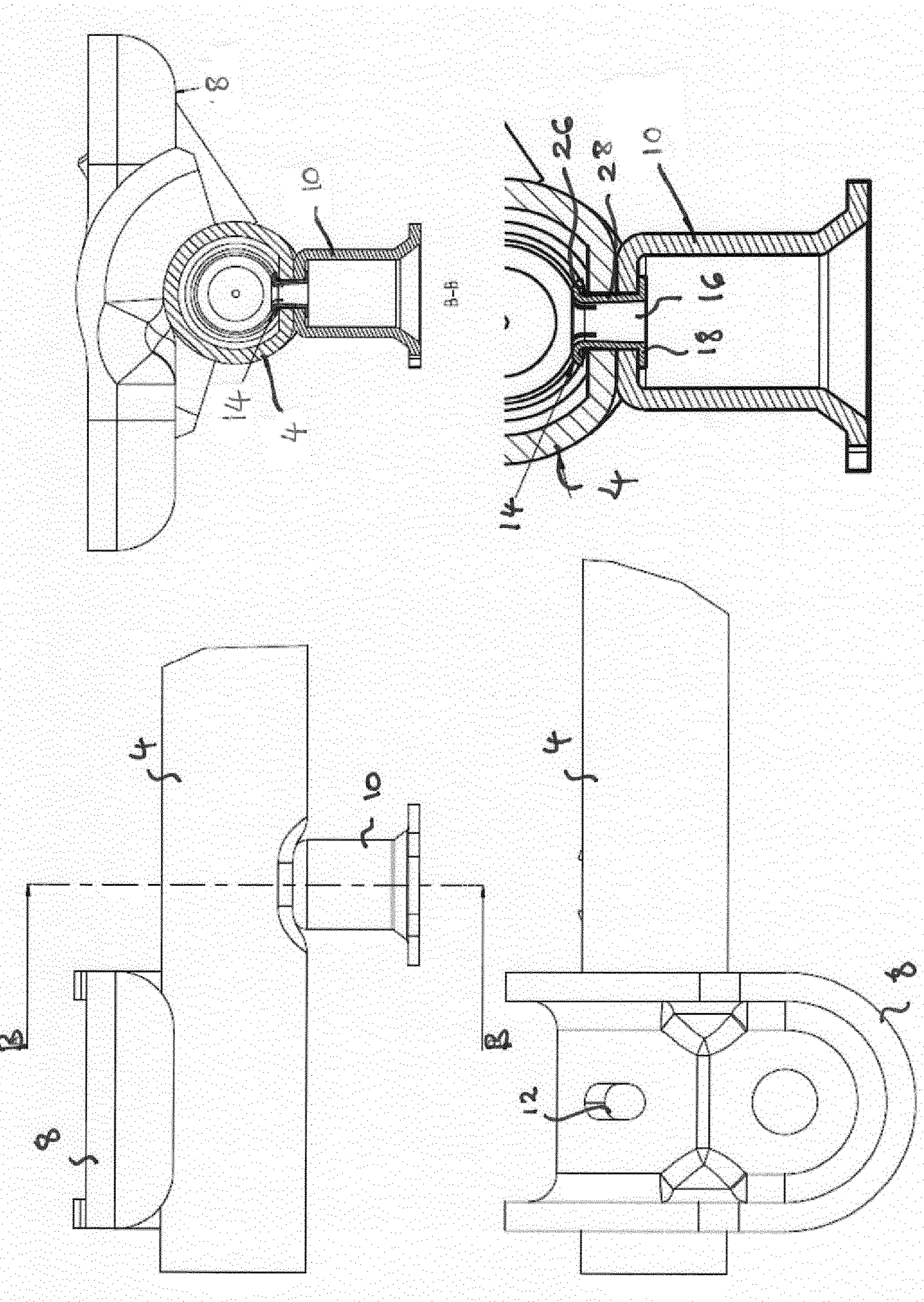

Fig. 3

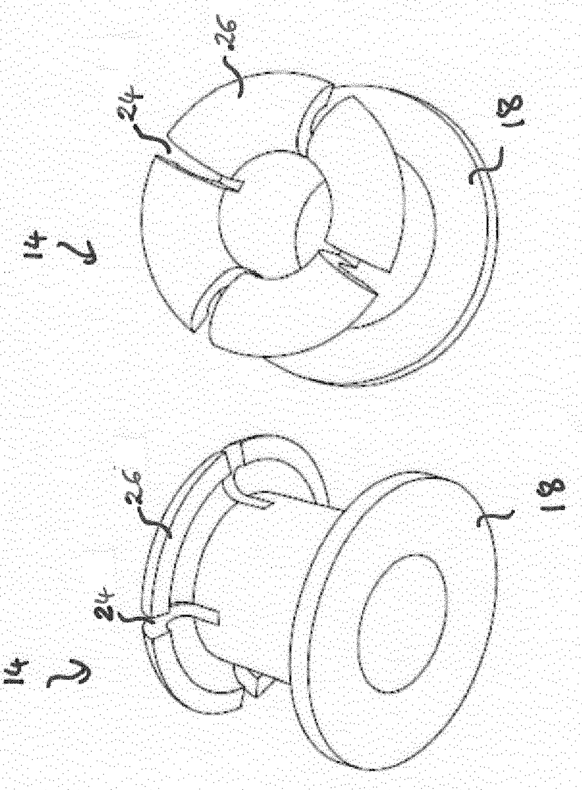

Fig. 5

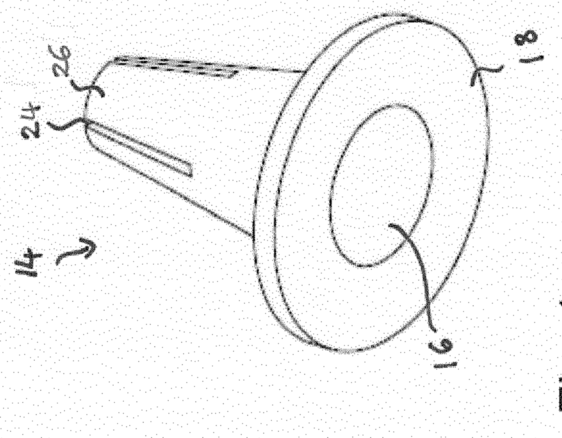

Fig. 4

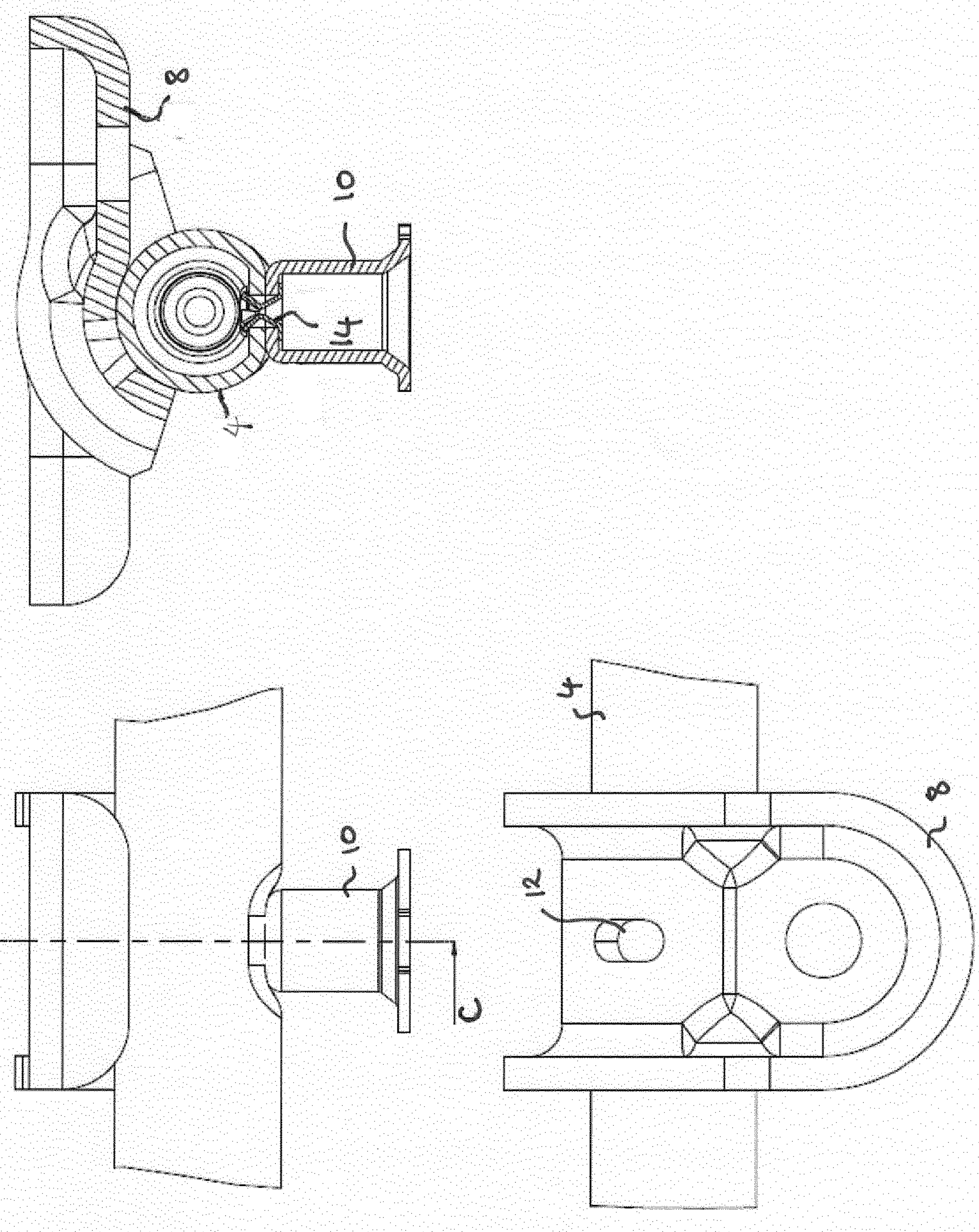

Fig. 6

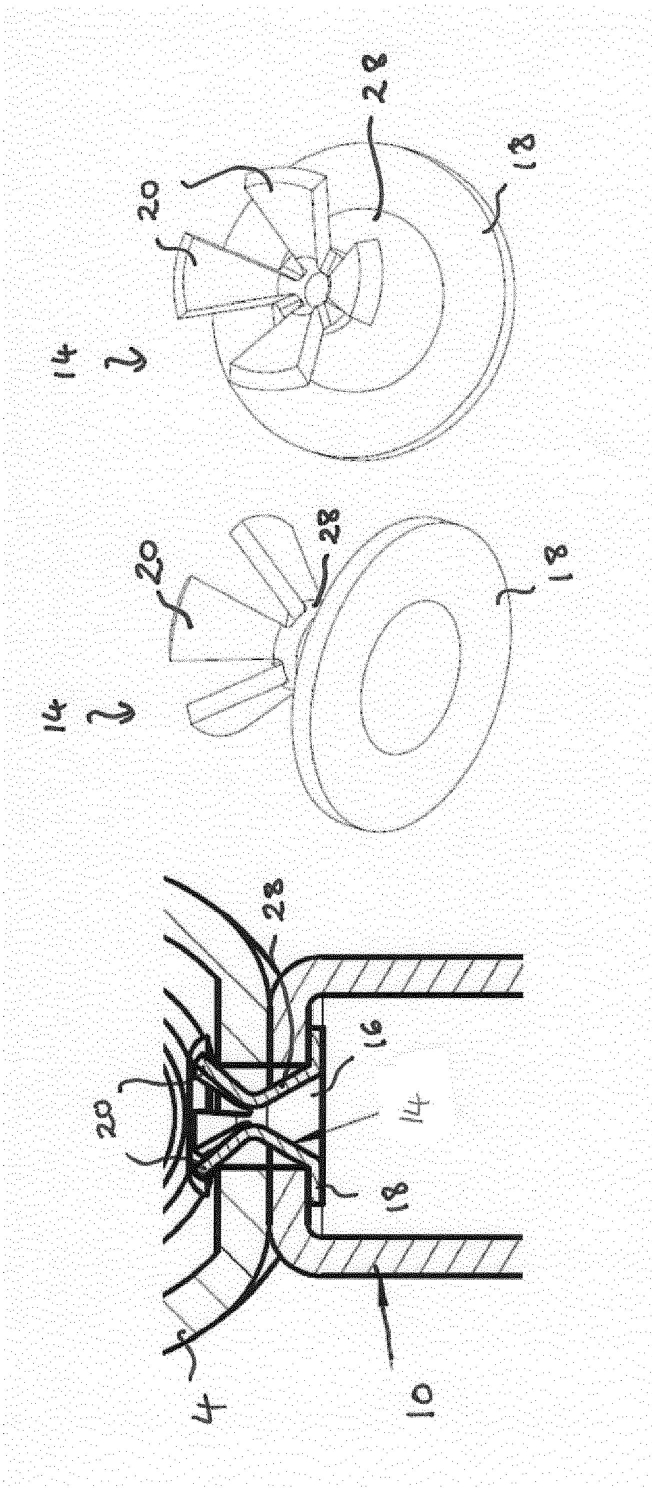

Fig. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 19 18 1354

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 A	US 2010/012091 A1 (KANNAN VENKATESH [US] ET AL) 21 January 2010 (2010-01-21) * paragraphs [0033], [0036], [0038], [0049]; figures 9, 1 *	1,2,4, 6-14 3,5,15	INV. F02M55/02 F02M61/16 F02M55/00 F16L47/00
X	DE 10 2006 010244 B3 (BENTELER AUTOMOBILTECHNIK GMBH [DE]) 6 September 2007 (2007-09-06) * paragraphs [0028], [0036], [0038]; figure 4 *	1-4,6-11	
X	EP 2 072 800 A1 (DELPHI TECH INC [US]) 24 June 2009 (2009-06-24) * paragraph [0024] - paragraph [0032]; figures 1, 2 *	1,4-11, 13-15	
X	DE 10 2008 057517 A1 (DAIMLER AG [DE]) 20 May 2010 (2010-05-20) * claim 1; figures 1-9 *	1-4,6-14	
X A	FR 2 444 813 A1 (CITROEN SA) 18 July 1980 (1980-07-18) * the whole document *	1,9 2-8, 10-15	TECHNICAL FIELDS SEARCHED (IPC) F02M F16L

The present search report has been drawn up for all claims

2

Place of search	Date of completion of the search	Examiner
The Hague	14 November 2019	Tortosa Masiá, A

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

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 19 18 1354

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 The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-11-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2010012091 A1	21-01-2010	US 2010012091 A1	21-01-2010
		US 2011192378 A1	11-08-2011
		US 2011315119 A1	29-12-2011
DE 102006010244 B3	06-09-2007	NONE	
EP 2072800 A1	24-06-2009	NONE	
DE 102008057517 A1	20-05-2010	NONE	
FR 2444813 A1	18-07-1980	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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

- EP 3470660 A **[0004]**