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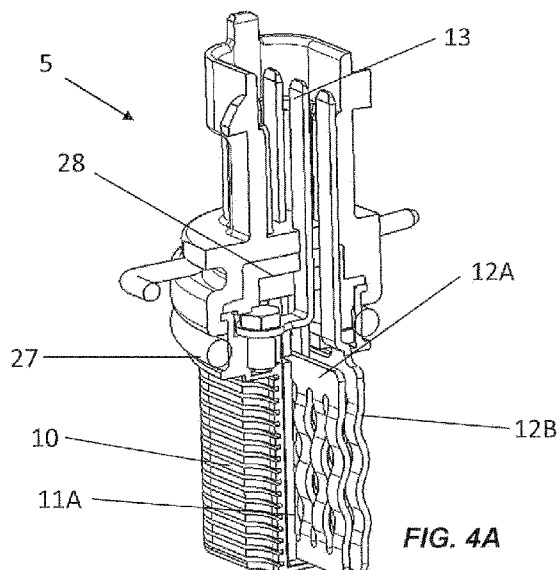


FIG. 4A

(57) Abstract: The present invention relates to a fuel heating device which can be applied to, for instance, automotive vehicle cold starts. The fuel heating device (5) is characterised by the fact of having: one fuel inlet (6) and at least one fuel outlet (7); further wherein the heating device (5) has at least one internal space (9) disposed between its fuel inlet (6) and its fuel outlet (7). The said internal space (9) is configured to house at least one heat exchanger (10), having the heat exchanger (10) at least a first and a second heating elements (11A, 11B) placed in an orifice in its interior. The heat exchanger (10) contains at least: a first electricity conductor (12A) in its orifice, the said first conductor (12A) being in electric contact with the first heating element (11A); a second electricity conductor (12B) in its orifice, the said second conductor (12B) being in electric contact with the second heating element (11B); and a third electricity conductor (13) in electric contact with the external surface of the heat exchanger (10).

'FUEL HEATING DEVICE'**FIELD OF APPLICATION**

[001] The present invention relates to a fuel heating device which may be applied, for example, in cold starts, improvement of drivability, reduction in emissions of pollutant gases, among other applications in automotive vehicles.

BACKGROUND OF THE INVENTION

[002] Cold start systems are commonly utilised in the automotive market, particularly for vehicles utilising fuels of lower volatility, such as ethanol, methanol, or dual fuel technology. As is known to those skilled in the art, the satisfactory combustion of alcohol is temperature conditioned. In the past it was very common to observe drivers experiencing difficulty in starting the alcohol powered vehicles thereof on slightly colder days. The technology popularly known as 'little petrol tank', based on the additional injection of petrol to increase the volatility of the fuel mixture, present today in the majority of the flex fuel automobiles in Brazil, was an important advance rendering the starts easier on colder days, however it still possesses diverse disadvantages, such as high emission of pollutant gases, increased safety risks, and leakage, in addition to the inconvenience that the user cannot neglect filling the 'little tank' on cold days in order to provide the cold starts of the vehicle.

[003] In this manner, aware of this reality, companies and research workers have developed solutions of electric heaters for the fuel to be heated minimally above the flashpoint of the fuel in question and thus achieve the provision of the ignition of the engine even on cold days, eliminating the necessity of additional injection of petrol or of the popularly known 'little petrol tank for cold starts'. An example of heating technology utilised is the heater known as a glow plug. Flowing from applications in diesel

vehicles, this type of heater takes the form of a metal rod positioned in the fuel gallery, heating fuel passing therethrough prior to being injected into the engine or into the inlet manifold of the engine.

5 [004] In spite of the development in respect of the 'little petrol tank', this heating technology employs a high temperature heater for rapid heating, producing risks of fuel boiling (should this occur, steam is injected instead of liquid fuel, leading to engine
10 failures), overheating, increase of internal pressures in the components, leakage and, in more extreme cases, even fire or melting of plastic parts. Other technologies of fuel heating for cold starts have been created, however having geometric constructions and
15 positionings differing from the glow plug, some, for example, incorporated into the fuel injector nozzle, all thereof until that point, by virtue of having a small area of heat exchange with the fuel, operating at high temperatures and, furthermore, also presenting the
20 overheating and safety risks of the glow plug type heater.

[005] In order to endeavour to avoid the risk of fuel overheating, fuel heaters function together with a heating control unit, that is to say electronic
25 hardware monitoring the heating of each heater, disconnecting the same in the case of overheating, working in a feedback control network in real time. By virtue of the indispensable electronic monitoring hardware the technology has become expensive, having
30 complex implementation, requiring additional vehicular calibration time for adjustments to, and programming of, preheating times, in addition whereto it must be borne in mind that, should an electronic component of the system 'burn out' or lose the connection thereof
35 during years of use, this may lead to a tragedy by virtue of the high temperature which the heaters may attain in contact with fuels.

[006] In order to solve the inconveniences and disadvantages brought about by this system of cold starts, the applicant has developed a new system wherein the usual heaters are replaced by a heating element of the PTC thermistor type (thermistor having a positive temperature coefficient), in conjunction with a high efficiency heat exchanger. In this manner, by virtue of being disposed between the inlet and outlet of the heating device, the fuel comes into contact with the heat exchanger which emits the heat received from the interior thereof by means of the thermistor. By means of this system, the fuel is heated rapidly, utilising the low surface temperature PTC thermistor, autocontrolled by the doping thereof with semiconductors, preventing the fuel exceeding a given temperature (selected in the process of doping and manufacturing) and eliminating the problems previously brought about. It must be noted that, whilst other heaters of the PTC type exist, such technologies having PTCs alone, lacking the use of the high efficiency heat exchangers, also demand a PTC having a high surface temperature, still retaining the necessity of electronic temperature control hardware.

[007] For reference purposes, the PTC type heating system having a high efficiency heat exchanger is described in the patent documents DE 10 2011 086 201 and DE 10 2012 220 429, the descriptions whereof are incorporated hereinto for reference. Nevertheless, in spite of this new cold starts system having brought great benefits, there still remain problems to be faced in the state of the art.

[008] One of these problems is in relation to the control of the temperature required to heat the fuel in such manner as to optimise the combustion thereof. For example, a cold engine, initially switched off, demands fuel at a higher temperature in comparison with an engine which is already in operation. Analogously, an

engine in operation demands fuel at a lower temperature in comparison with an engine which is switched off and cold.

[009] This difference in the temperature requirement
5 may arise even during the starts. For example, in the first seconds of operation the engine requires fuel at high temperature whilst, in the following seconds, the temperature required may be lower.

[010] In this manner, as is well known by those
10 skilled in the art, providing fuel at an inappropriate temperature may cause problems such as, for example, inadequate combustion, waste, and delay in starting the engine. Consequently, it is noted that the state of the art lacks a heating device comprising means to control
15 the heating of the fuel such as to optimise the combustion and prevent failures.

DESCRIPTION OF THE INVENTION

[011] Consequently, the object of the invention is to provide a fuel heating device comprising means
20 rendering possible the control of the heating of the fuel for starting and operating the vehicle, overcoming the problems in the state of the art.

[012] The objects of the present invention are achieved by means of a fuel heating device comprising:
25 one fuel inlet and at least one fuel outlet, further wherein the heating device comprises at least one internal space disposed between the fuel inlet and outlet thereof, wherein the said internal space is configured to house at least one heat exchanger,
30 wherein the heat exchanger is provided with at least a first and a second heating element inserted into an orifice within the interior thereof, wherein the heat exchanger comprises at least: a first electricity conductor within the orifice thereof, the said first
35 conductor being in electric contact with the first heating element, a second electricity conductor within the orifice thereof, the said second conductor being in

electric contact with the second heating element, and a third electricity conductor in electric contact with the external surface of the heat exchanger.

[013] The said fuel heating device furthermore presents the following characteristics being supplementary and/or of optional use:

- the first electricity conductor and the second electricity conductor are a conductive spring comprising: a contact portion, configured to make contact with the heating elements, and an electric contact extremity, configured to make contact with an electric circuit of an automobile, the contact portion and the contact extremity being integrally formed;
- the first heating element is disposed adjacently to one face of the contact portion of the first electricity conductor and the second heating element is disposed adjacently to one face of the contact portion of the second electricity conductor;
- the first and the second heating elements are maintained adjacently to each of the faces of the contact portion of each electricity conductor by means of the support made of polymeric material, the said support comprising front and rear locating walls for insertion in a removable manner of the heating elements and central receptacles for positioning of the first and second electricity conductors;
- the contact portions of the first and of the second electricity conductors, the heating elements and the support form a 'sandwich' arrangement;
- the heating device further comprises at least one thermally conductive sheet disposed around the 'sandwich' arrangement;
- the heating elements are thermistors;
- the heat exchanger comprises:
- a slotted portion provided with a plurality of slots in the external lateral surface thereof, and at

least one recess disposed in the external lateral surface of the slotted portion;

- the heat exchanger comprises a cross-section having an oblong format, wherein the said at least one
5 recess is disposed in at least one of the faces of the faces of greatest area;

- the heat exchanger comprises a circular cross-section, wherein the said at least one recess is disposed in at least a part of the lateral surface
10 thereof;

- the support possesses a cylindrical format wherein the central receptacles whereof comprise a circumferential arc format;

- the contact portion of the first and of the second
15 electricity conductor comprises a convex format;

- the first and the second heating elements and the at least one thermally conductive sheet comprise a convex format;

- it comprises at least one deflector fitted
20 adjacently to the fuel inlet thereof, wherein the said deflector is configured to divert the flow of incoming fuel to the inferior region of the internal space of the heating device;

- the heat exchanger comprises a superior sealing
25 portion continuous with the slotted portion, wherein the said sealing portion is configured to receive at least one sealing element;

- the internal space comprises a receptacle and a securing and sealing mouth, wherein the receptacle is
30 configured to accept the slotted portion of the heat exchanger and the securing and sealing mouth is configured to receive the sealing portion of the heat exchanger;

- the sealing element is a sealing ring of the O-
35 ring type;

- over the sealing portion of the heat exchanger there is disposed a safety cap configured to maintain

the first, the second and the third electricity conductors firmly in place;

- over the safety cap there is disposed a plastic cover, wherein this cover is injection moulded over the heat exchanger;

- it furthermore comprises a securing clamp inserted into through cavities of the securing mouth and disposed around the portion of the plastic cover located within the interior of the securing and sealing mouth, the said clamp furthermore comprising divergent free extremities;

- the fuel inlet of the heating device is capable of being fluidly connected to the fuel outlet from a fuel gallery and the fuel outlet of the heating device is capable of being connected to at least one fuel injector;

- the fuel heating device is integrally formed with the fuel gallery;

- the first heating element and the second heating element possess the same behaviour and the same cut out temperature; and

- the first heating element and the second heating element possess behaviour and cut out temperature differing from one another.

BRIEF DESCRIPTION OF THE DRAWINGS

[014] These and other objectives, technical and functional improvements and advantages of the fuel heating assembly, object of the present invention, shall be apparent to those skilled in the art on the basis of the schematic figures appended showing a preferred, however not limited, mode of embodiment of the present invention.

[015] Figure 1 shows a perspective view of the fuel heating device of the present invention connected to a fuel gallery and fuel injectors;

[016] Figure 2 shows a perspective view of the fuel heating device of the present invention connected to a fuel gallery;

5 [017] Figure 3 shows a perspective view of the fuel heating device of the present invention connected to a fuel gallery and to injectors according to a second option of installation;

[018] Figure 4A shows a detailed cross-sectional view of the fuel heating device of the present invention
10 according to a first particular embodiment;

[019] Figure 4B shows a cross-sectional view of the fuel heating device of the present invention according to a first particular embodiment;

15 [020] Figure 5 shows an exploded view of the components belonging to the heating device of the present invention according to a first particular embodiment;

[021] Figure 6 shows a perspective view of the heat exchanger of the fuel heating device according to a
20 first embodiment of the invention;

[022] Figure 7 shows a perspective view of the electricity conductor of the fuel heating device according to a first embodiment of the present invention;

25 [023] Figure 8 shows a perspective view of the support of the fuel heating device according to a first embodiment of the present invention;

[024] Figure 9 shows a lateral cross-sectional view of the fuel heating device according to a first
30 embodiment of the present invention, wherein the device is connected to a fuel gallery and to a fuel injector in a second option of installation (as shown also in figure 3);

[025] Figure 10 shows a lateral cross-sectional view
35 of the fuel heating device of the present invention according to a first embodiment, wherein the device is connected to a fuel gallery;

[026] Figure 11 shows a lateral cross-sectional view of the fuel heating device of the present invention, according to a first embodiment, connected to a fuel gallery, wherein the internal components of the heating device (with the exception of the deflector) have been removed to facilitate the visualisation;

[027] Figure 12 shows the cross-section of the fuel heating device, according to a first embodiment of the invention, wherein the heating device shown comprises a deflector;

[028] Figure 13 shows a lateral cross-sectional view of the fuel heating device according to a first embodiment of the invention. The heating device is connected to an injector and to a fuel gallery according to a first option of installation (shown in figures 1 and 2);

[029] Figure 14 shows a lateral cross-sectional view of the fuel heating device of the present invention, according to a first embodiment of the invention, connected to a fuel gallery. In this figure the second first option of installation is employed (as shown by figures 1, 2 and 13);

[030] Figure 15 shows a lateral cross-sectional view of the fuel heating device, according to a first embodiment of the present invention, connected to a fuel gallery, wherein the internal components of the heating device (with the exception of the deflector) have been removed to facilitate the visualisation. In this figure, the second first option of installation is also employed (as shown by figures 1, 2, 13 and 14);

[031] Figure 16 shows the cross-sectional profile of the fuel heating device, according to the first embodiment of the present invention, connected to a fuel gallery. This figure also shows the second first option of installation (as shown by figures 1, 2, 13, 14 and 15);

[032] Figure 17 shows a superior perspective view of the heating device without the components inserted;

[033] Figure 18 shows a detailed cross-sectional view of the fuel heating device of the present invention according to a second particular embodiment;

[034] Figure 19 shows a cross-sectional view of the fuel heating device of the present invention according to a second particular embodiment; and

[035] Figure 20 shows an exploded view of the components belonging to the heating device of the present invention according to a second particular embodiment.

DESCRIPTION OF THE EMBODIMENTS OF THE INVENTION

[036] The invention shall now be described in relation to the figures appended. In the figures and the description hereinafter similar parts are indicated using the same reference numbers. The figures are not necessarily to scale, that is say given characteristics of the invention may be shown with an exaggeration of scale or in a schematic form, and details of conventional elements may not be shown with the objective of illustrating this description with greater clarity and concision.

[037] The heating device 5 of the present invention may be connected to a fuel gallery, as shown by figures 1, 2 and 3. In figures 1, 2, 3, 11, 12, 15 and 16 it may be noted that the fuel gallery 2 is provided with a fuel inlet 3 and a fuel outlet. Each heating device 5 also comprises a fuel inlet 6 and a fuel outlet 7. It should be noted that the fuel inlet of the heating device 5 is fluidly connected to the fuel outlet from the fuel gallery 2. Consequently, the fuel outlet from the fuel gallery 2 may be embodied in such a manner as to coincide with the fuel inlet 6 of the heating device 5. This may be observed with greater clarity, for example, in figures 11, 12, 15 and 16. Additionally, as may be noted in figures 9 and 13, the fuel outlet 7

from the heating device 5 is capable of being connected to a fuel injector 8.

[038] In figures 11, 12, 15 and 16 it may be observed that the heating device 5 comprises an internal space 9 disposed between the fuel inlet 6 thereof and the outlet 7 thereof.

[039] On the basis of this construction, it may be observed that the fuel coming from the vehicle's tank passes through gallery 2, traverses the internal space 9 of the heating device 5 and, finally, is injected into the engine by means of one or more injectors 8.

[040] In order that the fuel may be satisfactorily heated, the present invention comprises a heat exchanger 10 disposed in the internal space 9 of the heating device 5. As may be observed from figures 6 and 20, the said heat exchanger 10 comprises a slotted portion 20 provided with a plurality of slots in the external lateral surface thereof, and a sealing portion 24 superior to and continuous with said slotted portion 20. Considering these two portions 20 and 24 of the heat exchanger 10, the internal space 9 is adapted to receive this component in the interior thereof, it being, for this purpose, provided with a receptacle 25 and a securing and sealing mouth 26. As may be observed in figures 9, 10, 13 and 14, the receptacle 25 is configured to accept the slotted portion 20, whilst the securing and sealing mouth 26 is configured to receive the sealing portion 24 of the heat exchanger 10. According to a first particular embodiment of the present invention, the heat exchanger 10 comprises a cross-section of substantially oblong format, as shown in figure 6, being provided with a recess 21 disposed in the external lateral surface of the slotted section 20, across the faces of greatest area. In a second particular embodiment of the present invention the said heat exchanger comprises a circular cross-section, as shown by figures 18 to 20, being provided with a recess

21 disposed in the external lateral surface of the slotted portion 20 in at least part of the external lateral surface thereof. Furthermore, the heat exchanger 10 is preferentially made of metallic material, not excluding, however, other conductive materials of heat and of electricity equally or superiorly efficient to the metals which may possibly be employed.

[041] The heat exchanger 10 is also provided with at least two heating elements 11A and 11B inserted into an orifice in the interior thereof, as shown by figures 4A, 4B, 18 and 19. These heating elements 11A, 11B are a thermistor of the PTC (positive temperature coefficient) type. In a particular embodiment of the present invention the heating elements 11A, 11B may have the same behaviour and the same cut out temperature, or behaviours and/or cut out temperatures differing from one another. In the same orifice of the heat exchanger 10 wherein the heating elements 11A, 11B are located there are also disposed a first electricity conductor 12A and a second electricity conductor 12B, respectively, in electric contact with the first or the second heating elements 11A and 11B. In the embodiment shown in the figures, the first electricity conductor 12A and the second electricity conductor 12B are a conductive spring shown, for example, in figures 5, 7 and 20. This spring comprises a contact portion 14 facing the heating elements 11A and 11B, and an electric contact extremity 15 integrally formed with the contact portion 14. In a first particular embodiment of the invention, the contact portion 14 of the first and second electricity conductors 12A and 12B possesses a flattened format, as shown by figure 7. In a second particular embodiment of the present invention, such contact portion 14 comprises a convex format, as shown by figures 18 to 20.

[042] The heat exchanger 10 furthermore comprises a third electricity conductor 13 in electric contact with the external surface thereof. This third electricity conductor 13 may be affixed to the heat exchanger 10 by any means possible such as, for example, by welding or by bolting. In the embodiment shown in figure 5, the third electricity conductor 13 is bolted to the heat exchanger 10 by means of a bolt 22. In addition, the first, the second and the third electricity conductors 12A, 12B and 13 are electrically connected to a circuit of the automobile, consequently permitting additional functionalities, as shall be described hereinafter. In the case of the first conductor 12A and of the second conductor 12B, the contact is made by means of the extremity 15 of each thereof. Preferentially, the circuit in question is a circuit already in existence in the ECU of the vehicle. Moreover, as shown by figures 5, 7 and 20, the contact portion 14 and the electric contact extremity 15 are formed in a single part.

[043] As figures 5 and 20 show, the first heating element 11A and the second heating element 11B are disposed adjacently to one face of a contact portion 14 of the first electricity conductor 12A and of the second electricity conductor 12B, respectively. As shown by figure 4B, a 'sandwich' arrangement is formed.

[044] In one embodiment of the present invention shown, for example, in figure 5, it may be noted that the heating elements 11A and 11B possess a substantially flattened or planar format. Nevertheless, this format may vary within the scope of the present invention as may be noted, for example, in the embodiment shown in figure 20. In this figure the first and the second heating elements 11A and 11B comprise a convex format. Even with this convex format a 'sandwich' structure is formed, as may be perceived from figures 18 and 19.

[045] Having the objective of maintaining the 'sandwich' structure united, duly located, and easily insertable there is, furthermore, provided a support 17, as shown by figures 5, 8 and 20. More precisely, the two heating elements 11A and 11B are maintained united by means of said support 17, made, it should be mentioned, from polymeric material. The support 17 furthermore comprises front and rear locating regions 18 for inserting the heating elements 11A and 11B in a removable manner and central receptacles 19 for positioning the first electricity conductor 12A and of the second electricity conductor 12B. The support 17 may have varied formats. For example, in figures 5 and 8 the support 17 possesses flattened locating regions 18 and central receptacles 19 disposed upon a surface appropriate for the oblong or elliptic format of the cross-section of the heat exchanger 10. In another embodiment of the invention, shown in figure 20, the support 17 possesses a circular cross-section and the central receptacles 19 take the form of a circumferential arc.

[046] Alternatively, in a particular embodiment of the present invention, having the objective of improving the conduction of the heat coming from the heating elements 11A and 11B and radiated by means of heat exchanger 10, there may be provided, optionally, one or more thermally conductive sheets 16. In the particular embodiments of the present invention shown in figures 5 and 20 the thermally conductive sheets 16 are disposed around the 'sandwich' arrangement formed by the heating elements 11A and 11B, by the contact portions 14 of the first and of the second electricity conductors 12A and 12B, and by the support 17. In figure 5, the sheet 16 has a format such as to permit enveloping the support 17 with the first conductor 12A, the second conductor 12B and the elements 11A and 11B installed. This format has the aspect of a 'U'.

Nevertheless, in other embodiments of the invention this format may vary. For example, in figure 20 it may be noted that the format of the thermally conductive sheets 16 is convex such as to achieve envelopment of the elements forming the 'sandwich' structure, also convex.

[047] In respect of the sealing of the heating device 5 of the present invention, initially it must be commented that the sealing portion 24 of the heat exchanger 10 is configured to receive at least one sealing element 27. In the embodiment shown in the figures, the sealing element 27 in question is a sealing ring of the O-ring type inserted into the sealing portion 27 of the heat exchanger 10 and which may be seen in figures 4A, 4B, 5, 9, 10, 13, 14, 18, 19 and 20. Additionally, now making reference to figures 5 to 20, over the sealing portion 24 of the heat exchanger 10 there is disposed a safety cap 28, configured to maintain the first, the second, and the third electricity conductors 12A, 12B and 13 firmly in place. More precisely, this safety cap 28 is fitted over all the electricity conductors 12A, 12B and 13, wherein this fitting may be realised, for example, by means of apertures provided in the safety cap 28. Over this safety cap 28 there is furthermore disposed a plastic cover 29, this cover 29 is injection moulded over the heat exchanger 10. The final format of this injection moulding may be conferred, for example, by means of the embodiments shown in figures 4A, 4B, 9, 13, 18 and 19.

[048] Reference is now made to figures 5, 9 to 17 and 20 in regard to the securing of the components within the interior of the internal space 9. As may be noted, the heating device 5 is provided with a securing clamp 30 for each heating device 5. This clamp 30 is inserted into through cavities 31 disposed in the securing and sealing mouth 26. On being inserted into these cavities

31, the clamp 30 is fits around the portion of the plastic cover 29 located within the interior of the securing and sealing mouth 26. The said clamp 30 additionally comprises divergent extremities 32
5 assisting it to remain firmly fitted.

[049] Further to the aforementioned components, in a particular embodiment of the present invention, the heating device 5 may optionally comprise a deflector 23, as shown by figures 9 to 12. This deflector is
10 fitted adjacently to the fuel inlet 6 (in the space shown in figure 17) and is configured to divert the flow of incoming fuel to the inferior region of the internal space 9 of the heating device 5. By means of this deflector, the fuel is forced to experience a
15 greater contact time with the heat exchanger 10, prior to being injected.

[050] In a particular embodiment of the present invention, the heating device 5 and the gallery 2 are integrally formed. In other words, these two components
20 may form a single part. In a particular embodiment of the present invention the heating devices 5 and the fuel gallery 2 are formed by moulding and injection of polymeric materials. Following forming, there are fitted within the interior of the internal space 9 the
25 heat exchanger 10 (and other components housed in the interior thereof), the deflector 23 (optionally), the sealing element 27 and the safety cap 28 which, subsequently, receives over it the plastic cover 29 injection moulded over the heat exchanger 10.

[051] In terms of installation option, on the basis of figures 1 to 3 and 9 to 16 it must be noted that there may be variations. In a given embodiment of the present invention the inlet 6 and the outlet 7 of fuel of the heating device 5 may be disposed such as to form
35 an angle therebetween (one in relation to the other) which may range between 0° and 90° , for example. Consequently, it may be observed in figures 9 to 12,

for example, that this angle is substantially 0° , whilst in figures 13 to 16 this angle is less than 90° , and in figure 4 the angle is substantially 90° . Clearly, the angle formed between the inlet 6 and the outlet 7 of fuel of the heating device 5 may vary depending on the configuration of the engine, on the space available, on the application, etc, such that the figures merely show an example of disposition within the various possibilities.

10 [052] As may be noted, the device 5 of the present invention is integrally formed being, consequently, a single part dispensing with the brackets and sealing rings to affix heating devices 5 and fuel gallery 2. Allied with this characteristic the robust sealing and fastening of the parts is additionally emphasised, thanks to the injection moulding of the plastic cover 29 and to the performance of the safety cover 28 in maintaining components in place. This, moreover, without counting on the assistance provided by the clamp 30.

[053] Additionally, it may also be noted that the fact that the heating device of the present invention comprises at least three electricity conductors 12A, 12B and 13 brings a series of advantages to the present invention. Among these advantages may be mentioned that two heating elements 11A and 11B may be activated together, increasing the heat delivered to the fuel or, furthermore, the selection may be made that solely one thereof be utilised. In this manner, should the vehicle demand a rapid heating of the fuel, the first and the second heating elements 11A and 11B may be activated. If the vehicle demands a solely slightly heated fuel, only one of the heating elements 11A or 11B is activated.

35 [054] The possibilities of control over the heat supplied to the fuel are increased on the basis of the possibility that the heating elements 11A, 11B may have

different behaviours and cut out temperatures. In this manner, activating one or other or, even, both thereof at the same time, provides flexibility for the design of the cold starts system of the vehicle, increasing
5 the possibility of delivering a better product to the consumer.

[055] Moreover, with these electricity conductors 12A, 12B and 13 the ECU of the automobile may be configured to feed the heating elements 11A, 11B during
10 varied periods of time. For example, a short period of fuel preheating may be configured, activating the two heating elements 11A, 11B simultaneously during the first seconds preceding the start of the vehicle. In this manner, the driver does not require to wait very
15 long to drive the vehicle thereof, by virtue of the fact that the fuel will already be at the ideal temperature when the start occurs.

[056] Another advantage and possibility of temperature control flowing from the present invention
20 is in relation to the fact that the ECU may be configured with control strategies of the on-off type or, even, they may utilise pulse width modulation (PWM).

[057] On the basis of these characteristics it may be
25 observed that the fuel heating device 5 presents a versatile solution rendering possible innumerable ways of controlling the heat provided to the fuel. In this manner, on rendering possible various types and strategies of control, the present invention achieves
30 the provision of means such that the fuel is always at the ideal temperature for the starts and use of the vehicle.

[058] Consequently, as the those skilled in the art will well understand, numerous modifications and
35 variations in the invention are possible in the light of the foregoing teachings without departing from the

scope of protection thereof, as delimited by the claims appended.

The use of this fuel heating device 5 is not only
5 limited to methanol, ethanol or flex fuel applications,
but can also be used for all kinds of other fuels.
Methanol, ethanol or flex fuel applications are only
preferred fields of application.

CLAIMS

1. FUEL HEATING DEVICE (5), characterised in that it comprises:

5 - one fuel inlet (6) and at least one fuel outlet (7);

 - wherein furthermore the heating device (5) comprises at least one internal space (9) disposed between the inlet (6) and outlet (7) of fuel thereof;

10 - wherein said internal space (9) is configured to house at least one heat exchanger (10), the heat exchanger (10) further being provided with at least a first and a second heating element (11A, 11B) inserted into an orifice within the interior thereof,

15 - wherein the heat exchanger (10) furthermore comprises at least:

 - a first electricity conductor (12A) in the orifice thereof, the said first conductor (12A) being in electric contact with the first heating element (11A);

20 - a second electricity conductor (12B) in the orifice thereof, the said second conductor (12B) being in electric contact with the second heating element (11B); and

25 - a third electricity conductor (13) in electric contact with the external surface of the heat exchanger (10).

2. HEATING DEVICE according to claim 1, characterised in that the first electricity conductor (12A) and the second electricity conductor (12B) are a conductive spring comprising:

30 - a contact portion (14), configured to make contact with the heating elements (11A, 11B); and

35 - an electric contact extremity (15), configured to make contact with an electric circuit of an automobile, the contact portion (14) and the contact extremity (15) being integrally formed.

3. HEATING DEVICE according to claims 1 and 2, characterised in that the first heating element (11A) is disposed adjacently to a face of the contact portion (14) of the first electricity conductor (12A) and the
5 second heating element (11B) is disposed adjacently to a face of the contact portion (14) of the second electricity conductor (12B).

4. HEATING DEVICE according to claim 3, characterised in that the first and the second heating elements (11A,
10 11B) are maintained adjacently to the faces of the contact portion (14) of each electricity conductor (12A, 12B) by means of a support (17) made of polymeric material, the said support (17) comprising front and rear locating walls (18) for insertion in a removable
15 manner of the heating elements (11A, 11B) and central receptacles (19) for positioning the first and second electricity conductors (12A, 12B).

5. HEATING DEVICE according to claims 3 and 4, characterised in that the contact portions (14) of the
20 first and of the second electricity conductors (12A, 12B), the heating elements (11A, 11B), and the support (17) form a 'sandwich' arrangement.

6. HEATING DEVICE according to claims 1, 4 and 5, characterised in it comprises furthermore at least one
25 thermally conductive sheet (16) disposed around the 'sandwich' arrangement.

7. HEATING DEVICE according to claim 1, characterised in that the heating elements (11A, 11B) are thermistors.

30 8. HEATING DEVICE according to claim 1, characterised in that the heat exchanger (10) comprises:

- one slotted portion (20) provided with a plurality of slots in the external lateral surface thereof; and
- 35 - at least one recess (21) disposed in the external lateral surface of the slotted portion (20).

9. HEATING DEVICE according to claim 8, characterised in that the heat exchanger (10) comprises a cross-section of oblong format, wherein the said at least one recess (21) is disposed in at least one of the faces of the faces of greatest area.

10. HEATING DEVICE according to claim 8, characterised in that the heat exchanger (10) comprises a circular cross-section, wherein the said at least one recess (21) is disposed in at least one part of the lateral surface thereof.

11. HEATING DEVICE according to claim 4, characterised in that the support (17) possesses a cylindrical format wherein the central receptacles (19) thereof comprise a circumferential arc format.

12. HEATING DEVICE according to claim 1, characterised in that the contact portion (14) of the first and of the second electricity conductor (12A, 12B) comprises a convex format.

13. HEATING DEVICE according to claims 1 and 6, characterised in that the first and the second heating elements (11A, 11B) and the at least one thermally conductive sheet (16) comprise a convex format.

14. HEATING DEVICE according to claim 1, characterised in comprising at least one deflector (23) fitted adjacently to the fuel entrance (6) thereof, the said deflector (23) being configured to divert the flow of incoming fuel to the inferior region of the internal space (9) of the heating device (5).

15. HEATING DEVICE according to claims 1 and 8, characterised in that the heat exchanger (10) comprises a superior sealing portion (24) continuous with the slotted portion (20), the said sealing portion (24) being configured to receive at least one sealing element (27).

16. HEATING DEVICE according to claims 1, 8 and 15, characterised in that the internal space (9) comprises a receptacle (25) and a securing and sealing mouth

(26), the receptacle (25) being configured to accept the slotted portion (20) of the heat exchanger (10) and the securing and sealing mouth (26) being configured to receive the sealing portion (24) of the heat exchanger.

5 17. HEATING DEVICE according to claim 15, characterised in that the sealing element (27) is a sealing ring of the O-ring type.

18. HEATING DEVICE according to claim 15, characterised in that over the sealing portion (24) of
10 the heat exchanger (10) there is disposed a safety cap (28) to maintain the first (12A), the second (12B) and the third (13) electricity conductors firmly in place.

19. HEATING DEVICE according to claim 18, characterised in that over the safety cap (28) there is
15 disposed a plastic cover (29), this cover (29) being injection moulded over the heat exchanger (10).

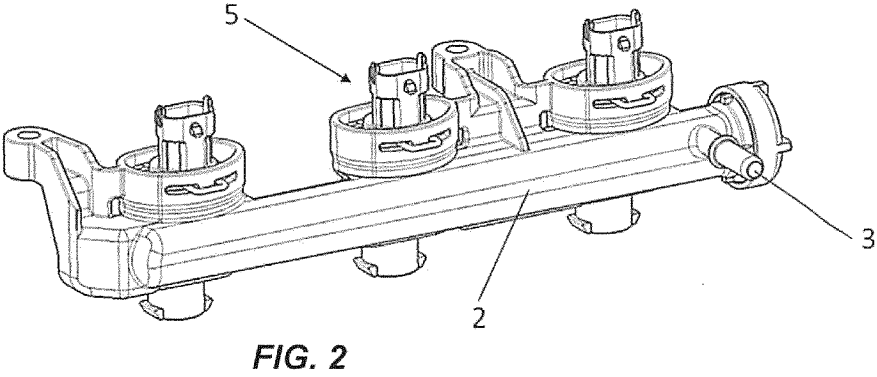
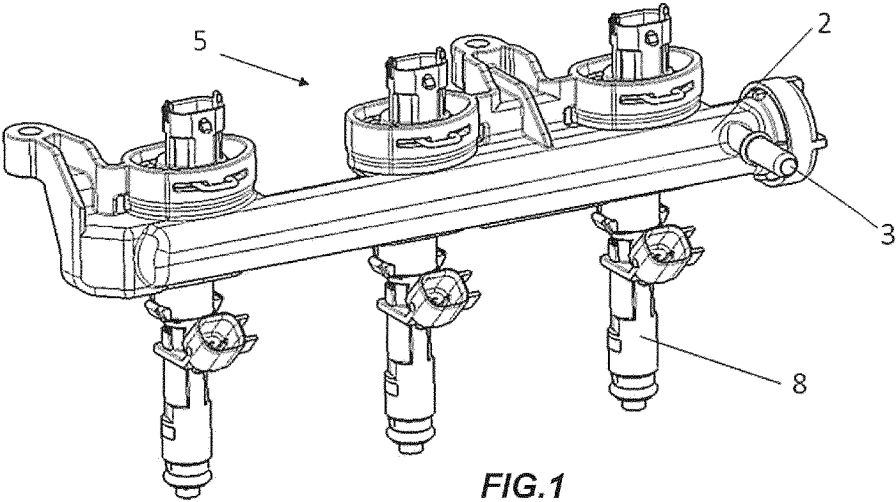
20. HEATING DEVICE according to claims 16 and 19, characterised in that it furthermore comprises a securing clamp (30) inserted into through cavities (31)
20 of the securing mouth (26) and disposed around the portion of the plastic cover (29) located within the interior of the securing and sealing mouth (26), the said clamp (30) furthermore comprising divergent free extremities (32).

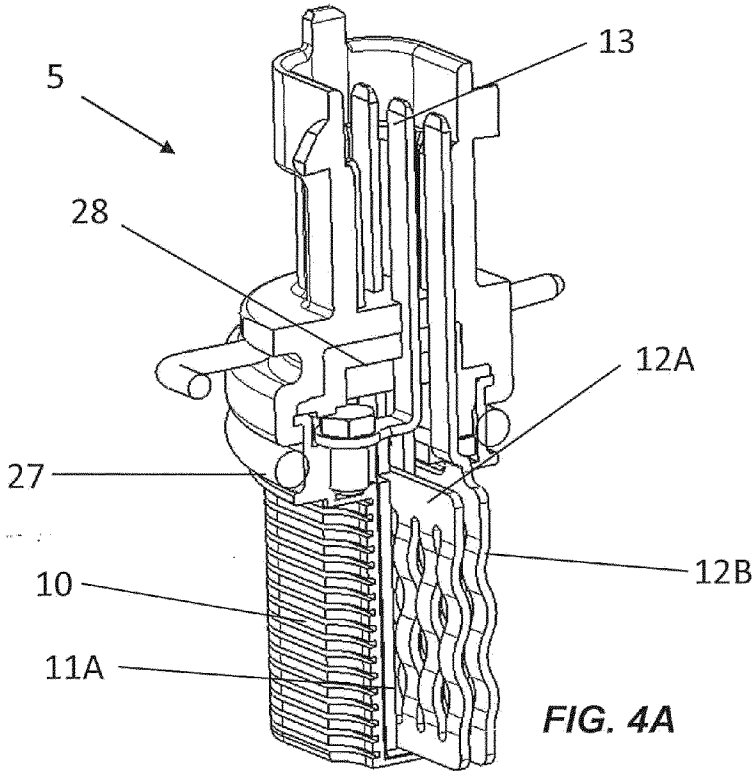
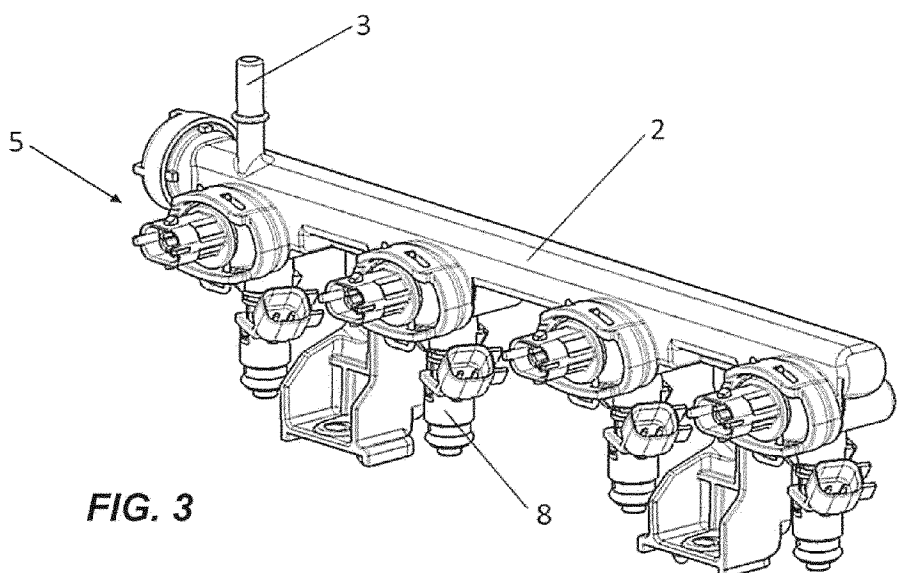
25 21. HEATING DEVICE according to claim 1, characterised in that the fuel inlet (6) of the heating device (5) is capable of being fluidly connected to the fuel outlet of a fuel gallery (2) and that the fuel outlet (7) of the heating device (5) is capable of being connected to
30 at least one fuel injector (8).

22. HEATING DEVICE according to claim 21, characterised in that it is integrally formed with the fuel gallery (2).

23. HEATING DEVICE according to claims 1 and 7,
35 characterised in that the first heating element (11A) and the second heating element (11B) possess the same behaviour and the same cut out temperature.

24. HEATING DEVICE according to claims 1 and 7, characterised in that the first heating element (11A) and the second heating element (11B) possess behaviour and cut out temperature differing from one another.





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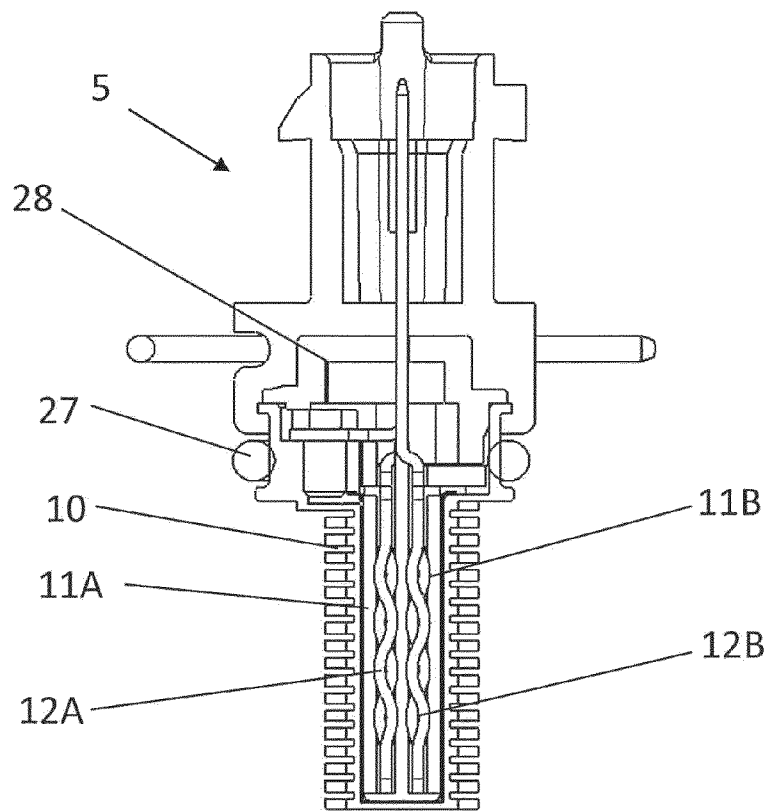


FIG. 4B

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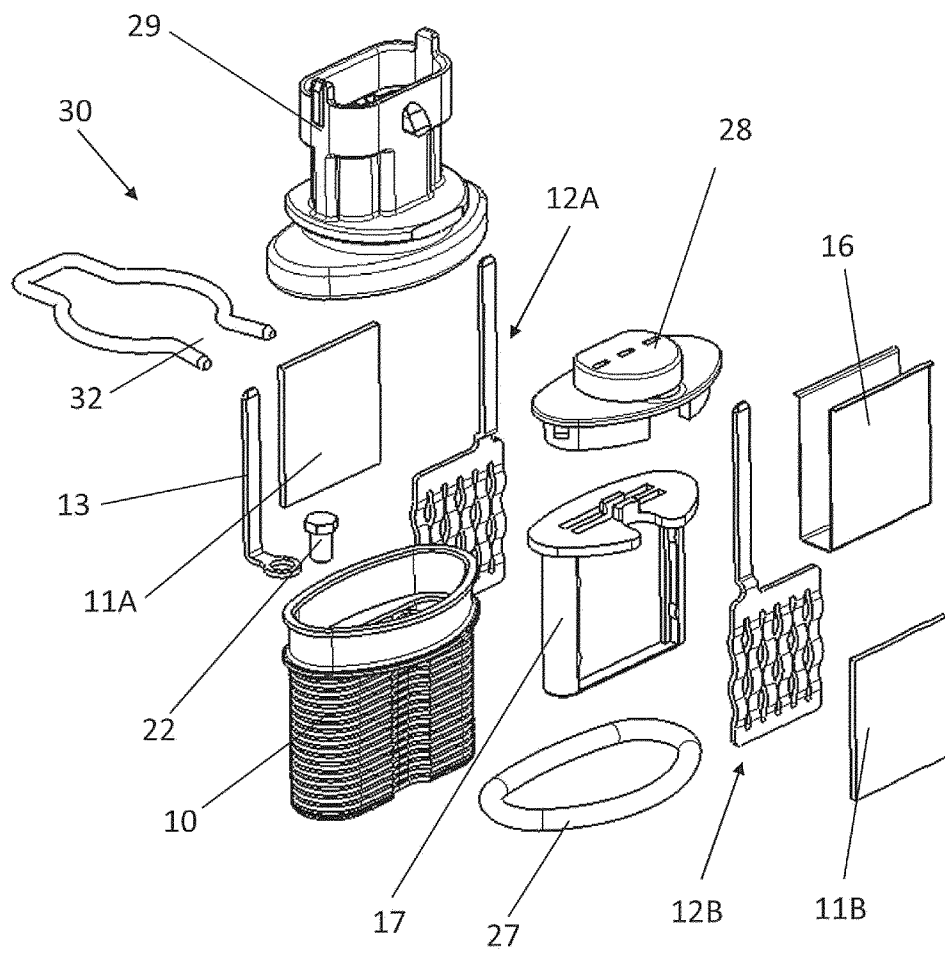


FIG. 5

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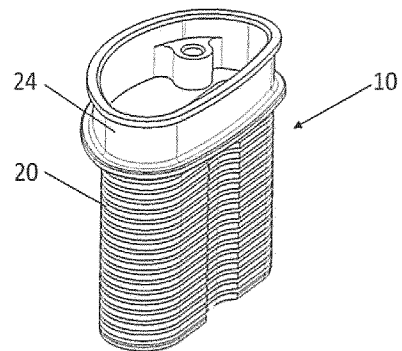


FIG. 6

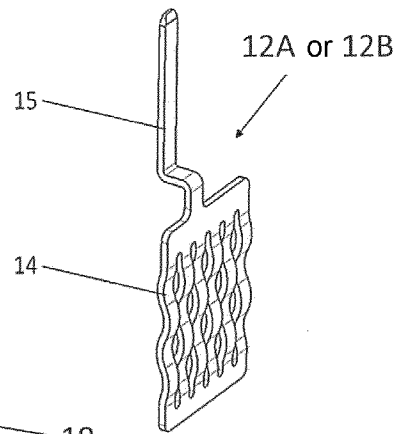


FIG. 7

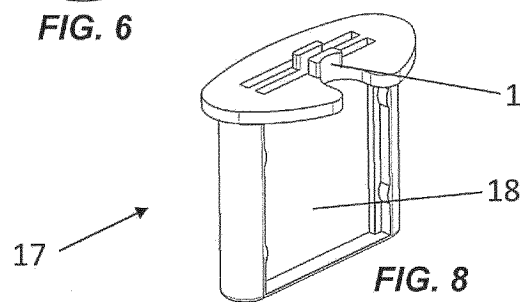


FIG. 8

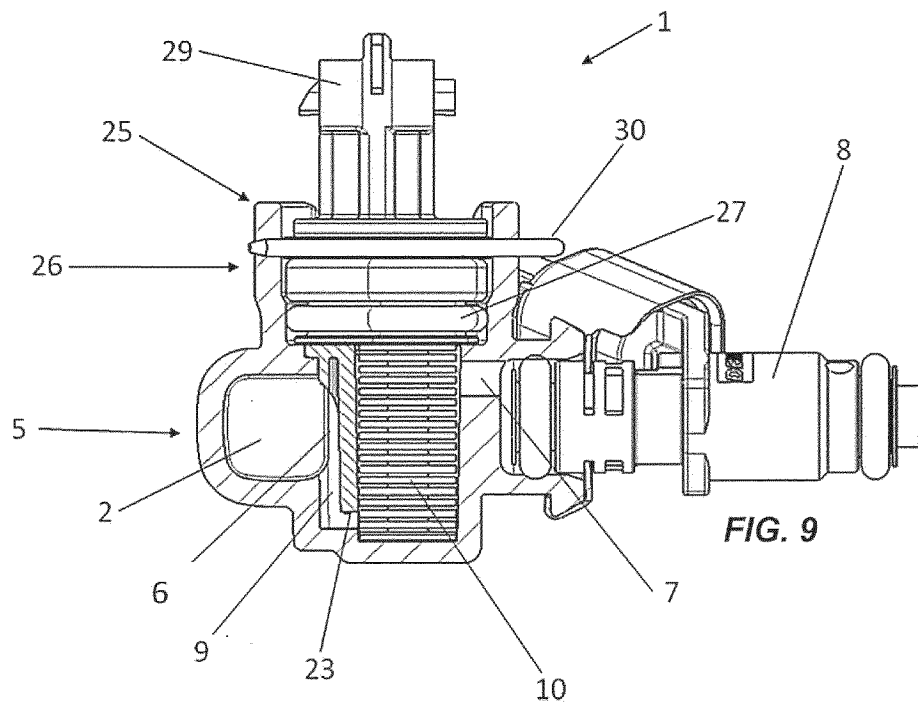
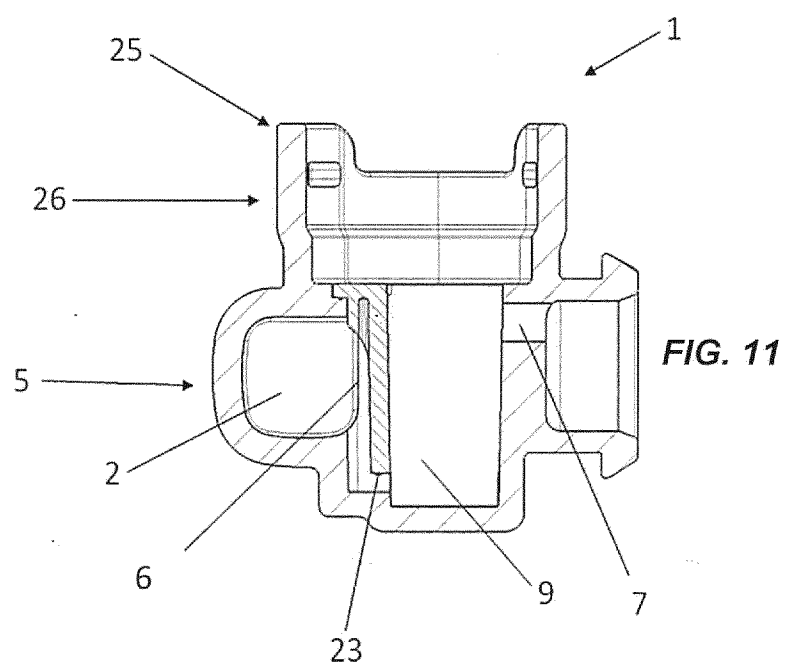
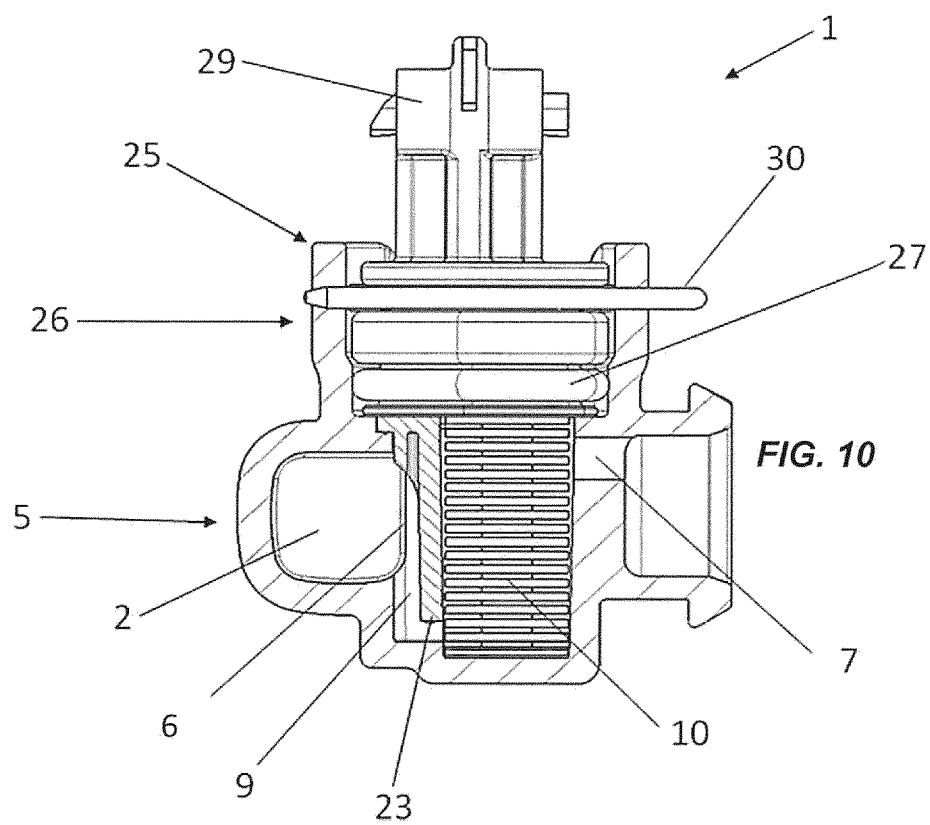
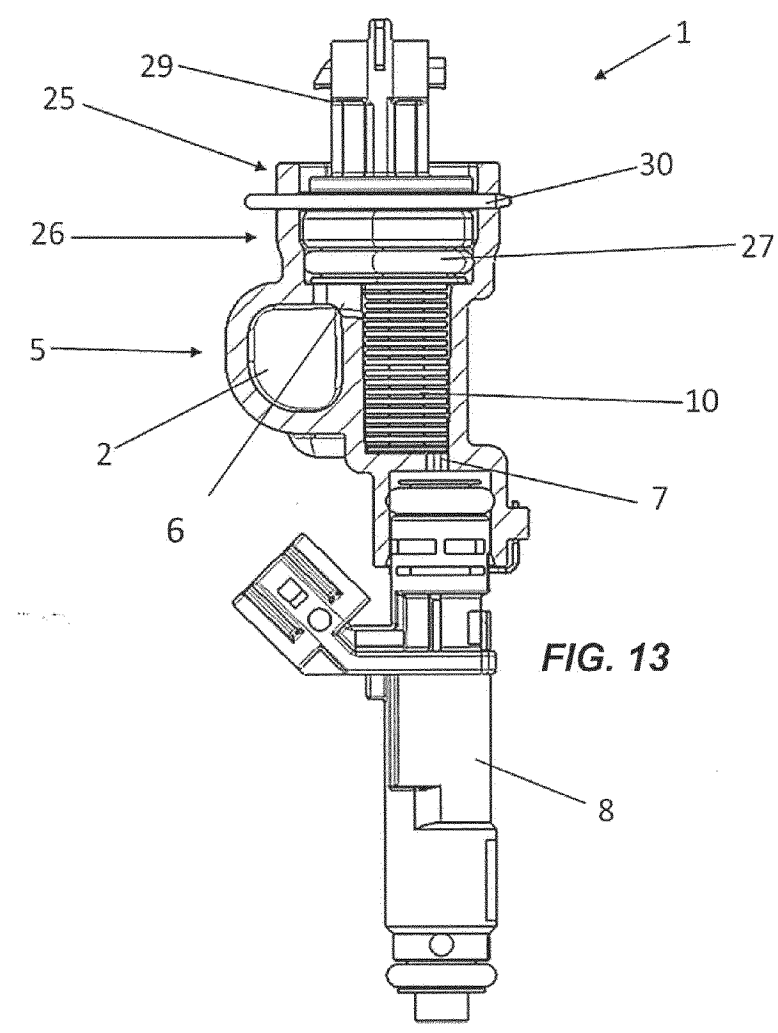
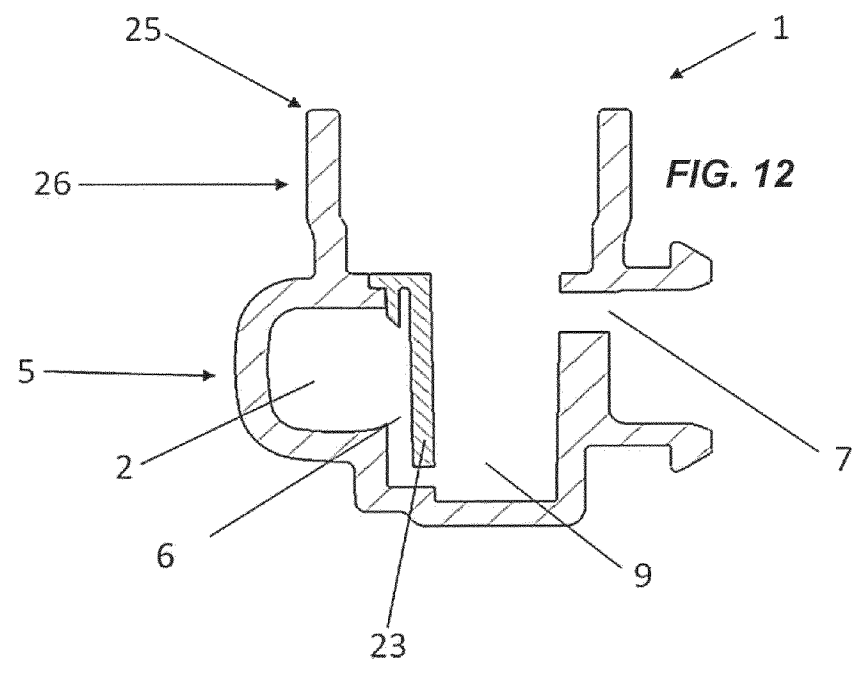


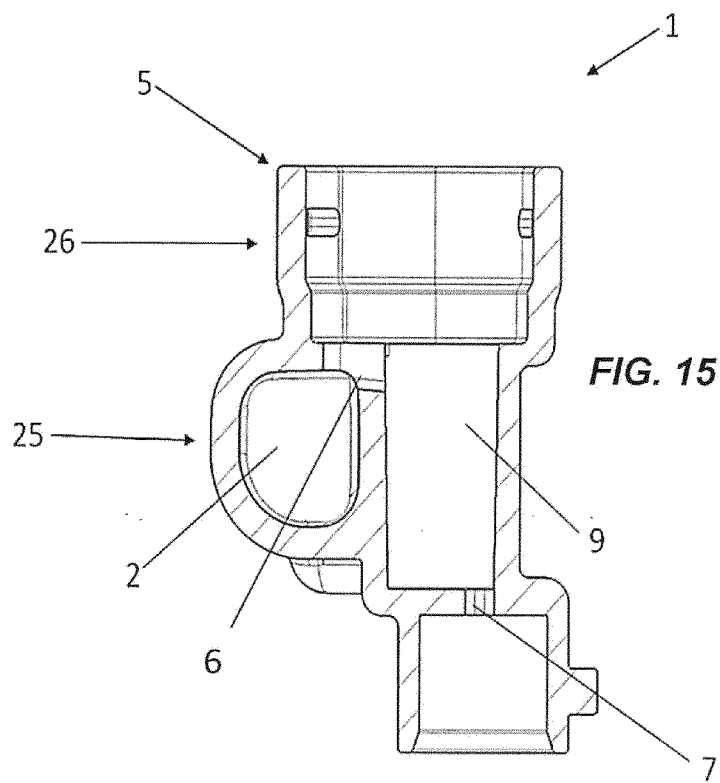
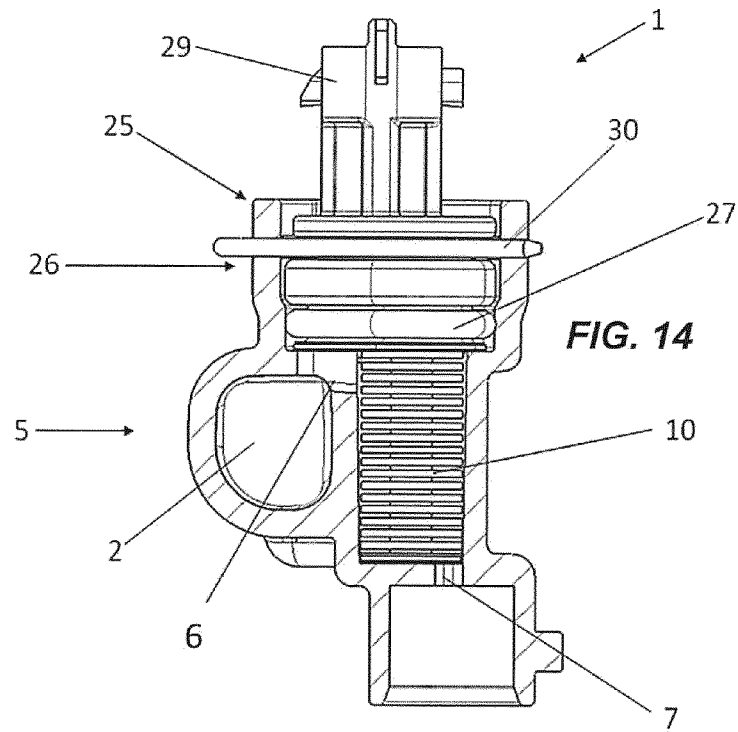
FIG. 9

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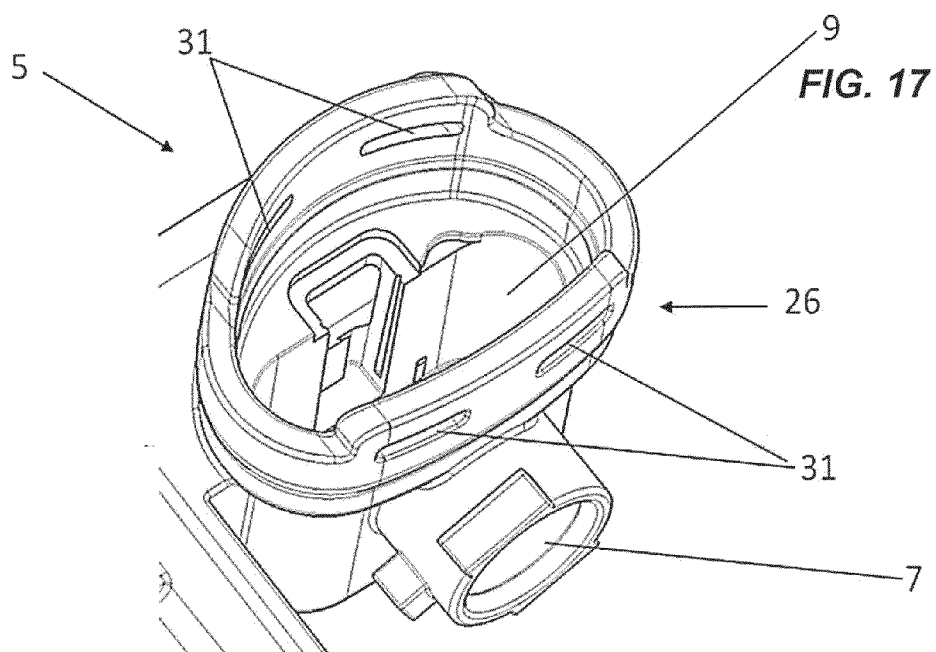
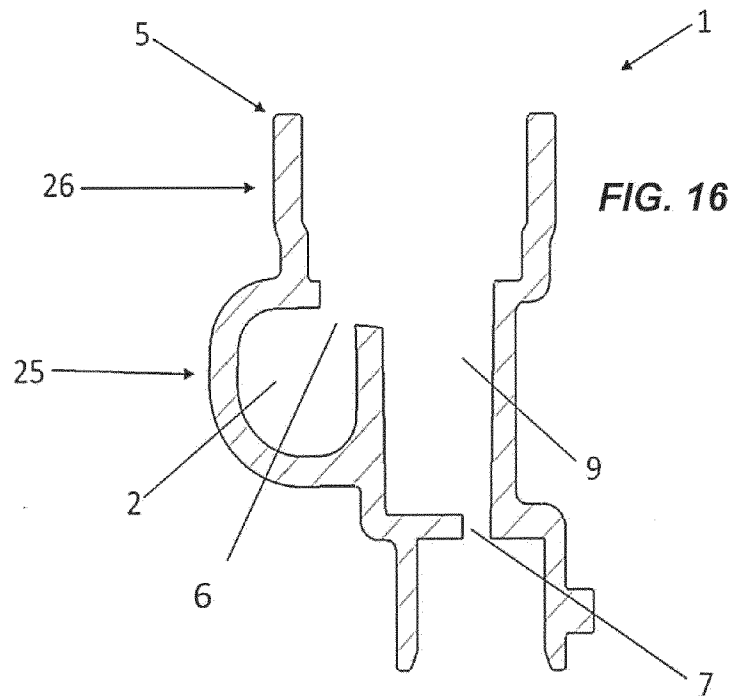




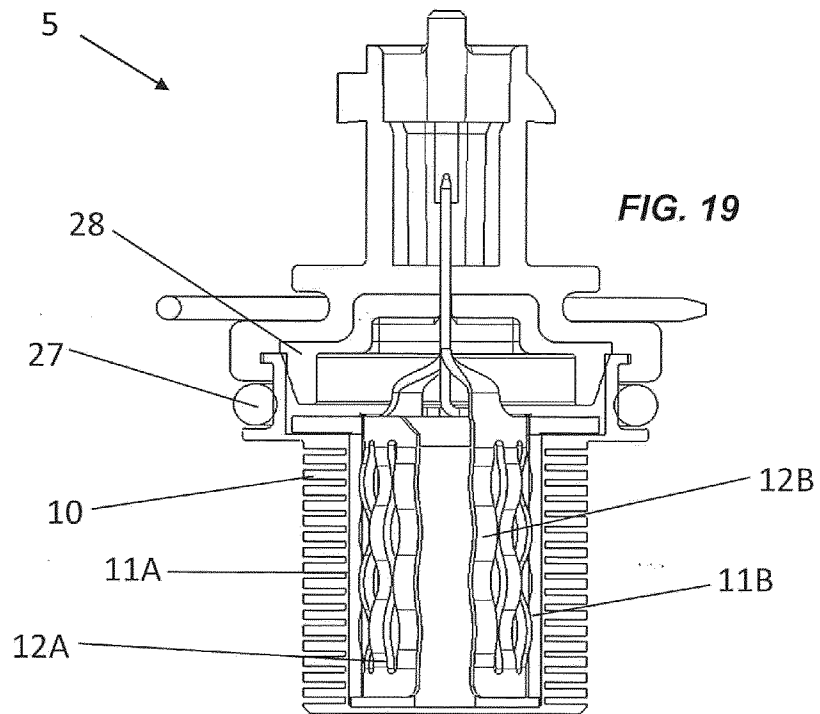
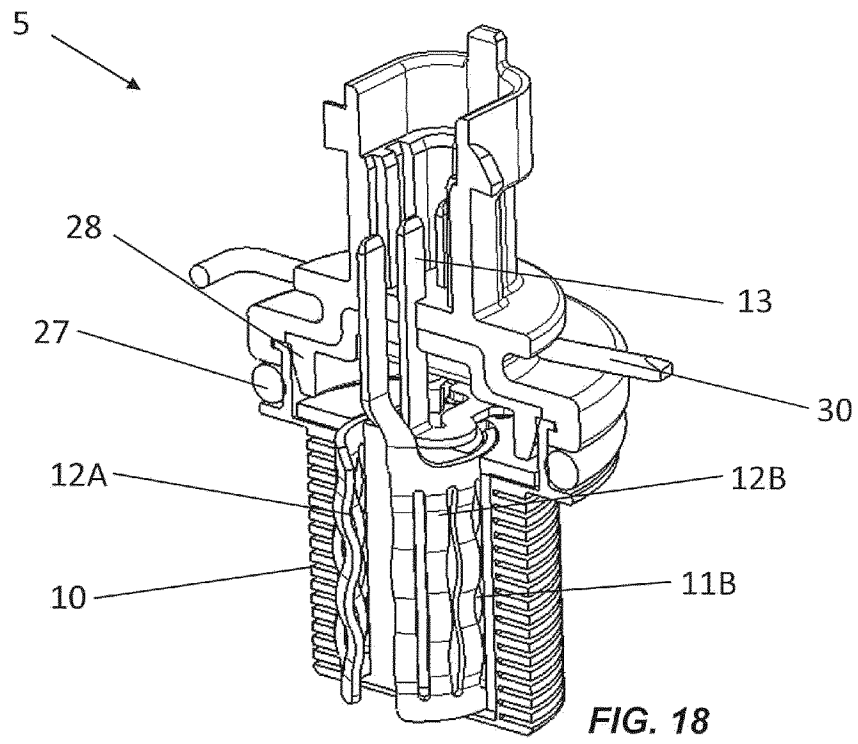
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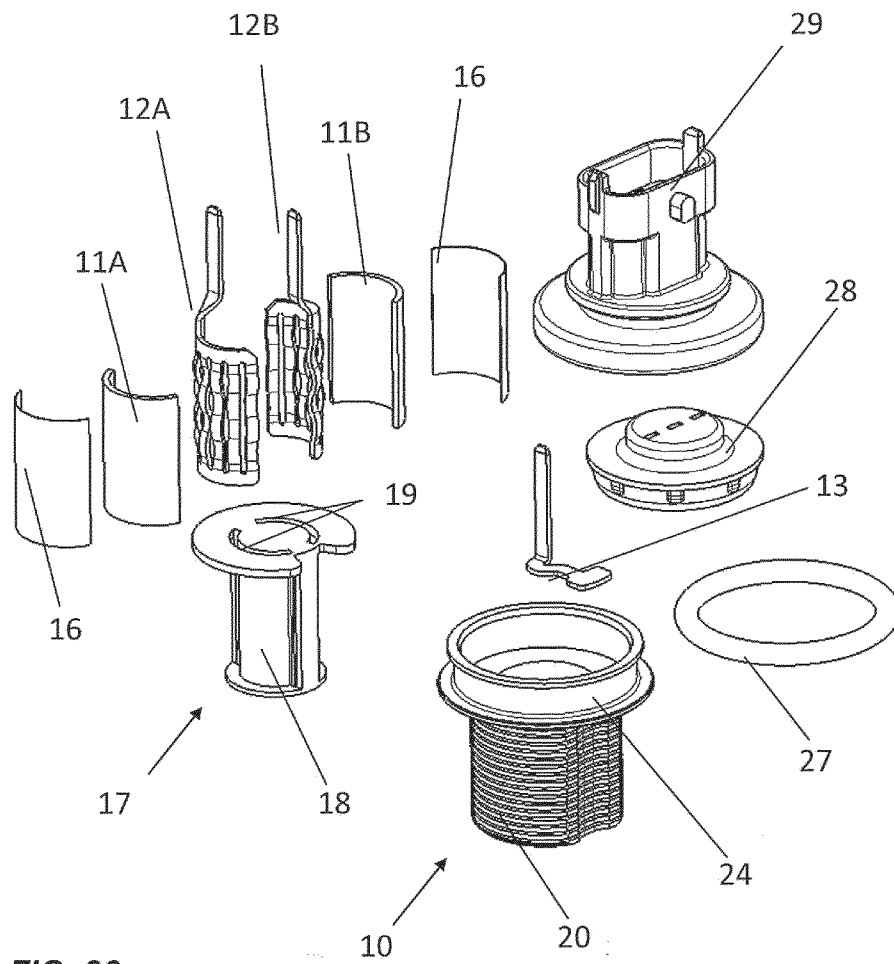


FIG. 20

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2016/076959

A. CLASSIFICATION OF SUBJECT MATTER INV. F02M53/02 F02M69/46 F02M51/00 F02M31/125 F02M53/06 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) F02M		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 108 809 A2 (ELTEK SPA [IT]) 14 October 2009 (2009-10-14) paragraphs [0051], [0059], [0068], [0077], [0078], [0081], [0110], [0115]; figures	1-3, 7-13, 15-24
A	----- EP 2 385 240 A1 (DELPHI TECH INC [US]) 9 November 2011 (2011-11-09) abstract; figures	1
A	----- DE 10 2012 220429 A1 (MAHLE INT GMBH [DE]) 15 May 2014 (2014-05-15) cited in the application abstract; figures ----- -/-	1
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 3 February 2017		Date of mailing of the international search report 13/02/2017
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Godrie, Pierre

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/076959

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Information on patent family members

International application No

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