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(54) **PIPE ASSEMBLY FOR THE FLOW OF A FLUID AND OF A CURRENT AND METHOD FOR ASSEMBLING SUCH A PIPE ASSEMBLY**

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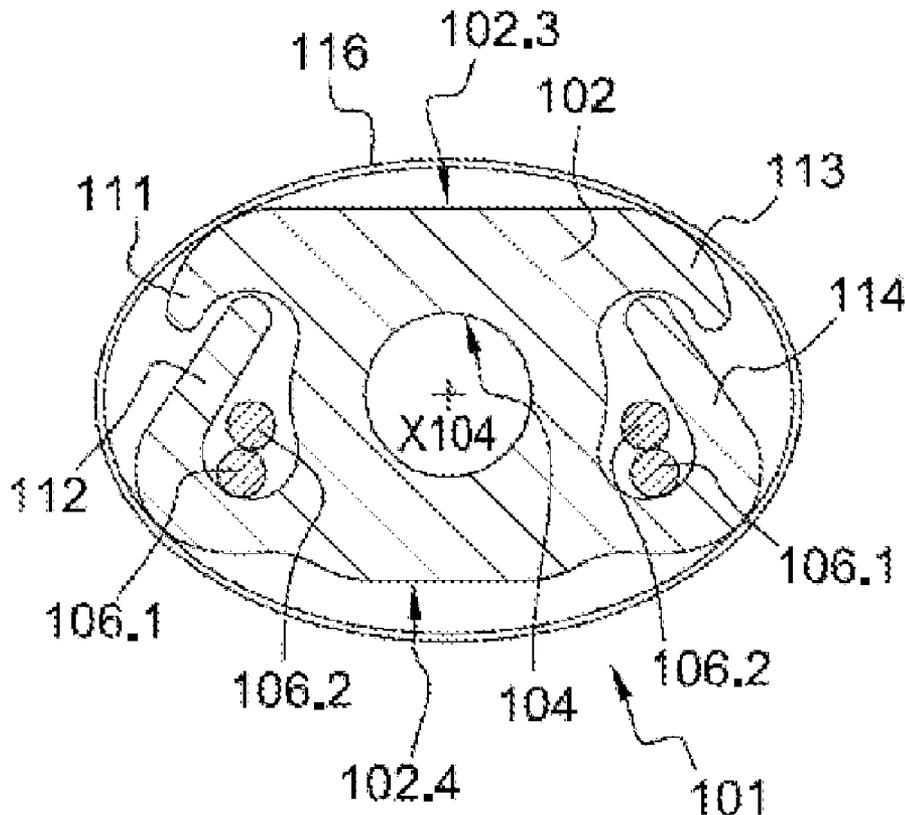
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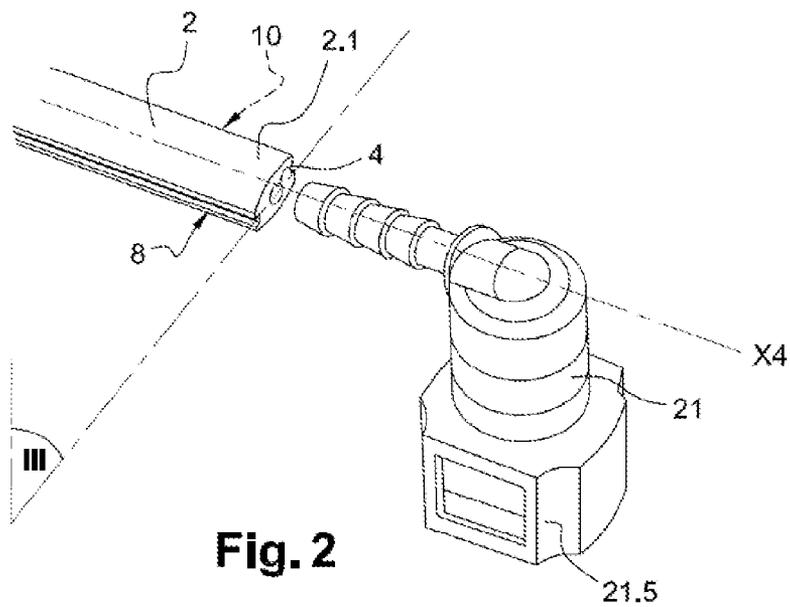
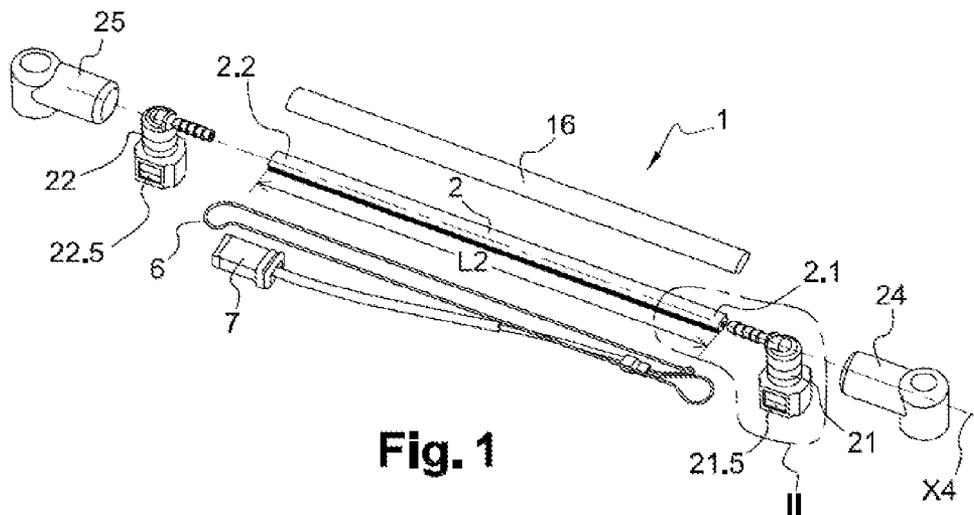
(57) **ABSTRACT**

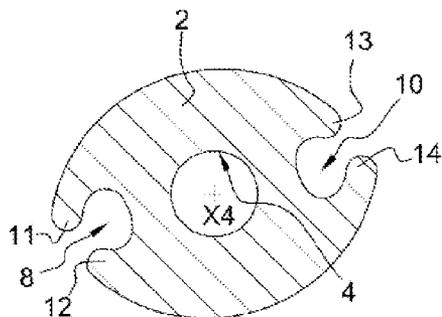
This pipe assembly comprises a pipe (2) having an internal duct (4) for the fluid and an electrical wire (6) longer than the pipe (2). The pipe (2) comprises:

- one or more groove(s) (8, 10) along the pipe (2);
- at least one lip (11, 12, 13, 14) which extends parallel to a groove (8, 10) and which can be deformed;
- between a configuration in which the electrical wire (6) can be introduced into the groove (8, 10); and
- a secondary configuration in which a lip (11, 12, 13, 14) covers the groove (8, 10).

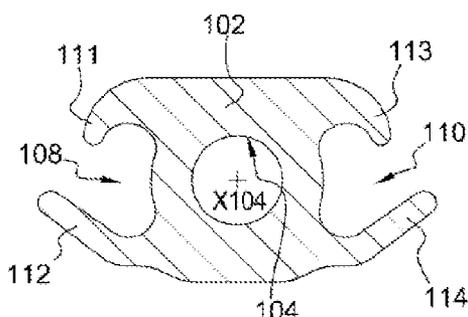
The pipe assembly also comprises means for keeping the or each lip (11, 12, 13, 14) in the secondary configuration.



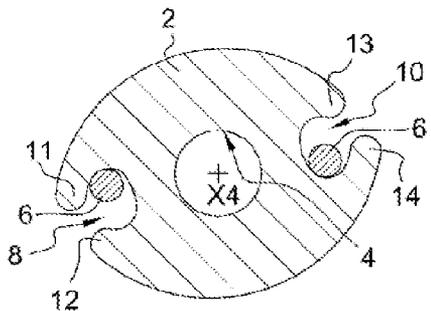




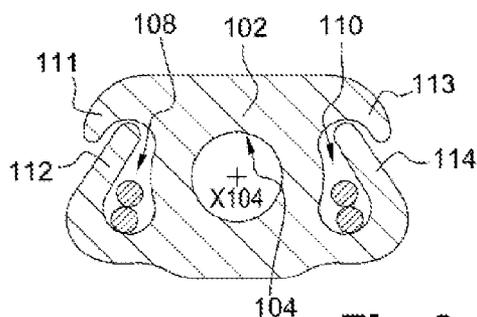
**Fig. 3**



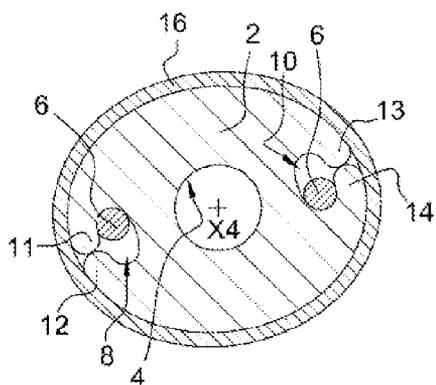
**Fig. 7**



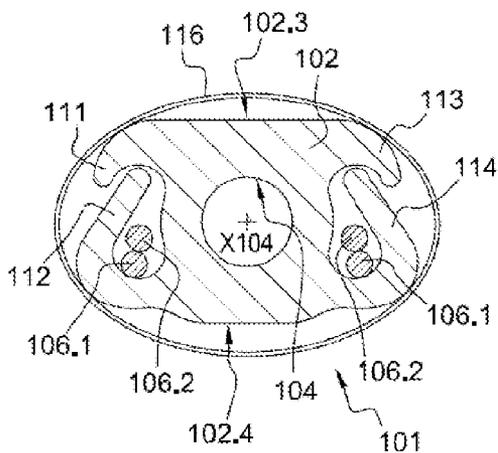
**Fig. 4**



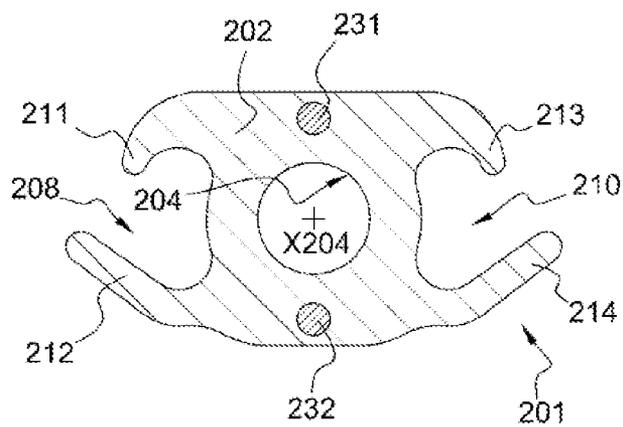
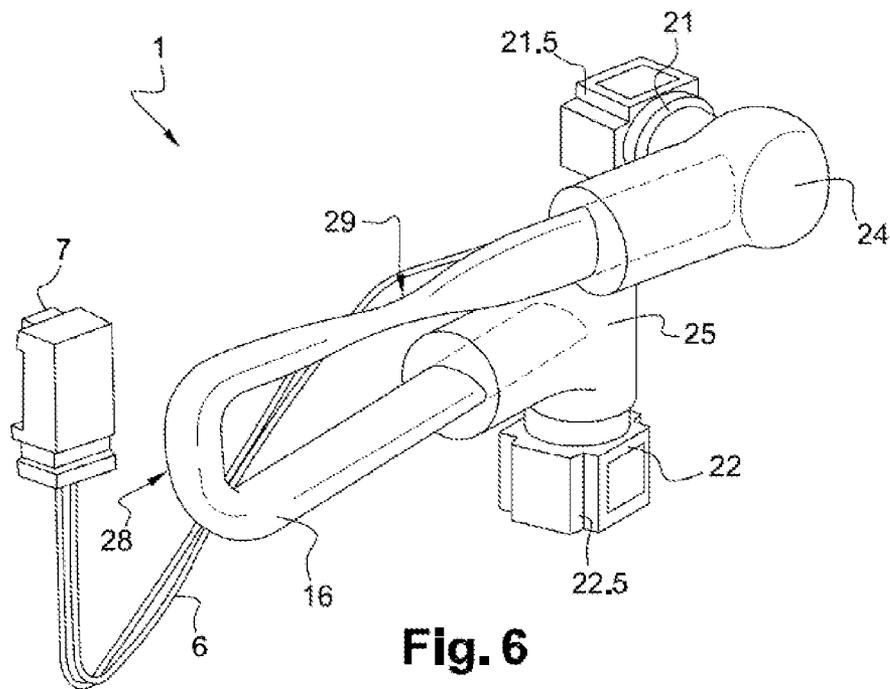
**Fig. 8**



**Fig. 5**



**Fig. 9**



**PIPE ASSEMBLY FOR THE FLOW OF A  
FLUID AND OF A CURRENT AND METHOD  
FOR ASSEMBLING SUCH A PIPE ASSEMBLY**

**[0001]** The present invention relates to a pipe assembly for the flow of a fluid and the circulation of an electrical current along the pipe. In addition, the present invention relates to a method for assembling such a pipe assembly.

**[0002]** The present invention is notably applicable to the automobile field, in particular to heat a fluid flowing in a pipe. It may be necessary to heat the fluids conveyed in order to de-ice them, in the case of use of the vehicle in very cold conditions. In particular, one of the known problems in the use of the aqueous urea solution is that it has a freezing point of approximately  $-12^{\circ}$  C. These icing constraints have led to the creation of reheating systems that are costly, complex and/or insufficiently energy efficient.

**[0003]** FR2915185A1 describes a pipe **11** having an internal duct configured for the flow of the fluid. An electrical wire **12** is wound helically around the pipe **11**, so as to heat the pipe **11** and the fluid which is flowing therein when the electrical wire **12** is supplied with current.

**[0004]** However, the electrical wire **12** emits as much heat toward the outside environment as toward the pipe **11**, which represents a significant heat loss. Therefore, the transfer of heat from the electrical wire **12** to the fluid has a low efficiency, which requires a high electrical energy consumption.

**[0005]** The present invention aims notably to resolve, wholly or partly, the problems mentioned above.

**[0006]** To this end, the subject of the invention is a pipe assembly, for the flow of a fluid and the circulation of an electrical current along a pipe, the pipe assembly comprising:

**[0007]** a pipe having at least one internal duct configured for the flow of the fluid; and

**[0008]** at least one electrically conductive wire having a length greater than or equal to the length of the pipe;

**[0009]** the pipe assembly being characterized in that the pipe comprises:

**[0010]** at least one groove extending overall between a first terminal portion of the pipe and a second terminal portion of the pipe;

**[0011]** at least one lip which extends substantially parallel to a respective groove and which can be deformed so as to change:

**[0012]** from a primary configuration in which at least one electrically conductive wire can be introduced into the respective groove;

**[0013]** to a secondary configuration in which said at least one lip covers, wholly or partly, the respective groove.

**[0014]** In other words, in service, an electrical wire extends in a groove and the retaining means retain the or each lip in a configuration in which this lip covers the groove.

**[0015]** Thus, such a pipe assembly prevents the electrical wire from escaping when an operator is handling this pipe assembly. Furthermore, the or each lip and its retaining means prevent any access to the electrical wire, which increases the safety and the efficiency of the pipe assembly.

**[0016]** In this application, the term “wire” designates electrically conductive elements of elongate shape, rectilinear or curved. Such an element can be, for example, made up of one or more strands.

**[0017]** According to one embodiment of the invention, said at least one lip is of a single piece with the pipe.

**[0018]** Thus, such a pipe assembly is relatively simple to manufacture, because the lip is made of the same material as the pipe. Furthermore, the method for producing such a pipe assembly requires relatively few steps.

**[0019]** As an alternative to this embodiment, at least one lip can be added on to the pipe. Thus, such a lip can, for example, be produced in a material that is distinct from the material of the pipe.

**[0020]** According to one embodiment of the invention, the pipe comprises, for at least one groove, two lips edging the respective groove, so that, in the secondary configuration, the two lips are in contact against one another and cover the respective groove.

**[0021]** Thus, these two lips make it possible to correctly keep the electrical wire in the groove, regardless of the position of the pipe before the retaining means are put in place, because each of the lips forms a scallop that can house the electrical wire.

**[0022]** According to one embodiment of the invention, the pipe comprises at least one so-called long lip and at least one so-called short lip, said at least one long lip and said at least one short lip being arranged so that, in the secondary configuration, a respective long lip penetrates into a cavity delimited by a respective short lip.

**[0023]** Thus, these long and short lips can be “sealed” before the retaining means are put in place, which simplifies the assembly of the pipe assembly.

**[0024]** According to one embodiment of the invention, the pipe assembly also comprises a first coupling and a second coupling having shapes respectively complementing the first terminal portion of the pipe and the second terminal portion of the pipe, the first coupling and the second coupling cooperating with the internal duct so that the fluid flows from the first coupling to the second coupling through the internal duct.

**[0025]** Thus, such first and second couplings make it possible to couple the pipe assembly to a fluid circuit, and keep the pipe in place in a specific position.

**[0026]** According to one embodiment of the invention, the pipe assembly also comprises retaining means for keeping said at least one lip in the secondary configuration, the retaining means comprising:

**[0027]** a first jacket made of thermoplastic material or of elastomer thermoplastic material which is overmolded at least around a part of the first coupling and around the first terminal portion of the pipe; and

**[0028]** a second jacket made of thermoplastic material or of elastomer thermoplastic material which is overmolded at least around a part of the second coupling and around the second terminal portion of the pipe.

**[0029]** Thus, such first and second jackets make it possible to secure the pipe, the or each electrical wire and the first and second couplings, which prevents them from becoming disassembled when an operator handles the pipe assembly.

**[0030]** According to one embodiment of the invention, the pipe assembly also comprises retaining means for keeping said at least one lip in the secondary configuration, the retaining means comprising a sheath configured to grip the pipe, preferably over the entire length of the pipe.

**[0031]** Thus, such a sheath makes it possible to deform the or each lip to its secondary configuration, which keeps each electrical wire in place.

**[0032]** According to one embodiment of the invention, the material that makes up the sheath is selected so that a heating of the sheath shrinks the sheath on to the pipe.

**[0033]** Thus, such a heat-shrinkable sheath facilitates assembly, because it can be prepositioned on the pipe, then heated to assume its definitive shrunk position. By being shrunk, the sheath grips the pipe and deforms the lip, which then covers the electrical wire.

**[0034]** According to one embodiment of the invention, with sheath, the sheath is a textile sheath, which is braided or woven, the thermoplastic or elastomer thermoplastic material of the first jacket and the thermoplastic or elastomer thermoplastic material of the second jacket being inserted between the stitches of the sheath.

**[0035]** In other words, during the overmolding, the thermoplastic or elastomer thermoplastic material(s) which is(are) overmolded on the first coupling and the second coupling is(are) inserted between the stitches of the sheath. Thus, such a textile sheath makes it possible to effectively securely attach the pipe to the first and second couplings.

**[0036]** According to one embodiment of the invention, the pipe comprises at least two grooves, two grooves being preferably situated respectively on two opposing sides of the internal duct.

**[0037]** Thus, these two grooves make it possible to house electrical wires on either side of the pipe, for example to uniformly heat the pipe and the fluid which is flowed therein. These two grooves can be rectilinear. Alternatively, these two grooves can have the shape of a double helix which is wound around the pipe.

**[0038]** According to one embodiment of the invention, the pipe comprises at least two grooves, two grooves being preferably situated respectively on two opposite sides of the internal duct.

**[0039]** According to a variant of the invention, the pipe assembly comprises at least two electrically conductive wires positioned in respective grooves. Thus, these two electrical wires for one groove make it possible to fulfil the electrical function (heating or other) with redundancy or with twice the heat exchange surface area.

**[0040]** According to one embodiment of the invention, the pipe is made of an elastomer, thermoplastic or elastomer thermoplastic material selected from the group consisting of ethylene-propylene-diene monomer (EPDM), of polyvinyl chloride (PVC) and of polypropylene-ethylene-propylene-diene monomer (PP-EPDM).

**[0041]** Thus, such a pipe is flexible, which makes it possible to position it easily in a specific position. Furthermore, such materials make it possible to produce the pipe by extrusion.

**[0042]** According to one embodiment of the invention, at least one electrically conductive wire is formed by a so-called resistive wire which is designed to convert an electrical current into heat by the Joule effect.

**[0043]** Thus, in service, such a resistive wire makes it possible to heat the pipe, and therefore the fluid which is flowing therein, with optimum heat efficiency. In practice, since the groove and the resistive wire are covered by one or more lip(s), the whole quantity of heat emitted by the resistive wire is received by the pipe, then transmitted to the fluid which is flowing therein.

**[0044]** According to one embodiment of the invention, the pipe comprises at least one fiber which is overall non-extendable and which is co-extruded with the pipe, said at least one fiber preferably being selected from the group consisting of glass fibers and textile fibers.

**[0045]** Thus, such a fiber limits the longitudinal elongation of the flexible pipe, when the pipe assembly is assembled and

handled by an operator. Such longitudinal elongation of the pipe would otherwise risk freeing or breaking the electrical wire.

**[0046]** According to a variant of the preceding embodiment, the pipe comprises at least two fibers, said at least two fibers being situated respectively on two opposite sides of the internal duct. Thus, these two fibers prevent any longitudinal elongation of the flexible pipe.

**[0047]** According to a variant of the invention, the pipe has a constant cross section. Thus, such a pipe can be manufactured by extrusion, which incurs a low cost. Advantageously, the pipe has a cross section of overall elliptical shape. Thus, such an elliptical shape makes it possible to limit the weight of the pipe. Alternatively, the outer surface of the pipe has at least two overall planar faces. Thus, such planar faces also make it possible to limit the weight of the pipe.

**[0048]** According to a variant of the invention, at least one groove is parallel to the internal duct. This groove may be rectilinear when the pipe is positioned in a rectilinear manner. Thus, such a groove can be formed during the extrusion of the pipe, which reduces the cost of manufacture of the pipe assembly. Alternatively, this groove can have a helical shape which is wound around the pipe. Thus, such a groove makes it possible to heat the pipe very uniformly.

**[0049]** According to a variant of the invention, the pipe assembly comprises at least two pipes. Thus, such a pipe assembly allows for a plurality of fluid flows and a plurality of electrical current circulations.

**[0050]** Moreover, the subject of the present invention is a method for assembling a pipe assembly according to the invention, the method comprising the steps of:

**[0051]** implementing a pipe assembly according to the invention;

**[0052]** placing said at least one lip in the primary configuration;

**[0053]** introducing said at least one electrically conductive wire into said at least one groove;

**[0054]** changing said at least one lip from the primary configuration to the secondary configuration; and

**[0055]** arranging the retaining means relative to the pipe in such a way as to keep said at least one lip in the secondary configuration.

**[0056]** Thus, such a method makes it possible to rapidly produce a pipe assembly according to the invention.

**[0057]** The embodiments of the invention and the variants of the invention mentioned above can be taken in isolation or in any technically possible combination.

**[0058]** The present invention will be well understood and its advantages will also emerge in the light of the following description, given solely as a non-limiting example and with reference to the appended drawings, in which:

**[0059]** FIG. 1 is an exploded perspective view of a pipe assembly according to a first embodiment of the invention;

**[0060]** FIG. 2 is a larger-scale view of detail II in FIG. 1;

**[0061]** FIG. 3 is a section of the pipe assembly of FIG. 1 in a plane III in FIG. 2, during an initial step of a method according to the invention;

**[0062]** FIG. 4 is a view similar to FIG. 3, during a subsequent step of the method according to the invention;

**[0063]** FIG. 5 is a view similar to FIG. 3, during a subsequent step of the method according to the invention;

**[0064]** FIG. 6 is an assembled perspective view of the pipe assembly in FIG. 1;

[0065] FIG. 7 is a view similar to FIG. 3 and illustrating a section of a pipe assembly according to a second embodiment of the invention, during an initial step of the method according to the invention;

[0066] FIG. 8 is a view similar to FIG. 7, during a subsequent step of the method according to the invention;

[0067] FIG. 9 is a view similar to FIG. 7, during a subsequent step of the method according to the invention; and

[0068] FIG. 10 is a view similar to FIG. 7 and illustrating a section of a pipe assembly according to a third embodiment of the invention, during an initial step of the method according to the invention.

[0069] FIGS. 1 and 2 illustrate a pipe assembly 1, which is intended for the flow of a fluid and for the circulation of an electrical current along a pipe 2. In the example of the figures, the fluid is a liquid made up of an aqueous urea solution and the purpose of the electrical current is to heat the aqueous urea solution as it flows in the pipe 2.

[0070] The pipe assembly 1 comprises the pipe 2 which has an internal duct 4, which can be seen in FIG. 2. The internal duct 4 is configured for the flow of the fluid. To this end, the internal duct 4 opens on to a first terminal portion 2.1 of the pipe 2 and on to a second terminal portion 2.2 of the pipe 2.

[0071] The pipe assembly 1 also comprises a wire 6 which is electrically conductive and which has a length greater than the length of the pipe 2. The wire 6 is here formed by a resistive wire which is designed to convert an electrical current into heat by the Joule effect. The wire 6 is here made up of a metallic material. The resistivity of the wire 6 is determined according to the application of the pipe assembly 1, so as produce the requisite quantity of heat.

[0072] The pipe assembly 1 also comprises an electrical connector 7 to which the wire 6 is securely attached. The function of the electrical connector 7 is to electrically connect the wire 6 to an electrical energy source which is not represented that belongs to the motor vehicle.

[0073] In FIG. 1, the wire 6 is folded on itself. In the example of the figures, the pipe 2 has a length L2 of approximately 300 mm and the wire 6 has a length of approximately 600 mm.

[0074] The pipe 2 comprises two grooves 8 and 10 which each extend overall between the first terminal portion 2.1 of the pipe 2 and the second terminal portion 2.2 of the pipe 2. Each groove 8 or 10 extends overall along the pipe 2. Each groove 8 or 10 forms a kind of concavity opening on the outer surface of the pipe 2.

[0075] In the example of the figures, each groove 8 or 10 is parallel to the internal duct 4, when the pipe 2 is rectilinear. Thus, each groove 8 or 10 is rectilinear when the pipe 2 is positioned in a rectilinear manner, along a longitudinal axis X4. As FIG. 3 shows, the two grooves 8 and 10 are situated respectively on the two opposite sides of the internal duct 4, that is to say on either side of the longitudinal axis X4.

[0076] The pipe 2 has a constant cross section, which here has an overall elliptical shape, as FIGS. 3, 4 and 5 show. In other words, the cross section of the pipe 2 is identical to the section illustrated in FIG. 3 in any cutting plane parallel to the plane III in FIG. 2, that is to say in any plane at right angles to the longitudinal axis X4.

[0077] The pipe 2 also comprises four lips 11, 12, 13 and 14. The pipe 2 here comprises, for each groove 8 or 10, two respective lips 11 and 12 or 13 and 14.

[0078] Each lip 11 or 12 extends here substantially parallel to the groove 8. The lips 11 and 12 edge the respective groove

8, so that, in the secondary configuration (FIG. 5), the lips 11 and 12 are in contact against one another and cover the groove 8. The lips 11 and 12 have substantially the same shape and the same dimensions.

[0079] Similarly, each lip 13 or 14 extends here substantially parallel to the groove 10. The lips 13 and 14 edge the respective groove 10, so that, in the secondary configuration (FIG. 4), the lips 13 and 14 are in contact against one another and cover the groove 10. The lips 13 and 14 have substantially the same shape and the same dimensions.

[0080] In the example of the figures, the lips 11, 12, 13 and 14 and the pipe 2 are of a single piece. The lips 11, 12, 13 and 14 are situated in an external peripheral region of the pipe 2. The pipe 2 here is made of an elastomer material.

[0081] Each lip 11 or 12 can be deformed so as to change:

[0082] from a primary configuration (FIG. 3) in which the wire 6 can be introduced into the groove 8;

[0083] to a secondary configuration (FIG. 5) in which the lips 11 and 12 totally cover the groove 8.

[0084] The primary configuration is an assembly configuration and the secondary configuration is a service configuration.

[0085] Similarly, each lip 13 or 14 can be deformed so as to change:

[0086] from a primary configuration (FIG. 3) in which the wire 6 can be introduced into the groove 10;

[0087] to a secondary configuration (FIG. 5) in which the lips 13 and 14 totally cover the groove 10.

[0088] Between the groove 8 and the groove 10, the wire 6 forms a fold or a bend at the terminal portion 2.1 or 2.2. In other words, the wire 6 describes a round trip out and back along the pipe 2, in the grooves 8 and 10.

[0089] Furthermore, as FIG. 5 shows, the pipe assembly 1 comprises a sheath 16 which is configured to grip the pipe 2 over the entire length L2 and over the entire outer surface of the pipe 2. The sheath 16 forms a retaining means for keeping the lips 11, 12, 13 and 14 in the secondary configuration (FIG. 5).

[0090] To this end, the material of which the sheath 16 is made is selected so that a heating of the sheath 16 shrinks the sheath 16 on to the pipe 2. Before the shrinking of the sheath 16, the sheath 16 can easily be threaded around the pipe 2. In FIG. 5, the sheath 16 is represented in the shrunk configuration, in which the sheath 16 grips the pipe 2 over the entire length L2 and over the entire outer surface of the pipe 2. The sheath 16 is here a braided textile sheath.

[0091] Furthermore, as FIGS. 1 and 6 show, the pipe assembly 1 comprises a first coupling 21 and a second coupling 22. The first coupling 21 and the second coupling 22 have shapes respectively complementing the first terminal portion 2.1 of the pipe 2 and the second terminal portion 2.2 of the pipe 2.

[0092] To this end, the first coupling 21 and the second coupling 22 each have a ringed end-fitting of "Christmas tree" type which can be fitted into the internal duct 4. Thus, the first coupling 21 and the second coupling 22 can cooperate with the internal duct 4 so that the aqueous urea solution flows from the first coupling 21 to the second coupling 22 through the internal duct 4.

[0093] The functions of the first coupling 21 and the second coupling 22 are to couple the pipe assembly 1 to a fluid circuit which is not represented, and to hold the pipe 2 in place in a specific position in the motor vehicle.

[0094] To this end, the first coupling 21 and the second coupling 22 have respective coupling parts 21.5 and 22.5

which are configured for a snap-fitting onto complementary elements which are not represented and linked to the motor vehicle.

[0095] Moreover, as FIGS. 1 and 6 show, the pipe assembly 1 comprises a first jacket 24 and a second jacket 25. The first jacket 24 and the second jacket 25 are made of a thermoplastic material.

[0096] The first jacket 24 is overmolded around a part of the first coupling 21 and around the first terminal portion 2.1 of the pipe 2. Similarly, the second jacket 25 is overmolded around a part of the second coupling 22 and around the second terminal portion 2.2 of the pipe 2.

[0097] The first jacket 24 and the second jacket 25 form retaining means for keeping the lips 11, 12, 13 and 14 in the secondary configuration (FIG. 5). In practice, the first jacket 24 and the second jacket 25 grip the lips 11, 12, 13 and 14.

[0098] After their overmolding, the thermoplastic material of the first jacket 24 and the thermoplastic material of the second jacket 25 are inserted between the stitches of the sheath 16 of textile type. The result of this is a strong mechanical cohesion of the sheath 16 with the first and second jackets 24 and 25, therefore with the first and second couplings 21 and 22.

[0099] To assemble the pipe assembly 1, one production method comprises the steps of:

[0100] implementing the pipe assembly 2, which is in the disassembled state in an initial step;

[0101] placing the lips 11, 12, 13 and 14 in the primary configuration (FIG. 3);

[0102] introducing the wire 6 into the grooves 8 and 10;

[0103] changing the lips 11, 12, 13 and 14 from the primary configuration (FIG. 3) to the secondary configuration (FIG. 5); and

[0104] arranging the retaining means relative to the pipe 2 so as to keep the lips 11, 12, 13 and 14 in the secondary configuration (FIG. 5).

[0105] For the step of arranging the retaining means relative to the pipe 2, the sheath 16 is threaded around the pipe 2 then shrunk by heating; furthermore, the first jacket 24 and the second jacket 25 are overmolded on the sheath 16 and on the first and second couplings 21 and 22.

[0106] After this assembly step, the pipe assembly 1 is in service configuration. The coupling parts 21.5 and 22.5 of the first coupling 21 and of the second coupling 22 are then snap-fitted onto the complementary members, which keep the pipe 2 in place in its specific position provided in the motor vehicle.

[0107] In this service configuration, the pipe 2 can be subject to mechanical bending, pulling and/or torsional stresses. In the example of FIG. 6, the pipe 2 is subject to mechanical bending and torsional stresses, located according to the arrows 28 and 29 in FIG. 6. The retaining means, here formed by the sheath 16 and by the first and second jackets 24 and 25, prevent the wire 6 from escaping from the groove, and even prevent any breakage of the wire 6.

[0108] FIGS. 7, 8 and 9 illustrate a part of a pipe assembly 101 according to a second embodiment of the invention. In as much as the pipe assembly 101 is similar to the pipe assembly 1, the description of the pipe assembly 1 given above in relation to FIGS. 1 to 6 can be transposed to the pipe assembly 101, apart from the notable differences described hereinbelow.

[0109] A component of the pipe assembly 101 that is identical or corresponds, by its structure or by its function, to a

component of the pipe assembly 1 bears the same numerical reference increased by 100. There are thus defined a pipe 102, an internal duct 104 with a longitudinal axis X104 and two grooves 108 and 110.

[0110] The pipe assembly 101 differs from the pipe assembly 1, in that the pipe 102 comprises two long lips 112 and 114 and two short lips 111 and 113. The long lip 112 and the short lip 111 are arranged so that, in the secondary configuration (FIG. 8), the long lip 112 penetrates into a cavity delimited by the short lip 111. This cavity corresponds to a part of the groove 108. The long lip 112 is folded at its base to penetrate into this cavity.

[0111] Similarly, the long lip 114 and the short lip 113 are arranged so that, in the secondary configuration (FIG. 8), the long lip 114 penetrates a cavity delimited by the short lip 113. This cavity corresponds to a part of the groove 110. The long lip 114 is folded at its base to penetrate this cavity.

[0112] Furthermore, the pipe assembly 101 differs from the pipe assembly 1, in that the pipe assembly 101 comprises two wires 106.1 and 106.2 which are electrically conductive and which are positioned in each groove 108 and 110.

[0113] Furthermore, the pipe assembly 101 differs from the pipe assembly 1, in that the outer surface of the pipe 102 has two faces 102.3 and 102.4 which are overall planar, instead of having a section that is overall elliptical like the pipe 2.

[0114] Moreover, the pipe assembly 101 differs from the pipe assembly 1, in that the sheath 116 is a retaining sheath, instead of a heat-shrinkable sheath like the sheath 16.

[0115] However, the sheath 116 is optional, because the long lips 112 and 114 are sufficient to keep the grooves 108 and 110 respectively closed, including when the pipe 102 is subject to a torsion or a bending (see FIG. 6).

[0116] Alternatively, to guarantee the closure of the grooves 108 and 110 by the long lips 112 and 114, the pipe assembly 101 can have added to it retaining means as described hereinabove in relation to FIG. 6 with a first and a second thermoplastic jackets overmolded on to the pipe and on to the first and second couplings.

[0117] FIG. 10 illustrates a part of pipe assembly 201 according to a third embodiment of the invention. In as much as the pipe assembly 201 is similar to the pipe assembly 101, the description of the pipe assembly 1 given hereinabove in relation to FIGS. 7, 8 and 9 can be transposed to the pipe assembly 201, apart from the notable differences described hereinbelow.

[0118] The component of the pipe assembly 201 that is identical or corresponds, by its structure or by its function, to a component of the pipe assembly 101 bears the same numerical reference increased by 100. There are thus defined a pipe 202, an internal duct 204 with a longitudinal axis X204, two grooves 208 and 210, short lips 211 and 213 and long lips 212 and 214.

[0119] The pipe assembly 201 differs from the pipe assembly 101 because that the pipe 202 comprises two fibers 231 and 232. The fibers 231 and 232 are overall non-extendable and they are co-extruded with the pipe 202. The fibers 231 and 232 therefore extend along the pipe 202. The fibers 231 and 232 here consist of glass fibers.

1. Pipe assembly (1; 101; 201), for the flow of a fluid and the circulation of an electrical current along a pipe (2; 102; 202), the pipe assembly (1; 101; 201) comprising:

a pipe (2; 102; 202) having at least one internal duct (4; 104; 204) configured for the flow of the fluid; and

at least one electrically conductive wire (6; 106; 206) having a length greater than or equal to the length (L2) of the pipe (2; 102;

202); the pipe assembly (1; 101; 201) being characterized in that the pipe (2; 102; 202) comprises:

at least one groove (8, 10; 108, 110; 208, 210) extending overall between a first terminal portion (2.1) of the pipe (2; 102; 202) and a second terminal portion (2.2) of the pipe (2; 102; 202);

at least one lip (11, 12, 13, 14; 111, 112, 113, 114; 211, 212, 213, 214) which extends substantially parallel to a respective groove (8, 10; 108, 110; 208, 210) and which can be deformed so as to change:

from a primary configuration in which at least one electrically conductive wire (6; 106; 206) can be introduced into the respective groove (8, 10; 108, 110; 208, 210);

to a secondary configuration in which said at least one lip (11, 12, 13, 14) covers, totally or partially, the respective groove (8, 10; 108, 110; 208, 210).

2. Pipe assembly (1; 101; 201) according to claim 1, in which said at least one lip (11, 12, 13, 14) is of a single piece with the pipe (2; 102; 202).

3. Pipe assembly (1; 101; 201) according to claim 1, in which the pipe (2; 102; 202) comprises, for at least one groove (8, 10; 108, 110; 208, 210), two lips (11, 12, 13, 14) edging the respective groove (8, 10; 108, 110; 208, 210), so that, in the secondary configuration, the two lips (11, 12, 13, 14) are in contact one against the other and cover the respective groove (8, 10; 108, 110; 208, 210).

4. Pipe assembly (1; 101; 201) according to claim 3, in which the pipe (2; 102; 202) comprises at least one so-called long lip (112, 114) and at least one so-called short lip (111, 113), said at least one long lip (112, 114) and said at least one short lip (111, 113) being arranged so that, in the secondary configuration, a respective long lip (112, 114) penetrates into a cavity delimited by a respective short lip (111, 113).

5. Pipe assembly (1) according to claim 1, also comprising a first coupling (21) and a second coupling (22) having shapes respectively complementing the terminal portion of the pipe (2) and the second terminal portion of the pipe (2), the first coupling (21) and the second coupling (22) cooperating with the internal duct (4) so that the fluid flows from the first coupling (21) to the second coupling (22) through the internal duct (4).

6. Pipe assembly (1) according to claim 5, also comprising retaining means for keeping said at least one lip (11, 12, 13, 14) in the secondary configuration, the retaining means comprising:

a first jacket (24) made of thermoplastic material or of elastomer thermoplastic material which is overmolded at least around a part of the first coupling (21) and around the first terminal portion (2.1) of the pipe (2); and

a second jacket (25) made of thermoplastic material or of elastomer thermoplastic material which is overmolded

at least around a part of the second coupling (22) and around the second terminal portion (2.2) of the pipe (2).

7. Pipe assembly (1; 101) according to claim 1, also comprising retaining means for keeping said at least one lip (11, 12, 13, 14) in the secondary configuration, the retaining means comprising a sheath (16; 116) configured to grip the pipe (2; 102) preferably over the entire length (L2) of the pipe (2; 102).

8. Pipe assembly (1) according to claim 7, in which the material forming the sheath (16) is selected so that a heating of the sheath (16) shrinks the sheath (16) on to the pipe (2).

9. Pipe assembly (1) according to claim 6 and according to one of claims 7 and 8, in which the sheath (16) is a textile sheath, which is braided or woven, the thermoplastic or elastomer thermoplastic material of the first jacket (24) and the thermoplastic or elastomer thermoplastic material of the second jacket (25) being inserted between the stitches of the sheath (16).

10. Pipe assembly (1; 101; 201) according to claim 1, in which the pipe (2; 102; 202) comprises at least two grooves (8, 10; 108, 110; 208, 210), two grooves (8, 10; 108, 110; 208, 210) being preferably situated respectively on two opposing sides of the internal duct (4; 104; 204).

11. Pipe assembly (1; 101; 201) according to claim 1, in which the pipe (2; 102; 202) is made of an elastomer, thermoplastic or elastomer thermoplastic material selected from the group consisting of ethylene-propylene-diene monomer (EPDM), of polyvinyl chloride (PVC) and of polypropylene-ethylene-propylene-diene monomer (PP-EPDM).

12. Pipe assembly (1; 101; 201) according to claim 1, in which at least one electrically conductive wire (6; 106; 206) is formed by a so-called resistive wire which is designed to convert an electrical current into heat by the Joule effect.

13. Pipe assembly (201) according to claim 1, in which the pipe (202) comprises at least one fiber (231, 232) which is overall non-extendable and which is co-extruded with the pipe (202), said at least one fiber (231, 232) being preferably selected from the group consisting of glass fibers and textile fibers.

14. Method, for assembling a pipe assembly (1; 101; 201) according to claim 1, the method comprising the steps of:

implementing a pipe assembly (1; 101; 201) according to one of the preceding claims;

placing said at least one lip (11, 12, 13, 14; 111, 112, 113, 114; 211, 212, 213, 214) in the primary configuration; introducing said at least one electrically conductive wire (6; 106; 206) into said at least one groove (8, 10; 108, 110; 208, 210);

changing said at least one lip (11, 12, 13, 14) from the primary configuration to the secondary configuration; and

arranging the retaining means relative to the pipe (2; 102; 202) so as to keep said at least one lip (11, 12, 13, 14) in the secondary configuration.

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