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(54) Electrical connection assembly

(57) The invention relates to an electrical connection assembly (1) and an electrical element (20) comprising an electrical connection assembly (1). Prior methods of making an electrical connection between two conductors

either require a third element, expose the two conductors to heat or are not reliable. The invention overcomes these disadvantages by using a first conductor (2) having a hole (4) into which a second conductor (3) with an elastic spring section (5) is inserted.

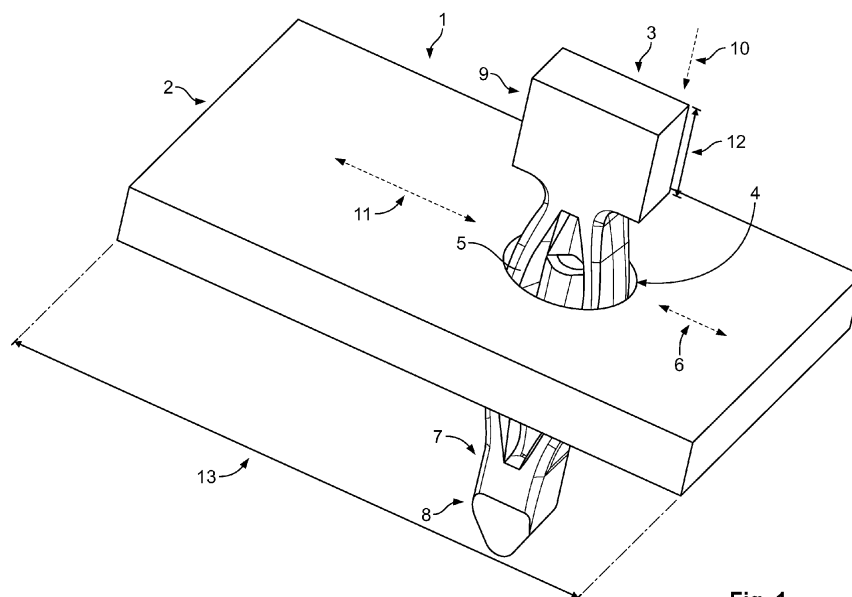


Fig. 1

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Description

[0001] The invention relates to an electrical connection assembly. Further, the invention relates to an electrical element comprising an electrical connection assembly.

[0002] Several methods of making an electrical connection between two conductors are already known from the prior art. However, all of these methods have drawbacks.

[0003] For example, two metal parts can be soldered or welded together, which gives a reliable and non-detachable connection, but this method requires two steps, the first step being the connecting and the second step the welding or soldering. Further, welding or soldering, in particular soldering with lead-free solders, produces high temperatures and is thus complicated and expensive, and exposes the conductors to potentially damaging heat.

[0004] Another method for making an electrical connection known from the prior art is by press fitting a pin into a sleeve made from metal, which is embedded in an insulating substrate. For example, a hole is drilled into a printed circuit board (PCB), a sleeve is inserted and a pin is introduced into the sleeve in the hole. The necessary force needed to make a good electrical contact is herein generated by the substrate in which the sleeve is embedded. Three parts, the pin, the sleeve and the substrate, are necessary for this connection. This makes the assembly complicated and limits the design, as the printed circuit board is usually big and flat.

[0005] A third example of an electrical connection is shown in EP 0 924 809, where a cylindrical pin is pushed into a hole of a metal part, wherein the hole has a limited elasticity due to its shape. However, this design only tolerates minor deviations in the size of the pin and/or the hole, as the electrical resistance will increase if the deviations are big.

[0006] Hence, the object of the present invention is to provide an electrical connection assembly having a low resistance that can in particular replace the PCB-based solution of the prior art. Further, the assembly should be easy to produce. It is also desired that the two conductors can be produced efficiently, in particular the two conductors should be cheap. Furthermore, the conductors should not be exposed to heat during the production to keep manufacturing simple.

[0007] The object is achieved by the present invention by making a connection between a first conductor of an essentially strip-like shape and a second conductor, which has a spring section by plugging the second connector in a press-fit manner into a hole of the first connector so that the spring section of the second conductor is elastically compressed in a diameter direction of the hole of the first connector, wherein the first connector is a lead frame.

[0008] The invention overcomes the disadvantages of the connections in the prior art. Only two parts, the two conductors, are necessary for making the connection and

are present in the assembly. No further elements like solder or a PCB have to be used, which lowers the manufacturing costs and opens up new design possibilities. Further, the conductors are not exposed to heat as in soldering or welding. Still, the resistance of the connection according to the invention is very low, due to the fact that the elasticity and elastic deformation of the press-fit connection is predominantly or exclusively in the male part of the connection which ensures a tight contact and tolerates deviations in the size of the conductors in the connecting portion.

[0009] The solution according to the invention may be combined as desired with the following further advantageous improvements.

[0010] The spring section of the second connector can be provided with two spring legs that are connected at at least one of the ends and which are separated by an opening. This design is very simple and thus easy to manufacture. Additionally, the restoring force of this simple shape can be calculated easily. In an advantageous development of this design, the opening between the two legs is closed, which can for example lead to an eye-of-needle shape of the spring section. Compared to an open version of this design, pins with the closed design are already available, which may lower the manufacturing costs.

[0011] In particular, pins with an eye-of-needle-like spring section with further spring elements within the needle eye can be advantageous, as the restoring force can be adjusted precisely, in particular the restoring force can be increased. For example, simple V-shaped sheets of metal might be used as additional spring elements. The legs of the V exert a force when they are pressed against each other. The restoring force will be greater if thicker layers of metal or stiffer metals are used.

[0012] In order to make the insertion of the second conductor into the first conductor or into further elements easier, it is advantageous if the second conductor has at least in and/or adjacent to the connecting portion a pin-like shape.

[0013] In another advantageous development, the second conductor has at least sectionwise a strip-like shape. Such a shape can be manufactured easily. Further, this shape is stable in two dimensions and has a certain flexibility in a third dimension. As the cross-section of the strip-like element is usually higher than a needle-type, higher currents can be used.

[0014] The first conductor is a lead frame. Lead frames can for example be produced by punching or stamping. Lead frames may for instance be used to connect several elements like pins in an electrical circuit, thereby replacing a PCB-based connection, which is a standard method up to now. Using lead frames is easier and cheaper, and further allows for different designs, in particular designs with less space requirements.

[0015] Although the hole of the first conductor might be at least slightly elastic, the rim of the hole is in a preferential development of the invention rigid, in particular

compared to the spring section of the second conductor. This helps to lower the electrical resistance, as the contact force between the rim of the hole and the spring section is increased. Further, such an improved engagement can also stabilize the interconnection mechanically. A hole that is too soft could be deformed by the spring force of the spring section of the second conductor. The rigidity, as opposed to elastic and/or plastic deformation, can be caused by the material itself and/or by the design. Additional elements to make the hole more rigid might also be provided at or close to the hole.

[0016] The electrical connection according to the invention comprises two conductors, which allows to use different materials of the two conductors, at least in the connecting portion. This is advantageous if for example a double-sided connector is to be produced in which two different materials, for example iron on one side and gold on the other side, is desired. Previous methods of assembling such a double-sided connector do not allow for this option. Such a method would be to bend a wire and then cover it with a housing or by moulding it into plastic.

[0017] In order to further improve the contact resistance, the first and/or the second conductor may additionally be plated, for example with tin or nickel. Such an additional plating could also provide protection against environmental influences or against corrosion. In this case, plating materials like gold or silver could be used. Additionally, the plating could help to improve the insertion or retention forces in the contact portion of the electrical connection assembly as it may lower or increase the friction coefficient between the first and second conductor.

[0018] Furthermore, using two conductors also allows for using two conductors with two different cross sections, which might be advantageous if for example a connector is to be manufactured that allows a cable with small diameters to be connected to a cable with larger diameters.

[0019] In an advantageous development of the invention, the direction of insertion of the second conductor is basically perpendicular to the longitudinal direction of the first conductor. For example, if a 90° conductor is to be manufactured, the second conductor can be press-fitted into the first connector, the first conductor being present in the connector already. Such a 90° conductor can be manufactured with very simple means still providing the necessary reliable contact between the two conductors. Further, such an orthogonal pressing step will not lead to unwanted movements of the first conductor, as no non-orthogonal components of the force are present. However, if an angle different from 90° is desired, conductors can be bent at sections that are away from the connecting portion.

[0020] Although a 90° connection as described in the last paragraph might be preferred in most cases, it is also possible to have an angle different from 90° when connecting the second conductor to the first conductor. For example, the hole of the first conductor can have a direction of its axis that is different from 90° with respect

to the longitudinal extension of the first conductor. In this case, the second conductor is inserted in a non-normal direction and for example a 60° connection could be made. Another possibility of making a non-orthogonal connection could be to have an oval hole which allows to insert the second conductor in a not perpendicular manner. Other holes in which one diameter direction on the surface is smaller or greater than the other diameter direction, for example slit-like holes, can also allow for a slant insertion of the second conductor into the first conductor.

[0021] Especially if a connector is to be produced comprising an electrical connection assembly according to the invention, it is advantageous if at least one conductor is additionally press-fitted into a plug housing at a support section of the conductor. The press fit at the support section can either be due to a spring force of either the conductor and/or the plug housing created by a spring section, or it may be solely due to the compressibility of the conductor and the plug housing. In particular, the additional press fit between the conductor and the plug housing can be such that it seals the conductor and the plug housing. For example, the engagement between the two can be gastight or watertight. For instance, the connector can be produced by inserting the first conductor on one side, press-fitting the second conductor into the plug housing and the first conductor, leading to a connector that is watertight on the side of the second conductor.

[0022] In a further advantageous development of the invention, the hole of the first conductor has a collar at a rear surface of the first conductor, the rear surface being situated in the direction of insertion of the second conductor. This helps to increase the contact area between the first and the second conductor, leading to a lower resistance and a mechanically more stable connection. In particular in systems where a lead frame replaces a PCB-based connection, the collar can help to improve the stiffness of the connection.

[0023] The geometry of the collar can be an important factor for the mechanical stability and the electrical connection between the first conductor and the second conductor. In particular, the height of the collar might be critical. The higher the collar is, the longer the contact area between the first conductor and the second conductor will be. However, as pins containing a spring section wherein the spring section is optimized for the standardized thicknesses of PCBs might already be available, adjusting the height of the collar to one of these standard thicknesses of PCBs could be advantageous as no further pins have to be produced.

[0024] Another important aspect of the collar could be the thickness of the wall. A thicker wall will usually provide a more rigid contact. However, a certain elasticity of the hole might be desired, and the thickness of the wall could be adjusted to the elastic properties of the collar. Additionally, thicker walls might be difficult to produce.

[0025] A third important aspect of the geometry of the collar could be its shape, particularly at the insertion area

where the second conductor is inserted into the first conductor and at the end of the collar. In contrast to an insertion area with sharp edges which gives a tighter contact between the first conductor and the second conductor, in most cases a rounded or funnel-like insertion area might be preferred as this allows for an easy insertion and might avoid that platings are peeled off from the second conductor.

[0026] The end of the collar should be smooth, that is it should not contain burrs, as these might initiate cracks or damage the second conductor.

[0027] The channel of the collar might usually be cylindrical, however, it can also have cross-sections that are oval, rectangular, square-like, polygonal or have an arbitrary shape.

[0028] In a further advantageous development of the invention, at least one of the first or second conductor has been shaped by stamping. As opposed to cutting, drilling or the like, stamping is a very simple method of producing metal parts, in particular small metal parts. Stamping also allows to produce large quantities of metal parts at low prices and within a short time.

[0029] Electrical connection assemblies according to the invention are in particular suited to be used in electrical elements. A further aspect of the invention thus relates to an electrical element comprising an electrical conductor assembly according to the present invention.

[0030] In an advantageous embodiment, such electrical element is a connector that has pins, wherein the pins are the conductors according to the invention.

[0031] In an even more preferred embodiment of the invention, the electrical element only consists of a plurality of first conductors, a plurality of second conductors and a single plastic part. For instance, the electrical element could be a double-sided connector that has been produced by inserting the first conductors into the single plastic part and in a subsequent step press-fitting the second conductors into the first conductors, preferably in combination with press-fitting the second conductors into the single plastic part at a support section of the second conductors. The resulting electrical connector has an improved design over the prior art connectors, as it is easy to produce due to the limited number of parts and the simple assembling step while still providing a reliable electrical connection and in a more preferred embodiment even providing a watertight connection due to the press-fitting of the second conductors into the single plastic part.

[0032] In an even more preferred embodiment, the electrical element has at least one first conductor facing in a first connection direction and at least one second conductor facing in a second connection direction, wherein the first and the second connection direction are 90° towards each other and the at least one first conductor is connected to the at least one second conductor in an area where the electrical element turns from the first connection direction to the second connection direction. Such an electrical element could for example be a 90°

connector.

[0033] The invention will be described hereinafter in greater detail and in an exemplary manner using advantageous embodiments and with reference to the drawings. The described embodiments are only possible configurations in which, however, the individual features as described above can be provided independently of one another or can be omitted.

[0034] In the drawings:

Fig. 1 shows a schematic perspective view of an electrical connection assembly according to the invention;

Fig. 2 shows a schematic perspective view of a preferred embodiment of the second conductor according to the invention;

Fig. 3 shows a schematic exploded perspective view of an embodiment of the invention;

Fig. 4 shows a schematic perspective view of another embodiment of an electrical connection assembly according to the invention;

Fig. 5 shows a schematic perspective sectional view of a first conductor according to the invention.

[0035] In Fig. 1, an exemplary electrical connection assembly 1 according to the invention is shown. A first conductor 2 of essentially strip-like shape is in an electrically conducting arrangement and in immediate contact with a second conductor 3. The first conductor 2 is provided with a hole 4 into which the second conductor 3 is plugged in a press-fit manner. The spring section 5 of the second conductor 3 is elastically compressed in a diameter direction 6 of the hole 4 of the first conductor 2. The second conductor 3 is further provided with a main section 9 and a tip section 7 having an insertion section 8. The second conductor 3 is inserted into the hole 4 of the first conductor 2 in a direction of insertion 10, which in this case is basically perpendicular to the longitudinal direction 11 of the first conductor 2. The longitudinal direction 11 of the first conductor 2 in the shown embodiment is basically parallel to the diameter direction 6 of the hole 4 in which the second conductor 3 is elastically compressed. However, the two can have any arbitrary angle between them.

[0036] The first conductor 2 and the second conductor 3 can be attached to an electrical circuit (not shown).

[0037] The length 12 of the main section 9 of the second conductor 3 shown here is very small. However, the length 12 may be longer.

[0038] The main section 9 of the second conductor 3 in this example has a rectangular cross-section. However, it can have any arbitrary shape.

[0039] The length 13 of the first conductor 2 can also be extended, making it easier to attach it to further elements.

[0040] Although the electrical connection assembly 1 shown in this figure has an angle between the insertion direction 10 of the second conductor 3 and the first conductor 2 that is basically 90°, this angle might be different, for example it could be 60°, 45° or any arbitrary angle. This could for example be achieved by a hole 4 that is slanted or by a hole 4 that does not have a circular cross-section. The hole 4 could for example have an oval cross-section or a slit-like cross-section.

[0041] This example shows that it might advantageous if the rim of the hole 4 of the first conductor 2 is rigid. The hole 4 is circular before the second conductor 3 is inserted. After the insertion, the hole 4 might be deformed in an elliptical manner as the spring section 5 of the second conductor 3 only exerts a spring force in one diameter direction 6 of the hole 4. Due to the cylindrical inner outline of the hole 4, the contact between the spring section 5 and the hole 4 is maximized and the pressure is minimized, which helps to avoid plastic deformation of small contact areas due to localized force peaks. Thus, the design of the hole 4 and its surrounding area can help to improve the contact. Additionally, as no elasticity is desired, the first conductor 2 can comprise, at least in the area around the hole, a rigid material to further increase the overall contact force.

[0042] Additionally, the first conductor 2 and/or the second conductor 3 could be plated or coated for example with tin, nickel, gold or silver. Such a coating or plating can help to improve the contact resistance between the first conductor 2 and the second conductor 3. As such a plating or coating can also have a protective character, for example to prevent corrosion or contact with water or air, such a coating or plating can also comprise materials that are not metals. For instance, polymers, plastics or the like could be used. Coatings or platings might also help to adjust the insertion or retention force, which allows to produce an electrical connection assembly 1 having a desired insertion and/or retention force.

[0043] In Fig. 2, the second conductor 3 is schematically shown in more detail. The spring section 5 is provided with two spring legs 14 which are connected to each other at a first end 15, which is located at the end of the main section 9. The two spring legs 14 are further connected to each other at a second end 16 which is located at the tip section 7. Between the first end 15 and the second end 16, the spring legs 14 are spread apart, thus making it necessary to exert a force in order to compress the spring section 5 in the compression direction 17. The spring section 5 has basically an eye-of-needle shape. However, the two spring legs 14 might also be connected at one first end 15 only, giving the spring section a pitch fork shape, which requires less force to compress it in the compression direction 17.

[0044] The spring section 5 is further provided with additional spring elements 18 in the area between the two spring legs 14. In this embodiment, the additional spring elements 18 are simply sheets of material that are shaped in a V-like manner, thus providing additional force when

being compressed in the compression direction 17. The thickness 19 of the material layer of the additional spring elements 18 can be adjusted to the desired spring force.

[0045] The spring legs 14 are basically round on the outside and flat on the inside, as such a design allows for an easy insertion into the hole 4 of the first conductor 2. However, the profile can have any shape, for example the spring legs 14 can be basically circular, elliptical or have a polygon profile, for example a rectangular profile.

[0046] The main section 9 has a rectangular profile, however it can be advantageous if the profile has at least in and/or adjacent to the connection section a pin-like shape, for example a cylindrical shape. This helps to make the insertion easier.

[0047] The second conductor 3 shown in Fig. 2 is one single piece of metal which was made by punching. However, the second conductor 3 could also be made by other manufacturing processes, like stamping, etching, cutting, drilling or the like.

[0048] In Fig. 3, an electrical element 20 comprising the electrical connection assembly 1 according to the invention is shown in an exploded view which can also be interpreted as the state before assembling the connector 21. During assembly, a plurality 22 of first conductors 2 is inserted into the plug housing 24 and in a subsequent step, a plurality 23 of second conductors 3 is press-fitted into the holes 4 of the first conductors 2. The simple design of the electrical connection assembly according to the invention thus leads to an easy manufacturing process of the connector 21, consisting only of the two steps of inserting the first and inserting the second conductors. Preferentially, at least one of the conductors is additionally press-fitted into the plug housing 24 at a support section 25.

[0049] In an even more preferred embodiment, the support section 25 and the corresponding counterpart in the plug housing 24 are connected in a sealing manner, thus providing a gastight or watertight connection. In particular, if all conductors on one side of the connector 21 are press-fitted in a sealing manner into the plug housing 24, a watertight termination on one side of the connector 21 is ensured.

[0050] Fig. 3 also shows that the first conductors 2 and the second conductors 3 can have different cross-sections, for example the first conductors 2 shown here have a bigger cross-section than the second conductors 3. This can be used to connect a wire with a small diameter to a wire with a larger diameter. Further, the different cross-sections could be necessary if one side of the connector 21 is a male side and the other side is a female side.

[0051] The first and second conductors 2, 3 might consist of the same material. However, they can also consist of different materials, at least at the connection portion.

[0052] The connector 21 shown here only consists of the plug housing 24, the plurality of first conductors 22 and the plurality of second conductors 23, which makes the resulting connector 21 cheap, all the more as only a

two-step process is necessary to assemble the connector 21. The first conductor 2 and second conductor 3 are the pins 30 of the connector 21.

[0053] The connector 21 shown in Fig. 3 has a 90° configuration between the first connecting direction 26 and the second connecting direction 27. The connection between the plurality of first conductors 22 and the plurality of second conductors 23 is situated in the area, where the plug housing 24 is angled, that is, at the point where the first connecting direction 26 and the second connecting direction 27 intersect. This guarantees an easy assembling process.

[0054] Fig. 4 shows another advantageous embodiment. Herein, the first conductor 2 is a lead frame 28, which is used to connect the pins 30 of stator coils 31. The pins 30 are thus the second conductors 3 of the electrical connection assembly 1. The lead frames 28 are basically planar. Such lead frames can for example be made by punching, cutting or etching a metal sheet. The lead frames 28 as well as the pins 30 are self-supporting, that is, there is no need to mechanically support the lead frame 28. This is in contrast to the solution according to the prior art, in which a printed circuit board with conductive elements which need mechanical support was used.

[0055] The electrical connection assembly 1 shown here can be insulated by e.g. overmoulding or by a housing. Such a further element can also mechanically support the electrical connection assembly 1 and/or it can have a protective character.

[0056] The holes 4 shown here are circular. However, these holes can have any other shape, e.g. they might be polygonal, elliptical, slit-like, etc.

[0057] Fig. 5 shows a preferred embodiment of the first conductor 2. The first conductor 2 is provided with a hole 4 which has a funnel-like insertion area 32 and a collar 33 at the rear surface 34, wherein the rear surface 34 is defined as a surface that is at the back side of the first conductor in the direction of insertion 10 of the second conductor 3. As the first conductor 2 can generally be very thin, it might be necessary to further mechanically support the second conductor 3 by providing more contact area between the first conductor 2 and the second conductor 3, which can for instance be achieved by providing a collar 33. A hole 4 with a collar 33 can for example be manufactured by pushing a die (not shown) into an initial hole 35. Having a collar 33 is particularly advantageous, if the first conductor 2 is a lead frame 28.

[0058] The insertion area 32 shown in Fig. 5 has a basically funnel-like structure as this makes insertion of the second conductor 3 easy and avoids that coatings or platings are scratched off. However, the insertion area might also be rounded or have sharp edges. Such sharp edges might provide a tighter fit of the second conductor 3 in the hole 4.

[0059] The height 36 of the collar 33 can be adjusted to the first conductor 2, in particular to the spring section 5 of the first conductor 2. For instance, the height 36 of the collar 33 might be such that it corresponds to the

thickness of a standard PCB, in particular to the thickness of one of the most common PCBs, which would be 1.6 mm.

[0060] The thickness 37 of the wall of the collar 33 might be a decisive factor of the mechanical and thus electrical contact between the first conductor 2 and the second conductor 3. The bigger the thickness 37 of the collar 33, the more stable the connection is. A collar 33 with a thinner wall might, however, provide a certain degree of elasticity and flexibility. Additionally, a thicker wall might be difficult to produce, in particular if the collar is produced by punching.

[0061] The collar 33 shown here has a circular cross-section. However, the cross-section could also have any other suitable shape. In particular, the shape of the collar 33 can be adapted to the shape of the second conductor 3.

[0062] The end section 38 of the collar 33 is smooth, that is, it does not have burrs or teeth-like structures as these might act as starting points for cracks. Further, such sharp structures might damage the second conductor 3.

Claims

1. Electrical connection assembly (1) comprising a first conductor (2) of essentially strip-like shape and a second conductor (3) that is arranged in an electrically conducting arrangement and in immediate contact with the first conductor (2) at a connecting portion of the assembly **characterised in that** the first conductor (2) is provided with a hole (4) into which the second conductor (3) is plugged in a press-fit manner, and **in that** the second conductor (3) is provided with a spring section (5) that is elastically compressed in a diameter direction (6) of the hole (4), the connecting portion thus comprising the hole (4) of the first conductor (2) and the spring section (5) of the second conductor (3), wherein the first conductor (2) is a lead frame (28).
2. Electrical connection assembly (1) according to claim 1 **characterised in that** the spring section (5) of the second conductor (3) is provided with two spring legs (14) that are connected at at least one of their ends and are separated by an opening.
3. Electrical connection assembly (1) according to claim 2 **characterised in that** the spring legs (5) are connected at two sides of the opening.
4. Electrical connection assembly (1) according to any of claims 1 to 3 **characterised in that** the second conductor (3) has at least in and/or adjacent to the connecting portion a pin-like shape.
5. Electrical connection assembly (1) according to any of claims 1 to 4 **characterised in that** the second

conductor (3) has at least sectionwise a strip-like shape.

6. Electrical connection assembly (1) according to any one of claims 1 to 5 **characterised in that** the rim of the hole (4) of the first conductor (2) is rigid compared to the spring section (5) of the second conductor (3). 5
7. Electrical connection assembly (1) according to any one of claims 1 to 6 **characterised in that** the first (2) and/or second conductor (3) is plated. 10
8. Electrical connection assembly (1) according to any one of claims 1 to 7 **characterised in that** the direction (10) of insertion of the second conductor (3) is basically perpendicular to the longitudinal direction (11) of the first conductor (2). 15
9. Electrical connection assembly (1) according to any one of claims 1 to 7 **characterised in that** the direction of insertion of the second conductor (3) is slanted to the longitudinal direction of the first conductor (2). 20
10. Electrical connection assembly (1) according to any one of claims 1 to 9 **characterised in that** the hole (4) has an oval shape. 25
11. Electrical connection assembly (1) according to any one of claims 1 to 10 **characterised in that** the hole (4) of the first conductor (2) has a collar (33) at a rear surface (34) of the first conductor (2), the rear surface (34) being situated in the direction of insertion (10) of the second conductor (3). 30
12. Electrical connection assembly (1) according to claim 11 **characterised in that** the height (36) of the collar (33) corresponds to the thickness of a printed circuit board. 35
13. Electrical connection assembly (1) according to claim 11 or 12 **characterised in that** the insertion area (32) of the collar (33) is rounded or funnel-like. 40
14. Electrical connection assembly (1) according to any of claims 11 to 13 **characterised in that** the end (38) of the collar (33) is smooth. 45
15. Electrical connection assembly (1) according to any of claims 1 to 14 **characterised in that** at least one of the first (2) or second conductor (3) has been shaped by stamping. 50

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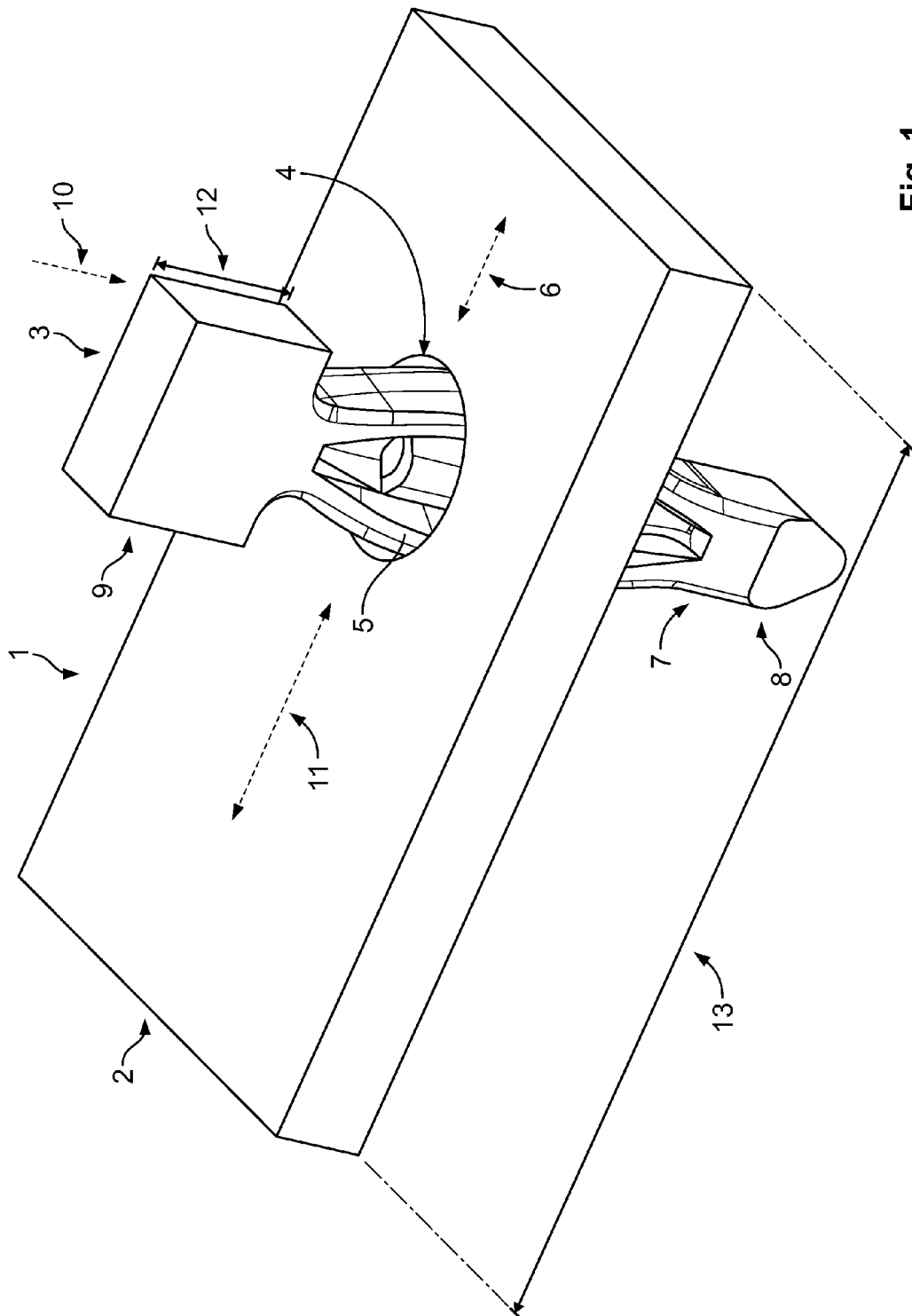


Fig. 1

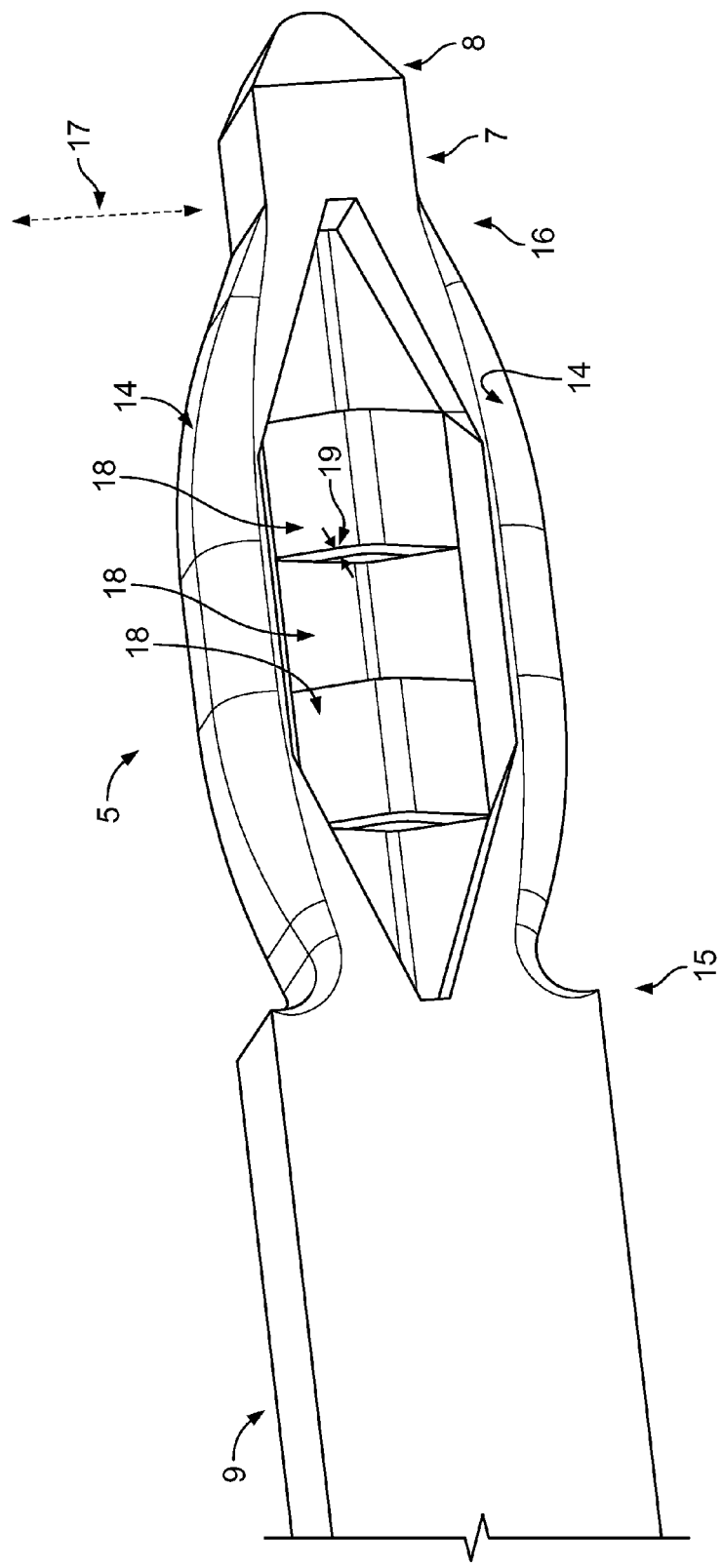


Fig. 2

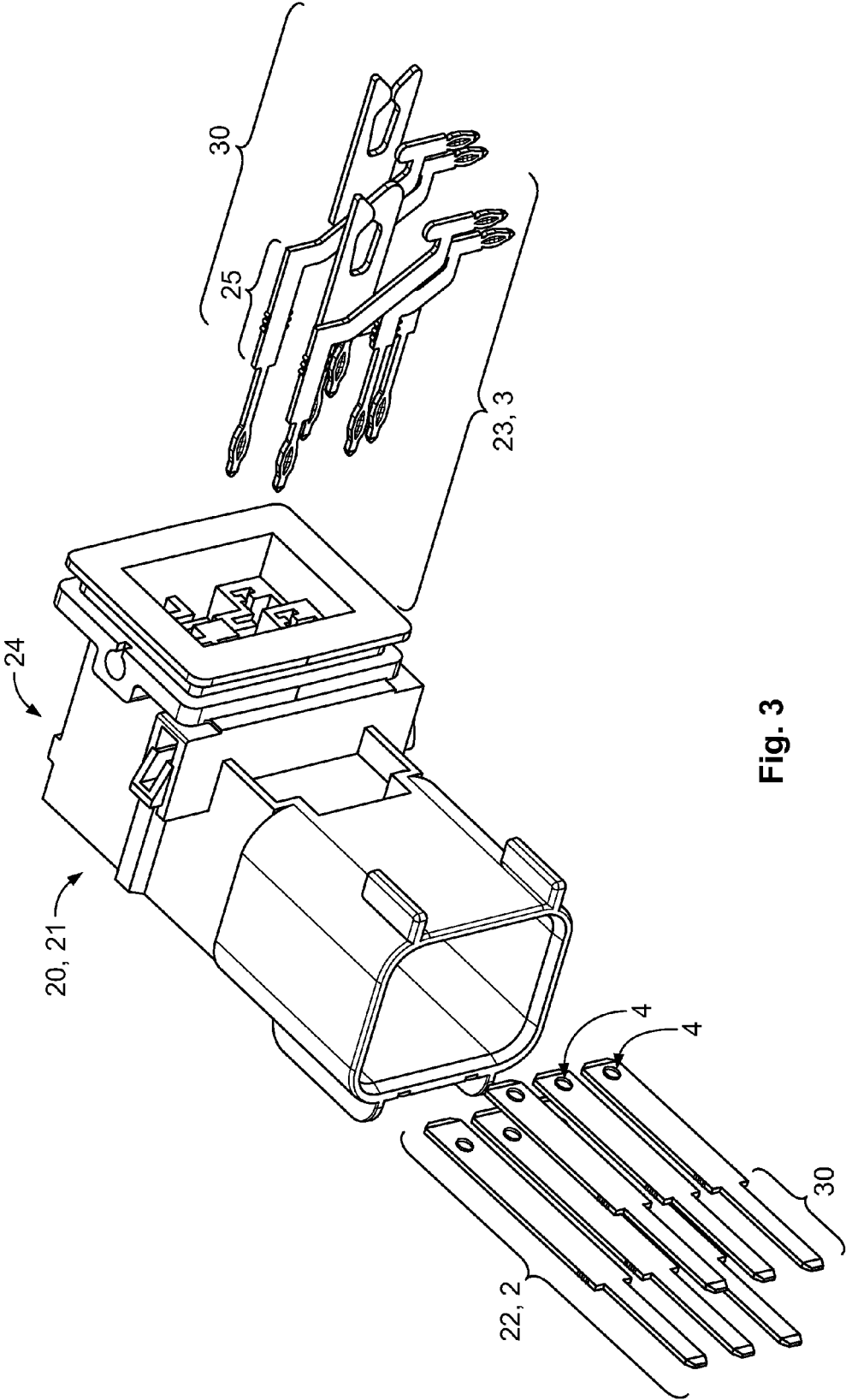


Fig. 3

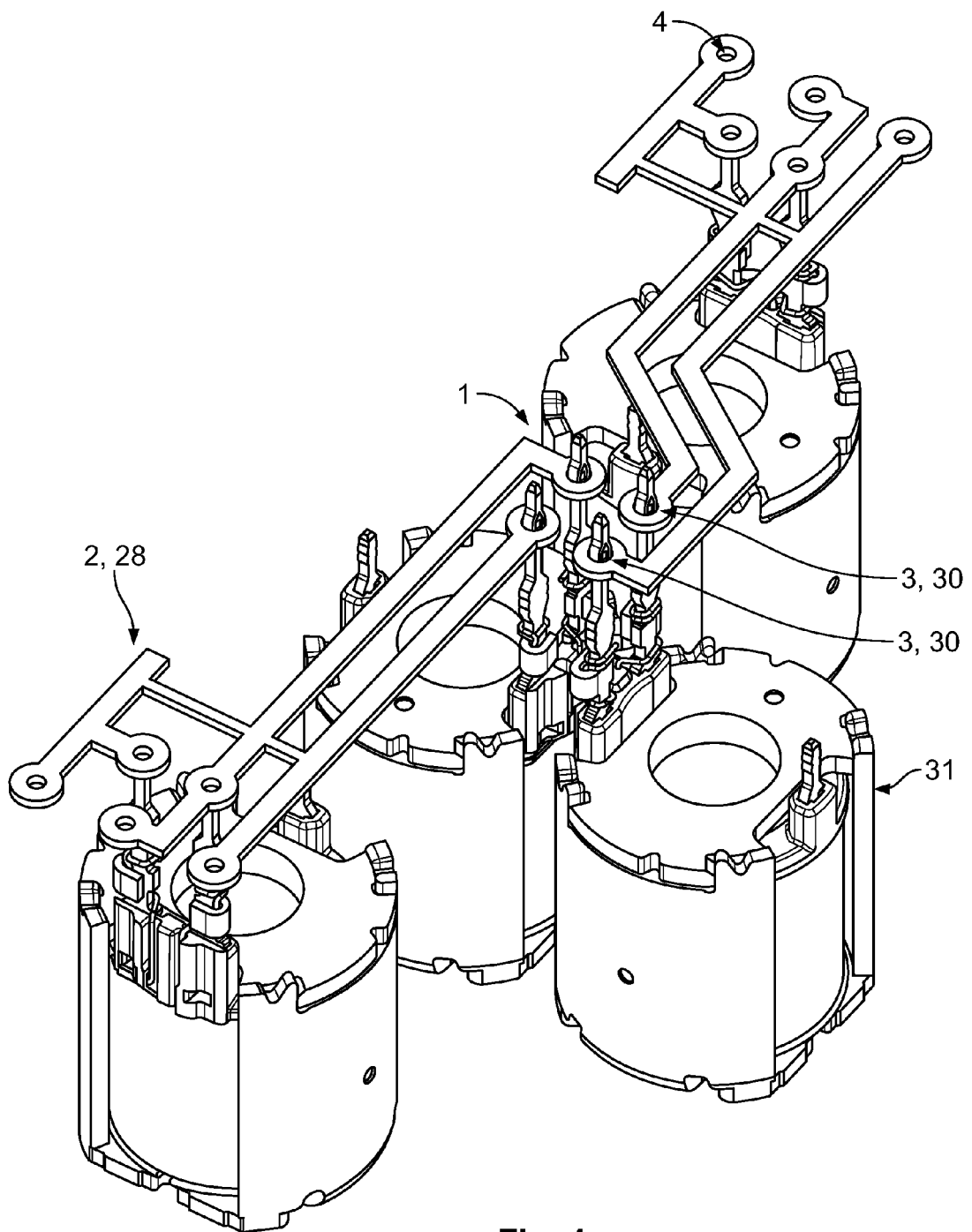


Fig. 4

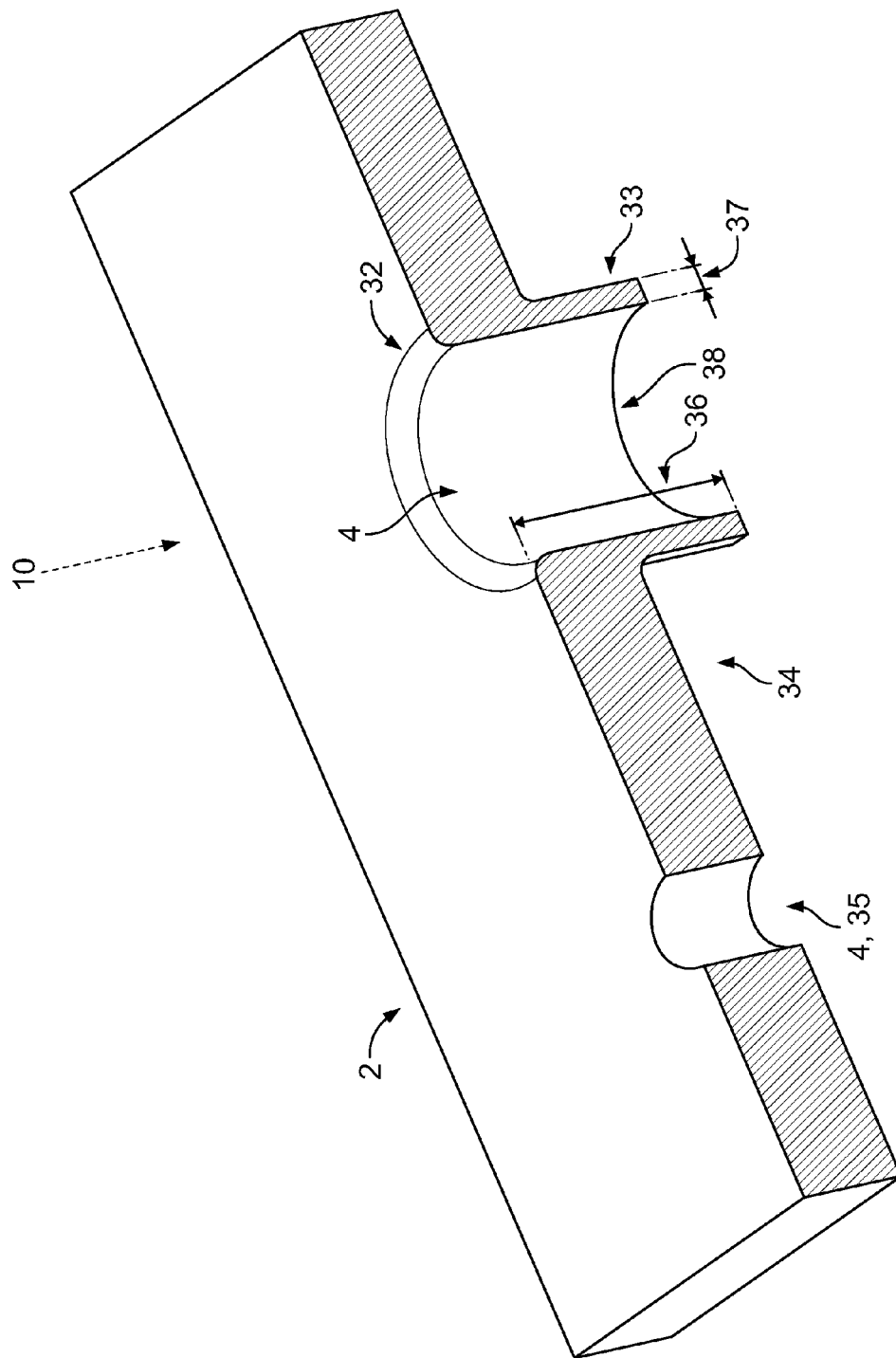


Fig. 5



EUROPEAN SEARCH REPORT

Application Number
EP 13 17 7976

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	EP 1 944 834 A2 (DELPHI TECH INC [US]) 16 July 2008 (2008-07-16) * paragraph [0005] - paragraph [0006] * * paragraph [0015] - paragraph [0024]; figures 1A, 3A *	1-15	INV. H01R13/05 H01R13/11
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 16 August 2013	Examiner Knack, Steffen
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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