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(54) **Összekötő darab földhőszonda-elrendezés csővezetékeihez**

Connector for tubular conduits of a geothermal probe assembly

The present invention relates to a connector for pipelines of a geothermal probe system according to the preamble of Claim 1.

Geothermal probe systems are known to the person skilled in the art and are used to harness geothermal energy. For this purpose, probe pipes which are connected to one another in pairs at their leading end via a connector referred to as a probe foot are sunk into a borehole in the earth.

During operation of the geothermal probe system, a heat transfer medium is conducted from a first probe head via a probe feed pipe to the probe foot, where it is deflected and conducted via a probe return pipe to a second probe head. The two probe heads are attached to a heat pump via a collective feed pipe or via a collective return pipe.

EP-A-0582118 describes a geothermal probe system which comprises pile probes connected in parallel, wherein two pile probes in each case are connected to one another using connecting parts. Said connecting part comprises two 90° fittings a connecting pipe.

By contrast, a probe foot is described in CH-A-687268 which is created by an integrally formed plastic pipe bent about 180°. The aforementioned plastic pipe is U-shaped and has no sudden narrowing, unlike bends formed from two 90° bends which are welded together.

A further geothermal probe pipe fitting made of plastic with a 180° bend is described in DE-A-10 2007 036 324, for example.

With regard to creating a probe foot which can be produced economically in large numbers, a connector was proposed in EP-A-1036974 which has a substantial Y-shape and comprises three pipe sections running in parallel, wherein the pipe section forming the Y trunk section is closed by means of a plug.

The connector described in EP-A-1036974 has proved extremely reliable. However, there is still potential for optimizing this connector too, in relation to maximizing the operational reliability of the geothermal probe system. In particular, it is desirable for wear or even damage to the geothermal probe system by any solids entrained in the heat transfer medium to be effectively minimized or even eliminated.

The problem addressed by the present invention therefore involves providing a connector which allows operationally reliable and low-wear operation of the geothermal probe system to be guaranteed, while retaining the advantages of the connector according to EP-A-1036974.

The problem according to the invention is solved by the subject matter of Claim 1. Preferred embodiments are subject of the dependent claims.

The present invention therefore relates to a connector for pipelines of a geothermal probe system comprising a feed portion extending from a connection side of the connector, a return portion which runs essentially parallel to the feed portion is flow-connected to the feed portion via a deflecting portion in the form of a pipe bend and extends in the direction of the connection side and a blind trunk portion leading away from the deflecting portion on the side directed away from the connection side.

The feed portion and the return portion of the connector are designed to be connected to a feed pipeline or to a return pipeline of a geothermal probe system.

According to the invention, the feed portion and the return portion are separated from one another, at least in certain regions, by a common wall. Consequently, pipe portions exist which are no longer completely separate, as is the case in the connector according to EP-A-1036974, for example.

On account of the small deflection radius of the deflecting portion that can be obtained according to the invention, optimized flow behaviour of the heat transfer medium can be guaranteed. This means that any solids entrained in the heat transfer medium are deposited in the trunk portion and therefore effectively removed from the heat transfer

medium circuit, which guarantees low-wear, reliable operation of the geothermal probe system. This effect can be explained in that, among other things, due to the small deflection radius that can be obtained according to the invention, the transverse acceleration acting on the solids is increased and they are thereby deflected in the region of the junction of the trunk portion out of the flow path and received in the trunk portion. The trunk portion of the connector according to the invention is usually configured in such a manner that during operation of the geothermal probe system, solids entrained in the heat transfer medium flowing through the connector are deflected from the flow path and deposited in the trunk portion.

Otherwise, on account of the embodiment according to the invention with the external dimensions of known connectors being retained, the wall thickness of the connector is increased, as a result of which a higher maximum permitted operating pressure is reached.

A particularly compact embodiment of the connector or the probe pipe arrangement and therefore the smallest possible deflection radius of the deflecting portion is obtained according to the invention, in that the wall thickness of the common wall between the feed portion and the return portion, measured in the longitudinal section through the centre, is smaller than the sum of the wall thickness of the feed portion and the wall thickness of the return portion on the side directed away from the common wall in each case. Any reinforcing elements arranged on the outer surface are not taken into account in this case when measuring the wall thickness.

Possible materials for the connector include, in particular, a plastic such as a polyolefin, for example polyethylene (PE), in particular PE-X, PE-RT, PE 80, PE 100 and PE 100-RC, polypropylene (PP), including PP-R, or polybutylene (PB). However, polyamides (PA), polystyrene (PS), styrene-butadiene (SB), acrylonitrile-butadiene-styrene polymerisates (ABS) or polyurethane (PUR), in particular, are also conceivable, for example. Otherwise, a fibre-reinforced embodiment of the aforementioned plastics can be used, as a result of which an even higher maximum permitted operating pressure can be reached.

The connector is preferably produced by injection-moulding. As an alternative to this, the connector may, however, also be produced by means of blow-moulding, casting or rotational moulding, for example. Furthermore, it is conceivable for individual parts of the connector to be finally elaborated by machining and/or for them to be assembled into a finished connector.

As mentioned above, it is conceivable for at least one layer of a further material embedded in the material to be present as the reinforcing material. All kinds of fibres are used for this purpose, for example elongated polyolefins. Otherwise, the layer can be formed by a foil such as a metal foil, for example.

As an alternative or in addition to the embedded layer, a wear-proof layer may be applied to the inner and/or outer surface. A layer of at least one material chosen from the group comprising PP, PE, PA, ABS, PPS (polyphenylene sulphide), PUR and thermoplastic polyester elastomers, such as Hytrel® (DuPont), is possible in this respect. The aforementioned materials may be optionally reinforced using carbon fibres, glass fibres, carbon nanotubes (CNT) and/or glass balls, for example.

The wall thickness and the material are chosen in such a manner that a nominal pressure NP of 20 bar or higher is permitted. This also contributes to a reliable operation of the geothermal probe system. A nominal pressure of 20 bar or higher can be obtained, for example, if a connector, e.g. in the feed or return, made of PE 100 with a diameter of 49 mm, a safety factor of 1.25 and a wall thickness of at least 5.5 mm is used. Through a corresponding choice of material, however, a nominal pressure of 20 bar or higher may be allowed, even with a thinner wall thickness.

It is further preferable for reinforcing elements to be arranged on the outer surface of the feed portion, of the deflecting portion, of the return portion and/or of the trunk portion. These are local thickened areas of the wall of the respective portion.

The reinforcing elements are preferably arranged in the region of the side directed away from the common wall, as said region is exposed to particularly great stress upon insertion in the bore hole due to projecting earth, for example.

The reinforcing elements may, in particular, exist as protuberances which are offset in relation to one another or follow one after the other in the axial direction of the respective pipe portion. It is further preferable in this case for the protuberances to have a circular, elliptical, eye-shaped and/or droplet-shaped basic profile. Alternatively or in addition to this, the reinforcing elements may be configured as ribs extending in the longitudinal direction. With both embodiments, it is guaranteed that any water present in the bore hole will be displaced in the interests of the simplest possible sinking of the probe pipes and will be able to escape upwards via the bead-like depressions formed between the reinforcing elements. Otherwise, the risk of the connector tilting in the bore hole is minimized by the shape of the reinforcing elements in the aforementioned embodiments.

The reinforcing elements may be made of the same material as the pipe portions or of another material, in particular a material with a greater hardness compared with the material of the pipe portions.

The simplest possible lowering into the bore hole can also be achieved by the connector having a scaly structure on its outer surface.

In order to further simplify the lowering of the probe pipes, the connector according to the invention preferably has in addition in the region of the common wall a projection protruding from the outer surface which forms a bearing surface running substantially at right angles in respect of the axial direction of the feed or return portion. If the probe pipes are introduced into the bore hole by means of a corresponding insertion device, in particular an insertion device according to EP-A-2123995, the aforementioned bearing surface allows an impact force to be exerted on the connector in order to insert the probe pipes. An insertion rod is usually used for this purpose or another impact device. Due to the arrangement of the projection in the region of the common wall, the impact force can be optimally absorbed; the risk of damage to the connector caused by the impact force can thereby be minimized. Otherwise, the fact that the bearing surface runs at right angles to the longitudinal axis of the probe pipes or else of the feed, return and trunk portion of the connector guarantees that the force is applied accurately in the

lowering direction and a deflection of the probe pipe arrangement in the direction of the bore hole walls can therefore be avoided.

According to a further preferred embodiment, the axis of the trunk portion runs centrally between the axis of the feed portion and the axis of the return portion. In this way, not only is the simplest possible lowering of the probe pipes made possible, but there is also optimum sedimentation of any solids entrained in the heat transfer medium in the trunk portion.

The term "blind", as used in connection with the present invention, means that the trunk portion is closed at its end directed away from the junction of the deflecting portion.

It is preferable in this respect for the end of the trunk portion which is directed away from the connection side to be closed by means of a plug, which allows the connector to be produced economically in large quantities. In particular, the plug has a cylindrical part and a base part which extends at right angles to said cylindrical part, wherein the plug with the cylindrical part projects into the interior of the trunk portion and is fixed thereto along the contact surfaces and is permanently tight. It is particularly conceivable in this case for the plug to be welded to the trunk portion.

Otherwise, it is preferable in this respect for the plug to have means for fastening a sinking weight.

It is conceivable, for example, for the plug to have a clip on its side directed away from the trunk portion for this purpose. Said clip usually lies in a plane running parallel to the axis of the feed portion, the return portion and the trunk portion. Cutouts may be provided in this clip for fastening a sinking weight, for example a weight container.

In order to connect the feed portion and the return portion of the connector to the feed pipeline and the return pipeline, respectively, butt welding, sleeve welding and/or heated coil welding may be used in particular. A connection by means of sleeve welding is usually preferred due to the short production times associated with it. If the

connection is made by means of butt welding, it is particularly preferable for the welding bead to be recessed inwards in relation to the outer contour, as a result of which the risk of damage through wear is minimized.

For permanent closure of the trunk portion with the plug, butt welding, sleeve welding, heated coil welding and/or casting are also possible.

Before the trunk portion is closed using the plug, sensors or similar means can moreover be introduced into the individual portions of the connector and/or into the feed pipeline and the return pipeline. In particular, a sensor can be introduced for pressure, temperature and/or flow velocity measurement. It is conceivable, for example, for a fibreglass cable to be blown into the feed and/or the return portion or else the feed and/or the return pipeline.

In order to optimize the flow behaviour, flow fittings are preferably arranged in the deflecting portion.

Apart from the connector described above, the present invention further relates to a method of removing solids from the flow path of a heat transfer medium of a geothermal probe system. This comprises the step of the heat transfer medium being conducted through a connector according to the above description, wherein the solids are deflected from the flow path and accommodated in the trunk portion of the connector. It is preferable in this case for the solids to be deposited in the trunk portion, in other words to form a sediment, as a result of which they are permanently removed from the flow path.

The invention is explained in detail with the help of the figures.

In the figures:

Fig. 1 shows a side view of a connector according to the invention;

Fig. 2 shows a longitudinal section through the centre of the connector shown in

Fig. 1;

Fig. 3 shows a plan view of the connection side of the connector shown in Figs. 1 and 2;

Fig. 4 shows a side view of a probe pipe arrangement comprising the connector shown in Figs. 1 to 3 and a feed pipeline and return pipeline connected thereto and partially depicted; and

Fig. 5 shows a longitudinal section through the centre of the probe pipe arrangement shown in Fig. 4.

As can be seen from the figures, the connector 2 according to the invention comprises a feed portion 4 and a return portion 6 running parallel thereto. These are separated from one another in certain regions by a common wall 7.

As can be seen particularly from Figs. 2 and 5, the feed portion 4 is flow-connected to the return portion 6 via a deflecting portion 8 in the form of a pipe bend. The deflection traced by the deflecting portion 8 is approx. 180° and runs in a circular shape in the embodiment shown.

In the region of their free end 10 or 12, the feed portion 4 and the return portion 6 exhibit means for attaching a corresponding feed pipeline 14 and a return pipeline 16, respectively, as can be seen particularly from Figs. 4 and 5. The corresponding side therefore forms the attachment side 18 of the connector 2.

In the embodiment shown, the front face 20 of the feed portion 4 and the front face 22 of the return portion 6 lie in the same plane. It is also conceivable, however, for these to be offset in relation to one another.

On the side directed away from the connection side 18, a trunk portion 24 leads away from the deflecting portion 8, which trunk portion likewise runs parallel to the feed portion 4 and to the return portion 6. The feed portion 4 and the return portion 6 are

arranged symmetrically in this case about the axis of the trunk portion 24.

According to Figs. 2 and 5, in the embodiment shown, the wall thickness of the common wall 7 between the feed portion 4 and the return portion 6, measured in the longitudinal section through the centre between the feed portion 4 and the return portion 6, is smaller than the sum of the wall thickness of the feed portion 4 and the wall thickness of the return portion 6 on the side 9 or 11, respectively, directed away from the common wall 7.

In comparison with the feed portion 4 and the return portion 6 which have a continuous, substantially identical, free pipe cross section, the free pipe cross section of the trunk portion 24 is of wider design, as emerges in particular from Figs. 2 and 5.

The trunk portion 24 has a first region 26 directed towards the deflecting portion 8 and a second region 30 directed towards the free end 28, wherein the inner diameter widens in a step-like manner during the transition from the first region 26 to the second region 30. In the embodiment shown, a plug 32 is inserted in the trunk portion 24. Said plug has a cylindrical part 33 and a base part 35 extending at right angles to said cylindrical part, wherein the cylindrical part 33 projects into the interior of the trunk part 24 and is fixed at the contact surfaces 34 to the inner surface 36 of the trunk portion 24.

In the embodiments shown in the figures, the plug 32 has a clip 40 on its side directed away from the trunk portion 24, which clip runs in a plane running parallel to the axis of the feed portion 4, of the return portion 6 and of the trunk portion 24. In the clip, two cutouts 42a, 42b arranged symmetrically about the axis of the trunk portion 24 are provided for fastening a sinking weight, for example a weight container. The cutouts 42a, 42b have a circular form in the embodiments shown, but they may exhibit any other shape suitable for the aforementioned purpose.

The clip 40 in the embodiment shown is in the shape of an isosceles trapezium, wherein the shorter of the two parallel base sides forms the leading end 38. The corners between the legs of the trapezium and the base side forming the leading end 38 have a rounded-off form in the embodiments shown, in order to minimize the risk of

tilting with the projecting earth in the bore hole and thereby guarantee the simplest possible lowering of the probe tube arrangement.

In the region of the side of the feed portion 4, of the return portion 6 and of the deflecting portion 8 directed away from the common wall 7 and therefore directed towards said common wall during the sinking of the bore hole wall, reinforcing elements 44 in the form of protuberances are arranged on the outer surface. These have a substantially eye-shaped basic profile in the embodiment shown. Apart from this, reinforcing elements 44 are also arranged in a circumferential manner on the outer surface of the trunk portion 24. Said reinforcing elements are likewise configured as protuberances with an eye-shaped basic profile in the embodiment shown; however the aforementioned basic profile has a greater surface area compared with the reinforcing elements 44 of the feed portion 4, of the return portion 6 and of the deflecting portion 6.

Furthermore, the connector 2 shown in the figures in the region of the common wall 7 has on both sides opposite one another a protrusion 46 which projects from the outer surface and forms a bearing surface 48 running essentially at right angles in relation to the axial direction of the feed portion 4 and the return portion 6, respectively. If the probe pipes, or else the connector connecting said probe pipes, are introduced into the bore hole by means of an insertion device, as is known from EP-A-2123995, for example, the bearing surface 48 allows a corresponding impact force to be applied to the connector 2. In the direction of the leading end 38, the projection 46 is also supported by supporting elements 50a, 50b, 50c.

According to Figs. 4 and 5, in the probe pipe arrangement shown, the connector 2 is connected to the feed pipeline 14 and the return pipeline 16 by means of butt welding. The resulting bead 52 is recessed inwardly in respect of the outer contour of the connector 2, as a result of which the risk of damage due to wear when lowering into the borehole is minimized.

Apart from butt welding, it is also conceivable in particular for the aforementioned components to be connected to one another by sleeve welding or heated coil welding.

In this connection, it is conceivable for the feed pipeline and the return pipeline to be inserted into the feed portion and the return portion, respectively, of the connector and welded at their contact surface to the inner surface of the respective portion.

It is further conceivable for the inner diameter of the feed portion and the inner diameter of the return portion to be widened in a step-like manner towards the free end, wherein the portion with the widened inner diameter corresponds to the welding portion of the respective portion.

During operation of the geothermal probe system, a heat transfer medium is pumped through the probe tubes and therefore through the feed pipeline 14, the feed portion 4, the deflecting portion 8, the return portion 6 and the return pipeline 16.

If there are solids in the heat transfer medium which could lead to wear or even damage to the geothermal probe system, these can be deposited in the trunk portion 24 of the connector 2 according to the invention and thereby removed from the heat transfer medium circuit. After prolonged use of the geothermal probe system, a kind of "pump sump" may therefore be formed, without the solids deposited therein being able to return to the heat transfer medium circuit and thereby have a detrimental effect on the geothermal probe system.

It has been shown that the effect of solids sedimentation in the trunk portion is particularly pronounced when the deflection radius traced by the deflecting portion 8 is minimized, as is the case due to the compact design of the connector 2 that can be obtained according to the invention. The small deflection radius means that the transverse acceleration acting on the solids is increased, so that more solids are deflected from the flow path in the region of the junction of the trunk portion 24 and are therefore received in said trunk portion 24 and preferably deposited therein.

EP 2 395 301

ÖSSZEKÖTŐ DARAB FÖLDHŐSZONDA-ELRENDEZÉS CSŐVEZETÉKEIHEZ

Szabadalmi igénypontok

1. Összekötő darab földhőszonda-elrendezés csővezetékeihez, amely az összekötő darab csatlakozó oldalától (18) induló előremenő szakaszt (4), egy lényegében ezzel párhuzamos, egy csőív alakú fordítószakaszon (8) át az előremenő szakasszal (4) áramlásilag összekötött és a csatlakozó oldalig (18) terjedő visszatérő szakaszt (6), és a csatlakozó oldallal (18) átellenes oldalon a fordítószakasztól (8) elvezető, vakon végződő törzsszakaszt (24) tartalmaz, **azzal jellemezve, hogy** az előremenő szakaszt (4) és a visszatérő szakaszt (6) legalább szakaszonként egy közös fal (7) választja el egymástól, továbbá közép-hosszmetszetben mérve az előremenő szakasz (4) és a visszatérő szakasz (6) közötti közös fal (7) falvastagsága kisebb, mint az előremenő szakasz, ill. a visszatérő szakasz közös fallal átellenes oldalán (9, ill. 11) mérhető falvastagságok összege.

2. Az 1. igénypont szerinti összekötő darab, **azzal jellemezve, hogy** a törzsszakasz (24) tengelye az előremenő szakasz (4) tengelye és a visszatérő szakasz (6) tengelye között középen helyezkedik el.

3. Az előző igénypontok egyike szerinti összekötő darab, **azzal jellemezve, hogy** a törzsszakasznak (24) a csatlakozó oldallal (18) átellenes vége dugóval (32) van lezárva.

4. A 3.igénypont szerinti összekötő darab, **azzal jellemezve, hogy** a dugónak (32) hengeres része (33) és erre merőleges fenékrésze (35) van, a dugó (32) hengeres része (33) benyúlik a törzsszakasz (24) belsejébe, és az érintkező felületeken (34) ezzel szilárdan össze van kötve.

5. A 3. vagy 4. igénypont szerinti összekötő darab, **azzal jellemezve, hogy** a dugó (32) süllyesztősúly rögzítésére szolgáló eszközökkel (42a, 42b) van ellátva.

6. Az előző igénypontok egyike szerinti összekötő darab, **azzal jellemezve, hogy** a törzsszakasz (24) úgy van kialakítva, hogy a földhőszonda-elrendezés üzemelése folyamán az összekötő darabon átáramló hőszállító közegben sodródó szilárd anyagok kiválnak az áramlási pályából, és letülepednek a törzsszakaszban (24).

7. Az előző igénypontok egyike szerinti összekötő darab, **azzal jellemezve, hogy** az előremenő szakasz (4), a fordítószakasz (8), a visszatérő szakasz (6) és/vagy a törzsszakasz (24) külső felületén erősítőelemek (44) vannak elhelyezve.

8. A 7. igénypont szerinti összekötő darab, **azzal jellemezve, hogy** az erősítőelemek (44) a mindenkori csőszakasz tengelyirányában egymás után vagy egymáshoz viszonyítva eltolva elhelyezkedő kiemelkedések.

9. A 8. igénypont szerinti összekötő darab, **azzal jellemezve, hogy** a kiemelkedések kerek, elliptikus, szem formájú és/vagy csepp alakú alapprofillal rendelkeznek.

10. Az előző igénypontok egyike szerinti összekötő darab, **azzal jellemezve, hogy** műanyagból, előnyösen poliolefinből van előállítva.

11. Az előző igénypontok egyike szerinti összekötő darab, **azzal jellemezve, hogy** a közös fal (7) közelében a külső felületből kiálló nyúlvány (46) van kialakítva, amely az előremenő szakasz (4), ill. a visszatérő szakasz (6) tengelyirányára lényegében merőleges felfekvő felületet (48) alkot.

12. Eljárás szilárd anyagok eltávolítására földhőszonda-elrendezés hőhordozójának áramlási pályájából, amely eljárás tartalmazza azt a lépést, hogy a hőhordozót átvezetjük az előző igénypontok egyike szerinti összekötő darabon (2), miközben a szilárd anyagokat kitérítjük az áramlási pályából, és felfogjuk az összekötő darab (2) törzsszakaszában (24).

13. A 12. igénypont szerinti eljárás, **azzal jellemezve, hogy** a szilárd anyagokat leülepítjük a törzsszakaszban (24).

A meghatalmazott:

ADVOPATENT
SZABADALMI ÉS VÉDJEGY IRODA
1255 Budapest, Pf.: 80.
4.

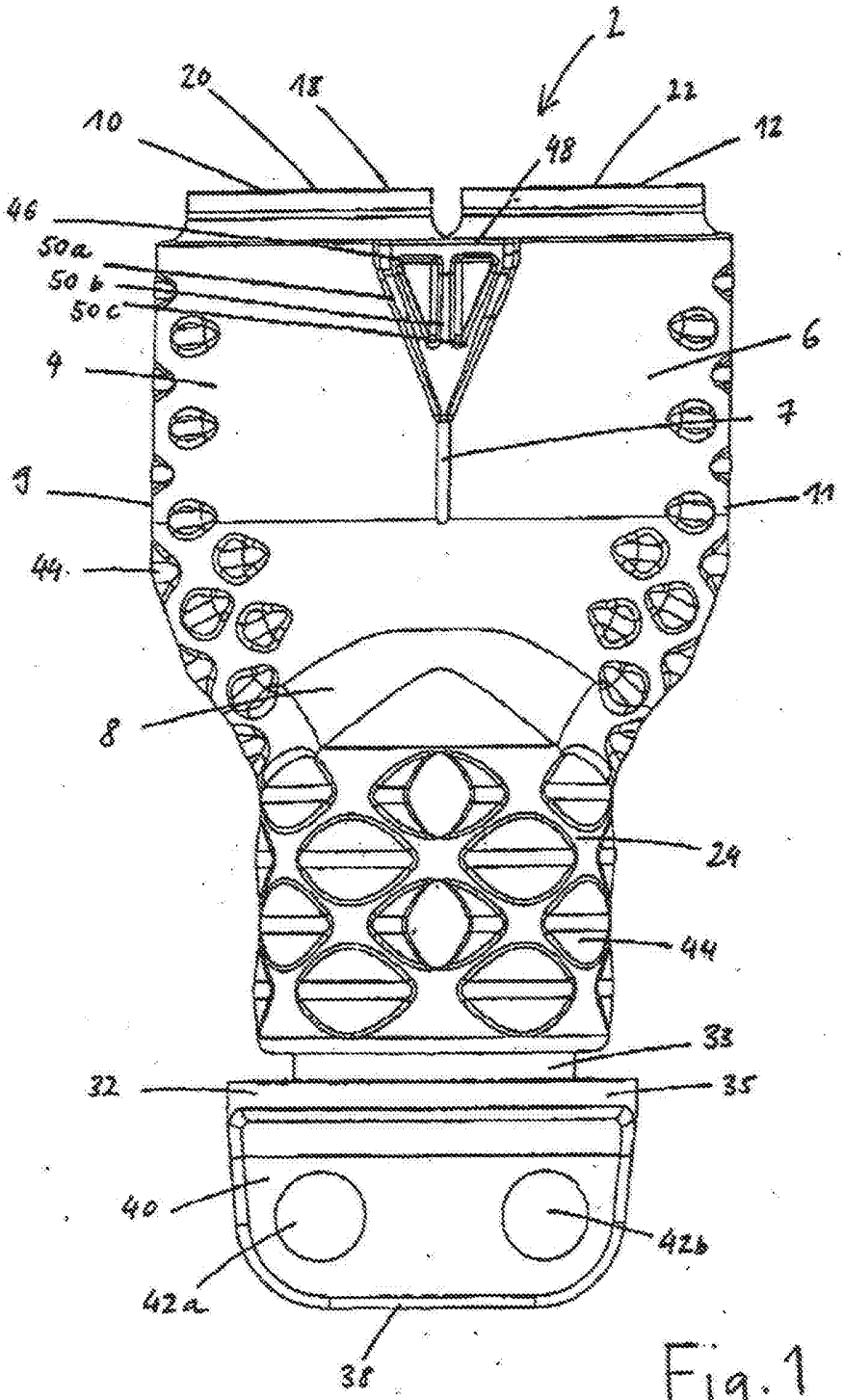
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Fig. 1

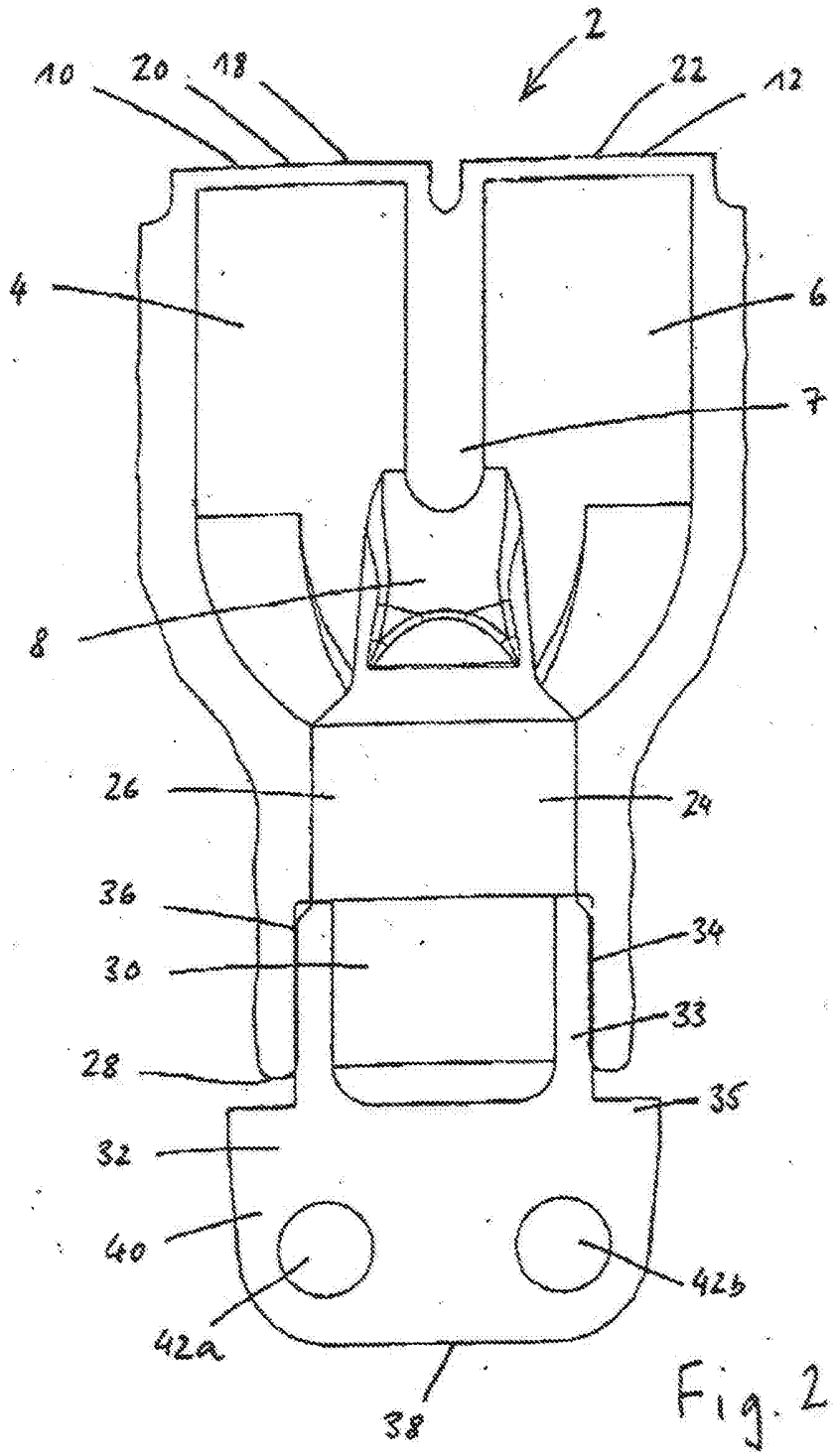

Fig. 2

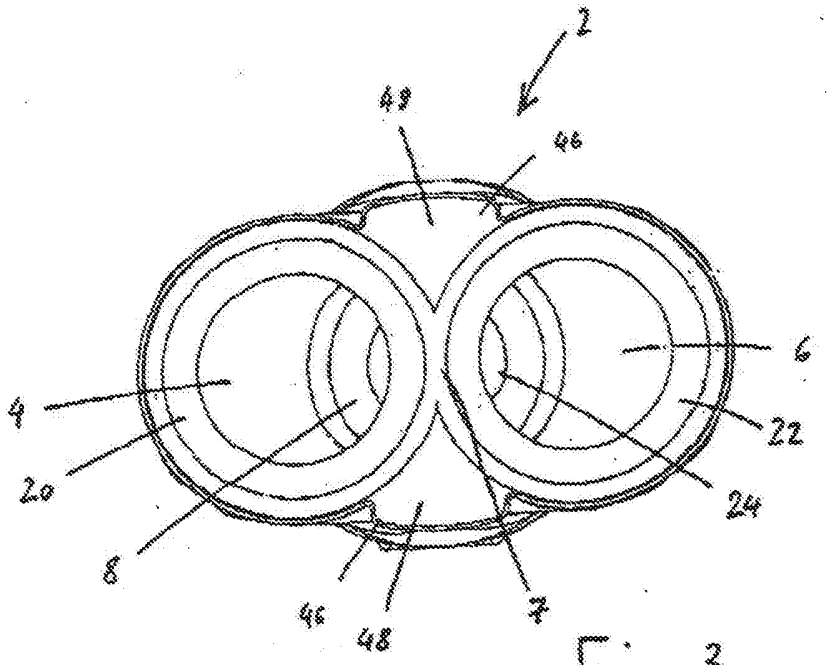

Fig. 3

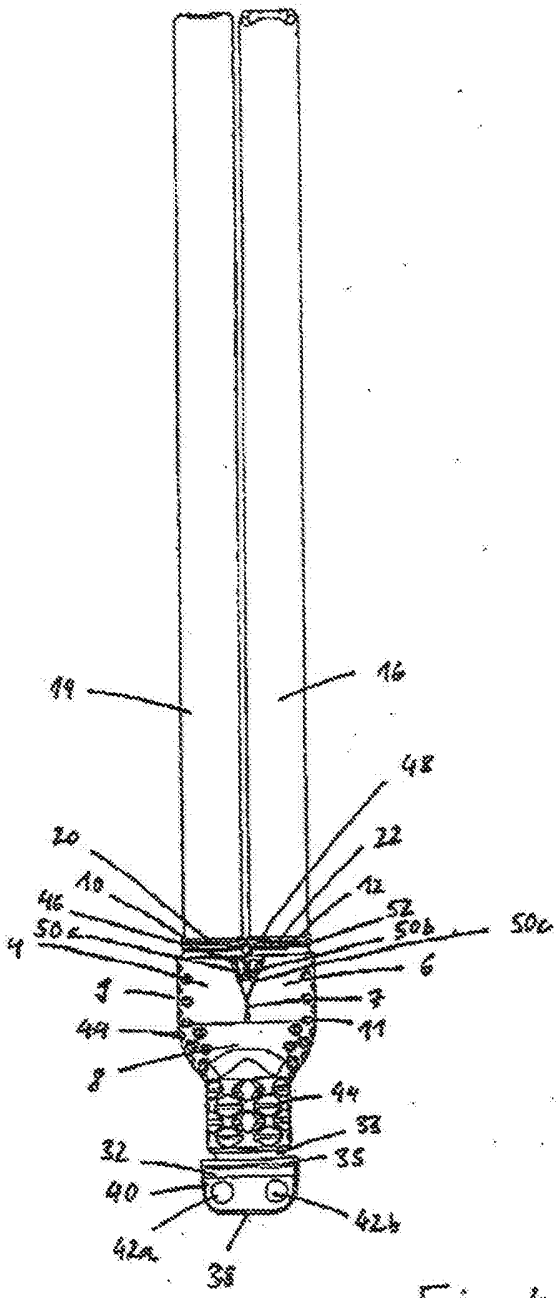

Fig. 4

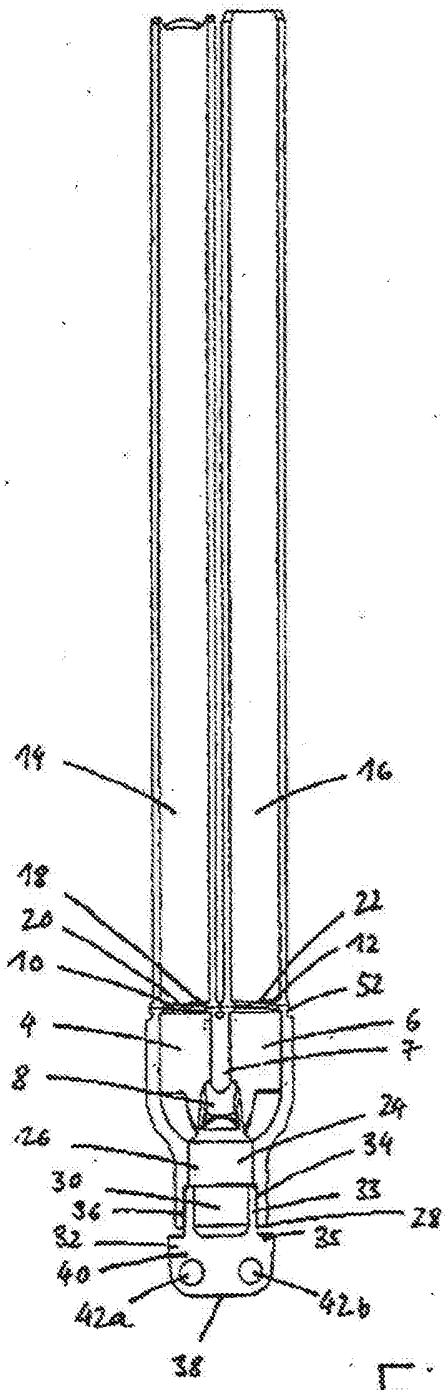

Fig. 5