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(73) Jogosult(ak):

Uponor Innovation AB, 73061 Virsbo (SE)

(72) Feltaláló(k):

FREERMANN, Reinhold, 48607 Ochtrup (DE)**WINTERSTEIN, Ralf, 98617 Meiningen (DE)****Riesselmann, Franz-Josef, 49393 Lohne (DE)**

(74) Képviselő:

SBGK Szabadalmi Ügyvivői Iroda, Budapest

(54)

Eljárás hengeres, szál alakú elem előállítására

Az európai szabadalom ellen, megadásának az Európai Szabadalmi Közlönyben való meghirdetésétől számított kilenc hónapon belül, felszólalást lehet benyújtani az Európai Szabadalmi Hivatalnál. (Európai Szabadalmi Egyezmény 99. cikk(1))

A fordítást a szabadalmas az 1995. évi XXXIII. törvény 84/H. §-a szerint nyújtotta be. A fordítás tartalmi helyességét a Szellemi Tulajdon Nemzeti Hivatala nem vizsgálta.

The invention relates to a method for producing a cylindrical, strand-shaped part. In particular, the invention relates to producing metal/plastic composite tubes as are used for example in the field of sanitary installations and heater systems.

Plastic/metal composite tubes are used with increasing preference since they combine the advantages of the plastic deformability of metal tubes with the advantages of the corrosion resistance of plastic tubes.

Plastic/metal composite tubes of this kind can be produced in various ways. Thus, for example, it is known to produce the metal layer of such a composite tube by moulding a metal strip, with the longitudinal edges of the metal strip overlapping each other and being welded or bonded to each other, or the longitudinal edges of the metal strip being connected by butt welding. A single- or multi-layer plastic tube is then extruded into the interior of the metal tube formed in this way. Examples of such production methods are found in DE-A-30 16 134, EP-A-0 353 977, EP-A-0 581 208, EP-A-0 920 972, WO-A-88/03084 and WO-A-01/85430.

Further, it is known to mould the metal tube onto a single- or multi-layer plastic tube, which has already been produced. An example of such a production method is described in EP-A-0 691 193. Further examples are found in DE-A-43 10 272, DE-A-44 04 492 and DE-C-195 36 689.

Finally, it is also known to apply the metal layer of a plastic/metal composite tube directly onto a plastic tube, which has already been produced, by extrusion. EP-B-0 125 788 describes that a metal tube is extruded onto a pre-fabricated plastic tube at a radial distance thereto, the metal tube subsequently reduced in diameter by a drawing process or a similar diameter-reducing process, so as to tightly abut the plastic tube. From US-A-5 222 284 it is known to reduce the diameter of a prefabricated plastic tube in order to then extrude a metal tube around the plastic tube (by extrusion), whereupon the tube which has been reduced in diameter widens again using the memory effect in order to thereby closely abut the metal tube from inside. Finally, it is known from DE-A-21 39 388 to press a seam-less metal tube onto a prefabricated plastic hose with the aid of a metal-



SZTNH-100093199

coating press. One problem in this connection are the temperatures which are generated in the metal-coating press due to the extrusion of the metal and which act on the plastic hose.

5 it is an object of the invention to provide a method for producing a cylindrical, strand-shaped plastic/metal composite part which is distinguished by high dimensional stability.

A method for producing a strand-shaped part, according to the pre-characterising clause of claim 1, is already known from document AU 2 690 971 A. This document discloses that:

- a hollow profile made of metal is extruded,
- the extruded hollow metal profile cools and/or is cooled, and
- 10 - a single- or multi-layer plastic strand is extruded into the extruded hollow metal profile after it has cooled or while it is cooling,
- wherein the plastic strand passes an output tool of an extruder that is inserted into the hollow metal profile and that is exposed to the heat of the extruded hollow metal profile and that has an output opening that is arranged within a region of the hollow metal profile
- 15 in which it is cooled from its temperature at extrusion.

In the method according to the invention, the metal layer or layer of the cylindrical, strand-shaped part is first extruded, in other words, it is produced by a continuous pressing or extrusion process wherein, at the same time or subsequent thereto, a single- or multi-layer plastic strand is extruded into the metal layer or stratum. This approach has

20 the advantage that the outer dimension of the cylindrical, strand-shaped part is defined by the extrusion process for the metal layer or stratum, in other words, by the extrusion process for the metal tube. Subsequent processing of the strand-shaped part produced in order to reduce its diameter and in order to reduce the diameter of the metal tube respectively is not required.

25 The metal tube, which after the extrusion process is in a heated state, has a positive effect, together with the heated single- or multi-layer plastic melt, in respect of the inner adherence to the metal tube.

The heat generated during extrusion of the metal is by far too high for it to be possible to extrude the plastic strand into the hollow metal profile directly after extrusion. Instead, for this purpose, a site within the hollow metal profile is required which in the machine direction is arranged downstream of the extrusion of the metal. According to the invention, this is achieved with the aid of a mandrel-shaped output tool projecting far into the hollow metal profile. This output tool, which is substantially embodied in the manner of a tube or mandrel, transports the plastic melt. So the plastic melt maintains its temperature, required for extrusion, over the relatively long path through the output tool, this output tool has to be heated.

Surprisingly, it has been found that the heat emanating from the extruded hollow metal profile can be used for heating or adjusting the temperature of the output tool. Two effects are achieved thereby, namely, on the one hand, that the hollow metal profile cools by dissipation of its heat to the output tool and, on the other hand, that the temperature of the output tool is controlled without using other, external heat sources.

Only by the subsequent extrusion of the plastic melt from inside into the seamlessly produced, extruded hollow metal profile, can the different materials, metal and plastic, be processed together with dimensional stability. In the process, the high dimensional stability is obtained in that the metal tube is produced without seams (extrusion). Pressing or extruding the metal tube onto a prefabricated plastic tube, which would also lead to a high dimensional stability, is not feasible due to the elevated temperatures of the extruded hollow metal profile. According to the invention, the plastic strand is extruded into the extruded hollow metal profile in that the output tool has a considerable length, so the plastic melt comes into contact with the hollow metal profile only when the latter has already cooled down to a temperature which is compatible with the plastic. In this regard, as already mentioned above, use is made of the fact that the temperature of the output tool is controlled along the full length thereof due to the heat dissipation from the extruded hollow metal profile.

Cylindrical, strand-shaped, hollow or solid profiled parts in particular can be produced with the inventive method. The method is particularly suited to producing multi-layer plastic/metal composite tubes.

In one development of the invention, a single- or multi-layer plastic layer can be applied exteriorly to the metal tube, preferably by extrusion. The outer plastic layer can be extruded directly onto the extruded metal tube or after cooling of the metal tube. If a plurality of plastic layers is extruded, this can be carried out by tandem extrusion of the individual layers or by coextrusion.

In an advantageous embodiment of the invention, the metal tube is preferably made of aluminium or an aluminium alloy. The multi-layer plastic layers which can be extruded into the metal tube or can be applied exteriorly to the metal tube, are preferably thermoplastic materials, with the respective plastic layers bordering the metal tube including thermoplastic adhesives.

The inventive method is particularly suited to producing multi-layer plastic/metal composite tubes having larger diameters (for example starting from 40 mm) in which, due to the wall thickness of the metal tube, after production of the metal tube it is possible to reduce the diameter thereof only with great expenditure in order to establish contact with the interior plastic strand. Therefore, according to the invention, this step of reducing the diameter of the metal tube is omitted in that the plastic strand is extruded into the completely produced metal tube (and, more precisely, on the inner side thereof). A disadvantage of diameter reduction of the metal tube also lies in that the reshaping of the metal causes hardened regions in the material, which in turn adversely affect the flexibility of the produced metal/plastic composite tube. To this extent the method according to the invention also has advantages in producing multi-layer plastic/metal composite tubes having smaller diameters (for example up to 40 mm), since the diameter reduction of the metal tube which could be performed in a machine-controlled manner in the case of such tube dimensions can be omitted. Not least of all, according to the invention, it is also possible to produce multi-layer plastic/metal composite tubes having smaller diameters because the output tool, in order to be temperature controlled, does not need to be heated by separate heating elements or the like, which would have to be provided as components of the output tool and would thereby enlarge its diameter, since the heat required for temperature adjustment of the output tool is made available by the heat of the extruded hollow metal profile.

Heating of the output tool by the extruded hollow metal profile, which is in the process of cooling down, is expediently achieved by a thermal coupling between the two elements. In this regard, it is particularly expedient if the extruded hollow metal profile moves over the output tool while contacting the same. In the process the output tool can assume the further function of stabilising the shape of the extruded hollow metal profile during the phase immediately after extrusion.

The output tool is expediently a tube or a mandrel-shaped tool having an annular space on whose output end an annular nozzle is arranged. The annular space, which is defined by two mutually concentric walls or surfaces (for example tubes), can be stabilised by webs connecting the walls, or the like. Plastic melt passing the annular space flows around these webs, and this is not disadvantageous to the extrusion process of the plastic strand. In the case of a multi-layer plastic-melt flow, the annular space should be free along its entire length. The tubes being formed between the annular space are then fixed to each other at one of their ends.

As already mentioned above, the method according to the invention is also suited to producing solid profiled parts. For example, the inventive method can be used for producing a cable enclosed by plastic and metal, or another solid or hollow profile having a substantially non-deformable and temperature-resistant shape, for example a metal tube. The cable or profile is centrally passed through the annular nozzles of the extruder for the plastic strand and the metal tube so, during the extrusion of the plastic strand, the space between the centrally arranged conductor and the metal tube is filled with plastic material. This plastic material can be, for example, a foamable plastic material. In this case, an adhesive is not necessarily required if it is guaranteed that the foamable plastic adheres by itself to the inner side of the metal tube with sufficient stability.

The invention will be illustrated in more detail below using embodiments and with reference to the drawings, in which in detail:

Fig. 1 shows the components of an extrusion plant for producing a cylindrical, strand-shaped hollow profile according to a first embodiment of the invention,

Fig. 2 shows the components of an extrusion plant for producing a cylindrical, strand-shaped hollow profile according to a second embodiment of the invention, and

Fig. 3 shows the components of an extrusion plant for producing a cylindrical, strand-shaped solid profile according to a first and a second embodiment of the invention.

Fig. 1 schematically illustrates the essential plant components of a device 10 for producing a multi-layer plastic/metal composite tube 12. The device 10 includes an extruder 14 and a pressing unit respectively for producing an aluminium tube 16. The annular nozzle of extruder 14 is shown at 18, and the metal which is heated for the plastic deformation process is designated by 20. The extruded aluminium tube 16 is extruded, for example, at temperatures between 450 and 500°C and then cools after discharge from the nozzle 18 (for example to 200 to 250°C, as indicated at 22).

A hollow mandrel 24 is centrally introduced into the extruded metal tube 16 through the annular nozzle 18, the mandrel 24 at one of its ends having an annular nozzle 26 by way of which a two-layer, hollow-cylindrical plastic strand 28 is discharged, which strand on the outside comprises a plastic adhesive layer 30 and on the inside an inner plastic layer 32 forming the subsequent base tube. Both plastic layers together are extruded by a coextruder 34 into the cooled metal tube 16, and, more precisely, against the inner side 36 of the tube. So the plastic melt reliably remains there, a gas, for example air, is introduced via the mandrel 24 into the plastic-melt tube (hollow-cylindrical plastic-melt strand 28), thereby building up an overpressure. The overpressure is maintained in the plastic-melt strand 28 by a plug 38 arranged therein, which plug is fastened at 42 outside of the extrusion components of device 10 by a cord 40 guided through the hollow mandrel 24. Instead of the plug 38, the produced metal tube 16 with interior plastic strand can be squeezed so as to prevent leakage of overpressure.

Fig. 2 shows a slightly modified variant 10' of a device for producing a multi-layer plastic/metal composite tube 12. In so far as the plant components shown in Fig. 2 are identical or functionally equivalent to the plant components according to Fig. 1, they are designated by the same reference numerals.

In the device 10' of Fig. 2, in contrast to the device 10 of Fig. 1, the metal tube 16 and the plastic strand 28 are coextruded. Apart from that, the production process is performed as described above.

Fig. 3 shows a device 10" which has a configuration similar to that of device 10' in Fig. 2 but which in Fig. 3 serves for producing a cylindrical, strand-shaped, solid or hollow profiled part 44 having a substantially non-deformable and temperature-resistant shape. In Fig. 3, the components identical to the plant components and elements in Figs. 1 and 2 are designated by the same reference numerals.

In the device 10" of Fig. 3, the metal tube 16 and the plastic strand 28 are again substantially coextruded. Lead through the hollow mandrel 24 of the extruder 34 for the plastic strand 28 is an electric conductor 46 which after leaving the hollow mandrel 24 is embedded in and enclosed by the material of plastic strand 28 so the plastic material is located between the inner side 36 of the metal tube 16 and the electric conductor 46. The device 10" of Fig. 3 can be used to produce, for example, electrically insulated cables which have a metal tube including the electric conductor 46 with interposition of a plastic material.

In respect of the devices 10, 10' and 10" shown in Figures 1 to 3, it should also be stated that these devices can additionally comprise one or more extruder(s) or a coextruder for externally applying single- or multi-layer plastic layers onto the metal tube 16. For reasons of simplification, these additional extruders, which are known in producing tubes, are not illustrated in Figures 1 to 3.

ELJÁRÁS HENGERES, SZÁL ALAKÚ ELEM ELŐÁLLÍTÁSÁRA

SZABADALMI IGÉNYPONTOK

1. Eljárás szál alakú elem előállítására, ahol

- egy zártszelvényt (16) extrudálnak fémből,
- az extrudált fém zártszelvény (16) lehül és/vagy lehűtik és
- az extrudált fém zártszelvény (16) belsejébe a hűlés után vagy aközben egyrétegű vagy többretegű műanyagszálat (28) extrudálnak,
- ahol a műanyagszál (28) egy, az extrudernek (34) a fém zártszelvénybe (16) bevezetett, az extrudált fém zártszelvény (16) hőjének kitett adagolószerszáman (24) halad át, amelynek adagolónyílása (26) a fém zártszelvényen (16) belül helyezkedik el, miközben az az extrudálási hőmérsékletéről lehül, azzal jellemezve, hogy
- az adagolószerszám (24) termikusan össze van kapcsolva a fém zártszelvénnel (16) amely egyúttal temperálja is, úgy, hogy az adagolószerszám (24) érintkezik a fém zártszelvény (16) belső falával.

2. Az 1. igénypont szerinti eljárás, azzal jellemezve, hogy a fém zártszelvény (16) külső felületére egy- vagy többretegű műanyagbevonatot visznek fel, előnyösen extrúzióval, tandemextrúzióval vagy koextrúzióval.

3. Az 1. és 2. igénypontok egyike szerinti eljárás, azzal jellemezve, hogy a fém zártszelvénybe (16) extrudált egy- vagy többretegű műanyagszál (28) műanyag csőként van kiképezve, és hogy a műanyag cső belsejében túlnyomást hoznak létre, ezzel a fémcsőhöz (16) nyomva a műanyag csövet.

4. Az 1. és 2. igénypontok egyike szerinti eljárás, azzal jellemezve, hogy az egy- vagy többretegű műanyagszál (28) tömör szelvényként van kiképezve és hogy a tömör szelvénybe a az extrúzió során tömör vagy üreges profilú, lényegében nem deformálható és hőálló elemet, különösen egy- vagy többszálas elektromos vezető anyagot (46) vezetnek be.

5. Az 1–4. igénypontok egyike szerinti eljárás, azzal jellemezve, hogy a fém zártszelvény (16) egy, az olvadáspontja alatt plasztikusan alakítható és extrudálható fémből vagy egy, az olvadáspontja alatt plasztikusan alakítható és extrudálható fémötvözetből készül.



SZTNH-100093200

6. Az 5. igénypont szerinti eljárás, azzal jellemezve, hogy a fém alumínium vagy hogy a fémötvözet alumíniumötvözet.
7. Az 1–6. igénypontok egyike szerinti eljárás, azzal jellemezve, hogy a műanyagszál (28) tapadást segítő anyagból álló külső réteggel (30), és egy, a külső réteget (30) határoló polimerréteggel rendelkezik.
8. A 2. igénypont szerinti vagy az előző igénypontok egyike szerinti eljárás, a 3. igénypont figyelembevételével, azzal jellemezve, hogy a fém zártszelvény (16) külső felületére felvitt műanyagréteg egy, a fém zártszelvényt (16) határoló, tapadássegítő anyagból álló belső réteggel és egy, a belső réteget határoló, polimeranyagból készült külső réteggel rendelkezik.
9. Az 1–8. igénypontok egyike szerinti eljárás, azzal jellemezve, hogy a fémcső és a műanyagszál (28) koextrudálással vagy egymás után elhelyezett extruderekkel készül.
10. Az 1–9. igénypontok egyike szerinti eljárás, azzal jellemezve, hogy a zártszelvény (16) fémcső.
11. Az 1–10. igénypontok egyike szerinti eljárás, azzal jellemezve, hogy a műanyagszál (28) különösen jól habosítható műanyagból áll, amely a fémhez tapadó vagy nem tapadó tulajdonsággal rendelkezik.
12. Az 1–11. igénypontok egyike szerinti eljárás, azzal jellemezve, hogy az adagolószerző (24) tűskét tartalmaz, amely csőközzel rendelkezik, amelynek axiális végén a tűske adagolónyílásaként (26) funkcionáló gyűrűs fűvóka helyezkedik el.

WO 2008/028866

PCT/EP2007/059099

- 1/3 -

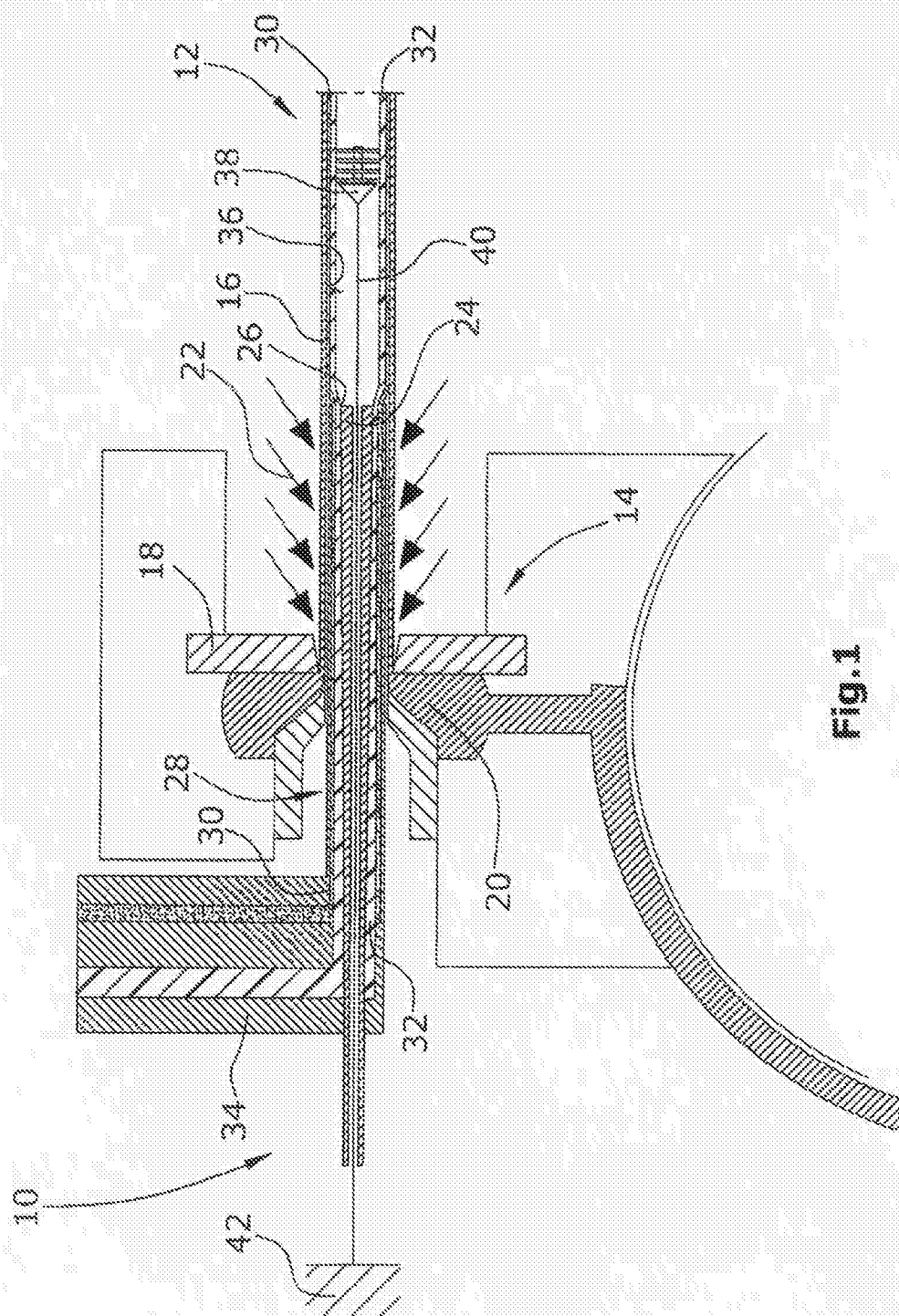
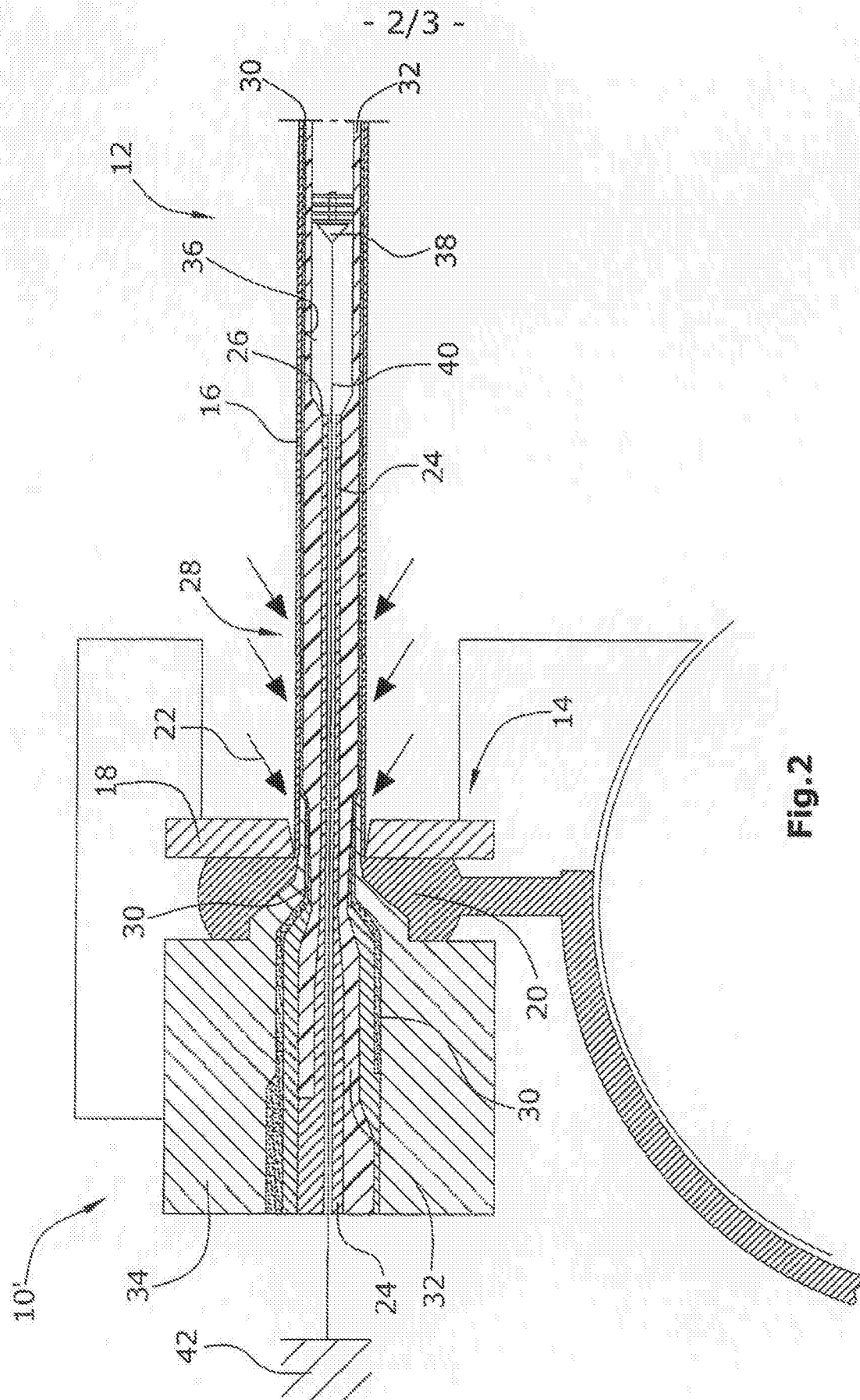


Fig. 1



SZTNH-100093201



WO 2008/028866

PCT/EP2007/059099

