

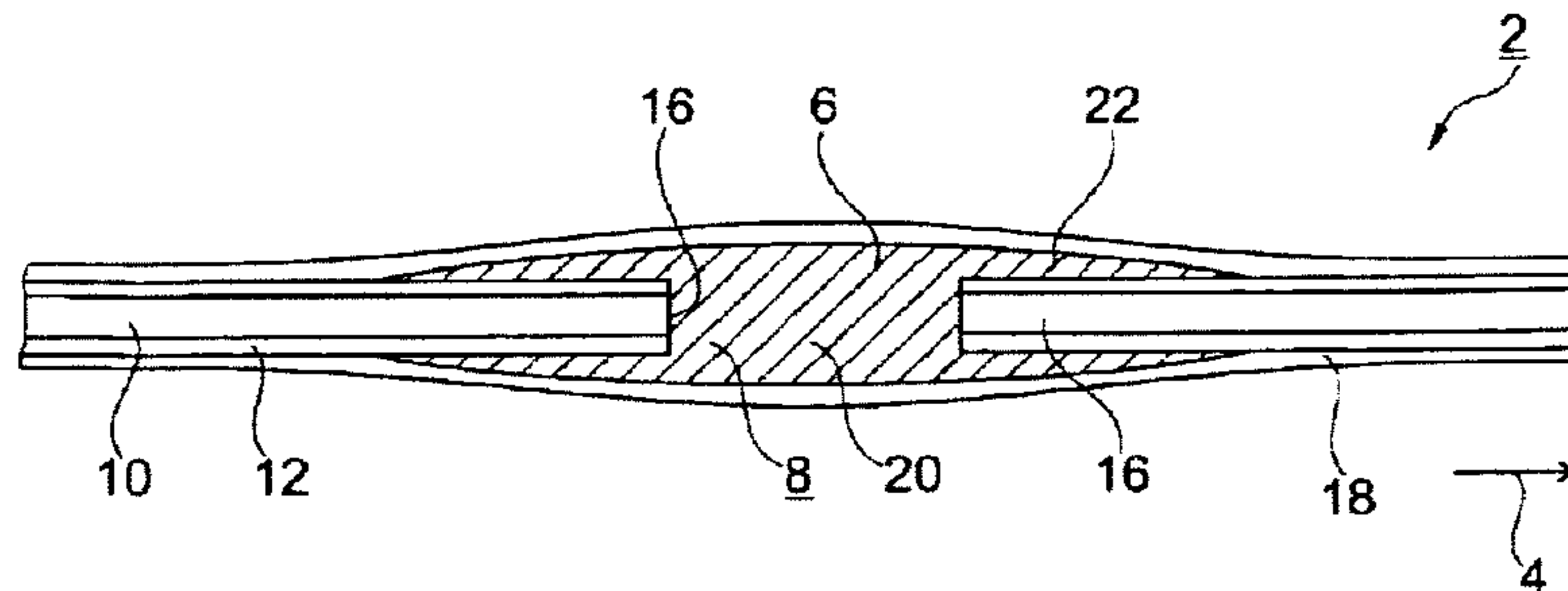


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(54) Titre : PROCEDE DE FABRICATION DE L'AME D'UN CABLE, COMPRENANT UN CONDUCTEUR ENTOURE PAR UN JOINT ISOLANT, DESTINE A UN CABLE, EN PARTICULIER A UN CABLE A INDUCTION, AME DE CABLE ET CABLE

(54) Title: METHOD FOR PRODUCING A CABLE CORE, HAVING A CONDUCTOR SURROUNDED BY AN INSULATION, FOR A CABLE, IN PARTICULAR FOR AN INDUCTION CABLE, AND CABLE CORE AND CABLE



(57) **Abrégé/Abstract:**

The invention relates to a production method for producing a cable core (2) for an induction cable (24) in a simple and simultaneously reliable manner, in which a raw conductor (14) is fed continuously to a processing machine (38) and separated in a recurring manner at specified length positions at a separating point (6) so that there are two wire ends (16). Said ends are then pulled apart from each other in the longitudinal direction of the cable (4) and then connected again by a connector (8) which has an insulating spacer (20) which separates the wire ends (16) from each other by a specified distance. The connector (8) is preferably designed as an injection molded part, in particular using the online process. A plurality of such cable cores (2) are connected to each other via a cabling process and then enclosed by a cable sleeve (34) to produce the induction cable (24).

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(54) Title: METHOD FOR PRODUCING A CABLE CORE HAVING A CONDUCTOR SURROUNDED BY AN INSULATION FOR A CABLE, IN PARTICULAR FOR AN INDUCTION CABLE, AND CABLE CORE AND CABLE

(54) Bezeichnung : VERFAHREN ZUR HERSTELLUNG EINER KABELADER MIT EINEM VON EINER ISOLIERUNG UMGEBENEN LEITER FÜR EIN KABEL, INSBESONDERE FÜR EIN INDUKTIONSKABEL, SOWIE KABELADER UND KABEL

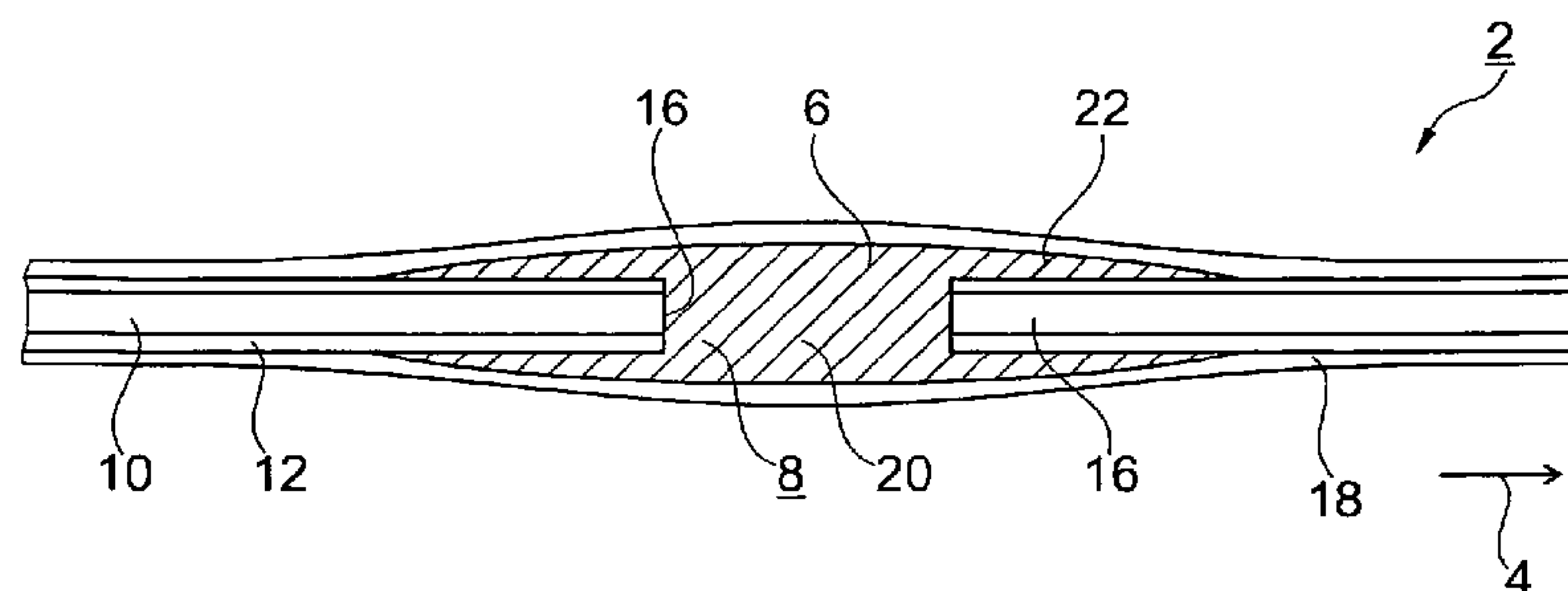


Fig. 1

(57) Abstract: The invention relates to a production method for producing a cable core (2) for an induction cable (24) in a simple and simultaneously reliable manner, in which a raw conductor (14) is fed continuously to a processing machine (38) and separated in a recurring manner at specified length positions at a separating point (6) so that there are two wire ends (16). Said ends are then pulled apart from each other in the longitudinal direction of the cable (4) and then connected again by a connector (8) which has an insulating spacer (20) which separates the wire ends (16) from each other by a specified distance. The connector (8) is preferably designed as an injection molded part, in particular using the online process. A plurality of such cable cores (2) are connected to each other via a cabling process and then enclosed by a cable sleeve (34) to produce the induction cable (24).

(57) Zusammenfassung: Um prozesstechnisch

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in einfacher und zugleich zuverlässiger Weise eine Kabelader (2) für eine Induktionskabel (24) herzustellen wird bei dem Herstellverfahren eine Rohader (14) fortlaufend einer Bearbeitungsmaschine (38) zugeführt und dort wiederkehrend an vorgegebenen Längenpositionen an einer jeweiligen Trennstelle (6) getrennt, so dass zwei Aderenden (16) vorliegen. Diese werden dann in Kabellängsrichtung (4) auseinander gezogen und anschließend wieder mit einem Verbinder (8) verbunden, welcher ein isolierendes Zwischenstück (20) aufweist, welches die Aderenden (16) um einen vorgegebenen Abstand voneinander trennt. Vorzugsweise wird der Verbinder (8) als Spritzgussteil und insbesondere im Online-Prozess ausgebildet. Zur Herstellung des Induktionskabels (24) werden mehrere derartiger Kabeladern (2) durch einen Seilprozess miteinander verbunden und anschließend von einem Kabelmantel (34) umgeben.

Description

**Method for producing a cable core, having a
conductor surrounded by an insulation, for a
cable, in particular for an induction cable, and
cable core and cable**

5

The invention relates to a method for producing a cable
core, having a conductor surrounded by an insulation,
for a cable, in particular for an induction cable. The
10 invention further relates to a cable core of this type
and also to a cable, in particular an induction cable
having a plurality of cable cores of this type. The
cable cores respectively have a conductor surrounded by
an insulation and are interrupted in the cable
15 longitudinal direction at predefined length positions
at separation points.

A cable of this type serves, in particular, for use as
a so-called induction cable for the formation of one or
20 more induction fields. The cable is intended, in
particular, for the inductive heating of deposits of
oil sand and/or of extra-heavy oil. Such an application
of an induction cable of this kind can be derived, for
example, from EP 2 250 858 B1. The technical boundary
25 conditions resulting from this application are met by
the cable which is described below.

For the construction of the induction fields or of the
inductive heating system, it is necessary that the
30 individual cores of the cable, at defined separation
points, are separated in a contact spacing having a
defined length of, for instance, several tens of
meters. Within the cable, a plurality of cores are
preferably combined into conductor groups, wherein the
35 separation points or interruptions of the cores of a
respective conductor group is situated at the same
length position.

A cable of this type is laid in the ground (oil sand) and serves for the inductive warming of the oil sand in order to liquefy, and suitably collect, the oil bound in the oil sand.

5

This technique is still comparatively young and is still in the trial stage. For large, industrial-scale applications, an inexpensive and, in process engineering terms, secure production of an induction
10 cable of this type, which can have a length of several km, is of advantage.

Accordingly, the object of the present invention is to enable an, in process engineering terms, secure and
15 reliable production of a cable of this type and to define an appropriate cable.

The object is achieved according to the invention by a method for producing a cable core having the features
20 as provided herein. The cable core comprises a conductor surrounded by an insulation and is designed for use in an induction cable. To this end, the cable core is interrupted in the cable longitudinal direction at predefined length positions at separation points. For
25 the production of a cable core of this type, a crude core is firstly fed continuously, i.e. in a continuous process, to a processing machine. The crude core is recurrently separated in the processing machine, in particular regularly at predefined length positions at
30 a respective separation point, so that two core ends exist. The free core ends are hereupon gripped by a gripping element of the processing machine and are pulled apart in the cable longitudinal direction. After this, the two core ends are reconnected to each other
35 with a connector, so that a continuous strand is recreated. The connector here has an insulating spacer part, in particular formed of a solid material, which spacer part is disposed between the two core ends and

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separates these from each other by a predefined distance.

By virtue of this embodiment, a process-reliable and automated production process for a cable core of this type is enabled. From the cable cores which have been prepared in this way, the actual cable is produced in a following method step.

10 With a view to an economical production process, in a particularly advantageous embodiment an extrusion coating of the core ends for the formation of the connector is provided. To this end, an injection mold is provided as part of the processing machine, which
15 injection mold, during the continuous process, encloses the mutually separated core ends at the separation point. Next, the injection molding compound, consisting of a suitable plastics insulation material, is injected, so that the connector is configured with the
20 insulating spacer part between the core ends and with sleeve portions surrounding the core ends.

With regard to the desired field of application for use in an induction cable, the cable ends are enclosed in a
25 snug-fitting manner within the connector, in particular in an airtight and, furthermore, also airless arrangement. The core ends are therefore embedded fully, and without gas pockets, within the material of the connector. This is achieved in a particularly
30 simple manner by the preferred injection method.

As an alternative to the injection method, a connector which is preferably likewise configured as an injection molded part is fed as a prefabricated component to the
35 processing machine and the core ends are introduced into opposing sleeve portions of the connector, whereafter these sleeve portions are connected to the core ends.

With regard to the tightly enclosing binding of the connector to the insulation, the latter is preferably integrally connected to the material of the connector.

5 This is realized, in particular, by a heat treatment and the use of suitable materials, which, when warmed, at least soften or partially melt. As the material both for the connector and for the at least outermost position of the insulation of the cable core, a

10 thermoplastic material is therefore preferably used.

Accordingly, a similar and, in particular, same material is also used also for the connector on the one hand and for the insulation on the other hand, at least

15 for an outer insulation layer. This is, in particular, a high-temperature resistant plastic, preferably PFA (perfluoroalkoxy polymer).

The connector and at least contiguous segments of the

20 core, preferably the entire core, are surrounded with a banding, in particular of PTFE (polytetrafluoroethylene). This is preferably in turn subjected to a temperature treatment, in particular a sintering process, so as to connect it as integrally as

25 possible to the insulation of the core and to the connector. As a result, a torsionally rigid wiring core is produced overall, which wiring core is electrically interrupted at defined separation points. At the separation points, the respective core ends are

30 connected to one another by the respective connector, with the release of the insulation spacer part, whereby, so to speak, a window is formed. As a result of the fusion of the core ends in the sleeve, in particular also in conjunction with the sintered PTFE

35 banding, in addition to the high torsional rigidity also a high tensile strength, in particular in the region of the connector, is obtained.

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With a view to a method which is as economical as possible, the production of the cable core is realized in the course of a rereeling operation. The crude core is here provided as a continuous product on a take-off
5 reel and unwound from this, led through the processing machine and subsequently, after the attachment of the individual connectors, rolled up again by a take-up reel.

10 In the course of this production method, in an expedient refinement the cable core is subjected to an on-line quality control, i.e. the quality of the connections at the separation points is checked continuously.

15

Above all, an electrical checking of the connectors is conducted. The connector - after having been removed from the injection mold after a defined cooling time - is subjected to a partial discharge test. It is herein
20 checked whether the connector, at a predefined voltage, has the desired insulation properties, before the cable core is then reeled onto the take-up reel.

In addition, a mechanical (tensile) testing device, if
25 required, is integrated into the process chain. Apart from this, further processing units are also - where necessary - integrated in the process chain, such as, for instance, an additional welding unit or a banding unit. In addition, in particular also an additional
30 temperature control unit, in particular for the thermal treatment (sintering process) of the applied banding, is provided.

At the end of this production process for the cable
35 core, the latter is therefore available, wound on a reel, for further processing. In a following method step, which can be take place at a later moment and also at another location, the individual cable cores

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are then used to produce the actual cable. This has at the end a plurality of such cable cores, which are surrounded by a common cable sheath. For the production of the cable, the individual cable cores are preferably, if need be, multiply stranded together.

The individual cable cores are here positioned relative to one another in such a way that the individual separation points of at least one group of cable cores are disposed at the same length position. A plurality of groups of cable cores can be provided (for instance 2 or 3), the separation points of which are oriented respectively at the same length position, wherein the separation points of the cable cores of different groups are arranged mutually offset.

The distance between the connector, and thus the separation points, typically measures around several meters, in particular several tens of meters. The separation points are here arranged in a predefined, in particular constant contact spacing.

The cable here expediently comprises a plurality of stranded elements, which on one side consist of a plurality of stranded-together cable cores and which are themselves, in turn, stranded together. The cable which is produced in this way has a length of typically at least several 100 meters up to several km. In the light of the sought purpose of application, namely as an induction cable for the warming of oil sands, it is designed overall to be high-temperature resistant for a temperature greater than 200°C. Accordingly, the materials used are also designed for a temperature of this magnitude.

This method therefore allows a fully automated production of a cable of this type, wherein recourse is

made to traditional cable production steps, such as the stranding process, etc.

5 The object is further achieved according to the invention by a cable core for a cable extending in a cable longitudinal direction, in particular for an induction cable, comprising a plurality of such cable cores, which respectively have a conductor surrounded by an insulation, wherein the respective cable core is interrupted in the
10 cable longitudinal direction at predefined length positions at separation points, with the formation of two core ends, characterized in that, for the connection of the core ends, a connector, extending in the cable longitudinal direction and having an insulating spacer
15 part, is provided, and the core ends, in the cable longitudinal direction, are fastened on both sides of the spacer part to the connector.

20 The object is further achieved according to the invention by the cable core as defined herein, characterized by a circumferential banding made of a high-temperature resistant plastic, which banding surrounds the connector and at least contiguous segments of the cable core. The advantages and preferred embodiments which are
25 mentioned with regard to the production method can analogously be transferred also to the cable core and to the cable.

30 According to an aspect of the present invention there is provided a method for producing a cable, which comprises the steps of:

producing a plurality of cable cores, each of the cable cores being produced by the further steps of:

35 feeding a crude core continuously to a processing machine and there, recurrently, at predefined length positions the crude core is

separated at a separation point, so that at the separation point two core ends exist, said crude core having an insulation surrounding a conductor;

5 pulling apart the core ends in a cable longitudinal direction; and

reconnecting the two core ends with a connector, the connector having an insulating spacer part for separating the core ends from each other by a predefined distance, the core ends in
10 the cable longitudinal direction fastened on both sides of the insulating spacer part to the connector, the insulating spacer part being disposed between the core ends and separating the core ends from each other by the predefined
15 distance, the connector being integrally connected to the insulation and the insulation having a first width and a first length, the connector having a second width being greater than the first width of the insulation and a second length being
20 less than the first length of the insulation;

stranding together the plurality of cable cores resulting in stranded cable cores; and

surrounding the stranded cable cores with a cable sheath to form the cable.

25

According to another aspect of the present invention there is provided a cable, comprising:

a cable sheath; and

a plurality of cable cores stranded together and
30 surrounded by said cable sheath, each of said cable cores containing:

a conductor;

insulation surrounding said conductor and having a first width and a first length,

wherein each of said cable cores including said conductor and said insulation being interrupted in a cable longitudinal direction at a predefined length position at a separation point, resulting in a
5 formation of two opposing core ends; and

a connector extending in the cable longitudinal direction and having an insulating spacer part, said opposing core ends, in the cable longitudinal direction, fastened on both sides of said insulating
10 spacer part to said connector, said insulating spacer part being disposed between said two opposing core ends and separating said two opposing core ends from each other by a predefined distance, said connector integrally connected to said insulation, said connector
15 having a second width being greater than said first width of said insulation and a second length being less than said first length of said insulation.

An illustrative embodiment is explained in greater
20 detail with reference to the figures, wherein, respectively in simplified representations:

fig. 1 shows a partial sectional representation of a cable core, connected at a separation point
25 by means of a connector, according to a first variant,

fig. 2 shows a representation, comparable to fig. 1, according to a second variant,

fig. 3 shows a cable core in side view,

30 fig. 4 shows a cross-sectional view of an induction cable, and

fig. 5 shows a heavily simplified production line for the production of the cable core.

35 From figs. 1 to 3, is represented in various representations a cable core 2, which extends in the cable longitudinal direction 4 and which, at

periodically recurring connecting points 6, respectively has a connector 8. The separation points 6 are configured in a predefined contact spacing a.

- 5 The cable core 2 comprises a central electrical conductor 10, which is surrounded by an insulation 12. The insulation 10 is preferably constituted by a multilayered insulation 12 consisting of different

insulating materials, which are respectively high-temperature resistant. According to a first variant, the insulation consists of only one insulation layer, preferably of PFA. According to a second variant, the
5 insulation 12 consists of two layers, preferably one layer of PFA and a further layer of a PTFE applied, in particular, as a banding. According to a third variant, three layers are provided, wherein preferably a PTFE banding is embedded in a sandwich-like manner between
10 two PFA insulation layers. Finally, according to a fourth variant there is provided an, in total, four-layered structure, in which, in turn, in a preferred embodiment, two intermediate layers are provided between two PFA coatings. The two intermediate layers
15 are here preferably a banded PTFE and a banded mica. The variants comprising an intermediate layer embedded between two PFA layers and configured, in particular, as a banding, shows particularly good mechanical stability.

20

As the electrical conductor 10, a wire, in particular a copper wire, and preferably a nickel-plated copper wire, is used. Alternatively, a stranded wire, for instance a copper or a nickel-plated copper stranded
25 wire, consisting of a multiplicity of individual wires, can also be used.

From a crude core 14 consisting of the conductor 10 and the insulation 12 is formed the cable core 2. To this
30 end, the crude core 14 is interrupted at the separation points 6, so that two opposing core ends 16 are formed. These are mutually connected by the connector 8. Common to both design variants of figs. 1 and 2 is the fact that the connector 8 enters into integral connection
35 with the insulation 12 of the core ends 16. In addition, in both design variants there is provided a further additional banding 18, in particular of PTFE, with which the connector and the contiguous segments of

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the crude core 14 are enwrapped. This banding 18, too, is preferably likewise integrally connected to the connector 8 and to the insulation 12.

5 The connector 8 is in both cases formed by a solid spacer part 20, which is respectively adjoined in opposite arrangement by sleeve portions 22, in which the core ends are held in a gas-free and gas-tight fitting.

10

Both connectors 8 are constituted by injection molded parts. As the material, preferably the same material as the outermost cover of the insulation 12 is used, in particular PFA. Due to the use of a thermoplastic, the
15 desired integral connection can be obtained in a simple manner through the introduction of heat.

In the design variant according to fig. 1, this occurs in a particularly favorable manner in process
20 engineering terms by virtue of the fact that the connector 8 is formed directly on the crude core 14 with the separated core ends 16 by an injection molding process.

25 By contrast, in the design variant of fig. 2, a prefabricated connector 8 is provided in the production process, into which connector the core ends 16 are respectively introduced, whereafter the sleeve portions 22 are integrally connected to the core ends 16, for
30 instance by pressing and/or heat treatment.

The connector 8 has a length, in total, of preferably several cm, for instance within the range from 5 cm to 15 cm. The length of the spacer part 20 here lies
35 within the range from 5 mm to 20 mm. The diameter of the crude core 14, and thus approximately the inner diameter of the sleeve portions 22, preferably lies approximately within the range from 1 mm to 3 mm. The

5 wall thickness of the sleeve portions 22 preferably lies within the range from 0.3 mm to 1 mm. In total, the connector 8 is symmetrical in construction. The contact spacing a between the connectors 8 measures in the region of several tens of meters.

An exemplary conductor structure of an induction cable 24 is represented in fig. 4.

10 According to this, the induction cable 24 has a total of three elements 26, which are respectively formed of a plurality of stranded together cable cores 2. In the illustrative embodiment, each element 26 has a central optical waveguide fiber 28, which is concentrically
15 surrounded by a first core layer comprising six cable cores 2. The first core layer is subsequently surrounded by a second core layer, in the illustrative embodiment consisting of twelve individual cable cores 2. The individual core layers are produced in a
20 stranding process. In the gap between the three elements 26, a further filling element 30, in particular made of glass silk or aramid, is disposed. The first layer comprising the six stranded together cable cores 2 can be surrounded - as represented in the
25 illustrative embodiment - by an intermediate casing 32, for instance of silicone. The three thus constructed elements 26 are in turn stranded together and subsequently surrounded with a cable sheath 34, in particular of silicone. The elements here respectively
30 have a diameter, for instance, of about 10 mm. The entire cable 24 has a diameter, for instance, of around 25 mm.

In principle, this induction cable 24 is also suitable
35 for other applications, for example for laying in a factory floor of a production workshop for the control of industrial robots which travel on the factory floor.

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Or for the heating of, for instance, oil-transporting pipes (pipeline).

The method for producing the cable core 2 is explained in greater detail with reference to fig. 5. The crude core 14 is provided on a take-off reel 36 and is led from this, via various deflection rollers of a processing machine, to and through the latter, whereafter it is led through a plurality of partially optional further processing and monitoring stations 40 and, at the end of the production process, is immediately wound up again, as a finished cable core 2, by a take-up reel 42. This cable core 2 is then available for the actual operation of producing the cable 24 by stranding processes.

The production of the cable core 2 from the crude core 14 is therefore realized, in total, in a continuous, ongoing process during a rereeling operation. Within the processing machine 38, the separation of the crude core 14 and the subsequent connection to the connector takes place. In the preferred design variant, the processing machine 38 contains an injection molding tool for the online formation of the connector 8 by an injection molding process. To this end, the crude core 14 is firstly held at the provided separation point 6 by two gripping elements and then separated, whereupon the two core ends 16 are pulled apart by a desired distance of 1 cm to 2 cm. Finally, the core ends 16 are inserted into the injection mould. To this end, the latter preferably has two shell halves, which, perpendicularly to the cable longitudinal direction, moves up to the core ends 16 and encloses these. After this, the injection molding compound is introduced. After a certain cooling time, the injection mold reopens and the cable core 2 is led onward. Following this process of applying the connector 8, in a preferred embodiment the application of the banding 18,

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with subsequent sintering for integral fastening of the banding 18, further takes place. This is realized, for instance, in one of the following processing stations 40. A further processing station 40 is designed as a
5 checking station for on-line quality control. Studies have shown that, in the here chosen embodiment comprising the direct extrusion coating of the core ends 16, a very good mechanical connection is obtained, so that a separate mechanical tensile test for the
10 respective connector 8 is waived.

An at least similar production process is also used in the embodiment of fig. 2. Instead of the online extrusion coating, however, the prefabricated connector
15 8 is here provided in the processing machine 38. The core ends 16 are introduced into the sleeve portions 22 with the aid of the gripping elements. In a following process step, the integral connection of the core ends within the connector 8 is realized, for instance, by
20 warming and press-molding. The entire production process, as represented in fig. 5, is controlled, for instance, by a control unit 44.

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Reference symbol list

	2	cable core
	4	cable length direction
5	6	separation point
	8	connector
	10	conductor
	12	insulation
	14	crude core
10	16	core end
	18	banding
	20	spacer part
	22	sleeve portion
	24	induction cable
15	26	element
	28	optical waveguide fiber
	30	filling element
	32	intermediate casing
	34	cable sheath
20	36	take-off reel
	38	processing machine
	40	processing station/monitoring station
	42	take-up reel
	44	control unit
25	a	contact spacing

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method for producing a cable, which comprises the steps of:
producing a plurality of cable cores, each of the cable cores
being produced by the further steps of:

feeding a crude core continuously to a processing
machine and there, recurrently, at predefined length positions
the crude core is separated at a separation point, so that at
the separation point two core ends exist, said crude core
having an insulation surrounding a conductor;

pulling apart the core ends in a cable longitudinal
direction; and

reconnecting the two core ends with a connector, the
connector having an insulating spacer part for separating the
core ends from each other by a predefined distance, the core
ends in the cable longitudinal direction fastened on both
sides of the insulating spacer part to the connector, the
insulating spacer part being disposed between the core ends
and separating the core ends from each other by the predefined
distance, the connector being integrally connected to the
insulation and the insulation having a first width and a first
length, the connector having a second width being greater than
the first width of the insulation and a second length being
less than the first length of the insulation;

stranding together the plurality of cable cores
resulting in stranded cable cores; and

surrounding the stranded cable cores with a cable sheath
to form the cable.

2. The method according to claim 1, which further comprises extruding the mutually separated core ends for a formation of the connector.
3. The method according to claim 1 or 2, which further comprises applying a banding to a cable core and the connector.
4. The method according to claim 3, which further comprises integrally connecting the banding to the insulation and/or the connector.
5. The method according to any one of claims 1 to 4, wherein a separation and connection of the crude core takes place in a re-reeling operation.
6. The method according to any one of claims 1 to 5, wherein the cable is an induction cable.
7. A cable, comprising:
 - a cable sheath; and
 - a plurality of cable cores stranded together and surrounded by said cable sheath, each of said cable cores containing:
 - a conductor;
 - insulation surrounding said conductor and having a first width and a first length, wherein each of said cable cores including said conductor and said insulation being interrupted in a cable longitudinal direction at a predefined length position at a separation point, resulting in a formation of two opposing core ends; and
 - a connector extending in the cable longitudinal direction and having an insulating spacer part, said opposing core ends, in the cable longitudinal direction, fastened on

both sides of said insulating spacer part to said connector, said insulating spacer part being disposed between said two opposing core ends and separating said two opposing core ends from each other by a predefined distance, said connector integrally connected to said insulation, said connector having a second width being greater than said first width of said insulation and a second length being less than said first length of said insulation.

8. The cable according to claim 7, wherein:
the cable is an induction cable; and
said connector having two sleeve portions on opposing sides of said insulating spacer part, said sleeve portions each surrounding one of said two opposing core ends having said conductor and said insulation surrounding said conductor.
9. The cable according to claim 7 or 8, wherein said connector has on both sides of said insulating spacer part a sleeve portion extending in the cable longitudinal direction and in which said opposing core ends are held.
10. The cable according to claim 7, wherein said connector is an injection molded part.
11. The cable according to claim 7, wherein said connector is formed by extrusion coating of said opposing core ends.
12. The cable according to any one of claims 7 to 11, wherein said separation point is repeated at a predefined contact spacing, wherein the predefined contact spacing measures in a region of several meters.

13. The cable according to any one of claims 7 to 12, wherein said connector and said insulation are formed of a similar material.

14. The cable according to any one of claims 7 to 13, further comprising a circumferential banding made of a plastic, said circumferential banding surrounding said connector and at least contiguous segments of said insulation surrounding said conductor.

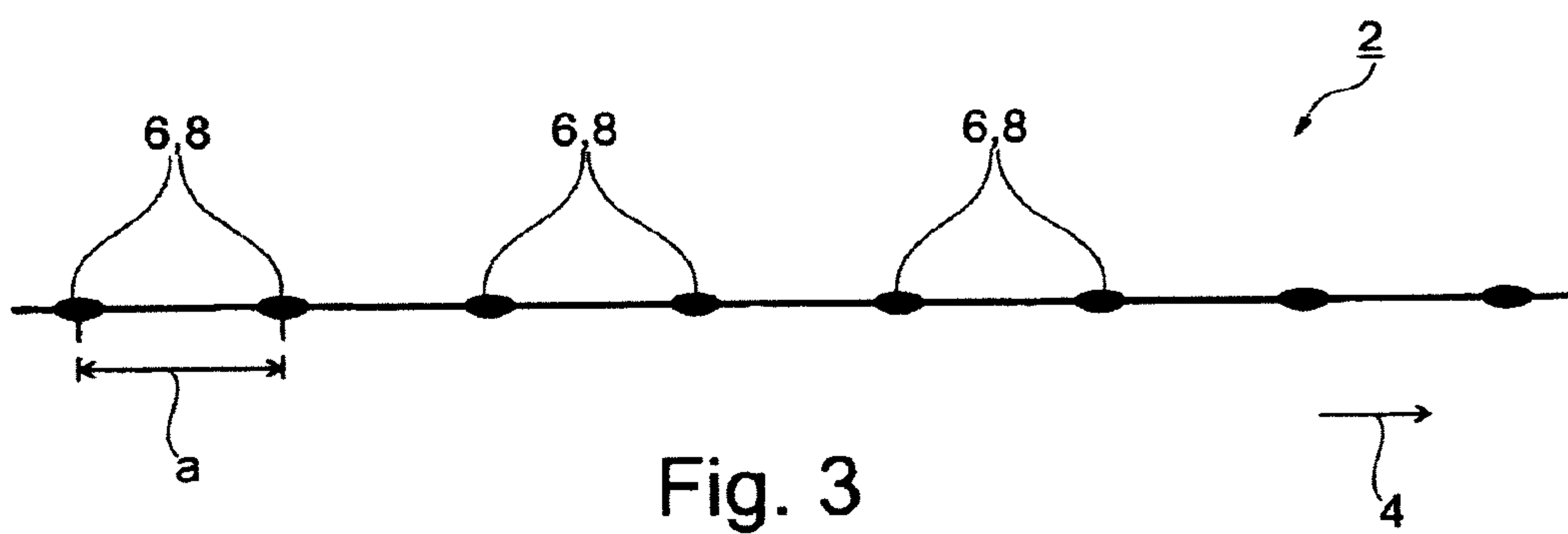
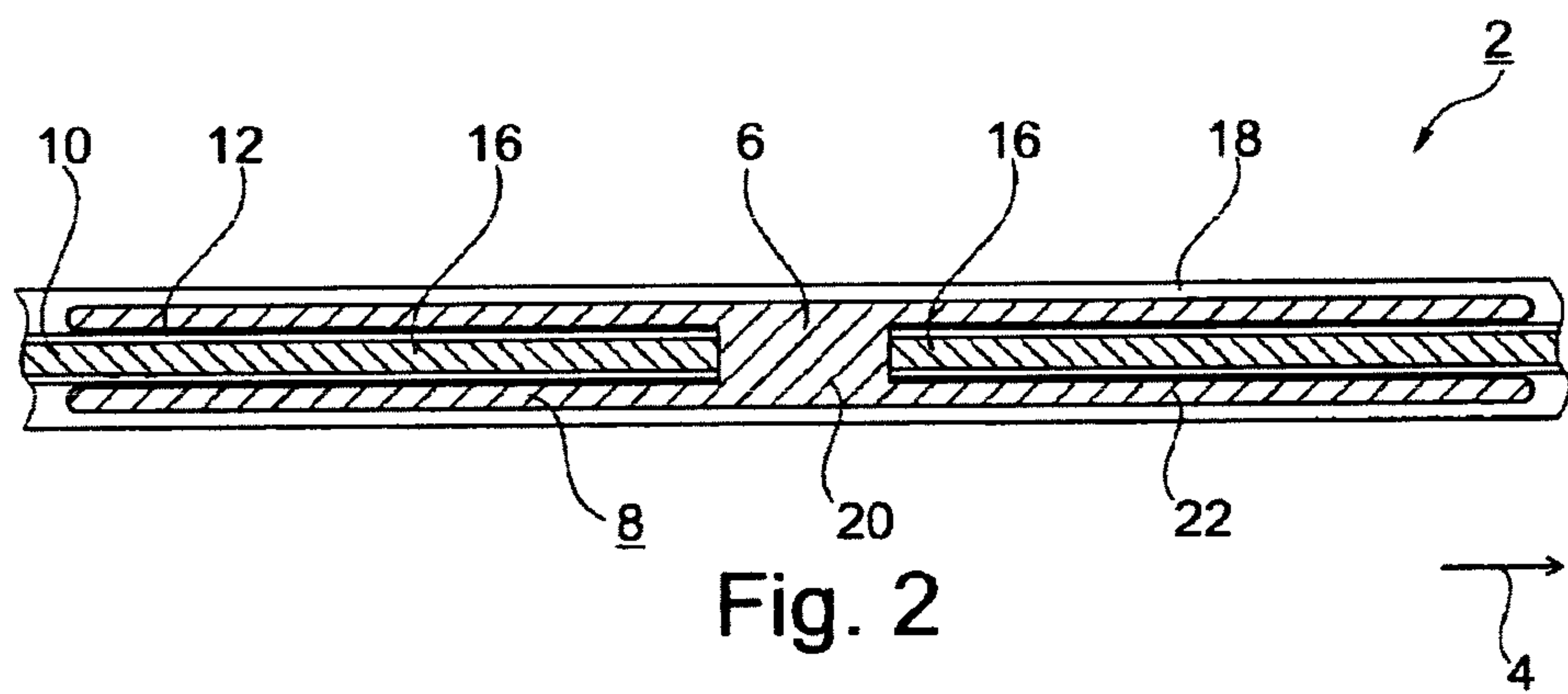
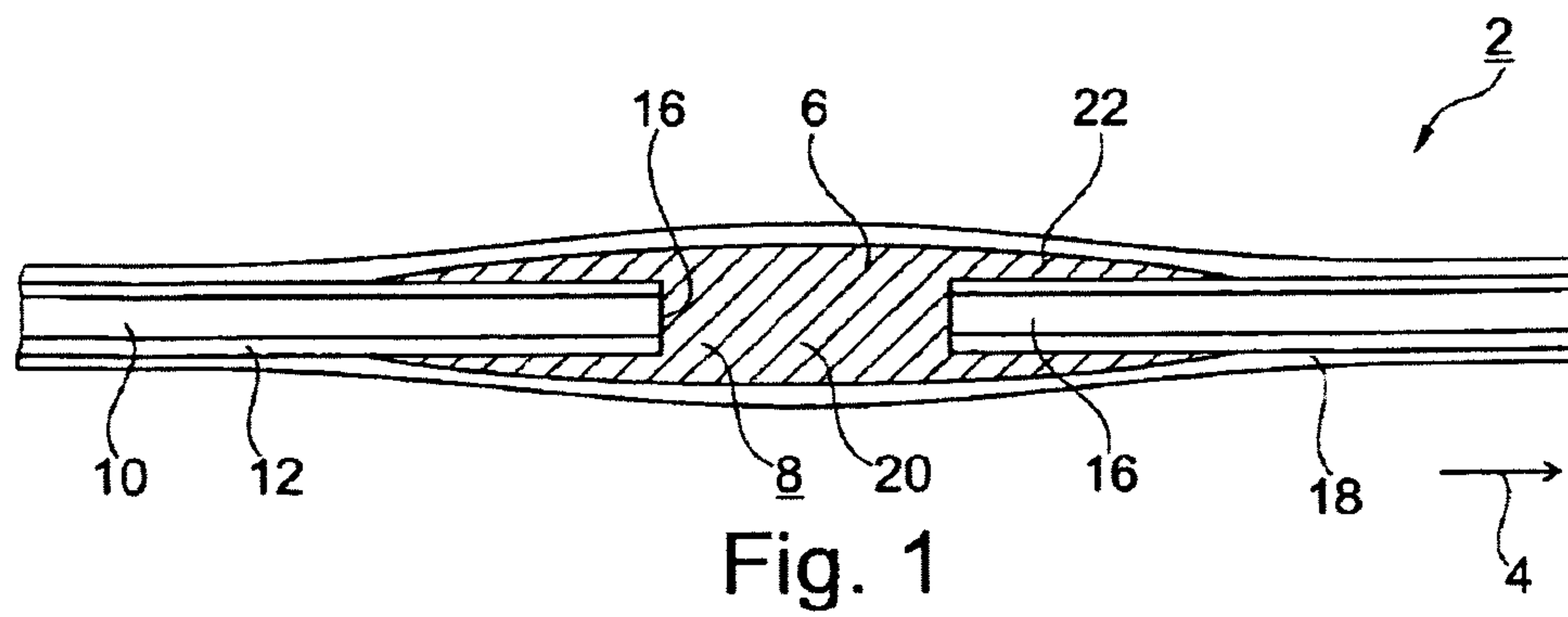
15. The cable according to claim 14, wherein said circumferential banding is integrally connected to said connector and/or said insulation.

16. The cable according to any one of claims 7 to 15, wherein said connector and said insulation are formed of a same material.

17. The cable according to claim 7, wherein:

the cable is an induction cable; and

said connector having two sleeve portions on opposing sides of said insulating spacer part, said sleeve portions each surrounding one of said two opposing core ends having said conductor and said insulation surrounding said conductor.



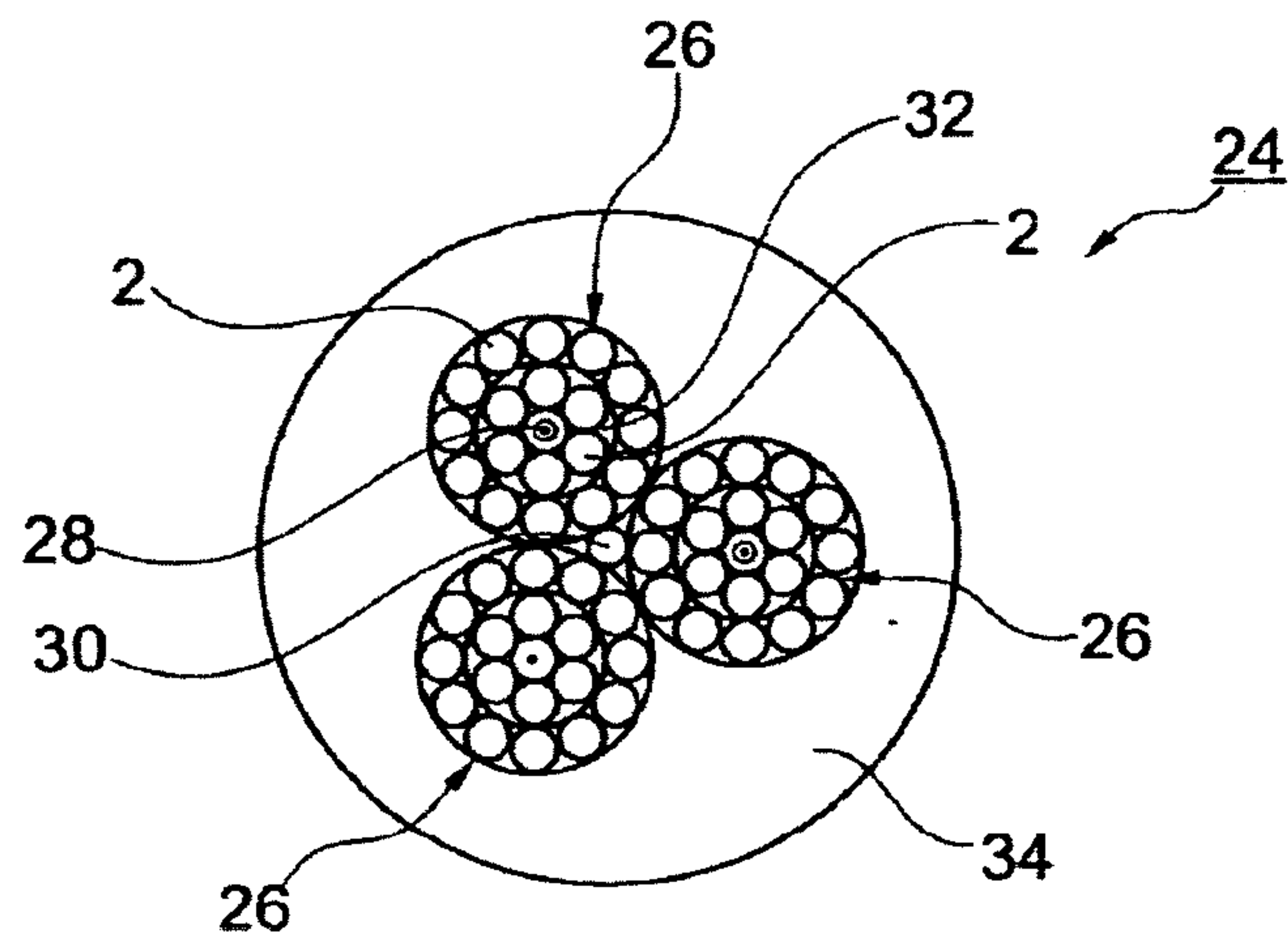


Fig. 4

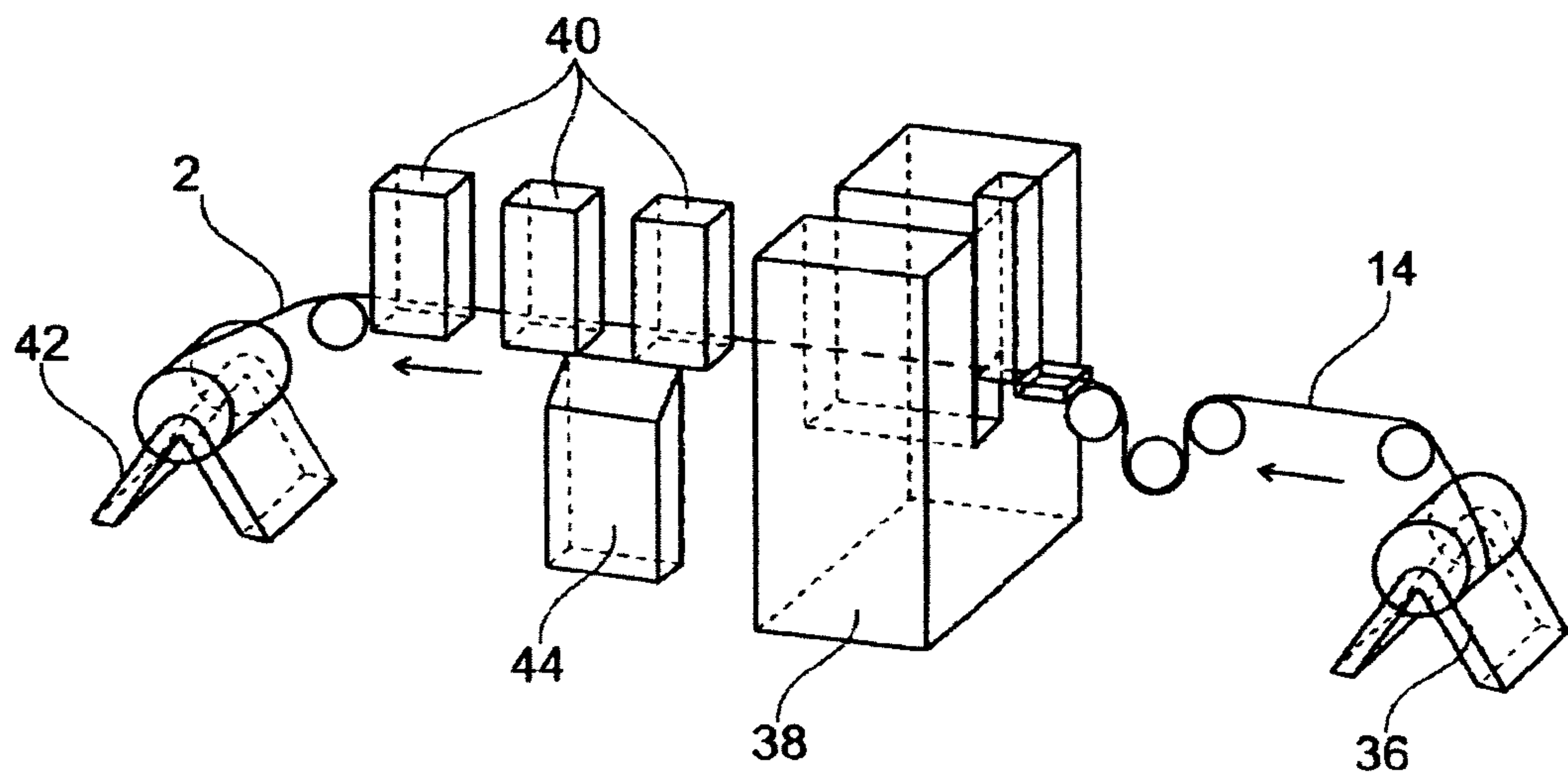


Fig. 5

