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(54) Covered rollers comprising air channels and method for covering a roller

(57) The invention relates to covered rollers comprising air channels and a method for covering a roller having substantially a cylindrical outer surface and a longitudinal axis, with a covering material such as an elastomer e.g. rubber or polyurethane, comprising the steps of:

- optionally removing of any old covering material,
- attaching at least an air channel on the outer face of the roller, such that at least an end of said air channel is able to be connected to an air supply,
- optionally cleaning the attached air channels and outer surface of the roller,
- applying one or more bonding agents to said air channels and outer surface,
- applying the elastomer on the outer surface of the roller such that at least the attached parts of the air channel are covered with said elastomer,
- allowing vulcanisation or curing of the elastomer, and
- performing a finishing step of the covered roller.

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Description

Field of the invention

[0001] The invention is related to rollers useful in all kinds of industries, such as transport, steel, textile, food processing, printing, etc. In general rollers are designed to perform a continuous rotational movement. The frictional forces acting upon the roll surface and other aging processes, such as wear, corrosion, etc. lead over a certain time lapse to a decrease in the diameter of the roll and to a deformation of the cylindrical shape. The life span of the roll or the roll core can in general significantly be exceeded when said roll core is covered and/or recovered with a wear resistant covering material, such as rubber. In printing industry, e.g. the flexographic and gravure printing industry these rollers are in general provided with detachable functional sleeves which are coaxial rigidly mounted thereon.

[0002] In a first aspect the invention is related to a method for covering new or used rollers.

[0003] In a second aspect the invention is related to providing rollers able to co-axially airmount said functional sleeves.

Background of the invention

[0004] Rollers are normally massive, made out of steel or another metal alloy and covered with an elastomer, such as a rubber or a polyurethane. The covering has a specific function, i.e. a protection of the roller core. Due to for example corrosion and wear of the surface, it generally has a shorter life-span than the average life-span of the roller itself. This brings about the necessity of (re)covering. In general (re)covering consist of several time consuming steps. The roller is dismantled at the customer premises and transported to a recoverer. After recovering according to the wishes of the customer, the roller is again transported to the customer and, after the wear of spared rollers, re-installed on a production line. The customer will generally grind the rollers himself in between the different recoverings, in view of attuning the covered surface correctly.

[0005] In recent years, the use of glass fibre reinforced or nickel sleeves mounted onto air shafts has gained popularity in the graphic sector, mainly in the helio and flexographics. The functional sleeve itself is either covered for laser engraving, or "naked", or covered with an "intermediate", and used on a non-continuous photofilm or continuous photopolymer rotation printer for repetitive printing. These sleeves need to be mounted concentric and coaxial on the roller. In order to provide a minimal axial tolerance during mounting and removing pressured air is provided upon the inner surface of said sleeve. This pressure boost will temporarily increase the diameter of the sleeve resulting in a smooth mounting or removal on the roll core. This method is herein referred to as airmounting.

[0006] In order to provide for an airmount configuration US 5,819,657 discloses a cylindrical spacer sleeve which is interposed between a printing sleeve and a printer roller. Said spacer sleeve consists of a cylindrical inner concentric layer. The interposition of said additional layer as a sleeve is a difficult operation in order to provide a precise and firm fitting in between the roller and the external printing sleeve, especially in working conditions.

[0007] Hollow rollers which are used in the flexographic printers described in US 5,706,731 can be able to act directly as an air supply. Airmounting of the sleeves is made possible due to perforations, which are provided directly in the material of the roller core, such that pressured air can flow from the inner part of the roller radially outwards. These hollow rollers have however several drawbacks. They are not protected against an aggressive working environment, such as acids and have limitations in their diameter. Furthermore, most existing rollers are massive and can not be used as air supply means.

Objects and summary of the invention

[0008] It is a principal object of the present invention to provide a method for covering rollers, which rollers may be new or may already previously be covered and used in recovering procedures, that would lower the cost and on the demand of the customer can provide for a suitable diameter.

[0009] It is another principal object of the present invention to provide a method for (re)covering a roller, which results in the possibility to airmount sleeves, even when the roller is massive.

[0010] Additional objects and advantages of the invention will be set forth in the detailed description hereunder. The objects and advantages of the invention may be realized and obtained by means of the features and combinations thereof particularly pointed out in the appended claims.

Summary of the invention

[0011] To achieve the objects in accordance with the purpose of the invention, the present invention pertains to a method for covering a roller having substantially a cylindrical outer surface and a longitudinal axis, with a covering material such as an elastomer e.g. rubber or polyurethane, comprising the steps of:

- optionally removing of any old covering material,
- attaching at least an air channel on the outer face of the roller, such that at least an end of said air channel is able to be connected to an air supply,
- optionally cleaning the attached air channels and outer surface of the roller,
- applying one or more bonding agents to said air channels and outer surface,

- applying the elastomer on the outer surface of the roller,
- allowing vulcanisation or curing of the elastomer, and performing a finishing step of the covered roller.

[0012] The method for covering a roller according to the invention consists of two main steps. A first step in which on the outer surface of the roller air channels are attached which will be covered by a second covering step. Holes drilled into the covering material will provide a roller capable of airmounting sleeves in a easy fashion. During the covering process the thickness dimension of the concentric cover layer, covering the fastened air channels, is chosen such that accommodation of the desired sizes of the functional sleeves to be airmounted thereon is made possible. Once curing or vulcanization is completed holes are provided, for example drilled through the cover layer connecting to the applied air channels. Preferably these air holes extend radially.

[0013] The applied air channels are provided with connecting means, able to be connected with a pressured air source. Pressured air is guided through the covering material via the embedded air channels and drilled holes towards the outer surface of the covered roller in order to facilitate the airmounting of sleeves.

[0014] The method of the invention provides several advantages. Airmounting becomes available for all kinds of rollers, used and new ones. Adjusting the amount of covering material makes a standardization of the applied measures possible. Old rollers can be reused for airmounting.

[0015] Via this system of covering a roller while at the same time providing airmounting means, the following further advantages are offered. High transport costs are avoided: transport between customer and covering operator is minimized into one-way transport of the much lighter sleeves, which are for example made out covered glass or carbon fibers tubes. The spare stock of rollers can be deminished drastically and can be replaced by a much smaller stock of covered glass fibre tubes. The invention offers the opportunity to follow the tendency of standardization of glass fibre tubes (sleeves) as far as the internal diameter is concerned.

[0016] Furthermore, the invention provides a complete protective cover for a roller, for example against aggressive environments, such as acid and base environments including a protective covering layer on both sides and (flanges and shoulder) of the roller.

Technical Description

[0017] The covering process of the invention contains several stages. The roller can either be a newly manufactured or a used covered roller.

[0018] A newly manufactured roller may be cleaned and degreased before further processing. For a used covered roller the old covering will be removed, using e. g. a turning off lathe or sandbelt driven backstand device. If necessary shot-blasting or abrading the surface is performed, in order to give an adequate structure for bonding. Two specific embodiments will be described herunder.

[0019] In a first embodiment a hollow cylindrical air pressure steel tube, for example outer diameter 6mm, internal diameter 4 mm, thickness 1mm; DIN 2445/2 is welded onto the outer face of the core. A primary tube is laid peripheral as a ring onto the roller near one of the flanges. Another air tube is welded on the roll core and extends over the complete surface of the roller in the longitudinal direction. The distance or spacing of the said peripheral ring to the closest edge of the face of the roller is measured and memorized such that later after covering the drilling of holes in the air tubes is made possible. A small part of the longitudinal air channel protrudes over the flange and is connectable to an air supply for airmounting sleeves. The position of the air channels is memorized.

[0020] Subject to the diameter and the length of the roller and the material of the sleeves to be mounted, additional tubes, preferably radial dispersed over the outline of the surface and/or parallel to the longitudinal axes of the roller may be attached by welding. Preferably for rollers up to lengths of 2500 mm and core diameters of 350 mm, one additional longitudinal air tube is provided, running up to approximately half of the length of the roller face. This air tube is preferably bent into an elbow configuration of approx. 90° and if necessary foreseen of a screw thread.

[0021] In a second embodiment a hollow cylindrical air pressure steel tube, for example outer diameter 6mm, internal diameter 4 mm, thickness 1mm, DIN 2445/2 is welded on the surface of the core. A tube is welded peripheral and after one circular turn around the roller face - bent longitudinal to the axis of the roller and brought as such to the middle of the roller. Arriving at the middle of the roller face this air tube is bent into an elbow configuration of approx. 90° and if necessary foreseen of a screw thread. A closing part with ball bearing inside, closed mechanically by a spring is fixed on this elbow edge.

[0022] Once more, care is taken that the tube extends over the face of the roller in the longitudinal direction of the roller face, such that a small part protrudes. This part will later serve as the air inlet for pressured air. The distance and position of said air channel is measured and memorized, such that drilling of the holes in the air tubes through the cover is possible.

[0023] Subject to the diameter and the length of the roller additional bends of the same tube, welded on the roller face, may be needed. Every position is carefully measured and memorized. For rollers up to a length of 2500 mm and core a diameter of 350 mm one additional longitudinal air tube is applied extending up to approximately half of the length the roller face. When automated the method is able to calculate the number of air channels and to memorize their position.

[0024] The applied covering material is preferably a rubber. The most preferred roller covering method according to the invention can be divided into six stages: metal or core preparation, rubber preparation, rubber application, vulcanization, finishing and inspection.

[0025] The covering may start with either a newly manufactured cylinder roll or a used and optionally covered roller. To ensure adequate adhesion of new rubber a chemically clean and prepared surface is needed. The following steps may be taken:

- determination of the core material; cores can be produced in mild steel, stainless steel, cast iron, aluminum, brass and various plastics. The nature of the material determines the subsequent surface preparation and bonding systems;
- removal of any old covering if present. This may be done by cutting off on a lathe. However this can lead to metal removal and a reduction in core diameter and to avoid this other methods involving techniques such as induction heating or cryogenic cooling may be used;
- degreasing; solvent or vapor degreasing are the normal processes but with reductions in permissible solvent emission levels, aqueous based systems are under investigation. Where a new roll is involved there is usually a need to remove residual oil and grease arising from the manufacturing process. Sweating with steam is the normal method of achieving this removal;
- shot-blasting or abrading the surface to give an adequate structure for bonding;
- application of bonding agents and tie coats by brushing or spraying. Ebonite bonding is still used but has mainly given way to other superior chemical bonding systems.

[0026] The rubber compound to be applied will have been formulated for its end use. It can contain as many as fifteen carefully weighed ingredients from the following material classes: base polymer or blend of polymers, reinforcing fillers, bulk fillers, plasticisers, processing acids, vulcanizing acids, anti-degradants, pigments. The ingredients are mixed together in a controlled order on an open roll mill or in an internal mixer until an homogeneous compound is produced. The compound is then sheeted off and tested to ensure quality. After being approved it moves on to the application stage, preferably in some cases this may involve further processing to produce physical forms suitable for the application to the core. These forms include a calendered sheet, a high quality sheet of even thickness, which is separated by fabric, plastic or coated paper liners and wound onto a mandrel and strips for strip building on the core or for feeding extruders for extruder covering

[0027] The standard process is a simple wrapping of calendered sheet around the core, taking great care to exclude air, until the required thickness is achieved. The process can be carried out on a table, between centres, or on a purpose made building machine.

[0028] Extruders are more commonly used where large numbers of rollers are involved. This may be done using a cross-head machine which extrudes a tube of rubber directly onto the core, or alternatively by the application of an extruded strip onto a rotating core, building up of the required thickness by spiral wrapping. A third approach is to extrude a tube and subsequently fit it to the core.

[0029] Whichever process is used to apply the rubber, some bandaging, which may be fabric or plastic film, is normally applied as soon as possible after application to prevent flow or movement of the rubber prior to or during vulcanization. The bandage may shrink and hence apply pressure to improve consolidation.

[0030] Other processes which may be used to apply a covering are:

- casting: polyurethane materials are commonly supplied as liquid systems, which utilise casting equipment to heat, de-gas, mix and dispense. The prepared core is surrounded by a sheet or machined metal mould, pre-warmed in an oven, filled with mixed polyurethane, and replace in the oven for curing. After cooling the mould is removed and the finishing operations performed;
- moulding: rubber material is formed by compression, transfer or injection moulding around the prepared core which is placed in a solid machined mould. This process is very suitable for smaller, high volume rollers.

[0031] The vulcanization or curing process, which is carried out by heat, effects a chemical change by cross-linking the polymer chains and in doing so it develops the full physical properties of the rubber. It is an irreversible reaction and cured rubber cannot be reprocessed within the factory.

[0032] During the vulcanization the separate layers of rubber also consolidate together to form a homogeneous mass which is bounded to the core.

[0033] Steam is commonly used as the heating medium and vulcanizing vessels or autoclaves may have direct heating, where steam fills the vessels, or indirect heating where no steam contacts the rollers. The latter is used where independent control of pressure, necessary to restrict bubbles in the rubber, and temperature are required. Large rolls require the use of sophisticated control systems to cope with the stepped heating and curing cycles which are necessary to allow adequate heating up of the metal core and the uniform curing of the rubber.

[0034] After vulcanizing the bandage is removed from the roller. For the vast majority of applications, machining operations will be necessary to produce the correct dimensions and surface finish.

[0035] Purpose made machines can be used to trim

or grind the end faces flush with the core and produce a chamfer if required. The face may be trimmed on a lathe or other cutting machine to within a few millimetres of the final diameter which is then ground to a finish.

[0036] A smooth finish may be required. The finished roller is carefully cleaned and inspected against requirements for hardness, surface finish and dimensions. The roller is finally wrapped and packaged to prevent damage in transit.

[0037] Application of bonding agents, tie coats or ebonite bonding is performed by brushing or spraying onto the metal core and air tubes. Once the pressured air tubing system is fixed to the metal roller, the covering material such as rubber or PU is applied.

[0038] The standard process used for rubber compounds is a simple wrapping of calendered sheets around the core and above the tubes. Great care is taken to press the calendered sheets to the core and tube surfaces in order to exclude air.

[0039] This process continues until the required thickness is reached and until the longitudinal and peripheral tubes are completely embedded in the rubber compound. The required thickness depends on the internal diameter of the applied sleeve, which will be airmounted on the covered roller later on. An oversize in diameter/thickness is applied in order to account for shrinkage during the vulcanization process, to allow for a grace zone for finishing and grinding to the required finishing diameter, and in order to grind a circular crib in the rubber compound at the outer edge of the roller face. This crib will have a thickness equal to the thickness of the sleeve, mounted onto the rubber or PUR covered core later on.

[0040] Transfer or injection moulding of the cover compound around the core and tube may be applied as an alternative production process for rubber compound application extrusion.

[0041] Whichever process is used, some bandaging such as fabric, cotton or plastic film is preferably applied as soon as possible after the application of the rubber compound, this in order to prevent flow or movement of the rubber prior to or during vulcanization. The bandage may shrink and hence apply pressure to improve consolidation.

[0042] For PUR compounds casting in machined metal moulds or ribbon flow casting on core and tubes is also available.

[0043] The vulcanization or curing process, which is carried out by heat, affects a chemical change by cross-linking the polymer chains and in doing so it develops the full physical properties of the rubber. It is an irreversible reaction. During this process the separate layers consolidate to form a homogeneous mass, bonded on the core, with the air pressure tubes embedded in this mass.

[0044] The vulcanization process for caster PUR rollers is replaced by a curing process which takes place in electrical furnaces. After vulcanization the bandage, if applied, is removed from the roller. At the sides of the roller face the surplus material, if any, is cut off with a special knife on a turning lathe. The air channels are in general complete embedded with covering material.

[0045] If present, the air tube(s) parts crossing this cutting plane are, at one side of the roller, equally cut off at the same outer length. A screw thread (M5) is again applied and, depending on the working environment of the roller, an inox or yellow brass plug is put onto the air tube, inserting an appropriate O-ring to seal the entirety.

[0046] This will protect the air tubes against possible penetration of liquids, such as water, solvents, acids, bases, inks, ..) during the customer's normal operation.

[0047] The covered roller face is then preferably grinded and trimmed to the required finishing diameter. This is done on a precision grinding lathe, and to a precision of up to 0.02 mm in diameter and cylindricity. The surface is usually made smooth using fine sandpaper.

[0048] At the outer edge across the tube inlets a chamfer is formed by leaving on approximately 1mm of rubber or PUR. This chamfer will help to fixate the sleeve onto the covered core later on, using pressured air.

[0049] Finally, using the measurements and the position memorized during the confection step, a number of generally 4 or more radially dispersed holes are drilled across the rubber or PUR covering into the air pressure tubes through the cover. Several holes may also be drilled in the longitudinal extending air channel.

[0050] These series of radially extending holes are being drilled through the outer covering layer in to the air channels embedded in the covering layer so as to communicate with these latter channels.

[0051] This set of holes will act as pressured air channels when airmounting or airdemounting a sleeve onto or off from the covered roller.

[0052] If necessary, flanges and shoulders across the roller face are also covered with rubber compounds or PUR during the confectioning process. This allows protection of the entire roller body against infiltration of aggressive media, e.g. acids or bases, which could be present at the customer's normal working conditions.

[0053] Pressured air upto 20 bar is supplied preferably via a reducer, preferably a needle valve and the inlet (s) of the air channels. Plugs screwed onto the air inlets of the air transport system embedded in the covered roller, are removed and replaced by an air supply connection piece, which is screwed herein.The pressured air is transported through the air tube system and is forced out again via the drilled holes.

[0054] This allows to slide a sleeve of for example glass fiber reinforced, carbon, nickel, PUR foam with hard top layer, etc. over the covered roller core, via the formation of a thin air film between the two elements expanding the diameter of the sleeve during mounting.

[0055] In an alternative version, when pushing the sleeve over the covered metal core, the sleeve will push the ball bearing down onto the spring, allowing air to escape onto the roller face. This again produces a thin air

film between covered roller face and sleeve, allowing to easily slide the sleeve over the total length of the core.

[0056] By cutting off the supply of pressured air the sleeve shrinks slightly and fixes itself tightly around the covered core (principle of airmounting). The sleeve itself may be covered with the final covering, such as rubber compound or PUR, which may be completely different from the compound applied onto the roller core, which cover is irrelevant for the understanding of the present invention.

[0057] In a preferred embodiment the pressured air is supplied by a booster regulator, such as the type VBA 1110-F02GN.

Brief description of the invention

[0058] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate several embodiments of the invention and, together with the description, serve to explain the principles of the invention.

Figure 1 is a cross sectional view along a longitudinal axis of a roller according to an embodiment of the invention with an enlarged detail;
Figure 2 is a cross sectional view along the line II-II of figure 1; and

Detailed description of the figures

[0059] Reference will now be made in detail to the presently preferred embodiments of the invention, one or more examples of which are illustrated in the accompanying drawings. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention.

[0060] The present invention is especially desired for used rollers, which are being recovered by applying the present method.

[0061] Figure 1 shows a roller 6 in cross-sectional view along a longitudinal axis 7. Roller 6 consist essentially of a cylindrical body part 8 and two side flanges 9 forming a closed cylindrical housing through which a support axe 10 protrudes. Several air channel tubes 4 are provided. These tubes are firmly attached e.g. welded on the cylindrical body part 8 of the roller 6. The air channel tubes 4 can extend in the longitudinal direction such as the longitudinal air channel 15 and along the periphery such as the ring-shaped air channel 16. Fig 2 is a cross section taken along II-II trhough the peripheral ring-shaped air channel 16.

[0062] When a covering material 5 is applied (e.g. via curing or vulcanization of a rubber material) on the roller 6, it will embed and cover these air channels 4 (15 and 16), with the exception of a small part, which will constitute the air inlet 12. The position of these covered tubes is memorized such that the blind drilling of holes is possible.

[0063] The thickness of the covering material layer 3, is chosen such that it is able to house in a sleeve 2. On said sleeve 2 a functional layer 1 is provided, for example a rubber lining etched with an image or a printing plate. The choice of covering material is such that it will last in the process or working environment wherein it is used for a substantial time period. In general, the roller 6 is made out of steel or other metal alloys. When also the side flanges 9 are covered, the material of the roller 6 will be totally protected against corrosion and other wear.

[0064] In order to co-axial concentric mount a sleeve 2 on the metal support cylinder roller 6 pressured air is provided on the internal surface of said sleeve 2. Said pressured air is delivered from a pump or a pressure booster via the air channels 4 and the holes 14, which act as air nozzles onto the inner surface of the sleeve 2. Due to the high pressure a small air film will result in a small increase of the diameter of the sleeve 2. This increase is only temporarily, during the mounting or the removal of said sleeve 2. The outlet means for the pressured air are holes 14 which have been drilled through the covering material 5 communicating with the air supply channel 4. It is also possible to provide an open elbow part 11 protruding through the covering material 5. In general, a set of holes 14 is drilled in a radial direction once the polymer has been vulcanized or cured. Four radially extending holes 14 are provided in the peripheral ring shaped air channel 16.

[0065] When applying the method of the invention care needs to be taken in order to identify the place and position where air channels are attached underneath the covering material. Once the sleeve 2 is aligned on the roller 6 a plug 13 is provided on the air channel inlet 12. Pressured air needs only to be provided during a small time period when mounting or demounting is performed. Preferably the peripheral air ring shaped channel 16 is provided in the first section. In first instance the sleeve 2 will pass through this peripheral air channel such that an extension of the diameter is provided on this position (airmounting will be in the direction from right to left in figure 1).

[0066] The above defined embodiments are non-limitative for the scope of the invention which is defined in terms of the claims.

Claims

1. A method for covering a roller having substantially a cylindrical outer surface and a longitudinal axis, with a covering material such as an elastomer e.g. rubber or polyurethane, comprising the steps of:

   - optionally removing of any old covering materi-

al,

- attaching at least an air channel on the outer face of the roller, such that at least an end of said air channel is able to be connected to an air supply,
- optionally cleaning the attached air channels and outer surface of the roller,
- applying one or more bonding agents to said air channels and outer surface,
- applying the elastomer on the outer surface of the roller such that at least the attached parts of the air channel are covered with said elastomer,
- allowing vulcanisation or curing of the elastomer, and
- performing a finishing step of the covered roller.

2. A method according to claim 1, further comprising the step of providing holes through the covering material extending in to the covered air channel.

3. A method according to claim 2, wherein said holes are drilled in the covering in the radial direction of the roller.

4. A method according to any of the previous claims 1, 2 or 3, wherein said air channel extends in the longitudinal direction of the roller.

5. A method according to any of the previous claims 1-4, wherein said or another air channel extends peripherally, and is preferably ring-shaped.

6. A method according to any of the previous claims 1-5, wherein one end of the air channel is bent, preferably bent radial outwardly able to protrude the covering material in the finished roller.

7. A covered roller obtainable according to any of the previous claims 1-6.

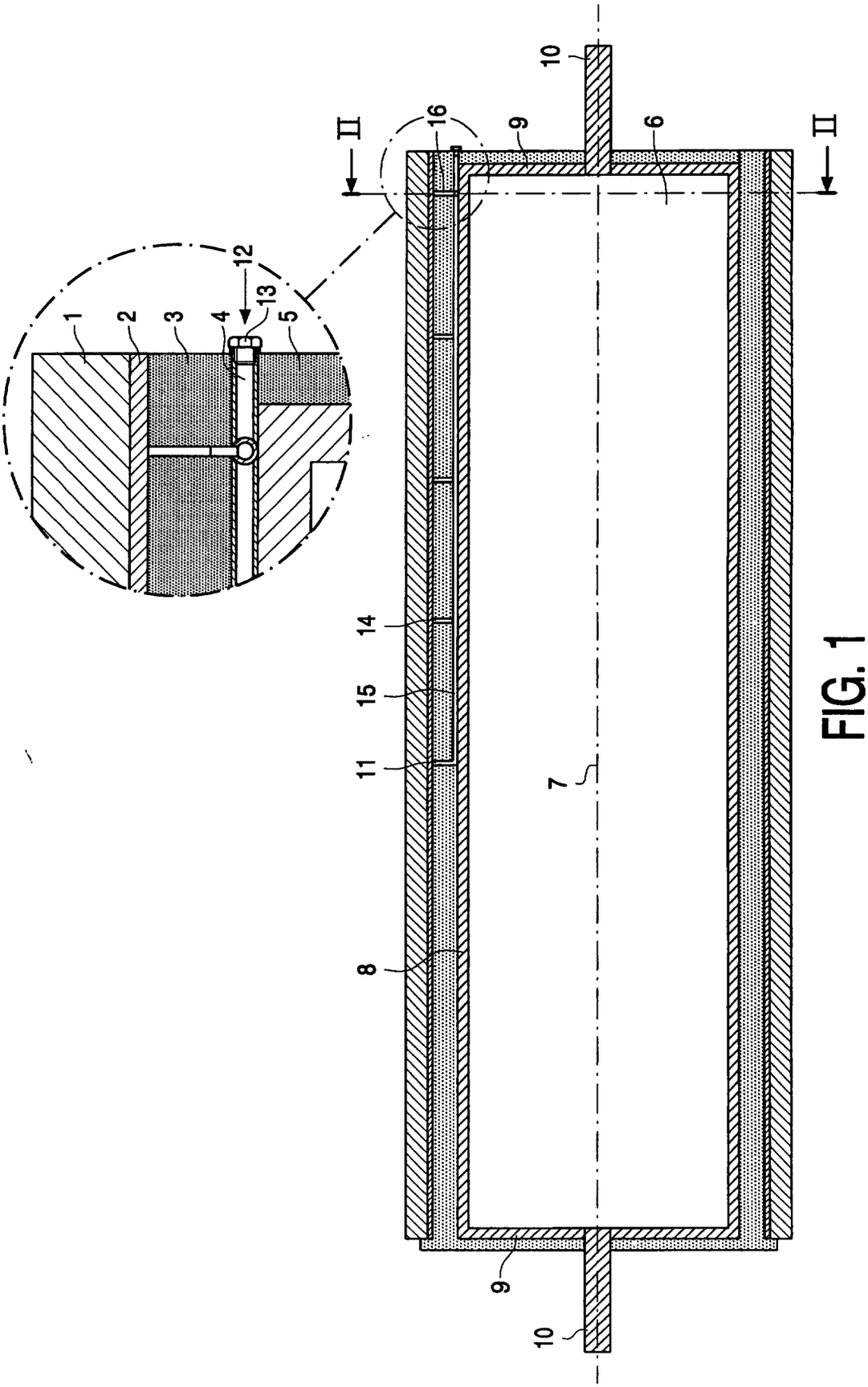

FIG. 1

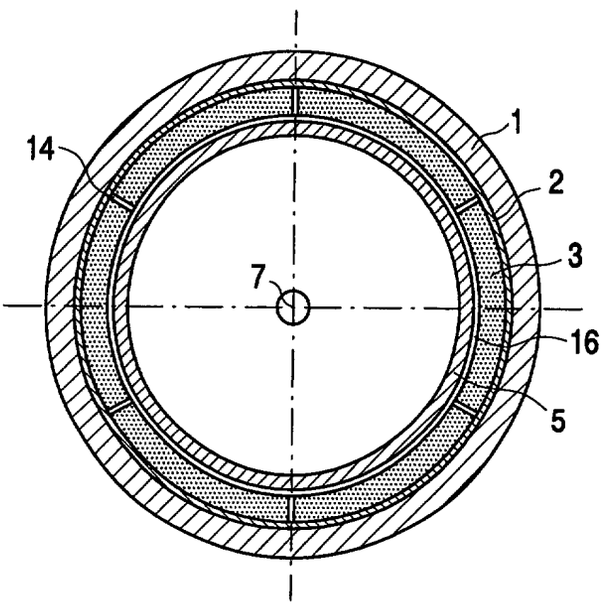

FIG. 2

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 01 87 0020

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	EP 0 076 777 A (HERLITZ) 13 April 1983 (1983-04-13) ---		B41F27/10
A	DE 199 18 432 A (SAUERESSIG) 26 October 2000 (2000-10-26) -----		

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

B41F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 July 2001	Loncke, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 01 87 0020

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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17-07-2001

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82