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(54) **METHOD AND MACHINE FOR PRODUCING A TUBULAR ELEMENT TO ACOUSTICALLY AND/OR THERMALLY INSULATE A COMPONENT OF A MOTOR VEHICLE**

VERFAHREN UND MASCHINE ZUR HERSTELLUNG EINES RÖHRENFÖRMIGEN ELEMENTS ZUR SCHALL- UND/ODER WÄRMEISOLIERUNG EINER KOMPONENTE EINES KRAFTFAHRZEUGS

PROCÉDÉ ET MACHINE POUR LA PRODUCTION D'UN ÉLÉMENT TUBULAIRE AFIN D'ISOLER ACOUSTIQUEMENT ET/OU THERMIQUEMENT UN COMPOSANT D'UN VÉHICULE MOTORISÉ

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Description

TECHNICAL FIELD

[0001] The present invention relates to a method and to a machine for producing a tubular element structured to be inserted/fitted in a component of a vehicle provided with an internal combustion engine so as to acoustically and/or thermally insulate said component.

[0002] In particular, the present invention relates to a method and to a machine for producing a sound-deadening and/or thermally insulating insert or tubular element that can be installed in a component of an internal combustion engine and/or in an exhaust system of a vehicle such as a car, a motor vehicle or the like; to which the following description specifically refers but without any loss of generality.

BACKGROUND ART

[0003] As is known, silencers in exhaust systems of motor vehicles define a stretch of the exhaust path along which the noise produced by the pressure waves of the exhaust gases emitted by the engine is attenuated. The silencer typically comprises an outer metal containment shell or casing, one or more ducts and/or metal diaphragms arranged within the casing and through which, in use, the exhaust gases flow, and a tubular element made of sound-deadening material, typically mineral fibres, which is generally fitted on the ducts, within the chamber, so as to attenuate the transmission of noise.

[0004] The tubular element generally comprises a reel or skein of wound fibres, which are resin-bonded, i.e., they are impregnated with consolidating resins and/or amalgams and then heat-set so as to be joined/compacted together to give the tubular element enough consistency to prevent the fibres from opening up when being fitted/installed on the duct to be acoustically insulated. The use of consolidating resins and amalgams to stiffen the tubular element is however inconvenient in that, in use, they are broken down and fragmented due to the high temperatures of the exhaust gases in the silencer, and therefore tend to be expelled through the exhaust system with undesirable consequences in terms of environmental pollution. In particular, the decomposition/fragmentation of the resins/amalgams causes, on the one hand, a gradual flaking and weakening of the fibres which reduces the sound-deadening capacity of the tubular element, and on the other, the expulsion of the fibres from the silencer.

[0005] WO2014017696 describes a method for producing a seamless tubular sleeve having no limitations in length, which is designed to be installed in ducts/conduits of industrial installations to repatir the latter. The method comprises the step of providing a thin compact layer made of non-woven fabric material, previously carded and pressed, similar to felt, having a certain width. The method further comprises the step of continuously feeding the layer to a threaded drum so as to wind it tangentially around the threaded surface thereof in such a way as to obtain, during the winding, adjacent side edges overlapping one another in a helical winding. The method also envisages imparting a roto-translational motion to the tubular layer around and along the longitudinal axis of the threaded drum via a pair of driving drums which are arranged adjacent to the threaded drum, and actuating a needle support head to join the overlapping edges of the wound layer as it advances along the threaded drum.

[0006] Likewise, US 3,758,926 discloses a method for producing a continuous longitudinal tubular sleeve in non-woven fabric material. The method comprises the steps of: providing a thin compact layer made of non-woven fabric material previously carded and pressed, substantially similar to felt, having a certain width, continuously feeding the layer to a rotary drum to wind the layer on the outer surface thereof, and axially moving the helically wound layer along the longitudinal axis of the rotary drum, so as to make the lateral edges thereof overlap in pairs. The method further comprises the step of needling the layer so as to mutually attach the overlapping side edges.

[0007] The methods described above produce tubular sleeves obtained from a layer that on one side are designed for protecting industrial plant pipes but on the other side are completely unsuitable to be mounted in silencers of exhaust systems of motor vehicles. In fact, the carded and pressed discontinuous short fibres that make up the layer quickly tend to disjoint on to the other when subjected to the high temperatures/pressures produced by the exhaust gases flowing through the silencer. The disjointing of the fibres, apart from causing a gradual deterioration of the efficiency of the silencer, also cause the fibers to be discharged through the vehicle exhaust system with evident problems in terms of environmental pollution.

[0008] Moreover, US 4,071,394 discloses a method for manufacturing a tubular filter designed to remove gel particles or unmilled paint particles thereform. In detail, the tubular filter is made by non-woven web comprising very short fibers made by rayon or darcon, randomly oriented. The rayon/darcon fibers of the filter made as disclosed in US 4,071,394 are completely unsuitable to be used in a silencer of motor vehicle because are higly polluting when subjected to the high temperatures of exhaust gas.

[0009] Furthermore, US 4,454,637 discloses a method for the production of a velour needlfelt unsuitable to be used in a silencer of motor vehicle.

DISCLOSURE OF INVENTION

[0010] The Applicant has conducted an in-depth study with the purpose to find a solution that would achieve the aim of producing, in a simple and economical manner, a sound-deadening and/or thermally insulating semi-rigid tubular element that is structured to be inserted/fitted in

a component of a vehicle provided with an internal combustion engine, and that does not contain any consolidating amalgam and/or resins, and therefore does not require any heat-setting operations.

[0011] This aim is achieved by the present invention in that it relates to a method for producing a tubular element that can be installed in a component of a vehicle provided with an internal combustion engine to acoustically and/or thermally insulate said component, according to claim 1 and the relevant dependent claims.

[0012] The present invention also relates to a machine for producing a tubular element that can be installed in a component of a vehicle provided with an internal combustion engine to acoustically and/or thermally insulate said component, according to claim 11 and the relevant dependent claims.

[0013] Preferably, the machine comprises movement means for alternately moving a needle support head along a rectilinear direction parallel to the punching needles towards and away from the tubular fibre skein so that the punching needles pass radially through said skein and needle the fibres. Preferably, the machine comprises a plurality of needle support heads angularly spaced about the longitudinal reference axis. Preferably, the machine comprises movement means which rotate the needle support heads about the longitudinal reference axis. Preferably, the machine comprises driving means designed to rotate the tubular fibre skein about said longitudinal reference axis. Preferably, the support means comprise a shaft extending parallel to said longitudinal reference axis and on which said tubular skein is mounted. Preferably, the shaft has a plurality of apertures through which, in use, said penetrating means can pass. Preferably, the driving means comprise a conveyor belt that has a surface section in contact with the outer surface of the skein on the side opposite to said shaft, and a belt driving device, which is designed to advance the belt so that the tubular skein slides/rolls on the shaft outer surface so as to rotate about said longitudinal axis. Preferably, the machine comprises means for rotating the shaft about said axis so as to cause the rotation of the tubular skein. Preferably, the machine comprises a nozzle support head provided with one or more nozzles designed to emit jets of water and/or air directed towards the tubular fibre skein, so as to pass through the fibres; the penetrating means comprising said jets of water or air.

[0014] The present invention also relates to a sound-deadening and/or thermally insulating tubular element structured according to claim 14. Preferably, the needling sections extend seamlessly between the opposite ends of the skein of continuous fibres. Preferably, the needling sections are angularly spaced in relation to one another about the longitudinal axis of the skein. Preferably, the needling sections are arranged parallel and adjacent to one another and close together around the entire skein so as to cover the entire surface thereof. Preferably, the needling sections are arranged parallel and adjacent to one another around the segment or portion of the skein. Preferably the tubular element is used/comprised in a heat shield. Preferably the tubular element is used/comprised in an exhaust system of the motor vehicle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] The present invention will now be described with reference to the accompanying drawings, which illustrate a non-limiting embodiment thereof, in which:

- Figure 1 is a perspective schematic view, with parts shown on an enlarged scale for the sake of clarity, of a sound-deadening and/or thermally insulating tubular element according to the present invention;
- Figure 2 schematically shows a longitudinal section of a portion of the exhaust gas system of an internal combustion engine of a vehicle comprising a silencer provided with the tubular element shown in Figure 1;
- Figure 3 is a cross-section of the portion of the exhaust system shown, in turn, in a cross-sectional view in Figure 2;
- Figures 4 and 5 are two perspective schematic views of two corresponding operating steps of the method for producing the tubular element shown in Figure 1, according to the present invention;
- Figures 6 to 9 are respective side elevation layout views, with parts removed for the sake of clarity, of the sequence of the operating steps of the method according to the present invention;
- Figure 10 is a perspective schematic view of a machine for producing the tubular element shown in Figure 1 according to the present invention;
- Figure 11 is front side schematic view of the machine shown in Figure 10;
- Figure 12 is a plan view of a detail of the machine shown in Figure 10, with parts shown in cross-section, parts removed for the sake of clarity, and parts shown on an enlarged scale;
- Figure 13 schematically shows an alternative embodiment of the machine according to the present invention;
- Figures 14 and 15 show examples of possible shapes of the tubular element that can be produced according to the present invention;
- Figures 16 and 17 show two possible alternative embodiments of the skein support shaft used by the method according to the present invention; and
- Figure 18 shows an example of a tubular element comprised in a vehicle heat shield.

BEST MODE FOR CARRYING OUT THE INVENTION

[0016] The present invention will now be described with reference to the accompanying figures in sufficient detail for those skilled in the art to produce and use it. Persons skilled in the art will be able to implement various modifications to the embodiments described herein and the general principles disclosed herein could be applied

to other embodiments and applications without departing from the scope of the present invention, as disclosed in the appended claims. Accordingly, the present invent is not to be limited in scope to the embodiments described and illustrated herein, but is to be accorded with the widest scope consistent with the principles and characteristics disclosed and claimed herein.

[0017] With reference to Figure 1, number 1 indicates as a whole a semi-rigid tubular insert or element made of continuous fibre, that is structured to acoustically and/or thermally insulate a component of a vehicle provided with an internal combustion engine.

[0018] It is understood that the tubular element to which the present invention refers, although composed of continuous fibres that are wound, twisted or needled together so as to form a skein and contain no resin and/or amalgam to hold the fibres together, has, thanks to the method described below, a high level of compactness/mechanical cohesion between the fibres which makes it possible to achieve a substantially semi-rigid and self-supporting fibrous tubular structure, capable of maintaining its tubular shape without collapsing/flattening itself out.

[0019] It is also understood that "component" means any substantially cylindrical or similarly shaped element/part of the vehicle on which the tubular element 1 may be fitted to thermally and/or acoustically insulate said part. For example the component may be comprised in the silencer or in the exhaust system or in the engine, or in the engine compartment or in the fuel tank.

[0020] According to the embodiment shown in Figures 1 and 2, the tubular element 1 is structured to be fitted/inserted in pipes, perforated tubular walls, ducts/exhaust conduits 3 in, connected to or passing through a chamber 2a of a silencer 2 of an exhaust gas system of an internal combustion engine of a vehicle so as to attenuate the noise/heat associated with the gas passing therethrough. It should be understood that the tubular element 1 may perform the sound-deadening/thermal insulation function independently, i.e. without the aid of additional external elements, or may cooperate with additional outer shells/casings for example to carry out the "resonator" function in the exhaust gas system.

[0021] It should also be added that the tubular element 1 may be comprised in a heat shield for externally lining an exhaust system duct 3. In this case the tubular element 1 may be interposed between an outer protection plate or shell or monocoque and the outer surface of the duct to be insulated. For example, as shown in the example in Figure 18, a heat shield 50 may comprise at least a protective outer monocoque 51 made of a rigid material, for example metal, shaped so as to cover/line at least an outer surface portion or section 52 of a component, preferably, but not necessarily, in the form of a duct 53 of the exhaust system, and at least one tubular element 1 that, fitted on the outer surface portion 52 of the duct 53 below the shell 51 so as to thermally and/or acoustically insulate the latter with respect to the duct 53 below. It is understood that, according to alternative embodiments, the heat shield could be used to thermally insulate a component arranged for example in the engine or the engine compartment or the fuel tank or the like.

[0022] According to a preferred embodiment shown in Figures 1 and 2, the tubular element 1 comprises a semi-rigid reel or skein M formed by continuous fibres F wound around a longitudinal axis A, so as to form adjacent turns which in turn form an overall tubular body, substantially corresponding to a sleeve extending along the axis A. The skein M has a cross-section that is preferably, but not necessarily, circular and has a predetermined diameter, preferably, but not necessarily, constant along the axis A. It is understood that the shape/size of the skein M are not limited to those of the skein M of the tubular element 1 illustrated in the example of Figures 1 and 2, but may be different. For example the shape/size of the skein M may be modified according to the shape of the component, preferably the duct on which it is fitted and/or the inner shape of the chamber 2a that accommodates it. For example, according to the alternative embodiments shown in Figures 14 and 15, the inside/outside diameter of the semi-rigid tubular skein M may vary along the axis A, for example, it may gradually decrease or increase, while the skein M may be provided with one or more truncated and/or cylindrical and/or spherical portions having different outside/inside diameters.

[0023] The continuous fibres F that form the semi-rigid skein M preferably comprise mineral fibres woven/needled together by means of the method that will be described in detail below.

[0024] It is understood that in the present description continuous fibre means a fibre having a length such as to form a plurality of wound and adjacent turns of the skein M. For a merely descriptive but not limiting purpose, a continuous fibre may preferably have a length of more than about 30 cm.

[0025] Preferably, the continuous fibres F may be volumized and/or textured. The fibres F may comprise any type of mineral fibre that is designed to attenuate the transmission of the noise/heat produced by the exhaust gases passing through the ducts 3. Preferably, the continuous fibres F may comprise, for example, glass fibres, basalt fibres, silica fibres, or any other similar type of mineral fibre having sound-deadening and/or thermal insulation properties that can be installed preferably in a silencer 2.

[0026] Alternatively or in addition to the types described above, the fibres F may conveniently comprise continuous fibres of synthetic material containing polystyrene and/or polypropylene and/or polyamide and/or Kevlar and/or carbon and/or aramid and/or cotton and/or any other type of similar synthetic material.

[0027] Alternatively or in addition to the types described above, the fibres F may conveniently comprise continuous metal fibres, preferably steel, for example stainless steel. Preferably the metal fibres may have a thickness comprised between approximately 6 and 400

micron. It is understood that the tubular element 1 may comprise one or more of the types of fibres described above.

[0028] With reference to Figures 7, 8, the tubular element 1 has one or more needling/weaving line portions T extending on the surface of the reel/skein M, parallel to one another and to the longitudinal axis A. Preferably, each line portions T extends seamlessly between the opposite distal ends of the skein M. Preferably, the line portions T are angularly spaced with respect to one another about the longitudinal axis A along the entire circumference of the skein M, so that it is completely needled on its entire surface. Preferably the line portions T are arranged adjacent and close to one another.

[0029] With reference to Figures 4 to 9, the operating steps of the method to produce the tubular element 1 according to the present invention will now be described. With reference to Figures 4 and 6, the method consists of providing a support element having an elongated shape, designed to support the skein M of continuous fibres F forming the tubular body.

[0030] According to a possible embodiment illustrated by way of example in Figures 4 and 5, the support element may comprise a shaft 10, extending along a longitudinal axis B, whereas the fibres F are wound around the shaft 10 so as to cross/overlap to form the turns of the skein M, which in turn has its longitudinal axis A coaxial to the longitudinal axis B of the shaft 10. In particular, the skein M is wound/fitted in the shaft 10 so as to remain axially fixed in relation to the shaft 10 during the rotation thereof. In this case, the skein M is wound around the shaft 10 so as to remain, during the rotation of the shaft 10, in a fixed axial position along the axis B so that its turns of continuous fibre do not undergo any axial displacement, but remain compactly wound and substantially stable in the respective initial axial positions. It should be noted that the maintenance of the skein M in the fixed axial position advantageously prevents the turns from disjointing one to the other, during the process. In this connection it should be noted that the methods described in WO2014017696 and US 3,758,926 are designed for winding compact layers of discontinuous fibres that, because they have been pressed and carded, are not likely to disjoint during the axial displacement of the wound tubular body, but are rather unsuitable when using reels of "continuous" fibres wound in turns as the axial displacements cause flaking of the reel, which is therefore of no use.

[0031] According to a preferred embodiment described by way of example, the shaft 10 may have an elongated cylindrical shape and a plurality of apertures 11 comprising, for example, radial holes, preferably blind. It is understood that the cross-section of the shaft 10 may be circular or elliptical, square, rectangular or similar, and thus modifiable according to the shape of the element 1 to be produced.

[0032] As for the apertures 11, according to a possible embodiment shown in Figures 4 and 5, these may be distributed on the body of the shaft 10 one after the other and a certain distance apart on a directrix, preferably equidistantly spaced, to form straight lines, parallel to one another and to the axis B. It is understood that the present invention is not limited to the distribution of the apertures 11 in a straight line as shown in Figures 4 and 5.

[0033] According to an alternative embodiment (not shown), the apertures 11 may be obtained in the shaft 10 so as to form a plurality of discontinuous longitudinal adjacent and angularly staggered sections. Furthermore, it is understood that the present invention is not limited to apertures in the form of blind holes, as shown in Figures 4 and 5, and according to an alternative embodiment it may comprise one or more narrow elongated grooves (about 3 mm wide) obtained in the outer surface of the shaft 10 so as to extend along the generatrices of the cylindrical surface of said shaft 10. Additionally, the present invention is not limited to a solid cylindrical shaft 10, and according to an alternative embodiment (not shown) it may comprise a tubular shaft provided with through apertures 11. According to an alternative embodiment illustrated by way of example in Figure 16, the shaft 10 may be different from a cylindrical body and comprise a profile having a polygonal cross-section, for example star-shaped, having a plurality of longitudinal side seats extending in straight lines and parallel to the axis B. According to another alternative embodiment illustrated by way of example in Figure 17, the shaft 10 may be provided with a series of supporting bars/rods arranged parallel to one another and angularly spaced about the axis B, so as to delimit the longitudinal through apertures 10.

[0034] With reference to Figures 4-9, the method also comprises the arrangement of penetrating elements structured so that, in use, they pass radially through the continuous fibres F of the skein M so as to twist them together at the penetration/crossing points, the arrangement of the penetrating elements in a position immediately adjacent to the shaft 10 and facing the tubular skein M wound around the shaft 10 (Figure 4), and the operation of the penetrating elements so that they penetrate the skein M radially and locally join/connect the fibres F along one or more longitudinal sections T, so as to stiffen/compact the tubular skein M at said line portions T.

[0035] According to a preferred embodiment illustrated by way of example in Figures 4 and 5, the penetrating elements comprise a plurality of punching needles 12, which extend orthogonally to the axis B, parallel to one another. In the example shown, the punching needles 12 may be arranged next to one another, preferably equally spaced, so as to form at least one row of needles lying on a plane parallel to the axis B. In the example shown in Figures 4 and 5, the punching needles 12 protrude from a needle support head 14 parallel to one another and perpendicular to the axis B.

[0036] According to a preferred embodiment illustrated by way of example in Figures 6-9, the method comprises the step of making the needle support head 14, and thus

the punching needles 12, move alternately from and towards the shaft 10 along a direction D orthogonal to the axis A and parallel to said punching needles 12, so that the punching needles 12 pass through the tubular skein M and form needling line portions T on said skein M.

[0037] It is understood that the term punching needle means a needle provided with a series of pointed and/or hooked or saw tooth-shaped side projections shaped so as to locally pull some fibres to make them penetrate into other adjacent fibres, compacting and/or weaving them together (Figure 12). The term "needling" refers to a purely mechanical operation whereby the punching needles 12 are moved alternately in the direction D parallel to said punching needles 12 and substantially transverse with respect to the fibres F, during which the punching needles 12 move the fibres F by means of their projecting parts, so as to cross/twist/overlap them and form a web of compact fibres, structurally similar to a fabric.

[0038] With reference to Figures 7, 8 and 9, the method also comprises the phase of rotating the tubular skein M around the axis B, with respect to the punching needles 12, or vice versa, keeping the tubular skein M in an axially fixed position relative to the shaft 10 along the axis B.

[0039] According to a possible embodiment, the skein M is rotated about the axis B, with respect to the punching needles 12.

[0040] According to a preferred embodiment illustrated by way of example in Figures 4-9, the skein M may be mounted idle on the shaft 10 so as to slip/slide freely on the outer surface thereof, remaining in an axially fixed position along the axis B, whereas the method may envisage maintaining the shaft 10 in an angularly fixed position and making the skein M rotate about the axis B by means of advancing means 13. According to a preferred embodiment described by way of example, the advancing means 13 may comprise a conveyor belt 28 with at least a superficial portion or section that is locally tangent to the skein M and in contact therewith. It is understood that the advancing means 13 are not limited to the conveyor belt 28 described above, but may alternatively and/or in addition comprise other means capable of performing the same function of advancing the skein M, such as one or more rollers/rotating disks placed adjacent to the shaft 10 and parallel to the axis B, so as to be at a tangent to the skein M.

[0041] Preferably, the conveyor belt 28 and the skein M may be of the same width.

[0042] According to an alternative embodiment (not shown) the advancing means 13 comprise the shaft 10 which rotates, while the skein M is angularly integral with the shaft 10, so as to be made to rotate thereby. For example, the skein M and the shaft 10 may be angularly fixed/stationary relative to one another, while the punching needles 12 are mounted in one or more needle support heads 14, angularly spaced from one another with respect to the axis B, and the method may comprise the step of rotating the needle support head(s) about the axis B, i.e. around the skein M, so as to make the punching needles 12 penetrate the skein M in a series of predetermined angular positions.

[0043] According to an alternative embodiment, the machine 20 comprises a plurality of needle support heads 14, which are angularly spaced with respect to one another around the axis B so that the punching needles 12 face towards the skein M. In use, the needle support heads 14 are angularly fixed with respect to the skein M and are moved in corresponding straight directions orthogonal to the axis B so as to perform a reciprocating motion towards and from the skein M, so that the punching needles 12 penetrate the skein M radially.

[0044] With reference to Figures 10 and 11, a preferred embodiment of a machine 20 for carrying out the method to produce the tubular element 1 will now be described. The machine 20 comprises: a support frame 21 designed to be placed on the ground, a spindle 22 arranged above the frame 21 and connected thereto by means of a vertical extension/pillar, and the shaft 10 supporting the skein M which protrudes from the spindle 22 above the frame 21 and is arranged so that the axis B is preferably horizontal. In the example shown, the shaft 10 is an elongated cylinder (as in the example, the tubular element 1 to be obtained has a cylindrical shape), and is provided on one side with a row of through apertures 11 lying on a horizontal plane. The shaft 10 may conveniently be mechanically coupled to the spindle 22 in a permanent but easily detachable manner, so that it can easily be coupled/uncoupled. Thus, in use, the shaft 10 can be conveniently removed from the spindle 22 and mounted on a rotating spindle of a winding machine (not shown) suitable for unwinding the continuous fibre from one reel and winding it on the shaft 10 to produce the wound turns forming the reel/skein M.

[0045] The machine 20 further comprises the needle support head 14 that is arranged above the supporting frame 21 in a position facing the side of the shaft 10 provided with the apertures 11, and a movement device 23 for moving the needle support head 14 along a direction D, from and towards the shaft 10 with a reciprocating motion, so that the punching needles 12 move repeatedly between a resting position in which the punching needles 12 are completely extracted from the skein (Figure 7), and a needling position (Figure 6, on the right in the drawing) in which they penetrate into the skein M so as to protrude into the apertures 11 of the shaft 10, and vice versa.

[0046] According to a preferred embodiment shown in Figures 10 and 11, the needle support head 14 is slidingly mounted on one or more straight guides 24 which are placed on the top plane of the frame 21, preferably below the shaft 11 and extending on said plane along a direction that is parallel to the direction D, while the movement device 23 may comprise a power unit for example, an electric motor controlled by an electronic control unit 25, and a motion transmission member 26 designed to transform the rotary motion of the electric motor shaft into linear motion and may comprise, for example, a crankshaft

mechanism connected at one side to the drive shaft and at the other to the needle support head 14, so as to make it slide, in use, on the guides 24 towards and from the shaft 10 along the direction D.

[0047] According to a preferred embodiment shown in figures 4, 5, 10 and 11, the machine 10 also includes a perforated sheller plate 27, which is interposed between the needle support head 14 and the shaft 10, and is structured to uncouple, in use, the fibres F held/moved by the punching needles 12 during their motion to the resting position. In the example shown, the perforated plate 27 extends parallel to the axis B so as to face the apertures 11 in the shaft 10, and has in turn a plurality of through apertures aligned axially with both the apertures 11 in the shaft 10 and the punching needles 12 so that it can be crossed thereby. Preferably, the machine 10 may be provided with a movement device (not shown) designed to move the perforated plate 27, preferably along a horizontal direction, towards and from the shaft 10 between an operating position where the perforated plate 27 is substantially in contact with the skein M in correspondence with the apertures 11 (Figure 5), and a resting position in which the perforated plate 27 is moved away from the shaft 10 and thus from the skein M (Figure 4).

[0048] According to a preferred embodiment shown in Figures 10 and 11, the machine 10 further comprises the driving element 13 that is designed to pull the skein M around the axis B, keeping it axially fixed along said axis B, and in the example shown, comprises the belt 28 which is arranged on one side of the shaft 10, on the opposite side in relation to the needle support head 14. The belt 28 is wound around a series of rollers 30 so as to form a closed ring, one section of which is tangential to the shaft 10. At least one of the rollers 30 is a driving roller and is mechanically connected to a power unit, such as an electric motor shaft, so as to be made to rotate about an axis parallel to the axis B. The two idle rollers 30 may be arranged above or below the shaft 10 so that the two respective axes of rotation are parallel to the axis B and surrounded by the advancing section that envelops them and at least partially comes into contact with the shaft surface 10 opposite the apertures 11. In the example shown the two idle rollers 30 lie on a vertical plane of the axis B, and in use keep the advancing section stretched and wound around a surface portion of the skein M.

[0049] In use, the skein M is arranged on the shaft 10. It should be specified that the machine 20 might be provided with a mechanism (not shown) able to unwind a fibre reel (not shown), in a controlled way, and simultaneously rotate the spindle 22 so as to wind the fibre F around the shaft 10 and form the skein M thereupon.

[0050] The electronic control unit 25 controls the operation of the advancing unit 13 so as to advance the belt 28 that, since it comes into contact with the skein M, causes said skein M to rotate about the axis B keeping it axially fixed. In other words, the belt 28 rotates the skein M about the axis B keeping the turns in the initial axial position so as to conveniently prevent any flaking of the reel.

[0051] The electronic control unit 25 also operates the movement means 23 synchronously with the advancing unit 13 so as to move the needle support head 14 and make the punching needles 12 intermittently penetrate the skein M, in order to form the needling sections T thereon. It should be specified that the speed of rotation of the skein M and the travel speed of needle support head 14 are determined in such a way as to prevent damage to the punching needles 12 by the rotating skein M. In particular, the needle support head 14 is moved at high speed compared to the speed of rotation of the skein M, so that the penetration/extraction of the punching needles 12 in the skein M is completed in a fraction of a second to allow the skein M to be rotated continuously. According to an alternative embodiment, the method can clearly perform the rotation of the skein M intermittently, that is in a stepwise manner.

[0052] After completion of needling, the tubular element 1 thus obtained is removed from the shaft 10 and then fitted on the silencer duct 2.

[0053] It is thus demonstrated that the present invention achieves the aforesaid aims. It should be added that the method is extremely convenient in terms of energy saving as it does not require any heat-setting operations.

[0054] The embodiment shown in Figure 13 regards a machine 30, that is similar to the machine 20, the component parts of which will be identified, wherever possible, with the same reference numbers used to denote corresponding parts of the machine 20. The machine 30 differs from the machine 20 in that, instead of having a needle support head 14 and punching needles 12, it is provided with a nozzle support head 31 and a plurality of nozzles 32 designed to emit, upon a command, jets of pressurized air or water 35 directed towards the shaft 10 so as to penetrate into the skein M of fibres. For example, the nozzles 32 may be connected to a pressurized air/water generating system 33, via a duct 39 structured to deliver pressurized air/water to said nozzles 32. In use, the jets of pressurized water/air 35 generated by the nozzles 32 penetrate radially into the skein M and impart on the fibres crossed radial displacements that weave/twist the fibres F together, so as compact them and stiffen the skein M.

Claims

1. A method for producing a tubular element (1) (60) designed to be installed in a component of a vehicle provided with an internal combustion engine to acoustically and/or thermally insulate said component; said method comprises the step of providing support means (10) which extend along a longitudinal reference axis (B);
said method being **characterized in**:

- providing on said support means (10) a tubular

fibre skein (M) having its longitudinal axis (A) parallel to said longitudinal reference axis (B) and comprising continuous fibres (F) in a material designed to reduce the transmission of the noise/heat produced in said component of said vehicle; said continuous fibres (F) are wound about said support means (10) so as to form adjacent turns, which form a tubular body;
- arranging, in a position adjacent to said tubular fibre skein (M), penetrating means (12) (35) structured to penetrate through the fibres (F) of said tubular fibre skein (M) ;
- operating driving means so as to rotate said tubular fibre skein (M) about said longitudinal axis (B) and to keep, during the rotation, the tubular fibre skein (M) in an axially fixed position with respect to said support means (10) along said longitudinal reference axis (B);
- passing through the turns of said tubular fibre skein (M) by means of said penetrating means (12) (35) to weave/twist the continuous fibres (F) together, so as to reciprocally join/connect them.

said tubular fibre skein (M) is mounted idle on said support means (10), so as to rotate about said longitudinal reference axis (B); said method comprising the step of sliding the tubular fibre skein (M) onto the outer surface of said support means (10) by means of advancing means (28), so as to make the tubular fibre skein (M) to rotate about said longitudinal axis (B) and hold, during said rotation, said tubular fibre skein (M) in said axial fixed position along said longitudinal reference axis (B).

2. The method according to claim 1, comprising the step of at least partially rotating said penetrating means (12) (35) about said longitudinal axis (B) so as to arrange them in predetermined angular positions.

3. The method according to any one of the preceding claims, wherein said penetrating means comprise at least one needle support head (14), and a plurality of punching needles (12) which protrude from said needle support head (14) towards said support means (10), along a direction which is orthogonal to said longitudinal axis (B); said method comprising the step of alternately moving the needle support head (14) along a straight direction (D) parallel to said needles (12), from and towards the tubular fibre skein (M) to cause the punching needles (12) to pass radially through the continuous fibres (F) of the tubular fibre skein (M), so as to needle the continuous fibres (F) together.

4. The method according to claims 1 or 2, comprising the step of providing a nozzle support head (31) provided with one or more nozzles (32) designed to emit water and/or air jets (35) towards said tubular fibre skein (M), so as to pass through the fibres (F); said penetrating means comprising said water or air jets.

5. The method according to any one of the preceding claims, wherein said support means (10) comprise at least one shaft (10) which extends along said longitudinal axis (B) and is provided with through apertures (11), through which, in use, said penetrating means are able to cross.

6. The method according to claim 1 and 5, comprising the step of providing a conveyor belt (28) that comprises at least a superficial portion that is locally tangent to said tubular fibre skein (M), so as to come into contact with the outer surface thereof, and of moving forward said conveyor belt (28) so that said fibre skein (M) slides on the outer surface of the shaft (10), in order to rotate about said longitudinal reference axis (B).

7. The method according to any one of the preceding claims, comprising the step of crossing through the turns of said tubular fibres skein (M) by means of said penetrating means (12) (35) to weave/twist the continuous fibres (F) together, in such a way as to form needling line portions (T) extending without interruption between the opposite ends of said skein (M).

8. The method according to claim 7, comprising the step of passing through the turns of said tubular fibre skein (M) by means of said penetrating means (12) (35) to form needling line portions (T) angularly spaced from one another about the longitudinal axis of said tubular fibre skein (M).

9. A machine for producing a tubular element (1) designed to be installed in a component of a vehicle provided with an internal combustion engine to acoustically and/or thermally insulate said component;
said machine being **characterized in that** it comprises:

- support means (10) extending along a longitudinal reference axis (B) and structured so as to support a tubular fibre skein (M) having its longitudinal axis (B) parallel to said longitudinal reference axis (B) and comprising continuous fibres (F) of a material designed to attenuate the transmission of the noise/heat generated in said component of said vehicle and that are wound about the longitudinal axis (A) so as to form adjacent turns, which forms a tubular body;
- driving means (28) for rotating said tubular fibre skein (M), when it is supported by said support

means (10) about said longitudinal axis (B) and keeping, during said rotation, said tubular fibre skein (M) in an axially fixed position in relation to said support means (10) along said longitudinal reference axis (B);
- penetrating means (12)(35) designed to penetrate the turns of said tubular fibre skein (M), when it is supported by said support means (10), to weave/twist the continuous fibres (F) together so as to reciprocally join/connect them.

10. The machine according to claim 9, wherein said penetrating means comprise at least one needle support head (14), and a plurality of punching needles (12) which protrude from said needle support head (14) towards said support means (10) along a direction which is orthogonal to said longitudinal reference axis (B); means for alternately moving the needle support head (14) along a straight direction (D) parallel to said needles (12), from and towards the tubular fibre skein (M) to cause the punching needles (12) to cross radially through the continuous fibres (F) of the tubular fibre skein (M) so as to needle the continuous fibres (F) together.

11. The machine according to claim 9, wherein said support means (10) comprise at least one shaft (10) extending along said longitudinal axis (B), and provided with through apertures (11) designed in use to be passed through by said penetrating means; said driving means comprising a conveyor belt (28) having at least a superficial portion which is locally tangent to said fibre skein (M) so as to come into contact therewith, and which is designed to pull said fibre skein (M) on the outer surface of the shaft (10) in order to make it rotate about said longitudinal reference axis (B).

12. A tubular sound-deadening and/or thermally insulating element (1) structured so as to be installed in a component of a motor vehicle; said element being produced with the method according to any one of the claims from 1 to 8.

13. An exhaust gas exhaust system of an internal combustion engine of a vehicle comprising a tubular element (1) produced according to claim 12.

Patentansprüche

1. Verfahren zum Herstellen eines röhrenförmigen Elements (1) (60), das darauf ausgelegt ist, in eine Komponente bzw. ein Bauteil eines Fahrzeugs eingebaut zu werden, das mit einem Verbrennungsmotor ausgestattet ist, um die Komponente akustisch und/oder thermisch zu isolieren; wobei das Verfahren den Schritt des Bereitstellens von Stütz- bzw. Trägermitteln (10) umfasst, die sich entlang einer längsverlaufenden Referenzachse (B) erstrecken;
wobei das Verfahren **gekennzeichnet ist durch**:

- Bereitstellen, auf bzw. an den Trägermitteln (10), eines röhrenförmigen Faserstrangs (M), dessen Längsachse (A) parallel zu der längsverlaufenden Referenzachse (B) verläuft und der Endlosfasern (F) aus einem Material umfasst, das darauf ausgelegt ist, die Übertragung der in der Bauteil des Fahrzeugs erzeugten Geräusche/Wärme zu reduzieren; wobei die Endlosfasern (F) um das Trägermittel (10) gewickelt sind, um benachbarte bzw. nebeneinanderliegende Windungen zu bilden, die einen röhrenförmigen Körper bilden;
- Anordnen von Penetrier- bzw. Durchdringungsmitteln (12) (35) in einer an den röhrenförmigen Faserstrang (M) angrenzenden Position, die strukturiert sind, **durch** die Fasern (F) des röhrenförmigen Faserstrangs (M) zu dringen;
- Betätigen von Antriebsmitteln, um den röhrenförmigen Faserstrang (M) um die Längsachse (B) zu drehen und um den röhrenförmigen Faserstrang (M) während des Drehens in einer axial fixierten Position in Bezug auf die Trägermittel (10) entlang der längsverlaufenden Referenzachse (B) zu halten;
- Durchdringen der Windungen des röhrenförmigen Faserstrangs (M) mithilfe der Durchdringungsmittel (12) (35), um die Endlosfasern (F) zusammen zu weben/drehen, um sie wechselseitig miteinander zusammenzufügen/zu verbinden,
wobei der röhrenförmige Faserstrang (M) frei bzw. leerlaufend auf den Trägermitteln (10) montiert ist, um sich um die längsverlaufende Referenzachse (B) zu drehen; wobei das Verfahren den Schritt des Schiebens des röhrenförmigen Faserstrangs (M) auf die äußere Fläche bzw. Außenfläche der Trägermittel (10) mithilfe von Vorschubmitteln (28) umfasst, um den röhrenförmigen Faserstrang (M) um die Längsachse (B) drehen zu lassen und den röhrenförmigen Faserstrang (M) während des Drehens in der axial fixierten Position entlang der längsverlaufenden Referenzachse (B) zu halten.

2. Verfahren nach Anspruch 1, umfassend den Schritt des zumindest teilweisen Drehens der Durchdringungsmittel (12) (35) um die Längsachse (B), um sie in vorherbestimmten Winkelpositionen anzuordnen.

3. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Durchdringungsmittel mindestens einen Nadelträgerkopf (14) umfassen sowie eine Mehrzahl von Stanznadeln (12), die entlang einer

Richtung, die senkrecht zu der Längsachse (B) verläuft, aus dem Nadelträgerkopf (14) zu den Trägermitteln (10) hin herausragen; wobei das Verfahren den Schritt des abwechselnden Bewegens des Nadelträgerkopfs (14) entlang einer geraden Richtung (D) parallel zu den Nadeln (12) von und zu dem röhrenförmigen Faserstrang (M) umfasst, damit die Stanznadeln (12) radial durch die Endlosfasern (F) des röhrenförmigen Faserstrangs (M) dringen, um die Endlosfasern (F) zusammenzunadeln.

4. Verfahren nach Anspruch 1 oder 2, umfassend den Schritt des Bereitstellens eines Düsenträgerkopfes (31), der über eine oder mehrere Düsen (32) verfügt, die darauf ausgelegt sind, Wasser- und/oder Luftstrahlen (35) zu dem röhrenförmigen Faserstrang (M) hin auszustoßen, um durch die Fasern (F) zu dringen; wobei die Durchdringungsmittel die Wasser- oder Luftdüsen umfassen.

5. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Trägermittel (10) mindestens einen Schaft (10) umfassen, der sich entlang der Längsachse (B) erstreckt und über Durchgangsöffnungen (11) verfügt, durch die die Durchdringungsmittel während des Betriebs stoßen können.

6. Verfahren nach Ansprüchen 1 und 5, umfassend den Schritt des Bereitstellens eines Förderbandes (28), das mindestens einen Oberflächenabschnitt umfasst, der den röhrenförmigen Faserstrang (M) lokal tangential ist, um mit dessen äußerer Fläche bzw. Außenfläche in Berührung zu kommen, und des Vorwärtsbewegens des Förderbandes (28), sodass der röhrenförmige Faserstrang (M) auf der äußeren Fläche bzw. Außenfläche des Schafts (10) gleitet, um sich um die längsverlaufende Referenzachse (B) zu drehen.

7. Verfahren nach einem der vorhergehenden Ansprüche, umfassend den Schritt des Durchdringens der Windungen des röhrenförmigen Faserstrangs (M) durch die Durchdringungsmittel (12) (35), um die Endlosfasern (F) so zusammen zu weben/drehen, dass Nadelungslinienabschnitte (T) gebildet werden, die sich ohne Unterbrechung zwischen den gegenüberliegenden bzw. entgegengesetzten Enden des Strangs (M) erstrecken.

8. Verfahren nach Anspruch 7, umfassend den Schritt des Durchdringens der Windungen des röhrenförmigen Faserstrangs (M) durch die Durchdringungsmittel (12) (35), um Nadelungslinienabschnitte (T) zu bilden, die um die Längsachse des röhrenförmigen Faserstrangs (M) herum winklig voneinander beabstandet sind.

9. Maschine zum Herstellen eines röhrenförmigen Elements (1), das darauf ausgelegt ist, in eine Komponente bzw. ein Bauteil eines Fahrzeugs installiert zu werden, das mit einem Verbrennungsmotor ausgestattet ist, um die Komponente akustisch und/oder thermisch zu isolieren;
wobei die Maschine **dadurch gekennzeichnet ist, dass** sie umfasst:

- Stütz- bzw. Trägermittel (10), die sich entlang einer längsverlaufenden Referenzachse (B) erstrecken und strukturiert sind, einen röhrenförmigen Faserstrang (M) zu stützen bzw. zu tragen, der eine Längsachse (B) parallel zu der längsverlaufenden Referenzachse (B) aufweist und Endlosfasern (F) aus einem Material umfasst, das darauf ausgelegt ist, die Übertragung der in der Komponente des Fahrzeugs erzeugten Geräusche/Wärme zu dämpfen, und der um die Längsachse (A) gewickelt ist, um benachbarte bzw. nebeneinanderliegende Windungen zu bilden, die einen röhrenförmigen Körper bilden;
- Antriebsmittel (28) zum Drehen des röhrenförmigen Faserstrangs (M), wenn dieser von den Trägermitteln (10) um die Längsachse getragen wird, sowie zum Halten des röhrenförmigen Faserstrangs (M) während des Drehens in einer axial fixierten Position in Bezug auf die Trägermittel (10) entlang der längsverlaufenden Referenzachse (B);
- Penetrier- bzw.Durchdringungsmittel (12) (35), die darauf ausgelegt sind, die Windungen des röhrenförmigen Faserstrangs (M) zu durchdringen, wenn er von den Trägermitteln (10) getragen wird, um die Endlosfasern (F) zusammen zu weben/drehen, um sie miteinander zu verbinden.

10. Maschine nach Anspruch 9, wobei die Durchdringungsmittel mindestens einen Nadelträgerkopf (14) und eine Mehrzahl von Stanznadeln (12), die entlang einer Richtung, die senkrecht zu der Längsachse (B) verläuft, aus dem Nadelträgerkopf (14) zu den Trägermitteln (10) hin herausragen; Mittel zum abwechselnden Bewegen des Nadelträgerkopfs (14) entlang einer geraden Richtung (D) parallel zu den Nadeln (12) von und zu dem röhrenförmigen Faserstrang (M), damit die Stanznadeln (12) radial durch die Endlosfasern (F) des röhrenförmigen Faserstrangs (M) dringen, um die Endlosfasern (F) zusammenzunadeln umfassen.

11. Maschine nach Anspruch 9, wobei die Trägermittel (10) mindestens einen Schaft (10) umfassen, der sich entlang der Längsachse (B) erstreckt und über Durchgangsöffnungen (11) verfügt, die darauf ausgelegt sind, während des Betriebs von den Durchdringungsmitteln durchstoßen zu werden; wobei die

Antriebsmittel ein Förderband (28) umfassen, das mindestens einen Oberflächenabschnitt umfasst, der den röhrenförmigen Faserstrang (M) lokal berührt, um mit dessen äußerer Fläche bzw. Außenfläche in Berührung zu kommen und das darauf ausgelegt ist, den Faserstrang (M) auf die äußeren Fläche bzw. Außenfläche des Schafts (10) zu ziehen, um ihn in Drehbewegung um die längsverlaufende Referenzachse (B) zu versetzen.

12. Röhrenförmiges, schalldämpfendes und/oder wärmeisolierendes Element (1), strukturiert, um in eine Komponente bzw. ein Bauteil eines Kraftfahrzeugs eingebaut zu werden; wobei das Element mit dem Verfahren nach einem der Ansprüche 1 bis 8 hergestellt wird.

13. Abgasauspuffsystem eines Verbrennungsmotors eines Fahrzeugs, umfassend ein röhrenförmiges Element (1), hergestellt nach Anspruch 12.

Revendications

1. Procédé de fabrication d'un élément tubulaire (1) (60) conçu pour être installé dans un composant d'un véhicule équipé d'un moteur à combustion interne pour isoler acoustiquement et/ou thermiquement ledit composant ; ledit procédé comprend l'étape consistant à fournir un moyen de support (10) qui s'étend le long d'un axe de référence longitudinal (B) ;
ledit procédé étant **caractérisé en ce que**

- l'on prévoit sur ledit moyen de support (10) un écheveau de fibres tubulaires (M) ayant son axe longitudinal (A) parallèle audit axe de référence longitudinal (B) et comprenant des fibres continues (F) dans un matériau conçu pour réduire la transmission du bruit/chaleur produite dans ledit composant dudit véhicule ; lesdites fibres continues (F) sont enroulées autour dudit moyen de support (10) de manière à former des spires adjacentes, qui forment un corps tubulaire ;
- l'on dispose, dans une position adjacente au dit écheveau de fibres tubulaires (M), un moyen de pénétration (12) (35) structuré pour pénétrer à travers les fibres (F) dudit écheveau de fibres tubulaires (M) ;
- l'on actionne des moyens d'entraînement pour faire tourner ledit écheveau de fibres tubulaires (M) autour dudit axe longitudinal (B) et pour maintenir, pendant la rotation, l'écheveau de fibres tubulaires (M) dans une position axialement fixe par rapport audit moyen de support (10) le long dudit axe de référence longitudinal (B) ;
- l'on traverse les spires dudit écheveau de fibres tubulaires (M) au moyen dudit moyen de pénétration (12) (35) pour tisser/tordre les fibres continues (F) ensemble, de manière à les joindre/les connecter mutuellement.
ledit écheveau de fibres tubulaires (M) est monté à vide sur ledit moyen de support (10), de manière à tourner autour dudit axe de référence longitudinal (B); ledit procédé comprenant l'étape de coulissement de l'écheveau de fibres tubulaires (M) sur la surface externe dudit moyen de support (10) au moyen d'un mécanisme d'avancement (28), de manière à faire tourner l'écheveau de fibres tubulaires (M) autour dudit axe longitudinal (B) et à maintenir, pendant ladite rotation, ledit écheveau de fibres tubulaires (M) dans ladite position fixe axiale le long dudit axe de référence longitudinal (B).

2. Procédé selon la revendication 1, comprenant l'étape de faire tourner au moins partiellement ledit moyen de pénétration (12) (35) autour dudit axe longitudinal (B) de manière à le disposer dans des positions angulaires prédéterminées.

3. Procédé selon l'une des revendications précédentes, dans lequel ledit moyen de pénétration comprend au moins une tête de support d'aiguille (14) et une pluralité d'aiguilles de poinçonnage (12) qui dépassent de ladite tête de support d'aiguille (14) vers ledit moyen de support (10), le long d'une direction qui est orthogonale audit axe longitudinal (B); ledit procédé comprenant l'étape consistant à déplacer alternativement la tête de support d'aiguille (14) dans un déplacement en ligne droite (D) parallèle auxdites aiguilles (12), depuis et vers l'écheveau de fibres tubulaires (M) pour faire passer les aiguilles de poinçonnage (12) radialement à travers les fibres continues (F) de l'écheveau de fibres tubulaires (M), de manière à assembler les fibres continues (F).

4. Procédé selon les revendications 1 ou 2, comprenant l'étape apportant une tête de support de buse (31) munie d'une ou plusieurs buses (32) conçues pour émettre des jets d'eau et/ou d'air (35) vers ledit écheveau de fibres tubulaires (M), de manière à traverser les fibres (F) ; ledit moyen de pénétration comprenant lesdits jets d'eau ou d'air.

5. Procédé selon l'une des revendications précédentes, dans lequel ledit moyen de support (10) comprend au moins un manchon (10) qui s'étend le long dudit axe longitudinal (B) et est pourvu d'ouvertures traversantes (11), par lesquelles, en utilisation, ledit moyen de pénétration est capable de traverser.

6. Procédé selon les revendications 1 et 5, comprenant l'étape de fournir une bande transporteuse (28) qui comprend au moins une partie superficielle qui est

localement tangente audit écheveau de fibres tubulaires (M), de manière à entrer en contact avec sa surface extérieure, et d'avancer ladite bande transporteuse (28) de sorte que ledit écheveau de fibres (M) glisse sur la surface extérieure du manchon (10), afin de tourner autour dudit axe de référence longitudinal (B).

7. Procédé selon l'une des revendications précédentes, comprenant l'étape de traverser les spires dudit écheveau de fibres tubulaires (M) au moyen dudit moyen de pénétration (12) (35) pour tisser/entrelacer les fibres continues (F) ensemble, de manière à former des portions de ligne d'aiguilletage (T) s'étendant sans interruption entre les extrémités opposées dudit écheveau (M).

8. Procédé selon la revendication 7, comprenant l'étape de passage à travers les spires dudit écheveau de fibres tubulaires (M) au moyen dudit moyen de pénétration (12) (35) pour former des portions de ligne d'aiguilletage (T) angulairement espacées les unes des autres autour de l'axe longitudinal dudit écheveau de fibres tubulaires (M) .

9. Une machine pour produire un élément tubulaire (1) conçu pour être installé dans un composant d'un véhicule équipé d'un moteur à combustion interne pour isoler acoustiquement et/ou thermiquement ledit composant ; ladite machine étant **caractérisée en ce qu'**elle comprend:

- un moyen de support (10) s'étendant le long d'un axe de référence longitudinal (B) et structuré de manière à supporter un écheveau de fibres tubulaires (M) ayant son axe longitudinal (B) parallèle audit axe de référence longitudinal (B) et comprenant des fibres continues (F) en un matériau conçu pour atténuer la transmission du bruit/de la chaleur généré dans ledit composant dudit véhicule et qui sont enroulés autour de l'axe longitudinal (A) de manière à former des spires adjacentes, qui forment un corps tubulaire;
- un mécanisme d'entraînement (28) pour faire tourner ledit écheveau de fibres tubulaires (M), lorsqu'il est supporté par ledit moyen de support (10) autour dudit axe longitudinal (B) et maintenir, pendant ladite rotation, ledit écheveau de fibres tubulaires (M) dans une position axialement fixe par rapport audit moyen de support (10) le long dudit axe de référence longitudinal (B) ;
- un moyen de pénétration (12) (35) conçu pour pénétrer les spires dudit écheveau de fibres tubulaires (M), lorsqu'il est supporté par ledit moyen de support (10), pour tisser/entremêler les fibres continues (F) ensemble de manière à les rejoindre/les connecter réciproquement.

10. La machine selon la revendication 9, dans laquelle ledit moyen de pénétration comprend au moins une tête de support d'aiguille (14) et une pluralité d'aiguilles de poinçonnage (12) qui dépassent de ladite tête de support d'aiguille (14) vers ledit moyen de support (10) le long d'une direction qui est orthogonale audit axe de référence longitudinal (B); un moyen pour déplacer alternativement la tête de support d'aiguille (14) dans un déplacement en ligne droite (D) parallèle auxdites aiguilles (12), depuis et vers l'écheveau de fibres tubulaires (M) pour amener les aiguilles de poinçonnage (12) à passer radialement à travers les fibres continues (F) de l'écheveau de fibres tubulaires (M) de manière à assembler les fibres continues (F).

11. La machine selon la revendication 9, dans laquelle ledit moyen de support (10) comprend au moins un manchon (10) s'étendant le long dudit axe longitudinal (B), et pourvu d'ouvertures traversantes (11) conçues pour être utilisées pour être traversées par ledit moyen de pénétration; ledit mécanisme d'entraînement comprenant une bande transporteuse (28) ayant au moins une partie superficielle qui est localement tangente audit écheveau de fibres (M) de manière à entrer en contact avec, et qui est conçue pour tirer ledit écheveau de fibres (M) sur la surface extérieure du manchon (10) afin de le faire tourner autour dudit axe de référence longitudinal (B).

12. Un élément tubulaire d'insonorisation et/ou d'isolation thermique (1) structuré de manière à être installé dans un composant d'un véhicule automobile ; ledit élément étant produit avec le procédé selon l'une des revendications 1 à 8.

13. Un système d'échappement de gaz d'échappement d'un moteur à combustion interne d'un véhicule comprenant un élément tubulaire (1) produit selon la revendication 12.

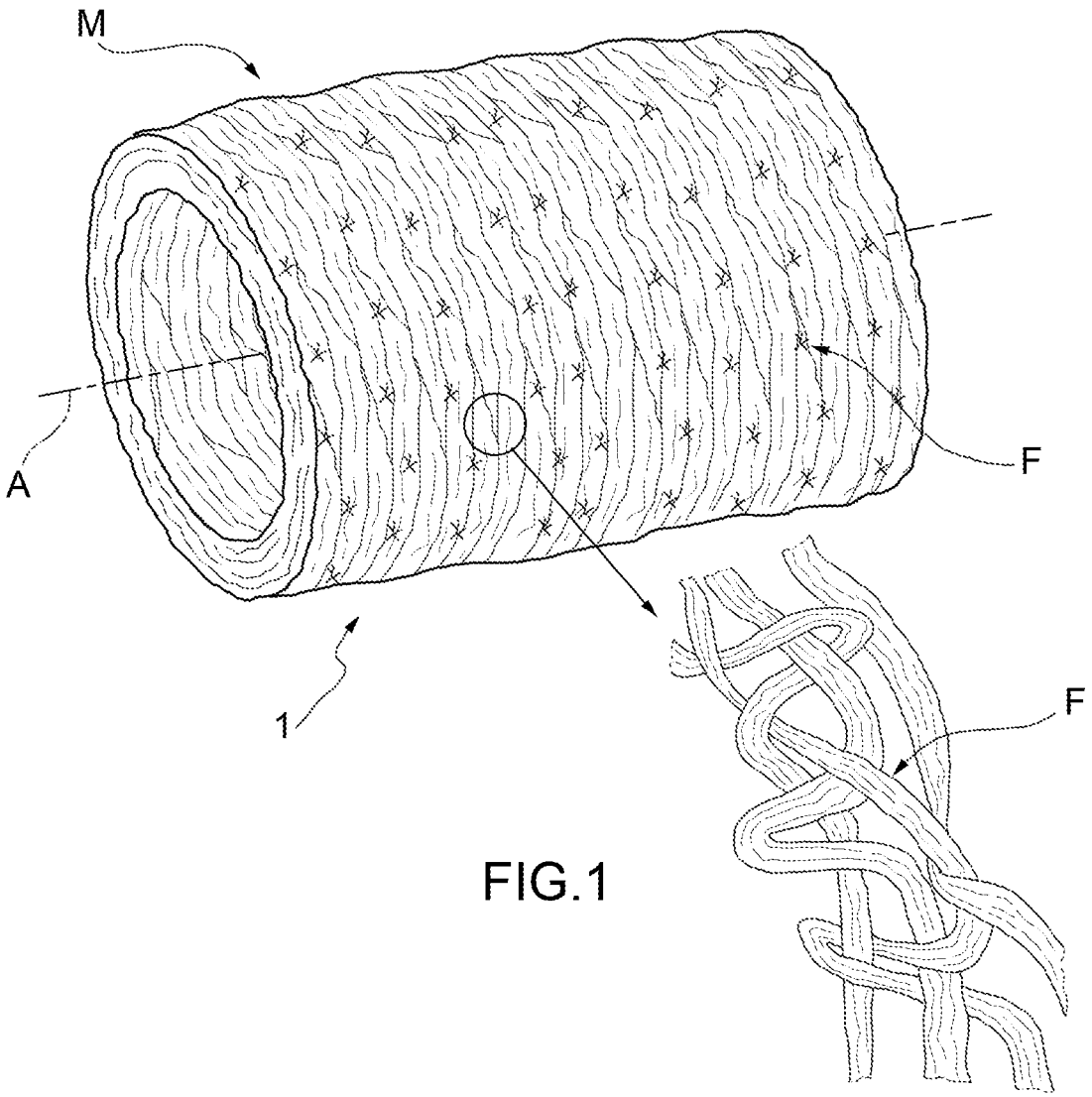


FIG.1

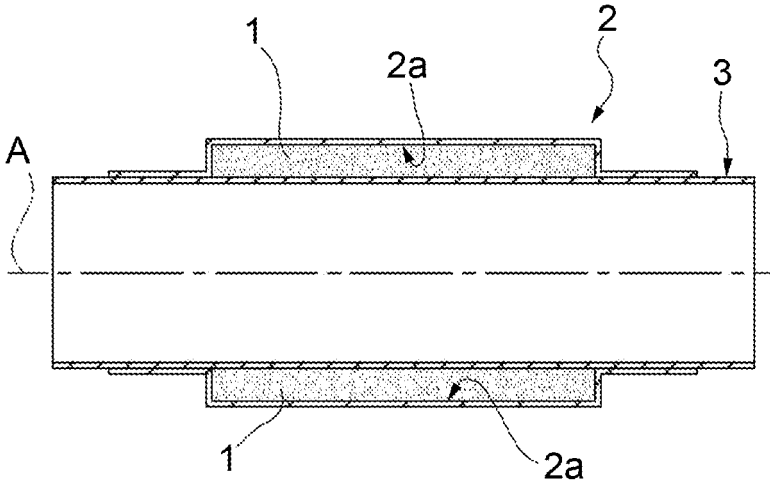


FIG.2

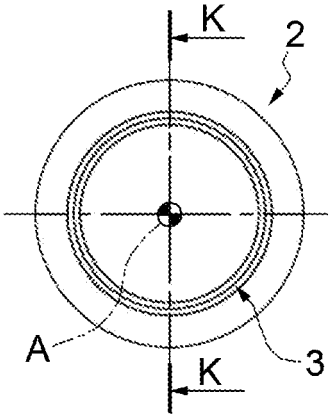


FIG.3

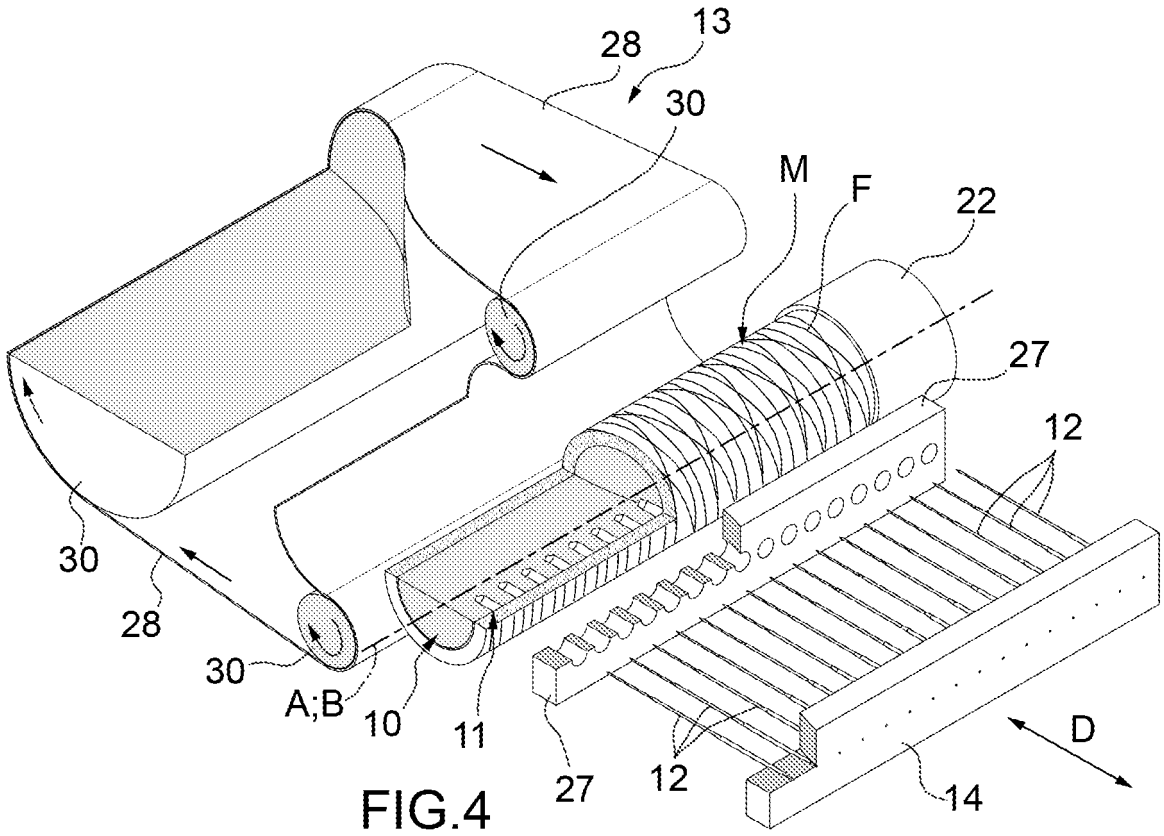

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FIG.4

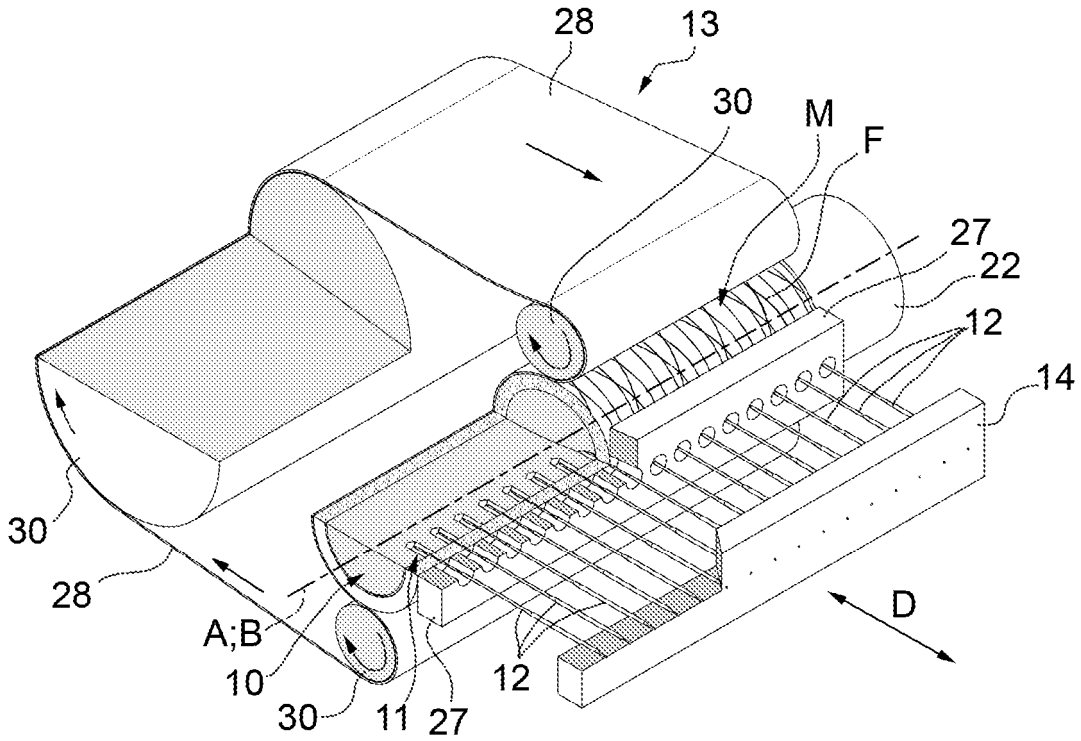

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FIG.5

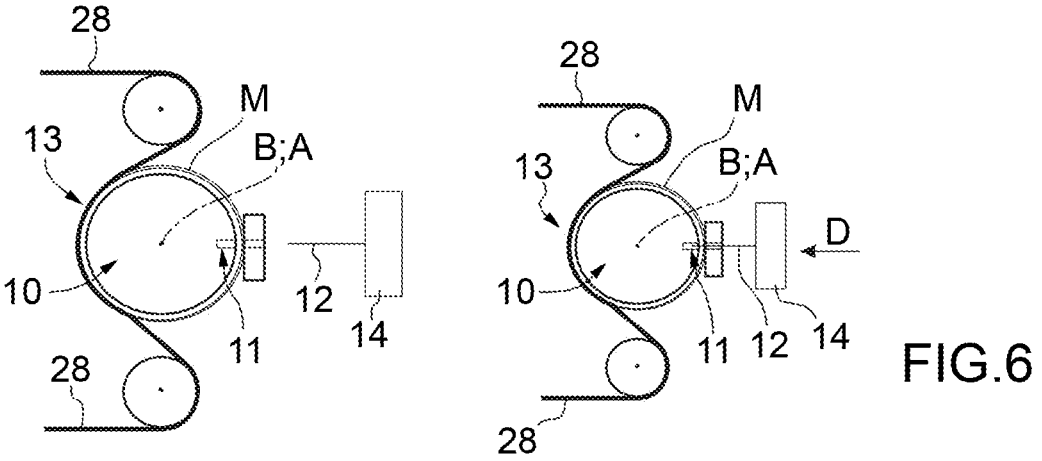


FIG.6

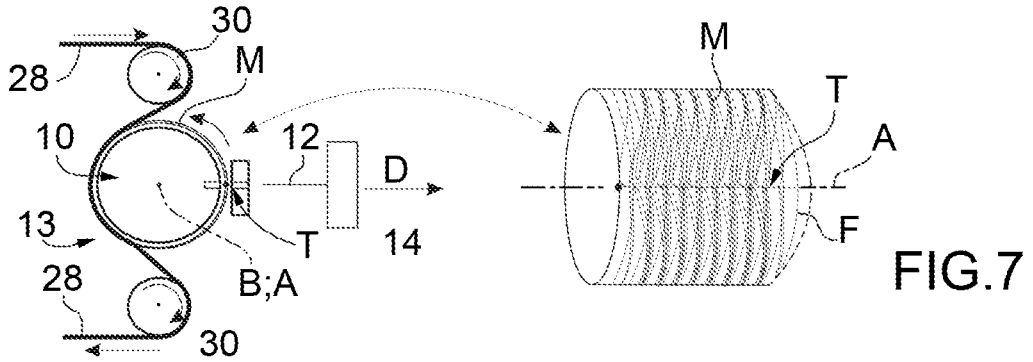


FIG.7

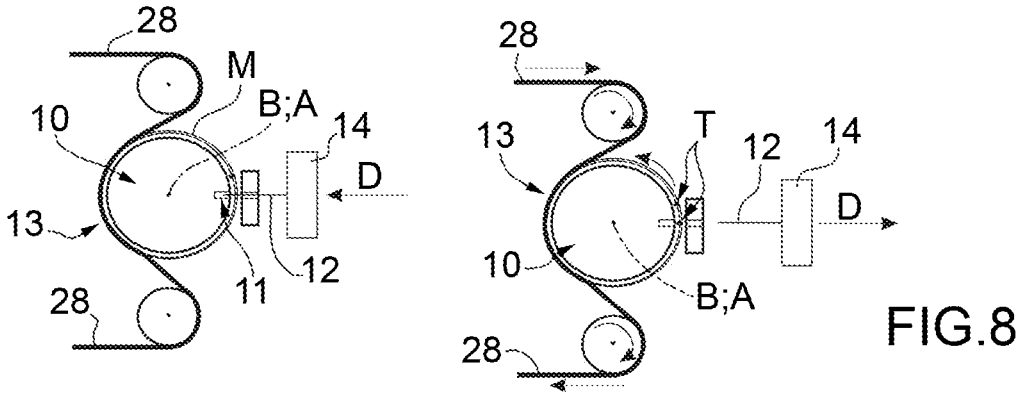


FIG.8

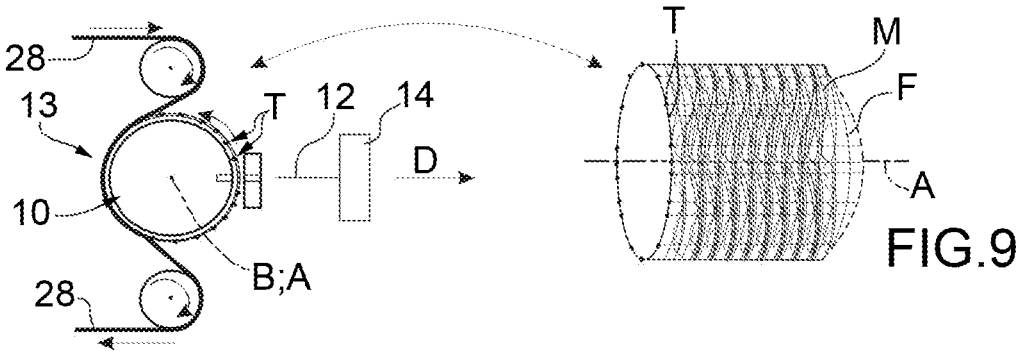


FIG.9

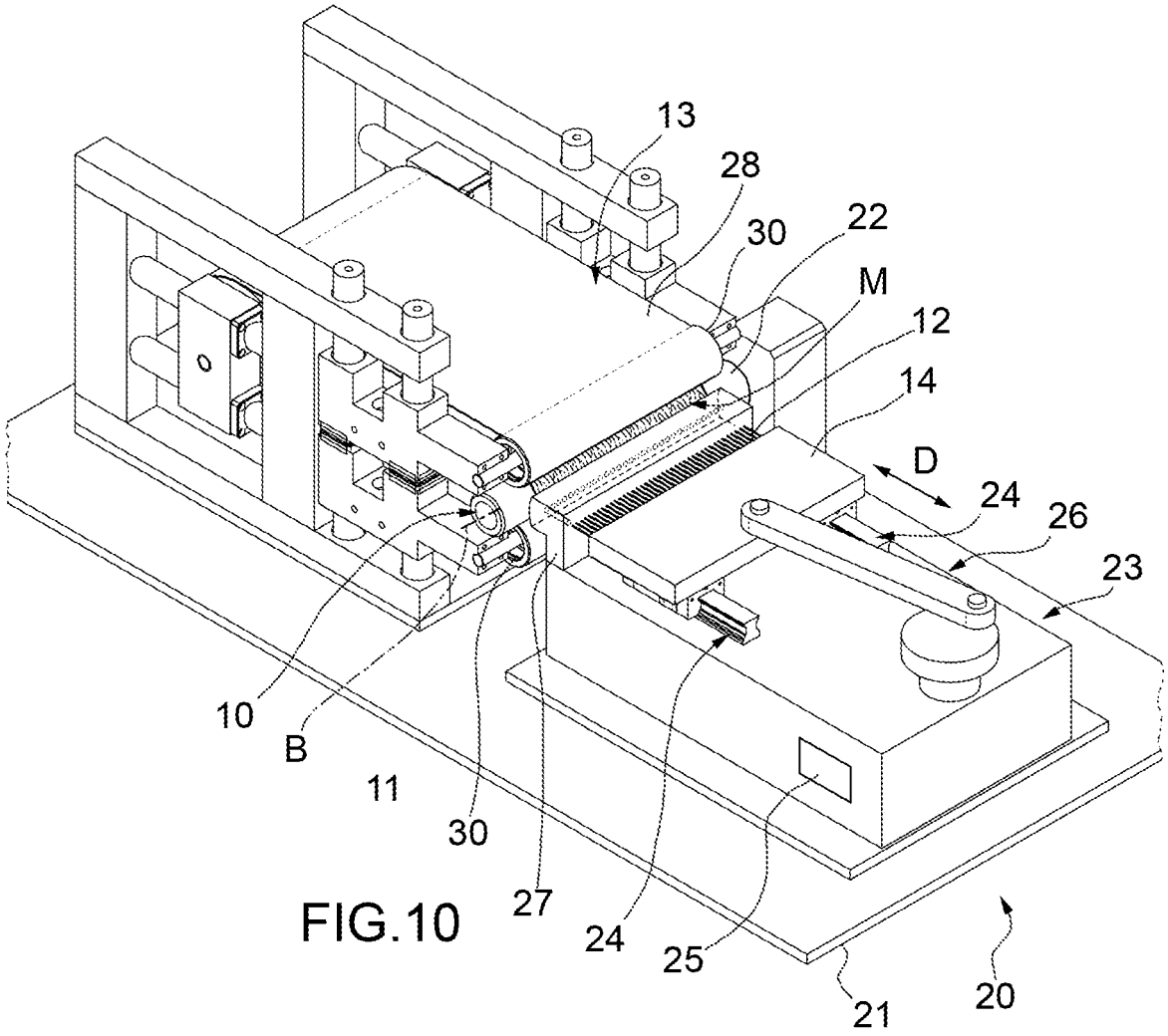

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FIG.10

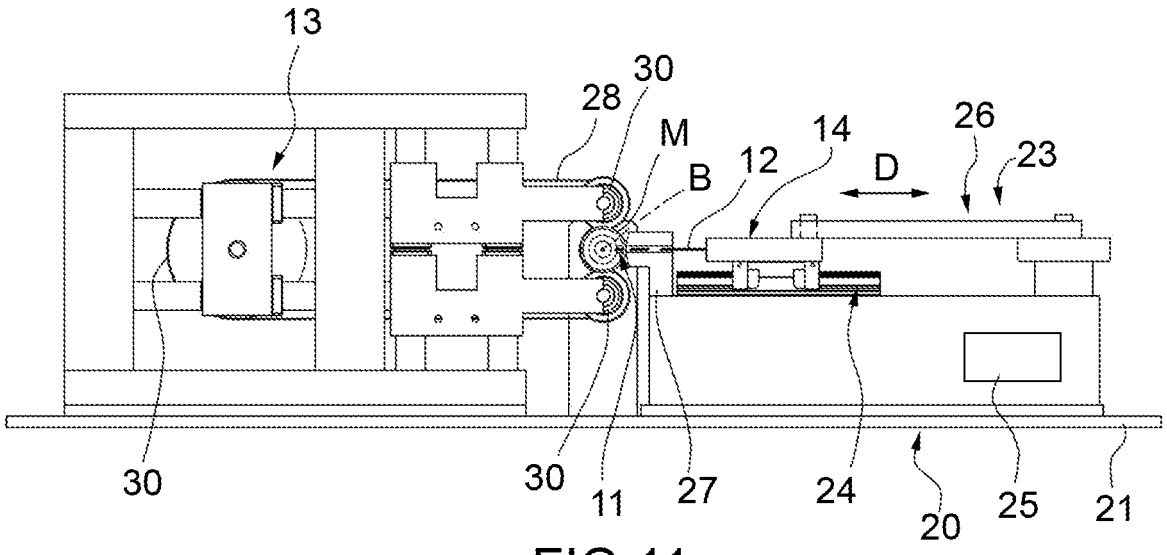

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FIG.11

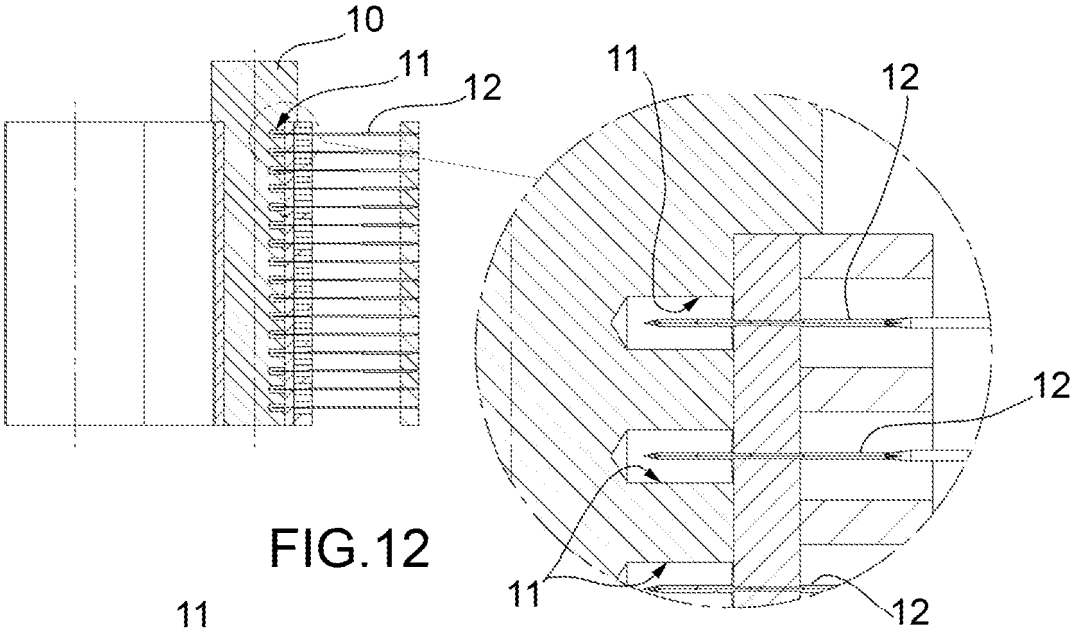
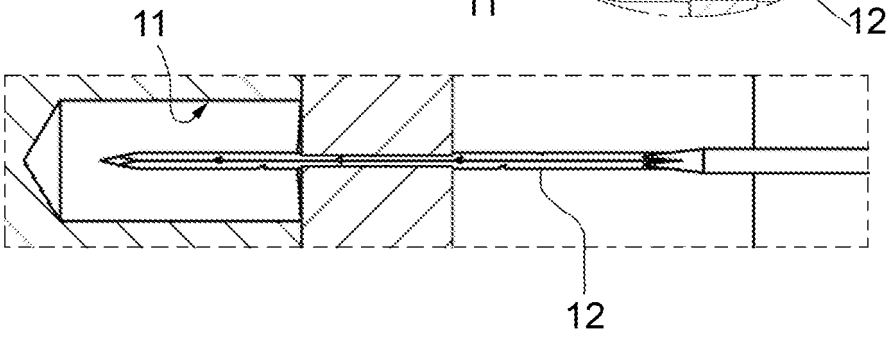


FIG.12



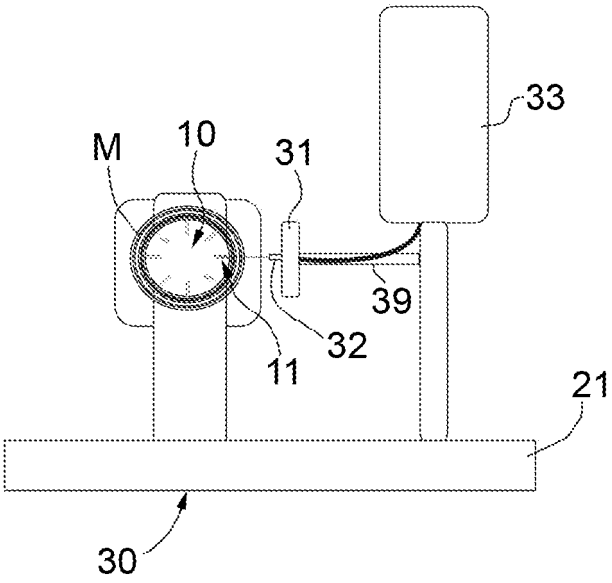


FIG.13

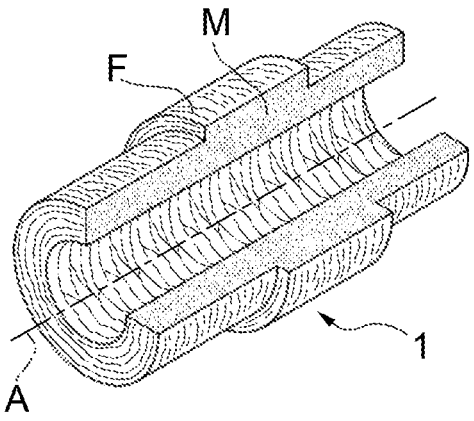


FIG.14

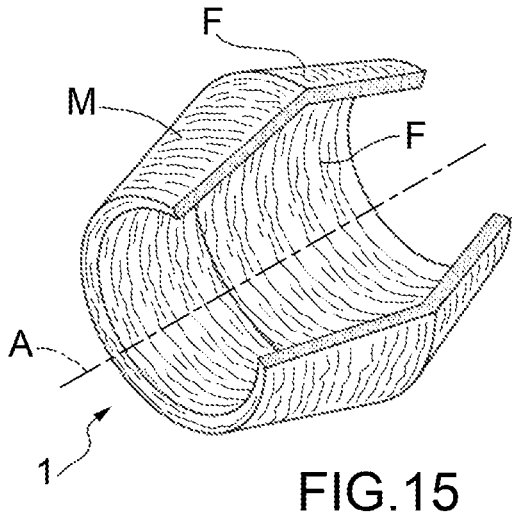


FIG.15

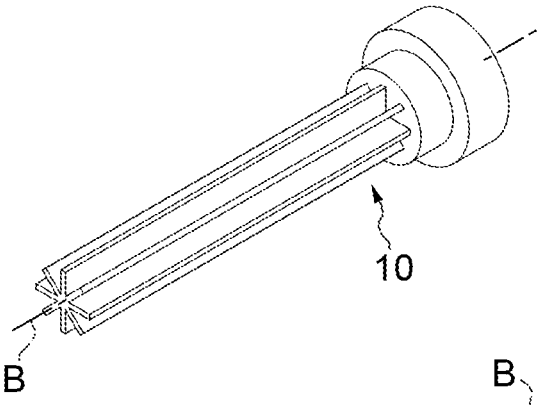


FIG.16

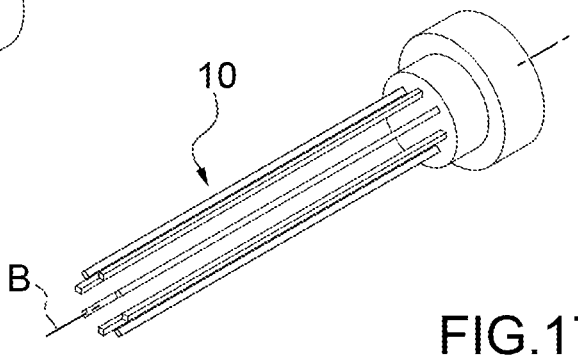


FIG.17

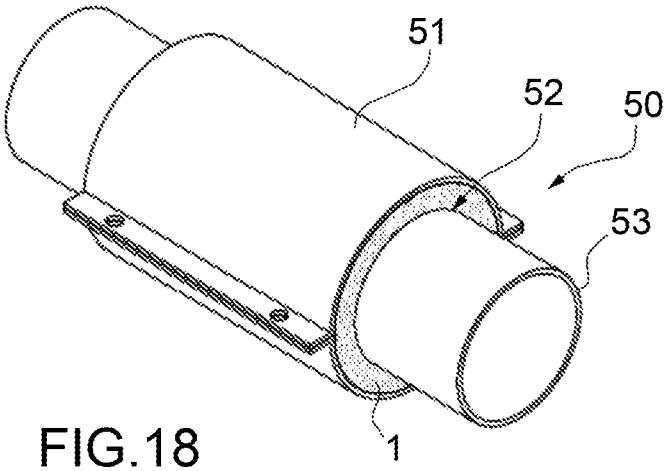


FIG.18

REFERENCES CITED IN THE DESCRIPTION

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- US 3758926 A **[0006] [0030]**
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