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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : A61B 17/34 | A2

(11) International Publication Number: WO 99/51152

(43) International Publication Date: 14 October 1999 (14.10.99)

(21) International Application Number: PCT/BG99/00006

(22) International Filing Date: 1 April 1999 (01.04.99)

(30) Priority Data:
102368 2 April 1998 (02.04.98) BG

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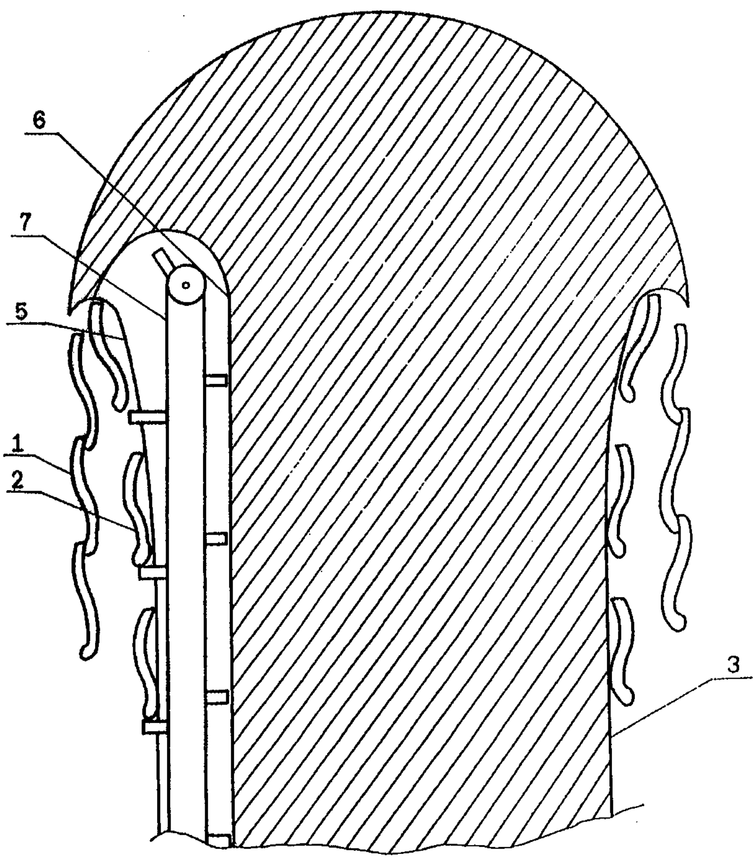
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: A CANNULA OF CHANGEABLE LENGTH AND SHAPE

(57) Abstract

A cannula of changeable length and shape, built up of consecutively arranged and touching each other elements, each of which occupies part of the cannula length, in which the change in the length and shape is effected by adding or removing from the end of the cannula elements with folding width, while the transport of the free and unlinked in the cannula wall elements towards its growing end or in the opposite direction is effected in a folded state through the interior of the cannula.



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A CANNULA OF CHANGEABLE LENGTH AND SHAPE

Sphere of Technics

The invention refers to a cannula of changeable length and shape, which can be used in medical application during the penetration of various devices, e.g. endoscopes, into the living systems as well as other activities, which necessitate the penetration into a medium, vulnerable to mechanical intervention and/or is without well-shaped confining walls.

State of Art

There are tubes, tubular elements (1-7) and devices., e.g. endoscopes, including tubes and tubular elements (8, 9), which are characterised by the fact that after penetrating into the body along the existing lumens - oesophagus, blood vessels, etc. - they ensure some protection from mechanical traumas to the surrounding tissues during the operation of the devices.

A disadvantage of the existing tubes, tubular elements and devices containing tubes and tubular elements is the fact that during their penetration into the living system as well as during their removal, they cause considerable traumas due to the friction between their outside surface and the medium of penetration and particularly to the side pressure exerted by the sections where there are curves.

The patent /13/ proposes a new principle of action of a three dimensional controllable cannula according to which the loading instrument is placed in a lumen of the cannula itself. The lumen is formed during the penetration into the body without having to use ready natural ways and operates on the principle of snail horns - protruding and retracting. The patent; however, does not propose a design working on this principle, neither the moving force which will open and close the cannula.

The aim of the invention is to create a cannula of changeable length and shape, which is to penetrate the living system not only through existing orifices and which is to reduce to a minimum the traumas to the surrounding medium e.g. the human body- The task is solved by a device in which the cannula is formed at entering the working medium only through lengthening, which enters the working medium only through lengthening the front end, which takes the turns in any direction only through growing in the same direction and which is taken out of the surrounding medium only through shortening of the front end, keeping static all the time and keeping stable its shape.

Technical Character of the Invention

A cannula 1 has been created, built up of consecutively arranged and touching separate, hollow, folding elements 2, each of which occupies part of the cannula length, whereat the change in its length is effected by adding or removing elements at the cannula end, while the change in its shape is effected when during the elongation of the cannula 1, the new consecutive elements 2 are orientated, arranged and linked with each other in such a way that the elongation results in forming a turn in the desired direction. The transport of the elements to the growing end of the cannula during its elongation as well as in the opposite direction toward the beginning of the cannula during its shortening, is effected in the interior of the cannula with the elements in a folded state. 2. To make possible the transportation of the separate elements through the interior of the cannula, these elements 2, which in a linked state have the diameter of the cannula wall 1, can change reversibly some of their dimensions by shrinking and expanding and the change occurs at the moment of linking the new elements with the growing end of the cannula or by removing elements from this end during its shortening.

The transport of the separate elements is effected by a device e.g. the endoscope 3, placed in the lumen of the cannula 1 determined by the dimensions of the hollow of the elements 2 bent in the cannula. This is achieved under the impact of a fibre 7 in the shape of an endless band, situated from the beginning of the endoscope 3, along the length on which fixing particles are linked, which during contact with the elements 2, catch them and carry them with their own movement towards the end or the beginning of the cannula 1 depending on the direction of movement of the endless fibre or it can be achieved under the impact of a flexible spiral, pushing with the surface of its helical line the elements toward the end or the beginning of the cannula depending on the direction of the spiral rotation.

The advantages of the described cannula consist of the following: The cannula 1 is static in respect to the surrounding medium with the exception of its end section, which lengthens or shortens and thus eliminates the friction between this medium and the cannula itself, or the endoscope placed in it.

The cannula has a stable shape i.e. it is comparatively hard and therefore during the turns the cannula and the endoscope 3 do not press laterally the surrounding medium. The described cannula does not traumatise the surrounding medium either by longitudinal friction, or by lateral pressing except at the moment and in the place of elongation and respectively shortening of the cannula.

Examples of Execution

Example 1. A cannula 1 of changing length and shape shown in figures 1, 2 and 3, consisting of consecutively arranged and linked with each other hollow, elements 2 , which elongated by means of consecutive adding of these elements to the growing end of the cannula, or shortens by consecutive removing of these elements from the end of the cannula, and the transport of the added or removed elements is effected through the interior of the cannula 1 from the beginning towards the end of the cannula or respectively from the end towards the beginning of this cannula. The elements 2 of the cannula 1 can reversibly expand in width, reaching the cannula diameter at the moment of their linking at the end of the cannula during its elongation or they can shrink in width, reaching with their external end a diameter, which is smaller than the internal diameter of the cannula at the moment of their removal from the cannula end during the shortening of this cannula. The free unlinked elements in the cannula wall are concentrically situated in the interior of the cannula 1, while in the remaining empty space in the interior of the cannula is located the device e.g. the endoscope 3, for whose penetration into the surrounding medium the cannula is designed, whose front end forms the head 4 and a conical enlargement 5 immediately under the endoscope head. In the longitudinal slit of the endoscope lies the endless transport fibre 7 on which at regular intervals are fixed the particles for clamping the elements 8 and the wheel 9, immediately under the endoscope head 11, which maintains the transport fibre 7 in a taut state.

The elongation of the cannula is effected by smoothly moving the endoscope 3 in the direction of its penetration in the surrounding medium, combined with rotating the transport fibre in a direction, in which its external part moves the clamping particles 8 towards the growing end of the cannula, while these particles 8 catch the elements 2 and transport them in the same direction and at the front end of the endoscope they force them to pass through the conical enlargement 5 of the reaching their maximum size at the end of the enlargement, while at the same time the outside back rounded part of the elements meshes for the internal front rounded part of the elements and they are included in the cannula wall.

The shortening of the cannula is effected by moving the endoscope 3 smoothly in the direction of its removal from the surrounding medium, combined with rotation of the transport fibre 7 in a direction, in which its external part moves the clamping particles 8 towards the beginning of the cannula, whereat the periphery of the endoscope head pushes the final element at the cannula end towards the interior of the cannula, and the element breaks off its preceding element and under the impact of the particles of the transport fibres 8 they slide into the space between the preceding element and the expander, whereat they shrink to their minimal diameter and moved by the particles, they are transported to the beginning of the cannula, outside the surrounding medium.

The change in the cannula shape is effected during the elongation of the cannula 1 by bending the endoscope head 3 in the desired direction, while each consecutive element, which is added to the growing end of the cannula meshes for the preceding end at a definite angle, different from 180□, while the degree of meshing from the external side of the forming turn is smaller than the degree of meshing from the internal side of the turn.

In this example the elements represent hollow bodies 2 of a shape close to the cylindrical, which consist of alternating longitudinal hard bands 10 and elastic longitudinal bands 11 while the width of the elastic bands is smaller than the width of the hard bands and in the back external end of the element the hard bands have rounded convex surface, and in the front end of the element the hard bands have rounded concave surface, whereat the curves of the two kinds of rounded surfaces are similar or coincide, to make possible both the linear meshing and the meshing at a definite angle of the convex surfaces in the back part of each element with the concave surfaces of the preceding element along the length of the cannula.

Example 2 . A cannula 1, shown in fig. 4, similar to that described in Example 1 , in which the transport of the elements 4 unlinked in the cannula in the space between the internal surface of the cannula and the external surface of the endoscope is effected by a flexible spiral 12, enveloping the endoscope 3 along its entire length, including its enlarged front end under the head. During the rotation of the spiral 12 in one or the opposite direction, it pushes with the surface of its helical line the elements in the desired directions.

An advantage of the described cannula is that the spiral 12, by which the transport of the free element is effected, does not occupy part of the endoscope volume.

Example 3. A cannula 1, shown in fig. 5, similar to that described in Example 1, in which the elements 2, building up the cannula, are with folding walls and are made of longitudinal unfolding bends 13 and folding bands 14, whereat the two halves of the folding bands are connected with hinges 15, while the folding bands 14 and the unfolding bands 13 are connected with hinges 16. The unfolding bands 13 have on the outside from the back end a rounded convex surface, while inside, from the front end, they have a rounded concave surface.

An advantage of the described cannula is that both in a folded and unfolded state, the elements are in equilibrium and that makes the structure of the cannula loaded with smaller internal tension.

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Description of attached figures

Fig. 1 - LONGITUDINAL SECTION

1. Cannula
2. Elements of the cannula
3. Endoscope
4. Endoscope head
5. Enlargement in the endoscope head
6. Slit for the transport fibre
7. Transport fibre
8. Clamping particles along the transport fibre
9. Wheel stretching the transport fibre

Fig. 2 - LONGITUDINAL VIEW

2. Element

10 Hard band

11. Elastic band

Fig. 3 - LONGITUDINAL SECTION

2. Element

Fig. 4 - LONGITUDINAL SECTION

1. Cannula
2. Element
3. Endoscope
4. Endoscope head
5. Enlargement at the end of the endoscope

12. Spiral

Fig. 5 - CROSS SECTION

13. Unfolding band

14. Folding band

15 Hinge between the particles on the folding band

16. Hinge between folding band

Patent claims

1. A cannula 1 of changeable length and shape, consisting of consecutively arranged and touching each other hollow element which elongates by executive adding of these elements to the growing end of the cannula or it shortens by consecutive removing the elements at the end of the cannula, characterised by the fact that the transport of the free, unlinked in the cannula wall elements, is effected through the interior of the cannula from the beginning toward the end during its elongation, or from the end toward the beginning during its shortening and the elements can reversibly expand in width, reaching the diameter of the cannula at the moment of their linking at the cannula end during its elongation, or they can fold reversible in width, reaching their external end a diameter, which is smaller than the interior diameter of the cannula at the moment of their removal from the cannula end during the shortening of this cannula.

2. A cannula, according to Claim 1 , characterised by the fact that the element are hollow bodies of a shape, close to cylindrical and they consist of alternating longitudinal hard bands 10 and elastic bands 11, and the width of the elastic bands is smaller than the width of the hard bands, whereat in equilibrium of the elastic bands the diameter of the elements coincides with the diameter of the cannula and at the back outside end of the elements tile hard bands have a rounded, concave surface, while at the front, internal end of the elements the hard bands have a rounded, concave surface, and the curves of the two kinds of rounded surfaces are similar and coincide.

3. A cannula, according to Claims 1 and 2, characterised by the fact that the free and unlinked with each other elements are concentrically located in the interior of the cannula, and in the remaining empty space in the interior of the cannula is place the device, e.g. the endoscope 3, for whose penetration into the surrounding medium the cannula is designed, and this endoscope has in its front end a head 4 and a conical enlargement 5, immediately under the endoscope head, and in a longitudinal slit 6 of the endoscope there is an endless transport fibre 7, at regular intervals of which are attached the particles 8 for clamping the elements and the wheel 9, immediately under the endoscope heads which maintains the transport

fibre in a taut state in such a way that the clamped particles from one half of the fibre stick out along the entire length of the endoscope outside its surface, while the particles from the other half of the fibres are under its surface.

4. A cannula, according to Claim 3, characterised by the fact that the elongation is effected by moving the endoscope smoothly in the direction of penetration into the surrounding medium, combined with rotating the endless transport fibre around the stretching wheel in such a way that the particles sticking out of the endoscope move in the direction of the growing end of the cannula, whereat they clamp the elements and transport them to the end of the endoscope and when they pass through the expander 5, the elements are enlarged to their maximum size and thereby they cause the meshing of the back convex, rounded part of the last element in the cannula with the front concave rounded part of the preceding element, whereas the shortening of the cannula is effected by moving the endoscope smoothly in the direction of its removal from the surrounding medium, combined with rotating the transport fibre in such a way that the particles sticking out of the endoscope move in the direction of the beginning of the cannula, and at the same time the periphery of the endoscope head pushes the last element at the end of the endoscope towards the interior of the cannula, whereat the elements breaks off the preceding element and under the impact of the particle of the transport fibre, they slide in the space between the preceding element and the expander, while they shrink to their minimal diameter and moved by the particles, they are transported towards the beginning of the cannula, outside the surrounding medium, whereas the change in the cannula shape is achieved during the elongation of the cannula by bending the endoscope head in the desired direction, and each consecutive elements, which is added to the growing end of the cannula meshes for the preceding element at a definite angle, different from 180□ and the degree of meshing from the external side of the turn is smaller than the degree of meshing from the internal side of the turn.

5. A cannula, according to Claim 1, characterised by the fact, that the transport of the free unlinked in the cannula wall elements, is effected under the impact of a spiral 12 , enveloping the endoscope, including the part of the expander, and this spiral pushes with the surface of its helical line the elements towards the

end or the beginning of the cannula depending on the direction of the spiral rotation.

6. A cannula, according, to Claim 2 and 5, characterised by the fact that the elements have folding walls and are made of alternating longitudinal unfolding bands 13 and folding bands 14, whereat the two halves of the folding bands are connected with the hinges 15, and the folding bands are connected with the unfolding ones with hinges 16, and the unfolding bands have from the outside back side of the element a rounded, convex surface, and from the internal, front side of the element - a rounded, concave surface, and the unfolding bands are wider than the folding bands.

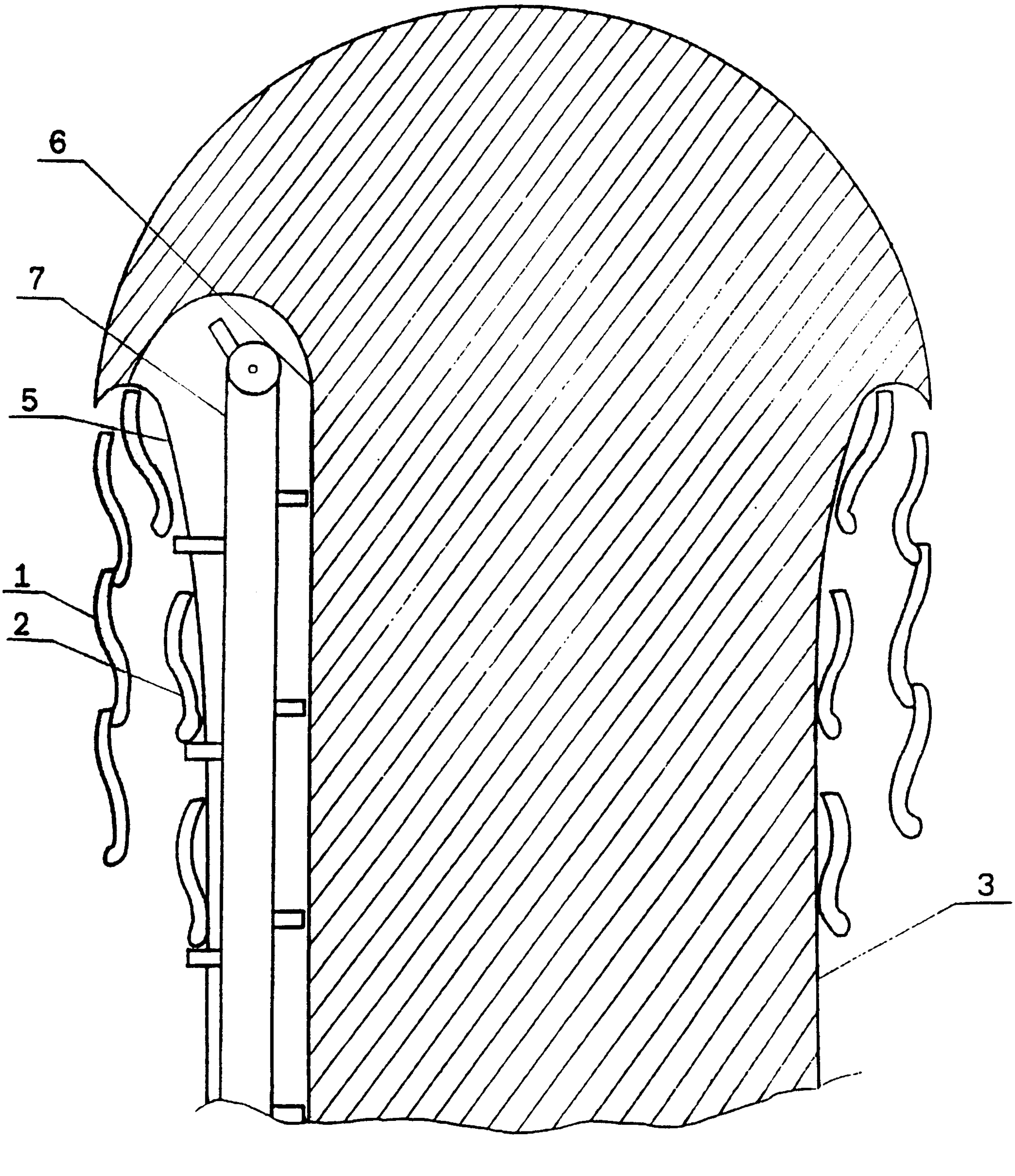

Fig.No.1

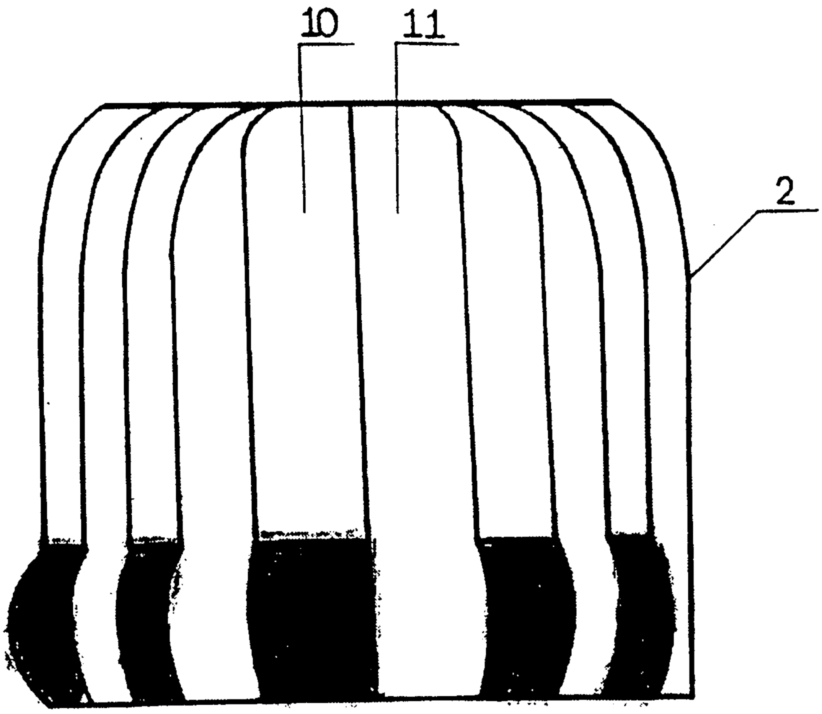

Fig.No.2

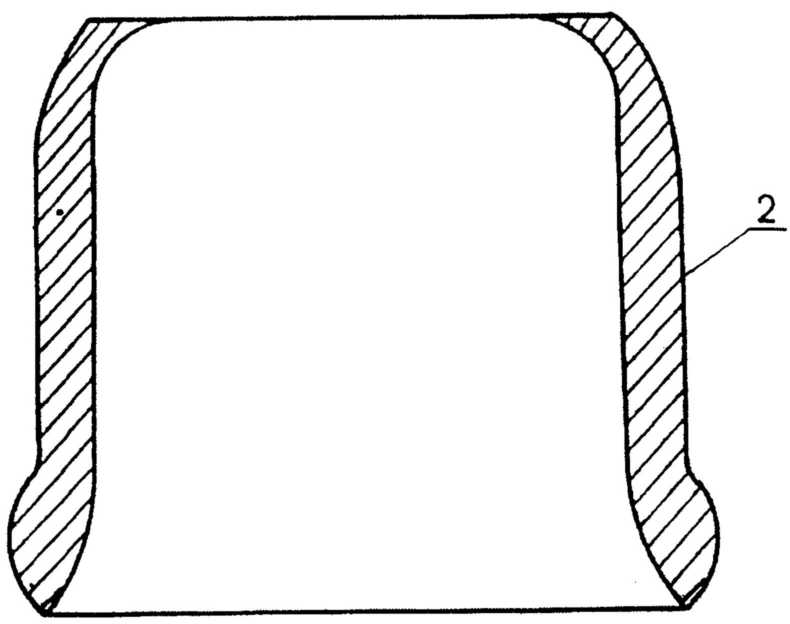

Fig.No.3

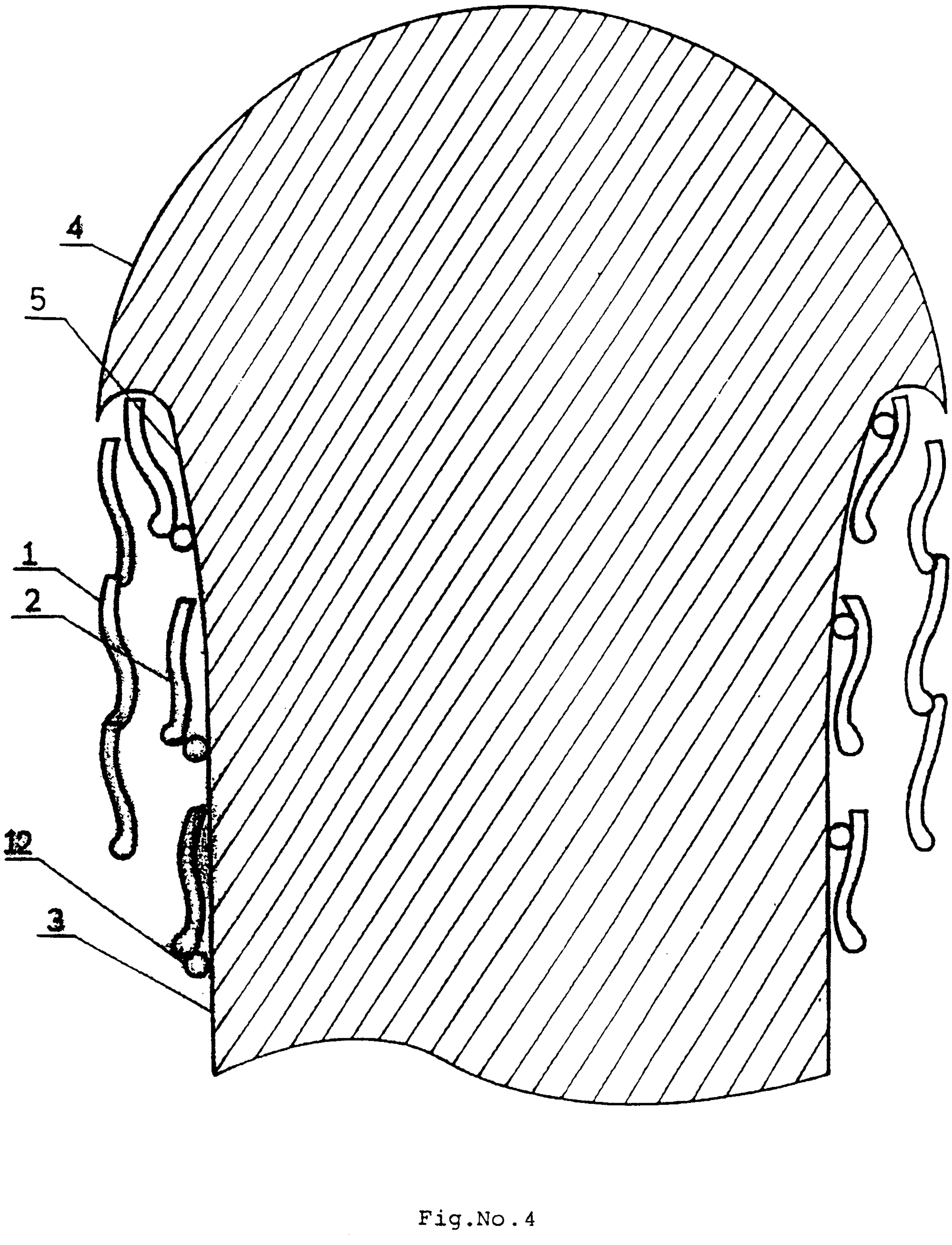

Fig.No.4

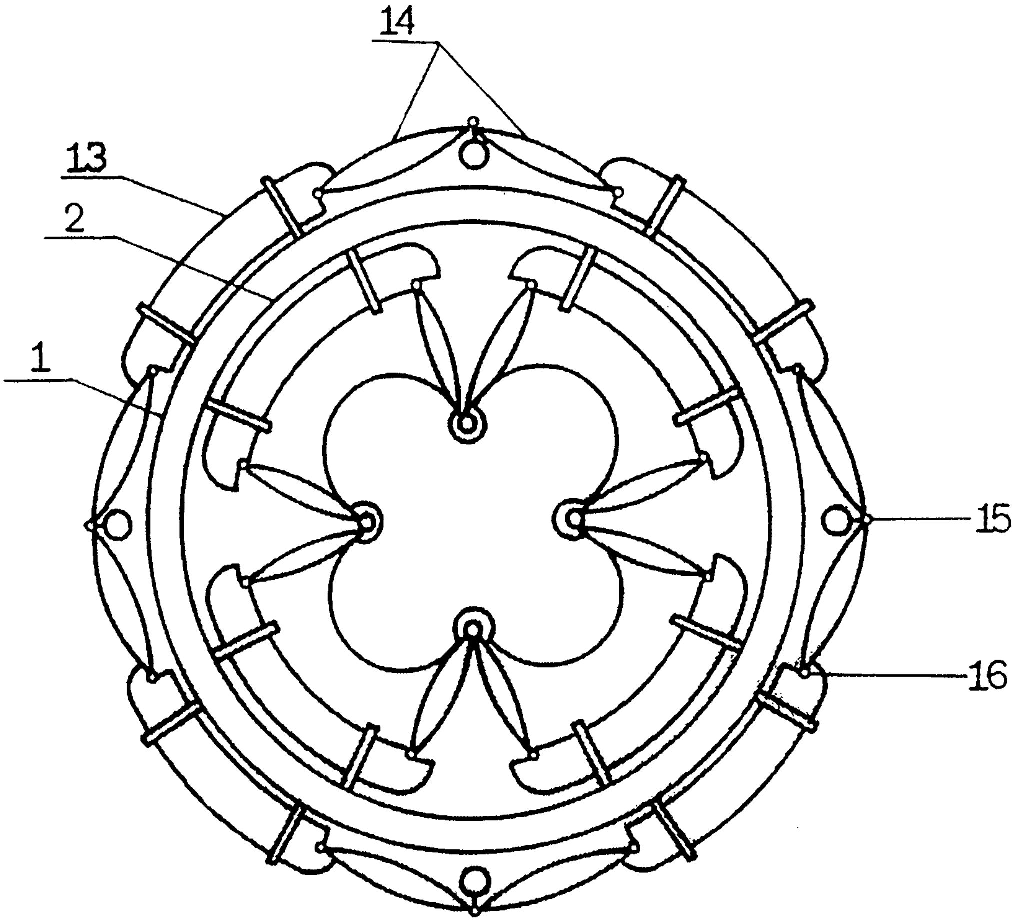

Fig.No.5