

### Band-shaped Occlusion Means

The invention relates to an implant for vascular applications that can be transported by means of a catheter and is intended in particular to influence the blood flow in the area of arteriovenous malformations, such as fistulas and aneurysms, to fill the saclike dilation of the malformation and to promote thrombus formation.

Aneurysms are usually saclike dilatations of the vessel wall and occur primarily in structurally weakened areas of the vessel wall due to the constant pressure of the blood. Therefore, the inner walls of an aneurysm are quite sensitive and susceptible to injuries that can lead to a rupture of the aneurysm sac. As a consequence, considerable health impairments, such as neurological malfunction, may occur that may even lead to the death of the patient. This may primarily be the case if such malformations are occurring in the cerebral area.

Current intravascular methods for the treatment of aneurysms are sufficiently known and in particular pursue two approaches. Either the aneurysm is filled with an occlusion means, with a variety of filling materials and techniques being known from the state of the art here, or access to the aneurysm, such as the neck of an aciniform aneurysm, is closed off from the blood vessel side making use of stent-like implants for this purpose. Both methods serve to reduce the blood flow into the aneurysm and in this way alleviate the pressure acting on the aneurysm, ideally eliminating it.

The filling material, usually platinum coils, is intended to fill the sac of the aneurysm and subsequently undergoes thrombogenesis forming into a more or less compact structure within the aneurysm. There are two problems of this treatment method that may lead to disadvantages encountered in the progression of the

disease. On the one hand, the aneurysm is insufficiently filled, which allows the blood supply to the aneurysm to continue and thus results in the pressure to further act on its inner wall. The danger of a continuous expansion of the aneurysm and finally its rupture remains, albeit in an attenuated form. On the other hand, this treatment method is only suitable for aneurysms with a relatively narrow neck – so-called aciniform aneurysms – as otherwise there is the risk that the coils protrude from a wide aneurysm neck into the blood vessel and thrombogenize there, which can lead to occlusions. In the worst case, a coil is completely washed out of the aneurysm and causes vessels to be occluded elsewhere.

- 10 To keep the coils in place in the aneurysm sac, the neck of the aneurysm is often additionally covered with a special stent.

Another intravascular treatment approach focusses on so-called flow diverters. These implants are similar in appearance to stents that are used in the treatment of stenosis. However, since the purpose of the flow diverters is not to keep a vessel open, but to obstruct access to the aneurysm on the side of the blood vessel, the mesh width is very narrow; alternatively, implants of this kind are coated with a membrane. The disadvantage of these implants is that there is a risk that existing side branches in the immediate vicinity of the aneurysm to be treated may sometimes be covered as well and thus closed off in the medium or long term.

- 20 In WO 2012/034135 A1 an implant has been disclosed that – in various embodiments – takes on a three-dimensional, almost spherical shape when it is liberated within the aneurysm and in this way fills the aneurysm. The basic material for the three-dimensional implant is in any case a mesh-like fabric, the embodiment examples and figures are all based on a tubular braiding consisting of shape memory material.

This means for the expanded, three-dimensional state of the implant that sometimes four or more fabric layers are arranged on top of each other so that an unfavorable stiffness is conferred to the almost round implant. Due to the fact that aneurysms are rarely absolutely round, a three-dimensional implant should be able to adapt to the morphology of the aneurysm in the best possible way. What is more, the implant is too voluminous for small-caliber catheters.

It is, therefore, the object of the present invention to provide an occlusion means for the intrasaccular treatment of a vascular aneurysm which, after expansion, takes on a defined, yet at the same time as flexible three-dimensional shape as possible. In addition, the implant is intended to promote the formation of thrombus within the aneurysm and to keep other treatment options open.

As proposed by the invention, this objective is achieved by the provision of an implant of the kind first mentioned above, in which the occlusion unit takes on a three-dimensional shape after expansion and subsequently is separated from the insertion unit by known techniques of mechanical, electrolytic or thermal detachment from or dissolution of the connection point. The occlusion unit consists of a framework formed from a plurality of struts with a covering spanned between them. The framework can be formed from a variety of wires or obtained by laser cutting. In any case, the material should have shape memory properties, in particular nitinol is conceivable here. The covering is preferably a polymer membrane, especially a nanomembrane obtained by electrospinning, but any other suitable membrane or covering, for example made of a plurality of braided or non-braided wires, is also conceivable. The wires in turn may also be covered with a membrane.

In a first embodiment, the occlusion unit in the stretched arrangement is provided with a central spine and has one or a plurality of arch struts attached to it. Spine and/or arch strut(s) consist of a shape memory material, for example of nitinol. They can also be made of other materials, such as polymers.

The central spine may have a spherical or helical shape imprinted on it, but any other shape is also conceivable. Preference is given to any shapes and forms that lead to the desired three-dimensional design of the implant and prove to be advantageous for intrasaccular expansion. This includes in particular forms and shapes in which the proximal and distal end of the occlusion unit reach into the lumen of the expanded occlusion unit having been placed into the aneurysm sac with a view to preventing injury to the wall of the aneurysm.

When in its stretched or elongated state, the shape of the implant can be supported by an additional supporting wire which can be retracted after implantation. Such an arrangement can simplify the navigation of the stretched implant by

means of a catheter. During transport, the support wire runs parallel to the implant and has no three-dimensional shape imprinted on it.

In a variant of the first embodiment, the spine in its stretched/elongated state can also be a coil capable of being stretched to at least the length of an arch strut. In this case, the support wire can pass centrally through the core of the coil and fix and keep the coil at the desired elongation. After expansion, the support wire is retractable and enables the spine to assume its three-dimensional memory shape and does not remain in the implant. The shape characteristics of the coil are in accordance with those of the solid variant described hereinbefore.

In another variant of the first embodiment the spine can be provided in the form of a tube. In this case, the supporting wire can pass centrally through the tube and in this way keep the tube in its stretched state. After expansion, the supporting wire is retractable and thus enables the tubular spine to assume its three-dimensional memory shape and does not remain in the implant. The shape characteristics of the tube are in accordance with those of the solid variant described above.

The arch strut or arch struts can have a sinusoidal configuration when in (partially) expanded condition. If one imagines an arch strut in a coordinate system, the axial spine forms the x-axis and the arch strut forms the sine curve. At the intersections of axial spine and arch strut, this arch strut can be secured to the spine. The shape formed by the axial spine and a curve of the superimposed arch strut is hereinafter referred to as wing. If one refers – for illustrative purposes only – to a sine wave, the curve of the arch strut corresponds to half a sine wave and the corresponding section of the spine to half a period length. For simplification and with respect to the area of the wing, only the spine section and the curve of the arch struts are to be referred to hereinafter. Likewise, the size of a wing shall be defined below by the ratio of its width (of the axial spine section) to its length (the maximum amplitude of the corresponding section of the arch strut curve).

In the event the occlusion unit consists of a spine and only one arch strut, 2 to 30, preferably 4 to 10 of these wings are formed. However, the number of wings also depends on the size of the implant. It may prove to be expedient to manufacture

implants having larger diameters suited for large aneurysms, even with more than 30 wings.

In another variant of the first embodiment, two arch struts can also be attached to a spine in such a way that the wings are alternately arranged. In this case, the second arch strut is arranged in particular axisymmetrically with respect to the axial spine. The wings formed by both arch struts are preferred, but not necessarily to lie in one plane. In the event the occlusion unit consists of a spine and two arch struts, 4 to 40, preferably 8 to 20 of these wings are formed. Embodiments comprising 40 or more wings are conceivable for implants having a large diameter to suit large aneurysms.

Conceivable as well are embodiments comprising a plurality of arch struts being provided with a plurality of wings. It is also conceivable that the wings do not lie in a single plane but are arranged for example spirally or in another way around the spine in order to achieve the desired three-dimensional shape in the expanded state.

The wings can be of the same or different sizes. If they are arranged so as to be sinusoidal, the amplitude and/or period length may decrease from proximal to distal – or vice versa. An alternating size variation or an arrangement that follows another pattern is also conceivable.

Aside from the sinusoidal form all other shapes are also conceivable.

The size of a wing as defined by the ratio of the axial spine section to the maximum amplitude of the pertinent section of the arch strut curve varies depending on the relevant embodiment.

The length of a wing will as a rule not deviate significantly from  $\frac{1}{4}(2\pi r)$ , where  $r=d/2$  and  $d$  is the diameter of the implant. Individual wings of the same implant may also deviate more strongly from this length if this is advantageous with respect to creating the desired three-dimensional shape.

The width of the corresponding spine section depends on the number of wings to be provided in the implant. If all wings are assumed to be of the same width, this means a width of  $(2\pi r)/2n$  for  $n$  wings in an alternating arrangement and  $(2\pi r)/n$  for  $n$  wings in an opposite arrangement. In the event individual wings overlap, the width may reduce further. Individual sections of the same implant may also deviate more strongly from this width if this is advantageous with respect to creating the desired three-dimensional shape.

The area of the wings is provided with a covering. This covering consists of a polymer membrane, preferably a polyurethane film or a nanomembrane of polycarbonate urethane (PCU), which is produced by electrospinning. Said membrane can be fixed to the arch strut and axial wire or just to the arch strut. In case the axial wire is designed as a coil, it is advisable to attach the membrane exclusively to the arch strut. However, a covering consisting of a polymer mesh, polymer threads, wires or a wire grid or wire braiding is also conceivable and possible.

With a view to increasing the thrombogenicity of the implant, thrombogenic materials, such as nylon filaments, can be spun or braided into the membrane. The membrane, the covering or, as the case may be, the arch struts or the axial wire can be coated with thrombogenic substances.

Aimed at stabilizing the membrane, the nylon filaments can be attached with one end each to the arch strut and/or axial spine. In a preferred embodiment, the filaments extend perpendicularly to the spine. Nevertheless, any other run is also conceivable. In another preferred embodiment, the filaments extend in parallel to the axial spine and are fixed at their ends only to the arch strut. Moreover, embodiments may be used that combine both options.

In case the spine is designed in the form of a coil, it is recommendable to attach the filaments exclusively to the arch strut.

In its expanded form the occlusion unit is of three-dimensional shape. In this context, ball-shaped, spherical or even ovoid figures are possible. Amorphous forms are also conceivable, as are helical structures. In expanded three-dimensional

shape, the wings of the occlusion unit may overlap but need not necessarily overlap.

To bring the occlusion unit into a stretched/elongated configuration as needed for navigation by means of the catheter, the wings must be placed against the spine.

- 5 Various options can be used for this purpose. As described hereinbefore, the spine can be provided in the form of a coil or spiral capable of being stretched to the length of the arch struts. It would also be conceivable that the arch struts are movably attached to the spine or that the wings are rolled up around the spine.

- 10 In a second embodiment, the occlusion unit consists of several struts with a covering spanned between them. In particular, this covering may consist of a polymer membrane, preferably a nanomembrane, which is produced by electrospinning. However, a covering consisting of a polymer film, a polymer braiding, polymer threads, wires or a wire grid or wire braiding is also conceivable and possible. In case the covering is a polymer membrane, a polyurethane in the form of a film or  
15 an electrospun fabric is particularly suitable. Preferably, such a polyurethane film is particularly thin, for example has a thickness of about 25nm.

- In the stretched/elongated form required for transportation within the catheter, the struts are arranged almost parallelly. The two outermost struts, that could also be referred to as frame struts, form the outer frame of the occlusion unit. The inter-  
20 mediately situated struts, which could also be referred to as intermediate struts, are conducive to forming the three-dimensional structure of the expanded occlusion unit.

- With a view to increasing the thrombogenicity of the implant, thrombogenic materials, such as nylon filaments, can be spun into the covering. The covering or, if  
25 thought expedient, the struts can also be coated with thrombogenic substances.

After expansion has been completed, the struts form lined-up subunits whose three-dimensional structure is shell-like. Between the subunits and at the distal and proximal end of the occlusion unit, the struts are arranged so as to be directly adjacent to each other. At these points, hereinafter referred to as interspaces, the

struts may lie adjacent to each other in unconnected form, may be twisted, may intersect, be welded or otherwise secured.

5 All struts forming the subunits pass through the entire occlusion unit from proximal to distal. In the event of laser-cut frames, these are as a rule cut from a single part, which may also be a tube. However, also conceivable are embodiments in which the individual subunits are manufactured separately and are only connected linearly to one another by means of additional wires.

10 After expansion has taken place, the shell-like subunits in their entirety form a spherical shape, which in particular is ball-shaped or ovoid in shape. Other forms are conceivable as well.

15 In a preferred variant of the second embodiment of the implant proposed by the invention, the framework of the occlusion unit consists of 4 struts. Moreover, the relevant occlusion unit preferably consists of 6 subunits. It may be considered expedient to produce implants of large size with significantly more than 4 struts and 6 subunits. Conceivable are embodiments comprising up to 12 struts and 20 subunits for implants meant to treat large aneurysms.

The shape of the subunits can be identical, i.e. all subunits of the occlusion unit have the same shape and size. However, embodiments are conceivable in which this is not the case.

20 It is particularly conceivable that the subunit located at the proximal and distal ends may have a different shape, which, for example, may prove to be beneficial for expansion, catheter navigation and guidance or the fabrication of the implant proposed by the invention.

25 It is moreover conceivable to have embodiments in which several subunits may differ, for example through a continuous or alternating or otherwise determined increase or decrease in size from one end of the implant to the other.

In an alternative embodiment, the occlusion unit of the inventive implant consists of a single strut or an occlusion coil.

Should the occlusion unit consist of a single strut, this is preferably a single wire made of a material having shape-memory characteristics, with all that has been  
5 described so far with respect to the materials of the embodiments mentioned hereinbefore applying to this alternative embodiment as well. The wire is coated with a membrane, in particular with a nanomembrane produced by an electrospinning process. In a first configuration that involves transportation by means of the catheter, the wire is stretched linearly. In a second configuration which is impressed  
10 on the shape memory material, the wire takes on its three-dimensional spatial structure after having been released from the catheter. This three-dimensional shape can be spherical or ovoid according to the embodiments described hereinbefore, however, it is also possible to have convoluted, helical or other forms that are suitable for filling a sac-like structure in single, plural or multiple number.

15 If the occlusion unit is a coil, said coil being also covered with a membrane, in particular a nanomembrane produced by an electrospinning process. The membrane covers the outside of the coil in a preferred embodiment in a socklike fashion from its distal to its proximal end, with the membrane adhering to the coil surface. Alternatively, a conceivable fixation method is to secure the membrane at  
20 the distal and proximal end of the occlusion unit. In this manner, the membrane is kept slightly movable on the coil surface and allows the flexibility of the implant to be maintained. At the same time, it acts as a stretch resistance element that prevents the coil from losing its primary shape. In additional embodiments, the membrane can also be provided to cover the coil only partially. It is also conceivable  
25 that the membrane is not only applied to the outer surface of the coil, but also to its inner surface or parts thereof.

The coil consists of a wire made of platinum or a platinum alloy, in particular a platinum-iridium alloy. In the interior of the coil there may be a wire of shape memory material that gives the coil a secondary three-dimensional shape after  
30 said coil has been released from the catheter. At the same time, the inner wire serves as a stretch resistance element, whereby the stretching resistance is further improved by the application of a membrane as proposed by the invention.

The three-dimensional shape of the coil can be spherical or ovoid according to the embodiments described hereinbefore, however, it is also possible to have convoluted, helical – in the form of a coiled coil for example – or other forms that are suitable for filling a sac-like structure in single, plural or multiple number.

- 5 With a view to increasing the thrombogenicity of the implant, thrombogenic materials can be spun into the membrane such as nylon filaments, for example. The covering or, if thought expedient, the struts and wires can also be coated with thrombogenic substances.

- 10 In all other respects, all statements made in connection with the embodiments mentioned hereinbefore, in particular also regarding the material of the membrane or other additional substances, apply to this embodiment as well.

- 15 The disadvantages of coils as filler elements for aneurysms as they have been described at the beginning are greatly reduced by coating with a membrane of the type detailed hereinbefore. The coating or covering of the wires or coils of the occlusion unit according to the invention means that the expanded occlusion unit is anchored much better in the aneurysm sac, and, furthermore, the formation of a thrombus is also significantly accelerated.

Both effects are based on the greatly increased surface area of an implant covered with a nanomembrane in comparison to an uncoated implant.

- 20 The invention is now described in detail as follows with reference being made to the figures showing the respective embodiments, where

- 25 Figure 1 shows a first embodiment of occlusion unit 1 of the implant according to the invention in partially expanded view external to a catheter consisting of an axial spine 2, an arch strut 5 with covering 6, and nylon filaments 7, 10,

Figure 2 is a schematic drawing of a first variant of the second embodiment 13 of the occlusion unit comprising four uniformly designed subunits 14 in partially expanded view external to a catheter,

5 Figure 3 is a schematic drawing of the second embodiment 13 of the occlusion unit according to the invention in fully expanded view 18 external to the catheter,

Figure 4 is a schematic drawing of a second variant of the second embodiment 13 in partially expanded view external to a catheter, with six subunits 14,

10 Figure 5 corresponds to Figure 4, with the framework solely being formed by the frame struts 16.

Figure 1 illustrates the first embodiment 1 of the occlusion unit of the implant proposed by the invention in partially expanded, stretched, two-dimensional view situated outside of the catheter, without the final three-dimensional shape being assumed. The centrally extending axial spine 2 with proximal 3 and distal 4 ends, an arch strut 5 forming the wings 5a with membrane 6 and nylon filaments 7, 10 which – in the case of arrangement 7 perpendicular to the spine 2 – are fastened to the arch strut 5, 8 and to the spine 2, 9, or in the case of arrangement 10 run parallel to the axial strut 2 with both ends 11, 12 being secured to the arch strut 5.

20 Figure 2 is a schematic drawing of a first variant of the second embodiment 13 of the implant according to the invention in partially expanded, stretched, two-dimensional view situated outside of the placement catheter, without the final three-dimensional shape being assumed (see Figure 3, numeral 18). The four uniformly designed subunits 14 are formed by struts 16, 17, which are provided with a covering 6. The frame of the occlusion unit is formed by two frame struts 16. Two intermediate struts 17 arranged between the frame struts 16 are used for further three-dimensional shaping, said intermediate struts lie side by side in the spaces 15 between the subunits 14 and at the respective proximal 3 and distal 4 ends or are connected to each other.

Figure 3 is a schematic drawing of the second embodiment 13 of the implant proposed by the invention in expanded view 18 situated external to the catheter. The implant has taken on its final three-dimensional shape. The sphere is formed by the frame 16 and intermediate struts 17 and by the covering 6, which is spanned  
5 between them. The subunits form individual spherical shell segments that join to form into a ball.

Figure 4 illustrates schematically a second variant of the second embodiment 13 of the implant according to the invention in partially expanded, stretched, two-dimensional view situated outside of the catheter, without the final three-dimensional shape (see Figure 3, numeral 18) being assumed. The six subunits 14 of  
10 this embodiment are not identical with each other. The first proximal and first distal subunits differ from the four subunits arranged in between in that the first proximal subunit has a pointed configuration towards its proximal end and the first distal subunit has a pointed configuration towards its distal end. The four subunits arranged in between are identical in shape. The subunits are formed by struts 16,  
15 17, which have a covering which is not shown in this illustration. The frame of the occlusion unit is formed by two frame struts 16. Two intermediate struts 17 arranged between the frame struts 16 are used for further three-dimensional shaping, said intermediate struts lie side by side in the spaces 15 between the subunits 14 and at the respective proximal 3 and distal 4 ends or are connected to  
20 each other.

Figure 5 corresponds to Figure 4, with the framework solely being formed by the frame struts 16.

### Claims

1. Implant for treating arteriovenous malformations, in particular aneurysms, consisting of an insertion unit and an occlusion unit (1, 13) separable there-  
5 from, with the occlusion unit (1) consisting of several subunits (5a, 14), with the subunits (5a, 14) comprising a framework having shape memory properties and being formed from wire or produced by laser cutting, wherein the framework is constructed of struts (5, 16, 17) and the occlusion unit (1, 13) being provided with a first stretched arrangement suited for transportation  
10 by means of a catheter and a second expanded arrangement after exit from the catheter, wherein the implant takes on a three-dimensional shape in the expanded arrangement of the occlusion unit (1, 13), characterized in that a covering (6) is located between the struts (5, 16, 17) of the framework of the occlusion unit (1, 13).
- 15 2. Implant according to claim 1, characterized in that the covering (6) is a membrane, in particular a membrane made of polymer material.
3. Implant according to claim 2, characterized in that the membrane (6) is a nanomembrane produced by an electrospinning process.
4. Implant according to claim 1, characterized in that the covering (6) is com-  
20 posed of wires, wherein the wires may or may not be braided.
5. Implant according to any one of the preceding claims, characterized in that the framework of the occlusion unit (1) consists of a central axial spine (2) and one or more arch struts (5) attached thereto, wherein the axial spine (2) can be supported during placement navigation by means of the catheter  
25 and for its subsequent release in the aneurysm in the stretched state by an additional supporting wire which can be removed after liberation of the im-plant.

6. Implant according to claim 5, characterized in that in the expanded state the arch struts (5) form wings (5a) arranged opposite or alternately in sinusoidal or other form, with the axial spine (2) corresponding to the x-axis and the arch strut (5) corresponding to a function curve, and the surface of a wing (5a) corresponding to the surface which lies between two intersection points of the function curve with the x-axis and is enclosed by the corresponding sections of the function curve and the x-axis.  
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7. Implant according to claim 6, characterized in that at least 3 wings (5a) are located on the axial spine (2) when arranged alternately and at least 6 wings (5a) are located on the spine when arranged oppositely.  
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8. Implant according to claim 7, characterized in that the wings (5a) have an identical shape and/or size in the expanded state.
9. Implant according to claim 7, characterized in that the wings (5a) in the expanded state have a different shape and/or size, and in particular that with a sinusoidal shape the amplitude and/or the period length decreases from proximal to distal or from distal to proximal.  
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10. Implant according to claim 7, characterized in that the wings (5a) have a different shape and/or size in the expanded state, wherein the shape and/or size alternating periodically or changing according to a different pattern.
- 20 11. Implant according to any one of claims 5 to 10, characterized in that the surface (5a) generated by the arch strut (5) in the expanded state is additionally reinforced by one or a plurality of filaments (7, 10) which are attached solely to the arch strut and preferably run parallel (10) to the spine.
- 25 12. An implant according to any one of claims 5 to 10, characterized in that the surface (5a) generated by the arch strut (5) in the expanded state is reinforced by one or a plurality of filaments (7, 10), wherein one end of the respective filament being connected to the arch strut (5) and the other end to the spine (2), so that the filament is preferably aligned perpendicularly (7) to the spine.

13. Implant in the form of a combination of claims 11 and 12.
14. Implant according to claim 11, characterized in that the spine (2) is an expandable coil or spiral, wherein the extended length in the stretched state for transportation by means of a catheter approximately corresponds to the length of an arch strut (5) in the stretched state.
15. Implant according to any one of claims 11 to 14, characterized in that the expansion unit (1) forms a spherical or ovoid shape in the expanded state.
16. Implant according to any one of claims 1 to 4, characterized in that the framework of the occlusion unit (13) consists of at least 2 struts (16, 17).
17. Implant according to claim 16, characterized in that the struts (16, 17) of the occlusion unit (13) extend in the stretched state substantially parallel to one another and, in the expanded state, form several linearly arranged three-dimensional subunits (14), with the struts (16, 17) lying proximally (3) and distally (4) and in the regions between the subunits (15) next to one another.
18. Implant according to claim 17, characterized in that the struts (16, 17) are connected to one another at the points of contact (3, 4, 15), in particular due to the struts crossing, being twisted and/or welded to one another.
19. Implant according to claim 17 or 18, characterized in that the occlusion unit (13) forms at least 2 subunits (14).
20. Implant according to claim 19, characterized in that the subunits (14) among themselves have an identical shape and/or size.
21. Implant according to claim 19, characterized in that the subunits (14) are not of identical shape and/or size among themselves, with in particular the first subunit arranged at the proximal (14a) and distal (14b) ends having a shape and/or size that differs from that of the other subunits (14).

22. Implant according to claim 19, characterized in that the subunits (14) are not of identical shape and/or size among themselves, with the subunits changing their shape and size continuously or alternately from the proximal to the distal end or according to another pattern.
- 5 23. Implant according to any one of claims 20 to 22, characterized in that the individual subunits (14) are shell-shaped after expansion and form a spherical or ovoid shape (18) in their final entirety.
24. Implant according to one or several of the preceding claims, characterized in that the membrane (6) contains thrombogenic additives.
- 10 25. Implant according to claim 24, characterized in that the thrombogenic additives are in particular nylon filaments.
26. Implant according to any one of the preceding claims, characterized in that the detachment mechanism is selected from mechanical, electrolytic or thermal separation methods.
- 15 27. Implant for treating arteriovenous malformations, in particular aneurysms, consisting of an insertion unit and an occlusion unit separable therefrom, wherein the occlusion unit is a strut or an occlusion coil with shape memory properties, which is formed from wire or produced by laser cutting and has a first stretched arrangement for navigation by means of a catheter and a  
20 second expanded arrangement after exit from the catheter, wherein the implant takes on a three-dimensional shape in the expanded arrangement of the occlusion unit, characterized in that there is a covering arranged around the strut or occlusion coil.
28. Implant according to claim 27, characterized in that the covering is a membrane, in particular a membrane made of polymer material.  
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29. Implant according to claim 28, characterized in that the membrane is a nanomembrane produced by an electrospinning process.

- 30. Implant according to claim 29, characterized in that the membrane contains thrombogenic additives.
- 31. Implant according to claim 30, characterized in that the thrombogenic additives are in particular nylon filaments.
- 5 32. Implant according to any one of claims 27 to 31, characterized in that the detachment mechanism is selected from mechanical, electrolytic or thermal separation methods.
- 33. Implant according to claims 2, 3, 28 or 29, characterized in that it is a polyurethane membrane.