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(54) **SHOCK-ABSORBING LINER FOR A PROTECTIVE HELMET AND PROTECTIVE HELMET COMPRISING SAID LINER**

(57) A shock-absorbing liner for a protective helmet, comprising at least an integrally moulded first part (2) shaped as a curved thin body and comprising a primary group (72) of ribs (6) extending in height along a same demoulding direction (X2) of said first part (2) and in length along a side (3) of said first part (2), and at least an integrally moulded second part (42) shaped as a curved thin body and comprising a secondary group (92)

of channels (8) extending in depth along a same demoulding direction (X1) of said second part (41) and in length along a side (5) of said second part (42). By translating the two parts (2, 42) one towards the other in a direction parallel to the demoulding direction (X2) they fit together, with said ribs (6) engaging into said channels (8). The invention also comprises a protective helmet provided with said liner.

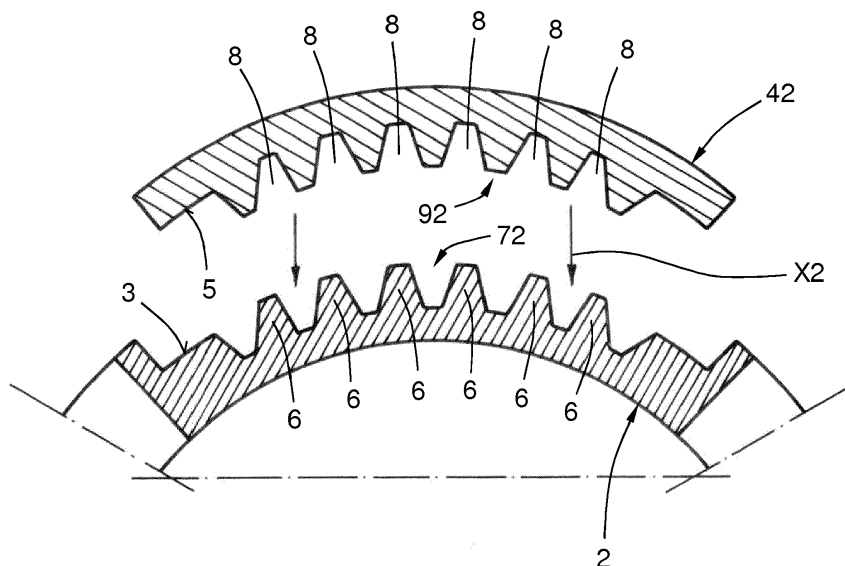


FIG. 4

DescriptionField of the Invention

[0001] The invention is comprised in the field of personal protective helmets.

[0002] More specifically, the invention relates to a shock-absorbing liner for a protective helmet, for being integrated between an outer shell of the helmet and an inner surface of said helmet aimed to face the head of the user, said shock-absorbing liner being of the type comprising:

- at least a first part shaped as a curved thin body and comprising protuberances extending from one side of said first part;
- at least a second part shaped as a curved thin body and comprising recesses on one side of said second part;

said first part and said second part fitting together, with said second part covering at least a portion of said first part and said protuberances of the first part being engaged into said recesses of the second part.

[0003] The invention also relates to a protective helmet comprising said shock-absorbing liner. The helmets to which the invention refers are personal protective helmets such as, by way of non-limiting examples, motorcycle helmets, bicycle helmets, ski helmets, climbing helmets, american football helmets, ice hockey helmets, baseball helmets, protective helmets for building or civil engineering works, police helmets, military helmets, etc.

State of the Art

[0004] US7802320 discloses a shock-absorbing liner for a protective helmet of the type indicated above, in which the protuberances of the first part are conical, each of them being oriented with an axial direction normal to an inner curved surface of the liner, and are embedded into the recesses of the second part, which are also conical and oriented in corresponding directions. This particular orientation of the conical protuberances and conical recesses, with an axial direction normal to an inner curved surface to the liner, is aimed to make the shock-absorbing materials of the parts to work mainly at compression when the helmet receives an impact on its outer shell. This is suitable, because the shock-absorbing materials of which the parts are generally made are foamed materials or the like having a high compressive strength but low tensile and shear strengths. The manufacturing process of this type of liners usually consists in moulding the first (or second) part in several sub-parts, and subsequently putting together these sub-parts in a second mould in which they integrally form the first (or second) part and in which the second (or first) part is also formed by overmoulding. As a result, the liner comprising the first part and the second part is integrally formed, one of

these parts being overmoulded on the other one.

Description of the Invention

[0005] The purpose of the invention is to provide a shock-absorbing liner on the type indicated above, that can be manufactured in a much simpler manner, and allowing a greater freedom to design the liner, the whole without a loss in the shock-absorbing performance of the liner.

[0006] This is achieved by means of a shock-absorbing liner of the type indicated above, characterized in that:

- the first part is an integrally moulded part, and the protuberances of said first part are ribs extending in height along a demoulding direction of said first part and in length along the side of said first part; said ribs being arranged in at least one primary group in which said ribs extend in height along a same demoulding direction of said first part;
- the second part is an integrally moulded part, apart from said first part, and the recesses of said second part are channels extending in depth along a demoulding direction of said second part and in length along the side of said second part; said channels being arranged in at least one secondary group in which said channels extend in depth along a same demoulding direction of said second part;
- the ribs of said at least one primary group and the channels of said at least secondary group being sized and shaped so that, by translating said first part and said second part one towards the other in a direction parallel to the demoulding direction in which said ribs of the primary group extend and the demoulding direction in which said channels of the secondary group extend, the second part matches the first part and said ribs engage into said channels.

[0007] Helmets have a shock deflecting and dispersing shell and a shock-absorbing liner. Adding ribs to the shock-absorbing liner increases its stiffness which supports the function of the outer shell, as a result the outer shell can be more flexible and therefore lighter. The structure of the ribs and channels and the overlap between the first and the secondary group are two parameters which allow optimizing the shock absorption (the way it absorbs shock) of the shock-absorbing liner.

[0008] Moreover, thanks to the arrangement according to the invention, the first part and the second part are moulded apart and can be matched to one another in order to form the shock-absorbing liner, so that the manufacturing process of the liner is much simpler. Since all the protuberances of one group extend in a single demoulding direction, these protuberances are not individually oriented in a normal direction with respect to the curvature of the liner. However, this does not imply a significant decrease of the shock-absorbing performance of the liner, because a group of protuberances can be

globally oriented in a normal direction. Furthermore, it is possible to have different groups of protuberances in the first part, each extending along a different demoulding direction, and different second parts each matching each of said groups of protuberances. This allows providing different groups of protuberances so that each group is globally oriented in a different a normal direction.

[0009] Another advantage of the invention is that different second parts, which are different for instance in the thickness or in the material of which they are made, can be alternatively matched to a same first part. This allows to easily adapting the performance of the liner, or its shape or size, to a particular design of the helmet, by simply choosing the first and second parts that are matched to form the shock-absorbing liner.

[0010] Preferred embodiments the features of which are described below have been provided based on the main invention.

[0011] In some possible embodiments, at least some of the ribs of the at least one primary group extend in straight planes, and corresponding channels of the at least one secondary group extend in corresponding straight planes. This arrangement allows absorbing the energy of an impact along predefined straight directions, so that the performance of the shock-absorbing liner can be improved for some designs of helmets. The straight planes can be parallel between them or divergent. For instance, the straight planes can extend radially from a central point. It is also envisaged that a rib, and the corresponding channel, has several portions extending each in a different straight plane.

[0012] In other possible embodiments, at least some of the ribs of the at least one primary group extend in curved planes and corresponding channels of the at least one secondary group extend in corresponding curved planes. These curved planes can be concentric circular, arched or non-uniformly curved, as well as any possible combination thereof. It is also envisaged that a rib, and the corresponding channel, has several portions combining straight planes and curved planes. Due to their multidirectional orientation, curved planes offer superior shock absorbing performance compared to straight planes for certain applications and certain sections of a helmet.

[0013] Preferably, the shock-absorbing liner comprises a plurality of said second parts, each matching said at least one first part, each second part covering a different portion of said at least one first part. This gives an increased degree of freedom for designing the first parts, since two or more second parts can be used for matching different portions of a first part. Moreover, using multiple second parts for each first part allows optimizing a helmet with various impact zones.

[0014] Preferably, the shock-absorbing liner comprises a plurality of said first parts. The first parts can be sized and shaped to be positioned side by side so that they form together a curved thin body. Optionally, a second part covers at least a portion of two or more first

parts. This gives an increased degree of freedom for designing the second parts, since two or more first parts can be used to match different portions of a second part. Moreover, using multiple first parts for a second part allows optimizing various impact zones in the helmet.

[0015] Preferably, said at least one first part comprises a plurality of primary groups of ribs, each of said primary groups having a different demoulding direction in which the ribs extend, and each of said primary groups is covered by a different second part. It is also envisaged that the least one second part comprises a plurality of secondary groups of channels, each of said secondary groups having a different demoulding direction in which the channels extend, and each of said secondary groups covers a different first part.

[0016] A first part having several primary groups of ribs extending in different demoulding directions can be moulded in one piece by using a complex mould with sliders. Similarly, a second part having several secondary groups of channels extending in different demoulding directions, can be moulded in one piece by using a complex mould with sliders. However, if one of those first or second parts is moulded in one piece, the other is moulded in several pieces so that the shock-absorbing liner can be assembled.

[0017] Preferably, the ribs have a tapered cross-sectional shape, with a decreasing width outwardly from the side of the first part, and the channels have a corresponding tapered cross-sectional shape, with a decreasing width inwardly from the side of the second part. Preferably, the tapered cross-sectional shape is a truncated triangle. A tapered cross-sectional shape of the ribs offer better shock absorbing properties than a rectangular profile

[0018] Preferably, the number of said ribs in said at least one primary group is three or more, and the number of said corresponding channels in said at least one secondary group is three or more.

[0019] In some possible embodiments, at least an insert is sandwiched between the side of the first part and the side of the second part. A sandwich construction allows further optimization of the material or the material composition of each layer. The inserts also allow extending the level of protection, for instance, protection against the effects of oblique impacts on the helmet.

[0020] Preferably, said insert is sandwiched between at least one of the ribs and the corresponding channel in which said rib engages. Inserts located between the ribs and the channels can be used for improving the shock absorption performance in small sections of the helmet or for enhancing the overall performance by applying it in larger sections.

[0021] Preferably, the first part of the shock-absorbing liner is made of a material or composition that is different from the material or composition of which the second part is made. For instance, the two parts can be made of a different polymer or from the same polymer but with different structure, such as EPS (Expanded polystyrene) or

other expanding polymer, so that the density is different. The use of different densities is a standard practice for optimizing the shock absorption and limiting the size of the outer shell of helmets. The advantage of the invention consists in that first and second parts with different material or composition can be formed and assembled in a particularly easy way, so that greater possibilities for designing the shock-absorbing liner are allowed. For instance, different second parts having the same shape but being made of a different material or composition can be provided to alternatively cover a same first part, so that a helmet manufacturer can choose the second part which is more suitable for the intended performance of the liner.

[0022] Preferably, at least one from said first part and said second part, more preferably both, is made of an expanded polymer like, for instance, EPS (expanded polystyrene) or EPP (expanded polypropylene).

[0023] The invention also comprises embodiments in which there are more parts, other than said first and second parts, that subsequently fit one over another like said first and second parts. To this aim, the second part can have ribs extending in a demoulding direction of said second part, and the liner can comprise an integrally moulded third part that has on a side channels extending in a demoulding direction of said third part, so that by translating the third part towards the second part in a direction parallel to said ribs and said channels, the third part matches the second part and said ribs engage into said channels.

[0024] The invention also relates to a protective helmet, characterised in that it comprises a shock-absorbing liner according to the invention integrated between an outer shell of the helmet and an inner surface of said helmet aimed to face the head of the user.

[0025] The invention also comprises other detail features illustrated in the following detailed description of an embodiment of the invention and in the attached drawings.

Brief Description of the Drawings

[0026] The advantages and features of the invention will be understood from the following description in which preferred embodiments of the invention are described with reference to the drawings without limiting the scope of the invention defined in claim 1.

Fig. 1 is an exploded perspective view of a first embodiment of the shock-absorbing liner.

Figs. 2 is a view corresponding to Fig. 1, in which the second parts are turned.

Fig. 3 is a sectional schematic view of a helmet comprising the shock-absorbing liner of Figs. 1 and 2. The sectional plane is vertical.

Fig. 4 is a sectional partial view with the same sectional plane than Fig. 3, showing the vertical translation direction for matching the top second part to the first part.

Fig. 5 is another sectional schematic view of the helmet, in which the sectional plane is horizontal

Fig. 6 is a sectional partial view with the same sectional plane than Fig. 5, showing the horizontal translation direction for matching the front second part to the first part.

Fig. 7 is a sectional partial view with the same sectional plane than Fig. 5, showing the horizontal translation direction for matching one of the lateral second parts to the first part.

Figs. 8 and 9 are partial perspective views of the first part, showing two possible different shapes of the ribs (the channels of the second part are not shown for the sake of simplicity; they have a corresponding shape for matching the ribs of the first part.).

Figs. 10A - 10H are top views schematically showing other possible different shapes of the ribs (the channels of the second part are not shown for the sake of simplicity; they have a corresponding shape for matching the ribs of the first part.).

Fig. 11 is a partial sectional view of the top of a helmet as in Fig. 3, illustrating the possible use of inserts sandwiched between the first part and the second part.

Detailed Description of Embodiments of the Invention

[0027] Figs. 1 to 7 show a first embodiment of a shock-absorbing liner 1 according to the invention, as well as a protective helmet (showed schematically in Figs. 3 and 5) in which said shock-absorbing liner is integrated.

[0028] The shock-absorbing liner 1 comprises one first part 2 and four second parts. The four second parts are a front second part 41, a top second part 42 and two side second parts 43. In Figs. 1 and 2 only one of the side second parts 43 is shown, the other is symmetrical as can be seen in Fig. 3.

[0029] The first part 2 and the second parts 41, 42, 43 are each an integrally moulded part shaped as a curved thin body. In the embodiment described herein, all the parts are made of EPS (Expanded polystyrene). The EPS of which the second parts 41, 42, 43 are made has a greater density than the EPS of which the first part 2 is made. However, in other possible embodiments the first and second parts can be made of any other expanded polymer different from EPS, or of any other shock-absorbing material or combination thereof, including composites. Furthermore, in other possible embodiments,

the first and second parts can differ not only in density, but also in another kind of composition like for instance the content, the distribution or the nature of fillers. In addition, material or composition of which the different second parts 41, 42, 43 are made can be the same or different.

[0030] In the embodiment depicted in the figures, the first part 2 is intended to form by itself an inner layer of a helmet. With this aim, the first part 2 is an integral part which is generally shaped to cover the head of a user. The outer side 3 of the first part 2 is provided with four primary groups of ribs 6: a front primary group 71, a top primary group 72 and two side primary groups 73 (only one of them is shown in Figs. 1 and 2). In each of said primary groups 71, 72, 73 the ribs 6 extend in height along a same demoulding direction, respectively X1, X2, X3, of the first part 2 and in length along the outer side 3 of said first part 2. For each of said primary groups 71, 72, 73 of ribs 6 of the first part 2, there is a corresponding second part 41, 42, 43 provided with a corresponding secondary group 91, 92, 93 of channels 8 extending in depth along a same demoulding direction, respectively X1, X2, X3, of said second part 41, 42, 43 and in length along the inner side 5 of said second part 41, 42, 43. The ribs 6 of each primary group 71, 72, 73 and the channels 8 of each secondary group 91, 92, 93 are sized and shaped so that, by translating each second part 41, 42, 43 towards the first part 2 in a direction X1, X2, X3 parallel to the demoulding direction in which the ribs 6 extend, and parallel to the demoulding direction in which the channels 8 extend, each second part 41, 42, 43 matches the first part 2 and the ribs 6 of each primary group 71, 72, 73 engage into the channels 8 of each corresponding secondary group 91, 92, 93. Figs. 4, 6 and 7 show the parts in a disassembled position. The demoulding direction X1, X2, X3, which is also the translating direction to assemble the parts, is indicated in these figures. The shock-absorbing liner 1 is thus assembled by coupling the second parts 41, 42, 43 and the first part 2 that fit together, so that each of the second parts 41, 42, 43 covers a different portion of the first part 2.

[0031] Figs. 3 and 5 show the shock-absorbing liner 1 integrated into a protective helmet 11. The helmet 11 is schematically depicted, so that it can have any other composition and shape. The shock-absorbing liner 1 is placed between an outer shell 12 of the helmet 11 and an inner surface 13 thereof aimed to face the head of the user. In the example shown in Fig. 3 the helmet 11 has a padding 14, so that said inner surface 13 is the inner surface of the padding 14. In other possible embodiments, the helmet neither has padding nor other kind of protective layers, and in this case the inner surface 13 is directly the inner surface of the shock-absorbing liner 1.

[0032] In the embodiment depicted in Figs. 1 to 7, the ribs 6 of each primary group 71, 72, 73 extend in parallel straight planes and the corresponding channels 8 of each secondary group 91, 92, 93 extend in corresponding parallel straight planes. Preferably the number of ribs in each

primary group 71, 72, 73 is three or more, and the number of the corresponding channels 8 in each secondary group 91, 92, 93 is three or more. In the figures, the front primary group 71 has four ribs 6 and the front secondary group 91 has four corresponding channels 8. The top primary group 72 has six ribs 6 and the top secondary group 92 has six corresponding channels 8. The side primary group 73 has five ribs 6 and the side secondary group 93 has five corresponding channels 8. The ribs 6 have a tapered cross-sectional shape, with a flat truncated top and a decreasing width outwardly from the outer side 3 of the first part 2. The channels 8 have a corresponding tapered cross-sectional shape, with a flat truncated bottom and a decreasing width inwardly from the inner side 5 of the second part 41, 42, 43. The slopes of all the ribs 6 and channels 8 within a same primary group 71, 72, 73, respectively a secondary group 91, 92, 93, are adjusted so that the normal to their surface has a component in the demoulding direction X1, X2, X3 that is always directed out of the first part 2, respectively out of the second part 41, 42, 43, in order to ensure that each of these parts can be demoulded in the demoulding direction X1, X2, X3 and that the second parts 41, 42, 43 can be assembled to the first part 2 in the same demoulding direction X1, X2, X3. For this reason, as can be seen in Figs. 4, 6 and 7, and in order to compensate the curvature of the parts, the slopes of the most eccentric ribs 6 and channels 8 are more pronounced than the ones of the central ribs 6 and channels 8 in each group.

[0033] Optionally, the first part 2, and possibly also the second parts 41, 42, 43 have openings for ventilation (not shown in the figures).

[0034] The ribs 6 and the corresponding channels 8 can have many other shapes in section, different from the ones depicted in Figs. 3-7. They can also have different shapes in the longitudinal direction. For instance, Fig. 8 shows an embodiment in which the ribs 6 of the top primary group 72 extend in curved planes, in particular in concentric circular planes. The central rib 6 has a cylindrical shape. The corresponding channels 8 of the top secondary group 92 (not shown in the figures) extend in corresponding concentric circular planes, and there is a central channel 8 with a cylindrical shape. Fig. 9 shows another possible embodiment in which the ribs 6 of the top primary group 72 extend in radial straight planes from a central point. The corresponding channels 8 of the top secondary group 92 (not shown in the figures) extend in corresponding radial straight planes from central point. Figs. 10A-10H show in a more schematic manner other possible geometries, among many others. Each of these figures 10A-10H is a schematic top view of a primary group of ribs 6 in the demoulding direction. The different geometries depicted in these figures are shown for illustration purposes. They can be implemented alone or in combination to form ribs 6 and channels 8 with different orientations and shapes in order to adjust the ratio between stiffness and absorption needed for each particular protective helmet.

[0035] Optionally, one or several inserts can be sandwiched between the outer side 3 of the first part 2 and the inner side 5 of the second part 41, 42, 43. The inserts can be of any type and material. This includes for instance a layer that extends over all or a part of the matching surface of the first part 2 and the second part 41, 42, 43, as well as a piece which is inserted in a particular location between said first and second parts. The insert can be located in any portion of the matching surface between the first part 2 and the second part 41, 42, 43, not necessarily between a rib 6 and a channel 8. In preferred embodiments, the insert is sandwiched between at least one rib 6 and the corresponding channel 8 in which said rib 6 engages. Fig. 11 shows an example in which an insert 10 is a shaped sheet that covers two ribs 6. The insert 10 can be, for instance, a sheet moulded from a composite material or from a polymer, and having a shape that matches the ribs 6.

[0036] In other possible embodiments (not shown in the figures), the shock-absorbing liner 1 has a plurality of first parts 2. Optionally, the different first parts 2 can match one another to form a composed part that is generally shaped to cover the head of the user. Optionally, a second part can comprise a plurality of secondary groups of channels 8, each of said secondary groups having a different demoulding direction in which the channels 8 extend, and each of said secondary groups covers a different first part 2. These possible embodiments have a general configuration which is opposite to the one depicted in Figs. 1-7. In this case, the second part has different secondary groups and several first parts are provided, each of said first parts covering a different portion of the second part corresponding to each secondary group.

[0037] More generally, the invention is not limited by the number of first parts, the number of primary groups of ribs in each first part, the number of second parts and the number of secondary groups of channels in each second part. They can be freely combined to design a variety of particular shock-absorbing liners intended to be integrated into a variety of protective helmets.

Claims

1. A shock-absorbing liner (1) for a protective helmet, for being integrated between an outer shell of the helmet and an inner surface of said helmet aimed to face the head of the user, said shock-absorbing liner (1) comprising:

- at least a first part (2) shaped as a curved thin body and comprising protuberances extending from one side (3) of said first part (2);
- at least a second part (41, 42, 43) shaped as a curved thin body and comprising recesses on one side (5) of said second part (41, 42, 43);

said first part (2) and said second part (41, 42, 43) fitting together, with said second part (41, 42, 43) covering at least a portion of said first part (2) and said protuberances of the first part (2) being engaged into said recesses of the second part (41, 42, 43); **characterised in that:**

- said first part (2) is an integrally moulded part, and said protuberances of the first part (2) are ribs (6) extending in height along a demoulding direction of said first part (2) and in length along the side (3) of said first part (2); said ribs (6) being arranged in at least one primary group (71, 72, 73) in which said ribs (6) extend in height along a same demoulding direction (X1, X2, X3) of said first part (2);
- said second part (41, 42, 43) is an integrally moulded part, apart from said first part (2), and said recesses of the second part (41, 42, 43) are channels (8) extending in depth along a demoulding direction (X1, X2, X3) of said second part (4) and in length along the side (5) of said second part (4); said channels (8) being arranged in at least one secondary group (91, 92, 93) in which said channels (8) extend in depth along a same demoulding direction of said second part (4);
- the ribs (6) of said at least one primary group (71, 72, 73) and the channels (8) of said at least one secondary group (91, 92, 93) being sized and shaped so that, by translating said first part (2) and said second part (41, 42, 43) one towards the other in a direction parallel to the demoulding direction (X1, X2, X3) in which said ribs (6) of the primary group (7) extend and the demoulding direction (X1, X2, X3) in which said channels (8) of the secondary group (91, 92, 93) extend, said second part (41, 42, 43) matches said first part (2) and said ribs (6) engage into said channels (8).

2. A shock-absorbing liner (1) according to claim 1, **characterised in that** at least some of the ribs (6) of said at least one primary group (71, 72, 73) extend in straight planes and corresponding channels (8) of said at least one secondary group (91, 92, 93) extend in corresponding straight planes.

3. A shock-absorbing liner (1) according to any one of claims 1 or 2, **characterised in that** at least some of the ribs (6) of said at least one primary group (71) extend in curved planes and corresponding channels (8) of said at least one secondary group extend in corresponding curved planes.

4. A shock-absorbing liner (1) according to any one of claims 1 to 3, **characterised in that** it comprises a plurality of said second parts (41, 42, 43), each

matching said at least one first part (2), each second part (41, 42, 43) covering a different portion of said at least one first part (2).

5. A shock-absorbing liner (1) according to claim 4, **characterised in that** said at least a first part (2) comprises a plurality of primary groups (71, 72, 73) of ribs (6), each of said primary groups (71, 72, 73) having a different demoulding direction (X1, X2, X3) in which the ribs (6) extend, and each of said primary groups (71, 72, 73) is covered by a different second part (41, 42, 43). 5
6. A shock-absorbing liner (1) according to any one of claims 1 to 5, **characterised in that** it comprises a plurality of said first parts (2). 10
7. A shock-absorbing liner (1) according to claim 6, **characterised in that** said at least one second part comprises a plurality of secondary groups of channels (8), each of said secondary groups having a different demoulding direction in which the channels (8) extend, and each of said secondary groups covers a different first part (2). 15
8. A shock-absorbing line (1) according to any one of claims 1 to 7, **characterised in that** said ribs (6) have a tapered cross-sectional shape, with a decreasing width outwardly from the side (3) of the first part (2), and said channels (8) have a corresponding tapered cross-sectional shape, with a decreasing width inwardly from the side (5) of the second part (41, 42, 43). 20
9. A shock-absorbing liner (1) according to any one of claims 1 to 8, **characterised in that** the number of said ribs (6) in said at least one primary group (71, 72, 73) is three or more, and the number of said corresponding channels (8) in said at least one secondary group (91, 92, 93) is three or more. 25
10. A shock-absorbing liner (1) according to any one of claims 1 to 9, **characterised in that** at least an insert (10) is sandwiched between the side (3) of the first part (2) and the side (5) of the second part (41, 42, 43). 30
11. A shock-absorbing liner (1) according to claim 10, **characterised in that** said insert (10) is sandwiched between at least one of said ribs (6) and the corresponding channel (8) in which said rib (6) engages. 35
12. A shock-absorbing liner (1) according to any one of claims 1 to 11, **characterised in that** said first part (2) is made of a material or composition that is different from the material or composition of which said second part (41, 42, 43) is made. 40

13. A shock-absorbing liner (1) according to any one of claims 1 to 12, **characterised in that** at least one from said first part (2) and said second part (41, 42, 43), preferably both, is made of an expanded polymer. 45

14. A protective helmet (11), **characterised in that** it comprises a shock-absorbing liner (1) according to any one of claims 1 to 13 which is integrated between an outer shell (12) of the helmet (11) and an inner surface (13) of said helmet (11) aimed to face the head of the user. 50

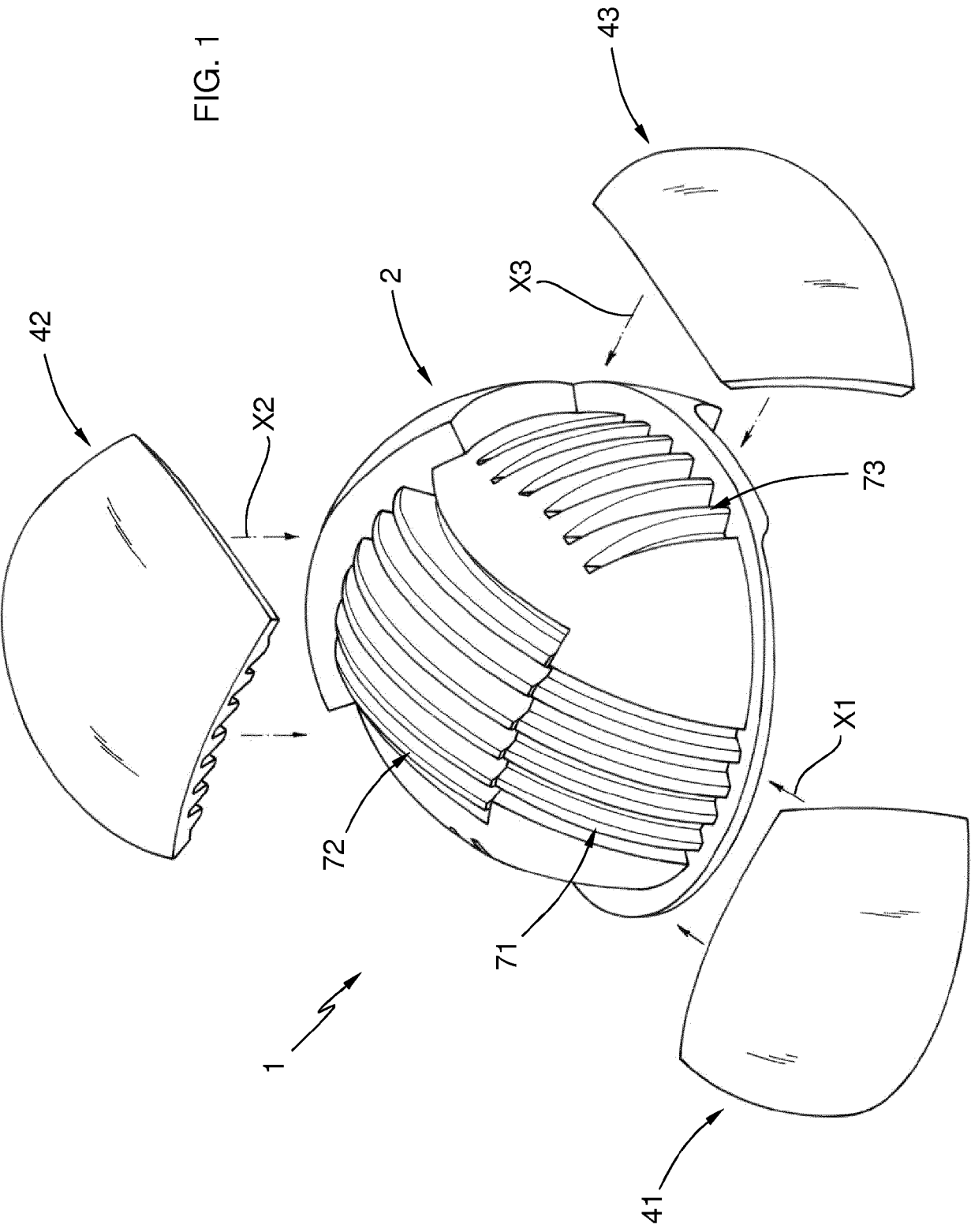
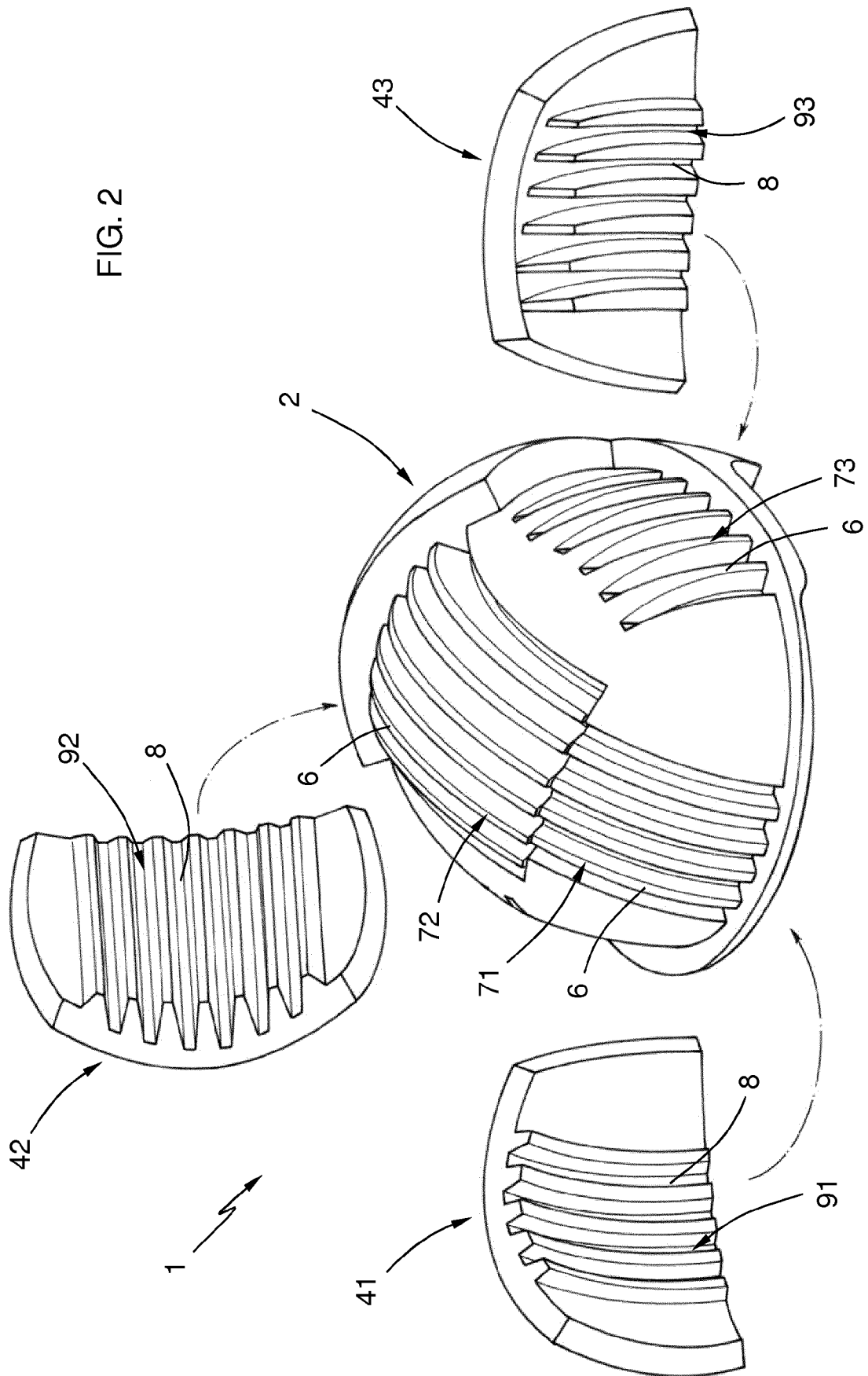


FIG. 2



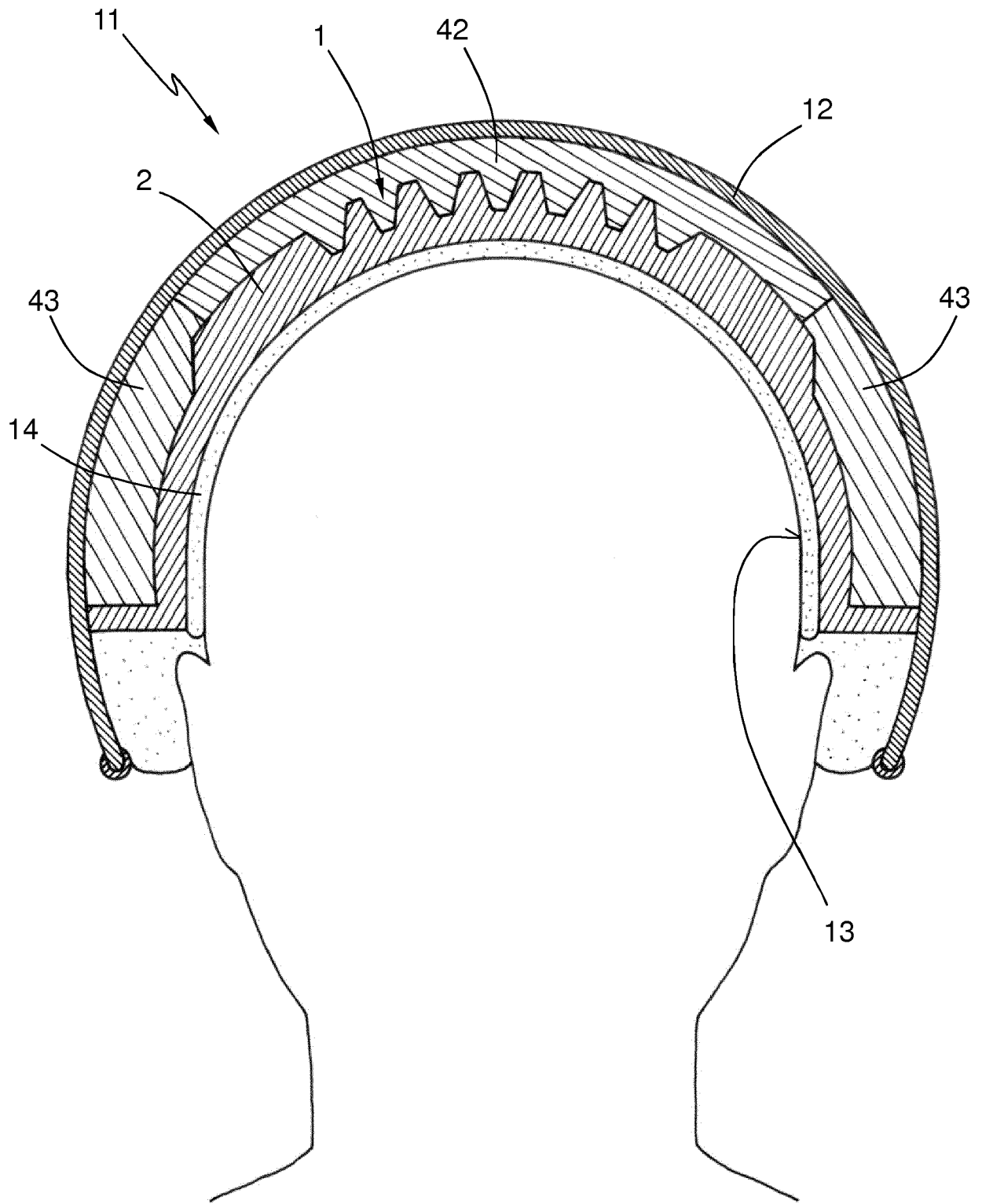


FIG. 3

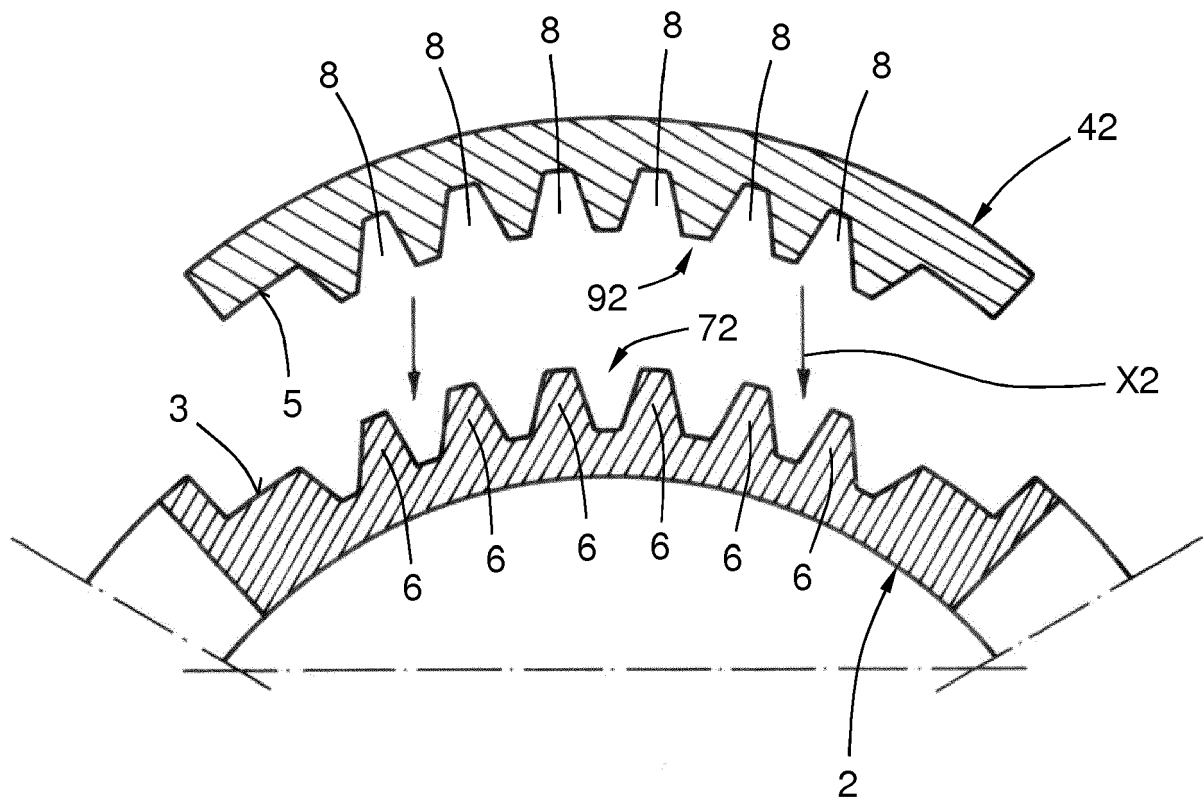


FIG. 4

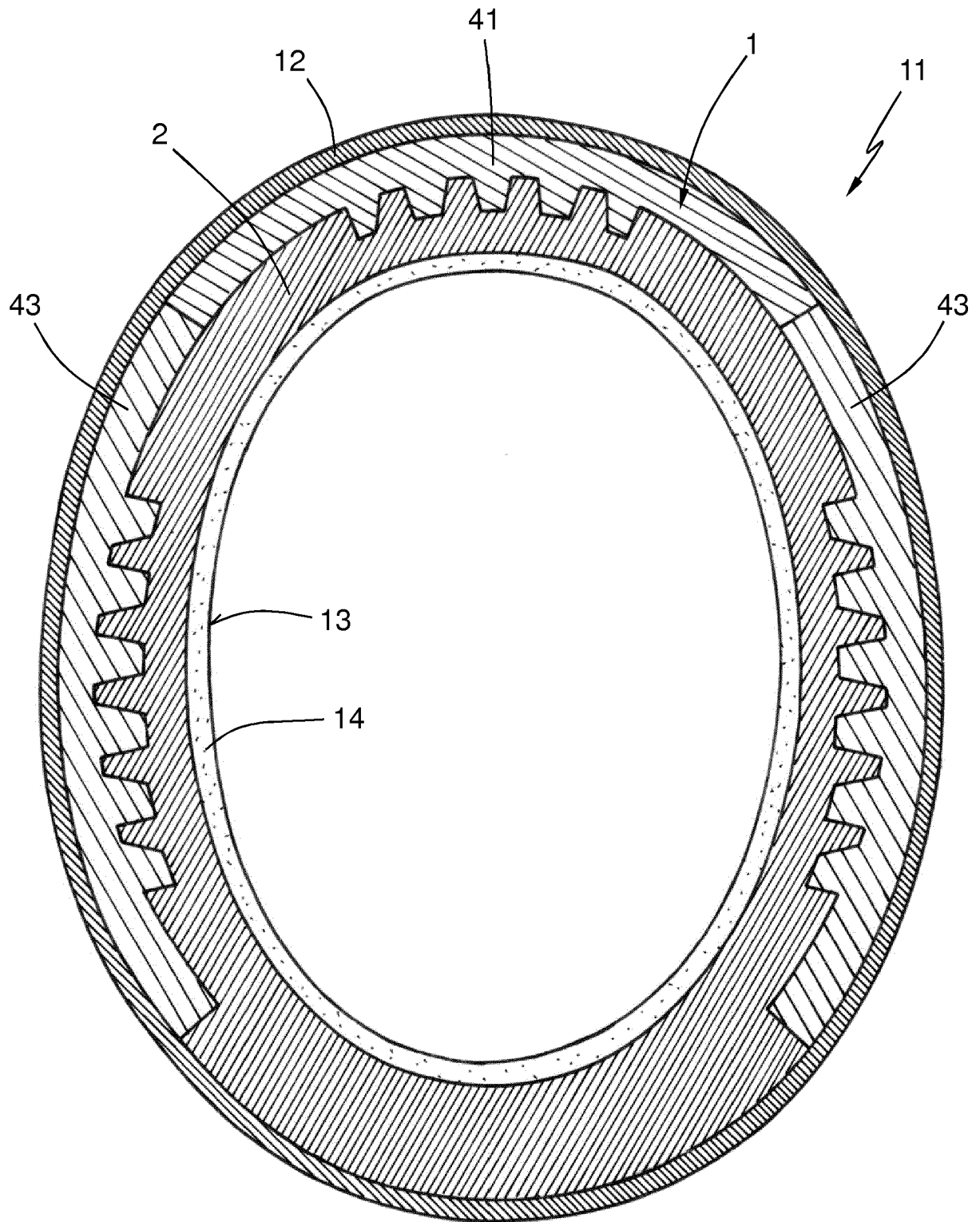


FIG. 5

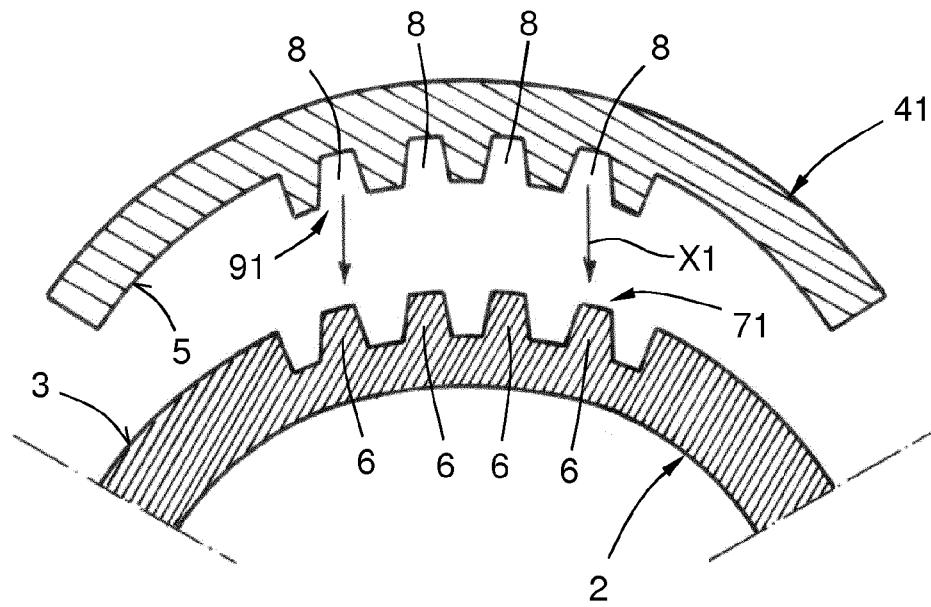


FIG. 6

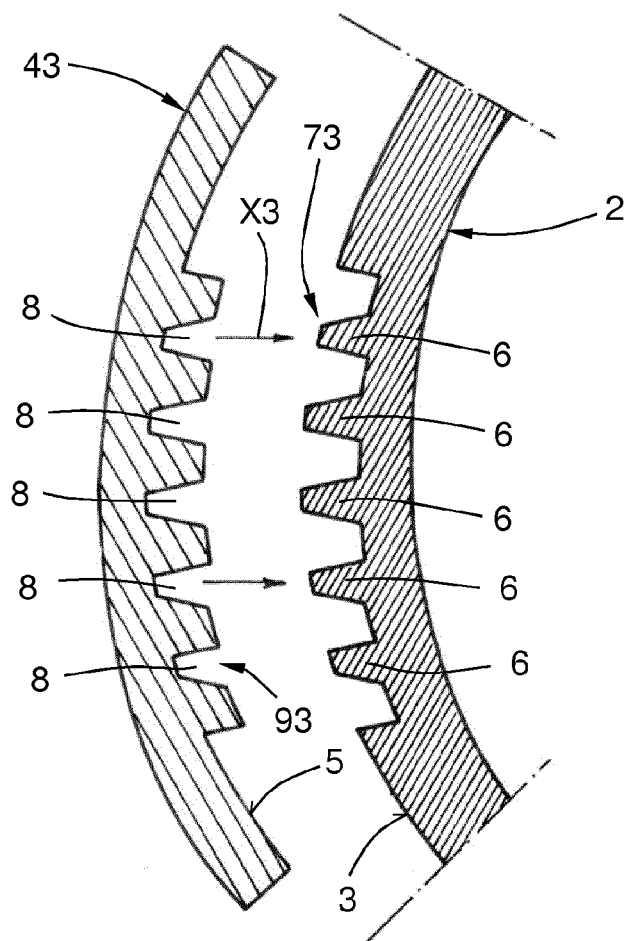


FIG. 7

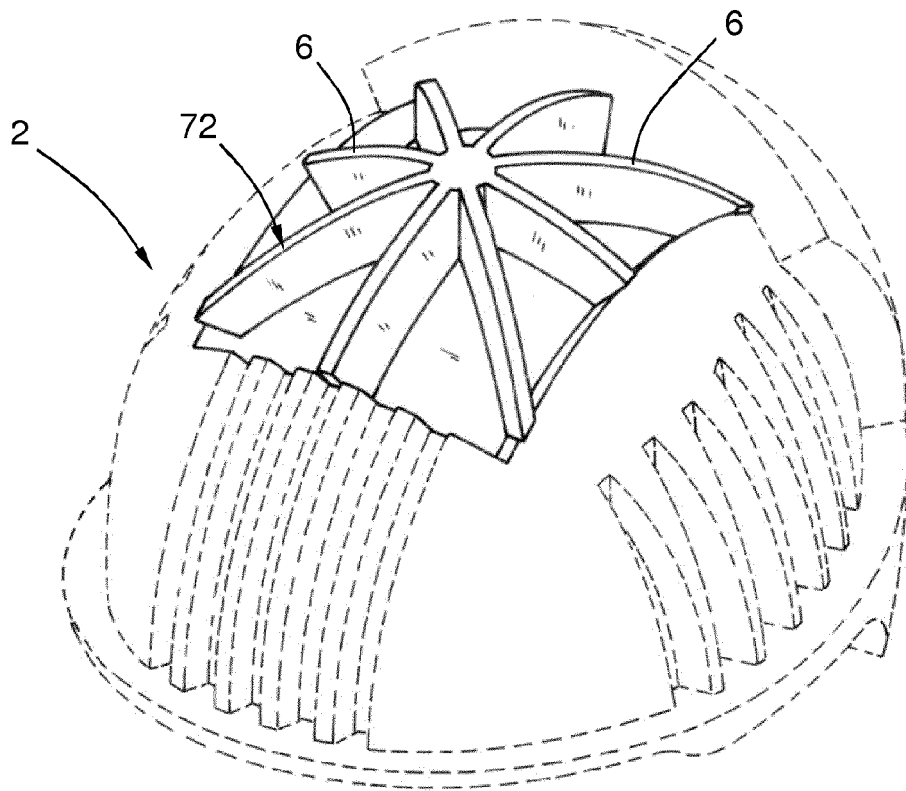


FIG. 8

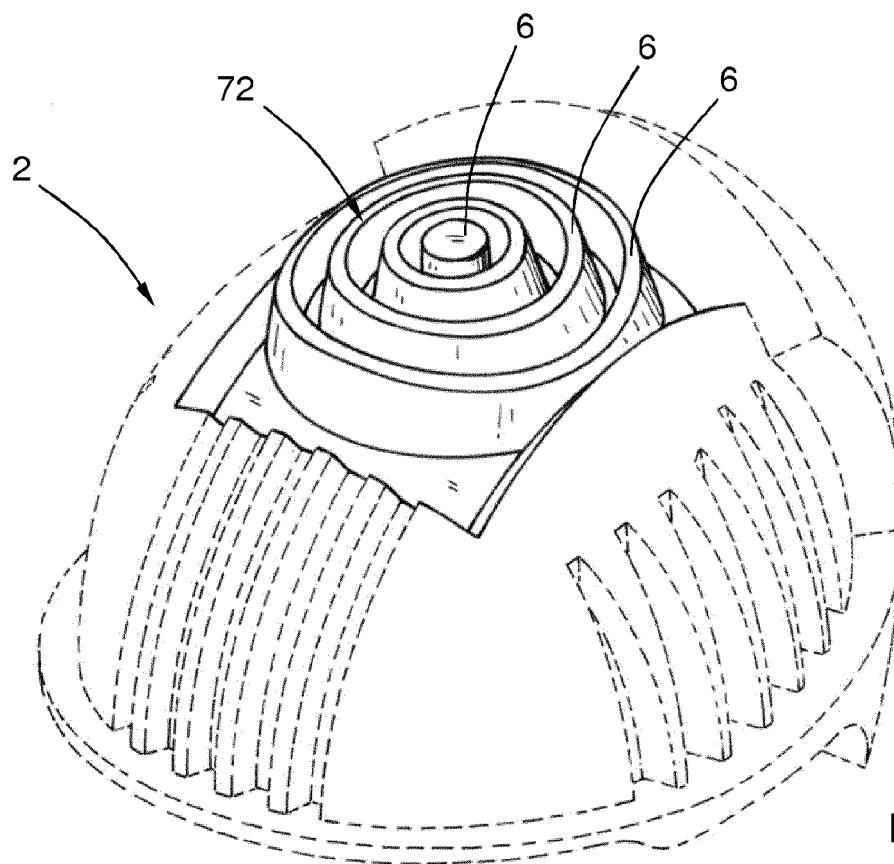


FIG. 9

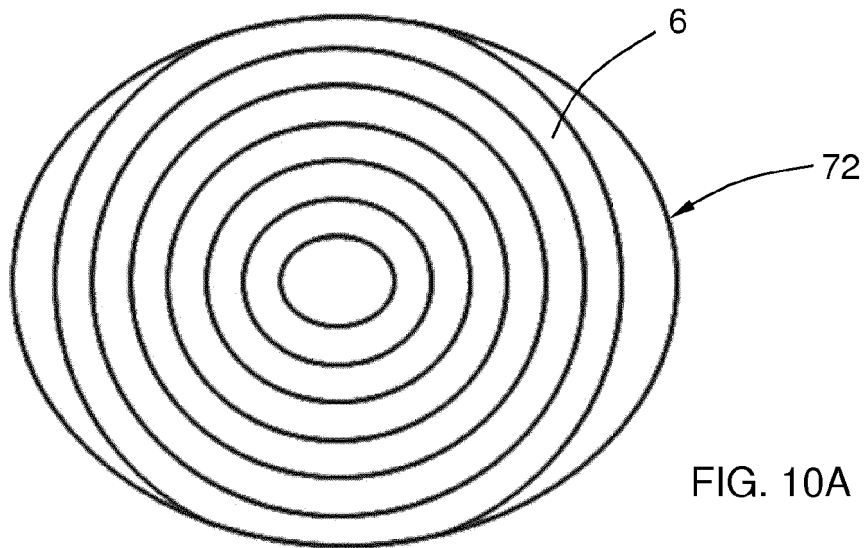


FIG. 10A

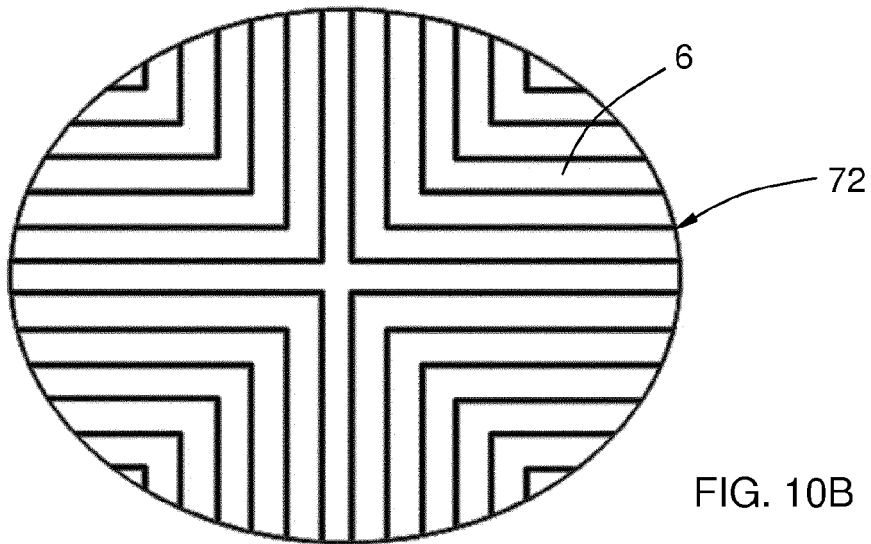


FIG. 10B

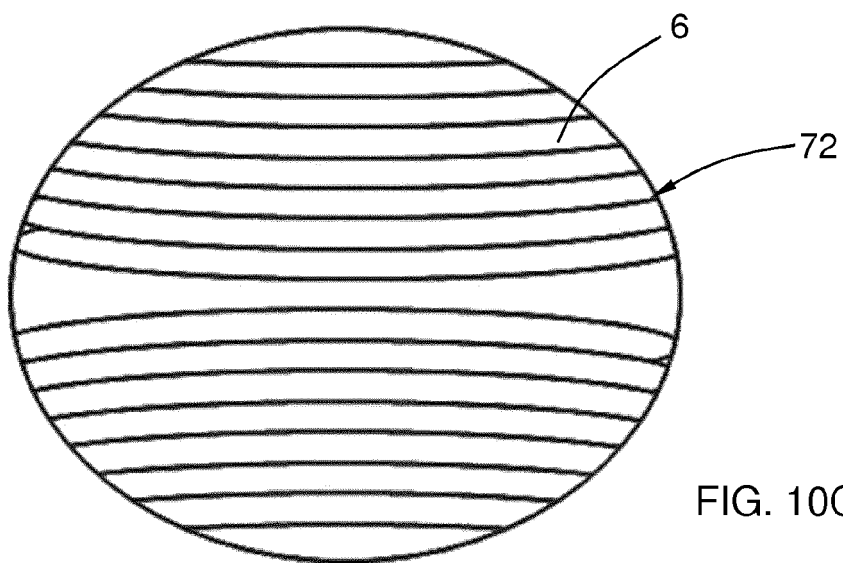


FIG. 10C

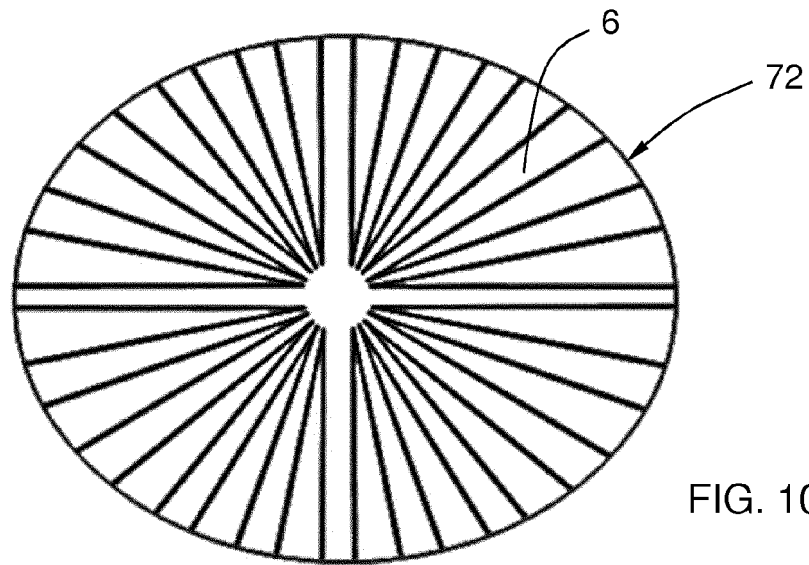


FIG. 10D

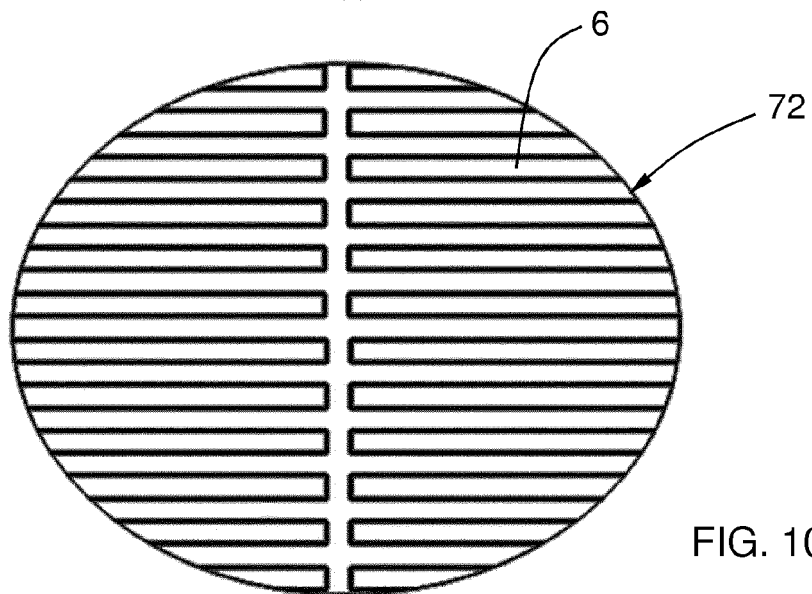


FIG. 10E

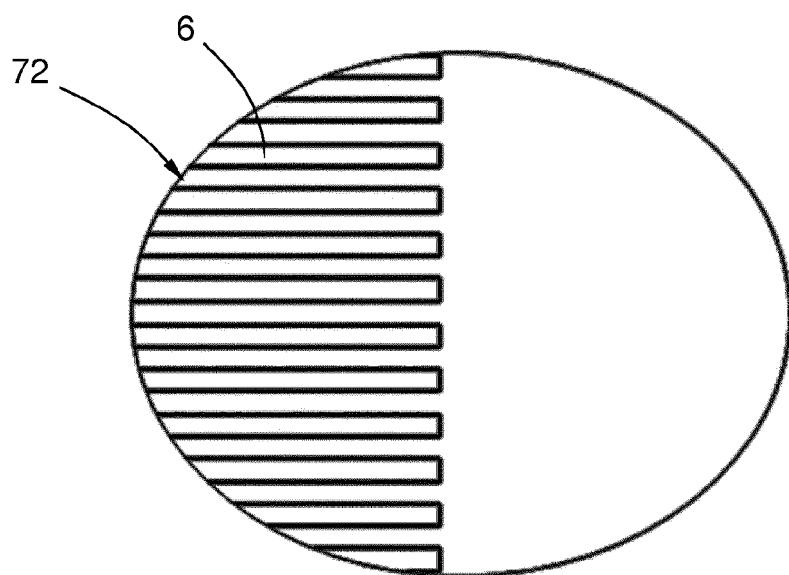


FIG. 10F

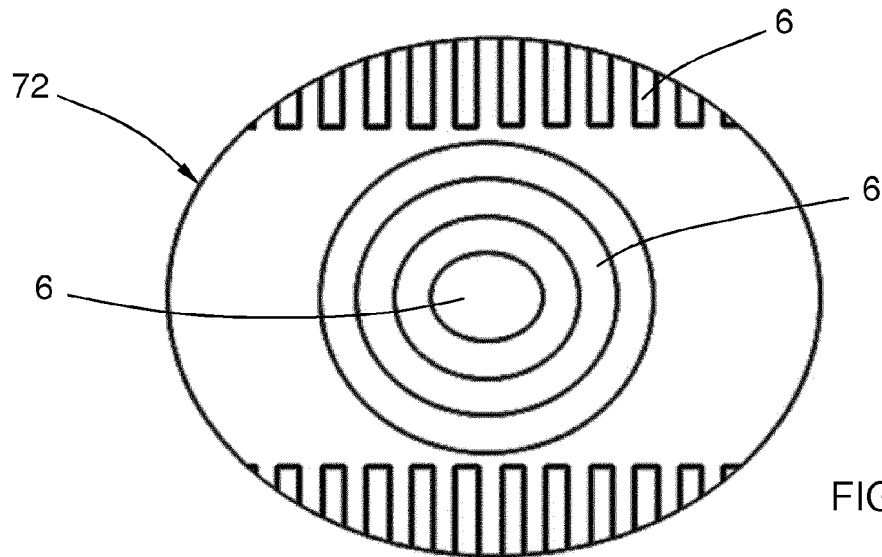


FIG. 10G

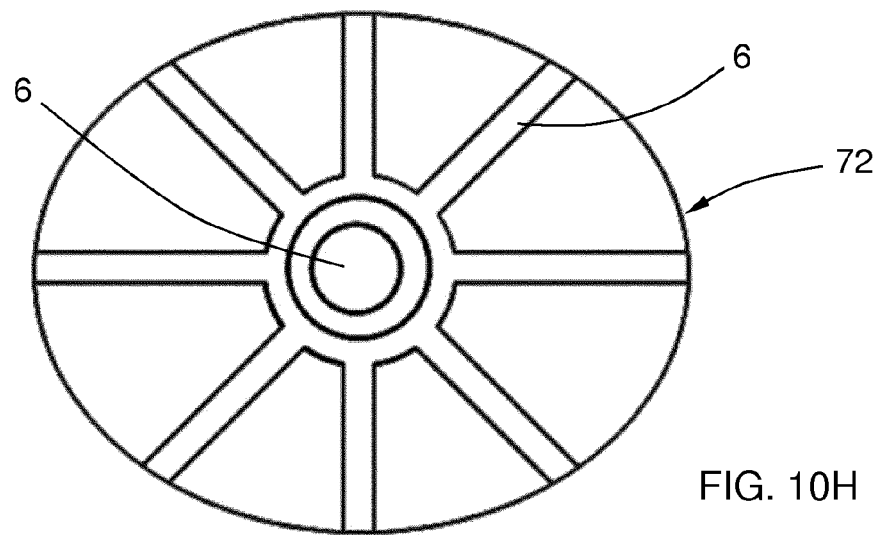


FIG. 10H

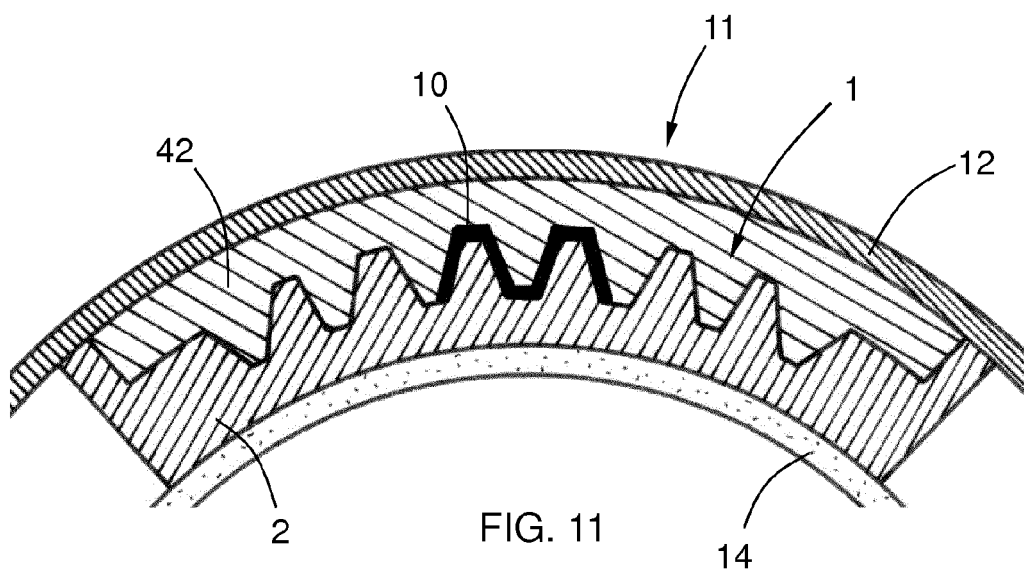


FIG. 11



EUROPEAN SEARCH REPORT

Application Number
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A	BE 836 581 A (MENTEN, JOZEF) 1 April 1976 (1976-04-01) * page 4, lines 3-30; figures 1-4 * -----	1-14	INV. A42B3/12
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			TECHNICAL FIELDS SEARCHED (IPC)
			A42B
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 5 July 2018	Examiner D'Souza, Jennifer
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05-07-2018

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