(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 700 636 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
08.09.2021 Bulletin 2021/36

(21) Application number: **18710769.3**

(22) Date of filing: **19.02.2018**

(51) Int Cl.:
A63C 19/06 *(2006.01)* ***E01C 13/08*** *(2006.01)*

(86) International application number:
PCT/EP2018/054010

(87) International publication number:
WO 2019/081068 (02.05.2019 Gazette 2019/18)

(54) ARTIFICIAL TURF VISUAL MARKING ELEMENT FOR MARKING A TURF SURFACE

KUNSTRASEN-SICHTMARKIERUNGSELEMENT ZUR MARKIERUNG EINER RASENFLÄCHE

ÉLÉMENT DE MARQUAGE VISUEL DE GAZON ARTIFICIEL PERMETTANT DE MARQUER UNE SURFACE DE GAZON

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **26.10.2017 US 201762577496 P**

(43) Date of publication of application:
02.09.2020 Bulletin 2020/36

(73) Proprietors:
- **Polytex Sportbeläge Produktions-GmbH**
  47929 Grefrath (DE)
- **Technology Licensing Corporation**
  Cincinnati, OH 45244 (US)
- **Stadia Turf Systems Pte Ltd**
  Singapore 048424 (SG)

(72) Inventors:
- **SICK, Stephan**
  47877 Willich-Neersen (DE)
- **LOHR, Ivo**
  47906 Kempen (DE)
- **HALLY, Stefan**
  41334 Nettetal (DE)
- **HEINLEIN, Mark**
  Cincinnati, Ohio 45230 (US)
- **SUTHERLAND, Hamish**
  Romsey, Victoria 3434 (AU)

(74) Representative: **Richardt Patentanwälte PartG mbB**
Wilhelmstraße 7
65185 Wiesbaden (DE)

(56) References cited:
WO-A1-99/61705
DE-A1- 19 748 486
US-A1- 2001 007 700
US-B1- 6 227 989
US-B1- 6 295 756

EP 3 700 636 B1

Description

Field of the invention

[0001] The invention relates to a turf surface and to a method of installing an artificial turf visual marking element in a natural turf surface.

Background and related art

[0002] In many sports such as soccer or American rules football the playing fields have very precisely defined boundaries and markings. When natural grass is used a groundskeeper or gardener needs to paint these markings on a field. This can be time consuming and can add to the expense of maintenance of a field or turf surface made from natural grass plants.

[0003] United States patent US 6,227,989 B1 discloses a line marking system for installing permanent field lines in a natural grass field. The system comprises a line fixed to a backing sheet which is installed under the grass sod. The backing sheet is preferably a mesh which allows the grass to grow through the backing sheet thereby anchoring the line to the ground. The line once affixed to the backing sheet completely blocks out sunlight. This prevents grass from growing through the backing sheet and intermingling with the line.

[0004] German patent application publication DE 197 48 486 A1 discloses a method of making visible markings in natural grass surfaces. A holding strip is placed in a trench, which is then filled with loose material. Filaments are then inserted into the holding strip through the loose material. The Filaments are held in place by the bottom strip, for example by a staple gun. The filaments have a color in contrast with the surrounding grass.

[0005] United States patent publication US 6,295,756 B1 discloses a playing surface including a synthetic turf base positioned atop a foundation. The synthetic turf base includes synthetic fibers secured to a backing material. The synthetic turf base also includes a surface layer of growth medium applied on top of the backing material to reach a predetermined depth. Natural grass is planted in the surface layer of growth medium. The backing is provided with perforations or openings sufficient in number to permit the roots of the natural grass to extend through the backing into the sub-base of the foundation.

[0006] International patent application publication WO99/61705A1 discloses a method of visually marking a line in a natural grass turf playing surface by embedding a synthetic grass strip within the turf. The synthetic strip has a middle band of light coloured synthetic grass to mark the line and outer bands of green coloured synthetic grass which blends in with the adjacent natural grass. Installation commences with cutting a shallow trench in the turf surface. The synthetic grass turf marking strip is laid into the trench. The strip includes an elongate flexible sheet backing, an underside of which is placed on the trench bottom. Tufted through the backing are parallel rows of synthetic ribbons, extending upwardly from the top surface of the backing a pile height sufficient to extend a selected distance above the trench. The strip is then buried in the trench under granular ballast material deposited on the backing and between the parallel rows of synthetic ribbons with an upper portion of the ribbons extending beyond the ballast, in a manner similar to artificial turf.

[0007] United States patent application publication US2001/007700A1 discloses a base layer for a combined synthetic and natural turf comprising a fabric of which at least a part of the weft and/or warp threads is manufactured from a biodegradable material and/or is wholly absent so that the fabric contains apertures, and synthetic turf fibers which are least partially cowoven with the fabric and of which one or both ends form synthetic grass blades. These ends only protrude from the fabric at those locations where the non-degradable warp and weft threads intersect. The base layer is used in combined synthetic and natural turfs comprising a foundation, optionally a first layer of growth substrate and a base layer according to the invention which is provided with a second layer of growth substrate in which grass plants grow.

Summary

[0008] The invention provides a turf surface according to claim 1 and a method of installing tificial turf visual marking element in a natural turf surface according to claim 14. Embodiments are given in the dependent claims.

[0009] Many players and coaches prefer to play sports on a natural turf surface. The use of field lines made from artificial turf that block the sun may introduce discontinuities or changes in the turf surface that may have a negative effect on the athletic performance of an athlete or may even interfere with the trajectory of a ball when it comes into contact with a marking on the turf surface. A line made from artificial turf within a natural grass field could also be a hazard. An athlete's cleats may be more likely to catch or bind on an abrupt transition to artificial turf and could possibly result in injury of the athlete.

[0010] Embodiments may provide for a durable means of marking a turf surface that minimizes the changes to the playing surface. Embodiments may use hybrid turf portions to provide line markings within an otherwise natural turf surface. Hybrid turf as used herein encompasses a backing with artificial turf fibers attached that permits the growth of natural grass plants between the artificial turf fibers. The hybrid turf portion may be constructed by burying an artificial turf marking element within the natural turf. The artificial turf marking element comprises an artificial turf backing with pores or holes which permit the growth of natural grass plants between contrasting artificial turf fibers. The contrasting artificial turf fibers provide a visual contrast to the natural grass plants and for visual marks on the turf surface. In addition to the region

where the artificial turf fibers are located, the artificial turf backing also comprises a structural support region. The structural support region lacks the contrasting artificial turf fibers. Natural grass plants also grow over the structural support region and help to anchor the artificial turf marking element and may also help to make the natural turf more durable.

[0011] In one aspect the invention provides for a turf surface. The turf surface for example may be in some examples a sport or playing field. The turf surface comprises one or more natural turf portions comprising natural grass plants that form a natural turf surface and at least one hybrid turf portion comprising an artificial turf visual marking element and the natural grass plants. The natural grass plants encompass living grass plants that may also be referred hereunto as grass. Hybrid turf portion may be a hybrid turf that comprises both natural grass plants and artificial turf elements that are combined. The artificial turf visual marking element comprises an artificial turf backing. The artificial turf backing is divided into at least one visual marking region and a structural support region. The structural support region is a label used to indicate a portion of the artificial turf backing that does not have the contrasting artificial turf fibers. The structural support region at least partially surrounds each of the at least one visual marking region. The artificial turf backing comprises holes throughout the visual marking region. The artificial turf backing comprises the holes throughout the structural support region. The natural grass plants of the hybrid turf portion comprise roots growing through the holes.

[0012] In different examples the artificial turf backing may take different forms. For example in some instances the artificial turf backing may be a woven fabric or other fabric made from fibers. The holes may be the natural spaces between the fibers making up the artificial turf backing. In other cases the artificial turf backing may be made from a plastic or other solid material that has the holes for the roots punched or cut through them. The term hole as used herein encompasses an opening that is large enough for grass roots to grow through. The holes may take different forms. As mentioned above the holes can be the spaces between woven or non woven fibers of a fabric. The holes can also be opening or slits punched or cut in a plastic or solid material.

[0013] The artificial turf visual marking element further comprises contrasting artificial turf fibers attached to the artificial turf backing only within the visual marking region. The contrasting artificial turf fibers provide a visual contrast to the natural grass plants within the visual marking region and the support region. That is to say the contrasting artificial turf fibers are used to provide a visual marking which is visible with respect to the natural grass plants.

[0014] This embodiment may be beneficial because it may provide for a means of providing for markings on the turf surface which do not need to be renewed periodically. For example in football, soccer or other sports fields in natural turf surfaces a grounds keeper or a gardener needs to repaint lines on the playing field at regular intervals such as before a weekly game. This can be extremely time consuming and requires great care to ensure that the lines are in the proper position every time. Additionally, for some sports teams, it may be desirable to have logos, numbers or other lettering which is present on the natural turf. This however may also be difficult to do regularly because it is extremely labor intensive. The artificial turf visual marking elements may therefore provide for markings or graphics on the turf surface which do not need to be renewed. The combination of the natural grass plants within the artificial turf visual marking element has the benefit of providing for a visual marking that still retains many of the properties of a natural grass surface.

[0015] The holes can be pores in the artificial turf backing.

[0016] The holes can have a diameter that is less than 10 mm in diameter. In this embodiment, the diameter of the holes is greater than any one of the following: 6 mm, 4 mm, and 3 mm. This embodiment may be beneficial because it may enable earthworms to travel through the holes and enable aeration of the portion of the turf surface which includes the artificial turf visual marking element.

[0017] The holes can be described as having a diameter it is understood that holes do not have to have a round shape. The "diameter" of a hole is descriptive of the size of a round or cylindrical object which can pass through the hole. For example the holes having a "diameter" of 10 mm means that a round object with a diameter of more than 10 mm will not pass through the hole.

[0018] The term "diameter" can be substituted with term the "diameter of the largest circle that fits within the opening of the hole." It is understood that this largest circle lies in the same plane as the opening. This measurement of the size of a hole is reasonable since it is for determining if an earthworm would fit through the hole or not. The restriction of the hole diameter to below 10 mm or below may be beneficial because making the holes too large may reduce how well the grass roots hold the artificial turf backing.

[0019] The structural support region can consist of natural grass plants. In this embodiment the structural support region only has natural grass plants in the structural support region. The structural support region lacks artificial turf fibers. In this embodiment the structural support region serves to further attach the artificial turf visual marking element using the roots of the grass plants growing in the structural support region.

[0020] The artificial turf backing can consist of a single base layer.

[0021] The artificial turf fibers can be tufted into the artificial turf backing.

[0022] In another embodiment the artificial turf visual marking element further comprises green artificial turf fibers attached to the artificial turf backing within the structural support region. This may be beneficial because it may provide for a transition from the artificial turf visual

marking element to the surrounding natural turf portions of the turf surface. This may also provide for more robust artificial turf visual marking elements, because there are a greater number of artificial turf fibers, that are for example more secure and therefore less susceptible to damage.

[0023] The green artificial turf fibers can be tufted to the artificial turf backing.

[0024] In another embodiment a density of the green artificial turf fibers within the structural support region decreases with increasing distance from the visual marking region. This embodiment may be beneficial because the density of artificial turf fibers versus the density of the natural grass plants is gradually transitioned. This may provide for a more natural appearance to the turf surface as well as providing for an artificial turf visual marking element which is better secured to the ground or base.

[0025] In another embodiment a density of the holes within the structural support region increases with increasing distance from the visual marking region. The holes provide access to the roots of the natural grass plants. Increasing the density of the holes within the structural support region as the distance increases from the visual marking region provides a means to better secure the edges of the artificial turf backing. The increase in the density of the holes may also facilitate an increase in the density of the natural grass plants near the edges of the artificial turf backing. This may additionally provide for a better attachment of the artificial turf backing to the ground.

[0026] The contrasting artificial turf fibers can be colored in any one of the following colors: red, orange, cyan, blue, violet, light green, black, grey, white, blue-green, black, orange, light blue, pink, Day-Glo green, light green, dark green, and combinations thereof. The use of these colors may be beneficial because they may provide for optical contrast between the natural grass plants and the artificial turf visual marking element.

[0027] In another embodiment the artificial turf visual marking element comprises any one of the following: a number, a letter, a Chinese character, a Kanji character, a Kana character, a picture, a graphical display, and combinations thereof. This embodiment may be beneficial because it may provide for a means of durably putting any one of these visual markings onto the turf surface.

[0028] In another embodiment the turf surface is a sport or playing field. This embodiment may be beneficial because artificial turf markings such as lines or other indicators are often necessary for a sport to be played properly.

[0029] In another embodiment the turf surface is any one of the following: a rugby field, a field hockey field, an American rules football field, a Gaelic rules football field, an Australian rules football field, a soccer field, a football field, a cricket pitch or field, a baseball diamond, and a sport field.

[0030] In another embodiment the artificial turf visual marking element is any one of the following: a line marking, a sideline, a boundary line, and a sideline.

[0031] In another embodiment the support region is an entire goal region. This embodiment may be beneficial because around the goal region in a sports field there is typically high foot traffic which results in high wear of the natural turf which results in thinning of the natural turf. Using the hybrid turf within the goal region may provide for a more robust natural turf surface.

[0032] The turf surface can be a soccer field.

[0033] The artificial turf visual marking elements can comprise any one of the following: a touchline, a sideline, a boundary line, a goal region, a goal line, a penalty spot, a center spot, a center circle, a corner arc, a half-way line, a penalty arc, and combinations thereof. A turf visual marking element according to any one of the following may be beneficial because it may provide an efficient means for permanently marking a soccer field. A penalty mark as used herein also encompasses the term commonly known as an 11-meter line.

[0034] The structural support region can comprise any one of the following: an entire goal box, an entire penalty box, an entire interior of a center line, an entire interior within a penalty arc, an entire interior within a corner arc, and combinations thereof. This may be beneficial because any one of these regions may be high foot traffic which results in high wear of the natural turf which results in thinning of the natural turf and this may provide for a more durable turf surface.

[0035] It should be noted that a goal box is sometimes referred to as a 5,5 meters (6-yard) box. A penalty box is sometimes referred to as an 16,5 meters (18-yard) box.

[0036] The turf surface can be an American rules football field.

[0037] The artificial turf visual marking element can be any one of the following: a goal line, a yard line, an end line, a limit line, a sideline, a sideline hash mark, an in field hash mark, a conversion line, a conversion hash mark, a field yard line number, and combinations thereof. This embodiment may be beneficial because it may provide for an efficient means of permanently marking an American rules football field.

[0038] The structural support region can comprise the entire end zone, a sideline region, and combinations thereof. This may be beneficial because the end zone or the sideline may be particularly high foot traffic which results in high wear of the natural turf which results in thinning of the natural turf and this may provide for a more robust turf surface.

[0039] In another embodiment at least one hybrid turf portion comprises less than 1% of the turf surface.

[0040] In another embodiment at least one hybrid turf portion comprises 5% or less of the turf surface.

[0041] In another embodiment at least one hybrid turf portion comprises 10% or less of the turf surface.

[0042] In another embodiment at least one hybrid turf portion comprises 50% or less of the turf surface.

[0043] In another embodiment the structural support region comprises 10% or less of the artificial turf backing.

[0044] In another embodiment the structural support region comprises 25% or less of the artificial turf backing.

[0045] In another embodiment the structural support region comprises 50% or less of the artificial turf backing.

[0046] In another embodiment the structural support region comprises 75% or less of the artificial turf backing.

[0047] In another embodiment the structural support region extends no further than 1 cm from the at least one visual marking region.

[0048] In another embodiment the structural support region extends no further than 5 cm from the at least one visual marking region.

[0049] In another embodiment the structural support region extends no further than 10 cm from the at least one visual marking region.

[0050] In another embodiment the at least one structural support region extends no further than 25 cm from the at least one visual marking region.

[0051] In another embodiment the structural support region extends no further than 50 cm from the at least one visual marking region.

[0052] In another embodiment the artificial turf backing comprises any one of the following: a woven fabric, a plastic material with punched holes, and a non-woven fabric. The non-woven fabric and the woven fabric may have holes due to the textile nature of their construction.

[0053] In another embodiment the contrasting artificial turf fibers and/or the green artificial turf fibers are attached to the artificial backing by any one of the following: tufting, weaving, and glueing.

[0054] The invention provides an artificial turf visual marking element for marking a natural turf surface. The artificial turf visual marking element comprises an artificial turf backing. The artificial turf backing is divided into at least one visual marking region and a structural support region at least partially surrounding each of the at least one visual marking regions. The artificial turf backing comprises holes throughout the visual marking region. The artificial turf backing comprises the holes throughout the structural support region. The natural grass plants of the hybrid turf portion comprise roots growing through the holes. The artificial turf visual marking element further comprises contrasting artificial turf fibers attached to the artificial turf backing only within the visual marking region. The contrasting artificial turf fibers provide a visual contrast to the natural grass plants or natural turf within the visual marking region and the support region.

[0055] The artificial turf backing can comprise any one of the following:
a woven fabric, a plastic material with punched holes, and a non-woven fabric.

[0056] The contrasting artificial turf fibers and/or the green artificial turf fibers can be attached to the artificial turf backing by any one of the following: tufting, weaving, and gluing.

[0057] In another aspect the invention provides for a method of installing an artificial turf visual marking element in a natural turf surface. Installation may occur into an existing natural turf surface, or it may occur prior to the planting and establishment of the natural turf surface. Both cases may be infilled onsite. Alternatively the infilling may occur offsite, and the natural turf seeded and established offsite, and then the finished product is installed onsite and made ready for play.

[0058] The method comprises digging an opening in a natural turf surface. For smaller regions the opening could for example be a trench. An alternative to trenching is excavating or stripping, particularly for larger areas. For example larger areas could be excavated or stripped using a machine that is typically, not always, designed to remove larger areas of natural turf.

[0059] The method further comprises placing the artificial turf visual marking element in the trench or opening. The method further comprises infilling or burying the artificial turf backing in the trench or opening. The natural grass plants may then grow over the area that was just buried in the trench or opening. This may be accomplished for example by the region that was formerly the trench or opening being seeded with grass seed or the grass may naturally spread over the course of time to fill in the open spots or exposed dirt that are in the former trench or opening.

[0060] In another embodiment the artificial turf backing has an underside. The underside comprises a linear alignment marking. The artificial turf visual marking element is rolled. The method further comprises marking a straight line in the trench or opening. The method further comprises placing the artificial turf visual marking element in the trench or opening. The method further comprises unrolling the visual marking region in the trench or opening such that the linear alignment marking is aligned with the straight line. This embodiment may be beneficial because it may be difficult to initially align the visual marking element properly on a sport field. If at least one hybrid turf portion comprises a line or a marking on its underside and is rolled, the person installing the hybrid turf portion can easily align an alignment mark on the underside with a mark in the trench or opening. This may be suitable for performing the initial alignment or even the final alignment of the artificial turf visual marking element with the turf surface.

[0061] It is understood that one or more of the aforementioned embodiments of the invention may be combined as long as the combined embodiments are not mutually exclusive.

Brief description of the drawings

[0062] In the following embodiments of the invention are explained in greater detail, by way of example only, making reference to the drawings in which:

Fig. 1 illustrates an example of an artificial turf visual marking element;
Fig. 2 illustrates an example of a turf surface;
Fig. 3 illustrates a further example of an artificial turf

visual marking element;

Fig. 4 illustrates a further example of an artificial turf visual marking element;

Fig. 5 illustrates a further example of an artificial turf visual marking element;

Fig. 6 illustrates a further example of an artificial turf visual marking element;

Fig. 7 illustrates a further example of an artificial turf visual marking element;

Fig. 8 illustrates a further example of a turf surface;

Fig. 9 illustrates a natural grass turf surface before installation of an artificial turf visual marking element;

Fig. 10 illustrates an opening dug in the natural grass turf surface of Fig. 9;

Fig. 11 illustrates the placement of an artificial turf visual marking element in the opening of Fig. 10;

Fig. 12 shows the an artificial turf visual marking element of Fig. 11 after the opening has been backfilled;

Fig. 13 illustrates an example of a turf surface that incorporates artificial turf visual marking elements;

Fig. 14 illustrates a further example of a turf surface that incorporates artificial turf visual marking elements;

Fig. 15 illustrates a further example of a turf surface that incorporates artificial turf visual marking elements; and

Fig. 16 illustrates a further example of a turf surface that incorporates artificial turf visual marking elements.

Detailed Description

[0063] Like numbered elements in these figures are either equivalent elements or perform the same function. Elements which have been discussed previously will not necessarily be discussed in later figures if the function is equivalent.

[0064] Fig. 1 shows an example of an artificial turf visual marking element 100. The artificial turf visual marking element 100 comprises an artificial turf backing 102. The artificial turf backing can be divided into a visual marking region 104 and at least one structural support region 106 which may at least partially surround the visual marking region 104. The artificial turf visual marking element 100 illustrated in Fig. 1 shows a cross-sectional view. The artificial turf visual marking element 100 may for example be used to make a line marking on a sport or athletic field. The artificial turf backing 102 is shown as having an underside 108 and a top 110. Within both the structural support region 106 and the visual marking region 104 it can be seen that there are a number of holes 112. The holes 112 may depend upon the type of artificial turf backing 102. For example the artificial turf backing 102 can be made from a solid material such as a sheet of plastic or other polymer material. In this case the holes 112 could be little holes punched or cut in the artificial turf backing 102. In other examples the artificial turf backing 102 may be a woven or non-woven textile material. The space between the fibers making up the artificial turf backing 102 in that case would then form the holes 112. The holes 112 allow clearance or the passage of roots from grass plants through the holes 112. On the top 110 it can be seen that there are a number of contrasting artificial turf fibers 114. The artificial turf fibers 114 may be contrasting such that they have a high visual contrast with natural grass plants.

[0065] Fig. 2 shows an example of a turf surface 200 that has been constructed by burying the artificial turf visual marking element 100 within natural turf. The turf surface 200 can be shown as comprising a natural turf portion 202 and a hybrid turf portion 204. The hybrid turf portion 204 was formed by burying the artificial turf visual marking element 100 of Fig. 1 within the earth 210. As illustrated in Fig. 1 the artificial turf backing 102 has a number of holes 112. In this example the natural grass plants 206 have a root structure 208 that grows through the holes 112. It can be seen that there are natural grass plants 206 growing throughout the hybrid turf portion 204. The growth of the foot structures 208 through the holes 112 helps to anchor the artificial turf visual marking element 100 within the earth 210. The contrasting artificial turf fibers 114 provide a visual contrast to the natural grass plants 206. This enables a permanent marking or graphics within the turf surface 200.

[0066] Fig. 3 shows a further example of an artificial turf visual marking element 100. The design shown in Fig. 3 is a variation of the design illustrated in Fig. 1. In this example again a cross-section of the artificial turf visual marking element 100 is shown. However, in this example the structural support region 106 only borders one portion of the visual marking region 104. The example shown in Fig. 3 may for example be useful in placing the artificial turf visual marking element 100 near a wall or other structure. The visual marking region 104 could for example be placed directly against a wall or other structure. In other instances it may not be necessary to have the structural support region 106 on both sides. For example at a side or end line one side may receive much less foot traffic or damage due to the playing of a sport.

[0067] The artificial turf visual marking element 100 shown in Fig. 3 can be used in the same way as is illustrated in Fig. 2.

[0068] Fig. 4 shows a further example of an artificial turf visual marking element 100. The artificial turf visual marking element 100 shown in Fig. 4 is a modification of the artificial turf visual marking element 100 illustrated in Fig. 1. In this example the holes 112 increase in frequency as the distance from the visual marking region 104 increases. This may be beneficial because it may provide more places for the roots, as illustrated in Fig. 2, to grow through the holes 112. This may provide better anchoring of the artificial turf backing 102 within the earth 210 as is shown in Fig. 2. The artificial turf visual marking element

100 shown in Fig. 4 may be substituted for the artificial turf visual marking element illustrated in Fig. 2.

[0069] Fig. 5 illustrates a further example of an artificial turf visual marking element 100. The artificial turf visual marking element 100 shown in Fig. 5 is similar to the design shown in Fig. 1. The design shown in Fig. 5 differs from that shown in Fig. 1 in that there are green artificial turf fibers 500 which are shown as being attached to the artificial turf backing 102 within the structural support regions 106. The addition of the green artificial turf fibers 500 may increase the durability of the turf surface in the vicinity where the artificial turf visual marking element 100 has been installed.

[0070] The artificial turf visual marking element 100 shown in Fig. 5 may be installed into the earth 210 as is shown in Fig. 2.

[0071] Fig. 6 shows a further example of an artificial turf visual marking element 100. The artificial turf visual marking element 100 shown in Fig. 6 is a modification of the design illustrated in Fig. 5. In this example the visual marking region 104 is only surrounded on one side by the structural support region 106. The design shown in Fig. 6 is analogous to the design illustrated in Fig. 3.

[0072] Fig. 7 shows a further example of an artificial turf visual marking element 100. The design illustrated in Fig. 7 is a modification of the design illustrated in Fig. 5. In Fig. 7 the density of the holes 112 increase as the distance from the visual marking region 104 increases. It can be seen that near the ends or borders of the structural support region 106 the density of holes has increased greatly. In this example also, the density of the artificial green turf fibers decreases as the distance from the visual marking region increases. In the example shown in Fig. 7 this has the effect as the distance increases from the visual marking region the amount of natural grass plants will increase. There will therefore be a gradual transition from artificial turf fibers to natural grass plants. This may be beneficial because the transition from the artificial turf fibers to natural grass plants will be gradual and less noticeable to players as well as to spectators viewing the turf surface. The design shown in Fig. 7 is analogous to the design illustrated in Fig. 4.

[0073] Fig. 8 illustrates a turf surface 200 formed using the artificial turf visual marking element 100 from Fig. 7. Fig. 8 is analogous to Fig. 2. In Fig. 8 it can be seen that the artificial turf visual marking element 100 has been partially buried within the earth or ground 210. The turf surface 200 comprises a natural turf portion 202 and a hybrid turf portion 204. The hybrid turf portion 204 was formed by burying the artificial turf visual marking element 100 of Fig. 7. Examining the surface it can be seen that there is a region indicated by the visual marking region 104 where the contrasting artificial turf fibers 114 will be clearly visible. There is also a region where there is a mixture of green artificial turf fibers 500 and natural grass fibers 206. Near the edges of the artificial turf backing 102 within the structural support region 106 the density of the green artificial turf fibers 500 gradually decreases. It can be seen that there is an increase in the number of natural grass plants 206. This provides for a smooth transition from a mixture of natural grass plants 206 and the artificial turf fibers to just the natural grass plants 206 within the natural turf portion 202. Additionally in this example, within the artificial turf backing 102 the density of the holes 112 increases. The root structure 208 of the natural grass plants 206 then is also able to better anchor the artificial turf backing 102.

[0074] Figs. 9-12 illustrate a method of fabricating the turf surface 200 illustrated in Fig. 2. The method illustrated in Figs. 9-12 also equally apply to the use of the artificial turf elements 100 shown in Figs. 3, 4, 5, 6, and 7. Fig. 9 illustrates the initial step or start of the method. In this step there is just a plane natural turf 202 that consists of natural grass plants 206 growing in the ground or earth 210. The root structure 208 of the natural grass plants 206 can be shown as growing throughout the ground 210.

[0075] Fig. 10 illustrates the next step of the method. The next step is to dig 1000 an opening 1004. In this example, the opening is a trench. On either side of the opening 1004 can be shown the natural grass plants 206. In some versions of the method there may be an optional straight line 1002 which may be used for aligning the artificial turf visual marking element 100 as it is unrolled.

[0076] Fig. 11 illustrates the next step. In Fig. 11 the next step is to place 1100 the artificial turf visual marking element into the opening 1004. Fig. 12 illustrates the next step in the method. In Fig. 12 the next step is to fill 1200 the opening. The opening is no longer present and in its place there is backfill material 1202. In Fig. 12 the natural grass fibers 206 have not grown over the artificial turf backing 102. This could be accomplished for example by sowing grass seed over the artificial turf backing 102 within the backfill material 1202 or it could be achieved by natural growth and spreading of the natural grass plants 206 over the artificial turf backing 102. The backfill material 1202 may for instance be any material in which natural grass plants 206 can grow. Typically a mixture of soil and sand will promote healthy natural grass plants 206.

[0077] After the grass has grown over where the opening was and has grown in between the contrasting artificial turf fibers 114, the method will result in the turf surface 200 shown in Fig. 2.

[0078] Fig. 13 illustrates an exemplary turf surface 200 that is in the form of a soccer field. Figs. 14-16 show further variations of the example illustrated in Fig. 13. The examples illustrated in Figs. 13-16 also apply to playing fields or turf surfaces for other sports such as field hockey or American football.

[0079] The field shown in Fig. 13 is shown as having markings for a touchline 1300, a center line 1302, a center spot 1304, a center circle 1306, two goal lines 1308, two goal boxes 1310, two penalty boxes 1312, two penalty arcs 1314, two penalty spots 1316, and four corner arcs 1318. The portions of the turf surface 200 which are just natural grass are indicated as being the natural turf por-

tion 202. In this example it can be seen that the natural turf portion 202 makes up almost the entire turf surface 200. All of the above structures and lines mentioned are surrounded by dotted lines which are used to indicate the position of the hybrid turf portion 204. In the example of Fig. 13 then, all of the field markings are made using a minimal amount of the artificial turf elements 100. This preserves the natural feel and playing effect of using a natural turf surface. However, the artificial turf elements 100 provide long lasting markings for all of the above mentioned markings. This reduces greatly also the amount of maintenance needed before a game is played on the turf surface 200.

[0080] Fig. 14 illustrates a further example of a turf surface 200. In this example the only hybrid turf portion 204 is a graphic in the center of the playing field. It can be seen that there is a large region of the hybrid turf portion 204 surrounded by the natural turf portion 202. This example may be beneficial when it is desired by the team to add a graphic or logo in the center or other portion of the playing field. The adding of a graphic may be much more labor intensive than simply adding lines or markings on the field. This may provide for a superior aesthetic to the field while reducing the costs of adding a graphic or logo.

[0081] Fig. 15 shows a further example of a turf surface 200. In this example only the goal box 1310 is made from the hybrid turf portion 204. In this example the entire goal box 1310 is made from hybrid turf. The interior region of the goal box 1310 is the structural support region 106. Within the goal box 1310 there is therefore a mix of both natural grass plants and artificial turf fibers. This may be beneficial because in the vicinity of the goal there is a larger amount of foot traffic and there may be more damage to the turf surface 200. This may provide for a means of not only marking the location of the goal box 1310 but also providing for a more robust and less maintenance of the turf surface 200.

[0082] Fig. 16 shows a variation of the design shown in Fig. 15. Except in this example the entire region encompassed by the penalty arc 1314, the penalty spot 1316, the penalty box 1312 and the goal box 1310 are made from the hybrid turf portion 204. The rest of the field is made from the natural turf portion 202. The majority of the hybrid turf portion 204 in this example is the structural support region 106. This may be beneficial because the structural support region with or without green artificial turf fibers may provide for better wear and tear of the region surrounding the goal.

[0083] The examples illustrated in Figs. 13-16 may be mixed or matched as long as they are not mutually exclusive. Likewise, the artificial turf elements 100, as illustrated in Figs. 1, 3, 4, 5, 6, and 7 may be used to construct the examples shown in Figs. 13-16.

List of reference numerals

[0084]

100	artificial turf visual marking element
102	artificial turf backing
104	visual marking region
106	structural support region
108	under side
110	top
112	holes
114	contrasting artificial turf fibers
200	turf surface
202	natural turf portion
204	hybrid turf portion
206	natural grass plants
208	roots
210	ground
500	green artificial turf fiber
900	start of method
1000	dig opening
1002	optional straight line
1004	opening
1100	place artificial turf visual marking element into the opening
1200	infill opening
1202	backfill material
1300	touch line or side line
1302	centerline
1304	center spot
1306	center circle
1308	goal line
1310	goal box
1312	penalty box
1314	penalty arc
1316	penalty spot
1318	corner arc

Claims

1. A turf surface (200), wherein the turf surface comprises one or more natural turf portions (202) comprising natural grass plants (206) and at least one hybrid turf portion (204) comprising an artificial turf visual marking element (100) and the natural grass plants (206); wherein the artificial turf visual marking element comprises :

   - an artificial turf backing (102), wherein the artificial turf backing is divided into at least one visual marking region (104) and a structural support region (106) at least partially surrounding each of the at least one visual marking region, wherein the artificial turf backing comprises holes (112) throughout the visual marking region, wherein the artificial turf backing comprises the holes (112) throughout the structural support region, wherein the natural grass plants of the hybrid turf portion comprise roots (208) growing through the holes;
   - contrasting artificial turf fibers (114) attached

to the artificial turf backing only within the visual marking region, wherein the contrasting artificial turf fibers provide a visual contrast to the natural grass plants within the visual marking region and the support region.

2. The turf surface of claim 1, wherein the artificial turf visual marking element further comprises green artificial turf fibers (500) attached to the artificial turf backing within the structural support region.

3. The turf surface of claim 2, wherein a density of the green artificial turf fibers within the structural support region decreases with increasing distance from the visual marking region.

4. The turf surface of claim 1, 2, or 3, wherein a density of the holes within the structural support region increases with increasing distance from the visual marking region.

5. The turf surface of any one of the preceding claims, wherein the artificial turf visual marking element comprises any one of the following: a number, a letter, a Chinese character, a kanji character, a kana character, a picture, a graphical display, and combinations thereof.

6. The turf surface of any one of the preceding claims, wherein the turf surface is any one of the following: a sport field, a rugby field, a field hockey field, an American rules football field, a Gaelic rules football field, an Australian rules football field, a soccer field, a football field, a cricket pitch, a baseball diamond.

7. The turf surface of any one of the preceding claims, wherein the artificial turf visual marking element is any one of the following, a line marking, a sideline, a boundary line, and a sideline, and combinations thereof.

8. The turf surface of any one of the preceding claims, wherein the support region comprises an entire goal region of the turf surface.

9. The turf surface of any one of claims 1 through 7, wherein the at least one hybrid turf portion comprises any one of the following: 1% or less of the turf surface, 5% or less of the turf surface, 10% or less of the turf surface, and 50% or less of the turf surface.

10. The turf surface of any one of claims 1 through 7, wherein the structural support region comprises any one of the following: 10% or less of the artificial turf backing, 25% or less of the artificial turf backing, 50% or less of the artificial turf backing, and 75% or less of the artificial turf backing.

11. The turf surface of any one of claims 1 through 7, wherein the structural support region extends no further than any one of the following distances from the at least one visual marking region: 1 cm, 5 cm, 10 cm, 25 cm, and 50 cm.

12. The turf surface of any one of the preceding claims, wherein the artificial turf backing comprises any one of the following, a woven fabric, a plastic material with punched holes, and a non-woven fabric.

13. The turf surface of any one of the preceding claims, wherein the contrasting artificial turf fibers and/or the green artificial turf fibers are attached to the artificial turf backing by any one of the following: tufting, weaving, and glueing.

14. A method of installing an artificial turf visual marking element in a natural turf surface, wherein the artificial turf visual marking element comprises :

- an artificial turf backing (102), wherein the artificial turf backing is divided into at least one visual marking region (104) and a structural support region (106) at least partially surrounding each of the at least one visual marking region, wherein the artificial turf backing comprises holes (112) throughout the visual marking region, wherein the artificial turf backing comprises the holes (112) throughout the structural support region, wherein natural grass plants (206) of a hybrid turf portion comprise roots (208) growing through the holes;
- contrasting artificial turf fibers (114) attached to the artificial turf backing only within the visual marking region, wherein the contrasting artificial turf fibers provide a visual contrast to the natural grass plants within the visual marking region and the support region;

wherein the method comprises:

- digging (1000) an opening (1004) in the natural turf surface;
- placing (1100) the artificial turf visual marking element in the opening;
- infilling (1200) the artificial turf backing in the opening; and
- growing the natural grass plants.

15. The method of claim 14, wherein the artificial turf backing has an underside (108), wherein the underside comprises a linear alignment marking, wherein the artificial turf visual marking element is rolled, wherein the method further comprises marking a line (1002) in the opening, and wherein placing the artificial turf visual marking element in the opening comprises unrolling the artificial visual marking element

in the opening such that the linear alignment marking is aligned with the line.

Patentansprüche

1. Rasenoberseite (200), wobei die Rasenoberseite einen oder mehrere natürliche Rasenabschnitte (202), die natürliche Graspflanzen (206) umfassen, und mindestens einen ein visuelles Kunstrasen-Markierelement (100) und die natürlichen Graspflanzen (206) umfassenden hybriden Rasenabschnitt (204) umfasst; wobei das visuelle Kunstrasen-Markierelement umfasst:

   - einen Kunstrasenträger (102), wobei der Kunstrasenträger geteilt ist in mindestens eine visuelle Markierungsregion (104) und eine strukturelle Stützregion (106), welche die mindestens eine visuelle Markierungsregion jeweils zumindest zum Teil umgibt, wobei der Kunstrasenträger über der gesamten visuellen Markierungsregion Löcher (112) umfasst, wobei der Kunstrasenträger die Löcher (112) über der gesamten strukturellen Stützregion umfasst, wobei die natürlichen Graspflanzen des hybriden Rasenabschnitts Wurzeln (208) umfassen, die durch die Löcher wachsen;
   - kontrastierende Kunstrasenfasern (114), die nur innerhalb der visuellen Markierungsregion an dem Kunstrasenträger angebracht sind, wobei die kontrastierenden Kunstrasenfasern einen visuellen Kontrast zu den natürlichen Graspflanzen innerhalb der visuellen Markierungsregion und der Stützregion bereitstellen.

2. Rasenoberseite nach Anspruch 1, wobei das visuelle Kunstrasen-Markierelement ferner grüne Kunstrasenfasern (500) umfasst, die innerhalb der strukturellen Stützregion an dem Kunstrasenträger angebracht sind.

3. Rasenoberseite nach Anspruch 2, wobei eine Dichte der grünen Kunstrasenfasern innerhalb der strukturellen Stützregion mit zunehmendem Abstand von der visuellen Markierungsregion abnimmt.

4. Rasenoberseite nach Anspruch 1, 2 oder 3, wobei eine Dichte der Löcher innerhalb der strukturellen Stützregion mit zunehmendem Abstand von der visuellen Markierungsregion zunimmt.

5. Rasenoberseite nach einem der vorangehenden Ansprüche, wobei das visuelle Kunstrasen-Markierelement irgendeines der Folgenden umfasst: eine Zahl, einen Buchstaben, ein chinesisches Schriftzeichen, ein Kanji-Schriftzeichen, ein Kana-Schriftzeichen, ein Bild, eine grafische Darstellung oder Kombinationen davon.

6. Rasenoberseite nach einem der vorangehenden Ansprüche, wobei die Rasenoberseite irgendeines der Folgenden ist: ein Sportfeld, ein Rugby-Feld, ein Hockey-Feld, ein Feld nach den Regeln des American Football, ein Feld nach den Regeln des Gaelic Football, ein Feld nach den Regeln des Australian Football, ein Fußballfeld, ein Football-Feld, ein Kricket-Pitch, ein Baseball-Infield.

7. Rasenoberseite nach einem der vorangehenden Ansprüche, wobei das visuelle Kunstrasen-Markierelement irgendeines der Folgenden ist: eine Linienmarkierung, eine Seitenlinie, eine Grenzlinie und eine Seitenlinie und Kombinationen davon.

8. Rasenoberseite nach einem der vorangehenden Ansprüche, wobei die Stützregion eine gesamte Zielregion der Rasenoberseite umfasst.

9. Rasenoberseite nach einem der Ansprüche 1 bis 7, wobei der mindestens eine hybride Rasenabschnitt irgendetwas der Folgenden umfasst: 1 % oder weniger von der Rasenoberseite, 5 % oder weniger von der Rasenoberseite, 10 % oder weniger von der Rasenoberseite und 50 % oder weniger von der Rasenoberseite.

10. Rasenoberseite nach einem der Ansprüche 1 bis 7, wobei die strukturelle Stützregion irgendetwas der Folgenden umfasst: 10 % oder weniger von dem Kunstrasenträger, 25 % oder weniger von dem Kunstrasenträger, 50 % oder weniger von dem Kunstrasenträger und 75 % oder weniger von dem Kunstrasenträger.

11. Rasenoberseite nach einem der Ansprüche 1 bis 7, wobei sich die strukturelle Stützregion nicht weiter als über irgendeine der folgenden Strecken von der mindestens einen visuellen Markierungsregion aus erstreckt: 1 cm, 5 cm, 10 cm, 25 cm und 50 cm.

12. Rasenoberseite nach einem der vorangehenden Ansprüche, wobei der Kunstrasenträger irgendeines der Folgenden umfasst: ein Gewebe, ein Kunststoffmaterial mit gestanzten Löchern und einen Vliesstoff.

13. Rasenoberseite nach einem der vorangehenden Ansprüche, wobei die kontrastierenden Kunstrasenfasern und/oder die grünen Kunstrasenfasern durch irgendetwas des Folgenden an dem Kunstrasenträger angebracht sind: Tuften, Weben und Leimen.

14. Verfahren zum Installieren eines visuellen Kunstrasen-Markierelements in einer natürlichen Rasenoberseite, wobei das visuelle Kunstrasen-Markierele-

ment umfasst:

- einen Kunstrasenträger (102), wobei der Kunstrasenträger geteilt ist in mindestens eine visuelle Markierungsregion (104) und eine strukturelle Stützregion (106), welche die mindestens eine visuelle Markierungsregion jeweils zumindest zum Teil umgibt, wobei der Kunstrasenträger Löcher (112) über der gesamten visuellen Markierungsregion umfasst, wobei der Kunstrasenträger die Löcher (112) über der gesamten strukturellen Stützregion umfasst, wobei die natürlichen Graspflanzen (206) eines hybriden Rasenabschnitts Wurzeln (208) umfassen, die durch die Löcher hindurch wachsen;
- kontrastierende Kunstrasenfasern (114), die nur innerhalb der visuellen Markierungsregion an dem Kunstrasenträger angebracht sind, wobei die kontrastierenden Kunstrasenfasern einen visuellen Kontrast zu den natürlichen Graspflanzen innerhalb der visuellen Markierungsregion und der Stützregion bereitstellen;

wobei das Verfahren umfasst:

- Ausbilden (1000) einer Öffnung (1004) in der natürlichen Rasenoberseite;
- Platzieren (1100) des visuellen Kunstrasen-Markierelements in der Öffnung;
- Einbringen (1200) des Kunstrasenträgers in die Öffnung; und
- Wachsen lassen der natürlichen Graspflanzen.

15. Verfahren nach Anspruch 14, wobei der Kunstrasenträger eine Unterseite (108) aufweist, wobei die Unterseite eine lineare Ausrichtmarkierung umfasst, wobei das visuelle Kunstrasen-Markierelement aufgerollt ist, wobei das Verfahren ferner das Markieren einer Linie (1002) in der Öffnung umfasst, und wobei das Platzieren des visuellen Kunstrasen-Markierelements in der Öffnung das Abrollen des visuellen Kunst-Markierungselements in der Öffnung auf solche Weise, dass die lineare Ausrichtmarkierung an der Linie ausgerichtet wird, umfasst.

Revendications

1. Surface de gazon (200), où la surface de gazon comprend une ou plusieurs parties de gazon naturel (202) comprenant des plants de gazon naturel (206) et au moins une partie de gazon hybride (204) comprenant un élément de marquage (100) visuel du gazon artificiel et les plants de gazon naturel (206), où l'élément de marquage visuel du gazon artificiel comprend :

- un support de gazon artificiel (102), où le support de gazon artificiel est divisé en au moins une région de marquage visuel (104) et une région de support structurel (106) entourant au moins partiellement chacune parmi l'au moins une région de marquage visuel, où le support de gazon artificiel comprend des trous (112) dans toute la région de marquage visuel, où le support de gazon artificiel comprend les trous (112) sur toute la région de support structurel, où les plants de gazon naturel de la partie de gazon hydride comprennent des racines (208) poussant à travers les trous ;
- des fibres de gazon artificiel (114) contrastantes fixées sur le support de gazon artificiel uniquement dans la région de marquage visuel, où les fibres de gazon artificiel contrastantes procurent un contraste visuel par rapport aux plants de gazon naturel dans la région de marquage visuel et la région de support.

2. Surface de gazon selon la revendication 1, dans laquelle l'élément de marquage visuel du gazon artificiel comprend en outre des fibres de gazon artificiel vertes (500) fixées sur le support de gazon artificiel dans la région de support structurel.

3. Surface de gazon selon la revendication 2, dans laquelle une densité des fibres de gazon artificiel vertes dans la région de support structurel diminue avec une distance croissante par rapport à la région de marquage visuel.

4. Surface de gazon selon la revendication 1, la revendication 2 ou la revendication 3, dans laquelle une densité des trous dans la région de support structurel augmente avec une distance croissante par rapport à la région de marquage visuel.

5. Surface de gazon selon l'une quelconque des revendications précédentes, dans laquelle l'élément de marquage visuel du gazon artificiel comprend un élément quelconque parmi les suivants : un nombre, une lettre, un caractère chinois, un caractère kanji, un caractère kana, une image, un affichage graphique, et des combinaisons de ceux-ci.

6. Surface de gazon selon l'une quelconque des revendications précédentes, dans laquelle la surface de gazon est l'une quelconque parmi les suivantes : un terrain de sport, un stade de rugby, un stade de hockey, un stade de football aux règles américaines, un stade de football aux règles gaéliques, un stade de football aux règles australiennes, un stade de soccer, un stade de football, un terrain de cricket, un terrain de base-ball.

7. Surface de gazon selon l'une quelconque des revendications précédentes, dans laquelle l'élément de

marquage visuel du gazon artificiel est l'un quelconque parmi les suivants, un marquage de ligne, une ligne de touche, une ligne de démarcation, et une ligne de touche, et des combinaisons de celles-ci.

8. Surface de gazon selon l'une quelconque des revendications précédentes, dans laquelle la région de support comprend une région de but de la surface de gazon.

9. Surface de gazon selon l'une quelconque des revendications 1 à 7, dans laquelle l'au moins une partie de gazon hybride comprend l'un quelconque parmi les suivants : 1 % ou moins de la surface de gazon, 5 % ou moins de la surface de gazon, 10 % ou moins de la surface de gazon, et 50 % ou moins de la surface de gazon.

10. Surface de gazon selon l'une quelconque des revendications 1 à 7, dans laquelle la région de support structurel comprend l'un quelconque parmi les suivants : 10 % ou moins du support de gazon artificiel, 25 % ou moins du support de gazon artificiel, 50 % ou moins du support de gazon artificiel, et 75 % ou moins du support de gazon artificiel.

11. Surface de gazon selon l'une quelconque des revendications 1 à 7, dans laquelle la région de support structurel ne s'étend pas plus loin que l'une quelconque des distances suivantes par rapport à l'au moins une région de marquage visuel : 1 cm, 5 cm, 10 cm, 25 cm et 50 cm.

12. Surface de gazon selon l'une quelconque des revendications précédentes, dans laquelle le support de gazon artificiel comprend l'un quelconque parmi les suivants, un tissu tissé, un matériau plastique avec des trous poinçonnés et un tissu non tissé.

13. Surface de gazon selon l'une quelconque des revendications précédentes, dans laquelle les fibres de gazon artificiel contrastantes et/ou les fibres de gazon artificiel vertes sont fixées au support de gazon artificiel par un moyen quelconque parmi les suivants : un touffetage, un tissage et un collage.

14. Procédé d'installation d'un élément de marquage visuel de gazon artificiel dans une surface de gazon naturel, où l'élément de marquage visuel de gazon artificiel comprend :

- un support de gazon artificiel (102), où le support de gazon artificiel est divisé en au moins une région de marquage visuel (104) et une région de support structurel (106) entourant au moins partiellement chacune parmi l'au moins une région de marquage visuel, où le support de gazon artificiel comprend des trous (112) dans toute la région de marquage visuel, où le support de gazon artificiel comprend les trous (112) sur toute la région de support structurel, où les plants de gazon naturel (206) de la partie de gazon hydride comprennent des racines (208) poussant à travers les trous ;
- des fibres de gazon artificiel (114) contrastantes fixées sur le support de gazon artificiel uniquement dans la région de marquage visuel, où les fibres de gazon artificiel contrastantes procurent un contraste visuel par rapport aux plants de gazon naturel dans la région de marquage visuel et la région de support ;

où le procédé comprend :

- le creusement (1000) d'une ouverture (1004) dans la surface de gazon naturel ;
- la mise en place (1100) de l'élément de marquage visuel de gazon artificiel dans l'ouverture ;
- le remplissage (1200) du support de gazon artificiel dans l'ouverture ; et
- la croissance des plants de gazon naturel.

15. Procédé selon la revendication 14, dans lequel le support de gazon artificiel possède une face inférieure (108), où la face inférieure comprend un marquage d'alignement linéaire, où l'élément de marquage visuel de gazon artificiel est soumis à un enroulement, où le procédé comprend ensuite le marquage d'une ligne (1002) dans l'ouverture, et où la mise en place de l'élément de marquage visuel de gazon artificiel dans l'ouverture comprend un déroulement de l'élément de marquage visuel artificiel dans l'ouverture de sorte que le marquage d'alignement linéaire est aligné avec la ligne.

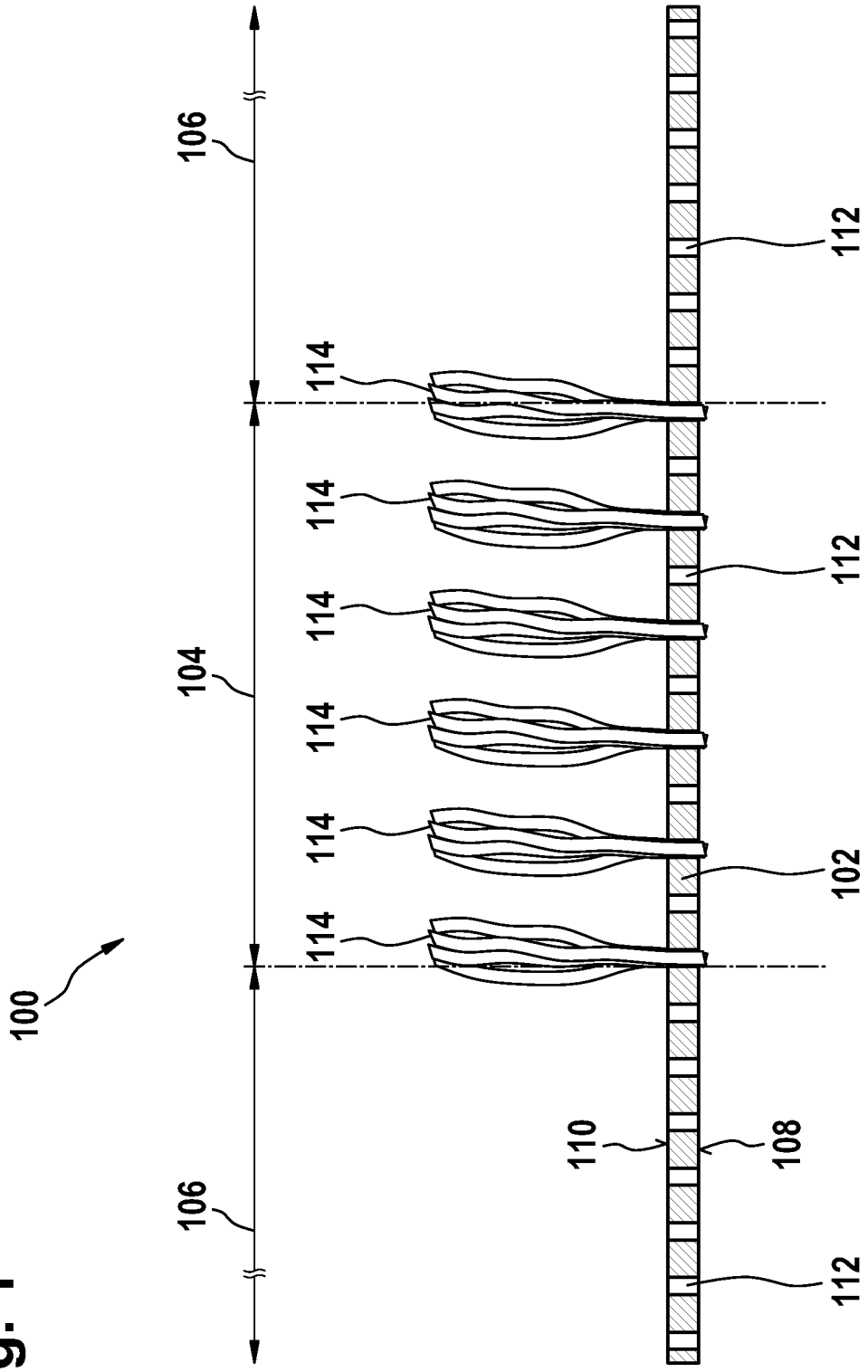
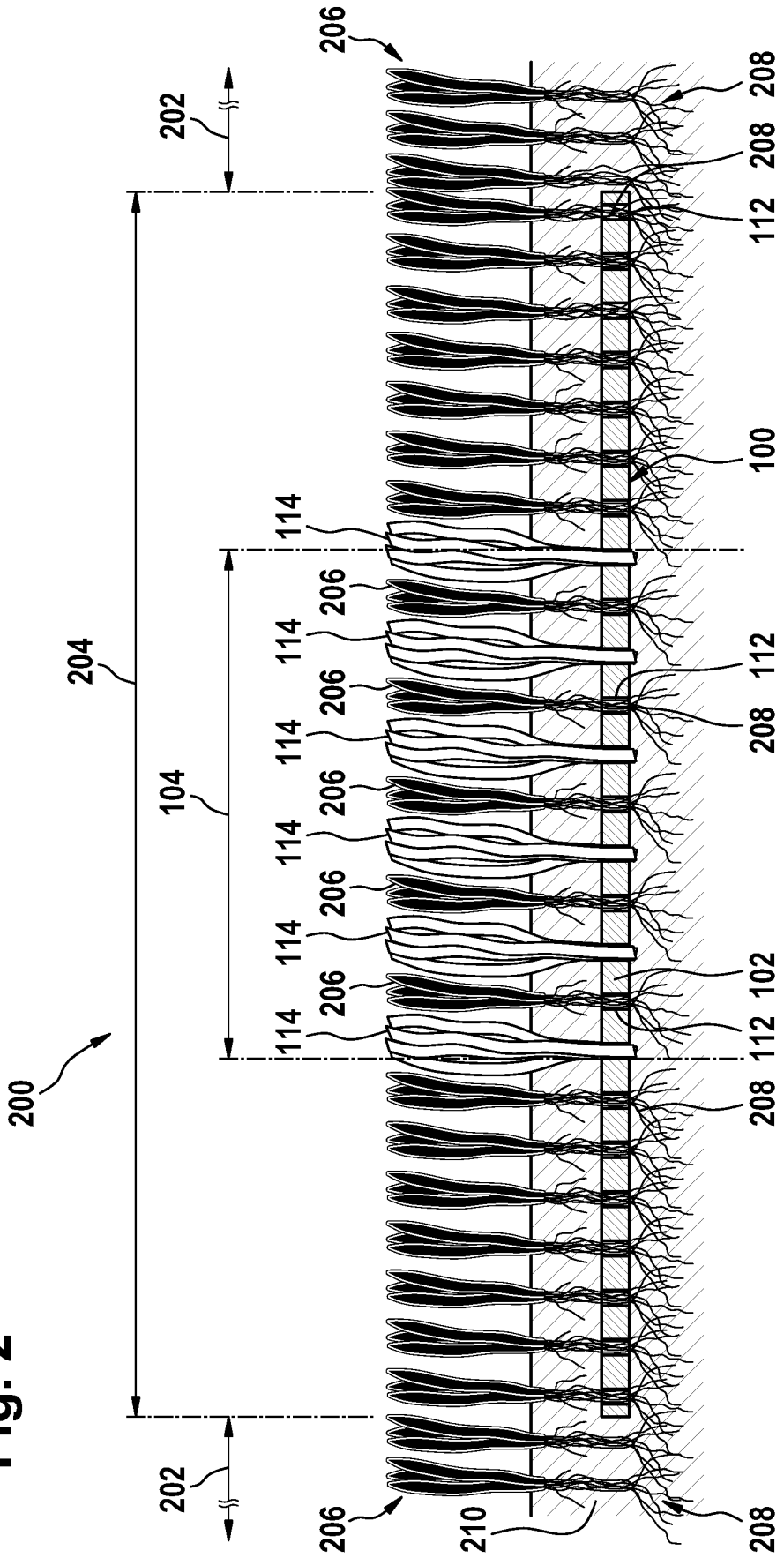


Fig. 1

Fig. 2


206
208
208
112
100
114
206
114
112
206
208
114
206
114
206
114
206
114
102
206
112
208
202
204
104
200
202
206
210
208

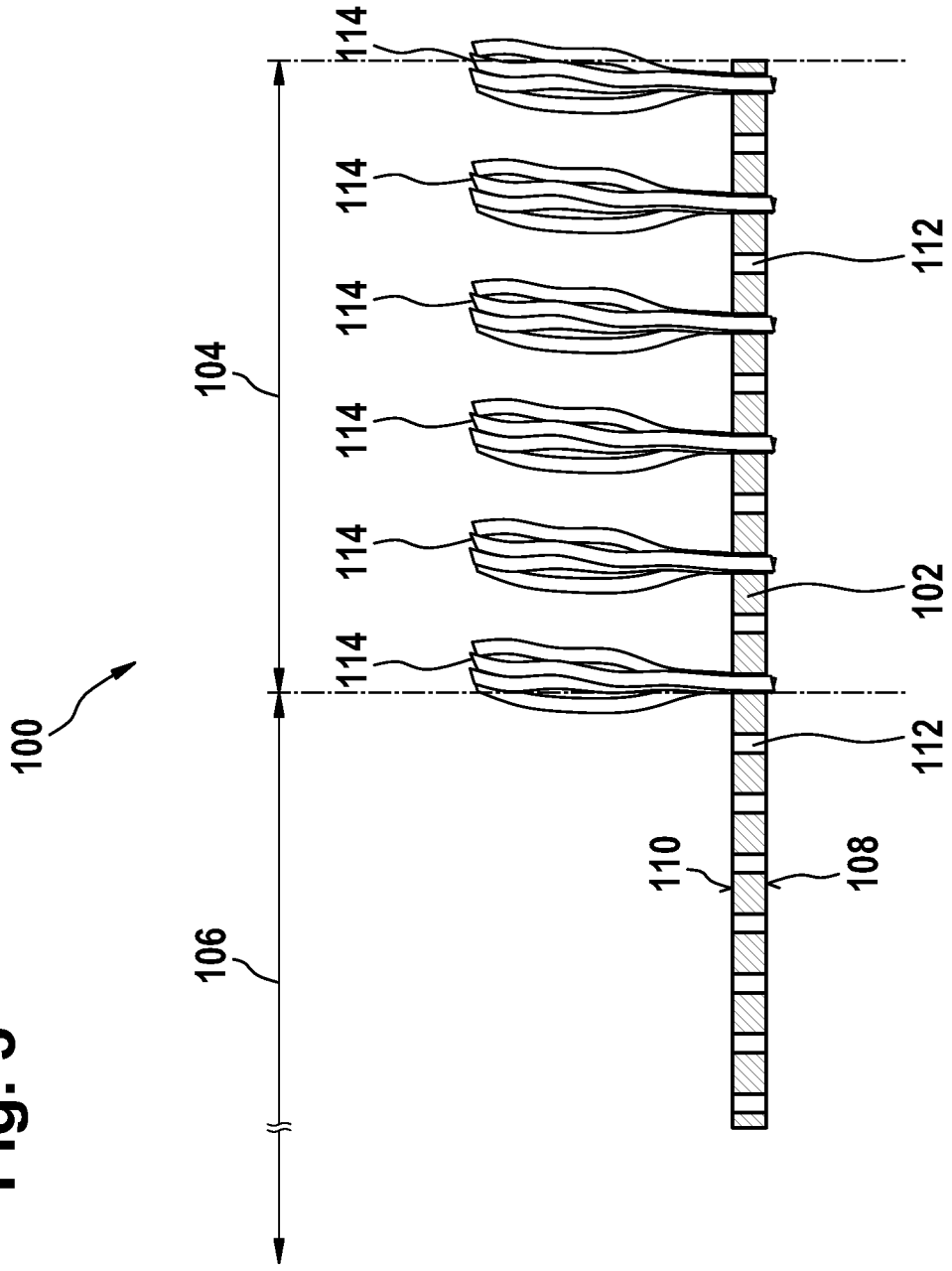


Fig. 3

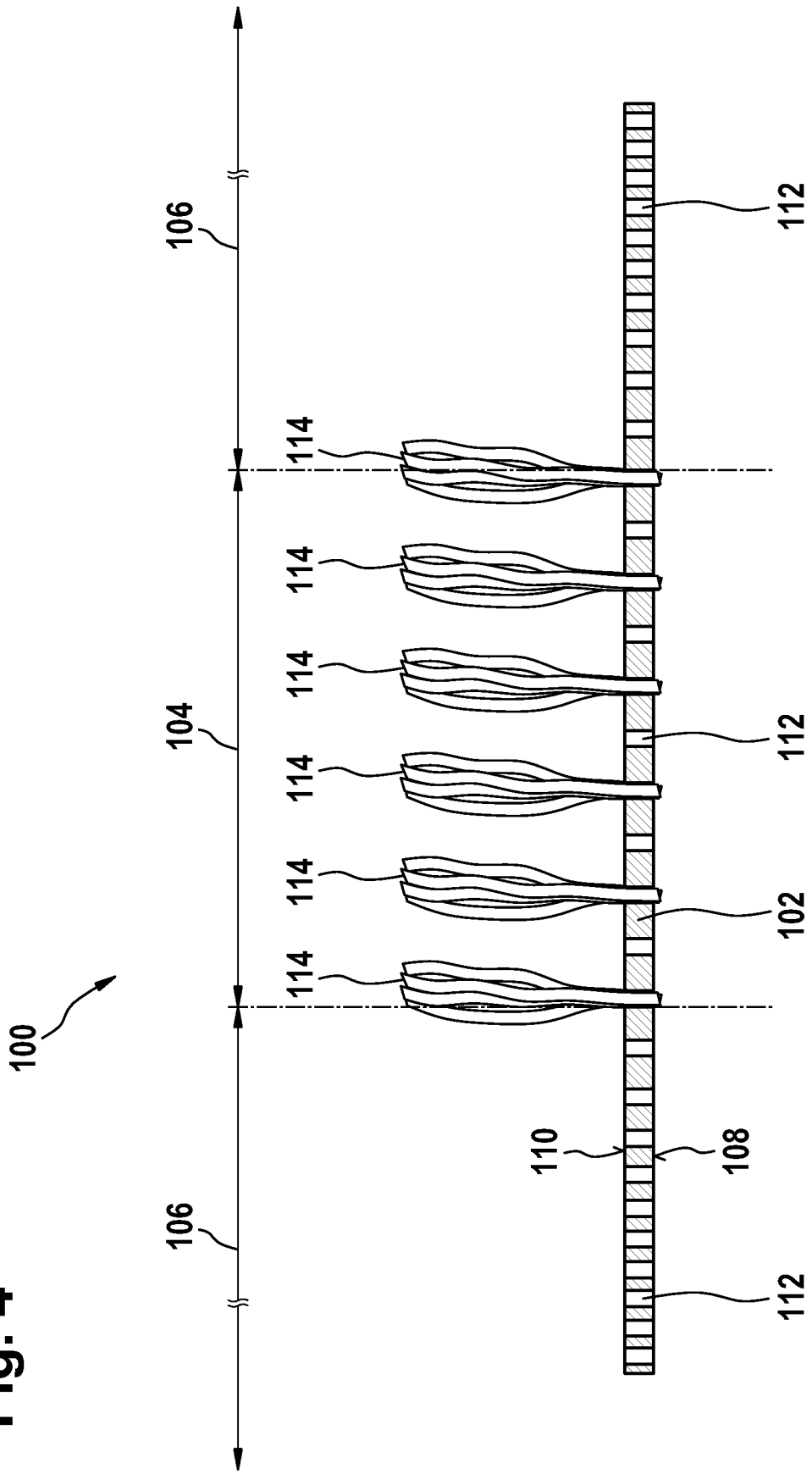
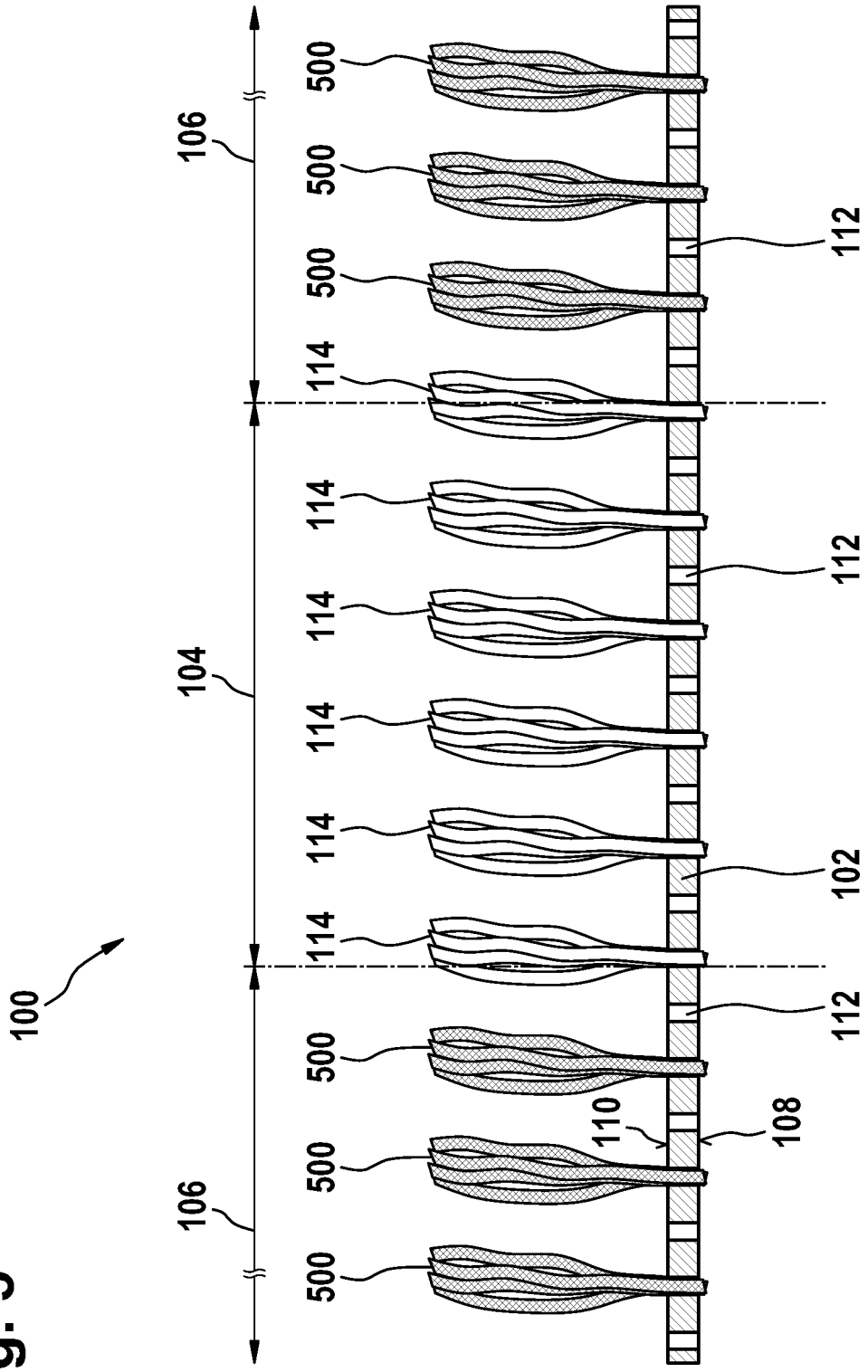

100
106
104
106
114
114
114
114
114
114
112
112
112
102
110
108
112

Fig. 4

Fig. 5


100
102
104
106
106
108
110
112
112
112
114
114
114
114
114
114
500
500
500
500
500
500

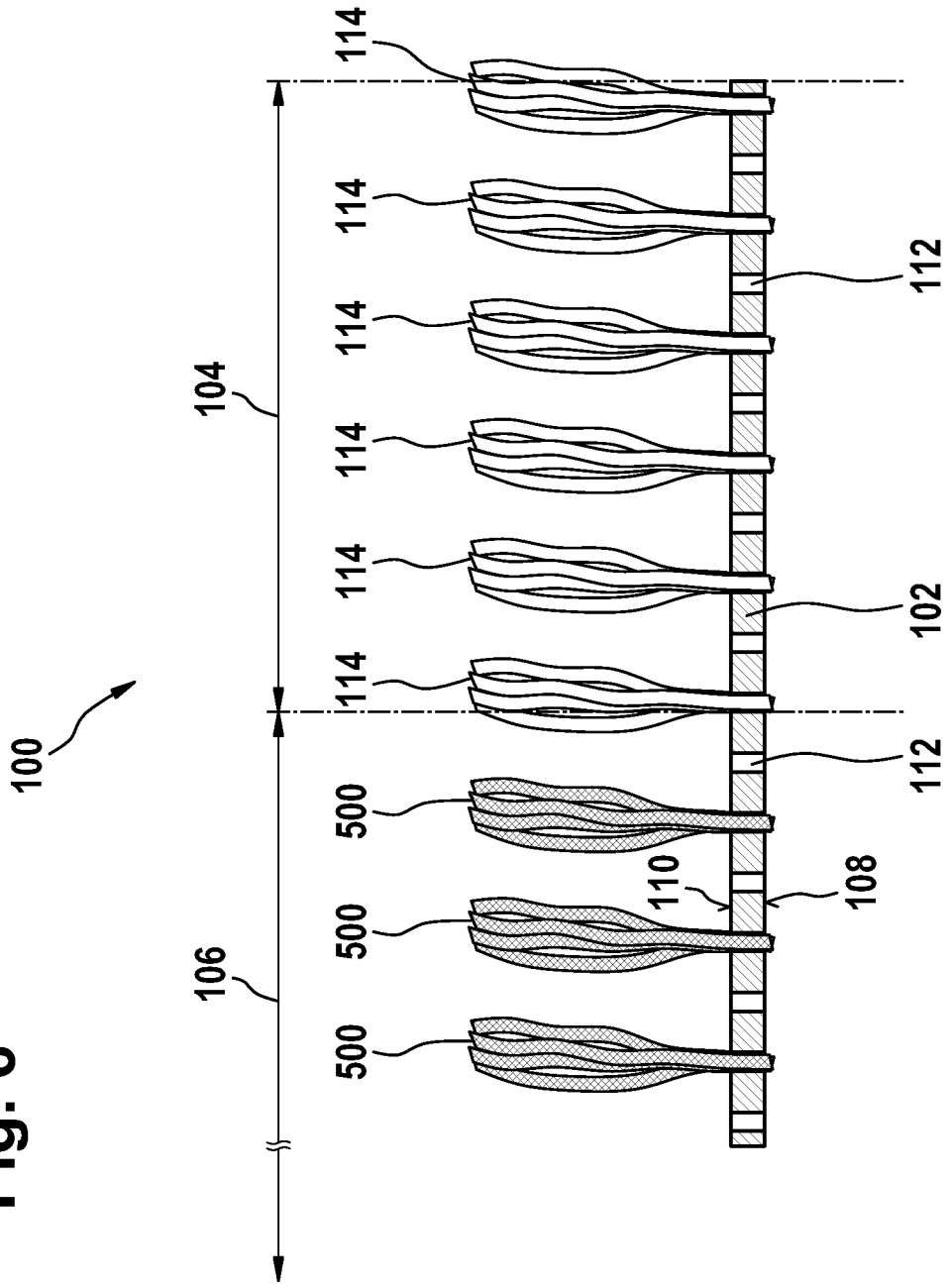

100
104
106
114
114
114
114
114
114
112
102
112
500
500
500
110
108

Fig. 6

Fig. 7

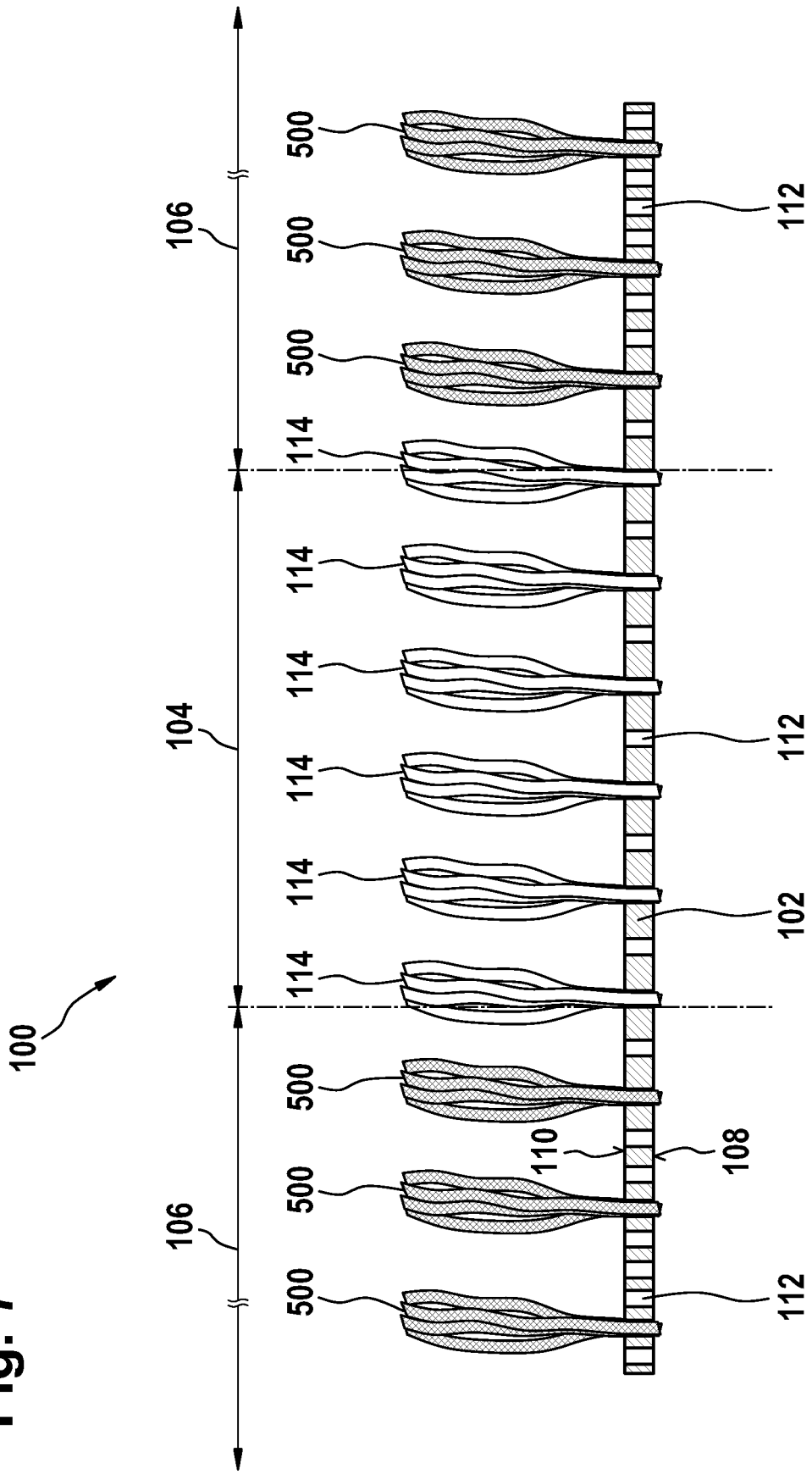
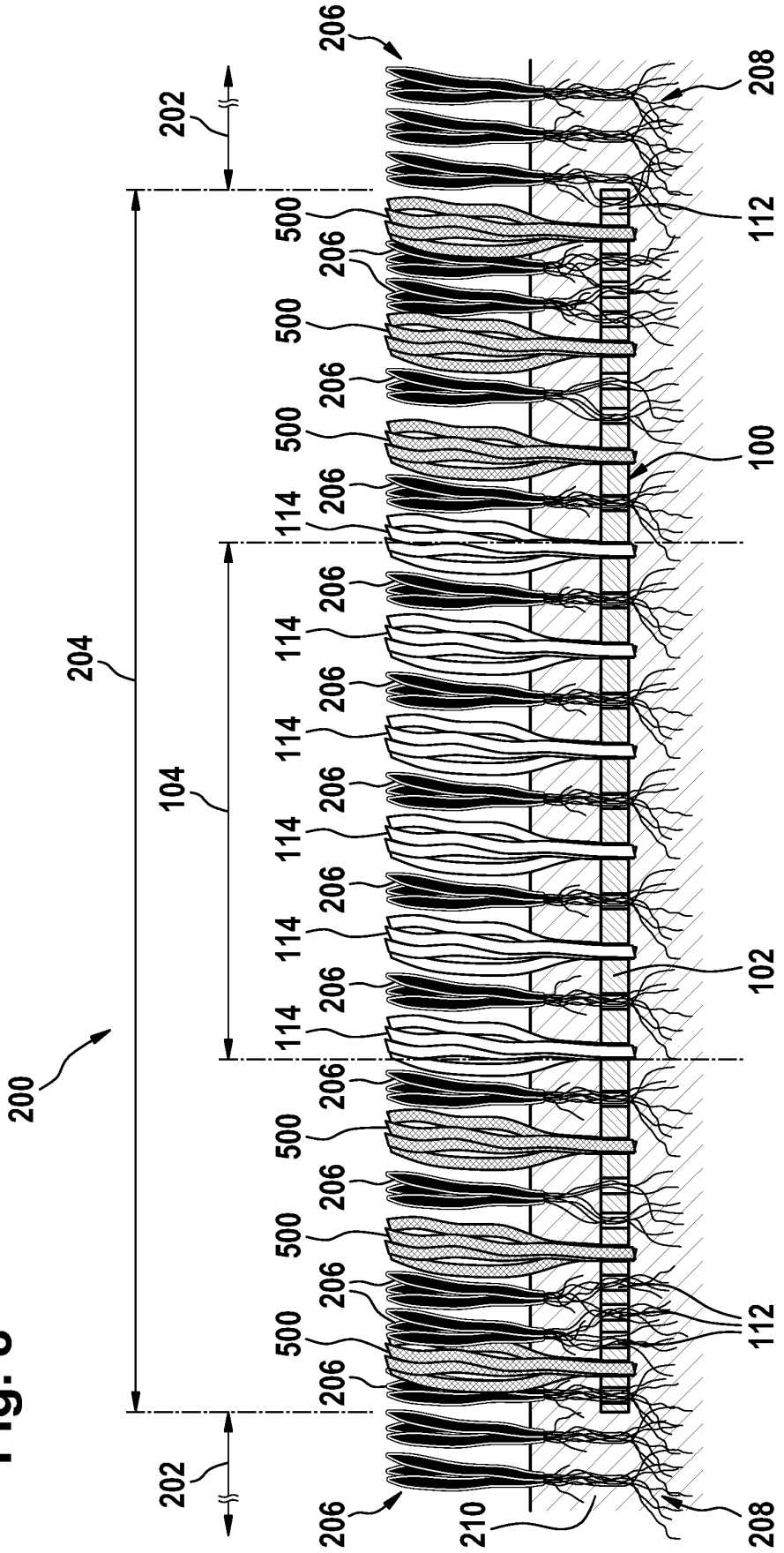

100
106
104
106
500
500
500
500
500
500
114
114
114
114
114
114
112
112
112
102
110
108

Fig. 8



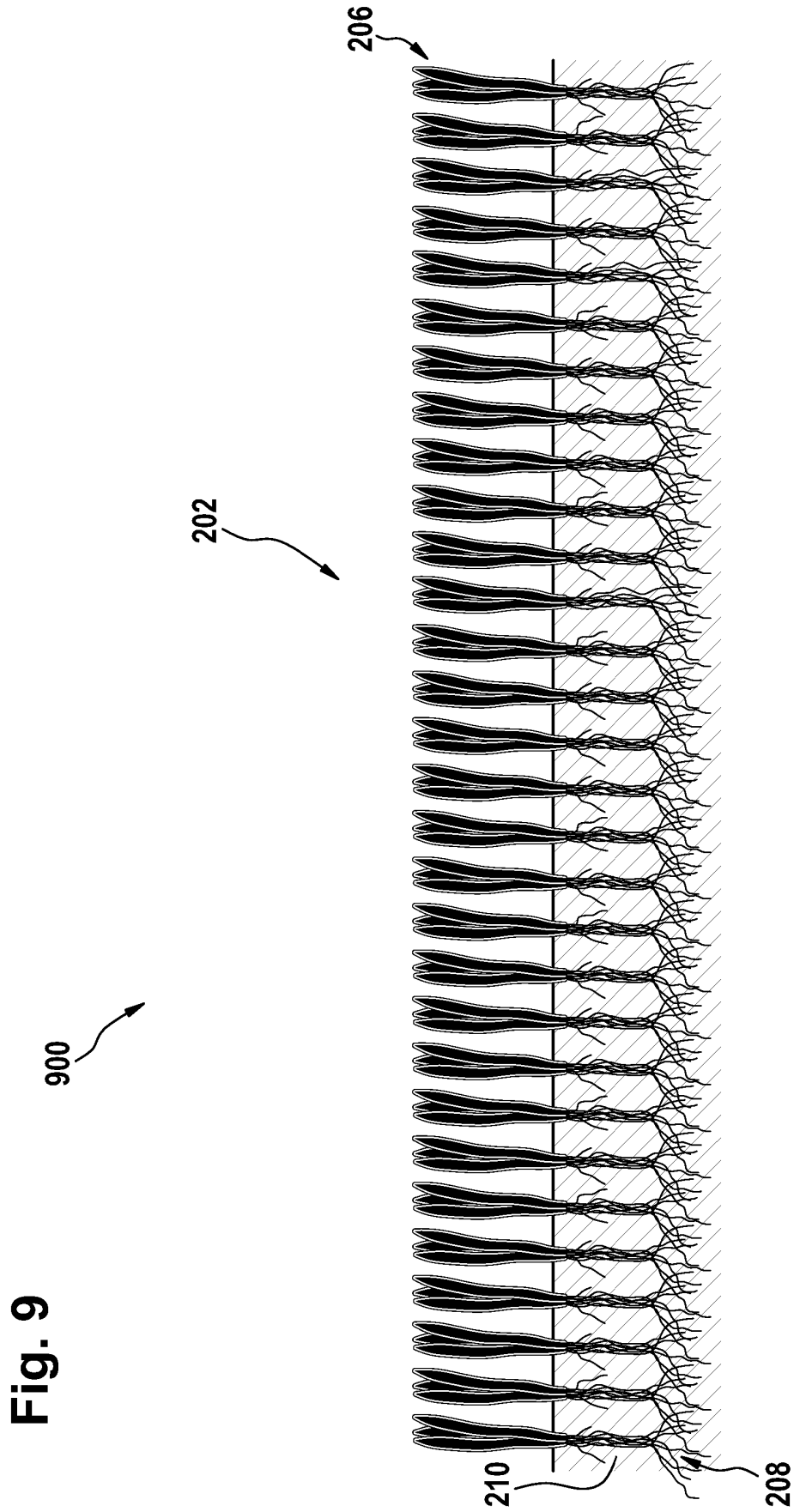


Fig. 9

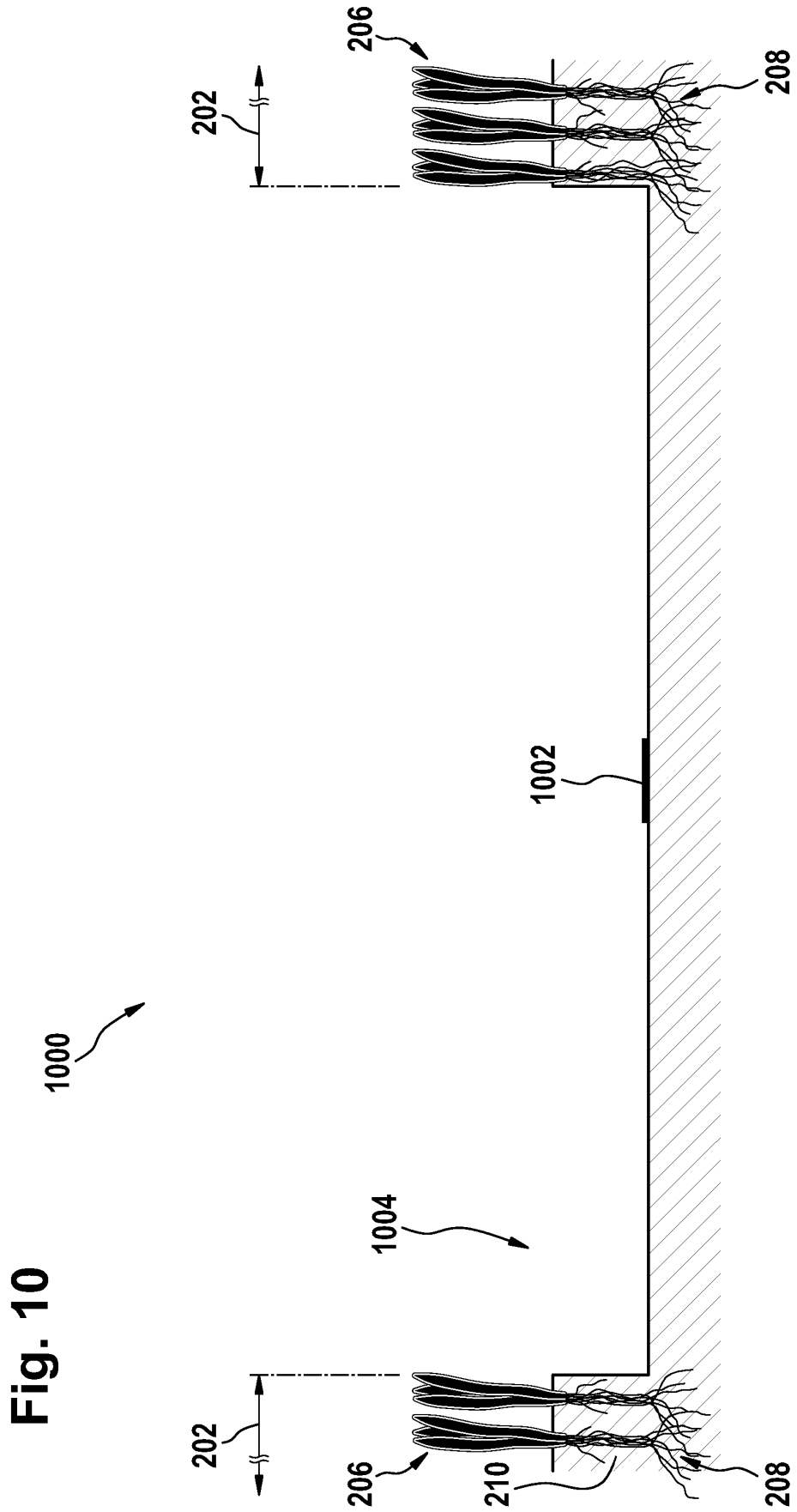
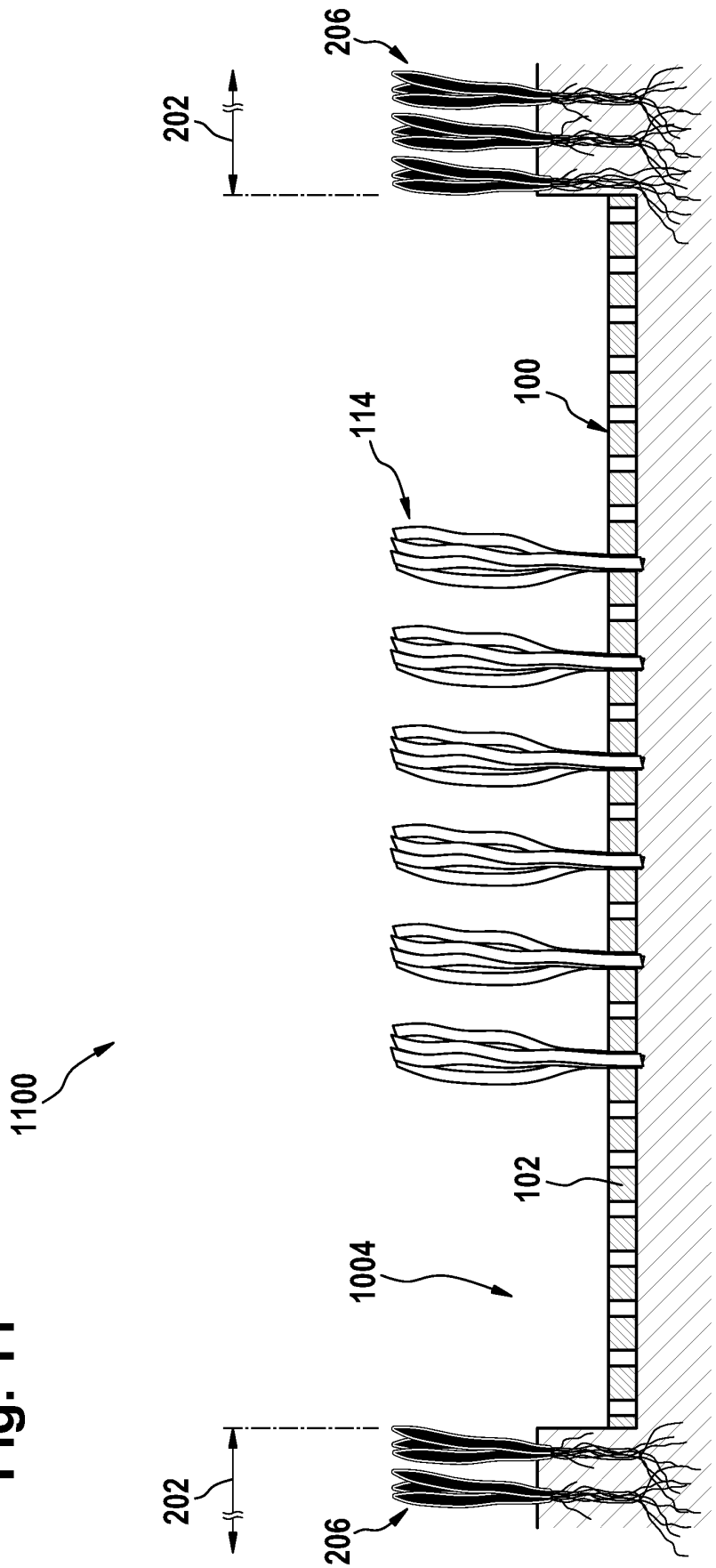


Fig. 10

Fig. 11



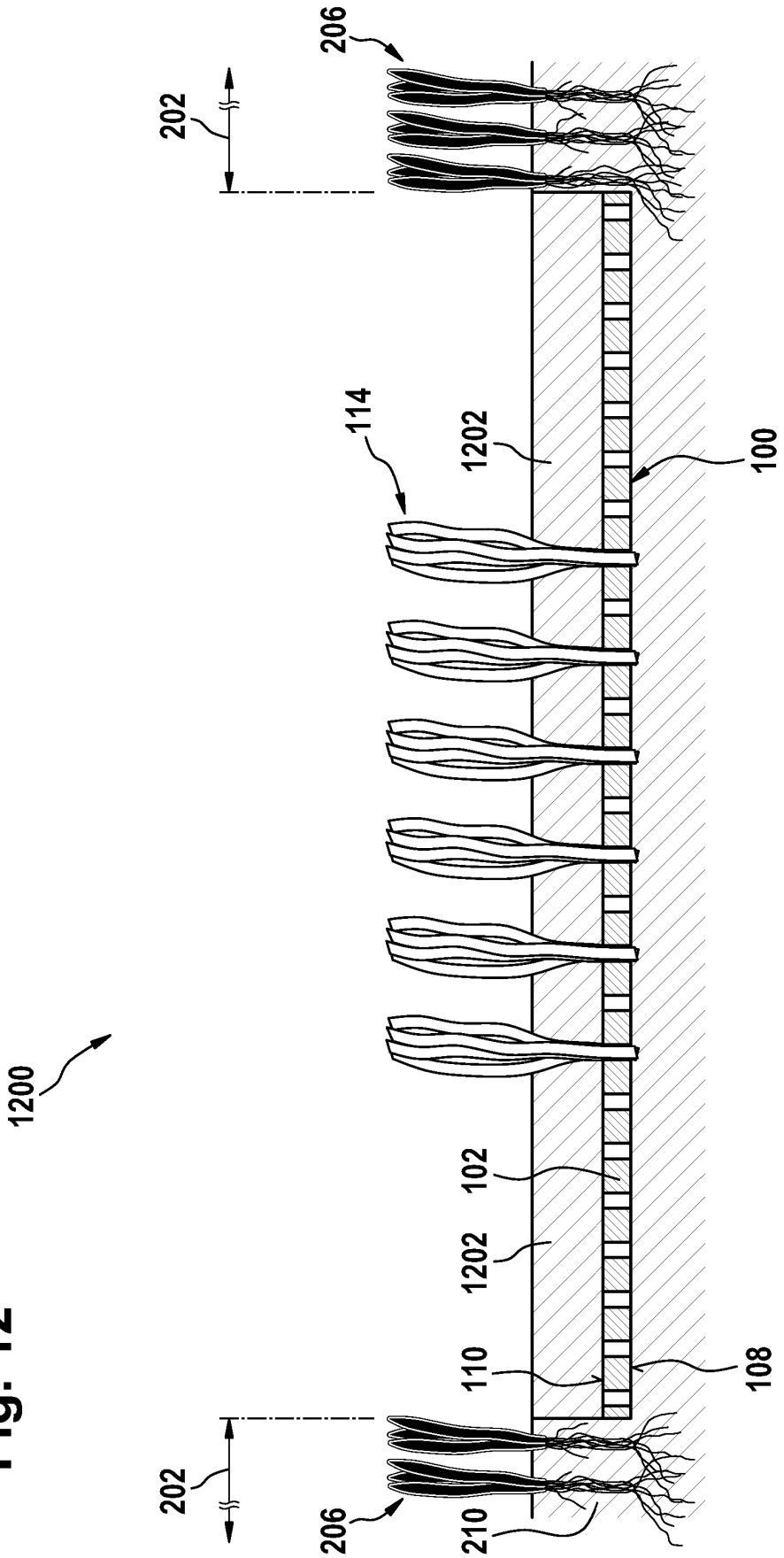
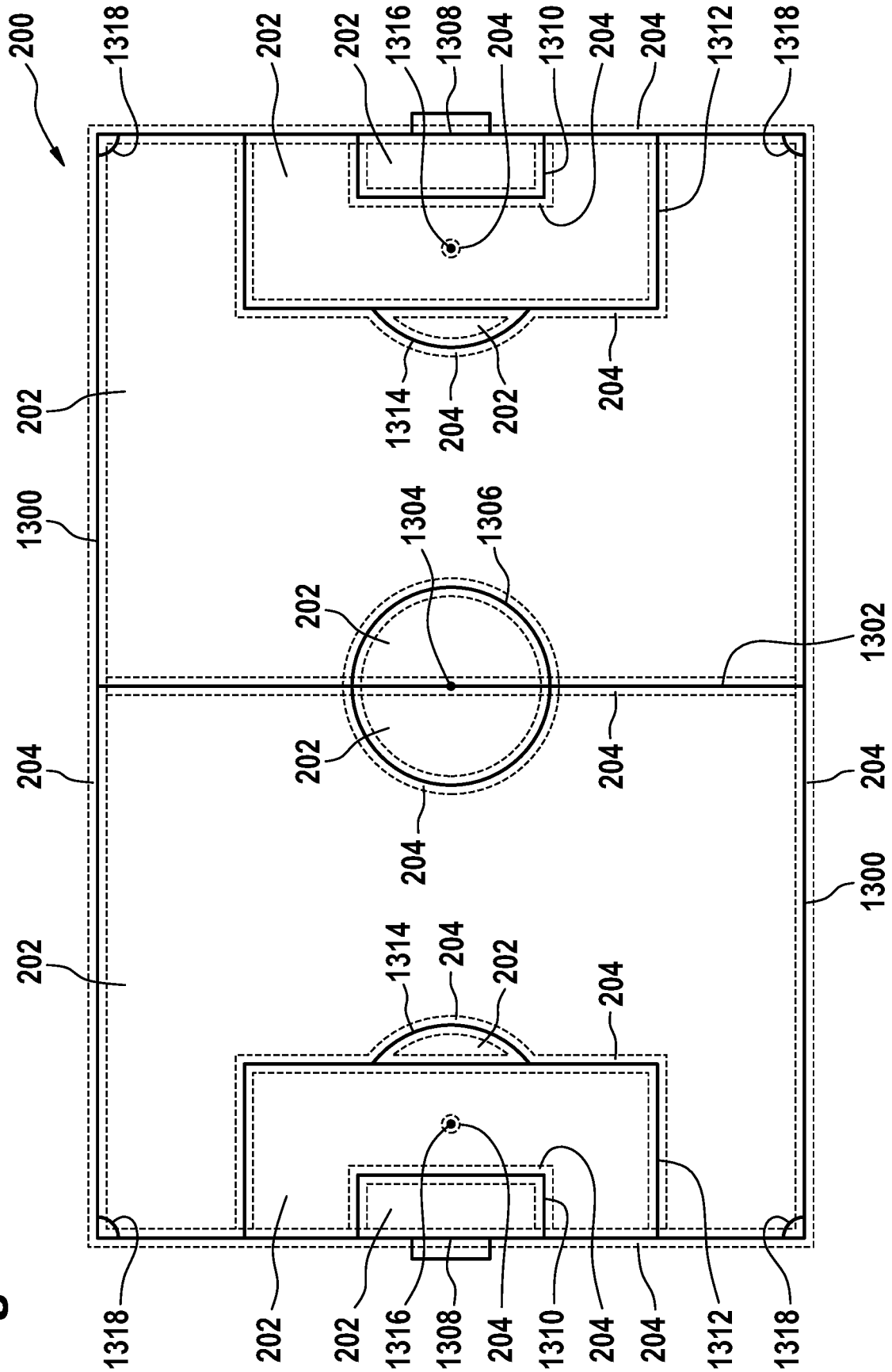


Fig. 12

Fig. 13


200
1318
202
202
1316
1308
204
1310
204
204
1312
1318
1314
204
202
204
202
1300
1304
1306
1302
204
204
1300
1318
202
202
1316
1308
204
1310
204
204
1312
1318

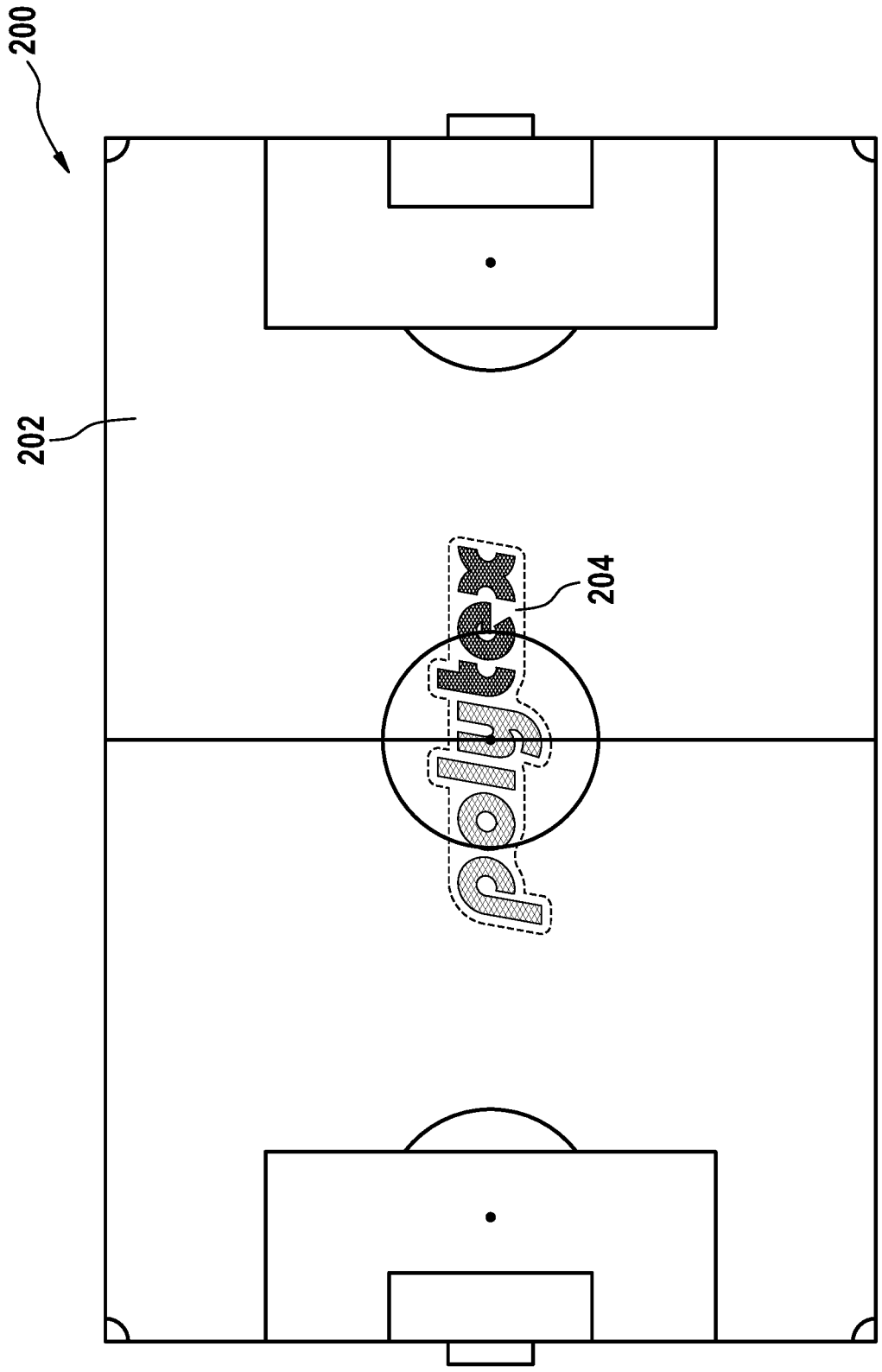


Fig. 14

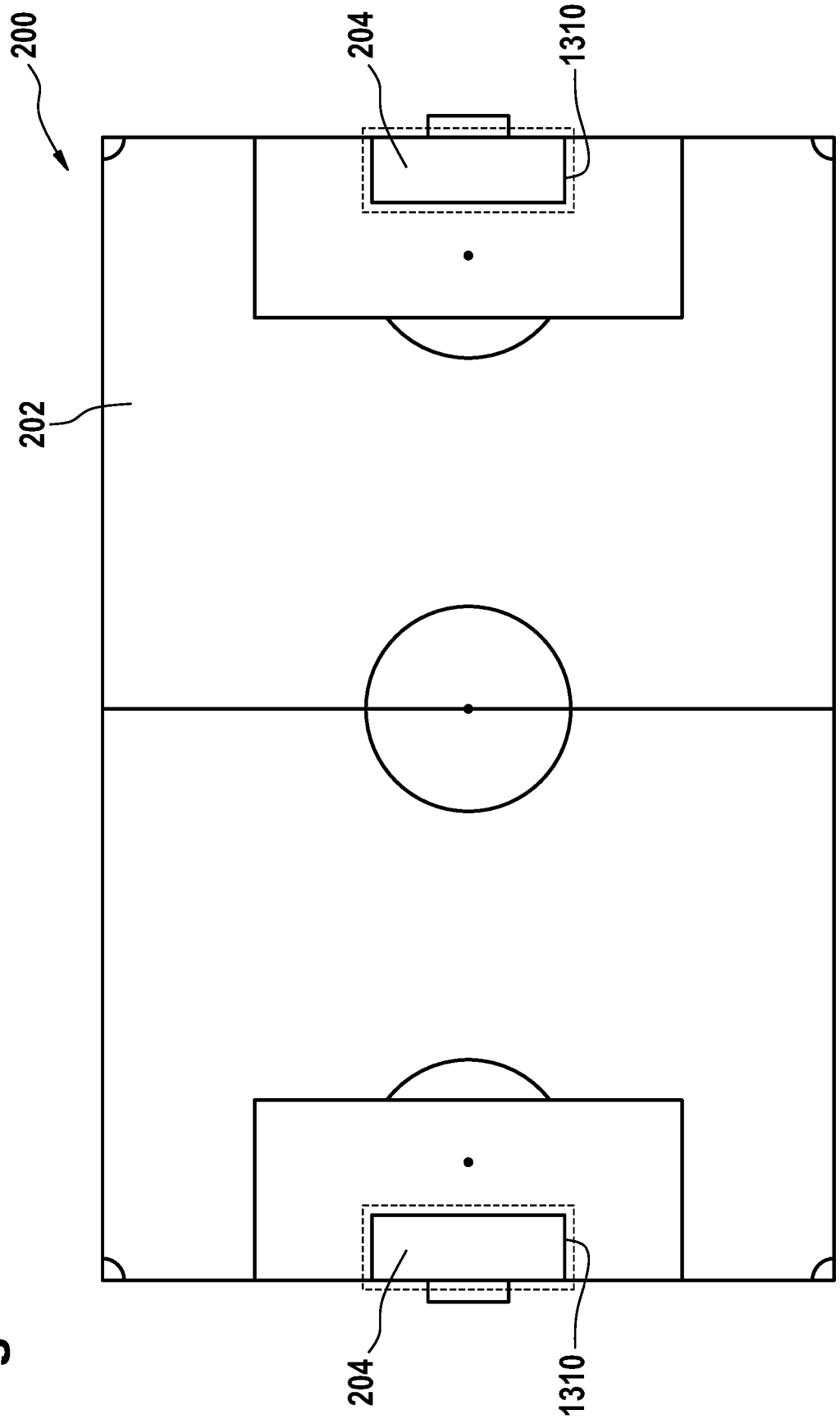


Fig. 15

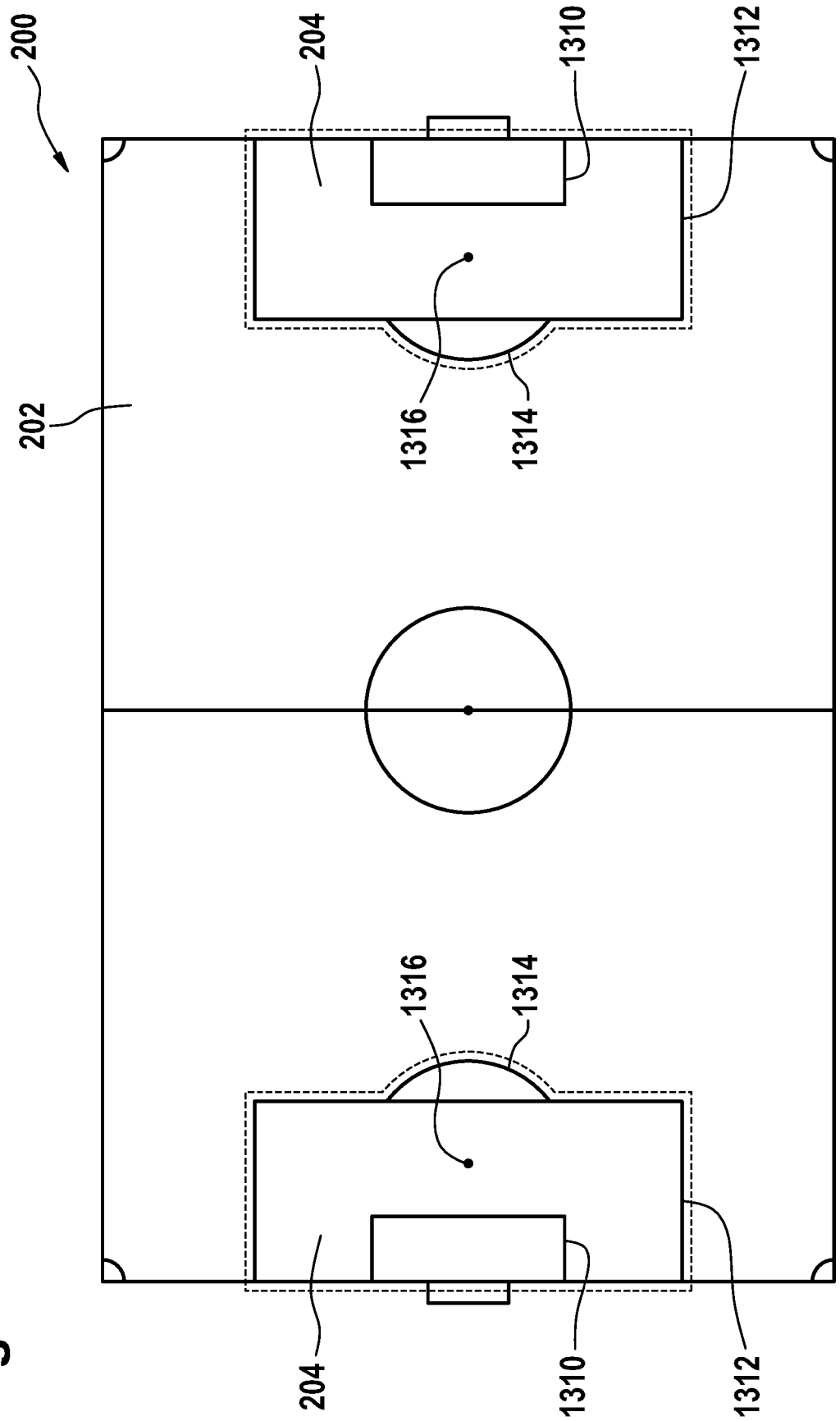


Fig. 16

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 6227989 B1 **[0003]**
- DE 19748486 A1 **[0004]**
- US 6295756 B1 **[0005]**
- WO 9961705 A1 **[0006]**
- US 2001007700 A1 **[0007]**