



(51) International Patent Classification:
E01C 13/08 (2006.01)

(21) International Application Number:
PCT/IB2013/051136

(22) International Filing Date:
12 February 2013 (12.02.2013)

(25) Filing Language: Italian

(26) Publication Language: English

(30) Priority Data:
12155131.1 13 February 2012 (13.02.2012) EP

(72) Inventor; and

(71) Applicant : SARRIS, Nikolas [IT/IT]; via Vincenzo Attimo 48, I-20021 Bollate (MI) (IT).

(74) Agent: LUNATI & MAZZONI S.R.L.; Via Carlo Pisacane 36, I-20129 Milano (MI) (IT).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,

HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

- with international search report (Art. 21(3))
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

(54) Title: MIXED TURF

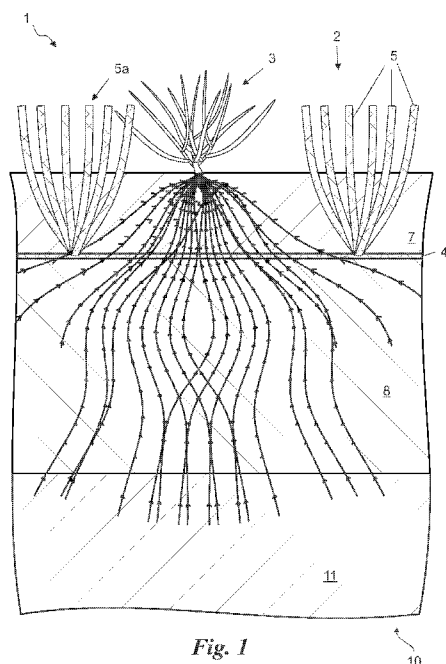


Fig. 1

(57) Abstract: A mixed turf (1) arranged on a soil (10) and comprising: a synthetic turf (2), natural grass (3) arranged in the synthetic turf (2), said synthetic turf (2) comprising: synthetic filaments (5) suitable to simulate grass blades and a backing (4) consisting of a membrane suitable to support the synthetic filaments (5), the backing (4) being further as a whole substantially draining, enabling transpiration and permitting the passage therethrough of the roots of said natural grass (3) and which is non-biodegradable.

DESCRIPTION

MIXED TURF

The present invention relates to a mixed turf, which is partly synthetic and partly natural, suitable, for example, for covering recreational or sports fields, ornamental
5 or play areas, as described in the preamble of Claim 1.

For practical and economical reasons, traditional natural turf coverings for sports fields and the like are frequently replaced by coverings made of synthetic materials simulating natural turf.

Particularly known are synthetic coverings simulating natural turfs comprising: a
10 support, or backing, consisting of a polymeric membrane to which a plurality of filaments, also made of polymeric material, are fixed by means of a polymeric latex or polyurethane resin which makes the backing impermeable, said filaments extending vertically to simulate natural grass blades. Numerous holes are made in the backing to allow the water to flow towards the underlying layers. These
15 coverings further comprise an infill material arranged on top of the support, consisting of granular material such as sand or the like, which has a stabilising, protecting and cushioning function. The infill and backing are permeable, or draining, and allow any excess water to flow towards the underlying soil.

Also known are mixed turfs, i.e. comprising structures of synthetic material mixed
20 with natural grass, which are more or less efficient and involve high costs for the production and/or maintenance of the turf.

For instance, patent application WO-A-2006/008579 and patent US-B-7,943,212 describe a technique for sowing natural grass seeds in the infill on top of the backing of a synthetic covering. In these cases the backing of the synthetic
25 covering is not biodegradable and acts as a barrier for the roots. It therefore

prevents the roots of the natural grass from penetrating deeply into the soil. The roots can, in fact, only grow horizontally inside the infill, which is about 4-5 cm thick. These coverings therefore require frequent watering in hot weather. In addition, in hot, wet weather conditions the natural grass could suffocate, thus
5 fostering the development of fungal diseases. When particularly wet weather conditions persist and there is also high biological activity in the soil, the oxygen in the vegetable substrate is depleted more quickly. This fosters anaerobic biological activity capable of capturing the little oxygen present in the sulphur oxides, thus releasing sulphuric acid (H_2S), a gas that is toxic for the roots.

10 These turf coverings require a great amount of care, involving considerable expense. Due to the lack of deep roots, there is the risk of the turf drying out during the hot summer months and, during long periods of wet weather, there is the risk of intoxication from the gases released due to anaerobic bacterial activity.

Patent US-B-6,145,248 discloses techniques for sowing natural grass in synthetic
15 coverings that, in theory, enable the roots of the natural grass to penetrate deeply into the soil due to the biodegradation of the backing of the synthetic turf. To enable this growth, the backing of the synthetic turf is partly biodegradable so as to become more porous in time, thus eventually allowing the roots to grow through it.

20 However, in this case, said backing loses its strength and there is a gradual reduction in the connection between the synthetic grass and the primary backing, thus eliminating the advantages of mixed turfs. In addition, the decomposition of the materials used, which depends on numerous factors and, in some cases, can take more than two years, contrasts with the need for the turf to grow quickly,
25 usually in 2-3 months during the summer break in the competition season. During

the first period, the roots penetrate the underlying support very little or not at all due to the limited circulation of air in the soil owing to the density of the water that deposits on the backing of the synthetic turf which thus forms an invisible water barrier. If the wet weather conditions persist, this fosters anaerobic bacterial activity and the release of gases that are toxic for the roots, as described in the previous case. The geotropic angle of the roots of the grass plants is thus altered so that these tend to grow in a horizontal direction. This fosters the formation of so-called "thatch", which further limits the gaseous exchange between the soil and the air. When the field is used 2-3 months after sowing, the upper layer is compacted even more, which further facilitates the formation of "felt" on the surface, so that the advantages of the synthetic grass are soon eliminated. The problem is difficult to solve and involves the use of equipment that also tends to spoil the structure of the synthetic grass. This method is not widespread due to the high costs of production and maintenance involved.

Patent US-B-6,372,310 also discloses techniques for sowing natural grass in synthetic turf that, in theory, enables the roots of the natural grass plants to pass through the holes in the backing that supports the synthetic grass blades, formed by enlarged spaces between the warp and weft threads, or due to the decomposition of some of the warp and weft threads in time. The present case differs from the previous one in that the plurality of holes are replaced with large gaps between the weft and warp yarns which are woven in a spaced manner or, in some cases, which are formed in time due to the partial use of biodegradable material. Forming the synthetic grass blades at the intersections of the backing leaves more room for the natural grass to grow on the surface and is more economical as less plastic is used. However, the penetration of the roots into the

underlying backing is limited for the same reasons mentioned above for the previous system. The connection of the grass blades to the backing is not guaranteed, according to the results of specific laboratory tests on synthetic grass. Upon close examination, it was observed that, to overcome the weakness of the connection between the fibres and the backing, the fibres are attached by applying a layer of latex resin to the lower part of the groups of rows that contain the synthetic grass fibres, making the backing partially impermeable. The groups of rows with the synthetic fibres alternate with the group of rows made partially with biodegradable fibres and the possibility of obtaining a stable fabric by eliminating a group of warp and/or weft fibres is doubtful. The natural grass dies quickly, before the fabric allows any deep growth of the roots due to intoxication from the gases released by the anaerobic bacterial activity.

Another type of technology, mainly applied to football fields, envisages the introduction of synthetic yarns into the natural grass field when already in use:

about 20 million synthetic yarns for a sports field of 7,000 m² inserted at a depth of up to 20 cm in the sandy soil to better withstand the "traffic" of a football match.

Although this method respects agronomic principles for the growth of natural grass, it can only be used in sandy soil, and is a complicated and expensive procedure that also involves the use of specific machinery characterised by low output and high maintenance costs. In large stadiums, major events, such as concerts are organised during the summer months. The field is covered with heavy slabs on which the stage can be erected, but which kill off the natural grass.

Growing new grass from seed takes a long time and this is often not compatible with the match schedule. It is therefore preferable to remove the old grass and lay

new turf. Since synthetic fibres are present in the first 20 cm of the soil, the entire

sand substrate must also be removed and must be disposed of as special waste. Separating the synthetic grass from the sand would also be an expensive process. Material handling alone has a significant effect on the time and costs of laying the new turf and inserting the new synthetic fibres.

- 5 Lastly, all of the systems for draining synthetic turf, mixed turf and even numerous natural turf surfaces have the drawback of using drainage systems that deliver rainwater into the sewer system or directly into the water table through absorbing wells, with all the risks resulting therefrom. It is for that reason that natural turf coverings for sports fields and the like, unlike grass fields in the countryside, are
10 regarded as impermeable.

In this situation the technical purpose of the present invention is to devise a mixed turf able to substantially overcome the drawbacks mentioned above. Within the sphere of said technical purpose, an important aim of the invention is to provide a mixed turf that is strong and of a high quality.

- 15 Another important aim of the invention is to obtain a mixed turf that is economical and of simple installation and maintenance.

A further aim of the invention is to provide a mixed turf that allows rapid water infiltration into the drainage layers without burdening the sewer system.

- The technical purpose and specified aims are achieved with a mixed turf as
20 claimed in the appended Claim 1.

Preferred embodiments are described in the dependent claims.

The characteristics and advantages of the invention are clearly evident from the following detailed description of a preferred embodiment thereof, with reference to the accompanying drawings, in which:

- 25 **Fig. 1** is a schematic cross-sectional view of the mixed turf according to the

invention;

Fig. 2a is an exploded and schematic cross-sectional view of a portion of a first example of a mixed turf according to the invention;

Fig. 2b is a view from above of a portion of a second example of a mixed
5 turf according to the invention;

Fig. 2c is a cross-sectional view along the line marked c-c in Fig. 2b;

Fig. 2d is a cross-sectional view along the line marked d-d in Fig. 2b;

Fig. 3a is a further schematic cross-sectional view of a first example of the mixed turf according to the invention;

10 **Fig. 3b** is a further schematic cross-sectional view of a second example of the mixed turf according to the invention;

Fig. 4 is a schematic view from above of the mixed turf according to the invention.

With reference to said drawings, reference numeral **1** globally denotes the mixed
15 turf according to the invention.

Conveniently, it is part of a soil **10** which also comprises a substrate **11**, as described below.

The covering **1** is suitable to constitute a substantially grassy surface, for example the surface of a sports field, and preferably of a football field, or also a surface of a
20 playing field, or of an ornamental, decorative or other area.

The mixed turf **1** comprises a synthetic turf **2** and natural grass **3**, arranged in said synthetic turf, as described more fully below.

In detail, the synthetic turf **2** comprises a backing **4**, described more fully below, and a plurality of synthetic filaments **5** simulating natural grass.

25 Conveniently, the backing **4** is a draining structure that, above all, enables

transpiration in both the wet and dry states. Moreover, the backing 4 is advantageously non-biodegradable, and more preferably fully non-biodegradable, so that the connection of the filaments 5 remains unchanged in time. Furthermore no polymers such as polyurethane or latex are applied to the bottom of said layer, 5 unlike with conventional systems.

The backing 4 also and conveniently has an irregular and jagged surface which increases the upper surface area of said backing 4 thus increasing the surface for interaction with any liquids and, as a consequence, increasing the permeability of said backing 4.

10 In particular, jagged surfaces minimise the formation of surface tension which may occur on smooth backings and also the formation of a water barrier due to the density of the water.

The backing 4 thus preferably has a three-dimensional shape in which the apertures are not arranged evenly along a continuous surface but are arranged on 15 surfaces with different angles of inclination.

In particular, the backing 4 comprises, in particular on the outside surface, an open-work or net-like fabric made of yarns with a large diameter or a non-woven fabric or a geocomposite, to achieve said characteristics of three-dimensionality and surface unevenness.

20 In a first example (Fig. 2a), the backing 4 preferably comprises at least one geonet 4a coupled with a geotextile 4b of non-woven fabric.

The coupling of geotextile materials and geonets as a base for synthetic grass is known in the prior art. In particular, both geonets and geotextiles are materials used in agriculture for soil consolidation or for similar purposes. Geotextiles made 25 of non-woven fabric are instead usually made up of extruded filaments arranged in

a uniform manner and subsequently needle-felted so as to constitute a felt or the like.

In this case the geonets 4a are of sizes such as to enable the passage of the roots of the natural grass 3, as described more fully below.

- 5 In greater detail, there are two geonets 4a, each coupled to a geotextile 4b. The two assemblies of geonets 4a and geotextiles 4b internally enclose the filaments 5 (Fig. 2a). Said filaments 5 are inserted by means of the prior art technique known as tufting, and glued, with melting of polymeric particles **4c** and in particular polyethylene, to the geonet 4a coupled to the upper geotextile 4b.
- 10 In particular, the outer layers of the backing 4 are both geotextiles.

The upper geonet 4a is preferably made of polyester and has a basis weight comprised between 25 g/m^2 and 100 g/m^2 , and more preferably between 30 g/m^2 and 60 g/m^2 and square meshes or the like having a width comprised between 0.5 mm and 4 mm.

- 15 The upper geotextile 4b is preferably made of polyester and has a basis weight comprised between 80 g/m^2 and 300 g/m^2 , and more preferably between 150 g/m^2 and 250 g/m^2 .

More preferably, the overall basis weight of the geotextile 4b and upper geonet 4a is comprised between 180 g/m^2 and 310 g/m^2 .

- 20 The lower geonet 4a is preferably made of polyester and has a basis weight comprised between 30 g/m^2 and 120 g/m^2 , and more preferably between 35 g/m^2 and 70 g/m^2 and square meshes or the like having a width comprised between 2 mm and 6 mm.

The lower geotextile 4b is preferably made of polyester and has a basis weight

- 25 comprised between 20 g/m^2 and 100 g/m^2 , and more preferably between 40 g/m^2

and 80 g/m².

More preferably, the overall basis weight of the geotextile 4b and lower geonet 4a is comprised between 75 g/m² and 150 g/m².

The synthetic filaments 5 are preferably stitched by means of said tufting to said
5 geonet 4a coupled to the upper geotextile 4b and preferably arranged in groups of
filaments **5a**. Conveniently, they are between 4 cm and 7 cm in length and are
preferably made of softer new-generation polyethylene, with special ribs to ensure
greater resilience. The space between the synthetic filaments 5 is optimised so
that there is room for the natural grass 3 to grow. In particular, the synthetic
10 filaments 5 are arranged in parallel rows spaced at distances of between 1 cm and
6 cm and more preferably of between 2 cm and 4 cm. Moreover, in some areas,
for example in the parts of a football field exposed to the heaviest wear, such as
the goal areas, the synthetic filaments 5 may be arranged closer together. In
particular, the synthetic filaments 5 do not exceed, in terms of arrangement density
15 in the soil, 10%-30% of the arrangement density of the natural grass 3 having the
desired density.

In a second example (Figs. 2b-2d) the backing 4 consists of a net-like or open-
work fabric having a warp consisting of first yarns **40**, preferably in polypropylene,
having a diameter comprised between 3 mm and 0.3 mm and in particular
20 between 1.8 mm and 0.7 mm. The distance between the first yarns 40 is
preferably between 3 mm and 8 mm and, more preferably, between 4 mm and 5
mm.

Moreover, the first yarns 40 are preferably at different levels, and preferably two
levels, at different heights and thus not aligned on the same plane.

25 The weft of said fabric consists of second yarns **41**, preferably in polyester or

polypropylene, having a diameter comprised between 0.1 mm and 1.5 mm and more in particular between 0.7 mm and 0.3 mm.

The weft is also preferably composed of the fibres that constitute the synthetic filaments 5, which cross a number comprised between 15 and 4 of first yarns 40
5 and protrude from both ends by several centimetres, so as to form the synthetic filaments 5. The filaments are also preferably in groups of three.

The distance between the first yarns 40 is preferably between 0.2 mm and 4 mm and, more preferably, between 0.4 mm and 1 mm. Said method, in which the synthetic filaments 5 are woven into the backing 4 and are an integral part thereof,
10 is also referred to as the woven method.

Said net and backing are also held together by means of an adhesive applied to the net so as not to fill the spaces obtained between the warp and the weft thanks to the open-work fabric and three-dimensional shape between the stitches.

The backing 4 is as a whole substantially permeable to water and, above all,
15 enables transpiration and allows the gasses in the soil to circulate freely. The term "as a whole" refers to the fact that the whole surface, on a macroscopic scale, of the backing has the characteristics of permeability and enabling transpiration, owing to the choice of the microscopic features of the backing: in particular, the three-dimensional shape of the backing which prevents the formation of a water
20 barrier due to the density of the water on top of the backing. Therefore this is not left merely to holes or macroscopic apertures in the backing, as is the case with the prior art backings.

The soil 10 further comprises an upper layer 7 arranged on top of the backing 4 and a lower layer 8 which supports the backing 4 and therefore comes into contact
25 with said backing 4 and with the upper layer 7.

Conveniently, the upper layer 7 is mainly made up of sand. In detail, the upper layer 7 is made up of: crushed stone and sand, the volume of which preferably represents between 40% and 90% of the overall volume of the upper layer 7, organic material of vegetable origin, the volume of which preferably represents
5 between 5% and 60% of the overall volume of the upper layer 7, optionally a fraction of sand of volcanic origin, the volume of which preferably represents less than 30% of the overall volume of the upper layer 7, and optionally agricultural soil, the volume of which preferably represents less than 15% of the overall volume of the upper layer 7.

- 10 The crushed stone and sand are of a siliceous nature with no active limestone, with pH values preferably comprised between 6.0 and 7.5, more preferably between 6.5 and 6.9. The sand grain size is aptly variable and the particle size curve has a fraction exceeding 85% that is between 0.05 mm and 2.00 mm, preferably between 0.25 mm and 1.20 mm, and a fraction of crushed stone less
15 than 15% measuring between 2 mm and 4 mm.

Said organic material of vegetable origin consists of blond, brown or black peat and possibly, of coconut husks, cork or other organic vegetable material.

The sand of volcanic origin consists of volcanic lapillus and pozzolan, with a particle size of between 0.05 and 3.00 mm.

- 20 The upper layer 7 is preferably between 2 cm and 4 cm thick and leaves a portion of the synthetic filaments 2 free, preferably between 1.5 cm and 3 cm in length. Moreover, the layer 7 permits drainage and improves the consistency of the playing surface, in particular to provide a firm support for players during the game, while at the same time promoting the growth of the natural turf.
- 25 The lower layer 8 is a draining vegetable layer in contact with the substrate 11. It is

preferably made up of inert crushed stone, the volume of which preferably represents less than 90% of the overall volume of the lower layer 8, inert sand, the volume of which preferably represents less than 90% of the overall volume of the lower layer 8, inert material of volcanic origin, the volume of which preferably represents less than 40% of the overall volume of the lower layer 8 and organic material of vegetable origin, the volume of which preferably represents between 5% and 50% of the overall volume of the lower layer 8.

Advantageously, the inert stone is of siliceous origin with no active limestone and pH values comprised between 6.0 and 7.5, preferably between 6.5 and 6.9. Particle size varies between 2 mm and 12 mm, preferably between 3 mm and 8 mm. The sand is silica sand with no active limestone and pH values comprised between 6.0 and 7.5, preferably between 6.5 and 6.9 with variable sizes and a particle size curve having a fraction of more than 85% between 0.05 mm and 2 mm, preferably between 0.25 mm and 1.2 mm. The inert materials of volcanic origin are of the volcanic lapillus and pozzolan type, the particle size of which is comprised between 3 mm and 5 mm. The layer 8 is doubled if the substrate 11 is arid, not water permeable and/or not draining, preferably with crushed silica stone as previously specified or, preferably, with the same material as specified above.

The turf 1 further comprises natural grass 3, as previously specified. In ideal conditions, the natural grass 3 is arranged in the covering 1 together with the synthetic turf 2 and is preferably present with an average density that is between 3 and 10 times higher than the average density of the synthetic turf 2 in the soil 10. The density can be measured visually, for example, by comparing the groups of synthetic filaments 5 and the tufts of natural grass 3. The natural grass is supported by the upper surface of the upper layer 7 and comprises roots that

advantageously extend over the whole of the upper layer 7, pass through the backing 4 and also extend along the lower layer 8 (Fig. 1) and preferably also along part of the substrate 11.

The substrate 11 consists of an existing soil, for example an agricultural soil or the like. It comprises a drainage system **12** consisting of trenches of various shapes and sizes, as shown in Figs. 3 and 4.

In particular, the system 12 comprises perimeter headers **13**, arranged around the perimeter of the sports field or the like (Fig. 4) and secondary drainage means **14** extending so as to at least partly join different portions of the perimeter headers and more preferably arranged diagonally with respect to the headers 13 (Fig. 4).

Said headers 13 and drainage means 14 extend starting from the upper surface of the substrate 11, bordering on the lower layer 8. They have widths comprised between 5 cm and 60 cm. In particular, the perimeter headers 13 preferably have a rectangular cross-section with a width comprised between 30 cm and 60 cm and a height comprised between 40 cm and 70 cm, while the secondary drainage means 14 also preferably have a rectangular cross-section with a width comprised between 8 cm and 35 cm and a height comprised between 20 cm and 40 cm.

Moreover, both the headers 13 and the drainage means 14 comprise inner pipelines consisting of microperforated pipes **16** laid in trenches of varying sizes and filled with sand, crushed stone or the like.

The drainage system 12 further comprises a plurality of micro-drains **15** connected for fluid passage with said drainage means 14 and consisting of closely spaced trenches arranged between 15 mm and 120 mm apart. They are preferably parallel to each other, perpendicular to the surface slope of the terrain, parallel to the two perimeter headers 13, for example (Fig. 4) the larger headers in the case

of a rectangular field. Alternatively, they may be arranged parallel to the surface slope or diagonally with respect to the surface slope of the field in the direction opposite to that of the other diagonal drainage means 14. They too extend starting from the upper surface of the substrate 11 at a depth of between 10 cm and 25 cm
5 and have a width comprised between 2 cm and 6 cm (Fig. 3a).

Instead of the micro-drains 15, a continuous and uniform layer of crushed stone 18 may be laid beneath the lower layer 8 (Fig. 3b).

Lastly, the turf 1 is provided with an automatic watering system comprising irrigators of the type known in the prior art, with a range of up to 22 m.

10 The invention comprises a new process for creating a mixed turf 1 described above in a structural sense.

In particular, the process consists of providing the substrate 11 with the drainage system 12 described above, arranging the lower layer 8 on top of this, arranging the synthetic turf 2 over this, covering the synthetic turf with the upper layer 7 and
15 introducing the natural grass 3. The natural grass 3 is preferably introduced and obtained by sowing grass seeds on the spot. Alternatively, the upper layer 7 and the natural grass 3 are obtained in a nursery and subsequently transplanted onto the described structure, after which it is cultivated using the traditional methods used to cultivate turf.

20 The establishment of the fresh seedlings is aided by the shade provided by the synthetic grass, which also simplifies subsequent maintenance. In cold weather the synthetic yarns protect the seedlings from freezing conditions and facilitate their establishment.

The mixed turf 1 according to the invention and the process described achieves
25 some important advantages. The applicant has found that, surprisingly, the prior

art structures comprising backings consisting of substantially impermeable membranes provided with apertures or macroscopic holes did not allow transpiration and gaseous exchange between the soil and the air due to the density of the water and surface tension, which caused the water to be deposited
5 on the backing of the synthetic turf blanket and obstruct said holes or apertures. The applicant therefore unexpectedly discovered that the described backing 4, which is a permeable structure and enables transpiration owing to the microscopic characteristics of the backing 4, which also extend over the whole surface of said backing 4, permits the passage of water and air, contrary to what had been initially
10 thought. Said advantage is due in particular to the described jagged, three-dimensional surface.

With the turf 1, the roots are thus able to proliferate deep in the soil so that the backing is anchored by the roots of the natural grass 3. Thus, owing to the described combination of the synthetic turf 2 and the natural grass 3, the natural
15 grass 3 is able to withstand summer droughts, trampling, and horizontal pull when players fall and skid on the grass, and ensures good playability.

More specifically, the synthetic yarns protect the leaves and especially the crown, which is the most delicate part of the plant. At the same time the roots grow vigorously, extend deep into the soil and cling to the backing 4 thus forming a firm
20 mixed turf that can withstand trampling and players falling and skidding on the turf. Damage resulting from the use of the field is limited, so that a uniform and safe playing surface is maintained, while at the same time saving money in terms of extraordinary maintenance.

The mixed turf 1 is also simple and relatively economical to install. The rainwater
25 is kept in the soil between the micro-drains, excess water is dispersed in the soil

and only a minimum amount is drained into the sewer system or the water table.

Moreover, the conformation of the drainage system 12 is particularly suited to the described turf 1, probably due to the described type of backing 4, and permits improved hydration of the natural grass 3.

- 5 In particular, the rainwater passes through the upper layer 7, the backing 4 and the lower layer 8, and is conveyed into the micro-drains 15. The function of the lower layer 8 and micro-drains 15 is to rapidly absorb and preserve rain and irrigation water, keeping the soil between the micro-drains 15 moist, so that said water is then returned to the natural grass 3 in the form of moisture thus considerably
10 reducing the amount of water required for irrigation.

This makes it easier to reduce the frequency of watering, a condition that promotes deep, healthy rooting, a fundament requirement in order to improve the strength of the natural turf.

- The excess water flows into the headers 13 and drainage means 14 and is drained
15 into the underlying soil so that the rainwater is not carried into the sewer system, which helps to prevent flooding of the covered field in the case of heavy rainfall, while at the same time enabling the roots of the grass plants to grow. Once the roots reach the lower layer 8 or substrate 11, they can better use the water reserves and nutritional elements therein, including those added with manure
20 during subsequent maintenance.

- The soil 10 thus obtained does not retain the water and prevents the formation of impermeable barriers due to the effect of its density, so as to preserve two fundamental properties, i.e. permeability and transpiration, even when the soil is too wet, so as to allow the roots of the natural grass to penetrate deeply as far as
25 the original soil.

In the event of heavy rainfall, the infiltration of rainwater through the described upper layer 7 and lower layer 8 is ensured by the porosity formed due to the use of the described particle sizes. In this manner, the grass surface can continue to be used without losing its physical properties during the sports activity.

- 5 Modifications and variations may be made to the invention described herein without departing from the scope of the inventive concept as expressed in the independent claims.

CLAIMS

1. A mixed turf (1) arranged on a soil (10) and comprising: a synthetic turf (2), natural grass (3) arranged in said synthetic turf (2), said synthetic turf (2) comprising synthetic filaments (5) suitable to simulate grass blades and a
5 backing (4) consisting of a membrane supporting said synthetic filaments (5), said mixed turf (1) being characterised in that: said backing (4) is on the whole substantially draining and enables transpiration and permits the passage therethrough of the roots of said natural grass (3), and in that said backing (4) is non-biodegradable.
- 10 2. A mixed turf (1) as claimed in claim 1, wherein said backing (4) has a three-dimensional shape in which the apertures are not arranged uniformly along a continuous surface but on surfaces at different angles of inclination.
3. A mixed turf (1) as claimed in one or more of the preceding claims, wherein said backing (4) has an irregular and jagged surface.
- 15 4. A mixed turf (1) as claimed in one or more of the preceding claims, wherein said backing (4) comprises a non-woven fabric.
5. A mixed turf (1) as claimed in one or more of the preceding claims, wherein said backing (4) comprises at least one geonet (4a) and at least one geotextile (4b).
- 20 6. A mixed turf (1) as claimed in claim 5, wherein said backing (4) comprises two of said geonets (4a) and two of said geotextiles (4b), said geotextiles (4b) constituting the outer faces of the backing (4) and said geonets (4a) enclosing said filaments (5).

7. A mixed turf (1) as claimed in one or more of the preceding claims, wherein said backing (4) comprises open-work fabric comprising first yarns (40) having a diameter comprised between 3 mm and 0.3 mm.

8. A mixed turf (1) as claimed in claim 5, wherein said first yarns (40) have
5 a diameter comprised between 1.8 mm and 0.7 mm.

9. A mixed turf (1) as claimed in one or more of the preceding claims, wherein said first yarns (40) are arranged on two levels so as to form a backing (4) with a three-dimensional open-work fabric.

10. A mixed turf (1) as claimed in one or more of the preceding claims,
10 wherein the arrangement density in the soil of said synthetic filaments (5) is less than between 10% and 30% of the arrangement density of said natural grass (3).

11. A soil (10) comprising a mixed turf (1) as claimed in one or more of the preceding claims and further comprising: an upper layer (7), mainly
15 composed of sand and arranged on top of said backing (4), a lower layer (8) suitable to support said backing (4) and which comes into contact with said backing (4) and with said upper layer (7) and a substrate (11) bordering on said lower layer (8).

12. A soil (10) as claimed in claim 11, wherein said sand of said upper
20 layer (7) consists of crushed stone and sand having pH values comprised between 6.0 and 7.5 and of which a fraction higher than 85% having a particle size comprised between 0.05 mm and 2.00 mm.

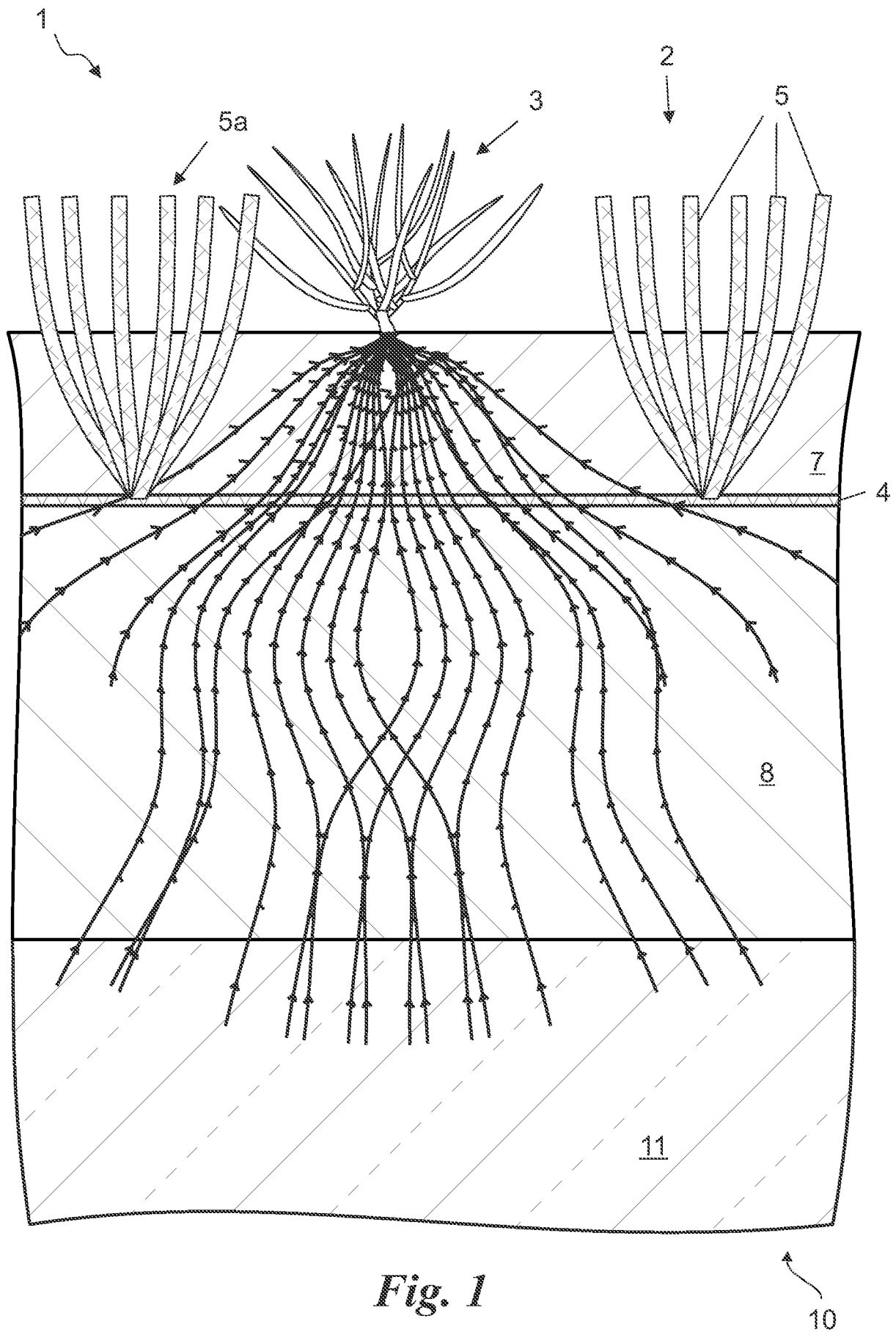
13. A soil (10) as claimed in one or more of claims 11-12, wherein said substrate (11) comprises a drainage system (12) consisting of trenches and
25 including: perimeter headers (13) arranged around the perimeter of the soil (10)

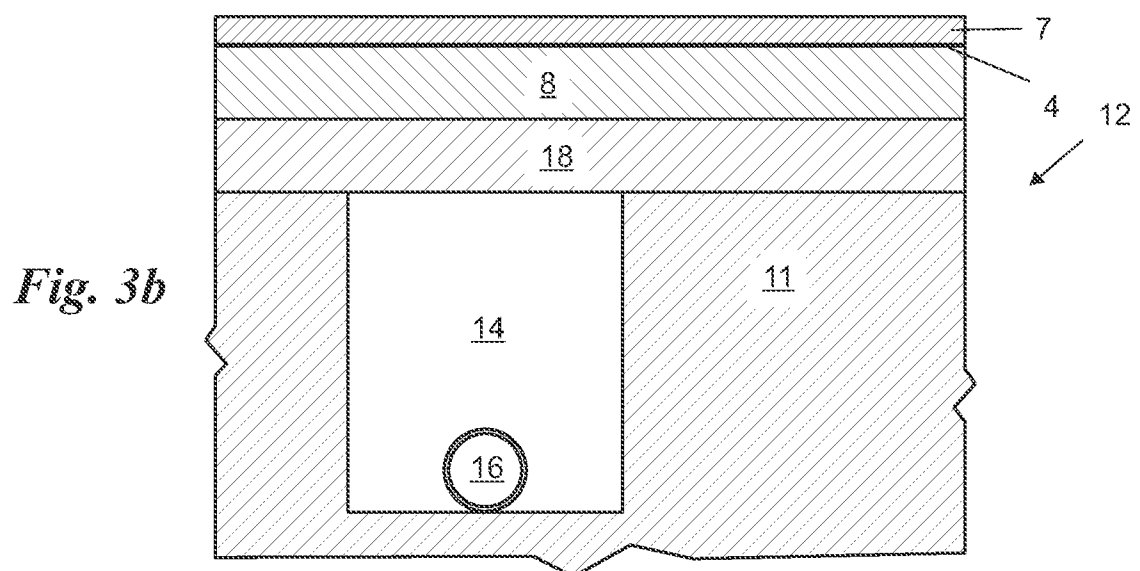
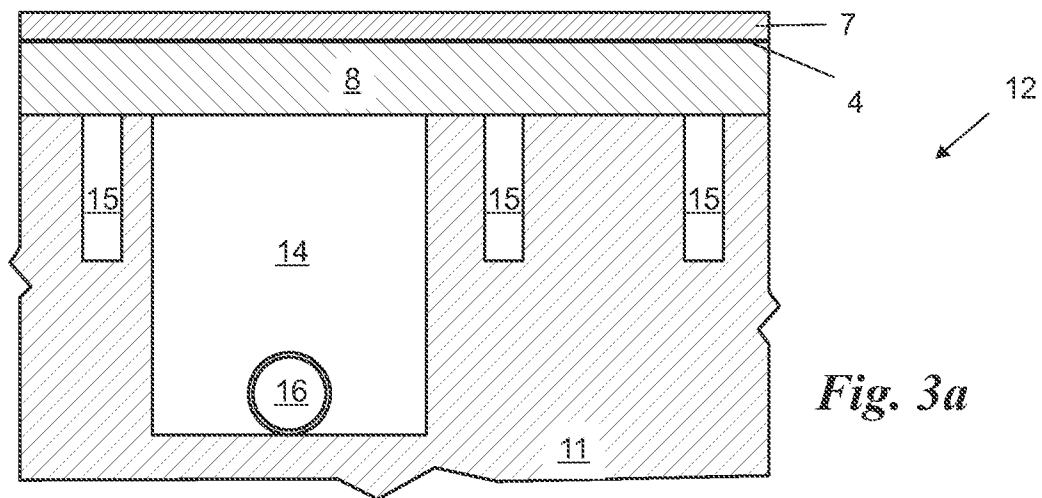
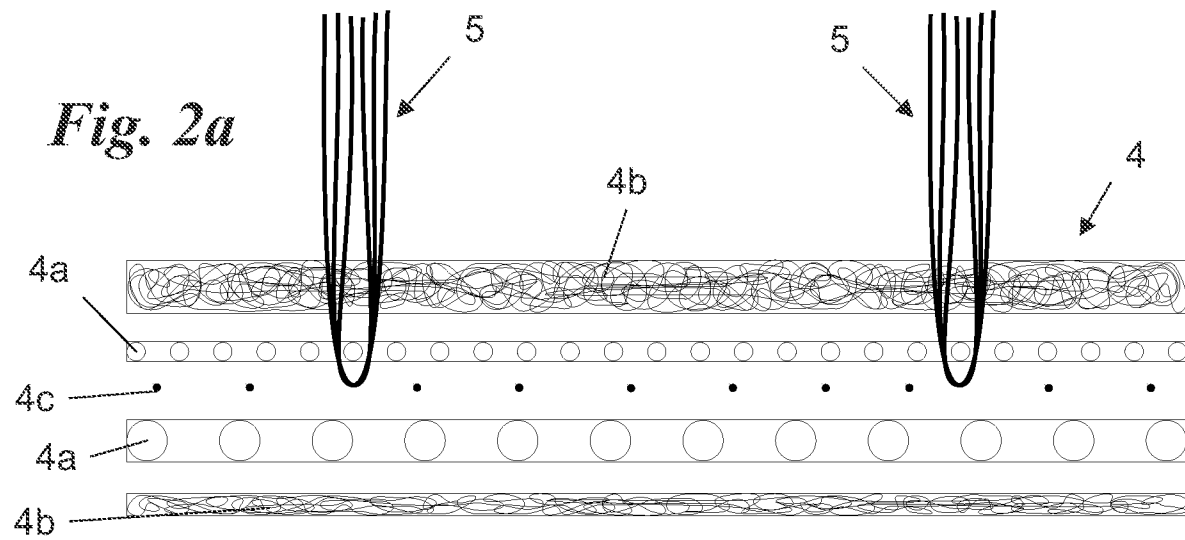
and secondary drainage means (14) extending over said soil and at least partly joining different parts of said perimeter headers (13).

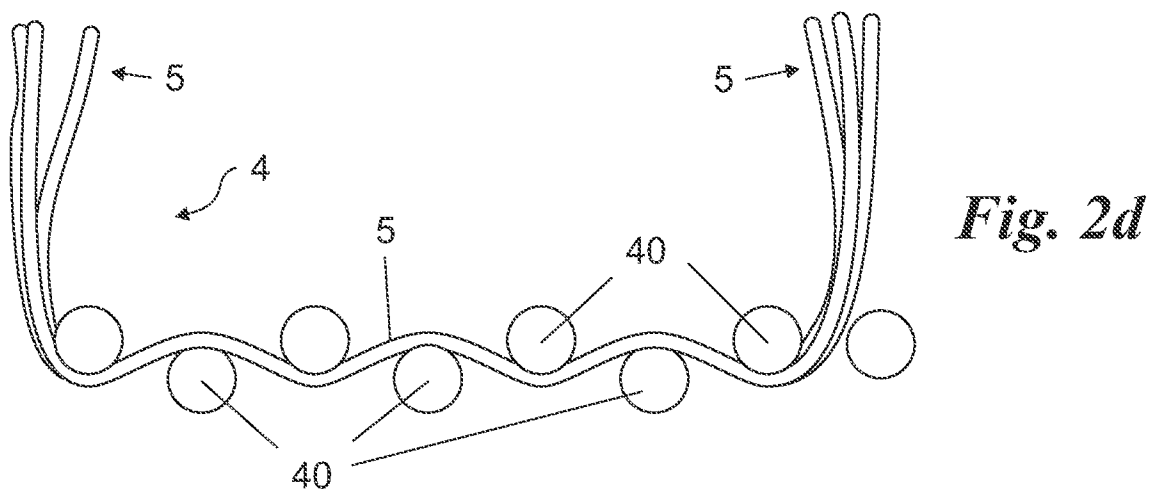
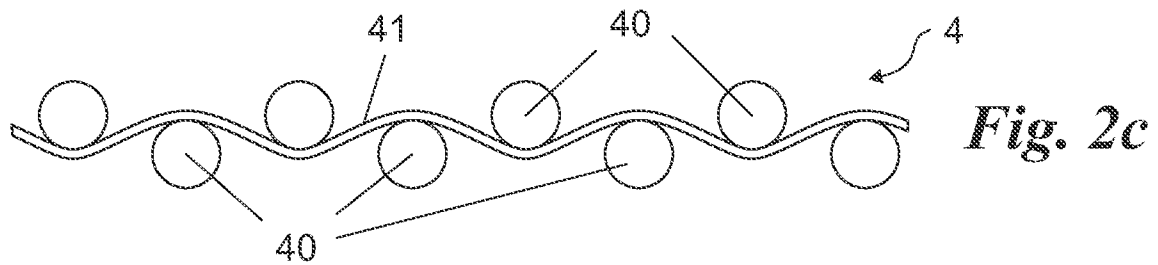
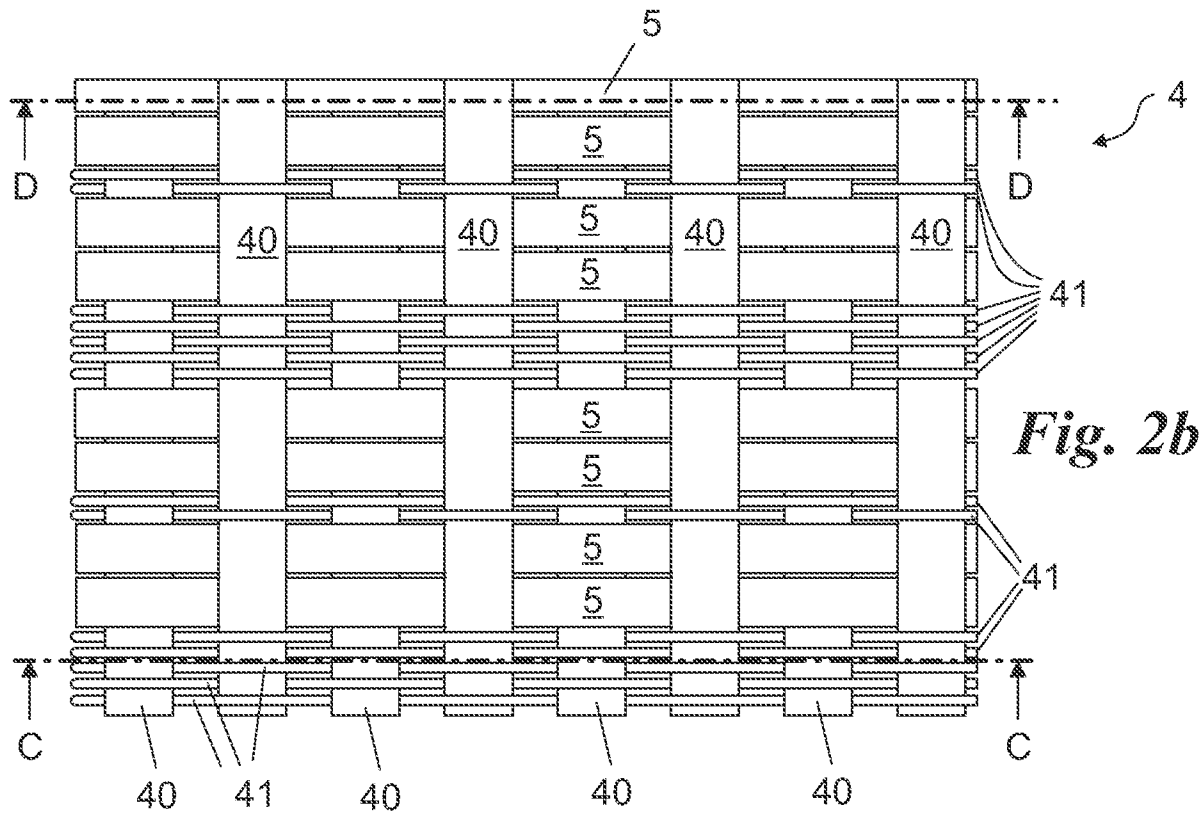
14. A process for creating a mixed turf (1) as claimed in one or more of the preceding claims, wherein said synthetic turf (2) is laid first and then said
5 natural grass (3) is introduced.

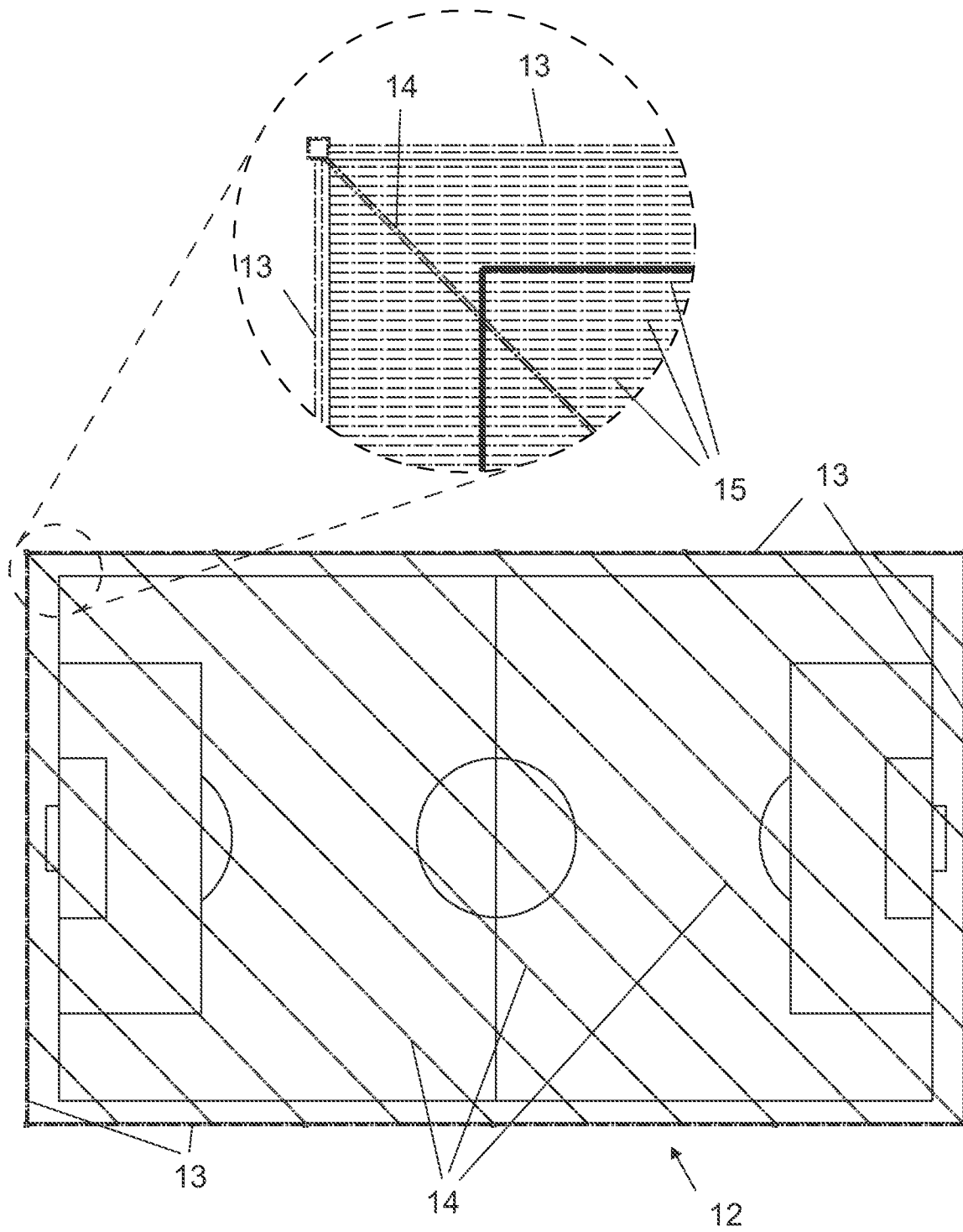
15. A process for creating a mixed turf (1) as claimed in the preceding claim, wherein said natural grass (3) is introduced by sowing on the spot.

16. A process for creating a mixed turf (1) as claimed in claim 13, wherein said natural grass (3) is obtained in a nursery and subsequently
10 transplanted in said turf (1).







*Fig. 4*

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/051136

A. CLASSIFICATION OF SUBJECT MATTER
ADD. E01C13/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E01C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 932 196 A1 (MOUSSARD CYRIL RENE LUCIEN [FR]) 11 December 2009 (2009-12-11)	1,10-12, 14-16
Y	the whole document	2-9,13
Y	WO 89/01076 A1 (MOGFORD NOEL PETER JOHN [AU]) 9 February 1989 (1989-02-09) page 6, line 15 - page 7, line 37 figures 1,2	2-9
Y	GB 2 352 954 A (CHARLES LAWRENCE SURFACES PLC [GB]) 14 February 2001 (2001-02-14) page 3, line 28 - page 5, line 3 figures 1,2	13
A	FR 2 244 356 A5 (MASQUELIER HENRI [FR]) 11 April 1975 (1975-04-11) the whole document	9-12



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

29 July 2013

Date of mailing of the international search report

06/08/2013

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040,
Fax: (+31-70) 340-3016

Authorized officer

Kremsler, Stefan

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2013/051136

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2932196	A1	11-12-2009	NONE
WO 8901076	A1	09-02-1989	NONE
GB 2352954	A	14-02-2001	NONE
FR 2244356	A5	11-04-1975	NONE