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(54) **SUBSTRUCTURE FOR AN ARTIFICIAL LAWN**

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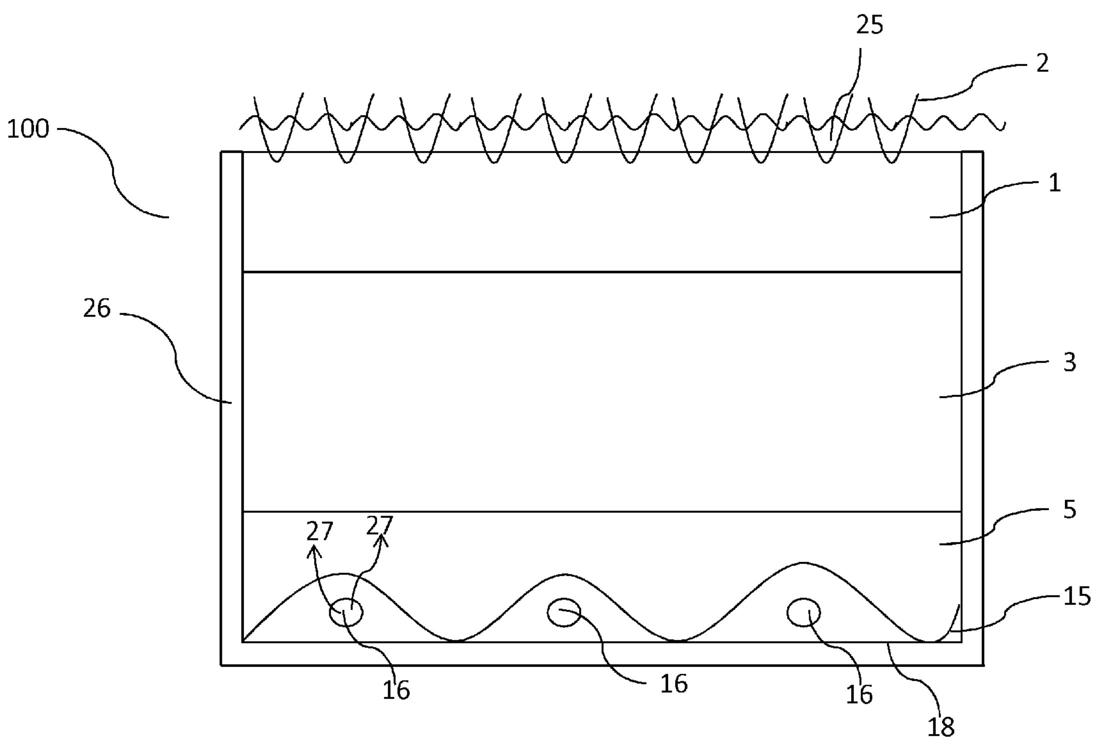
(57) **ABSTRACT**

The present invention relates to a substructure for an artificial lawn, comprising a top layer of artificial grass fibres and a number of underlying layers including a base layer, one or more intermediate layers and possibly other layers. The aforesaid substructure preferably comprises a water-permeable shock-absorbing layer, wherein said shock-absorbing layer is separated from said top layer of artificial grass fibres by one or more intermediate layers, wherein said one or more intermediate layers are selected from the group consisting of crushed stone, lava and sand, or a combination thereof.



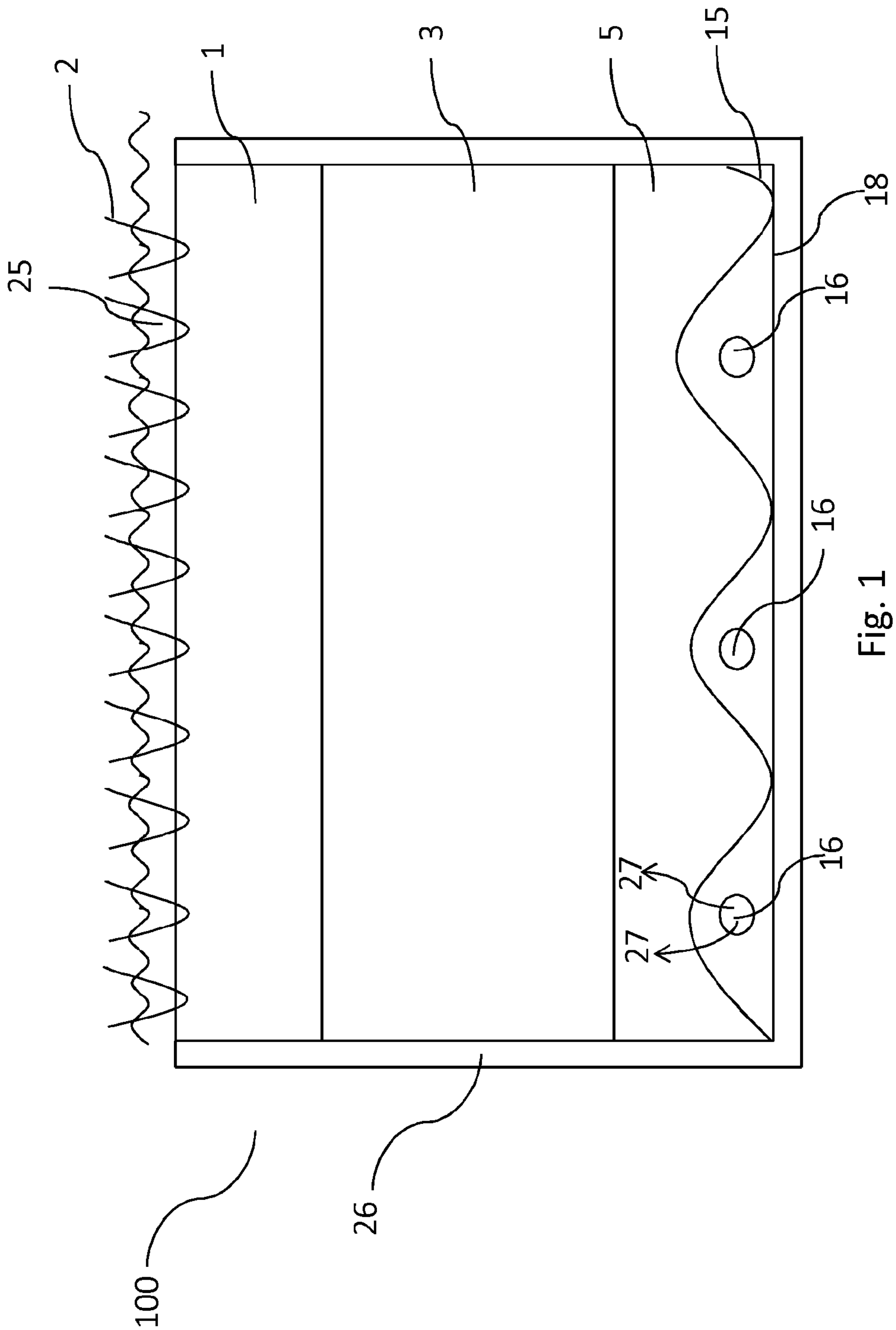


Fig. 1

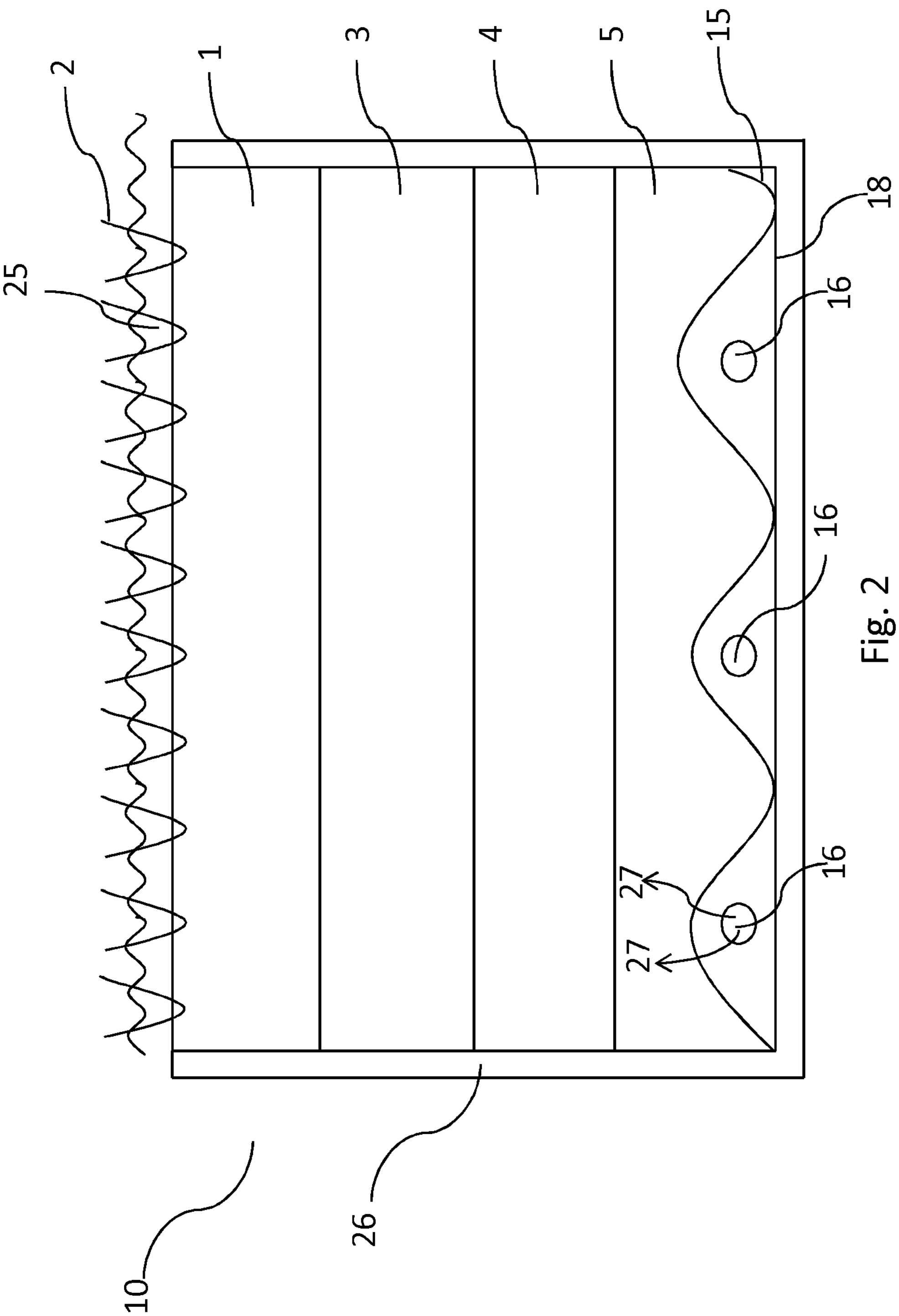


Fig. 2

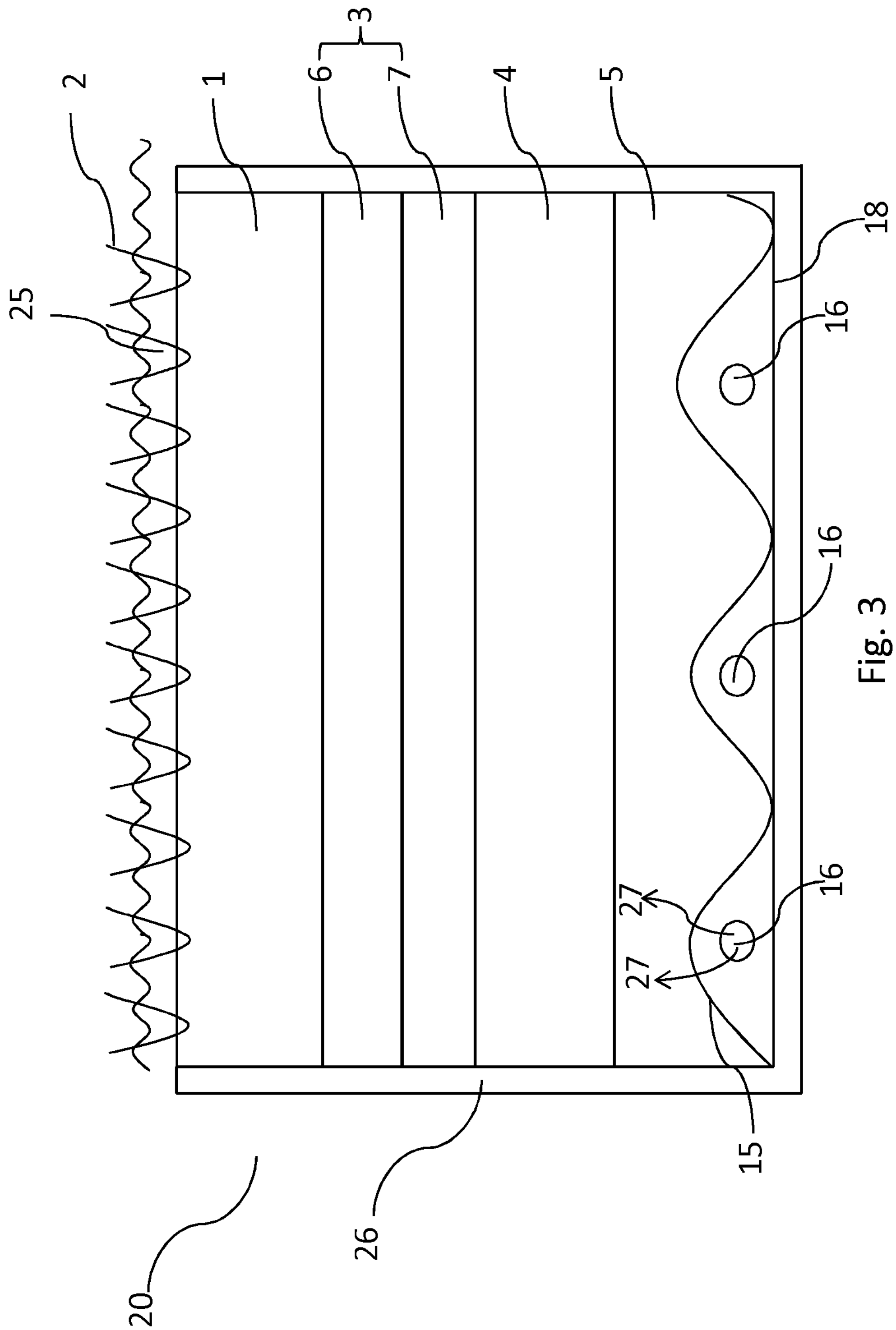


Fig. 3

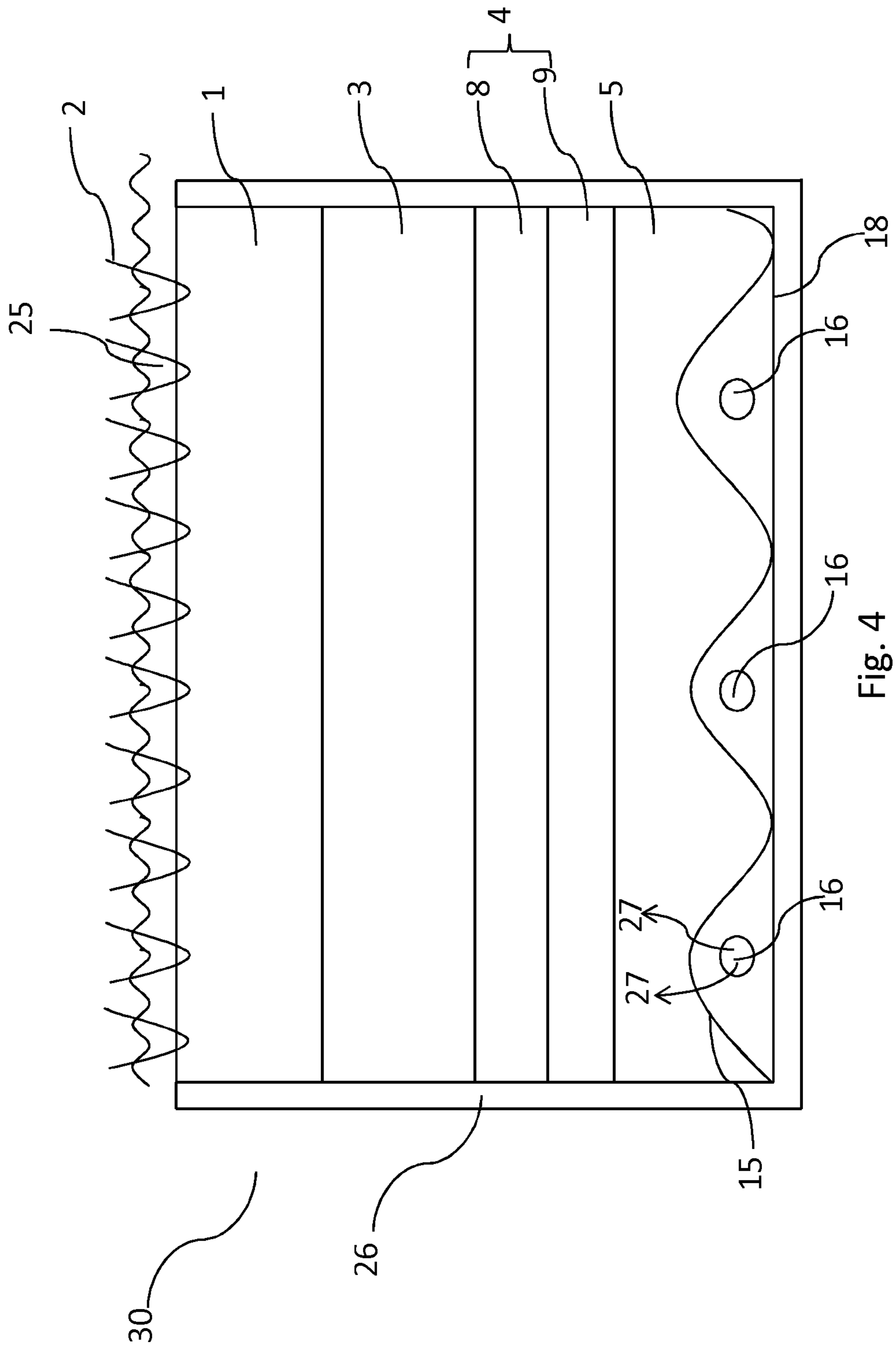


Fig. 4

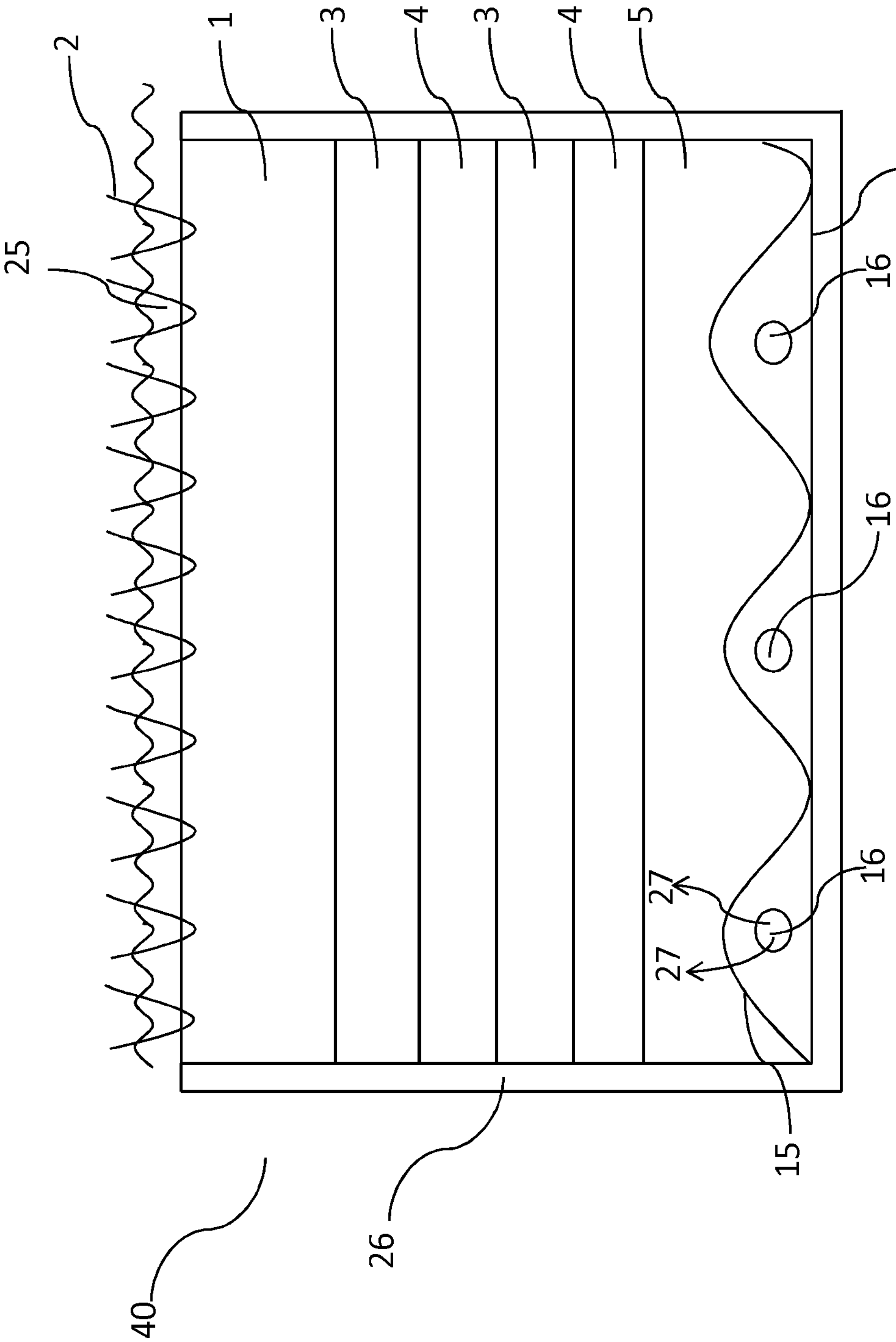


Fig. 5

SUBSTRUCTURE FOR AN ARTIFICIAL LAWN

[0001] The present invention relates to a substructure for an artificial lawn, comprising a top layer of artificial grass fibres and a number of underlying layers including a base layer, one or more intermediate layers and possibly other layers.

[0002] In patent literature a number of publications are known in which a substructure is shown. From Dutch patent No. 1021171 there is thus known a substructure wherein an artificial lawn is made up of a comparatively hard underlayer, on which a flat layer of resilient and/or damping material is arranged, which layer may exhibit a thickness of about 6-35 mm, for example 10-14 mm. Arranged on the aforesaid resilient and/or damping layer is a top layer in the form of artificial turf consisting of a backing and synthetic grass blades connected thereto by tufting, knitting or weaving. The resilient and/or damping layer can be formed in different ways, for example by starting from a mixture of rubber granules, which are mixed with a liquid binder, for example polyurethane.

[0003] A substructure for practicing the sport of golf is known per se from British patent publication GB 2,072,022.

[0004] International application WO 2006/007862 further discloses a substructure for a sports floor.

[0005] From Dutch patent No. 1013987 there is furthermore known a substructure arranged on a foundation layer for a sports field at least partially covered with natural grass, which substructure partially consists of rock wool.

[0006] Dutch patent No. 1016193 discloses an artificial lawn comprising a drainage layer made up of gravel, an underlayer arranged on top of the drainage layer, which underlayer comprises the earth that was originally dug off and subsequently removed, and an upper layer, in which fibres are present.

[0007] From European application EP 1 428 935 there is known a substructure for an artificial lawn in which a so-called "undersheet" of a geotextile material is laid over a prepared base, on which undersheet a layer of sand is arranged, on which subsequently a layer of rubber and finally a textile web are laid so as to thus form a so-called "envelope". The undersheet and the textile web are bonded together at their margins. Finally, an artificial lawn is installed on said substructure.

[0008] European application EP 0 093 008 discloses a base on which an envelope of a particular fabric is arranged, which envelope is filled with sand, for example, an underlayer comprising a sheet of bound rubber particles, on which underlayer an artificial lawn or a polyethylene foam layer can be provided. Depending on the sport to be practised, different sand grain sizes are used.

[0009] European application EP 1 462 572 relates to a substructure for sports floors, wherein a sand package is provided, in which a water distribution system is installed, which system comprises distribution pipes connected to a water reservoir.

[0010] From International application WO 2013009174 in the name of the present applicant there is known a substructure for an artificial lawn wherein an underlayer is present under a top layer of artificial grass fibres, which underlayer comprises a base layer, an intermediate layer located on top of said base layer and a sand layer located on top of said intermediate layer, wherein in particular the sand layer comprises at least two sublayers, wherein the first sublayer comprises a sand fraction having a particle size which is greater than the particle size of the sand fraction of the second sublayer.

[0011] Dutch patent NL 2009968 relates to a substructure for an artificial lawn, comprising a substantially water-impermeable insulation layer for draining the artificial lawn substantially in a horizontal direction and a drainage layer arranged on top of and/or in the insulation layer for draining the artificial lawn substantially in a vertical direction, such that an artificial lawn is positioned above the granulate layer, wherein the substructure construction further comprises a discharge system installed along the side edges. Rain water is thus discharged through the lava layer in a vertical direction up to the insulation layer, whereupon the water is laterally discharged in a substantially horizontal direction to drains provided at the side edges. Such drains are connected to a suction pipe and a pump via piping, wherein the discharged moisture is transported to a purification unit via a pressure pipe, after which the individual components are conveyed to reservoirs via conveyor pipes.

[0012] French patent publication FR 2 395 357 relates to a substructure for a sports field, comprising, in succession, a screed, a covering layer with a thickness of 25 mm, a dynamic layer with a thickness of 60 mm and a composite layer with a thickness of 100 mm, which aforementioned three layers are composed of the same type of material, viz crushed stone, lava or rubble, albeit in different grain sizes, viz. 0/3 mm, 3⁄16 mm and 16-32 mm, respectively. A drainage channel is provided at the edges or the circumference of such a substructure, whilst the area of the substructure is subdivided into zones of equal dimensions, in which a network of irrigation channels is provided. In the case of heavy rainfall, excess precipitation is discharged via the drainage channel.

[0013] US patent application US 2004086664 relates to an artificial lawn comprising polypropylene monofilament-type artificial grass fibres.

[0014] German Offenlegungsschrift DE 38 35 880 relates to a resilient mat used in a substructure for practising sports.

[0015] Artificial lawns are generally used for a large number of sports, for example soccer and field hockey. In particular in the world of soccer the use of artificial grass will expand enormously. Because soccer is a contact sport with short sprints, sliding tackles and jumps, in particular when corners are taken, it is desirable that an artificial lawn exhibits a high degree of damping and resilience substantially similar to those of a natural substructure, viz a natural lawn. The substructure of a soccer field must further exhibit an optimally natural drainage behaviour, which implies that the formation of water puddles on the field in the case of rainfall is minimized. Furthermore, the top layer of such a soccer field must have the same "feel" as that of a natural lawn.

[0016] In the present artificial lawns on which soccer is played, the damping of the lawn depends substantially on the selection of the so-called infill material, for example ground rubber particles. With the passage of time, the damping of such a lawn will differ from the originally set value. Furthermore it is often necessary to provide certain places on the soccer field with extra amounts of infill material, which will lead to a non-homogeneous damping of the soccer field.

[0017] Another point of particular attention regarding sports fields whose top layer comprises artificial grass fibres, or possibly a combination of artificial grass fibres and natural grass, is the development of high temperatures. In particular in the case of sports fields situated in regions with a hot climate, the temperature of the lawn can run so high that playing on such a lawn is found to be objectionable by players. It is therefore desirable to develop a substructure for a sports field wherein the temperature of the lawn, in particular of the top layer thereof, can be controlled to a certain extent.

[0018] One aspect of the present invention is to provide a substructure for a sports field, in particular a sports field on which soccer is played, which substructure provides the sports field with damping characteristics which substantially correspond to those of a natural lawn.

[0019] Another aspect of the present invention is to provide a substructure for a sports field, in particular a sports field on which soccer is played, which substructure has a water management such that the formation of water puddles is minimised.

[0020] Another aspect of the present invention is to provide a substructure for a sports field, in particular sports field on which soccer is played, wherein the water level of the sports field can be controlled to a desired value.

[0021] Yet another aspect of the present invention is to provide a substructure for a sports field, in particular the sports field which soccer is played, wherein a substantially flat, stable base is obtained.

[0022] Yet another object of the present invention is to provide a substructure for a sports field wherein the temperature of the top layer of the sports field is more or less controllable, in particular wherein the occurrence of high-temperature is prevented.

[0023] The present invention thus relates to a substructure for an artificial lawn, comprising a top layer of artificial grass fibres and a number of underlying layers including a base layer, one or more intermediate layers and possibly other layers, wherein the aforesaid substructure is surrounded by an envelope, wherein said envelope is constructed so that the level of the water present within the envelope is vertically adjustable, wherein the adjustment of the aforesaid level can be carried out by using a pipe system positioned within the aforesaid envelope, through which pipe system water can be passed, wherein water can be withdrawn from the aforesaid substructure using the aforesaid pipe system, which water can exit to the aforesaid layers of the substructure.

[0024] The present inventors have found that one or more of the above aspects are met when such a substructure is used. To achieve a good vertical distribution of the water level in the substructure it is preferred that the aforesaid pipe system is located near the bottom side of the aforesaid envelope. From the viewpoint of a homogeneous distribution of the water level in the entire substructure, viz those in vertical (height) and in horizontal direction, it is desirable that the pipes of the aforesaid pipe system are spaced a regular distance apart and that the pipe system extends substantially over the entire area of the aforesaid substructure. It has now been found to be possible to adjust the water level in the envelope such that the players of the artificial lawn will experience a surface temperature which is described as acceptable even in hot climatic regions. The "hot feet" sensation that is experienced with prior art artificial lawns is thus remedied.

[0025] To prevent damage to and clogging of the aforesaid pipe system it is desirable that the aforesaid pipe system is separated from said one or more layers by means of a water-permeable film.

[0026] In a special embodiment, the aforesaid substructure comprises a water-permeable shock-absorbing layer, wherein said shock-absorbing layer is separated from said top layer of artificial grass fibres by one or more intermediate layers. By providing a physical separation between the top layer of artificial grass fibres and the shock-absorbing layer, which separation concerns the presence of one or more intermediate layers, one or more of the aforesaid aspects are additionally met. The material for such an intermediate layer is selected from the group consisting of crushed stone, lava and sand, or a combination thereof.

[0027] Preferred materials for the shock-absorbing layer include: SBR rubber, ground plastic particles, polyethylene, polypropylene, polyamide, polyester or a mixture thereof, preferably polyethylene foam, possibly in combination with one or more binders. In certain embodiments it is desirable that the shock-absorbing layer is made up of a number of separate shock-absorbing layers. In other embodiments it is desirable that the shock-absorbing layer is made up of a single shock-absorbing layer.

[0028] The top layer of artificial grass fibres is preferably provided with a so-called infill material having a good water-permeability, preferably sand of the type that has a particle size distribution wherein 25-75 wt. % of the sand passes through a 0.250 mm sieve, in particular wherein 90-99% of the sand passes through a 1 mm sieve. Said type of infill material is in particular suitable because of its good water-permeability, which aspect is of major importance in the present substructure, in particular as regards the simulation of "ebb and flow" yet to be discussed hereinafter.

[0029] It is in particular desirable that the aforesaid one or more intermediate layers comprise sand, wherein the sand comprising intermediate layer is made up of at least two sublayers, wherein the first sublayer comprises a sand fraction having a particle size greater than that of the sand fraction of the second sublayer, wherein the first sublayer with the coarser sand fraction is positioned near the top layer. Such a composition of the sandy sublayers provides good water permeability and damping properties.

[0030] It is desirable that the sublayer comprising the coarser sand fraction is positioned near the top layer. Rainwater that will be discharged in downward direction through the top layer of artificial grass fibres will thus first pass the coarse sand fraction in the sand layer and subsequently the less coarse sand fraction. A good passage of rainwater is ensured. Moreover, the opposite direction of the movement of water in the substructure, viz from the bottom to the top, has found to be advantageous with such a distribution of fractions in the sand layer.

[0031] The present substructure in fact exhibits a simulation of "ebb and flow", which means that the water level in the substructure can rise and fall, wherein the water level can be adjusted as desired. It is desirable, therefore, that the layers present in the substructure make the transport of water possible. Such a transport of liquid through the substructure therefore has an upward direction of movement, viz in the direction of the top layer, and a downward direction of movement, viz away from the top layer, wherein the level or the position of the liquid in the substructure has been found to be precisely adjustable. The pipe system present in the substructure makes it possible to supply water to the substructure, so that the water level in the substructure, seen in vertical direction, will rise, or to withdraw water from the substructure, so that the water level will fall, seen in vertical direction. The pipe system is thus provided with openings, through which water surrounding the pipe system can enter the pipe system or, conversely, water can exit the pipe system. Because the aforesaid envelope surrounds the substructure on all sides, the water present in the substructure can be withdrawn from the substructure via said pipe system. In the case of very heavy precipitation, there is a possibility that the sports field will be flooded at the edges, in particular if the water-withdrawing capacity of the pipe system is insufficient. It will be apparent that the "upper side" of the substructure can be regarded as the surface on which sports are practised.

[0032] The particle size values mentioned herein also ensure a quick transport of water through the sand layer, which is desirable if an adjustment of the water level is aimed at. If a sand fraction comprising smaller particles than discussed above is used, the water transport will experience a greater resistance, which will adversely affect the speed of response or response time of the water management system.

[0033] By using the aforesaid substructure configuration, a substructure is obtained which provides a stable base for the installation of an artificial lawn wherein the formation of holes and protrusions is minimised.

[0034] In such an embodiment it is preferable that the at least two sublayers of the aforesaid sand layer are separated from each other by means of a separation layer.

[0035] According to another embodiment it is preferable that the aforesaid one or more intermediate layers comprise sand, wherein said sand has a particle size distribution wherein 25-75 wt. % of the sand passes through a 0.250 mm sieve, in particular wherein 90-99% of the sand passes through a 1 mm sieve. Such a sand composition exhibits very good water-permeability and damping characteristics.

[0036] Said intermediate layers and shock-absorbing layers may be separated from each other by a separation layer, in particular in order to prevent undesirable movement or mixing of sand fractions.

[0037] Examples of desired separation layers include cloth, fibre fabric, mat and geotextile. The separation layer is water-permeable and is preferably provided with perforations, so that transport of water can take place but movement of solid matter from one sublayer to the other sublayer is impeded.

[0038] In order to obtain in particular good damping properties it is desirable that the aforesaid shock-absorbing layer is embedded between two separate sand layers, wherein the two sublayers are preferably of the same type. In such an embodiment a number of shock-absorbing layers may be alternated with a number of sand layers by means of which the degree of damping of the final lawn can be controlled.

[0039] In certain embodiments, the shock-absorbing layer may comprise at least two separate shock-absorbing layers, for example three, four but in certain embodiments even five separate, shock-absorbing layers, wherein one or more intermediate layers, in particular sand layers, may be present between said shock-absorbing layers.

[0040] In the latter embodiment, such sand layers may be made up of at least two sublayers, wherein the first sublayer comprises a sand fraction having a particle size greater than that of the sand fraction of the second sublayer, wherein the sublayer with the coarser sand fraction is located near the top layer.

[0041] In certain embodiments, on the other hand, it is desirable that the sand layer between the shock-absorbing layers has a particle size distribution wherein 25-75 wt. % of the sand passes through a 0.250 mm sieve, in particular wherein 90-99% of the sand passes through a 1 mm sieve.

[0042] The particle size of the sublayer with the coarse fraction is preferably such that at least 80% of the particles have a particle size that ranges from 0-32 mm, preferably 1-32 mm, in particular 1-8 mm, more in particular 1-4 mm.

[0043] The thickness of the sublayer with the coarse fraction is preferably 50-200 mm, in particular 75-125 mm.

[0044] The second sublayer preferably comprises sand particles of which at least 80% have a particle size greater than 80 μm, preferably greater than 100 μm, in particular greater than 125 μm; the second sublayer in particular comprises sand particles of which at least 50% have a particle size greater than 125 μm, preferably greater than 150 μm, in particular greater than 200 μm.

[0045] The total thickness of layers located under the top layer of artificial grass fibres is in particular 40-150 cm.

[0046] The present substructure is thus surrounded by an envelope, wherein said envelope is constructed so that the water level within the envelope is vertically adjustable.

[0047] The aforesaid envelope is in particular made of a water-impermeable film, in particular a film selected from the group consisting of high density polyethylene (HDPE) and ethylene propylene diene monomer (EPDM).

[0048] For the transport of water through the package of layers of the present substructure it is desirable that a pipe system is present in one of the intermediate layers, preferably located under the aforesaid shock-absorbing layer (if present), through which pipe system water can be passed, wherein water can exit to the layers of the substructure.

[0049] The pipe system is in particular provided with pressure-reducing means for creating an underpressure in the pipe system, wherein the pipe system further comprises a water reservoir provided with one or more connection openings, an adjustable overflow for adjusting the water level in said reservoir, water level measuring means and a controllable water supply with the necessary piping, pumps and valves.

[0050] The pressure reducing means in particular comprise water level reducing means for reducing the water level in the reservoir, wherein in particular the water level reducing means comprise a plunger pump.

[0051] The water reservoir is in particular incorporated in a circuit which further comprises a buffering vessel and an overflow, wherein the water reservoir is connected to the substructure via one or more connection openings, which connection openings abut the water-impermeable layer.

[0052] In a preferred situation, use can be made of solar energy and/or wind energy for driving the pumps, valves and control means.

[0053] The use of a substructure as described above, in particular if the substructure is surrounded by an envelope, makes it possible to irrigate the artificial grass fibres "from below", as it were. After all, the supply of water to the top layer of artificial grass fibres takes place via the sand layer located under the top layer, wherein in particular the intermediate layer is configured so that the water present in the sand layer cannot drain away to the layers under the sand layer. In addition to that, the aforesaid values for the grain analysis of the sand layer (carried out via a sieve setup in which several saves with different mesh widths are stacked one on top of the other, the layer that remains on the sieve in question is measured and the results are plotted in a graph) provide a good possibility of transporting water, viz as regards speed and retention capacity. Within that framework, coarser sand types are preferred. In addition to that it has been found that, using such a sand package, very flat layers can be obtained, which is desirable for playing football. Moreover, depressions or rutting will not occur when the structure is subjected to heavy loads from above, for example from vehicles moving thereover.

[0054] For supplying water to the "bottom side" of the top layer in this manner it is therefore desirable that a pipe system is present in one of the intermediate layers, through which pipe system water can exit to the layers thereabove. The pipe system is preferably positioned in a layer comprising a sand fraction that can be considered to be "fine", because in this way a quick response time is ensured. Such a position is also desirable in connection with the possibility of freezing, which makes it desirable to install the pipe system at some depth in the substructure, which situation may occur in particular during cold wintry periods in certain countries. In another embodiment, on the other hand, it is also possible to position the pipe system in a sand layer comprising a coarser sand fraction.

[0055] The pipe system thus comprises pipes provided with regularly spaced perforations, wherein the water to be supplied to the artificial lawn can exit the pipe system via said perforations and subsequently accumulate more or less in the layers under the top layer of artificial grass fibres. It has been found that the preferred grain size of the sand particles makes it possible to adjust the water level in the sand layer such that an artificial lawn is obtained in which the water level, in combination with the damping level aimed at, makes playing on the lawn, in particular playing soccer, possible.

[0056] In order to prevent the water that is supplied to the layers via the pipe system from undesirably draining away to the underlying layers, it is preferable that such a layer is screened off at the bottom side thereof by means of a water-impermeable layer, preferably a film, for example a polyethylene film.

[0057] It is moreover desirable that the overall construction of the present substructure meets shock absorption and energy restitution requirements, because excessive springiness of an artificial lawn is found to be unpleasant and tiring by players. If the overall construction of the artificial lawn exhibits too much springiness, this will cause a ball that lands on the artificial lawn to bounce back too high and too fast in comparison with a natural lawn, which is undesirable. Moreover, players find running and making sprints thereon to be tiring and also unnatural. The present inventors have found that the special manner of positioning the shock-absorbing layer in the substructure makes it possible to construct a lawn in which the above problems are minimised.

[0058] The pipe system that is used preferably comprises pressure reducing means for creating an underpressure in the pipe system, wherein the pipe system further comprises a water reservoir provided with one or more connection openings, an adjustable overflow for adjusting the water level in the reservoir, water level measuring means and a controllable water supply. In such a construction it is in particular desirable that the pressure reducing means comprise water level reducing means for reducing the water level in the reservoir, wherein the water level reducing means preferably comprise a plunger pump. The aforesaid pipe system is furthermore preferably provided with a control unit that is connected at least to said water level measuring means, said controllable water supply and said pressure reducing means. Said construction is thus suitable for supplying water to the substructure; it has in particular been found to be possible to treat a large ground area therewith.

[0059] The present invention will now be explained by means of a number of schematically illustrated examples, in which regard it should be noted, however, that the schematic views shown in the appended figures should not be construed as limitative. Moreover, the figures are not drawn to scale.

[0060] FIG. **1** is a schematic view of the substructure for an artificial lawn according to the present invention.

[0061] FIG. **2** is a schematic view of a substructure for an artificial lawn according to the present invention.

[0062] FIG. **3** is a schematic view of another substructure for an artificial lawn according to the present invention.

[0063] FIG. **4** is a schematic view of another substructure for an artificial lawn according to the present invention.

[0064] FIG. **5** is a schematic view of another substructure for an artificial lawn according to the present invention.

[0065] FIG. **1** is a schematic view of a substructure **100** for an artificial lawn according to the present invention. The substructure **100** comprises a top layer **1** provided with artificial grass fibres **2**, in which top layer **1** a so-called infill material **25** having a good water-permeability is present. The substructure **100** is surrounded by an envelope **26**, which envelope **26** is constructed so that the water level within the envelope **26** is vertically adjustable, which adjustment of the aforesaid level can be carried out by means of a pipe system **16** positioned within the aforesaid envelope, through which pipe system **16** water can be passed, wherein water can be withdrawn from said substructure **100** by means of said pipe system **16**, which water can exit to the aforesaid layers of the substructure **100**. The pipe system **16** is located near the bottom side **18** of the envelope **26**, in particular in the base layer **5**, the pipes being spaced a regular distance apart, and extends over substantially the entire area of the substructure **100**. The pipe system **16** is separated from the base layer **5** by a water-permeable film **15**. The openings of the pipe system **16**, which openings (not shown) are located at the circumferential side thereof and which make it possible to supply and discharge water, are thus protected against damage, for example, but also against the ingress of sand-like materials, which could lead to clogging. The layer **3** comprises a material selected from the group consisting of crushed stone, lava and sand, or a combination thereof. The pipe system described in the present application is thus a single pipe system, by means of which the water level in the substructure can be adjusted. Since the pipes of the pipe system are spaced a regular distance apart, a good supply and discharge of water both in horizontal and in vertical direction is realised in the substructure. In this way a good, quick and precise control of the water level is possible.

[0066] FIG. **2** shows a substructure **10** for an artificial lawn, comprising a top layer **1** in which artificial grass fibres **2** are present. Present in the top layer **1** is a so-called infill material **25** having a good water-permeability, preferably sand of the type that has a particle size distribution wherein 25-75 wt. % of the sand passes through a 0.250 mm sieve, in particular wherein 90-99% of the sand passes through a 1 mm sieve. Located under the top layer **1** is an intermediate layer **3** selected from the group consisting of crushed stone, lava and sand, or a combination thereof. Located under the intermediate layer **3** is shock-absorbing layer **4**, under which shock-absorbing layer **4** a base layer **5** is located. The base layer **5** is provided with a water-permeable film **15** at the bottom side, under which film **15** a number of drainage pipes **16** are located. The whole of top layer **1**, intermediate layer **3**, shock-absorbing layer **4** and base layer **5** is surrounded by a water-impermeable envelope **26**, which envelope **26** is made of a film selected from the group consisting of high density polyethylene (HDPE) and ethylene propylene diene monomer (EPDM). The water level in the vertical column consisting of the top layer **1**, the intermediate layer **3**, the shock-absorbing layer **4** and the base layer **5** can be controlled and adjusted by supplying and discharging water via the drainage pipes **16**. Reference numeral **27** schematically indicates a situation in which a slight overpressure is created in the drainage pipes **16**, so that water can exit the drainage pipes **16**. Because of the presence of the envelope **26**, the exiting water can only move upward, in the direction of the top layer **1**. It has thus been found to be possible to direct water exiting from the drainage pipes **16** toward the top layer **1**, so that the players of the lawn will experience a natural moisture content. If desired, the water level thus achieved can subsequently be lowered again by creating a slight underpressure in the drainage pipes **16**, so that water will be removed, resulting in a reduced water level in the package consisting of the top layer **1**, the intermediate layer **3**, the shock-absorbing layer **4** and the base layer **5**. Said water level can thus be adjusted and controlled by means of the pressure in the drainage pipes **16**. The presence of said envelope thus ensures that the water exiting from the drainage pipes **16** cannot drain away undesirably. Such a natural moisture content makes it possible to approximate the natural characteristics of a natural lawn, especially as regards the sliding behaviour. In particular in the case of the sport of soccer, in which sliding tackles frequently occur, it is desirable that the surface on which the soccer is played does not put the players at a disadvantage. Although mention is made of artificial grass fibres in the top layer **1** in the present description, the top layer **1** may also comprise natural grass talks in addition to artificial grass fibres. Such a lawn, also referred to as hybrid lawn, is disclosed in U.S. Pat. No. 5,540,960 in the name of the present applicant, the contents of which are to be considered as fully incorporated herein. If desired, the top layer **1** may comprise so-called infill materials (not shown).

[0067] FIG. **3** shows a substructure **20** for an artificial lawn, comprising a top layer **1** provided with artificial grass fibres **2**. Present in the top layer **1** is a so-called infill material **25** having a good water-permeability, preferably of the type as described with reference to FIG. **2**. Located under the top layer **1** is an intermediate layer **3**, which is made up of two separate sand layers **6**, **7**. The sand layers **6**, **7** can thus be regarded as two sublayers, wherein the first sublayer **6** comprises a sand fraction having a particle size greater than that of the sand fraction of the second sublayer **7**, wherein the first sublayer **6** with the coarser sand fraction is located near the top layer **1**. Located under the intermediate layer **3** is a shock-absorbing layer **4**, under which shock-absorbing layer **4** a base layer **5** is located. The base layer **5** is provided with a water-permeable film **15** at the bottom side thereof, under which film **15** a number of drainage pipes **16** are located. The whole of top layer **1**, intermediate layer **3**, shock-absorbing layer **4** and base layer **5** is surrounded by a water-impermeable envelope **26**, which envelope **26** is made of a film selected from the group consisting of high density polyethylene (HDPE) and ethylene propylene diene monomer (EPDM). Reference numeral **27** schematically indicates a situation in which a slight overpressure is created in the drainage pipes **16**, so that water can exit the drainage pipes **16**. Because of the presence of the envelope **26**, the exiting water can only move upward, in the direction of the top layer **1**. As already discussed with reference to FIG. **2**, the special composition of the substructure and the presence of drainage pipes **16** make it possible to realise a quick an precise adjustment of the water level in the substructure **20**.

[0068] FIG. **4** shows a substructure **30** for an artificial lawn, comprising a top layer **1** provided with artificial grass fibres **2**. Present in the top layer **1** is a so-called infill material **25** having a good water-permeability, preferably of the type as described with reference to FIG. **2**. Located under the top layer **1** is an intermediate layer **3** selected from the group consisting of crushed stone, lava and sand. Located under the intermediate layer **3** is a shock-absorbing layer **4**, which shock-absorbing layer **4** is made up of a number of separate shock-absorbing layers **8**, **9**, under which a base layer **5** is located. The base layer **5** is provided with a water-permeable film **15** at the bottom side thereof, under which film **15** a number of drainage pipes **16** are located. The whole of top layer **1**, intermediate layer **3**, shock-absorbing layer **4** and base layer **5** is surrounded by a water-impermeable envelope **26**, which envelope **26** is made of a film selected from the group consisting of high density polyethylene (HDPE) and ethylene propylene diene monomer (EPDM). Reference numeral **27** schematically indicates a situation in which a slight overpressure is created in the drainage pipes **16**, so that water can exit the drainage pipes **16**. Because of the presence of the envelope **26**, the exiting water can only move upward, in the direction of the top layer **1**. The water level in the vertical column consisting of the top layer **1**, the intermediate layer **3**, the shock-absorbing layer **4** and the base layer **5** can be controlled and adjusted in a precise and quick manner by supplying and discharging water via the drainage pipes **16**.

[0069] FIG. **5** shows a substructure **40** for an artificial lawn, comprising a top layer **1** provided with artificial grass fibres **2**. Present in the top layer **1** is a so-called infill material **25** having a good water-permeability, preferably of the type as described with reference to FIG. **2**. Located under the top layer **1** is an intermediate layer **3** selected from the group consisting of crushed stone, lava and sand. Located under the intermediate layer **3** are a number of alternately arranged intermediate layers **3** and shock-absorbing layers **4**, which are positioned on top of a base layer **5**. Such intermediate layers have been selected from the group consisting of crushed stone, lava and sand, or a combination thereof. In a special embodiment it is desirable that the shock-absorbing layer **4** is made up of a number of separate shock-absorbing layers (not shown). The base layer **5** is provided with a water-permeable film **15** at the bottom side thereof, under which film **15** a number of drainage pipes **16** are located. The whole of top layer **1**, intermediate layers **3**, shock-absorbing layers **4** and base layer **5** is surrounded by a water-impermeable envelope **26**, which envelope **26** is made of a film selected from the group consisting of high density polyethylene (HDPE) and ethylene propylene diene monomer (EPDM). Reference numeral **27** schematically indicates a situation in which a slight overpressure is created in the drainage pipes **16**, so that water can exit the drainage pipes **16**. Because of the presence of the envelope **26**, the exiting water can only move upward, in the direction of the top layer **1**. The water level in the vertical column consisting of the top layer **1**, the intermediate layer **3**, the shock-absorbing layers **4** and the base layer **5** can be controlled and adjusted in a precise and quick manner by supplying and discharging water via the drainage pipes **16**. Although the substructure **40** as shown comprises a construction of intermediate layer **3**, shock-absorbing layer **4**, intermediate layer **3**, shock absorbing layer **4**, it is also desirable in certain embodiments that one or more shock absorbing layers **4** are made up of a number of separate shock-absorbing layers **8**, **9**, which separate shock-absorbing layers **8**, **9** may in turn be separated from each other by an intermediate layer **3** or a base layer **5**.

[0070] The present substructure as shown in a number of embodiments in FIGS. **1-4** in fact shows a simulation of "ebb and flow", which means that the water level in the substructure can rise and fall, wherein the desired water level is adjustable.

[0071] For easy reference, the separation layers that may be positioned between the aforesaid layers are not shown in the figures. Examples of such separation layers are course, fibre fabric, mat and geotextile.

[0072] In FIGS. **1-4**, the operation of the drainage tubes **16** is not discussed, but it can take place in the manner as published in WO2013/009174 in the name of the present applicant, the contents of which document may be considered as fully incorporated herein.

[0073] In WO2013/009174 the manner in which a drainage system is connected to a pipe that is in liquid communication with the substructure shown in FIGS. **1-4** is described in great detail. Because of said liquid communication between the drainage system and the substructure, the height of the liquid level in the drainage system is an indication of the liquid level in the substructure. The drainage system is provided with a pipe, wherein the height of the water level in the drainage system is determined by the positioning of the height of the pipe, which positioning is adjustable. Said pipe is in communication with an overflow via a conduit, which overflow is in communication with a buffer vessel via a conduit, which buffer vessel in turn in communication with the drainage system via another conduit.

[0074] If the water level in the substructure decreases to an undesirably low level, for example in the case of evaporation caused by radiation from the sun and wind, it is desirable that the intended water level be restored, viz. that water is supplied to the substructure. If the water level in the substructure has risen to undesirably high level due to heavy rainfall, however, it is desirable that the intended water level in the substructure be restored. In the latter situation, the water level in the drainage system will rise and the "excess" water will be discharged from the drainage system as a result of the liquid communication between the substructure and the drainage system. The water to be discharged is directed to a so-called overflow. In the overflow, the water discharged from the substructure is collected and subsequently directed to a buffer vessel, which is in particular intended to function as a water reservoir for adjusting and maintaining the water level in the substructure, and consequently also in the drainage system, to/at the desired level. Via a measuring and control system, the supply of water from the buffer vessel to the drainage system is started when this is desirable.

[0075] It should be noted that the parts shown in FIGS. **1-4** are not drawn to scale.

[0076] To obtain an optimum energy consumption it is desirable that the equipment used in the drainage system is driven via solar energy and/or wind energy. It is also possible to use heating elements in the drainage system or in the buffer vessel and/or the overflow, which heating elements are preferably powered by solar energy and/or wind energy.

1. A substructure for an artificial lawn, comprising a top layer of artificial grass fibres and a number of underlying layers including a base layer, one or more intermediate layers and possibly other layers, characterised in that the aforesaid substructure is surrounded by an envelope, wherein said envelope is constructed so that the level of the water present within the envelope is vertically adjustable, wherein the adjustment of the aforesaid level can be carried out by using a pipe system positioned within the aforesaid envelope, through which pipe system water can be passed, wherein water can be withdrawn from the aforesaid substructure using the aforesaid pipe system, which water can exit to the aforesaid layers of the substructure.

2. A substructure according to claim **1**, characterised in that the aforesaid pipe system is located near the bottom side of the aforesaid envelope.

3. A substructure according to either one or both of claims **1-2**, characterised in that the pipes of the aforesaid pipe system are spaced a regular distance apart and that the pipe system extends substantially over the entire area of the aforesaid substructure.

4. A substructure according to one or more of the preceding claims, characterised in that the aforesaid pipe system is separated from said one or more layers by means of a water-permeable film.

5. A substructure according to one or more of the preceding claims, characterised in that aforesaid envelope is made of a water-impermeable film, in particular a film selected from the group consisting of high density polyethylene (HDPE) and ethylene propylene diene monomer (EPDM).

6. A substructure according to one or more of the preceding claims, characterised in that the aforesaid substructure comprises a water-permeable shock-absorbing layer, wherein said shock-absorbing layer is separated from said top layer of artificial grass fibres by one or more intermediate layers.

7. A substructure according to claim **6**, characterised in that the shock-absorbing layer is made up of a number of separate shock-absorbing layers comprising one or more components selected from the group consisting of SBR rubber, ground plastic particles, polyethylene, polypropylene, polyamide, polyester or a mixture thereof, preferably polyethylene foam, possibly in combination with one or more binders.

8. A substructure according to one or more of the preceding claims, characterised in that the aforesaid one or more intermediate layers comprise sand, wherein the sand comprising intermediate layer is made up of at least two sublayers, wherein the first sublayer comprises a sand fraction having a particle size greater than that of the sand fraction of the second sublayer, wherein the first sublayer with the coarser sand fraction is positioned near the top layer.

9. A substructure according to claim **8**, characterised in that the at least two sublayers of the aforesaid sand layer are separated from each other by means of a separation layer.

10. A substructure according to one or more of the preceding claims, characterised in that the aforesaid one or more intermediate layers comprise sand, wherein said sand has a particle size distribution wherein 25-75 wt. % of the sand passes through a 0.250 mm sieve, in particular wherein 90-99% of the sand passes through a 1 mm sieve.

11. A substructure according to one or more of the preceding claims, characterised in that one or more of the aforesaid intermediate layers and/or shock-absorbing layers are separated from each other by a separation layer

12. A substructure according to one or more of claims **9-11**, characterised in that the aforesaid separation layer is selected from the group consisting of cloth, fibre fabric, mat and geotextile.

13. A substructure according to one or more of claims **6-12**, characterised in that the aforesaid shock-absorbing layer is embedded between two separate sand layers.

14. A substructure according to claim **13**, characterised in that the two sand layers are of the same type.

15. A substructure according to one or more of claims **6-14**, characterised in that the shock-absorbing layer is made up of at least two separate shock-absorbing layers.

16. A substructure according to claim **15**, characterised in that one or more intermediate layers are present between the aforesaid shock-absorbing layers, wherein the aforesaid one or more intermediate layers comprise sand.

17. A substructure according to claim **16**, characterised in that the aforesaid sand is made up of at least two sublayers, wherein the first sublayer comprises a sand fraction having a particle size greater than that of the sand fraction of the second sublayer, wherein the sublayer with the coarser sand fraction is located near the top layer.

18. A substructure according to claim **16**, characterised in that the aforesaid sand has a particle size distribution wherein 25-75 wt. % of the sand passes through a 0.250 mm sieve, in particular wherein 90-99% of the sand passes through a 1 mm sieve.

19. A substructure according to one or more of claims **8-18**, characterised in that the particles of the sublayer with the coarse fraction have a particle size such that at least 80% of the particles have a particle size that ranges from 0-32 mm, preferably 1-32 mm, in particular 1-8 mm, more in particular 1-4 mm.

20. A substructure according to one or more of claims **8-19**, characterised in that the thickness of the sublayer with the coarse fraction is 50-200 mm, in particular 75-125 mm.

21. A substructure according to one or more of claims **8-20**, characterised in that the second sublayer comprises sand particles of which at least 80% have a particle size greater than 80 μm, preferably greater than 100 μm, in particular greater than 125 μm.

22. A substructure according to one or more of claims **8-21**, characterised in that the second sublayer comprises sand particles of which at least 50% have a particle size greater than 125 μm, preferably greater than 150 μm, in particular greater than 200 μm.

23. A substructure according to one or more of the preceding claims, characterised in that the total thickness of layers located under the top layer of artificial grass fibres is 40-150 cm.

24. A substructure according to one or more of the preceding claims, characterised in that the pipe system is provided with pressure-reducing means for creating an underpressure in the pipe system, wherein the pipe system further comprises a water reservoir provided with one or more connection openings, an adjustable overflow for adjusting the water level in said reservoir, water level measuring means and a controllable water supply with the necessary piping, pumps and valves.

25. A substructure according to claim **24**, characterised in that the pressure reducing means comprise water level reducing means for reducing the water level in the reservoir, wherein in particular the water level reducing means comprise a plunger pump.

26. A substructure according to either one or both of claims **24-25**, characterised in that the water reservoir is in particular incorporated in a circuit which further comprises a buffering vessel and an overflow.

27. A substructure according to one or more of claims **24-26**, characterised in that the water reservoir is connected to the substructure via one or more connection openings, which connection openings abut the water-impermeable layer.

28. A substructure according to one or more of claims **24-27**, characterised in that use is made of solar energy and/or wind energy for driving the pumps, valves and control means.

29. A substructure according to one or more of the preceding claims **1-28**, characterised in that the top layer is provided with a so-called infill material having a good water-permeability, preferably sand of the type that has a particle size distribution wherein 25-75 wt. % of the sand passes through a 0.250 mm sieve, in particular wherein 90-99% of the sand passes through a 1 mm sieve.

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