

(19)



(11)

EP 3 704 308 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention
of the grant of the patent:
05.01.2022 Bulletin 2022/01

(51) Int Cl.:
E01H 1/05 (2006.01) E01H 1/08 (2006.01)
E01H 1/10 (2006.01)

(21) Application number: **18796053.9**

(86) International application number:
PCT/EP2018/079986

(22) Date of filing: **02.11.2018**

(87) International publication number:
WO 2019/086596 (09.05.2019 Gazette 2019/19)

(54) ARTIFICIAL TURF CLEANING SYSTEM AND METHOD

KUNSTRASENREINIGUNGSSYSTEM UND VERFAHREN

SYSTÈME DE NETTOYAGE DE GAZON ARTIFICIEL ET PROCÉDÉ

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

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(30) Priority: **02.11.2017 EP 17199739**

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(43) Date of publication of application:
09.09.2020 Bulletin 2020/37

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NL-C1- 1 023 007 US-A- 5 093 955
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Description

Field of the invention

[0001] The invention relates to artificial turf, in particular to the cleaning and maintenance of artificial turf as field hockey field.

Background and related art

[0002] Artificial turf, also known as artificial grass or synthetic turf, is a surface that is made up of fibers which is used to replace grass. The structure of the artificial turf is designed such that the artificial turf has an appearance which resembles grass. Typically artificial turf is used as a surface for sports such as soccer, American football, rugby, tennis, golf, for playing fields, or exercise fields. Furthermore artificial turf is frequently used for landscaping applications.

[0003] Artificial turf may be manufactured using techniques for manufacturing carpets. For example artificial turf fibers which have the appearance of grass blades may be tufted or attached to a backing. Often times artificial turf infill is placed between the artificial turf fibers. Artificial turf infill is a granular material that covers the bottom portion of the artificial turf fibers. The use of artificial turf infill may have a number of advantages. For example, artificial turf infill may help the artificial turf fibers stand up straight. Artificial turf infill may also absorb impact from walking or running and provide an experience similar to being on real turf. The artificial turf infill may also help to keep the artificial turf carpet flat and in place by weighting it down.

[0004] Artificial turf may also be used without artificial turf infill. Artificial turf carpets used without infill may be referred to as unfilled artificial turf. One usage of unfilled artificial turf is for field hockey. During the use of unfilled artificial turf for field hockey, the field or pitch is flooded or filled with water using a sprinkler system. Drains may be used to drain the water from the unfilled artificial turf when the field is not in use. When the field is in use, the drains may also be used to control the amount of water in the field and prevent or reduce the formation of puddles.

[0005] The guide by the International Hockey Federation July 2007, "Care and Maintenance of Synthetic Turf Hockey Pitches," pamphlet available online [http://www.fih.ch/files/Sport/Pitches/Care of synthetic turf.pdf](http://www.fih.ch/files/Sport/Pitches/Care%20of%20synthetic%20turf.pdf) discloses the maintenance for synthetic turf hockey pitches. In §2.6, This guide describes how the pitch should be properly watered during all times of activity: both during practices and matches. In §3.3 it is detailed how brush suction machines should be used daily or once or twice a week to remove fine dust from the turf surface as well as from deeper layers of the carpet. §3.5 describes how Algae invasions of artificial turf hockey pitches can result in a coloration change in an artificial turf that can also be slippery. The guide recommends the

use of an approved algae killer as a preventative measure. The use of an algae killer as a prophylaxis is described as adding a dosage system that continually adds the algae killer to the sprinkler system. Alternatively, the recommended dosage can be dispensed from a motorized high pressure sprayer.

[0006] United States patent application US 2017/260704 A1 discloses a cleaning device includes a chassis that can be moved over a ground surface. The cleaning device further includes a space in which a roller-shaped brush provided with bristles is arranged in a rotatable manner about an axle in such a way that the ground can be brushed therewith. The space is connected to an outlet channel for the removal of material brushed away by the bristles. An air channel is arranged in the brush and coaxially with the axle. The air channel has a series of openings directed towards the outlet channel and open between the bristles.

[0007] European patent publication EP 2 230 357 A2 discloses an apparatus for cleaning a surface comprising an elongate air plenum rotatably mounted beneath a cover for rotation about an axis perpendicular to a longitudinal axis of the air plenum. The air plenum is connectable to a source of pressurized air and being provided with at least one first air outlet directing pressurized air at and in a direction substantially perpendicular to a surface to be cleaned.

[0008] United States patent publication US 5,093,955 A discloses a combination floor sweeping and scrubbing machine is as compact and maneuverable as an equivalent machine which only sweeps or scrubs, while retaining typical hopper and tank volumes. Its operator can change it from sweeping to scrubbing or vice versa at any time by moving a few controls and without adding or removing any parts. It has one debris hopper and one horizontal cylindrical rotating brush and they function in both the sweeping and scrubbing modes. A vacuum system supplies dust control during sweeping and vacuum pickup of dirty solution during scrubbing. In the scrubbing mode a single tank supplies scrubbing solution and receives dirty solution picked up from the floor.

[0009] United States patent application publication US 2006/236494 A1 discloses a floor cleaner configured to perform both hard and soft floor cleaning operations includes a mobile body, a motorized cleaning head, a cleaning liquid dispenser, a vacuum, a first vacuum extractor tool and a vacuum squeegee connected to the mobile body. The mobile body is configured to travel over a surface. The motorized cleaning head is connected to the mobile body and includes a cleaning tool. The cleaning liquid dispenser is configured to apply a cleaning liquid to the surface or the cleaning tool. The first vacuum extractor tool is configured for vacuum communication with the vacuum through a first vacuum path.

[0010] Netherlands patent publication NL 1 023 007 C1 discloses a street cleaning machine that has nozzles mounted on a manifold so that they are located next to the brush, which has a ring-shaped cross-section. A drive

device is provided for rotating the manifold.

[0011] International patent application publication WO 2018/136924 A1 discloses a machine for removing paint and other unwanted material from turf comprises a vacuum device operable to remove paint and other material from turf, a scrubbing device operable to strip paint from the turf, and a chassis that carries the vacuum device and scrubbing device across the turf. The vacuum device includes a vacuum head and a compression bar. The vacuum includes a chamber having an entrance and an exit, wherein when air is urged out of the chamber through the exit, ambient air adjacent to the vacuum head flows into the chamber through the entrance. The compression bar is located adjacent to and outside of the vacuum head's entrance and operable to exert pressure on the turf to cause fluid in the field to pool adjacent to the vacuum head's entrance.

Summary

[0012] The invention provides for a method and a turf system in the independent claims. Embodiments are given in the dependent claims.

[0013] As was described above, artificial turf used as field hockey field may become invaded with algae. The conventional means to avoid this is the prophylactic use of an algae killer to do this. A problem with the use of algae killer is that when the field is drained these chemicals are released into the environment. Embodiments may provide a way to reduce or eliminate the usage of algae killers when maintaining an artificial turf.

[0014] Embodiments may use an artificial turf cleaner that that applies a detergent mixture to the artificial turf at the same time as the artificial turf cleaner is mechanically brushing the artificial turf surface. After the artificial turf surface has been brushed the artificial turf cleaner vacuums the detergent mixture from the artificial turf removing at least a portion of the algae. Using such an artificial turf cleaner during regular maintenance of the artificial turf may have the advantage that algae can be controlled without the use of algae killers.

[0015] A detergent mixture as used here encompasses a mixture comprising a detergent and water. Detergents which are environmentally friendly can be chosen. In any case, because the detergent mixture is immediately vacuumed from the artificial turf very little of the detergent is released into the environment.

[0016] In some examples further methods may be used to reduce the environmental impact. For example as the detergent mixture and removed algae is vacuumed up it can be filtered and then immediately reused to further clean algae from the artificial turf.

[0017] In one aspect, the invention provides for a method of cleaning algae from an artificial turf surface using an artificial turf cleaner configured for being propelled in a motion direction. The artificial turf cleaner could take different forms in different examples. For example the artificial turf cleaner could be implemented as a push

cart, a trailer, attached to a vehicle, or a component of a vehicle.

[0018] An artificial turf as used herein encompasses a synthetic turf that may be an unfilled artificial turf. It is understood herein that references to "artificial turf" is in this embodiment to be interpreted as referring to "unfilled artificial turf."

[0019] The method comprises propelling the artificial turf cleaner across the artificial turf in the motion direction.

10 The method comprises applying the detergent mixture to the artificial turf using the artificial turf cleaner. The applying of the detergent mixture is performed as the artificial turf cleaner is propelled in the motion direction across the artificial turf. The artificial turf is at least partially covered with algae. The method further comprises mechanically brushing the artificial turf and the detergent mixture with the artificial turf cleaner to at least partially remove the algae. The mechanical brushing is performed as the artificial turf cleaner is propelled in the motion direction across the artificial turf. The method further comprises vacuuming the detergent mixture from the artificial turf using the artificial turf cleaner. The vacuuming of the detergent is performed as the artificial turf cleaner is propelled in the motion direction across the artificial turf.

25 As the detergent mixture is removed from the artificial turf the portion of the algae that was mechanically removed from the artificial turf may also be vacuumed up or at least partially vacuumed up. This embodiment may be beneficial because it may eliminate the need to spray or apply algae killer to the artificial turf.

[0020] It should be noted that the above method and artificial turf cleaner described here refer to the removal and cleaning of algae from an artificial turf surface. In use, the artificial turf cleaner may also remove other materials from the artificial turf such as, but not limited to: lichen, mold, bacteria, moss, a biofilm, adherent deposits, and combinations thereof. Adherent deposits may include any material or staining material which adheres to or is stuck to the artificial turf.

40 **[0021]** According to the invention, the artificial turf is a field hockey field. It is understood that references to hockey field and field hockey field herein are equivalent. This embodiment may be beneficial because when artificial turf is used for field hockey it is typically sprayed or flooded with water to enable the puck in field hockey to travel across the surface and obtain the proper playing field characteristics. This has the disadvantage that because the artificial turf is often kept wet an algae can invade artificial turf fibers of the field hockey field.

50 **[0022]** In another embodiment, the artificial turf comprises artificial turf fibers tufted into an artificial turf backing. The artificial turf comprises the feature of the artificial turf fiber forming a pile with a height between 10 mm and 14 mm high above the artificial turf backing. The pile has a height preferably between 11 and 13 mm high.

[0023] In another embodiment, the artificial turf comprises the feature of the artificial turf pile being tufted in rows. The rows have a spacing between 0.44 cm and

0.50 cm. In another embodiment, the artificial turf comprises the feature of the rows having between 40 and 45 tufts of artificial turf fiber per 10 cm.

[0024] In another embodiment, the artificial turf comprises the feature of each of the tufts of the artificial turf fiber comprising between 180 and 250 artificial turf fibers.

[0025] In another embodiment, the artificial turf comprises the feature of the pile comprising at least 500,000 artificial turf fibers per square meter.

[0026] The above features of the artificial turf describe features which are typical for field hockey fields. They are on the average having much higher density of artificial turf fibers than are used for other sports such as soccer or football. The use of these higher number of artificial turf fibers per square meter may provide a space where moisture is more easily retained and algae growths more easily form. Embodiments of the invention may therefore provide for a means to maintain an artificial turf with a reduced amount of algae growth.

[0027] In another embodiment, the method is repeated daily.

[0028] In another embodiment, the method is repeated once or twice a week.

[0029] In another embodiment, the artificial turf cleaner comprises a reservoir configured for storing the detergent mixture. The reservoir is at least partially filled with the detergent mixture. The method further comprises at least one rotatable brush configured for brushing the artificial turf surface by rotating. The term "rotatable" is used to indicate that the brushes are configured for rotating when the artificial turf cleaner is operated. Each of the at least one rotatable brush is configured for receiving the detergent mixture from the reservoir and applying the detergent mixture to the artificial turf surface. The artificial turf cleaner further comprises a vacuum system configured for removing the detergent mixture from the artificial turf surface. The vacuum system is mounted behind the multiple rotatable brushes in the motion direction. Having the rotatable brush receive the detergent mixture may provide for reduced waste of the detergent and enable a larger fraction of it to be vacuumed up after the mechanical brushing.

[0030] In another embodiment, each of the at least one rotatable brush is configured for receiving the detergent mixture from the reservoir and applying the detergent mixture to the artificial turf using at least one pressure nozzle. For example each rotatable brush may have one or more pressure nozzles mounted on it so that as the brush rotates the pressure nozzle rotates also. This may cause a high pressure stream of detergent mixture to move in a circular fashion over the surface of the artificial turf. This may assist the mechanical brushing in removing the algae.

[0031] The at least one rotatable brush could rotate such that it rotates parallel to a horizontal plane when the artificial turf cleaner is in an operating position. The one or more high pressure nozzles could be aimed at the horizontal plane. As the brush rotates, the stream of de-

tergent mixture would follow a circular trajectory on the artificial turf and would assist in the removal of algae. A further advantage of this arrangement is that the number of high pressure nozzles may be reduced in comparison to the use of a spray bar in front of the at least one rotatable brush. If a spray bar is used, a larger number of pressure nozzles may be needed to completely spray the artificial turf ahead of the at least one rotatable brush. This could result in the need for more and/or stronger compressor to provide pressure for the pressure nozzles. A pressure nozzle attached to a rotatable brush moves and is able to clean (or assist in cleaning) a larger area.

[0032] In another embodiment, the at least one pressure nozzle is configured for applying the detergent mixture using a pressure between 30 and 350 bar. In other embodiments, the pressure is between 80 and 300 bar. In yet other embodiments, the pressure is between 100 and 250 bar.

[0033] In another embodiment, the artificial turf is an unfilled artificial turf.

[0034] In another aspect, the invention provides for a turf system which comprises an artificial turf. The turf system further comprises an artificial turf cleaner for cleaning algae from the artificial turf surface. The artificial turf cleaner is configured for being propelled in a motion direction when cleaning the artificial turf. The artificial turf cleaner comprises a reservoir configured for storing a detergent mixture. The artificial turf cleaner is configured for applying the detergent mixture to the artificial turf surface. The artificial turf cleaner further comprises at least one rotatable brushes configured for brushing the artificial turf surface. The artificial turf cleaner further comprises a vacuum system configured for removing the detergent mixture and at least some of the algae from the artificial turf. The vacuum system is mounted behind the multiple rotatable brushes in the motion direction.

[0035] In another embodiment, the at least one rotatable brush comprises multiple rotatable brushes. Adjacent brushes of the multiple rotatable brushes rotate in opposite directions. This may result in reduced vibrations being generated in the artificial turf cleaner.

[0036] In another embodiment, each rotatable brush is configured for receiving the detergent mixture from the reservoir and applying the detergent mixture to the artificial turf surface. For example each rotatable brush may comprise one or more nozzles mounted to it for dispensing the detergent mixture. In some examples the one or more nozzles are pressure nozzles.

[0037] In another embodiment, the artificial turf cleaner further comprises an applicator mounted in front of the at least one rotatable brush in the motion direction for applying the detergent mixture from the reservoir to the artificial turf. In some examples the applicator may be a spray bar with multiple nozzles. In some further examples, the multiple nozzles of the spray bar may be pressure nozzles.

[0038] In another embodiment, the turf cleaner is configured for being pulled behind a vehicle. For example

the turf cleaner could be implemented as a trailer.

[0039] In another embodiment, the turf cleaner is integrated into a vehicle. For example the turf cleaner may be an attachment which can be attached to or integrated into a vehicle. A concrete example would be an attachment that is connected to a tractor or the front of a truck.

[0040] In another embodiment, the vehicle is an autonomous vehicle. For example the vehicle may be able to drive or follow a path on the artificial turf to automatically clean and remove the algae from the artificial turf.

[0041] In another embodiment, the autonomous vehicle comprises a positioning system for determining a current location. The autonomous vehicle is configured for automatically cleaning the artificial turf using the turf cleaner according to the current location and a map of the artificial turf. In some examples the autonomous vehicle may also be able to travel between different hockey fields.

[0042] In another embodiment, the turf system further comprises a detergent mixture tower and a spigot arm. The detergent mixture tower is filled with the detergent mixture. The reservoir is configured for receiving the spigot arm before filling the reservoir. For example if the turf systems comprise an autonomous vehicle the autonomous vehicle may be configured for moving the artificial turf cleaner automatically to the detergent mixture tower and using the spigot arm. This may enable the artificial turf cleaner to function in a fully automatic mode.

[0043] In another embodiment, the artificial turf comprises a sprinkler system for flooding or watering the artificial turf. The artificial turf further comprises at least one drain for draining the water from the artificial turf. The at least one drain may be controllable so that the at least one drain can be closed to enable flooding of the artificial turf. The drain may also be controllable so that the at least one drain can be opened to drain water from the artificial turf.

[0044] In another non-claimed example, the disclosure provides for an artificial turf cleaner for cleaning an artificial turf surface. The artificial turf cleaner is configured for being held in a motion direction when cleaning the artificial turf. The artificial turf cleaner comprises a reservoir configured for storing a detergent mixture. The detergent mixture comprises water and a detergent. The artificial turf cleaner is configured for applying the detergent mixture to the artificial turf surface. The artificial turf cleaner further comprises at least one rotatable brush configured for brushing the artificial turf surface. The artificial turf cleaner further comprises a vacuum system configured for removing the detergent mixture from the artificial turf surface. The vacuum system is mounted behind the at least one rotatable brush in the motion direction.

[0045] In another embodiment, the at least one rotatable brush is multiple rotatable brushes.

[0046] In another embodiment, adjacent brushes of the multiple rotatable brushes rotate in opposite directions. This may reduced vibrations in the artificial turf cleaner.

[0047] In another embodiment, each of the multiple brushes has a center of rotation.

[0048] In another embodiment, each of the at least one brushes comprises two extensions extending in opposite directions from the center of rotation. Each of the two extensions comprises a brushing surface with bristles.

[0049] In another embodiment, each of the at least one brushes comprises at least two extensions extending from the center of rotation. At least one of the at least two extensions comprises a brushing surface with bristles.

[0050] The at least two extensions could for example be two extensions and form a bar like structure that rotates. In another example there could be four extensions that form a cross like structure.

[0051] In another embodiment, a pressure nozzle for dispensing the detergent mixture is mounted at least one of the at least two extensions. In some examples there is a pressure nozzle mounted on each of the at least two extensions distal to the brushing surface.

[0052] In another embodiment, the at least one brush are configured for rotating perpendicular to the motion direction.

[0053] In another embodiment, the at least one rotatable brush is configured to rotate parallel to a horizontal plane when the artificial turf cleaner is in an operating position.

[0054] In another embodiment each of the at least one rotatable brush is configured for receiving the detergent mixture from the reservoir and applying the detergent mixture to the artificial turf surface. For example the detergent mixture could be dispensed within the brush or adjacent to the brush.

[0055] In another embodiment each center of rotation lies along a line perpendicular to the motion direction.

[0056] In another embodiment at least one of the at least two extensions comprises at least one nozzle configured for spraying the detergent mixture onto the artificial turf surface. This embodiment may be beneficial because the detergent mixture is only applied where the at least one rotatable brush is actively cleaning the artificial turf surface.

[0057] In another embodiment, the artificial turf cleaner further comprises a spray bar with additional pressure nozzles. The spray bar is mounted in front of the at least one rotatable brush in the motion direction. In this embodiment the pressure nozzles are used to pressure clean the artificial turf initially. Then the brushes and the pressure nozzles on the brushes clean the artificial turf additionally.

[0058] In another embodiment the vacuum system is configured for returning the vacuumed detergent mixture into the reservoir. This may be beneficial because it may reduce the amount of time before the artificial turf cleaner needs to refill with the detergent mixture.

[0059] In another embodiment the vacuum system comprises a filter for filtering the vacuum detergent mixture before returning the vacuumed detergent mixture

into the reservoir. This may be beneficial because it may help prevent the debris, artificial turf infill or other material from damaging the artificial turf cleaner.

[0060] In another embodiment the artificial turf cleaner further comprises a magnetic materials removal component for removing magnetic materials from the artificial turf surface. For example a high power magnet may be used for picking up and removing magnetic materials from the artificial turf surface.

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

Brief description of the drawings

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

- Fig. 1 shows a flow chart which illustrates a method of removing algae from artificial turf
- Fig. 2 illustrates an example of an artificial turf cleaner;
- Fig. 3 shows a cross sectional view of the artificial turf cleaner of Fig. 2;
- Fig. 4 shows a cross sectional view of an alternative artificial turf cleaner;
- Fig. 5 illustrates a further example of an artificial turf cleaner;
- Fig. 6 shows a cross sectional view of the artificial turf cleaner of Fig. 5;
- Fig. 7 illustrates an example of a turf system;
- Fig. 8 illustrates a further example of a turf system;
- Fig. 9 illustrates a further example of an turf system;
- Fig. 10 illustrates a further example of an turf system;
- Fig. 11 illustrates a further example of an turf system; and
- Fig. 12 illustrates an example of a rotatable brush.

Detailed description

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

[0064] Fig. 1 shows a flowchart which illustrates a method of cleaning algae from an artificial turf. First in step 100 an artificial turf cleaner is propelled across the artificial turf. Next, in step 102 a detergent mixture is applied to the artificial turf using the artificial turf cleaner. Step 102 is performed at the same time as step 100. Steps 102 and 102 and 104 may be performed at the same time. Then in step 104 the artificial turf is brushed mechanically along with the detergent mixture to at least partially remove the algae. Step 104 is performed at the same time as step 100. Then finally in step 106 the de-

tergent mixture and at least some of the removed algae is vacuumed from the artificial turf using the artificial turf cleaner.

[0065] Figs. 2 and 3 shows a top view 202 and a side view 206 of a turf cleaner 200. There is a section line 204. The side view 206 of the turf cleaner 200 is shown along the section line 204. The turf cleaner 200 is illustrated without motors for the brushes or without wheels. It is understood that the turf cleaner 200 could be incorporated into a number of different types of vehicles or trailers or push carts.

[0066] The turf cleaner comprises three rotatable brushes 208. Each of the rotatable brushes has a center of rotation 210. It can be seen that each of the rotatable brushes 208 is moving in a rotational direction 212. The rotational direction of adjacent rotatable brushes 208 is reversed. This may be beneficial for reducing the amount of vibrations that are generated. Each of the rotatable brushes 208 comprises two extensions 214 that form a bar-like structure. The rotatable brushes 208 however may comprise more than two extensions. For example there may be for extensions that form a cross like structure.

[0067] At the end of each extension is a bristle 216 and a nozzle 218. Having the nozzle 218 at the end of each extension 220 has the benefit that it reduces the number of nozzles that are necessary. Because the rotatable brushes 208 rotate the nozzle 218 is rotated over the entire surface of the artificial turf that is brushed. In some examples the detergent mixture is pressurized and sprayed at approximately a pressure of 200 bar. For example a pressure of 100 to 250 bar may be typically used. The reduction in the number of nozzles 218 reduces the size of the pump necessary to maintain this pressure. Having the nozzle 218 adjacent to or within a bristle may be beneficial because it may reduce the amount of detergent mixture needed to clean the artificial turf.

[0068] The turf cleaner 200 is configured for moving in a motion direction 222 when in the operating position. It can be seen that there is a vacuum system 224 located behind the rotatable brushes 208 in the motion direction 222. After the detergent mixture has been sprayed and brushed the vacuum system 224 removes any algae and possibly adherent deposits that have been removed and also detergent mixture. The detergent mixture may for example be stored in a reservoir 228. The reservoir 228 is shown as being partially filled with the detergent mixture 230. In this example the vacuum system 224 runs recovered detergent mixture 230 through a filter 226 and then returns the used detergent mixture back into the reservoir 228. This may be beneficial because it may reduce how often the reservoir 228 needs to be refilled. There are a number of pipes which show a flow of the detergent fluid 230 from the reservoir 228 through the extensions 220 to the two nozzles 230 that are mounted at the end of the extensions 220.

[0069] There are bristles 216 that are mounted at the ends of each of the extensions 220. The dashed line 232

shows the location of a plane that would be parallel to an artificial turf surface being cleaned by the turf cleaner 200. It can be seen that the rotatable brushes 208 rotate in a plane parallel to the horizontal plane 232. In the example shown in Fig. 3 the center of rotations 210 of each of the rotatable brushes 208 is shown as being perpendicular to the motion direction 222. This is one configuration. In other examples the center of rotations 210 of the rotatable brushes 208 could be staggered according to alternate brushes so that there is more of an overlap between areas that are cleaned by each of the rotatable brushes 208.

[0070] Fig. 4 shows a cross-sectional view 206 of a turf cleaner 400. The turf cleaner 400 illustrated in Fig. 4 is similar to the turf cleaner 200 illustrated in Figs. 2 and 3. In the example shown in Fig. 4 when fluid is recovered by the vacuum system 224 it is not returned to the reservoir 228, it is returned instead to a waste tank 402. The waste tank 402 is shown as being filled with waste fluid 404. Adjacent to the vacuum 224 there is an optional magnetic material removal component 406 for removing magnetic or ferric materials from the artificial turf. The magnetic material removal component 460 may be incorporated into the other examples as well.

[0071] Figs. 5 and 6 show a top 202 and a side view 206 of an alternate artificial turf cleaner 500. The examples shown in Figs. 5 and 6 are similar to the examples shown in Figs. 2, 3 and 4 except instead of having nozzles 118 at the tips of the extensions 120 there is instead a spray bar 502. The spray bar 502 is shown as being connected to the reservoir 128. The filter 226 may be an optional component in Figs. 4, 5, and 6.

[0072] The features of the embodiment shown in Figs 5 and 6 may be combined with the features of the embodiments shown in Figs. 2 and 3. Figs 2 and 3 shows the nozzles 218 being mounted on the extensions 220. Figs. 5 and 6 shows the nozzles 218 being mounted on the spray bar 502. A combination could have the spray bar 502 with nozzles 218 as well as nozzles 218 on the extensions 220. This could improve the cleaning ability of the artificial turf cleaner.

[0073] Fig. 7 illustrates an example of a turf system 700. The turf system 700 comprises an artificial turf 702 and a vehicle 704 pulling a trailer 706. The artificial turf cleaner 100 is integrated into the trailer 706. The other artificial turf cleaners illustrated in the other Figs. could also be integrated into the trailer 706. The same is true for Figs. 7, 8, 9, 10 and 11.

[0074] Fig. 8 illustrates a further example of a turf system 800. In the example in Fig. 8 the turf cleaner 100 is either integrated into or attached directly to the vehicle 704.

[0075] Fig. 9 shows a further example of the turf system 800. In this example the vehicle 704 of Fig. 8 has been modified and turned into an autonomous vehicle 704'. The autonomous vehicle 704' now comprises a positioning system 900 and a controller 902. The positioning system 900 could for example be a GPS system or other

radio location system for determining the location of the autonomous vehicle 704'. The controller 902 may then use the current location of the autonomous vehicle 704 and a map of the artificial turf surface 702 to automatically guide the autonomous vehicle 704' to clean the artificial turf 702.

[0076] Fig. 10 shows a further view of the turf system 800. In the example shown in Fig. 10 the turf system further comprises a detergent mixture tower 1000 which comprises a spigot arm 1002. The spigot arm 1002 can be placed in a retracted position 1004 or a filling position 1006. In the filling position 1006 the detergent mixture tower 1000 is able to automatically dispense detergent mixture 130 to the reservoir 128 of the autonomous vehicle 704'. This may enable the fully automated cleaning of the artificial turf 702.

[0077] Fig. 11 shows a further view of the turf system 800. This shows a top view where the artificial turf 702 is a field hockey field 1100. The autonomous vehicle 704' is able to automatically clean the field hockey field 1100. Although the example in Fig. 11 is shown with an autonomous vehicle 704 pulling a trailer 200 any of the other examples of the artificial turf cleaner could be used or substituted into Fig. 11. The autonomous vehicle 704 has the positioning determining system 900. In some examples the positioning determining system 900 is a GPS system. In other examples the hockey field 1100 comprises a transmitter 1102 that provides a locator signal to the positioning system 900.

[0078] The artificial turf 702 of Fig. 11 is shown as optionally having sprinklers 1104 at its edges for wetting or flooding the artificial turf. The sprinklers could alternatively be located within the playing surface. The artificial turf 702 may also optionally comprise one or more drains 1106 for draining the artificial turf 702 from water. The drain 1106 could for example be connected to a drainage system beneath the artificial turf 702. The drain 1106 could, for example, be switchable so that the drain can be closed to allow the artificial turf to flood with water or to be opened to allow a flooded artificial turf to drain.

[0079] Fig. 12 illustrates an alternative rotatable brush 208 that could be used in any of Figs. 2 through 6. In the rotatable brush 208 shown in Fig. 12, there are four extensions 214 that form a cross-like structure. The arrangement of the nozzles 218 and bristles 216 is equivalent to that which is shown in Figs. 3 and 6. In Fig. 12 as well as in Figs. 3 and 6, the bristles need not be located on every extension. They could be present on one or more extension.

[0080] The nozzles 218 may also be located in alternative positions 218' and 218". The nozzle can be located within the structure of the bristle 216 as is shown by position 218'. In Fig. 12 the nozzle 218 is distal to the bristle 216. However, the position of the bristle and the nozzle can be swapped so that the bristle is distal to the nozzle 218".

[0081] Further the relative positioning of the nozzles 218, 218', 218" and bristles 216 relative to each other

may be different on different extensions 214. One extension may possibly only have a bristle 216. Another extension may possibly only have one or more nozzles 218, 218', and/or 218". Another extension may have a bristle 216 and then one or more nozzles at positions 218, 218', and/or 218".

[0082] The differences described in Fig. 12 are also applicable to the rotatable brushes 208 shown in Figs. 2 through 6.

List of reference numerals

[0083]

100	propelling the artificial turf cleaner in the motion direction across the artificial turf	15
102	applying a detergent mixture to the artificial turf using the artificial turf cleaner and during propelling the artificial turf cleaner	
104	mechanically brushing the artificial turf and the detergent mixture to at least partially remove the algae using the artificial turf cleaner and during propelling the artificial turf cleaner	20
106	vacuuming the detergent mixture from the artificial turf using the artificial turf cleaner and during propelling the artificial turf cleaner	25
200	turf cleaner	
202	top view	
204	section line	
206	side view	30
208	rotatable brush	
210	center of rotation	
212	rotational direction	
214	extension	
216	bristle	35
218	nozzle	
218'	nozzle	
218"	nozzle	
220	extension	
222	motion direction	40
224	vacuum system	
226	filter	
228	reservoir	
230	detergent mixture	
232	horizontal plane	45
234	flow of detergent mixture	
400	turf cleaner	
402	waste tank	
404	waste fluid	
406	magnetic material removal component	50
500	artificial turf cleaner	
502	spray bar	
700	turf system	
702	artificial turf	
704	vehicle	55
706	trailer	
800	turf system	
900	positioning system	

902	controller
1000	detergent mixture tower
1002	spigot arm
1004	retracted position
5 1006	filling position
1100	field hockey field
1102	transmitter
1104	sprinkler
1106	drain

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Claims

1. A method of cleaning algae from an artificial turf (702) using an artificial turf cleaner (200, 400, 500) configured for being propelled in a motion direction (222) when cleaning the artificial turf, wherein the artificial turf is a field hockey field (1100), wherein the artificial turf is at least partially covered with the algae, wherein the method comprises propelling (100) the artificial turf cleaner in the motion direction across the artificial turf while the artificial turf cleaner performs:
 - applying (102) a detergent mixture (230) to the artificial turf;
 - mechanically (104) brushing the artificial turf and the detergent mixture to at least partially remove the algae; and
 - vacuuming (106) the detergent mixture together with the removed algae from the artificial turf.
2. The method of claim 1, wherein the artificial turf comprises artificial turf fibers tufted into an artificial turf backing, wherein the artificial turf comprises any one of the following features:
 - the artificial turf fiber forms a pile with a height between 10 mm and 14 mm high above the artificial turf backing, preferably between 11 mm and 13 mm high;
 - the artificial turf pile is tufted in rows, wherein the rows have a spacing between 0.44 cm and 0.50 cm;
 - the rows have between 40 and 45 tufts of artificial turf fiber per 10 cm;
 - each of the tufts of artificial turf fiber comprise between 180 and 250 artificial turf fibers;
 - the pile comprises greater than 500000 artificial turf fibers per square meter; and
 - combinations thereof.
3. The method of any one of the preceding claims, wherein the artificial turf cleaner comprises:
 - a reservoir (228) configured for storing the detergent mixture, wherein the reservoir is at least partially filled with the detergent mixture, wherein the artificial turf cleaner is configured for ap-

- plying the detergent mixture to the artificial turf;
 - at least one rotatable brush (208) configured for brushing the artificial turf; and
 - a vacuum system (224) configured for removing the detergent mixture from the artificial turf, wherein the vacuum system is mounted behind the at least one rotatable brush in the motion direction.
4. The method of claim 3, wherein the at least one rotatable brush is configured for receiving the detergent mixture from the reservoir and applying the detergent mixture to the artificial turf using at least one pressure nozzle (218, 218', 218").
5. The method of claim 4, wherein the at least one pressure nozzle is configured for applying the detergent mixture using a pressure between 30 bar and 350 bar.
6. The method of any one of the preceding claims, wherein the artificial turf is an unfilled artificial turf.
7. The method of any one of the preceding claims, wherein the method further comprises:
 - filtering the vacuumed detergent mixture before returning the vacuumed detergent mixture into the reservoir, and
 - returning vacuumed detergent mixture into the reservoir.
8. A turf system (700, 800) comprising:
 - an artificial turf (702), wherein the artificial turf is a field hockey field (1100); and
 - an artificial turf cleaner (200, 400, 500) for cleaning the artificial turf, wherein the artificial turf cleaner is configured for being propelled in a motion direction (222) when cleaning the artificial turf, wherein the artificial turf cleaner comprises:
 - a reservoir (228) at least partially filled with a detergent mixture (230), wherein the artificial turf cleaner is configured for applying the detergent mixture to the artificial turf;
 - at least one rotatable brush (208) configured for brushing the artificial turf and the detergent mixture to at least partially remove algae from the turf and
 - a vacuum system (224) configured for removing the detergent mixture together with the removed algae from the artificial turf, wherein the vacuum system is mounted behind the at least one rotatable brush in the motion direction.
9. The turf system of claim 8, wherein each of the at least one rotatable brush is configured for receiving the detergent mixture from the reservoir and applying the detergent mixture to the artificial turf using at least one pressure nozzle (218, 218', 218").
10. The turf system of claim 9, wherein the artificial turf cleaner further comprises a spray bar with additional pressure nozzles (218), wherein the spray bar is mounted in front of the at least one rotatable brush in the motion direction.
11. The turf system of claim 10, wherein the at least one rotatable brush is configured to rotate parallel to a horizontal plane (232) when the artificial turf cleaner is in an operating position, wherein each of the at least one rotatable brush has a center of rotation, wherein each of the at least one rotatable brush comprises at least two extensions extending from the center of rotation, wherein at least one of the at least two extensions comprises a brushing surface with bristles (216), and wherein the at least one pressure nozzle is mounted on at least one of the at least two extensions.
12. The turf system of any one of claims 8 through 11, wherein the vacuum system is configured for returning vacuumed detergent mixture into the reservoir.
13. The turf system of claim 12, wherein the vacuum system comprises a filter (226) for filtering the vacuumed detergent mixture before returning the vacuumed detergent mixture into the reservoir.
14. The turf system of any one of claims 8 through 13, wherein the turf cleaner is configured for being pulled behind a vehicle (704) or being integrated into the vehicle, wherein the vehicle is a autonomous vehicle, wherein autonomous vehicle comprises a positioning system (900) for determining a current location, wherein the autonomous vehicle is configured for automatically cleaning the artificial turf using the turf cleaner according to the current location and a map of the artificial turf.
15. The turf system of any one of claims 8 through 14, wherein the artificial turf comprises a sprinkler system for flooding the artificial turf, wherein the artificial turf further comprises at least one drain for draining the artificial turf, wherein the at least one drain is configured for closing during flooding of the artificial turf, and wherein the at least one drain is configured for opening during draining of the artificial turf.

Patentansprüche

1. Verfahren zum Befreien eines Kunstrasens (702)

von Algen unter Verwendung eines Kunstrasenreinigungsgeräts (200, 400, 500), das dafür ausgelegt ist, in einer Bewegungsrichtung (222) angetrieben zu werden, wenn der Kunstrasen gereinigt wird, wobei der Kunstrasen ein Feldhockey-Feld (1100) ist, wobei der Kunstrasen zumindest zum Teil mit den Algen bedeckt ist, wobei das Verfahren einschließt, dass das Kunstrasenreinigungsgerät in der Bewegungsrichtung über dem Kunstrasen angetrieben wird (100), während das Kunstrasenreinigungsgerät durchführt:

- Aufbringen (102) einer Reinigungsmittelmischung (230) auf den Kunstrasen;
- mechanisch (104) Bürsten des Kunstrasens und der Reinigungsmittelmischung, um die Algen zumindest zum Teil zu entfernen; und
- Absaugen (106) der Reinigungsmittelmischung zusammen mit den entfernten Algen von dem Kunstrasen.

2. Verfahren nach Anspruch 1, wobei der Kunstrasen Kunstrasenfasern umfasst, die in einen Kunstrasenrücken getuftet sind, wobei der Kunstrasen irgendeines der folgenden Merkmale umfasst:

- die Kunstrasenfaser bildet einen Flor mit einer Höhe zwischen 10 mm und 14 mm hoch über dem Kunstrasenrücken, vorzugsweise zwischen 11 mm und 13 mm hoch;
- der Kunstrasenflor ist in Reihen getuftet, wobei die Reihen einen Abstand zwischen 0,44 cm und 0,50 cm aufweisen;
- die Reihen weisen zwischen 40 und 45 Kunstrasenfaserbüschel pro 10 cm auf;
- jedes von den Kunstrasenfaserbüscheln umfasst zwischen 180 und 250 Kunstrasenfasern;
- der Flor umfasst mehr als 500.000 Kunstrasenfasern pro Quadratmeter; und
- Kombinationen davon.

3. Verfahren nach einem der vorangehenden Ansprüche, wobei das Kunstrasenreinigungsgerät umfasst:

- einen Vorratsbehälter (228), der dafür ausgelegt ist, die Reinigungsmittelmischung aufzunehmen, wobei der Vorratsbehälter zumindest zum Teil mit der Reinigungsmittelmischung gefüllt ist, wobei das Kunstrasenreinigungsgerät dafür ausgelegt ist, die Reinigungsmittelmischung auf den Kunstrasen aufzubringen;
- mindestens eine rotierbare Bürste (208), die dafür ausgelegt ist, den Kunstrasen zu bürsten; und
- ein Unterdrucksystem (224), das dafür ausgelegt ist, die Reinigungsmittelmischung von dem Kunstrasen zu entfernen, wobei das Unterdrucksystem in der Bewegungsrichtung hinter

der mindestens einen rotierbaren Bürste montiert ist.

4. Verfahren nach Anspruch 3, wobei die mindestens eine rotierbare Bürste dafür ausgelegt ist, die Reinigungsmittelmischung aus dem Vorratsbehälter zu empfangen und die Reinigungsmittelmischung unter Verwendung mindestens einer Druckdüse (218, 218', 218'') auf den Kunstrasen aufzubringen.

5. Verfahren nach Anspruch 4, wobei die mindestens eine Druckdüse dafür ausgelegt ist, die Reinigungsmittelmischung unter Verwendung eines Druckes zwischen 30 bar und 350 bar aufzubringen.

6. Verfahren nach einem der vorangehenden Ansprüche, wobei der Kunstrasen ein ungefüllter Kunstrasen ist.

7. Verfahren nach einem der vorangehenden Ansprüche, wobei das Verfahren ferner umfasst:

- Filtern der aufgesaugten Reinigungsmittelmischung vor dem Zurückführen der aufgesaugten Reinigungsmittelmischung in den Vorratsbehälter, und
- Zurückführen der aufgesaugten Reinigungsmittelmischung in den Vorratsbehälter.

8. Rasensystem (700, 800), umfassend:

- einen Kunstrasen (702), wobei der Kunstrasen ein Feldhockey-Feld (1100) ist; und
- ein Kunstrasenreinigungsgerät (200, 400, 500) zum Reinigen des Kunstrasens, wobei das Kunstrasenreinigungsgerät dafür ausgelegt ist, in einer Bewegungsrichtung (222) bewegt zu werden, wenn der Kunstrasen gereinigt wird, wobei das Kunstrasenreinigungsgerät umfasst:

- einen Vorratsbehälter (228), der zumindest zum Teil mit einer Reinigungsmittelmischung (230) gefüllt ist, wobei das Kunstrasenreinigungsgerät dafür ausgelegt ist, die Reinigungsmittelmischung auf den Kunstrasen aufzubringen;
- mindestens eine rotierbare Bürste (208), die dafür ausgelegt ist, den Kunstrasen und die Reinigungsmittelmischung zu bürsten, um den Rasen zumindest zum Teil von Algen zu befreien; und
- ein Unterdrucksystem (224), das dafür ausgelegt ist, die Reinigungsmittelmischung zusammen mit den entfernten Algen von dem Kunstrasen zu entfernen, wobei das Unterdrucksystem in der Bewegungsrichtung hinter der mindestens einen

rotierbaren Bürste montiert ist.

9. Rasensystem nach Anspruch 8, wobei die mindestens eine rotierbare Bürste jeweils dafür ausgelegt ist, die Reinigungsmittelmischung aus dem Vorratsbehälter zu empfangen und die Reinigungsmittelmischung unter Verwendung mindestens einer Druckdüse (218, 218', 218'') auf den Kunstrasen aufzubringen.
10. Rasensystem nach Anspruch 9, wobei das Kunstrasenreinigungsgerät ferner eine Sprühleiste mit zusätzlichen Druckdüsen (218) umfasst, wobei die Sprühleiste in der Bewegungsrichtung vor der mindestens einen rotierbaren Bürste montiert ist.
11. Rasensystem nach Anspruch 10, wobei die mindestens eine rotierbare Bürste jeweils dafür ausgelegt ist, parallel zu einer horizontalen Ebene (232) zu rotieren, wenn das Kunstrasenreinigungsgerät in einer Betriebsposition ist, wobei die mindestens eine rotierbare Bürste jeweils einen Rotationsmittelpunkt aufweist, wobei die mindestens eine rotierbare Bürste jeweils mindestens zwei Verlängerungen aufweist, die sich von dem Rotationsmittelpunkt aus erstrecken, wobei mindestens eine von den mindestens zwei Verlängerungen eine Bürstenoberfläche mit Borsten (216) umfasst und wobei die mindestens eine Druckdüse an mindestens einer von den mindestens zwei Verlängerungen montiert ist.
12. Rasensystem nach einem der Ansprüche 8 bis 11, wobei das Unterdrucksystem dafür ausgelegt ist, aufgesaugte Reinigungsmittelmischung in den Vorratsbehälter zurückzuführen.
13. Rasensystem nach Anspruch 12, wobei das Unterdrucksystem ein Filter (226) zum Filtern der aufgesaugten Reinigungsmittelmischung vor dem Zurückführen der aufgesaugten Reinigungsmittelmischung in den Vorratsbehälter umfasst.
14. Rasensystem nach einem der Ansprüche 8 bis 13, wobei das Rasenreinigungsgerät dafür ausgelegt ist, hinter einem Fahrzeug (704) gezogen zu werden oder in das Fahrzeug integriert zu werden, wobei das Fahrzeug ein autonomes Fahrzeug ist, wobei ein autonomes Fahrzeug ein Positionierungssystem (900) zum Bestimmen eines aktuellen Standorts umfasst, wobei das autonome Fahrzeug dafür ausgelegt ist, den Kunstrasen unter Verwendung des Rasenreinigungsgeräts gemäß dem aktuellen Standort und einer Karte des Kunstrasens automatisch zu reinigen.
15. Rasensystem nach einem der Ansprüche 8 bis 14, wobei der Kunstrasen ein Berieselungssystem zum Fluten des Kunstrasens umfasst, wobei der Kunst-

rasen ferner mindestens einen Ablauf zum Entwässern des Kunstrasens aufweist, wobei der mindestens eine Ablauf dafür ausgelegt ist, sich während des Flutens des Kunstrasens zu schließen, und wobei der mindestens eine Ablauf dafür ausgelegt ist, sich während des Entwässerns des Kunstrasens zu öffnen.

10 Revendications

1. Procédé de nettoyage d'algues sur un gazon artificiel (702) en utilisant un nettoyeur de gazon artificiel (200, 400, 500) conçu pour être propulsé dans une direction de déplacement (222) lors du nettoyage du gazon artificiel, dans lequel le gazon artificiel est un terrain de hockey sur gazon (1100), dans lequel le gazon artificiel est au moins partiellement recouvert d'algues, où le procédé comprend la propulsion (100) du nettoyeur de gazon artificiel dans la direction de déplacement à travers le gazon artificiel pendant que le nettoyeur de gazon artificiel exécute :
 - l'application (102) d'un mélange de détergents (230) sur le gazon artificiel ;
 - le brossage mécanique (104) du gazon artificiel et du mélange de détergents pour enlever au moins partiellement les algues ; et
 - l'aspiration (106) du mélange de détergents conjointement avec les algues enlevées du gazon artificiel.
2. Procédé selon la revendication 1, dans lequel le gazon artificiel comprend des fibres de gazon touffées dans un support de gazon artificiel, où le gazon artificiel comprend l'une quelconque des caractéristiques suivantes :
 - les fibres de gazon artificiel forment un empilement avec une hauteur entre 10 mm et 14 mm au-dessus du support de gazon artificiel, de préférence une hauteur entre 11 mm et 13 mm,
 - l'empilement de gazon artificiel est touffeté en rangées, où les rangées ont un espacement entre 0,44 cm et 0,50 cm ;
 - les rangées ont entre 40 et 45 touffes de fibres de gazon artificiel pour 10 cm ;
 - chacune des touffes de fibres de gazon artificiel comprend entre 180 et 250 fibres de gazon artificiel ;
 - l'empilement comprend plus de 500000 fibres de gazon artificiel par mètre carré ; et
 - des combinaisons de celles-ci.
3. Procédé selon l'une quelconque des revendications précédentes, dans lequel le nettoyeur de gazon artificiel comprend :

- un réservoir (228) conçu pour stocker le mélange de détergents, où le réservoir est au moins partiellement rempli avec le mélange de détergents, où le nettoyeur de gazon artificiel est conçu pour appliquer le mélange de détergents sur le gazon artificiel ;
 - au moins une brosse rotative (208) conçue pour brosser le gazon artificiel ; et
 - un système d'aspiration (224) conçu pour enlever le mélange de détergents du gazon artificiel, où le système d'aspiration est monté derrière l'au moins une brosse rotative dans la direction de déplacement.
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15. Système de gazon selon l'une quelconque des revendications 8 à 14, dans lequel le gazon artificiel comprend un système d'arrosage pour inonder le gazon artificiel, où le gazon artificiel comprend en outre au moins un drain pour drainer le gazon artificiel, l'au moins un drain étant conçu pour se fermer durant l'inondation du gazon artificiel et l'au moins un drain étant conçu pour s'ouvrir durant le drainage du gazon artificiel.

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Fig. 1

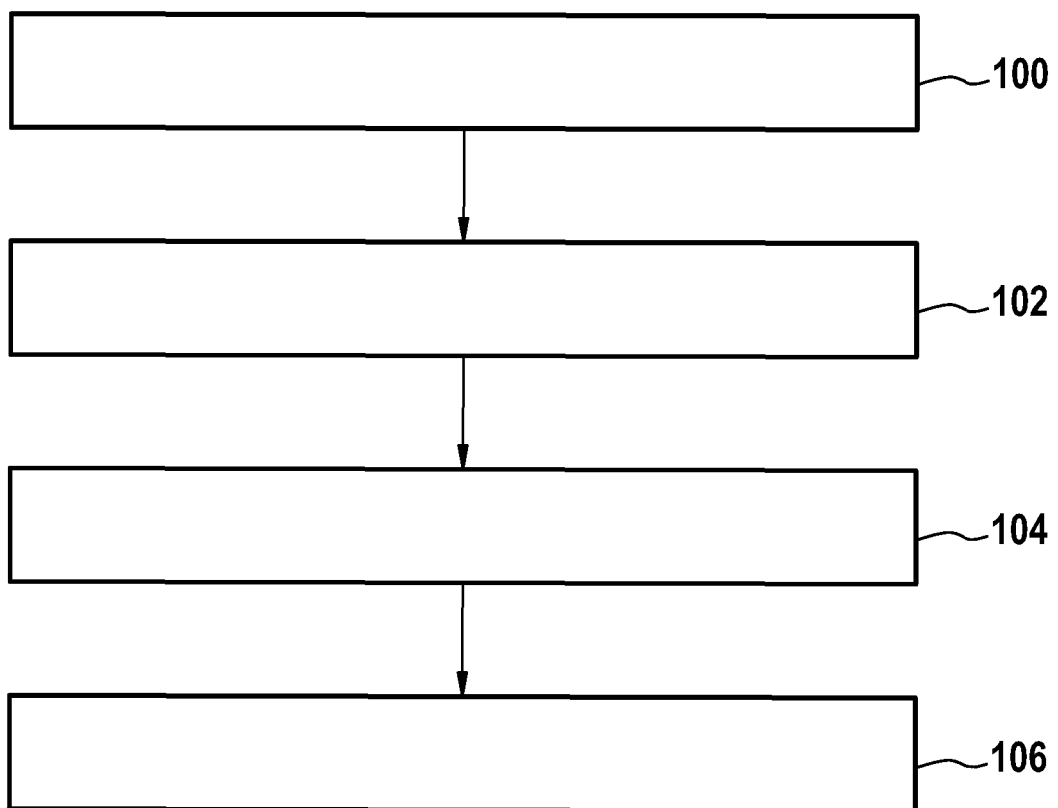


Fig. 2

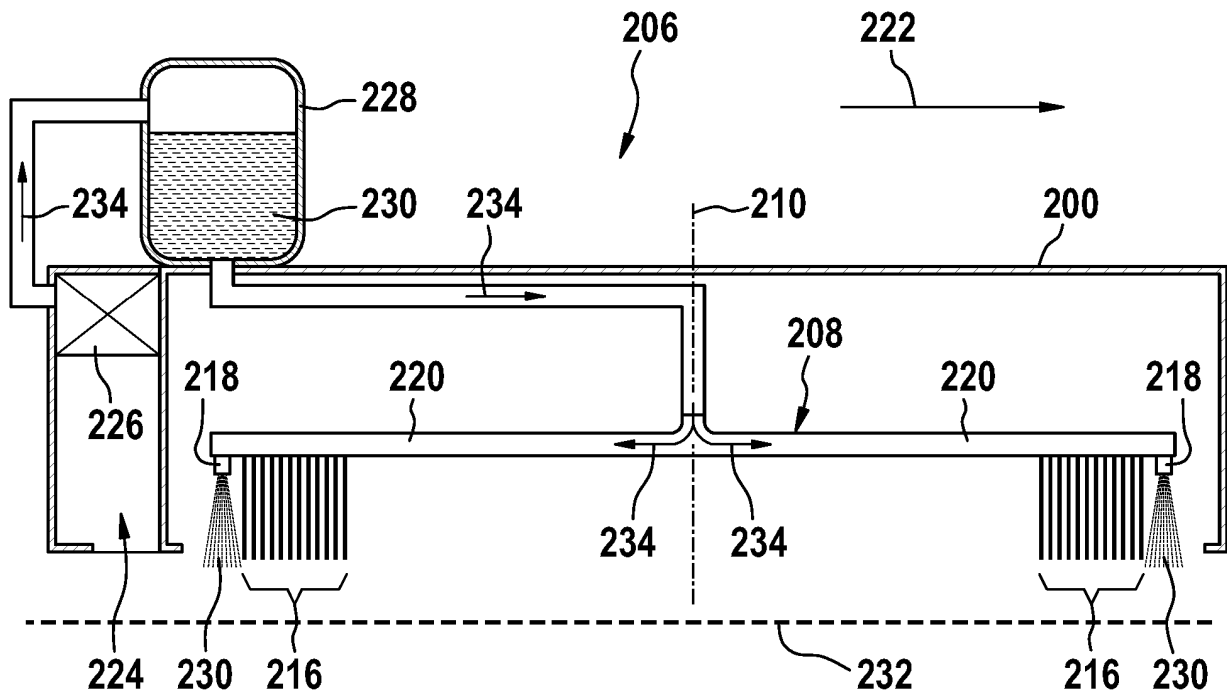


Fig. 3

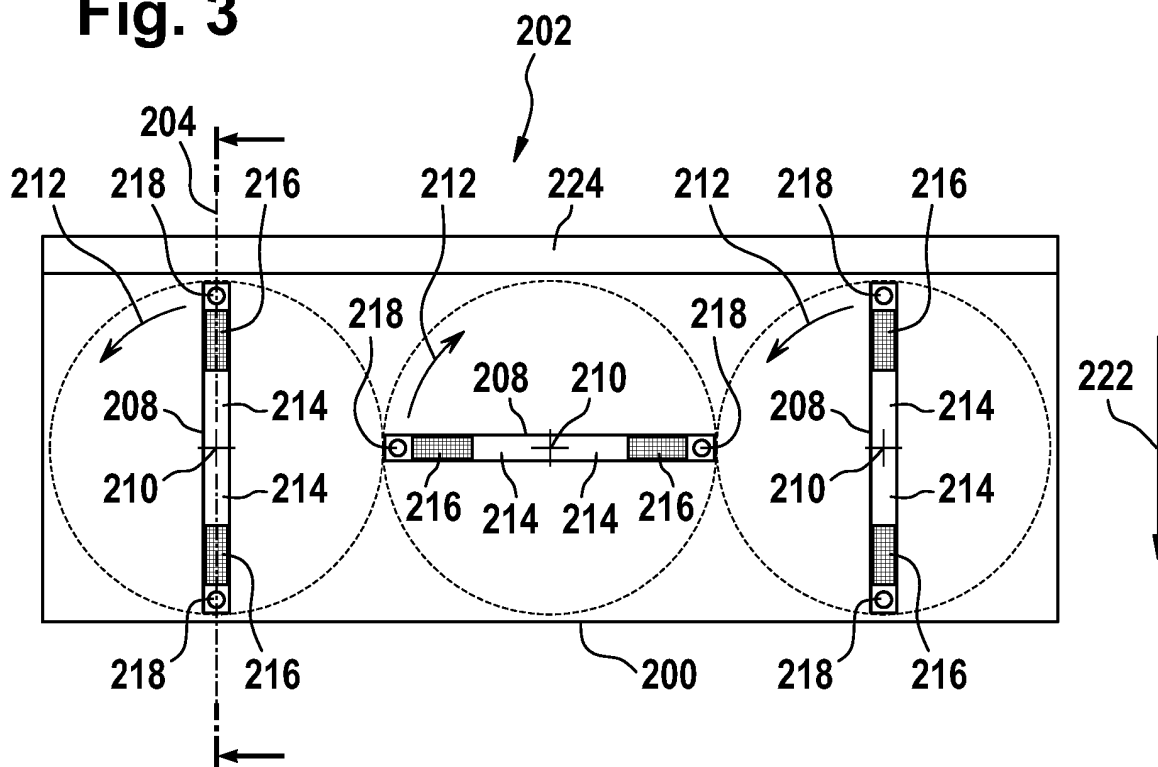


Fig. 4

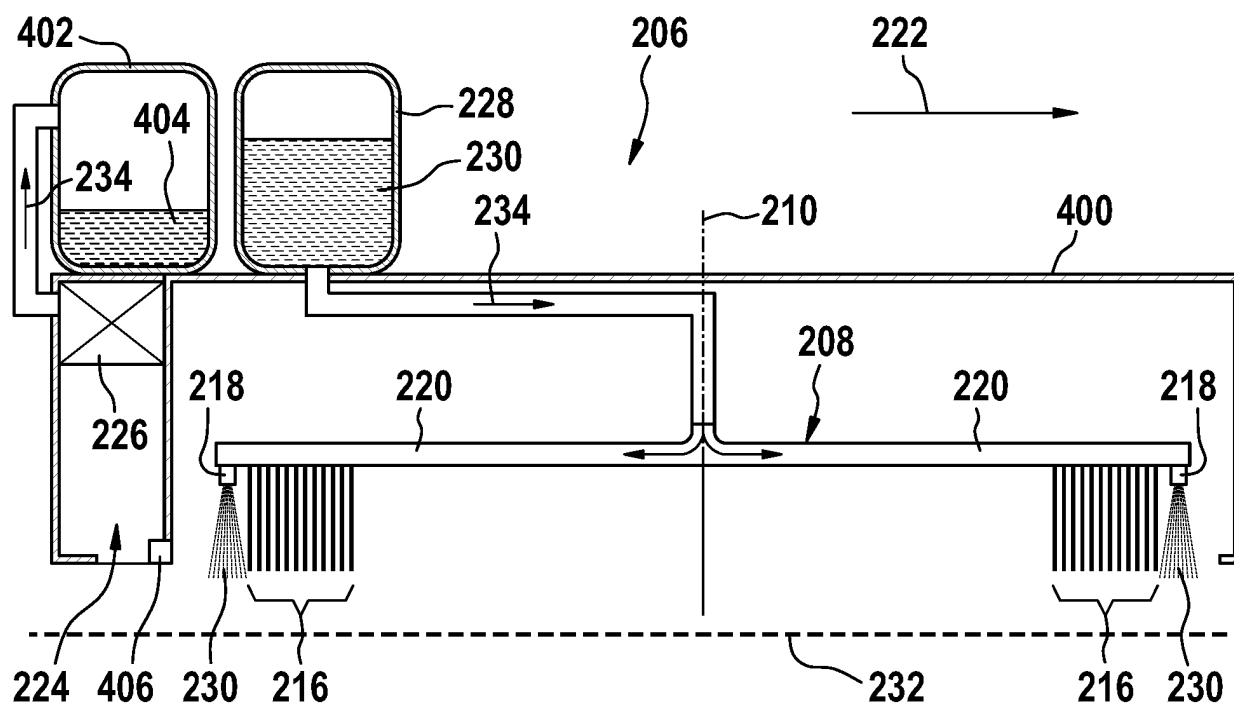


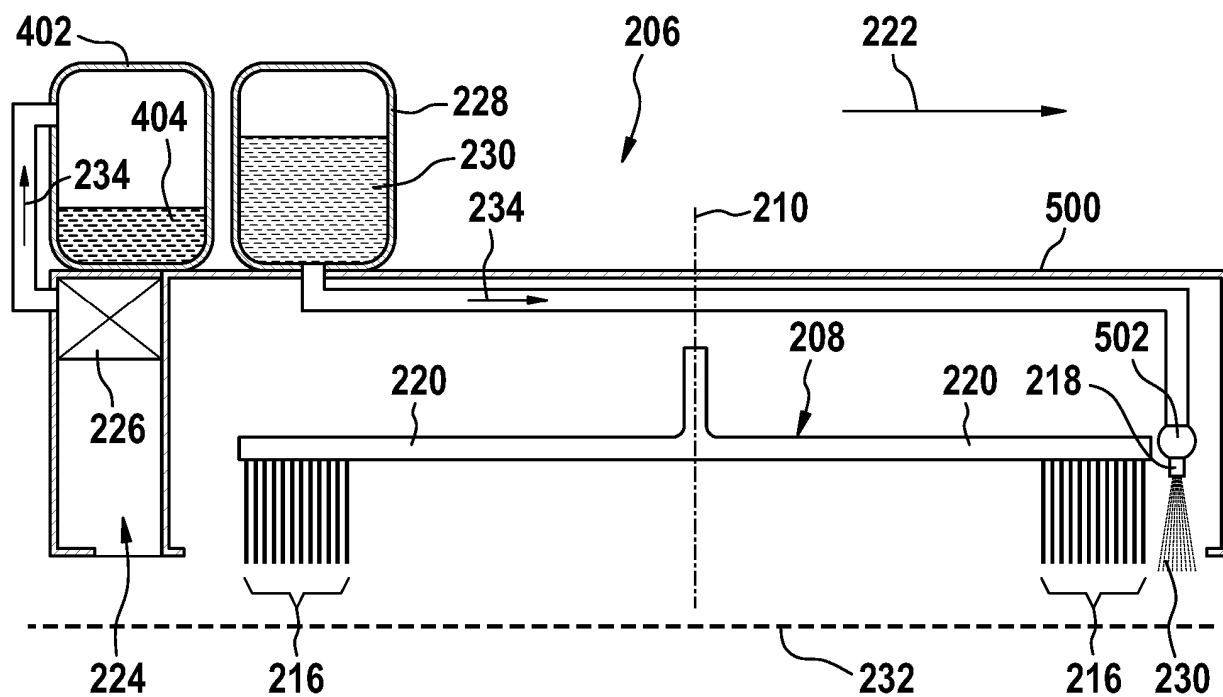
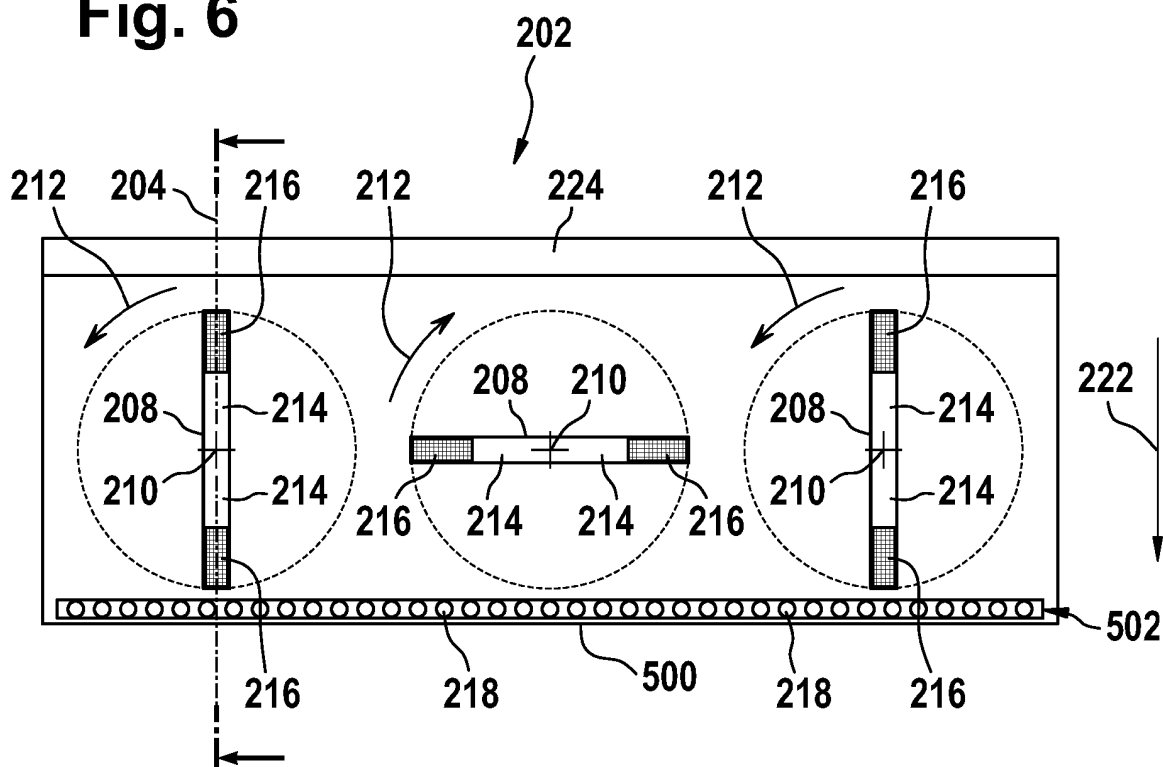
Fig. 5**Fig. 6**

Fig. 7

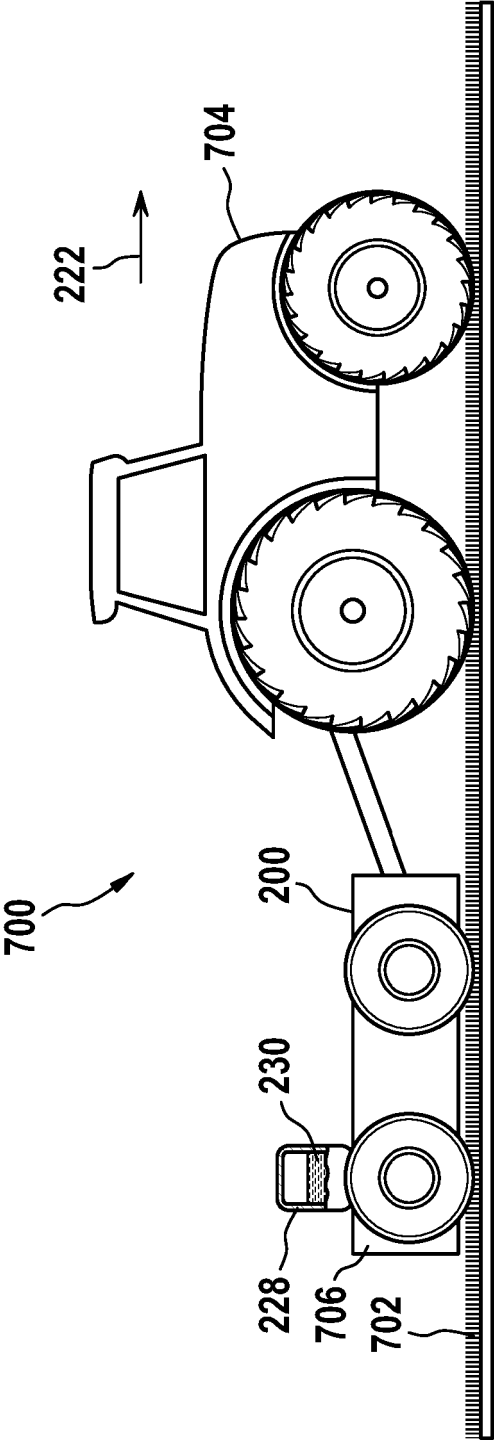
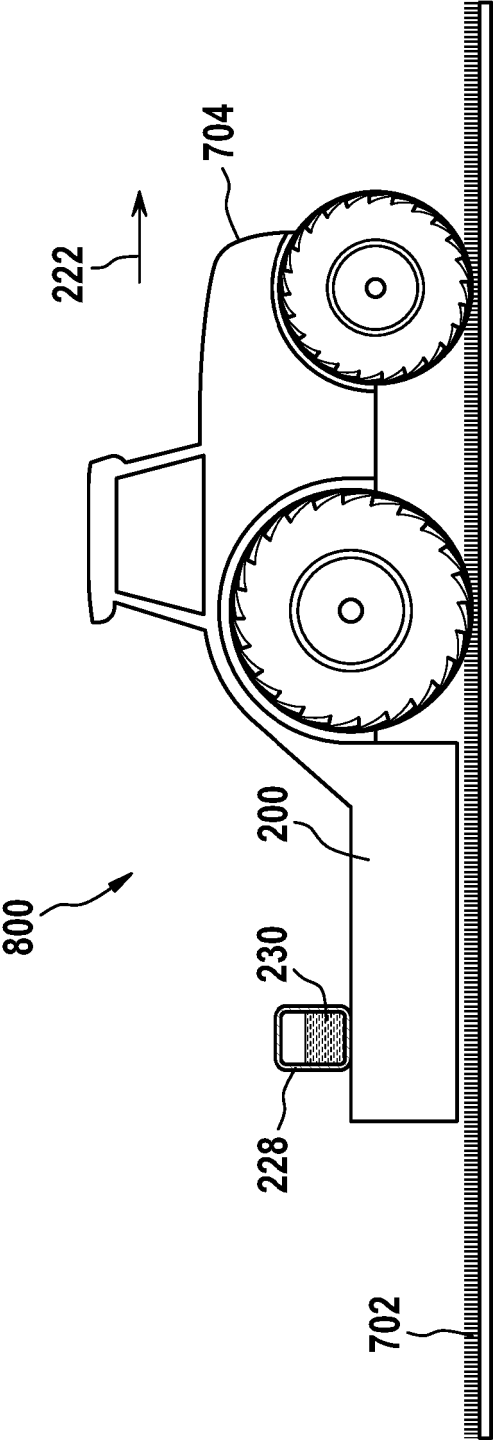


Fig. 8



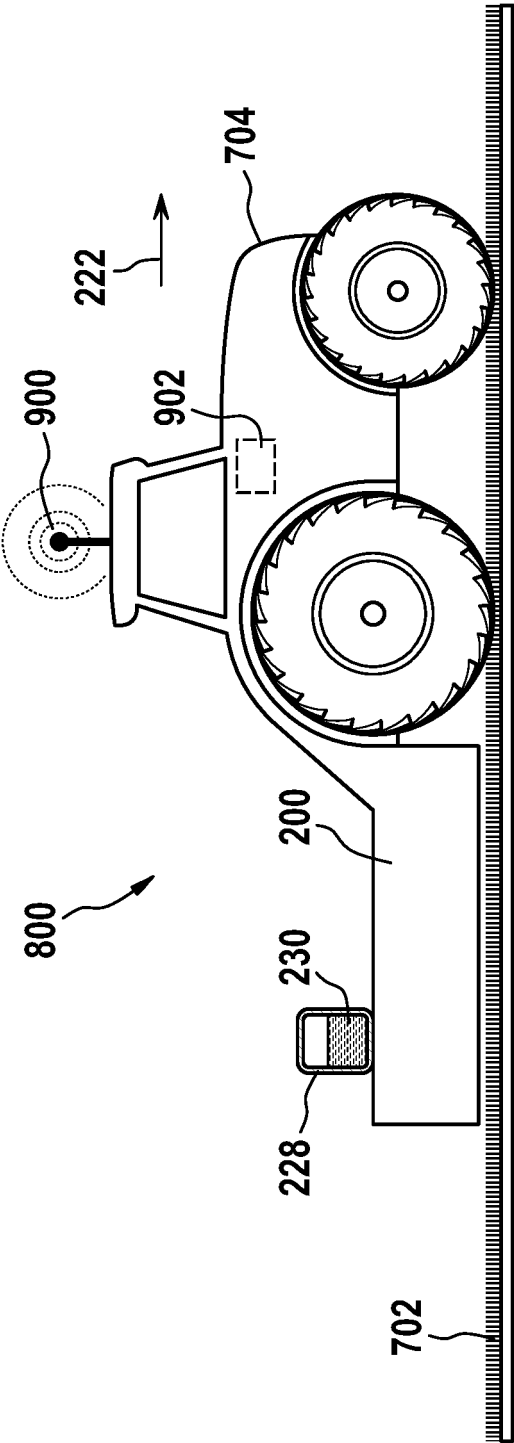


Fig. 9

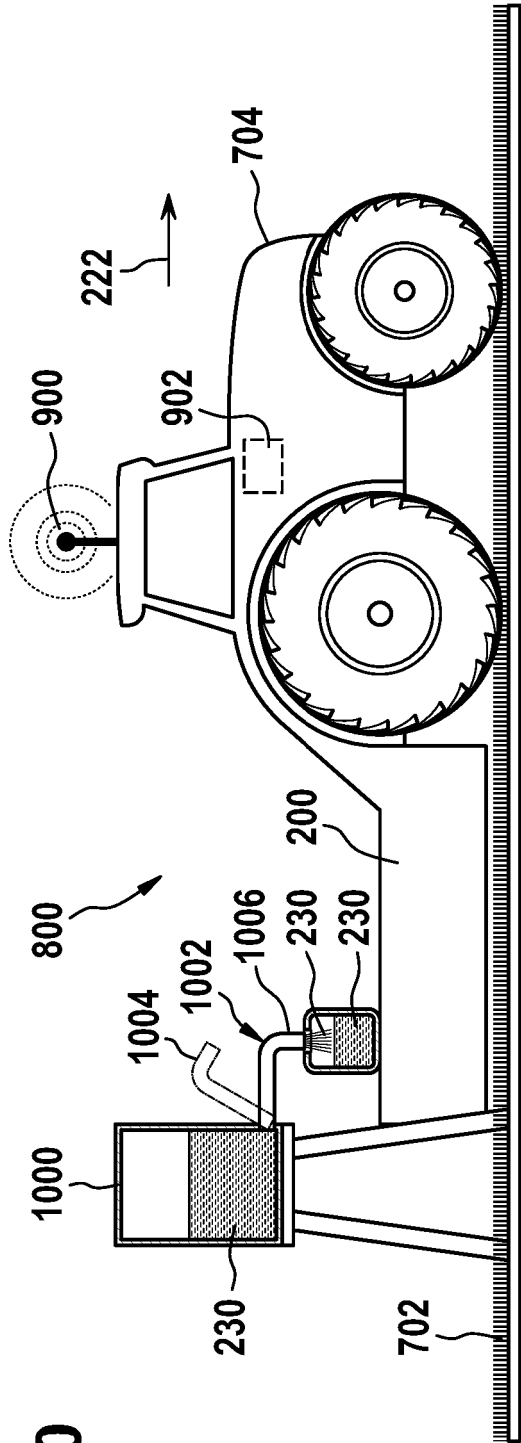


Fig. 10

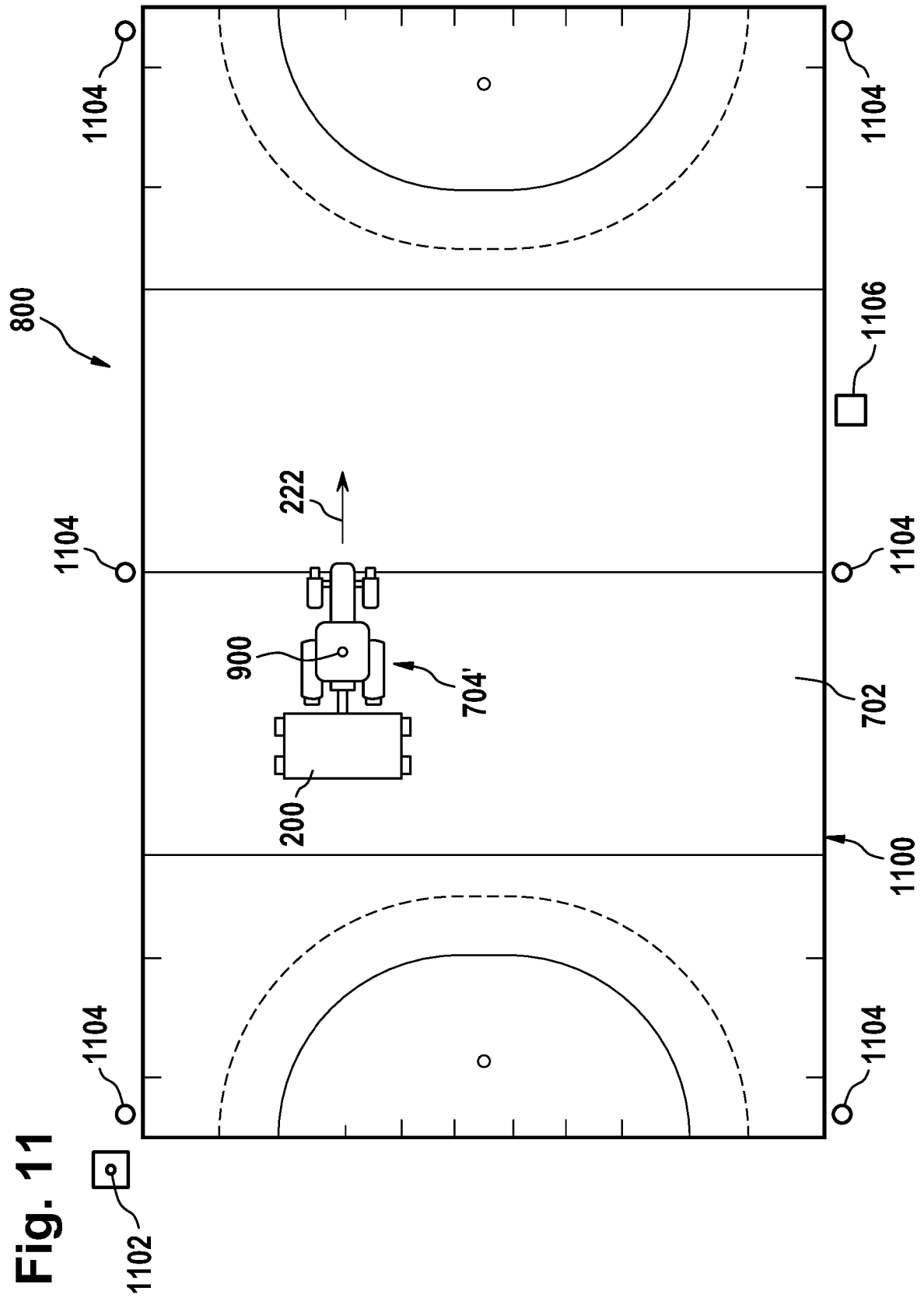
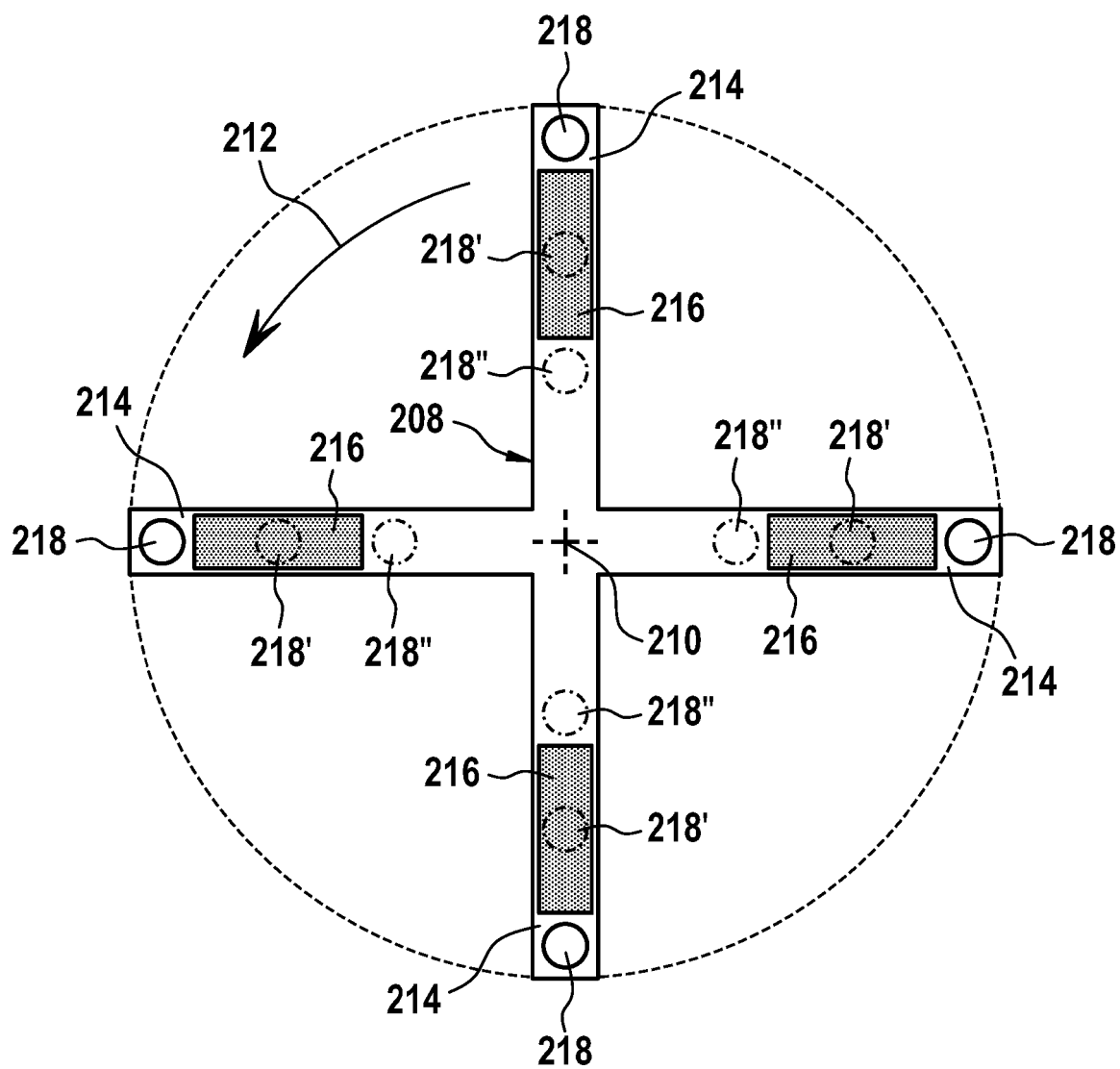


Fig. 12



REFERENCES CITED IN THE DESCRIPTION

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