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(54) MARKING DEVICE, TRAILER UNIT FOR A MARKING DEVICE AND METHOD FOR MARKING A NUMBER, LETTER OR SYMBOL

(57) The invention relates to a marking device (10; 100) for marking a football field layout. The marking device (10; 100) comprises a drive unit (1; 101) and a trailer unit (2; 102), wherein the drive unit (1; 101) comprises a frame, at least three wheels (8a-8c, 108a-108c) for carrying the frame, in particular one line spray nozzle (11) for marking straight lines on the ground, the line spray nozzle (11), being fixedly attached to the frame or moveably attached to the frame for adjusting the position of the line spray nozzle (11), a motor (16a) for driving at least one of the wheels (8a-8c) of the drive unit (1) and/or a handle (16b) for a user to push the drive unit (101), in particular a drive unit pump (28) for pumping paint to the nozzle, and a command unit (5) for commanding the pump and/or nozzle and/or motor. The drive unit (1; 101) and the trailer unit (2; 102) are attached through a coupling, in such a way, that the trailer unit (2; 102) is pullable by the drive unit. The trailer unit (2; 102) comprises a support frame, at least one, in particular two, wheel (13a, 13b) for carrying the support frame, and at least one set of, in particular forty, symbol spray nozzles (12) for spraying a symbol on the ground, the nozzles (12) being fixedly attached to the support frame.

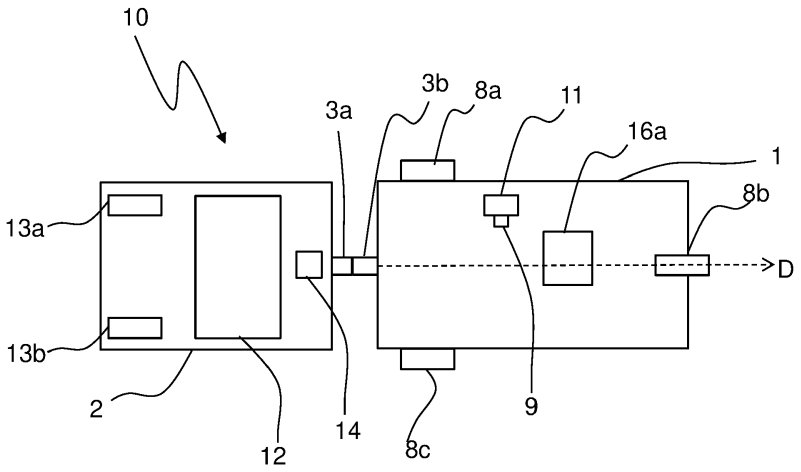

Fig. 1

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Description

[0001] The invention relates to a marking device for marking a football field layout, a trailer unit for a marking device and a method for marking a number, letter or symbol.

[0002] Marking devices are usually used to mark lines on the floor, such as street markings or markings on sports fields. They are adapted to mark lines such as the outer lines on a sports field like the end lines in the end zone of football fields or lines in the middle area of sports fields, which span the width of the sports field such as yard lines.

[0003] Marking devices which are used to mark straight lines are disclosed in DE 40 13 960. The lines are made by dropping paint on a marking wheel and moving said marking wheel. Thus the disclosed device is not adapted for coloring symbols other than lines.

[0004] A football field layout comprises, however, further necessary markings in an area between the end zones. This area comprises yard line numbers between the yard lines. Further, usually the names of the competing sports teams are written in the end zones.

[0005] The marking devices disclosed in US 2011/0039021 has a spray nozzle which allows for marking symbols such as stars. However, having only one nozzle, the device takes a long time when marking numbers and team names, as the devices have to twist and turn for the nozzle on the marking device to spray these symbols. So, usually, these types of markings are sprayed by hand using stencils.

[0006] It is the object of the invention to solve the problems posed in the state of the art and in particular to provide a device for easily and quickly marking a pattern on a floor surface, especially for marking an entire sports, in particular football, field layout. It is further an object of the invention to provide a trailer unit which is easily and quickly connectable to a drive unit and is able to spray symbols, numbers or letters quickly. Furthermore, it is the object of the invention so provide a method for easy and quick marking of an entire sports , in particular football, field layout.

[0007] The problems are solved by a marking device, a trailer unit for a marking device and a method for marking according to the independent claims.

[0008] In particular, the problem is solved by a marking device for marking a sports, in particular football, field layout. The marking device comprises a drive unit and a trailer unit, wherein the drive unit comprises

a frame
at least three wheels for carrying the frame,
in particular one line spray nozzle for marking straight lines on the ground, the spray nozzle, being fixedly attached to the frame or moveably attached to the frame for adjusting the position of the nozzle,
a motor for driving at least one of the wheels of the drive unit and/or a handle for a user to push the drive unit,
in particular a drive unit pump for pumping paint to the nozzle,
and a command unit for commanding at least one of the pump, nozzle and motor.

[0009] The drive unit and the trailer unit are connected through a coupling in such a way, that the trailer unit is pullable by the drive unit. The trailer unit comprises

a support frame
at least one wheel, preferably two wheels, for carrying the support frame,
and at least one set of, in particular forty, symbol spray nozzles for spraying a symbol on the ground, the nozzles being fixedly attached to the support frame.

[0010] Such a marking device allows for an easy and quick marking of a pattern such as an entire football field layout. Further, a marking device as described allows for an improved weight distribution, and a compact arrangement of the necessary components.

[0011] In terms of this document, pattern relates to an arrangement of lines and/or symbols and/or numbers and/or letters. The line spray nozzle may be adapted to mark the long straight lines of a football field layout.

[0012] Symbols include straight lines, like dash marks, or curved lines, such as a copy right symbols, or combination thereof, pictures or parts of pictures. 'Symbol' also relates to a sign, shape, or mark used as a representation of something else, such as an object, function or process. Examples may be characters in musical notation, waved lines for representation of water, heart shape to represent love, etc.

[0013] The line spray nozzle on the drive unit may be adapted to easily and quickly mark straight, long lines. Further, if the nozzle is moveable, such a nozzle may mark lines in positions, where the marking device is not able to drive over such as near walls or posts. Also, such a line spray nozzle would allow for the line spray nozzle and the symbol spray nozzles to be engaged at the same time. That is, the line spray nozzle could be moved in a position for spraying the yard line of a football field and the symbol spray nozzles could simultaneously spray the yard line number. This would shorten the needed spray time for the entire football field layout.

[0014] The symbol spray nozzles on the trailer unit are adapted to mark symbols, numbers and letters. The symbol spray nozzles may be arranged in a line, especially in two or several lines. With multiple nozzles arranged in a line, an entire symbol, number or letter may be printed in one drive-through. The number of symbol spray nozzles can be at least 10, preferably at least 20. The more nozzles the higher the resolution of the pattern the trailer unit is able to provide. The maximum number of nozzles can be 200, in particular 100.

[0015] The fixed symbol spray nozzles provide an easy

and stable build of the trailer unit.

[0016] The command unit may be adapted to calculate the necessary paint volume to mark an entire pattern, such as an entire football field layout. The command unit may be adapted to calculate a drive speed and/or spray speed, especially in regard of a slope.

[0017] The marking device may be adapted to connect to a docking station. The marking device may comprise at least one proximity sensor and/or acceleration sensor and/or tilt sensor.

[0018] The marking device may comprise at least one energy level sensor and/or fuel level sensor. The command unit may be adapted to calculate fuel consumption or amount of energy to drive and spray a predetermined pattern. The command unit may be adapted to warn a user of insufficient level of fuel or energy and/or calculate a path for spraying a predetermined pattern using less energy and/or fuel.

[0019] The coupling may be an indirect coupling, such as a first part of a coupling on the drive unit, a second part of a coupling on the trailer unit and between these two coupling parts another unit. This unit would comprise a third coupling part and a fourth coupling part, the third coupling part would connect to the first coupling part of drive unit and a fourth coupling part to connect to the second coupling part of the trailer unit, to arrange the drive unit and the trailer unit in a kind of marking device train.

[0020] The marking device may comprise at least one line sensor for recognizing lines on the floor. The line sensor may be a camera, a color and/or contrast sensor. The command unit may be adapted to calculate a correlation of a location with the predetermined pattern and the input of the line sensor, in such a way, that only if the location and predetermined pattern indicate the presence of a line and the line sensor indicates an absence of a line the line spray nozzle and/or the symbol spray nozzles are engaged by the command unit. This allows for an easy way for re-spraying an already present pattern without using too much paint. The command unit may be adapted to calculate spray intensity levels based on input by a user, for example to redraw an existing pattern.

[0021] The marking device may be adapted to engage the line spray nozzle and the symbol spray nozzles independently.

[0022] The line spray nozzle may be attached to a moving mechanism, especially a moveable arm or bar. The moving mechanism may be adapted for rotation or extension. Especially, the marking device may comprise a mechanism for detachably fixing the line spray nozzle in a start position and/or an end position. The start position may be in a center region beneath the frame, the end position may be on a side of the marking device. The moving mechanism may be controlled by the command unit. The moving mechanism may be controlled to follow a predetermined line, especially where the predetermined line deviates from a drive line. The drive line in this case would be the line over which the marking device drives.

[0023] Alternatively, the symbol spray nozzles and the line spray nozzle may be switched, such that the symbol spray nozzles would be arranged on the drive unit and the line spray nozzle would be arranged on the trailer unit.

[0024] The marking device may comprise further sensors, such as a touch sensor, an accelerometer etc.

[0025] Especially, the trailer unit is arranged in a driving direction in a position behind the drive unit. This allows for an easy attachment of the trailer unit to the drive unit. Alternatively, the trailer unit is arranged in a driving direction in a position on the side of the drive unit. This allows for easily spraying a broader pattern, such as lines on one side and symbols next to it, for shortening the spray time.

[0026] Preferably, the drive unit comprises at least a first container for a first color of paint. Most preferably, the drive unit comprises at least a second container for a second color of paint and a third container for a third color of paint.

[0027] A first container of paint on the drive unit allows for the drive unit to work independently of the trailer unit, such that the trailer unit may be detached, if only long straight lines need to be marked. This allows for an optimization of the use of the marking device. If there are more containers, it is possible to mark different color of lines or symbols and it is possible to spray more complex symbols involving different colors. Alternatively or additionally to a container on the drive unit, the trailer unit may comprise a container for paint. This allows the symbol spray nozzles to spray independently of the drive unit's storage of paint. It also allows for an optimized distribution of weight between the drive unit and the trailer unit.

[0028] The container or containers may comprise at least one level sensor or level indicator. This prevents running out of paint. The level sensor may comprise a sensor for sensing capacity, weight, or proximity of the paint to the bottom or the top of the container. The level sensor may be based on different technologies, such as radar or electro mechanics.

[0029] Especially, the command unit may be adapted to inform a user of low paint container level or insufficient paint to complete a chosen predetermined pattern, especially based on input of the at least one level sensor. The command unit may be adapted to calculate, recognize and/or store an empty location, the empty location being a position in a pattern and/or a location on a floor, where the paint container is empty or will be empty. The command unit may be adapted to command stopping or returning to an initial position upon the level sensor indicating a certain emptiness level of the container. The command unit may be adapted to calculate a return route to the empty location and/or a continuation route of the unfinished pattern.

[0030] Preferably, the trailer unit comprises a paint transportation system from the first container to the symbol spray nozzles, wherein the paint transportation sys-

tem comprises ducts for transporting paint and a paint connection end for sucking in paint.

[0031] This allows the trailer unit to easily connect and transport paint from the first container to the symbol spray nozzles. The paint transportation system may be adjusted to allow connection to additional containers on the drive unit and/or additional or alternative containers on the trailer unit.

[0032] Preferably, the drive unit pump and/or an additional pump on the drive unit is adapted for pumping paint to the symbol spray nozzles.

[0033] If the drive unit pump is adapted for pumping paint to the symbol spray nozzles, the build needs fewer parts and is thusly simplified. If there is an additional pump on the drive unit, the pumps may be individually adjusted to the necessary flow for a multitude of nozzles.

[0034] Preferably, the paint transportation system comprises a trailer unit pump on the trailer unit for pumping paint to the symbol spray nozzles.

[0035] If there is a pump on the trailer unit, the trailer unit may be easily adapted for different kinds of already existing drive units.

[0036] Preferably, the paint connection end is adapted to at least one of hanging freely into the paint container and being removably attached to the paint container.

[0037] A paint connection end which is adapted to hang freely into a container is easily and quickly connected without the need for a specific connection element on the container itself. A connection end removeably attached to the paint container provides a more secure connection, while still being able to be detached, so that the trailer unit may be removed.

[0038] The paint connection end which is adapted to being removably attached to the paint container allows for a secure way of connecting the end to the container.

[0039] Preferably, the command unit is adapted to command the symbol spray nozzles on the trailer unit.

[0040] This allows for a simple and easy way to command the symbol spray nozzles.

[0041] Preferably, the trailer unit comprises a control unit for controlling the symbol spray nozzles, wherein the trailer unit comprises an information connection between the command unit and the control unit for transporting command information, the information connection being at least one of a wired and a wireless connection.

[0042] This allows for the trailer unit to be easily and quickly be attached to an existing drive unit without a big update to the software of the command unit. The wireless connection may be a Bluetooth connection, a wlan connection and/or a radio connection.

[0043] Preferably, the trailer unit and/or the drive unit comprises a GNSS receiver or a reflector for a robotic total station attached to the frame for detecting a current location.

[0044] This allows for an easy and precise location of the marking device and therefore a precise application of the marking. The trailer unit and/or the drive unit may comprise further sensing devices for orientation such as cameras or distance sensors.

[0045] Preferably, the drive unit is adapted to compare a detected location to a predetermined pattern and adapted to calculate a location and/or a direction, by means of the command unit and/or a comparator.

[0046] This allows for a quick and precise application of the marking, as the marking device may find the best route to complete the pattern.

[0047] The marking device may be adapted to follow the predetermined pattern, indicate to a user a deviation of the marking device from said predetermined pattern, stop a deviation of the marking device from the pattern and/or adjust the spraying to the deviation from the pattern.

[0048] The command unit may be adapted to calculate a starting position for starting to spray, especially a starting position relating to the starting position of the trailer unit. As the trailer unit is coupled to the drive unit and the trailer unit is pulled by the drive unit, if turned, the drive unit may already be in a position for spraying, however, the trailer unit is not yet aligned with the drive unit and thus not in a starting position for spraying. The command unit may also be adapted to calculate the quickest route for spraying a complete pattern, which may include long straight lines and symbols, letters or numbers, especially in consideration of needed starting positions and eliminating long distance drives without any spraying wherever possible.

[0049] Preferably, the drive unit is adapted to be steered autonomously, in particular based on at least one of the calculated location and direction.

[0050] This allows for the marking device to mark an entire football field layout without the need of a user to be present.

[0051] The drive unit may be adapted to follow routes calculated by the command unit. Especially, the drive unit may be adapted to autonomously return to an initial position, particularly a docking station, especially dependent on fuel and/or power levels.

[0052] Preferably, the drive unit comprises a prompting device for providing steering information to a user. The drive unit is adapted to be steered by means of a manual steering device.

[0053] This allows for a driver to control the marking more directly, e.g. in case of the marking taking place on difficult terrain, where a user has to be more present. Especially, the prompting device and the command unit may be part of an interface device, such as a tablet or smartphone. The interface device may be adapted to instruct a user or disclose the direction and/or location for the user to start spraying. The handle to push the marking device may be adapted to be used as the manual steering device.

[0054] Preferably, the marking device comprises a motor unit between the drive unit and the trailer unit for driving the marking device. The motor unit comprises a frame, a motor, and at least two wheels.

[0055] This allows for the marking device to be moved

by the user without having to push. The motor unit may comprise a seat, a fuel container, a paint container and/or a line sensor.

[0056] Preferably, the coupling is one of a trailer ball hitch coupling or a tow bar coupling.

[0057] This allows for an easy and quick coupling of the trailer unit and the drive unit. In case that the marking device comprises a motor unit between the drive unit and the trailer unit, there is a coupling between the drive unit and the motor unit and between the motor unit and the trailer unit.

[0058] Preferably, the drive unit or trailer unit comprises a power source element, additionally or instead of a motor, for powering the command unit.

[0059] Preferably, the trailer unit comprises a power connection for powering the symbol spray nozzles. The power connection is removably attached to the power source or the motor.

[0060] This allows for an easy use of the marking device. The trailer unit and the drive unit can easily be detached.

[0061] In particular, the marking device may comprise a trailer unit as described below.

[0062] Especially, the marking device may comprise means for following a method as described below.

[0063] The problem is solved further by a trailer unit for a marking device, preferably a marking device as previously described. The trailer unit comprises, a support frame, at least one, in particular two, wheel for carrying the support frame, at least one set of, preferably forty, symbol spray nozzles for spraying a symbol on the ground, the nozzles being fixedly attached to the support frame and at least a first part of a coupling adapted for removably coupling the trailer unit to a drive unit. The trailer unit is adapted to be connected to an external source of power and/or an external supply of paint and/or an external source of command information for spray pattern instructions.

[0064] This trailer unit is easily and quickly attached to already existing drive units. Such a trailer unit is low-cost, compact and easily adaptable to the need of different spray tasks.

[0065] The symbol spray nozzles may be arranged on an underside of the support frame in a position of use. In particular, the symbol spray nozzles may be arranged to spray in the direction of the floor in a position of use. The symbol spray nozzles may be arranged in at least one row. The at least one row of symbol spray nozzles may be arranged essentially perpendicular to a drive direction. The at least one wheel may be arranged on the side or sides of the symbol spray nozzle in regards to the drive direction to ensure that the wheel does not drive over the freshly sprayed paint.

[0066] The first part of a coupling may be attached on a first side of the trailer unit. The first side is arranged first in the drive direction. The first part of the coupling may be arranged in such a way on the trailer unit which allows the trailer unit to be pulled by the first part of the coupling, especially in the drive direction. The first part of the coupling may be arranged on a first side of the support frame, wherein the support frame has no protrusions above the first part of the coupling in a position of use, for easy access to couple and un-couple the trailer unit.

[0067] The at least one set of symbol spray nozzles may be arranged on the side opposite of the first side, especially on a bar. The bar may extend behind the wheels. The symbol spray nozzles may be arranged between the wheels.

[0068] The trailer unit may comprise two wheels. In particular, the two wheels may be arranged parallel to each other and in a drive direction, such that the trailer unit is moveable in the drive direction.

[0069] The trailer unit may comprise at least one, preferably two, support element for supporting the trailer unit in case of the trailer unit not being coupled to the drive unit. The support element may be extendably attached to the support frame. The support element or elements may be arranged on an underside of the support frame or on a side of the support frame. Especially, the support element or elements may be arranged on an opposite part of the underside respective to the wheels and/or the opposite side of the support frame respective to the wheels.

[0070] The trailer unit may comprise an interface device for coupling the trailer unit to an external power source, in particular a power source and a container on a drive unit. In particular, the interface device is extendable from the trailer unit.

[0071] The trailer unit may comprise a first part of a wired or wireless connection to a source of command information, such as a Bluetooth or USB or HDMI port.

[0072] The trailer unit may comprise a positioning element, especially a signal element for sending position information. This allows for calculating turn angles and drive ways based on the distance of the trailer unit to a drive unit and improves the adaptability of the trailer unit to the use of different drive units.

[0073] Preferably, the trailer unit comprises a control unit for controlling the symbol spray nozzles. The control unit is adapted to control the nozzles according to command information.

[0074] This allows the trailer unit to be controlled from an already existing command unit, without having to adapt said command unit to command the trailer unit.

[0075] Preferably, the trailer unit comprises a paint transportation system to the symbol spray nozzles. The paint transportation system comprises ducts for transporting paint and a paint connection end for sucking in paint.

[0076] This allows the trailer unit to be attached to a container separate from the trailer unit. The trailer unit may comprise ducts for transporting different kinds of color. The trailer unit may comprise ducts and a connection end adapted to transport a first color of paint. The trailer unit may comprise a container for a second color

of paint, and secondary ducts and a second paint connection end for said container. The trailer unit may comprise a second container for a third color of paint, and tertiary ducts and a third paint connection end for said second container. The paint transportation system and the symbol spray nozzles may be adapted to mix the different colors of paint and/or spray images using colors.

[0077] Preferably, the trailer unit comprises a trailer unit pump for pumping paint to the symbol spray nozzles.

[0078] This allows the trailer unit to be attached to a drive unit without the need to adjust the drive unit. Alternatively, the trailer unit may comprise no pump for paint. In this case, the trailer unit would need to rely on a pump of another unit such as the drive unit for pumping the paint or the trailer unit may be adapted to use other means for moving the paint, such as specialized ducts for sucking paint or the use of gravity.

[0079] Especially, the problems are solved by a marking device for marking a sports, preferably football, field layout. The marking device comprises a trailer unit as previously described.

[0080] The marking device may comprise a drive unit with a motor and/or a handle and/or at least one nozzle, especially a nozzle which is movably attached, and/or a holder for an interface device. Especially, the drive unit may comprise a handle for steering the marking device. The marking device may comprise a motor unit. The motor unit may comprise a motor and/or a seat for a driver to sit on and/or at least one container of paint.

[0081] The problems are solved by a method for marking a number, letter and/or symbol with a marking device, especially a marking device as previously described. The method comprises the steps:

- Defining a pattern, wherein the pattern is in particular a number and/or a letter and/or a symbol, or a sequence of a numbers and/or letters and/or symbols,
- Determining a current position with a GNSS receiver or a prism for a robotic total station mounted on a drive unit and/or a trailer unit of a marking device,
- Comparing the current position to the defined pattern and calculating at least one of a location and a direction, preferably by a command unit on the drive unit,
- Driving by the drive unit autonomously or steered by a user, the drive unit tugging the trailer unit,
- Spraying the previously defined pattern by symbol spray nozzles, which are located on the trailer unit, while the trailer unit is being moved by means of the drive unit and/or a motor unit.

[0082] The method allows for a quick and easy spraying of complex patterns.

[0083] The method may comprise any one or any combination of the following steps:

- Calculating the necessary paint volume for the defined pattern,
- Sensing the amount of paint in at least one container of the marking device,
- Comparing calculated necessary paint volume to the sensed paint volume,
- Calculating the necessary power for the defined pattern,
- Calculating stops for refilling of paint and/or power supply,
- Calculating the shortest route for spraying the defined pattern, in particular taking into account necessary starting positions of the trailer unit symbol spray nozzles, especially including the calculated stops for refilling of paint and/or power supply,
- Sensing line data, especially with a camera and/or color sensor,
- Comparing sensed line data with the defined pattern,
- Spraying missing lines depending on the comparison of sensed line data with the line data of the defined pattern,
- Informing a user of the calculation results and/or alarming a user of low supplies
- Providing drive information to a user,
- Comparing sensed motion information and/or sensed position information to a calculated route,
- Adjusting speed and/or direction and/or position based on calculated discrepancies between sensed information and calculated route,
- Adjusting the use of symbol spray nozzles and line spray nozzle for the shortest route.

[0084] Preferably, the pattern comprises straight lines. These lines are sprayed by a line spray nozzle on the drive unit.

[0085] This allows for quickly and easily spraying the layout of a complete football field.

[0086] The method may comprise the step of moving the line spray nozzle into a spray position. The spray position may be a position on a side of the drive unit relative to the driving direction.

[0087] This allows for spraying lines close to a wall or post, where driving over the line is difficult or impossible.

[0088] Further, the method may comprise the step of simultaneously spraying a line with the line spray nozzle, especially a line spray nozzle extended into a spray position, and spraying a symbol or symbols with the symbol spray nozzles. That is, the line spray nozzle and the symbol spray nozzles may be engaged at the same time.

[0089] The simultaneous spraying of symbols like yard line numbers and lines such as the yard lines allows for shortening the necessary spray time.

[0090] Preferably, the method comprises the steps of

- Calculating a start position, particularly a start position of the trailer unit, in which the trailer unit is positioned to spray the previously defined pattern,
- Driving to the start position.

[0091] Such steps help increase the precision of the

spraying of the trailer unit, especially as the position of the trailer unit needs to be taken into account, when the marking device turns.

[0092] Preferably, the marking device comprises a speed measurement device or the command unit is adapted to calculate the movement speed of the marking device. The command unit is adapted to adjust a spray speed of the symbol spray nozzles to the movement speed of the marking device.

[0093] This allows for ensuring the pattern to be accurate and of enough spray density even on hilly terrain.

[0094] The invention will be further outlined in the following with reference to preferred embodiments with drawings, without being limited thereto. The figures show:

Fig. 1 a scheme of a first version of a marking device,
Fig. 2 a scheme of interactions between a trailer unit and a drive unit of the marking device of figure 1,
Fig. 3 a scheme of a second version of a marking device,
Fig. 4 a diagram of a method for marking numbers, letters and/or symbols

[0095] Figure 1 shows a scheme of a first version of a marking device, the short marking device 10. The marking device 10 comprises a drive unit 1 and a trailer unit 2. The trailer unit 2 is coupled to the drive unit 1 via a two-part coupling 3a, 3b for tugging the trailer unit 2 after the drive unit 1. The trailer unit 2 comprises a support frame. Attached to the support frame are two wheels 13a, 13b, a set of forty symbol spray nozzles 12, a first part of the coupling 3a and an extendable support element 14. The drive unit 1 also comprises a frame. Attached to the frame of the drive unit are a motor 16a for driving the marking device 10, three wheels 8a-8c, and a line spray nozzle 11 attached to the frame via an extendable arm 9. A second part of the coupling 3b is also attached to the frame.

[0096] The symbol spray nozzles 12 are arranged in a row with a width of essentially 1200 mm. This allows the trailer unit 2 to spray a number on an American football field layout in one go, as this corresponds to the necessary width for such a number.

[0097] The amount of 40 symbol spray nozzles 12 allows for a print resolution of 30mm x 30mm.

[0098] Thus, when spraying a pattern, the drive unit 1 tugs the trailer unit 2 in the drive direction D, powered by the motor 16a of drive unit 1. The marking device 10 drives over a surface to be marked with lines and/or symbols. The symbol spray nozzles 12 spray symbols, numbers and letters, and the line spray nozzle 11 sprays lines.

[0099] Figure 2 shows a diagram of the interaction between the drive unit 1 and the trailer unit 2 of a marking device 10.

[0100] For the spraying, the drive unit 1 comprises a container 4 for paint and a line spray nozzle 11. The trailer unit comprises a paint transportation system 20 for transporting paint from the paint container 4 to the symbol spray nozzles 12. The paint transportation system 20 comprises a pump 21 and ducts 22. The duct 22 which starts at the container 4 has a paint connection end 29 for sucking in paint. The paint connection end 29 in this case is adapted to be releasably attached to the container 4.

[0101] In this version of the marking device 10, the drive unit 1 also comprises a pump 28 for pumping paint to the line spray nozzle 11 and ducts 23 which lead from the container 4 to the line spray nozzle 11. In another version of the marking device 10, the pump 28 is the only pump for pumping paint to both the symbol spray nozzles 12 and the line spray nozzle 11.

[0102] The drive unit 1 comprises a command unit 5. The command unit 5 is adapted for connecting wirelessly to an interface device for a user to choose or enter a pattern, access information on the marking device 10 etc. Based on the chosen or entered pattern, command information is provided by the command unit 5. Command information, such as steering, calculating a path and for accessing the line spray nozzle 11, and command information of the symbol spray nozzles 12 is sent from the command unit 5 via a wireless connection 24 to a control unit 7 on the trailer unit 2. The control unit 7 accesses the symbol spray nozzles 12 on the trailer unit 2.

[0103] From motor 16a a power line is drawn to the trailer unit 2 to power the pump 21, the symbol spray nozzles 12 and the control unit 7.

[0104] The drive unit 1 comprises a GNSS-receiver 6 for determining the position by use of the signal 26 of a satellite 27.

[0105] Thus, a user chooses a pattern on an interface device or enters a pattern on the interface device. The command unit 5 determines the position of the marking device 10 with information of the GNSS receiver 6. Then, the command unit 5 calculates the pattern position and relates the pattern position to the determined position. The marking device 10 autonomously drives to a calculated start position for starting to spray. The command unit 5 accesses the line spray nozzle 11 and/or sends command information to the control unit 7 for accessing the symbol spray nozzles 12, depending on the chosen pattern to start spraying. The pump 21 and/or the pump 28 are accessed for pumping paint from the container 4 to the symbol spray nozzles 12 and/or the line spray nozzle 11. The marking device 10 travels autonomously a path calculated by the command unit 5 while spraying the pattern and returns to the start position in a docking station.

[0106] Figure 3 shows a scheme of a second version of marking device, a three part marking device 100. The marking device 100 comprises a drive unit 101, a trailer unit 102 and a motor unit 103 . The motor unit 103 is arranged between the drive unit 101 and the trailer unit 102. The trailer unit 102 is in essence identical to the trailer unit 2 (see figure 1 and 2) and for the details the description of trailer unit 2 is referenced here. The drive

unit 101 differs from the drive unit 1, in that the drive unit 101 comprises a handle 16b for pushing and steering the marking device 100 and does not comprise a motor 16a. For the other details, the description of the drive unit 1 of figures 1 and 2 is referenced. The motor unit 103 comprises a frame and attached to the frame a motor 119, a container for fuel, three wheels 18a-128c, and a seat for a user to sit on. The drive unit 101 and the motor unit 103 are coupled by a two-part coupling 118a, 118b and the trailer unit 102 is coupled to the motor unit 103 with another two-part coupling 117a, 117b.

[0107] The user chooses or enters a pattern in an interface device, in this case a tablet. The command unit calculates a path to spray the pattern and presents it to the user on the tablet. The user drives the marking device 100 following the presented path on the interface device, while the marking device 100 sprays the pattern.

[0108] Figure 4 shows a diagram of a method for marking numbers, letter and/or symbols.

[0109] In a first step 70, a pattern is defined. A pattern includes any lines, symbols, number and/or letters of a design to be sprayed by a marking device 10 (see figure 1) or a marking device 10 (see figure 3). In the case of an American football field layout, the pattern is stored in the memory of the command unit and is chosen by a user. Additionally, the user may amend the pattern to incorporate the name of the teams playing or other details of the pattern.

[0110] In a second step 71, the position of the marking device 10 is determined by use of a GNNS receiver.

[0111] In a third step 72, the determined position is compared to the predetermined patter and a direction or a location is calculated based on the comparison by the command unit. The command unit determines the shortest spray path, by calculating the distance and the necessary start positions for the trailer unit to start spraying.

[0112] In a fourth step 73, the marking device 10 drives or is driven by the user in the calculated direction or to the calculated location.

[0113] In a fifth step 74, the defined pattern is sprayed. For the spraying, the symbol spray nozzles are accessed by the control unit and the line spray nozzle is accessed by the command unit.

[0114] The method allows for quickly spraying an entire football field layout: As the line spray nozzle is adapted to spray the lines and the symbol spray nozzles are adapted to spray symbols, numbers and letters, when they are used in combination, the determination of the drive way for a certain pattern may be optimized.

Claims

1. A marking device (10; 100) for marking a football field layout, comprising a drive unit (1; 101) and a trailer unit (2; 102), wherein the drive unit (1; 101) comprises a frame

at least three wheels (8a-8c; 108a-108c) for carrying the frame,

in particular one line spray nozzle (11) for marking straight lines on the ground, the line spray nozzle (11) being fixedly attached to the frame or moveably attached to the frame for adjusting the position of the nozzle,

a motor (16a) for driving at least one of the wheels (8a-8c) of the drive unit (1) and/or a handle (16b) for a user to push the drive unit (100),

in particular a drive unit pump (28) for pumping paint to the nozzle (11),

and a command unit (5) for commanding at least one of the pump (28), nozzle (11) and motor (16a),

characterized in that

the drive unit (1) and the trailer unit (2) are connected through a coupling, in such a way, that the trailer unit (2) is pullable by the drive unit (1), the trailer unit (2) comprises

a support frame

at least one, in particular two, wheel for carrying the support frame,

and at least one set of, in particular forty, symbol spray nozzles (12) for spraying a symbol on the ground, the nozzles (12) being fixedly attached to the support frame.

2. The marking device (10) according to claim 1, wherein the drive unit (1) comprises at least a first container(4) for a first color of paint, preferably the drive unit (1) comprises at least a second container for a second color of paint and a third container for a third color of paint.

3. The marking device (10) according to claim 2, wherein the trailer unit (2) comprises a paint transportation system (20) from the first container (4) to the symbol spray nozzles (12), wherein the paint transportation system (20) comprises ducts (22) for transporting paint and a paint connection end (29) for sucking in paint.

4. The marking device (10) according to claim 3, wherein the paint transportation system (20) comprises a trailer unit pump (21) on the trailer unit (2) for pumping paint to the symbol spray nozzles (12).

5. The marking device (10) according to any one of the claims 1-4, wherein the trailer unit (2) comprises a control unit (7) for controlling the symbol spray nozzles (12), wherein the trailer unit (2) comprises an information connection between the command unit (5) and the control unit (7) for transporting command information, the information connection being at least one of a wired and a wireless connection.

6. The marking device (10) according to any of the preceding claims, wherein the trailer unit (2) and/or the drive unit (1) comprises a GNSS receiver (6) or a reflector for a robotic total station attached to the frame for detecting a current location.

7. The marking device (10) according to claim 6, wherein the drive unit (1) is adapted to compare a detected location to a predetermined pattern and adapted to calculate a location and/or a direction, by means of the command unit (5) and/or a comparator.

8. The marking device (10) according to claim 7, wherein the drive unit (1) is adapted to be steered autonomously, in particular based on at least one of the calculated location and direction.

9. The marking device (10) according to claim 7, wherein the drive unit (1) comprises a prompting device for providing steering information to a user, wherein the drive unit (1) is adapted to be steered by means of a manual steering device.

10. The marking device (10) according to claim 9, wherein the marking device (10) comprises a motor unit (103) between the drive unit (1) and the trailer unit (2) for driving the marking device (10), wherein the motor unit (103) comprises a frame, a motor (119), and at least three wheels (128a-128c).

11. Trailer unit (2) for a marking device (10), preferably a marking device (10) according to any one of the previous claims, wherein the trailer unit (2) comprises

    a support frame
    at least one, in particular two, wheel (13a, 13b) for carrying the support frame,
    at least one set of, preferably forty, symbol spray nozzles (12) for spraying a symbol on the ground, the nozzles (12) being fixedly attached to the support frame
    and at least a first part of a coupling (3a) adapted for removably coupling the trailer unit (2) to a drive unit (1) and/or a motor unit (103),

    wherein the trailer unit (2) is adapted to be attached to an external source of power and/or an external supply of paint and/or an external source of command information for spray pattern instructions.

12. The trailer unit (2) according to claim 11, wherein the trailer unit (2) comprises a control unit (7) for controlling the symbol spray nozzles (12), wherein the control unit (2) is adapted to control the nozzles (12) according to command information.

13. The trailer unit (2) according to one of the claims 11 or 12, wherein the trailer unit (2) comprises a paint transportation system (20) to the symbol spray nozzles (12), wherein the paint transportation system (20) comprises ducts (22) for transporting paint, wherein the paint transportation system (20) comprises a paint connection end (22) for sucking in paint.

14. Method for marking a number, letter and/or symbol with a marking device (10) according to one of the claims 1-13, comprising the steps:

    - Defining a pattern, wherein the pattern is in particular a number and/or a letter and/or a symbol, or a sequence of numbers and/or letters and/or symbols
    - Determining a current position with a GNSS receiver (6) or a prism for a robotic total station, in particular mounted on a drive unit (1) and/or a trailer unit (2) of a marking device (10)
    - Comparing the current position to the defined pattern and calculating at least one of a location and a direction, preferably by a command unit (5) on the drive unit (1),
    - Driving by the drive unit (1) autonomously or steered by a user, the drive unit (1) tugging the trailer unit (2)
    - Spraying the previously defined pattern by symbol spray nozzles (12), which are located on the trailer unit (2), while the trailer unit (2) is being moved by means of the drive unit (1) and/or a motor unit (103).

15. Method according to claim 14, wherein the pattern comprises straight lines, wherein these lines are sprayed by a line spray nozzle (11) on the drive unit (1).

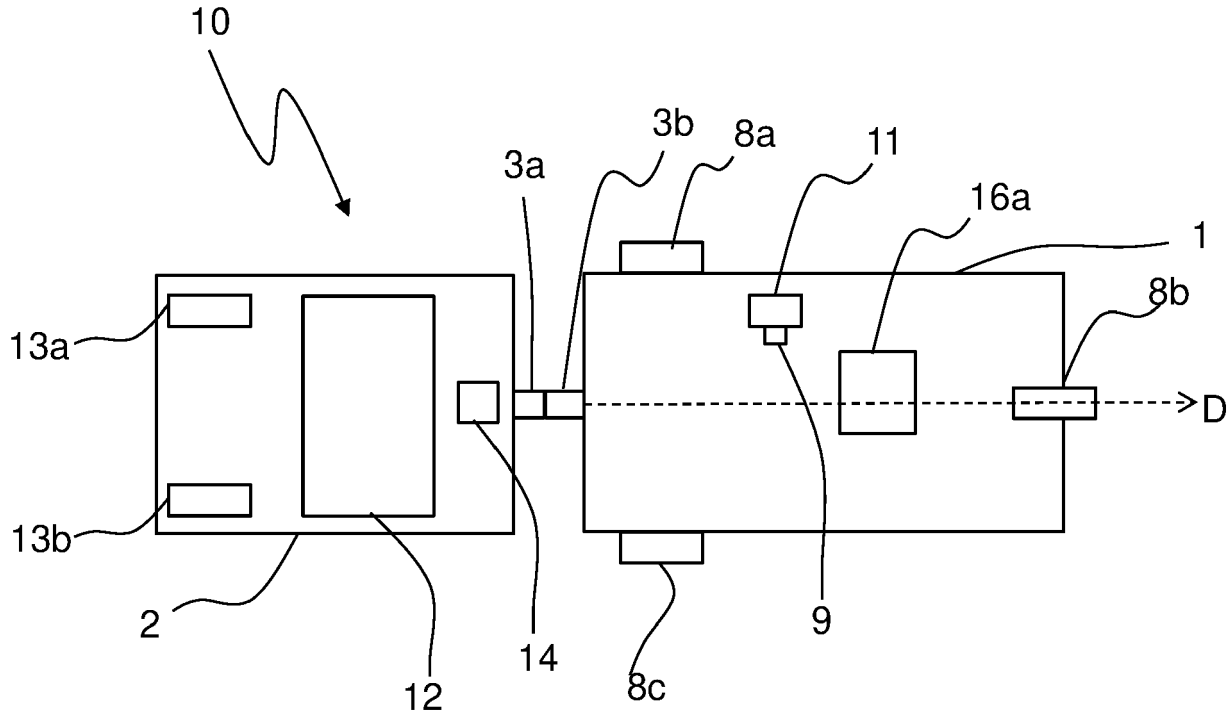
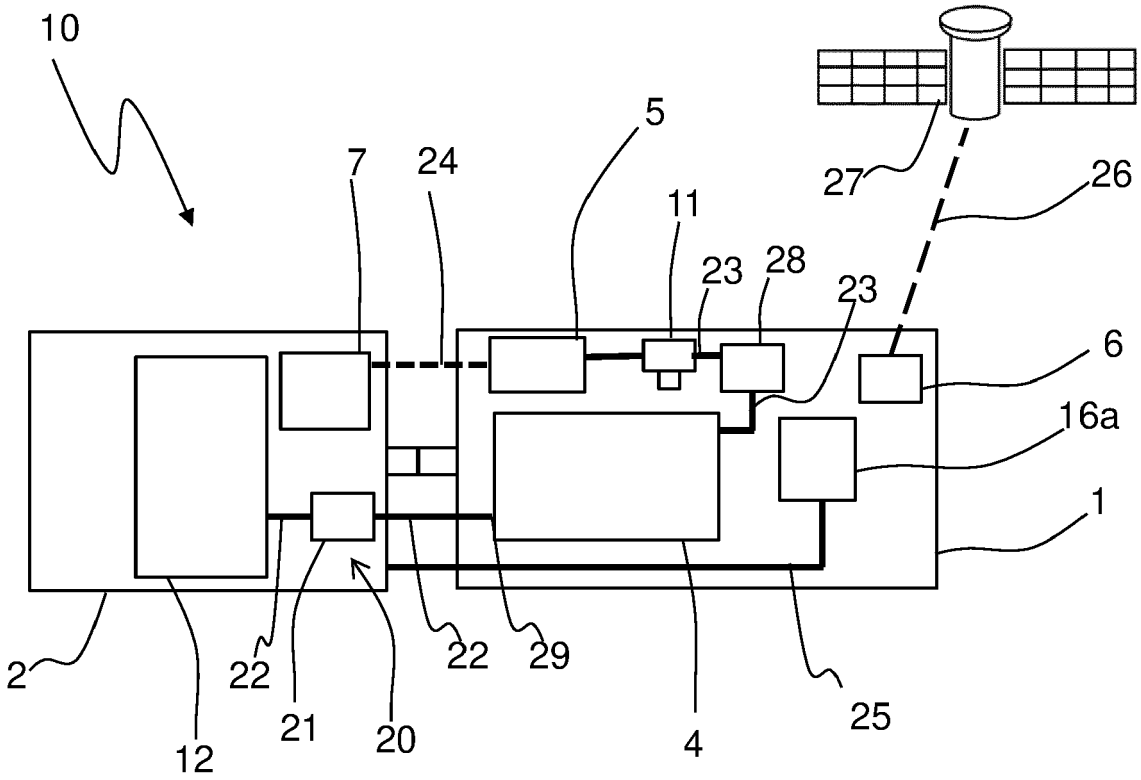

10
3b
8a
11
3a
16a
1
8b
13a
D
13b
2
12
14
8c
9

Fig. 1


10
5
7
24
27
26
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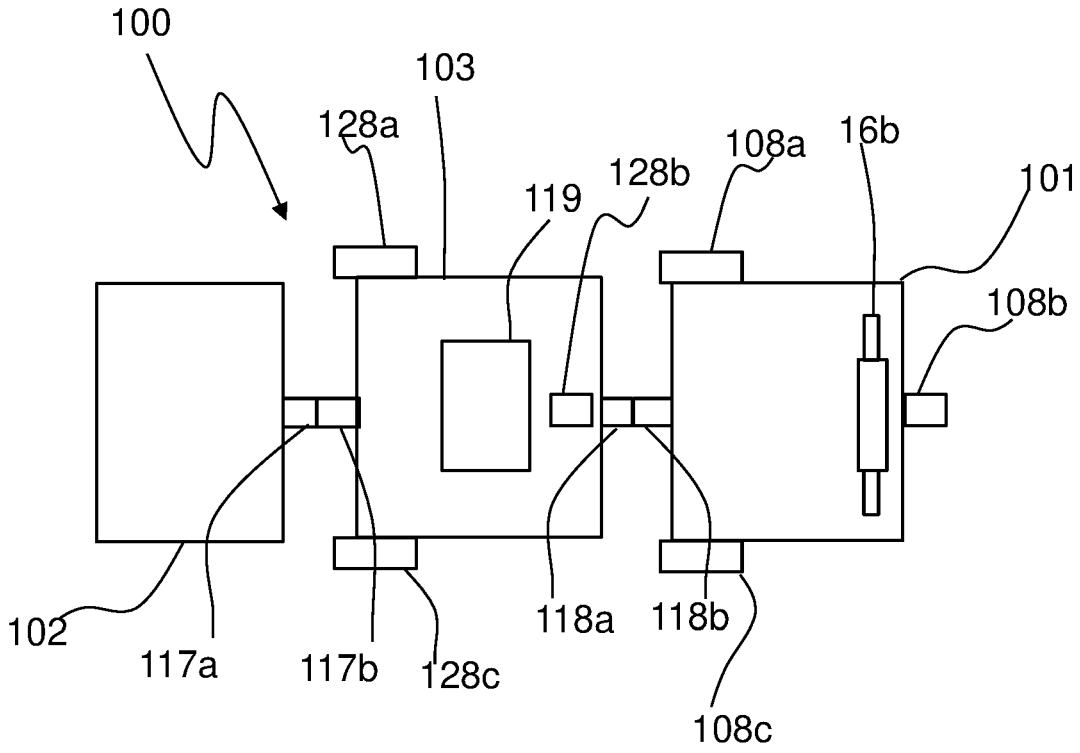
28
23
6
16a
1
2
22
22
29
21
20
4
25
12

Fig. 2


100
103
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101
108b
102
117a
117b
128c
118a
118b
108c

Fig. 3

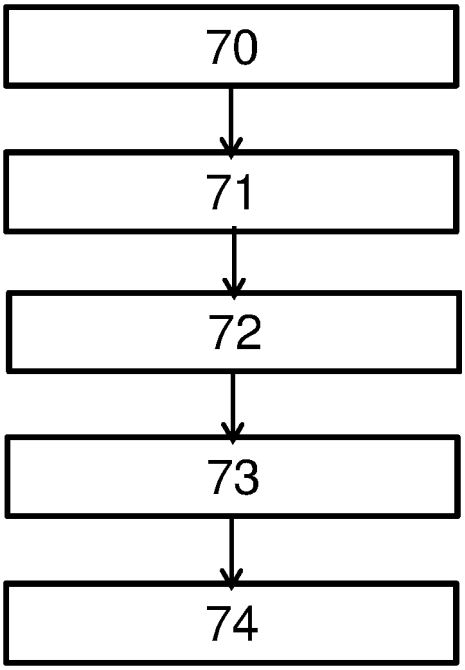

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 21 20 6131

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 April 2022	Murer, Michael

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21-04-2022

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