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(54) Title: CLEARING SAW SYSTEM AND METHOD

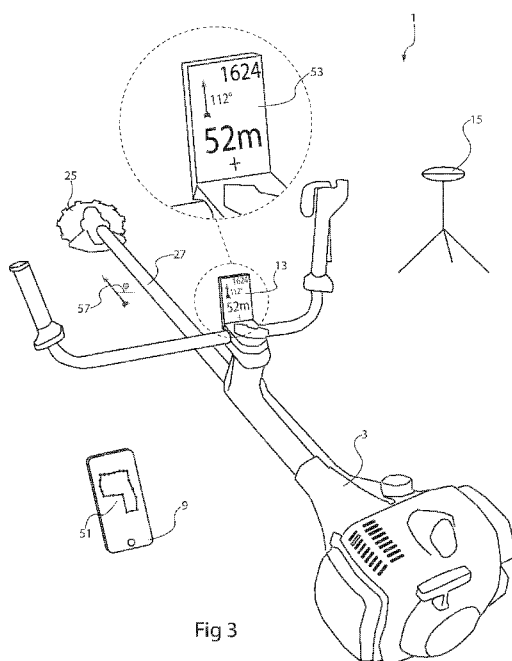


Fig 3

(57) Abstract: The present disclosure relates to a clearing saw system 1 comprising a clearing saw 3, a current position sensing device 5, carried by a clearing saw operator 7 also carrying a processing control unit 9 receiving position data from the position sensing device 5. The position sensing device 5 comprises a memory 11 storing positions corresponding to a processing area. A clearing saw indicator unit 13, is attached to the clearing saw 3 and comprises a display. The processing control unit 9 sends at least one distance indication to the clearing saw indicator unit 13 based on the stored positions and the current position, and the clearing saw indicator unit 13 displays an indication, for instance a distance along a bearing to a border of the processing area, based on the distance indication. This facilitates efficient processing of a specific area with the clearing saw system.



CLEARING SAW SYSTEM AND METHOD

Technical field

The present disclosure relates to a clearing saw system comprising a clearing saw.

5 The disclosure also considers a corresponding method.

Background

Clearing saws are used in forestry mostly for cutting small trees in dense populations in order to promote growth among remaining specimens. To this end, clearing saws are configured to be carried by a user that remains standing while the clearing saw is
10 able to cut a small tree close to ground. Such work is often carried out by contractors that are assigned to harvest a specific percentage of trees of specific species within a well-defined area.

A general problem with clearing saw systems is how to make this work more efficient.

Summary

15 One object of the present disclosure is therefore to provide a clearing saw system allowing more efficient work to be carried out. This object is achieved by means of a clearing saw system as defined in claim 1. More specifically, a clearing saw system of the initially mentioned kind comprises a position sensing device, configured to be carried by the clearing saw operator and sensing its current position, and a process-
20 ing control unit configured to be carried by the clearing saw operator and receiving position data from the position sensing device. The processing control unit comprises a memory storing positions corresponding to a processing area. A clearing saw indicator unit is configured to be attached to the clearing saw and comprises a display. The processing control unit is configured to send at least one distance indication to
25 the clearing saw indicator unit based on the stored positions and the current position, and the clearing saw indicator displays an indication based on the distance indication.

When thereby provided with distance indications that may indicate the distance to for instance a work area border in the direction of the clearing saw, the operator may
30 very efficiently process the desired working area without risking entering a neighboring parcel of land, and without needing to manually check positions in relation to a map, for instance. This provides for a more efficient work to be carried out.

The clearing saw indicator unit may comprise a direction detection unit for determining a heading orientation of the clearing saw. This allows the indicator unit for instance to display the distance to a border of an area to be processed in different directions as the user points with the clearing saw in those different directions, in

5 which he may consider moving.

Typically, the clearing saw may comprise a power unit, a cutting head, and a pole connecting the power unit with cutting head, and the heading for which the orientation is determined may be the heading along said pole.

The clearing saw indicator unit may be configured to communicate its heading orientation to the processing control unit, which in return communicates a distance indication to the clearing saw indicator unit, based on the stored positions, the current position, and the heading.

Alternatively, the processing control unit may be configured to communicate a plurality of distance indications to the clearing saw indicator unit, based on the stored positions, and the current position, and the clearing saw indicator unit, may be configured to display a distance based on said plurality of distances and the heading orientation.

The position sensing device may be integrated in the processing control unit. The processing control unit may be a user equipment such as a mobile telephone. It may be configured to display the processing area on a display.

The clearing saw may comprise a socket for the indicator unit.

The present disclosure also considers a method employed in a clearing saw system comprising a clearing saw. The method includes storing a set of positions relating to a set of objects in a processing area, determining the current position of the clearing saw, determining the orientation of the heading of the clearing saw, determining, based on the current position and the stored set of positions, a distance to an object in the set of objects in said heading orientation, and displaying said distance on a display arranged on the clearing saw. This obtains advantages corresponding to the above system and may be varied correspondingly.

The present disclosure also considers a clearing saw indicator unit, configured to be attached to the clearing saw. The clearing saw indicator unit includes a display, an

orientation detecting unit, detecting the heading orientation of the clearing saw, and a receiver, configured to receive a distance to at least one object. The display is configured to display the distance to an object in the heading of the clearing saw.

5 The clearing saw indicator unit may further comprise a vibration sensor for detecting vibrations corresponding to a cutting of a tree by means of the clearing saw. The indicator unit may increment a counter based on detected vibrations.

The indicator unit may be configured for inductive charging. Thereby, some connectors exposed to demanding environments can be eliminated.

The clearing saw indicator unit may be configured to report data regarding cut trees.

10 Brief description of the drawings

Fig 1 shows a clearing saw in use.

Fig 2 illustrates an area to be processed.

Fig 3 shows components of a clearing saw system according to the present disclosure.

15 Fig 4 illustrates schematically nodes in an example of a system.

Fig 5 is a flow chart illustrating a method according to an example of the present disclosure.

Fig 6 illustrates the area of fig 2 being processed.

Fig 7 shows determining of a distance in the context of fig 6.

20 Fig 8 illustrates the area of fig 6 after processing.

Detailed description

The present disclosure relates to clearing saws, sometimes referred to as brush cutters, more specifically to methods and arrangements related to clearing saws.

25 An example of a clearing saw 3 is illustrated in fig 1. In a basic outline, the clearing saw 3 comprises a power unit 23 and a rotary cutting head 25. The power unit 23 and the cutting head 25 are located on opposite ends of a pole 27 or tube, through which rotary power from the power unit 23 to the cutting head 27 is conveyed by means of a rotary shaft hidden in the pole 27.

Typically, the power unit 23 is a 2-stroke internal combustion engine or a battery powered electric motor, although other power units are conceivable. The cutting head 25 usually carries a circular saw disc as illustrated, which is particularly useful for cutting small trees, although a trimmer line or a brush knife may replace the saw disc in case softer vegetation is to be cut.

In many cases a small gear box 28 may be located in the cutting head.

As illustrated, the user 7, may carry the clearing saw 3 using a harness 29, keeping the relatively heavy power unit 23 close to the user's 7 body and the cutting head 25 close to the ground, in an ergonomically acceptable manner. Clearing saws as shown in fig 1 are of course well known in the art.

When used professionally in forestry, a clearing saw is often used to thin out a population of small trees to promote the growth of the remaining trees, sometimes referred to as cleaning. Typically, there is also a desire to obtain certain ratios of different species among the remaining trees e.g. 80% spruce (often planted) and 20% birch (usually from wild seeds). There is often also a desire to remove individual trees with less favorable growth pattern, e.g. double stems.

Due to the objectives above, the relatively high physical demands, and safety issues concerned, clearing saws are in many cases operated professionally by subcontractors that are hired to carry out cleaning on a parcel of land on behalf of the landowner. In many cases, the subcontractor visits this parcel for the first time when carrying out the work. The methods and arrangements or systems described herein are aimed at facilitating work in such circumstances.

Fig 2 illustrates an area 31 to be processed. The area has an outer boundary 33 which may be defined by a plurality of interconnected coordinates 35. Additionally, other limitations may be defined, such as an inner area 37, which may for instance be a habitat exhibiting rare species and which should not be processed. This data, expressed as coordinates, may be sent to the subcontractor, for instance, along with instructions specifying in more detail how the area should be processed. Such instructions may include which species should be predominantly removed and retained, respectively, as well as the percentage of trees that should be cut.

Fig 3 shows components of a clearing saw system 1 according to one example of the present disclosure. In addition to the clearing saw 3, a clearing saw indicator unit 13, is attached to the clearing saw 3. In the illustrated case, the indicator unit is attached to a clearing saw that initially did not have such a unit, and is screwed onto the clearing saw together with the handlebar thereof, over the tube 27 that leads to the cutting head 25. In this location, the display of the indicator unit 13 is easily readable for the user while processing an area. It would also be conceivable to provide a specific socket on the clearing saw where an indicator unit 13 can be docked, or even to produce a clearing saw provided with an indicator unit 13 integrated therein.

Generally, the indicator unit 13 may comprise a direction sensing device, as will be described, and comprises a display. The indicator unit 13 is capable of communicating with a nearby or a remote control unit 9 as will be discussed, preferably in a wireless manner.

While it would be possible to build a lot of the electronic functions of the system into the indicator unit 13, it may be advantageous to keep its complexity and power consumption low. The location of attachment on the clearing saw 3 is exposed to rain and snow, widely varying temperatures, saw dust and other debris, falling branches, and most certainly to strong vibrations. For this reason, it may be preferred to keep the functionality of the indicator unit 13 to a minimum, and to locate the interactive user interface and most processing power to a separate device in the form of a control unit 9 such as a smart phone or another separate unit that the user can carry in his clothing, or to a central processing device with which the control unit 9 communicates.

However, if a rugged enough indicator unit 13 is provided, it is conceivable to use this unit as the only unit carried by the user. Then, the indicator unit 13 comprises the relevant features of the control unit 9 that will be discussed.

In view of the difficult operating environment, inductive charging of the indicator unit 13 may be considered to reduce the number of external connectors, optimally to zero.

In the case illustrated in fig 3, there is provided a processing control unit 9, which as shown can be a smart phone provided with a dedicated application software for processing with a clearing saw.

The control unit 9 may then be carried by the clearing saw operator for instance in an inner pocket and is thus not nearly as exposed to the exterior as is the indicator unit 13.

The control unit 9 may comprise a GPS or other satellite navigation receiver to determine its own position and thus the clearing saw operator's position. As will be discussed, the accuracy of this position may be enhanced down to errors of a few centimeters. The control unit 9 is further capable of communicating with the indicator unit 13, typically employing a short-range communications interface such as Bluetooth or similar interfaces.

Optionally, the control unit 9 may connect to remote locations to download map data, processing instructions, etc. and, in the case the control unit is a smart phone, such communications interfaces using mobile data or WLAN are readily available at no additional cost.

As illustrated in fig 3, the control unit 9 may further comprise a display 51 providing a user interface where the clearing saw user can study the area to be processed, particular instructions and potential obstacles in the area, for instance. The display may also show instructions regarding how the area is to be processed, particular species cut or kept, desired density in terms of stems per hectare in the processed area, etc. The control unit 9 then also comprises the memory and processing capability needed to produce a user interface.

In order to improve the position detection accuracy, enhanced satellite navigation technologies may be employed. One such technology is Real-time Kinematics, RTK, where, in addition to the mobile position detection device in the control unit 9, a further, separate, and fixed base station 15 is used at a known location. In RTK both the mobile position detection device and the base station 15 receive signals from satellites and resolve, with relatively lower precision, their positions. Additionally the base station 15 communicates correction data based on the carrier phase of received data. Thanks to this data, the mobile position detection device can resolve its position with relatively higher precision down to centimeter level.

The RTK concept itself is well-known per se and not discussed in greater detail. It should be noticed that other enhancement techniques for satellite positioning exist such as Differential Global Positioning Systems, DGPSs, which would be an alter-

native. However, for instance a GPS receiver in the control unit 9 without such enhancement techniques would be sufficient in many applications.

Fig 4 illustrates schematically nodes and blocks within nodes in an example of a system 1.

- 5 The position sensing device 5, is intended to be carried by the clearing saw operator as indicated with dotted lines in fig 4 it may be integrated in the processing control unit 9, although it may also be a separate unit. In principle it could also be integrated in the indicator unit 13. Generally, the position sensing device 5 is configured to sense its position, typically by receiving signals from a number of satellites 41 using a
10 GPS receiver 43 or similar, and sensing its current position, by comparing time shift between received signals as is well known per se.

As mentioned, the precision of the position detection may be enhanced by also receiving correcting information from an RTK base station 15 and is then provided with an RTK receiver 45.

- 15 The position detection unit 5 can therefore determine the position of the clearing saw operator 7 and the clearing saw itself, and this position is communicated to the processing control unit 9.

As mentioned, the processing control unit 9 may be carried by the clearing saw operator 7 or may in principle be integrated with the clearing saw indicator unit 13.

- 20 The processing control unit 9 may comprise a memory 47, a CPU 49 or the like and typically also a display 51. As was indicated in fig 3, the processing control unit 9 may be accomplished by means of a user equipment such as a smart phone executing an app, although a dedicated processing control unit 9 may also be considered.

- 25 Typically, the processing control unit 9 will receive map data corresponding to the area to be processed 31 (cf. Fig 2), which will be stored in the memory 47. By also receiving position data from the position sensing device 5, the CPU 49 or similar can determine that the clearing saw operator 7 is working within the correct area.

- The CPU 49 or the like is further capable of determining the distances to the borders
30 of the area to be processed 31. Corresponding information may be sent to the clearing saw indicator unit 13, as will be discussed.

The clearing saw indicator unit 13, is configured to be attached to the clearing saw 3 and comprises a display 53. The clearing saw indicator unit 13 further comprises a direction detection unit 55, such as an electronic compass, which are well known per se. The clearing saw indicator unit 13 is therefore capable of determining the orientation of its heading 57 (cf. Fig 2) which may be expressed as an angle φ in relation to a reference direction. The clearing saw indicator unit 13 may be attached to the clearing saw 3 in such a way that the detected heading 57 is aligned with the heading of the pole or tube 27 of the clearing saw 3.

The processing control unit 9 is configured to send at least one distance indication to the clearing saw indicator unit 13 based on the stored positions of the map and the current determined position. To this end, the processing control unit 9 comprises at least a transmitter 59 for this transmission and the clearing saw indicator unit 13 comprises a corresponding receiver 61. In an alternative embodiment, two-way communication may be employed as will be discussed.

Based on the received distance indication the clearing saw indicator unit 13 can display an indication of the distance to for instance a border of the area to be processed along a specific heading, typically in the direction the pole or tube 27 points, as mentioned above. This is shown in fig 3 where the distance to the border is 52 m.

Depending on the configuration of the receivers and transmitters in the clearing saw indicator unit 13 and the processing control unit 9, two different communication schemes are possible.

If two-way communication is possible, the clearing saw indicator unit 13 may communicate its heading orientation to the processing control unit 9, which in response communicates the distance relevant in that heading orientation.

It is also possible to let the processing control unit 9 communicate distances for a number of headings and let the clearing saw indicator unit 13 select the distance most relevant for its heading orientation for displaying. While this requires transmission of more data, no communication in the opposite direction is strictly necessary and the clearing saw indicator 13 may also indicate distances in multiple alternative directions, if desired.

Further functionalities may be included in the clearing saw indicator unit 13. For instance, a microphone and sound processing unit may be included therein. When cutting a small tree using a circular blade the blade produces a characteristic sound that can be detected. More generally, a vibration sensor 63 may be provided that
5 detects the vibrations caused by the blade cutting through a tree. The clearing saw indicator unit 13 can therefore assist in keeping track of how many trees that have been cut down in a working session. In the simplest form, this data may be shown on the display of the clearing saw indicator unit as indicated in fig 3, where 1624 cuts have been made. More sophisticated recording schemes may be achieved as will be
10 discussed.

The clearing saw indicator unit may also be configured to display the heading orientation it has detected, as illustrated $\varphi=112^\circ$. Additionally the position could be displayed (not shown).

Further, the clearing saw indicator unit may in some cases provide an indication
15 whether a sufficient number of trees has been cut at the current location in the area to be processed. This may be determined based on the initial instructions on how work is to be carried out, as well as based upon the above-discussed registration of cutting events. If so, a plus sign may for instance indicate that the condition in question has not been met and that the operator should continue cutting trees
20 nearby, as illustrated. If this sign disappears, the operator may move on to a new location in the area.

Fig 5 is a flow chart illustrating a method according to an example of the present disclosure together with fig 2 and figs 6-8. A method for operating a clearing saw system may then begin with the processing unit 9 receiving 71 map data relating to
25 an area to be processed. This map data may include matter similar to what is illustrated in fig 2, such as a plurality of interconnected coordinates 35 making up an outer border 33 and in some cases an inner area 37 within the outer border 33 that is not to be processed.

The map data is thus stored in the processing unit 9 and may be studied by the user
30 before beginning operation, if desired. In addition to the map data, instructions regarding cutting may be received and displayed to inform the user about the task to be carried out. This transmission may be carried out using different channels such as

mobile data transmission or the like, but the transfer of information may be carried out hours or days in advance and need not be done on site. With information about the area to be processed, the user may begin working and enter the area in question at an insertion point 81 as indicated in fig 6, showing the area of fig 2 being

5 processed.

During processing the position unit 5 detects 73 its current position p , and the display unit 13 detects 75 the heading orientation ϕ of the clearing saw, typically in the direction 57 of the elongated tube of the clearing saw, as already discussed. The processing unit 9 determines 77 distance d to an object o in the map data based on
10 the current position and the map data, as illustrated with two examples in fig 7. In those examples, the objects are outer and inner boundaries, respectively, of the area to be processed, but the distance to other objects of interest during processing could also be calculated.

When calculated, the clearing saw indicator unit 13 displays 79 the distance d to the
15 object in heading of the clearing saw. Thereby, the operator can work within the area in a very efficient manner without having to check a map and compare with a position manually. Typically, as illustrated in fig 6, the operator can proceed through the area along a path in a meandering fashion from the entry point 81 to an exit point 83, cutting trees to his right and left along the path. This results in a work area with a
20 thinner tree distribution, as illustrated in fig 8. The exception to this is the area 37 of fig 2, which is left intact.

As mentioned, the cutting of a tree may be acoustically detected, and the position of the cut tree may be determined by the detected position of the position detection device, optionally enhanced with data relating to the heading orientation of the
25 clearing saw at the time of the cut. It is possible with this data to accomplish a map with the distribution of the cut trees, and such a map may be used as a receipt of the work carried out. It is also possible to register for instance the time from entry 81 to exit 83 in the processed area, for instance for charging a client/landowner.

As illustrated in fig 4, a central node 85, which may be common to many
30 clearing saw systems, may provide services distributing maps of areas to be processed as well as instructions regarding how processing is to be carried out. By providing data back from the processing unit 9, it is possible to evaluate the work

carried out on a remote location, even down to individual trees being cut. The clearing saw indicator unit may thus be configured to report data regarding cut trees to other nodes in the system. This may provide data sets relating to several work sessions in several different processed areas which may be evaluated for developing

5 work with clearing saws as well as other processes in forestry.

The present disclosure is not restricted to the above examples and may be varied and altered in different ways within the scope of the appended claims.

For instance, while the area to be processed in the example is defined by a set of positions enclosing the area, other options are possible. For instance, if trees under
10 an overhead power line are to be cut the area could be defined by a line following the power line and a specific distance, e.g. 15 m, from the power line. This defines an area containing trees that may interfere with the power line if allowed to become too tall.

15

CLAIMS

1. A clearing saw system (1) comprising a clearing saw (3),
characterized by further comprising

5 - a position sensing device (5), configured to be carried by the clearing saw operator (7) and sensing its current position,

 - a processing control unit (9) configured to be carried by the clearing saw operator (7), receiving position data from the position sensing device (5) and comprising a memory (11) storing positions corresponding to a processing area, and

10 - a clearing saw indicator unit (13), configured to be attached to the clearing saw (3) and comprising a display, wherein

 the processing control unit is configured to send at least one distance indication to the clearing saw indicator unit (13), based on the stored positions, and the current position, and the clearing saw indicator unit (13) is configured to display
15 an indication based on the distance indication.

2. Clearing saw system (1) according to claim 1, wherein the clearing saw indicator unit (13), comprises a direction detection unit (55) for determining a heading (57) orientation of the clearing saw.

3. Clearing saw system (1) according to claim 2, wherein the clearing
20 saw (3) comprises a power unit (23), a cutting head (25), and a pole (27) connecting the power unit (23) with cutting head (25), and wherein said heading (57) is the heading along said pole (27).

4. Clearing saw system (1) according to claim 2 or 3, wherein the clearing saw indicator unit (13), is configured to communicate said heading (57)
25 orientation to the processing control unit (9), which in return communicates said at least one distance indication to the clearing saw indicator unit (13), based on the stored positions, the current position, and the heading orientation.

5. Clearing saw system (1) according to claim 2 or 3, wherein the processing control unit (9) is configured to communicates a plurality of distance
30 indications to the clearing saw indicator unit (13), based on the stored positions, and

the current position, and the clearing saw indicator unit (13), is configured to display a distance based on said plurality of distances and said heading (57) orientation.

6. Clearing saw system (1) according to any of the preceding claims, wherein said position sensing device (5), is integrated in said processing control unit (9).

7. Clearing saw system (1) according to claim 6, wherein said processing control unit (9) is a user equipment such as a mobile telephone.

8. Clearing saw system (1) according to any of the preceding claims, wherein the processing control unit (9) is configured to display the processing area on a display (51).

9. Clearing saw system (1) according to any of the preceding claims, wherein the clearing saw (3) comprises a socket for the indicator unit (13).

10. A method in a clearing saw system (1) comprising a clearing saw (3), the method **characterized by**:

- storing (71) a set of positions relating to a set of objects in a processing area
- determining (73) the current position of the clearing saw (3),
- determining (75) the orientation of the heading of the clearing saw (3),
- determining (77), based on the current position and the stored set of positions, a distance to an object (o) in said set of objects in said heading orientation, and
- displaying (79) said distance on a display arranged on the clearing saw.

11. A clearing saw indicator unit (13), configured to be attached to the clearing saw (3) characterized by

- a display (53),
- an orientation detecting unit (55), detecting the heading (57) orientation of the clearing saw, and
- a receiver (61), configured to receive a distance to at least one object,
- wherein the display (53) is configured to display the distance to an object in the heading orientation of the clearing saw.

12. Clearing saw indicator unit (13) according to claim 11, further comprising a vibration sensor (63) for detecting vibrations corresponding to a cutting of a tree by means of the clearing saw.

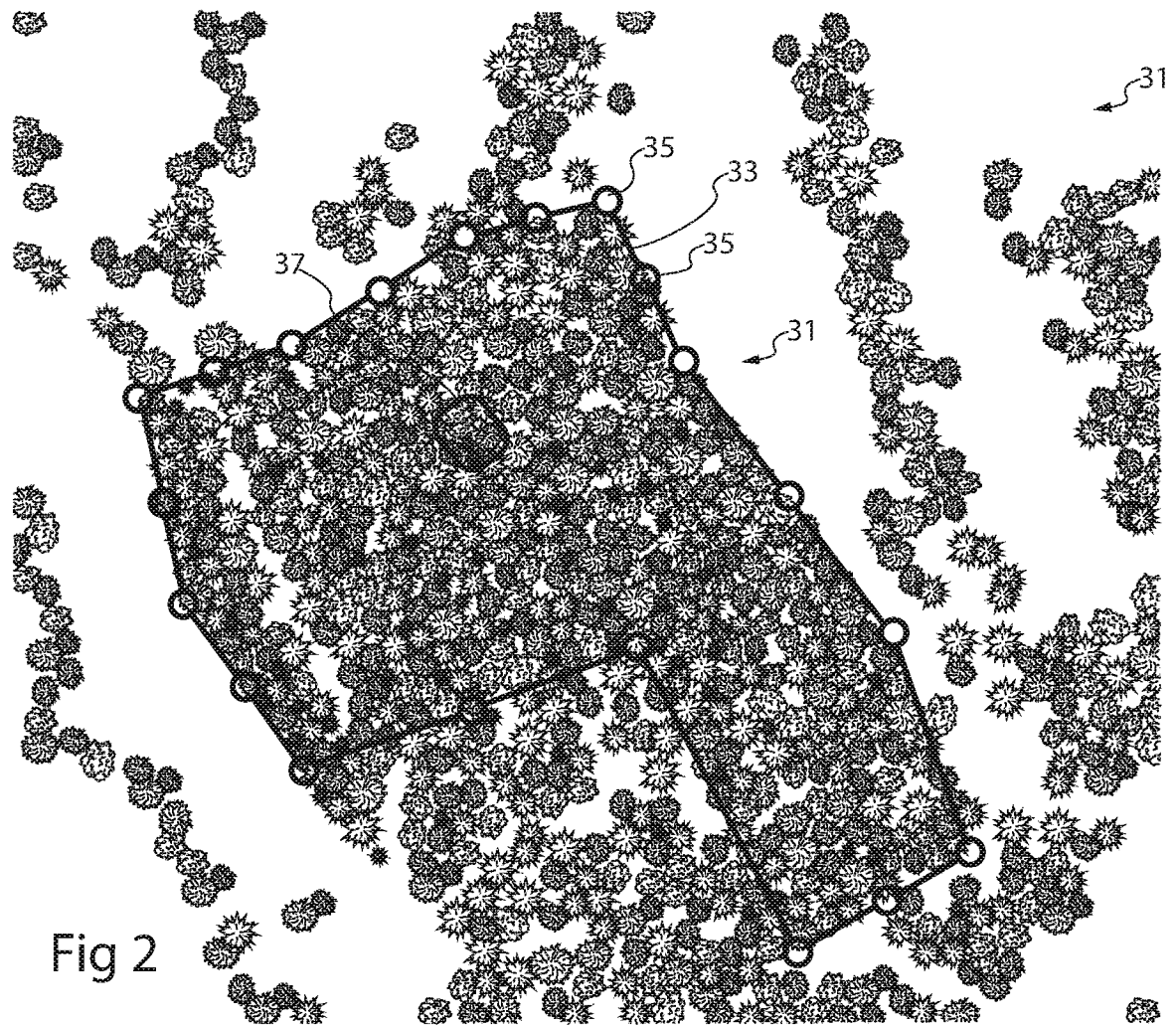
5 13. Clearing saw indicator unit (13) according to claim 12, wherein the indicator unit increments a counter based on a vibration detection.

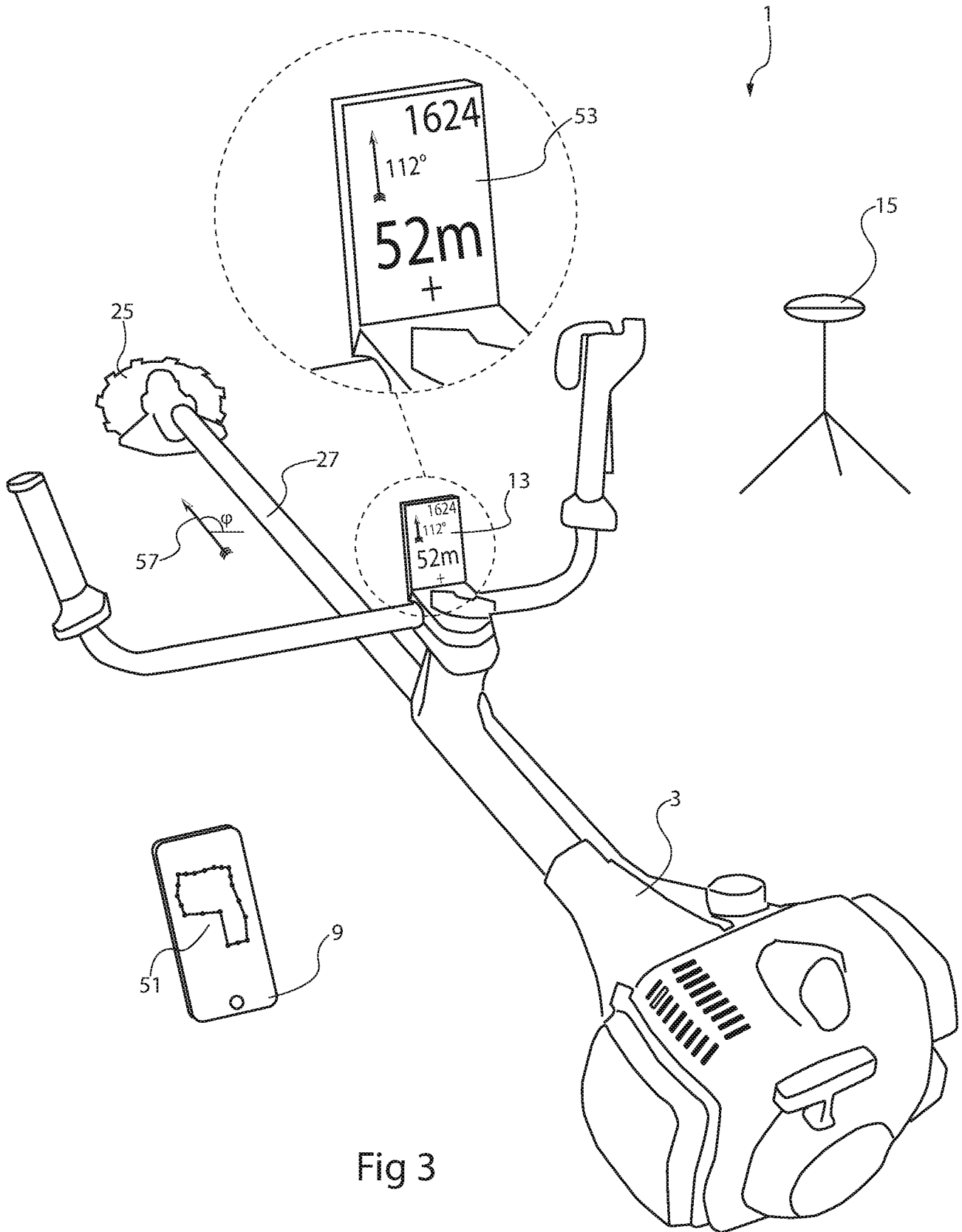
14. Clearing saw indicator unit (13) according to any of claims 11 - 13, wherein the indicator unit (13) is configured for inductive charging.

10 15. Clearing saw indicator unit (13) according to any of claims 12 - 14, wherein the clearing saw indicator unit (13) is configured to report data regarding cut trees.



Fig 1





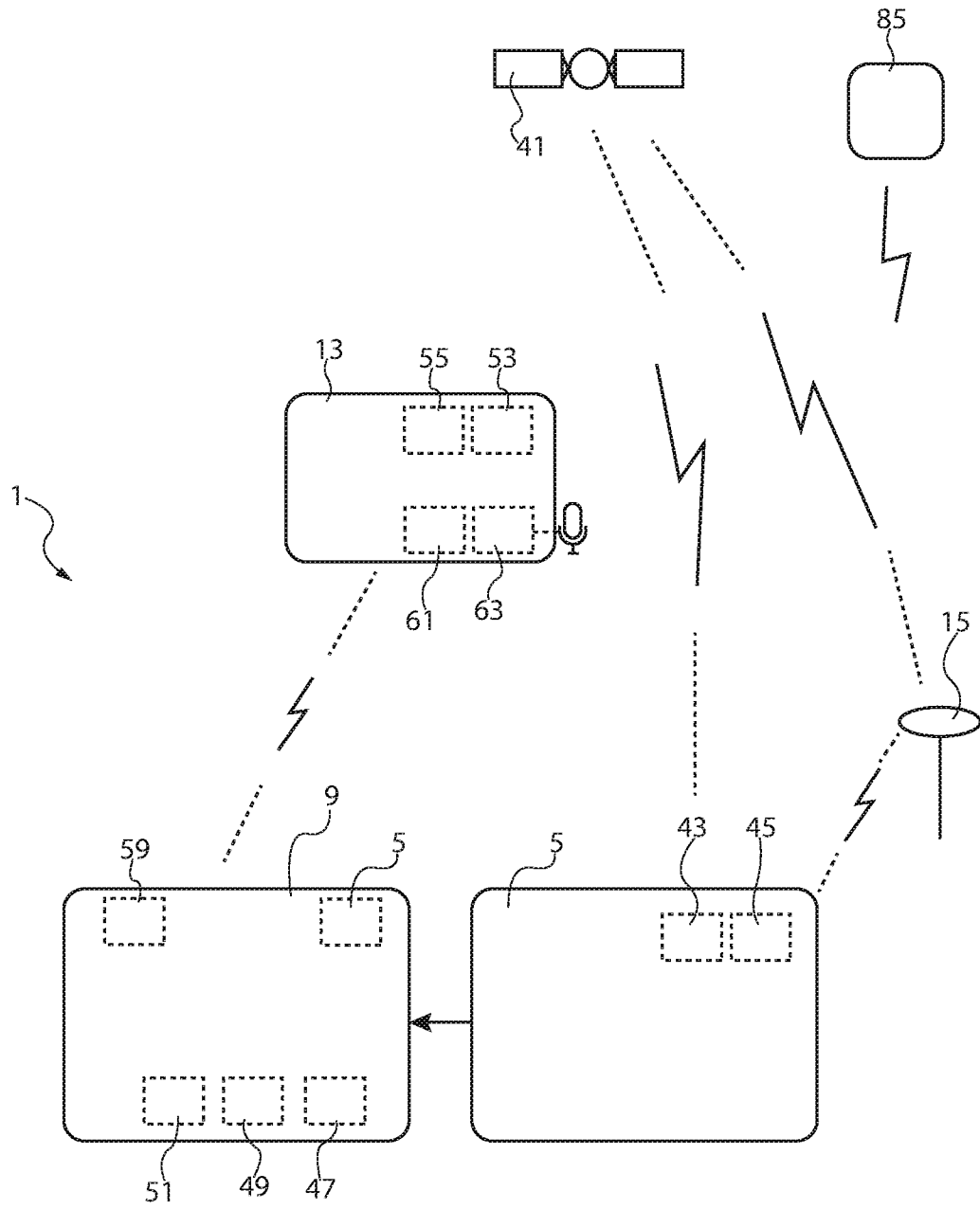


Fig 4

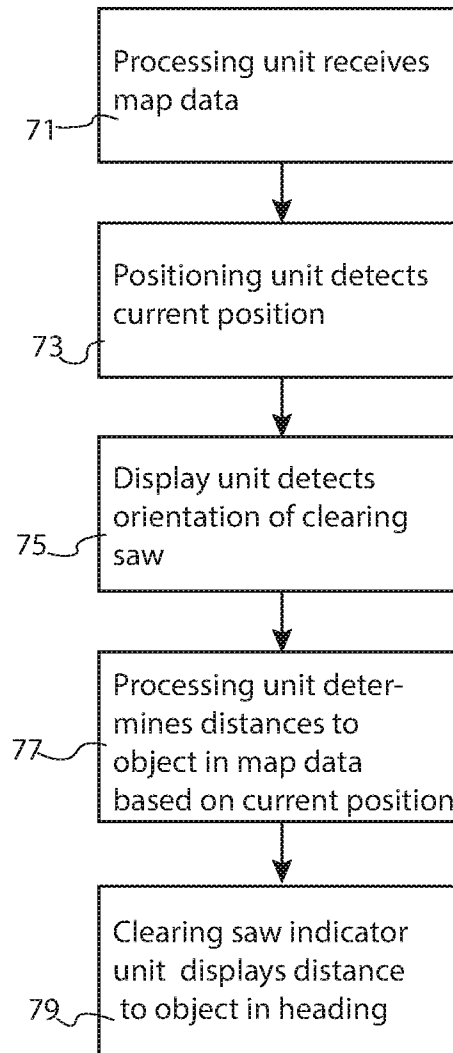
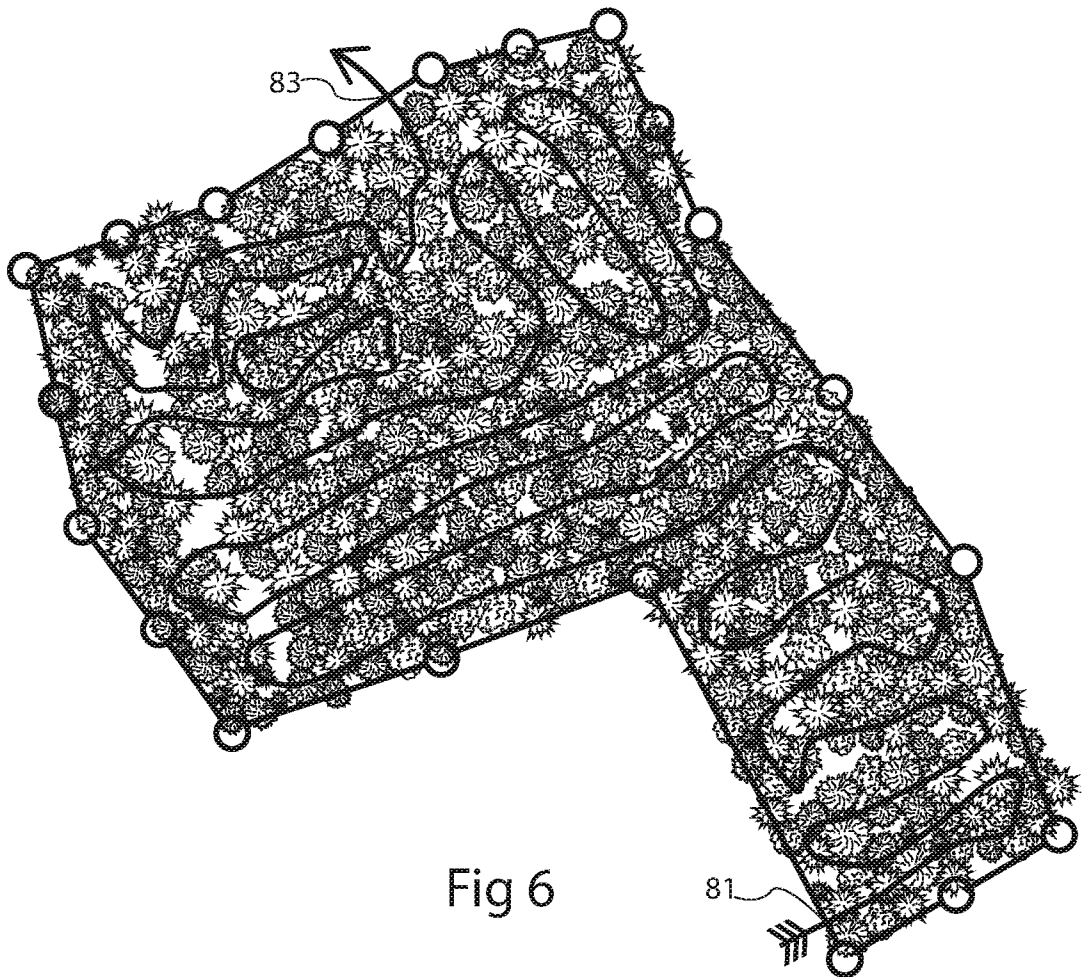
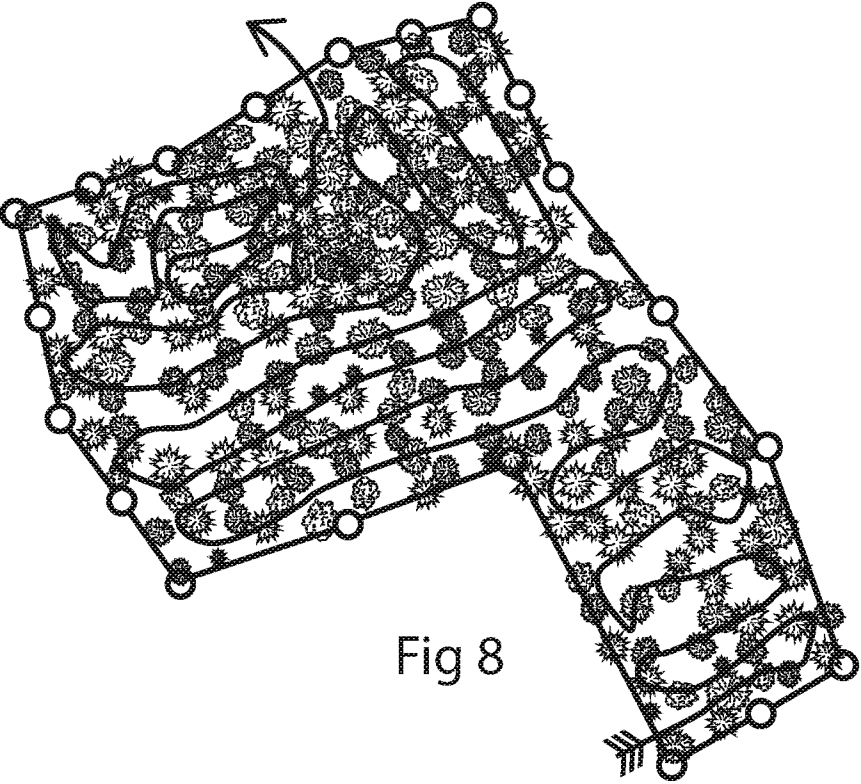
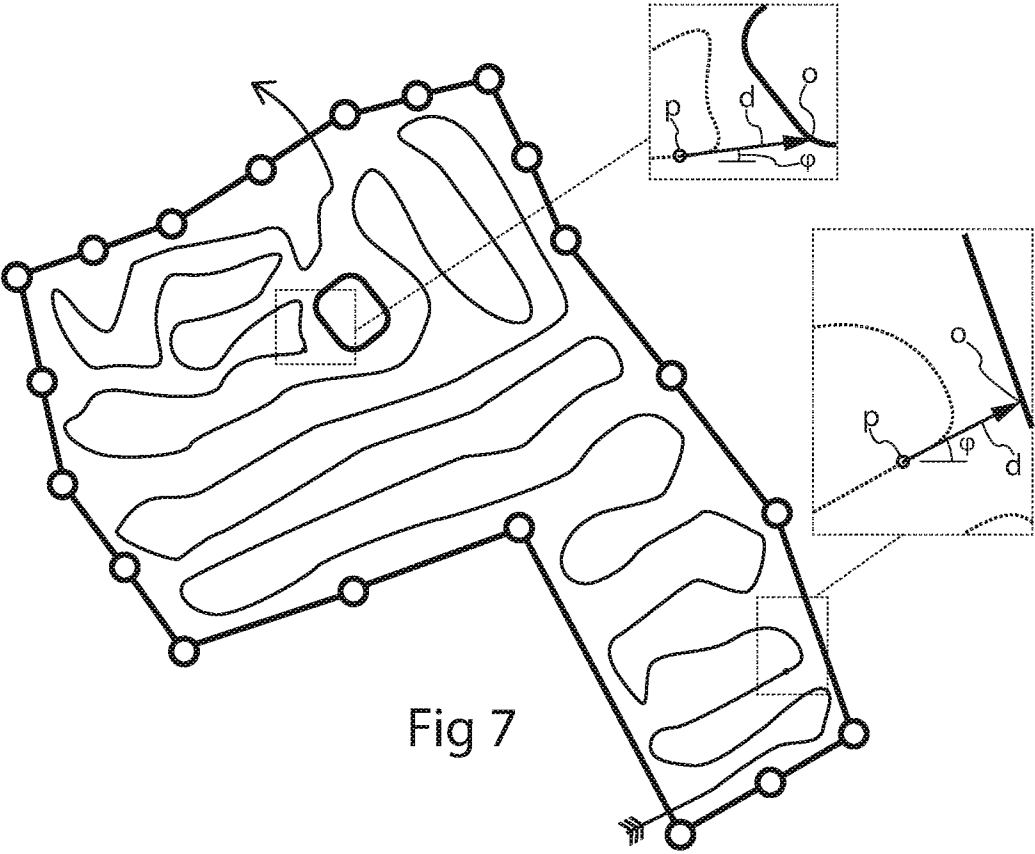


Fig 5





INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2024/050340

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: A01D, B27B, G01C, G05D

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

SE, DK, FI, NO classes as above

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

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 20180116104 A1 (ALEXANDERSSON DANIEL ET AL), 3 May 2018 (2018-05-03); abstract; paragraph [0016]; figure 2 --	1-15
Y	US 20210344371 A1 (LAMARR JR GERALD J), 4 November 2021 (2021-11-04); paragraphs [0015]-[0030]; figures 1-4 --	1-15
A	WO 2017167783 A1 (HUSQVARNA AB), 5 October 2017 (2017-10-05); abstract; page 4, line 17 - page 8, line 10; figures 1-2b --	1-15
A	US 6044316 A (MULLINS DONALD B), 28 March 2000 (2000-03-28); abstract; figures 1,3,6,9 --	1-15

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search 24-05-2024	Date of mailing of the international search report 24-05-2024
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2024/050340

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A	US 5666792 A (MULLINS DONALD B), 16 September 1997 (1997-09-16); abstract; figure 1 -- -----	1-15

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Information on patent family members

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