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**DEVICE FOR PRODUCING A GROUND PROFILE FOR PROMOTING
GERMINATION AND ESTABLISHMENT OF SEEDLING AND PLANT IN
FORESTRY**

5 Description

The invention relates to a device for producing a ground profile for promoting the germination and establishment of the seedling and plant in forestry, comprising a land vehicle and at least one ground profiler having a profiling tool designed for producing a
10 ground profile.

Seeding machines that are moved through the forest in a motorized manner or manually and with the aid of draft animals are known for sowing forest seeds. EP 2 781 145 B1 describes a disc harvester and a method for producing seed rows for the forest seeding of
15 coniferous species. EP 2 944 176 B1 describes a piece of forest sowing equipment having discs with teeth on the periphery (toothed discs) for producing a seed groove and a method for sowing deciduous tree species.

EP 3 381 254 A1 describes a device for sowing forest seeds comprising a motorized piece
20 of work equipment having a gripping tool or an interface for an attachment and a piece of seeding equipment or a seeding assembly which is designed to be gripped by the gripping tool and/or to be connected to the interface in the attached position. The piece of work equipment may be a forestry machine, an excavator, or a crane. The device may comprise a depth limiter which limits the penetration depth of the seeding assembly or
25 piece of seeding equipment in the forest floor. The depth limiter may be a roller apparatus that is coupled to the boom or a gripping tool or a seeding assembly or piece of seeding equipment and that limits the penetration depth of the seeding assembly or piece of seeding equipment in the forest floor. Furthermore, the depth limiter may comprise a sensor which is designed to detect the distance between the sensor and the surface of the
30 ground. A control apparatus is connected to the sensor and an adjusting apparatus is connected to the control apparatus, the adjusting apparatus being designed to adjust the position of the piece of seeding equipment or seeding assembly to a specified value

relative to the surface of the ground. When the roller apparatus makes contact with the surface of the ground, high forces can be introduced into the roller apparatus, piece of seeding equipment, and boom. Due to the high forces, the device can become damaged and the forest floor compacted. The sensor is expensive, imprecise, and susceptible to faults due to the harsh working conditions.

US 2016/338260 A1 describes a row unit for distributing seeds. The row unit comprises a shaft which penetrates the earth and thus opens it so far that seeds can be introduced into the earth by means of a seed delivery system. The row unit comprises a ski which is intended to prevent the shaft from sinking in too deep. The shaft and the seed delivery system project into the earth through a slot in the rear region of the ski. Furthermore, in the front region, the ski comprises an angled projection which is intended to facilitate excavation of the subsoil.

EP 3 360 403 A1 describes a sowing assembly for a sowing machine. The sowing assembly comprises, inter alia, a seed coulter which is designed to dispense seeds into a seed furrow. The seed coulter is arranged between two depth control elements which may alternatively be designed as belt drives or depth control runners.

EP 3 420 790 A1 describes an agricultural planting system which has automatic pressure control. A gauge wheel, among other things, is used for this purpose. US 2017/359950 A1 describes a device for planting seedlings in terrain that has obstacles or that is uneven. The device comprises a vehicle which has a movable arm to which seedling injectors are attached.

Proceeding from this, the object of the invention is to provide a device for producing a ground profile of the type mentioned at the outset in which the profiling depth of the profiling tool can be controlled more precisely and with reduced fault susceptibility and with less loading of the device and ground.

The object is achieved by means of a device having the features of claim 1. Advantageous embodiments of the device are given in dependent claims.

The device according to the invention for producing a ground profile for promoting the germination and establishment of the seedling and plant in forestry comprises a land vehicle, at least one ground profiler having a profiling tool designed for producing a ground profile in the ground, an apparatus for pressing the ground profiler onto the ground with an adjustable pressing pressure, and a depth limiter that is designed to be supported on the surface of the ground when the profiling tool has penetrated the ground by a given profiling depth.

10 In the device according to the invention, the penetration of the profiling tool into the ground is limited to a specified profiling depth in that the depth limiter is supported on the surface of the ground. The apparatus for pressing the ground profiler onto the ground has an adjustable pressing pressure, such that the dependence on the design of the ground profiler and on the properties of the ground can be adjusted. By adjusting the pressing pressure, the ground profiler is pressed onto the ground precisely with the pressing pressure that is required for achieving the specified penetration depth. Consequently, it is possible to always work with a low pressing pressure such that the desired profiling depth is maintained better and the structure of the device is loaded less and the forest floor is compacted less. The device is structurally relatively simple, can maintain the specified profiling depth precisely, and also allows for fault-free working in the harsh working conditions.

The term “ground profile” refers to elongate indentations which are prepared for receiving forest seeds in the forest floor. These may, in particular, be seed strips with a central ridge as per the invention described in EP 2 781 145 B1 or seed grooves as per the invention described in EP 2 944 176 B1.

According to one embodiment of the invention, the device comprises a metering device for seeds and, if necessary, a storage container for seeds. In this embodiment, the seeds can be mechanically dispensed into the ground profile at the same time as the ground profile is formed. However, the invention also relates to embodiments in which the device is only designed to form ground profiles. In this embodiment, the ground profile can

induce the natural regeneration of forest trees and/or seeds can be supplied in a targeted manner to the ground profile and/or plants can be planted into the ground profile. If necessary, seeds can also be placed in the ground profile in a targeted manner by hand or using an additional sowing device.

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The ground profiler is a movable tool or aid for producing a ground profile for sowing forest seeds, for natural regeneration, or for planting forest plants.

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According to the invention, the ground profiler is a disc harvester having two concavely curved discs on an equipment carrier or a piece of forest sowing equipment having two toothed discs on an equipment carrier. According to another embodiment, the disc harvester comprises an arrangement of discs as described in EP 2 781 145 B1. In this regard, reference is made to the above-mentioned European patent, the content of which is hereby included in this application. However, in contrast to the disc harvester described therein, the ground profiler of the present invention comprises only one equipment carrier on which the rotary shafts are mounted, which rotary shafts bear the two discs, and, if necessary, a metering device for seeds. Moreover, the ground profiler comprises no additional support shaft. This reduces the working width and increases the range of use of the ground profiler in the forest stands.

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According to another embodiment, the ground profiler is a piece of forest sowing equipment having two peripherally toothed discs on an equipment carrier. According to another embodiment, the piece of forest sowing equipment comprises an arrangement of discs as described in EP 2 944 176 B1. In this regard, reference is made to the above-mentioned European patent, the content of which is hereby included in this application. However, in contrast to the piece of forest sowing equipment described therein, the ground profiler of the present invention comprises only one equipment carrier to which the rotary bearings are fastened, in which rotary bearings the discs are mounted by means of bearing shafts and, if necessary, a metering device for seeds. However, the ground profiler comprises no device for coupling a traction source (e.g. a workhorse or forest machine), no protective frame, no holder for additional weights, and no grip for handling

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the piece of equipment in the field. This increases the maneuverability and the range of use in the forest stand.

Another embodiment comprises at least one ground profiling assembly that is a unit
5 consisting of multiple interacting ground profilers. Larger areas can be worked with a ground profiling assembly than with one ground profiler.

According to another embodiment, the land vehicle is a motorized land vehicle, preferably a motorized off-road vehicle.

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According to another embodiment, the device is a motorized ground profiler or seed assembly or a motorized piece of work equipment connected to at least one ground profiler. The motorized ground profiler or ground profiling assembly is a land vehicle that is also designed as a ground profiler or ground profiling assembly. A motorized piece of
15 work equipment can also be used for purposes other than for producing a ground profiler, in particular for sowing forest seeds.

According to another embodiment, the motorized ground profiler or ground profiling assembly or the motorized piece of work equipment may comprise at least one internal
20 combustion engine and/or at least one electric motor for driving the relevant piece of equipment.

According to another embodiment, the motorized ground profiler or ground profiling assembly or the motorized piece of work equipment having at least one attached ground
25 profiler is a self-driving (e.g. controlled and/or remote-controlled by a driver traveling along with it) or autonomously driving (independently driving) vehicle.

According to another embodiment, the motorized ground profiler or ground profiling assembly or the motorized piece of work equipment travels on wheels or tracks, i.e. it is
30 a wheeled vehicle or a tracked vehicle.

According to another embodiment, the device comprises a motorized piece of work equipment having a gripping tool and/or an interface for an attachment and at least one ground profiler which is designed to be gripped by the gripping tool and/or to be connected to the interface in the attached position. The ground profiler can be easily
5 connected to the motorized piece of work equipment if it is to be used for producing a ground profile.

According to another embodiment, the gripping tool or the interface is arranged at the end of a boom of the piece of work equipment. According to another embodiment, the boom
10 is an articulated arm or telescopic arm. Conventional work equipment with booms can be used for this purpose. By moving the boom, the piece of work equipment can displace the at least one ground profiler along a seed section. Here, the piece of work equipment may stand on a specified track or be moved along a specified track and handle work areas in a larger area next to the track. Tracks of this kind (e.g. logging trails) are often laid with a
15 spacing of 40 m or 20 m in forestry. By displacing the ground profiler proceeding from the tracks, a high working speed can be achieved and rough or steep terrain can be worked. In addition, compacting of the ground can be avoided as a result.

According to another embodiment, the motorized piece of work equipment is a forestry
20 machine (forest machine), a mini excavator or other excavator, or a crane or a cable winch. The forestry machine may be a forestry machine with a cable winch. The motorized piece of work equipment may be a conventional piece of work equipment that is already present at a forestry operation or the like.

According to another embodiment, the ground profiler comprises an adapter and the motorized piece of work equipment comprises a quick-change device for connection to the adapter. In this embodiment, the device according to the invention is particularly easy to assemble. According to another embodiment, the adapter is an MS03 adapter or other commercially available and/or standardized adapter and the quick-change device is an
30 MS 03 quick-changer or other commercially available and/or standardized quick-changer.

According to the invention, the depth limiter is a sled that is arranged on the underside of the ground profiler. This allows for a particularly robust design and uniform distribution of the pressing pressure on the surface of the forest floor. According to the invention, the sled comprises an upwardly curved or bent edge at the front end in the direction of travel.

5 According to another embodiment, the rear edge of the sled is also curved or bent upward. Thus, the bearing elements of the discs close to the ground are protected and the sled is prevented from getting stuck in the ground. According to another embodiment, the sled comprises a plate in front of the discs of the disc harvester or piece of forest sowing equipment in the direction of travel and, according to the invention, comprises a cutout
10 in the region of the discs and runners next to the discs. According to another embodiment, the sled is arranged substantially in front of the discs in the displacement direction of the ground profiler.

According to another embodiment, the depth limiter is connected to the ground profiler
15 via an adjusting apparatus, wherein the adjusting apparatus is designed to adjust the height of the depth limiter relative to the profiling tool of the ground profiler. As a result, it is possible to adjust the depth limiter to the properties of the ground to be worked.

The adjusting apparatus may be a manually driven mechanical adjusting apparatus that
20 must be adjusted by hand. According to another embodiment, the adjusting apparatus is a hydraulic and/or pneumatic and/or electric adjusting apparatus. This embodiment allows for fast adjustment of the height of the depth limiter. In particular, adjustment is possible during production of a ground profile in order to adapt the device to changes in the ground properties in the work area.

25 According to another embodiment, an electronic control apparatus is connected to the adjusting apparatus and is designed to adjust the height of the depth limiter.

Another embodiment comprises at least one sensor which is designed to determine the
30 pressing pressure by means of which the apparatus for pressing presses the ground profiler onto the ground, and an electronic control apparatus that is connected to the sensor and

the apparatus for pressing in order to press the ground profiler against the ground until an adjustable pressing pressure is reached.

The sensor may, in particular, detect the pressing pressure in a hydraulic system for driving a boom of a motorized piece of work equipment. The motorized piece of work equipment is potentially already equipped with a corresponding sensor in order to limit the maximum forces acting on the structure.

According to another embodiment, a computer is connected to the control apparatus, wherein the computer is designed to adjust the height of the depth limiter and/or the pressing pressure by means of which the ground profiler is pressed against the ground, and/or the amount and/or the mass flow of seeds dispensed into the ground profile by the metering device depending on data relating to the properties of the ground to be worked. The data relating to the ground properties in a particular area of forest may, for example, be obtained by evaluating maps and/or analyzing the terrain and/or retrieved from geoinformation systems and used for adjusting the depth limiter and/or pressing pressure and/or the metering of seeds by means of the metering device. The data can be supplied to the computer for this purpose.

The invention will be explained in more detail in the following based on the appended drawings of an exemplary embodiment. In the drawings:

Fig. 1 shows a ground profiler having an adapter for connection to a motorized piece of work equipment in a perspective view obliquely from above;

Fig. 2 shows the ground profiler in a side view;

Fig. 3 shows an excavator having an attached ground profiler according to Fig. 1 and 2 in a side view;

Fig. 4 shows a quick-change device of an excavator with an attached ground profiler in a detail view.

According to Fig. 1, the ground profiler 1 comprises a compact equipment carrier 2. Same comprises two first profile supports 3, 4, which are interconnected to form a V-shaped arrangement. Furthermore, the equipment carrier 2 comprises a second profile support 5, which is connected at the tip of the V to the upper side of the two first profile supports 3, 4. The first and second profile supports 3, 4, 5 are all box profiles.

First axial bearings 6, 7 are secured to the ends of the two first profile supports 3, 4 that are remote from the tip of the V and second axial bearings 8, 9 are secured to the sides of the second profile support 5 close to the end thereof remote from the tip of the V. A shaft 10, 11 is mounted in each case between a first axial bearing 6, 7 and a second axial bearing 8, 9, on which shaft a concavely curved disc 12, 13 is held in each case.

An adapter 14 is welded to the second profile support 5 above the tip of the V. In the example, it is an MS 03 adapter.

A plate 15 having a transport lug 16 is welded therebehind on the upper side of the second profile support.

A sled 17 consisting of a thick metal sheet is welded to the underside of the equipment carrier 2. The sled comprises a strip-shaped portion 18 below the tip of the V, which strip-shaped portion is curved upward at the front approximately up to the lower edge of the adapter 14. At the rear, the sled 17 comprises two runners 19, 20, which each extend below a first profile support 3, 4 and each comprise an upwardly bent portion behind their rear end. Thus, the sled 17 comprises a cutout 21 between the strip-shaped front portion 18 and the two runners 19, 20, between which cutout the two discs 12, 13 reach through with their lower edges.

The ground profiler 1 corresponds to the disc harvester of EP 2 781 145 B1 with regard to the arrangement of the discs 12, 13 on an equipment carrier 2.

According to Fig. 3 and 4, the ground profiler 1 is mounted on the boom 22 of an excavator 23 designed as a wheeled piece of equipment. The boom 22 comprises a quick-change device 24, which is designed as an MH3 quick-change device. The ground profiler 1 is mounted on the boom 22 so as to point toward the piece of work equipment 23 in the displacement direction.

To produce the seed strip, the machine driver of the excavator 23 places the ground profiler with the sled 17 on the forest floor and controls the boom 22 such that the sled 17 glides over the surface of the ground. The apparatus for pressing (hydraulics) of the boom 22 is controlled such that the pressing pressure does not exceed a particular value. During the displacement of the ground profiler 1 over the ground, the two discs 12, 13 penetrate into the ground by a particular penetration depth and produce two parallel seed strips in the humus layer behind the ground profiler, which seed strips reach down to the mineral soil layer. A central ridge of natural soil is left between the two seed strips. After the ground profile 24 has been produced, it can induce natural forest regeneration and/or seeds can be supplied to the ground profile in a targeted manner, e.g. by means of sowing by hand or mechanically. Furthermore, the ground profile may be used to establish plants that may be inserted in the ground profile.

PATENTKRAV

1. Apparat til fremstilling af en jordprofil til fremme af spiring og etablering af frøplanter og planter i skoven, omfattende et landkøretøj (23), i det mindste en
5 jordprofilerer (1) med et profileringsværktøj (12, 13), der er dannet til at frembringe en jordprofil (24) i jorden, en indretning til at presse (22) jordprofilereren (1) mod jorden med et indstilleligt presstryk, og en dydbegrænser (17), som er dannet til at blive understøttet på jordoverfladen, når profileringsværktøjet (12, 13) er trængt en given profileringsdybde ind i
10 jorden, hvorved jordprofilereren (1) er en skivehøster med to konkavt krumme skiver (12, 13) på en udstyrsbærer (2) eller et skovsåapparat med to fortandede skiver på en udstyrsholder,

kendetegnet ved, at dydbegrænseren (17) er en slæde, der er arrangeret på jordprofilererens (1) underside, og som omfatter en opad krummet eller bøjet kant
15 på den i køreretningen forreste ende, en udsparring (21) i området ved skiverne (12, 13), samt løbere (19, 20) ved siden af skiverne (12, 13).

2. Apparat ifølge krav 1, og som omfatter en doseringsindretning for såmateriale, hvorved doseringsindretningen fortrinsvis er arrangeret på jordprofilereren (1).

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3. Apparat ifølge krav 1 eller 2, hvorved slædens bagkant er krummet eller bøjet opad.

4. Apparat ifølge et af kravene 1 til 3, og som omfatter mindst et
25 jordprofileringsaggregat, der er en enhed, som består af en flerhed af jordprofilerere (1).

5. Apparat ifølge et af kravene 1 til 4, hvorved landkøretøjet (23) er et motordrevet landkøretøj.

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6. Apparat ifølge krav 5, og som er en motordrevet jordprofilerer eller profileringsaggregat eller et motordrevet arbejdsaggregat (23), der er forbundet med mindst een jordprofilerer (1).

7. Apparat ifølge krav 6, hvorved det motordrevne arbejdsapparat (23) er en forstmaskine (skovmaskine), en minibagger eller anden bagger eller en kran eller et kabelspil.

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8. Apparat ifølge krav 6 eller 7, hvorved den mindst ene jordprofilerer (1) er grebet af et gribeværktøj i det motordrevne arbejdsapparat (23) eller løsbart er forbundet med et interface (24) for et påbygningsapparat på det motordrevne arbejdsapparat.

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9. Apparat ifølge krav 7 eller 8, hvorved jordprofilereren (1) omfatter en adapter (14), og det motordrevne arbejdsapparat (23) omfatter en hurtigskift-anordning (24) til forbindelse med adapteren (14).

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10. Apparat ifølge et af kravene 1 til 9, hvorved dydbegrænseren (17) via en indstillingsindretning er forbundet med jordprofilereren (1), hvorved indstillingsindretningen er udformet til at justere dydbegrænserens (17) højdeposition i forhold til profileringsværktøjet (12, 13) i jordprofilereren (1).

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11. Apparat ifølge et af kravene 1 til 10, hvorved indstillingsindretningen er en hydraulisk og/eller en pneumatisk og/eller en elektrisk indstillingsindretning.

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12. Apparat ifølge krav 11, omfattende en med indstillingsindretningen forbundet elektronisk styringsindretning, der er udformet med henblik på indstilling af dydbegrænserens (17) højdeposition.

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13. Apparat ifølge et af kravene 1 til 12, omfattende mindst en sensor, som er udformet til at bestemme tilpresningstrykket, med hvilket indretningen til tilpresning (22) presser jordprofilereren (1) mod jorden, og en elektronisk styringsindretning, der er forbundet med sensoren og indretningen til presning (22) med henblik på at presse såanordningen (1) mod jorden indtil opnåelse af et indstilleligt tilpresningstryk.

14. Apparat ifølge krav 12 og/eller 13, omfattende en computer, der er forbundet med styringsindretningen, hvorved computeren er indrettet til at indstille dybdebegrænserens (17) højde og/eller pressetrykket, ved hjælp af hvilket jordprofilereren presses mod jorden, og/eller mængden af såmaterialet, som
- 5 afgives ved hjælp af doseringsindretningen, og/eller den afgivne massestrøm af såmaterialet i afhængighed af data vedrørende beskaffenheden af jorden, der skal bearbejdes.

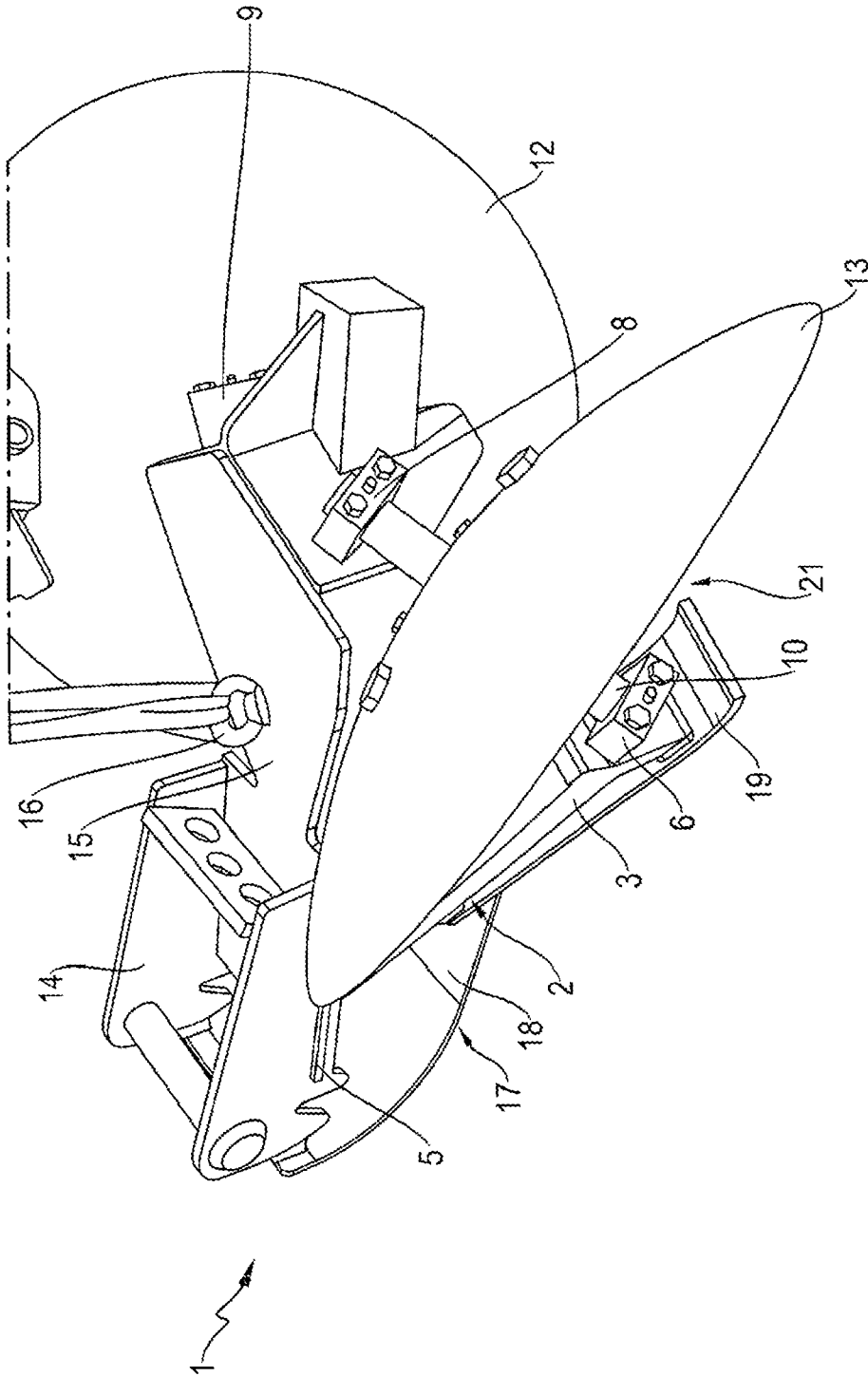


Fig. 1

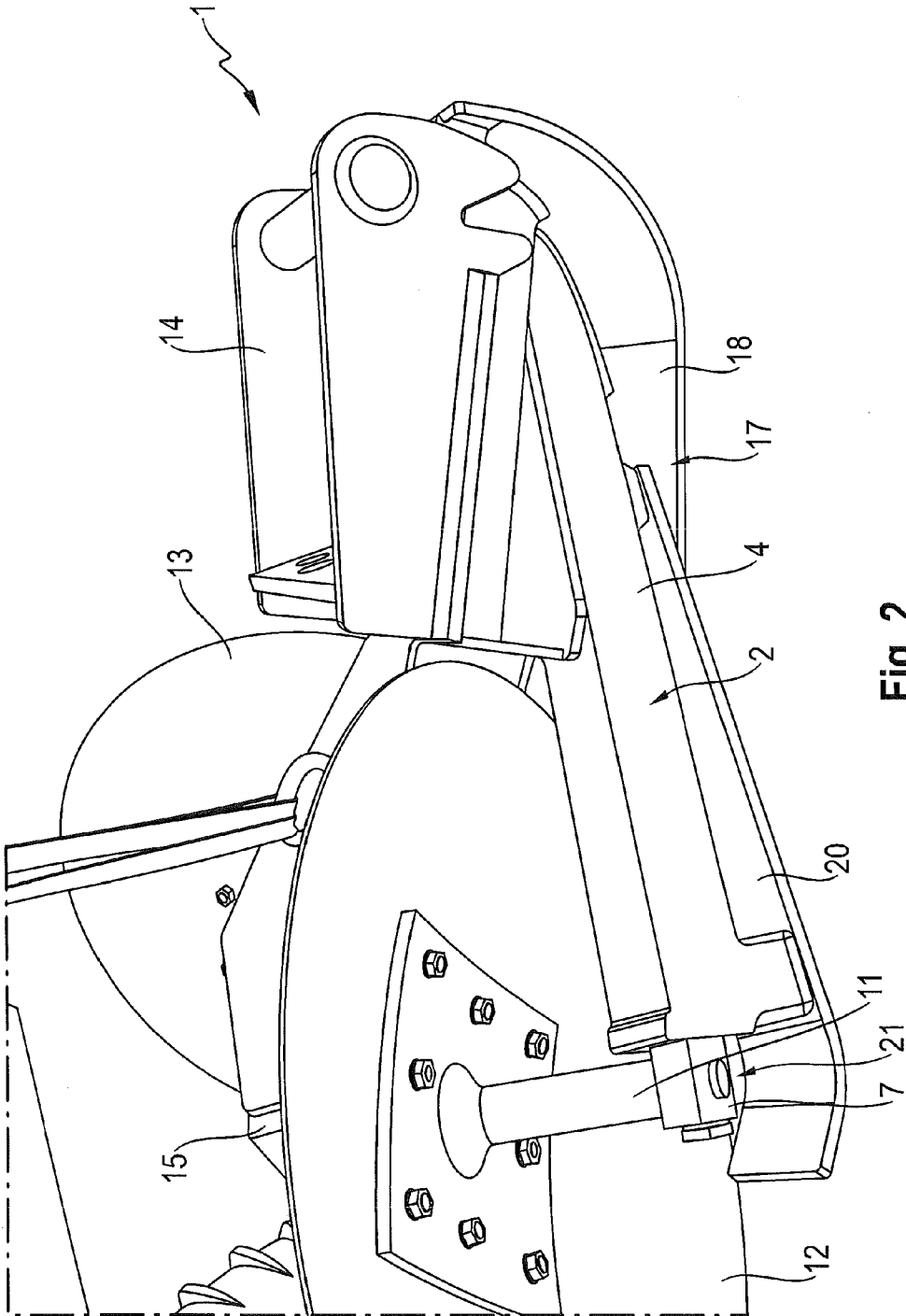


Fig. 2

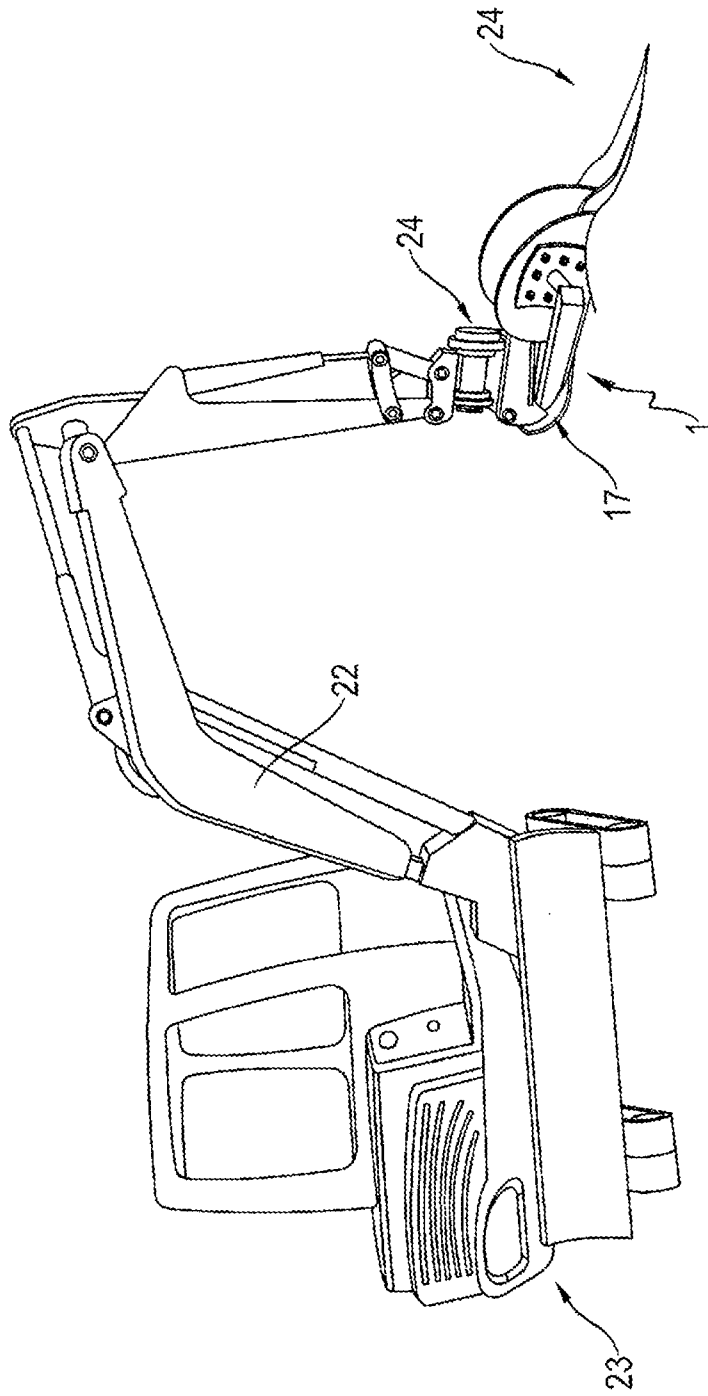


Fig. 3

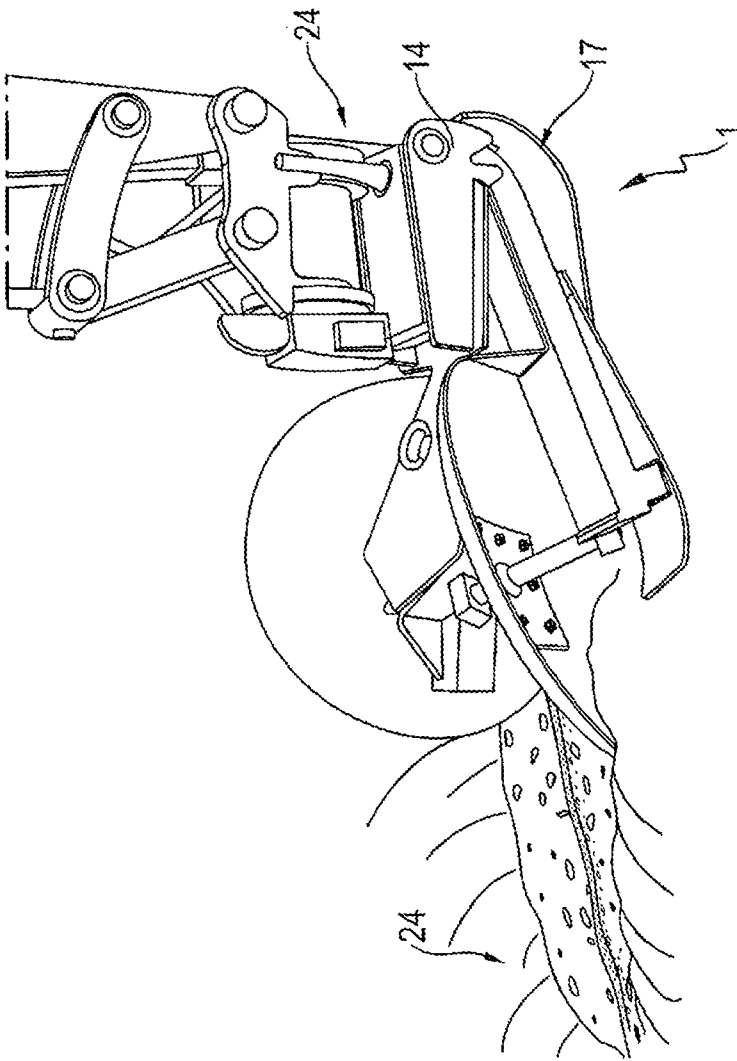


Fig. 4