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(54) **Milling cylinder and apparatus for levelling verges along roads**

(57) An apparatus for levelling verges along roads, comprising a milling cylinder (4) with a substantially circular-cylindrical jacket surface and several ribs (25) extending in the longitudinal direction of the milling cylinder (4) and protruding with a certain height from the jacket surface, and a peg cylinder (11), which cylinders are both suspended at an inclination relative to horizontal corresponding to the intended inclination of the verge surface and such that the peg cylinder (11) relative to the travelling direction of the apparatus is positioned behind the milling cylinder (4), as well as driving devices (15, 16) for rotating the two cylinders (4, 11) about their respective longitudinal axes. The ribs (25) of the milling cylinder (4) each follow a helical line (30) forming an angle of 10-30° with the travelling direction.

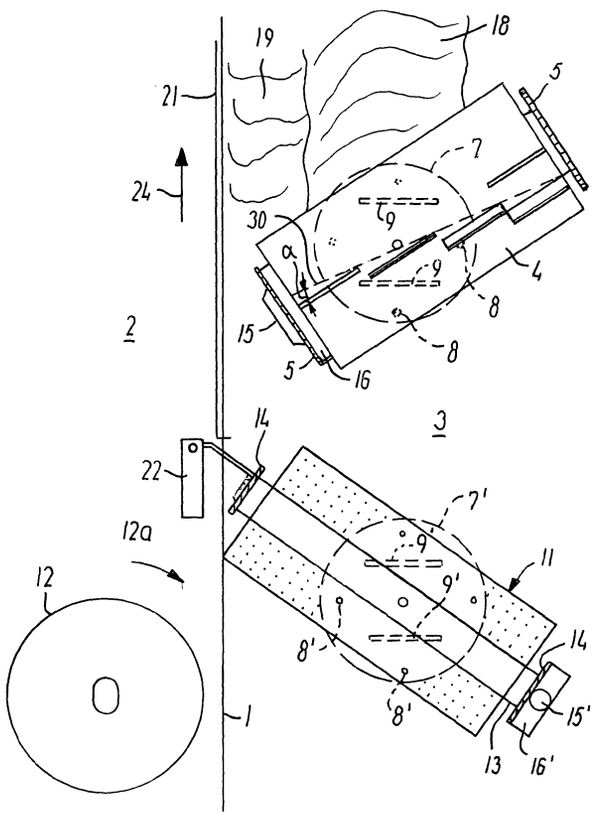

FIG.1

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Description

[0001] The invention relates to a milling cylinder for levelling verges along roads, comprising several ribs extending in the longitudinal direction of the milling cylinder and sweeping by rotation of the milling cylinder a cylindrical surface of rotation.

[0002] The invention further relates to an apparatus for levelling verges along roads, comprising a milling cylinder and a peg cylinder, which cylinders are both suspended at an inclination relative to horizontal corresponding to the intended inclination of the verge surface and such that the peg cylinder relative to the travelling direction of the apparatus is positioned behind the milling cylinder, as well as driving devices for rotating the two cylinders about their respective longitudinal axes.

[0003] Along roads, such as country roads, gravel verges are normally provided, the surface of which, when the road has just been laid out, extends from the roadway substantially on a level therewith and somewhat out to the side, the verge having a certain slope to ensure that for instance rainwater running off the roadway is conducted further beyond the verge, until it seeps down into the ground or is conducted down into a ditch. This drainage of water is important, as the water, if it seeps down into the ground immediately outside the roadway, on the long view may undermine the roadway.

[0004] It is, however, a problem that the material of the verge immediately bordering the roadway is whirled up as times go by and moved a distance away from the roadway, for which reason a bank tends to form, which moreover is likely to be consolidated by natural plantation, such as grass, spreading from the surroundings of the roadway. Thus, there is also a tendency of a ditch being formed between the roadway and said bank, said ditch being inclined to collect rainwater, and from the ditch said rainwater seeps down into the ground, whereby, as mentioned above, there is a risk of the road being undermined. It is therefore necessary on and off to level or re-profile the verge such that the material from the bank is moved to border roadway and such that the intended outwards and downward inclination of the verge is once more restored.

[0005] Fig. 5 shows a drawing from an official, Danish instruction concerning re-profiling of verges. Fig. 5 thus illustrates the purpose of re-profiling, namely that the material from a bank 18 is to be moved towards the roadway 2 to fill up a ditch 19. The height of the bank and the depth of the ditch will typically be in the range of 0-15 cm. The width b_1 will typically be in the area of 30-50 cm, and the width b_2 of the bank or the area, from which it is desired to remove the material to ensure a downward inclination, will typically be in the range of 75-100 cm.

[0006] The verge will, as mentioned, often be covered by grass. It is desirable when re-profiling that the cover of grass can be re-established without subsequent seeding. Therefore, a minimum damage of the existing roots of the verge is desired. After the re-profiling the verge has to be compacted, as a minimum by being run over by a vehicle used for the work (a lorry), to obtain the same carrying capacity as the adjacent areas.

[0007] DK-B-173221 describes a milling cylinder and an apparatus comprising the milling cylinder, which is suited for use in re-profiling of verges. The milling cylinder comprises ribs extending from the jacket surface to a height of up to 30 mm from the jacket surface, and the ribs extend continuously over the whole length of the cylinder, along the guides of the jacket surface. The milling cylinder and the peg cylinder are driven to rotation with a peripheral speed of 1-2 m/sec. and 1.6-3.2 m/sec., respectively. With this apparatus it is possible to work at a travelling speed of approximately 4-5 km/h.

[0008] Attempts to work at a higher travelling speed have resulted in intense vibrations in the apparatus, in particular when work is carried out in a sticky or very compacted soil. Furthermore, it is preferred that the ribs only extend up to approximately 25 mm beyond the jacket surface of the cylinder in order not to become too power consuming.

[0009] The object of the invention is therefore to provide an improved apparatus for levelling or re-profiling verges.

[0010] This object is met by a milling cylinder according to claim 1 and an apparatus according to claim 10, which comprises this cylinder.

[0011] The milling cylinder according to the invention is thus characterized in that each rib follows a helical line, which in the surface of rotation forms an angle in the range of approximately 10°-30°, in particular 10°-20°, with the travelling direction of the surface of rotation. This corresponds to the fact that the helical line from one end to the other of the milling cylinder, relative to the guides, increases 1-2 times by the peripheral distance between adjacent ribs.

[0012] The individual ribs are in preferred embodiments divided into sections for reasons of manufacture. In this connection two adjacent sections of a rib have a spacing of at the most 2 cm in the axial direction (underlap). If the spacing becomes too big, the desired degree of fineness of the treated verge surface will not be obtained. The adjacent sections of a rib may be mutually overlapping in the axial direction, or the ends of adjacent sections of a rib may be substantially in line in the peripheral direction.

[0013] The individual sections extend preferably in the travelling direction of the surface of rotation to make the manufacture as easy as possible.

[0014] The milling cylinder preferably comprises a substantially circular cylindrical body carrying the ribs, the body having a diameter of 20-50 cm, in particular approximately 30 cm, and the ribs have preferably a height of 25-50 mm, in particular 35-45 mm, and most particular approximately 40 mm.

[0015] By a milling cylinder according to the invention it is possible in operation to travel at a speed of up to 15

km/h, dependent on the condition of the verge to be treated, without the power consumption becoming excessive.

[0016] As mentioned in DK-B-173221 attempts have been made by using a rotating peg cylinder to break down a bank in a verge. This resulted, however, in the drawback that both the material of the bank and the immediately underlying material were raked up, which left the verge soft and porous, which is unfortunate, as water from the roadway can then seep down through the verge.

[0017] Furthermore, attempts have been made to treat a verge by an apparatus having a milling cylinder of the type, which is generally described in US-A-4 006 936 or US-B-6 626 499. However, the results have been most unsatisfactory: The cutters of the milling cylinder were worn excessively quickly, and the surface of the treated verge was raked up and porous.

[0018] In the apparatus, which according to the invention is provided with a milling cylinder according to the invention, at least the milling cylinder is preferably floatingly suspended with the possibility of rotating about an axis extending in the intended travelling direction. The floatingly suspended cylinder(s) is/are forced by a spring towards a basic position, in which the cylinder has the intended inclination.

[0019] The milling cylinder is preferably suspended such that the side facing forwards in operation is obliquely facing the roadway, the peg cylinder is suspended such that its side facing forwards in operation is obliquely facing away from the roadway, and the driving devices of the cylinders are adapted to drive the cylinders reversely relative to the travelling direction in operation.

[0020] The driving device of the milling cylinder is preferably adapted to give the milling cylinder a peripheral speed in the range of 1 to 4 m per sec. Likewise, the driving device of the peg cylinder may be adapted to give the peg cylinder a peripheral speed of 1 to 4 m per sec.

[0021] Preferably, the apparatus also comprises a rotating brush.

[0022] In a preferred embodiment the apparatus further comprises a support wheel connected with the end of the peg cylinder facing the roadway and running in parallel with the travelling direction.

[0023] Preferably the apparatus further comprises a screening device positioned on the side of the milling cylinder facing the roadway.

[0024] In operation the apparatus is preferably carried by a motor vehicle, for instance a lorry.

[0025] The apparatus is preferably provided with a driving device yielding up to 90 kW, but very often the apparatus will only consume down to 15 kW. Of this amount approximately 1-2 kW is consumed by the rotating brush, approximately 20% or presumably 4-5 kW is consumed by the peg cylinder, whereas the major part is consumed by the milling cylinder. The consumption of the milling cylinder is by far more dependent on the condition of the verge to be treated than is the consumption of the brush and the milling cylinder.

[0026] The invention will be described in detail in the following by means of an example of an embodiment with reference to the accompanying schematic drawings, in which

Fig. 1 shows the mutual positioning relative to the roadway of the individual components of the apparatus when in use,
Fig. 2 a view from behind relative to the travelling direction of the milling cylinder according to claim 1 when in use,
Fig. 3 a view from behind relative to the travelling direction of the peg cylinder in Fig. 1 when in use,
Fig. 4 a view of the milling cylinder in Figs 1 and 2, seen from the exterior end, and
Fig. 5 a sectional view of a verge for illustrating the work done by means of the apparatus.

[0027] In Fig. 1 the line 1 symbolizes the border between a roadway 2 and a verge 3. As shown schematically, the apparatus comprises a milling cylinder 4 suspended in a frame 5 (see also Fig. 2). On the upper side of the frame 5 a circular plate 7 is fastened by means of bolts 8, said plate being provided with two triangular flaps 9. The flaps are provided with two coaxial holes 10 for being mounted at the end of a lift arm or the like.

[0028] Moreover, a peg cylinder 11 is provided with a shaft 13 suspended in a frame 14 provided with a plate 6, which by means of bolts 8' is connected with a plate 7' provided with flaps 9' having coaxial holes 10' for suspension.

[0029] In the example the two frames 5 and 14 each carry a motor, like for instance a hydraulic motor 15, 15', respectively, which through suitable gears 16 and 16', respectively, is adapted to run the milling cylinder 4 and the shaft 13 with the peg cylinder 11, respectively.

[0030] In operation the two frames 5 and 14 are for instance carried by a lorry, the frames being suspended by means of the holes 10, 10' in the flaps 9, 9', such that they may each rotate about a basic position, towards which they are influenced by means of springs (not shown), and about axes extending in parallel with a travelling direction 24 of the apparatus.

[0031] The angular position of the frames 5, 14' in horizontal plane can be adjusted, the plates 7, 7' being provided with a number of bolt holes (not shown).

[0032] The motor 15 of the milling cylinder 4 is positioned closest to the road, which enables the milling cylinder 4 to operate close to poles at the edges, crash barriers and the like objects at the roadside.

[0033] A rotating brush 12 with a substantially vertical axis of rotation is placed behind the cylinders relative to the travelling direction 24. The rotational direction of the brush 12 is indicated by an arrow 12a.

[0034] Next to the milling cylinder 4 a screen 21 is pro-

vided to prevent the milling cylinder 4 from throwing material on to the roadway 2.

[0035] A support wheel 22. is mounted on the frame 14.

[0036] In operation, the apparatus travels along a road in the direction shown by the arrow 24 with the milling cylinder in front to mill away a bank 18 and to move its material to a ditch 19 between the bank 18 and the roadway 2. In this manner material is moved from the hatched area of the bank 18 in Fig. 5 to the area of the ditch 19 likewise hatched.

[0037] The milling cylinder thereby divides the material milled away from the bank into fine particles, which is a prerequisite for its being re-used immediately after.

[0038] The succeeding peg cylinder 11 has the function of levelling the material from the previous bank and of removing roots, bigger stones and the like, which on account of the oblique position of the peg cylinder 11 is guided to the edge of the verge. The brush 12 takes care of bringing material, which in spite of the screen 21 of the milling cylinder 4 may have been thrown out on the roadway 2, out into the verge 3 again.

[0039] The support wheel 22 runs in operation on the roadway 2 and ensures that the peg roller 11 does not hit the roadway.

[0040] After the operation described above, the verge may be rolled, and the treatment is then finished.

[0041] In the embodiment shown the longitudinal direction of the milling cylinder 4 forms an angle relative to the transverse direction of the road of approximately 35°, whereas the longitudinal axis of the peg roller 11 relative to the transverse direction of the road forms an angle of approximately 33°. The two angles may according to conditions be adjusted up till 15° to one side or the other.

[0042] The milling cylinder 4 is according to the invention provided with ribs 25 extending along helical lines. The ribs 25 are in the embodiment shown each divided into four sections, 25a, 25b, 25c, 25d, which are staggered relative to one another such that they, like steps, follow a helical line 30. In the embodiment the sections are staggered in such a manner that the first section 25a of a rib is in line with the last section 25d' of the adjacent rib, the sections each extending along a guide of the jacket surface of the milling cylinder 4. In the embodiment described the helical line 30 in the plane of the jacket surface forms an angle α of approximately 15° with the guides. For the sake of clarity only one rib with all four sections is shown in the drawings, and all the outer sections all are only shown in one side (the right side relative to the travelling direction 24) of the milling cylinder 4.

[0043] The milling cylinder 4 comprises in the embodiment a tubular piece 26, onto which carrier pieces 27 have been welded, on which carrier pieces the rib sections 25a-25d in the form of steel lists are fastened. The ribs 25 protrude in the embodiment approximately 40 mm from the jacket surface of the tubular piece 26.

[0044] In the embodiment shown the milling cylinder has preferably a length of approximately 75 cm and an outer diameter (the diameter swept by the ribs 25) of approximately 38 cm, whereas the peg cylinder has a diameter of approximately 35 cm. The peripheral speed of the milling cylinder as a consequence of its rotation is in the example of the embodiment between 1 and 4 m per sec. The peripheral speed of the peg cylinder also lies between 1 and 4 m per sec. The travelling speed of the apparatus in operation is 4-15 km/h depending on the condition of the verge 3.

[0045] Tests with an apparatus as described above have shown that the milling cylinder 4 rakes up and divide into fine particles the material of the bank 18 and moves it up to the roadway, the material "running" along the milling cylinder 4. This effect is on account of the helical shape enhanced in comparison with the effect obtained by the apparatus known from DK-B-173221. The subsequent peg roller 11 levels the bank material, bigger objects like stones, roots and branches "running" simultaneously along the peg roller 11 to the outer edge of the verge. The treated verge 3 has, where the bank 18 was previously situated, in spite of the use of a milling cylinder with ribs divided into sections a solid, untreated bottom, and the ditch 19 has been filled with the material from the bank and may subsequently be rolled over, for instance by means of the wheels of the lorry.

Claims

1. A milling cylinder (4) for levelling verges (3) along roads, comprising several ribs (25) extending in the longitudinal direction of the milling cylinder and sweeping by rotation of the milling cylinder a cylindrical surface of rotation, **characterized in that** each rib (25) follows a helical line (30), which in the surface of rotation forms an angle (α) in the range of approximately 10°-30°, in particular 10°-20°, with the travelling direction of the surface of rotation.

2. A milling cylinder according to claim 1, **characterized in that** the individual ribs (25) are divided into sections (25a-25d), whereby a spacing of at the most 2 cm in the axial direction (underlap) is provided between two adjacent sections of a rib.

3. A milling cylinder according to claim 2, **characterized in that** adjacent sections of a rib are mutually overlapping in the axial direction.

4. A milling cylinder according to claim 2, **characterized in that** the ends of adjacent sections (25a-25d) of a rib are substantially in line in the peripheral direction.

5. A milling cylinder according to any of the claims 2-4, **characterized in that** the individual sections (25a-

25d) extend in the travelling direction of the surface of rotation.

6. A milling cylinder according to any of the claims 2-5, **characterized in that** each rib (25) is divided into 2-8 sections, in particular 3-6 sections, and preferably into 4 or 5 sections (25a-25d) .

7. A milling cylinder according to any of the claims 1-6, **characterized in that** the peripheral distance, measured in the surface of rotation, between two adjacent ribs (25d-25d') is 10-20 cm, in particular 13-18 cm, and most particular approximately 15.

8. A milling cylinder according to any of the claims 1-7, **characterized in** comprising a substantially circular cylindrical body (26) carrying the ribs (25), the body (26) having a diameter of 20-50 cm, in particular approximately 30 cm, and the ribs having a height of 25-50 mm, in particular 35-45 mm, and most particular approximately 40 mm.

9. A milling cylinder according to any of the claims 1-8, **characterized in that** at least the side of each rib facing forwards in the direction of rotation extends substantially radially, viewed in section, perpendicular to the axis of rotation.

10. An apparatus for levelling verges along roads, comprising a milling cylinder (4) and a peg cylinder (11), which cylinders are both suspended at an inclination relative to horizontal corresponding to the intended inclination of the verge surface and such that the peg cylinder (11) relative to the travelling direction (24) of the apparatus is positioned behind the milling cylinder (4), as well as driving devices (15, 16; 15',16') for rotating the two cylinders (4, 11) about their respective longitudinal axes, **characterized in that** the milling cylinder is a milling cylinder (4) according to any of the claims 1-9.

11. An apparatus according to claim 10, **characterized in that** at least the milling cylinder (4) is floatingly suspended with the possibility of rotating about an axis extending in the intended travelling direction (24).

12. An apparatus according to claim 11, **characterized in that** the floatingly suspended cylinder(s) is/are forced by a spring towards a basic position, in which the cylinder has the intended inclination.

13. An apparatus according to any of the claims 10-12, **characterized in that** the milling cylinder (4) is suspended such that its side facing forwards in operation is obliquely facing the roadway (2), that the peg cylinder (11) is suspended such that its side facing forwards in operation is obliquely facing away from the roadway (2), and that the driving devices of the cylinders (15, 16; 15', 16') are adapted to drive the cylinders (4; 11) reversely relative to the travelling in operation.

14. An apparatus according to any of the claims 10-13, **characterized in that** the driving device (15, 16) of the milling cylinder is adapted to give the milling cylinder (4) a peripheral speed in the range of 1 to 4 m per sec.

15. An apparatus according to any of the claims 10-14, **characterized in that** the driving device (15', 16') of the peg cylinder is adapted to give the peg cylinder (11) a peripheral speed of 1 to 4 m per sec.

16. An apparatus according to any of the claims 10-15, **characterized in** comprising a rotating brush (12).

17. An apparatus according to any of the claims 10-16, **characterized in** comprising a support wheel (22) connected with the end of the peg cylinder (11) facing the roadway (2) and running in parallel with the travelling direction (24).

18. An apparatus according to any of the claims 10-17, **characterized in** comprising a screening device (21) positioned on the side of the milling cylinder (4) facing the roadway (2).

19. An apparatus according to any of the claims 10-18, **characterized in that** the driving device of the apparatus yields up to 90 kW.

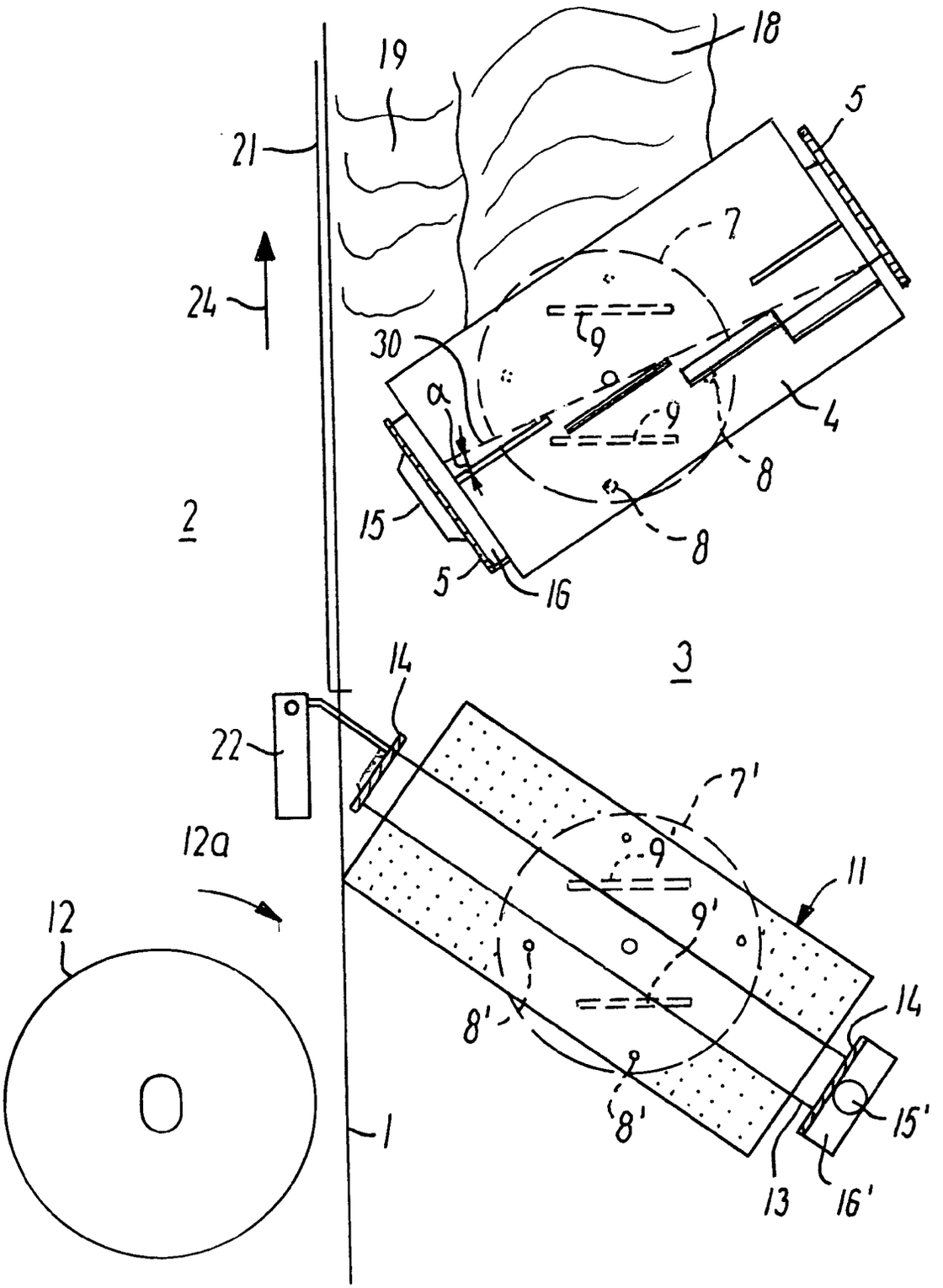
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FIG.1

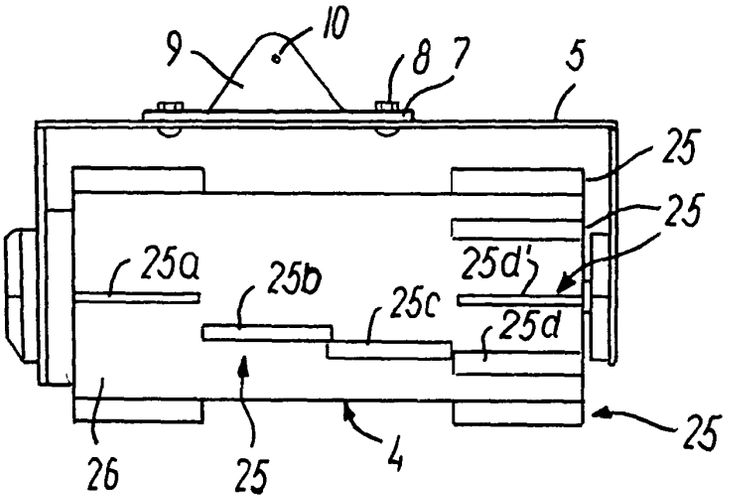

FIG.2

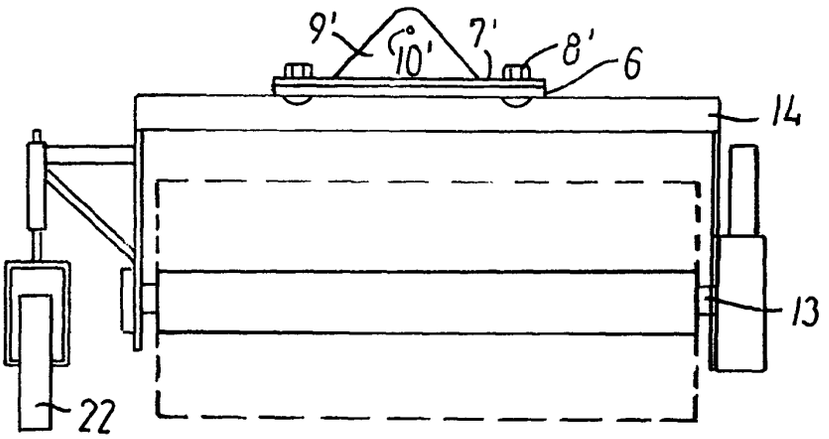

FIG.3

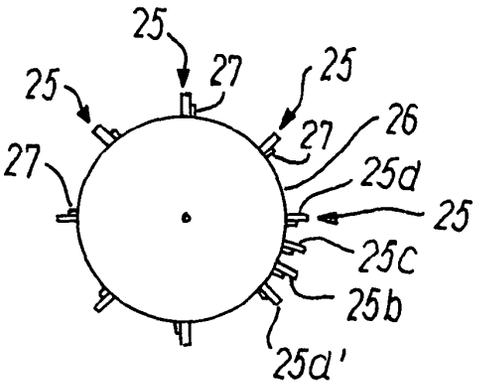

FIG.4

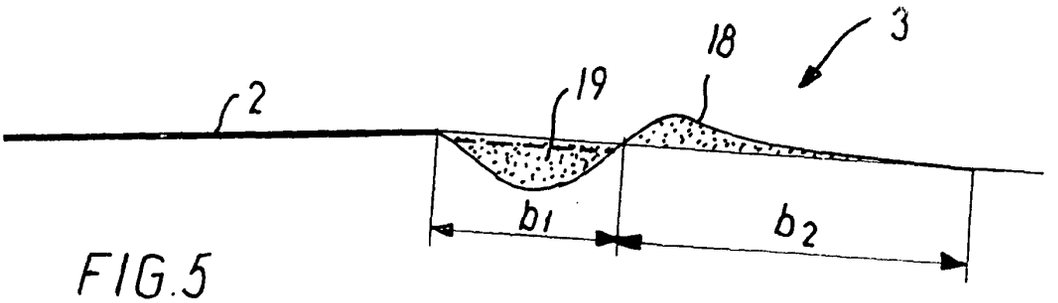

FIG.5

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EUROPEAN SEARCH REPORT

Application Number
EP 04 38 8030

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

E01C
E02F
E01H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	20 September 2004	Movadat, R

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