



(72) GOSSOP, John, GB

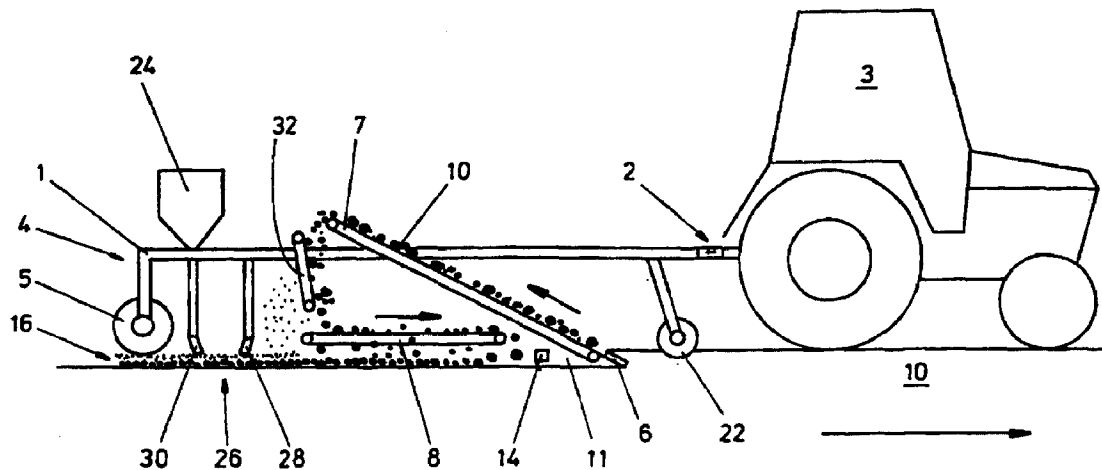
(71) GOSSOP, John, GB

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(54) **MACHINE POUR LA PREPARATION DES SOLS**

(54) **MACHINE FOR SOIL PREPARATION**



(57) L'invention concerne une machine pour la préparation des sols. Cette machine comprend un moyen de levage du sol (6, 7) pour soulever une couche du sol, un moyen de rupture du sol (8) pour briser la couche du sol, et un châssis (1) auquel sont fixés le moyen de levage du sol (6, 7) et le moyen de rupture du sol (8).

(57) A machine for preparation of soil comprises a soil lifting means (6, 7) for lifting a layer of soil, a soil breaking means (8) for breaking up the layer of soil, and a frame (1), the soil lifting means (6, 7) and soil breaking means (8) being attached to the frame (1).



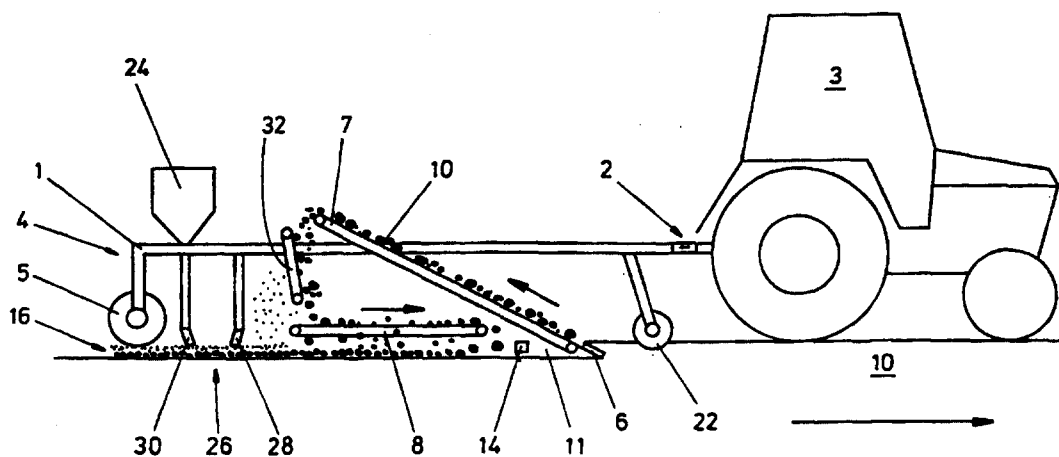
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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: MACHINE FOR SOIL PREPARATION



(57) Abstract

A machine for preparation of soil comprises a soil lifting means (6, 7) for lifting a layer of soil, a soil breaking means (8) for breaking up the layer of soil, and a frame (1), the soil lifting means (6, 7) and soil breaking means (8) being attached to the frame (1).

### MACHINE FOR SOIL PREPARATION

The present invention relates to a machine for soil or earth preparation, particularly although not  
5 exclusively in the agricultural field.

#### Background Art

In the preparation of fields for planting of  
10 agricultural crops, the aim of soil preparation is to bury a crop residue and weeds from a previous crop, loosen the soil, and provide a suitable tilth for the crop to be planted. Many crops require relatively small soil  
15 particles on the uppermost layer of the soil, at a depth of a few centimetres to tens of centimetres from the surface, this being the depth at which the seed for the crop is sown.

Conventional methods of soil preparation include a  
20 primary cultivation and a secondary cultivation. In the primary cultivation, crop residue from the previous crop, and weeds are buried within the soil, and in the secondary cultivation, an uppermost layer of the soil is broken down into relatively small sized particles.

25

The most popular tool for carrying out the primary  
cultivation for hundreds of years has been the  
conventional plough. The plough inverts the soil, giving  
excellent burial of surface residues. However, there are  
30 disadvantages with the conventional plough. Firstly, because the soil is in contact with the plough share, mould board and skimmer, there are high levels of friction in drawing the plough through the soil. Where the plough is towed by a wheeled tractor, because the force necessary  
35 to pull the plough is transmitted to the ground through

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the tractor wheels, there may occur wheel slippage in wet conditions, which causes the soil underneath the tractor wheels to smear and compact, in the bottom of the furrow. The smeared and compacted soil impedes drainage from the furrow.

Secondly because a plough body turns soils over into a space left by a preceding plough body, it is not possible to start at one side of a field and work up and down a field, without the use of a reversible plough which has a set of left hand mould boards for ploughing down a field in one direction, and another opposite set of mould boards for ploughing up the field in an opposite direction.

The reversible plough is expensive, and has the operational complication of switching between mould boards for ploughing in different directions.

A third problem with the conventional plough is that as tractors increase in size, farmers require ploughs with more furrows. As each furrow must be staggered on the plough frame, the total length of the plough frame becomes unmanageable.

Once the primary cultivation of the land has been completed by ploughing, the secondary cultivation is carried out on the soil structure let by the plough. Machines for secondary cultivation include trailed or powered harrows, which break clods by striking, cutting or crushing, to reduce clod size and consolidate the seed bed.

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FR-A-2566615 describes a machine for burying stones under finer soil to reclaim stony land. The machine uses a vibrating sieve to grade the stones. However, the machine does not cultivate the soil in so far as the soil  
5 is not broken up into smaller particles.

US-A-2785613, US-A-2110997 and US-A-1786226 describe machines for the preparation of farmland. Each discloses means for breaking the soil such as by means of a hammer  
10 mill, a shaker and a toothed cylinder respectively. However, in each case objectionable material, such as stones, is conveyed to a dump box or the like.

Disclosure of the invention

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Specific embodiments of the present invention aim to provide a single machine of cultivation of land in one or more passes.

20

According to one aspect of the present invention there is provided a machine for preparation of soil comprising a soil lifting means for lifting a layer of soil, a soil breaking means for breaking up the layer of soil, and a frame, the soil lifting means and soil  
25 breaking means being attached to the frame, characterised in that said soil breaking means comprises a web or grader, the soil being dropped onto or thrown towards said web or grader such that impact of the soil with said web or grader causes a reduction of the soil into smaller  
30 particles, and wherein the machine comprises a web or grader for grading the soil particles into coarse and fine particles, the soil layer being re-laid onto the exposed soil bed such that the coarse particles are situated underneath the fine particles in the re-laid soil layer.  
35 Suitably, the machine is adapted to be towed behind a

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tractor unit. As the machine moves in a forward direction, the soil lifting means lifts a surface layer of soil, thereby exposing a soil bed or subsoil bed. The soil layer is broken up into smaller sized particles by the soil breaking means, and is then re-laid onto the soil bed. By lifting and breaking up the upper layer of soil in an area of land, the soil layer can be broken down into smaller sized soil particles. Preferably, the soil layer is lifted to a height above a height of the original undisturbed soil layer:

Preferably, the web/grader for grading the soil particles also performs the function of breaking up the soil. The soil layer is preferably broken up into coarse and fine soil particles.

Preferably, the soil layer is broken by being dropped from a height above the height of the original undisturbed soil layer.

Preferably, said lifting means comprises one or a plurality of shares, arranged to cut into the soil layer as the machine is drawn in a forward direction.

Preferably, the soil lifting means comprises a conveyor. Preferably, the conveyor carries the soil in a direction upwardly and towards the rear of the machine. Preferably, the conveyor is angled to convey the soil to a height above the height of the original undisturbed soil layer. The conveyor may be a rubber conveyor, although any suitable material may be used. Preferably, the conveyor is driven by a power take off shaft of the tractor.

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The soil breaking means may further comprise one or a plurality of rotors or tines arranged to break the soil layer as it travels up the conveyor. One or a plurality of rollers may be included to crush lumps of soil.

5

Preferably, the web or grader is situated under an upper end of the conveyor. The web or grader may be vibrated. The web or grader may be provided with one or a plurality of agitators or scrubbers.

10

Preferably the soil breaking means comprises two web or grader devices. A first web or grader device may be arranged substantially horizontally and a second web or grader may be arranged substantially vertically or at a slight, preferably rearwards, angle to the vertical. Preferably, the second web/grader is located above and towards the rear of the first web/grader. Preferably the second web/grader has a forward face adapted in use to move upwards.

20

Preferably the machine comprises a further soil breaking means mounted forwardly of the first soil breaking means for partially cutting or breaking the soil before it passes to the soil lifting means. Preferably, the further soil breaking means comprises one or more discs or a roller which may be adjustable to control the depth of the shares. Preferably, the roller incorporates one or more discs, or tines spaced across its width.

30

The relatively fine particles may occupy predominantly an upper portion of the re-laid soil layer to a depth 0 to 90 mm from the surface of the re-laid soil layer, however there is no limit to the depth of the finer particles within the re-laid layer.

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Preferably, the soil layer drops onto the web/grader at rear end of web/grader. Preferably, the finest soil particles fall through a rear most end of the web/grader and the coarsest particles fall through or from a front  
5 end of the web/grader, such that as the web/grader moves forward the coarsest particles are deposited directly onto the soil bed or subsoil bed, and successively finer soil



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particles are re-laid over the coarse particles as the machine moves forward.

Some, or most of the surface trash and crop residue  
5 may also be carried by the web or grader to be deposited under the finer particles. On stony soil, the larger stones may be deposited under the smaller stones.

There may be provided a levelling device, preferably  
10 following the web/grader, for levelling out a surface of the re-laid soil layer.

There may be provided, at a rear end of the machine,  
a seed planter apparatus, for planting or sowing seeds  
15 onto the prepared soil.

A rear end of the frame may be supported by a plurality of wheels. The plurality of wheels may be preferably situated at a position rearward of a position  
20 at which the soil layer is re-laid, such that the wheels travel over the re-laid soil layer. The wheels may act to compress and thereby consolidate the re-laid soil layer.

The machine may be fully mounted to a tractor and be  
25 capable of being lifted by a tractor.

#### Description of the drawings

For a better understanding of the invention, and to  
30 show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Referring to Figure 1 of the accompanying drawings,  
35 there is shown schematically a soil preparation machine

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according to a first specific embodiment of the present invention, as towed by a conventional tractor unit.

Figure 2 shows schematically a second specific embodiment of the invention, as towed by a conventional tractor unit.

Best mode for carrying out the invention

10 Referring to Figure 1 of the accompanying drawings, a soil preparation machine comprises a frame 1, a plurality of wheels 5 supporting the frame; one or a plurality of shares 6; first and second forwardly mounted upright discs 12, 13; a conveyor 7 for receiving a soil  
15 layer 10; one or more subsoil tines 14 for tining an exposed soil bed or subsoil bed 11 behind the shares; a web or grader 8 for breaking up, grading and re-laying the soil layer 10 onto the bed 11; and a levelling bar 20 for levelling off an upper surface of the re-laid soil  
20 layer 16.

The frame 1 is arranged to be supported at a forward end 2 by a conventional tractor unit 3, and supported at a rearmost end 4 by the one or plurality of wheels 5  
25 attached to the frame 1. The one or a plurality of shares 6 and the conveyor 7, constitute a soil lifting means. The shares are angled downwardly and in a direction towards the front of the frame, so that when the frame is drawn in a forward direction, the shares dig into the  
30 undisturbed soil layer 10 and lift the soil layer 10 onto the conveyor 7. The conveyor is driven by a power take off shaft from the tractor, for lifting the soil bed in a direction upwardly and towards the rear of the frame. The vibrating web or grader 8 is positioned underneath an  
35 upper end of the conveyor 7, such that soil material

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having travelled up the conveyor to a height above the level of the original undisturbed soil layer 10 falls off the end of the conveyor onto the web or grader.

5           The shares may be plough shares, although preferably the shares are substantially flat.

10           Where the machine is used on heavy soil, additional parts may be added to aid clod size reduction, e.g. the rotors or tines to engage the soil as it flows up the conveyor and/or falls onto the grader. One or a plurality of rotors or tines for engaging and further breaking up the soil as it passes up the conveyor, and/or as it falls onto the grader or web may be provided.

15           The web or grader 8 may be arranged so as to grade finer material at a rear end of the web or grader, and grading successively coarser soil particles towards the front the web/grader.

20           As the machine move forwardly, the soil layer 10 is removed and transported up the conveyor and to the back of the web/grader. Coarse soil particles are transported to the front of the web/grader and dropped onto the exposed soil bed behind the shares. As the soil material falls onto the rear of the web/grader, fine particles of soil fall through and form the re-laid soil layer 16 laid on top of the coarser particles. As the machine moves forward, successively finer particles are dropped on top of the coarse particles, until the finest material, which is dropped at the back of the web/grader is dropped upper most on the re-laid soil layer 16. The grader could be a web/spools, or star wheels of the type commonly used on potato harvesters to separate the soil from potatoes.

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The grader may be removable and replaceable with a grader having differently sized gaps, and the particle size of the soil may be adjusted by removal and replacement of the grader. The grader may comprise two or  
5 more short graders used in cascade, a first short grader being set above a second short grader, the first short grader having smaller gaps than the second short grader, having larger gaps.

10 Behind the web/grader may be provided a levelling bar  
20 for levelling the top of the re-laid soil layer 16. The levelling bar 20 may compensate for any uneven distribution of soil through the grader.

15 The wheels 5 supporting the rear of the frame run over the re-laid soil layer 16. The wheels 5 may serve the dual purpose of supporting the rear of the frame, and consolidating the seed bed. There may be provided one or more subs-soil tines, for tining the exposed soil bed  
20 immediately behind the share. The shallow sub-soil tines behind the share may aid drainage under the seed bed.

The working depth of the un-disturbed soil layer 10 to be lifted is adjusted either by setting the tractor  
25 lift arms, or using adjustable depth wheels at the front of the frame.

30 Preferably, the first and second discs, placed either side of share at the front of the frame, are provided for the purpose of making a clean cut in a direction along the direction of travel of the machine.

There may be mounted a seeder unit at the rear of the frame, in order to place seed in the soil prior to the  
35 seed bed being traversed by the wheels 5.

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By varying the conveyor speed on the machine, and by pulling the machine in the forward direction selected by use of different gear and throttle settings on the tractor, it may be possible to achieve a well controlled seed bed formation of the re-laid soil layer 16 at the rear of the machine.

The web/grader speed may be adjustable and variable to allow control of the re-laid soil layer 16.

Referring to Figure 2, the machine is substantially similar to that shown in Figure 1 with some modifications. The same reference numerals are used to describe like parts. In the second embodiment, the discs 12, 13 as described with reference to Figure 1 are incorporated into a full width roller 22 i.e. extending across substantially the width of the machine. The roller 22 is adjustable and controls the depth of the shares. The roller may incorporate other discs, spikes or tines at intervals across its width to partially cut or break the soil before it enters the machine, thereby contributing to the finished seed-bed.

A seeder unit 24 is mounted at the rear of the frame 1. The levelling device 26 comprises two levelling bars supported by the frame. One levelling bar 28 lies transversely to the machine and at a slight forward angle to the vertical; the other levelling bar 30 lies transversely at a slight rearward angle to the vertical. Such a levelling device can provide improved levelling of the top layer.

Because of the forward travel of the entire machine and the rearward travel of the conveyor 7 the soil does

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not drop straight down but is thrown partly towards the back of the machine. It has been found that a web 32 in a near vertical position with the first face of the web travelling upwards is effective at breaking some of the soil clods and allowing fine soil through. The larger soil particles and trash roll by gravity down the face of the web on to the main web 8. Alternatively, other breaking and grading means could be used instead of this vertical web, such as rotors, tines and rollers.

10

The web or grader 32 and web or grader 8 may comprise any suitable material.

The machine may find application in various agricultural uses as follows:

15

(i) Post harvest: some farmers like to cultivate stubble straight after harvest to mix the stubble with soil to encourage bacterial breakdown and to germinate weed seeds, so keeping the soil clean. The machine according to the specific embodiments may be used for post harvest stubble mixing, instead of the conventional disc harrow or tined cultivator. The machine may work shallowly and quickly in this mode of operation. The machine could also be used at a greater soil depth, to loosen and partly break up the soil to be later cultivated by the same machine or another machine.

20

25

(ii) Seed bed preparation: seed bed preparation as described hereinabove may be carried out either on previous stubble, or on land already cultivated by the machine, or another prior art machine.

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(iii) Beach improvement: the machine may be used for the improvement of seaside beaches having a mix of sand and stones by burying the stones under a layer of sand.

5 It will be appreciated that the machine may be used in any suitable circumstance requiring the cultivation or preparation of soil or land.

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**CLAIMS:**

1. A machine for preparation of soil comprising a soil lifting means (6,7) for lifting a layer of soil (10), a soil breaking means (8,32) for breaking up the layer of soil, and a frame (1), the soil lifting means and soil breaking means being attached to the frame, characterised in that said soil braking means comprises a web or grader (8, 32), the soil being dropped onto or thrown towards said web or grader (8, 32) such that impact of the soil with said web or grader cause a reduction of the soil into smaller particles, and wherein the machine comprises a web or grader (8, 32) for grading the soil particles into coarse and fine particles, the soil layer being re-laid onto the exposed soil bed such that the coarse particles are situated underneath the fine particles in the re-laid soil layer (16).

2. A machine as claimed in claim 1, wherein said web or grader (8,32) for grading the soil particles also performs the function of breaking up the soil.

3. A machine as claimed in any preceding claim, wherein the soil layer (10) is broken up into coarse and fine soil particles.

4. A machine as claimed in any preceding claim, wherein the soil layer (10) is broken by being dropped from a height above the height of the original undisturbed soil layer.

5. A machine as claimed in any preceding claim, wherein said lifting means (6,7) comprises one or a plurality of shares (6), arranged to cut into the soil layer as the machine is drawn in a forward direction.

AMENDED SHEET



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6. A machine as claimed in any preceding claim, wherein the soil lifting means (6, 7) comprises a conveyor (7).

7. A machine as claimed in claim 6, wherein the soil  
5 breaking means further comprises one or a plurality of rotors or tines arranged to break the soil layer as it travels up the conveyor (7).

8. A machine as claimed in claim 6 or claim 7, wherein  
10 the soil breaking means includes one or a plurality of rollers to crush lumps of soil as the soil travels up the conveyor (7).

9. A machine as claimed in any of claims 6, 7 or 8,  
15 wherein the web or grader (8, 32) is situated under an upper end of the conveyor.

10. A machine as claimed in any preceding claim, wherein  
20 the web or grader (8, 32) is vibrated.

11. A machine as claimed in any preceding claim, wherein  
the soil breaking means (8, 32) comprises a first web or  
grader device (8) arranged substantially horizontally and  
a second web or grader (32) arranged substantially  
25 vertically or at a slight angle to the vertical.

12. A machine as claimed in claim 11, wherein the second  
web or grader (32) is located above and towards the rear  
of the first web or grader (8).

13. A machine as claimed in claim 11 or claim 12 wherein  
30 the second web or grader (32) has a forward face adapted in use to move upwards.

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14. A machine as claimed in any preceding claim, wherein the machine comprises a further soil breaking means (12, 13, 22) mounted forwardly of the first soil breaking means (8, 32) for partially cutting or breaking the soil before  
5 it passes to the soil lifting means (6, 7).

15. A machine as claimed in claim 14, wherein said further soil breaking means comprises one or more discs (12, 13) or a roller (22).  
10

16. A machine as claimed in any preceding claim wherein, in use, the finest soil particles fall through a rear most end of the web/grader (8) and the coarsest particles fall through or from a front end of the web/grader (8), such  
15 that as the web/grader moves forward the coarsest particles are deposited directly onto the soil bed or subsoil bed, and successively finer soil particles are re-laid over the coarse particles as the machine moves forward.  
20

17. A machine as claimed in any preceding claim, wherein a levelling device (20, 28, 30) is provided for levelling out a surface of the re-laid soil layer (16).  
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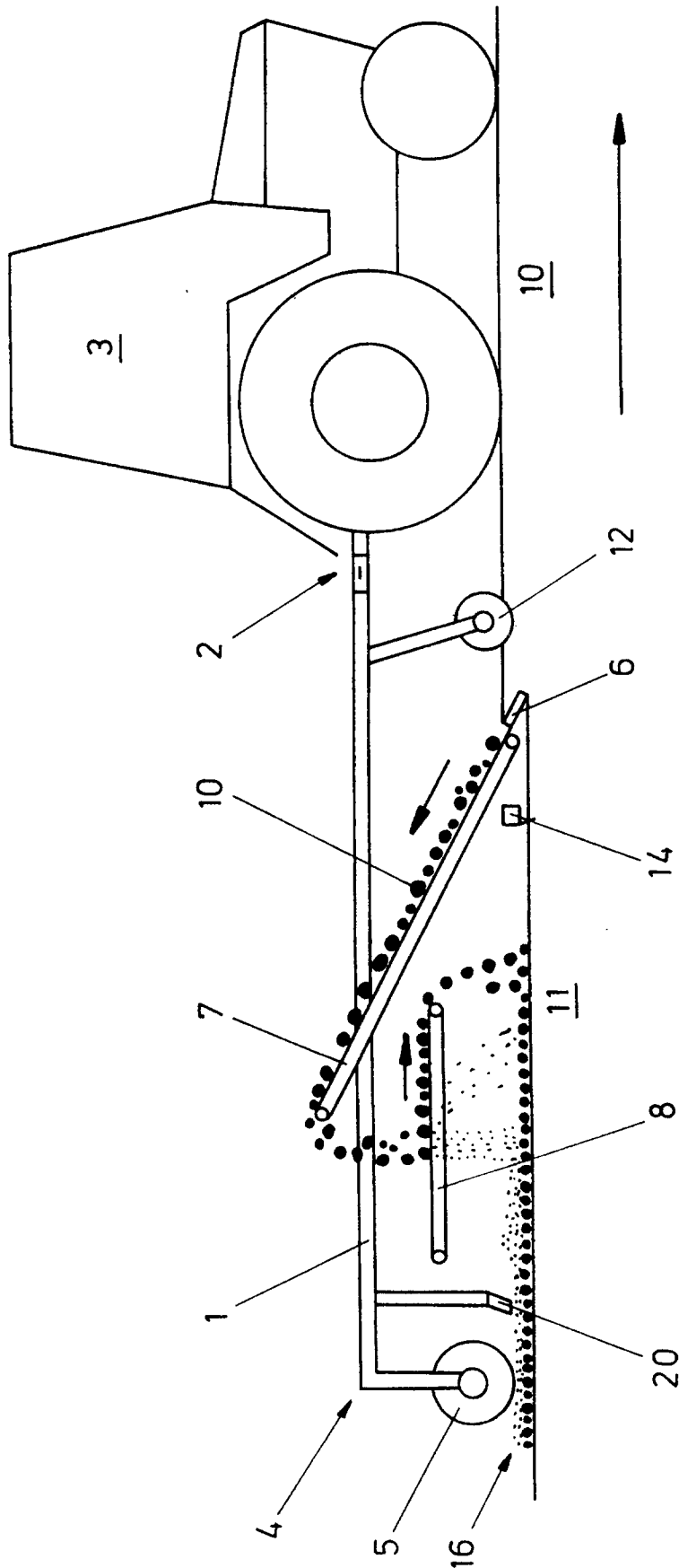


FIG. 1

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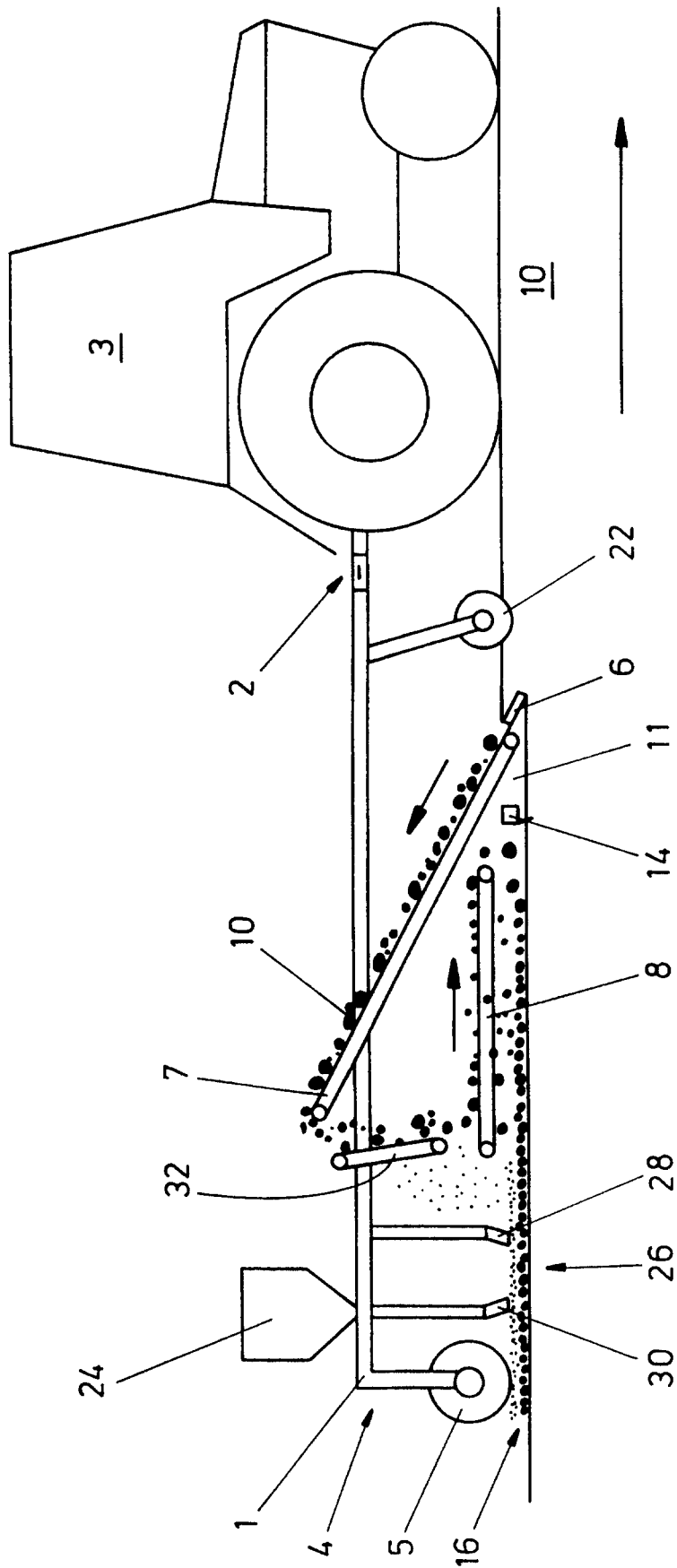


FIG. 2

