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(54) Device for mixing soil materials

(57) The invention relates to a device for mixing soil materials, especially for mixing a blend component directly into the soil materials in the ground. The device comprises at least two mixing drums (2) rotatable about their axes of rotation, which are at a short distance from one another. Between the drums (2) a fixing frame (14) to which is fixed a plunging arm (1). At the upper end of plunging arm (1) are attachment means (10) for attaching to a power machine extension arm. The axes of rotation of the mixing drums (2) are inclined in comparison to the plane perpendicular to the vertical axis of the device in such a way that when the plunging arm (1) is in the vertical direction, the axes of rotation of the mixing drums (2) slant downwards towards the outer ends of the drums. In this case the ends of the mixing drums closest to one another are essentially closer to one another at their lower edges than at their upper edges. Due to this, the body of the device does not form a dead zone which would resist the working motion.

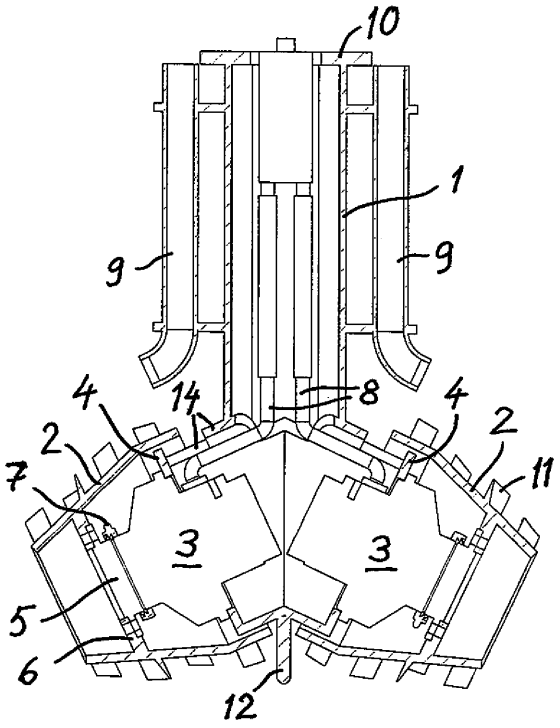

Fig. 1

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Description

[0001] The present invention relates to a device for mixing soil materials, especially for mixing a blend component directly into the soil materials in the ground, the device comprising at least two mixing drums rotatable about their axes of rotation, which are at a short distance from one another and have inner ends and outer ends, which are further away from one another than the inner ends, between the inner ends of the drums a fixing frame on which the mixing drums are supported, and a plunging arm, the lower end of which is fixed to the fixing frame and at the upper end of which are attachment means for attaching to a power machine extension arm.

[0002] This type of device is known from the Applicant's patent publication FI-107629. In this known device, the problem is that when the device is plunged in the working direction into the mass to be stabilised, the frame of the device forms a dead zone, which hinders or resists the working motion. This problem arises especially with soils with a relatively high shearing strength.

[0003] From the publications US 4133397 A1 and JP 2007262819 is known a device for mixing soil materials, wherein the body branches and is fixed to those ends of the drums which are further away from one another. The body extending beyond the drums or at least to the outer edge of the mixing area hinders the work and the mixing process.

[0004] The aim of the invention is to solve this problem by improving the device so that the frame will no longer form a dead zone in the working direction, nor hinder the working motion into the material to be stabilised or into the ground.

[0005] This aim is achieved by means of the invention, on the basis of the characteristics disclosed in the appended claim 1.

[0006] Preferred embodiments of the invention are disclosed in the dependent claims.

[0007] One embodiment of the invention is illustrated in the following with reference to the appended drawings, in which:

Figure 1 shows the device according to the invention as a cross-section along line A-A of Figure 2;

Figure 2 shows the device according to the invention as seen from the side;

Figure 3 shows the same device as a perspective view diagonally from above; and

Figure 4 shows the same device as seen from the front.

[0008] The device according to the embodiment comprises two mixing drums 2 rotatable about their axes of rotation, which are at a short distance from one another. Between the drums 2 is fixing frame 14 comprised of short pipes with a relatively large diameter. The lower end of the plunging arm 1 is fixed to the fixing frame and at the upper end of the plunging arm 1 are attachment means 10 for attaching to a power tool extension arm.

[0009] The novel aspect of the invention is that the axes of rotation of the mixing drums 2 are inclined in comparison to the plane perpendicular to the vertical axis of the device in such a way that when the plunging arm 1 is in the vertical direction, the axes of rotation of the mixing drums 2 slant downwards towards the outer ends of the drums. In this case, the ends of the mixing drums 2 closest to one another are essentially closer to one another at their lower edges than at their upper edges. The distance between the lower edges of the said ends of the drums 2 is preferably less than the minimum thickness of the plunging arm.

[0010] The mixing drums 2 are the shape of a truncated cone and the angle of inclination of the axes of rotation of the drums with respect to the horizontal plane is preferably about half the coning angle of the drum. In this case, the lower part of the drums 2 is horizontal, which is advantageous if the material is mixed in a flat-bottomed container. On the outer surface of the drums 2 is a desired number of mixing blades or wings 11 of a desired shape. Between the lower edges of the mixing drums 2 is preferably a fixed projection 12 extending to the level of the blades or wings 11 of the mixing drums or below them, when the plunging arm 1 is in the vertical direction. In this case, the blades or wings 11 will not touch the bottom of the container in container mixing.

[0011] The suspension and rotation of the mixing drums 2 is preferably carried out by having hydraulic motors 3 inside the mixing drums, on the bearings of which motors the mixing drums are mounted. In this case, no separate power transmission with chains, cogwheels or shafts is required. Nor is a separate motor cowling required in the frame, which would be driven into the ground during operation and would for its part hinder the moving of the device. Reference numeral 8 indicates hydraulic pipes or tubes, which lead to each motor 3 separately inside the plunging arm 1.

[0012] In a preferred embodiment of the invention, the volume flow required by the hydraulic motors 3 of two or more drums 2 is distributed essentially equally by means of small but high-speed hydraulic pumps connected to the same shaft. Therefore, an individual mixing drum 2 cannot rotate essentially slower than the other drums, even if it has a higher load. The pumps may be in the actuator, that is the power machine, or in the mixing device according to the invention. Connecting the pumps mechanically to rotate at essentially the same speed may also be carried out by other means than by connecting the pumps on the same shaft.

[0013] According to another preferred embodiment of the invention, the distribution of the volume flow is not realised with flow distribution pumps or flow distribution valves, but the drum motors are variable displacement motors, the speed of rotation of which is maintained es-

sentially the same by adjusting the rotational volume as the incoming volume flows change.

[0014] It is also possible to use variable displacement motors and flow distribution. The drums will rotate at the same speed, but the rotational volume of all drums is adjusted so that a greater torque will become available. In this case, the speed of rotation will obviously decrease, because the installed power is constant. A high torque may be required when the soil has a high shearing strength.

[0015] In a preferred embodiment of the invention, the transitional area between the body of the hydraulic motor 3 and the rotating hub 5 is sealed with a replaceable gasket, which is kept in place with an opening band 7. The mixing drum 2 is fixed to the flange of the rotating hub 5 of the hydraulic motor 3 with a flange joint. The hydraulic motor 3 is in turn fixed to the mounting flange 4 of the body 14 with a flange joint.

[0016] On the outside of the plunging arm 1, above each mixing drum 2, are fixed stabiliser feed pipes 9 opening directly above the mixing drums 2.

[0017] It is obvious that the invention is not limited to the above embodiment. There may be more than two mixing drums 2. For example, in a structure with three drums, from above the mixing drums 2 and their axes of rotation would be seen at an angle of 120° with respect to one another. One structural alternative could also be a structure where there are two of the first presented drum structures in succession. This alternative could come into question when high capacity is required. The simple structure of the device according to the invention makes it lightweight, which means that only sufficient hydraulic power from an excavator is required.

Claims

1. A device for mixing soil materials, especially for mixing a blend component directly into the soil materials in the ground, the device comprising at least two mixing drums (2) rotatable about their axes of rotation, which are at a short distance from one another and have inner ends and outer ends, which are further away from one another than the inner ends, between the inner ends of the drums (2) a fixing frame (14) on which the mixing drums are supported, and a plunging arm (1), the lower end of which is fixed to the fixing frame (4) and at the upper end of which are attachment means (10) for attaching to a power machine extension arm, **characterised in that** the axes of rotation of the mixing drums (2) are inclined in comparison to the plane perpendicular to the vertical axis of the device in such a way that when the plunging arm (1) is in the vertical direction, the axes of rotation of the mixing drums (2) slant downwards towards the outer ends of the drums, whereupon the inner ends of the mixing drums closest to one another are essentially closer to one another at their lower edges than at their upper edges.

2. A device as claimed in claim 1, **characterised in that** the mixing drums (2) are the shape of a truncated cone and the angle of inclination of the axes of rotation of the mixing drums is about half the coning angle of the drum.

3. A device as claimed in claim 1 or 2, **characterised in that** between the lower edges of the mixing drums (2) is a fixed projection (12) extending to the level of the mixing blades (11) of the mixing drums or below them, when the plunging arm (1) is in a vertical position.

4. A device as claimed in any of the claims 1 to 3, **characterised in that** inside the mixing drums (2) are hydraulic motors (3), on the bearings of which the mixing drums (2) are mounted.

5. A device as claimed in claim 4, **characterised in that** the transitional area between the fixed body of the hydraulic motor (3) and the rotating hub (5) is sealed with a replaceable gasket.

6. A device as claimed in any of the claims 1 to 5, **characterised in that** each mixing drum (2) is rotated by a hydraulic motor (3), actuated by a pump, which is mechanically connected to rotate at essentially the same speed as a pump rotating another mixing drum or other mixing drums, and that the pumps are either in conjunction with the power machine or the mixing device.

7. A device as claimed in any of the claims 1 to 6, **characterised in that** each mixing drum (2) is rotated by a hydraulic motor (3), and that the hydraulic motors are variable displacement motors, the speed of rotation of which is maintained essentially the same by adjusting the rotational volume as the incoming volume flows change.

8. A device as claimed in any of the claims 1 to 7, **characterised in that** on the surface of the mixing drums (2) are protruding mixing blades or wings (11).

9. A device as claimed in any of the claims 1 to 8, **characterised in that** on the plunging arm (1) is fixed a pipe (9) opening above each mixing drum (2) for feeding stabiliser onto the mixing drum (2).

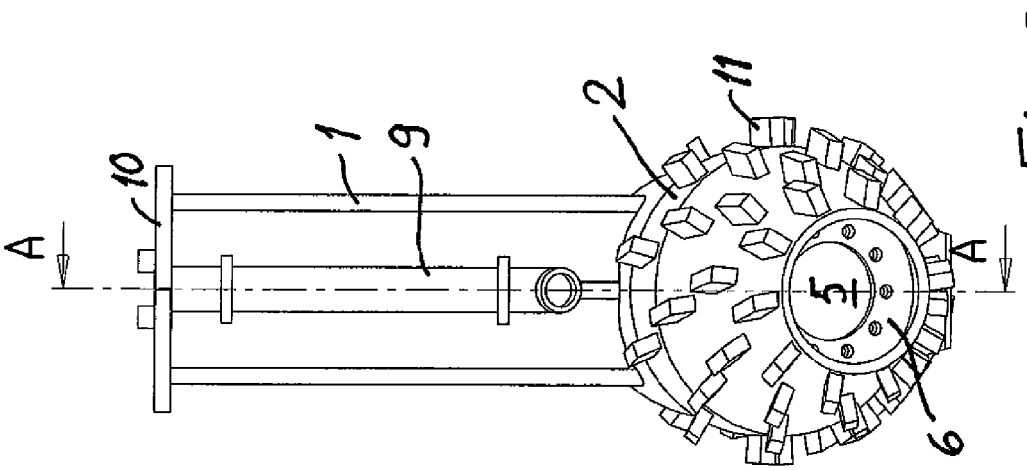

Fig. 2

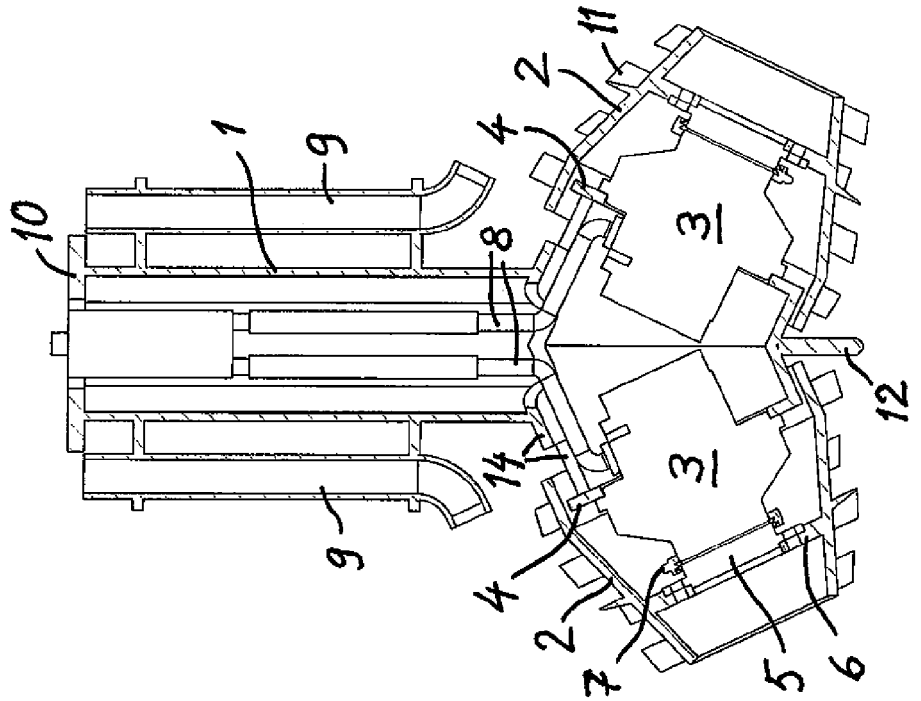

Fig. 1

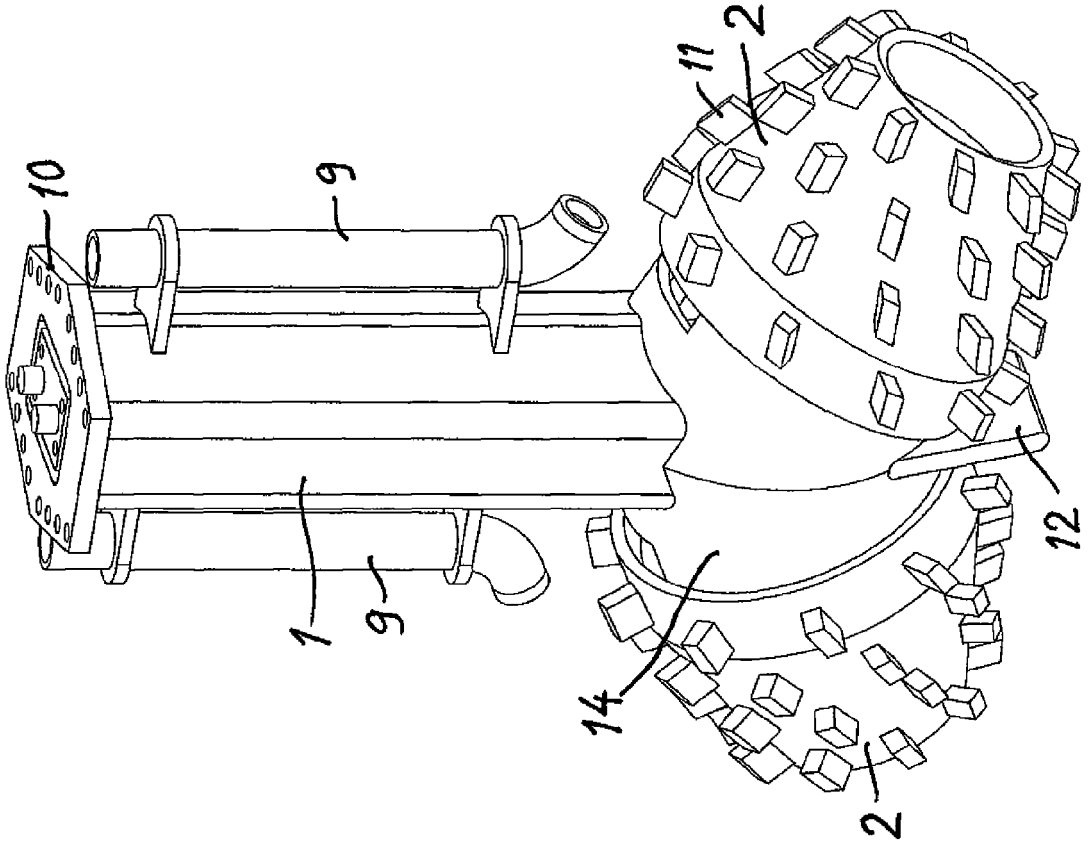

Fig. 3

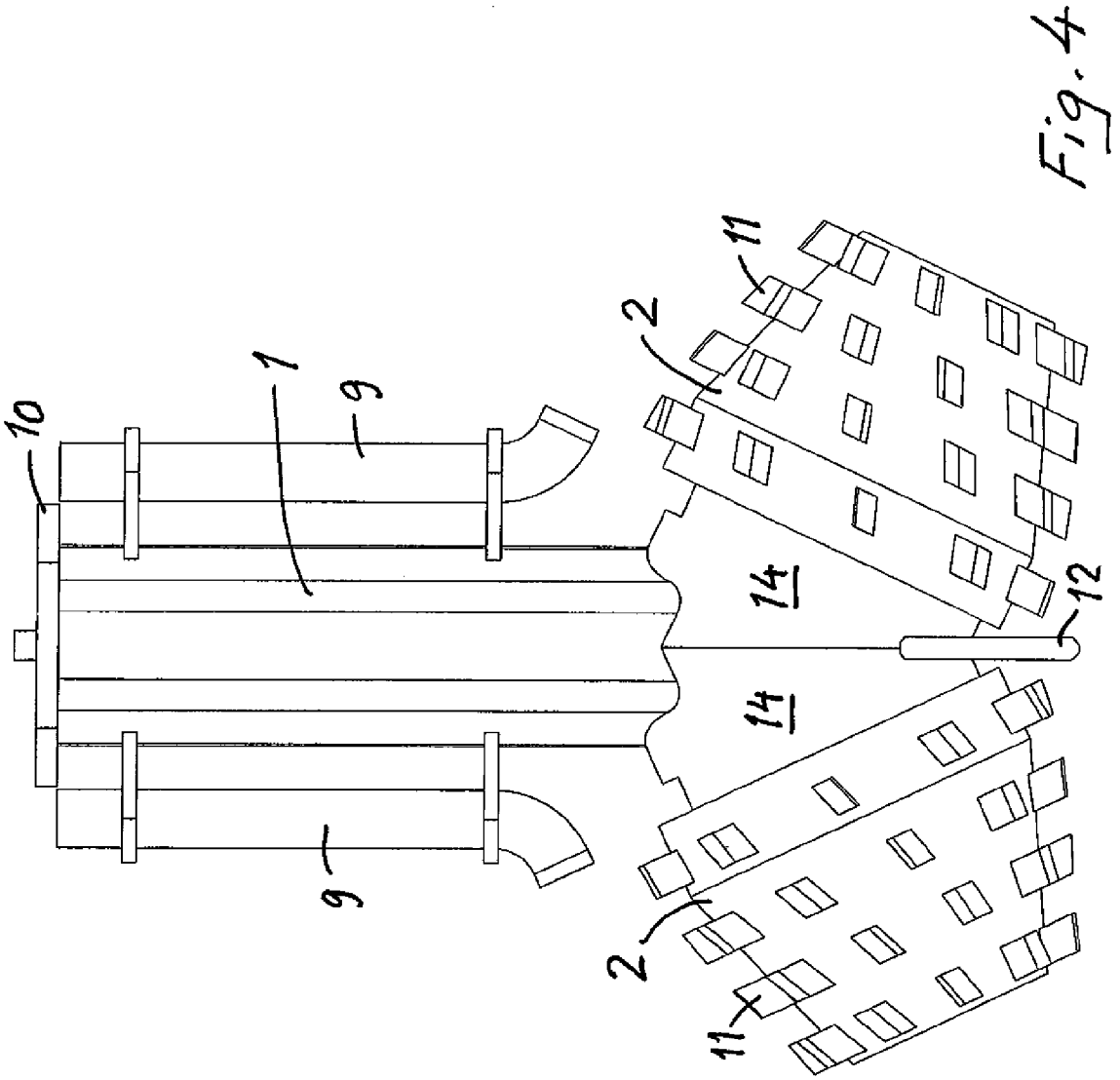

Fig. 4

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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 5732

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	JP 2007 262819 A (TAISEI CORP; TOA TONE BORING KK; SEIWA RENEWAL WORKS CO LTD) 11 October 2007 (2007-10-11) * abstract *	1	INV. E02D3/12 E02D17/13
A,P	WO 2009/118386 A1 (ALLU DEUTSCHLAND GMBH [DE]; REINHARDT WOLFGANG [DE]) 1 October 2009 (2009-10-01) * page 2; figures 1,2 *	1-9	
A,P	US 7 604 301 B1 (LANG WILLIAM J [US]) 20 October 2009 (2009-10-20) * column 2, line 27 - column 7, line 43; figures 2,5 *	1-9	
A	EP 0 906 990 A1 (IDEACHIP OY [FI]) 7 April 1999 (1999-04-07) * paragraph [0007] - paragraph [0019]; figure 2 *	1-9	

TECHNICAL FIELDS SEARCHED (IPC)

E02D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 January 2010	Geiger, Harald

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 09 17 5732

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25-01-2010

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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- US 4133397 A1 **[0003]**
- JP 2007262819 B **[0003]**