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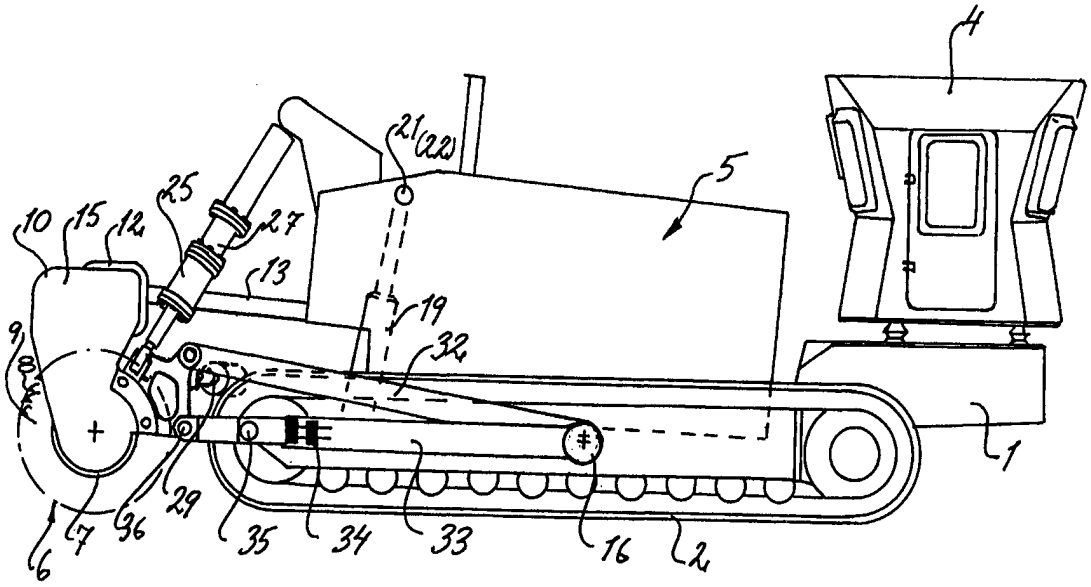
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(57) Abstract

The present invention relates to a method and a device for clearing mines deployed on or in the ground using a mechanical demining vehicle operating on the rotary cultivator principle in a way that prevents major damage to the demining tool (6) or the engine (5). The basis of the present invention is that the demining tool (6) is enabled to deflect away from large mine detonations whereby the demining tool (6) moves in coordination with the engine so that neither it nor its drive function suffers any major damage.

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DEMINING METHOD AND DEDICATED DEMINING VEHICLE

The present invention relates to a method for rapid clearance of landmines located freely on the surface of the ground or buried in the upper ground layer whereby major damage to the demining vehicle and the demining tool mounted thereon is avoided. The present invention also incorporates a dedicated design of the demining vehicle.

The expression 'landmines' used herein denotes both smaller types of anti-personnel (AP) mines as well as the significantly larger anti-vehicle and anti-tank mines.

As there is usually a mix of both types of mines in a mined zone one must be prepared to neutralise both types when demining mined zones.

To be able to neutralise buried mines of the above types the ground needs to be comprehensively worked down to a sufficient depth in the upper ground layer. Previously, most interest has been focused on military requirements for demining vehicles for rapid breaching of routes through minefields, while the final demining of minefields after the end of a conflict has been performed by the time consuming method of using probes or electromagnetic mine detectors. The latter are very reliable provided individual mines each contain at least some quantity of metal, but the number of false alarms owing to metal fragments in the ground can be considerable, especially in areas where battles have previously been fought. Electromagnetic mine detectors are, in fact, highly sensitive and require, moreover, trained personnel. This type of mine clearance is thus very time consuming and labour intensive, as is the use of probes, and is also very costly.

In latter years, however, various quarters have started to show an interest in developing mechanical mine clearance vehicles that operate in a similar way to

mechanical rotary cultivators and which, in suitable ground, have displayed a capability for clearing considerably greater areas per unit of time than has been possible previously.

Demining devices operating like rotary cultivators—by means of toothed rollers, demining discs or some other type of tool— either 'chew' or tear apart any mines in their path or cause them to detonate either in or under the demining tool. The larger types of mines, however, often cause such extensive damage to the demining tool that it must be repaired or replaced before demining operations can continue. The mounting and/or driveline for the demining tool may also be damaged and may be much more difficult to rectify than the tool itself which can usually be replaced fairly easily, but each work stoppage should preferably be avoided, especially if they involve costs for irreparable materiel.

The desire to avoid as far as possible damage to the demining tool, its mount and drive function must, however, be combined with enablement of a sufficiently large mass and force on the demining tool that it constantly reaches the desired, pre-determined operating depth. This places major—and partially contradictory—demands on the design.

The present invention now offers a combined demining tool and drive-motor mount for demining vehicles of the type herein mentioned that enables a large mass to be exerted on the demining tool while also minimising damage to the demining tool in the event of any large mine detonations in or under the tool, and that also prevents damage to the tool's drive function and engine.

As claimed in the present invention the demining vehicle's demining tool that operates in the ground similar to a rotary cultivator or, to be more precise, the mounts which carry the rotating demining tool are interconnected with the engine that drives the tool, and in the present case also drives the demining vehicle, to form a longitudinal (in relation to the vehicle) interactive unit. This unit in turn is mounted on the chassis of the demining vehicle via a torsion shaft transverse to the

longitudinal axis of the chassis which shaft is located at the same height as the engine and is so located longitudinally that a necessary part of its dead weight bears on the demining tool. The angle setting of the complete unit relative to the ground surface is in turn determined by dedicated devices that lift the ends of the demining tool that bear most of the dead weight of the unit. The tilt of the demining tool relative to the ground surface is what determines the operating depth of the tool in the ground. The mounting of the demining tool / engine unit around a torsional shaft transverse to the longitudinal axis of the chassis in combination with a lifting function journalled at the ends of the demining tool that bear most of the combined weight of the unit mean in turn that any mine detonation in or under the demining tool initiates an upwards swing of the demining tool / engine unit which will minimise the damage effect of the detonation on the demining tool itself, its mounts and drive function. The complete basic concept thus provides a method for reducing the effect of a mine detonation in or under the demining tool by means of a weighted-load counter-spring of the active system in which the engine—which must be present and must provide high output—constitutes the main constituent of the counter-weight. As the demining tool and the engine constitute a coordinate unit in the longitudinal axis of the demining vehicle, the load on the drive coupling between the engine and demining tool is also reduced.

As claimed in a preferred variant of the demining vehicle in the present invention, the demining vehicle is equipped with further devices for as far as possible eliminating the negative effects of any mine detonations on the demining tool and its mounts and engine.

The demining tool mounts in the inverted cradle supporting the demining tool have thus been designed to be spring-loaded so that some of the stresses on the demining tool caused by any mine detonation can be assimilated immediately by the mounts.

Furthermore, the demining tool cradle is united with the engine of the above mentioned coordinate unit journalled around the transverse shaft by shock absorbers

mounted between them with a great capability for assimilating stresses caused by any mine detonations.

The method and device as claimed in the present invention is defined in the Patent Claims below, and shall now be described in more detail with reference to the appended figures:

Figure 1 shows a diagonal projection of a demining vehicle as defined in the present invention,

Figure 2 shows a side projection of the same general vehicle, and

Figure 3 shows the chassis and drive tracks of the same vehicle.

Corresponding parts on the various figures have the same designation on each figure.

The demining vehicle in question comprises a chassis 1, two drive tracks 2 and 3, an armoured spring-mounted control cab 4, and an engine compartment 5 incorporating an engine which is not illustrated in detail but which drives the demining vehicle as well as the rotatable demining tool 6 mounted at the front of the vehicle. The demining tool 6 comprises a central, mainly horizontal roller 7 fitted with a large number of demining discs 9 incorporating teeth 8 around their periphery. The demining tool 6 is in turn mounted and journalled for rotation in an inverted cradle 10. As previously mentioned these mounts should preferably be sprung. Level with the horizontal cross-piece 11 of the cradle 10 there is a mitre-wheel gear 12 driven by the engine in the engine compartment via a drive shaft 13. The power output from the mitre-wheel gear 12 is a second drive shaft 14, which may be fitted with a torque limiter, that provides drive to the demining tool 6 at one outer end of the cradle 10 via an enclosed chain-drive 15. Figures 1 and 2 illustrate two alternative designs of the enclosure of the mitre-wheel gear 12 and chain-drive 15.

Propulsion of the demining vehicle over the ground is driven, as indicated previously, by the same engine as the demining tool 6, but in the version illustrated in the figures propulsion is via enclosed hydraulic motors.

The demining tool 6 can be raised and lowered and can also be inclined or tilted relative to the horizontal plane by the same motor-driven hydraulics.

As claimed in the present invention the engine compartment 5 (the '5' also denotes the engine therein) and the demining tool 6 and its cradle 10 are interconnected to form a functionally coordinate unit of previously described type in the longitudinal axis of the demining vehicle, which unit is journalled around the transverse shaft 16 which is located transverse to the longitudinal axis of the vehicle.

The transverse shaft 16 mountings on the demining vehicle chassis are designated 17 and 18 in Figure 3 whereof 18 is concealed from view in the figure.

The combined engine compartment and demining tool unit has its centre of gravity longitudinally ahead of the transverse shaft 16. This means that more than half of the combined weight of the unit is concentrated over the demining tool 6.

There are two hydraulic lift pistons 19 and 20 (20, however, is concealed in the figures) that control the operating depth of the demining tool 6 in the upper ground layer. These two hydraulic lift pistons incorporate damping functions that dampen the oscillation of the engine compartment and demining tool. The upper mounts 21 and 22 of the hydraulic lift pistons 19 and 20 are located in the combined unit, i.e. inside the engine compartment 5 (22 is concealed in Figure 2), and the lower mounts 23 and 24 are located on the chassis 1 (see Figure 3).

The demining tool 6 can also be inclined or tilted relative to the demining vehicle to enable small undulations in the upper ground layer to be followed. Tilting is controlled by two hydraulic tilt pistons 27 and 28 which also incorporate shock

absorbers 25 and 26. For lateral control of the cradle 10 of the demining tool 6 there is a further shock absorber 29 mounted between the chassis 1 and the cradle 10 designed to assimilate lateral oscillation between the chassis and cradle.

The cradle 10 of the demining tool 6 is also fitted with lateral supports, different designs of which are shown in Figures 1 and 2.

In Figure 1 the lateral support consists of a pair of tubular lateral supports 30 and 31 located on each side of the demining vehicle that are mounted via journals both in the cradle 10 and in the vehicle chassis level with the transverse shaft 16.

In Figure 2 the same lateral support function is comprised instead of a rigid beam 32 journalled in the cradle 10 and similarly journalled level with the transverse shaft 16 in which latter mounting point one end of a support beam 33 is also journalled and which incorporates al least one shock absorber 34 and whose other end incorporates a twin link 35 and 36 via which it is mounted on the cradle 10. The purpose of the twin link is to prevent twisting of the roller 7 when it is tilted.

The functioning of the complete demining vehicle is as follows. The operating depth of the demining tool 6 in the upper ground layer is controlled by the hydraulic lift pistons 19 and 20. More than half of the weight of the engine compartment 5 and demining tool 6 and its cradle 10 bear on the demining tool. When the demining tool starts to operate the demining discs 9 work down to the desired depth and as the demining vehicle moves forwards the demining tool works through the upper ground layer. The objective is that mines encountered will either be 'chewed' into small harmless fragments or will be made to detonate. The tilt function enables the demining tool to follow any undulations in the ground so that it operates at a constant depth.

If a large mine such as an anti-vehicle or anti-tank mine is made to detonate in or under the demining tool, the resultant stresses are absorbed by the demining tool 6, partially by the spring mounts in the cradle 10, partially by the shock absorbers 25

and 26 located between the cradle and the engine, and partially by an upswing by the entire engine compartment and demining tool unit.

By means of this arrangement damage to the demining tool 6 is usually restricted to only one or two demining discs 9, even in the case of very powerful mine explosions, and individual demining discs or sections thereof are relatively easy to replace. In an extreme case the complete demining tool 6 can be replaced. What is vital is that there is no damage to the cradle 10 or driveline of the demining tool.

PATENT CLAIMS

We hereby claim and desire to secure by Letters Patent the following.

1. A method whereby in the event of mine detonations caused by a demining tool (6) the risk of major damage to the demining tool (6) and its driveline (12–15) is minimised when demining with a demining vehicle designed to operate in the upper ground layer with a rotating, engine (5) driven demining tool (6) mounted at the front of the said demining vehicle and operating in the upper ground layer down to a pre-determined depth with the object of fragmenting mines in the ground and/or causing mines in its path to detonate w h e r e i n the demining tool (6) via the mount or mounts in which it rotates interconnected with the engine (5) driving the rotation to form a longitudinally coordinate unit (5–10) relative to the demining vehicle which unit is able to pivot around a transverse shaft (16) located in the vehicle chassis (1) at that part of the unit (5, 10) comprised of the engine (5) and which transverse shaft (16) is so located at a position along the longitudinal axis of the said unit (5–10) that the unit is front-heavy since more than half its dead weight is located ahead of the said transverse shaft (16) in the direction of operation of the demining vehicle and whereby the tilt position of the said unit (5–10) relative to the chassis (1) of the demining vehicle, that also determines the operating depth of the demining tool (6) in the upper ground layer, is in turn controlled by the hydraulic lift pistons (19, 20) operating between the chassis (1) and the unit (5–10) and designed to compensate for the front-heaviness of the unit (5–10) to enable the demining tool (6) to achieve the desired operating depth.

2. A method as claimed in Claim 1 w h e r e i n the demining tool (6) while interconnected with the engine (5) in the longitudinal axis of the demining vehicle to form a coordinate unit (5, 10) it is possible to tilt the said unit within a certain angle range laterally relative to the horizontal plane to enable the demining

tool (6) to be tilted to follow any minor undulations in the ground surface while the demining vehicle is moving forwards.

3. A method as claimed in Claim 1 or 2 wherein each type of sudden movement by the demining tool (6) and the coordinate engine (5) is dampened by shock absorbers (25, 26, 29, 34) operating in respective directions.

4. A method as claimed in Claims 1, 2 or 3 wherein the tilt of the unit (5, 10) relative to the chassis (1) of the demining vehicle is controlled by hydraulic lift pistons (19, 20) arranged between them to compensate for the front-heaviness of the said unit.

5. A demining device as claimed in any the methods claimed in Claims 1–4 for clearing landmines on or in the upper ground layer and down to a pre-determined depth thereunder of the type that comprises a self-propelled demining vehicle the front part of which incorporates an engine driven rotating demining tool (6) operating in the upper ground layer down to a pre-determined depth below the surface of the ground that fragments into harmless pieces or detonates any mine in its path wherein the engine (5), driving the rotation of the demining tool (6) via the journalled mounts in which the said demining tool is mounted to enable rotation, is interconnected in the longitudinal axis of the demining vehicle with a coordinate unit (5, 10) which is in turn journal mounted to be tiltable around a transverse shaft (16) mounted in the demining vehicle chassis (1) lateral to the joint longitudinal axis of the demining vehicle and the coordinate unit (5, 10) which transverse shaft (16) is so located longitudinally that more than half the unit's (5, 10) weight is located ahead of the said transverse shaft (16) in the direction of operation of the demining vehicle and whereby between the said unit (5, 10) and the demining vehicle chassis (1) devices are arranged that control their tilt relative to each other (19, 20).

6. A demining device as claimed in Claim 5 wherein the said devices (19, 20) for controlling the tilt of the coordinate unit (5, 10) and the chassis (1)

relative to each other and whereby the operating depth of the demining tool (6) is also controlled by the hydraulic lift pistons (19, 20) located between the said unit (5, 10) and the chassis (1) ahead of the transverse shaft (16).

7. A demining device as claimed in Claim 5 or 6 wherein the interconnection between the engine (5) and the demining tool (6) is so designed that the said demining tool, which preferably is in the form of a disc or roller demining device (6–9) mounted lateral to the direction of operation and longitudinal axis of the demining vehicle, can be inclined or tilted relative to the horizontal plane to enable the demining tool (6) to follow minor undulations in the ground.

8. A demining device as claimed in any of the Claims 5–7 wherein shock absorbers (25, 26, 29, 34) are mounted between the mounting points of the demining tool (6), the coordinate unit (5, 10) as such, and the demining vehicle chassis (1) to prevent any sudden movements to the demining tool (6) and its coordinate unit (5, 10).

9. A device as claimed in any of the Claims 5–8 wherein the demining tool (6) that consists of a toothed, demining roller (7–9), arranged lateral to the actual demining vehicle, the outer periphery of which demining roller may be, and preferably is, divided into discs with a combined width greater than that of the demining vehicle and whose drive is transmitted from the engine by a drive shaft (13) located along the central longitudinal axis of the demining tool / engine around which the demining tool (6) and its mounts can be tilted by the coordinated hydraulic tilt pistons (27, 28) mounted between the demining tool cradle (10) and the engine compartment (5), while the cradle (10) end-plates are supported relative to the lateral direction of the demining vehicle by the support guides and shock absorbing devices (30, 31 and 33, 34) located between the end-plates of the cradle(10) and the demining vehicle chassis (1).

10. A demining device as claimed in any of the Claims 5–9 wherein the demining tool (6) mounts in which it is journalled to enable rotation within its

cradle (10) are designed to be able to assimilate and dampen certain loads caused by detonating mines while the cradle (10) is in turn mounted on the engine compartment (5) via shock absorbers (25, 26, 29, 34) each of which is designed to assimilate and dampen further loads while the combined motion of the demining tool (6) and the engine (5) enable any residual loads from a mine detonation to be dampened.

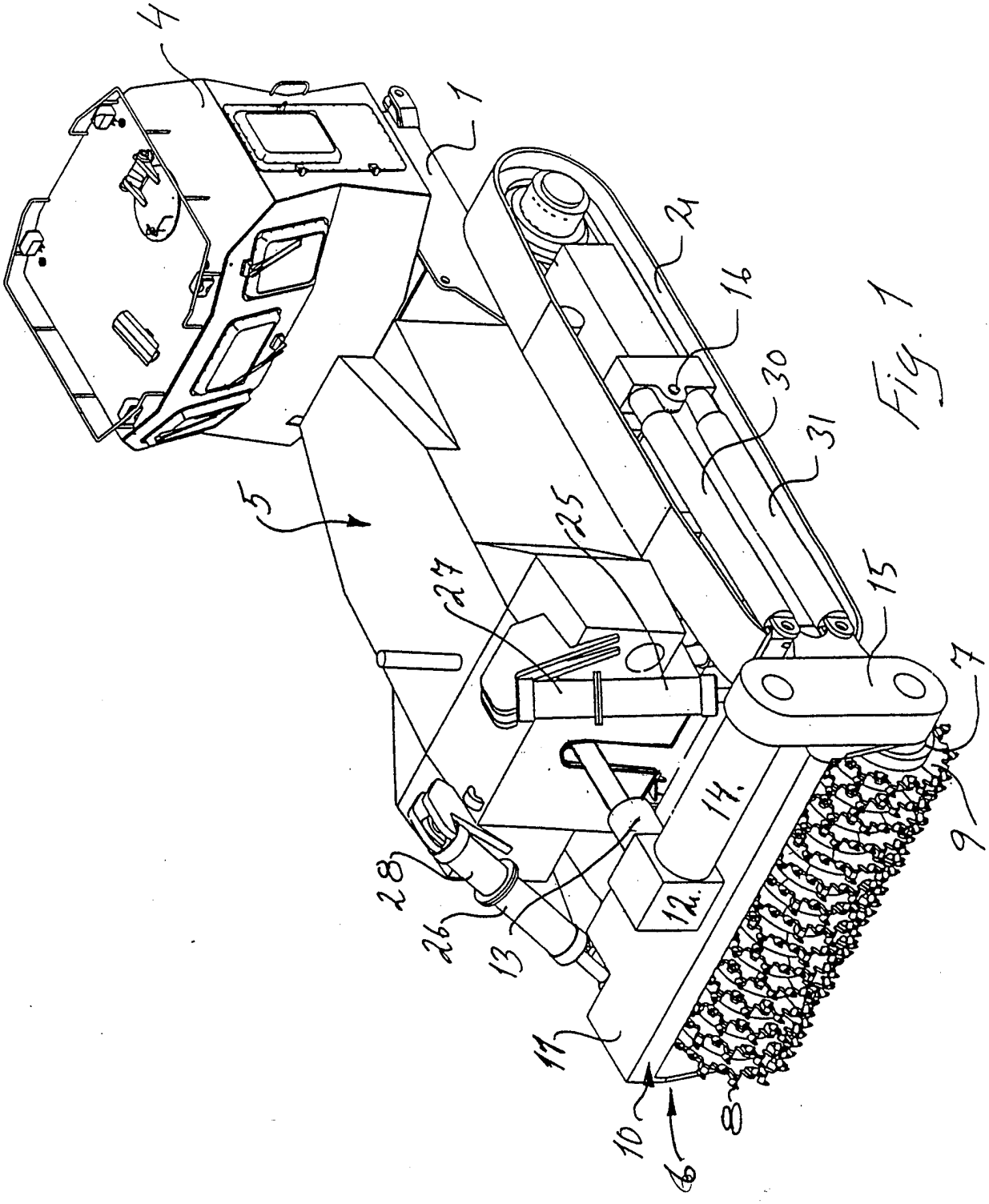


Fig. 1

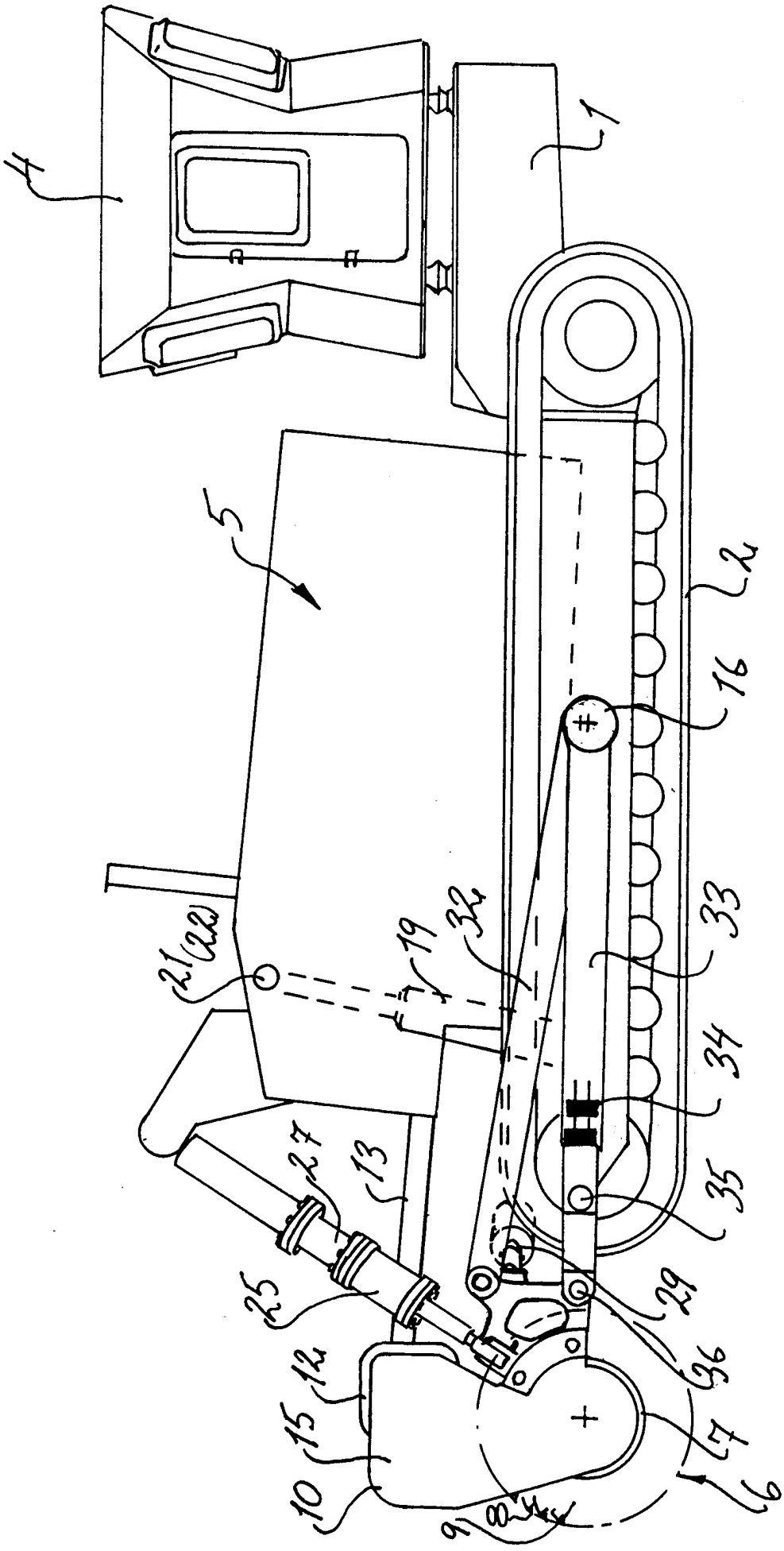


Fig. 2

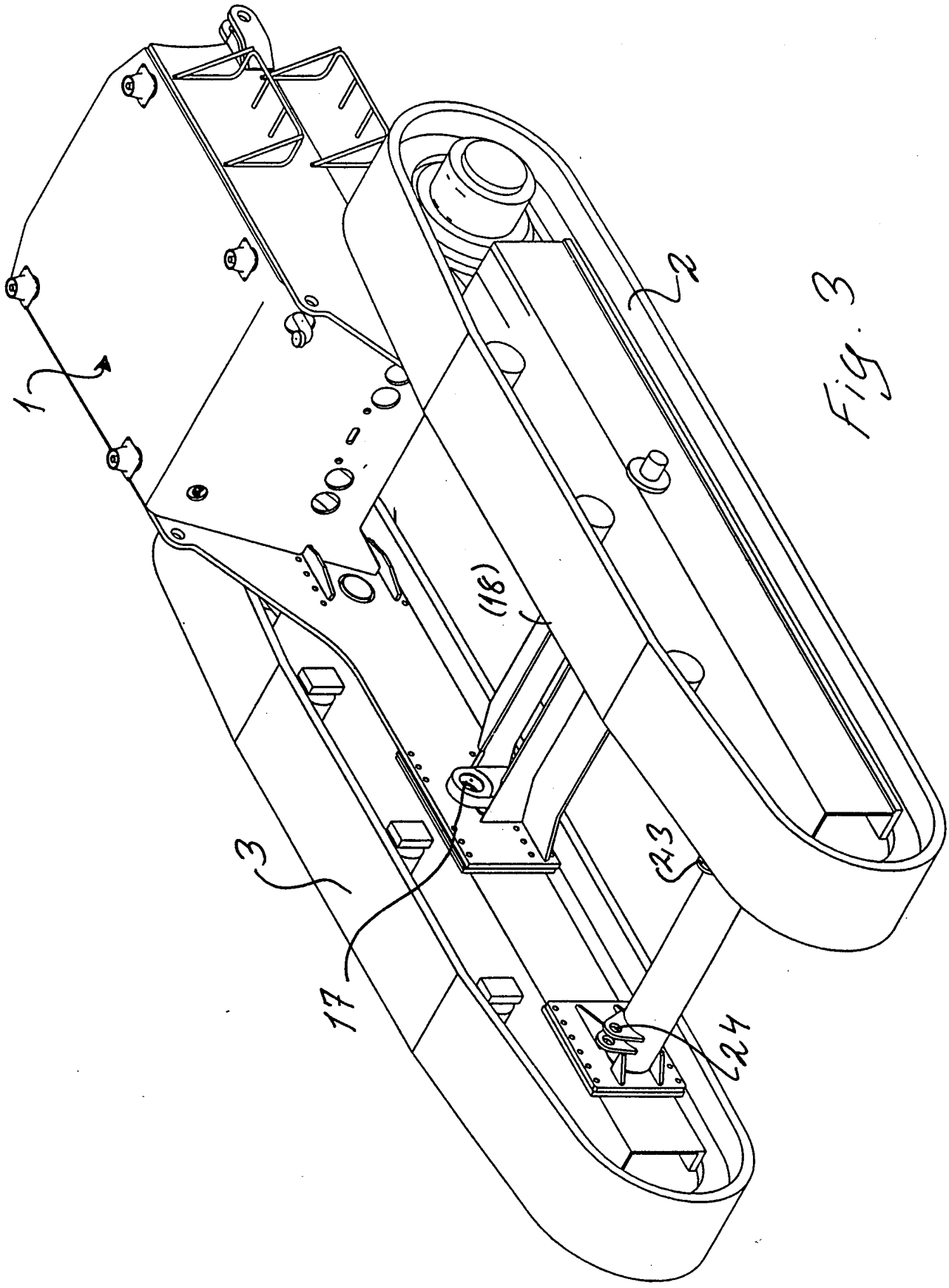


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 98/01150

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: F41H 11/12 // F41H 11/16
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)

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

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	SE 505197 C2 (TONSTAD MASKINFABRIKK AS ET AL), 14 July 1997 (14.07.97) --	1-10
Y	SE 505190 C2 (TONSTAD MASKINFABRIKK AS ET AL), 14 July 1997 (14.07.97) --	1-10
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Y	DE 2318055 B2 (LICENTIA PATENT-VERWALTUNGS-GMBH), 20 March 1975 (20.03.75) --	1-10

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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PCT/SE 98/01150

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

27/07/98

International application No.
PCT/SE 98/01150

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