

CABLE PLOUGH

The invention relates to cable-laying devices, and particularly concerns a cable plough consisting of a chassis which moves over the ground where a cable is to be laid, and on which a plough element consisting of a combination of a displacing part (ploughshare) and a cable-laying housing is fixed at a pivot point on a pivot arm, wherein the plough element can be adjusted by rotation of the pivot arm from a raised position to a preset ploughing position and can additionally pivot around the said pivot point in a plane lying parallel with the ploughing direction.

Cable ploughs presently manufactured by the applicant in numerous variants are suitable for laying fairly light cables in the case of narrow and confined cable-laying routes. The cable-laying depth is generally about 80 cm. The cable to be laid is fed continuously and laid through the cable-laying housing disposed behind the ploughshare. A cable storage drum can be mounted on the chassis of the cable plough or, if required, on the tractor vehicle.

Cable ploughs of this kind are generally used on land for light cables. In the present case, an object of the invention is to provide a cable plough which also handles fairly large cable diameters and can be used especially over difficult terrain and in particular under water in shallows. In areas of this kind the ground is sometimes very easy to penetrate, since it is mud or silt; however, coral or rock formations can also occur which offer considerable resistance to the displacing part of the plough. In this case it is not necessary to maintain the ploughing depth of 80 cm, since a reduced depth of penetration is adequate.

Accordingly, an object of the present invention is to design a cable plough of the type referred to above so that the plough automatically adjusts to an appropriate cable-laying depth over difficult terrain or ground in which very soft and very hard formations alternate, while the pulling resistance of the plough varies automatically according to the ground conditions.

According to the present invention, a cable plough consists of a chassis adapted to move over the ground having mounted thereto a pivot arm extending rearwardly from a first pivot point adjacent a front end of the chassis, on which arm a plough element consisting of a combination of a displacing part (ploughshare) and a cable-laying housing is fixed at a second pivot point adjacent the free end of the pivot arm, wherein the plough element can be moved by rotating the pivot arm from a raised position to a lowered, ploughing position, the plough element being capable of pivotal motion about the said second pivot point in a plane parallel to the direction of ploughing, and wherein when the ploughing element is pivoted relative to the pivot arm about the second pivot point and the pivot arm and plough element are forced out of the lowered ploughing position, the plough element is subjected to a counteracting turning moment by means of a suitable device which forces it back towards the lowered, ploughing position.

This counteracting turning moment may be constant, or it may alternatively be regulated according to the angle of deflection of the plough element relative to the pivot arm, and here the nature of the ground formations in question must be taken into account. When a hard area of ground is encountered, the plough element pivots out of the preset ploughing position and in so doing penetrates into the ground to a lesser depth as the angle of the cutting edge of the ploughshare alters in relation to the direction of ploughing and lifts the plough out of the furrow.

It has been found that the angle between the cutting edge of the ploughshare and the ground surface should preferably lie between 30 and 35° in the lowered ploughing position.

Preferably, the device for exerting a counteracting turning moment on the plough element consists of a piston and cylinder arrangement which is operated hydraulically and buffered with a pressure reservoir, preferably a pneumatic reservoir.

In this case, the chassis preferably consists of a sledge framework with two runners.

In addition, the weight and weight distribution of the "pivot arm and plough element" combination of elements can be adjusted so that when the ploughshare is tilted back on contact with harder ground, the entire pivot arm rotates about the first pivot point to lift the plough element, and consequently a reduced ploughing depth is set according to the movement and pivoting of the ploughshare about the second pivot point on the pivot arm.

This results in an advantageous automatic adjustment of the ploughshare according to the depth of ploughing and penetration of the particular ground required at any time.

An example of the present invention will now be described in detail with reference to the accompanying drawings, in which:

Figure 1 shows a side view of a cable plough; and

Figure 2 shows a plan view of the cable plough of Figure 1.

Referring now to the Figures, a cable plough, denoted by the reference number 1, is shown in a side view in Figure 1. Here, the pivoting parts are shown in the lowered ploughing position in heavy lines, whereas deflected positions of these parts are shown in fine lines. The cable plough shown in Figure 1 is designed in particular for underwater operation in shallow areas. In this case, a cable 8 on a cable drum 9 is fed via a cable guide, which will be described in detail below, to a cable-laying housing 5 from which it is laid in a ploughed trench.

In this particular case the cable plough 1 is constructed on a sledge-like chassis 2 which has two runners 2', 2" which come together in a bow 10 of the chassis 2 and terminate in a bow fairing 11. A towing yoke 12 is also fixed to the bow fairing 11, allowing towing cables or chains to be attached either at a single central towing eye, or at towing eyes positioned at the ends of the yoke 12. Extending supports 24, 24' are also provided to prevent the plough from tipping sideways on uneven ground.

The chassis 2 supports a mounting frame 13 which carries a hinge 14 adjacent the forward end of the chassis 2. The hinge 14 is the mounting for a pivot arm 6 which lies centrally above the runners 2', 2" and extends rearwardly from the hinge 14. In the normal

position the pivot arm 6 lies horizontally on the chassis 2. It can adopt a variety of positions raised above the horizontal, and two of such positions may be fixed. An arch-like supporting device 15 is provided for this in which the pivot arm 6 can be locked in one of a number of raised positions with cross-bars (shown by broken circles in Figure 1).

A plough element 3 is located at the rearmost end of the pivot arm 6. The plough element 3 consists of a combination of a displacing part 4, also called a ploughshare, and the cable-laying housing 5 fixed immediately behind it. The upper part of the plough element 3 forms a feed funnel 16 which receives the cable 8 and guides it downwards into the mouth of the cable-laying housing 5.

As can be seen in Figure 1, the plough element 3 is suspended pivotably at a pivot point 7 with its pivoting plane parallel with the direction of ploughing. It can also be seen from Figure 2 that the set angle θ which the cutting edge 17 of the ploughshare makes with the vertical in the lowest ploughing position (shown in solid line) lies between 30 and 35°. In front of the feed funnel 16 the plough element 3 is extended to form a lever arm which is rigidly connected to the displacing part and the cable-laying housing. At one end the lever arm has a hinge mounting 18 provided with an attachment for a piston rod 19 which goes into a cylinder 20. In turn, the cylinder 20 is mounted on the pivot arm 6 by a pin 25 at the end of the cylinder 20 remote from the plough element. As can be seen, positioned on either side of the piston and cylinder arrangement 19, 20 there are two pressure gas reservoirs 21, 22 mounted on the pivot arm 6 and connected to the cylinder 20 by means of fluid lines (not shown). When the piston rod 19 moves into the cylinder 20, fluid is displaced from the cylinder to the pressure gas reservoirs 21, 22, which are configured as so-called diaphragm reservoirs, and act both as resilient counter pressure generators and as shock absorbers. Normally, the pressure gas reservoirs 21, 22 act on the piston and cylinder system 19, 20 so that the lever arm is urged rearwards to rotate the plough element 3 to its position shown in solid lines in Figure 1, described as the lowered ploughing position.

However, with the design described above, when the plough element is pivoted about the pivot point 7 when forced out of the preset ploughing position, the plough element 3 experiences a counteracting turning moment from the piston and cylinder assembly which urges the plough element 3 back into the preset ploughing position.

When the cable plough 1 described above is used, this means that at the normal depth of penetration of the cable plough in its lowest ploughing position, which lies between 50 and 80 cm for example, and the displacing part 4 resists the normal counter force with the aid of the device described above. However, if the force acting on the the plough element increases, the plough element 3 pivots in an anti-clockwise direction (as in Figure 1) and in so doing clearly penetrates to a lesser depth below the level of the ground. Here, the supporting arm 6 may also be pivoted upwards bit by bit if the force on the plough element reaches a sufficiently high value. However, it is also possible to lock the pivot arm in a specific raised position initially in order to limit the depth of penetration of the plough. The automatic adjustment of the depth of the plough is clearly related to the set angle " β " which is established empirically and allows the depth of the plough to be set as desired according to the nature of the ground.

The level of the counteracting turning moment will depend primarily on the dimensions of the plough and on the desired depth of penetration, which is again a function of the design of the plough element, the breadth of the furrow and similar parameters which will be familiar to one skilled in the art.

In the present case, the cable plough is lowered onto the ground or sea bed and pulled by a powerful towing ship. Tests have revealed that satisfactory ploughing results can be obtained using the plough described above.

CLAIMS

1. A cable plough consisting of a chassis adapted to move over the ground having mounted thereto a pivot arm extending rearwardly from a first pivot point adjacent a front end of the chassis, on which arm a plough element consisting of a combination of a displacing part (ploughshare) and a cable-laying housing is fixed at a second pivot point adjacent the free end of the pivot arm, wherein the plough element can be moved by rotating the pivot arm from a raised position to a lowered, ploughing position, the plough element being capable of pivotal motion about the said second pivot point in a plane parallel to the direction of ploughing, and wherein when the ploughing element is pivoted relative to the pivot arm about the second pivot point and the pivot arm and plough element are forced out of the lowered ploughing position, the plough element is subjected to a counteracting turning moment by means of a suitable device which forces it back towards the lowered, ploughing position.
2. A cable plough, according to Claim 1, wherein in the lowered ploughing position the cutting edge of the ploughshare makes an angle of between 30 and 35° with the vertical.
3. A cable plough as claimed in Claim 1 or Claim 2, wherein the device for generating a counteracting turning moment consists of a hydraulic piston and cylinder arrangement buffered with a pressure reservoir.
4. A cable plough as claimed in Claim 3, wherein the hydraulic piston and cylinder acts between the pivot arm and the plough element.
5. A cable plough according to any preceding Claim, wherein the chassis consists of a sledge framework with two runners.



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6. A cable plough according to any preceding Claim, wherein the pivot arm can be locked in at least one position above the lowest position.

7. A cable plough substantially as herein described with reference to Figures 1 and 2 of the accompanying drawings.
