United States Patent [19]

Clayton

[11] **3,724,108**

[45] **Apr. 3, 1973**

[54] PLOW DEPTH ADJUSTMENT APPARATUS

[75] Inventor: **Eric Arthur Clayton,** Stockton-on-Tees, England

[73] Assignee: **Hadswell Yates Developments Limited,** Yorkshire, England

[22] Filed: **Jan. 29, 1971**

[21] Appl. No.: **110,821**

[52] **U.S. Cl.** **37/193,** 172/483, 172/668, 172/699

[51] **Int. Cl.** **E02f 5/18**

[58] **Field of Search** 37/193, 98; 61/72.6; 172/699, 172/700, 478, 483, 484, 668

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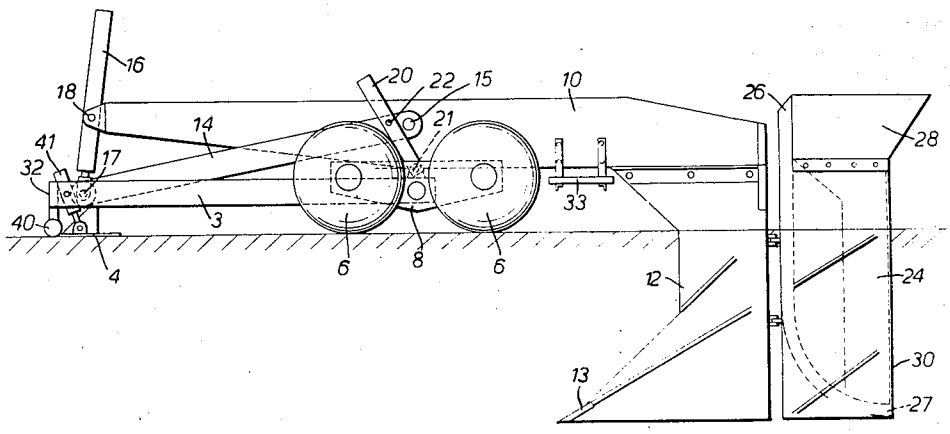
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Primary Examiner—William B. Penn
Assistant Examiner—Clifford D. Crowder
Attorney—Watson, Cole, Grindle & Watson

[57] **ABSTRACT**

A mole plough comprises a wheeled carriage on which is pivotally mounted an elongated rigid beam carrying at its rear end a coulter provided with a mole. The beam is pivotally connected at a point intermediate in its length to the rear ends of a pair of forwardly-extending tension links whose front ends are pivoted to the front end of the carriage. The links thus transmit the majority of the tractive force from the carriage to the beam and thence to the coulter and mole. The beam is supported at an adjustable height by means of a pair of pivoted raising rams acting between the carriage and the links near their rear ends. At its front end the beam is provided with a grading control ram acting between the front end of the beam and the front end of the carriage, extension and contraction of the grading control ram altering the height of the front end of the beam relatively to the carriage.

13 Claims, 4 Drawing Figures



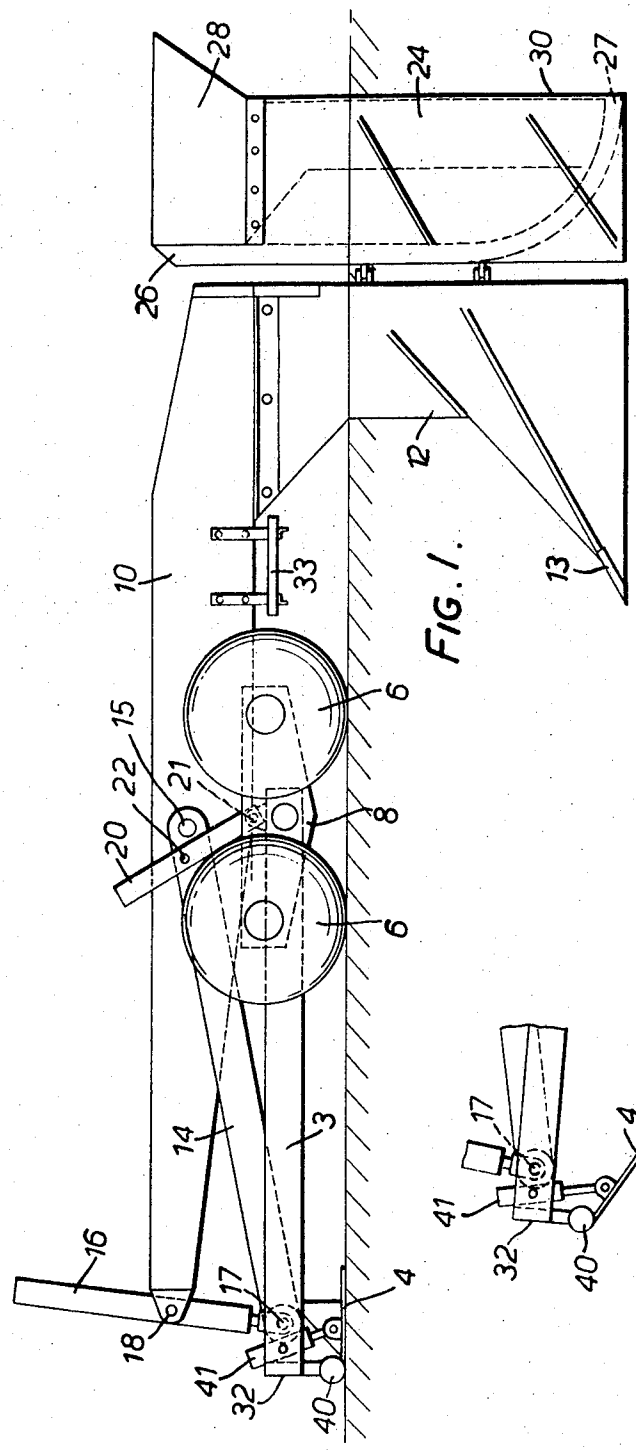


FIG. 1.

FIG. 1A.

INVENTOR
ERIC ARTHUR CLAYTON

BY
Watson, Cole, Grindle & Watson
ATTORNEY

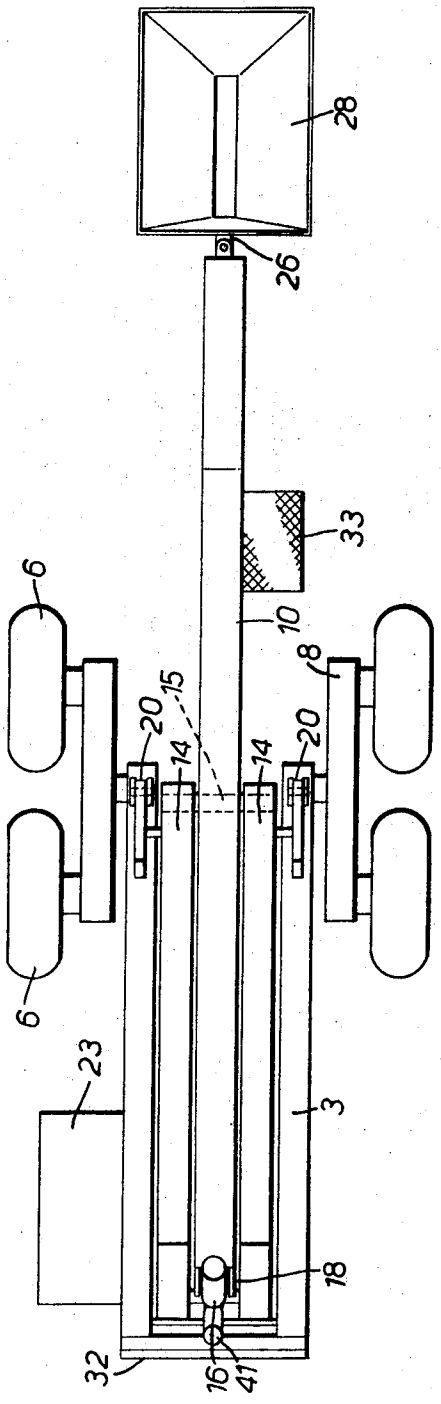


FIG. 2.

INVENTOR
ERIC ARTHUR CLAYTON

BY
Watson, Cole, Grindle & Watson
ATTORNEY

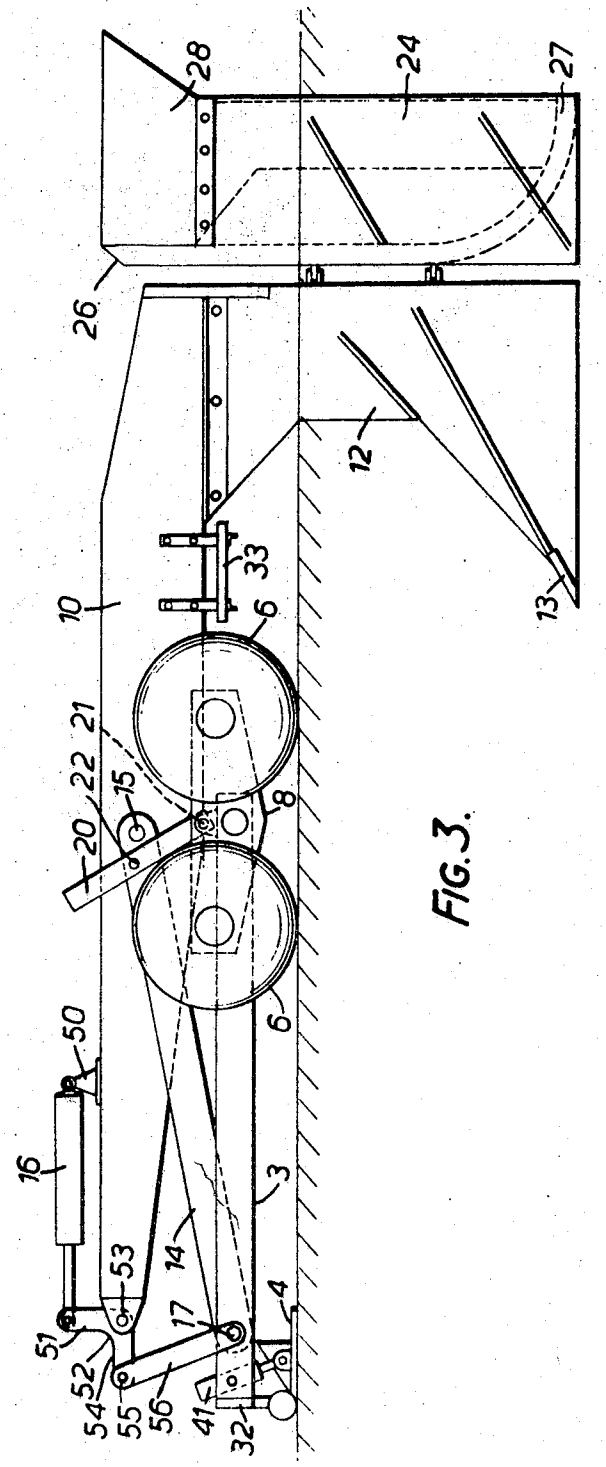


FIG. 3.

INVENTOR
ERIC ARTHUR CLAYTON

BY
Watson, Cole, Grindle & Watson
ATTORNEY

PLOW DEPTH ADJUSTMENT APPARATUS

This invention relates to mole ploughs which can be employed to lay piping, ducts, or other conduit means in the ground — for example, drainage tubes, cable ducts and water supply piping — where it is required to regulate the gradient or level at which the conduit means are laid.

When a run of drainage tubing, for example, is being laid, it is important to control its gradient as it is placed in position so that water collected in the laid pipe will run freely to its outlet end. On level land this presents little difficulty, but if the line of the piping crosses an undulating ground surface, the carriage or chassis on which the plough coulter is mounted will, in following this surface, produce a similar undulation in the level of the pipe as it is laid if the draught of the coulter relative to the carriage remains unchanged. The object of the present invention is to provide an improved means for mounting the coulter on the carriage and for controlling the coulter draught whereby this defect can be avoided.

According to the invention, a mole plough comprises a wheeled carriage on which is mounted a longitudinally rigid beam having a coulter secured to and depending from its rear, the beam having pivotally connected to the carriage through a forwardly-extending tension-transmitting link whose rear end is pivoted to the beam and whose leading end is pivoted to the carriage, the link being arranged to transmit the major part of the tractive effort between the carriage and the coulter, and a displacement control device being provided to vary the draught of the coulter relative to the carriage, said device being operable to raise and lower the forward end of the beam relative to the carriage.

Preferably, the pivotal connection of the tension link to the beam is at an intermediate point along the length of the beam, and the displacement control device is connected to the beam at or adjacent the forward end of the beam.

Conveniently, the displacement control device comprises a fluid pressure ram that may be connected directly or indirectly to the beam. For example, where the ram is pivoted directly to the beam, with said pivot located at or adjacent the forward end of the beam, the ram axis can be arranged to extend transversely to the beam to a second pivot connection with the carriage or with the tension link, extension and contraction of the ram varying the distance between its pivot connections and so displacing the forward end of the beam upwardly and downwardly.

The plough may be provided with a further fluid pressure ram, referred to as the raising ram, to raise the coulter from the ground, and to facilitate such a raising operation the tension link can be constructed as one or more rigid struts which is or are also able to transmit to the carriage a compression thrust from the weight of the raised beam. The raising ram preferably has a first pivot connection with the carriage and a second, upwardly-displaceable pivot connection at or adjacent said first pivot connection between the tension-link and the beam.

The invention may be carried into practice in various ways, but two specific embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings, wherein:

FIG. 1 is a side elevation of a mole plough;

FIG. 1A is a fragmentary view of the front end of the mole plough showing its front supporting skid tilted upwardly;

FIG. 2 is a plan view of the mole plough of FIGS. 1 and 1A, and

FIG. 3 is a side elevation of a modified embodiment of mole plough.

In the embodiment of FIGS. 1 and 2, the mole plough is of the self-levelling type and comprises a carriage including a chassis 3 supported on a front skid 4 and on two pairs of rear wheels 6 mounted to a bogie 8 pivoted to the chassis frame. The chassis 3 carries a supporting beam 10 from the overhanging rear end of which depends a blade-like coulter 12 of the plough, the coulter 12 having a mole 13 at its foot. The beam 10 is not secured directly to the chassis 3, but instead the front ends of a pair of rigid tension-carrying links 14 are pivoted to the front end of the chassis 3, and the rear ends of the links 14 are pivoted to the beam 10 at an axis 15 located at an intermediate point along the length of the beam, the links 14 having only a slight inclination to the horizontal when the coulter 12 is in a working position in the ground below the level of the chassis.

A hydraulic control ram 16 for grading control is pivoted to the front end of the chassis co-axially with the front pivot 17 of the links 14, and the cylinder of the ram 16 is pivoted to a fork 18 on the front end of the beam 10. The opposite end of a further pair of hydraulic rams 20 are pivoted respectively at 21 and 22 to the chassis 3 to the rear ends of the links 14 adjacent their connection to the beam 10, for the purpose of raising the beam to lift the coulter 12 clear of the ground.

A motor and pump unit for the hydraulic rams 16 and 20 is not shown, but is mounted on a platform 23 of the chassis. Also provided but not illustrated is a conventional reel carrier on the chassis 3 for holding a coil of flexible drainage pipe (for example made of polyvinyl chloride) that is to be fed to a dispenser 24 pivoted to the rear of the coulter 12. A conduit 26 is incorporated in the dispenser 24 and extends down through the dispenser from above ground level to a rearwardly-directed mouth 27 located at the bottom of the rear edge of the dispenser 24 at the level of and behind the mole 13. The flexible pipe can be fed down through the conduit 26 into the ground. The dispenser 24 also includes means for laying grit on top of the pipe emerging from the mouth 27, said means inoluding a hopper 28 and a slidably adjustable discharge gate 30.

When the coulter 12 has been raised clear of the ground by the rams 20, the plough can travel on its wheeled bogie, a cross beam 32 at its front end then being connected to a trailer hitch on a towing vehicle to hold the skid 4 clear of the ground. In this condition the tension links 14 are inclined at a larger acute angle to the horizontal, and hence they are able to assist in supporting the raised beam 10, by transmitting to the front of the chassis 3 a thrust component due to the weight of the beam.

When the coulter 12 has been lowered into the ground for a drain-laying operation, the rams 20 have their control connections in a neutral position so that they are permitted to expand a contract lengthwise freely in response to any axial force applied to them. While they are so connected in neutral, the control ram

16 is operated to determine the depth of the coulter relatively to the chassis as it is drawn through the ground. Extension of the ram 16 tends to swing the beam in the clockwise direction according to FIG. 1 about the rear pivot 15 of the links 14 but, because of the self-levelling characteristic of the coulter, as the machine moves forwards the coulter 12 due to the ground reaction forces exerts a moment on the beam 10 as a result of this displacement of the beam that causes a counter-clockwise pivoting of the links 14 with the result that the beam remains in substantially the same orientation but at a higher level, with the coulter raised nearer the level of the chassis. Retraction of the ram 16 similarly lowers the beam and the colter relatively to the chassis.

As a drain is being laid therefore, an operator travelling on a platform 33 fitted to the beam is able to view two level marks fixed at spaced positions on the ground along the line of travel, together with a sighting mark carried by the beam 10 and, by controlling the extension and contraction of the ram 16 so that all three marks are kept coincident, he maintains the coulter 12 at a steady depth in relation to the line defined by the fixed level marks. The positions of these two marks therefore determine the grading of the laid drain, which can be maintained constant irrespective of any undulations in the surface of the ground being traversed by the plough.

Because of the dimensions and arrangement of the links 14 relative to the beam 10, during a ploughing traverse they remain in a position close to the horizontal over a range of depth adjustment. Consequently, they carry as a tensile force by far the greater part of the total tractive effort between the towing bar 32 of the chassis 3 and the coulter 12. The ram 16 is therefore substantially relieved from transmitting any of this force and it bears little or no force acting transversely to its axis while, in addition, the pressure force in it can be kept to a minimum to assist accurate control of the coulter. It will also be noted that the tractive effort will be applied to the plough through the towing point on the cross bar 32 at the front end of the chassis which always remains close to the ground, independently of the level of the coulter and the movement of the beam 10.

The front skid 4 is pivotally attached at 40 to the front end of the chassis 3, and the attitude of the skid relatively to the chassis can be varied pivotally by means of a hydraulic ram 41 acting between the skid and the chassis. Thus the skid can be moved by the ram 41 between its position shown in FIG. 1 in which it is approximately parallel to the chassis 3, and its position shown in FIG. 1A in which it is tilted upwardly.

The control of the attitude of the skid 4 by the ram 41 serves three purposes. Firstly the skid can be set to a suitable angle of tilt which will ensure that it planes over the surface of undulating ground rather than ploughing through it, when the machine is in use. Secondly the skid can be used as an additional ram-controlled grading means. Thirdly, the skid enables the front end of the chassis 3 to be raised by the tilting of the skid, to facilitate the attachment of the chassis to a towing vehicle for moving the plough to a new location.

In an alternative arrangement illustrated in FIG. 3, the control ram 16 is located above and substantially parallel to the forward part of the beam 10, it having a rear pivot to a lug 50 projecting upwardly from the beam 10 and a forward pivot to the upright arm 51 of a bell crank lever 52 pivoted at its center 53 to the forward end of the beam 10. The other arm 54 of the lever 52 extends forwards from that center pivot 53 and is pivoted at 55 to the upper end of a link 56 whose lower end is pivoted at 17 on the front of the chassis 3. In other respects the plough of this embodiment is similar to that of FIGS. 1 and 2, and similar parts are given the same reference numerals. Since in the arrangement of FIG. 3 the tension-carrying links 14 are disposed similarly to those in the embodiment of FIGS. 1 and 2, they again transmit the major part of the tractive effort to the beam 10, and the control ram 16 raises and lowers the beam by pivoting the bell crank lever 52. The operation of this embodiment is generally similar to that of FIGS. 1 and 2.

In either of the arrangements described, it would be possible to connect the control ram 16 between the beam 10 and the tension-carrying links 14 or between said beam and the chassis 3 to give a similar result, providing that, in the second instance, as shown, the connection to the chassis 3 is on the same pivot pin by which the links are attached.

What we claim as our invention and desire to secure by Letters Patent is:

1. A mole plough comprising a carriage, an elongate rigid beam having a coulter rigidly secured to and depending from its rearward end, means for moving said coulter between a transporting position and a working position, a forwardly extending tension-transmitting linkage pivotally connecting said beam to said carriage so that said beam is substantially parallel to said carriage, said linkage having a rearward end pivotally connected to said beam and a forward end pivotally connected to said carriage and being at a small angle to the horizontal when said coulter is in its working position so as to transmit the major part of the tractive effort between said carriage and said coulter, and a displacement control device for varying the draught of said coulter relative to said carriage, said device acting between said beam and said carriage and being operable to raise and lower said forward end of said beam relative to said carriage.

2. A mole plough according to claim 1 wherein the pivotal connection of the tension-transmitting linkage to the beam is located at an intermediate region in the length of the beam.

3. A mole plough according to claim 1 wherein the displacement control device is connected to the beam at the forward end of the beam.

4. A mole plough according to claim 1 wherein the displacement control device comprises a fluid pressure ram pivoted to the beam.

5. A mole plough according to claim 4 wherein said ram has a longitudinal axis which extends transversely to the beam.

6. A mole plough according to claim 5 wherein the ram has a further pivot connection to one of the carriage and the tension-transmitting linkage, extension and contraction of the ram varying the distance between its pivot connections.

7. A mole plough according to claim 1 wherein the displacement control device comprises a fluid-pressure ram pivoted to the beam, the axis of the ram extending

above the length of the beam, and wherein the ram has a further pivot connection to one arm of a bell-crank lever pivoted at its fulcrum to the beam, the other arm of the bell-crank lever being coupled through an intermediate link to the carriage.

8. A mole plough according to claim 1 wherein said means for moving said coulter between its transporting position and its working position comprises a raising ram actuated by fluid pressure and mounted on the carriage.

9. A mole plough according to claim 8 wherein the raising ram has a first pivot connection with the carriage and a second, upwardly displaceable pivot connection adjacent the rear pivotal connection of the tension-transmitting linkage to the beam.

10. A mole plough according to claim 9 wherein the second pivotal connection of the raising ram attaches the ram to the tension-transmitting linkage.

11. A mole plough according to claim 1 wherein the plough is provided with a traction member on the carriage below the level of the beam, to which traction member a towing vehicle can be coupled.

12. A mole plough as claimed in claim 1, wherein the carriage is provided at its forward end with a ground-engaging support which is vertically-adjustable relatively to the carriage.

13. A mole plough as claimed in claim 12 in which the ground-engaging support comprises a skid plate pivoted at its forward edge about a transverse pivotal axis to an anchorage on the forward end of the carriage and adjustable by being tilted about and downwardly below the said pivotal axis.

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