(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 409 797 B1

(12) EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:
23.04.2014 Bulletin 2014/17

(21) Application number: **01978001.4**

(22) Date of filing: **19.10.2001**

(51) Int Cl.:
E02F 5/04 *(2006.01)* ***E02F 5/10*** *(2006.01)*
E02F 3/06 *(2006.01)*

(86) International application number:
PCT/AU2001/001349

(87) International publication number:
WO 2002/033181 (25.04.2002 Gazette 2002/17)

(54) TRENCHING MACHINE

GRABENZIEHMASCHINE

EXCAVATRICE DE TRANCHEE

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR

(30) Priority: **19.10.2000 AU PR089100**

(43) Date of publication of application:
21.04.2004 Bulletin 2004/17

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- **DATABASE WPI Week 197508, Derwent Publications Ltd., London, GB; Class Q42, AN 1975-C1222W, XP008099445 & SU 422 830 A (BUILD IND RES INST) 05 September 1974**
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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a trenching machine for cutting a trench for *insitu* casting of a concrete retaining wall.

BACKGROUND TO THE INVENTION

[0002] The technique of continuous casting of a concrete retaining wall, in which a trench is continuously excavated and filled with concrete, is well known. Australian Patent No. 584083 by Foundation Technology Limited describes such a method of continuous casting in which a continuous excavator is mounted on a workhead, and the sides of the trench are temporarily lined with form work integrally mounted on the workhead immediately following the excavator. Australian Patent No. 637347, also by Foundation Technology Limited, describes a trenching machine that incorporates a trenching arm supporting an endless chain or other carrier carrying cutting teeth exposed along the chain for excavating the soil in front of the trenching arm. The cutting apparatus of AU 637347 includes a tooth mounting assembly whereby a cutting tool may be moved from an extended position, in which the tooth's cutting edge extends beyond a side of the carrier in a stowed position.

[0003] One of the problems with these prior art trenching machines is that the endless chain type excavator is very expensive to operate and maintain. There are many moving parts that wear out, and the drive needed to keep the endless chain rotating must be quite powerful and robust due to the weight of the moving parts and soil resistance.

[0004] US Patent No. 4199033 describes an augering apparatus intended for attachment as an accessory to a hydraulically operated boom of a backhoe or the like. This document forms the basis for the preamble of claim 1.

SUMMARY OF THE INVENTION

[0005] The present invention was developed with a view to providing a trenching machine that employs a more efficient excavating technique.

[0006] Throughout this specification the term "comprising" is used inclusively, in the sense that there may be other features and/or steps included in the invention not expressly defined or comprehended in the features or steps subsequently defined or described. What such other features and/or steps may include will be apparent from the specification read as a whole.

[0007] According to the present invention there is provided a trenching arm used for cutting a trench for *insitu* casting of a concrete retaining wall, the trenching arm comprising:

a cutting auger having a substantially helical cutting blade for cutting into soil and transporting the soil to the surface;

a main frame on which the cutting auger is rotatably mounted, the main frame being adapted to be carried in a generally vertical orientation by a support vehicle; and,

a motor mechanically coupled to the cutting auger for rotating the cutting auger whereby, in use, as the main frame is driven in a forwards direction the cutting auger cuts the soil in front of it and carries the soil to the surface creating a trench behind the main frame that can be filled with concrete to form a retaining wall;

characterised in that said main frame is provided with a rotatable coupling for mechanically coupling the trenching arm to a support vehicle such that the trenching arm can be made to travel in different directions relative to the support vehicle;

and, in that said main frame is provided with a pair of substantially parallel, planar shield members, respectively mounted either side of the main frame and adapted to hold open the side walls of the trench created behind the main frame for concrete to be poured into, wherein the shield members become progressively narrower in a direction away from the rotatable coupling. Preferably the trenching arm further comprises a self-levelling mechanism for adjusting the angle at which the main frame is carried whereby, in use, a prescribed level of trench on a sloping grade can be minimised.

[0008] In another embodiment said cutting auger is one of a plurality of cutting augers rotatably mounted side by side on the main frame for cutting a trench of increased width.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] In order to facilitate a more comprehensive understanding of the nature of the invention, a preferred embodiment of the trenching arm in accordance with the present invention will now be described in detail, by way of example only, with reference to the accompanying drawings, in which:

Figure 1 is a side elevation of a preferred embodiment of the trenching arm in accordance with the present invention;

Figure 2(a) is a front elevation of the trenching arm of Figure 1;

Figure 2(b) is a rear elevation of the trenching arm of Figure 1;

Figure 3 is a side elevation of an extendable boom for the trenching arm of Figure 1; Figures 4(a), (b) and (c) illustrate extension of the boom of Figure 3 in different positions; Figure 5 is a partial cut-away end view of a self-levelling mechanism provided within the trenching arm of Figure 1;

Figure 6 is a partial cut-away side view of the self-levelling mechanism of Figure 5; Figure 7 is a top plan view of the trenching arm of Figure 1;

Figures 8 and 9 are section views of the trenching arm through the lines A-A and B-B respectively in Figure 1;

Figure 10 is a side elevation of the trenching machine of Figure 1 shown *insitu* as used for cutting a trench and casting a concrete retaining wall; and,

Figures 11 and 12 illustrate the trenching arm of Figure 1 being used to cut a trench and cast a concrete retaining wall.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0010] A preferred embodiment of the trenching arm 10 as illustrated in Figures 1 to 4 comprises a cutting auger 12 having a generally helical cutting blade 14 for cutting into soil and transporting the soil to the surface. The cutting auger 12 is rotatably mounted on a main frame 16 which is designed to be carried in a substantially vertical orientation by a support vehicle (not illustrated). A hydraulic motor 18 is mechanically coupled to the cutting auger 12 for rotating the cutting auger.

[0011] Preferably the cutting auger 12 is tilted at an angle of between θ = 45° to 90°, more preferably approximately θ = 80° as can be seen most clearly in Figure 1. Typically, the helical cutting blade 14 is formed from a series of blade segments supported on a common drive shaft 20 so as to form one continuous helical flight. However, the cutting blade 14 may also be formed as a discontinuous series of helical flights. Drive shaft 20 is typically a hollow shaft having an outer diameter of approximately 100mm to 120mm, whilst the flights of the cutting blade 14 are typically between 70mm to 100mm wide, making a total outer diameter of the cutting blade of approximately 240mm to 320mm. The full length of the helical cutting blade of this embodiment is approximately 6.5m. Drive shaft 20 is rotatably supported on the main frame 16 by means of a plurality of sealed, heavy duty bearings held on support brackets 22. A pair of substantially parallel, planar shield members 24 are mounted either side of the main frame 16 and are designed to act as a temporary form work for holding open the side walls of the trench created behind the trenching arm in use.

[0012] The main frame 16 is preferably provided with a rotatable coupling 26 for mechanically coupling the trenching arm to a boom 28 (see Figures 5 and 6) carried by a support vehicle. In this way, the trenching arm 10 can be made to travel in different directions to form a continuous trench for casting angled, curved or even circular walls. Hence, the trenching arm could be used for casting, for example, a retaining wall for a lined pit or shaft.

[0013] Advantageously the boom 28, to which the trenching arm 10 is rotatably coupled, is an extendible boom as illustrated more clearly in Figures 3 and 4. As shown in Figure 3, the boom 28 preferably comprises a first boom segment 50 mechanically coupled at one end to a work arm 52 of a support vehicle, for example, excavator 54. A second boom segment 56 is telescopically received within the first boom segment 50, and comprises an hydraulic ram 58 received within the hollow interior of the first boom segment 50 and connected at one end 60 thereto, the other end of the ram 58 being connected to a sleeve 62 of the second boom segment 56. Sleeve 62 is mechanically coupled to a coupling head 64, to which the trenching arm 10 is rotatably coupled, at two pivot points 66 and 68. Sleeve 62 is coupled to the first pivot point 66 adjacent a lower edge of the coupling head 64 at a fixed distance, whereas it is coupled to the second pivot point 68 by a variable distance controlled by a small hydraulic ram 70. Hydraulic ram 70 is pivotally mounted on the sleeve 62 and can be operated independently of the ram 58. Extension and retraction of the ram 70 results in a tilting of the coupling head 64, (and thereby also trenching arm 10) in a plane which passes through the boom 28. This means, for example, when the trenching arm 10 is being lifted by boom 28, it can be maintained in a substantially vertical orientation as the height of the coupling head 64 above the ground increases. In such a lifting operation, it may also be necessary to extend boom 28 by actuating the hydraulic ram 58. The ability to increase and decrease the length of extendible boom 28 is also very useful when constructing a retaining wall within an area where the excavator 54 has restricted manoeuvrability. In normal use, the trenching arm 10 would be supported some distance from and adjacent to the excavator 54 via the work arm 52 as shown in Figure 4(b). However, when extending the wall, for example, into a corner, where the excavator 54 may not be able to travel, the reach of the boom 28 may be extended as shown in Figures 4(a) and (c).

[0014] The rotatable coupling 26 for mechanically coupling the trenching arm to the coupling head 64 of the boom 28 is shown more clearly in Figures 5 and 6. Rotatable coupling 26 comprises a hydraulically actuated turntable 80 rotatably coupled to a mounting plate 82 provided at the top end of the trenching arm 10. A pair of hydraulic actuators 84, offset with respect to the centre of rotation of the turntable 80, are provided to actuate the rotatable coupling in either rotational direction. This greatly enhances the utility of the trenching arm 10, as it permits the trenching arm to be moved in directions other than parallel to the direction of travel of the support vehicle.

[0015] Also shown in Figures 5 and 6 is a self-levelling mechanism 90 for adjusting the angle at which the trenching arm 10 is carried by the boom 28 so as to maintain a prescribed level and depth of trench, particularly on a sloping grade. The self-levelling mechanism 90 comprises two sub-assemblies for providing a levelling action in two perpendicular planes of movement respectively. Both sub-assemblies of the self-levelling mechanism 90 are preferably housed within a sub-frame 108 that is bolted or welded into a recess provided in the top end of the main frame 16 of the trenching arm 10. Advantageously, this permits the self-levelling mechanism 90 to be readily removed for maintenance purposes, or replaced if necessary, without disturbing the structural integrity of the trenching arm 10. The first sub-assembly of the self-levelling mechanism 90 is shown in Figure 5, and is designed to provide a levelling or tilting action in a plane perpendicular to the direction of travel of the trenching arm 10. The first sub-assembly comprises a support arm 92 that is fixed at one end to the sub-frame 108 of the trenching arm 10 so as to immoveable relative thereto. The other end of the support arm 92 has a hydraulic actuator 94 connected at one end thereto. The other end of the hydraulic actuator 94 is pivotally connected to the mounting plate 82, which is in turn pivotally coupled to the sub-frame 108 at pivot point 96. As noted above, mounting plate 82 is rotatably coupled to the turntable 80. With this arrangement, activation of the hydraulic actuator 94 will result in a tilting motion of the trenching arm 10 in the direction of arrow AA shown in Figure 5. Preferably, there are a pair of said hydraulic actuators 94, with corresponding support arms 92, however only one is visible in Figure 5 as the other is mounted directly behind it but spaced apart from it.

[0016] The second sub-assembly of the self-levelling mechanism 90 is illustrated in Figure 6. As with the first sub-assembly, the second sub-assembly also comprises a pair of hydraulic actuators 98 pivotally connected at their lower ends to the sub-frame 108 of the trenching arm 10, and pivotally connected at their upper ends to a pivot arm 100. Pivot arm 100 is pivotally mounted on the main frame 16 of the trenching arm 10 by means of a pivot shaft 104 that is mounted in a pair of bearing mounting blocks 102 (only one mounting block 102 is visible, as the other one is located directly behind it on the other side of the main frame 16). Bearing mounting blocks 102 are fixed to the main frame 16 at respective ends of the pivot shaft 104 that extends from side to side the full width of the main frame 16. Pivot shaft 104 effectively acts to locks the sub-frame 108 into the main frame 16. When either one or both of hydraulic actuators 98 are activated, the main frame 16 of the trenching arm 10 will be caused to swivel or tilt on pivot shaft 104 in the direction of arrows BB shown in Figure 6. It will understood therefore that the two sub-assemblies of the self-levelling mechanism 90 effectively act in a similar manner to the perpendicular cross-over shafts in a universal joint to create universal movement.

[0017] The self-levelling mechanism 90 may be manually controlled to adjust the angle of inclination with respect to the vertical of the trenching arm 10 in use, or alternatively it may be automatically controlled by a pre-programmed microprocessor-controlled servo control system. In either case, the main function of the self-levelling mechanism is to permit the angle at which the trenching arm 10 is carried on the coupling head 64 to be adjusted as required, to maintain the desired cutting depth, orientation or direction of the helical cutting auger 12 on the trenching arm 10. Thus, for example, when the end of a trench has been reached, and the trenching arm 10 needs to be lifted upwards out of the trench, it is preferable at that point to change the angle of inclination of the cutting auger 12 to as near as possible to the vertical so that the end face of the trench, and therefore of the retaining wall formed therein, will be as close as possible to the vertical.

[0018] In use, as the main frame 16 is driven in a forwards direction through the soil, the cutting auger 12 cuts the soil in front of the trenching arm and carries it to the surface, creating a trench behind the main frame that can be filled with concrete to form a retaining wall. Preferably, the concrete can be pumped into the trench simultaneously as the trench is being formed by the trenching arm so that the surrounding soil does not collapse. Advantageously, the weight of the concrete behind the trenching arm 10 helps to thrust it forwards in the trench. The trenching arm can also be operated to cast a wall below the level of the water table without the use of bentonite (although bentonite may be used if desired). The concrete will fill the void behind the trenching arm before the water can, since it is heavier than water and therefore displaces any water that may be present. The trenching arm 10 may also be fitted with height adjustable skids or similar depth control means fitted to the shield members 24 and adapted to ride on the top surface of the soil. Soil deflecting blades (not illustrated) may also be provided adjacent to the front edge of the trenching arm at the soil surface, for pushing soil, lifted to the surface by the cutting auger 12, away from the trench being formed behind the trenching arm. The deflecting blades may be formed integral with the level control means or skids. Alternatively, or in addition, a side chute may be provided at the top of the auger arranged to drop the soil a short distance to one side.

[0019] Operation of the trenching arm 10 will now be described with reference to Figures 10, 11 and 12.

[0020] In use, the trenching arm 10 is first raised to a vertical position using boom 28, and then lowered into the ground. The weight of the trenching arm 10 may be sufficient in itself to help drive the cutting auger 12 into the soil, or an additional downwards force may be applied via the boom 28. As the cutting auger 12 is on an 80° angle it digs the soil away from the bottom of the trenching arm, which allows the arm to dig itself into the ground. As the cutting auger 12 extends down and under the rearwards projecting shield members 24, soil resistance is reduced when digging down vertically. Depending on soil conditions, the cutting auger 12 may be tilted at an angle that varies from vertical to 45°. As can be seen in Figure 10, the line of force of any downwards thrust applied to the trenching arm via rotatable coupling 26 is substantially aligned with the bottom end of the cutting auger 12.

[0021] The support vehicle, typically an excavator, then travels forward drawing the trenching arm 10 forwards with it. As the trenching arm is forced forwards in a horizontal direction, the cutting auger 12 cuts the soil in front of it and carries it to the surface, creating a void 30 behind the main frame 16 which is held open by the shield members 24. The concrete can then be poured into the void 30 between the shield members 24 (see Figures 7 and 8). As the trenching arm travels forwards through the soil, the concrete slumps into the trench and is then able to provide a counter pressure to the lateral pressure on the walls of the trench to hold it open. The weight of the concrete pressing on the rear of the main frame 16 also helps to drive the cutting auger 12 forwards through the soil. Once the concrete has formed a continuous column from top to bottom at the full depth required, the retaining wall can be continuously formed by the trenching arm travelling forwards and the concrete being poured in continuously behind the trenching arm at the same time.

[0022] The main frame 16 may also be provided with a shutter 34, (see Figure 1), held in grooves at the back end. When starting the concrete pour, shutter 34 will allow the new wall to have a square starting face as it prevents the soil from falling into the void created directly behind the cutting auger 12. When the cutting auger 12 has reached the prescribed depth, the trenching arm 10 is driven forwards through the soil and concrete pouring has commenced, shutter 34 can be removed as the concrete slump will hold the soil in place. Adjacent the bottom end of the trenching arm 10 there is provided a horizontal hinged flap 36 with side walls which is normally held in an upwards position as shown in Figure 1. There are also provided two vertical hinged flaps 38 (see also Figure 2) that are normally closed. Flaps 38 are approximately one metre in height and prevent the soil from falling into the void directly behind the cutting auger 12 as the trenching arm is augered downwards into the soil. This void is filled with concrete. As the trenching arm continues downwards into the soil, concrete is being poured into the open space between shield members 24. The concrete will act to stop the soil coming into the back of the open end of the trenching arm. When the trenching arm reaches the required depth full of concrete, the arm can then be moved forward. At the top of the open shield members a small shutter 39 is attached to the back of the shield members, just above the surface of the laid concrete to maintain a head of concrete. As the trenching arm moves forward the two flaps 38 at the bottom of the shield will open out with the force of the concrete, also allowing the flap 36 to fall back and lay on the bottom of the trench. Flap 36 prevents the concrete from flowing forwards into contact with the bottom end of the cutting auger 12.

[0023] To give strength to the finished concrete retaining wall, fibreglass or steel fibre can be mixed with the cement. In addition, reinforcing bars 42 can be placed in the concrete while it is still wet to give lateral strength (see Figure 10). If desired blockouts can be inserted, laced to the reinforcing bar, to insert ground anchors at a later stage during construction of the retaining wall (for non-cantilevered walls).

[0024] When removing the trenching arm from the ground at completion of concreting, the helical cutting blade 14 of the cutting auger can be rotated in the reverse direction to refill the void left by the trenching arm, as it is withdrawn, against the finished concrete wall.

[0025] Using a cutting auger to excavate the soil is a much more efficient method of excavation. It significantly reduces the soil friction as the trenching arm travels through the soil. The narrowing of the shield members 24 towards the bottom of the trenching arm also minimises the surface area subject to lateral soil pressure, further helping to reduce soil friction as the trenching arm is forced through the soil. Cutting bits 40 can be welded to the edge of the flights of the cutting blade 14 (see Figure 9) for cutting through stiff soils and to reduce wear on the flights. If it is desired to cut a wider trench, a cutting auger of increased diameter may be used, or alternatively two or more cutting augers may be rotatably mounted side by side on the main frame for cutting a trench of increased width.

[0026] Now that a preferred embodiment of the trenching arm has been described in detail, it will be appreciated that it provides a number of significant advantages over prior art trenching machines, including the following:

(i) fewer moving parts, means less wear and reduced maintenance costs;

(ii) helical cutting auger requires less torque to rotate than a toothed chain-type excavator, giving reduced operating costs and improved efficiency;

(iii) reduced lateral surface area and less aggressive cutting action reduces energy losses due to soil friction;

(iv) overall weight and size of the trenching arm is reduced making it easier to transport and manoeuvre; and,

(v) cost of manufacturing the trenching arm is also significantly reduced.

[0027] Numerous variations and modifications will suggest themselves to persons skilled in the excavating arts, in addition to those already described, without departing from the basic inventive concepts. The trenching arm can also be used to dig trenches for laying pipes and cables. All such variations and modifications are to be considered within the scope of the present invention, the nature of which is to be determined from the appended claims.

Claims

1. A trenching arm (10) used for cutting a trench for *insitu* casting of a concrete retaining wall, the trenching arm (10) comprising:

a cutting auger (12) having a substantially helical cutting blade (14) for cutting into soil and transporting the soil to the surface;
a main frame (16) on which the cutting auger (12) is rotatably mounted, the main frame being adapted to be carried in a generally vertical orientation by a support vehicle; and,
a motor (18) mechanically coupled to the cutting auger (12) for rotating the cutting auger whereby, in use, as the main frame (16) is driven in a forwards direction the cutting auger cuts the soil in front of it and carries the soil to the surface creating a trench behind the main frame that can be filled with concrete to form a retaining wall;
said main frame (16) being provided with a rotatable coupling (26) for mechanically coupling the trenching arm (10) to a support vehicle such that the trenching arm (10) can be made to travel in a variety of directions relative to the support vehicle;
and **characterised by** the main frame (16) being provided with a pair of substantially parallel, planar shield members (24), respectively mounted either side of the main frame (16), and adapted to hold open the side walls of the trench created behind the main frame for concrete to be poured into;
wherein the shield members (24) become progressively narrower in a direction away from the rotatable coupling.

2. A trenching arm (10) as defined in claim 1, wherein said rotatable coupling (26) comprises a turntable (80) rotatably mounted on said main frame (16) and rotatably activated by a pair of actuators (84).

3. A trenching arm (10) as defined in claim 1, wherein said main frame (16) is mechanically coupled to an extendable boom (28) carried by the support vehicle whereby, in use, said boom (28) can be extended or retracted to increase the manoeuvrability of the trenching arm.

4. A trenching arm (10) as defined in claim 1, wherein the trenching arm further comprises a self-levelling mechanism (90) for adjusting the angle at which the main frame (16) is carried whereby, in use, a prescribed level of trench on a sloping grade can be minimised.

5. A trenching arm (10) as defined in claim 4, wherein said self-levelling mechanism (90) comprise a first sub-assembly for effecting a tilting movement of the trenching arm (10) in a first vertical plane, and a second sub-assembly for effecting tilting movement of the trenching arm (10) in a second vertical plane that is substantially perpendicular to said first vertical plane.

6. A trenching arm (10) as defined in claim 1, wherein said cutting auger (12) is mounted on the main frame (16) at an angle of between 25° to 0° to the vertical.

7. A trenching arm (10) as defined in claim 1, wherein said cutting auger (12) is mounted on the main frame (16) at an angle of 10° to the vertical.

8. A trenching arm (10) as defined in claim 1, wherein said cutting auger (12) is one of a plurality of cutting augers rotatably mounted side by side on the main frame (16) for cutting a trench of increased width.

Patentansprüche

1. Grabenschneide-Arm (10), welcher zum Schneiden eines Grabens zum in-situ-Gießen einer Beton-Stützmauer verwendet wird, der Grabenschneide-Arm (10) umfassend:

eine Schneide-Schnecke (12), welche eine im Wesentlichen schraubenförmige Schneide-Klinge (14) zum Schneiden in Erdreich und Transportieren des Erdreichs an die Oberfläche aufweist;
einen Hauptrahmen (16), auf welchem die Schneide-Schnecke (12) drehbar montiert ist, wobei der Hauptrahmen dazu eingerichtet ist, in einer im Wesentlichen vertikalen Orientierung von einem Tragefahrzeug getragen zu werden; und
einen Motor (18), welcher mechanisch mit der Schneide-Schnecke (12) zum Drehen der Schneide-Schnecke gekoppelt ist, wobei im Betrieb, wenn der Hauptrahmen (16) in eine Vorwärtsrichtung angetrieben wird, die Schneide-Schnecke das Erdreich vor sich schneidet und das Erdreich an die Oberfläche transportiert, wobei hinter dem Hauptrahmen ein Graben erzeugt wird, welcher mit Beton gefüllt werden kann, um eine Stützmauer zu bilden;
wobei der Hauptrahmen (16) mit einer drehbaren Kopplung (26) zum mechanischen Koppeln des Grabenschneide-Arms (10) an ein Tragefahrzeug bereitgestellt ist, so dass der Grabenschneide-Arm (10) dazu gebracht werden kann, sich in verschiedene Richtungen relativ zu dem Tragefahrzeug zu bewegen;

und **dadurch gekennzeichnet, dass** der Hauptrahmen (16) mit einem Paar im Wesentlichen paralleler, planarer Schirmelemente (24) bereitgestellt ist, welche jeweils an jeder Seite des Hauptrahmens (16) montiert sind, und dazu eingerichtet sind, die Seitenwände des Grabens offen zu halten, welcher hinter dem Hauptrahmen erzeugt wird, um Beton hinein zu gießen; wobei die Schirmelemente (24) in einer Richtung weg von der drehbaren Kopplung zunehmend schmaler werden.

2. Grabenschneide-Arm (10) nach Anspruch 1, wobei die drehbare Kopplung (26) eine Drehscheibe (80) umfasst, welche drehbar an dem Hauptrahmen (16) montiert ist und drehbar von einem Paar von Aktuatoren (84) aktiviert wird.

3. Grabenschneide-Arm (10) nach Anspruch 1, wobei der Hauptrahmen (16) mechanisch an einen ausfahrbaren Ausleger (28) gekoppelt ist, welcher von dem Tragefahrzeug getragen wird, wobei im Betrieb der Ausleger (28) ausgefahren oder eingefahren werden kann, um die Manövrierbarkeit des Grabenschneide-Arms zu erhöhen.

4. Grabenschneide-Arm (10) nach Anspruch 1, wobei der Grabenschneide-Arm ferner einen Selbst-Justage-Mechanismus (90) zum Anpassen des Winkels, unter welchem der Hauptrahmen (16) getragen ist, umfasst, wobei im Betrieb ein vorgeschriebenes Graben-Niveau an einem geneigten Gefälle minimiert werden kann.

5. Grabenschneide-Arm (10) nach Anspruch 4, wobei der Selbst-Justage-Mechanismus (90) eine erste Unter-Anordnung zum Bewirken einer Kipp-Bewegung des Grabenschneide-Arms (10) in einer ersten vertikalen Ebene, und eine zweite Unter-Anordnung zum Bewirken einer Kipp-Bewegung des Grabenschneide-Arms (10) in einer zweiten vertikalen Ebene umfasst, welche im Wesentlichen rechtwinklig zu der ersten vertikalen Ebene ist.

6. Grabenschneide-Arm (10) nach Anspruch 1, wobei die Schneide-Schnecke (12) an dem Hauptrahmen (16) unter einem Winkel von zwischen 25° bis 0° zur Vertikalen montiert ist.

7. Grabenschneide-Arm (10) nach Anspruch 1, wobei die Schneide-Schnecke (12) an dem Hauptrahmen (16) unter einem Winkel von 10° zur Vertikalen montiert ist.

8. Grabenschneide-Arm (10) nach Anspruch 1, wobei die Schneide-Schnecke (12) eine aus einer Mehrzahl von Schneide-Schnecken ist, welche Seite an Seite rotierbar an dem Hauptrahmen (16) zum Schneiden eines Grabens von erhöhter Breite montiert sind.

Revendications

1. Bras d'excavation de tranchée (10) utilisé pour creuser une tranchée pour le coulage *in situ* d'un mur de soutènement en béton, le bras d'excavation de tranchée (10) comprenant :

   une tarière de forage (12) ayant une lame de forage essentiellement hélicoïdale (14) pour creuser dans le sol et pour transporter la terre à la surface ;
   un cadre principal (16) sur lequel la tarière de forage (12) est montée en rotation, le cadre principal étant adapté pour être transporté dans une orientation globalement verticale par un véhicule de support ; et,
   un moteur (18) couplé mécaniquement à la tarière de forage (12) pour faire tourner la tarière de forage moyennant quoi, en cours d'utilisation, à mesure que le cadre principal (16) est entraîné dans une direction vers l'avant, la tarière de forage creuse le sol à l'avant de celuici et transporte la terre à la surface créant une tranchée derrière le cadre principal qui peut être remplie avec du béton pour former un mur de soutènement ;
   ledit cadre principal (16) étant muni d'un accouplement rotatif (26) pour coupler mécaniquement le bras d'excavation de tranchée (10) à un véhicule de support de sorte que le bras d'excavation de tranchée (10) puisse être amené à se déplacer dans une variété de directions par rapport au véhicule de support ;
   et **caractérisé en ce que** le cadre principal (16) étant muni d'une paire d'éléments de protection planaires essentiellement parallèles (24), montés respectivement sur chaque côté du cadre principal (16), et adaptés pour maintenir ouvertes les parois latérales de la tranchée créée derrière le cadre principal pour le coulage du béton dans celle-ci ;
   où les éléments de protection (24) se rétrécissent progressivement dans une direction loin de l'accouplement rotatif.

2. Bras d'excavation de tranchée (10) tel que défini dans la revendication 1, dans lequel ledit accouplement rotatif (26) comprend une plaque tournante (80) montée en rotation sur ledit cadre principal (16) et activée en rotation par une paire d'actionneurs (84).

3. Bras d'excavation de tranchée (10) tel que défini dans la revendication 1, dans lequel ledit cadre prin-

cipal (16) est couplé mécaniquement à une flèche extensible (28) portée par le véhicule de support moyennant quoi, en cours d'utilisation, ladite flèche (28) peut être étendue ou rétractée pour augmenter la manoeuvrabilité du bras d'excavation de tranchée.

4. Bras d'excavation de tranchée (10) tel que défini dans la revendication 1, dans lequel le bras d'excavation de tranchée comprend en outre un mécanisme de mise à niveau automatique (90) pour régler l'angle selon lequel le cadre principal (16) est porté moyennant quoi, en cours d'utilisation, un niveau prescrit de tranchée sur une pente inclinée peut être minimisé.

5. Bras d'excavation de tranchée (10) tel que défini dans la revendication 4, dans lequel ledit mécanisme de mise à niveau automatique (90) comprend un premier sous-ensemble pour effectuer un mouvement de basculement du bras d'excavation de tranchée (10) dans un premier plan vertical, et un deuxième sous-ensemble pour effectuer un mouvement de basculement du bras d'excavation de tranchée (10) dans un deuxième plan vertical qui est essentiellement perpendiculaire audit premier plan vertical.

6. Bras d'excavation de tranchée (10) tel que défini dans la revendication 1, dans lequel ladite tarière de forage (12) est montée sur le cadre principal (16) à un angle compris entre 25° et 0° par rapport à la verticale.

7. Bras d'excavation de tranchée (10) tel que défini dans la revendication 1, dans lequel ladite tarière de forage (12) est montée sur le cadre principal (16) à un angle de 10° par rapport à la verticale.

8. Bras d'excavation de tranchée (10) tel que défini dans la revendication 1, dans lequel ladite tarière de forage (12) est l'une d'une pluralité de tarières de forage montées en rotation côte à côte sur le cadre principal (16) pour creuser une tranchée de largeur accrue.

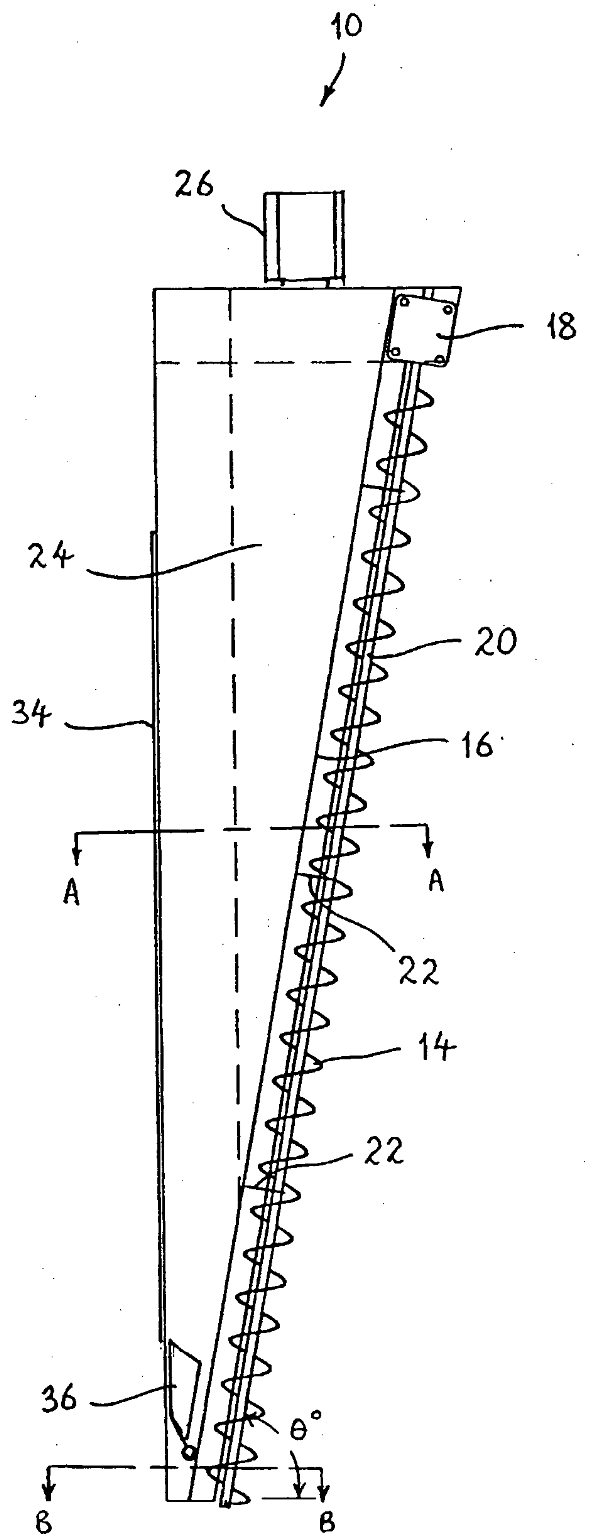

FIG. 1.

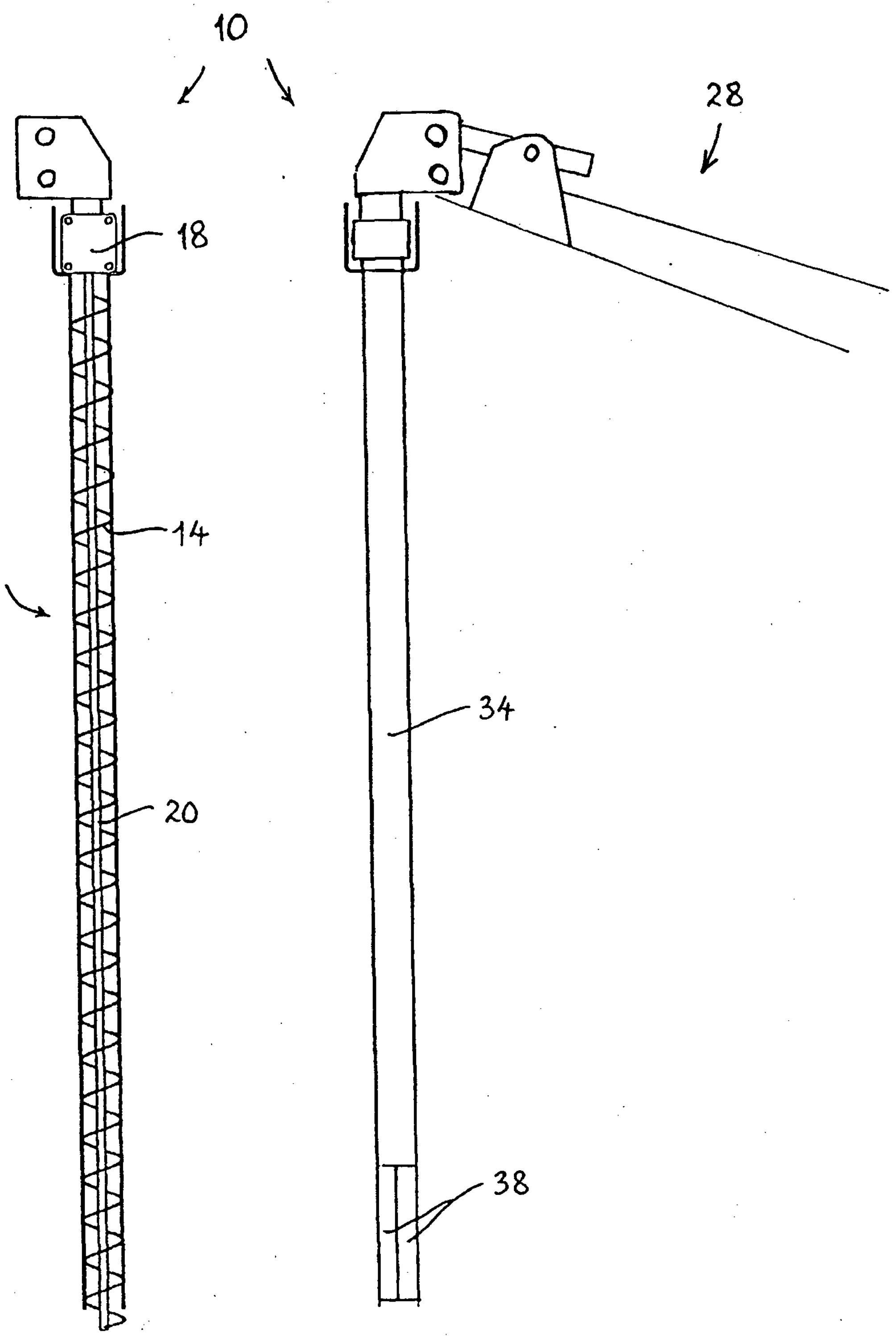

FIG. 2(a). FIG. 2(b).

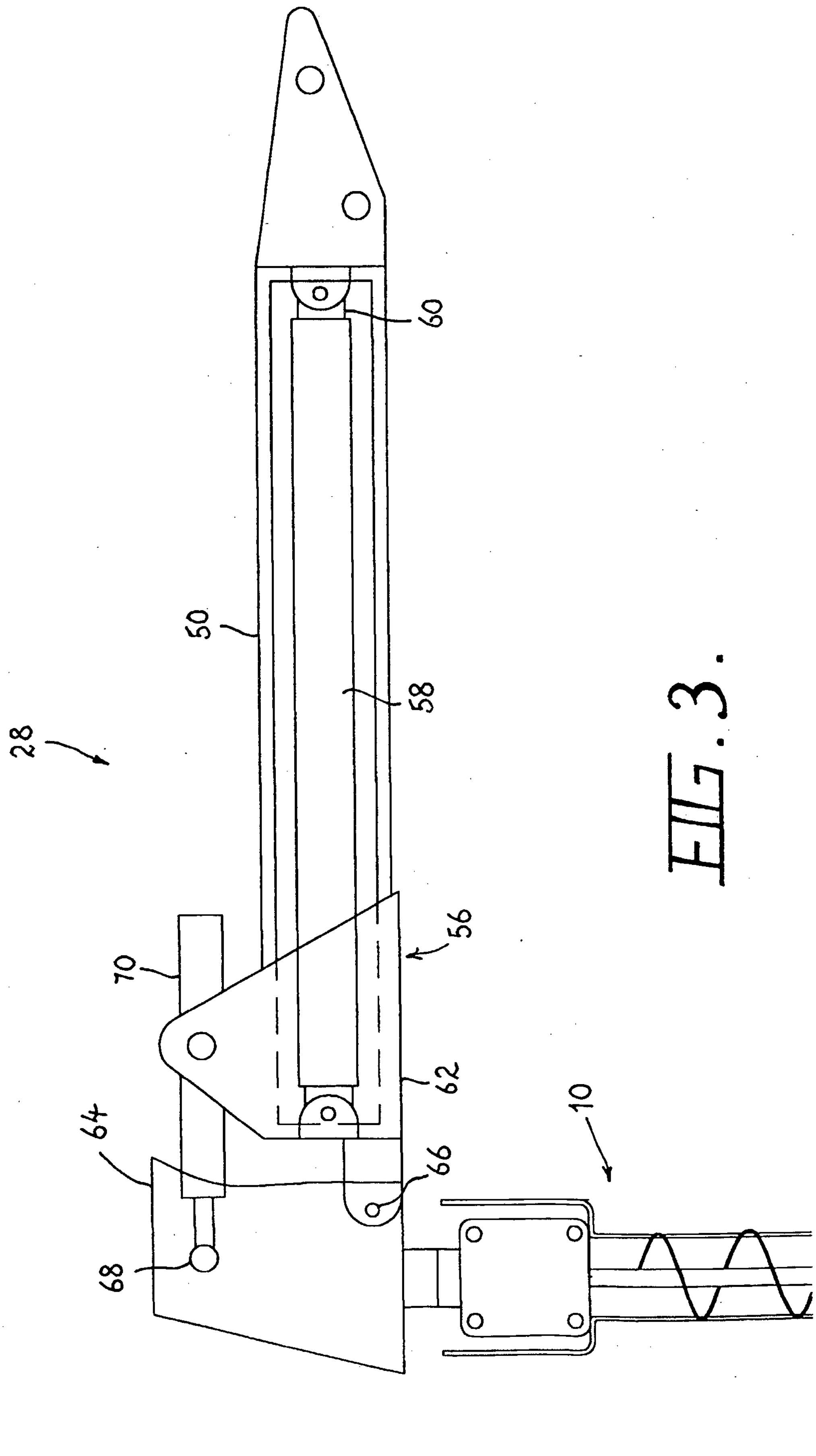

FIG. 3.

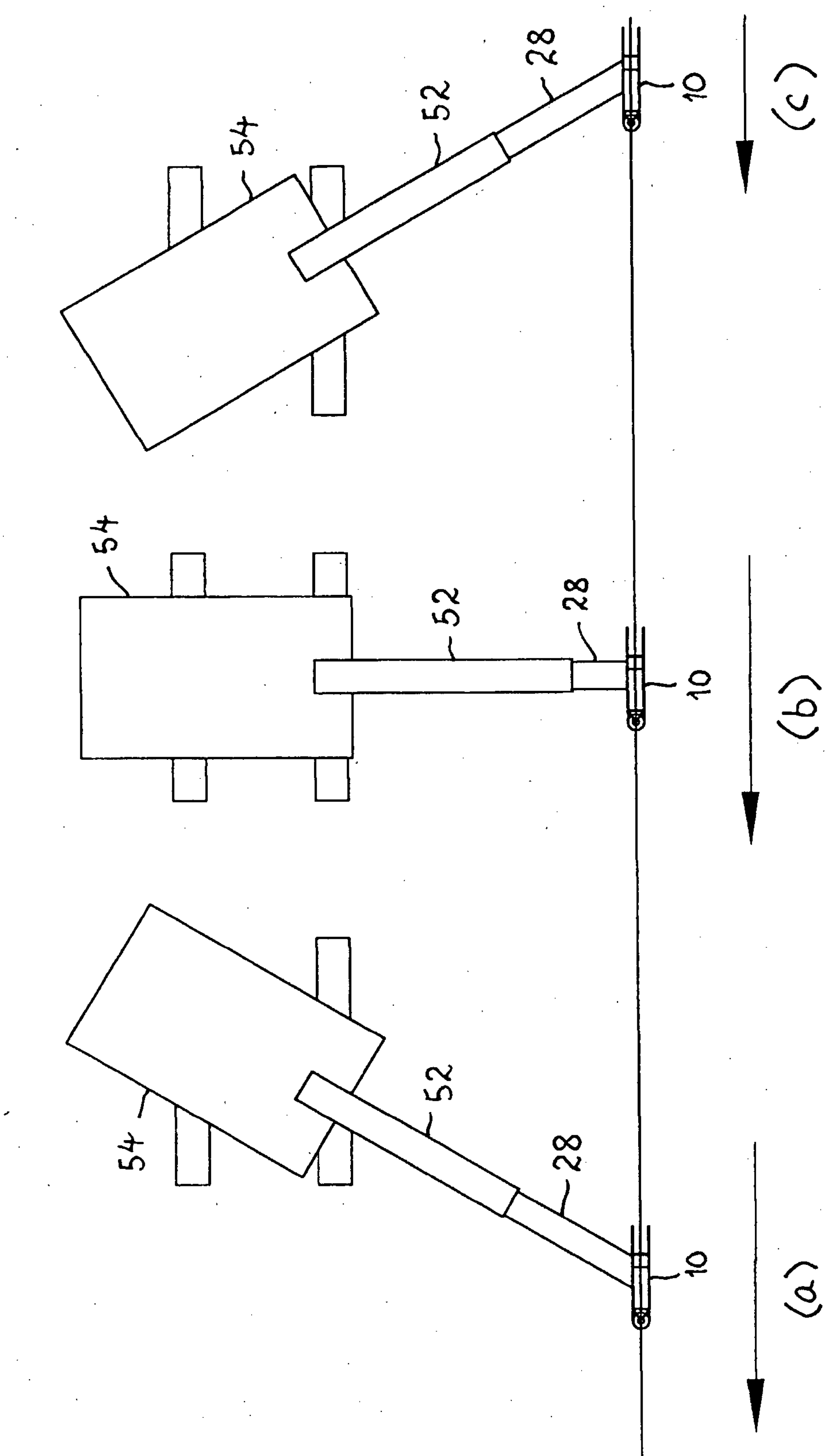

FIG. 4.

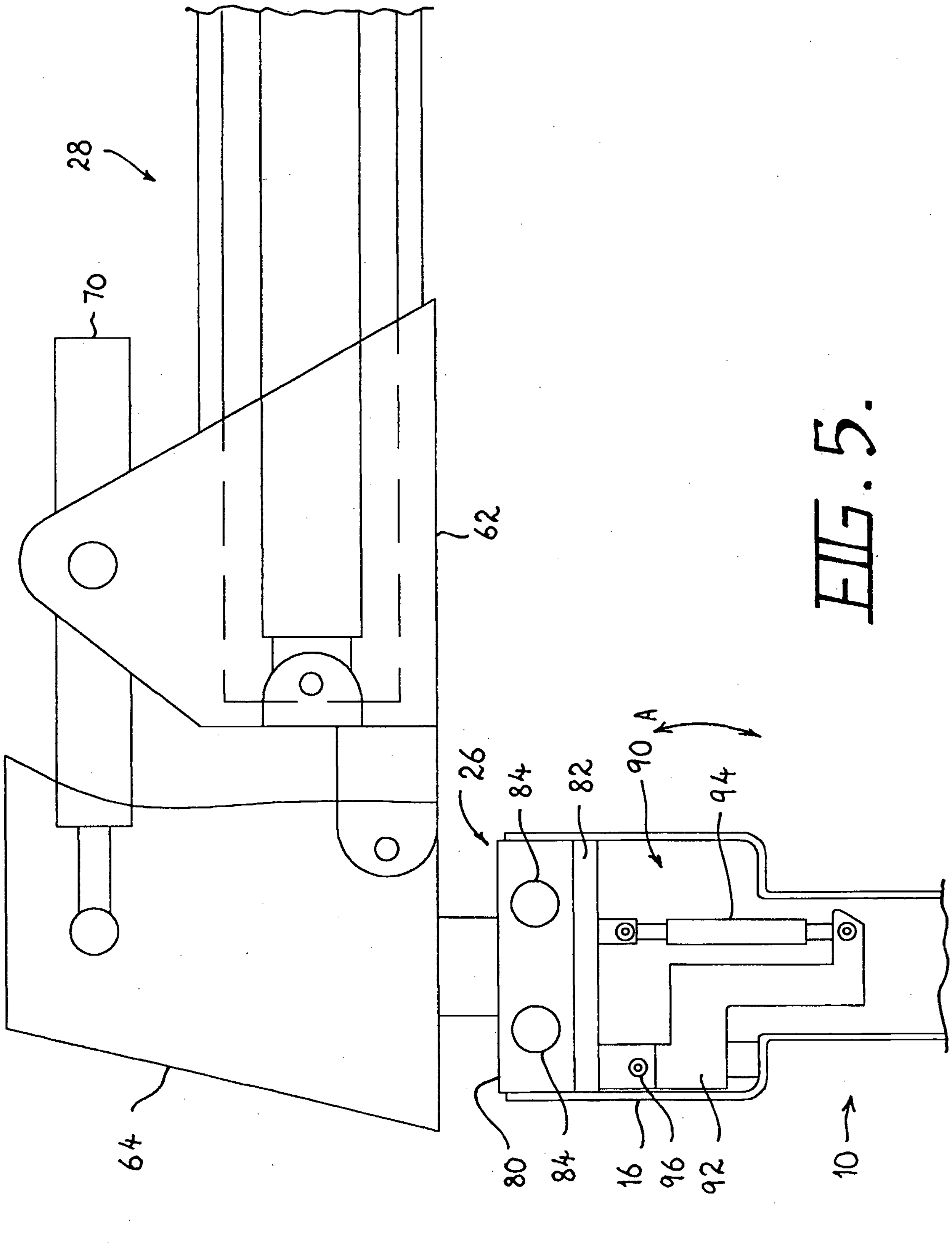

FIG. 5.

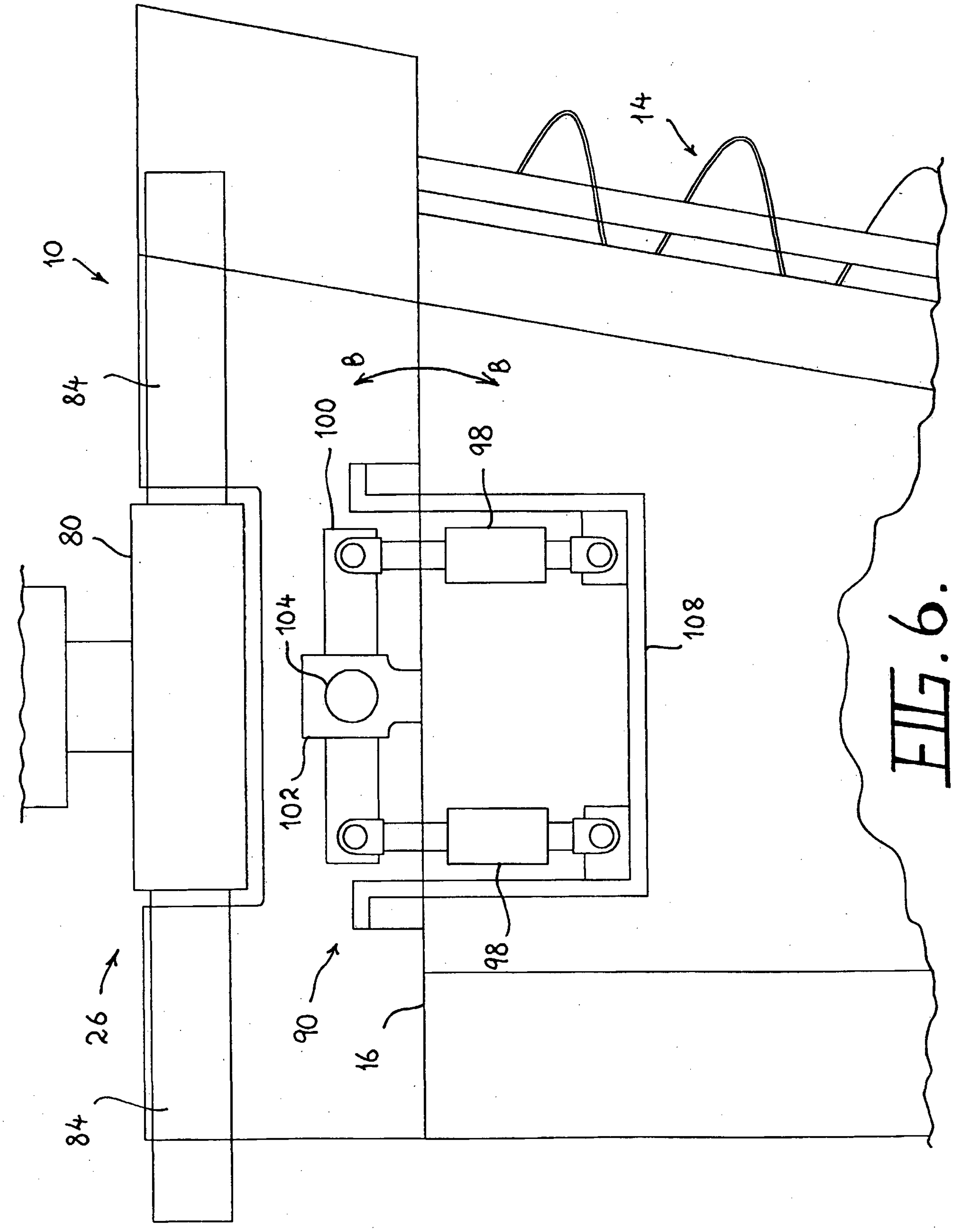

FIG. 6.

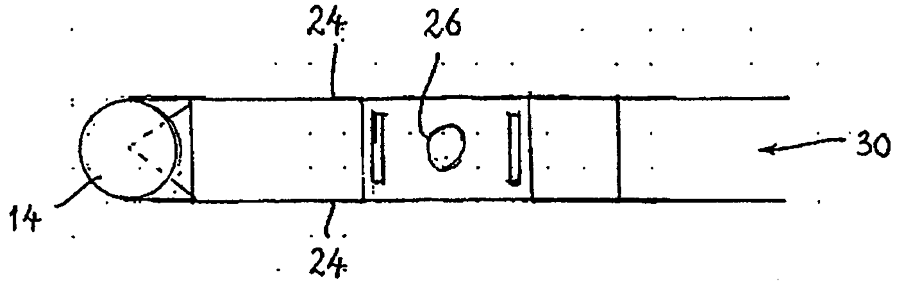

FIG. 7.

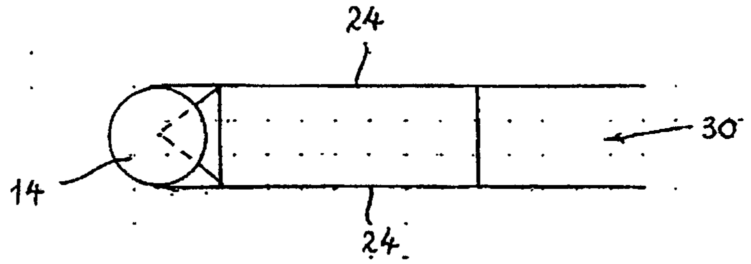

FIG. 8.

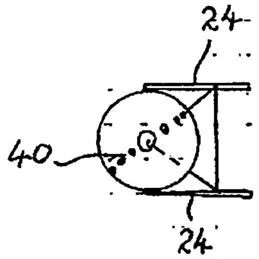

FIG. 9.

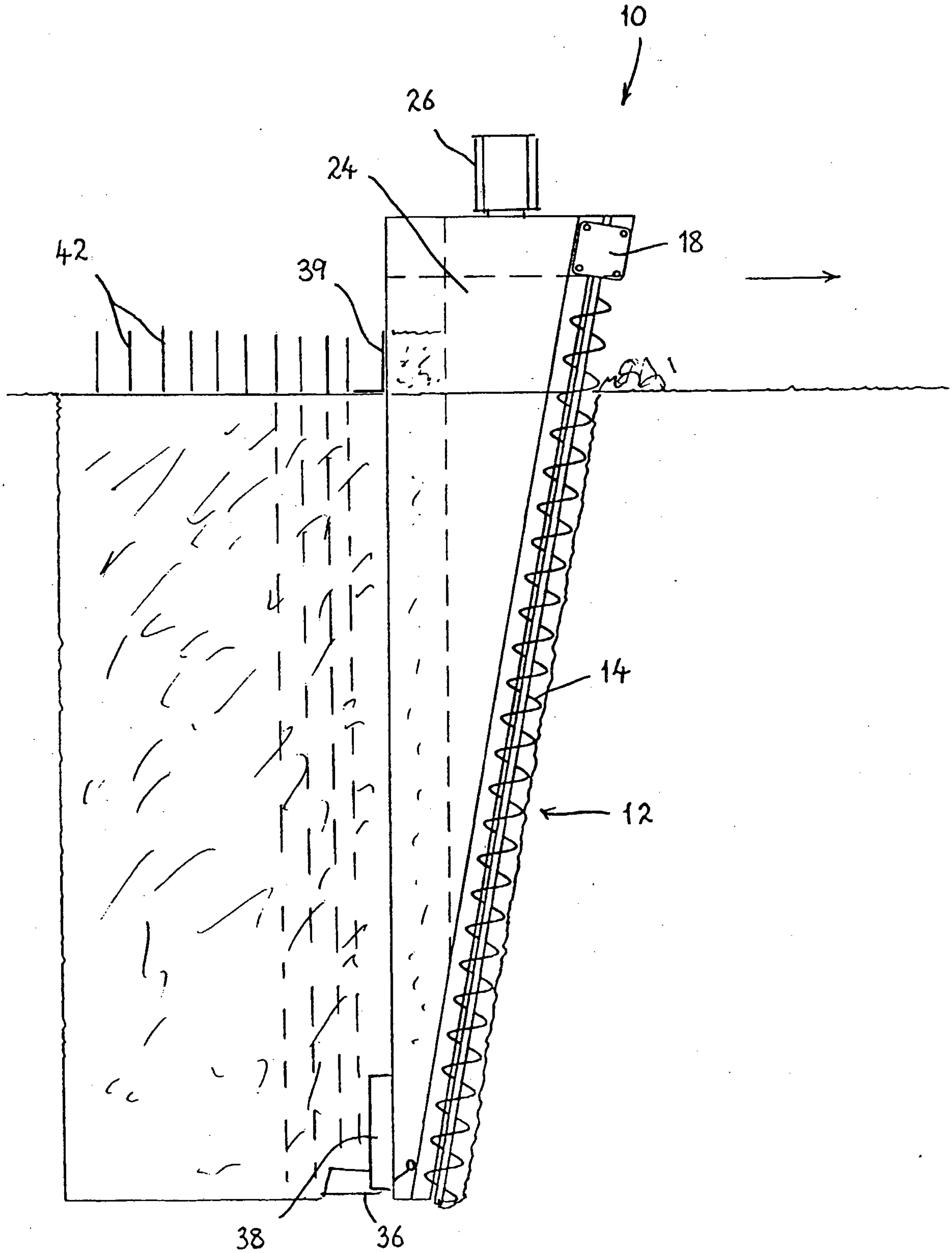

FIG. 10.

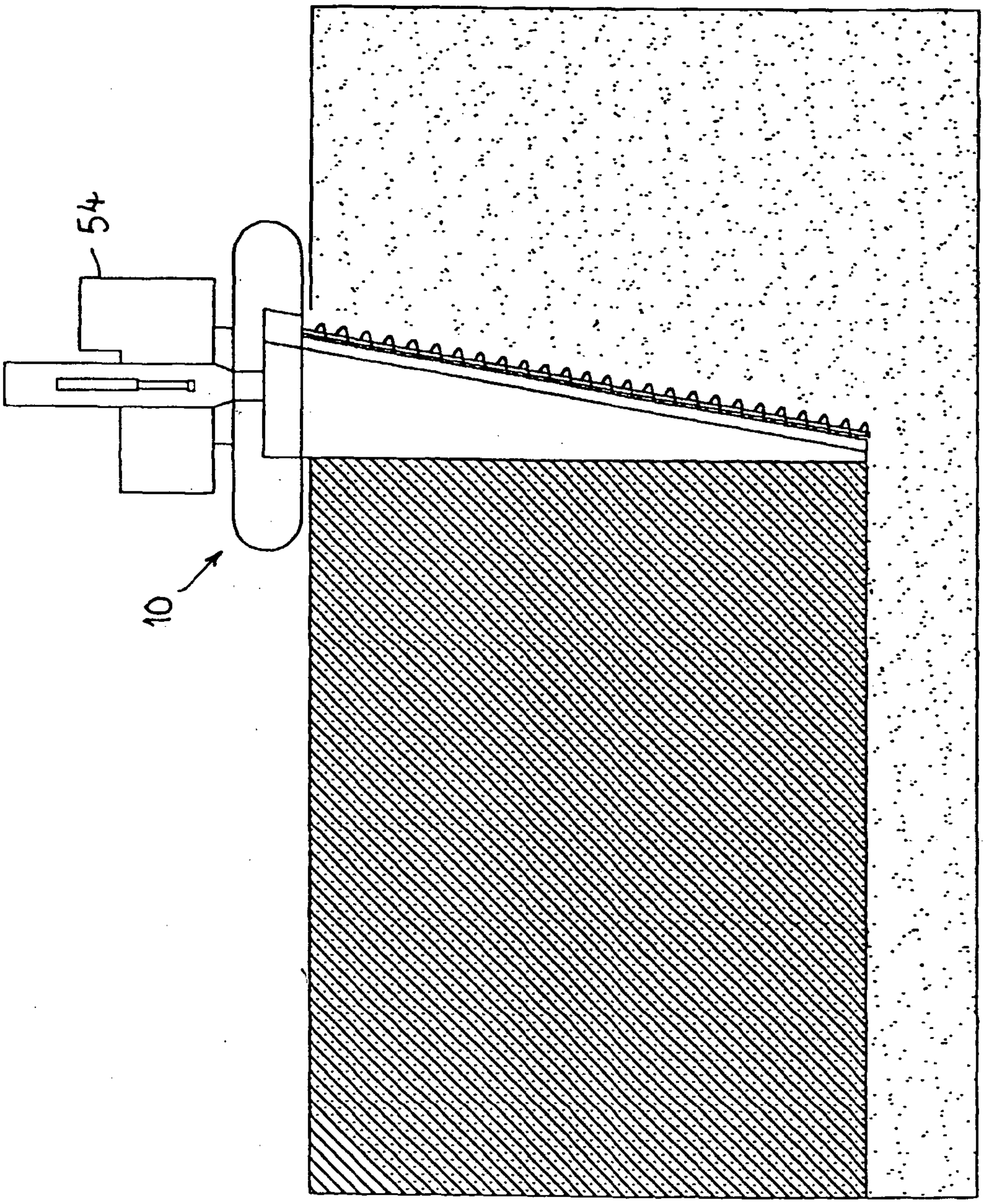

FIG. 11.

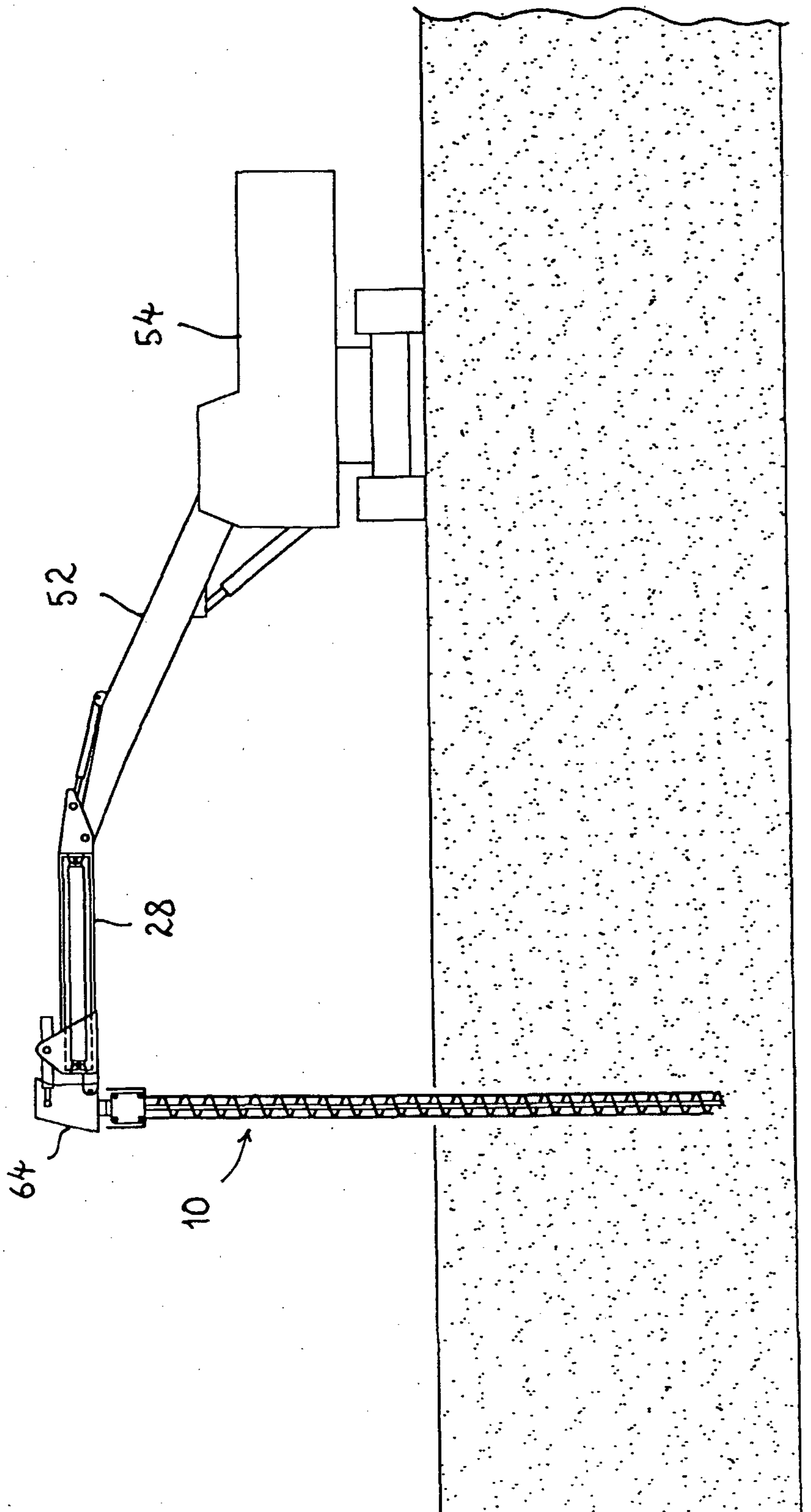

FIG. 12.

REFERENCES CITED IN THE DESCRIPTION

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