Jan. 23, 1962 S. W. GALBRAITH ET AL 3,017,935

DRILLING APPARATUS FOR TRACTORS

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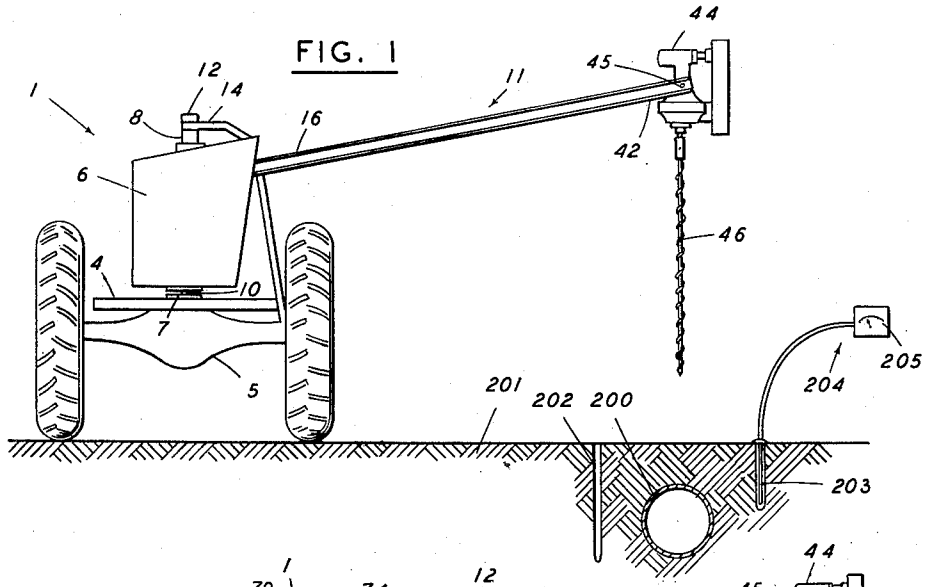
FIG. 1



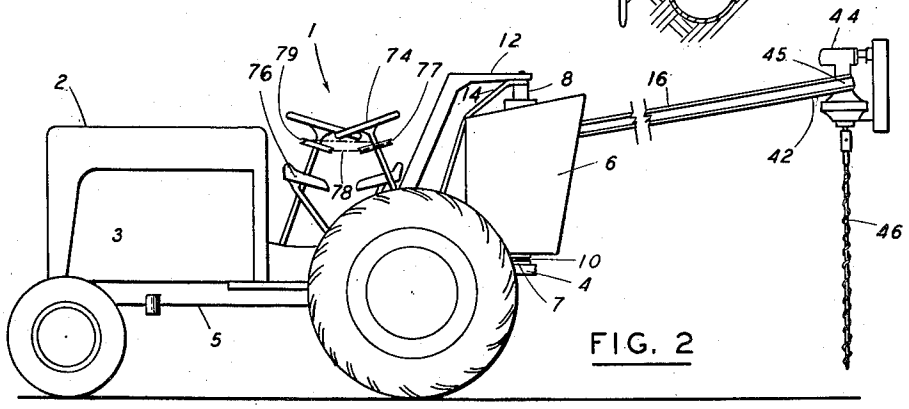


FIG. 2

FIG. 3

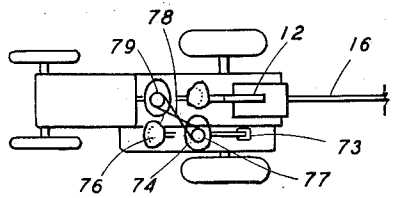


FIG. 4

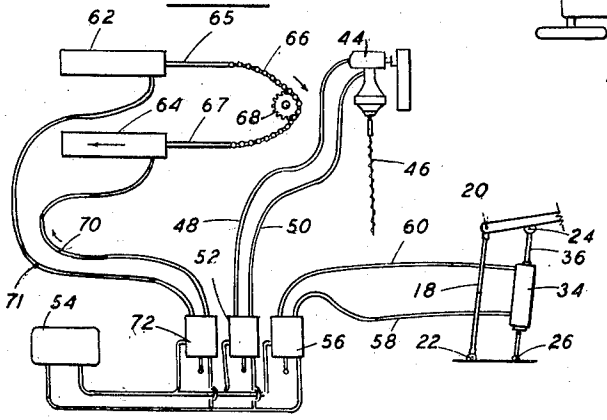


FIG. 10

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DRILLING APPARATUS FOR TRACTORS

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FIG. 5

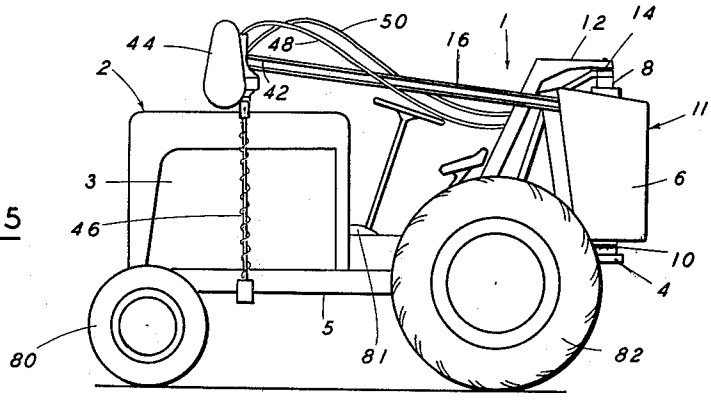
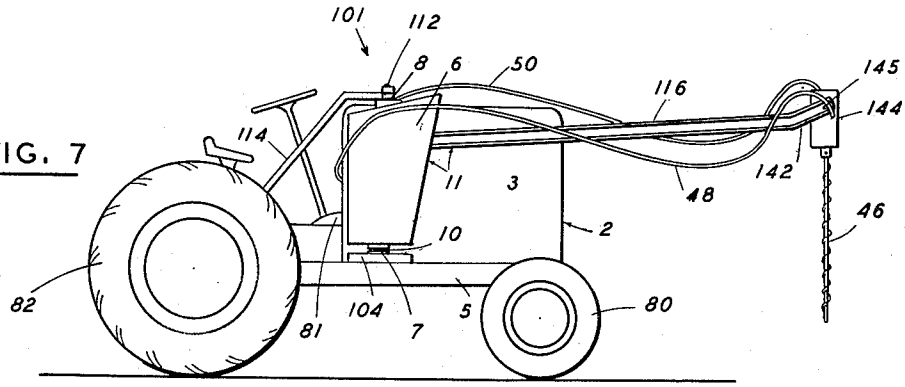


FIG. 7



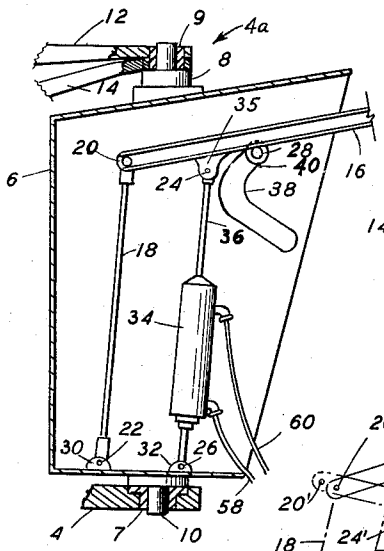


FIG. 6

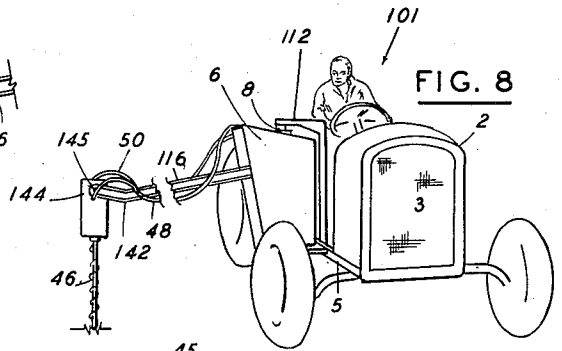


FIG. 8

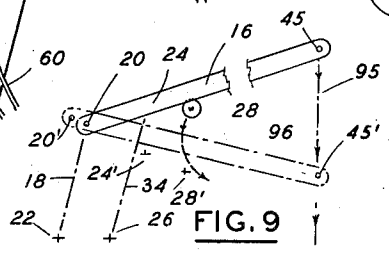


FIG. 9

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DRILLING APPARATUS FOR TRACTORS

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Filed Feb. 18, 1958, Ser. No. 715,885
5 Claims. (Cl. 175—123)

This invention relates generally to earth boring apparatus, and more specifically to a device for drilling a shallow vertical hole in the ground by a tractor mounted boom drill.

The primary object of this invention is to provide a drilling device which comprises a rigid boom which is pivotally supported relative to the tractor mount and to which boom a drilling head and drill bit are interposed between the tractor mount and the boom to cause said drill bit to travel in a vertical line when the boom is pivoted vertically.

Another object is to provide a completely hydraulically operated tractor mounted vertical hole drilling device which may be installed on a conventional farm tractor and wherein the three operations of laterally swinging the boom, raising or lowering the boom, and rotation of the drill bit may be simultaneously or selectively controlled by an operator from a seat in a position to conveniently observe the drilling operation.

And a further object is to provide a rear mounted vertical hole drilling device which may be installed on a conventional tractor in a manner to cause the reverse speed of the tractor to become the forward speed of the now modified drilling unit.

And yet another object is to provide a tractor mounted vertical hole drilling device which utilizes weight of the tractor to assist in the drilling operation.

And a still further object is to provide a vertical hole drilling device which includes a boom pivoted at its forward end to a substantially vertical link which in turn is pivoted to the tractor mount at its lowermost position, and which boom is subsequently journalled in a cam track and is pivoted to power unit at a point between the cam track and the vertical link.

These and other objects and advantages will be apparent from an examination of the following specification and drawings in which:

FIGURE 1 represents a rear end elevational view of the complete tractor boom drill assembly of this invention in its side drilling position.

FIGURE 2 is a side elevational view of the device of FIGURE 1 in its rear drilling position.

FIGURE 3 is a top plan outline view of the device of FIGURE 2.

FIGURE 4 is an outline schematic view of the hydraulic circuit of this invention.

FIGURE 5 is a side elevational view of the device of FIGURE 1 in its carrying position.

FIGURE 6 is a detail view of the boom carrying housing with the near side plate removed for clarity of illustration.

FIGURE 7 is a side elevational view of a modified embodiment of the device of FIGURE 1 in which the boom is mounted on the side of the tractor.

FIGURE 8 is a perspective view of the device of FIGURE 7 in operation.

FIGURE 9 is a diagrammatic view of the movement of the boom between any two vertical positions.

FIGURE 10 is a fragmentary detail view of one suitable drill used with this assembly.

Referring now more particularly to the characters of reference on the drawing, it will be observed that the complete vehicle boom drill assembly 1 is mounted on a conventional tractor 2, consisting of an engine 3, a tractor chassis or frame 5 including the necessary wheels and controls to provide controlled mobility. The boom drill sub-assembly 11 rests on a support frame 4 which is part of a superstructure frame 4a rigidly attached to the chassis 5. The support frame 4 is provided with a bearing 7 in which fits the lower shaft 10, bearing 7 supports housing 6 and permits said housing to rotate about a vertical axis thru the lower shaft 10 and upper shaft 8. Upper shaft 8 fits into a bearing 9 in bracket 12 which is rigidly attached to chassis 5. Bracket 12 receives additional strength from brace 14 which is rigidly attached to bracket 12 and chassis 5. A rigid boom 16 extends outward from housing 6, the end of rigid boom 16 within housing 6 being pivotally connected to tie-rod 18 by pin 20. Tie-rod 18 is, in turn, pivotally connected to housing 6 by means of pin 22 thru tie-rod pin bracket 30 which is anchored to housing 6. Housing 6 contains a hydraulic cylinder 34 which is pivotally connected to housing mounted hydraulic cylinder pin bracket 32 by means of pin 26. Piston rod 36 is in turn pivotally connected to integral bracket 35 of rigid boom 16 by means of pin 24. A horizontal shaft 28 is integrally fastened to rigid boom 16 so that the axis of the horizontal shaft is perpendicular to the axis of the boom. Each side of the housing 6 supports a cam slot or track 38 in which the cam follower or roller 40 moves when the boom 16 is elevated or lowered. Each end of shaft 28 carries a cam follower 40 which may be in the form of a wheel or bearing which is free to rotate on shaft 28 to minimize friction on the surface of the cam slot 38. The rigid boom 16 is coupled to housing 6 by means of tie-rod 18 and the hydraulic cylinder 34 and its piston rod 36 and these links are free to move except for the restraining action of cam slot 38 acting thru the cam followers 40 and in turn thru the horizontal shaft 28. This restraining force exerted by the cam slot 38 on the rigid boom 16 prevents the quadrilateral formed by lines connecting pins 20, 22, 26, 24, and 20 from collapsing. In addition to this function, the cam slot 38 performs another very important function which will be explained hereafter.

A yoke 42 is connected rigidly to the outer end of the rigid boom 16. This yoke supports a hydraulic motor and gear box referred to as drill motor 44 by means of pin 45 whose axis is horizontal and perpendicular to the axis of the rigid boom 16. The drill motor 44 is connected to and drives a drill or bit 46 which may be an earth boring auger. The drill 46 and motor 44 are free to rotate about the axis of pin 45 so that the pull of gravity will maintain the drill 46 in a vertical position at all times regardless of the position of the rigid boom 16. The motor 44 is driven by hydraulic fluid under pressure which is received thru the supply hose 48 and which is returned thru the return hose 50. The operation of hydraulic motor 44 is controlled by valve 52 and is driven by the engine 3 of the vehicle 2 in a well known manner. The operation of hydraulic cylinder 34 which causes the rigid boom 16 to raise or lower is controlled by valve 56 which directs the flow of hydraulic fluid under pressure supplied by pump 54 thru hose 58 to cylinder 34; this valve also controls the release of fluid from cylinder 34 to return hose 58 permitting the boom 16 to descend. Boom drill sub-assembly is caused to rotate about a vertical axis thru shafts 8 and 10 thus causing the drill 46 to traverse horizontally over the ground in an arc, by the action of two hydraulic cylinders 62 and 64 which are mounted on the chassis of the vehicle. The piston rods 65 and 67 of these cylinders are connected to opposite ends of a drive chain 66 which passes around a sprocket 68 mounted on lower shaft 10 and connected to the shaft in such a manner as to cause any rotation of sprocket 68 to be transmitted to and rotate the lower

shaft 10 and the housing 6 thus causing the rigid boom 16 and its associated parts to rotate directly with the sprocket. The hydraulic cylinders 62 and 64 are connected by means of hydraulic hoses 70 and 71 to traverse control valve 72 which in turn is connected to the pump 54. Traverse control valve 72 is constructed in such a way that fluid under pressure can be directed to the cylinders 62 and 64 thru either hydraulic hose 70 or 71; the hose not serving as a supply hose will function as a return hose. The traverse control valve 72 can also be operated to prevent any flow of hydraulic fluid either to or from the hydraulic cylinders 62 and 64; this provision permits these cylinders to be locked in place by the fluid trapped in the cylinders and in the hoses. Cylinders 62 and 64 are connected to valve 72 in such a way that whenever the valve 72 is permitting fluid to pass, the piston rods of one cylinder will be caused to extend while the piston rod of the other cylinder will be caused to retract, thus exerting a pull on drive chain 66 to cause sprocket 68 to rotate thus causing the boom drill sub-assembly 11 to rotate with the sprocket 68. To facilitate operation of the vehicle assembly 1 when drilling an auxiliary steering wheel 74 is provided which is used to steer the vehicle when the operator is seated on the auxiliary seat 76 facing the rear of the vehicle. The auxiliary steering wheel 74 is supported in a dummy bearing box 73 and is connected to the conventional steering wheel by means of a crossed V-belt 78 and pulleys 77 and 79 causing the vehicle to turn in the direction the operator is steering the auxiliary wheel 74 and consequently the steerable tractor wheels 80 when the vehicle is traveling in reverse. Auxiliary tractor controls (not shown) are provided which can be operated when the operator is occupying the auxiliary seat 76 which permits the tractor to be operated and controlled from this position. When in the now rear facing position, the operator will be driving for the most part in reverse gear thru the conventional transmission 81 and drive wheels 82.

The other important function of cam slot 38 will now be described. It is essential that drill 46 travel in or along a path coincident with its vertical axis when the rigid boom 16 is elevated or lowered in order that the hole drilled will be straight. If the rigid boom 16 operated about a fixed pivot to raise and lower the drill 46 the path followed by the pins 45 in the yoke 42 at the end of the rigid beam 16 would be the arc of a circle and the curvature of this arc would cause a horizontal displacement of the pin 45 toward the fixed pivot whenever the rigid boom 16 was moving away from the point at which pins 45 were on the same level as the fixed pivot. In order to eliminate this horizontal displacement and to cause the drill to descend and elevate along a vertical line which coincides with the axis of the drill 46, the contour of the cam slot 38 is made such that as the cam follower 40 moves in cam slot 38 it will cause the rigid boom 16 to move in a direction so that as the boom is raised above the horizontal the boom will be extended further in the direction of drill 46 a sufficient amount to exactly compensate for any horizontal displacement which would otherwise occur.

The embodiment 101 shown in FIGURES 7 and 8 is similar in construction to that shown in the other figures except that there the housing 6 and the entire boom drill sub-assembly 11 is mounted on the side of the tractor 2 by a support frame 104 which is directly attached to the chassis 5. With this embodiment for the purposes of this invention, the operator simply drives the tractor 2 in a conventional manner in a path parallel to an underground pipeline 200 and allows the boom 116 (or 16 of FIGURE 1) to extend out to the vicinity of the pipeline and operates the proper control valves to allow the drill 46 to rotate at drilling speed while it is being lowered into the earth 201 to produce a relatively shallow hole 202 near the pipeline 200. As these holes 202 are completed, the operator may insert the probe 203 of a gas

detector 204 to determine if any gas is escaping from the pipeline. Once a definite gas showing is reflected by the gage 205, the operator will drive the tractor in both directions from the first hole 202 to determine just where the heaviest concentration occurs, and this point is then marked for subsequent excavation work to stop the leak in the pipeline 200.

It will be noted in the detail drawing of FIGURE 10 that the drill 46 is actually constructed of a metal rod 90 and a pair of metal strips 91 which are spirally wound about the rod 90 and welded thereto to form a helical flute to lift the dirt out of the hole 202 when drilling. It will also be noted that the point 92 of the drill 46 is so constructed that it will not dig into or damage the pipeline 200 in the event the holes were drilled thereabout.

In FIGURE 9 it will be clearly seen why the forward end of the boom 16 as represented by pin 45 will always move in the same straight vertical line as indicated by path 95. As the boom 16 moves downward by pivoting about pin 20, the link represented by tierod 18 will move rearward due to the captive movement of point 28 in path 96, and this path is so controlled by the action of follower 40 in cam slot 38 that the front end of the boom 16 (pin 45) will always follow the vertical line path 95.

From the foregoing description it will be readily seen that there has been produced a device which substantially fulfills the objects of the invention as set forth herein. The invention is not limited to the exemplary constructions herein shown and described, but may be made in many ways within the scope of the appended claims.

What is claimed is:

1. In mechanism for drilling accurately placed holes, the combination comprising, a tractor, a frame secured to said tractor, said frame having two bearing means each suitable to hold a vertical shaft, a housing with five generally rectangular sides and one open side comprising three vertical sides and top and bottom horizontal sides, a first vertical shaft secured to the exterior of said top horizontal side for turning in one of said frame bearing means, a second vertical shaft secured to the exterior of said bottom horizontal side for turning in the second said frame bearing means, a constant length boom having a pivot end within said housing and extending out through said open side in said housing to an outer end for supporting a drill mechanism, a tie rod pivotally attached at one end of said boom and pivotally attached at its other end to the interior of the bottom horizontal side, a hydraulic cylinder to move said constant length boom pivotally attached at one end to said boom and pivotally attached at its other end to the interior of the bottom horizontal side, means between said housing and said boom for guiding the motion of said boom outer end in a straight vertical line.

2. A boom assembly, comprising: a supporting frame, a housing structure pivoted at its upper and lower ends to said frame, said structure open at one end and mounted for substantial azimuth movement on said frame by rotation in said pivoted ends, a constant length boom extending from the open end of said structure, roller means cooperatively connected between the inner end of said boom and said structure, and constant length link means pivoted at one end to said boom and at its other end to said housing, a power unit pivotally connecting said boom and structure, track means in said structure comprising said cooperating connection with said roller means whereby the outer end of said boom will travel in a straight vertical line in a plurality of vertical planes when an upward force is applied to said boom by said power unit and when said structure is rotated.

3. A boom assembly, comprising: a supporting frame, a quadrilaterally shaped housing structure including generally horizontal top and bottom sides enclosing the top and bottom of said housing structure, vertically aligned

shafts extending outward respectively from each of said horizontal sides, bearing means supported by said frame cooperating with said shafts for permitting rotation of said housing structure, generally flat side walls on all but one of the vertical sides of said housing structure, a constant length boom having a pivot end within said housing structure and extending out from the open side of said housing structure, rod means linking said pivot end of said boom to said bottom horizontal side of said housing structure, guide means between said boom and said housing structure for causing the outer end of said boom to traverse a straight vertical line, and power means between the pivot end of said boom and said guide means for lifting said boom.

4. A boom assembly, comprising: a supporting frame, a housing structure having horizontal top and bottom plates and vertical side walls, one of said side wall areas being open, vertically aligned shafts providing means for attaching said housing structure to said frame, a fixed length boom extending out from the open side of said housing structure, a pivot at the inner end of said boom and said pivot adapted to float in the enclosed portion of said housing structure, link means pivotally attached to the pivot end of said boom and to said bottom plate, guide means between said boom and said housing for causing the outer end of said boom to traverse a straight vertical line, and hydraulic cylinder means for moving said boom, said hydraulic cylinder being pivotally attached to said bottom plate and to said boom between said guide means and said link means in substantially parallel relationship to said link means, an hydraulic drilling unit at the free end of said boom, hydraulic steering means operative to rotate said housing structure and position said drill unit at a desired drilling area, and

an hydraulic system for operating said boom cylinder, said steering means and said drilling unit from a common source.

5. A boom drill assembly, comprising: a supporting frame, a housing structure having a flat horizontal bottom pivotally supported on said frame, a fixed length boom extending from said housing structure, a tie rod pivotally attached to the inner end of said boom and to said housing structure, guide means between the boom and said housing for causing the outer end of said boom to traverse a straight line, and an hydraulic cylinder applied between said housing and said boom to power actuate said boom in said straight line, said hydraulic cylinder and said tie rod each pivoted at one end to said housing bottom and at their outer ends to said boom at the same spaced distance apart whereby said link, hydraulic cylinder and their pivoted attachment spacing distances along the boom and housing structure respectively combine to form with said flat horizontal bottom a swinging trapezium structure which applies its movement to the boom.

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