April 15, 1969 J. C. FAILING 3,438,450

HYDRAULICALLY OPERATED EARTH BORING TOOLS

Filed Feb. 24, 1967 Sheet 1 of 4

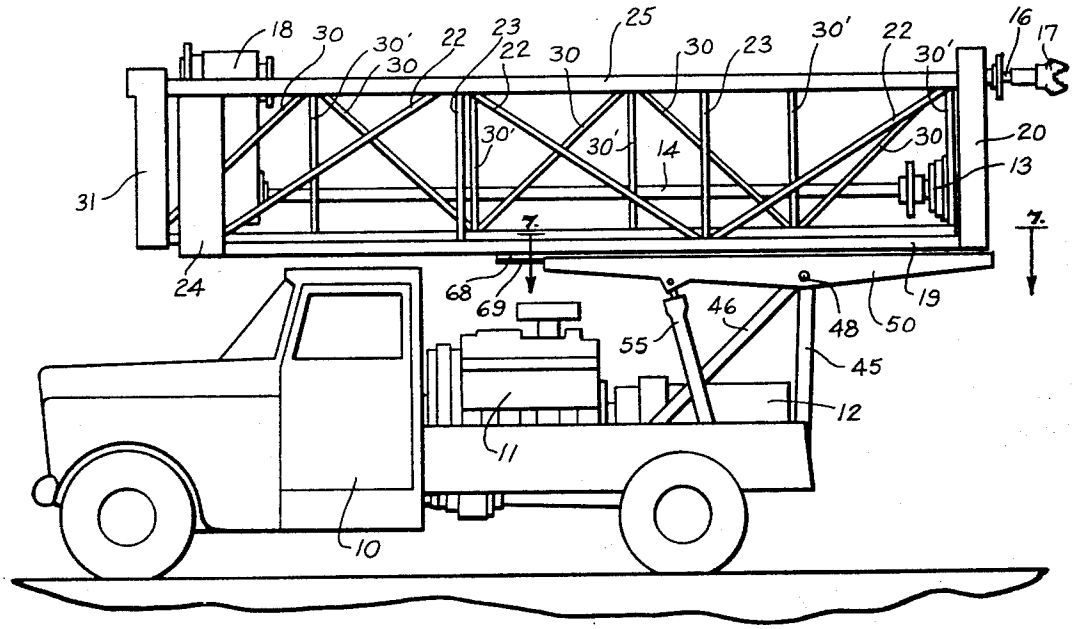


Fig. 1.

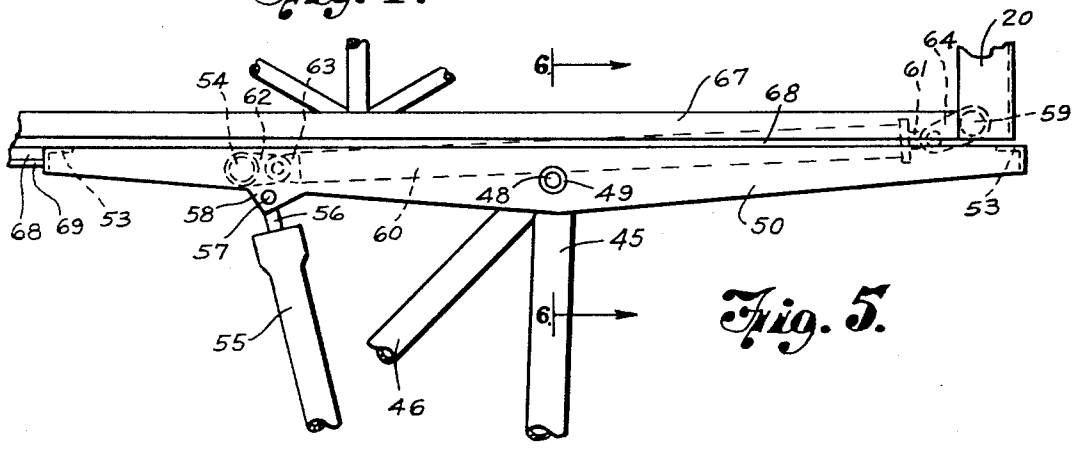


Fig. 5.

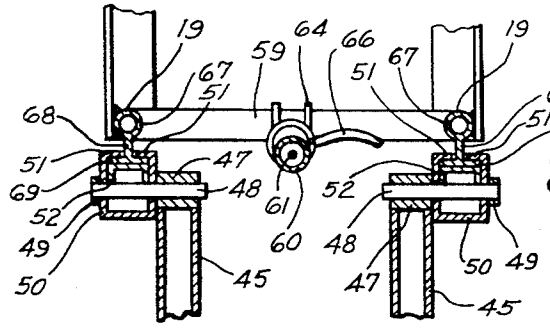


Fig. 6.

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HYDRAULICALLY OPERATED EARTH BORING TOOLS

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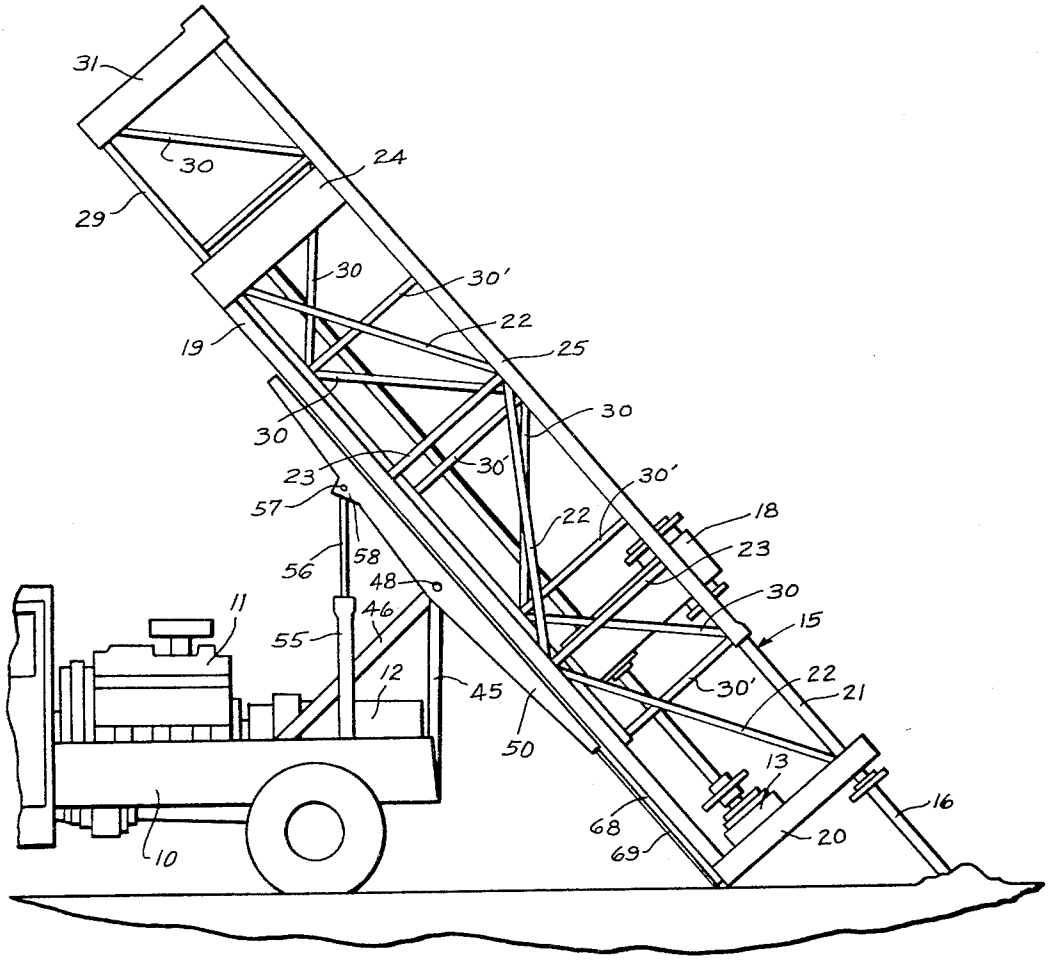


Fig. 2.

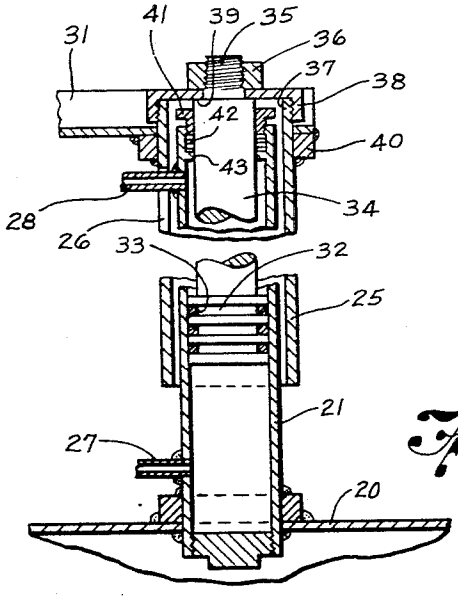


Fig. 10.

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HYDRAULICALLY OPERATED EARTH BORING TOOLS

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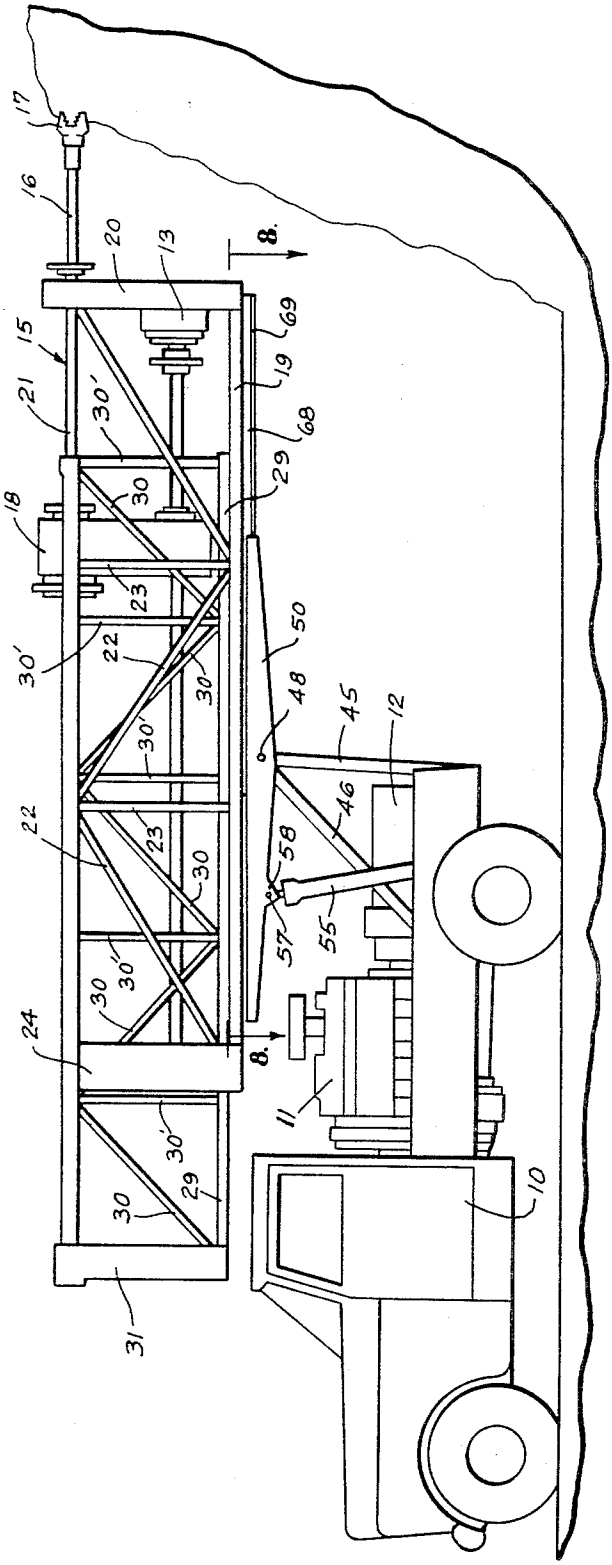


Fig. 3.

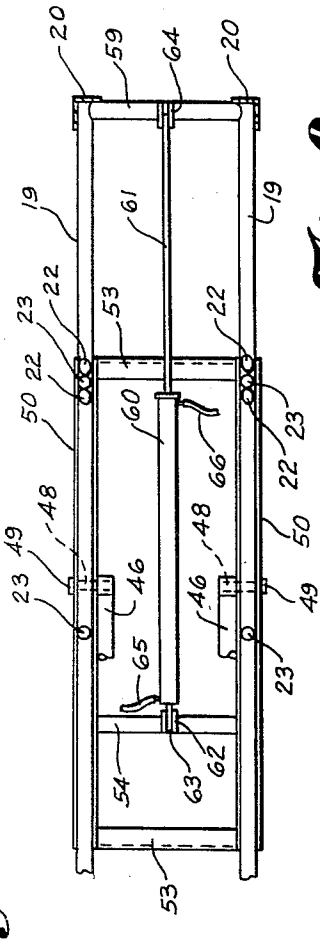


Fig. 8.

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HYDRAULICALLY OPERATED EARTH BORING TOOLS

Filed Feb. 24, 1967 Sheet 4 of 4

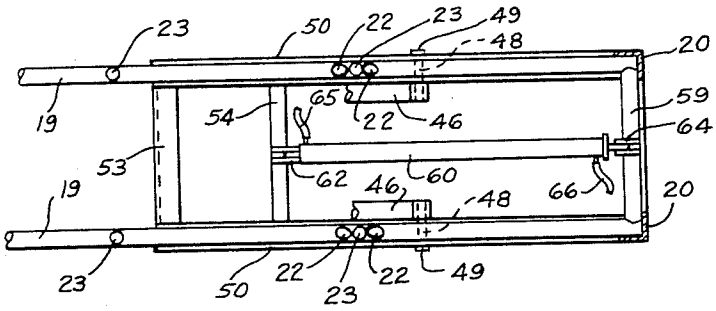


Fig. 7.

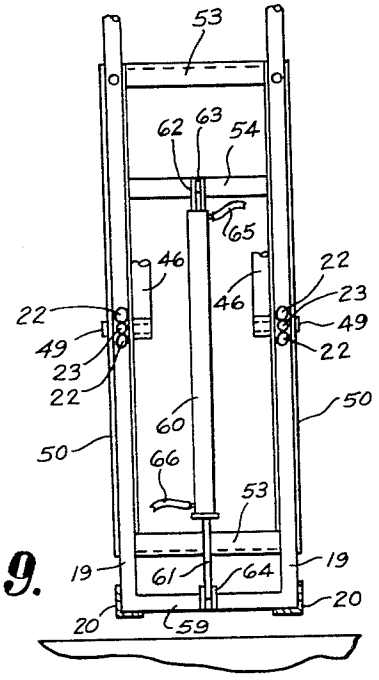


Fig. 9.

Fig. 4.

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United States Patent Office 3,438,450 Patented Apr. 15, 1969

3,438,450

HYDRAULICALLY OPERATED EARTH BORING TOOLS

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Filed Feb. 24, 1967, Ser. No. 618,480
Int. Cl. E21c 11/02, 9/00, 5/10
U.S. Cl. 173—44 8 Claims

ABSTRACT OF THE DISCLOSURE

A vehicle mounted earth boring apparatus adapted to drill at any angle between the horizontal and vertical and closely adjacent the support for the same. It is mounted on a rigid frame fixed on the vehicle and has a pair of transversely spaced bearings on it in which stub shafts are mounted that pivotly connect elongated side members of a cradle with the rigid frame. The cradle also has a pair of cross members and a hydraulic cylinder is mounted between a cross member on the cradle and a cross member on a mast, for adjusting the position of the mast lengthwise of the cradle. The mast has transversely spaced longitudinal frame members that are slidably connected with the longitudinal members of the cradle, there being interengaging guide flanges on the longitudinal cradle members and the longitudinal frame members of the mast. The angular position of the cradle about the pivot members connecting it with the rigid frame members is adjusted by hydraulic cylinders extending between the cradle and the supporting vehicle. The mast is provided with a mounting for a drill and drive means for the drill that is movable lengthwise of the mast by means of hydraulic cylinders. The particular drive for the drill disclosed is a kelly held against endwise movement relative to the mast and driving means between the kelly and a drive sleeve connecting with the string of drill pipe. The mounting for the drive sleeve and its string of drill pipe is adjustable lengthwise of the mast by means of hydraulic cylinders which are incorporated in the mast and mounting for the drive sleeve.

My invention relates to earth boring tools and more particularly to a hydraulically operated earth boring tool.

My invention is an improvement over the invention disclosed in the patent of Jay C. Failing, No. 3,228,487, patented Jan. 11, 1966, on Hydraulically Operated Earth Boring Tools. It applies particularly to earth boring tools utilizing a driving means in which a drive sleeve is provided that is mounted on a suitable supporting member movable up and down along the mast of the drilling apparatus.

In the present invention, I not only provide hydraulic means for moving such a supporting member longitudinally of, or up and down, a mast of a drilling apparatus, but provide hydraulic means for positioning the mast in any desired angular position with respect to the supporting means upon which the mast is mounted. The supporting means is ordinarily a vehicle upon which the apparatus is mounted. The mounting of my improved hydraulically operated earth boring apparatus with respect to the vehicle is such, that it can be mounted so that the mast will extend at any angle with respect to the vehicle from a horizontal to a vertical position, and is mounted so as to be if closely adjacent the supporting means, such as the vehicle, when it is in any of the positions thereof that approach the vertical.

My improved mounting of the mast with respect to the vehicle is of such a character that the lower end of the mast is adapted to be in close proximity to the ground or other surface upon which the support for the mast, such as a vehicle, is mounted.

More specifically, my invention comprises a cradle mounted on the support to turn about a horizontal axis, means for mounting the cradle so that it can be adjusted to any desired angular position with respect to the support, said means being hydraulically operated, and means for mounting the mast for movement longitudinally of itself on the cradle, the position of the mast with respect to the cradle, being controlled by hydraulic means.

In order to provide for a secure mounting of the mast on the cradle, interengaging means are provided on the mast and the cradle for slidably mounting the mast on the cradle for guided movement thereof on said cradle, said means comprising flanged guide members on the cradle and on the mast that have the flanges thereon interengaging.

The hydraulic means that controls the position of the cradle, is pivotally connected at one end thereof with the cradle and at the other end thereof with the supporting means such as the vehicle, while the hydraulic means for locating the mast with respect to the cradle, lengthwise of the mast, comprises hydraulic means mounted between the cradle and the mast which is provided with links flexibly connecting the opposite ends of the hydraulic means with the mast and the cradle.

SUMMARY

It is the principal object of my invention to provide in earth boring apparatus a support upon which a cradle is mounted to turn about a horizontal axis that is fixed relative to the support, a mast, drilling means mounted on the mast, means on the cradle for mounting the mast for movement longitudinally itself on the cradle by a guided sliding connection, and hydraulic means for moving the mast lengthwise of itself with respect to the cradle. Other objects and advantages of my invention will appear as the description of the drawings proceeds.

In the drawings:

FIG. 1 is a view in side elevation of my improved hydraulic earth boring means mounted in inoperative position on the vehicle.

FIG. 2 is a similar view showing my improved earth boring apparatus in position to drill into the earth at an oblique angle, the vehicle upon which the mast is mounted being shown partly broken away.

FIG. 3 is a similar view showing the position of the mast when drilling horizontally into a hill or similar formation at a position above the vehicle and the support therefor.

FIG. 4 is a view similar to FIG. 1 showing the mast in position for drilling vertically into the earth.

FIG. 5 is a fragmentary elevational view on an enlarged scale showing the mounting of the cradle, the operating means for moving the cradle about its pivotal mounting and a portion of the mast.

FIG. 6 is a fragmentary sectional view taken on the line 6—6 of FIG. 5.

FIG. 7 is a horizontal section partly broken away taken on the line 7—7 of FIG. 1.

FIG. 8 is a view similar to FIG. 7 showing a different position of the parts.

FIG. 9 is a section taken on the line 9—9 of FIG. 4 partly broken away, and

FIG. 10 is a fragmentary sectional view of the hydraulic means for moving the drilling means longitudinally of the mast and associated parts.

Referring in detail to the drawings, my improved hydraulic earth boring apparatus is shown as being mounted on a suitable support such as a vehicle 10, which is provided with a prime mover, such as an internal combustion engine 11, which prime mover is suitably connected with a pump 12 for hydraulic fluid to be utilized in operating my drilling apparatus. The pump 12 supplies hydraulic

fluid to a hydraulic motor, such as shown in the patent to Failing, 3,228,487, which is connected with a transmission **13**, that drives the kelly **14**, mounted on the mast **15** in such a manner that it does not have any endwise movement with respect to said mast. Means is provided for driving the drill pipe **16** upon the end of which the drill bit **17** is provided, such as that shown in said Patent 3,228,487, said driving means for the drill pipe **16** being mounted in the housing **18**, which is mounted for movement longitudinally of the mast **15** for feeding the drill bit **17** into the earth or withdrawing the same therefrom.

The mast **15** is provided with a pair of longitudinally extending tubular frame members **19**, constituting a pair of legs of said mast, which extend from and are secured in fixed position to transverse frame members **20** at one end thereof. Also secured to the transverse frame members **20**, in fixed position, are the hydraulic cylinders **21**, which form the other pair of the legs of the mast. Suitable bracing means **22** and **23** connect the hydraulic cylinders **21** and the tubular members **19**. Transverse frame members **24** are provided at the upper ends of the tubular members **19** and hydraulic cylinders **21** to connect the same. The construction of the frame of the mast is substantially that shown in said Patent No. 3,228,487.

The housing **18** is mounted on a framework that is movable with respect to the mast, longitudinally thereof. Said framework comprises a pair of tubular members **25**, which are slotted as at **26**, to accommodate the frame members **22** and **23** and the hydraulic fluid conduits **27** and **28** leading into the opposite ends of the hydraulic cylinder. The housing **18** is also connected with a pair of longitudinal frame members **29**, which are connected with the tubular member **25** by means of diagonally extending bracing members **30** and transverse bracing members **30'**, that are out of alignment with the bracing members **22** and **23** and by means of the transverse bracing means **31** at the upper ends thereof. Thus the housing **18**, and the frame upon which it is mounted, are mounted for movement as a unit on the mast, longitudinally thereof.

The means for moving the platform **18** and the movable framework on which it is mounted with respect to the mast is shown more in detail in FIG. 10. A piston **32** having sealing means **33** is provided with a piston rod **34**, which has a screw-threaded reduced end portion **35** that is secured in fixed position on the transverse bracing member **31** by means of a nut **36** engaging the screw-threaded end thereof. The upper ends of the tubular members **25** are each provided with an externally threaded portion **37**, in which the internal threads on the cap **38** engage. The reduced portion **35** extends through an opening in the cap **37** and the cap is seated against a shoulder **39** on the piston rod where the reduced portion **35** joins the main body portion of said piston rod. A ring **40** embraces the tubular member **25** and is secured in fixed position to the transverse bracing means **31** and to said tubular member by means of welds, as clearly shown in FIG. 10. Thus the upper ends of the tubular members **25** are fixed to the transverse bracing means **31** and thus to the movable framework. Suitable means is provided for obtaining a fluidtight sliding connection between each of the hydraulic cylinders and the piston rod **34**, at the upper end thereof, comprising a flanged sleeve **41** which slidably receives the piston rod **34** and which is screw-threadedly connected with the upper end of the hydraulic cylinder **21**. Suitable packing material **42** is provided between said sleeve **41** and an inwardly directed flange **43** on the hydraulic cylinder **21**.

It will be obvious that when the hydraulic fluid is supplied through the conduit **27** to the hydraulic cylinder **21** the piston, and thus the frame upon which the housing **18** is mounted. will move upwardly with respect to the mast, and when hydraulic fluid is introduced through the conduit **28** the reverse movement of the housing **18** and

the drilling means carried thereby will take place. Hydraulic means is thus provided for moving the driving means for the drilling means lengthwise of the mast, the means for moving said drilling means and its driving means lengthwise of the mast, being substantially the same as that shown in the patent to Failing, No. 3,228,487.

The mounting for the mast on a support, such as the vehicle **10**, comprises a frame mounted in fixed position on said vehicle having the vertically extending members **45** and the obliquely extending members **46**. Said frame is provided with bearing members **47** that have the shafts **48** mounted therein, which are provided with collars **49** on the outer ends thereof that engage with the outer sides of the longitudinal members **50** of a cradle. Said shafts **48** pivotally mount said longitudinal members **50** on the frame having the members **45** and **46**. The longitudinal members **50** taper from their pivotal mounting toward the opposite ends thereof, as will be obvious from FIGS. 1 to 5 inclusive. Said longitudinal frame members **50** of said cradle are preferably of a box-like character in cross section and terminate in inwardly directed longitudinal flanges **51**. The longitudinally extending members **50** also each have a channel member **52** mounted therein with its web portion extending in spaced relation to the inwardly directed flanges **51** and with its flanges secured to the side walls of the box-like longitudinally extending members **50**. A guide slot is thus formed between the web portion **52** and the inwardly directed flanges **51** on the box-like body portion of the longitudinal members of the cradle. (See FIG. 6.) The frame members **19** have a tubular body portion **67** from which a web portion **68** extends to the flange **69** which fits slidably between the flanges **51** and the web portion **52**.

The longitudinal members **50** are connected at their opposite ends by means of transverse angle members **53** to form a rectangular frame and a transverse member **54** is also provided extending between and secured to said longitudinally extending members **50** of the cradle. The member **54** is circular in cross section as will be obvious from FIG. 5.

The position of the cradle about the pivot members **48**, is determined by means of hydraulic cylinders **55** from which the piston rods **56** extend to pivot members **57**, which are mounted in the ears **58** provided on the longitudinally extending members **50**. The hydraulic cylinders **55** are each pivotally mounted on the vehicle **10** at the end thereof opposite that from which the piston rod **56** extends. It is accordingly possible, by controlling the supply of hydraulic fluid to the hydraulic cylinders **55**, to vary the position of the cradle between a horizontal position thereof such as that shown in FIG. 1 and the vertical position thereof shown in FIG. 4, and to any angular position between said horizontal and vertical positions.

A transverse member **59**, circular in cross section, extends between the angle members **20**, being fixed to the tubular members **19** at opposite ends of said member **59**. A hydraulic cylinder **60**, having the piston rod **61** extending therefrom, is mounted between the mast and the cradle, a link **62** being pivotally connected with an ear **63** extending endwise from the hydraulic cylinder **60** and with the transverse member **54**. A link **64** is pivotally connected with the end of the piston rod **61** and with the transverse member **59**. It will accordingly be seen that the hydraulic cylinder and its piston rod are flexibly connected with the mast and with the cradle at opposite ends thereof. Conduits **65** and **66** lead from a suitable source of hydraulic fluid, such as the pump **12**, to opposite ends of the hydraulic cylinder **60**. By supplying hydraulic fluid to either the end of the cylinder having the conduit **65** connected therewith or the end of the cylinder having the conduit **66** connected therewith, the position of the piston connected with the piston rod **61** can be determined, and thus the position of the mast with respect to the cradle, longitudinally of the mast, can be determined by supplying

hydraulic fluid as desired through either the conduit **65** or **66** to said hydraulic cylinder.

Thus the position of the mast with respect to the vehicle **10**, and with respect to the ground, can be determined by varying the angular position of the cradle **50**, by means of the hydraulic cylinders **55**, and by varying the position of the mast on the cradle, by means of the hydraulic cylinder **60**, so that either a horizontal or a vertical position or any oblique angular position between said horizontal and vertical positions of the mast can be obtained and the mast can be adjusted so that its lower end will be in close proximity to the surface of the earth into which the drill is to be driven no matter at what angular position the mast may be when such drilling operation is undertaken.

What I claim is:

1. In earth boring apparatus a support, an upstanding frame mounted in fixed position on said support, a cradle comprising a pair of transversely spaced longitudinally extending elongated frame members and transversely extending elongated longitudinally spaced frame members having their ends rigidly connected with said longitudinally extending frame members to form an open frame, means for mounting said cradle on said upstanding frame to pivot about a horizontal axis fixed with respect to said upstanding frame, said longitudinally extending frame members and said support, means extending between said support and said cradle to swing said cradle about said axis, a mast, drilling means mounted on said mast, means on said mast and longitudinal frame members for mounting said mast for guided movement longitudinally of said mast on said cradle, and means for moving said mast longitudinally of itself relative to said cradle.

2. In the earth boring apparatus claimed in claim **1** a framework mounted on said mast for movement longitudinally of said mast and driving means for said drilling means mounted on said framework for movement therewith.

3. In the earth boring apparatus claimed in claim **1** the means for mounting said cradle on said upstanding frame including bearing members mounted in fixed position on said upstanding frame, and a shaft mounted on each of said longitudinally extending frame members, each of said shafts engaging in one of said bearing members.

4. In the earth boring apparatus claimed in claim **1** a pair of transversely spaced longitudinally extending legs on said mast, the mounting for said mast including guide flanges on said legs extending through the major portion of the length thereof and transversely spaced flanges on said longitudinally extending frame members extending through the major portion of the length thereof to provide a guide slot between the same for said guide flanges.

5. In the earth boring apparatus claimed in claim **1** the means for mounting said cradle on said upstanding frame being widely spaced from the ends of said longitudinally extending frame members.

6. In the earth boring apparatus claimed in claim **1** said means to swing said cradle being hydraulically actuated.

7. In the earth boring apparatus claimed in claim **1** a cross member on said mast, and said means for moving said mast longitudinally of itself comprising hydraulic means and links pivotally connected with the opposite ends thereof, with said cross member and one of said transversely extending frame members.

8. In the earth boring apparatus claimed in claim **1** one of said transversely extending members extending perpendicularly to said longitudinally extending members at opposite ends thereof.

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ERNEST R. PURSER, *Primary Examiner.*

U.S. Cl. X.R.

173—28