July 4, 1967 N. D. BECKER ETAL 3,329,401

APPARATUS FOR RECOVERING DRILL PIPE

Original Filed June 19, 1961 2 Sheets-Sheet 1

FIG. 1

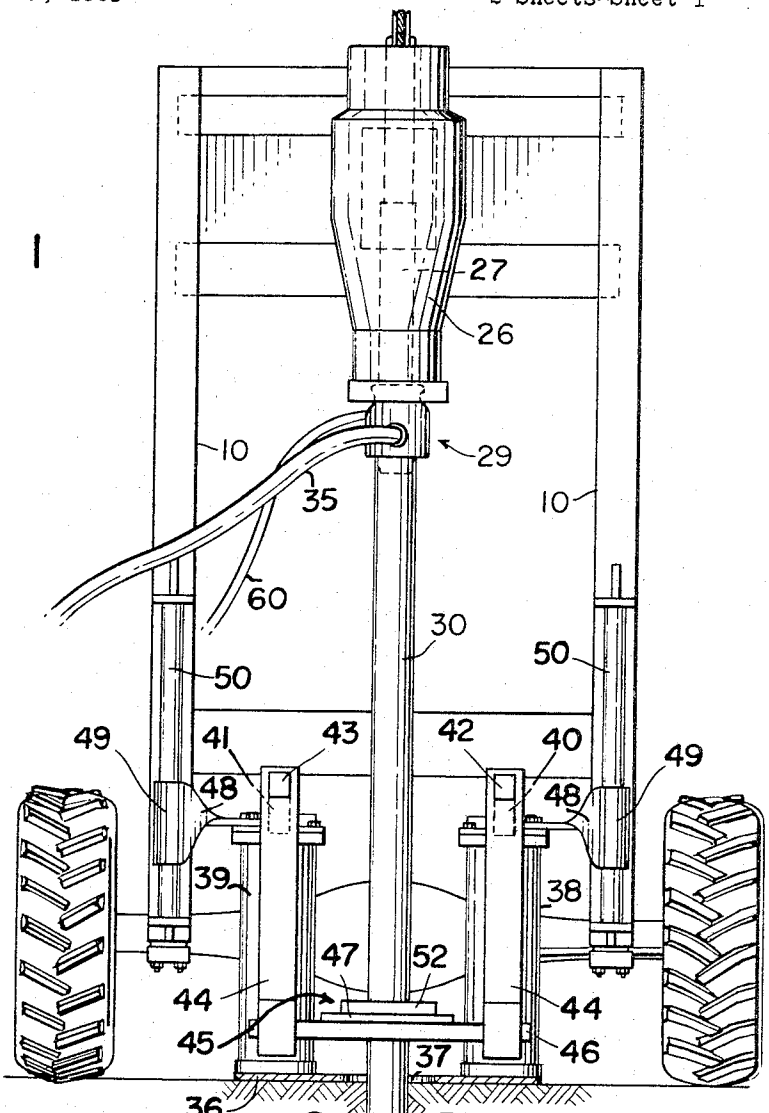
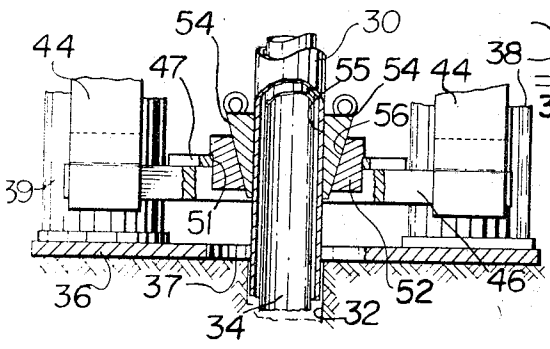


FIG. 4



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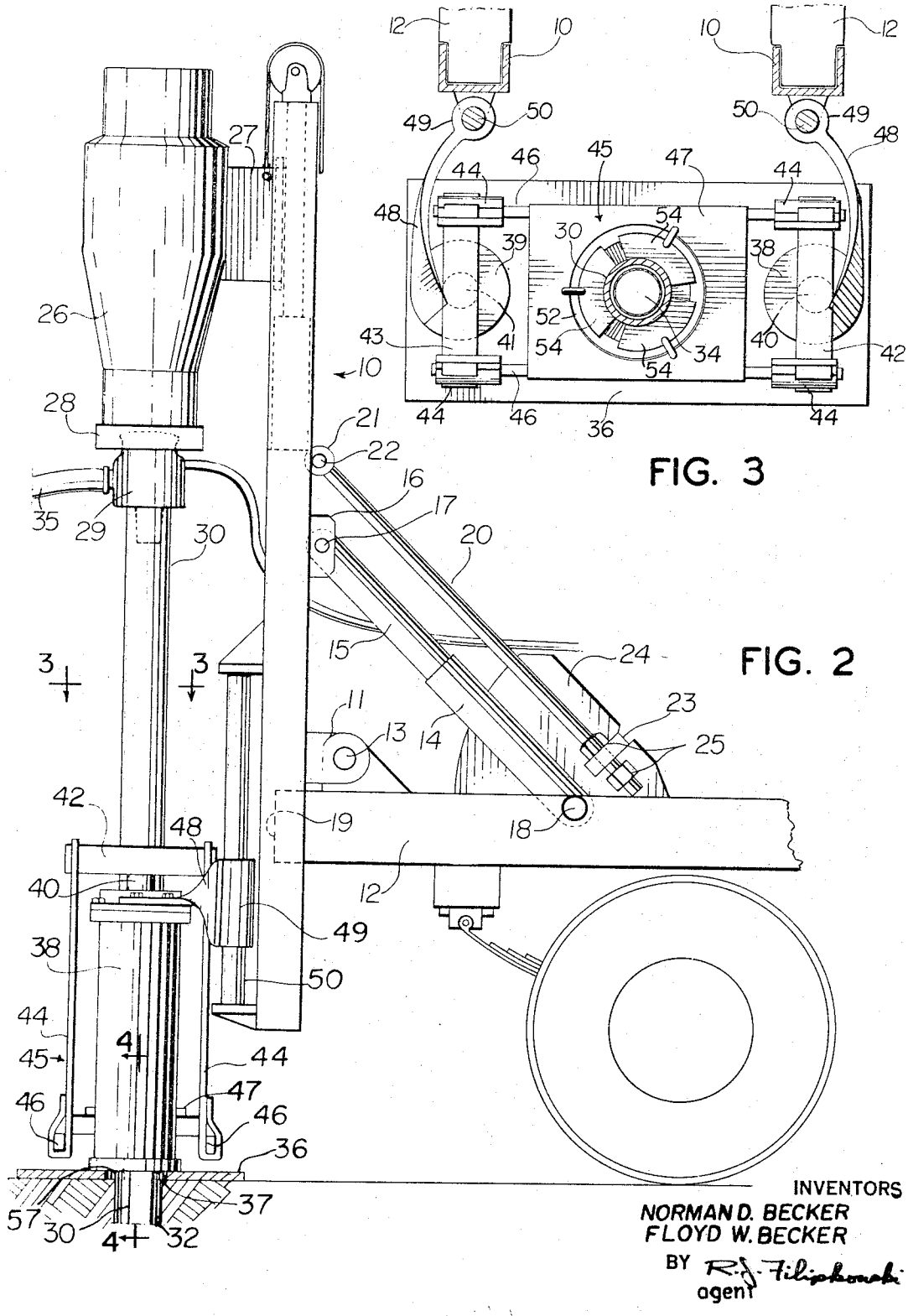


FIG. 3

FIG. 2

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United States Patent Office 3,329,401 Patented July 4, 1967

3,329,401

APPARATUS FOR RECOVERING DRILL PIPE

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Original application June 19, 1961, Ser. No. 118,191, now Patent No. 3,280,925, dated Oct. 25, 1966. Divided and this application July 29, 1966, Ser. No. 568,929
3 Claims. (Cl. 254—29)

ABSTRACT OF THE DISCLOSURE

A casing puller mounted on a pivoting frame in a vehicle, arranged to lower a slide-guided rigid apertured platform base of the puller to the ground when the frame is swung upright to register the aperture about the casing, the base supporting spaced upright hydraulic cylinders whose piston rods carry a depending apertured cradle that may be rested on the base to engage slips inserted in its aperture with the casing.

When slips are also provided in the platform aperture to prevent dropping of the casing, the latter may be rapidly pulled up when the piston rods are reciprocated, elevating the casing at each upstroke.

This application is a division of application Ser. No. 118,191, filed June 19, 1961, for an invention in "Method and Apparatus for Impact Drilling of Overburden," now Patent No. 3,280,925.

The present invention relates to transportable earth boring apparatus, and specifically to lifting apparatus for withdrawing drill pipe from a borehole. The invention is particularly useful for providing a means for raising drill pipe which remains constantly in operative readiness during the impact drilling operation, requiring only the insertion of suitable grab means to engage the pipe, but which is entirely clear of the pipe and working zone during the drive operation. Moreover the raising means lends itself ideally to support by the same derrick as carries the impact engine so as to provide an integral and self-contained system.

In our parent application, U.S. Ser. No. 118,191 there is described and claimed an apparatus for impact driving of a tubular hollow drill pipe carrying an annular toothed bit so as to cause the bit and drill pipe to penetrate overburden. In that method, a novel combination of steady axial loading of the bit and intermittent transfer of impact energy to the bit makes possible the penetration of ground in which conventional methods prove costly or incapable of making a straight borehole, such as river bed gravels, shales, and glacial till—materials which may generally be grouped under the heading "overburden."

The present invention is concerned with the provision of associated means for applying upward, lifting force on the pipe and which is capable of exerting the relatively enormous starting pulls required to move the pipe along the closely fitting borehole made by impact drilling. The starting pull is particularly greater in that method of drilling whereby the contents of the borehole have been retained within the pipe for removal therewith.

According to the invention there is provided a transportable lifting device having a base adapted to be set on the ground surface about the borehole opening, the base supporting a pair of laterally spaced erect hydraulic cylinders whereof their piston rods extend upward and carry on their upper ends short beams which in turn carry depending links straddling the cylinder, the lower ends of the links being connected to the ends of a transverse horizontal cradle closely overlying the base and having an aperture adapted to fit around the drill pipe so that grab

means insertable into the aperture can grip the pipe and raise it whenever the pistons are jointly actuated to elevate the cradle.

The invention may be the better understood from a reading of the following specification in combination with the accompanying figures of the drawing, wherein,

FIGURE 1 is a front elevation view of a drilling apparatus carrying the lifting device of the present invention;

FIGURE 2 is a side elevation view of the apparatus of FIGURE 1;

FIGURE 3 is a plan view of the lifting device, looking downward from a sectioning plane indicated by line 3—3 in FIGURE 2; and,

FIGURE 4 is a front elevation detail view in partial section taken on a vertical plane designated by line 4—4 of FIGURE 2.

Referring to the drawing, a transportable earth boring apparatus as more fully described in our application Ser. No. 118,191 and as shown by FIGURES 1 and 2 herein, comprises an erectible derrick frame **10** pivotably supported as by brackets **11** from a horizontally extending vehicle frame **12**, to rotate about a transverse horizontal axis in bearing pins **13**. The derrick frame is arranged to be erected and lowered by linear motor means **14**, such as a hydraulic or pneumatic piston and cylinder supplied by fluid under pressure through suitable control valves and lines (not shown). One end of a piston rod **15** is secured rotatably on bracket **16** fixed to the derrick, turning about pivot pin **17** in the bracket, while the cylinder has its lower end supported rotatably in the vehicle frame as by pivot pin **18**. In the erected position, a prolongation **19** of the rear part of the vehicle frame **12** serves as a stop to limit backward swing of the upper part of the derrick frame. The derrick is braced in erected position by strut **20** secured rotatably at its upper end in derrick bracket **21** on pivot pin **22**, and is held adjacent its lower end in slotted lug **23** of vehicle bracket **24**, the lug being interposed between stop nuts **25** spaced adjustably along the strut.

A percussion motor **26** which may be a diesel pile hammer of known type is supported by a vertically adjustable carrying structure **27** in the upper part of the derrick frame **10**, and is formed with a downwardly facing striking part **28** adapted to deliver blows against an anvil cap **29** carried removably upon the upper end of drill pipe **30**. Suitable means are provided for elevating and lowering the hammer so that the full weight thereof may be rested on the end of hollow tubular drill pipe **30**, or so that the hammer may raised entirely clear of the pipe as when a length is to be added or removed. The same means also serve to lift or lower the raising apparatus, as will appear from the further description hereinafter.

While the manner of impact drilling as described in the aforesaid parent application Ser. No. 118,191 need not be described here in full detail, it will be helpful to understand that subjecting the drill pipe **30** to steady impressed axial loading and to impact energy delivered by repeated downward blows on the anvil cap causes the annular bit **31** to penetrate the overburden or other ground, by effecting lateral and axial displacement of solid obstacles encountered, and by fragmenting the same, so that the bit may progress downward. In this manner a substantial part of the volume of earth materials occupying the eventual borehole **32** is deflected, and part is received within the bit aperture **33**. In the preferred method as described in our parent application, means are provided for pneumatically or hydraulically clearing the fragments entering the bit aperture and elevating them continuously under the lifting force of a fluid stream issuing from the bit and flowing up the central conduit **34**, whence they issue by way of exhaust duct **35** above the surface from a side of the

anvil cap **29**. In an alternative method, the fragments are forced upward solely by the intermittent downward passage of the bit and drill pipe, no fluid being supplied by conduit **60**, so that these fragments occupy the volume of the conduit **34** and are removed with the drill pipe when it is withdrawn.

When the drill pipe requires to be removed from the borehole, the hammer means and the anvil are raised well clear of the upper end of the drill pipe **30**; the distance should be not less than the length of a section of the drill pipe. When a considerable length of drill string is in the ground it has been found that a large starting pull is required, which may be in excess of 30 tons. Consequently robust equipment of considerable power is required, particularly when it is recognized that the rate of withdrawal should be comparable to or faster than the rate of descent; in certain soil materials such as fine gravels the penetration rate may be very rapid.

An apparatus for guiding and grabbing the drill string comprises a base platform **36** in the form of a rectangular rigid plate member, disposed in the horizontal plane to be supported upon the ground surface and having a circular aperture **37** registered coaxially with the pipe **30** and freely passing the drill pipe therethrough. The platform supports a pair of upright hydraulic motors **38**, **39** spaced on opposite sides of the aperture, of the piston-and-cylinder type whereof their driven elements, specifically their piston rods **40**, **41** are driven vertically with respect to the platform. Fixed upon the upper ends of the piston rods are longitudinal horizontal beams **42**, **43**, from the ends of which depend pairs of tension strap members **44** of such length that in the fully retracted position of the pistons, the lower ends of the tension members reach almost to the platform surface. A cradle structure generally designated **45** is carried by the lower ends of strap members **44**, including transverse beams **46** and a strong horizontal plate **47** supported upon and extending across beams **46**.

The assembly comprising the base platform **36** and the cylinders **38**, **39** is supported from the derrick **10** by braces **48** fixed on the upper cylinder ends, the braces including sleeve parts **49** and being slidably received on upright guides **50** fixed on and spaced to the rearward side from the derrick. When the derrick is lowered to the horizontal position, the entire raising apparatus is lifted by the braces **48** and is carried above the rearward frame parts **12**.

Plate **47** is apertured at **51**, the aperture registering in vertical spaced coaxial relation with aperture **37**, and supporting a thrust block **52** which is coaxially apertured by bore **53**. The latter aperture is of conic form, and enlarges upwardly. Its minor diameter end is slightly larger than the outside diameter of the drill pipe **30**, so that a set of wedges or slips **54** may be placed around the pipe and within the block. The slips may be any convenient number, for example three, and have milled and hardened inner gripping faces **55** of cylindric form and conic outer faces **56** complementary to the form of bore **53**.

As the piston rods **40** and **41** are caused to be raised jointly, as by the application of fluid under pressure through suitable conduits and control valves (not shown) to motors **38** and **39**, the cradle **45** with plate **47** and thrust block **52** is raised, causing the wedges or slips **54** to clamp the pipe **30**, and to grip it tightly as lifting force is applied. When the upward limit of motion of the rods **40**, **41** has been reached, the motors are then operated to drive their piston rods down, thereby lowering the cradle structure **45** and thrust block **52**. The wedges or slips disengage and slide down about the pipe which remains standing in the borehole in its raised position in most instances, depending on the extent of earth friction. In the event that such frictional holding is insufficient to keep the drill pipe steady, resort may be had to the use of conventional drill pipe clamps to prevent lowering, such devices (not shown) being suitably locatable removably at the platform aperture **37**.

The raising and lowering operations on the cradle structure are repeated as quickly as desired, the hydraulic fluid pumps being chosen preferably of such capacity that the withdrawal of a drill string requires a fraction of the time taken to drive it into the ground. The up-and-down reciprocation of the cradle structure **45** therefore causes the drill pipe **30** to be pulled out of the hole by increments, until a length is clear. The free length is then unscrewed and lifted and swung away by conventional crane means or the like, and succeeding lengths are similarly brought up and removed. When the last length which carries the bit **31** is brought up a catcher or stop (not shown) may be employed to cover the hole opening **57**.

To dismantle the apparatus for transport, the frame **27** is suitably connected, as by chain and hook means, with the platform **36**, and the hammer and the lifting apparatus are raised together to bring the center of gravity into suitable relation to the axis in pivot pins **13** when lowered to the horizontal. To lower the derrick, strut **20** is released, and rod **15** of the erection motor **14** is retracted.

We claim:

1. Means for recovering a string of drill pipe extended above ground from a borehole comprising, an erectible derrick frame, a transport vehicle having pivot means supporting said derrick frame for rotation about a transverse horizontal axis, motive power means arranged for controllably erecting and lowering said derrick frame about said axis, a platform braced to said frame and guidedly movable therealong adapted to be supported on the ground when said frame is erected, said platform having an aperture for freely receiving said drill pipe therethrough, a pair of lifting jacks spaced on either side of said aperture and having driven elements movable vertically, a lifting cardle supported from said driven elements and having a transverse member parallel with said platform and movable between a lowered position adjacent the upper surface of said platform and a raised position spaced above said platform in accordance with the upper limit of the driven member motion, aperture means in said cradle vertically registered coaxially on said platform aperture adapted to receive said drill pipe, and having upwardly opening conic form adapted to removably receive slip means for gripping said drill pipe when said cradle is raised to pull said pipe upward on upward motion of said driven elements, and operable to release said drill pipe from said cradle when said driven elements are lowered.

2. Means for recovering a drill pipe as claimed in claim **1** wherein said cradle is supported on said driven members by pairs of straps having their lower ends fixed on the ends of said transverse member and having their upper ends fixed on longitudinal beams respectively carried by the driven members, said beams being parallel and extending at right angles to a line joining said lifting jacks, whereby said cardle provides unobstructed access to the drill pipe between said jacks.

3. A vehicle-supported transportable apparatus for raising a string of tubular drill pipe in a borehole, said vehicle having a frame rotatable on pivot means in said vehicle about a transverse horizontal axis and having means for turning said frame between a horizontal transport position and a vertical operative position, slide means carried by said frame, means guidedly supporting said apparatus on said slide means for reciprocal motion between a retracted position in said frame when said frame is horizontal and an extended operative ground-engaging position when said frame is erect, said apparatus comprising a rigid platform adapted to be set on the ground in load-bearing relation about said borehole to overlie said borehole, a pair of laterally spaced hydraulic piston-and-cylinder motor means supported on said platform on opposite sides of said borehole, and having vertically driven members selectively actuatable for raising and lowering movements, a depending cradle structure

supported from said driven members, said structure comprising a transverse member disposed horizontally above said platform between said motor means and pairs of upright links connecting ends of said transverse member with respective ones of said pair of driven members, said platform and said transverse member each having a circular aperture formed therein, said apertures being in vertical alignment and adapted to receive a drill pipe extended above said borehole through said apertures, said aperture in said transverse member being adapted to support slip means removably insertable around said pipe, whereby said slip means effect lifting of said drill pipe on raising movement of said cradle structure and release said drill pipe on lowering movement.

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