United States Patent [19]

Lang et al.

[11] **3,832,918**

[45] **Sept. 3, 1974**

[54] **BREAKOUT WRENCH**

[75] Inventors: **David M. Lang**, South Milwaukee; **Jack D. Nelmark**, New Berlin; **Matthew Smith**, Milwaukee, all of Wis.

[73] Assignee: **Bucyrus-Erie Company**, South Milwaukee, Wis.

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[52] **U.S. Cl.** **81/57.33**, 81/57.34

[51] **Int. Cl.** **B25b 13/50**

[58] **Field of Search** ..... 81/57.33, 57.34, 57.35, 81/53 A, 53 R

[56] **References Cited**

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2,546,224	3/1951	Johansen	81/57.34
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Primary Examiner—James L. Jones, Jr.

Attorney, Agent, or Firm—Quarles & Brady

[57] **ABSTRACT**

A breakout wrench for drilling apparatus includes a pivotably mounted slide arm upon which a carriage is slidably mounted and a set of wrench jaws which are attached to a wrench arm swingably disposed upon the carriage for engaging and loosening a drill string section of the drilling apparatus. A hydraulic cylinder associated with and disposed beneath the slide arm is attached to the carriage to provide movement of the carriage along the slide arm and impart a wrenching movement to a drill string section through the accompanying wrench arm. A stop pin is provided to secure the slide arm in a stored position during normal drilling operations.

7 Claims, 6 Drawing Figures

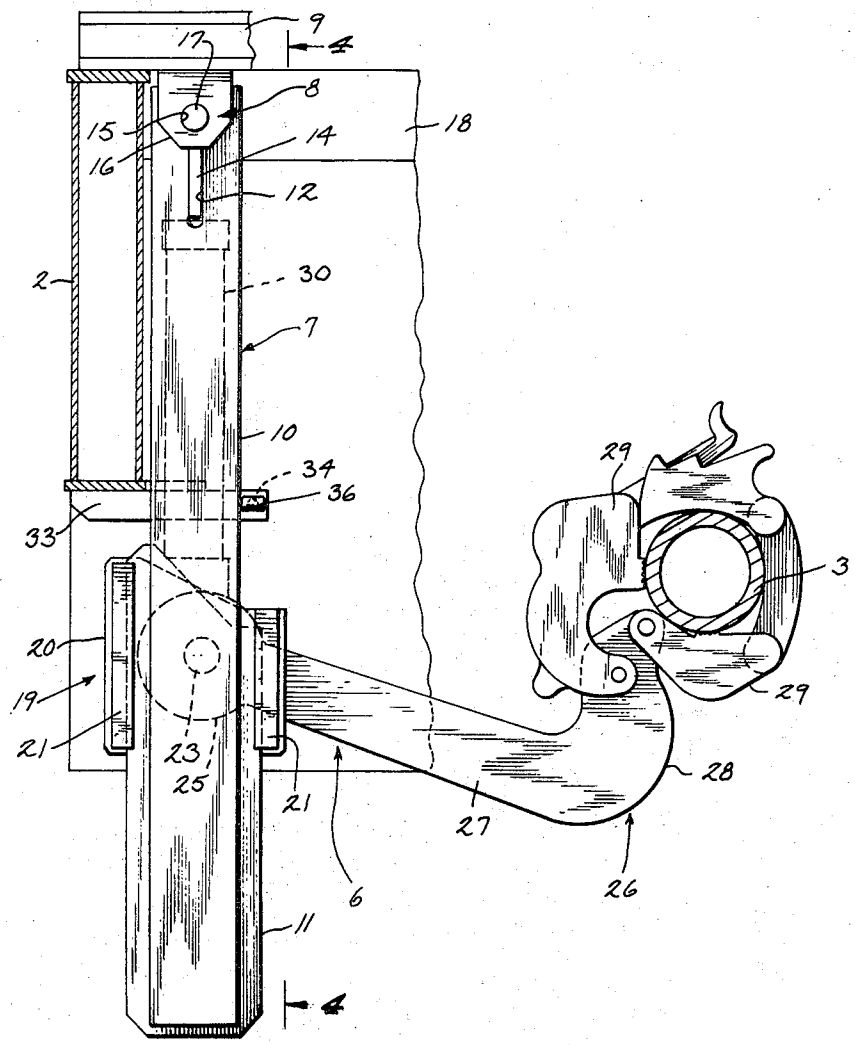

Fig. 1

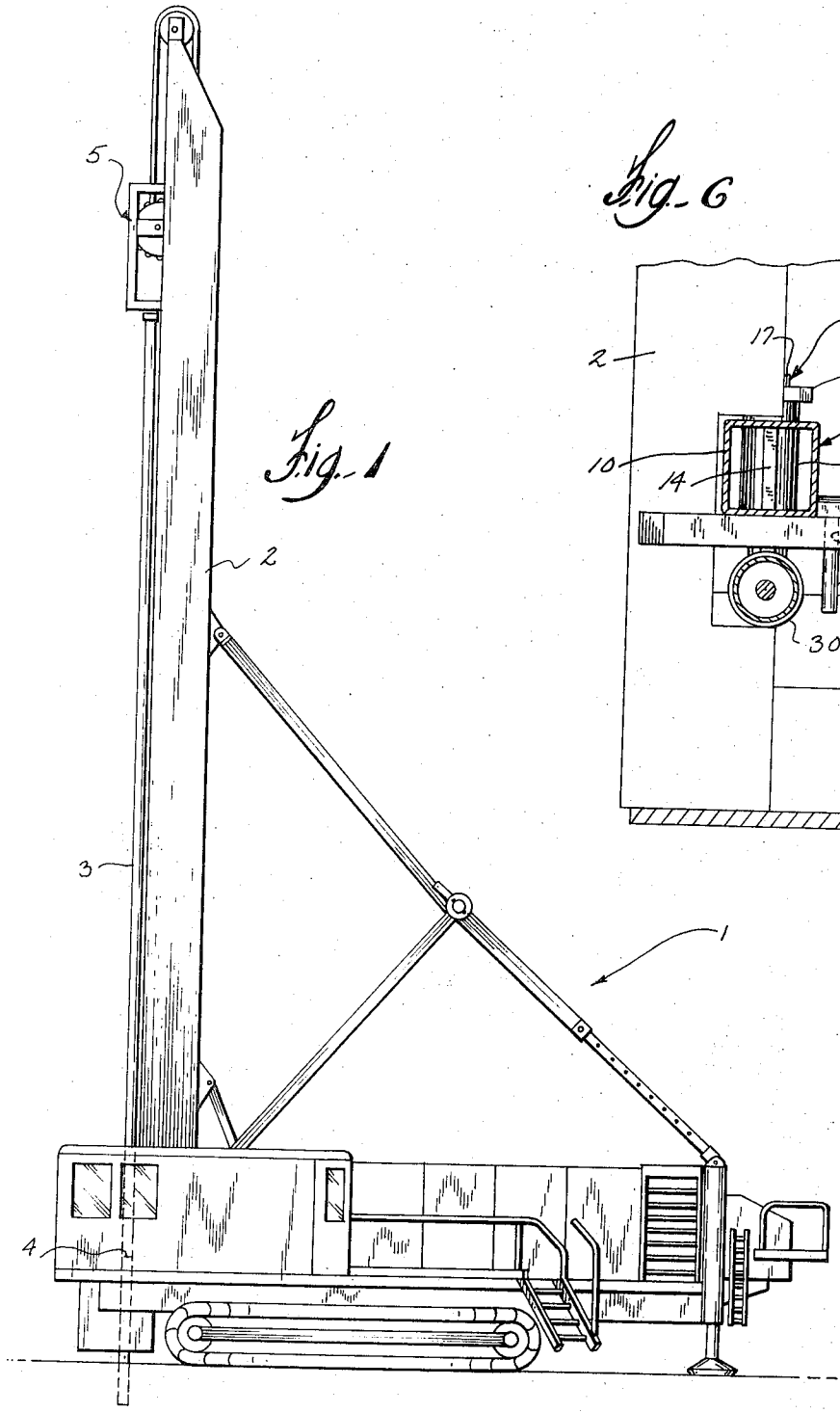

Fig. 6

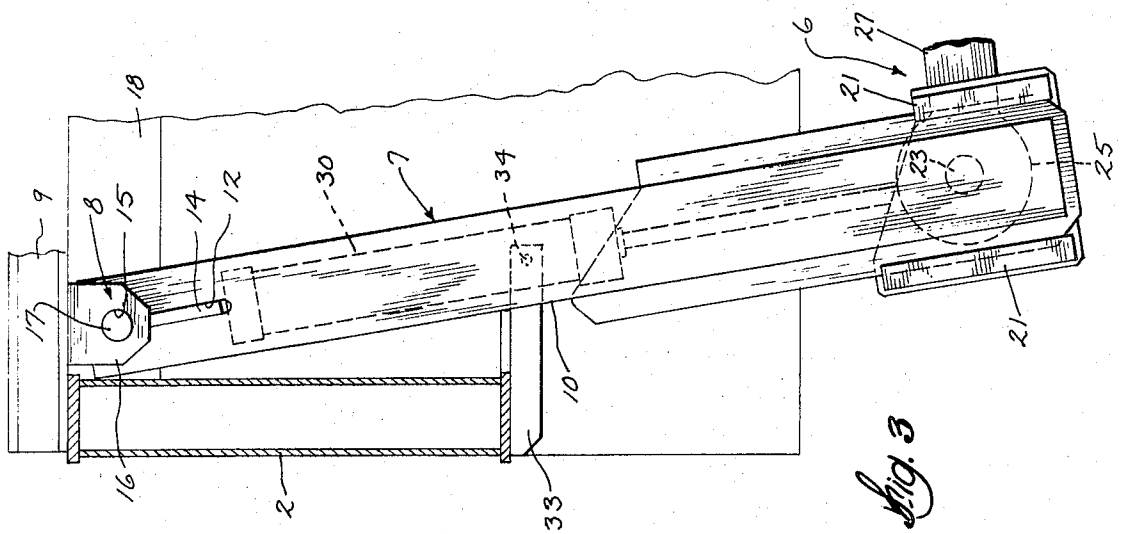
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Fig. 3

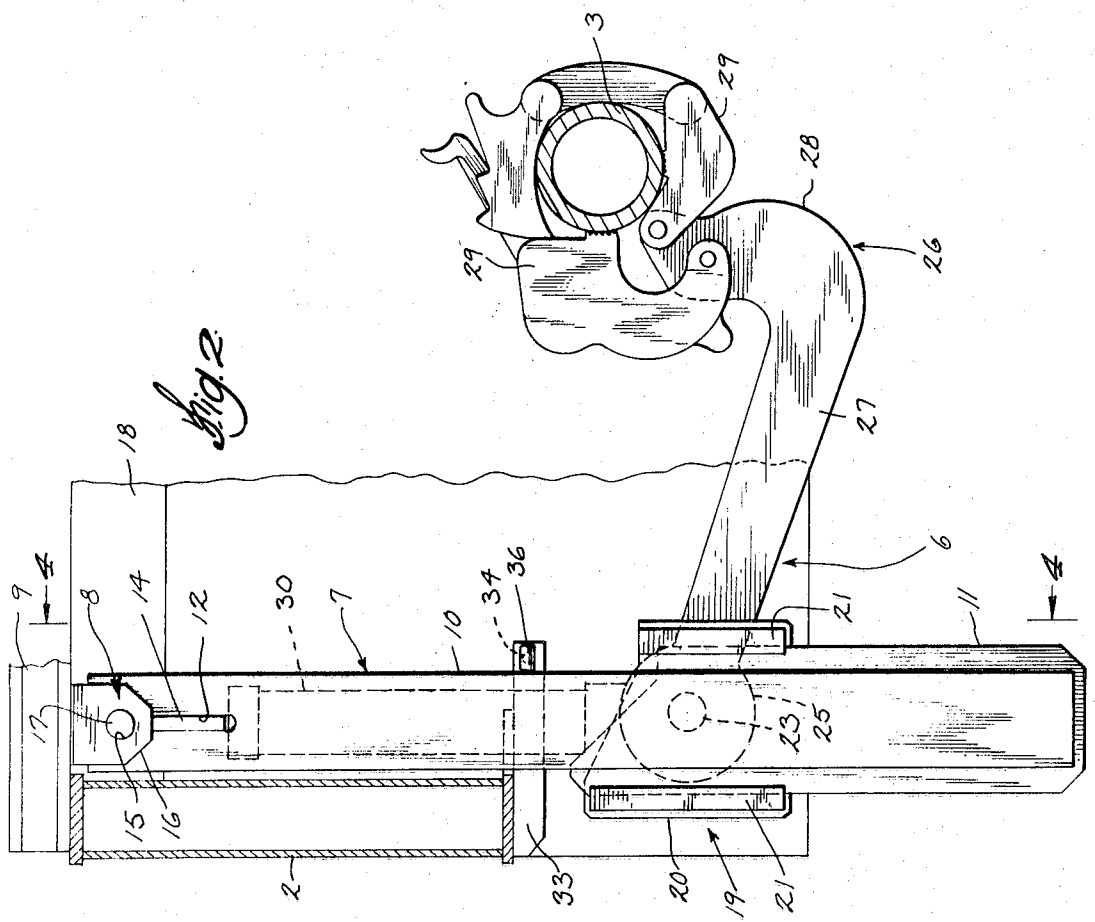
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Fig. 2

Fig. 4

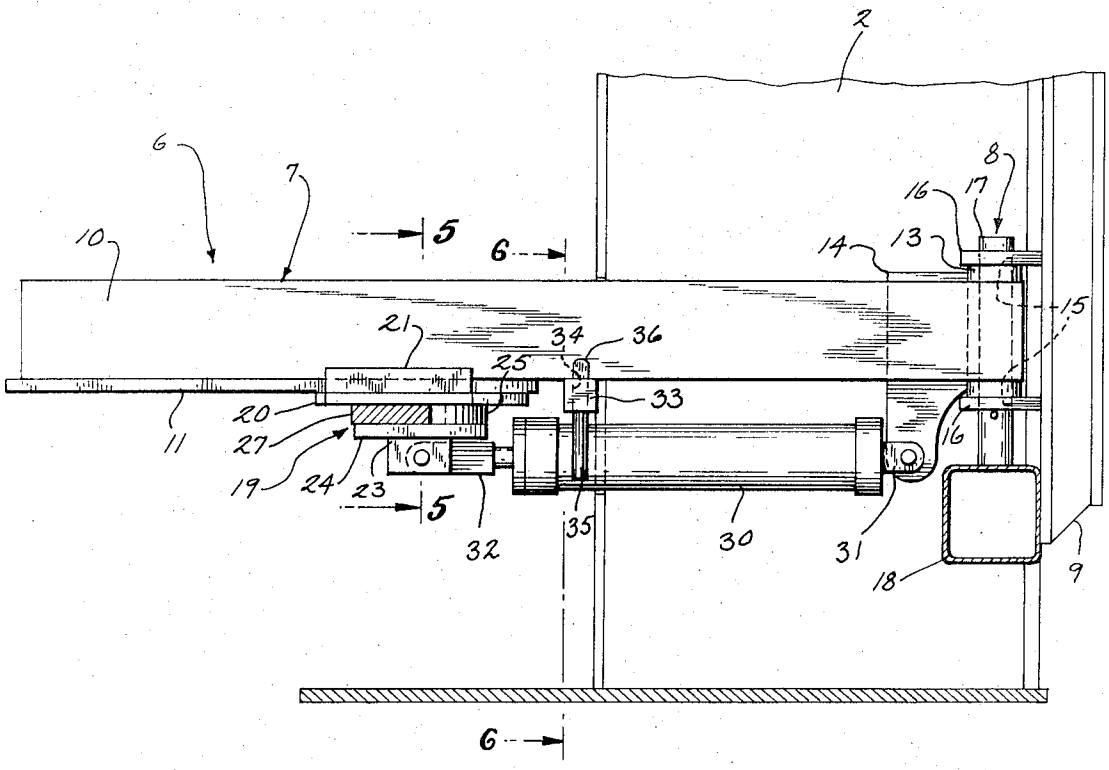
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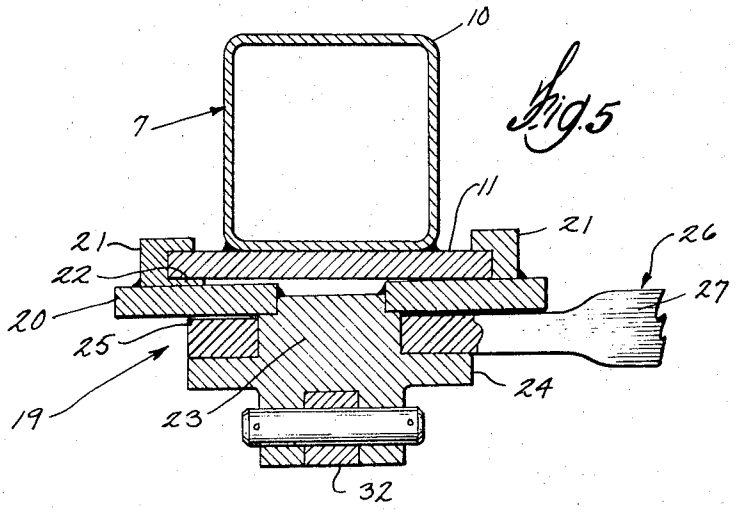
Fig. 5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BREAKOUT WRENCH

BACKGROUND OF THE INVENTION

The invention relates to rotary drilling apparatus and more particularly to a breakout wrench used to loosen and disconnect sections of a drill string. The preferred embodiment is especially useful in the disjointing of pipe sections in a rotary blast hole drill, but the invention is not limited exclusively to this application and may be utilized whereever it is desirable to withdraw pipe sections in drilling apparatus.

In typical blast hole drilling operations, it is customary procedure to drive a drill string formed by several joined sections of drill pipe, each having a typical length of 60 feet, into the earth forming a deep, elongated hole within which a blast or dynamite charge may be inserted subsequent to withdrawal of the drilling apparatus. During such withdrawal, it is necessary to employ a breakout wrench for uncoupling individual pipe sections of the drill string from themselves and from the rotary head mechanism. The disconnecting of the threaded pipe joints in the string is actually effected by gripping tongs or jaws which engage and rotate an upper pipe section while the next lower section is held against rotation by an associated tool wrench or backup tong. Since the drill pipe sections are extremely heavy and cumbersome, it is desirable to provide a breakout wrench which will safely and quickly facilitate a loosening of the joints and require a minimum of manual handling.

Conventional breakout wrenches are known to those in the art as "Byron Jackson" casing tongs comprising a large size wrenching mechanism which must be lifted into place about a pipe section by means of a suspension cable and fixedly pinned by hand at one end. Such a casing tong further includes jaws at the other end which are manually disposed and locked about the periphery of the drill pipe, the jaws being actuated to rotatably breakout a pipe joint by retracting a hydraulic cylinder connected to the wrenching mechanism. Utilization of these wrenching appliances provides an eccentric rotation about the drill pipe due to its fixed end construction and necessitates a great deal of skillful manipulation in order to effectively break a pipe joint.

Other arrangements further employing hydraulic actuation to enable uncoupling of drill pipe lengths are disclosed in U.S. Pat. No. 2,737,839 issued to Paget on Mar. 13, 1956 and U.S. Pat. No. 3,288,000 issued to Foster on Nov. 29, 1966. In the Paget device, a multicylinder linkage is translatable via a series of pivot points throughout a horizontal plane to allow gripping tongs to engage and rotate a pipe section. The breakout power tongs of Foster comprise a combination rotary driving mechanism-breakout device driven by a gear motor operable by a source of fluid pressure.

SUMMARY OF THE INVENTION

The present invention provides a breakout wrench for drilling apparatus having a pivotably mounted slide arm, a carriage slidably mounted upon the slide arm, a hydraulic actuator connected intermediate the carriage and slide arm, a wrench arm pivotably affixed to the carriage and a set of wrench jaws joined to the outer end of the wrench arm. The slide arm swings in a horizontal plane towards and away from a drill string and the hydraulic actuator causes the carriage to move axially back and forth along the slide arm whereupon the accompanying wrench arm and wrench jaws are pivotable to positively engage and rotate a length of drill pipe.

It is a general objective of the invention to provide a breakout wrench which will loosen pipe joints between successive sections of drill pipe and between the rotary head mechanism and a drill pipe section quickly and effectively with a minimum of manual effort. This is accomplished by employing a construction which furnishes threefold movement of the components to insure that a centralized rotation of the drill pipe is attained. A single hydraulic cylinder allows for an efficient positioning of the wrench jaws about the pipe when in a relaxed position and serves to impart a positive uncoupling of the drill pipe during extension. This feature especially provides for a substantial reduction in cost and weight of the entire device and offers a breakout arrangement not only functionally preferable but economically attractive.

Another objective of the invention is to provide a breakout wrench which eliminates the need for manually connecting a cable to the wrench unit and subsequently pinning a hydraulic cylinder to the wrench. By pivotably mounting the slide arm to the drilling apparatus and disposing a hydraulic cylinder beneath the slide arm for pivotal movement with it, the only manual task entailed is for a single man to lock the wrench jaws about the pipe. As a result, not only is the amount of manual labor significantly decreased but also the margin of safety in handling is tremendously improved.

The foregoing and other objects and advantages of the invention will appear from the following description. In the description, reference is made to the accompanying drawings, which form a part hereof, and in which there is shown by way of illustration and not of limitation a preferred embodiment of the invention. Such embodiment does not represent the full scope of the invention, but rather the invention may be employed in many different embodiments, and reference is made to the claims herein for interpreting the breadth of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a view in elevation of a rotary blast hole drill incorporating the breakout wrench of the present invention;

FIG. 2 is a top view of the breakout wrench, as mounted in FIG. 1, showing the hydraulic actuating cylinder in retracted position and illustrating the manner in which the wrench jaws engage a drill pipe section;

FIG. 3 is a top view of the breakout wrench, similar to FIG. 2, showing the slide arm swung away from the mast upright and the hydraulic actuating cylinder in a fully extended position;

FIG. 4 is a side view in elevation of the breakout wrench of FIG. 2 taken on the plane 4—4;

FIG. 5 is a fragmentary view in cross section of the slide arm, wrench arm and carriage of FIG. 4 taken on the plane 5—5; and

FIG. 6 is a view in cross section of the breakout wrench of FIG. 4 taken on plane 6—6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a rotary blast hole drill, generally designated by the reference numeral 1, includes a tiltable mast 2 pivotably movable between a horizontal transporting position and a series of variable, raised drilling positions, one of which is vertical as illustrated. A number of drill pipe sections 3 are joined together by threaded pipe joints 4 and the drill string thus formed is driven downwardly into the earth by means of a rotary head driving mechanism 5 which runs longitudinally along the mast 2. Since a blast hole drill of the character above outlined is well known and does not per se comprise substance of the present invention further description thereof is unnecessary. While the invention is suitable for such drills, however, it should be understood that it is applicable to any oil, gas or water drilling rig as well as any other equipment which necessitates uncoupling of drill pipe sections.

As shown best in FIGS. 2–4, the improved breakout wrench, generally designated by the reference numeral 6, has a slide arm 7 mounted at its inner end on a pivot hinge 8 for swinging movement towards and away from the drill pipe 3. The hinge 8 is preferably secured to a supporting frame 9, but may be located at any desirable point upon the drilling apparatus 1. The slide arm 7 comprises an elongate, cantilevered box beam 10 having a flat guide rail 11 welded, or otherwise affixed, to the underside of the outer portion of the beam 10. The box beam 10 is also formed at its inner end with a vertical, keyshaped opening 12. A tubular sleeve 13 and a downwardly projecting reaction plate 14 are inserted through the opening 12, and the sleeve 13, plate 14 and beam 10 are welded together to form a unitary whole. The sleeve 13 forms a mounting post for the slide arm 7 that is disposed between and vertically aligned with apertures 15 of two parallel, spaced apart and horizontally disposed support plates 16 of the pivot hinge 8. A drop pin 17, that is a part of the hinge 8, is inserted through the apertures 15 and the sleeve 13, with its lower end resting upon the topside of a transverse crossbeam 18 to serve as the axis about which the slide arm 7 pivots.

A carriage 19 is slidably mounted upon and hangs beneath the guide rail 11. This carriage 19 has a flat base plate 20 on which a pair of spaced, parallel slides 21 are mounted that extend upwardly and turn over the side margins of the guide rail 11. The slides 21 thus define a trackway within which the guide rail 11 fits to form the slide mounting for the carriage 19. As viewed in FIG. 5, the left hand slide 21 includes a shallow levelling strip 22 which functions to cant the base plate 20 at a slight angle, for a purpose to be hereinafter described.

Disposed immediately beneath and fixed to the base plate 20 is a spindle 23 that is an integral part of the carriage 19. The spindle 23 includes a bearing collar 24, and resting upon the collar 24 is a socket end 25 of a wrench arm 26. The socket end 25 is annular, surrounds the spindle 23, and is held captive by the carriage 19 to provide a pivoted mounting for the wrench arm 26. An elongate shank portion 27 of the wrench arm 26 extends horizontally in cantilever fashion from the socket end 25 and terminates in a curved outer end portion 28. Pivotably attached to the outer end portion 28 is a set of wrench jaws 29 similar, or like, those of a "Byron Jackson" casing tong. The wrench arm 26 is positioned in a substantially horizontal plane, and to facilitate this orientation the levelling strip 22 is provided which cants the carriage 19 to counteract for the looseness of the assembled parts and the mass of the wrench arm 26, which combine to slightly depress the wrench arm 26 from the axis of the spindle 23.

Turning now to FIGS. 4 and 6, a double-acting hydraulic cylinder 30 is located beneath the box beam 10 of the slide arm 7 for pivotal movement therewith. The casing end 31 of the cylinder 30 is pinned to the lower end of the reaction plate 14, and the rod end 32 is pinned to the underside of the carriage spindle 23. As a result of these connections, actuation of the hydraulic cylinder 30 causes the carriage 19 to move back and forth along the longitudinal axis of the slide arm 7.

In order to prevent the breakout wrench 6 from interfering with a drill string during normal drilling operations, means are provided to secure the slide arm 7 adjacent an upright of the mast 2. Specifically, with reference to FIGS. 2, 4 and 6, a horizontal bar 33 is secured to the mast upright and projects toward the mast center in parallel relationship with the mast crossbeam 18. When the slide arm 7 is pivoted clockwise, as viewed from above in FIG. 2, the bar 33 is beneath the slide arm 7 and above the hydraulic cylinder 30. The bar 33, then serves as a rest for the slide arm 7 and its end extends beyond the bottom of the beam 10, to present a vertical bore 34. A removable stop pin 35 with a head 36 is inserted in the bore 34, and the head 36 acts as a stop holding the slide arm 7 from swinging toward the drill string. The wrench arm 26 may be swung outward to the outboard side of the mast 2, where it will not obstruct rotary drilling operations.

To operate the breakout wrench 6, the wrench arm 26 is swung into the position shown in FIG. 2, and the wrench jaws 29 are locked about the periphery of the drill pipe section 3 above one of the pipe joints 4. The next successive lower drill pipe section 3 is held against rotation by a conventional holding wrench (not shown). Referring to FIG. 3, the stop pin 35 is removed to allow the slide arm 7 to swing freely, and the hydraulic cylinder 30 is extended. Such extension of the cylinder 30 causes the carriage 19 to move outwardly along the slide arm 7 to apply a turning force to the wrench arm 26 in a wrenching movement around the upper drill pipe section 3. The threaded pipe joint 4 is thus broken, or uncoupled, efficiently and safely and usual drill pipe handling apparatus may be employed to remove the drill pipe section from the drill string.

The pivotal connection of the slide arm 7 and the sliding attachment of the wrench arm 26 eliminates the need for using a cable for positioning a breakout wrench. The combination of elements also greatly reduces the amount of manual handling incurred in the setup and operation of a breakout mechanism. Accordingly, the possibility of serious injury is lessened and safety in disjointing drill string sections is improved. In addition, the movable carriage 19 and pivotable wrench arm 26 and jaws 29 coact to transmit a positive, centralized wrenching movement for loosening the joints of a drill string.

We claim:

1. In a breakout wrench for grasping and turning sections of a drill string of a drilling apparatus, the combination comprising:

a slide arm pivotally mounted at one end on the drilling apparatus which swings in a plane substantially normal to a drill string of the drilling apparatus;

a carriage slidably mounted upon said slide arm for movement back and forth along said slide arm;

a hydraulic cylinder associated with said slide arm for pivotal movement therewith, and having one end connected to said carriage for moving said carriage along said slide arm;

an elongate wrench arm pivoted to and extending from said carriage for a swinging movement relative to said slide arm in a plane substantially paralleling the plane of movement of said slide arm; and

a set of wrench jaws attached to the outer end of said wrench arm adapted to close upon a section of a drill string to apply a wrenching movement thereto.

2. A breakout wrench as in claim **1,** wherein said slide arm comprises an elongate cantilevered beam with a guide rail affixed to the underside of the outer portion of said beam, and said carriage hangs from and slides along said guide rail.

3. A breakout wrench as in claim **2,** wherein said carriage has a base plate underlying said guide rail and a pair of spaced, parallel slides affixed to said base plate that extend upward and turn over said guide rail to hang from and slide along said rail.

4. A breakout wrench as in claim **3,** wherein said base plate of said carriage has a depending spindle portion about which said wrench arm rotates, and the connection of said slide arm with said hydraulic cylinder is with such spindle portion.

5. A breakout wrench as recited in claim **1** having a pivot hinge on the drilling apparatus which includes a substantially upright rotatable member, said slide arm being secured to said rotatable member, and there being a reaction plate secured to said rotatable member that extends beneath said slide arm, and with said hydraulic cylinder disposed beneath said slide arm with one end connected to said reaction plate.

6. In a breakout wrench for grasping and turning sections of a drill string of a drilling apparatus having a mast framework, the combination comprising:

an elongated slide arm pivotably affixed at one end to the drilling apparatus and swingable towards and away from a drill string in a plane substantially normal to the drill string;

a substantially upright pivot hinge securing the one end of said slide arm to the drilling apparatus;

a carriage having a trackway slidably engageable with said slide arm for longitudinal movement therealong and a spindle portion disposed beneath said trackway;

a hydraulic cylinder associated with said slide for pivotal movement therewith and having one end connected to said carriage for moving said carriage along said slide arm and another end attached to said pivot hinge;

an elongate wrench arm disposed on and pivoted about said spindle portion for a swinging movement relative to said slide arm in a plane substantially paralleling the plane of movement of said slide arm; and

a set of wrench jaws pivotably attached to the outer end of said wrench arm and adapted to grippingly engage and rotate a section of a drill string.

7. A breakout wrench as recited in claim **6,** wherein said wrench arm includes a curved outer end portion to which said wrench jaws are attached, an elongated shank portion extending horizontally from said curved outer end portion and a socket end connecting said shank portion with said spindle portion for rotation thereabout.

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