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MAKE-UP AND BREAK-OUT MECHANISM FOR DRILL PIPE JOINTS

Filed May 16, 1960

3 Sheets-Sheet 1

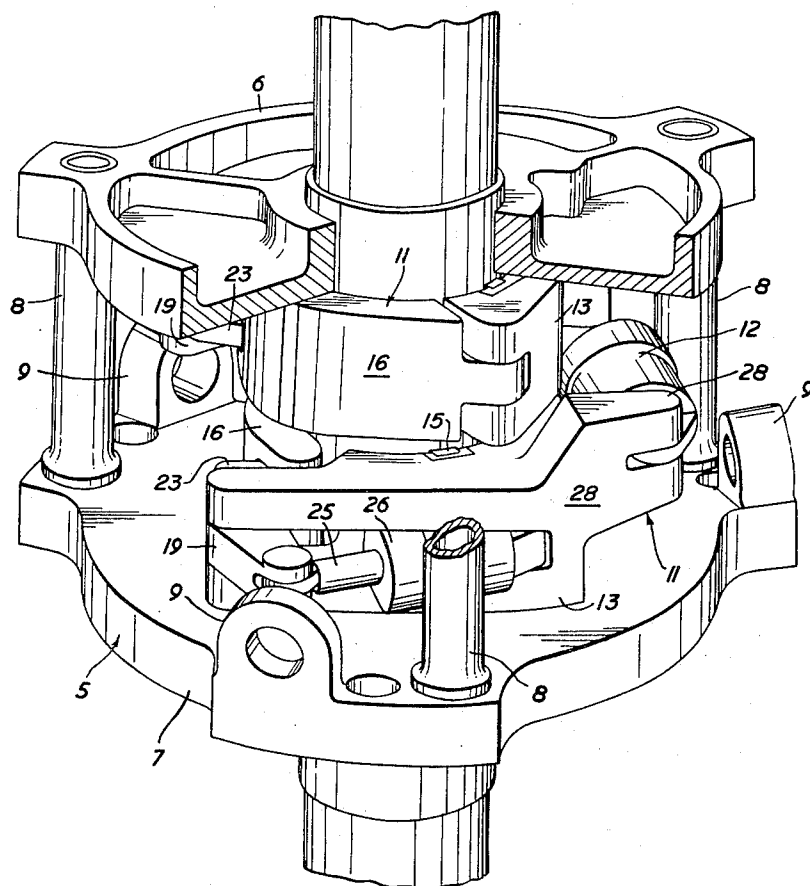


FIG. 1.

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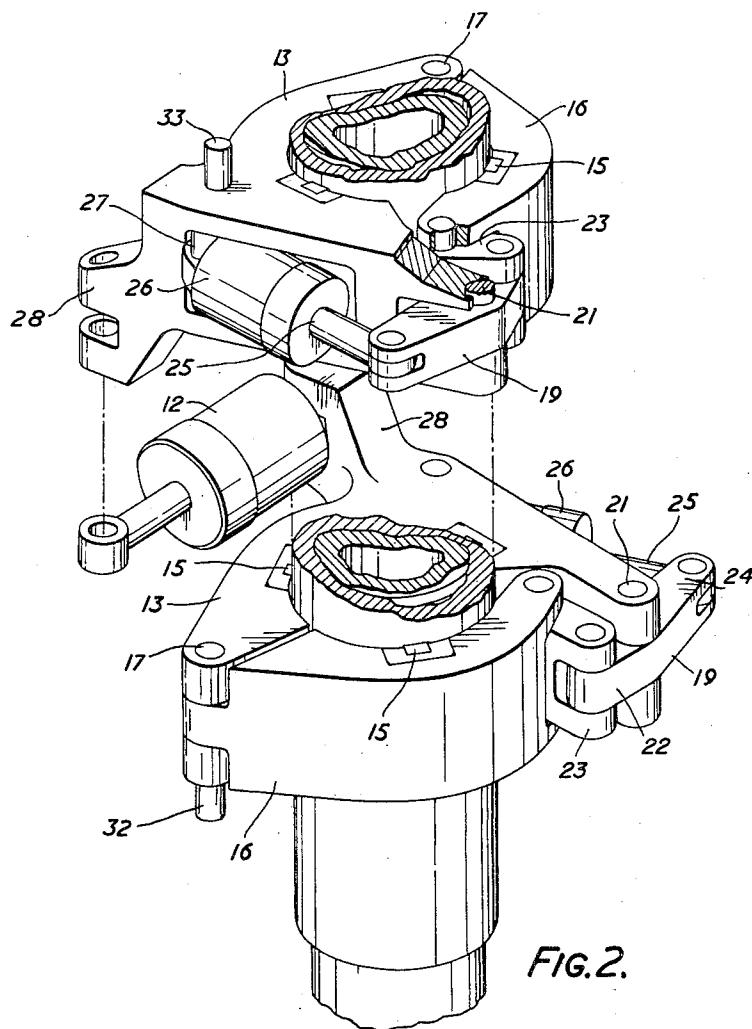
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3 Sheets-Sheet 2



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3 Sheets-Sheet 3

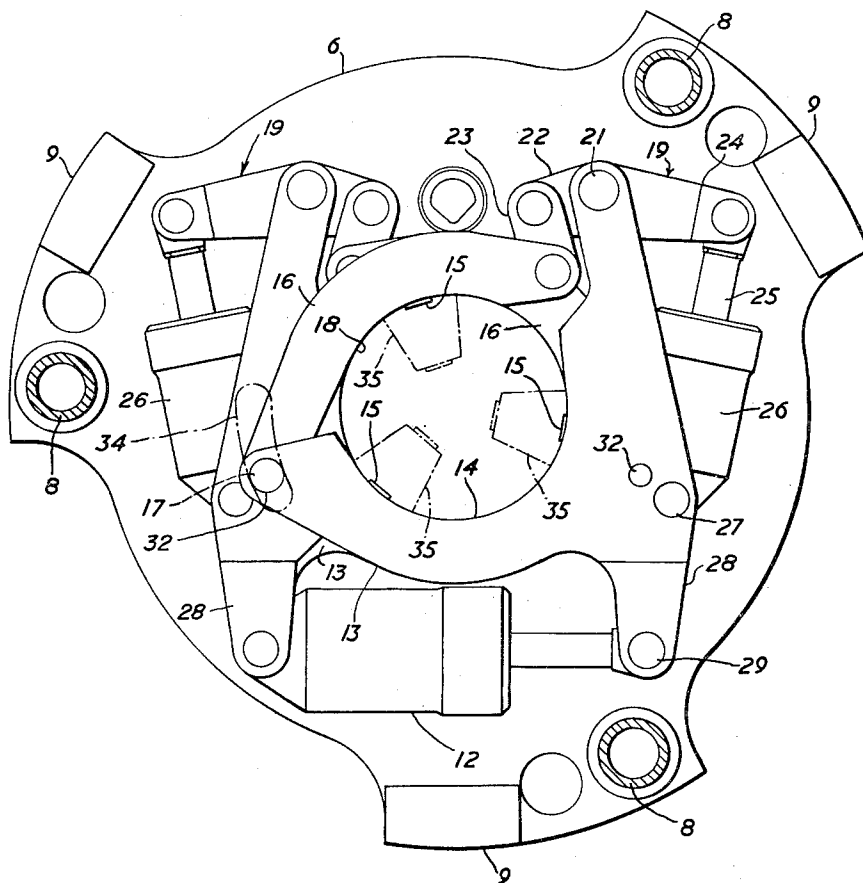


FIG. 3.

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1

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MAKE-UP AND BREAK-OUT MECHANISM FOR DRILL PIPE JOINTS

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6 Claims. (Cl. 81-53)

The present invention relates to earth boring equipment and more particularly to a make-up and break-out unit of the kind employed in earth boring equipment, and hereinafter described, for the purposes of applying the final tightening force to screwed-up joints between drill pipes when making up a drill pipe string and performing the initial loosening of screwed-up pipe joints when dismantling a drill pipe string.

In U.S. patent application No. 33,158, filed June 1, 1960 there is described equipments for mechanically handling strings of drill pipe when withdrawing the string from a bore hole and automatically dismantling from the string the individual pipes as they emerge from the hole. The equipments are reversible and may be used to assemble pipes into a string as the string is run back into the bore hole. The equipment required for dismantling a string or adding single pipes to a string which is being built up includes mechanism for unscrewing and screwing up the pipe joints under relatively light load, usually called the spin-off mechanism. The pipe joints are, however, finally tightened by the make-up and break-out mechanism which is also used, of course to "break" the joints, that is to say unscrew them to the "point" where the spin-off mechanism can complete the unscrewing.

The actual drilling process has the effect of tightening the pipe joints still further and it, therefore, follows that a somewhat greater force is required to unscrew the joints than was used when screwing them up.

In the handling of drill pipes in conventional, what may be termed manual, rigs jaws are provided which may be brought into action by power means to perform these unscrewing and screwing up actions as may be required. In general they are arranged so that they may be engaged upon the pipe from the side, that is to say, they can open to admit the pipe and are then closed around the pipe to grip the same before they are operated to tighten or loosen the joint. In the case of an automatic rig and provided it is of a kind in which the lifts which support the pipe string do not pass one another, the break-out mechanism can permanently surround the pipe string and indeed it is attractive to do this in order to save time. In an automatic rig every pipe joint is operated upon and pipes are removed singly instead of in threes as is more customary in manual rigs, so that it is important not to lose time bringing the mechanism into engagement with the pipe and removing it at each joint. Instead the pipe merely passes through the break-out mechanism.

The present invention relates to a break-out or make-up jaw assembly particularly suitable for use in an automatic rig, in that it may take the form of a compact unit which may permanently surround the pipe.

One form of make-up and break-out unit for the tool joints of a drill string is illustrated in the accompanying drawings, in which:

FIGURE 1 is a perspective view of the unit operating on a tool joint broken away in part to show interior details;

FIGURE 2 is a perspective view of the clamping and torque applying components of the unit operating on a tool joint, shown axially separated for clarity, but with supporting cage elements omitted; and

2

FIGURE 3 is a plan view from below of the unit with the lower plate of the supporting cage removed.

The make-up and break-out unit is mounted in a skeleton framework or cage indicated generally at 5 and comprising a top plate 6 and a bottom plate 7 spaced apart and connected by three pillars 8. The bottom plate has three apertured lugs 9 by means of which the unit may be attached to the vertical lift platform of an automatic drilling rig.

Mounted within the cage are two jaw assemblies indicated generally at 11 in FIGURE 1. Both devices are similar and one is inverted in respect to the other, while a hydraulic actuator 12 is interposed between them to provide the torque for making or breaking the tool joint.

One such jaw assembly will be described. Essentially the device comprises a large jaw 13 having an inner curved surface 14 carrying two pipe-gripping pads 15 and a small jaw 16 pivoted to the large jaw 13 on a pin 17, this small jaw 16 having an inner curved surface 18 provided with a single gripping pad 15. The three gripping pads are disposed in the operative position of the jaws to lie substantially 120° apart around the tool joint with which they engage. The outer ends of the jaws 13 and 16 are interconnected by a load amplifying linkage which comprises a lever 19 mounted on a fulcrum pin 21 at the free end of the jaw 13, the lever 19 having its shorter lever arm 22 pivotally connected by a link 23 to the small jaw 16, and its longer lever arm 24 pivotally connected to the piston rod 25 of a hydraulic actuator. The actuator cylinder 26 is pivotally connected at 27 to an intermediate position on the large jaw 13.

This large jaw 13 has a forked lug 28 which is offset to one side of the central plane of the jaw 13 to provide a connection for a make-up and break-out actuator 12 by means of a pivot pin 29 extending across the forked lug 28. Since the other jaw assembly is inverted with respect to the one described, it will have a forked lug 28 likewise offset to one side of the central plane of the jaw 13, and the extent to which both such forked lugs are offset is arranged to bring them into the same transverse plane so that the make-up and break-out actuator 12 operates horizontally between them.

The large jaw of the lower pair is fixedly although resiliently located in the bottom plate 7 by a hinge pin 32, see FIGURE 2, forming an extension of the pin 17, which engages a soft rubber bushing therein (but not shown) to provide adequate play for accommodation movement between the pair of jaws and the pipe joint without straining.

The large jaw 13 of the upper pair has a pin 33, seen only in FIGURE 2, corresponding to the hinge pin 32 of the lower pair, which is located within an arcuate slot 34, FIGURE 3, in the top plate 6. The plates 6 and 7 are omitted in FIGURE 2. The pin 33 in the upper jaw 13 is not to be confused with the hinge pin 17 with which it is substantially co-axial in the relative positions of the two pairs of jaws shown in FIGURE 3. The slot 34 permits the required degree of angular movement during make-up or break-out of the upper pair of jaws with respect to the lower pair, which latter pair is stationary with respect to the housing. The angle of movement provided by the actuator 12 and allowed for by movement of the pin 33 in the slot 34 is sufficient both to tighten up the screw joint between two pipes, and when working in the opposite direction to break-out a fully tightened joint so that the upper pipe can be removed by spinning off under a light torsional load.

The make-up and break-out actuator 12 is extended to break out a tool joint, and it will be observed that the smaller jaw 16 will trail during the break-out action. The larger area of the actuator 12 is subject to fluid pressure during break-out and the grip on the tool joint is, to some

extent, augmented by the trailing shoe effect of the small jaw 16.

The jaws 13 and 16 are adapted to take interchangeable die holders having gripping pads 15 for engaging the tool joint. One set of die holders 35 capable of operating with the smallest diameter of tool joint is shown in chain dot line in FIGURE 3, while the pads 15 shown in full line can be fitted to operate on the largest size of tool joint. Clearly, the torque requirement for making and breaking joints in the two sizes will be widely different and it will, therefore, be convenient to vary the working pressure available at the actuator 12 accordingly.

It is to be observed that in the above-mentioned description the make-up and break-out actuator 12 operates directly between the two jaw assemblies 11 which grip the respective sides of the tool joint so that the reaction load is taken directly one on the other and not through the lift platform, or the like as in previously known arrangements.

I claim as my invention:

1. A break-out mechanism of the kind referred to comprising an upper pipe gripping jaw assembly and a lower pipe gripping jaw assembly, mounting means interconnecting said assemblies to provide for relative turning movement of one assembly with respect to the other substantially about the pipe axis, a lug formed on the upper jaw assembly in a position displaced towards the lower jaw assembly, a lug formed on the lower jaw assembly in a position offset towards the upper jaw assembly, both said lugs being transversely separated in a common plane to which the pipe is perpendicular, and a hydraulic actuator pivotally interposed between said lugs to effect relative turning movement of the jaw assemblies.

2. A break-out mechanism according to claim 1, wherein the upper and lower jaw assemblies are similarly constructed and one of said assemblies is inverted with respect to the other.

3. A break-out mechanism according to claim 1, wherein the mounting means comprises a cage surrounding the pipe axis, a first, substantially fixed, location in the cage for one jaw assembly, and a second location in the housing for the other jaw assembly, said second location providing for turning movement of said other jaw assembly substantially about the pipe axis.

4. A break-out mechanism according to claim 1, wherein each jaw assembly comprises two jaws pivoted together for opening and closing movement in a plane to which the pipe axis is perpendicular, a load amplifying linkage, including a lever, interconnecting the ends of the jaws remote from their pivotal connection, and a hydraulic actuator interposed between one jaw and the lever, whereby said load amplifying linkage is operative to effect a smaller movement of the end of the other jaw to which it is attached than the corresponding stroke of the hydraulic actuator.

5. A break-out mechanism of the kind referred to comprising a supporting cage including an upper and a spaced lower plate centrally apertured to pass a pipe string, an upper pipe gripping jaw assembly and a lower pipe gripping jaw assembly, locating means interengageable between each jaw assembly and the corresponding plate of the cage, at least one of said locating means being arranged for limited rotational movement of its jaw assembly about the pipe axis, each jaw assembly including a pair of jaws pivotally interconnected and means to constrict them relatively into gripping engagement with the pipe, and means reacting from one jaw assembly directly upon the other to urge the two jaw assemblies in one or the opposite rotational sense, to make-up or to break-out a screw joint intermediate pipes gripped by the respective jaw assemblies.

6. A break-out mechanism as in claim 5, wherein the locating means of one jaw assembly includes a hinge pin constituting the pivotal interconnection between said jaw assembly and its plate, and projecting towards said plate, and an arcuate slot in the plate centered about the pipe axis, wherein the projecting hinge pin is received.

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