

May 11, 1937.

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2,079,841

ROTARY RIG DRILLING CONTROL

Filed Dec. 7, 1935

3 Sheets-Sheet 1

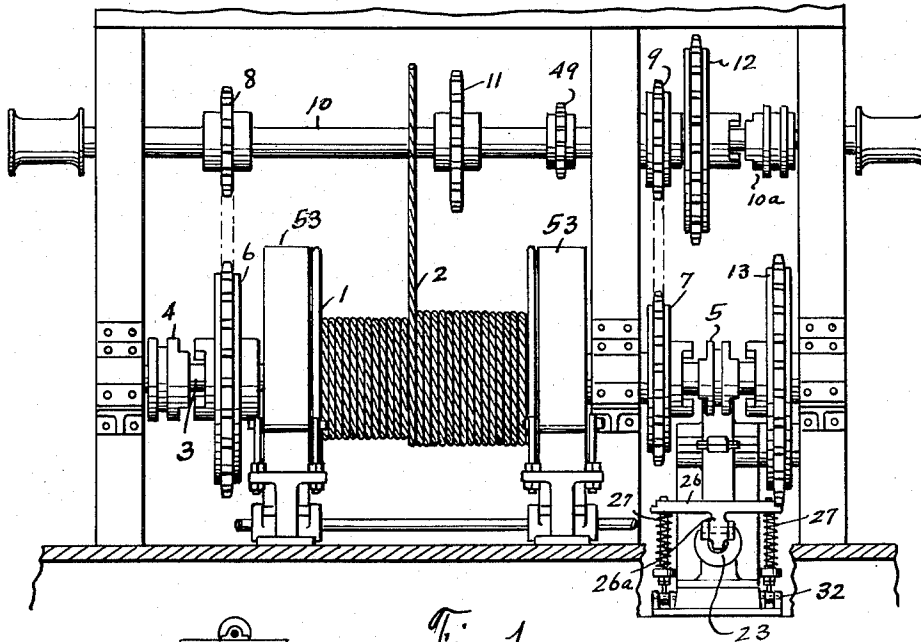


Fig. 1.

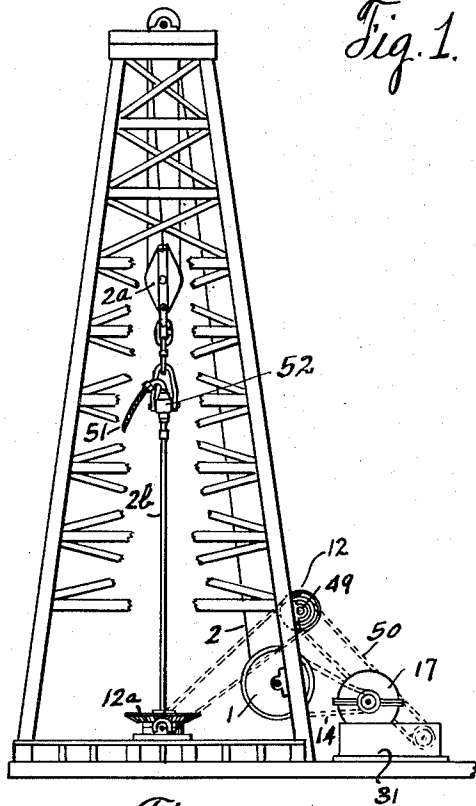


Fig. 2.

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3 Sheets-Sheet 2

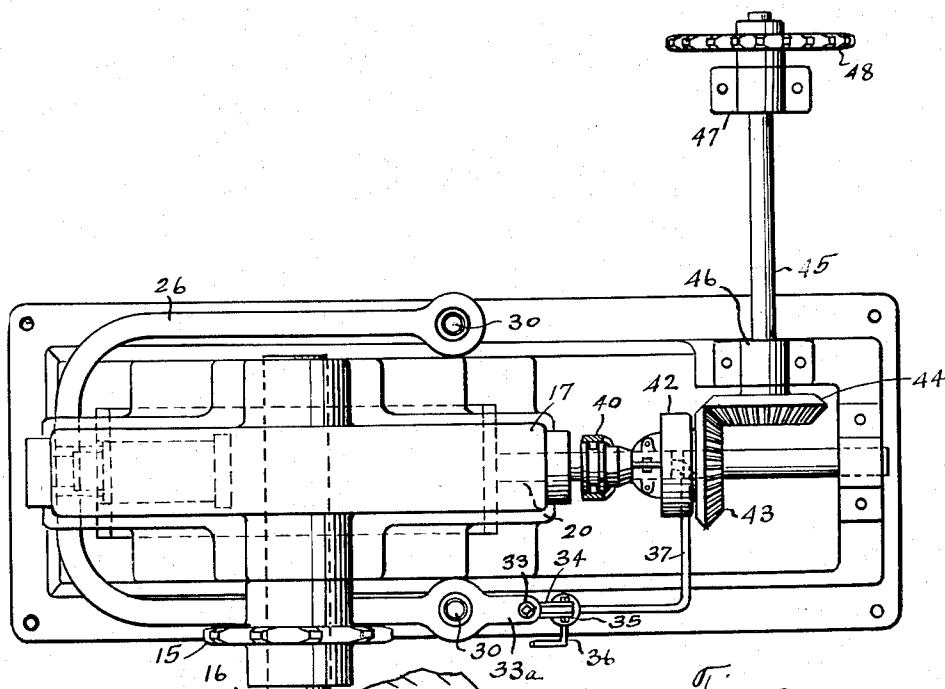


Fig. 3

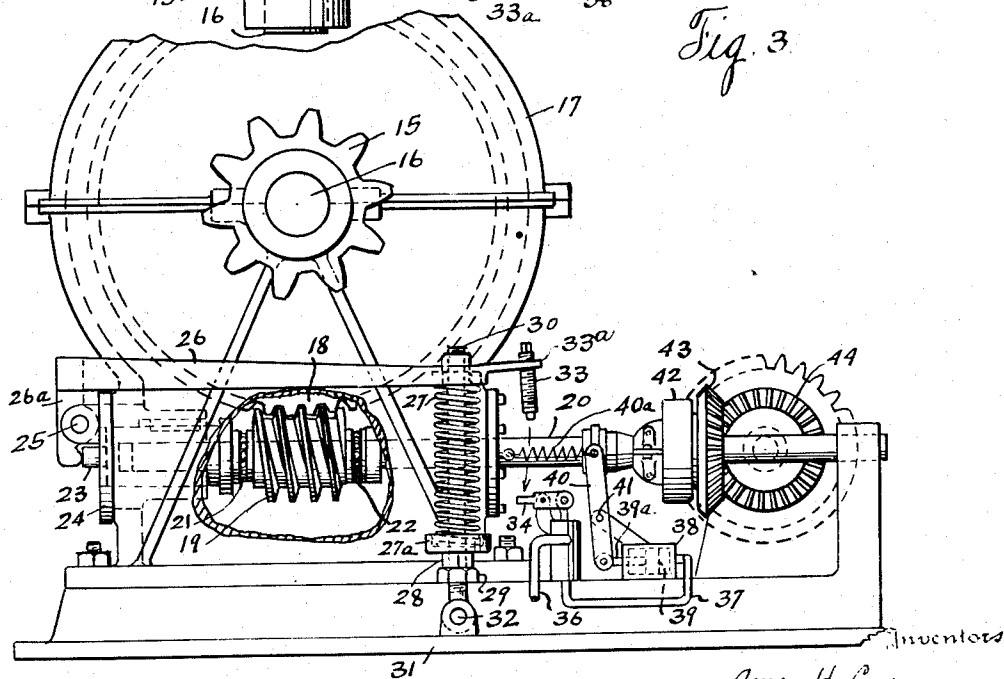


Fig. 4.

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3 Sheets-Sheet 3

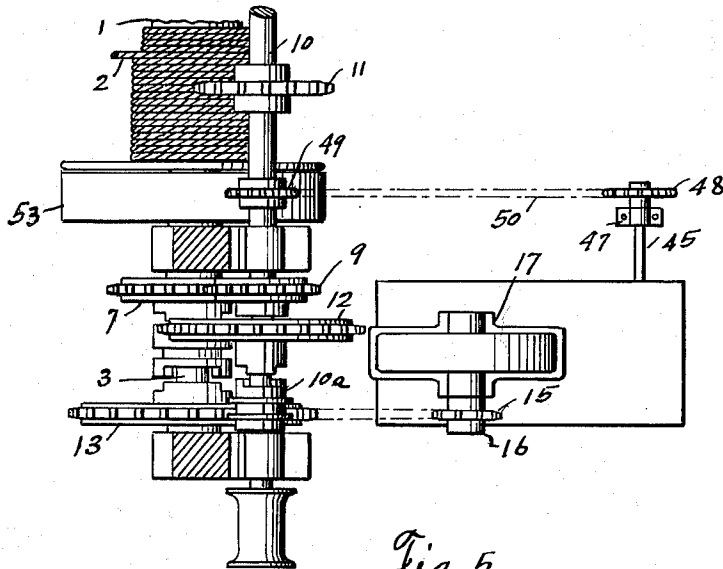


Fig. 5.

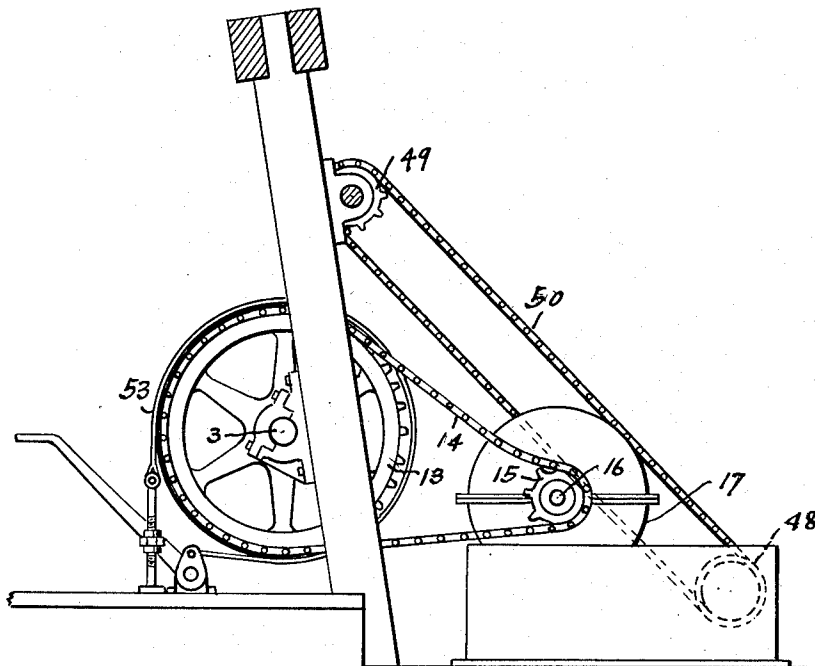


Fig. 6.

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2,079,841

ROTARY RIG DRILLING CONTROL

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Application December 7, 1935, Serial No. 53,314

4 Claims. (Cl. 255—19)

This invention relates to a rotary rig drilling control.

An object of the invention is to provide apparatus for maintaining a pre-determined portion of the weight of the drill stem supported by the drilling tool during the drilling operation.

Another object of the invention is to provide apparatus whereby the weight sustained by the drilling tool may be automatically maintained while drilling.

A further object of the invention is to provide an apparatus whereby the weight sustained by the drilling tool during the drilling operation may be controlled by maintaining the required tension on the drilling line.

The maintenance of a proper weight on the cutting surface of the drilling tool, in drilling formation at the bottom of the well bore by the rotary method, is important in the successful and efficient drilling of a well. The proper weight to be applied to the tool changes constantly as the nature of the formation being drilled changes, the required weight also varying as other drilling conditions vary, such as the nature of the drilling fluid used, the general conditions of the well bore, and the type of drilling tool and equipment used. It is common practice to control the weight on the cutting surfaces of the drilling tool by the use of a manually controlled brake band applied to the braking surface of the cable-winding drum of the drawworks whereby the tension on the drilling line, which supports the drill stem, operates to rotate the drum and let out the line to permit the drill stem and drilling tool to descend as drilling progresses. In carrying out this method, the brake band is ordinarily released intermittently by the operator, thus allowing loads of constantly changing intensity to be placed on the drilling tool. It is not uncommon, however, to provide means for constantly applying the brake band to the brake drum, for example by placing a weight on the brake lever, and depending upon the coefficient of friction between the brake band and brake surface of the drum to maintain a constant load on the drilling line.

This latter method is necessarily unreliable due to the nature of the braking surface, and in common with the above-mentioned method of manually controlling the brake, has proved to be unsatisfactory for the reason that by either of the methods commonly practiced and taking into consideration varying drilling conditions and formations, a uniform load cannot be maintained on the drilling tool.

The apparatus hereinafter described has been

provided to automatically maintain a pre-determined portion of the weight of the drill stem supported by the drilling tool during drilling operations.

With the above and other objects in view the invention has particular relation to certain novel features of construction, operation, and arrangement of parts, an example of which is given in this specification and illustrated in the accompanying drawings, wherein:

Figure 1 shows a front elevational view of a conventional drawworks showing the controlling apparatus associated therewith.

Figure 2 shows an elevational view of a complete drilling apparatus as assembled in a derrick showing an end view of a conventional drawworks equipped with the controlling apparatus.

Figure 3 shows a partial plan view of the controlling mechanism.

Figure 4 shows an end elevation of the controlling mechanism partly broken away.

Figure 5 is a fragmentary horizontal sectional view of the drawworks showing the controlling mechanism associated therewith, and,

Figure 6 shows an end view of the drawworks showing the controlling mechanism in its relation thereto.

Referring now more particularly to the drawings wherein like numerals of reference designate the same parts in each of the figures, the numeral 1 designates the drum of a conventional drawworks. One end of the drilling line 2 is wound around this drum, and this drilling line operates over the crown block of the conventional derrick and supports the traveling block 2a which, in turn, is connected to the upper end of the drill stem 2b in the conventional manner and whereby said drill stem and the drilling tool attached to the lower end thereof may be elevated and lowered. The drum 1 is keyed or otherwise secured to the drum shaft 3 on which are splined the clutches 4 and 5. Loosely mounted on the drum shaft are the sprocket wheels 6 and 7 which are aligned with corresponding sprocket wheels 8 and 9 which are fixed on the line shaft 10 of the conventional drawworks. Conventional sprocket chains operate over the corresponding pairs of sprockets 6, 8, and 7, 9, respectively, whereby rotation is constantly transmitted to the sprocket wheels 6 and 7, as shaft 10 rotates.

Fixed on the line shaft 10, there is also a sprocket wheel 11 and rotation is constantly imparted to the line shaft 10 from a suitable prime mover through a transmitting sprocket chain operating over the sprocket wheel 11. Loosely

mounted on the line shaft 10 there is also a sprocket wheel 12 from which the conventional rotary drilling machine 12a on the derrick floor is driven through a suitable transmitting sprocket chain. The sprocket wheel 12 may be clutched with and declutched from the shaft 10 by means of a clutch 10a. The clutches 4, 5, may be selectively engaged with the sprocket wheels 6, 7, to impart rotation to the shaft 3 and the drum 1 at the selected rate of speed.

Loosely mounted on the shaft 3 there is a sprocket wheel 13, and the clutch 5 may be shifted to engage said last-mentioned sprocket wheel with its shaft. A sprocket chain 14 operates over the sprocket wheel 13 and also operates over the sprocket wheel 15 which is keyed or otherwise fixed to the transverse shaft 16. The shaft 16 is mounted in suitable bearings in the gear case 17 which encloses the worm gear 18, fixed on the shaft 16. The gear 18 meshes with the worm 19 which is feather keyed on the longitudinal shaft 20 mounted in the gear case. A locking type of worm gear reduction unit is thus provided. It will be noted that the worm 19 is keyed to rotate with its shaft 20, but is free to slide longitudinally thereon, and the worm 19 is provided with the end thrust bearings 21, 22.

One end of the worm shaft is mounted in an end bearing 23 which is feather keyed into the housing sleeve 24 located in the end of the gear case 17, and the bearing 23 is free to move longitudinally on the shaft 20 and in the housing 24.

Pivoted to the housing 24 by means of a trunion pin 25 there is a U-shaped lever 26. The cross-bar of this lever has an overturned arm 26a, the free end of which rests against the outer end of the bearing 23. The free ends of the side arms of the lever 26 rest on the compression springs 27 which, in turn, are mounted in the cups 27a. These cups are supported on the adjusting nuts 28 which are locked in position by the jam nuts 29 on the bolts 30. These bolts are pivotally mounted on the base 31 of the gear case by means of the journal pins 32. The bolts 30 extend upwardly through the springs 27 and through the ends of the side arms of the lever 26. One arm of this lever 26 has an extension 33a and a set-screw 33 is threaded through this extension. There is a suitable valve 35 having the operating lever 34 connected to the valve stem and arranged in the path of the adjustable set-screw 33. The valve 35 has the inlet line 36 and the outlet line 37. The outlet line 37 is connected into the hydraulic cylinder 38 in which is located a piston 39. This piston is fixed to a piston rod 39a whose outer end is pivotally connected to the clutch lever 40 which is pivoted on the pin 41 and is operably connected with the clutch 42. This clutch is mounted on the shaft 20 and is normally held disengaged by the pull spring 40a provided to clutch the bevel gear wheel 43 with, and disengage it from, said shaft 20 on which said gear wheel is also mounted. The gear wheel 43 is in mesh with a similar gear wheel 44 and this last mentioned gear is fixed on the inner end of the counter-shaft 45. This last mentioned shaft extends outwardly from the gear case and is mounted in suitable bearings 46, 47. Fixed on the outer end of the counter-shaft 45, there is a sprocket wheel 48, and fixed on the counter-shaft 10 and in alignment with the sprocket wheel 48, there is a sprocket wheel 49, and operating over said sprocket wheels 48 and 49, there is a sprocket chain 50.

In operation the drilling tool is lowered to the bottom of the well bore and the pump for forcing the drilling fluid down through the drill stem is then started. The drilling fluid will be delivered through the hose 51 and the swivel 52 downwardly through the drill stem 2b to the drilling tool. The drill stem is then lifted so that the drilling tool will clear the bottom of the hole, allowing the total weight of the drill stem to be supported by the drilling line 2, and the drill stem and tool are held in suspended position by setting the brake bands 53 on the braking surfaces of the drum 1. The clutch 5 is then engaged with the sprocket wheel 13 and the brake bands released. The weight of the drill pipe transmitted to the line 2 is then transmitted through the drum 1, the drum shaft 3, the clutch 5, the sprocket wheel 13, the sprocket chain 14, the sprocket 15, the shaft 16, and the worm gear 18, to the worm 19. Since the worm gear reduction unit is of the locking type, the load on the line 2 will be transmitted in an amount proportional to the leverage embodied in the system to the worm teeth in the form of a thrust against the thrust bearing 21 and the bearing 23. This thrust is in turn transmitted to the lever 26 and in proportionate amounts to the springs 27 which yield a distance proportionate to the thrust transmitted. The set-screw is adjusted to contact the valve lever 34 and to actuate said lever so as to open the valve 35. It is to be noted that the total weight of the drill stem and drilling tool is now on the drilling line. It is necessary to now adjust the set screw 33 so that only a portion of the weight of the drill stem and drilling tool will operate through the mechanism described to open the valve 35. To accomplish this the set-screw 33 is adjusted further inwardly, that is, further toward the valve lever 34 the required distance, said required distance bearing approximately the same ratio to the full travel of the lever 26, due to the total weight of the drill stem and tool, that the portion of the total weight of the drill stem to be carried by the drilling tool bears to the total weight of the drill stem. These ratios, as given, may not be exact, but generally stated, the set screw 33 is first adjusted to open the valve 35 with the full weight of the drill stem and tool on the line 2, and said screw is then further adjusted so as to open said valve when the predetermined load to be carried by the drilling tool is exceeded. The rotary drilling machine is then started and the sprocket 49 and beveled gear wheel 43 will be in motion. Water under pressure is supplied from a suitable source through inlet line 36 controlled by the valve 35, and said valve having been opened by the set-screw 33 as hereinabove explained, the water will be admitted to the cylinder 38 under sufficient pressure to operate the piston therein and the clutch lever 40 connected to said piston, thus in turn causing the clutch 42 to engage the bevel gear wheel 43 and the shaft 20 will be thereby rotated.

The worm 19 will rotate with said shaft 20 in a direction to allow the worm gear 18 to turn in the direction of the pull on the chain 14, thus playing out the line 2 and allowing the drilling tool to descend to the bottom of the hole being drilled. A portion of the total weight of the drill pipe is thereby transferred from the wire line or cable 2 to the cutting surface of the drilling tool. When the proportional amount of weight, corresponding to the position of the set-screw 33 is transferred to the drilling tool and thus relieved from the wire line, a corresponding portion of the

thrust is taken off of the bearing 23, the lever 26, and the springs 27. Said springs 27 then operate to elevate the lever 26 and the set-screw 33, said set-screw disengaging the valve lever 34 and the supply of water to the cylinder 38 is cut off, thus allowing the clutch 42 to disengage the bevel gear 43 from the shaft 20. The worm 19 then stops and locks the worm gear 18, holding the drum stationary until such time as the drilling tool drills far enough to increase the weight on the wire line 2 with the resultant engagement of the gear 43 and the shaft 20 as before, and thereupon the line 2 is again played out, allowing a predetermined portion of the weight of the drill stem to be maintained on the cutting surface of the drilling tool.

A preferred embodiment of the invention has been shown and described, but it is obvious that various mechanical changes may be made without departing from the principle of the invention. The disclosure is by way of illustration only, while the broad principle of the invention will be defined by the appended claims.

What we claim is:—

1. In a rotary drilling rig having a rotatable drum and a flexible line wound thereon and connected to, and supporting a drill stem in a well; a gear operatively connected with the drum, a worm in mesh with the gear and arranged to normally hold said gear and drum against rotation, a driving member, means arranged to be actuated by the line, through said gear and worm, upon an increase in tension of the line, and effective to operatively connect the driving member with the worm whereby the worm will be rotated to release said gear and to allow the gear and drum to turn only to unwind the line and permit the drill stem to descend.

2. In a rotary drilling rig having a rotatable drum and a flexible line wound thereon and connected to, and supporting a drill stem in a well; a gear operatively connected with the drum, a worm in mesh with the gear and arranged to normally hold said gear and drum against rotation, a driving member, means arranged to be actuated by the line, through said gear, and worm, upon an

increase in tension of the line, and effective to operatively connect the driving member with the worm whereby the worm will be rotated to release said gear and to allow the gear and drum to turn only to unwind the line and permit the drill stem to descend, and means for disconnecting the driving member from the worm upon descent of the drill stem and a reduction in the tension on the line.

3. In a rotary drilling rig having a rotatable drum and a flexible line wound thereon and connected to and supporting a drill stem in a well; a gear operatively connected with the drum, a worm in mesh with the gear, said gearing being of the locking type to normally hold the drum against rotation, a driving member, means arranged to be actuated by the line, through said gearing, upon an increase in tension in the line, and effective to operatively connect the driving member with the worm whereby the worm will be rotated to release said gear and to allow the gear and drum to turn to permit the line to unwind and the drill stem to descend and means for disconnecting the driving member from the worm upon descent of the drill stem and a reduction in the tension of the line.

4. In a rotary drilling rig having a rotatable drum and a flexible line wound thereon and connected to and supporting a load in a well; gearing of the locking type arranged to normally hold the drum against rotation and including a worm, a driving member, means arranged to be actuated by the line through said gearing upon an increase in tension of the line and effective, when actuated, to operatively connect the driving member with the worm whereby the worm will be rotated to allow the drum to turn to permit the line to unwind and the load to descend, said means including a pressure fluid operable clutch, and means for disconnecting the driving member from the worm upon descent of the load and a reduction in the tension on the line.

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