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2,133,016

CONTROL APPARATUS FOR DRILLING WELLS

Filed Dec. 8, 1934

2 Sheets-Sheet 1

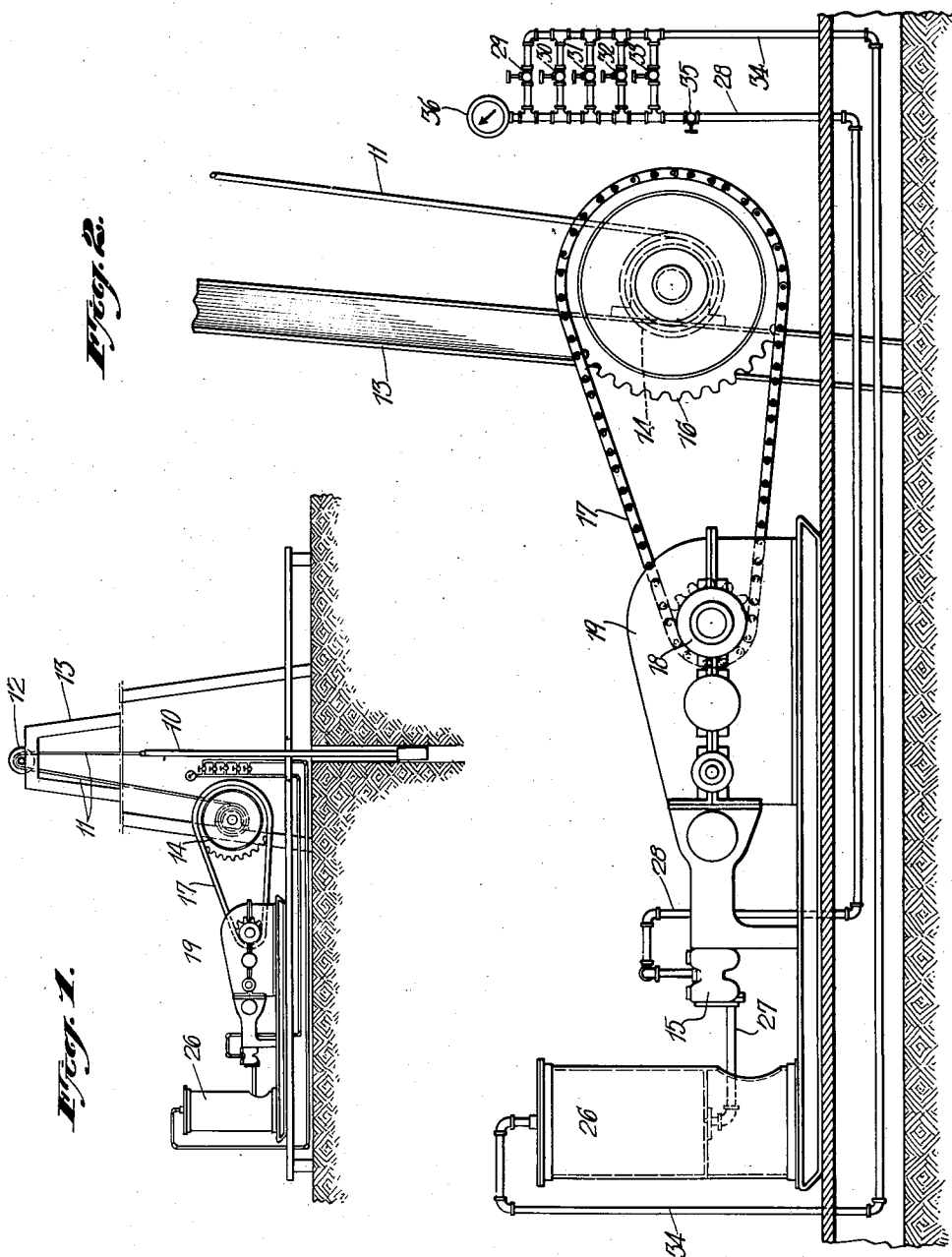


Fig. 1.

Page 2.

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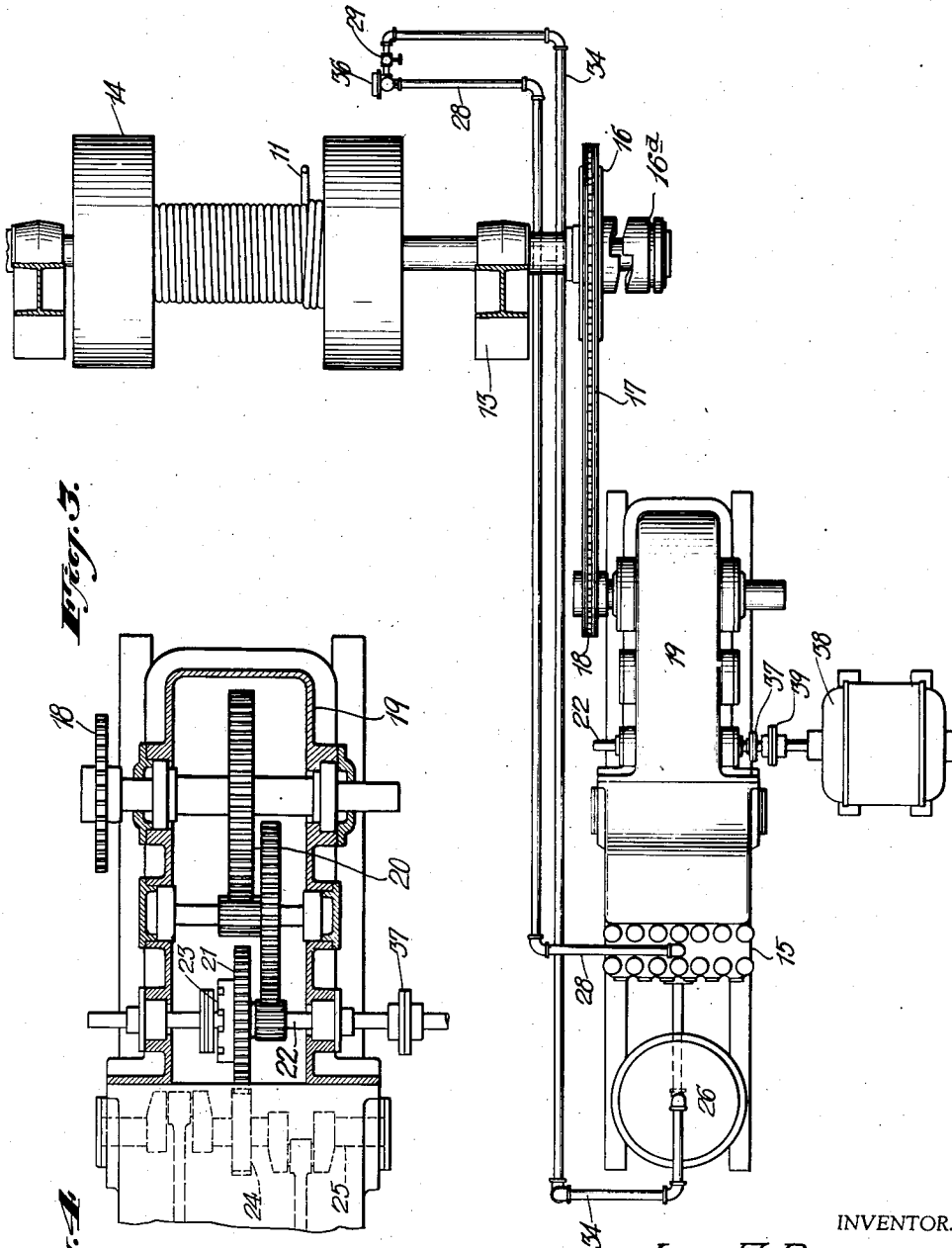


Fig. 3.

Fig. 1.

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CONTROL APPARATUS FOR DRILLING
WELLSJohn E. Brantly, Birmingham, Ala., assignor to
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Application December 8, 1934, Serial No. 756,696

7 Claims. (Cl. 255—19)

My invention relates to a hydraulic mechanism for controlling the feed of a drill stem to a well being drilled.

In the drilling of wells, particularly wells for petroleum, a heavy drill stem and drilling apparatus extending into the well are suspended on a cable running over crown pulleys on the top of a derrick and thence to a winding drum near the base or floor of the derrick. As the drilling of the well proceeds, the drill stem is gradually lowered into the well by permitting or causing the winding drum to rotate to permit the cable to gradually unwind. The unwinding of the cable and consequent lowering of the drill stem must be such as to avoid throwing too great a proportion of the weight of the drill stem onto the rock or earth at the bottom of the well, because this may cause the drilling point to sink too deeply into the rock and become wedged or stuck therein so that it cannot be rotated or moved and may become broken. For the best results the drum should be unwound at such a rate for given conditions in the well as to support a portion of the weight of the drill stem on the cable and throw the remaining part of the weight of the drill stem, in accordance with particular rock formation encountered, onto the bottom of the well.

In a hydraulic control for the unwinding of the drum, the force or energy imparted to the drum shaft by the weight of the drill and its attached parts supported by the cable is used to force water or other liquid against a resistance. To avoid sudden changes in the weight carried by the cable and consequently to avoid such changes in the weight of the drill supported in the bottom of the well, the movement of the fluid should be as smooth as possible and free from intermittent stoppages or pulsations. As the characteristics of the earth through which the drill penetrates vary at different depths, it is also necessary that the resistance may be accurately and promptly adjusted to maintain a predetermined proportion of the weight suspended by the cable and to enable the driller to have constantly an indication of the weight thus supported.

In my invention hydraulic means are provided whereby the liquid is forced by the unwinding of the drum in a smooth, even fashion, and in which the resistance or pressure thus generated may be accurately determined and controlled. Also the apparatus is such that the unwinding control may be easily and quickly changed and

the drum rotated in a winding direction to lift the drill from the well.

The various features of the invention are illustrated in the accompanying drawings in which Fig. 1 is a diagrammatic sketch showing the relation of the control apparatus and winding drum to the derrick and drill stem; Fig. 2 is a side view on a larger scale of the winding drum and hydraulic control device; Fig. 3 is a plan view of the drum and control apparatus; and Fig. 4 is a plan view partly in section of a portion of the control mechanism.

In my invention a drill stem 10 is supported by a cable 11 that passes over a crown pulley 12 on a derrick 13 and is then wound on a drum 14. The drill stem may be of any suitable type, such as used for rotary drilling, and any of the suitable drilling rigs may be employed. As the drill 10 gradually bores into the earth to form the well, it is lowered by the rotation of the drum 14 to unwrap additional lengths of the cable 11. The gradual steady unwrapping of the cable 11 rotates the drum 14 with a considerable force and this force is opposed and taken up in pumping or otherwise driving water or other liquid against a selected pressure. The driving connections between the drum 14 and a pump 15 may be of any suitable type, preferably having a speed multiplying or power reducing transmission. In the accompanying drawings this transmission is shown by way of example as comprising a sprocket wheel 16 rotatably mounted on the drum shaft and, in one direction of rotation, engaging a clutch 16a, keyed to the drum 14. The sprocket wheel 16 when engaged by the clutch 16a drives a sprocket chain 17 which in turn drives a sprocket wheel 18 of a gear box 19. In the gear box 19 are a number of gears indicated at 20 and 21 of Fig. 4 which serves as speed multiplying and power reducing means. For example, in one installation the power was reduced in a ratio of about 85 to 1 and a speed proportionately increased. The end gear 21 of the gear box at 19 is supported on a shaft 22 to which it may be clutched by means of a clutch 23. It meshes directly with a gear 24 on the crank shaft 25 of the pump 15 which is preferably a multi-cylinder double acting pump, six cylinders being shown by way of example.

Liquid such as water or oil is supplied from a storage tank or reservoir 26 through a pipe 27 to the pump 15 and is then forced thereby through piping 28 to a plurality of control valves 29, 30, 31, 32 and 33 arranged in parallel and connecting the pipe 28 to a return pipe 34 leading back

to the tank or reservoir 26. The control valves 29—33 are of different sizes. For example, in one illustration they ranged from $\frac{1}{4}$ inch to 2 inch valves, the valve 33 being a $\frac{1}{4}$ inch valve, valve 32 being a $\frac{1}{2}$ inch valve, valve 31 being a $\frac{3}{4}$ inch valve, valve 30 being a 1 inch valve and valve 29 a 2 inch valve. A master control valve 35 is also provided on the pipe 28 through which flow of liquid from the pump 15 may be entirely shut off. An indicator 36 is also mounted on a pipe 28 to indicate the fluid pressure maintained therein. The valve assembly 29—33 and the indicator 36 may be mounted in any desired position enabling the control to be placed within the derrick convenient to the driller so that it may be instantly at his command. In operating the apparatus the unwinding of the drum may be entirely stopped by closing the valve 35. This completely stops the flow of fluid from the pump 15 and thereby stops the rotation of the drum to which the pump is positively connected by the transmission mechanism. By closing all of the valves 29—33, except a selected valve, and then opening the valve 35, liquid is permitted to flow from the pump 15 through the connecting pipes to the tank 26 and back to the pump under a resistance which controls the speed of the pump and consequently the rate of unwinding of the drum 14. For example, when only the valve 33 is open a maximum of resistance is offered and the drum 14 unwinds very slowly.

The pressure indicated by the indicator 36, when all of the valves 29—33 are closed, is a measure of the weight of the drill stem and any drop in this pressure as any of the valves 29—33 is opened and the fluid circulating is an indication of the proportionate weight of the drill stem removed from the supporting cable and thus transferred to the bottom of the well being drilled. The indicator 36 therefore gives an immediate and accurate indication to the driller of the pressure being exerted by the drill stem on the earth formations at the bottom of the well. For a given type of earth or rock formation the valve 29—36 may be regulated from the derrick floor to provide the exact drill stem pressure required. Also due to the multiplication of speed from the drum 14 to the pump 15 and to the use of several cylinders whereby pulsations are evenly distributed throughout a pumping cycle the reactions of the pump to the drum 14 are smoothed out and a very steady resistance to the rotation of the drum is provided. To indicate the rate of drilling or the rate at which the drill is lowered into the well a speed indicator shown diagrammatically at 37, Figs. 3 and 4, is provided on the shaft 22. By indicating the revolutions per minute or other period of time this speed indicator gives an accurate measure of the rate of lowering of the drill stem.

When it is desired to lower the drill stem rapidly into the well the clutch 23 is moved to declutch the gear 21 from the shaft 22 thereby throwing the pump out of operation. When the drill stem is to be lifted out of the well, the drum shaft is driven from the drawworks of the drilling apparatus in the usual manner and, in the event that the gear 21 is not declutched from the shaft 22, the sprocket wheel 16 will override the clutch 16a and the reducing mechanism and pump will not be operated. In case of an emergency, however, the drill stem can be raised by declutching the clutch 23. The shaft is then driven by means of a motor 38 which is connected to the shaft 22 by a suitable flexible

coupling 39. The motor thus drives the sprocket wheel 18 through the shaft 22 and gear train 21, 20. Thus, the same gear box and driving mechanism may be used for controlling the descent of the drill and for hoisting it from the well.

It will be understood that the sprocket driving connections between the drum 14 and the gear box 19, the construction of the gear box itself and the type of pump 15 are given merely by way of example of suitable transmission mechanisms and pumping apparatus. As these are mechanical constructions for which alternatives are well known, it will be understood that other alternative arrangements of transmission mechanism and other types of pumping apparatus than those specifically described may be used. With the above arrangement of the various elements of the combination there is provided a control mechanism for the unwinding of the drum that enables the drill to be smoothly lowered without changes in the effective weight or pressure imparted to the drilling end and in which this weight is under the convenient and immediate control of the driller and whereby the apparatus may be quickly shifted to hoist the drill instead of lowering it.

What I claim is:

1. A brake for drilling apparatus comprising a drum, a drill suspending cable wrapped on said drum, a speed multiplying transmission means driven by said drum, a pump driven by said transmission means, a fluid circuit in series with said pump and having a plurality of throttle valves arranged in parallel in said circuit.

2. A brake for drilling apparatus comprising a drum, a drill suspending cable wrapped on said drum, a speed multiplying transmission means driven by said drum, a pump driven by said transmission means, a fluid circuit in series with said pump and having a plurality of throttle valves arranged in parallel in said circuit and an indicator in said circuit in advance of said throttle valves.

3. A brake for drilling apparatus comprising a drum, a drill suspending cable wrapped on said drum, a speed multiplying transmission means driven by said drum, a double acting multi-cylinder pump driven by said transmission means, a fluid circuit in series with said pump and having a plurality of throttle valves arranged in parallel in said circuit.

4. A brake for drilling apparatus comprising a drum, a drill suspending cable wrapped on said drum, a speed multiplying transmission means driven by said drum, a pump driven by said transmission means, a fluid circuit in series with said pump and having a plurality of throttle valves arranged in parallel in said circuit and a speed indicator connected to said transmission mechanism.

5. A brake for drilling apparatus comprising a drum, a drill suspending cable wrapped on said drum, a speed multiplying transmission means driven by said drum, a pump driven by said transmission means, a fluid circuit in series with said pump and having a plurality of throttle valves arranged in parallel in said circuit and a driving motor and means to selectively connect said motor to said transmission mechanism.

6. A brake for drilling apparatus comprising a drum, a drill suspending cable wrapped on said drum, a speed multiplying transmission means driven by said drum, a pump driven by said transmission means, a fluid circuit in series with

said pump and having a plurality of throttle valves arranged in parallel in said circuit, a driving motor for said transmission and means for disconnecting the driving means from the transmission to the pump.

5 7. A brake for drilling apparatus comprising a drum, a drill suspending cable wrapped on said drum, a speed multiplying transmission, engaging means driving said transmission from said

drum, said means disengaging when the direction of rotation is reversed, a pump driven by said transmission, a fluid circuit in series with said pump and having a plurality of throttle valves arranged in parallel in said circuit, and a driving motor, and means to selectively connect said motor to said transmission mechanism. 5

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