

June 30, 1942.

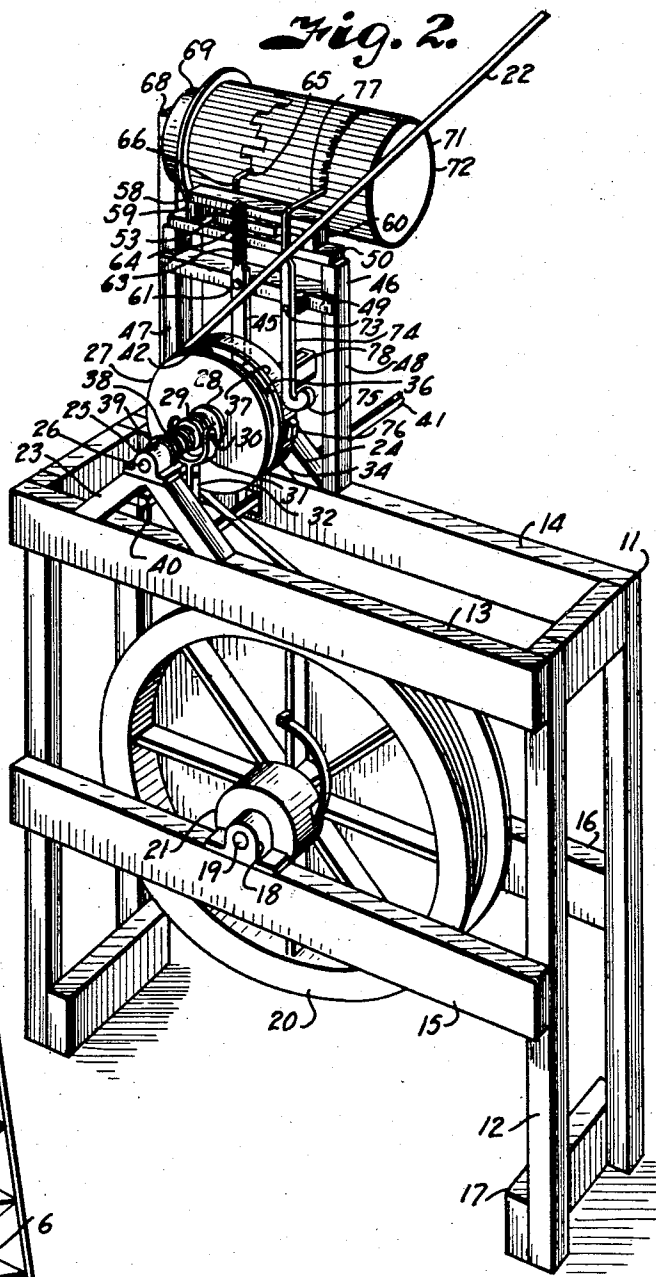
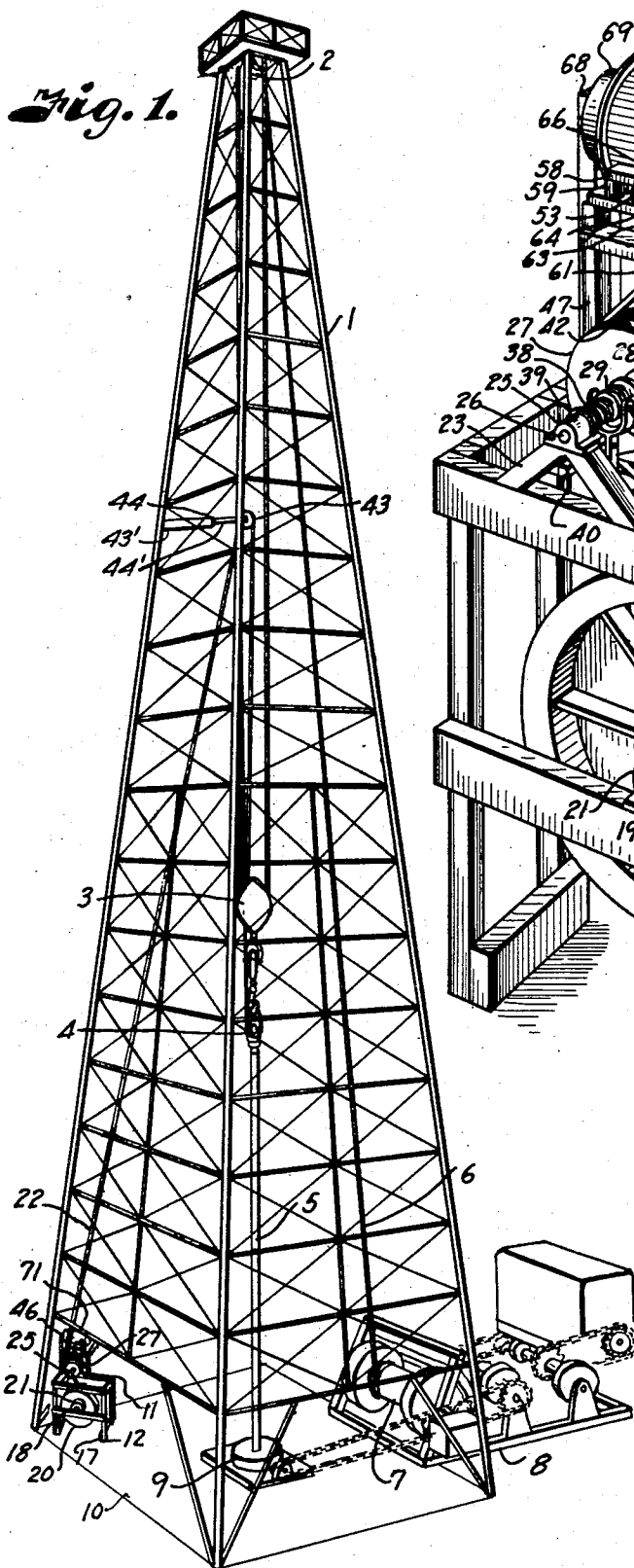
P. B. NICHOLS

2,287,819

DEVICE FOR RECORDING DRILLING OPERATIONS

Filed May 21, 1938

2 Sheets-Sheet 1



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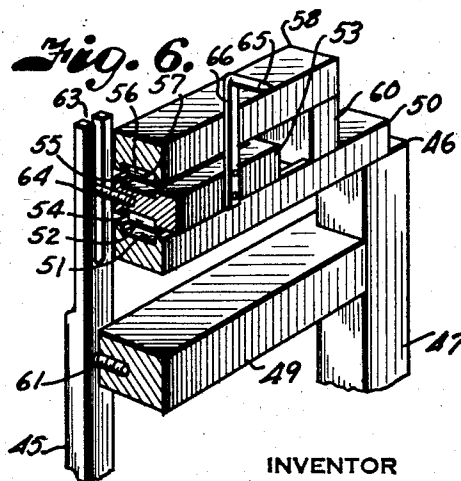
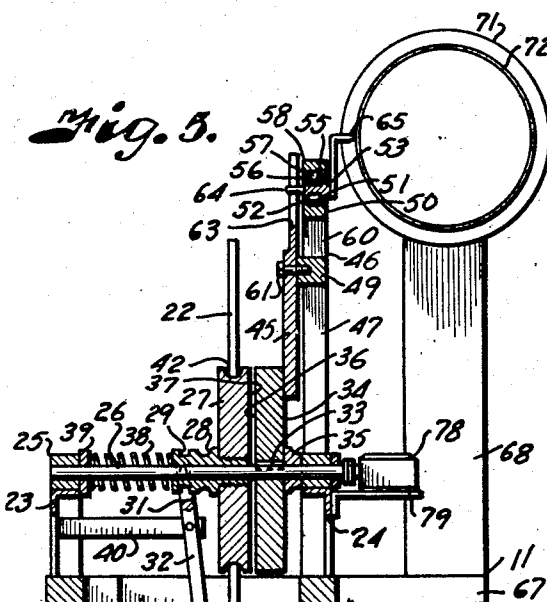
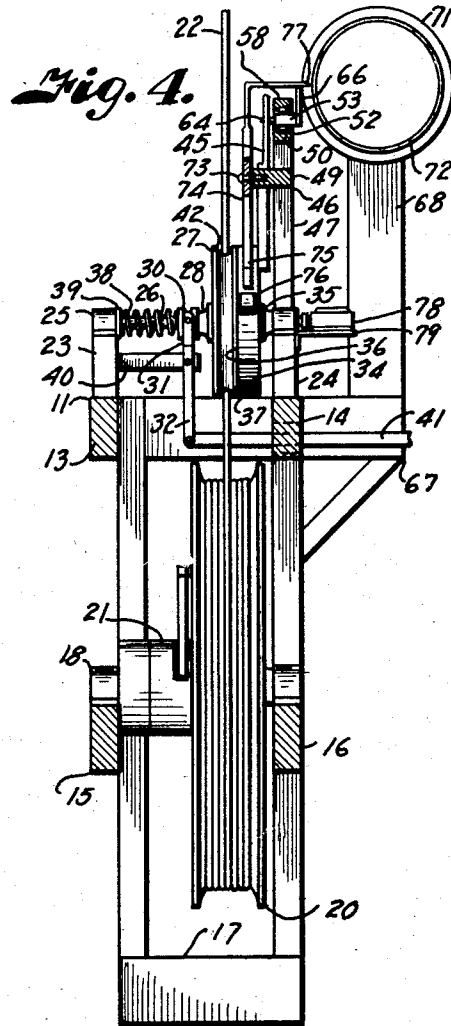
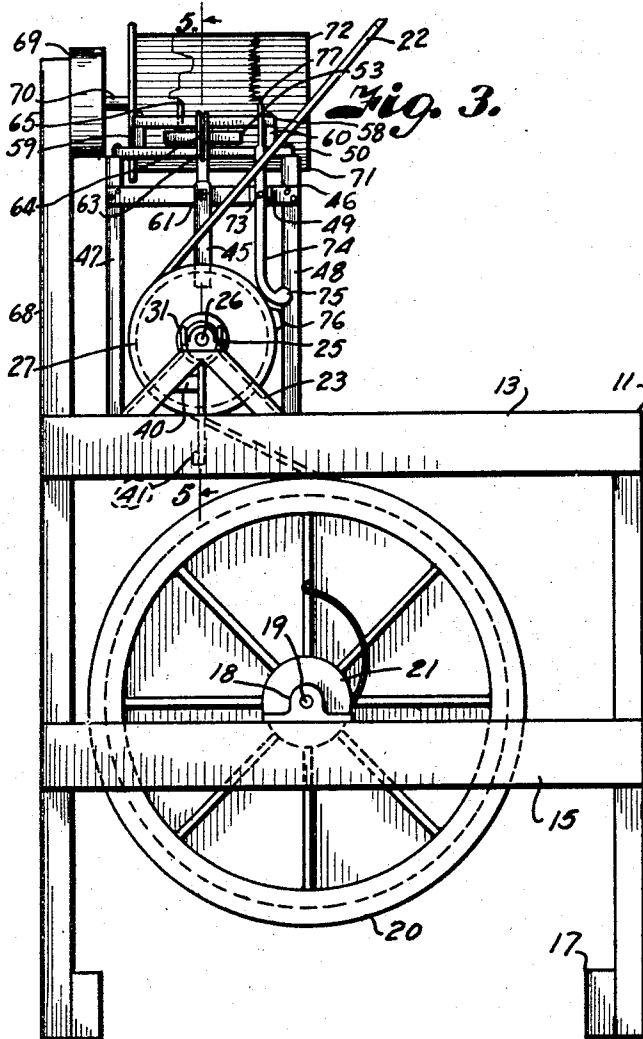
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DEVICE FOR RECORDING DRILLING OPERATIONS

Filed May 21, 1938

2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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DEVICE FOR RECORDING DRILLING
OPERATIONS

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by mesne assignments, of one-half to Cities
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Application May 21, 1938, Serial No. 209,257

3 Claims. (Cl. 234—5.8)

This invention relates to the art of drilling earth formations and particularly to a recorder operable in conjunction with a rotary drilling rig for graphically recording drilling operations, and has for its principal object to provide mechanism of this character for automatically recording the time that the drill is in operation, speed of penetration through the earth formations and depth of drilling.

Other important objects of the invention are to provide a device of this character for recording change in drilling action of the bit as it penetrates formations of varying hardness; and to record other operations in rotary drilling, such as running in and pulling of the drill pipe, the making of connections, time of shut-downs for repairs, in their relation to time and sequence to each other.

It is a further object of the invention to provide an apparatus of this character which is of simple construction and capable of positive operation and responsive to movements of the drilling string of a rotary rig.

In accomplishing these and other objects of the invention, as hereinafter pointed out, I have provided improved structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a perspective view of a rotary well drilling rig and derrick equipped with a recording apparatus embodying the features of the present invention.

Fig. 2 is an enlarged detail perspective view of the recording apparatus.

Fig. 3 is a side elevational view thereof.

Fig. 4 is an end elevational view.

Fig. 5 is a detail section on the line 5—5 of Fig. 3.

Fig. 6 is a detail perspective view of the pen and its actuating lever for recording rate of drilling, depth of the drill hole, and change of formation through which the drill bit progresses.

Referring more in detail to the drawings:

1 designates a standard derrick supporting a crown block 2 carrying pulleys from which the drilling string is suspended by tackle mechanism 3 connected with a swivel head 4 on the drilling string 5. The tackle mechanism is actuated through a cable 6 operating over a winding drum 7 of a conventional rotary draw-works 8 to raise and lower the drilling string. The draw-works is also utilized in running in and withdrawing the drilling string, applying sections of drill pipe and other drilling operations as in conventional practice. The drilling string extends through a ro-

tary turntable 9 and carries a suitable bit (not shown) for drilling earth formations.

Mounted on the floor 10 of the derrick is a recording apparatus embodying the features of the present invention. The recording apparatus includes a frame 11 having legs 12 connected by upper and lower longitudinal bars 13—14 and 15—16 and cross bars 17 to form a rigid structure. Mounted on the longitudinal bars 15 and 16 are bearings 18 supporting a shaft 19 which rotatably carries a cable winding drum 20. Connected with the winding drum is a spring motor 21 normally tensioned to rotate the drum in a direction to wind a cable 22 thereon and which is yieldably responsive to pull of the cable in permitting unwinding of the cable therefrom in following the movements of the drilling string as later described.

Carried on the longitudinal bars 13 and 14, adjacent one of the ends thereof, are brackets 23 and 24 carrying bearings 25 for mounting the ends of a shaft 26 carrying a measuring wheel 27. The wheel 27 includes a hub 28 that is loosely and slidably mounted on the shaft 26 and which is provided with an annular groove 29 engaging the pins 30 on the forked end 31 of a shifting lever 32 to effect sliding movement of the wheel on the shaft. Secured to the shaft by a spline 33, in juxtaposition with the wheel 27, is a driven disk 34 that is retained from longitudinal movement on the shaft by a thrust collar 35 engaging against the end of the bearing supported on the bracket 24. The disk 34 has a side face 36 adapted for frictional engagement with the adjacent side face 37 of the measuring wheel under influence of a coil spring 38 that is sleeved on the shaft 26 and has one end seated on a washer 39 engaging the bearing 25 and its opposite end against the hub of the measuring wheel as best shown in Fig. 5. The shift lever 32 is pivotally supported on an arm 40 that projects inwardly from the bracket 23 and is actuated by a rod 41 extending to a point adjacent the driller's station on the derrick floor.

The measuring wheel has a grooved periphery 42 for accommodating the cable 22 that runs thereover and over a pulley 43 carried at the end of a bracket 43' affixed to one of the derrick legs and mounted in such manner that it will swing horizontally to one side as the kelly rod of the drilling string is unscrewed and lowered "into the rathole," thus leaving the derrick clear for withdrawing or running in drill pipe. The body of the bracket may be formed of telescoping pipe sections 44 and 44' so that the

pulley may be centered over the swivel head 4. From the pulley 43 the cable extends downwardly within the derrick and connects with the swivel head 4 so that as the drilling string is lowered with progress of the bit, the cable 22 is correspondingly unwound from the cable reel to effect rotation of the measuring wheel and corresponding rotation of the disk when the shift lever is released to permit frictional driving engagement of the measuring wheel. The disk 34 is formed of a magnetizable material and is adapted to attract a magnet 45 that is carried on the frame 46 of a recorder mechanism.

The frame 46 includes uprights 47 and 48 located on the respective sides of the bearing bracket 24 and projecting upwardly from the bar 14, as shown in Figs. 2 and 3, to carry a cross bar 49 having its ends secured thereto at points spaced below the upper ends thereof. Mounted on the ends of the uprights is a rail 50 having a groove 51 in its upper face to form a track for rollers 52. Supported on the rollers 52 is a carriage 53 comprising a bar having grooved tracks 54 and 55 in the upper and lower faces thereof to be guidingly engaged by the rollers 52 and an upper set of rollers 56 that are seated in the grooved track 55 and engage in a groove track 57 of an upper rail 58. The upper rail 58 is supported from the rail 50 by spacing blocks 59 and 60 so that the carriage is mounted for free longitudinal movement between the respective sets of rollers under actuation of the magnet 45. The magnet 45 is pivotally supported on the cross bar 49 by a pivot pin 61 at a point substantially over the extended axis of the disk 34 so that the lower end of the magnet overlaps and substantially contacts the side face of the disk.

Projecting from the pivot end of the magnet is an arm 62 having a longitudinal slot 63 for engaging a pin 64 that projects from the adjacent side of the carriage so that when the magnet is moved by its attraction to the disk 34 the carriage is moved along the supporting tracks to carry a stylus or pen 65 that is carried on an arm 66 attached to one end of the carriage as best shown in Fig. 6. Projecting upwardly from a lateral extension 67 on the longitudinal bar 14 is a bracket 68 which carries a clock mechanism 69 having a driving shaft 70 located in substantially the horizontal plane of the stylus 65 to mount a recorder drum 71 which carries a chart 72 that is contacted by the stylus to record deflections of the magnet. Also pivotally mounted on a pin 73 at the end of the cross bar 49 adjacent the upright 48 is a lever arm 74 having a cam engaging lower end 75 that is adapted to be engaged by a lug 76 projecting from the periphery of the disk 34 to move the lever arm upon each revolution of the disk for making a record on the chart by a stylus 77 that is connected to the upper end of the lever arm and is supported in substantially the horizontal plane of the stylus previously described.

The shaft 70 may be connected with a counter 78 that is supported on a bracket 79 extending laterally from the bearing support 24 to register the number of rotations of the wheel 27 in a forward direction.

The mechanism thus described is mounted at a convenient point on the derrick floor, for example, adjacent one of the derrick legs as shown in Fig. 1. The free end of the cable is placed in the groove of the pulley 27 and over the pulley 43 that is secured to the bracket 44 so that

it can be connected with the swivel head 4. When thus connected, any vertical movement of the swivel head incidental to drilling operations produces a corresponding rotational movement of the pulley 27, the cable being kept taut at all times by the spring mechanism operating on the cable reel.

In using an apparatus constructed and assembled as described, a chart 72 is applied to the recording drum and the styluses are adjusted so that they make contact therewith. The clock motor 69 is then set in motion to effect rotation of the recording drum. Assuming that the drilling string is being rotated by the turnable 9 to rotate the drill bit, progress of the bit pulls on the cable 22 so that it is unwound from the reel progressively with penetration of the bit. This movement of the cable imparts a corresponding rotation of the measuring pulley to effect swinging movement of the magnet in the direction of disk rotation, which effects corresponding opposite movement of the carriage and is recorded by the stylus on the chart.

The magnet 45 shows the direction of movement of the cable 22 and consequently the direction of movement of the drill bit, and this movement is recorded on the chart by the stylus 65. During normal drilling operations the magnet 45 will ride near the edge of the disk in the direction of rotation as far as its length will allow. However, if the bit encounters a formation which causes the drill pipe to move vertically, as in "rough drilling," the vertical movement will be transmitted by the line of cable 22 to the pulley 27, and through the pulley to the disk 34, and thence to the magnet which is sensitive to any reverse motion having followed the disk as far in the normal direction as its position will allow. This reverse movement will be shown on the chart as an increase in width of the record made by the stylus 65. In the same manner the magnet will act to effect recording by reversal of position the moment the bit is raised off the bottom of the well, or as in withdrawing the drilling string, circulating of fluid, or while repairs are being made, etc.

The drilling speed is shown by the number of horizontal lines made by the stylus 77 on the time chart 72, for example if a measuring wheel is two feet in circumference the record of the stylus 77 will be a vertical line until it is forced out of line by the lug 76, thereby making a short horizontal line. The distance between any two of these horizontal lines will be shown on the chart as the elapsed time of drilling two feet of formation. The stylus 77 simultaneously records the depth of drilling since the lever is actuated on each revolution of the disk, the cam striking the lower end of the lever to effect pivotal movement thereof. The lower end of the arm, being heavier than the pen end, assumes its perpendicular position after each actuation thereof by the cam. The recordings on the charts will not only show the speed and depth of drilling through the various formations, but it will also indicate and record the operations in rotary drilling such as round trips, connections, shut-downs for repairs, etc. in their relation to time and to each other.

From the foregoing it is apparent that I have provided a simple mechanism which is well adapted for recording the various drilling operations connected with a rotary drilling rig and which accurately records the operations.

What I claim and desire to secure by Letters Patent is:

1. A recorder including a chart, means movably supporting the chart, means for advancing said chart, a stylus, means pivotally supporting the stylus for contact with the chart, a freely movable magnet connected with said stylus, a rotor formed of magnetizable metal, means supporting the rotor in the field of said magnet, an actuator for said rotor adapted for connection with an operating mechanism having irregular movement in opposite directions, a second stylus, means movably supporting said second stylus in contact with the chart, a cam-engaging arm connected with said stylus, and a cam on said rotor for effecting a recording by said stylus of definite predetermined advance of the rotor in one direction.

2. A recorder including a chart, means removably supporting the chart, means for advancing said chart, a stylus, means movably supporting the stylus for contact with the movable chart, a freely movable deflecting member connected with the stylus, a rotor member, one of said members constituting a magnet for effecting a magnetic drag between said members to actuate the deflecting member, means supporting the rotor member for rotation relatively to the deflecting member, an actuator for said rotor member for connection with an operating mechanism hav-

ing intermittent directional movement, a second stylus, means movably supporting the second stylus in contact with the chart, a cam-engaging arm connected with the stylus, and a cam on said rotor for effecting a recording by said stylus of definite predetermined advance of the rotor in one direction.

3. A recorder including a chart, means removably supporting the chart, means for advancing the chart, a stylus, means movably supporting the stylus in contact with the chart, a freely oscillatable member connected with the stylus and adapted upon oscillation to move the latter, a rotor member, one of said members constituting a magnet for effecting a magnetic drag between the members to actuate the oscillatable member, said oscillatable member being positioned adjacent the rotor member and being normally disposed substantially radial thereto, said oscillatable member being adapted upon rotation of the rotor member to move out of and away from its substantially radial position with respect to the rotor member and to approach a tangential position with a portion thereof in proximity to the peripheral regions of the rotor member due to the magnetic drag between the members, and means connecting the rotor member with an operating mechanism having intermittent directional movement.

PAUL BRISCOE NICHOLS.