Nov. 16, 1926. 1,607,006

R. E. LEONARD

WELL DRILLING APPARATUS

Filed August 13, 1925 2 Sheets-Sheet 1

Fig. 1.

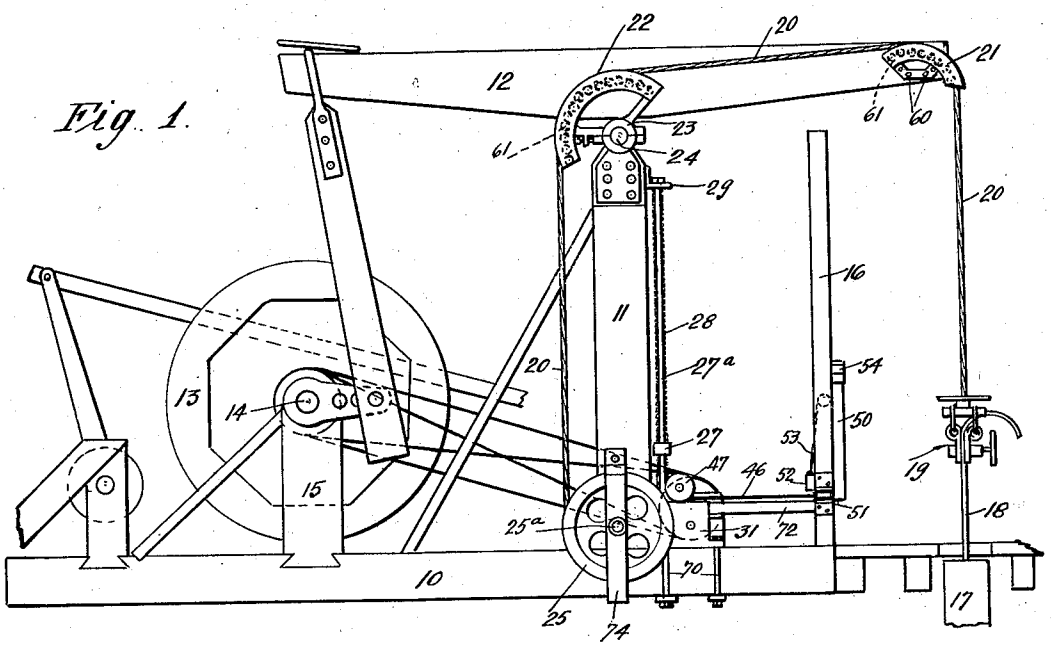
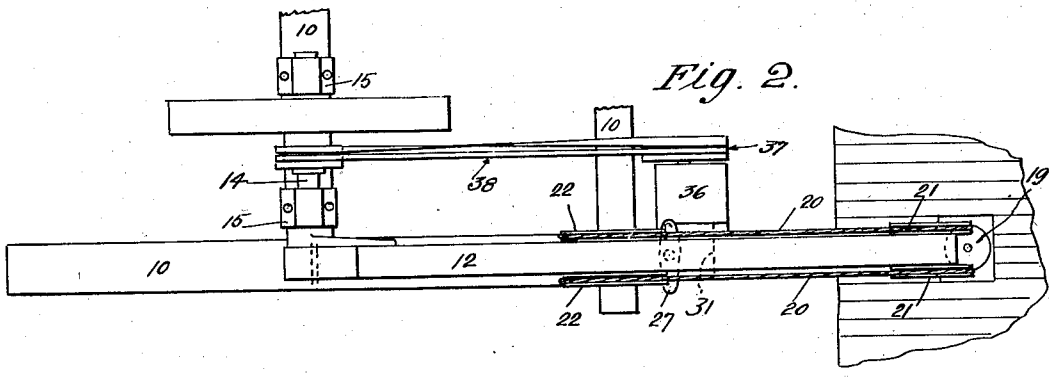



Fig. 2.




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Fig. 3.

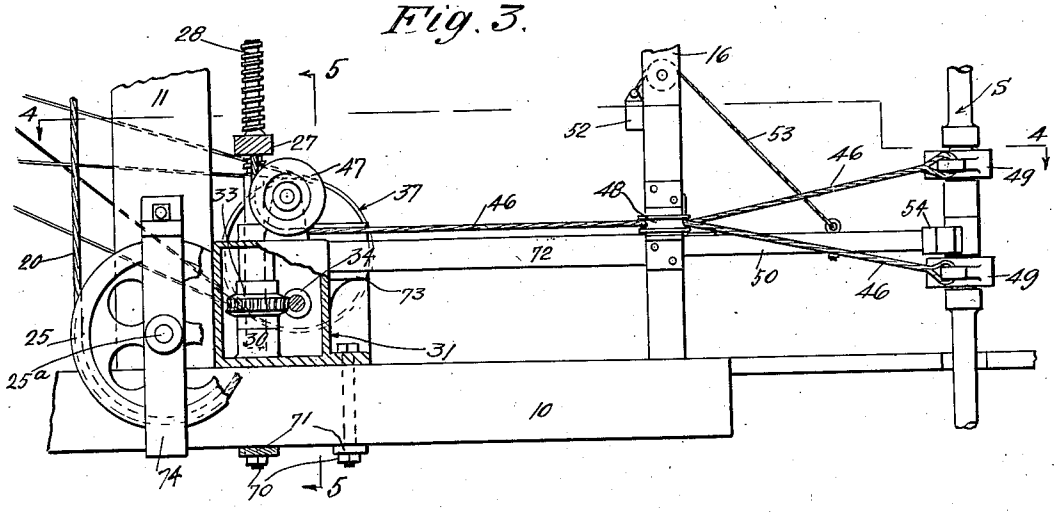



Fig. 4.

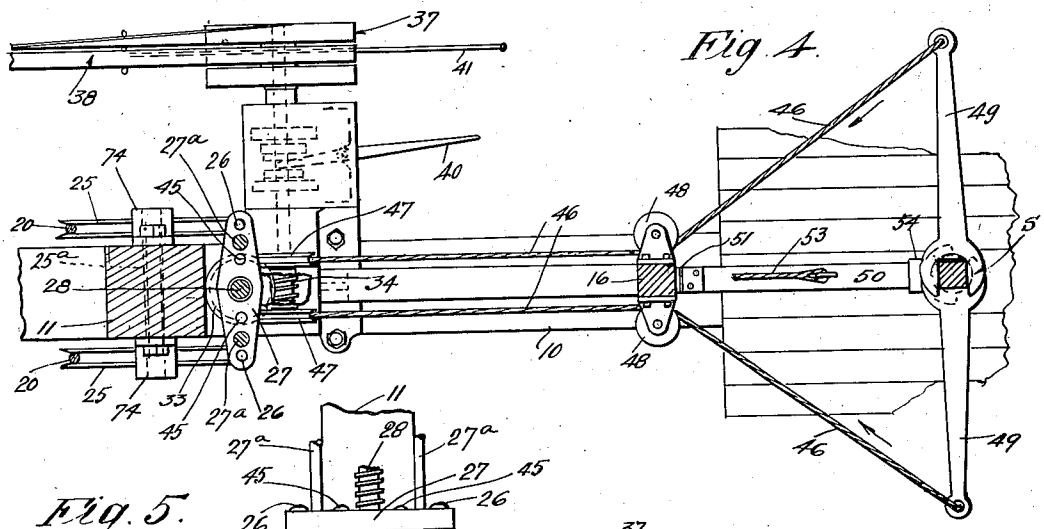
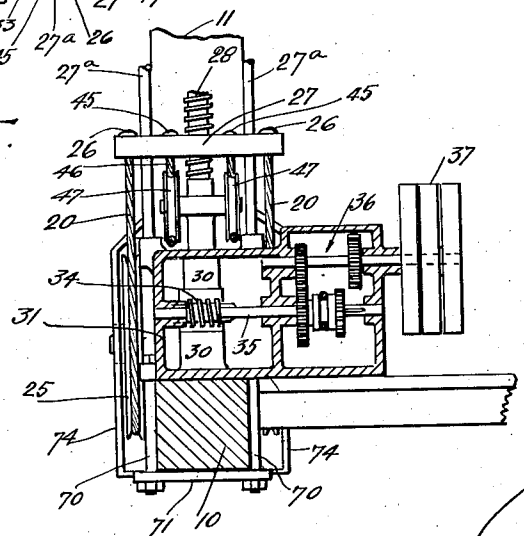



Fig. 5.




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Patented Nov. 16, 1926. 1,607,006

# UNITED STATES PATENT OFFICE.

ROY E. LEONARD, OF ALHAMBRA, CALIFORNIA.

## WELL-DRILLING APPARATUS.

Application filed August 13, 1925. Serial No. 49,907.

This invention has to do with apparatus facilitating drilling and allied operations on deep wells, such as oil wells; and has more particularly to do with apparatus adapted to lower, or raise, a drilling line during drilling operations and also for setting and unsetting the threaded joints of well pipe or drill pipe or the like. In its general and broader aspects this invention is of the general nature of my invention entitled Well drilling apparatus for which United States Letters Patent No. 1,508,704 was issued to me on September 16, 1924, the present invention including certain improvements, mainly by way of greater simplicity, inexpensiveness and facility of operation.

In the device of said issued patent there is shown and explained a power element that is adapted by certain arrangements and connections to take the place of the ordinary temper screw and also to provide power for screwing and unscrewing threaded joints. I have shown in said patent an individual power unit for these purposes; whereas in the present invention I use the power transmission arrangement which takes power from other parts of the drilling rig and therefore from the original prime mover of the rig; there are also certain other improvements contained within the present invention, and all of these improvements and their advantages will be best understood from the following detailed description wherein, for the purpose of illustrating the invention, I have set forth a preferred form of device. For this purpose, reference is had to the accompanying drawings, in which:

Fig. 1 is a side elevation showing a standard rig equipped with my device;

Fig. 2 is a plan of the same;

Fig. 3 is an enlarged fragmentary side elevation with the parts broken away in section; Fig. 3 also showing the parts in their position for operating upon screw-threaded tool joints or the like;

Fig. 4 is a plan of the parts shown in Fig. 3; and

Fig. 5 is a front elevation of certain parts of Fig. 3 taken as indicated by line 5—5 on Fig. 3 and having certain parts broken away for illustration.

In the drawings I show portions of a standard rig including sills 10, Samson post 11, walking beam 12 and band wheel 13 mounted on its shaft 14 on posts 15. All these parts are well known. Mounted on sill 10 forward of Samson post 11 is the usual headache post 16. A well casing is shown at 17, a drilling line at 18, and the drilling line clamps at 19. These clamps are usually supported upon a temper screw which is suspended from the forward end of a walking beam 12; but my invention provides two cables 20 extending down to clamp 19 and secured to the clamp in any suitable manner for support. These two cables pass over two guides 21 at the forward end of the walking beam, the guides being constructed so as to pass the cable easily and with a minimum of friction, as will be hereinafter described. The cables also extend over two substantially semi-circular guides 22 which are mounted on and carried by the upper halves 23 of the bearings of walking beam trunnions 24.

At the bottom of the Samson post on each side there is a large sheave 25 around and under which the two cables 20 pass; the ends of the two cables finally coming up and attaching at 26 to a cross head 27. Cross head 27 is in the nature of a vertically traveling nut that is traversed vertically on guide rods 27ª by the operation of a long screw-threaded shaft 28 which is mounted in a suitable bearing 29 at its upper end and in bearings 30 at its lower end within a housing 31 which contains the gears that operate the screw. Worm gear 33 is mounted on the screw shaft 28 between bearings 30, and a worm 34 meshes with the worm wheel and drives screw 28 at a comparatively low speed. Worm 34 is mounted on horizontal shaft 35 that is driven through the medium of a change gear mechanism 36, from belt wheels 37, belt driven by straight and crossed belts 38 from band wheel shaft 14.

The change gear mechanism 36 may be of any of the usual kinds, and this device may be of a rather simple type involving, say, two speeds. A handle 40 may serve to operate the change gear and a handle 41 may serve to shift the two belts 38 to run the device in opposite directions and to operate screw 28 in opposite directions.

From what has been said it will readily be understood how screw 28 may be operated automatically during drilling operations to lower the drilling cable slowly as the drilling progresses. This lowering will be perfectly uniform and under automatic control, needing no manual attention, and may be at

any desired speed. In the original design of this device the proportionate sizes of the belt drive pulleys and gear ratios, etc., will be fixed so that the low speed of change gear mechanism 36 will be about the correct average for the downward feed of the drilling cable. If for any reason this speed is too fast, it may temporarily be checked by occasionally throwing the screw 28 out of operation; if it be too slow it may periodically be sped up by throwing the change gear mechanism to its higher speed for a short period. If in any given formation it is found that the feed ratios are much too slow or too fast, they may be easily changed by changing the sizes of the belt pulleys.

My device is not limited in its usefulness to paying out drilling cable during drilling operations, but it has other utilities that, although not likely to be called so constantly into service, are nevertheless of great value. For instance when tools are stuck and must be jarred loose, my device supplies a means of raising them as desired, without having to unhitch from the clamps and raise with the bull wheels. Such operations have many times caused disastrous delays. And the same things are true in fishing operations where the tools can, with my device, be reciprocated and at the same time or without any appreciable delay, moved up or down. And, as will be noted, a considerable power can be exerted in taking up the line to loosen stuck tools.

Yoke 27 also has connected with it at 45 another pair of cables 46 which run under small sheaves 47 and thence forwardly to sheaves 48 mounted on vertical shafts on opposite sides of headache post 16. Thence these cables 46 run to the ends of tongs 49 which are applied to a pipe or tool string, one above and one below the joint; and by proper placement of the tongs and by pulling inwardly on the ends of the tongs in the directions indicated by the arrows in Fig. 4, the desired operations may be accomplished with a large amount of force. As the tongs are pulled in by cables 46 toward headache post 16, it is desired to have a brace that prevents movement of the tool or pipe string toward the headache post; and this is provided in a thrust brace 50 hinged at 51 to the headache post to be thrown up vertically alongside the post when not in use. Such a brace may have a counter weight 52 connected to it by cable 53, and at its outer end it may have a semi-circular shoe 54 to engage against the pipe or tools that are being operated.

When screw threaded joints are being set up or broken, the mechanism may be operated at low speed so as to get highest power or it may be operated at higher speed so as to get quicker action.

In order to provide means for passing cables 20 up to and along the length of beam 12 and allow the cables such movement as is required for feeding out the drilling line, I provide the guides 21 and 22 somewhat as illustrated. Guides 21 are bolted, as at 60, to opposite sides of the forward end of the walking beam. These guides are in the nature of curved channels with rollers 61 inset, the cables passing over the rollers. Guides 22 are constructed in a similar manner with the rollers 61, these guides being substantially semi-circular in extent. They are mounted on, or constructed integrally with, the upper half 23 of the bearing block that carries walking beam trunnion 24, and the guide is concentric with the trunnion. This arrangement does away with any longitudinal motion of cables 20 due to beam oscillation; and at the same time the construction is superior to the mounting of a sheave on the end of walking beam trunnion 24, as such a construction would involve the necessity of lengthening the trunnion.

The advantages of simplicity and of direct and positive action are apparent in my device. Also it has the advantages of rugged strength and very little liability to deterioration or injury. The parts are solidly mounted in well protected positions and are well connected with the structural members of the rig. For instance, it will be noted that the screw shaft 28 is mounted close to and parallel with Samson post 11, and that gear casing 31 is mounted in the angle between the post and sill 10. The gear casing is held down on sill 10 by bolts 70 and straps 71. Between the casing and headache post 16 there is a horizontal thrust brace 72 supported on a bracket 73 at the casing, this thrust member supporting the headache post against the rearward thrust that is imposed upon it by the brace 50. The large sheaves 25 are mounted on a shaft $25^a$ that may pass through the Samson post, and the sheaves are enclosed within mounting straps or irons 74. The small sheaves 47 are mounted directly on top of casing 31. The lower ends of guide rods $27^a$ are mounted on casing 31 and at their upper ends in bearing bracket 29; the guide rods being thus accurately aligned with relation to screw 28.

I claim:

1. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, embodying a cable extending from a position alongside the lower end of the Samson post up to and along the walking beam and depending from the walking beam end and there connected to the drilling line, a vertical screw shaft journalled adjacent the Samson post, a nut yoke engaging said

screw shaft and to which the end of said cable is secured, a worm gear mechanism driving said screw shaft and means to drive said worm gear mechanism from the band wheel shaft.

2. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, embodying a cable extending from a position alongside the lower end of the Samson post up to and along the walking beam and depending from the walking beam end and there connected to the drilling line, a vertical screw shaft journalled adjacent the Samson post, a nut yoke engaging said screw shaft and to which the end of said cable is secured, a worm gear mechanism driving said screw shaft and means to drive said worm gear mechanism from the band wheel shaft, said last mentioned means including a change speed device and rotation reversing means.

3. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, embodying a cable extending from a position alongside the lower end of the Samson post up to and along the walking beam and depending from the walking beam end and there connected to the drilling line, a vertical screw shaft journalled adjacent the Samson post, a nut yoke engaging said screw shaft and to which the end of said cable is secured, a worm gear housing mounted on and secured to a sill at the lower end of the Samson post, the lower end of said screw shaft being journalled in said casing, a worm wheel on the shaft within the casing, a worm meshing therewith within the casing, means to drive said worm including a change speed mechanism, and a reversible driving means connecting the change speed mechanism with the band wheel shaft.

4. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, embodying a worm gear casing mounted on a sill forward of the Samson post and secured to the sill, vertically aligned bearings in said casing and a vertical screw shaft having its lower end journalled in said bearings and extending out of the casing upwardly alongside the Samson post with a bearing on the post at its upper end. a screw follower nut on said screw shaft, a pair of cables secured to said follower nut, a pair of sheaves mounted on the opposite sides of the lower end of the Samson post and under which said cables pass, a pair of guides mounted on the upper end of the Samson post, said guides being circular and concentric with the center of oscillation of the walking beam, a pair of guides mounted on the forward end of the walking beam, said cable extending over said guides and down to the drilling cable below the forward end of the walking beam; a worm gear on said screw shaft within said casing, a cross shaft within said casing carrying a worm meshing with said worm gear, a change speed mechanism associated with said casing to drive said cross shaft at different speeds, and a reversible belt drive taking power from the band wheel shaft to drive said change speed mechanism.

5. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, embodying a worm gear casing mounted on a sill forward of the Samson post and secured to the sill, vertically aligned bearings in said casing and a vertical screw shaft having its lower end journalled in said bearings and extending out of the casing upwardly alongside the Samson post with a bearing on the post at its upper end, a screw follower nut on said screw shaft, a pair of cables secured to said follower nut, a pair of sheaves mounted on the opposite side of the lower end of the Samson post and under which said cables pass, a pair of guides mounted on the upper end of the Samson post, said guides being circular and concentric with the center of oscillation of the walking beam, a pair of guides mounted on the forward end of the walking beam, said cable extending over said guides and down to the drilling cable below the forward end of the walking beam; a worm gear on said screw shaft within said casing, a cross shaft within said casing carrying a worm meshing with said worm gear, a change speed mechanism associated with said casing to drive said cross shaft at different speeds, and a reversible belt drive taking power from the band wheel shaft to drive said change speed mechanism; a pair of sheaves mounted on top said worm gear casing, another pair of cables attached to said follower nut and passing under said sheaves and forwardly and adapted to be attached to tongs applied to a string of tools or the like.

6. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, said means being actuated

from the band wheel shaft, means in connection with said first mentioned means and utilizing power derived from the band wheel to apply power to wrenches on a string of tools or the like.

7. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, embodying a worm gear casing mounted on a sill forward of the Samson post and secured to the sill, vertically aligned bearings in said casing and a vertical screw shaft having its lower end journalled in said bearings and extending out of the casing upwardly alongside the Samson post with a bearing on the post at its upper end, a screw follower nut on said screw shaft, a pair of cables secured to said follower nut, a pair of sheaves mounted on the opposite side of the lower end of the Samson post and under which said cables pass, a pair of guides mounted on the upper end of the Samson post, said guides being circular and concentric with the center of oscillation of the walking beam, a pair of guides mounted on the forward end of the walking beam, said cable extending over said guides and down to the drilling cable below the forward end of the walking beam; a worm gear on said screw shaft within said casing, a cross shaft within said casing carrying a worm meshing with said worm gear, a change speed mechanism associated with said casing to drive said cross shaft at different speeds, and a reversible belt drive taking power from the band wheel shaft to drive said change speed mechanism; a pair of sheaves mounted on top said worm gear casing, another pair of cables attached to said follower nut and passing under said sheaves and forwardly and adapted to be attached to tongs applied to a string of tools or the like; a post on the sill forward of the Samson post, a pair of sheaves on opposite sides of said post to pass and guide said last mentioned cables, a horizontal thrust brace between said post and said worm gear casing, and a brace on the forward side of said post adapted to be thrown into endwise engagement with said string of tools or the like.

8. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, embodying a cable extending from a position alongside the lower end of the Samson post up to and along the walking beam and depending from the walking beam end and there connected to the drilling line, means guiding said cable up to and along the walking beam in such manner that said cable is not moved longitudinally by the oscillation of the walking beam, a vertical screw shaft journalled adjacent the Samson post, a nut yoke engaging said screw shaft and to which the end of said cable is secured, a worm gear mechanism driving said screw shaft and means to drive said worm gear mechanism from the band wheel shaft.

9. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam actuated by band wheel rotation, said means embodying a cable moving mechanism situated near the lower end of the Samson post, a cable passing up along the Samson post and out along the walking beam to its end and depending therefrom and connected with the drilling line, guides for said cable guiding the cable in such manner that oscillation of the walking beam does not cause longitudinal motion of the cable with reference to the walking beam, a vertical screw journalled adjacent the Samson post, a nut on the screw to which the cable is connected, and means to drive the screw from the band wheel.

10. In a drilling rig, means for paying out or taking up a line, embodying a rotatable screw mounted in stationary bearings, a nut engaging said screw, means connecting the line with said nut, and means for rotating said screw, said means embodying a driving means and a reverse and a change speed mechanism between the driving means and the screw.

11. In a drilling rig, means for paying out or taking up a line, embodying a rotatable screw mounted in stationary bearings, a nut engaging said screw, means connecting the line with said nut, means for rotating said screw, said means embodying a worm gear mechanism driving said screw, a change speed mechanism driving the worm, and reversible driving means for the change speed mechanism.

12. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, embodying a cable extending from a position alongside the lower end of the Samson post up to and along the walking beam and depending from the walking beam end and there connected to the drilling line, a vertical screw shaft journalled adjacent the Samson post, a nut yoke engaging said screw shaft and to which the end of said cable is secured, a worm gear mechanism driving said screw shaft, and means to drive said worm gear mechanism.

13. In combination with a drilling rig of

the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, embodying a worm gear casing mounted on a sill forward of the Samson post and secured to the sill, vertically aligned bearings in said casing and a vertical screw shaft having its lower end journalled in said bearings and extending out of the casing upwardly alongside the Samson post with a bearing on the post at its upper end, a screw follower nut on said screw shaft, a pair of cables secured to said follower nut, a pair of sheaves mounted on the opposite side of the lower end of the Samson post and under which said cables pass, a pair of guides mounted on the upper end of the Samson post, said guides being circular and concentric with the center of oscillation of the walking beam, a pair of guides mounted on the forward end of the walking beam, said cable extending over said guides and down to the drilling cable below the forward end of the walking beam; a worm gear on said screw shaft within said casing, a cross shaft within said casing carrying a worm meshing with said worm gear, a change speed mechanism associated with said casing to drive said cross shaft at different speeds, a reversible driving means for said change speed mechanism; a pair of sheaves mounted on top said worm gear casing, another pair of cables attached to said follower nut and passing under said sheaves and forwardly and adapted to be attached to tongs applied to a string of tools or the like.

14. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, embodying a cable extending from a position alongside the lower end of the Samson post up to and along the walking beam and depending from the walking beam end and there connected to the drilling line, means guiding said cable up to and along the walking beam in such manner that said cable is not moved longitudinally by the oscillation of the walking beam, a vertical screw shaft journalled adjacent the Samson post, a nut yoke engaging said screw shaft and to which the end of said cable is secured, a worm gear mechanism driving said screw shaft, and means to drive said worm gear mechanism.

15. In combination with a drilling rig of the standard type, embodying sills and Samson post and walking beam and a band wheel and shaft, means for paying out or taking up drilling line below the end of the walking beam, embodying a cable extending from a position alongside the lower end of the Samson post up to and along the walking beam and depending from the walking beam end and there connected to the drilling line, a vertical screw shaft journalled adjacent the Samson post, a nut yoke engaging said screw shaft and to which the end of said cable is secured, and means to drive said screw shaft.

In witness that I claim the foregoing I have hereunto subscribed my name this 25th day of July 1925.

ROY E. LEONARD.