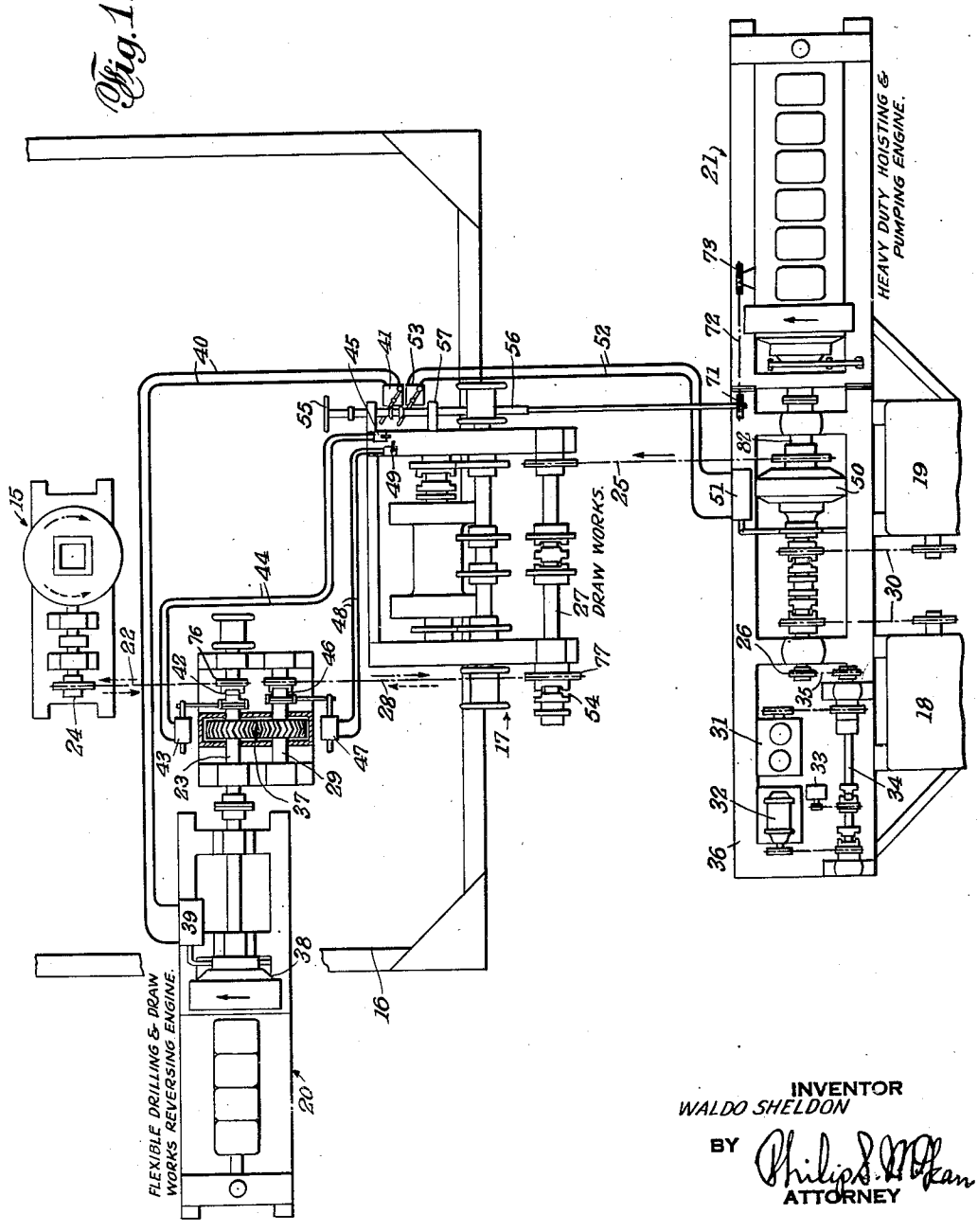
Nov. 21, 1939. W. SHELDON 2,180,724

ROTARY DRILLING

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Fig. 1.

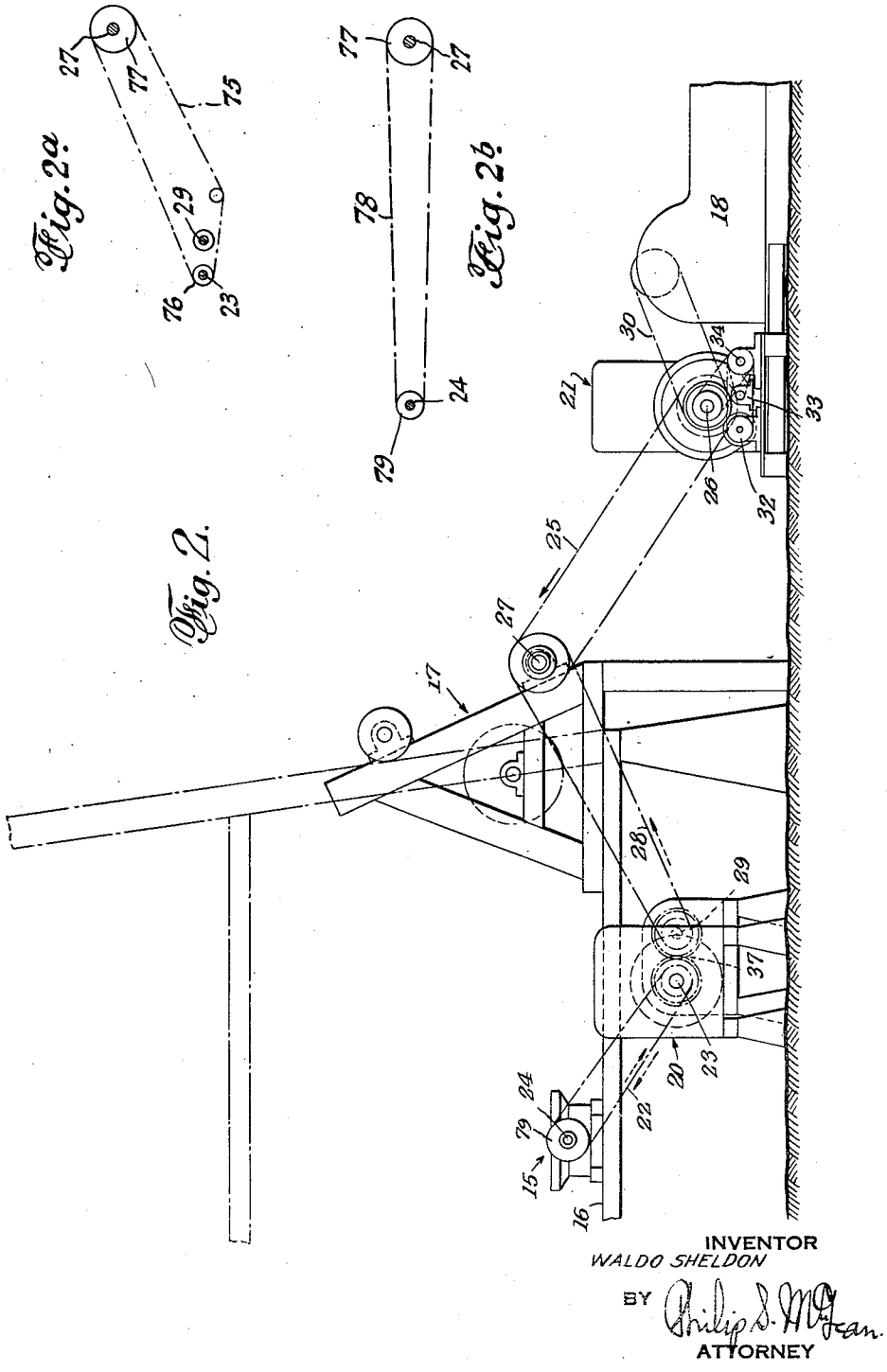


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ROTARY DRILLING

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Fig. 3.

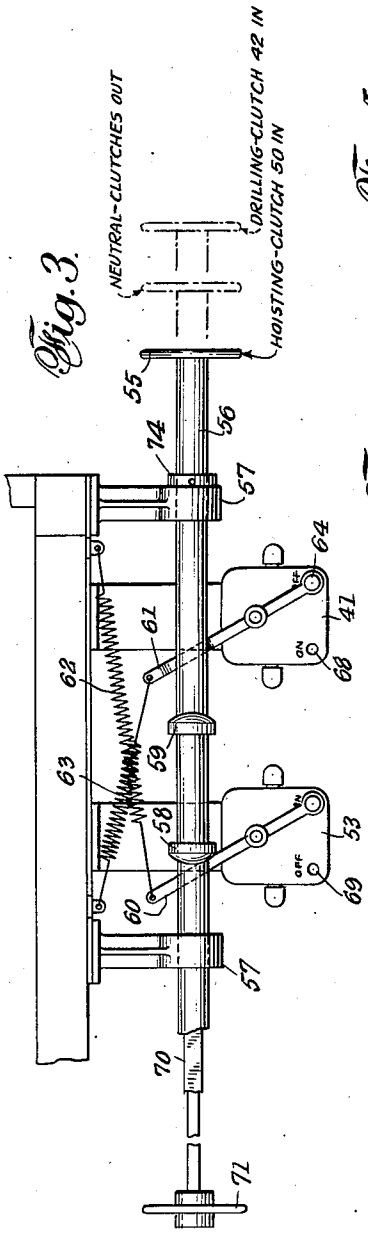


Fig. 5.

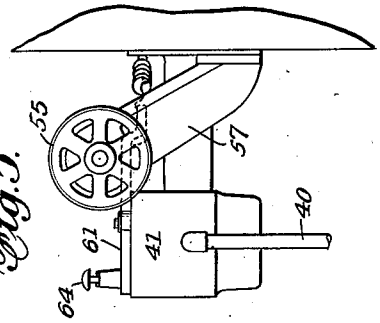


Fig. 4.

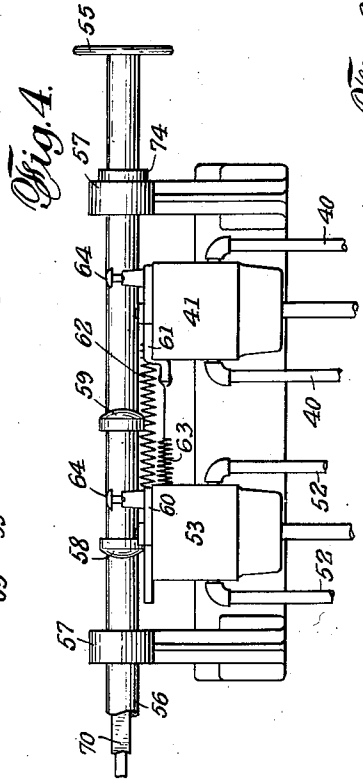
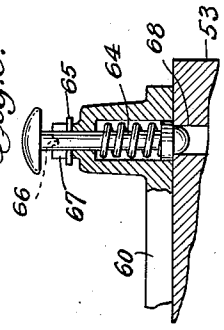


Fig. 6.



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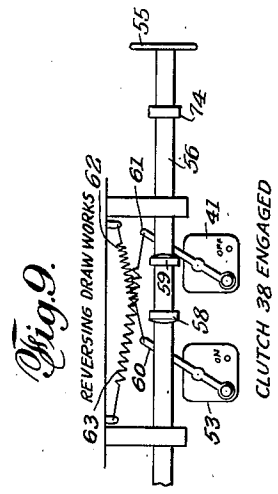


Fig. 9.

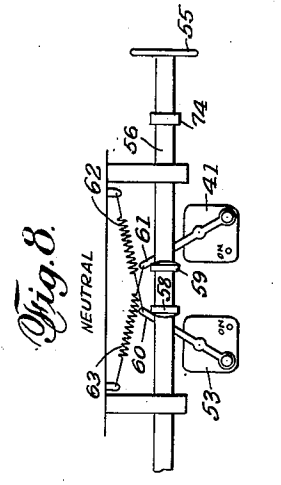


Fig. 8.

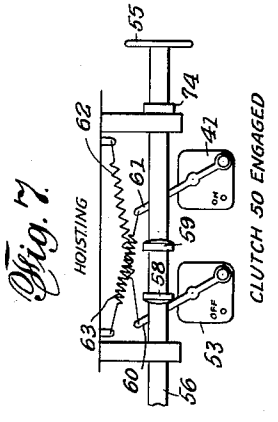


Fig. 7.

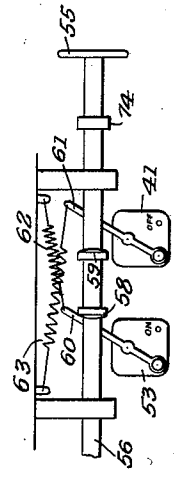


Fig. 11.

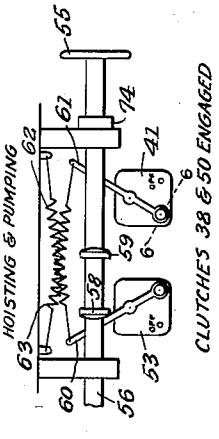


Fig. 10.

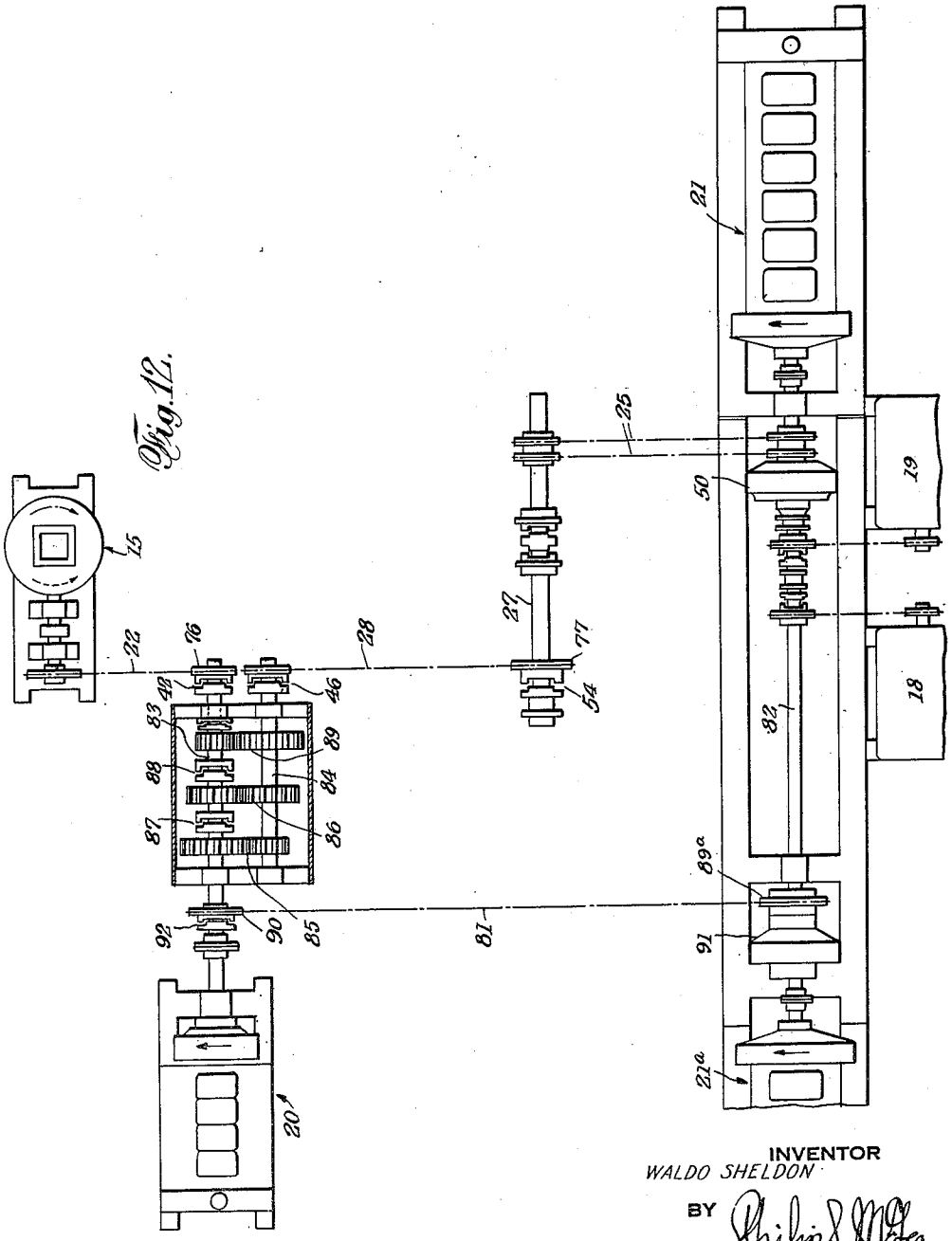
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Fig. 12.



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UNITED STATES PATENT OFFICE

2,180,724

ROTARY DRILLING

Waldo Sheldon, South Norwalk, Conn.

Application July 3, 1937, Serial No. 151,774

10 Claims. (Cl. 255—19)

The invention herein disclosed relates to rotary drilling operations.

Special objects of the invention are to provide the necessary power for hoisting, operation of the pumps, the lesser required power but greater flexibility for operation of the rotary, for quick reversal of the drawworks and of the rotary when needed and to effect operations such as indicated practically, efficiently and safely.

Other important objects are to provide full power for all operations, while enabling economical use of such power and to apply the power in a manner to guard against "twistoffs" and the like.

Further objects and the novel features of construction, combinations and r lations of parts constituting the invention will appear and are set forth in the following specification:

The drawings accompanying and forming part of the specification illustrate certain practical commercial embodiments of the invention, but it is to be understood that various modifications and changes may be made, all within the true intent and broad scope of the invention as hereinafter defined and claimed.

Fig. 1 is a broken plan and partly diagrammatic representation of an embodiment of the invention.

Fig. 2 is a broken side elevation as viewed at the left in Fig. 1.

Figs. 2*a* and 2*b* are diagrammatic views of modified forms of driving connections.

Fig. 3 is a broken plan and partly sectional detail view of the special combination control at the driller's stand.

Fig. 4 is a broken part sectional side elevation of the control mechanism.

Fig. 5 is a broken end elevation of the same.

Fig. 6 is an enlarged broken sectional detail of one of the holdout latches as on substantially the plane of line 6—6 of Fig. 10.

Figs. 7, 8, 9, 10 and 11 are broken plan views illustrating different positions and conditions of the control mechanism. Fig. 12 is a broken plan of the modified form of the invention.

In Figs. 1 and 2, the rotary is indicated at 15, mounted on the derrick floor 16, and drawworks at one side of the derrick at 17, and the pumps at 18, 19.

For the lighter work of driving the rotary, reversing the drawworks and the like, a relatively low power flexible drilling engine 20 is provided and for the heavy work of driving the pumps and hoisting, a heavy duty greater power engine 21, is provided.

These engines may be mounted as shown in Fig. 2, the lighter engine 20 below the derrick floor between the rotary and drawworks and the heavier engine 21, to the outer side of the drawworks below the level of the derrick floor.

The drive of the rotary is effected by sprocket chain connections 22, extending from the shafting 23, of the smaller engine upwardly to the pinion shaft 24, of the rotary and the forward drive of the drawworks is effected by sprocket chain connections 25, from the shafting 26, of the larger engine to the jack shaft 27, of the drawworks.

Reverse drive of the drawworks is effected through sprocket chain connections 28, from a reversely turning shaft 29, driven by the smaller drilling engine to the jack shaft 27.

The mud pumps are shown as driven through more or less conventional clutch controlled sprocket chain connections 30, from the pumping engine shafting 26.

Auxiliary equipment such as air compressor 31, lighting generator 32 and wash-down pump 33, Fig. 1 are shown as driven indirectly from the pumping engine shafting through the medium of an auxiliary shaft 34, coupled to shafting 26, by sprocket connection 35. If desired, a small auxiliary or starting engine may be mounted on the sub-base 36, carrying this auxiliary equipment, for operating the compressor for starting purposes and other general uses.

The shaft 29 forming part of the drawworks reversing connections is shown as directly driven from the drilling engine shafting 23, through a set of reversing gears 37.

Clutches are provided for controlling the various parts as follows:

The drilling engine has a clutch at 38, operable from an air cylinder at 39, remotely controlled through piping 40, from a valve 41, Fig. 1.

The rotary drive 22 is governed by a clutch 42, operable by air cylinder 43, connected by piping 44, with a remote control valve 45.

The reverse drive at 28 is controlled by clutch 46, on the reversely rotating shaft 29, operated by air cylinder 47, connected by piping 48, with remote control valve 49.

The forward drive connections 25 for the drawworks are controlled by clutch 50, on the hoisting engine shafting operated by air cylinder 51, connected by piping 52, with control valve 53.

A clutch is indicated on the jack shaft at 54,

for use when the reversing connections 26 are in service. This may be a hand operated clutch.

The drilling engine clutch control valve 41, the rotary drive clutch control valve 45, the reverse drive clutch control valve 49, and the forward drive or the hoisting clutch control valve 53, may be and preferably are conveniently grouped for operation by the driller, substantially as indicated in Fig. 1 and a suitable interlock preferably is provided to prevent accidental use of both forward and reverse drives at the same time. In the present illustration, this interlock is combined with the heavy duty engine control, as shown more particularly in Figs. 1, 3, 4 and 5, where 55 designates a hand wheel on a tubular shaft 56, rotating and sliding in bearings 57, and carrying spaced oppositely acting cam shoulders 58, 59, and engageable respectively with the oppositely acting lever handles 60, 61, of the forward drive control valve 53, and drilling engine clutch valve 41, respectively. These two valve control handles are shown as tensioned to their "off" or clutch opening positions by springs 62, 63. For locking them in the "on" or clutch closed positions, these levers are shown as carrying spring pressed plungers 64, Fig. 6, which when turned to shift the cross pins 65, from holding-out notches 66, into notches 67, will drop into appropriately placed seats 68. Similarly, if desired, these locking plungers may be employed to secure the control levers in the "off" or clutch open positions by dropping the plungers, when the levers are so shifted into the "off" position seats or sockets 69.

Control of the heavy duty engine is effected from hand wheel 55, through the medium of a squared shaft 70, slidingly keyed in the sliding and rotating hand wheel shaft 56, and carrying or connected with a sprocket wheel 71, over which a chain 72, is run to the throttle control sprocket 73, Fig. 1.

Operation

Hoisting.—With the heavy duty engine 21 turning in the direction of the arrow, forward rotation of the drawworks is effected through the drive 25, under control of clutch 50, and operation of the latter is controlled from hand wheel 55, through valve lever 60. In the hoisting position indicated in Fig. 3, the hand wheel is pushed all the way in to the limit permitted by engagement of stop collar 74, with bearing bracket 57, in which relation, cam shoulder 58, holds clutch control lever 60, in the "on" position, with clutch 50 engaged. The inward position of cam shoulder 59 at such time leaves the spring 63, free to hold the control lever 61, for the drilling engine clutch 38, in the "off", clutch open position, all as diagrammatically represented in Fig. 7. During hoisting operations, the valve 45 will have been turned as in Fig. 1, to open the rotary drive clutch at 42, and valve 49, be set to close the reverse drive clutch 46.

To stop hoisting, the hand wheel is pulled out to the intermediate position indicated in Figs. 3 and 8, permitting spring 62, to pull the clutch control lever 60, over into the "off" position for effecting disengagement of the forward drive clutch 50.

For reversing the drawworks, the hand wheel is pulled the full extent of its outward movement as indicated in broken lines in Fig. 3 and full lines in Fig. 9, to cause cam shoulder 59, to throw control lever 61, into the "on" position for effecting engagement of the drilling engine clutch 38. Then with clutches 46 and 54, engaged, the reverse drive at 28, will be made effective to reverse the drawworks and through the interlocking system described, this can only take place when forward drive clutch 50, is disengaged. This relation of the parts is indicated in Fig. 1.

Drilling

When rotating and pumping, the control mechanism may be set as in Fig. 10, with the hand wheel 55, at its inward limit holding clutch control lever 60, in the "on" position with clutch 50 engaged for running the pumps, the drawworks clutches being out, and control lever 61, being secured by latch plunger 64, in the "on" position for holding the drilling engine clutch 38, engaged, the valve 45, being positioned at this time to effect engagement of the rotary drive clutch 42. Under these conditions, the hand wheel may be pulled out at any time to the neutral position, Fig. 11, for throwing the clutch 50 to stop the pumps. To stop the rotary, the latch pin 64, can be withdrawn to permit control lever 61, to return to the "off" position for effecting disengagement of the drilling engine clutch 38.

Reversing rotary.—Reversal of the rotary is effected from the heavy duty pumping and hoisting engine 21, through forward drive connection 25, to the jack shaft and back through the drawworks reversing drive 28, reverse gear set 27, and rotary drive connection 22. In such case, the forward drive clutch 50, is engaged and the clutches 54, 46 and 42 are closed while clutch 38, at the drilling engine is open. For such operations, the control mechanism may be in the position shown in Figs. 3 and 7, holding the forward drive clutch 50, at the hoisting engine on, the clutch 38, at the drilling engine open and valves 45, 49, Fig. 1, turned to effect closing of the rotary drive clutch 42, and reversely running clutch 46.

Fig. 2 shows by full line arrows how the forward drive connections 25, from the hoisting and pumping engine to the drawworks always run in the same direction. The broken line arrows at 22 and 28, indicate how the drilling engine 20, can be used to turn the rotary forwardly and drive the drawworks jack shaft reversely and the dotted line arrows at 28 and 22 show how with the drilling engine clutch disconnected, the hoisting and pumping engine may drive through connections 25, 28, 37 and 22 to reverse the rotary.

Forward and reverse drive of the drawworks and rotary are thus accomplished simply and directly without the use of reversing clutches or the like and without reversing the engines. The smaller engine is of sufficient power to operate the rotary and to reverse the drawworks and is therefore economical for these purposes and can be of a flexible type for turning the rotary and reversing the drawworks at different speeds.

The hoisting and pumping engine on the other hand, can be of the heavy duty type, economical for its purposes of hoisting and operating the pumps. When desired, the power from this engine can be taken through the forward drive and reversing connections 25, 28, to back the rotary. Compressors, generators, auxiliary smaller pumps and other auxiliaries, such as indicated at 31, 32, 33, Fig. 1, are readily operated off the heavy duty engine shafting.

While it is preferred that the larger engine be of sufficient power to carry the full hoisting and pumping loads, the construction disclosed

permits a ready compounding of the power of the two engines, or forward drive of the draw-works in an emergency, from the smaller engine by substitution for drive chains **22** and **28**, of a single drive chain, such as indicated in Fig. 2*a*, from sprocket **76**, on motor shafting **23**, **25**, to sprocket **77**, on the jack shaft. Also in an emergency, the rotary may readily be driven from the hoisting and pumping engine as by substituting for the two drive chains **22**, **28**, Fig. 2, a single drive chain at **78**, Fig. 2*b*, running from sprocket **77**, on the jack shaft to sprocket **79**, on the rotary pinion shaft **24**.

While usually practical to employ sprocket chains for the various drive connections, other forms of drive connections may be employed. The clutches may be of the frictional or of the positive jaw type or combinations of both, such as indicated. Electrical, hydraulic, mechanical or other forms of control mechanism may be employed in place of the pneumatic control system illustrated. Terms employed herein have therefore been used in a descriptive rather than in a limiting sense, except possibly as limitations may be imposed by state of the prior art.

Fig. 12 illustrates possible modifications of the invention involving provision of a multiple speed gear box at **80**, in place of the reverse gear set at **37**, Fig. 1, and a drive at **81**, from the shafting **82**, of the main or heavy duty engine **21**, enabling the latter to accomplish all driving functions. This single engine form of drive has many advantages and has now become practical with the proved reliability of present day heavy duty Diesel engines.

The gear box **80** may include two, three or more speed changes and is here shown in simplified form involving parallel shafts **83**, **84**, carrying different speed gear sets **85**, **86**, controlled by clutches **87**, **88**, and back-drive connecting gears **89**. The jack shaft **84** turns the reverse of shaft **83**, and hence is used for the reverse drive **28**, to the draw-works jack shaft **27**, and the forwardly rotating shaft **83**, carries the forward drive **22** to the rotary.

In this particular disclosure, a light duty drilling engine **20** is shown coupled to the forward drive shaft **83**, of the change speed gear set, but it will be appreciated that if a single engine drive is desired, this drilling engine may be omitted and the operation of the rotary be effected from the main engine **21**, through sprocket **89***a*, on the main engine shafting **82**, drive chain **81**, and sprocket **90**, on shaft **83**, of the gear box, which latter will then serve for the different drive speeds of the rotary. The reversely turning shaft **84** of the gear box may then be used when required, to reverse the draw-works and by use of the gears of different speed ratios, the draw-works may be reversed at different speeds. As these are relatively light operations, the change speed gear box will serve for all forward drive of the rotary and reverse drive of the draw-works. Clutches are indicated at **91**, **92**, for control of the drive from the main engine shafting **82**, to the gear box. In the case of a multiple engine hook-up, including both a drilling engine **20** and hoisting engine **21**, the drive connections at **81**, may be used for power compounding purposes or as an emergency drive in case of break-down of either engine.

In place of a single heavy duty engine, so-called "twin" engines may be employed at opposite ends of the same shafting **82**, as indicated at **21***a*, in Fig. 12, either one or both of which may be used, as occasion requires. With a drilling engine in the combination, this would involve three separate engines which could be used conjointly or separately, as desired. The change speed gear box may be interposed directly between the rotary and draw-works as indicated in Fig. 12, where straight line drives may be run from the forwardly turning shaft to the rotary and from the reversely rotating shaft to the draw-works.

What is claimed is:

1. In rotary drilling, the combination of rotary and drawworks, a relatively low power non-reversible flexible engine for operating the rotary and reversing the drawworks, a greater power heavy duty non-reversible hoisting engine for forward drive of the drawworks and reverse rotation of the rotary, one way running rotary drive connections from the drilling engine to the rotary, one way running forward drive connections from the hoisting engine to the drawworks, reversely running one way drive connections from the drilling engine to the drawworks and means for selectively controlling said drive connections for driving the rotary forwardly and the drawworks reversely from the drilling engine and for driving the drawworks forwardly and the rotary reversely from the hoisting engine.

2. In rotary drilling, the combination with rotary and drawworks, of a relatively low power flexible drilling engine and a relatively high heavy duty hoisting engine, clutch controlled forward drive connections from said hoisting engine to the jack shaft of the drawworks, clutch controlled drive connections from the drilling engine to the rotary, a shaft driven reversely from the drilling engine and clutch controlled reverse drive connections from said reversely running shaft to the jack shaft of the drawworks.

3. In rotary drilling, the combination with rotary and drawworks, of a relatively low power flexible drilling engine and a relatively high heavy duty hoisting engine, clutch controlled forward drive connections from said hoisting engine to the jack shaft of the drawworks, clutch controlled drive connections from the drilling engine to the rotary, a shaft driven reversely from the drilling engine, clutch controlled reverse drive connections from said reversely running shaft to the jack shaft of the drawworks and control mechanism including interlocking means for preventing reverse drive of the drawworks from the drilling engine when the forward drive from the hoisting engine is in service.

4. In rotary drilling, the combination with rotary and drawworks, of separate engines for hoisting and drilling, forward drive connections from said hoisting engine to the drawworks, forward drive connections from the drilling engine to the rotary, reversely running drive connections from the drilling engine to the drawworks, means for effecting the coupling and uncoupling of said drive connections, including interlocking means for preventing reverse drive of the drawworks from the drilling engine when the forward drive from the hoisting engine is in service.

5. In rotary drilling, the combination with rotary and drawworks, of separate engines for drilling and hoisting, forward drive connections from the drilling engine to the rotary and the reverse driving connection from the drilling engine to the drawworks, forward drive connections from the hoisting engine to the drawworks, means for enabling the use of said reverse driving connections and said rotary drive connections for ef-

fecting reverse drive of the rotary from said forward drive connections from the hoisting engine and control mechanism including interlocking means for preventing reverse drive of the drawworks when the forward drive is in service and for preventing forward drive of the rotary when said reverse driving connection and rotary forward drive connections are in service with the drawworks forward drive for reversing the rotary.

6. In combination with a rotary and drawworks, a light duty, flexible non-reversible drilling engine, one way running forward drive connections from said drilling engine to said rotary, a heavy duty non-reversible hoisting and pumping engine, one way running forward drive connections from said heavy duty hoisting engine to said drawworks, one way running reverse driving connections from said light duty drilling engine to said drawworks and means for effecting reverse drive of the rotary from said heavy duty hoisting engine through said forward drive drawworks connections and reverse drive connections and independently of said light duty engine and for effecting reverse drive of the drawworks from said light duty engine through said reverse driving connections independently of said heavy duty hoisting engine.

7. In combination with a rotary and drawworks, a change speed gear set having geared together forwardly and reversely rotating shafts, forward drive connections from the forwardly turning shaft of said change speed gear set to said rotary, reverse drive connections from said reversely turning shaft to said drawworks, power means for driving one of said shafts of said change speed gear set, said change speed gear set including means for effecting different changes in speed of the said drive connections and clutch means for enabling selection of drive from said change speed gear set to either the rotary or the drawworks.

8. In combination with a rotary and drawworks, a change speed gear set interposed between said rotary and drawworks and including forwardly and reversely rotating shafts, drive connections from said forwardly rotating shaft to said rotary, reverse drive connections from said reversely rotating shaft to said drawworks, power means for driving one of said shafts and including an engine, forward drive connections from said engine to said drawworks and forward drive connections from said engine to said forwardly rotating shaft of said change speed gear set.

9. In combination with a rotary and drawworks, engines in back-to-back relation, clutches controlling use of either or both, forward drive connections from said engines to said drawworks, geared together shafts turning in opposite directions, drive connections from said engines to one of said shafts and drive connections from said shafts to said rotary and drawworks respectively.

10. In combination with a rotary and drawworks, a change speed gear set interposed between said rotary and drawworks and including reversely rotating shafts geared together and one connected to drive the rotary in a forward direction and the other connected to drive the drawworks in reverse direction, an engine, forward drive connections from said engine to said drawworks and connections from said engine to one of the shafts of said change speed gear set for effecting drive of the rotary in reverse direction.

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