July 11, 1939. W. D. DAVIDSON ET AL 2,165,350

CONTROL FOR FOUR-SPEED PORTABLE DRILLING MACHINES

Filed July 6, 1936 3 Sheets-Sheet 1

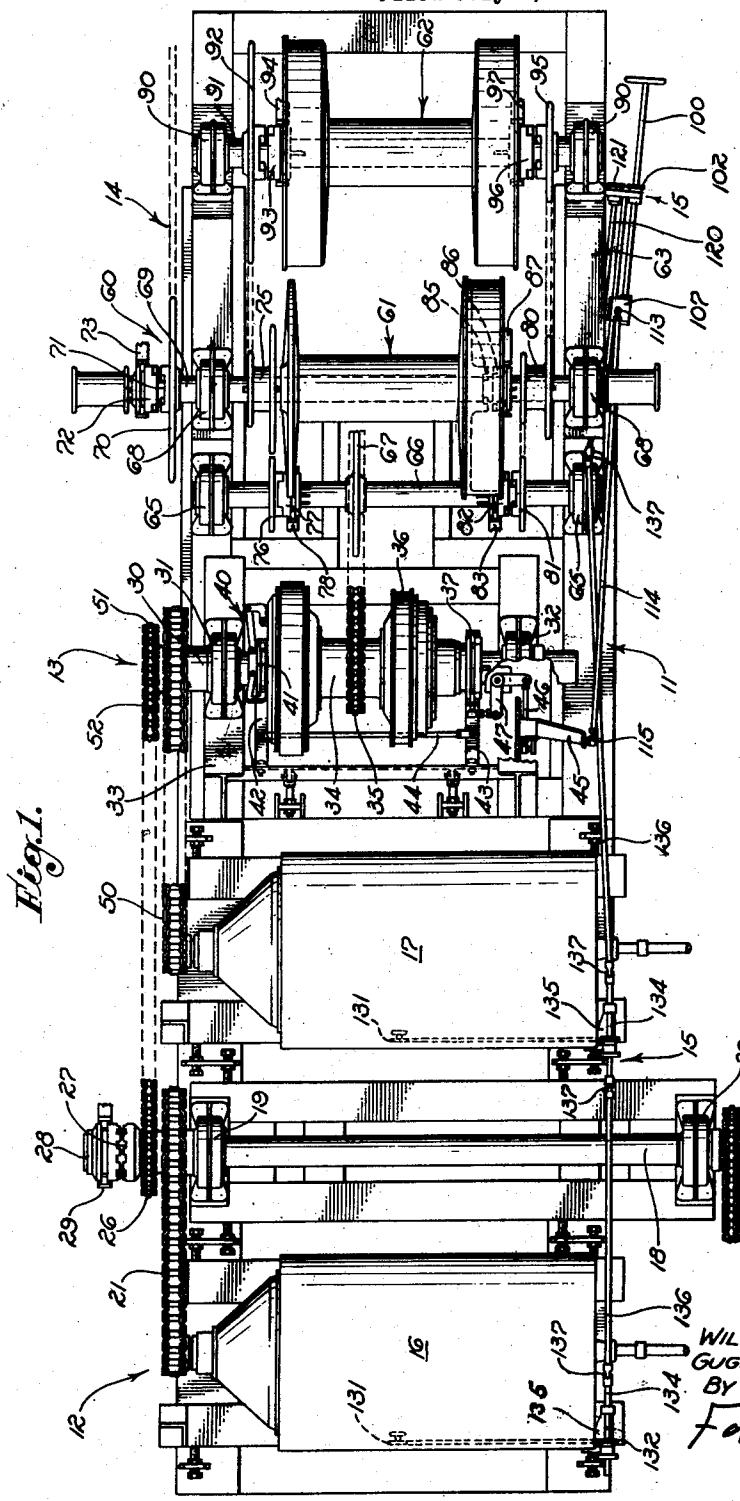


Fig. 1.

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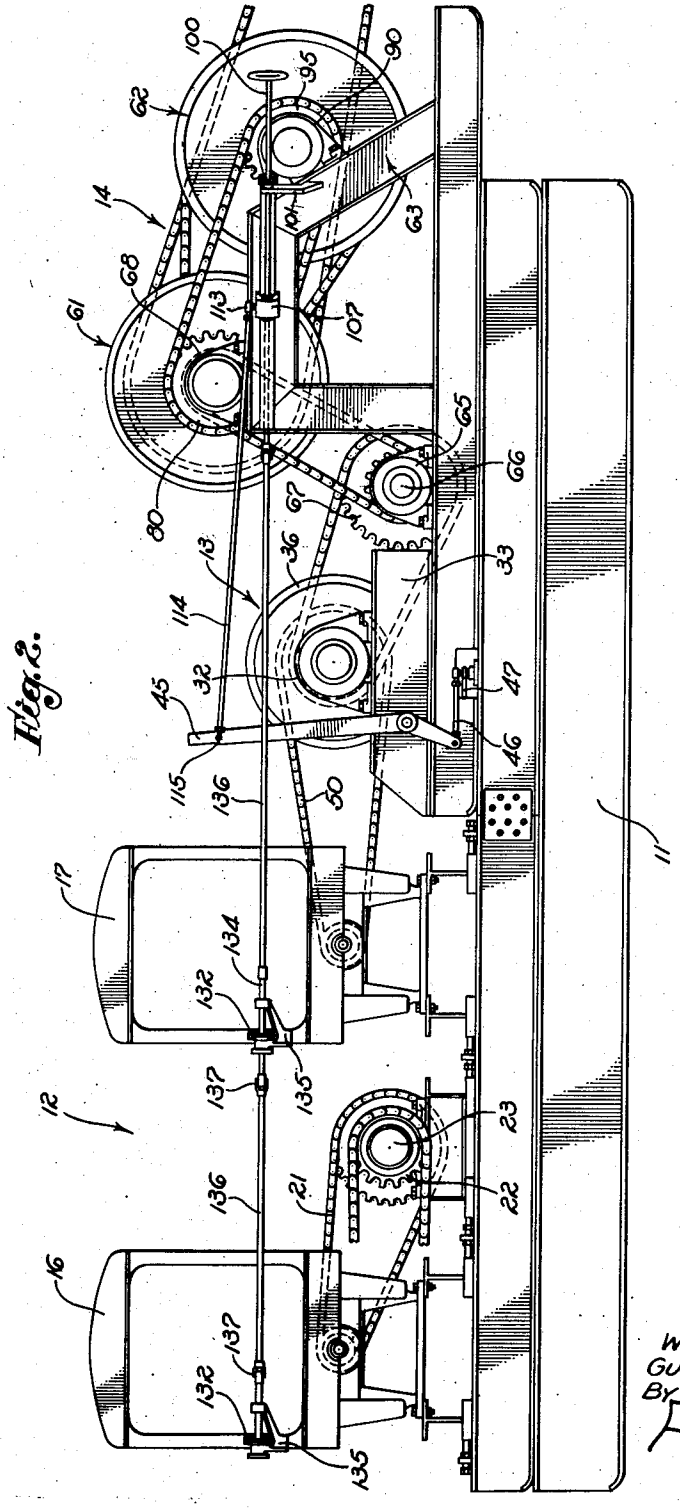


Fig. 2.

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Fig. 3.

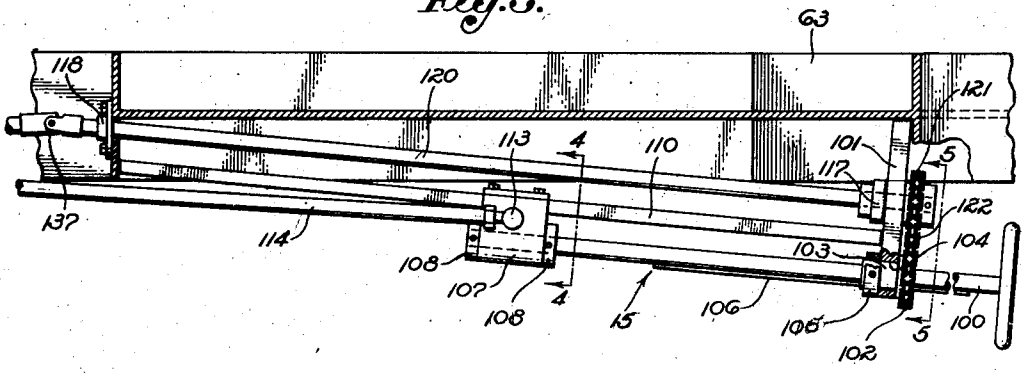


Fig. 4.

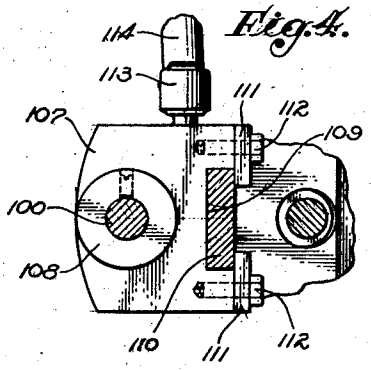


Fig. 5.

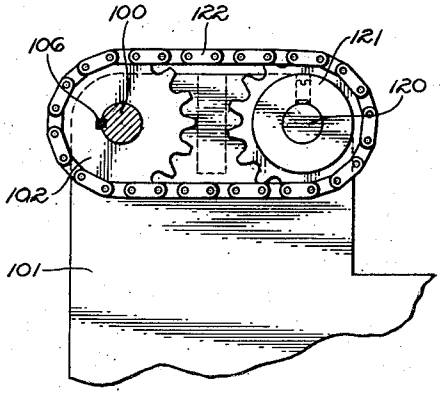
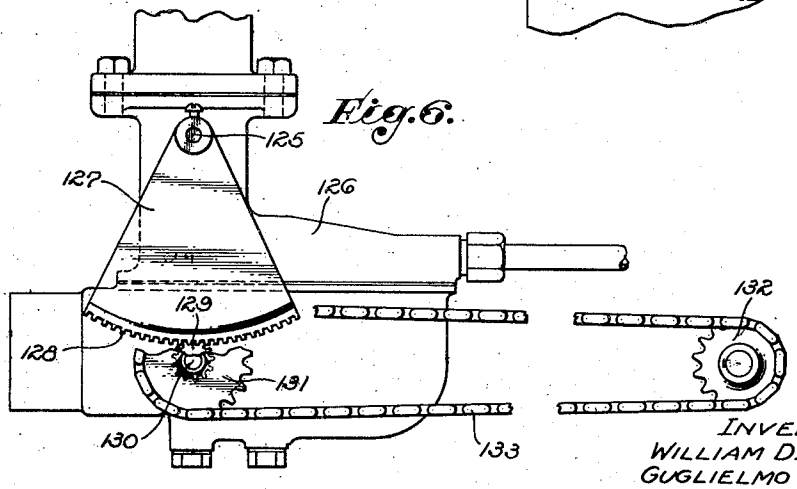


Fig. 6.



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Patented July 11, 1939 2,165,350

UNITED STATES PATENT OFFICE

2,165,350

CONTROL FOR FOUR-SPEED PORTABLE DRILLING MACHINES

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Application July 6, 1936, Serial No. 89,096

7 Claims. (Cl. 74—472)

Our invention relates to machines employed in the oil well drilling art, and particularly to machines adapted to transmit rotary power from a power source to various apparatus used while drilling wells, such as a rotary machine for rotating the drill pipe in the well and hoisting apparatus for handling drill pipe, casings, pipe tongs, bailers, and the like; and also for transmitting power for various uses after the well has been drilled.

Our invention comprises a new combination which provides in a portable unitary structure apparatus which is capable of doing in a better and more convenient way work of various independent machines which are at present used in drilling wells.

In order that the importance of our invention to the well drilling industry may be better understood, we will, as briefly as possible, describe the equipment that it is necessary to utilize at present in drilling an oil well. A rotary machine placed on a derrick floor is used to rotate a drill pipe which extends into the well and is connected to a bit for rotating the same. The rotary machine is connected by a chain-and-sprocket connection to a draw works, which in turn is connected by a chain-and-sprocket to an internal combustion engine. The draw works is provided with various shafts which are connected together by a chain-and-sprocket connection to provide various speed combinations for rotating the drill pipe at various speeds. The draw works is also provided with a rotary drum upon which a heavy cable is wound. This cable is extended upwardly around a crown block at the top of the derrick and the free end thereof is connected to a travelling block which in turn is connected to the upper end of the drill pipe by a swivel to support the weight of the drill pipe and the bit in the well.

It is frequently necessary during the drilling of an oil well, due to the well "sanding up" at the bottom, to remove the drill pipe from the well and to bail out the sand and rotary mud at the bottom of the well. This is done by lowering a bailer by a cable to the bottom of the well where the bailer is allowed to fill with sand and rotary mud which is raised to the surface of the ground and dumped. This is done repeatedly until sufficient sand has been removed so that drilling may be continued.

If the equipment of the well being drilled does not include some manner of hoisting apparatus in addition to the rotary drum included in the draw works, the cable must be disconnected from the travelling block and crown block and stripped from the rotary drum so that the cable from the bailer may be wound thereon and the rotary drum used as a bailer hoist. It is not possible to use the drilling cable for a bailer cable because the bailer cable must reach to the bottom of the well and the heavier drilling cable is not long enough. The spool of the rotary drum is grooved to guide the large diameter drilling cable and when it is necessary to use the rotary drum as a bailer hoist, it is necessary to cover the grooved spool with a smooth core provided for the purpose so that the smaller diameter cable used in bailing will wind properly. The great disadvantage of using the rotary drum in the above mentioned manner has led to the almost universal use of special apparatus for hoisting the bailer, such as sand reels or auxiliary hoists, which, in some instances, in addition to special motive power requires special gear reduction.

After a well has been drilled and brought in and the heavy drilling machinery, including the special hoisting equipment referred to above, has been entirely dismantled and removed from the well to make room for pumping machinery, it is sometimes found necessary to "re-drill" the well. This may become necessary either because the well has been entirely depleted and it is desired to drill the well deeper to contact a new stratum or the well may have become sanded up so that it can no longer be pumped. The cost of transporting and reinstalling the heavy drilling machinery and the auxiliary apparatus necessary for bailing, and the dismantling of the pumping machinery to make room therefor is frequently found to be prohibitive, and the well may therefore be lost.

It is an object of the invention to overcome this problem by providing a portable unitary machine which may be easily and cheaply transported and installed in a derrick and which is capable of re-drilling and bailing the well without dismantling the pumping machinery, and without the addition of any auxiliary apparatus, such as hoists, mechanism for operating pipe tongs, motive power, etc.

It is another object of the invention to provide a portable apparatus including a rotary drum suitable for use in drilling, power transfer means suitable for driving a rotary machine for rotating a drill pipe in a well, a hoisting means such as a sand reel, a reverse gear mechanism for driving the apparatus in reverse direction, a drive mechanism including power means for

driving the apparatus through the reverse gear and for operating a slush pump, all incorporated in a unitary structure so that the structure may be quickly and easily moved from one well to another with the drilling cable and hoisting cable wound on their respective drums and reels ready for use at all times without change.

It is another object of the invention to provide in an apparatus of the character described an engine driven reverse gear mechanism connected for operating a work mechanism in forward and reverse directions, and operating means therefor including a single operating member for reversing the reverse gear mechanism and for controlling the speed of the engine.

It is another object of the invention to provide in an apparatus of the character described in the above paragraph a drive mechanism utilizing two engines, one of which is normally connected for driving a slush pump and the other of which is connected for driving the reverse gear mechanism; means associated with the first mentioned engine whereby the reverse gear mechanism may be driven by both of the engines; and operating means including a single operating member for controlling the speed of both of the engines and for actuating the control means of the reverse gear mechanism.

It is another object of the invention to provide in combination with the drive mechanism and the reverse gear mechanism mentioned above, a work mechanism including a hoisting device, such as a sand reel which is provided with driving means capable of two speeds; a low speed for starting the bail from the bottom of the well, and a high speed for use in raising the bail from the well after the load is reduced.

Another important and novel feature of the invention resides in the provision of a floating sand reel, which is free spooling, to allow the bail to be run into the well without the necessity of reversing the direction of rotation of the reverse gear mechanism.

It is another object of the invention to provide in an apparatus of the character described a work mechanism including a rotary drum which is provided with drive means capable of two different speeds, a rotary machine drive sprocket capable of two different speeds and a sand reel having drive means capable of two different speeds, all of these members being driven by a reverse gear mechanism capable of reversing the direction of rotation of each of the members in either of their two speeds; the sand reel being also freely rotatable when desired for running the bailing device into the well.

It is another object of the invention to provide in combination an apparatus comprising: a drive mechanism including one or more engines; a reverse gear mechanism driven by one or both of the engines and including a reciprocating control lever for reversing the mechanism; work mechanism driven by the reverse gear mechanism; and operating means including an operating member journalled for rotational and longitudinal movement, the operating member being operatively connected with the control lever to reciprocate the lever when moved longitudinally and operatively connected with the throttles of the engines to actuate the throttles when rotated.

These and other objects of the invention will be made clear in the following part of the specification and the appended claims in connection with the accompanying drawings.

In the drawings,

Fig. 1 is a top plan view of our complete portable unitary drilling machine.

Fig. 2 is a side elevation of the machine shown in Fig. 1.

Fig. 3 is an enlarged fragmentary view of the operating means showing the details of construction and operation of the operating member for controlling the reverse gear mechanism of the apparatus and the throttles of the engine.

Fig. 4 is a section taken as indicated by the line 4—4 of Fig. 3.

Fig. 5 is a section taken as indicated by the line 5—5 of Fig. 3.

Fig. 6 is a fragmentary view illustrating the carburetor of one of the engines of the apparatus and a portion of the operating means associated with the operating member for actuating the throttle of the carburetor.

Our drilling apparatus comprises generally a supporting structure 11 upon which are mounted a driving mechanism 12, a reverse gear mechanism 13, a work mechanism 14, and an operating means 15.

The drive mechanism 12 is preferably a multiple-engine unit and comprises a first engine 16, a second engine 17, and a countershaft 18. The engines 16 and 17 may be internal combustion engines and are preferably positioned in parallel relationship with the axes thereof transverse to the length of the supporting structure 11. The countershaft 18 is journalled by suitable bearings 19 and 20 mounted on the supporting structure 11, the countershaft being preferably positioned between the engines 16 and 17, as shown, and parallel with the axes thereof. The first engine 16 is connected for driving the countershaft 18 by power transfer means in the form of a chain-and-sprocket connection 21, the respective sprockets being fixed to the engine shaft and the countershaft for constantly driving the countershaft when the engine 16 is operating in gear. Mounted on the countershaft 18 adjacent the bearing 20 is a primary floating sprocket 22 having associated therewith a clutch member 23 which is splined to the countershaft and rotates therewith, there being a clutch throw-out yoke 24 for moving the clutch member 23 into and out of engagement with a clutch face 25 on the sprocket 22. As shown in Fig. 1 the sprocket 22 may be a double sprocket so that the two chains may be associated therewith for driving two slush pumps if desired. Mounted on the opposite end of the countershaft 18 adjacent the chain-and-sprocket connection 21 is a secondary floating sprocket 26 having a clutch face 27 thereon which is engageable by a clutch member 28 splined to the shaft, there being a clutch throw-out yoke 29 operable to move the clutch member 28 into and out of engagement with the clutch face 27.

The reverse gear mechanism 13 comprises generally a drive shaft 30 journalled in suitable bearings 31 and 32 carried by a base structure 33 which in turn is mounted on the supporting structure 11, and a driven part 34 having power transfer means thereon in the form of a sprocket 35. At one end of the driven part 34 is a brake drum 36 and a forward drive clutch mechanism 37 adapted to accomplish a direct drive connection between the drive shaft 30 and the driven part 34 so that when the clutch mechanism 37 is engaged the driven part 34 will rotate with the drive shaft 30. At the opposite end of the driven part 34 is a reverse gear device 40 having a reverse clutch mechanism 41 which may be engaged so as to cause the reverse gear device 40 to drive the driven part 34 in a

direction opposite to the rotation of the drive shaft 30. As the general construction of the reverse gear mechanisms and their forward and reverse clutches are well known in the art, these parts are only generally indicated and are not shown in detail. In connection with our present apparatus we prefer, however, to utilize a reverse gear mechanism of the type fully disclosed in the United States patent to Tremolada, No. 1,862,871, which includes a neutral brake and operating mechanism therefor arranged to brake the driven part 34 to a complete stop when both the forward drive clutch mechanism 37 and the reverse clutch mechanism 41 are disengaged; or, in other words, when the reverse gear mechanism is in neutral. The operating mechanism of the reverse gear 13 includes a clutch throw-out yoke 42 associated with the reverse clutch mechanism 41 and a clutch throw-out yoke 43 associated with the forward clutch mechanism 37, these yokes being connected by a link 44 for transmitting the movement of one yoke to the other. The yoke 43 is operated by an oscillating or swinging control lever 45 which is connected thereto by a link 46 and a bell crank 47 in such a manner that when the control lever is swung the clutch mechanisms 37 and 41 will be simultaneously operated to engage and disengage the clutch mechanisms and to operate the neutral brake included in the mechanism.

The driven shaft 30 of the reverse gear mechanism 13 is driven by the second engine 17 through a power transfer means in the form of a chain-and-sprocket connection 50, the respective sprockets thereof being fixed to the engine shaft and the shaft 30 for constantly driving the shaft 30 when the second engine is in operation in gear. Fixed on the outer end of the drive shaft 30 is a sprocket 51, which is connected to the secondary float sprocket 26 by a chain 52.

It will be seen from the description thus far that the first motor 16 is connected for constanty driving the countershaft 18 and is normally used to drive one or more slush pumps through the primary floating sprocket 22, and the second motor is connected for constantly driving the drive shaft 30 of the reverse gear mechanism. If, however, more power is desired to drive the reverse gear mechanism, the clutch member 28 may be engaged with the clutch face 27 to drive the secondary sprocket 26 which places both the first and second engines in driving relationship with the drive shaft 30 of the reverse gear mechanism 13. The clutch 23 associated with the primary floating sprocket 22 may at this time be either engaged or disengaged as desired.

The work mechanism 14 comprises generally a rotary machine drive 60, a sand reel 61, and a drill cable drum 62. The preferred manner of associating the rotary drive, sand reel, and the drum with relation to the previously described parts of the apparatus is as follows. Mounted on the supporting structure 11 adjacent the reverse gear mechanism 13 is a sand reel and drum supporting member comprising a base member which, as shown best in Fig. 2, may be a part of the base member 33 of the reverse gear mechanism, and upon which a pair of relatively spaced uprights 63 is mounted. Each of the uprights 63 comprises a vertical leg and a sloping leg connected at their upper ends by a horizontal beam substantially as shown in Fig. 2. Journalled by suitable bearings 65 positioned adjacent the reverse gear mechanism is a jack shaft 66 having a sprocket 67 fixed thereon in alignment with the sprocket 35 of the driven part 34 included in the reverse gear mechanism, the sprocket 67 being driven thereby. Journalled by bearings 68 mounted on the horizontal beams of the uprights 63 is a sand reel shaft 69 upon which the sand reel 61 is freely rotatable, there being suitable bearing means, not shown, for preventing relative longitudinal movement of the sand reel on the shaft 69. Mounted on one outer end of the sand reel shaft, on the same side of the apparatus as the power transfer means 21 and 50, is a floating rotary drive sprocket 70 having formed thereon a clutch face 71 engageable by a clutch part 72 splined on the shaft, there being clutch throw-out means 73 for engaging and disengaging the clutch parts 71 and 72. Keyed to the sand reel shaft 69 on one side of the sand reel 61 is a double sprocket 75. Mounted to float on the jack shaft 66 in alignment with one-half of the sprocket 75 is a floating sprocket 76 having a clutch face thereon engageable by a clutch part 77 splined on the jack shaft and movable into and out of engagement with the sprocket 76 by throw-out means 78. The sprockets 75 and 76 constitute a low-speed driven means for the sand reel shaft 69 and for the rotary machine driven means 60 comprising the sprocket 70. Mounted on the sand reel shaft 69 on the opposite side of the sand reel 61 is a fixed double sprocket 80. Journalled to float on the jack shaft 66 in alignment with one-half of the sprocket 80 is a sprocket 81 having a clutch face engageable by a clutch part 82 splined on the shaft 66 and moved into and out of engagement with the sprocket 81 by throw-out means 83. Formed on the sand reel, on the end thereof adjacent the sprocket 80, is a clutch part 85 which is engaged by a clutch member 86 splined to the shaft 69 and movable into and out of engagement with the clutch part 85 by throw-out means 87. The sprockets 80 and 81 constitute a high-speed drive means for the shaft 69 and for the rotary drive sprocket 70 through this shaft. The sprockets 75 and 76 and the sprockets 80 and 81 likewise respectively constitute low and high speed drive means for the sand reel shaft 61, it being obvious that by manipulation of the movable clutch part 86 the sand reel may be caused to rotate with the shaft 69 when the clutch part 77 or 82 of either the low or high speed drive means for the shaft 69 is engaged. Journalled by suitable bearings 90, mounted as shown on the sloping leg of the uprights 63, is a drum shaft 91 upon which the drum 62 is fixed. Journalled so as to float on the drum shaft 91 in alignment with one-half of the sprocket 75 is a sprocket 92 having a clutch face thereon engageable by a splined clutch part 93 which is movable into and out of engagement with the sprocket 92 by throw-out means 94. The sprockets 75 and 92 constitute the low-speed drive for the drum 62. Journalled so as to float on the drum shaft 91 in alignment with one-half of the sprocket 80 is a sprocket 95 having a clutch face engageable by a clutch part 96 splined on the shaft and movable into and out of engagement with the sprocket 95 by a throw-out means 97. The sprockets 80 and 95 constitute the high-speed drive means for the drum 62.

It will be clear from the drawings that the rotary machine drive sprocket 70 is capable of being driven at one of two speeds; likewise, that the sand reel 61 and the drum 62 are capable of being driven selectively or simultaneously at one of two speeds, and that at either of these speeds the direction of rotation of the rotary drive, the

sand reel, or the drum may be reversed by manipulating the control means of the reverse gear mechanism. It will likewise be clear that either the rotary machine drive, the sand reel, or the drum may be driven through the reverse gear by one or both of the engines 16 and 17 at will.

The invention includes a novel operating means by which the control means of the reverse gear mechansm and the throttles of both of the engines are controlled by a single operating member. The operating means 15 of the invention comprises an operating member 100 journalled for longitudinal and rotational movement, the operating member being operatively connected to the control means of the reverse gear mechanism and to the throttles of the engines 16 and 17 so that a longitudinal movement of the operating member actuates the control means of the reverse gear mechanism and a rotational movement of the operating member actuates the throttles of the engines. The preferred form of operating means comprises a supporting member 101 which is preferably secured to part of the supporting structure 11; for instance, upon one of the uprights 63. Journalled in the support member 101 is a sprocket 102 having a hub portion 103 extending through an opening 104 in the support member, there being a collar 105 removably fixed in a position surrounding the hub 103, as shown, to retain the sprocket 102 in journalled relationship on the support member. The sprocket 102 has a central opening through which the operating member 100 extends, the operating member being keyed to the sprocket 102 by a key 106 so that the sprocket 102 is driven by a rotation of the operating member while permitting the member to move longitudinally relative thereto. Journalled on the inner end of the operating member 100 is a guide block 107 retained thereon by collars 108, the guide block having a recess 109 adapted to slidably engage a guide rib 110 mounted in parallel relationship with the operating member 100, as shown. Retaining lugs 111 secured to the block 107 by suitable means, such as bolts 112, so as to extend over the upper and lower edges of the guide rib 110, as shown in Fig. 4, are provided to retain the block 107 thereon. Secured to the block 107 by a ball-and-socket joint 113 is a link 114 which in turn is connected by a ball-and-socket joint 115 to the upper end of the control lever 45 of the reverse gear mechanism 13. Journalled in parallel relationship with the control member 100, as by a bearing 117 formed in the support member 101 and a bearing 118 supported by the upright 63 substantially as shown, is an engine throttle control shaft 120. Fixed on the outer end of the control shaft 120 is a sprocket 121 which is connected with the sprocket 102 by a chain 122.

Mounted on the throttle shaft 125 of the carburetor 126 of each of the engines 16 and 17, as shown in Fig. 6, is a segment 127 having teeth 128 formed on the periphery thereof which engage a pinion 129 journalled on a pin 130, suitably supported as by connection with the body of the carburetor 126. Mounted on the pin 130 is a sprocket 131 which is fixed to the pinion 129 for rotation therewith on the pin. Keyed on the shaft 120 adjacent each of the engines 16 and 17 is a sprocket 132 each of which is drivably connected to the sprockets 131 by power transfer means in the form of a chain 133.

In some instances the throttle control shaft 120 may comprise a plurality of sections 134, suitably supported as by brackets 135 mounted on the frames of the engines 16 and 17, these sections being connected together by links 136 and universal joints 137 to form a flexible shaft extending from the sprocket 121 to the sprocket 132 of the first engine 16. It will be clear that when the operating member 100 is rotated, regardless of its longitudinal position relative to the sprocket 102, the sprocket 102 will rotate the shaft 120 through the sprocket 121, thus actuating the shaft 125 in an obvious manner through the sprockets 131 and 132, the pinion 129, and the segment 127 to control the speed of the engines.

Although we have illustrated and described only one complete form of our portable drilling apparatus, and of the novel operating means for controlling both the reversing of the work mechanism and the speed of the drive engines, it should be understood that various modifications of the operating means and various arrangements of the drive mechanism and reverse gear mechanism with respect to the work mechanism may be made without departing from the scope of the invention which should be interpreted by the appended claims and not by the details of construction shown in the illustrative drawings and described in detail in the specification.

We claim as our invention:

1. In an apparatus of the character described, the combination of: a reverse gear mechanism including a swinging control lever; an engine operably connected to drive said reverse gear mechanism; an operating member journalled for rotational and longitudinal movement; a link swiveled to said operating member and to said control lever and operable to swing said lever when said operating member is moved longitudinally; a shaft having means associated therewith for actuating the throttle of said engine when said shaft is rotated; and means rotatable with said operating member for rotating said shaft.

2. In an operating means for an engine driven reverse gear mechanism including a reverse gear control means and an engine control means, one of which is operable by rotational movement and the other of which is operable by longitudinal movement, the combination including: an operating member journalled on a support member for longitudinal and rotational movement; a link connecting said operating member and the control means which is operated by longitudinal movement in order to operate same when said operating member is moved longitudinally; a shaft journalled adjacent said operating member; means whereby a rotational movement of said operating member causes said shaft to rotate; and connecting means connected to said shaft and to the control means which is operable by rotational movement for operating same when said operating member is rotated.

3. In an operating means for an engine driven reverse gear mechanism including a reverse gear control means and an engine control means, one of which is operable by rotational movement and the other of which is operable by longitudinal movement, the combination including: an operating member journalled on a support member for longitudinal and rotational movement; a longitudinally movable slide means to which said operating member is connected; a connecting means connecting said slide means and the control means which is operated by longitudinal movement in order to operate same when said operating member is moved longitudinally; a shaft journalled adjacent said operating member; means whereby a rotational movement of

said operating member causes said shaft to rotate; and a second connecting means connected to said shaft and to the control means which is operable by rotational movement for operating same when said operating member is rotated.

4. In an operating means for operating a combination having two control means, one of which is operable by rotational movement and the other of which is operable by longitudinal movement, the combination including: an operating member journalled on a support member for longitudinal and rotational movement; a longitudinally movable slide means to which said operating member is connected; a connecting means connecting said slide means and the control means which is operated by longitudinal movement in order to operate same when said operating member is moved longitudinally; a shaft journalled adjacent said operating member; means whereby a rotational movement of said operating member causes said shaft to rotate; and a second connecting means connected to said shaft and to the control means which is operable by rotational movement for operating same when said operating member is rotated.

5. In an operating means for operating a combination having two control means, one of which is operable by rotational movement and the other of which is operable by longitudinal movement, the combination including: an operating member journalled on a support member for longitudinal and rotational movement; a longitudinally movable slide means to which said operating member is rotatably connected and which is longitudinally movable upon longitudinal movement of said operating member; a connecting means connecting said slide means and the control means which is operated by longitudinal movement in order to operate same when said operating member is moved longitudinally; a shaft journalled adjacent said operating member; means whereby a rotational movement of said operating member causes said shaft to rotate; and a second connecting means connected to said shaft and to the control means which is operable by rotational movement for operating same when said operating member is rotated.

6. In an operating means, the combination of: a support means; an operating member journalled on said support means for rotational and longitudinal movement; a guide supported by said support means; a slide longitudinally movable on said guide and being rotatably connected to said operating member, said slide being longitudinally movable by said operating member and having a connection means for connecting same to a means to be longitudinally moved thereby; a rotatable shaft rotatably supported by said support means and having a connection means for connecting same to a means to be rotated thereby; and rotating means interconnected between said operating member and said shaft whereby upon rotation of said operating member said shaft is caused to rotate, said operating member, said guide, and said shaft all extending substantially parallel to each other.

7. In an operating means for an engine driven reverse gear mechanism including a reverse gear control means and an engine control means, the combination of: a shaft; a guide in parallel relation to said shaft; an operating member parallel to said shaft and said guide journalled for rotation and longitudinal movement; a sliding head slidable on said guide and being connected to said operating member so as to be moved thereby; means for transmitting rotation from said operating member to said shaft whereby rotation of said operating member will be accompanied by rotation of said shaft; means connecting said sliding head to said reverse gear control means so that movement of said head on said guide will operate said reverse gear control means; and means connecting said shaft to said engine control means so that rotation of said shaft will actuate said engine control means.

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