

Oct. 22, 1963

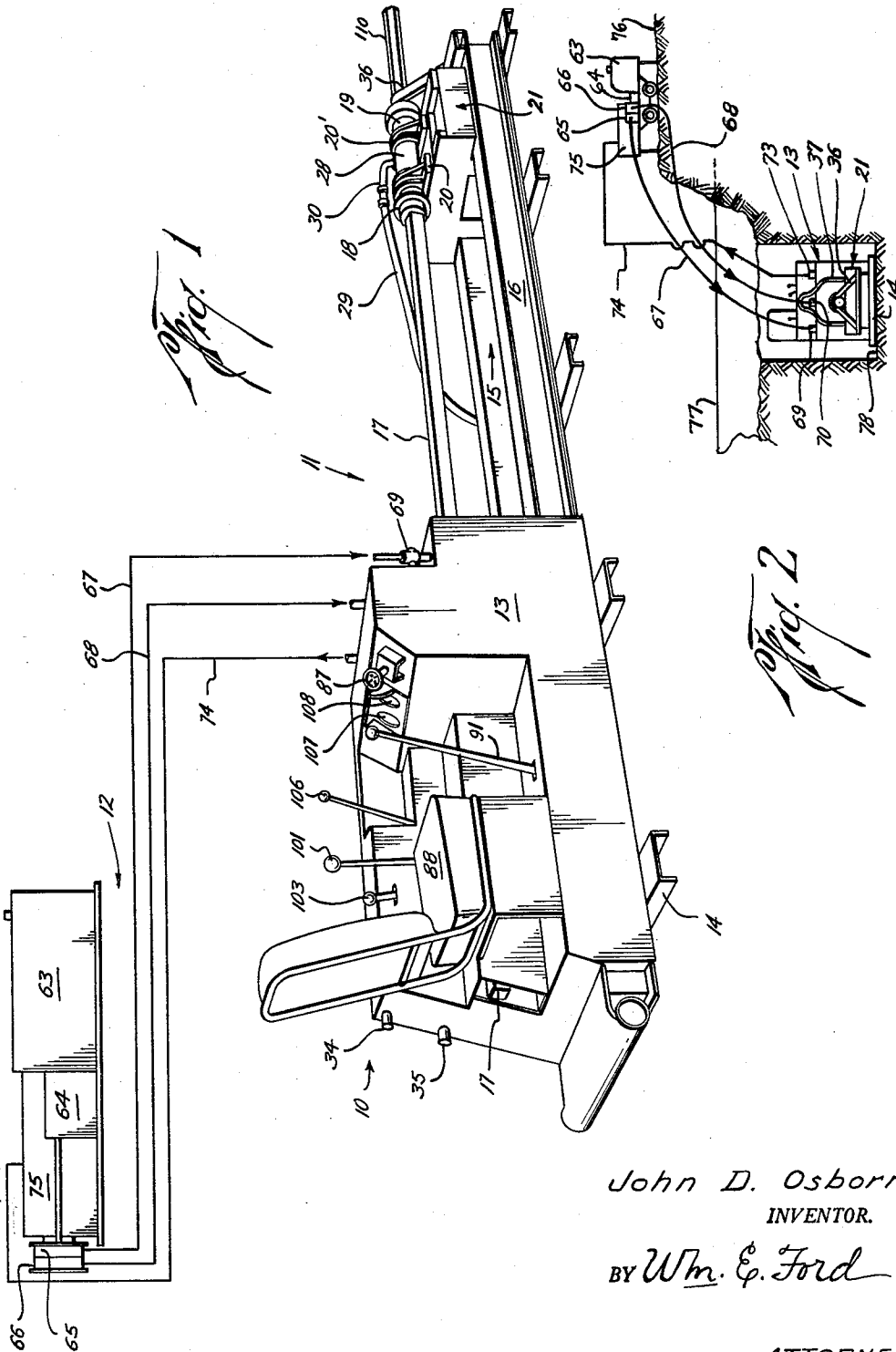
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HYDRAULICALLY OPERABLE HORIZONTAL DRILLING APPARATUS

Filed Jan. 20, 1959

3 Sheets-Sheet 1



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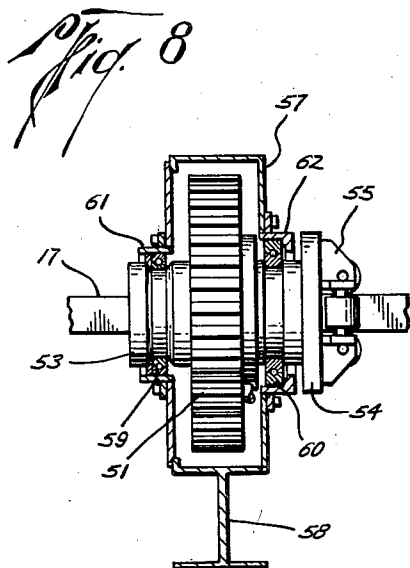
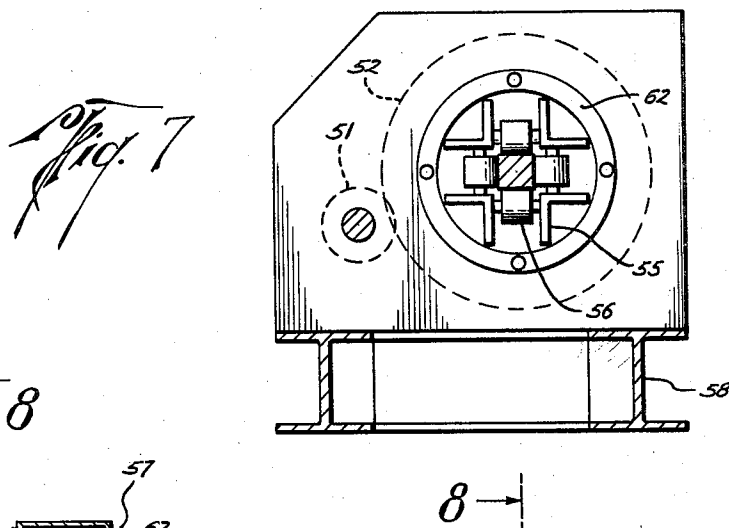
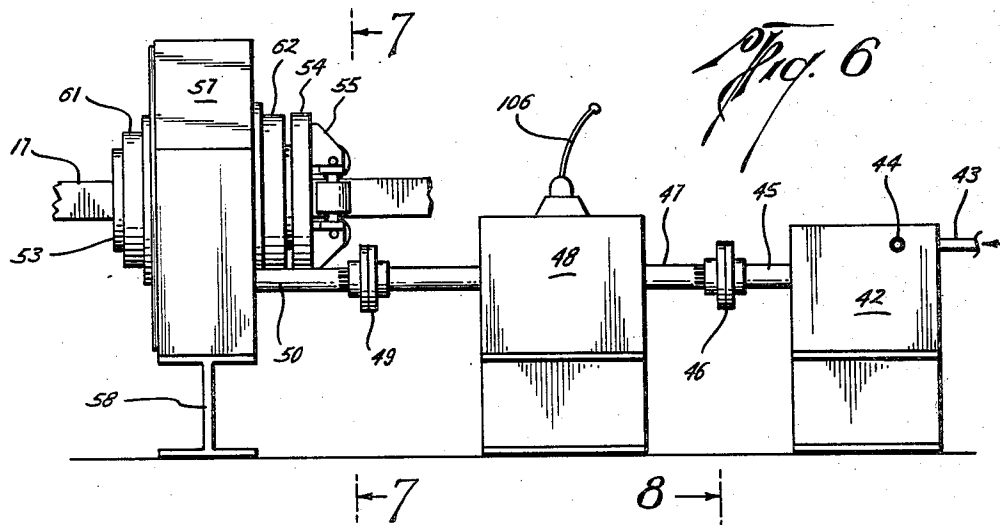
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1

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HYDRAULICALLY OPERABLE HORIZONTAL DRILLING APPARATUS

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Filed Jan. 29, 1959, Ser. No. 783,001

3 Claims. (Cl. 173-74)

This invention relates to a hydraulically operable horizontal drilling apparatus for drilling under roadbeds and the like which comprises a drilling machine adapted to be readily positioned for drilling, as in a ditch adjacent to a roadbed, the apparatus also including a hydraulic means adapted to circulate the fluid to operate the machine, such means being positionable at another and more easily approached location.

It is consequently a primary object of this invention to provide hydraulically operable, horizontal drilling apparatus with drilling mechanism readily positionable in drilling position, and with the hydraulic means which circulates fluid to operate the mechanism being positionable in a more easily accessible location, as above a ditch beside a road under which a horizontal hole is to be drilled.

It is also an important object of this invention to provide hydraulically operable horizontal drilling apparatus of this class with the drilling machine housing providing a control seat for the operator from which may be controlled the type of fluid delivered to the swivel, the direction of fluid delivered to the motor, the rate of kelly rotation, the force of fluid delivered to the ram, and the direction of ram movement.

It is another object of this invention to provide hydraulically operable, horizontal drilling apparatus of this class in which the force and direction of ram movement, the speed and direction of kelly rotation, and the delivery of selected drilling fluid to the swivel of the drilling spindle, is positively controlled.

Other and further objects will be apparent when the specification hereinbelow is considered in connection with the drawings in which:

FIG. 1 is a perspective view of a horizontal boring machine embodying the principles of this invention, and including a partial diagram of the hydraulic actuating system of the machine;

FIG. 2 is a transverse sectional view through the earth, showing a frontal view of the machine and a side view of the hydraulic actuating system shown in FIG. 1;

FIG. 3 is a full diagrammatic view of the hydraulic actuating system of the machine shown in FIGS. 1 and 2;

FIG. 4 is a side elevational view of the carriage of the machine, including the swivel and diagram of fluid delivery to swivel;

FIG. 5 is a transverse elevational view, part in section, taken along line 5-5 of FIG. 4;

FIG. 6 is a side elevational view of the transmission of the machine shown in FIGS. 1 and 2;

FIG. 7 is a transverse elevational view, part in section, taken along line 7-7 of FIG. 6; and

FIG. 8 is a side elevational view, taken along line 8-8 of FIG. 7.

Referring in detail to the drawings in which like reference numerals are applied to like elements in the various views, horizontal drilling apparatus 10 is shown in FIG. 1 which includes a horizontal drilling machine 11 and a hydraulic means or system 12 which is adapted to circulate hydraulic fluid to operate the machine 11. The machine includes a housing 13 mounted on base supports 14, indicated as inverted channels, a track 15 comprising transversely spaced apart I-beams 16 extending longitudinally from said housing and over similar base supports 14.

A kelly 17 extends forwardly from the housing 13 and is flange connected at 18 to a tubular drill spindle 19

2

which is journaled in suitable pillow blocks 20, 20' supported by a carriage 21 which in turn is supported by the track 15. The carriage 21 includes, respectively, longitudinal and transverse frame members 22, 23. The carriage also provides longitudinal frame members 22' spaced inwardly from the outer frame members 22, and these frame members 22, 22' provide journals for the shafts of rollers 24 which support the frame as they roll along the tops of the I-beams 16. Also the transverse frame members 23 support brackets 25 which extend therebelow and mount journal plates which supply the journals for the shafts of rollers 26 and 27, which guide the carriage 21 with relation to the I-beams 16 and roll respectively along the inner surfaces of the I-beam webs and along the under surfaces of the inner sides of the top I-beam flanges.

A swivel 28 of the conventional type shown in Patent No. 2,684,834 issued July 27, 1954 to Clare G. Miller, John D. Osborn, and John Osborn is provided to stationarily surround the rotating spindle 19 and convey the fluid delivered into the swivel into the tubular interior of such rotating spindle 19.

Such a swivel 28 is indicated in FIG. 1 of such patent by the reference numeral 30 and is shown in cross-sectional detail in FIG. 4 of such patent. The means of delivering fluid into such swivel is shown in FIGS. 1 and 4, fluid being carried thereto from a flexible hose 29 into a nozzle 30 which makes connection into the swivel. The hose in turn receives fluid from a pipe 31 supported by the machine which extends from a three-way, four-port valve 32 which is controlled by a lever 103 shown in FIG. 1. Supply lines 34 and 35 in turn extend from the valve 32, such lines being indicated diagrammatically in FIG. 4, and the inlet connections therein being shown extending from the left rear of the housing 13 shown in FIG. 1, and also indicated by reference numerals 34 and 35.

The forward end of the spindle 19 extends through a guide bracket 36 mounted on the forward end of the track 15, as shown in FIGS. 1 and 2, and located centrally of the machine, at the forward end of the housing 13 and at the rear end of the track 15, as indicated in FIG. 2, there is provided a lift loop 37, to which an elevating means, as a drag line or crane, may be attached to handle the machine into and out of drilling position.

The carriage 21 is moved along the track 15 by a rod 38 which is connected by means of a clevis 39 to a cross-pin 40 journaled in parallel, spaced apart plates 41 supported from the front transverse plate 23 of the carriage 21, the rod serving as the piston rod or ram rod of a hydraulic cylinder-ram unit, the cylinder being indicated by the reference numeral 71 in FIG. 3 and being rigidly connected to the stationary parts of the machine 11 with its ram or piston 72 being rearwardly in the cylinder 71 while the rod 38 extends forwardly from the ram and outwardly of the forward end of the cylinder.

The drive for the kelly 17 is effected by a hydraulic motor 42 to which fluid is supplied from the hydraulic system 12 through an inlet 43 to be discharged therefrom through an outlet 44, such hydraulic system to be explained in detail hereinbelow. The motor shaft 45 is connected by a flange 46 to a transmission shaft 47 of a transmission 48 which controls rate of rotation of the shaft 47, such shaft 47 being connected at its end opposite the flange 46, by means of a flange 49, to a drive shaft 50 which mounts a pinion 51 within a housing or guard 57. The pinion 51 in turn meshes with a ring gear 52 within the guard 57, such ring gear having hub flanges 53 and 54 extending respectively from the rear and forward sides thereof.

The opening through the hub flange 53 is of square cross-section to receive the kelly 17 therethrough and the forward hub flange 54 mounts angle brackets 55, as best shown in FIG. 7, which supply the journals for the shafts

of rollers 56, one to bear on each side of the square cross-section kelly 17, the gear housing 57 mounts rollers 56 to serve as rotational anti-friction elements, thereby providing an anti-friction support as guide for the kelly as it follows the movement of the spindle 19 to the after end of which spindle 19 the kelly 17 is flange connected at 13, as shown in FIG. 4.

As best seen in FIGS. 1 and 4, the carriage 22 supports the swivel 28 along therewith, while the spindle 19 is also carried along therewith. This is true since the spindle 19 is indicated in FIGS. 1 and 4 to be connected to the carriage 22 at the pillow blocks 20, 20' within which the spindle 19 also rotates. This is described in U.S. Patent No. 2,684,834 issued July 27, 1954, to Clare G. Miller, John Osborn, and John D. Osborn, the applicant herein. See column 2, lines 12-20 of such patent. The carriage 22 in turn is moved either forwardly or retracted rearwardly responsive to movement which the ram rod 38 imparts thereto.

The guard or gear housing 57 is supported by I-beams 58 comprising structural members of the housing 13 and such housing includes rear and forward retainer rings 61 and 62, respectively, for bearing assemblies 59 and 60 in the rear and forward parts of the guard 57, the inner races of such bearing assemblies being received respectively in grooves in the rear and front hub flanges 53 and 54. Any suitable bearing assemblies may serve the purpose, ball bearing assemblies being generally indicated.

In relative position the hydraulic motor 42 is under the left hand, forward part of the housing 13, the transmission 48 is immediately rearwardly thereof, and the kelly drive, including the pinion 51 and the ring gear 52, is immediately rearwardly of the transmission 48, the relative position of the rear end of the kelly being indicated by the reference numeral 17 at the rear end of the machine shown in FIG. 1.

The physical arrangement of the machine 11 with relation to the hydraulic system 12 places the machine in a ditch 78 adjacent a roadbed and the hydraulic system 12 at an elevation thereabove as at an elevation 76 beside the roadbed 77. Such relative relations are indicated in FIGS. 1 and 2. The hydraulic system 12 includes an engine 63 which, through a transmission means 64, is shown driving pumps 65 and 66 having discharge lines 67 and 68 therefrom connecting respectively into inlet fittings 69 and 70 on the forward part of the housing. The inlet 69 connects inwardly of the housing to the hydraulic fluid control system for the cylinder-ram 71, 72, the rod 38 extending sealably through the forward end of the cylinder 71 for connection to the carriage 21 as hereinabove described. On the other hand, the inlet 70 connects inwardly of the housing to the hydraulic fluid control system for the fluid motor 42, hereinabove described.

Also the return lines from the fluid controls for both the cylinder-ram and motor combine within the housing 13 and connect into a common outlet 73 at the forward part of the housing from which a return line 74 carries the fluid back to the reservoir 75 of the hydraulic fluid system 12. From the reservoir 75 the pumps 65 and 66 take fluid through suction lines 79 and 80, respectively, not shown in FIG. 2, but indicated in FIG. 3.

The arrangement of the supply lines 67, 68, 74 is such with relation to the housing 13 that, as one looks forwardly, the inlet 69 to the ram fluid control is on the right, the inlet 70 to the motor fluid control system is located centrally, and the single outlet 73 of the consolidated fluid return for both systems is on the left.

Within the machine housing 13 the fluid control line 67 for the cylinder-ram system branches so that the ram control fluid passes through a conduit 81 to a four-port, four-way valve 82, shown in FIG. 3, and the portion thereof to be by-passed passes through a conduit 84 to a regulator valve 85 which may be adjustably set to control the proportion of fluid which may pass therethrough with rela-

tion to the proportion of fluid that may pass through the conduit 81.

Such regulator valve 85 also regulates the distribution of the fluid that is allowed to pass therethrough so that part thereof returns through the by-pass conduit 89 to the return line 74, and the remainder thereof passes from the regulator valve 85 to flow through a conduit 90 to a needle valve 86 having a control handle 87 located on the housing as shown in FIG. 1 and in immediate grasp of the operator as he sits in the control seat 88. This handle 87 may thus be manually regulated to control the amount of fluid returning through the needle valve 86 via the conduit 90 to the return line 89.

The part of the fluid not by-passed passes through the conduit 81 and through the four-port, four-way valve 82 when in the position shown in FIG. 3, and through a conduit 81' into the rear end of the cylinder 71 to exert pressure upon the ram 72 to move it forwardly. Under these conditions the fluid in the cylinder 71 forward of the ram 72 is urged out therefrom through the valve 82 to pass by way of the return conduit 92 to join the return line 93 into which the motor fluid return also connects. Such return conduit 93 then connects into the outlet 73 which in turn establishes communication with the exterior return conduit 74.

The lever 91 shown in FIG. 1 is connected to reverse the direction of fluid flow through the valve 82, and when moved to effect reversal, the driving fluid from the conduit 81 passes therefrom through the valve 82 to the return conduit 92, while the fluid in the cylinder to the rear of the ram 72 is forced out the rear end of the cylinder 71 through the conduit 81' to the return line 92 as the ram is moved rearwardly. Thus an operator seated on the operator's seat 88 has full control of both the needle valve through its handle 87, and of the ram lever 91 from a single seated position to control respectively the force with which fluid is delivered into the cylinder and the direction of flow thereto.

The direction of motor rotation is similarly chosen, a conduit 99 connecting with the inlet 70 to convey fluid therefrom to a four-port, four-way valve 100, positioned as shown in the drawings, and therefrom through a conduit 104 into the motor suction line 43, the discharge fluid from the motor 42 discharging through the discharge conduit 44 and valve 100 into the discharge conduit 102. Conversely, the direction of fluid flow through the motor 42 may be changed, and this can be done by operation of the motor control lever 101 shown in FIG. 1 to place the conduit 99 in communication with the fluid conduit 44 so that the fluid discharges from the motor by way of the fluid conduit 43, the valve 100, and the discharge conduit 102.

The lever 106, shown in FIGS. 1 and 6, controls the speeds, selective through the transmission 48, at which the pinion 51 may be rotated by the motor 42. Additionally, the lever 103, shown in FIG. 1, control the selection of the position of the valve 32, thereby determining whether fluid, as water, supplied through the inlet 34 may be delivered to the spindle 28, or whether fluid, as drilling mud or compressed air, connected to the inlet 35, may be delivered to such spindle.

As shown in FIGS. 1 and 4, a gauge 107 is provided in the conduit 81 with space observable in the panel board of the housing to indicate to the operator the pressure developed in the pressure fluid conduit delivering fluid to the cylinder 71. Also a similar gauge 108 is provided in the conduit 99 with gauge face observable in the housing panel board to indicate the pressure in the conduit 99 which delivers pressure fluid to drive the motor 42.

Success or failure in road boring operation depends in many cases on the degree of control the operator of the machine may be able to exercise in drilling. As is well known, the drill stem is extended as drilling progresses by inserting sections of drill pipe or drill stem between the leading section, conventionally mounting the

conventional drilling bit or cutter, and the end of the spindle 19 which extends forwardly of the carriage 22.

In the drilling operation ram movement is controlled by control fluid which passes out the forward end of the cylinder 71 and through the valve 82 to pass successively thereafter through conduits 92, 93 and 74 to the reservoir 75, and thence through conduits 67 and 81, through valve 107, and by way of the conduit 105 into the rear end of the cylinder 71 to urge forwardly against the piston 72. When the drill stem has been extended into the drill bore the length of a section of drill stem or drill pipe, disconnection from the spindle driven drill stem section can be made and the carriage retracted by the ram head or piston 72 as fluid flow is reversed to enter the forward end of the cylinder 71. Thus the ram rod 38 draws the carriage 22 rearwardly to permit another drill stem section to be added by insertion between the part of the drill stem carrying the cutter and the forward end of the spindle 19. In such case an instance for the necessity for a machine affording a fine degree of control can be seen in the following example as when the reamer or cutter which is producing the bore strikes a rock formation and it becomes necessary for the operator almost instantaneously to change the advancing speed imparted to the carriage by ram movement while also almost instantaneously he must change the rate of rotation imparted to the drill stem through the kelly. Otherwise failure to effect such quick changes can result in the reamer teeth being broken off or in cases the drill stem may be severed.

It can be seen that similar hazardous conditions may be abruptly encountered in cases where the bore hole is created beginning on the far side of the roadbed. In such cases a pilot hole has first been drilled as the drill stem is extended through and beneath the roadbed to the far side, then the reamer has been installed on the far side and the drill stem rotated in direction to ream a bore back through from the far side to the near side, the drill stem being progressively shortened as drilling progresses backwardly.

The inlet 34 has generally connected thereto a regular water line to supply the water which circulates out the reamer orifices on the end of the drill stem to lubricate the formation and reamer teeth and abet drilling, while the inlet 35 may have connected thereto a drilling mud line to supply a circulating fluid which may form a filter cake on the drilled bore wall as to prevent spalling in sand formations, also a compressed air line may be connected to the inlet 35 when compressed air is to be employed, as to blow out the cuttings behind the reamer.

The invention is directed to provide the most flexibly operable horizontal drilling machine which has been offered to the trade, the machine being manipulated by a single operator who sits in a position accessible to the controls for all of the elements entering into the operation of the machine and such controls being effective immediately, as actuated, and the response of the various elements to control actuation being also effective substantially immediately. There may be variation, modification and alteration as regards any specific structure for carrying out the operations, and all structural arrangements and control systems are considered, as such may fall within the broad spirit of the invention, and within

the broad scope of interpretation claimed and merited for the appended claims.

What is claimed is:

1. A machine for drilling substantially horizontal bores under road beds and the like and positionable at desired elevation for drilling, as in a ditch adjacent a road bed, said machine including and a housing a track extending longitudinally forward from said housing, said machine also comprising a carriage mounted to move along said track, a cylinder connected to said machine, a ram head piston within said cylinder with rod extending from said piston and from said cylinder and connected to said carriage, a hollow spindle with opposed ends journally connected to said carriage and extending therefrom and adapted to establish fluid communication with a drill stem connected to the forward end of said spindle, a swivel mounted on said carriage and receiving said spindle rotatably therethrough, said swivel and said spindle being correlatively adapted for fluid delivery to said drill stem while said carriage carries along therewith said swivel mounted thereon and said spindle journally connected thereto, a kelly slidably mounted in said housing with its forward end connected to the rear end of said spindle, a speed controlled hydraulic motor adapted to receive drive fluid to rotate said motor in opposite directions responsive to change of drive fluid flow direction therethrough, a transmission driven by said motor and adapted to receive said kelly for longitudinal movement slidably therethrough and to rotate said kelly, and control means accessible for operation by an operator centrally positioned on said machine and including means for selectively supplying ram operating fluid at controlled rates to opposite ends of said cylinder, means for selectively supplying motor operating fluid at controlled rates and to flow in opposite directions through said motor, and means for supplying drilling fluid to said swivel for delivery therefrom into said spindle and drill stem, said control means for supplying ram and motor operating fluid including a reservoir positioned at a different elevation separate from said housing, and said motor operating fluid supplying means and said ram operating fluid supplying means each including an engine driven pump for taking fluid from and returning it to said reservoir.

2. A machine for drilling as claimed in claim 1 in which the central position of the operator is a control seat provided by said housing and in which said control means comprises means supported by said housing adjacent said operator.

3. A machine for drilling as claimed in claim 1 in which said means for supplying drilling fluid to said swivel includes means selectively operable to admit a drilling liquid and a compressed gas.

References Cited in the file of this patent

UNITED STATES PATENTS

2,196,260	Gatto	Apr. 9, 1940
2,226,643	Swansen	Dec. 31, 1940
2,294,318	Rich	Aug. 25, 1942
2,588,068	Williams et al.	Mar. 4, 1952
2,684,834	Miller et al.	July 27, 1954
2,734,723	Larcen	Feb. 14, 1956
2,811,335	Fletcher et al.	Oct. 29, 1957