July 27, 1954 C. G. MILLER ET AL 2,684,834

HORIZONTAL BORING MACHINE

Filed Oct. 7, 1950 2 Sheets-Sheet 1

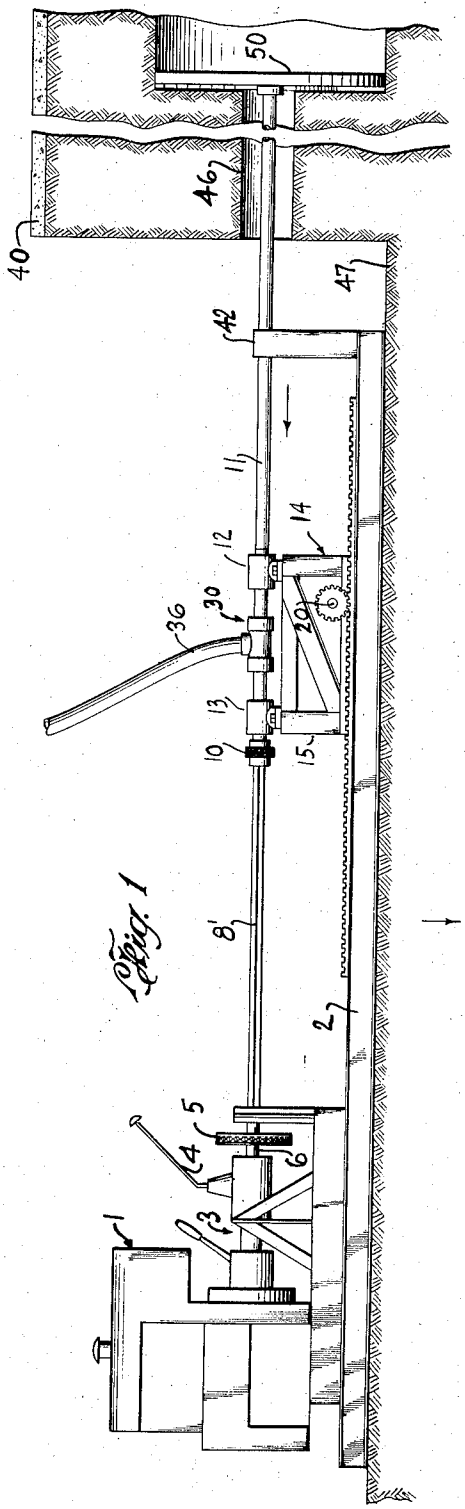


Fig. 1

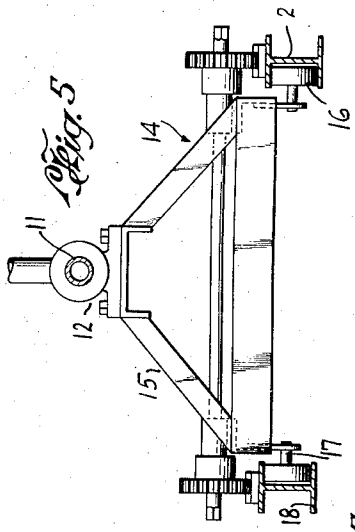


Fig. 5

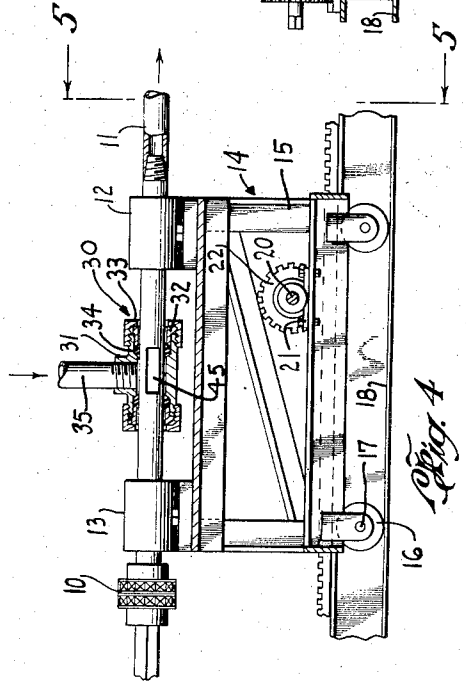


Fig. 4

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2 Sheets-Sheet 2

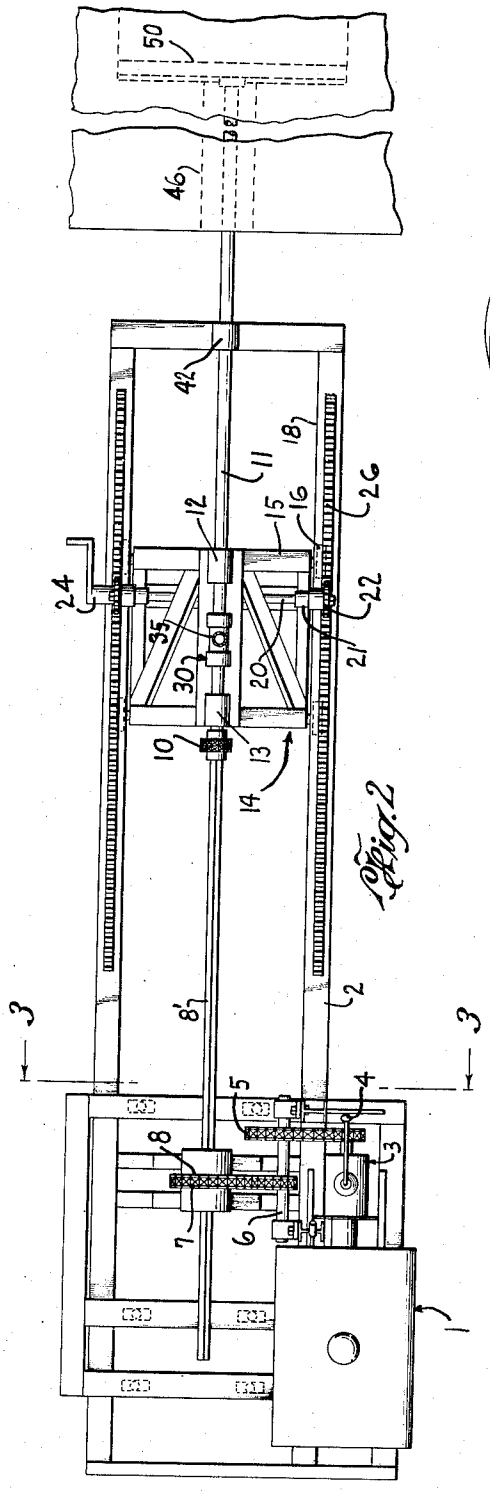


Fig. 2

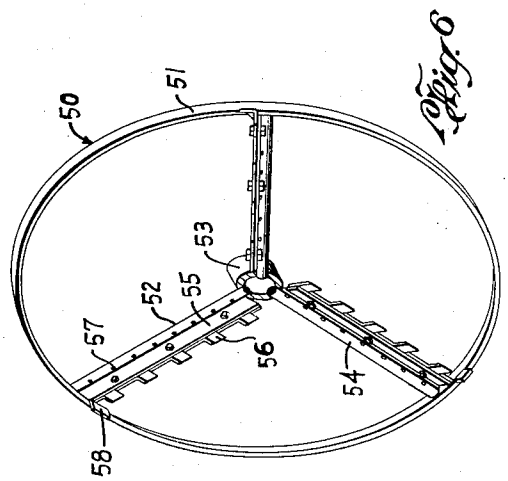


Fig. 6

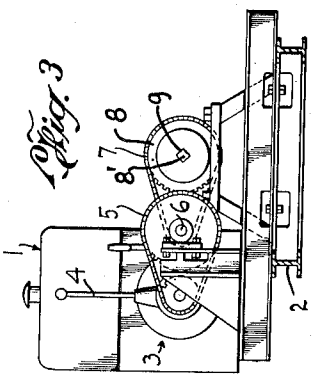


Fig. 3

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Patented July 27, 1954

2,684,834

UNITED STATES PATENT OFFICE

2,684,834

HORIZONTAL BORING MACHINE

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Application October 7, 1950, Serial No. 189,022

7 Claims. (Cl. 255—20)

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This invention relates to a horizontal boring machine which is adapted to rotationally project a drilling bit to drill a substantially horizontal pilot hole, and to ream the hole as the projected drill stem is retracted.

It is an object of this invention to provide a horizontal drilling machine and drilling method in which a stationary prime mover is equipped with a Kelly bushing in a rotary member through which a kelly is projected; such kelly being connected to the drill stem on which the bit is installed and which drills the pilot bore; and after which the reamer is installed on the drill stem to ream the pilot bore as the drill stem is retracted.

It is a further object of this invention to provide a horizontal drilling machine of this class which is adapted to supply drilling fluid through the drill stem to lubricate the drilling of the pilot hole bit and the reaming of the reamer which enlarges the pilot hole.

It is a further object of this invention to provide a horizontal drilling machine of this class which has a carriage adapted to be fed forward, or retracted outwardly, by manually operable means permitting an infinitesimal degree of control for the drill stem travel.

It is an object of this invention to provide a horizontal drilling machine of this class which has a stationary engine mounted on the frame thereof; which has a kelly rotationally projected through the driving means; and which has a carriage mounted to be moved along the track and to support the drill stem to which the kelly is attached.

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

Fig. 1 is an elevation showing the machine in the act of reaming out a pilot bore;

Fig. 2 is a plan view of the machine shown in Fig. 1;

Fig. 3 is an elevation of the drive transmission mechanism as viewed on line 3—3 of Fig. 2;

Fig. 4 is a fragmentary sectional elevation showing the carriage, and including a fluid supply therefor;

Fig. 5 is an end elevation of the travelling carriage, looking in the direction of the arrows on line 5—5 of Fig. 4;

Fig. 6 is a perspective view of the reamer.

As shown in Fig. 1, a prime mover, as a gasoline engine 1, is mounted on the main frame 2, consisting of a pair of longitudinal I-beams joined and spaced apart by suitable transverse framing

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members. This engine has the conventional transmission 3 and gear shift lever 4 and, through speed reduction gearing, such as a belt or roller chain connection 5, rotates the shaft 6, which in turn, through the belt connection 7, rotates the gear 8 which has a non-circular hole, as the square hole 9, axially therethrough. The transmission details are best visualized when Fig. 3 is considered.

A kelly, or square cross-section member 8', passes through the hole 9, and has a sliding drive connection fit therewith. The opposite end of the Kelly drive shaft is connected by means of the flange coupling or drive joint 10 to a hollow sectional drill stem 11 the initial section of which constitutes a drive connector rotatably mounted as by well known type of rotary and end thrust bearings housed by the pillow blocks or bearings 12 and 13 on the carriage 14 for travel back and forth with the carriage. This carriage 14, as most clearly shown in Figs. 4 and 5, has a frame 15 which has the wheels 16 mounted on the axles 17 thereof, the wheels riding on a trackway affording by the co-operating flanges 18 of the spaced I-beams constituting the main frame 2.

The carriage 14 has the shaft 20 mounted for rotation in the pillow blocks 21 thereof. This shaft has on one end thereof the pinion 22, and the other end is of a non-circular cross-section to receive the socket lever 24. On the shaft 20 inwardly of the socket lever 24, the pinion 22 meshes with, and moves along, the rack 26 which is mounted on the frame 2. The longitudinal spacing of the wheels 16 insures that the carriage will move along in a substantially straight line.

A stuffing box 30 surrounds the rotatable drill stem section between the bearings 12 and 13, and thus moves back and forth with the carriage 14. This stuffing box comprises the conventional body 31, gland 32 and closure 33, the gland being moved by the threading of the closure member upon the body so as to compress the seal 34 against the drill stem surface. A connection for fluid, as the connection 35, is provided, as shown in Fig. 4 and such connection may preferably be a flexible one to accommodate carriage travel as shown by the hose connection 36 in Fig. 1.

A bit, not shown, which has fluid openings therethrough, is employed to drill a pilot hole through a formation, as the formation beneath the railroad or highway 40. In the drilling of such pilot hole the rotation of the prime mover 1 rotates the gear 8 thereof which in turn rotates or constitutes the rotatable driver for the drive

transfer shaft or kelly 8' through the slip drive joint afforded by the sliding of the kelly within the non-circular hole 9. This rotates the bit to drill the pilot hole and the kelly slides through the driving means as the carriage 14 is fed forwardly on the track flanges 13 and direct the drill under the road bed. This feeding of the carriage is best accomplished in practice by manual force on the handle of the socket lever 24, although a power operated drive under manual control may be employed.

As the pilot hole is bored, it may be necessary in the event the drill stem length is less than the length to be tunneled to add additional sections of drill stem to the drill stem 11 and this is done by breaking the drill stem section, as by tongs, preferably at a joint, as shown in Fig. 4, when the carriage approaches the vicinity of the guide post 42, then retracting the carriage and inserting an additional drill stem section. As the drilling progresses, the drilling fluid, as water, or as a drilling mud, is supplied through the hose or connection 36 to the stuffing box 30 into the ports 45, as the drill stem 11 rotates. This fluid passes through the hollow drill stem and outwardly through the holes in the bit to lubricate and soften the formation which the bit is drilling.

When the pilot hole 46 has been completed underneath the road 40 to the side opposite the ditch 47, in which the machine has been set up, the bit is removed. Then a reamer 50 is installed on the drill stem 11 on the far side of the road, and the prime mover 1 rotates the drill stem 11 as the carriage 14 under control of rack and pinion manipulation, is retracted or moved backwardly and toward the prime mover 1. This drill stem rotation and reverse longitudinal movement of the carriage causes the reamer 50 to ream out, or enlarge, the hole 46. Any drill stem sections which may have been added during forward drilling operation will need to be removed in stages as the reaming operation progresses with the back travel of the carriage through pinion and rack operation.

The reamer 50 comprises a rim 51 which surrounds and is connected as by welding to the outer ends of radially extending arms 52 which are welded or otherwise connected centrally to a hollow tube 53. The tube 53 is a co-axial extension of the drill stem 11 and is either integral with the stem or a separate part joined to the stem by a pipe coupling. The arms 52 comprise pipes 54 which have blade supports 55 connected thereto and which have mounted thereon a group of radially spaced blades 56. The radial location of the several supports relative to one another is such that the blades of successive supports are staggered or have rotary paths offset and the several succeeding blades co-operate to cut throughout the entire diameter of the reamer 50. The pipes 54 constitute branch conduits communicating with the hollow tube 53 or drill stem end, and water, or fluid, flows radially outward therethrough and is discharged through the jets or ports 57 into contact with the formation being reamed by the blades 56. Connected to, or adjacent the rim 51, are mounted blades 58 which have surfaces extending axially, whereas the surface of the blades 56 extend in a transverse plane across the drill stem axis.

The diameter of the reamer and of the drill bit will depend upon the desired size of the tunnel. In some instances the use of a drill bit alone may suffice without being followed up by a reamer enlargement. When the stroke of the machine is completed a conduit such as a pipe line may be projected under a road without having had to break up the road surface or detour the flow of road traffic. Before inserting the conduit the reamed out dirt may be removed by drawing forward a suitable clearout plug on the end of a winch cable. A cable may conveniently be attached to the end of the drill stem beyond the reamer prior to the start of reaming operation so that the cable will be pulled through the tunnel as the reamer is retracted and upon completion of the reaming operation the cable can be readily attached to a winch.

Broadly this invention considers a horizontal boring machine having a stationary engine mounted in a track; such engine being adapted to drive a kelly, or non-circular member, which moves axially through the driving means bushing. It also considers a machine of this type which has the kelly connected to a drill stem, the drill stem being mounted to rotate in a carriage which is movable along the track.

What is claimed is:

1. In a horizontal boring machine, a frame, a driving means fixedly located on one end of the frame and provided with a non-circular axial hole therethrough, a travelling carriage movable along said frame in the region beyond said fixedly located driving means and including bearing means and a stuffing box, means for moving the carriage along the frame, a hollow drill stem mounted for travel with the carriage and rotation in said bearing means and said stuffing box, port means through the wall of said drill stem within said stuffing box, a Kelly member slidably fitted through said non-circular hole and drive connected to the inner end of said drill stem, means for supplying pressurized fluid into said stuffing box to enter said hollow drill stem through said port means, and an earth cutting tool on the outer end of said drill stem having passage means communicating with the passageway through the hollow stem so the fluid may be ejected to aid the cutting operation of said tool.

2. In a horizontal boring machine, the combination of, a frame, a driving means mounted in fixed relation thereon having a non-circular axial hole therethrough, a frame mounted travelling carriage including bearing means, a drill stem mounted for movement with the carriage and for rotation in said bearing means, means for regulating carriage travel, a Kelly member adapted to be slidably fitted through said non-circular hole and to be drive-joined to the inner end of said drill stem for travel with the carriage mounted drill stem, and an earth cutter on the outer end of said drill stem adapted to cut a hole as said driving means rotates said kelly and said drill stem as said carriage is moved along said frame.

3. In a horizontal boring machine, the combination of, a frame, a driving means thereon having a non-circular axial hole therethrough, rack means on said frame, a frame mounted travelling carriage having shaft means mounted for rotation therein and having pinion means on the ends thereof to engage said rack means, means to rotate said shaft means, bearing means in said carriage, a drill stem movable with the carriage and mounted for rotation in said bearing means, a Kelly member adapted to be slidably fitted through said non-circular hole and to be drive connected to the inner end of said drill stem for travel with the carriage mounted drill

stem, and a material removing tool on the outer end of said drill stem adapted to form a hole as said driving means rotates said kelly and said drill stem as said carriage is moved along said frame by the application of force to rotate said shaft means.

4. In a horizontal boring machine, the combination of, a frame, a driving means fixedly located thereon having a non-circular axial hole therethrough, a rack means on said frame, a frame supported travelling carriage having shaft means mounted for rotation therein and having pinion means on the ends thereof to engage said rack means, means to rotate said shaft means, axle and wheel means connected to support said carriage for motion along said frame, bearing means in said carriage, a drill stem mounted for travel with the carriage and for rotation in said bearing means, a Kelly member adapted to be slidably fitted through said non-circular hole and to be drive coupled to the inner end of said drill stem for travel with the carriage mounted drill stem, and material moving tool on the outer end of said drill stem adapted to form a hole as said driving means rotates said kelly and said drill stem as said carriage is moved along said frame by the application of force to rotate said shaft means.

5. In a horizontal boring, the combination of, a frame, a driving means fixedly located thereon having a non-circular axial hole therethrough, a travelling carriage adapted to be moved along said frame and including bearing means and a stuffing box, carriage travel control means, a drill stem mounted for rotation in said bearing means and said stuffing box and carried by said bearing means for travel with the carriage, port means in said drill stem within said stuffing box, a Kelly member adapted to be slidably fitted through said non-circular hole and to be drive connected to the inner end of said drill stem for travel with the carriage mounted drill stem, means for supplying pressurized fluid into said stuffing box to enter said drill stem through said port means, and a reamer on the outer end of said drill stem having work performing teeth and means for conveying the fluid from the drill stem to the region of said teeth to aid the teeth in reaming.

6. An earth boring rig of a type to excavate roadbed earths beneath an established road level, including a main frame having a trackway toward its forward end, a traveling carriage operating on said trackway, interengaging rack and pinion elements carried one by the trackway and the other by said carriage, a manual control for rotating the pinion and, by reason of pinion engagement with the rack, causing carriage travel, a drill stem drive connector rotatably mounted on and movable with said carriage, power drive mechanism therefor mounted on the rear of said frame beyond the range of carriage travel, and a drive transmission between said drill stem drive connector and said power drive mechanism including a rotatable driver, a drive transfer shaft having a drive joint at its forward end with said drill stem connector and a sliding drive connection throughout its length with the rotatable driver and being of a length greater than the range of carriage travel to span the space between said rotatable driver and said drill stem connector throughout the range of carriage travel.

7. In a boring machine of the character described, a stationary main supporting frame having a carriage trackway throughout a portion of its length, a power drive unit fixedly mounted on the frame beyond said trackway, a traveling carriage guided by the trackway for to and fro movement relative to said fixedly mounted power drive unit, means to transmit to and fro travel to the carriage on said trackway, a drill stem connecting section carried for travel with the carriage and rotatably mounted thereon, and a Kelly type drive connecting said traveling stem connecting section with the fixedly mounted power drive unit, said Kelly type drive including a rotary element drive connected with the power drive unit and rotatably mounted on the frame at a fixed location beside the power drive unit and a drive transmitting shaft of a length to span the distance between said traveling drill stem connecting section and the fixedly located rotary element in all positions throughout their range of relative travel, with drive couplings to both thereof, one of such drive couplings being a slide fit drive joint.

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