

March 31, 1953

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2,633,334

BORING TOOL

Filed Nov. 14, 1949

3 Sheets-Sheet 1

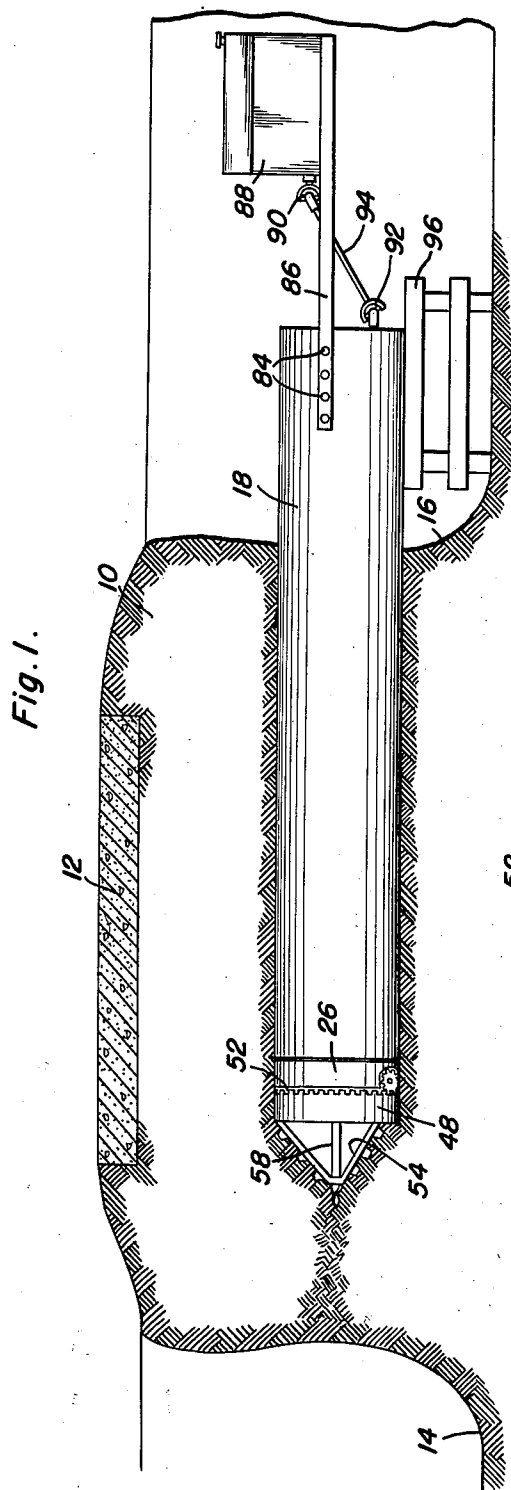


Fig. 1.

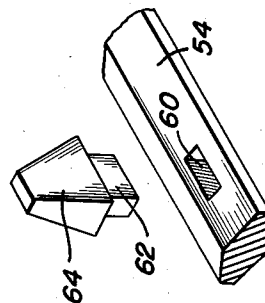


Fig. 6.

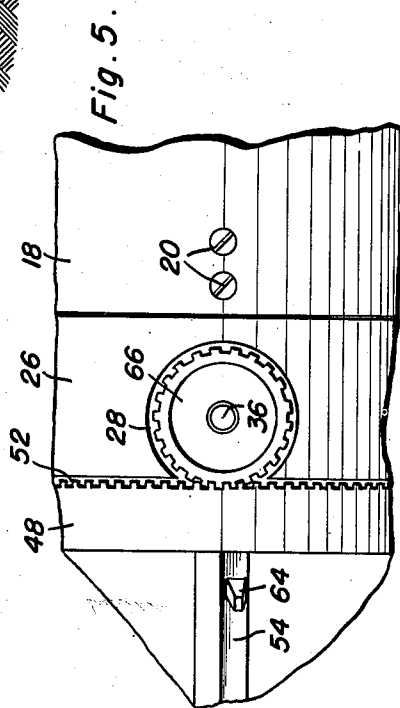


Fig. 5.

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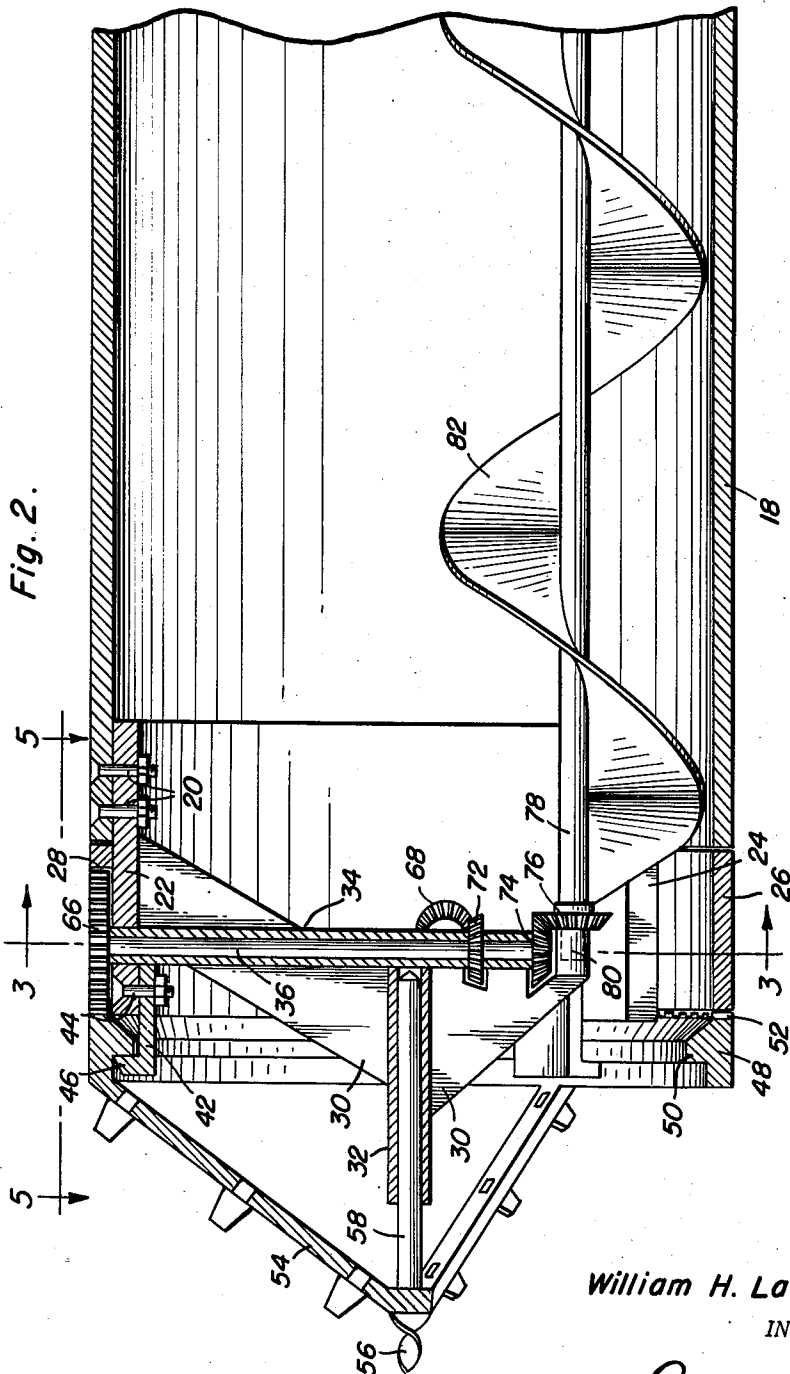
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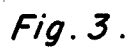
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BORING TOOL

3 Sheets-Sheet 3



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UNITED STATES PATENT OFFICE

2,633,334

BORING TOOL

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Application November 14, 1949, Serial No. 126,990

7 Claims. (Cl. 255—20)

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This invention comprises novel and useful improvements in a boring tool and more specifically pertains to a rotary drilling apparatus for excavating horizontal tunnels for receiving pipe casings therein, in an improved manner.

The primary object of this invention is to provide a rotary drilling apparatus for laying pipe casings in horizontal tunnels in an improved manner.

A further important object of the invention is to provide a tunnel excavating apparatus which may be readily mounted upon a pipe casing section in order to perform its excavating operation.

A still further object of the invention is to provide an improved rotary drilling apparatus in conformity with the foregoing objects which shall have a simplified and improved mechanism and drilling operation, which may be associated with a pipe casing in an improved manner for carrying out the desired drilling operation; and wherein there is provided improved means for operating the rotary drilling apparatus and for removing material excavated thereby, all housed within a pipe casing section.

These, together with various ancillary features and objects of the invention which will later become apparent as the following description proceeds, are attained by the present invention, a preferred embodiment of which has been illustrated by way of example only in the accompanying drawings, wherein:

Figure 1 is a side elevational view showing a preferred embodiment of the invention in operative position for excavating a horizontal tunnel below a road bed for receiving a conduit or casing member therein;

Figure 2 is a fragmentary vertical central longitudinal sectional view through a portion of a pipe casing having the invention applied thereto;

Figure 3 is a vertical transverse sectional detail view taken substantially upon the plane of the section line 3—3 of Figure 2 and illustrating the driving mechanism of the rotary drilling apparatus;

Figure 4 is an end elevational view of the drilling apparatus illustrated in Figure 2 and taken from the left end thereof;

Figure 5 is a horizontal sectional detail view taken substantially upon the plane of section line 5—5 of Figure 2; and

Figure 6 is a group perspective detail view illustrating a portion of the cutter bar and of a cutting tooth forming a part of the invention.

Referring now more specifically to the accom-

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panying drawings, wherein like numerals designate similar parts throughout the various views, attention is directed first to Figure 1 wherein there is disclosed, purely by way of illustrating the principle and manner of applying the invention, a portion of a road bed 10 having a road surface 12 thereon, the road having a pair of drainage or other ditches 14 and 16 extending parallel to and upon opposite sides of the road.

Although the principles of the invention, and the rotary drilling apparatus forming the subject thereof are applicable to a variety of purposes for drilling horizontal and other tunnels through the earth, the invention is especially adaptable for drilling horizontal transverse tunnels beneath a road bed for connecting drainage ditches on both sides of the same, or for receiving pipes or conduits which it is desired to conduct beneath the road bed. For this purpose, the invention conveniently employs a cylindrical or other elongated member 18 which may conveniently comprise a section of a pipe or conduit casing, this section being employed to detachably receive the rotary drilling head, the power operating means for the same, and a waste material excavating means employed therewith, as set forth hereinafter.

Referring now more specifically to Figure 2, it will be understood that the casing section 18 which may conveniently comprise a cylindrical conduit or casing section, is open at both of its ends, these being hereinafter referred to as the front and rear ends. Detachably mounted upon the front end of the casing section 18, in any suitable manner such as by fastening bolts 20 or the like, is a support 22 which may conveniently comprise a cylindrical sleeve or the like and which may be loosely but snugly received in the open front end of the casing section 18 as shown clearly in Figure 2.

As shown best in Figure 3, this support or sleeve 22 is provided with a longitudinal slot 24 at its lower side, for a purpose which will be later apparent.

Mounted upon the exterior surface of the support sleeve 22, is an annular sleeve 26, which in effect forms a smooth continuation of the exterior surface of the casing section 18, and which at suitable circumferential intervals is provided with annular cut out portions 28. Suitable radially extending support ribs 30 are connected with the interior surface of the support sleeve 22, and merge into a tubular member 32 which is axially disposed with respect to the casing section 18 and extends forwardly from the front

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end thereof as shown in Figure 2. Similar radially disposed bores 34, are received in the ribs 30, and serve to journal and mount radially extending drive shafts 36, 38 and 40.

Obviously, any desired number of radial drive shafts could be provided, but for the purpose of illustrating the principles of the invention it has been deemed sufficient to illustrate three of these shafts.

A plurality of forwardly extending supporting, journaling and retaining brackets 42 are provided which are secured to the support sleeve 22 as by bolts 44, whereby the brackets are retained on the inner surface of the support sleeve and extend outwardly therefrom, being provided with upwardly inturned fingers or flanges 46.

A drill head consisting of an annular member 48 is provided with an integral internal flange 50 thereon, this flange being received within the upturned fingers 46 whereby the latter serve to retain the drill head in operative position in the assembly as set forth hereinafter.

What may be termed the rear surface of this drill head 48, is provided with a plurality of teeth 52 and constitutes thereby a ring gear, the latter facing rearwardly of the device. The outer surface of the drill head 48 is preferably substantially flush with the exterior surfaces of the casing section 18 and of the support sleeve member 26. Both the forward and rear ends of the drill head are open in order that material excavated by the drill may pass through the head, through the support member around the radial ribs 30, and longitudinally of the casing section 18 for discharge from the rear end thereof.

Integrally formed with or if desired rigidly attached but separately secured to the forward or front end of the drill head 48, are a plurality of forwardly inclined cutting bars 54, any suitable number of these bars being employed, these bars being connected at their forward end to provide an auger or drill bit 56, which is disposed upon the longitudinal axis of rotation of the drilling head. The bit 56, cutter bars 54 are likewise provided with an axially extending shank 58 which is journaled in and carried by the forwardly extending tubular member 32 for rotation therein.

As will be apparent from Figures 2 and 6, each of the cutter bars 54 is preferably provided with a plurality of longitudinally spaced slots or recesses 60, which are adapted to detachably receive the shank portions 62 of any suitable type of cutting teeth 64. Preferably, the forwardly inclined cutter bars 54 are disposed radially of the shaft 58 which lies upon the axis of rotation of the cutter head, and the plurality of drill teeth 64, secured in the retaining slots 60, are preferably spaced successively laterally of the cutter bars in the direction of rotation of the latter.

Rigidly secured to the outer ends of each of the shafts 36, 38 and 40, is a driving gear 66, which is constantly in mesh with the ring gear 52 for driving the latter upon rotation of the driving shafts 36, 38 and 40. At their inner extremities, the shafts 38 and 48 are each provided with driven gears 68 and 70 which constantly mesh with a similar gear 72 fixedly secured to the shaft 36 adjacent its lower end, whereby rotation of the shaft 36 will cause operation of the plurality of driving gears 66 to thereby rotate the drill head. Preferably, the shafts 36, 38 and 40 and the gear 66 are disposed at equal angular intervals about the circumference of the ring gear for imparting an evenly distributed thrust to

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the same for rotating the drill head and the cutter elements carried thereby.

At its lower extremity, the shaft 36 is provided with a beveled gear 74 which is constantly in mesh with a similar gear 76 rigidly carried by a power shaft 78, having its front end journaled as at 80 in a suitable bearing and the radial web members 30. The shaft 78 may conveniently comprise the central shaft of a spiral screw conveyor 82, the latter being disposed in the lower portion of the casing section 18 and extending into the slotted portion 24 of the support sleeve 22, as will be apparent from Figures 2-4.

At its rear end, the casing section 18 has suitably detachably secured thereto as by fastening bolts 84, a rearwardly extending frame construction 86 upon which is mounted a suitable prime mover such as an internal combustion engine, an electric motor or the like as indicated at 88. The latter is operatively connected, as by universal couplings 90 and 92, and an intermediate shaft 94, to the rear end of the power shaft 78 for rotating the same.

From the foregoing, the construction and operation of the device will now be readily apparent. When it is desired to excavate a tunnel beneath a road bed, a casing section 18 is positioned in the ditch 16 and has the prime mover secured thereto as shown in Figure 1, while the drill head is secured to the forward end of the same. Conveniently, the casing section may be supported in proper position as by a supporting platform or the like 96. Upon rotation of the power shaft 78 by the prime mover 88, the shaft 36 is rotated, and through the gears 72, 68 and 70, the shafts 38 and 40 are likewise rotated. The three driving gears 66 carried at the outer ends of the same now cause rotation of the ring gear, and through the latter of the drilling head and of the cutter elements carried thereby. The latter serve to excavate and bore into the soil, and will thus form a tunnel therein. The entire apparatus, consisting of the casing section 18 and of the instrumentalities detachably secured thereto and carried thereby, may then be advanced into the tunnel so formed by any desired means. As the device is advanced, it will be evident that the excavating screw 82 will remove the material excavated by the cutter or drill head longitudinally of the casing section of the members carried thereby, whereby this material will be discharged from the rear end of the device.

It is evident that although the device has been illustrated as employed for drilling a horizontal tunnel beneath a road bed, the same is adapted for many other purposes, a very important feature of this construction being the ease with which the drilling head, the power plant, the driving connection between the same and the excavating means may be detachably mounted upon a conventional casing section to perform the complete drilling apparatus.

From the foregoing, the construction and operation of the device will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art after a consideration of the foregoing specification and accompanying drawings, it is not desired to limit the invention to the exact construction shown and described, but all suitable modifications and equivalents may be resorted to, falling within the scope of the appended claims.

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Having described the invention, what is claimed as new is:

1. A rotary drilling apparatus comprising a casing having open front and rear ends, a support detachably secured upon the front end of said casing and within the interior thereof, a drill head journaled on said support and having an exterior surface forming a smooth continuation of that of the casing and having cutting means, driving means operatively connected to said drill head and extending through said casing, a conveyor surrounding said driving means and extending through said casing for removing material from said drill head.

2. A rotary drilling apparatus comprising a casing having open front and rear ends, a support detachably secured upon the front end of said casing and within the interior thereof, a drill head journaled on said support and having an exterior surface forming a smooth continuation of that of the casing and having cutting means, a driving means operatively connected to said drill head and extending through said casing, a conveyor extending through said casing for removing material from said drill head, said cutting means comprising a plurality of bars angularly and forwardly inclined from said drill head, a plurality of cutting teeth mounted on each bar.

3. A rotary drilling apparatus comprising a casing having open front and rear ends, a support detachably secured upon the front end of said casing and within the interior thereof, a drill head journaled on said support and having an exterior surface forming a smooth continuation of that of the casing and having cutting means, a driving means operatively connected to said drill head and extending through said casing, a conveyor extending through said casing for removing material from said drill head, said cutting means comprising a plurality of bars angularly and forwardly inclined from said drill head, a plurality of cutting teeth mounted on each bar, said teeth being spaced longitudinally and laterally of said bar.

4. A rotary drilling apparatus comprising a hollow support, a cylindrical drill head journaled upon said support and having a ring gear at its rear edge, a plurality of cutter bars extending forwardly of said drill head and rigidly secured at the axis of rotation thereof, a plurality of radial drive shafts journaled solely in said support, and having driving and driven gears thereon, said driving gears meshing with said ring gear at circumferentially spaced positions, a power shaft operatively connected to said driven gears, said drill head being journaled upon the exterior surface of said support, means for guiding and retaining said drill head on said support.

5. A rotary drilling apparatus comprising a

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hollow support, a cylindrical drill head journaled upon said support and having a ring gear at its rear edge, a plurality of cutter bars extending forwardly of said drill head and rigidly secured at the axis of rotation thereof, a plurality of radial drive shafts journaled solely in said support, and having driving and driven gears thereon, said driving gears meshing with said ring gear at circumferentially spaced positions, a power shaft operatively connected to said driven gears, said drill head being journaled upon the exterior surface of said support, means for guiding and retaining said drill head on said support, means for mounting said support on the open end of a casing.

6. A rotary drilling apparatus comprising a hollow support, a cylindrical drill head journaled upon said support and having a ring gear at its rear edge, a plurality of cutter bars extending forwardly of said drill head and rigidly secured at the axis of rotation thereof, a plurality of radial drive shafts journaled solely in said support, and having driving and driven gears thereon, said driving gears meshing with said ring gear at circumferentially spaced positions, a power shaft operatively connected to said driven gears, said drill head being journaled upon the exterior surface of said support, means for guiding and retaining said drill head on said support, means for mounting said support on the open end of a casing, means for removing through said casing the material cut by said drill head.

7. A rotary drilling apparatus comprising a hollow support, a cylindrical drill head journaled upon said support and having a ring gear at its rear edge, a plurality of cutter bars extending forwardly of said drill head and rigidly secured at the axis of rotation thereof, a plurality of radial drive shafts journaled solely in said support, and having driving and driven gears thereon, said driving gears meshing with said ring gear at circumferentially spaced positions, a power shaft operatively connected to said driven gears, said cutter bars having each a plurality of longitudinally and laterally spaced apertures, cutting teeth received in said apertures.

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