Jan. 13, 1953 I. R. SMITH 2,625,376

ROAD AUGER BORING MACHINE

Filed June 29, 1950 3 Sheets-Sheet 1

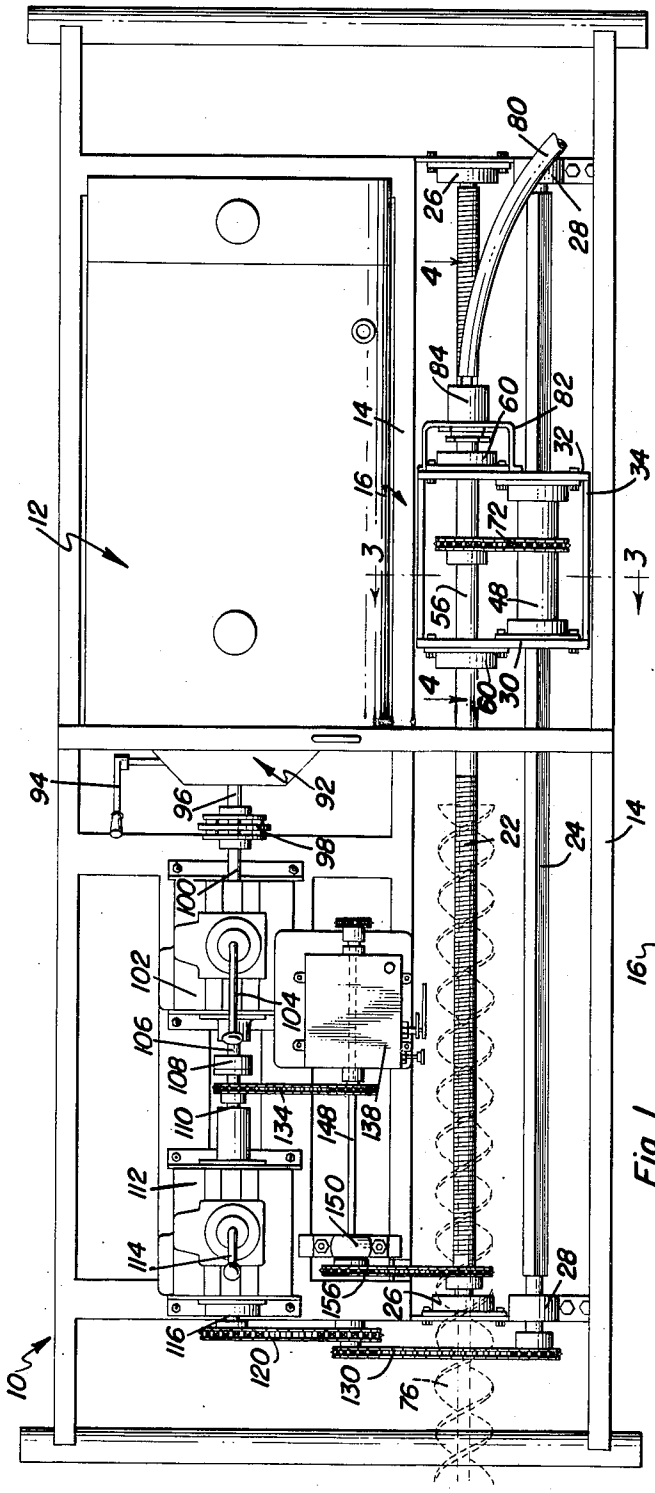


Fig. 1

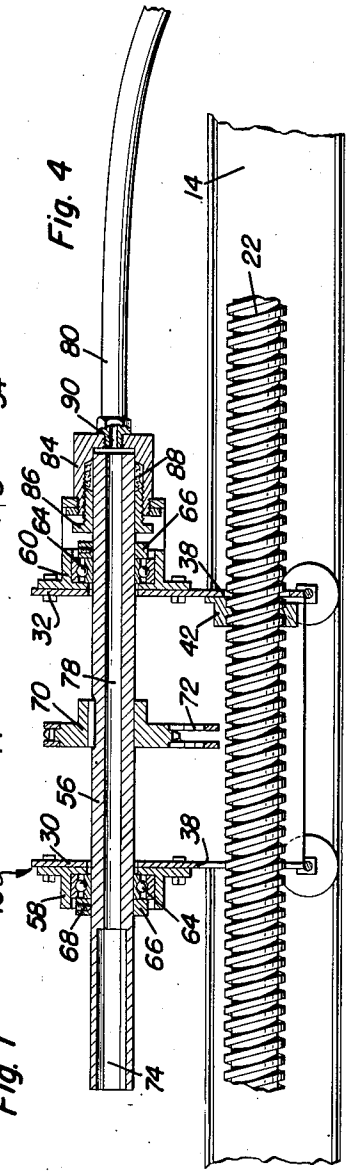


Fig. 4

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ROAD AUGER BORING MACHINE

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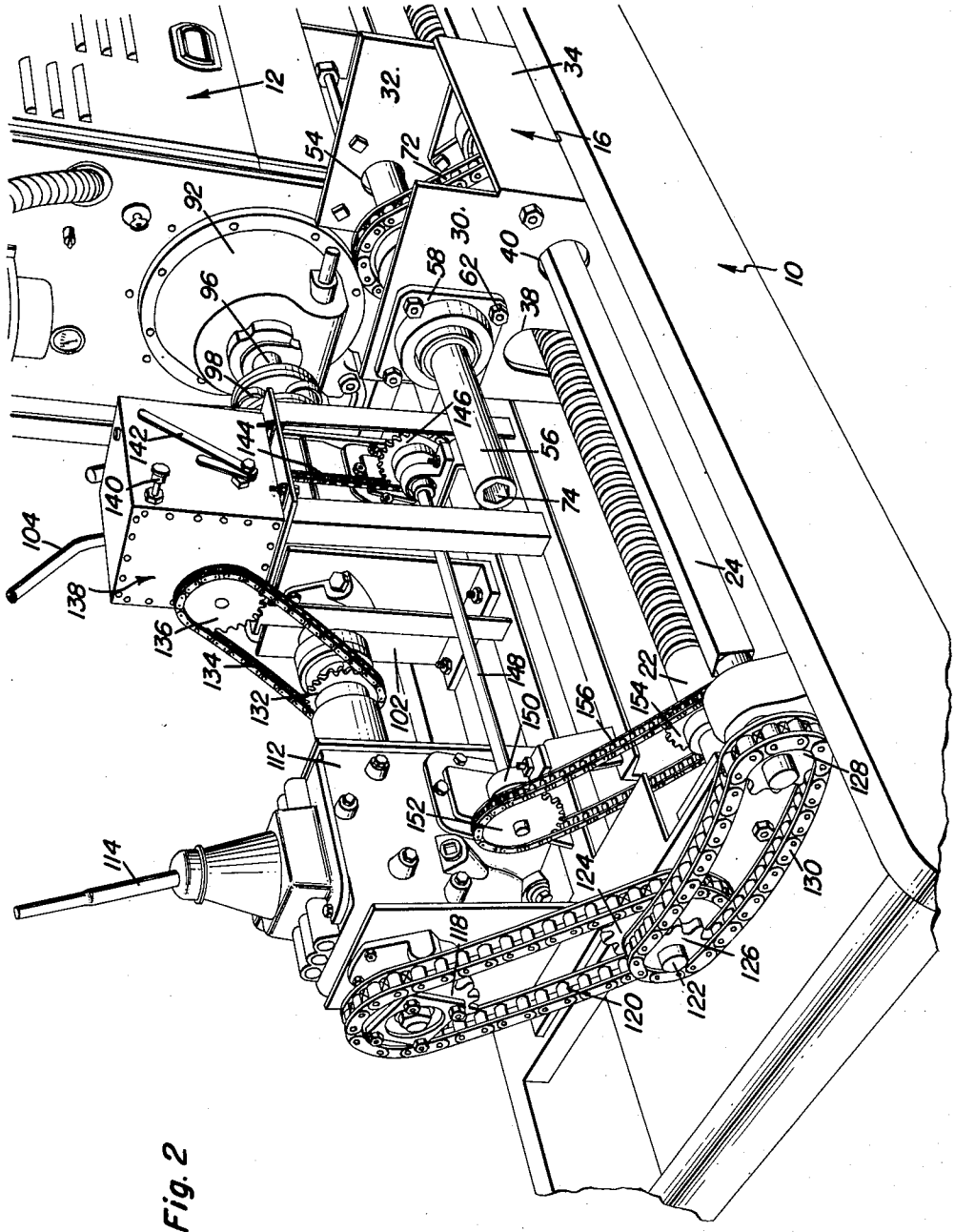



Fig. 2

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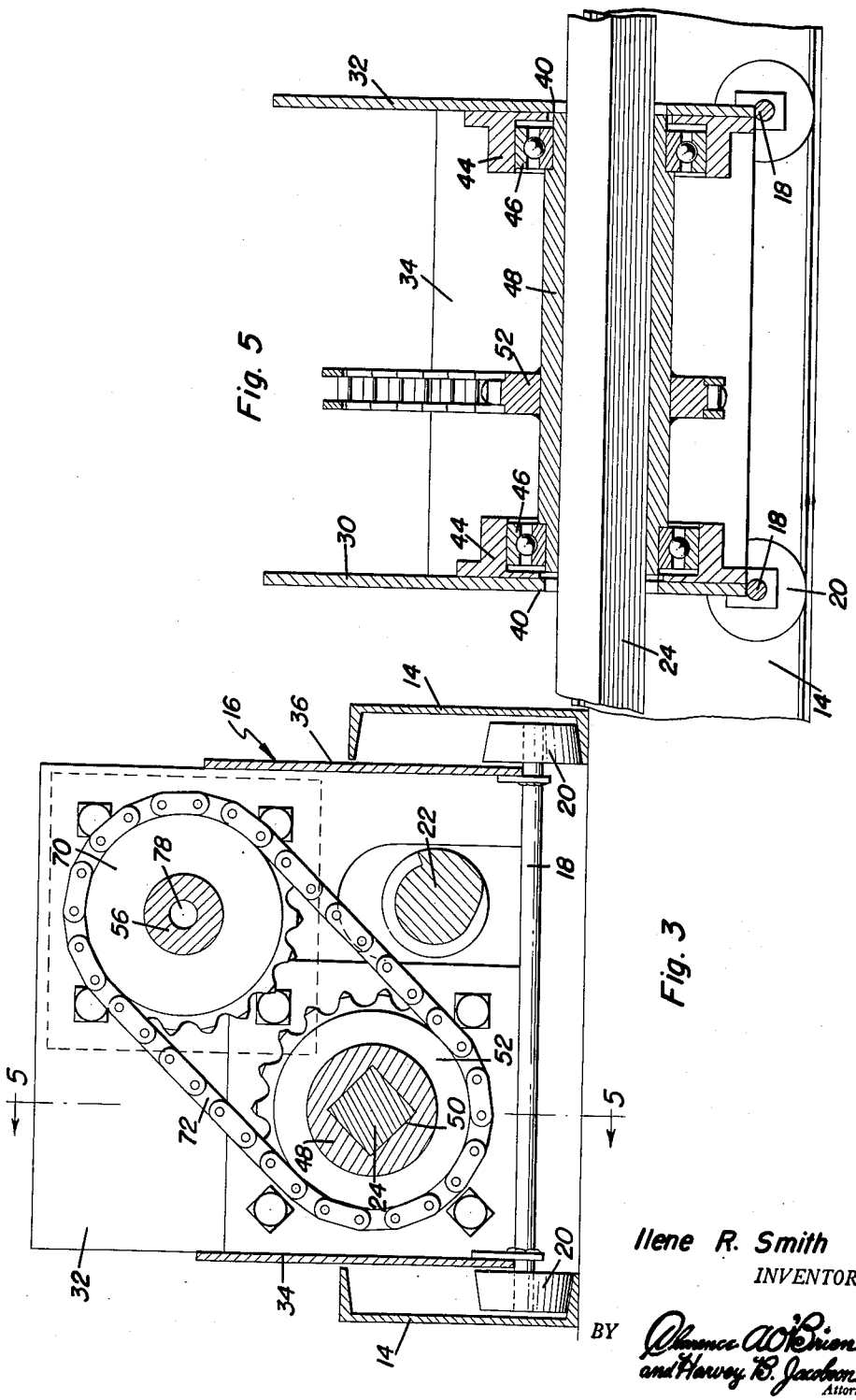



Fig. 5

Fig. 3

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## ROAD AUGER BORING MACHINE

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Application June 29, 1950, Serial No. 171,009

7 Claims. (Cl. 255—20)

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This invention comprises novel and useful improvements in a road auger boring machine and more specifically pertains to a boring and drilling apparatus for horizontal drilling operations.

The primary object of this invention is to provide a drilling apparatus specifically designed for boring holes and tunnels under roads, highways, railroads, canals, small rivers, and the like.

A further object of the invention is to provide a drilling apparatus capable of boring tunnels or passages of from 2 to 36 inches in diameter and from 50 to 200 feet in length.

A still further object of the invention is to provide an improved drilling apparatus in which a drilling shaft is rotatably carried by a carriage, the latter being capable of longitudinal guided movement in the direction of the drilling shaft while maintaining an unbroken driving connection with the drill shaft.

A further object of the invention is to provide an improved driving assembly for selectively imparting controlled longitudinal travel to the carriage and for selectively and at varying speeds continuously operating the drilling shaft during such travel.

Yet another important object of the invention is to provide a drilling apparatus in conformity with the foregoing object in which provision is made for supplying a drilling or cooling fluid to the drilling shaft, through the same through the drill bit assembly, which shall be operated during the drilling operation.

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 top plan view of a suitable apparatus incorporating therein the principles of this invention;

Figure 2 is a perspective view of a portion of the drilling apparatus shown in Figure 1;

Figure 3 is a vertical transverse sectional view taken substantially upon the plane indicated by the section line 3—3 of Figure 1 and showing some of the interior construction of the carriage assembly;

Figure 4 is a vertical longitudinal sectional view taken substantially upon the plane indicated by the section line 4—4 of Figure 1 through the carriage assembly and showing the association of the feed screw and of the drill shaft therewith; and

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Figure 5 is a vertical longitudinal sectional view through the carriage assembly taken substantially upon the plane indicated by the section line 5—5 of Figure 3.

Referring now more specifically to the accompanying drawings, wherein like numerals designate similar parts throughout the various views, it will be seen that the apparatus incorporating therein the principles of this invention consists of a supporting frame of any desired character, indicated generally by the numeral 10, upon which is mounted a source of power such as an internal combustion engine, indicated generally by the numeral 12, and having tracks which may conveniently take the form of channel iron members 14 upon which is mounted for longitudinal travel a carriage assembly indicated generally by the numeral 16 and provided with supporting axles 18 and wheels 20 by means of which the carriage is movably mounted upon the trackway.

Journaled in suitable supporting brackets in the supporting framework 10 and between and slightly above the tracks 14 are a feed screw 22 and a drive shaft 24, the feed screw having any desired pitch of thread along its length, while the drive shaft 24 is preferably of a non-circular cross-section, a square shape being indicated, for a purpose which will later be set forth.

The carriage assembly has openings therethrough receiving the feed screw and the drive shaft so that the carriage is movable longitudinally of the same in a manner and for a purpose to be subsequently set forth.

As shown best in Figure 1, the feed screw and drive shaft are journaled in suitable journal bearings of any desired character, indicated at 26 and 28, respectively, and are capable of selective and relatively variable operation from the power source 12 by an operating means to be subsequently disclosed.

Reference is now made more specifically to Figures 3–5 for an understanding of the construction of the carriage assembly, the manner in which the same is associated with the feed screw and drive shaft and with a drill operating means.

The carriage assembly 10 comprises front and rear substantially vertical metal plates 30 and 32 to which are welded side plates 34 and 36, see Figure 3, which thus form a box-like receptacle which is open at its top and bottom. The end plates 30 and 32 are provided with apertures 38 and 40 for loosely receiving the feed screw 22 and the drive shaft 24 therethrough.

As will be apparent from Figure 4, the end plate 32 has fixedly secured in any desired man-

ner upon its inner surface and over the aperture 40 an internally threaded member or nut 42 which is screw threaded upon the feed screw 22 but is thus fixedly secured to the carriage 16. It will thus be apparent that as the feed screw is rotated, its engagement with the nut member 42 will cause an axial movement of the carriage relative to the feed screw, this movement being permitted by the rolling and supporting engagement of the wheels 20 upon the track members 14.

Referring now more specifically to Figures 3 and 5, it will be seen that the inner surfaces of the plates 30 and 32 are provided with bearing boxes 44 disposed about the apertures 40, which contain anti-friction bearing assemblies 46, of any desired character, these bearing assemblies journaling therebetween a sleeve 48 having a non-circular axial bore 50 adapted to non-rotatably but slidably receive the drive shaft 24. Intermediate its ends, the sleeve 48 has fixedly secured thereto a sprocket gear 52 whereby power or rotation imparted to the sleeve 48 by the drive shaft 24, regardless of whether the carriage is stationary or is moving longitudinally of the feed screw, drive shaft and track, may be transmitted to a driven member, as set forth hereinafter.

As will be further apparent from Figure 5, it will be seen that the bearing assemblies 46 serve to prevent endwise movement of the sleeve 48 between the end plates 30 and 32, as well as serve to journal the sleeve 48 for rotation.

The end plates 30 and 32 are further provided with apertures 54 through which extend a drill shaft 56 whose ends extend beyond both of the end plates. In order to journal and retain the drill shaft 56 and sustain the end thrust on the same, bearing boxes 58 and 60 are mounted upon the outer surfaces of the end plates 30 and 32 and are removably retained thereon as by fastening bolts or the like 62. These bearing boxes have outwardly opening chambers which receive the anti-friction bearing assemblies 64 therein, these bearing assemblies being retained in place by collars 66 having set screws 68. As will be apparent from Figure 4, the collars serve to retain the bearing assemblies in their journal boxes and also to secure the drill shaft 56 against endwise movement relative to the carriage, while permitting free rotative movement.

Suitably secured to the drill shaft 56 intermediate its ends is a sprocket gear 70 which is operatively connected to the sprocket gear 52 of the sleeve 48 by a driving means consisting of a sprocket chain 72.

It will be noted that the front end of the drill shaft 56 is provided with a socket 74 in which may be detachably mounted and secured a drill or auger bit of any desired character, such as the auger bit indicated in dotted lines at 76 in Figure 1, this auger bit being disposed above the feed screw 22 and extending forwardly from the supporting frame 10.

The drill shaft is further provided with an axial bore 78 extending throughout the length of the same, this bore communicating with the socket 74 and with the customary bore or passages provided in the auger bits, drill bits, or drilling stem assemblies with which the device is to be employed. A flexible conduit 80 which may be extended to any suitable fluid pressure source whereby a suitable fluid in the form of a gas or liquid may be supplied under pressure to the interior of the drill shaft and from thence to the interior of the auger or drill bits to cool the same, or facilitate the drilling operation as desired, is operatively connected to the rear end of the drill shaft 56.

For that purpose, the rear plate 32 of the carriage is provided with a rearwardly extending bracket 82 which embraces and extends rearwardly from the journal box 60 and has a cylindrical housing 84 suitably detachably connected to the bracket in a rigid manner, this housing containing a packing gland 86 which slidably embraces the drill shaft 56 and compresses a suitable packing or sealing means 88 within the cylindrical housing 84, thereby preventing any leakage of fluid between the housing 84 and the drill shaft 56. By means of a tubular nipple 90 extending through the rear end of the housing 84, the abovementioned flexible conduit 80 is connected to and in communication with the interior of the housing 84. It will thus be apparent that the source of fluid under pressure is at all times in communication with the bore 78 within the drill shaft 56, while the same is in operation.

In operating the device, as so far described, it will be understood that the supporting framework 10, which might conveniently be mounted upon wheels for mobility, if desired, will be properly positioned for initiating a drilling or boring operation, as, for example, in boring a tunnel beneath a roadbed or the like.

With the carriage 16 at the rearward end of the feed screw 22, an auger bit is secured in the socket 74 of the drill shaft 56, and power is applied to the drive shaft 24 which, through the sprocket gearing assembly within the carriage, effects rotation of the drill shaft and auger bit. Upon actuation of the feed screw, the carriage, together with the auger bit, will then be advanced at an adjustable and controlled rate against the surface to be drilled, and the drilling operation will be continued at any desired rate of speed until the carriage has advanced to the forward end of the feed screw. At this time, the rotation of the feed screw will be reversed to retract the carriage, and successive extensions will be applied to the auger bit and drill shaft in order to advance the auger bit to effect the completion of the desired tunneling operation.

Reference is now made more particularly to Figures 1 and 2 for an understanding of the operating means for adjustably and variably connecting the source of power consisting of the engine 12 selectively to the feed screw 22 and the drive shaft 24. The power plant 12 is provided with a conventional clutch assembly, the casing of which is indicated generally by the numeral 92 and having a control lever 94. Extending from this clutch is a power shaft 96 connected by any suitable form of removable coupling 98 to the input shaft 100 of a variable speed conventional transmission assembly 102, provided with a control lever 104 and an output shaft 106. The shaft 106 is in turn connected by a coupling member 108 to the input shaft 110 of a second variable speed transmission gearing assembly 112 having a control lever 114. The power output shaft 116 from the second transmission assembly is provided with a sprocket gear 118 over which is entrained a driving sprocket 120.

The supporting framework is provided with a stub axle 122 extending laterally therefrom, upon which is freely rotatably mounted a double sprocket gear assembly consisting of a first sprocket 124 engaged by the sprocket chain 20, and a second sprocket 126 which is connected

with a sprocket 128 on the drive shaft 24 by a sprocket chain 130.

While it is understood that any desired type of engine, clutch assembly and transmission change speed gearings may be employed in the driving train hereinbefore described, one satisfactory arrangement for the purpose of this invention may consist of any desired form of engine 12 such as a 15 horsepower gasoline engine, and which operates at approximately 1600 R. P. M., while the clutch assembly 92 may conveniently comprise a twin disk clutch. Each of the transmission gearing assemblies 102 and 112 may consist of a heavy-duty, special Ford truck transmission having four speeds forward and one reverse speed. It will thus be apparent that great flexibility and variation of speed may be obtained in driving the drive shaft 24 from the power plant 12.

It is, however, desirable to operate the feed shaft at various selected speeds in accordance with the type of work being performed by the machine, and especially at variable rates with respect to the rotation of the drive shaft. For this purpose, a special drill feeding mechanism is provided for obtaining a reversible and highly variable drive of the feed screw. For this purpose, the input shaft 110 of the second transmission casing 112 is provided with a sprocket gear 132 which operates by means of a sprocket chain 134 a driven sprocket gear 136 by means of which power is applied to the input side of a hydraulic transmission casing indicated generally by the numeral 138. This hydraulic transmission assembly may be of any known conventional design and it is to be understood that the principles of the present invention are not limited to any particular type of such transmission. However, the hydraulic transmission is provided with a control knob 140 and the speed ratio control or adjusting lever 142. By this means, the output shaft of the hydraulic casing, not shown, but connected to the sprocket chain 144, may have its direction of rotation selectively reversed through the control member 140 with respect to the rotation of the driving sprocket gear 136; and by means of the lever 142, the speed of rotation of the output shaft may be varied from zero to a maximum in either direction of rotation with respect to the driving sprocket 136.

The sprocket chain 144 connects the sprocket attached to the output shaft of the hydraulic transmission to a sprocket gear 146 carried by one end of a lay shaft 148 suitably journaled as by bearings 150 upon the supporting framework 10, this lay shaft having a further sprocket gear 152 which is connected to a sprocket gear 154 on the feed screw 22, as by a sprocket chain 156.

By the foregoing arrangement, it is evident that the feed screw 22 may have its direction of rotation varied as desired and have its speed of travel varied from zero to a maximum in either direction of rotation at any time without affecting the speed of rotation of the driving shaft 24. Thus, while the driving shaft, and consequently the drill shaft and the auger bit, may be rotated continuously at a uniform speed, the carriage 16 and consequently the drill shaft 56 and auger bit assembly may be fed into the work at any desired rate of speed; may be held stationary so that the auger bit may function to remove the material drilled or bored; and may be retracted at any speed and even stopped at any time as desired in order to permit the removal, replacement or servicing of the auger or drill bit assemblies.

It is to be understood that the machine may be constructed of any desired size, and as so far described the machine is capable of handling auger bits for effecting borings from 2 to 36 inches in diameter and from 50 to 200 feet in length. Conveniently, augers of up to six feet in length are intended to be employed, and the travel of the carriage along the feed screw is approximately six feet at a normal constant feed rate of approximately 5 to 48 inches per minute.

From the foregoing, it is felt that the construction and operation of the invention together with its many advantages will be readily apparent, 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.

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

1. A drilling machine comprising a support frame having a track, a carriage mounted for movement upon said track, a feed screw and a drive shaft journaled in said frame and extending through said carriage, a drill shaft journaled in said carriage and carried thereby, driving means in said carriage operatively connecting said drill shaft and drive shaft, a nut secured to said carriage and journaled on the feed screw for moving the carriage upon rotation of the feed screw, operating means for said feed screw and for said drive shaft, said operating means including a power shaft and a fluid transmission having an infinite number of forward and reverse speed ratios connected with said power shaft and said feed screw.

2. A drilling machine comprising a support frame having a track, a carriage mounted for movement upon said track, a feed screw and a drive shaft journaled in said frame and extending through said carriage, a drill shaft journaled in said carriage and carried thereby, driving means in said carriage operatively connecting said drill shaft and drive shaft, means on said carriage operatively connecting the same to said feed screw, operating means for selectively and independently driving said feed screw and said drive shaft, said operating means including a power shaft and a fluid transmission having an infinite number of forward and reverse speed ratios connecting said feed screw with said power shaft.

3. A drilling machine comprising a support frame having a track, a carriage mounted for movement upon said track, a feed screw and a drive shaft journaled in said frame and extending through said carriage, a drill shaft journaled in said carriage and carried thereby, driving means in said carriage operatively connecting said drill shaft and drive shaft, means on said carriage operatively connecting the same to said feed screw, operating means for selectively and independently operating said feed screw and said drive shaft, said operating means including a power shaft and a pair of change speed mechanisms operatively connecting said power shaft with said feed screw and said drive shaft, the change speed gearing mechanism connecting said feed screw

with said power shaft consisting of a fluid transmission having an infinite number of forward and reverse speed ratios.

4. A drilling machine comprising a support frame having a track, a carriage mounted for movement upon said track, a feed screw and a drive shaft journaled in said frame and extending through said carriage, a drill shaft journaled in said carriage and carried thereby, driving means in said carriage operatively connecting said drill shaft and drive shaft, means on said carriage operatively connecting the same to said feed screw, a power shaft on said frame, means connecting said power shaft with said feed screw and said drive shaft for selectively and independently driving said drive shaft and said feed screw at varying speeds and in reverse directions to one another, said last means including a fluid transmission having an infinite number of forward and reverse speed ratios connecting said feed screw with said power shaft.

5. A drilling machine comprising a support frame having a track, a carriage mounted for movement upon said track, a feed screw and a drive shaft journaled in said frame and extending through said carriage, a drill shaft journaled in said carriage and carried thereby, driving means in said carriage operatively connecting said drill shaft and drive shaft, means on said carriage operatively connecting the same to said feed screw for movement therealong, a power shaft on said frame, separate operating means connecting said feed screw and said drive shaft to said power shaft, said operating means for said feed screw consisting of a fluid transmission having an infinite number of forward and reverse speed ratios.

6. A drilling machine comprising a support frame having a track, a carriage mounted for movement upon said track, a feed screw and a drive shaft journaled in said frame and extending through said carriage, a drill shaft journaled in said carriage and carried thereby, driving means in said carriage operatively connecting said drill shaft and drive shaft, means on said carriage operatively connecting the same to said feed screw for movement therealong, a power shaft on said frame, separate operating means connecting said feed screw and said drive shaft to said power shaft, said operating means for said feed screw consisting of a fluid transmission having an infinite number of forward and reverse speed ratios, said driving means including a sleeve slidably and non-rotatably receiving said drive shaft and being journaled at its ends to the end walls of said carriage, and means connecting the drill shaft to the sleeve for simultaneous rotation therewith.

7. A drilling machine comprising a support frame having a track, a carriage mounted for movement upon said track, a feed screw and a drive shaft journaled in said frame and extending through said carriage, a drill shaft journaled in said carriage and carried thereby, driving means in said carriage operatively connecting said drill shaft and drive shaft, means on said carriage operatively connecting the same to feed screw for movement therealong, operating means for said feed screw and for said carriage for selectively and independently operating said feed screw and said drive shaft at varying speeds with respect to one another, said operating means including a power shaft, a fluid transmission having an infinite number of forward and reverse speed ratios connecting said feed screw to said power shaft.

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