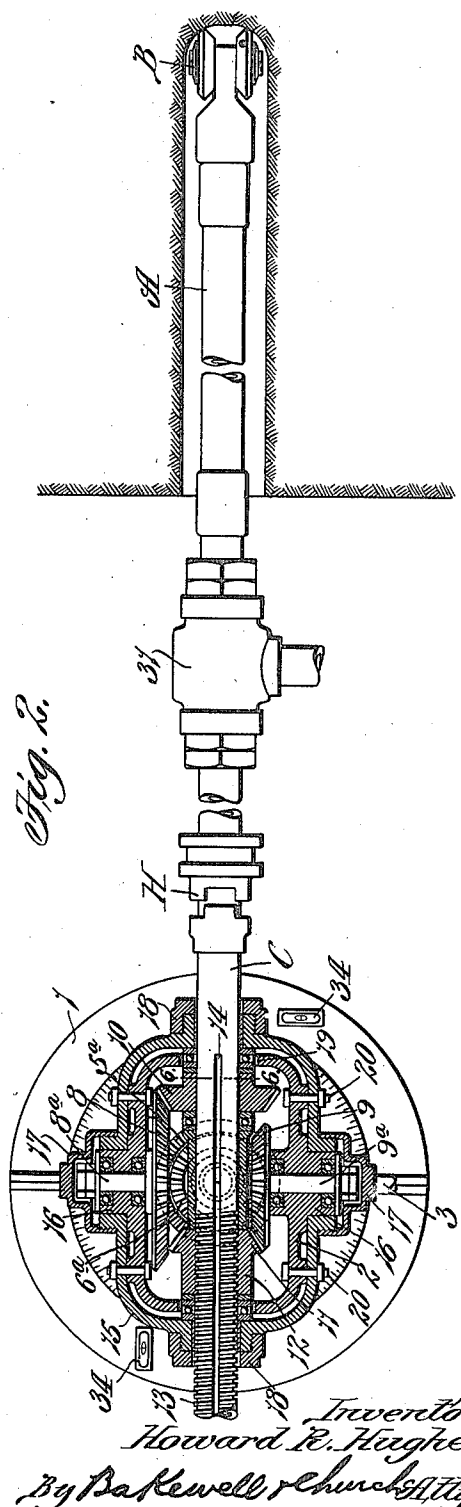
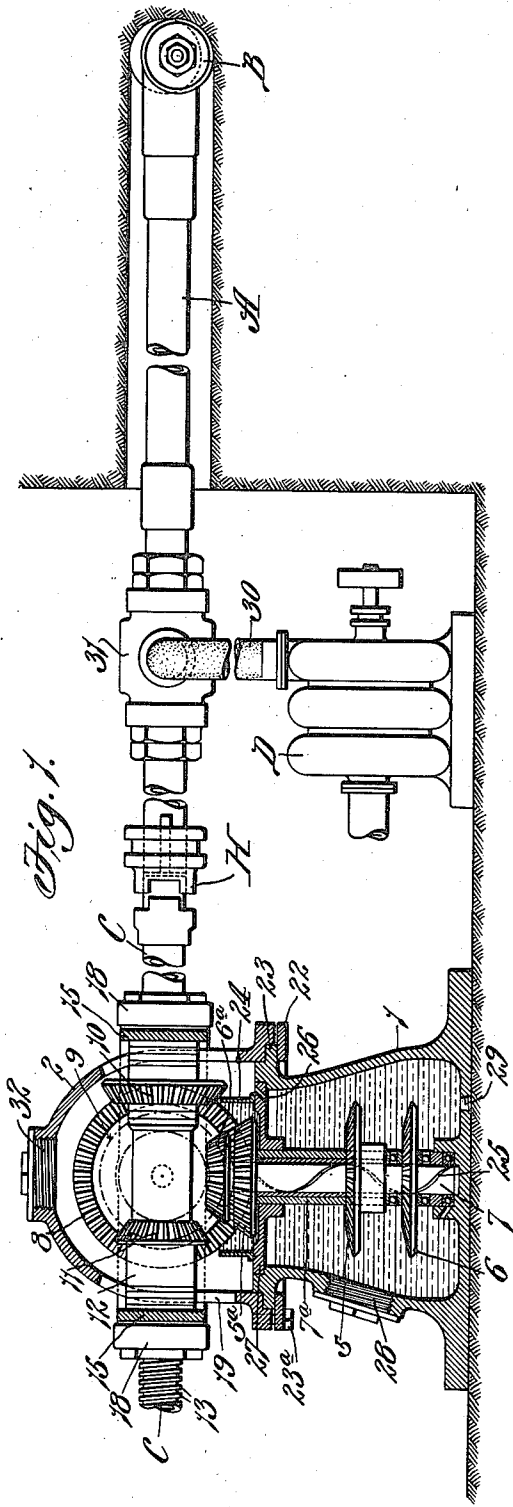


H. R. HUGHES.
HORIZONTAL DRILLING MACHINE.
APPLICATION FILED DEC. 27, 1915.

1,224,930.

Patented May 8, 1917.
2 SHEETS—SHEET 1.

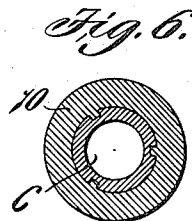
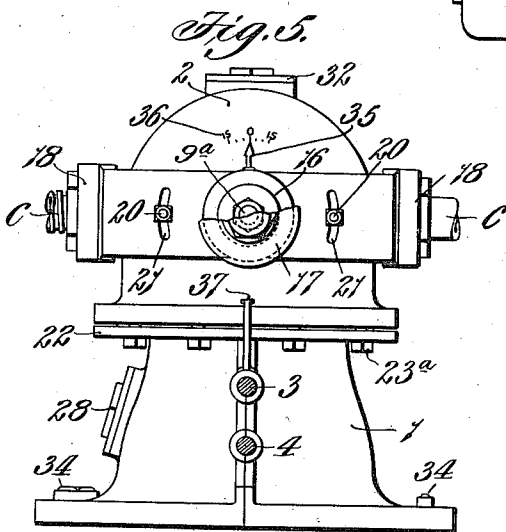
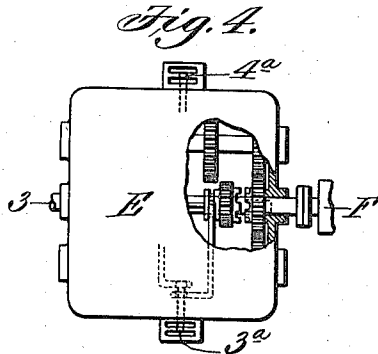
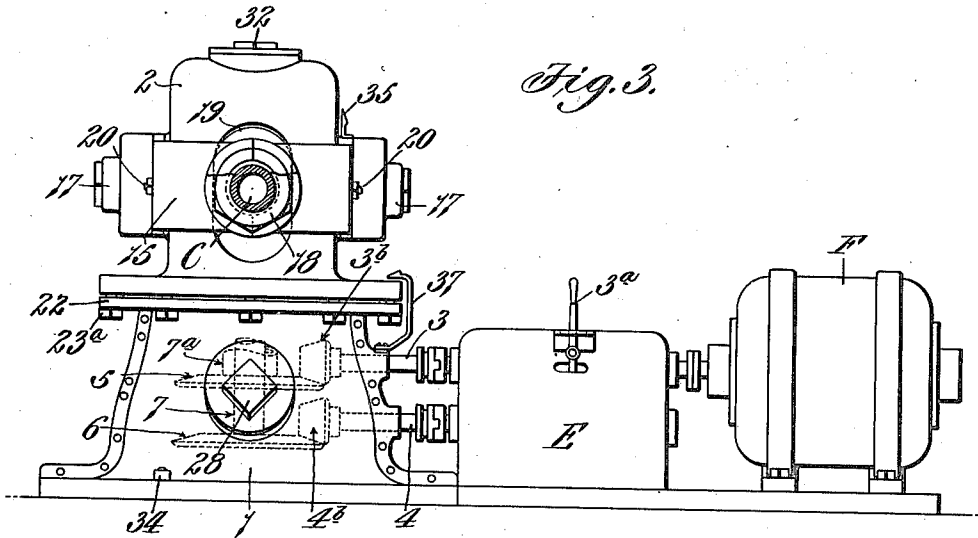


Inventor,
Howard R. Hughes.
By Bakewell & Church, Attys

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UNITED STATES PATENT OFFICE.

HOWARD R. HUGHES, OF HOUSTON, TEXAS.

HORIZONTAL-DRILLING MACHINE.

1,224,930.

Specification of Letters Patent.

Patented May 8, 1917.

Application filed December 27, 1915. Serial No. 68,859.

To all whom it may concern:

Be it known that I, HOWARD R. HUGHES, a citizen of the United States, residing at Houston, Texas, have invented a certain new and useful Improvement in Horizontal-Drilling Machines, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to a machine for drilling a horizontal, or approximately horizontal, hole in the earth.

The main object of my invention is to provide a practicable machine of simple construction for practising the invention described in my pending application filed December 7, 1915 under Serial No. 65,472, which relates to a method for destroying military fortifications, trenches and other objects located some distance from a place where the machine is installed.

Another object is to provide a machine for the purpose described that can be moved easily from place to place and which is so constructed that the mechanism for rotating and feeding the drill stem operating member is completely housed and protected from injury from objects that are thrown into the air when a shell explodes in proximity to the machine.

Another object is to provide a machine of the character described which is so constructed that it can be adjusted easily to vary the angle at which the hole is bored and to change the direction that the hole extends from the machine.

And still another object is to provide a horizontal drilling machine of novel construction that comprises means for keeping the moving parts of the machine thoroughly lubricated. Other objects and desirable features of my invention will be hereinafter pointed out.

In my pending application Serial No. 65,472, filed December 7, 1915, previously referred to, I have described a method for destroying military fortifications, trenches and other objects which consists in drilling a horizontal, or approximately horizontal, hole in the earth, to a point in proximity to the object which is to be destroyed, positioning an explosive at the inner end of the hole in proximity to said object and thereafter firing the explosive. While the machine herein shown is particularly adapted for

use in military operations of the character described in my pending application previously mentioned, it, of course, can be used for any purpose that necessitates the formation of a horizontal, or approximately horizontal, hole in the earth.

Figure 1 of the drawings is a side elevational view of my improved machine, partly in vertical section.

Fig. 2 is a top plan view of the machine, partly in horizontal section.

Fig. 3 is an end view of the machine.

Fig. 4 is a top plan view of the gear box, partly broken away, to show the gears inside of the box.

Fig. 5 is a side elevational view of a portion of the machine, illustrating the oscillating yoke or carrier in which the drill stem operating member is mounted; and

Fig. 6 is a transverse sectional view of the drill stem operating member and the pinion thereon.

Referring to the drawings, which illustrate the preferred form of my invention, A designates a drill stem to which a drill bit or rotary boring drill B of any preferred construction is connected. C designates a drill stem operating member that rotates the drill stem A and feeds it forwardly through the earth and D designates a pump of any suitable type for forcing water through the drill stem A, which is hollow, the drill stem A being made up of short sections of pipe that are coupled together in the same manner as is now generally practised in well drilling operations.

The drill stem operating member C forms a part of a machine that comprises means for feeding the member C forwardly or rearwardly at different speeds and means for rotating the member C in clockwise and anti-clockwise directions at different speeds. In the embodiment of my invention herein illustrated the machine just mentioned is provided with a housing that consists of a base portion 1 and a top portion 2 which is preferably adjustably mounted on the base portion 1. The machine also comprises a gear box E that is provided with two shafts 3 and 4 that drive gears which impart rotary movement to the drill stem operating member C and also feed said member forwardly and backwardly. Any suitable means may be employed for driving the gears in the gear box E, the means herein shown for this purpose consisting of

an electric motor F. The particular type of gear box E that is used is immaterial, and while I prefer to use a gear box provided with gears for driving the shafts 3 and 4 three speeds forwardly and three speeds rearwardly, or reverse, I wish it to be understood that my invention is not limited to a machine equipped with a gear box of any particular number of speeds or of any particular construction. The gear box E is provided with manually-operable levers 3^a and 4^a for controlling the speeds of the shafts 3 and 4 and the direction of rotation of said shafts. The shafts 3 and 4 are journaled in bearings in the base portion 1 of the housing of the machine, as shown in broken lines in Fig. 3, and said shafts are provided at their inner ends with beveled pinions 3^b and 4^b, respectively, that mesh with beveled gears 5 and 6, respectively, that are arranged inside of the base portion 1 of the casing, as shown in Fig. 1. The gear 6 is rigidly connected to a vertically-disposed shaft 7 which is provided at its upper end with a beveled gear 6^a and the gear 5 is rigidly connected to the lower end of a sleeve 7^a that surrounds the shaft 7 and which is provided at its upper end with a beveled gear 5^a, said shaft and sleeve being journaled in suitable bearings carried by the base portion 1 of the housing which is preferably made oil tight so that it will act as a holder or reservoir for lubricating oil, as shown in Fig. 1. The gear 5^a meshes with a beveled gear 8 carried by a horizontally-disposed shaft 8^a that is journaled in a bearing in one side of the top portion 2 of the housing, and the gear 6^a meshes with a beveled gear 9 carried by a horizontally-disposed shaft 9^a that is journaled in a bearing in the other side of the top portion 2 of the housing, as shown in Figs. 1 and 2. The gear 8 meshes with a beveled pinion 10 that is splined to the drill stem operating member C and the gear 9 meshes with a beveled pinion 11 carried by a horizontally-disposed, rotatable sleeve 12 which is provided with internal screw threads that mesh with external screw-threads 13 on the drill stem operating member C. The internally screw-threaded sleeve 12 is mounted in such a manner that it cannot move longitudinally of the drill stem operating member C, and consequently, when said sleeve revolves the cooperating screw threads on same and on the rear end portion of the drill stem operating member C will cause said member C to be fed forwardly or rearwardly, depending upon the direction of rotation of the sleeve 12. The pinion 10 is provided with splines or keys that fit in longitudinally-disposed key-ways 14 formed in the drill stem operating member C, and consequently, whenever the pinion 10 revolves, the member C will revolve with it.

When the sleeve 12 and pinion 10 are in operation, the drill stem A will not only be rotated, but it will also be moved longitudinally. Suitable end thrust bearings are preferably provided for the feeding sleeve 12 and for the driving pinion 10, and a tubular-shaped spacing device is loosely mounted on the drill stem operating member C between the sleeve 12 and the pinion 10, so as to prevent them from moving longitudinally of the member C away from the end thrust bearings previously mentioned. The top portion 2 of the housing is so constructed that the drill stem operating member C can be tilted vertically, so as to vary the angle of the hole that is to be formed in the earth.

The drill stem operating member C is rotatably mounted in a carrier 15 which preferably consists of a yoke that is oscillatingly mounted on horizontally-disposed trunnions 16 that project laterally from the sides of the top portion 2 of the housing, as shown in Fig. 2, said trunnions also serving as supports for the bearings in which the shafts 8^a and 9^a are journaled. If desired, removable caps 17 can be mounted on the yoke 15, so as to cover the openings in same through which the trunnions 16 project and also to house the ends of the horizontal shafts mounted in said trunnions. The yoke 15 is preferably split or formed in two halves and the two parts of same are clamped together by sleeves 18 that are screwed onto semi-circular-shaped extensions on the two halves of the yoke that embrace bushings or other suitable bearings which surround the drill stem operating member C. The front and rear walls of the top portion 2 of the housing are provided with vertically-disposed, elongated slots 19, as shown in Figs. 1 and 3, so as to permit the drill stem operating member to be tilted or oscillated vertically, and means are employed for locking the yoke 15 in adjusted position, after the member C has been arranged at the desired angle, the means herein shown for locking the yoke 15 in adjusted position consisting of bolts 20 in the side walls of the top portion 2 of the housing that project through elongated slots 21 in the yoke 15, as shown in Fig. 5.

In order that the machine may be used for drilling holes that radiate from the machine, I have constructed the machine in such a manner that the drill stem operating member C can be swung horizontally, without changing the position of the base portion 1 of the housing. In the embodiment of my invention herein illustrated this is accomplished by mounting the top portion 2 of the housing on the base portion 1 in such a way that it can be turned with relation to same, the base portion 1 thus acting as a vertical axis about which the top portion 2

and the carrier 15 thereon can be swung in a horizontal direction. Any suitable means may be employed for holding the top portion 2 of the housing in adjusted position, the means herein illustrated for this purpose
 5 consisting of a clamping ring 22 arranged on the underside of a laterally-projecting flange 23 at the upper end of the base portion 1 and detachably connected to said top
 10 portion 2 by means of bolts or other suitable fastening devices 23^a, as shown in Figs. 1 and 3.

The lubricating oil in the base portion 1 is conveyed upwardly into an oil receptacle
 15 24 carried by the plate of said base portion by means of a spiral groove 25 in the vertical shaft 7, said oil holder 24 being large enough so that the gears 8 and 9 will dip into the oil in same, and thus keep the pinions 10 and 11 thoroughly lubricated, the
 20 gears 5 and 6 in the base portion 1 being kept thoroughly lubricated by the oil in said base portion and the pinions 5^a and 6^a being kept thoroughly lubricated by the oil
 25 in the oil holder 24. The surplus oil that drains off the gears and pinions in the top portion 2 of the housing is conducted back into the oil reservoir in the base portion 1 by means of one or more ducts 26 formed in
 30 the top plate 27 of the base portion 1, as shown in Fig. 1. The base portion 1 is provided with a clean-out opening that is normally closed by a cap 28 and a drain opening is formed in the bottom of the oil reser-
 35 voir in the base portion 1, so as to permit said reservoir to be drained, said opening being normally closed by a plug 29. A clutch H is arranged in the drill stem oper-
 40 ating member C, as shown in Figs. 1 and 2, so as to permit the drill stem to be fed forwardly into the hole or pulled out of the hole when the drill is idle or not rotating, said clutch H being of any preferred con-
 45 struction. The water pump E may be driven by any suitable means (not shown) and a flexible discharge pipe 30 leads from said pump to a swivel 31 on the drill stem operating member C, said swivel being so
 50 constructed that the drill stem operating member C can rotate with relation to the portion of the swivel 31 to which the flexible discharge pipe 30 from the pump is connect-
 55 ed. A removable cap 32 in the top portion 2 of the housing normally closes an opening in same that permits the gears and pinions inside of the top portion of the housing to be inspected or adjusted. In order to facili-
 60 tate the installation of the machine, I have provided the bottom flange 33 of the base portion 1 with two spirit levels 34, as shown in Fig. 2, that enable the base portion to be set perfectly level.

One desirable feature of an apparatus of the construction above described is that it
 65 can be moved easily from place to place,

owing to the fact that it is composed of a number of units, each of which is light enough to enable it to be moved easily,—for example, the motor F constitutes one unit, the gear box E another unit, the base
 70 portion 1 of the housing another unit and the top portion 2 of the housing still another unit. The top portion 2 of the housing and the carrier 15 thereon in which the drill stem operating member C is journaled
 75 can be removed easily and quickly from the base portion 1, by simply taking off the clamping ring 22 and raising said top portion 2 upwardly far enough to disengage the gears 8 and 9 thereon from their coöperat-
 80 ing pinions 5^a and 6^a, which pinions are carried by the base portion 1 of the housing. The drill stem operating member C can be arranged in a perfectly horizontal position or in an inclined position by simply
 85 loosening the clamping bolts 20 and tilting the yoke 15 upwardly or downwardly, said yoke being preferably provided with an indicator 35 that coöperates with a scale 36 on the side wall of the top portion 2 of the
 90 housing, as shown in Fig. 5, so as to facilitate the proper adjustment of the drill stem operating member C. Said member C can also be moved horizontally by releasing the clamping bolts 23^a and turning the top
 95 portion 2 of the housing on the base portion 1, said base portion being provided with an indicator 37, as shown in Fig. 3, that coöperates with a scale on the top
 100 portion 2 of the housing to facilitate the proper adjustment of the drill stem operat-
 ing member C in a horizontal direction.

When the motor F is in operation and the gears in the gear box E are connected up with the drive shaft of the motor, the
 105 shafts 3 and 4 will revolve, and thus rotate the gears 5 and 6 on the vertical shaft 7 and the sleeve 7^a in the base portion 1 of the housing of the machine. The various gears and pinions that are interposed be-
 110 tween the gears 5 and 6 and the drive pinion 10 and the feed pinion 11 cause the drill stem A to revolve and to be fed forwardly a distance equal to the length of the ex-
 115 ternally screw-threaded portion 13 on the drill stem operating member C, assuming, of course, that the forward speed gears of the gear box are operative. After the member C reaches the end of its forward stroke the
 120 drill stem A is disconnected from the member C and said member C is thereafter fed rearwardly, or in the opposite direction, by throwing the reverse gears in the gear box E into operation. Another section of drill
 125 stem is then connected to the member C and to the outer end of the portion of the stem that remains in the hole and the forward drive gears in the gear box are thrown into operation so as to cause the drill stem to be fed forwardly a distance equal to the
 130

length of the section that was added to the drill stem, it, of course, being understood that the bit or boring tool B on the end of the drill stem revolves at a high speed when the drill stem is being fed forwardly. When the drill is in operation the pump D forces water through the drill stem so as to flush out the hole and remove the material that the drill disintegrates, and after the hole has been formed said pump can be used to force an explosive carrier through the drill stem, so as to position the explosive in proximity to the object that is to be destroyed, as described in my pending application previously referred to. The rotary speed and the rate of feed of the drill stem can be controlled accurately by shifting the gears in the gear box, and if it is desired to have the boring drill B remain idle when the drill is being withdrawn from the hole, or being introduced into the hole, this can be accomplished by manipulating the clutch H in the drill stem operating member C. The machine can be installed or disassembled easily, and when it is in use the moving parts of same, such, for example, as the various feeding and driving pinions and gears are protected by a strong metallic housing that prevents them from being injured by flying earth and objects that are thrown into the air when shells explode in proximity to the machine.

As previously stated, the machine herein illustrated is particularly adapted for use in military operations of the character previously referred to on account of its compactness, simplicity of construction and the ease with which it can be moved from place to place. I do not wish it to be understood, however, that the machine is limited to use in military operations, as it can be used in any earth drilling operation requiring the formation of a horizontal, or approximately horizontal, hole in the ground.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is:

1. A horizontal drilling machine, comprising a closed housing that comprises a base portion and a removable cover resting on same and adapted to be turned about a vertical axis, an approximately horizontally-disposed drill stem operating member that passes through openings in the cover of said housing, and a rockable carrier for said member journaled on the cover of horizontally-disposed trunnions on said housing.

2. A horizontal drilling machine, comprising a housing provided with a reservoir for holding lubricating oil and having a removable top portion that protects the elements arranged inside of the housing, a substantially horizontally-disposed drill stem operating member, means carried by said housing for supporting said member, coop-

erating gears and pinions in said housing for rotating said member and for feeding it longitudinally, some of said elements being immersed in the oil in said reservoir, and means for conducting oil to the remaining elements that are arranged above the oil in said reservoir.

3. A horizontal drilling machine provided with a housing that comprises a stationary base portion and a removable top portion that constitutes a cover for said base portion and protects the elements arranged inside of same, a substantially horizontally-disposed drill stem operating member, means mounted on the top portion of the housing for carrying said member, and mechanism for rotating said drill stem operating member and for feeding it longitudinally comprising cooperating elements in the base portion and in the top portion of the housing that loosely engage each other and which are mounted so that the top portion of the housing and the parts carried by same can be removed as a unit from the base portion of the housing without disturbing the elements arranged inside of said base portion.

4. A horizontal drilling machine provided with a housing that comprises a stationary base portion and a top portion that cooperates with said base portion to protect the elements arranged inside of the housing, a substantially horizontally-disposed drill stem operating member, a rockable carrier arranged on the top portion of said housing for supporting said member, driving gears in the base portion of the housing that revolve about a vertical axis, one of which is used to feed the drill stem-operating member and the other to rotate said member, cooperating gears on the top portion of the housing that revolve about a horizontal axis, and pinions on said drill stem operating member that mesh with said last mentioned gears and which rotate said member and feed it longitudinally when said gears are in operation.

5. A horizontal drilling machine, comprising a housing that is provided with a stationary base portion and a top portion, a substantially horizontally-disposed drill stem operating member, a yoke-shaped carrier on the top portion of said housing for supporting said member, a vertically-disposed shaft in the base portion of said housing provided with a gear, a sleeve surrounding said shaft and provided with a gear, one of said gears being used to feed said drill stem operating member and the other to rotate said member, and means carried by the top portion of the housing and by said drill stem operating member that cooperates with said gears to feed said member longitudinally and to impart rotary movement to same.

6. A horizontal drilling machine, comprising a housing that is provided with a stationary base portion and a top portion, a substantially horizontally-disposed drill stem operating member, a yoke-shaped carrier on the top portion of said housing for supporting said member, a vertically-disposed shaft in the base portion of said housing provided with a gear, a sleeve surrounding said shaft and provided with a gear, one of said gears being used to feed the drill stem operating member and the other to rotate said member, means carried by the top portion of the housing and by said drill stem operating member that cooperates with said gears to feed said member longitudinally and to impart rotary movement to same, an oil holder that surrounds said gears, and means for conducting lubricating oil from the base portion of said housing into said oil holder.

7. A horizontal drilling machine provided with a closed housing that comprises a stationary base portion, a removable top por-

tion that can be turned with relation to said base portion, means for securing said top portion in adjusted position, a substantially horizontally-disposed drill stem operating member that passes through the top portion of the housing and projects through elongated slots therein, a carrier for said member arranged on the top portion of the housing and oscillatingly mounted on same in such a manner that said drill stem operating member can be raised and lowered, means for holding said carrier in adjusted position, means on the base portion of said housing for indicating when it is perfectly level, and indicators for showing the horizontal adjustment of the top portion of the housing and the vertical adjustment of said carrier.

In testimony whereof I hereunto affix my signature in the presence of two witnesses, this 22nd day of December, 1915.

HOWARD R. HUGHES.

Witnesses:

THOS. M. APPELGARTH,
Dr. DANCHAR.