

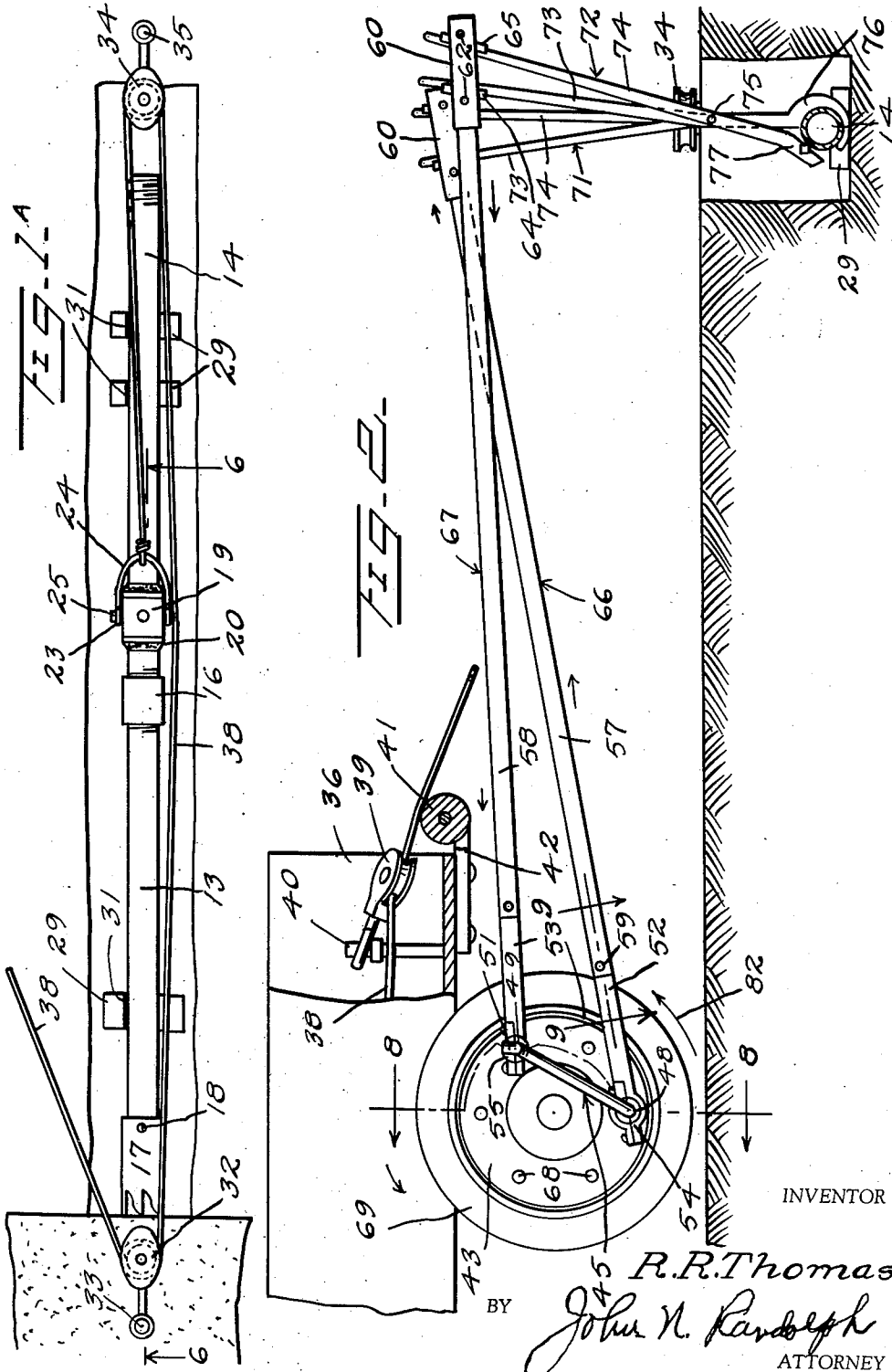
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Filed April 8, 1955

4 Sheets-Sheet 2



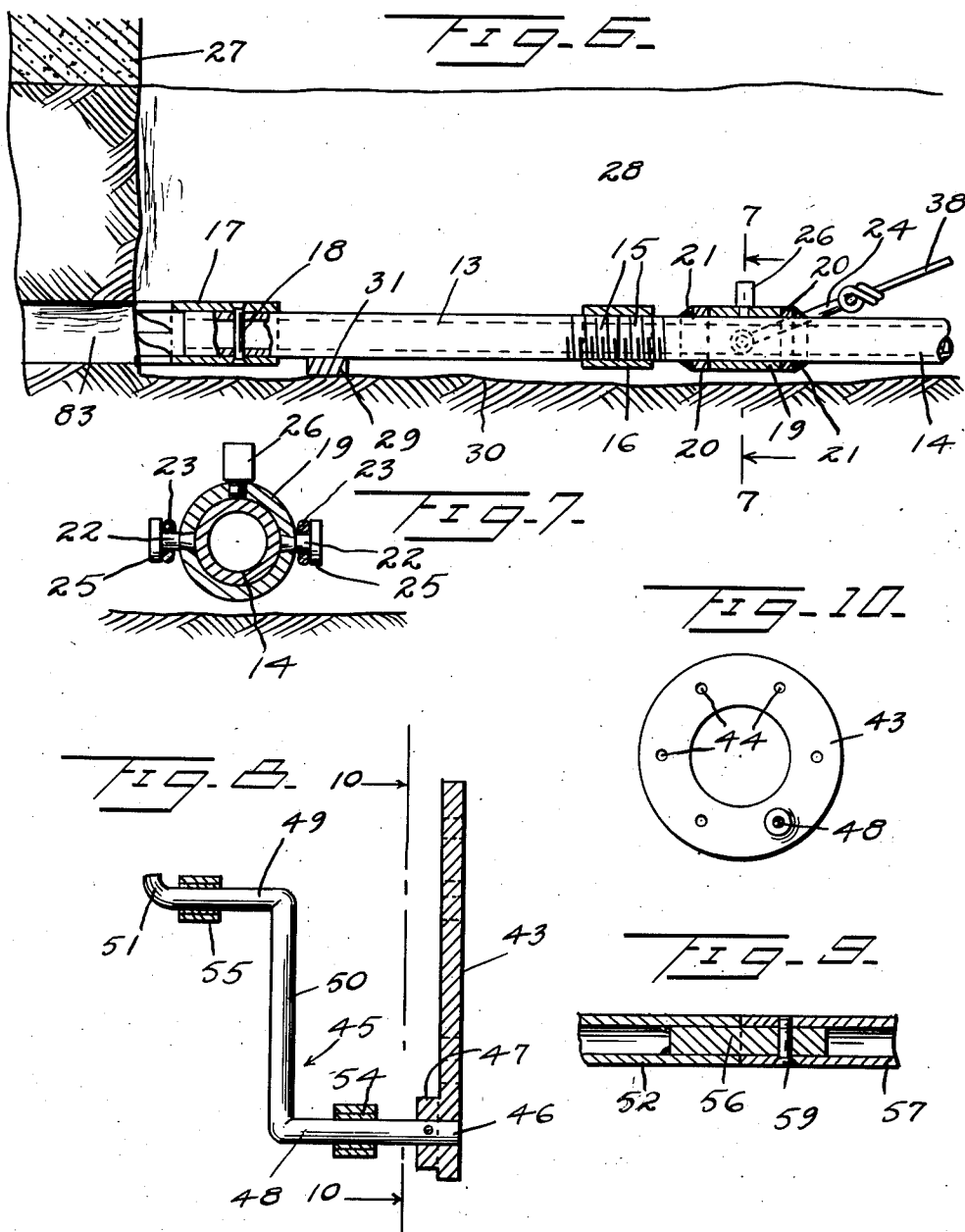
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TUNNELING APPARATUS

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10 Claims. (Cl. 255—20)

This invention relates to an apparatus for tunneling and more particularly to an apparatus for accomplishing a substantially horizontal underground boring operation.

More particularly, it is a primary object of the present invention to provide an underground boring apparatus of simple construction which may be very economically manufactured and which may utilize the power of a motor truck for operating the apparatus thus greatly simplifying the apparatus and eliminating the necessity of providing a separate power source for operating the boring device.

A further object of the invention is to provide a boring apparatus wherein the prime mover of a truck utilized to transport the apparatus may be employed for simultaneously turning the apparatus about its longitudinal axis and for displacing the apparatus longitudinally for accomplishing the boring operation.

A further object of the invention is to provide an apparatus having novel means for operatively connecting the apparatus to a motor truck for driving the apparatus from the prime mover of the truck.

Various other objects and advantages of the invention will hereinafter become more fully apparent from the following description of the drawings, illustrating a presently preferred embodiment thereof, and wherein:

Figure 1 is a top plan view, partly broken away, showing the apparatus in an operative boring position;

Figure 1A is a fragmentary plan view of a part of the apparatus with the parts arranged for pulling the auger from a hole bored thereby;

Figure 2 is an enlarged sectional view, partly in elevation, taken substantially along a plane as indicated by the line 2—2 of Figure 1;

Figure 3 is an enlarged fragmentary vertical sectional view of a part of the apparatus, taken substantially along a plane as indicated by the line 3—3 of Figure 1;

Figure 4 is a vertical sectional view of a part of the apparatus, taken substantially along a plane as indicated by the line 4—4 of Figure 3;

Figure 5 is a fragmentary horizontal sectional view, taken substantially along a plane as indicated by the line 5—5 of Figure 3;

Figure 6 is a fragmentary longitudinal sectional view, taken substantially along a plane as indicated by the line 6—6 of Figure 1A;

Figure 7 is a detail cross sectional view, taken substantially along a plane as indicated by the line 7—7 of Figure 6;

Figure 8 is an enlarged fragmentary sectional view of a part of the boring attachment taken substantially along a plane as indicated by the line 8—8 of Figure 2 and shown detached from the motor vehicle;

Figure 9 is an enlarged fragmentary longitudinal sectional view, taken substantially along a plane as indicated by the line 9—9 of Figure 2, and

Figure 10 is a sectional view on a reduced scale, taken substantially along a plane as indicated by the line 10—10 of Figure 8.

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Referring more specifically to the drawings, the tunneling apparatus in its entirety and comprising the invention is designated generally 12 and includes at least two lengths of pipe or rigid tubing 13 and 14. The pipes 13 and 14 have adjacent ends which are threaded as seen at 15 and which are detachably connected to one another in end-to-end relation by a threaded collar or sleeve 16, as best seen in Figure 6. An auger 17 of any conventional type is secured to and projects from the other, leading end of the pipe 13. The auger 17 is shown connected to the pipe 13 by a rivet or similar fastening 18. A sleeve 19 is swivelly mounted on the pipe 14, adjacent its threaded end 15, and is loosely disposed between collars 20 which are immovably secured to the pipe 14, as by means of welding, as seen at 21. The collars 20 prevent the sleeve 19 from moving longitudinally relative to the pipe 14. The sleeve 19 is provided with aligned trunnions 22, as best seen in Figure 7 on which are journaled eyes or loops 23 forming the ends of a bail 24. The trunnions 22 are provided with heads 25 at their outer ends to retain the eyes or loops 23 in engagement therewith. A grease or lubricant fitting 26 is carried by the upper portion of the sleeve 19, between and circumferentially spaced from the trunnions 22, and by means of which the bore of the sleeve and the pipe portion engaged thereby can be lubricated to permit the pipe 14 to rotate freely relative to the sleeve 19, as will hereinafter be described.

The auger 17 is adapted to be utilized for tunneling or horizontally boring underground, as for example, under a highway 27 or under the foundation of a building or other structure. For this purpose, a trench 28 is dug at a right angle to the highway 27 and extends from one side thereof, in which the connected pipes 13 and 14 are disposed lengthwise of the trench 28, with the auger 17 at the inner end of said trench, as illustrated in Figures 1 and 6. The pipes 13 and 14 may be supported in horizontal positions in any suitable manner, as by means of blocks 29 which rest on the bottom 30 of the trench 28 and which may have upwardly opening notches 31 forming grooves or channels in which the pipes 13 and 14 rest.

A pulley 32 is anchored, as by means of a stake 33 adjacent the inner end of the trench 28, and a similar pulley 34 is anchored, as by means of a stake 35 adjacent the outer end of the trench 28. The pulleys 32 and 34 are disposed adjacent ground level, as illustrated in Figure 2.

The apparatus 12 is utilized in conjunction with a conventional motor truck on which the apparatus can be transported. A part of the motor truck is illustrated in the drawings including a part of the truck body 36. The motor truck is equipped with a power winch 37 of conventional construction located in the truck body 36 and which can be driven in a conventional manner, not shown, by a power take-off shaft. A flexible member 38, such as a line or cable, is wound on the winch 37 and has one end extending therefrom around a pulley 39 which is swingably connected, as seen at 40 to the truck body 36. The truck body 36 may be provided with a roller 41 disposed beyond the rear end thereof and journaled in bearings 42. The flexible member 38 extends from the pulley 39 over a portion of the roller 41 and at an oblique angle away from the rear end of the truck body 36 to the pulley 32 around which it is trained. The flexible member 38 extends from the pulley 32 to the bail 24 to which an end thereof is secured, as seen in Figure 1.

The apparatus 12 also includes an annular plate 43, as best seen in Figures 8 and 10, having a plurality of circumferentially spaced openings 44. As best seen in Figure 8, a rod 45 has an end 46 secured in a boss 47

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forming a part of the plate 43. A part of the rod 45 which extends outwardly from the boss 47 forms a crank 48. The rod 45 also includes a second crank 49 which is outwardly offset relative to the crank 48. An intermediate rod portion 50 connects the outer end of the crank 48 to an inner end of the crank 49. The crank 49 has a stop portion or abutment 51 at its outer, free end. As best seen in Figure 2, the cranks 48 and 49 are spaced substantially equal distances from the center of the plate 43 and are circumferentially spaced relative to one another.

A pair of arms 52 and 53 have journal members 54 and 55, respectively, at corresponding ends thereof which are journaled on the cranks 48 and 49 and which preferably include antifriction bearing means. The arms 52 and 53 have restricted stems at opposite ends thereof which engage in complementary ends of a pair of pipes 57 and 58. The stems 56 are secured to the pipes 57 and 58 by suitable fastenings 59, as best seen in Figure 9. A pair of metal strap members or plates 60, as best seen in Figures 3, 4 and 5, are secured to the opposite end of each pipe 57 and 58 and extend outwardly therefrom. The strap members 60 of each part 57 and 58 have inner ends which straddle said part and are secured thereto in any suitable manner as by welding, as seen at 61. A pair of pins 62 are supported by each pair of straps 60 and have their ends journaled in openings 63 of said straps. The pins 62 are spaced a substantial distance apart. A channel member is secured intermediate of its ends in any suitable manner, as by welding, as seen at 61, to each of the pins 62. The channel member 64 of the inner pin 62 opens outwardly, as best seen in Figure 5, and the channel member 65 of the outer pin 62 opens inwardly, so that the open sides of said channel members face toward one another. As seen in Figures 3 and 5, said channel members 64 and 65 are disposed between the pins 62 and are swingable with said pins relative to the straps 60. The parts 52, 54, 57 and the straps 60, pins 62 and channels 64 and 65 associated with the part 57 combine to form a pitman, designated generally 66. Similarly, the parts 53, 55, 58, and the straps 60, pins 62 and channels 64 and 65 associated with the part 58, combine to form a pitman 67.

The plate 43 is adapted to be secured by fastenings 68 which engage the openings 44 to the outer side of a rear wheel 69 of the truck, or if the wheel 69 is removed, to the brake drum 70. The fastenings 68 may comprise conventional lug bolts. The wheel 69 to which the plate 43 is secured is jacked up, as illustrated in Figure 2 so that it can be revolved by the prime mover or engine of the truck and while the truck is held stationary as by blocks, not shown, placed against the other wheels of the truck.

The tunneling apparatus 12 also includes a pair of tongs, designated generally 71 and 72, each comprising a pair of arms 73 and 74 which are swingably connected to one another near to but spaced from lower ends thereof by a pivot fastening 75. The lower end of the arm 73 of each pair of tongs terminates in a substantially semicircular portion forming a hook or bowl 76 which opens toward the lower end of the arm 74 and which engages partially around the pipe 14. The lower end of the arm 74 terminates in a part 77 which is disposed at an angle to the remainder of the arm 74 and which extends in a direction away from the arm 73. The part 77 has a groove 78 extending transversely therethrough, as best seen in Figure 3, which is rectangular in cross section and with a corner portion thereof opening outwardly of the inner side of the part 77, so that the opening of the groove 78 is of a width substantially less than an inner part of said groove. An elongated die 79, of rectangular or square cross section, is applied endwise to the groove 78 and a wedge member 80, of angular cross section, is driven into said groove 78 between its bed portion and two of the sides of the die 79 for securing the die immovably in the arm portion 77 and with one longitudinal edge of the die

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protruding from the inner edge of the arm portion 77, as illustrated in Figure 3. It will be readily apparent that the die 79 can be removed from the groove 78 and turned to position different ones of its longitudinal edges in an operative position, so that as each edge of the die becomes worn the die can be removed and turned to position another sharp edge thereof in an exposed position to engage the pipe 14. As seen in Figure 2, the bowl or hook portion 76 engages the half of the pipe 14 which is located remote from the truck and the die 79 engages a part of the pipe which is circumferentially spaced from the portion thereof engaged by the hook or bowl 76. The upper, free ends of the arms 73, which extend upwardly from the trench 28, are disposed nearer the wheel 69 than the upper ends of the arms 74.

The upper ends of the arms 73 and 74 of the tongs 71 engage the channels 64 and 65, respectively, of the pitman 66 and the channels 64 and 65 of the pitman 67 engage the upper portions of the arms 73 and 74, respectively, of the tongs 72. Said channels are initially permitted to slide downwardly on the arms of the tongs to adjacent the pivot 75 in order that the lower ends of the tongs can be opened sufficiently to engage the tongs with the pipe 14, as illustrated in Figures 2 and 3, after which the end portions 60 of said pitmans are swung upwardly relative to the tongs. Suitable means may be provided for holding the channels 64 and 65 in engagement with the upper portions of the arms 73 and 74, respectively, and remote from the tong pivot 75, as for example pins 81 which extend slidably through the arms 73 and channels 64 and similar pins 81 which slidably engage the arms 74 and channels 65, as illustrated in Figure 3. As best illustrated in Figure 3, when the tong portions 76 and 79 are in engagement with the pipe 14, the spacing between the beds of the channels 64 and 65 is slightly greater than the spacing between the remote edges of the arms 73 and 74 which engage said channel beds to permit the tongs to be released from gripping engagement with the pipe 14 while the arms thereof are in engagement with the channels 64 and 65. As best seen in Figure 4, the upper ends of the arms 73 and 74 of each pair of tongs are disposed in alignment, as by laterally offsetting the upper portion of the arms 74.

Assuming that the apparatus is arranged as illustrated in Figures 1 and 2, and that the wheel 69 and brake drum 70 are rotated counterclockwise, as seen in Figure 2 and as indicated by the arrow 82, and that the winch 37 is driven in a direction for winding the cable 38 thereon, when the apparatus 12 is thus actuated the auger 17 will be rotated and will be simultaneously advanced from right to left as seen in Figure 1, for boring a hole 83 below ground level under the roadway 27. To accomplish this result, the pipes 13 and 14 forming a stem for the auger 17 are pulled from right to left as seen in Figure 1, due to the fact that the cable 38 extends from the bail 24 toward the left as seen in Figure 1 and around the pulley 32 and the cable end attached to said bail is pulled toward the pulley 32. At the same time, the plate 43 rotates with the wheel 69 and brake drum 70 in a direction as indicated by the arrow 82. This rotation of the plate 43 and the rod 45 causes the pitmans 66 and 67 to be reciprocated. As the pitman 66 moves in one direction, the pitman 67 moves in the opposite direction, due to the circumferential spacing between the cranks 48 and 49 to which said pitmans are connected. In the position of the rod 45 as seen in Figure 2, the crank 49 and the pitman 67 connected thereto are moving toward the left. Accordingly, the channel member 65 of the pitman 67 is pulling on the upper portion of the arm 74 in a direction from right to left as seen in Figure 2, causing said arm to tend to swing counterclockwise about its pivot 75 so that the die 79 thereof is forcibly urged against the pipe 14 to prevent the tongs from turning relative to said pipe. Consequently, the pipes 13 and 14 and the auger 17 will turn in a counterclockwise direction as seen in Figure 2

or in the direction as indicated by the arrow 84, as seen in Figure 1.

Since the crank 48 at the same time is moving from left to right of Figure 2, the pitman 66 connected thereto is being pushed or thrust toward the tongs 71 to which it is connected so that the channel member 64 thereof is exerting a thrust against the arm 73. As seen in Figure 3, sufficient play exists between the upper portions of the arms of each pair of tongs and the channel members 64 and 65 engaged thereby, so that when a thrust is being exerted by the channel 64 against the arm 73, the arm 74 of the same pair of tongs will loosely engage in its channel 65 and its die 79 will not be held in gripping engagement with the pipe 14. Accordingly, the pipe 14 can turn relative to the tongs 71 which are being swung from left to right as seen in Figures 2 and 3.

It will be readily apparent that when a pull is subsequently exerted on the pitman 66 the tongs 71 thereof will function to grip and turn the pipes and auger in the direction as indicated by the arrow 84 and at the same time a thrust will be exerted on the pitman 67 which will cause the tongs 72 to swing counterclockwise as seen in Figures 2 and 3 and to turn relative to the pipe 14. Thus, this oscillating movement of the tongs in opposite directions relative to one another will effect a rotation of the auger and pipes in the direction as indicated by the arrow 84 for drilling the hole 83.

The pipe ends 15 and the collar 16 are threaded in such a direction that rotation of the pipe 14 by the tongs 71 and 72 will tend to tighten the connection of the collar with said pipe ends. It will also be understood that additional lengths of pipe may be utilized with additional collars 16 and which can be interposed between the pipes 13 and 14. Such additional pipes are provided with two threaded ends corresponding to the ends 15 and may be of any desired length.

The blocks 29 function to maintain the pipes 13 and 14 and auger 17 in substantially a horizontal position and in longitudinal alignment with a portion of the trench 28 in which said pipes are disposed, so that the auger 17 will drill in a straight line. Additionally, certain of the blocks 29 are disposed to be engaged by the bowls 76 of the tongs 71 and 72 to resist displacement of the tongs with the pipe 14 from right to left as seen in Figure 1, so that said tongs will be maintained substantially in alignment with the cranks 48 and 49, respectively.

When it is desired to remove the auger from the bored hole, either after completing the boring operation, or for cleaning the auger, the cable 38 is payed out and the end thereof attached to the bail 24 is unfastened and extended around the pulley 34 and then re-attached to the bail 24, as illustrated in Figure 1A. The tongs may then be disconnected from the pipe 14, after which the winch 37 is driven for winding the cable 38 thereon so that the cable portion extending between the bail 24 and pulley 34 will exert a pull on said bail to pull the pipes 13 and 14 and auger 17 from left to right as seen in Figure 1A for removing the auger from the drill hole.

Various modifications and changes are contemplated and may obviously be resorted to, without departing from the function or scope of the invention as hereinafter defined by the appended claims.

I claim as my invention:

1. A drilling apparatus of the character described comprising an elongated stem adapted to be disposed in substantially a horizontal position, an auger fixed to and extending beyond one end of said stem, two tongs engaging said stem remote from the auger and projecting at substantially right angles from the stem, a rotatably driven means disposed with its axis of rotation substantially parallel to said stem, a pair of cranks secured to said rotatably driven means, said cranks being radially spaced from the axis of rotation of said means and being circumferentially spaced relatively to one another, a pair of pitmans, said pitmans having complementary ends

journaled on said cranks, means forming parts of the opposite ends of said pitmans and connecting said last mentioned pitman ends to the arms of said two tongs remote from the stem, said pitmans being reciprocated in opposite directions relative to one another by rotation of said first mentioned means for oscillating the tongs in opposite directions relative to one another, each of said tongs having an arm against which a force is exerted by the pitman connected thereto upon movement of said pitman in one direction, said tong arm having a toothed jaw face which is moved into gripping engagement with the stem when the tongs thereof are swung by engagement of the pitman means with said arm for causing the stem and auger to turn with said tongs, each of said tongs including a second arm against which a force is exerted by the pitman connected thereto for swinging the tongs in the opposite direction, said second arm of the tongs having a smooth jaw face capable of slidably engaging the stem whereby the tongs are swung relative to the stem when moved in the last mentioned direction, a sleeve swivelly and nonslidably mounted on said stem between the auger and said tongs, and power driven pulling means operable simultaneously with said first mentioned means, connected to said sleeve, and extending therefrom toward the auger for moving the stem and auger in a direction longitudinally of the stem to advance the auger in a drilling operation as the auger is revolved.

2. An apparatus as in claim 1, and guide means in which said stem is slidably and turnably supported for retaining said stem against rocking movement during the drilling operation thereof, said guide means including parts disposed in engagement with portions of said tongs to prevent movement of the tongs with the stem lengthwise of said stem.

3. An apparatus as in claim 1, said pulling means including a bail swingably supported on the swivelly mounted sleeve, and a pulley disposed remote from the auger and about which the pulling means is trained for reversing the direction of pull on said bail for withdrawing the auger and stem from a hole drilled by the auger.

4. The combination with a motor vehicle equipped with a power winch and a rotatably driven part capable of revolving when the vehicle is stationary; a tunneling apparatus including an elongated stem, an auger fixed to and extending from one end of said stem, means supporting said stem for rotation and sliding movement of the stem and auger, two tongs each having jaws engaging said stem remote from the auger, said tongs extending at substantially right angles from the stem and each including a pair of pivoted arms forming extensions of the jaws, each of said tongs including a jaw having means for gripping the stem and a second jaw slidably engaging the stem, a pitman connected to each of said tongs, said pitmans having means at corresponding ends thereof for engaging each of the arms of the tongs connected thereto, means connecting the opposite ends of said pitmans to said rotatably driven part for converting the rotary motion of said part to reciprocating motion of said pitmans and for simultaneously moving the pitmans in opposite directions relative to one another for reciprocating said tongs simultaneously in opposite directions, said pitman means including abutments engaging and exerting a thrust against arms of the tongs forming extensions of the jaws provided with said gripping means when the pitmans are moved in one direction to urge said gripping means toward the stem for turning the stem with the tongs, said pitman means including abutments engaging and exerting a thrust against the arms of the tongs forming extensions of said second jaws when the pitmans are moved in the opposite direction to urge said second jaws only toward the stem for turning the tongs relative to the stem, a cable partially wound on said winch and having a free end portion extending longitudinally of the stem in a direction away from said auger, a sleeve swivelly and nonslidably mounted on said stem between the auger

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and tongs and remote from said auger, and a bail connecting the sleeve and cable, whereby the stem and auger is advanced by operation of the winch simultaneously with rotation of the stem and auger by said tongs.

5. In an apparatus as in claim 4, said abutments of each of the pitmans including a pair of channel members disposed in longitudinally spaced relation to one another and having open sides facing toward one another in which the arms of the tongs engage.

6. In an apparatus as in claim 5, and means for pivotally mounting said channel members on the pitmans for individual swinging movement of said channel members relatively to the axes of the pitmans.

7. In an apparatus as in claim 4, the axis of rotation of said rotatably driven part being disposed substantially parallel to the stem, said means connecting the rotatably driven part to the pitmans comprising a mounting plate detachably secured to said rotatably driven part for rotation therewith, and a pair of cranks fixedly supported by said mounting plate and on which opposite ends of said pitmans are journaled, said cranks being radially

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spaced from the axis of rotation of said part and being circumferentially spaced relative to one another.

8. In an apparatus as in claim 4, and holding means engaging portions of said pairs of tongs and retaining the tongs against movement with the stem in a direction longitudinally of the stem.

9. In an apparatus as in claim 4, said stem being formed of detachably connected sections disposed in end-to-end relation to one another.

10. In an apparatus as in claim 4, said bail being pivotally mounted on the sleeve, and means for reversing the direction of pull of the cable on said bail for withdrawing the auger and stem from a drill hole.

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