Nov. 8, 1932. T. C. SMITH ET AL 1,887,172

COMBINED EARTH BORING MACHINE AND DERRICK APPARATUS

Filed July 2, 1932 6 Sheets-Sheet 1

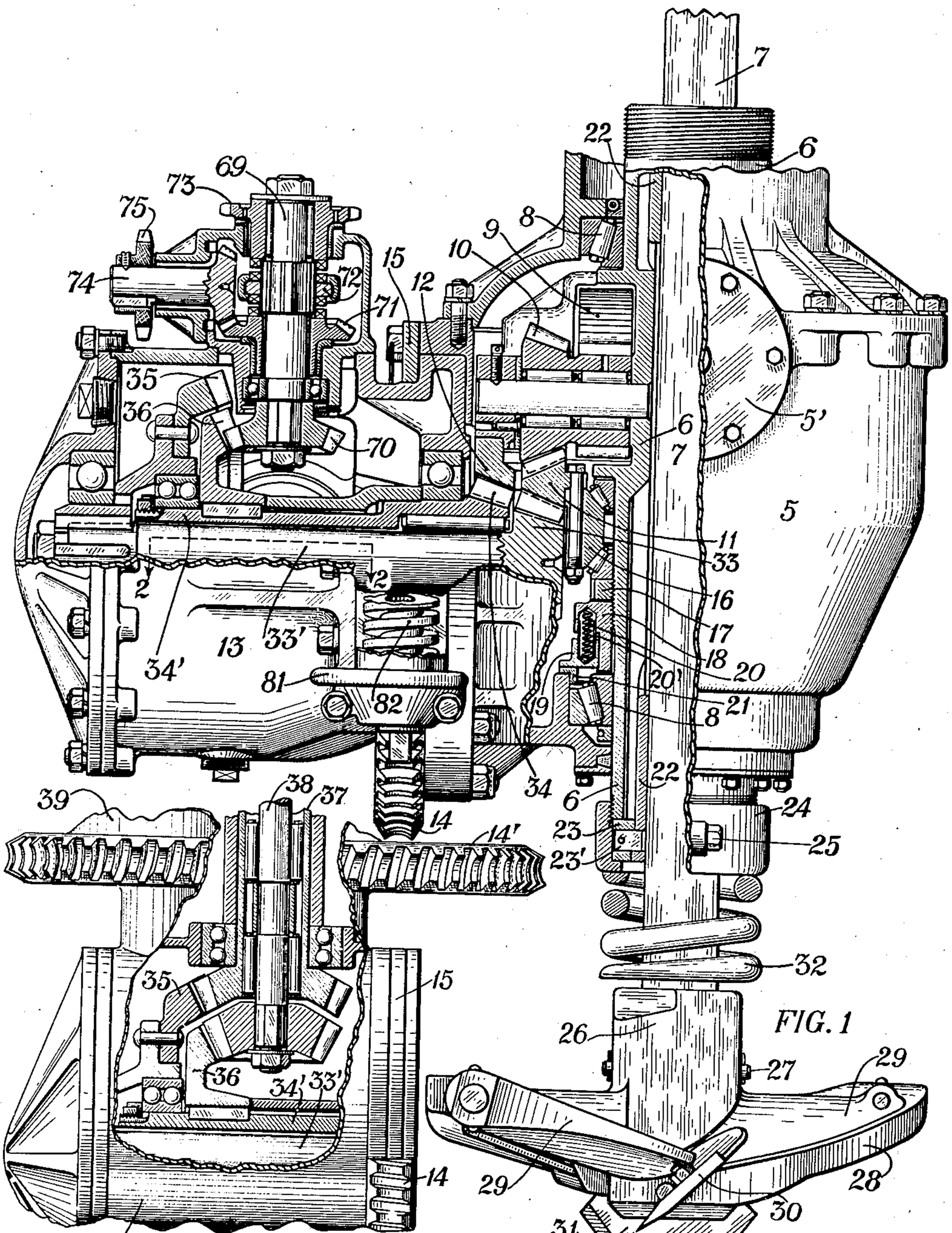

FIG. 1

FIG. 2

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COMBINED EARTH BORING MACHINE AND DERRICK APPARATUS

Filed July 2, 1932 6 Sheets-Sheet 2

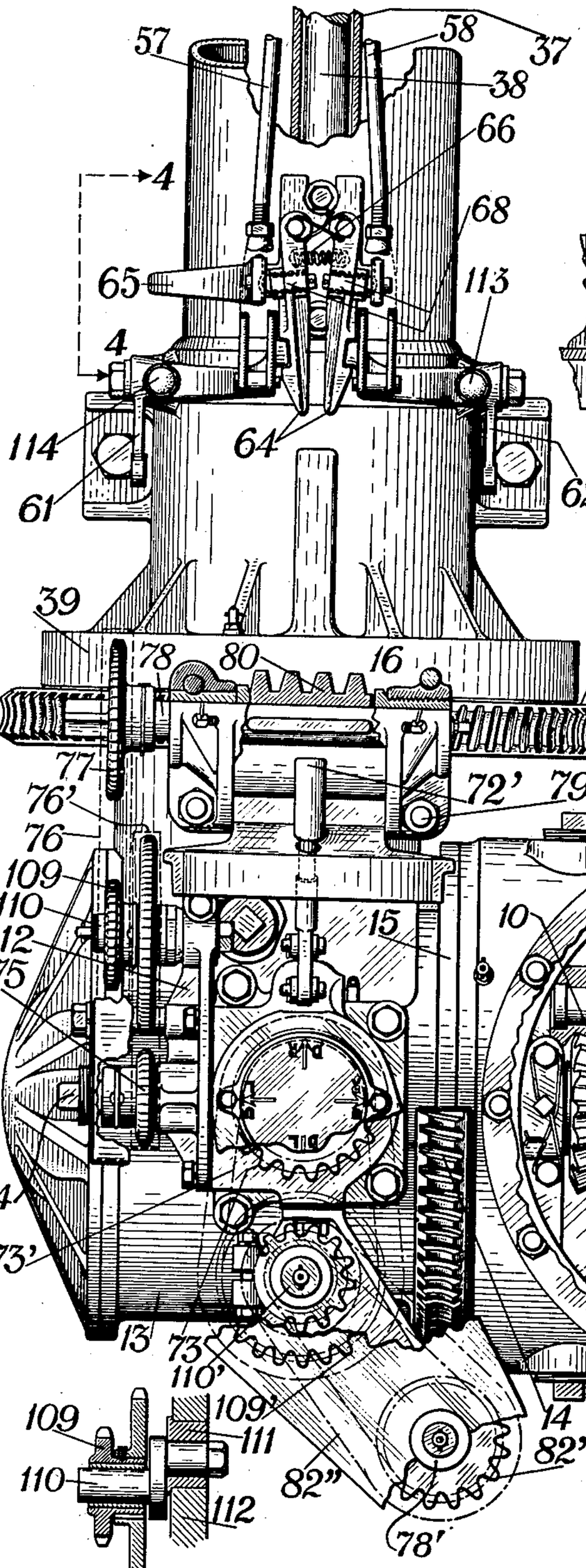

FIG. 3

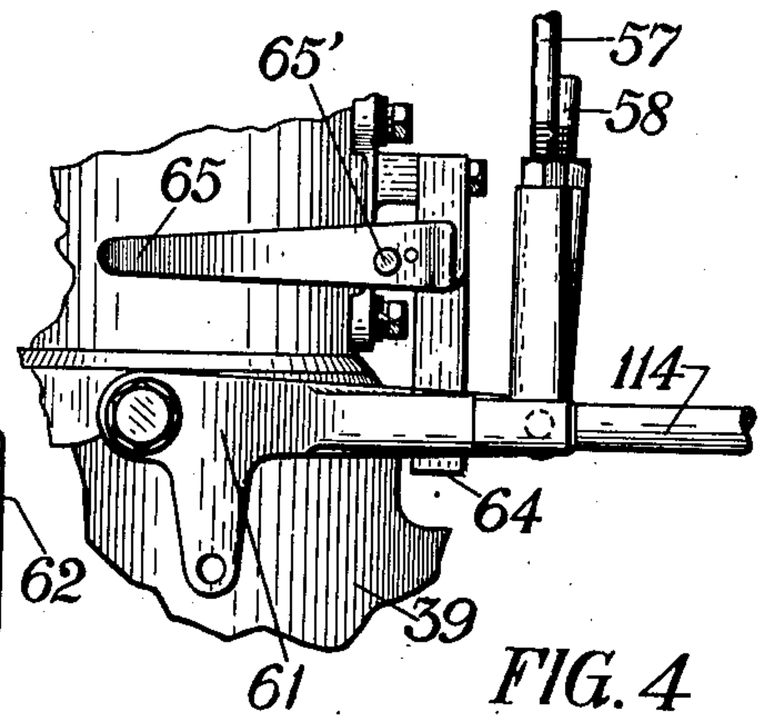

FIG. 4

FIG. 3a

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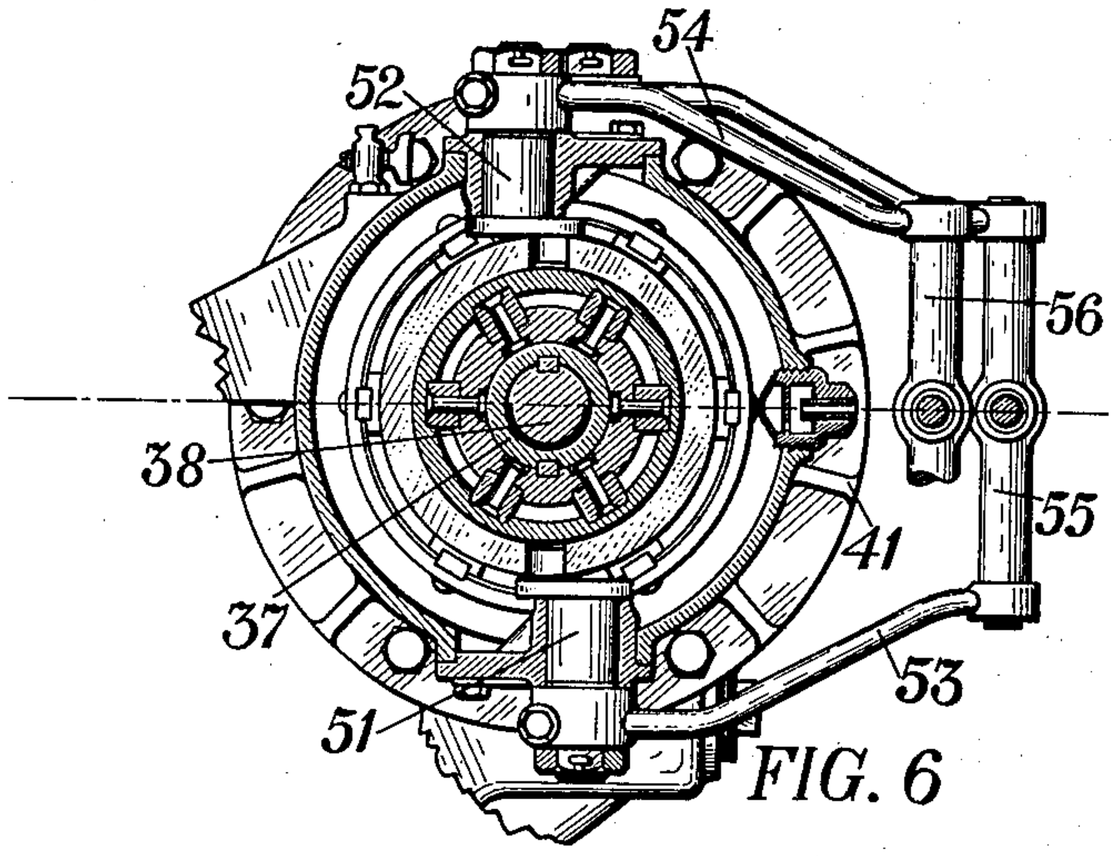

FIG. 6

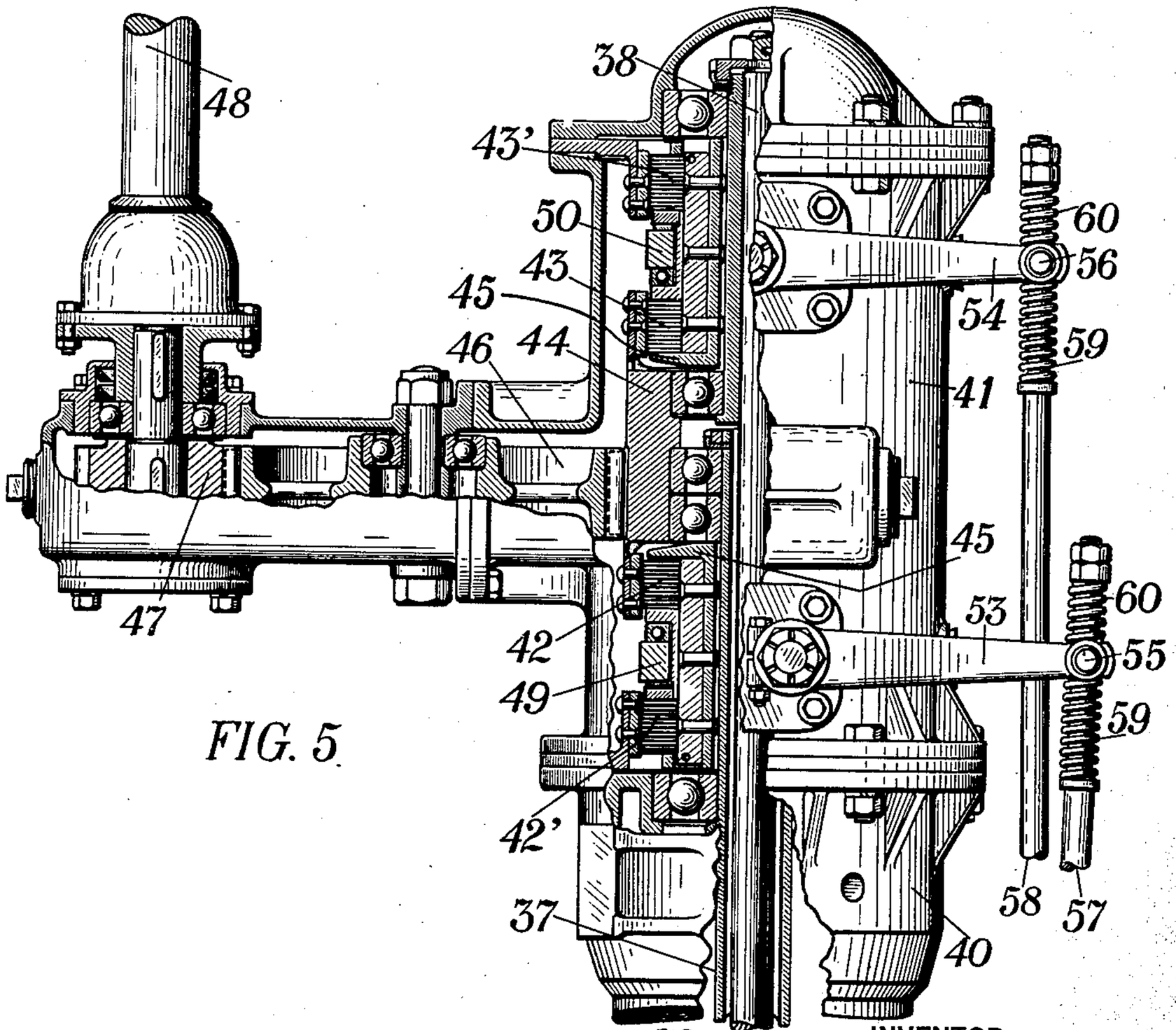

FIG. 5

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COMBINED EARTH BORING MACHINE AND DERRICK APPARATUS

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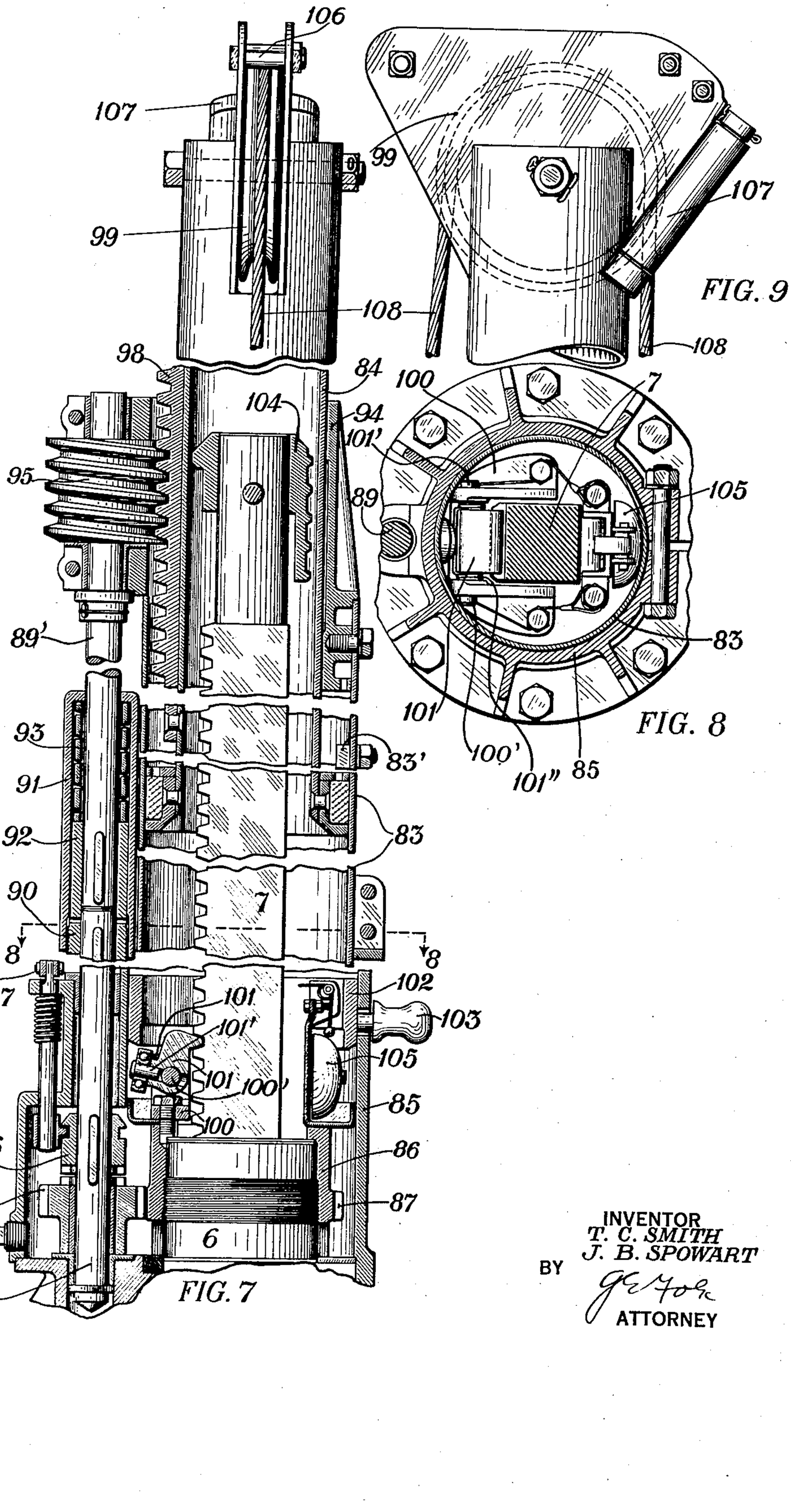

FIG. 7

FIG. 8

FIG. 9

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COMBINED EARTH BORING MACHINE AND DERRICK APPARATUS

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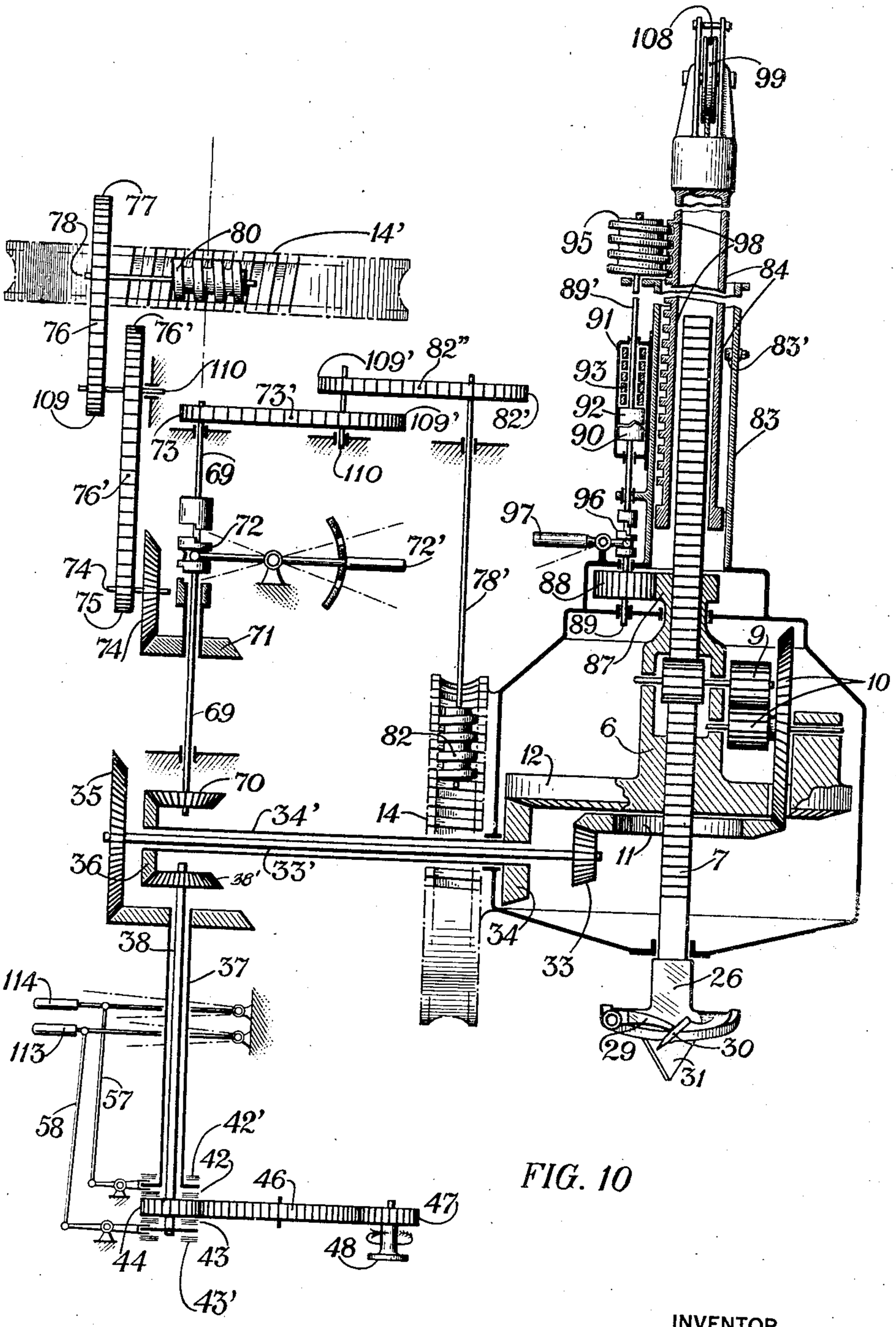

FIG. 10

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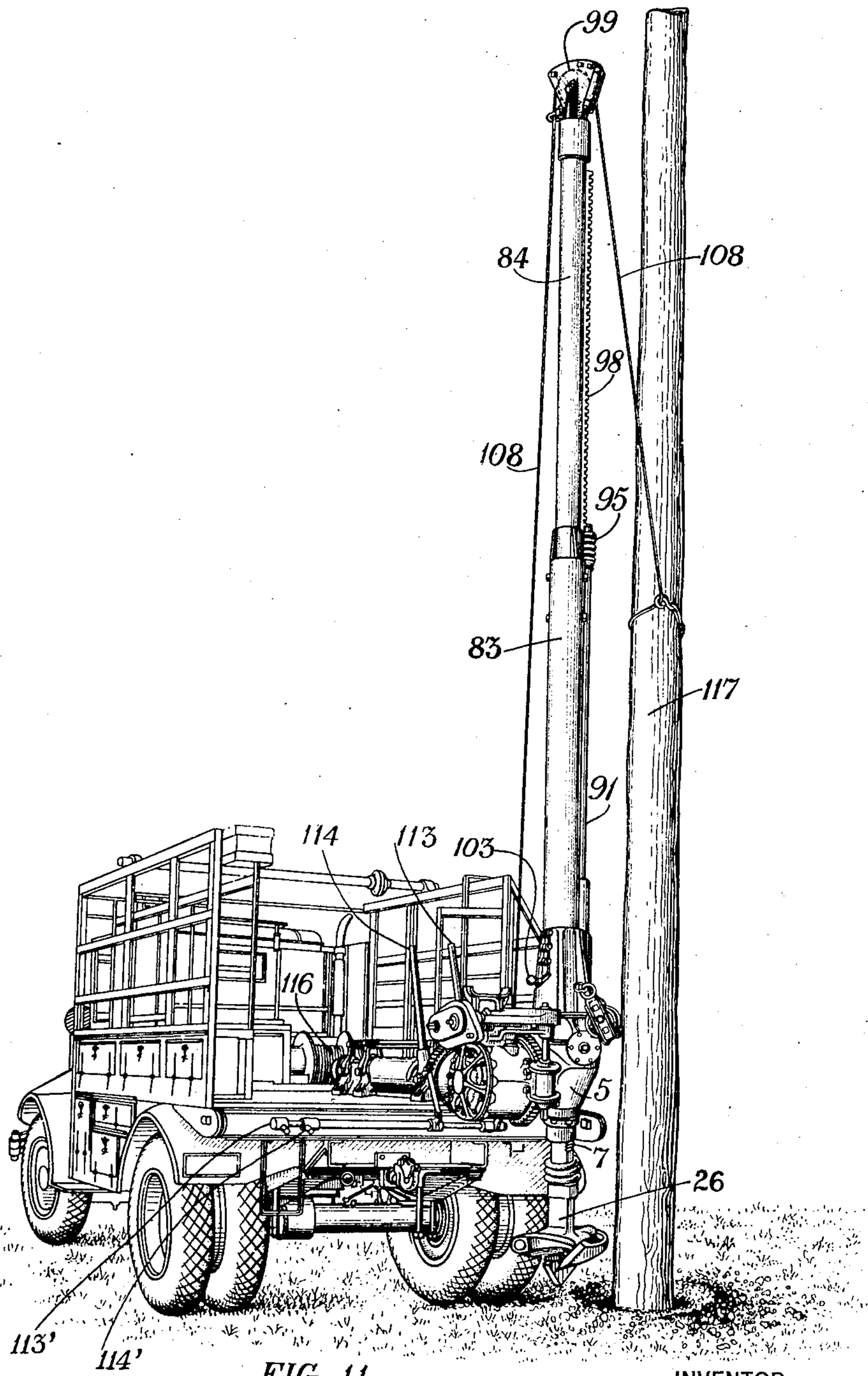

FIG. 11

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Patented Nov. 8, 1932 1,887,172

UNITED STATES PATENT OFFICE

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COMBINED EARTH BORING MACHINE AND DERRICK APPARATUS

Application filed July 2, 1932. Serial No. 620,694.

This invention relates to combined earth boring and derrick apparatus, and more particularly to arrangements of this character which are of the portable power driven type and adapted for boring holes and installing poles therein.

One of the objects of this invention is to provide a combined earth auger and derrick apparatus adapted to be mounted on a motor truck and so positioned that the operating mechanism therefor may be coupled to the engine shaft or power take-off of the truck, thereby enabling the boring operation of the auger or the adjustment of the derrick to various heights to be effected by means of the power derived from the engine.

Another object of the invention is to provide improved leveling mechanism for the boring mechanism whereby in case the truck is standing on sloping or uneven ground, the auger and connected driving mechanism may be adjusted by power to assume a plumb position; or where required, may be adjusted to bore in an inclined position.

A further object consists in the provision of braking mechanism for insuring positive locking action for the apparatus when in normal position.

These and further objects will be apparent from the following detailed description, when considered in connection with the accompanying drawings in which one embodiment of the improved invention is illustrated.

In the drawings, in which like characters of reference designate like parts throughout:

Figure 1 is an elevation partly in section, showing the auger and its shaft and the transmission mechanism by which these members are driven;

Fig. 2 is a plan view partly in section taken on the line 2—2 of Fig. 1 looking in the direction of the arrows.

Fig. 3 is a plan view of Fig. 1 partly in section;

Fig. 3*a* is a detail of the chain drive adjusting mechanism;

Fig. 4 is an elevation taken on the line 4—4 of Fig. 3 showing a brake lock;

Fig. 5 is a side elevation partly broken away to show internal mechanism of the two main drive clutches and brakes;

Fig. 6 is a sectional view of the two clutches shown in Fig. 5, one clutch being shown on one side of the center or dotted line and the second clutch being shown on the other side of said line;

Fig. 7 is an elevation in section of a telescoping derrick adapted to be connected to the upper end of the apparatus shown in Fig. 1 and to be adjusted through power applied to said apparatus.

Fig. 8 is a section taken on the line 8—8 of Fig. 7;

Fig. 9 is a side elevation of the top portion of the derrick shown in Fig. 7;

Fig. 10 is a schematic view of the boring and derrick apparatus; and

Fig. 11 is a perspective view of the boring and derrick apparatus mounted in position upon a truck.

The apparatus shown on the accompanying drawings including the boring and derrick apparatus, as will be presently described in detail, is adapted to be suitably mounted upon a truck and operated by the truck engine through changeable speed transmission (not shown). The boring apparatus functions to dig holes in which poles or the like are to be positioned and the derrick apparatus functions to place poles in these holes. This latter operation is performed by means of a line wound upon a winch drum carried by the truck, which passes over a sheave carried by the derrick and is secured at one end to a pole or the like. The pole is thus raised or lowered in accordance with the direction of rotation of the winch drum.

Referring to the drawings showing the improved apparatus, the numeral 5 designates a housing which serves as a casing for a rotatable carrier or sleeve 6. A rack shaft 7 or shank is adjustably mounted in the carrier 6. The carrier is mounted in the housing 5 on bearings 8 and serves to support in addition to the rack shaft 7, a double spur gear 9. One side of this gear is in mesh with rack shaft 7 and the other side of the gear is in mesh with the spur side of a bevel spur gear 10. The casing 5 is provided with a

hand-hole cover 5′ to facilitate the removal and replacement of gears 9 and 10. The bevel side of the gear 10 is in mesh with a double bevel idler gear 11. The rotatable carrier 6 is provided with a bevel gear 12. A thrust roller 10ª (Fig. 3) is in contact with the rack shaft 7 and is positioned on the carrier 6 in opposite relation to double spur gear 9. A casing 13 extends into a bore in the side of housing 5, and is secured thereto by means of a 180° worm-wheel segment 14 and an abutting 180° plain segment 15, and is kept in position by means of bolts. The worm-wheel 14 also serves the purpose of tilting the housing 5 with respect to the casing 13, as will be later referred to. The gear 11 (Fig. 1) carried by the member 6 is supported by bearing 16, and this bearing is kept in position by means of lock nuts 17 and 18. Lock nut 18 is provided with a chamber, and a disc 19 lying adjacent thereto is provided with a cooperating chamber. These chambers contain a tube 20′ which serves as a guide for a spring 20 and also transmits rotation to disc 19. The spring 20 exerts pressure and tends to separate the lock nut 18 and disc 19. The disc 19 is pressed by means of the spring 20 against disc 21 and effects a seal at this point to prevent the escape of oil or other lubricant. The carrier 6 is provided at each of its ends with four thrust plates 22 which extend longitudinally thereof. These plates completely and evenly surround the rack shaft 7 and serve as a bearing therefor. The thrust plates are inserted in ways in carrier 6 and are housed in a cage 23 and held there by pins 23′. Each end of carrier 6 is threaded for the reception of a lower collar 24 and an upper collar 86, which will be later referred to. The collar 24 after being properly positioned, is clamped to the carrier by means of bolt 25 to hold the collar securely in place. The rack shaft 7 has an auger 26 secured to its lower end by means of pin 27. The auger is provided with two auger blade supports 28 which are slightly inclined and may be substantially in the form shown in Fig. 1. A trap or gate 29 is hinged to each support, and the members 29 are pivotally arranged so that as the auger bores into the earth the traps are caused to rise and permit the loose earth to pile up on the top surfaces of the traps and supports. When the auger is raised out of the hole, these traps close to prevent the earth accumulated on top of the auger from falling back into the hole. The auger is provided with a blade 30 bolted to each support, and a point 31 is suitably affixed to the auger base. A spring 32 is positioned about the shaft 7 between the top of the auger 26 and the collar 24 and serves as a shock absorber when the rotating auger is raised from the earth.

Pinions 33 and 34 are in mesh with the feed gear 11 and the drive gear 12, respectively. A solid shaft 33′ extends from the pinion 33 and terminates in a bevel gear 35, and a sleeve shaft 34′ surrounding the solid shaft extends from the pinion 34 and terminates in a bevel gear 36. The pinions 33 and 34 and the gears 35 and 36 with their respective shafts and bearings form an intermediate reduction unit which is suitably journaled at its extremities in casing 13. The casing 13 extends in an angular direction of 90° from the plane of this intermediate reduction unit and enters a bore in casing 39. The casing 13 is secured to the casing 39 by means of a 180° worm-wheel segment 14′ and an abutting 180° plain segment and kept in position by means of bolts. The worm-wheel segment 14′ serves the purpose of tilting the housing 13 with respect to casing 39, as will be presently described. The bevel gears 35 and 36 are in mesh with pinions mounted on concentric shafts 37 and 38, one end of each shaft being journaled in casing 13, and the other ends of said shafts are journaled in the casings 40 and 41. The casing 40 and 41 are bolted together, as shown in Fig. 5. A feed clutch 42 is mounted on the end of shaft 37, and a drive clutch 43 is mounted on the end of shaft 38. The clutches 42 and 43 each consists of a series of plates, which slide alternately on keys at one end of gear 44 and clutch drum 45. On the opposite ends of the clutch drums 45, there is mounted a series of clutch plates. These plates slide on keys on the clutch drum 45, and brake shells 42′ and 43′ in a manner similar to that described in connection with the clutches 42 and 43. Clutch throw collars 49 and 50, as shown in Figs. 5 and 6, are positioned between each set of clutch plates on each clutch drum 45, and are provided on one side with ball bearings to take up the thrust applied by the power of clutches 43 and 42. A bronze ring is provided on the opposite side of each of the clutch throw collars 49 and 50 to take up the thrust of the brake. Gear 44 is driven by gear 46, which in turn is driven by gear 47. This latter gear derives its power from some such source as an engine carried by a motor truck, or other power transmission connected to a propeller shaft 48.

The clutch throw collars 49 and 50 are moved by clutch throw cams 51 and 52 to compress clutch plates 42 and 43, respectively, and so transmit power. Pairs of parallel arms 53 and 54 are attached at one of their ends to the cams 51 and 52, respectively, and transverse bars 55 and 56 connect the opposite ends of the pairs of parallel arms together. Clutch push rods 57 and 58 are attached to the centers of each of the bars 55 and 56, respectively, and equalizing springs 59 and 60 are positioned about the push rods on each side of said bars. The clutch push rods 57 and 58 are attached to control lever arms 61

and 62, to which levers 113 and 114 are attached, respectively (Figs. 3 and 4). When an operator desires to control the boring machine from a position in the rear of the truck and while standing on the ground, instead of from the truck body as just described, control levers 113 and 114 may be attached to control lever stubs 113′ and 114′ (Fig. 11) respectively. These stubs are positioned in a transverse position on the rear end of the truck body and are connected by suitable linkage to the control lever arms 61 and 62, (Figs. 3 and 4) respectively. Each of the control lever arms 61 and 62 is provided with a lug which extends into slots in the locking arms 64 when the brake-lock handle 65 is positioned to permit spring 66 to exert tension and spread the individually pivoted locking arms 64, thus holding control lever arms 61 and 62 in a locked position. Brake-lock handle 65 and brake-lock cam 67 are provided with suitable detents and are pinned to a common shaft 65′. This shaft 65′ is housed so that when the brake-lock handle 65 is moved partly about its shaft center, plungers 68 are displaced from the detents in the handle 65 and cam 67, and when control lever arms 61 and 62 are pulled back slightly they release their lugs from the slots in locking arms 64. Springs about the plungers 68 compress the locking arms and so leave a clear path for the control lever arms 61 and 62 back and forth when power on brake is applied by levers 113 and 114.

A drive shaft 69 (Fig. 1) is journaled in the upper part of casing 13 and has a pinion 70 on its lower end which meshes with bevel gear 36. An idler gear 71 is also carried by the shaft 69, and is provided with jaws for engagement with jaw clutch 72, which is splined to shaft 69 and controlled by a handle 72′ (see Figs. 3 and 10). This handle is mounted on a casting carried by casing 13. The drive shaft 69 also carries an idler sprocket 73 provided with jaws for engagement with jaw clutch 72. Bevel gear 71 is in mesh with pinion 74, and this pinion has an extended shaft to which a sprocket 75 is attached. The sprocket 75, by means of chain 76, drives sprocket 77 which is keyed to shaft 78. A double sprocket 109 lies between the sprockets 75 and 77, and has a shaft 110 journaled in a double eccentric mounting 111, which is secured in a clamping bracket 112. The mounting of the shaft 110 in this manner permits the clamping of the shaft after adjusting each eccentric, in order to tighten the chains 76 and 76′. Shaft 78 is journaled in a housing 79, and carries a worm 80 which is in mesh with worm-wheel 14′. The housing 79 is bolted to casing 13 in a horizontal position and in such manner that when the worm 80 is driven it will turn the casing 13 and the attached casing 5 with its contained rack shaft and auger, 90° to either side of the vertical axis of casing 39 according to the direction of rotation of the worm 80 on worm-wheel 14′. The tilting of the casing 5 in this manner permits the auger to be adjusted angularly to the right or left as required. Worm housing 81 is bolted to casing 13 in a vertical position (Fig. 1), and when its worm 82 is driven, the worm-wheel 14 will raise or lower on its worm, thus tilting casing 5 with its contained auger forwardly or rearwardly with respect to the horizontal axis of casing 13. This permits the auger to bore in a plumb position when the truck is standing on either a horizontal or an inclined plane. Shift handle 72′ is adapted to be moved to engage jaw clutch 72, with jaws of gear 71 and through mating gear, sprockets and chains to drive worm 80; or to be moved to engage jaws of sprocket 73 on shaft 69. Sprocket 73, by means of a chain 73′, shown in dotted lines in Fig. 3, drives a sprocket 82′, which is on the same shaft as the drive worm 82. A double sprocket 109′ lies between the sprockets 73 and 82′, and has a shaft 110′ journaled in a double eccentric mounting similar to that shown in connection with the gear 109 and shaft 110 in Fig. 3ª. This arrangement permits of adjustment to tighten the chains 73′ and 82″ through which sprockets 73 and 82′ are interconnected. When the clutch 72 is engaged to drive the sprocket 73, the chain of gearing above described operates the worm 82 (Fig. 1) to drive the worm-wheel 14. A neutral position is provided for handle 72′. It will be thus seen that the operation of worm 80 will tilt the auger to bore in an angular direction to the right or left, and the operation of worm 82 will tilt the auger to bore in an angular direction to the front or rear as seen from Fig. 1. A derrick to be presently described, which is carried by the casing 5 partakes of the angular adjustments of the auger shaft. A plumb bob 118 is attached to casing 5 (Fig. 3) to indicate the plumb position of the auger.

The rack shaft 7 has a cap 104 at its top (Fig. 7) which is provided with spaced projections. These projections successively register with a pivoted spring and cause its associated arm to successively strike a gong 105 to signal that the rack shaft is near its lowermost position.

The derrick shown in Figs. 7, 8 and 9 is provided with a lower tubular portion 83 and an upper tubular portion 84 which telescopes therein. A stop 83′ is attached to the tubular portion 83 and serves to limit the upward travel of the tube 84. The outer tube 83 is provided with a base 85, which may be bolted to the casing 5, shown in Fig. 1. A collar 86 is threaded on the end of the carrier 6, and is provided with peripheral gear teeth 87. These teeth mesh with pinion 88, which idles on shaft 89 and this shaft is journaled

in the casing 85. The shaft 89′ carries a worm 95 which is driven through the engagement of the jaw clutch 96, which is operated by handle 97. A rack 98 carried by the inner tube 84 meshes with worm 95, and said tube is raised or lowered in its companion tube 83 in accordance with the direction of travel of the worm 95. A sleeve 90, having jaws, is keyed and locked to the top of shaft 89 and is in line with an upper shaft 89′, which is provided at its bottom with a sleeve 92, having jaws and being adjustably keyed to shaft 89′ to permit its sliding in a vertical direction. A helical spring 93 is seated on top of sleeve 92 and extends about shaft 89′ in the tubular casing 91 which is adjustably mounted on sleeve 90. This spring exerts tension to maintain the jaws of the sleeves 90 and 92 in engaged relation with each other to drive worm 95 in either direction in its travel on rack 98. When the rack has reached its extreme upper or lower travel, it disengages the sleeves 90 and 92 and breaks the drive to the worm 95. This provides an overrunning clutch safety feature in the event that power is not disconnected at control lever 113 shown in Fig. 10. A sheave 99 mounted between plates, as shown in Figs. 7 and 9, is carried on the top of the tube 84. A pair of rollers 107 is mounted in opposite relation to each other on the plates, and a rope 108 passes over the sheave 99 and between these rollers. The rollers, being mounted in an inclined position as more clearly shown in Fig. 9, guide the rope in its angular or sidewise travel. A frame 100 (Fig. 8) of substantially U-shape, is bolted to the collar 86 and is provided with two lugs on which a shaft 100′ is journaled. This shaft carries a rack-lock 101, with a tooth member and a pin 101′ extending outwardly therefrom carries a ball bearing. A spring 101″ coiled about shaft 100′ on either side of the rack-lock (Fig. 7) with each end secured in frame 100 exerts pressure to mesh the tooth part of rack-lock 101 with the rack shaft 7. The rack-lock is controlled by a ring 102 which is slidably mounted within the walls of the casing 85. The ring has a handle 103 attached thereto which moves in an arcuate groove in the casing 85, to release the spring pressure on the rack-lock 101 and disengage the tooth member which engages with the teeth of rack 7 and permit the free vertical movement of rack 7 or to lock the rack 7 and provide a support therefor when the rack is in an unoperated position. The handle 103 is in a locked position and its movement in said groove to an unlocked position will force ring 102 to move downwardly and engage the rack-lock and effect its release by disengaging the tooth portion of the rack-lock from rack shaft. The movement of the handle upwardly in the groove will permit the rack-lock to engage with the rack 7.

In the operation of the apparatus, as may be followed by reference to Fig. 10, power is applied from any suitable source through a changeable speed transmission connected to the propeller shaft 48. This power is applied to operate the improved apparatus by means of levers 113 and 114. Lever 113 controls driving power for rotating the rack shaft 7, and lever 114 controls feeding power for forcing the rack shaft in a downward direction into the earth. In the opposite position each of these levers controls a brake on the same shaft. It will be assumed that power is applied to the propeller shaft to drive it in a clockwise direction as indicated by the arrow in Fig. 10. The rotation of the propeller shaft causes the rotation of gear 47, which in turn causes the successive rotation of gears 46 and 44. When the clutches 42 and 43 by means of their respective levers are thrown into engagement with gear 44 they are driven thereby. Feed clutch 42 is adapted to rotate shaft 37, and drive clutch 43 is adapted to rotate shaft 38. The pinion 38′ at the end of the shaft 38 rotates gear 36 which in turn through a conecting shaft 34′ rotates gear 34, and thus causes the rotation of gear 12 and rack carrier 6. As previously pointed out the pinion 9 and bevel spur pinion 10 are journaled in the rack carrier 6, and the rack 7 is also supported thereby. Consequently as the rack carrier 6 is rotated, it causes these elements to rotate with it. The driving operation just described causes the rotation and slow automatic downward feeding of the auger assembly. The feeding operation whereby the rack shaft 7 and its auger assembly is forced in a downward direction at an accelerated speed to that described under the driving operation when both clutches 42 and 43 are engaged with gear 44, cause shaft 37 and its pinion to rotate, and in turn rotate gear 35 and its shaft 33′ to which pinion 33 is connected. Pinion 33 rotates feed idler gear 11 which causes pinion 10 to rotate and in turn to rotate pinion 9. As this later pinion is in mesh with the rack 7 the movement applied thereto will force the rack downwardly, causing the auger to be rotated and fed into the earth. As this downward movement of the auger continues, the pivoted gates 29 are forced to an open position and permit the borings to pile upon the auger. When a sufficient depth has been reached, control lever 113 is moved to a brake position engaging brake clutch 43′ to operate and through its gear connections hold drive gear 12 in a locked position. Control lever 114 is engaged with clutch 42 and through its gear rotations raises rack 7. Gates 29 close when the auger is raised and retain the borings on the top of the auger. When the auger is raised to a sufficient height above the hole, both levers 113 and 114 are applied to engage

with clutches 42 and 43 respectively, causing the gear connections to rotate the auger and throw off the borings on the top of the auger by centrifugal force. The operations above described are repeated until the desired depth of hole is reached.

In the boring of plumb holes when the truck is on sloping or uneven ground, or when the boring of holes in a sloping direction is required, it is necessary to tilt the rack shaft 7 to the position desired. Lift handle 72′ is moved under this condition to cause engagement of jaw clutch 72 to provide power to rotate worm 80 or to rotate worm 82 in accordance with the direction of tilting desired as previously described. Power for rotating these worms is applied by lever 113, and the direction in which it is desired to rotate said worms is changed at the source of power to which the propeller shaft 48 is connected. When the machine is not in operation levers 113 and 114 are pushed into braking position, and are locked in this position by brake lock handle 65 (Fig. 3).

The derrick as shown in Figs. 7, 8 and 9 is attached to the rack carrier 6 in the casing 5, as formerly outlined. The rack shaft 7 extending through the tubular portions 83 and 84 of the derrick provide a reinforcement therefor. The rack shaft 7 may be lowered to cause its attached auger to rest upon the ground. When the auger and shaft are in this position an auxiliary support is provided for the derrick whereby heavy poles may be raised and lowered with additional safety. In order to raise the derrick to a required height for setting poles, jaw clutch handle 97 is operated to engage jaw clutch 96 with the jaws of pinion 88. Drive control lever 113 is then released from its locked position and operated to engage the drive clutch 43 (Fig. 5). The engagement of drive clutch 43 rotates shaft 38 and its pinion, which is in mesh with gear 36 (Fig. 1) rotating shaft 34′ and pinion 34. Pinion 34 rotates rack carrier 6 and its attached cap 86 (Fig. 7) and gear 87, which in turn rotates pinion 88, shaft 89, overrunning clutch 90 and 92, couple shaft 89′ to rotate worm 95. The rotation of this worm which engages rack causes the elevation of the tube 84 and its associated sheave 99 to the proper height, at which point it is locked as previously described. The derrick is shown in this extended position in Fig. 11. To lower the derrick the operation is the same as that described in connection with raising of the derrick, with the exception that the direction of rotation is changed at the source of power. It will be obvious by reference to Fig. 11 that with one end of the rope 108 attached to the pole 117, and passing over the sheave 99 and thence to the winch 116, the operation of the winch will cause the rope to be drawn and raise the pole into position and set it in the hole prepared by the boring apparatus.

Poles may be raised or lowered at various angles in accordance with the adjustments of the worm 80 or the worm 82, as described in connection with the adjustment of the auger shaft.

Poles may also be raised or lowered by extending or telescoping the derrick tubes by means of power.

What is claimed is:

1. In a combined earth boring machine and derrick apparatus, a casing, an extensible derrick mounted thereon, a carrier rotatably mounted in the casing, a shank vertically movable in the carrier, an auger carried by said shank, means for rotating said shank to operate said auger, and means whereby the rotation of said carrier will elevate and lower said derrick.

2. In a combined earth boring machine and derrick apparatus, a casing, an extensible derrick of tubular formation mounted thereon, a carrier rotatably mounted in the casing, a shank vertically movable in the carrier and in the derrick, an auger carried by said shank and raised and lowered in accordance with the movement of the shank, means to rotate said shank to operate said auger, and means whereby the rotation of said carrier will cause the elevation of said derrick.

3. In a combined earth boring machine and derrick apparatus, a casing, an extensible derrick mounted thereon, a carrier rotatably mounted in the casing, a shank vertically movable in the carrier, an auger carried by said shank, means entering said casing for transmitting power to rotate said carrier and shank to operate said auger, and means whereby the rotation of said carrier will elevate and lower said derrick.

4. In a combined earth boring machine and derrick apparatus, a casing, an extensible derrick of tubular formation mounted thereon, a carrier rotatably mounted in the casing, a shank vertically movable in the carrier and in the derrick an auger carried by said shank and moving with the shank longitudinally to raise and lower the auger, means entering said casing for transmitting power to rotate said carrier and shank to operate said auger, and means whereby the rotation of said carrier will elevate and lower said derrick.

5. In a combined earth boring machine and derrick apparatus, a casing, an extensible derrick mounted thereon, a carrier rotatably mounted in the casing, a shank vertically movable in the carrier, an auger carried by said shank, means for transmitting engine power to operate said carrier and shank to rotate said auger and simultaneously feed it downwardly, and means whereby the rotation of said carrier will elevate and lower said derrick.

6. In a combined earth boring machine and derrick apparatus, a casing, an extensible derrick mounted thereon, a carrier rotatably mounted in the casing, a shank vertically movable in the carrier, an auger carried by said shank, means for rotating said carrier and shank to operate said auger, means whereby the rotation of said carrier will elevate and lower said derrick, and means for adjusting the casing to cause the shank and derrick to assume desired angular positions.

7. In a combined earth boring machine and derrick apparatus, a casing, a carrier rotatably mounted therein, an extensible derrick of tubular formation mounted on the casing, a shank vertically movable and rotatable with the carrier and in the derrick, thrust mountings for the shank positioned in the carrier, an auger carried by said shank and raised and lowered in accordance with the movement of the shank, means to rotate said carrier and shank to operate said auger, and means whereby the rotation of said carrier will cause the elevation of said derrick.

8. In a combined earth boring machine and derrick apparatus, a stationary casing, an extensible derrick mounted thereon, a carrier rotatably mounted in the casing, a shank vertically movable in the carrier, an auger carried by said shank, gate members pivotally attached to the auger, means entering said casing for transmitting power to rotate said carrier and shank to operate said auger, and means whereby the rotation of said carrier will elevate and lower said derrick.

9. In a combined earth boring machine and derrick apparatus, a casing, a derrick mounted thereon, said derrick comprising a tubular portion having a tubular sleeve telescopically associated therewith, a carrier rotatably mounted in the casing, a shank vertically and rotatably movable in the carrier and in the derrick, an auger carried by said shank and raised and lowered in accordance with the movement of the shank, means entering said casing for transmitting power to rotate said carrier and shank to operate said auger, means whereby the rotation of said carrier will elevate and lower the tubular sleeve of said derrick, and means for limiting the tubular sleeve in its travel in either direction.

10. In a combined earth boring machine and derrick apparatus, a casing, an extensible derrick mounted thereon, a carrier rotatably mounted in the casing, a shank vertically movable in the carrier, an auger carried by said shank, means for transmitting power to operate said carrier and shank to rotate said auger and simultaneously feed it downwardly, means whereby the rotation of said carrier will elevate and lower said derrick, and means for automatically disengaging power from said derrick at its extreme limits of travel in either direction.

11. In a combined earth boring machine and derrick apparatus, a casing, an extensible derrick of tubular formation mounted thereon, a carrier rotatably mounted in the casing, a shank vertically movable in the carrier and in the derrick, an auger carried by said shank and raised and lowered in accordance with the movement of said shank, means for transmitting engine power for operating said carrier and shank to rotate said auger and simultaneously feed it downwardly, means to indicate the approach to the downward limit of the shank, whereby the rotation of said carrier will elevate or lower said derrick, and an overrunning clutch for disengaging power from the derrick at its extreme limits of travel in either direction.

12. In a combined earth boring machine and derrick apparatus, a casing, an extensible derrick mounted thereon, a carrier rotatably mounted in the casing, a shank vertically movable in the carrier, an auger carried by said shank, means for rotating said carrier and shank to operate said auger, means whereby the rotation of said carrier will elevate and lower said derrick, and means for locking said shank in a desired position.

13. In a combined earth boring machine and derrick apparatus, a casing, a telescoping derrick mounted on the casing, a carrier rotatably mounted in the casing, a shank extending therethrough, an auger carried by the shank, a gear transmission within the casing adapted to impart a rotary movement to the carrier and shank, means whereby the rotary movement of said carrier will elevate or lower said derrick, a second gear transmission within the casing adapted to impart vertical movement to the shank, separate driving shafts entering the casing and actuating each transmission, a common drive shaft, means for transmitting power therefrom to the last named shafts, and a compound clutch on each of said last named shafts, said clutches being adapted to transmit power to each shaft or lock said shafts against rotation.

14. In a combined earth boring machine and derrick apparatus, a casing, a telescoping derrick mounted on the casing, a carrier rotatably mounted in the casing, a shank extending therethrough, an auger carried by the shank, a gear transmission within the casing adapted to impart a rotary movement to the carrier and shank, means whereby the rotary movement of said carrier will elevate or lower said derrick, a second gear transmission within the casing adapted to impart vertical movement to the shank, separate driving shafts entering the casing and actuating each transmission, a common drive shaft, means for transmitting power therefrom to the last named shafts, a compound clutch on each of said last named shafts, said clutches being adapted to transmit power to each

shaft or provide a brake for said shafts against rotation, and manually operated means for operating said clutches independently of each other.

15. In a combined earth boring machine and extensible derrick apparatus, a casing, a telescoping derrick mounted on the casing, a carrier rotatably mounted on the casing, a shank extending therethrough, an auger secured to one end of said shank, a pair of gears within the casing and surrounding the carrier and shank, means for transmitting power from said gears to the carrier to impart vertical and rotary movement to the shank, means responsive to the rotary movement of the carrier for elevating or lowering said derrick, means for rotating the gears in unison and one gear at a greater speed than the other, and means for locking either gear against rotation.

16. In a combined earth boring machine and telescoping derrick apparatus, a stationary supporting casing, an intermediate casing carried thereby and turnable with relation to a boring case carried by the intermediate casing and turnable with relation thereto, and said intermediate casing and boring case being turnable independently of each other, a carrier rotatably mounted in the boring case, a rack shaft vertically movable in the carrier, an auger carried at one end of the rack shaft, means carried by the carrier for operating said rack shaft and auger in a rotary downward direction and means whereby the rotation of said carrier will elevate and lower said derrick.

17. In a combined earth boring machine and derrick apparatus, a stationary supporting casing, an intermediate casing carried thereby and turnable with relation thereto, a boring case carried by the intermediate casing and turnable with relation thereto, and said intermediate casing and boring case being turnable independently of each other, and at right angles to each other to permit universal adjustment, a telescoping derrick carried by said boring case, and means for elevating and lowering said derrick.

18. In a combined earth boring machine and derrick apparatus, a stationary supporting casing, an intermediate casing carried thereby and turnable with relation thereto, a boring case carried by the intermediate casing and turnable with relation thereto, and said intermediate casing and boring case being turnable independently of each other and at right angles to each other to permit universal adjustment, means for turning the respective casing, said means also locking the casings against turning movement, a tubular telescoping derrick mounted on said boring case, a carrier rotatably mounted in the boring case, a rack shaft vertically movable in the carrier and in the derrick, an auger on one end of the rack shaft, means for rotating the rack shaft to lower and raise the auger, and means whereby the rotation of the carrier will elevate and lower the derrick.

19. In a combined earth boring machine and derrick apparatus, a stationary supporting casing, an intermediate casing carried thereby and turnable with relation thereto, a boring case, a tubular telescoping derrick mounted thereon, said boring case being carried by the intermediate casing and turnable with relation thereto, a tubular telescoping derrick carried by the boring case, said intermediate casing and boring case being turnable independently of each other and at right angles to each to permit universal adjustment, means for turning the respective casings, said means also locking the casings against turning movement, a shaft extending through the boring case and into the tubular telescoping derrick, means within said case for imparting a vertical and rotary movement to the shaft, an auger carrier at one end of the shaft, and means whereby the auger and derrick are raised and lowered.

20. In a combined earth boring machine and derrick apparatus, a stationary supporting case, a head member secured at one end thereof and turnable about a central axis, an intermediate casing secured to the head member, a boring case, an extensible derrick mounted thereon, said boring case being secured to the intermediate case and turnable about the central axis of the intermediate case, said head member and the boring case being turnable at right angles to each other to permit universal adjustment, and means whereby each casing may be turned independently of the other.

21. In a combined earth boring machine and derrick apparatus, a stationary supporting case, a head member secured at one end thereof, an intermediate casing secured to the head member, a boring case, an extensible derrick mounted thereon, said boring case being secured to the intermediate case and turnable about the central axis of the intermediate case, said intermediate case and the boring case being turnable at right angles to each other to permit universal adjustment, a sleeve shaft and an interior solid shaft journaled in the stationary supporting case, means for transmitting power or brake and lock to either shaft or to both in unison, a sleeve shaft and an internal solid shaft journaled in the intermediate casing, bevel gears connecting the sleeve shafts, means from one bevel gear to transmit power for turning boring case with relation to intermediate case, and the intermediate case with relation to stationary supporting case, bevel gears connecting the interior solid shafts, a pair of gears disposed in the boring case, pinion gears secured on the last named sleeve and interior solid shaft intermeshing with the gears in the boring case, a shaft passing

through the boring case and the gears contained therein, and means for transmitting vertical and rotary movement to said shaft from the two gears through which it passes.

22. In a combined earth boring machine and derrick apparatus, a stationary supporting casing, an intermediate casing carried thereby and turnable with relation thereto, a boring case, an extensible derrick mounted thereon, said boring case being carried by the intermediate casing and turnable with relation to said intermediate casing, said intermediate casing and boring casing being turnable independently of each other, a shaft extending through the boring case, an auger carried by said shaft, means for transmitting power through the stationary supporting case, the intermediate case and the boring case to rotate and elevate the last named shaft and the auger carried thereby, and means whereby the operation of said shaft raises and lowers the extensible derrick.

23. In a combined earth boring machine and derrick apparatus, a casing, an extensible derrick of tubular formation mounted thereon, a shank vertically movable in the casing, and in the derrick, and an auger carried by said shank, and movable thereby to an earth engaging position, the portion of said shank extending into the tubular derrick forming a reinforcement therefor, and said auger in its earth engaging position forming an auxiliary support for the boring machine and derrick.

24. In a combined earth boring machine and derrick apparatus, a casing, an extensible derrick of tubular formation mounted thereon, a shank vertically movable in the casing and extending into the derrick, and an auger carried by said shank and being movable thereby to a raised and lowered position, the portion of the shank extending into the tubular derrick forming a reinforcement therefor, and said auger in its lowered position engaging the earth to form an auxiliary support for the boring machine and derrick.

In testimony whereof, we have signed our names to this specification this 29th day of June 1932.

TEMPLE C. SMITH.
JOHN B. SPOWART.