Feb. 6, 1962 J. J. MORACCO ET AL 3,020,012

LOW OVERHEAD JUMBO DRILL SUPPORTING BRACKET

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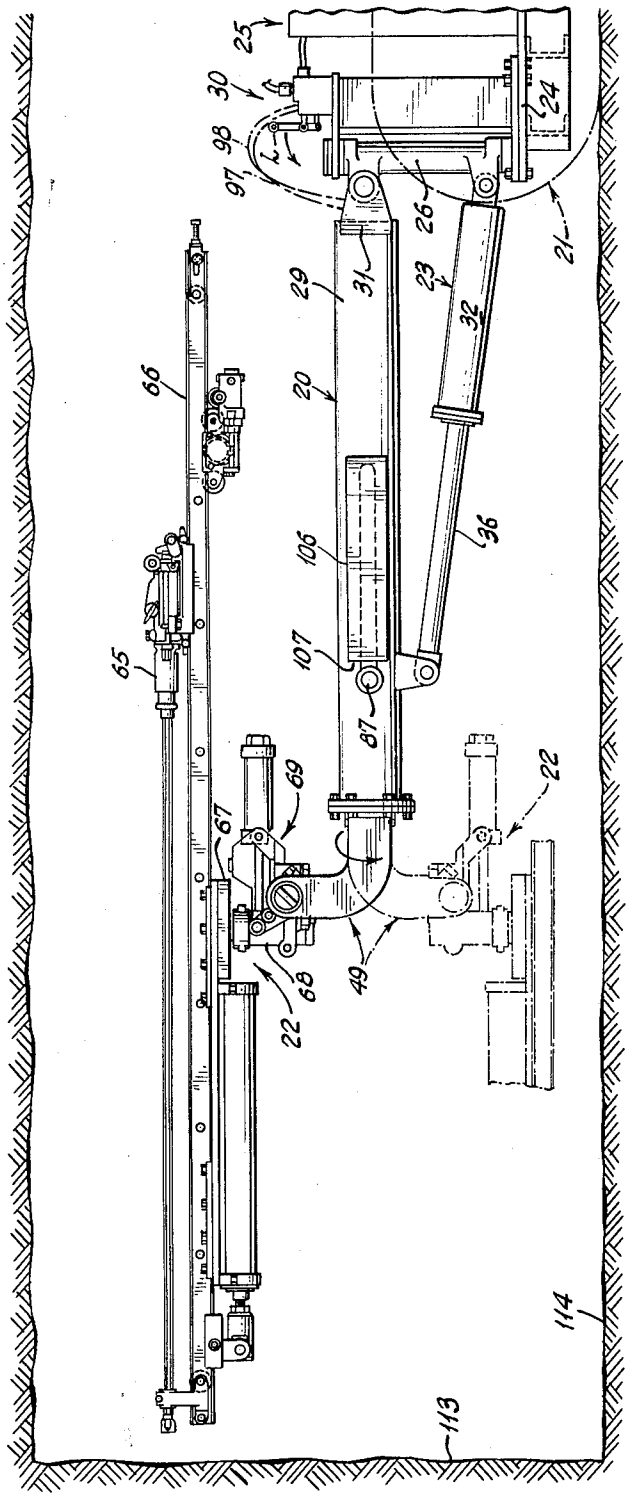


Fig. 1.

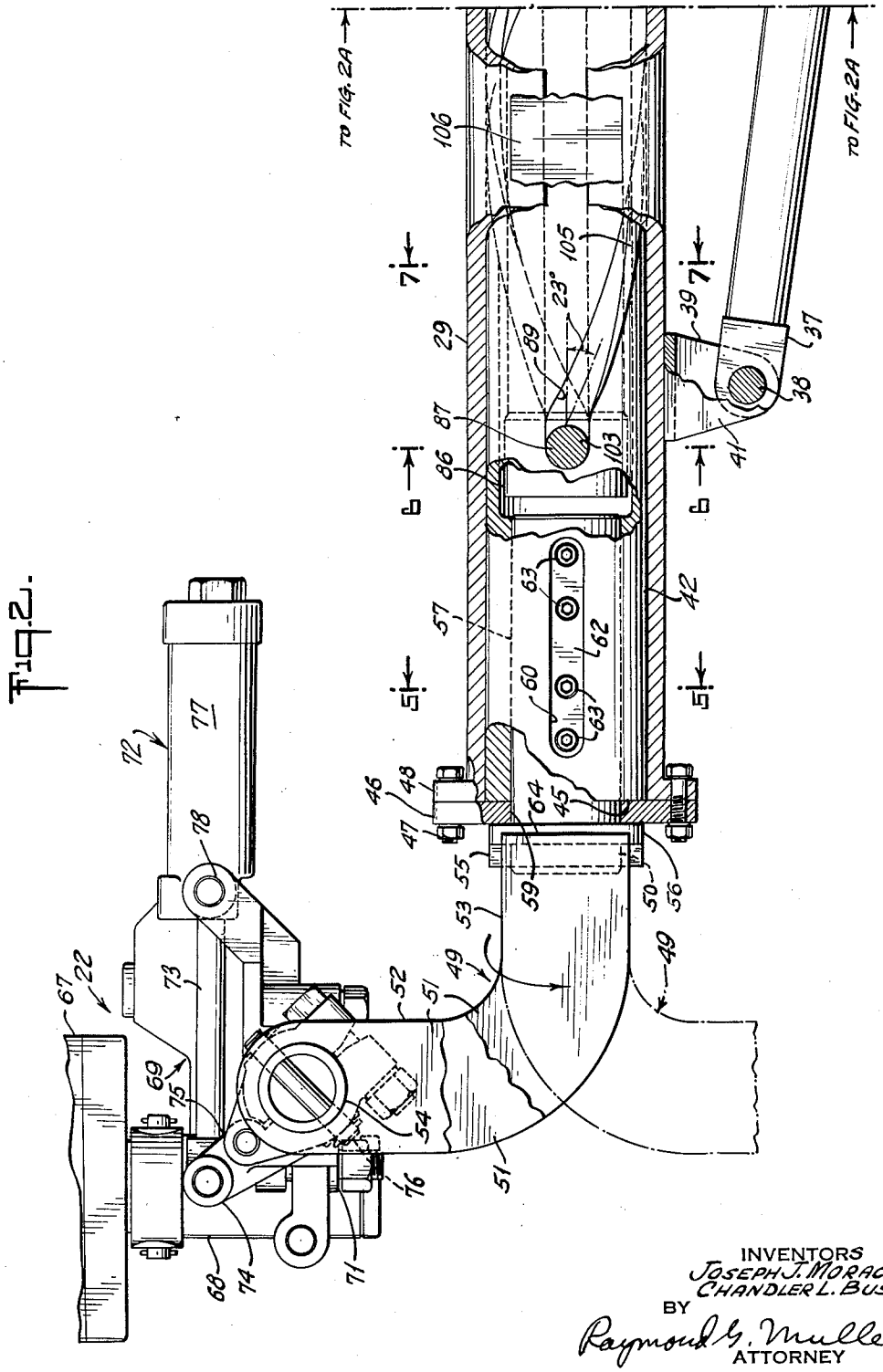
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LOW OVERHEAD JUMBO DRILL SUPPORTING BRACKET

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Fig. 2.



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LOW OVERHEAD JUMBO DRILL SUPPORTING BRACKET

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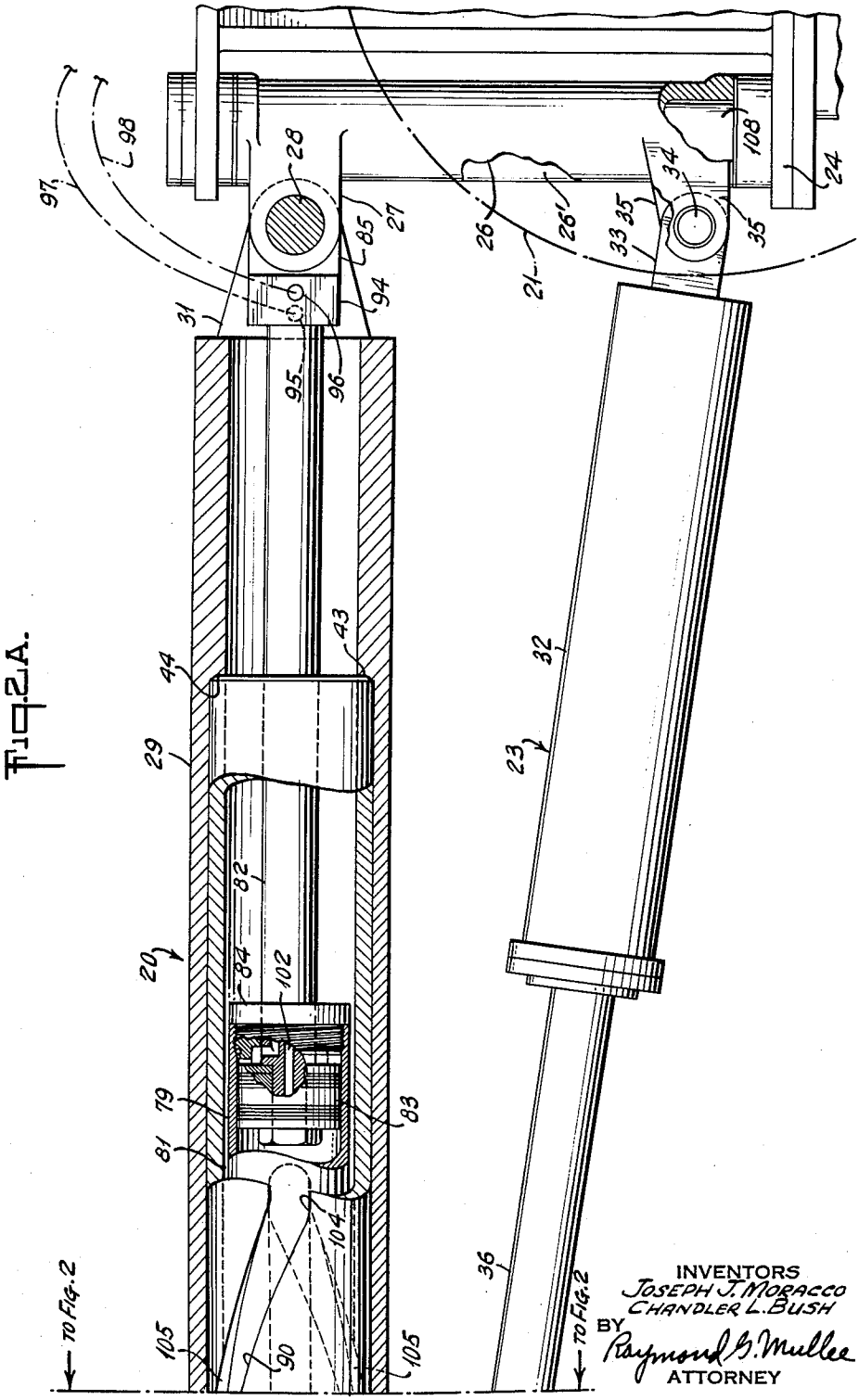


FIG. 2A.

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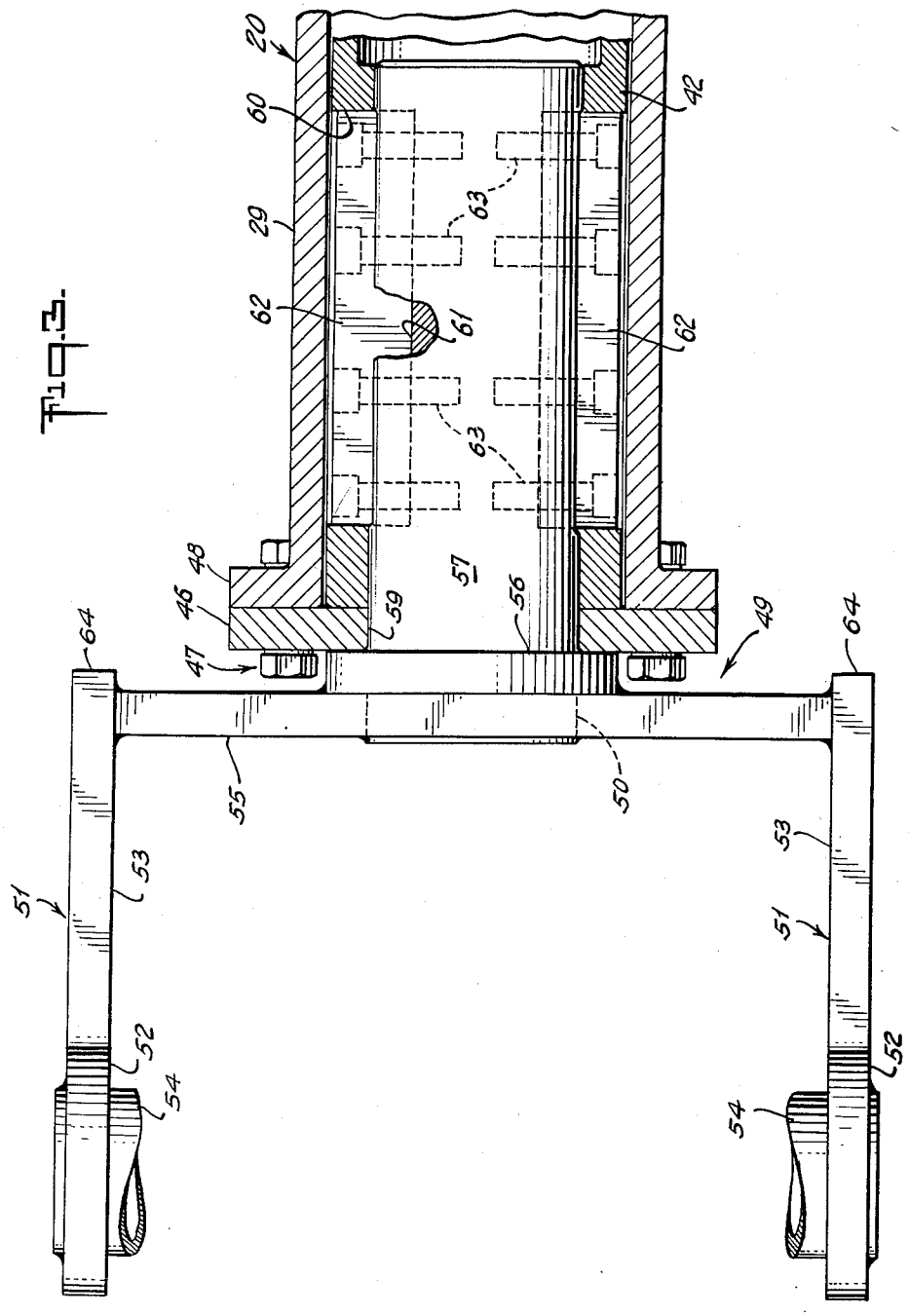
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FIG. 4.



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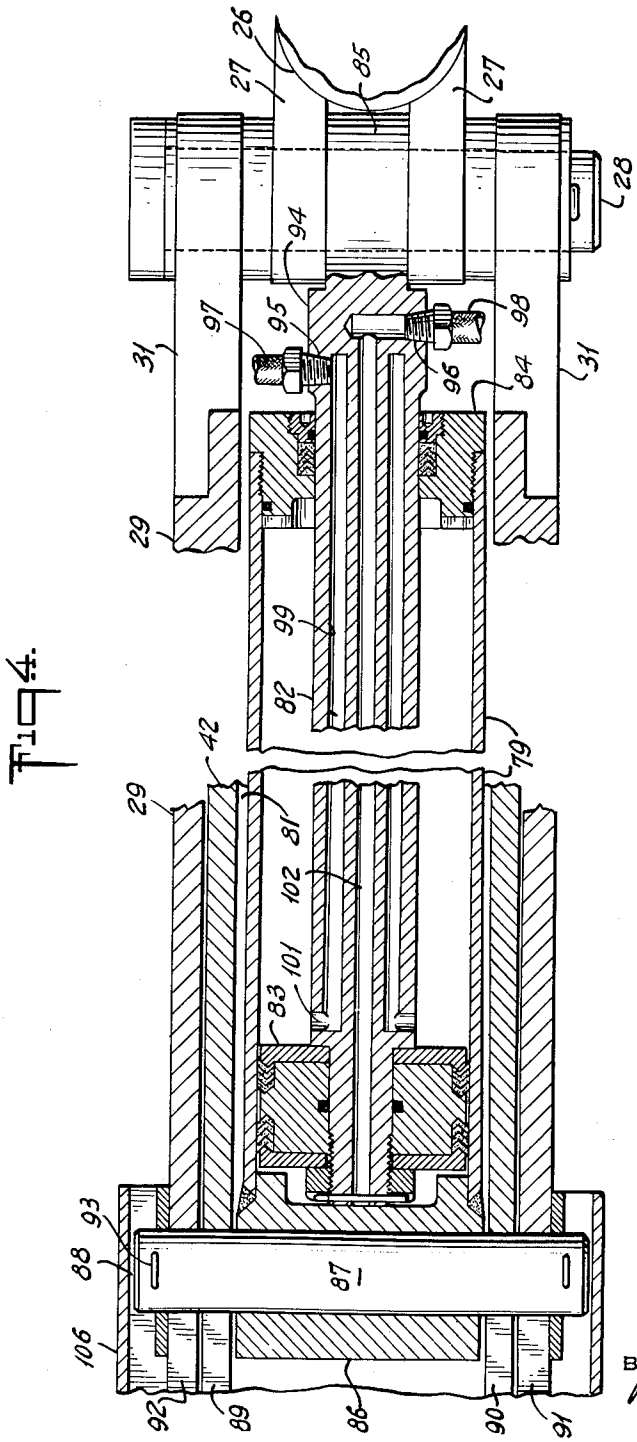


Fig 4.

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Fig. 5.

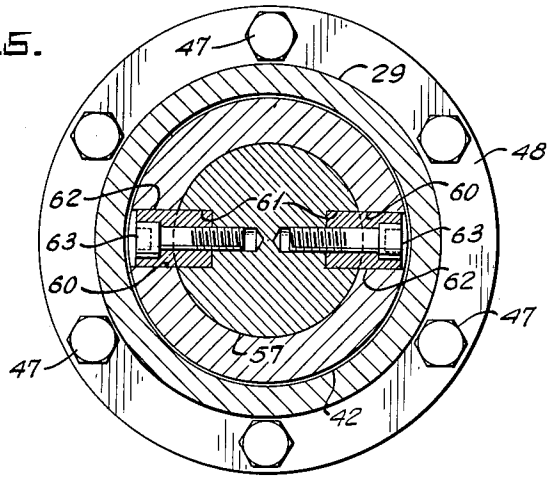


Fig. 6.

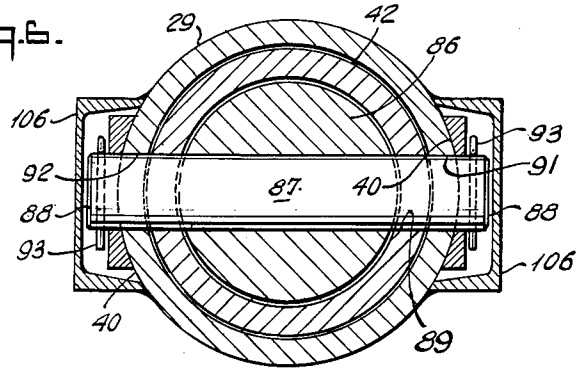
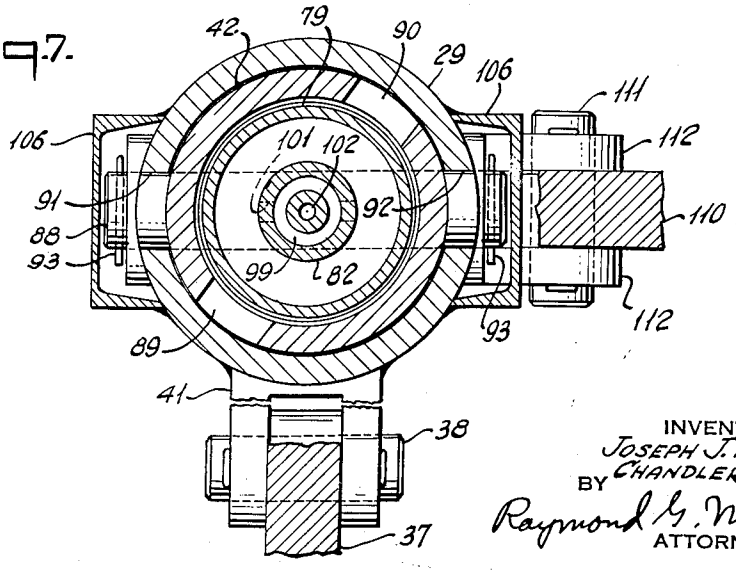


Fig. 7.



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United States Patent Office 3,020,012 Patented Feb. 6, 1962

3,020,012
LOW OVERHEAD JUMBO DRILL SUPPORTING BRACKET

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Filed Feb. 27, 1959, Ser. No. 796,071
11 Claims. (Cl. 248—16)

This invention relates to boom supported rock drill apparatus. It is particularly directed to improvements in the boom of the apparatus whereby the conditions under which the drill may be efficiently operated are materially increased and the work that is accomplished is substantially multiplied.

Boom supported rock drills have a base support, such as a rig. This locates or maintains the horizontal plane of the boom at a substantial distance above the ground level. Under such conditions the capacity of such drills is limited when attempting snake hole drilling in close proximity to the ground level, or when attempting to drill parallel to the ground and below the horizontal plane of the boom assembly. Where low overhead conditions are encountered, limited tilting of the rock drill in a vertical plane as well as difficulty in maneuvering of the entire apparatus further limit the capacity of a boom supported or jumbo drill apparatus in effecting snake hole operations, and other operations near the ground level or in a horizontal plane below the level of the boom.

An object of this invention is to provide new and useful improvements of a practical nature in boom supported drill apparatus, whereby the capacity and range of operation of such drills is substantially increased.

A further object of the invention is to provide an improved boom supported rock drill apparatus of a practical nature for effecting snake hole operations, and for drilling in upright walls at levels substantially parallel to and below the horizontal plane of the boom, as well as at levels substantially parallel to and in close proximity to the ground.

A more particular object of the invention is to provide an improved and practical boom assembly for supporting a rock drill, whereby the latter may be rolled over or rotated about the longitudinal axis of the boom from one position to a diametrically opposite position, or to any position intermediately of such positions.

Another object of the invention is to provide a boom assembly having a hydraulically powered swivel support for a rock drill, whereby the rock drill may be angularly positioned about the longitudinal axis of the boom assembly.

A further object of the invention is to provide a jumbo rock drill apparatus which is particularly suited for low overhead drilling operations.

The invention further lies in the particular structure and novel arrangement of its various components, as well as in their cooperative association with one another to effect the results intended herein.

The foregoing and other objects and advantages of this invention will appear more fully hereinafter from a consideration of the detailed description which follows, taken together with the accompanying drawings wherein an embodiment of the invention is illustrated. It is to be expressly understood, that the drawings are for purposes of illustration and description, and they are not to be construed as defining the limits of the invention.

In the drawings:

FIG. 1 is a side elevational view of a jumbo rock drill apparatus embodying the invention, only the forward or

mounting end of the tractor support being shown at the right end;

FIGS. 2 and 2A are continuations of one another, and show a side elevational view of the apparatus, parts being cut away to better illustrate the association of various components to one another;

FIG. 3 is a plan view of the mounting fork showing its association with the boom drill assembly;

FIG. 4 is a longitudinal section on a horizontal plane through the boom assembly, and is directed principally to showing the structure of the hydraulic cylinder;

FIG. 5 is a section on line 5—5 of FIG. 2;

FIG. 6 is a section on line 6—6 of FIG. 2; and

FIG. 7 is a section on line 7—7 of FIG. 2.

In the accompanying drawings is disclosed a jumbo rock drill apparatus which is characterized by among other features a roll-over boom assembly. In general, the apparatus includes (FIGS. 1, 2, 2A) a roll-over boom assembly 20 which is supported at its rear end upon a vehicle 21, and which supports at its forward end a rock drill assembly 22. The boom assembly is pivotally anchored to the vehicle, and is associated with hydraulically powered lift means 23, in such manner that it may be selectively pivoted up or down in a vertical plane from horizontal. The rock drill assembly 22 is swivelled to the boom assembly, whereby it may be rolled over or rotated through an angle of 180 degrees about the longitudinal axis of the boom assembly from an upright position in a plane above the boom assembly as in FIG. 1, to an upside down position in a plane below the boom assembly (broken line FIG. 1); and it may be returned to its upright position through the same angle of rotation, or it may be locked in any intermediate angular position in the span of rotation.

The supporting vehicle 21 is here illustrated as a tractor, shown partially in broken line, preferably of low overall height so that it may be entered into tunnels having low overhead conditions. The tractor has a low central base or platform 24 carrying a hydraulic supply system 25 which supplies through conventional hose lines, and an associated manually operable flow control unit 30, hydraulic fluid to operate various hydraulically powered components of the apparatus. Mounted upon the forward end of the platform is a vertical pedestal or standard 26 for supporting the boom assembly. Integral with the upper end of this standard is a pair of laterally spaced parallel ears 27 (FIGS. 2A, 4). These extend forwardly, and support between them a horizontal pin 28. On this pin the boom assembly 20 is pivotally anchored at its rear end, and is adapted to pivot in a vertical plane.

The roll-over boom assembly 20 includes an elongated open ended main or outer cylinder or hollow boom 29 (FIGS. 2, 2A, 4). Integral with this cylinder and extending in longitudinal continuation of the rear end thereof is a pair of laterally spaced parallel ear plates 31 between which are received the ears 27 of the standard. Ears 31 are pivotally anchored by means of transverse holes therein upon the pin 28. The boom assembly 20 is also supported by means of its outer cylinder 29 on the hydraulically powered lift means 23. The latter includes a hydraulic lift cylinder 32 having a closed rear end from which axially extends an eye lug 33. To obtain angular movement of the hydraulic cylinder in a vertical plane, this lug is pivoted upon a horizontal pin 34 supported between a pair of ears 35 extending forwardly from the lower end of the standard 26. A piston rod 36 axially extendible in and out of the head end of the lift cylinder by means of the usual hydraulically powered piston within the cylinder, has at its end an eye lug 37 which is pivoted on a horizontal pin 38 supported be-

tween depending ears 39 of a bracket 41. The latter bracket is fixed to the forward underside area of the outer cylinder 29 of the boom assembly. The boom assembly is caused to swing on its pivot pin 28 up or down from horizontal, accordingly as the piston rod 36 is hydraulically extended from or retracted into the lift cylinder 32.

Slidably entered into the outer cylinder 29 through the forward end of the latter is an elongated open ended cylindrical roll-over sleeve 42 (FIGS. 2, 2A). This sleeve bears upon the inner wall of the outer cylinder and is rotatable relative thereto. The sleeve is shorter than the outer cylinder, and is confined therein. The rear end 43 of the sleeve bears against an annular internal shoulder 44 of the outer cylinder; and the forward end 45 of the sleeve bears against the inner flat surface of an external cap plate 46. The latter plate is secured over the front end of the outer cylinder by means of an annular series of nuts and bolts 47 which engage an annular marginal area of the cap plate with a peripheral end flange 48 of the outer cylinder.

Associated with the forward end of the sleeve for rotation with the latter as a unit is a mounting fork 49 (FIGS. 1–3) which serves as a support for the rock drill assembly 22. The mounting fork is removably fixed to the sleeve as a unit. The mounting fork includes a pair of laterally aligned plates 51 of right angular configuration, comprising a pair of outer arm portions 52 continuing at right angles from a pair of inner arm portions 53. These plates are held in fixed parallel spaced relation by means of a transverse cylindrical shaft 54 fixed between the outer forward ends thereof; and by means of a transverse plate 55 fixed between the rear ends of the plates. The vertical axis of the outer arms 52 of the mounting fork is radial to or perpendicular to the longitudinal axis of the boom assembly. Extending axially rearward from the center of the transverse plate 55 is a trunnion or pin 57 having a stub forward end 50 fixed in a complementary center hole of the transverse plate, and having a peripherial collar or flange 56 abutting and fixed to the rear of the transverse plate. The flange 56 defines a radial shoulder about the body of the pin which bears against the outer flat surface of the cap plate 46. The rear body portion of the pin 57 extends with a bearing fit through a complementary axial hole 59 of the cap plate, and continues with a slide fit into the open front end of sleeve 42 wherein it is locked or fixed fast to the latter.

The means whereby the mounting fork and sleeve are made unitary or fixed together includes (FIGS. 2, 3, 5) a pair of diametrically opposed longitudinal key slots 60 in the sleeve registering with complementary slots or recesses 61 in the pin. In each pair of registered slots 60, 61 is received a complementary key 62. A line of bolts 63 passing transversely through each key, and threadedly engaged in the solid intermediate body of the pin rigidly secure the pin and the sleeve together for swivelling or rotation as a unit relative to the outer cylinder 29. The keys 62 and the heads of the bolts 63 are confined in the key slots below the periphery of the sleeve so as not to interfere with rotation of the latter relative to the outer cylinder. The flange 56 of the pin is relatively thick; it serves to space the rear ends 64 of the plates 51 of the mounting fork, as well as the transverse plate 55, forwardly and clear of the cap plate 46 so as to avoid interference of these elements with projecting portions of the nuts and bolts 47 when the mounting fork and the sleeve rotate as a unit relative to the outer cylinder 29.

The mounting fork 49, as appears in FIGS. 1 and 2, has a normal upright position, wherein the transverse shaft 54 is horizontal and in a plane substantially above the plane of the outer cylinder of the boom assembly 20. The rock drill assembly 22 is mounted centrally upon this shaft. It includes a conventional elongated rock drill 65 arranged to be fed in conventional manner along an elongated rock drill slide channel 66 which is clamped into a saddle 67. The saddle is carried by a chassis or block 68 of a drill-positioner unit 69. This block is clamped at its bottom end 71 on shaft 54 for pivotal movement about the latter in a vertical plane. Hydraulically powered means 72 is associated by means of a piston rod 73 with a crank arm 74 of a crank 75 pinned fast at 76 to shaft 54; and has a hydraulic cylinder 77 pivotally anchored on a horizontal pin at 78 to the block 68. This hydraulically powered means 72 serves to control angular positioning of the block 68 and of the associated rock drill assembly relative to shaft 54. Block 68 has a normal position atop shaft 54 as indicated in FIGS. 1 and 2, wherein the rock drill assembly 22 is maintained in a plane spaced substantially above the boom assembly 20 and substantially parallel thereto. The outer arms 52 of the mounting fork 49 extend radially relative to the boom assembly sufficiently to maintain the rock drill assembly spaced clear of the boom assembly.

Hydraulically powered means (FIGS. 2, 2A, 4) associated with the sleeve 42 of the boom assembly is operable to rotate or roll the sleeve through an angle of 180 degrees relative to the outer cylinder 29 and to return it through the same angle. As earlier mentioned, the mounting fork 49 and the rock drill assembly 22 are adapted to rotate or swivel together with the sleeve 42 as a unit. Accordingly, when the sleeve is rotated from its normal position shown in FIGS. 1 and 2, the rock drill assembly 22 which is shown top side up at a level above that of the boom assembly will be carried with the sleeve through an angle of rotation of 180 degrees to a position upside down at a level below that of the boom assembly, as indicated by the broken line in FIGS. 1 and 2.

The hydraulically powered means includes an elongated hydraulic cylinder 79 which is axially disposed in sleeve 42 for longitudinal movement relative to the latter. The cylinder 79 has an operational annular clearance 81 between it and the inner wall of the sleeve to allow slight radial play of the cylinder in its movements. An elongated piston rod 82 anchored axially at its forward end to a piston 83 within the hydraulic cylinder 79 extends rearwardly and axially with a non-leak slide fit through a closure plug 84 threaded into the rear end of the latter cylinder. The piston rod has a thickened rear end-piece, the rearmost part of which defines an eye lug 85. The latter extends between the ear plates 27 of the standard 26, and is pivotally anchored for movement in a vertical plane upon the pin 28. The forward end of cylinder 79 is closed by a cylindrical head piece 86 which carries a roll or cam pin 87 in a transverse hole thereof. The pin 87 is slidably mounted within the transverse hole of the head piece 86 and thereby is adapted to rotate within the latter. The pin has a horizontal roll axis mutually perpendicular to the longitudinal axis of the sleeve 42. This pin projects (FIGS. 1, 2, 2A, 4, 6) at its ends 88 through a pair of parallel and diametrically opposed spiral or lead slots 89, 90 in the sleeve, and through a pair of parallel and diametrically opposed longitudinal slots 91, 92 in the outer cylinder 29. The terminal ends of the several slots are in lateral alignment.

The hydraulic cylinder 79 is adapted to be hydraulically moved forwardly and rearwardly relative to the sleeve so as to carry the cam pin 87 longitudinally through the several slots from one end of the latter to the other. The pin is adapted to roll as it rides through the slots. Cotter pins and end washers 93 prevent lateral escape of the pin. The end washers conform at their inner surface 40 with the contour of the outer cylinder for easy sliding along the latter. A block portion 94 of the end-piece of the piston rod 82 has a pair of radial inlet ports 95, 96, connected through hose lines, 97, 98 and through the flow control unit 30 with the hydraulic supply system 25. Port 95 connects with an annular passage 99 which extends longitudinally through the thick wall of the piston rod 82 and communicates by radial passages 101 with the interior of the

hydraulic cylinder **79** rearwardly of the piston **83**. Accordingly, hydraulic fluid entered into port **95** acts upon the rear inner end of the cylinder **79** to drive it axially rearward relative to the stationary piston **83** and relative to the sleeve **42** to the position shown in FIG. 4. The other port **96** communicates with a passage **102** which runs axially through the piston rod and opens at its end into the interior of cylinder **79** beyond the piston **83**, so that hydraulic fluid entered into this port drives the cylinder **79** forwardly relative to the stationary piston **83** and relative to sleeve **42** to the position in FIGS. 1, 2, and 2A.

The forward and the rear terminal ends **103, 104** of the several slots **89** to **92** are slightly greater in diameter than the ends of the cam pin **88** to allow free movement of these ends; and are laterally aligned with one another on a common axis. The width of the several slots **89** to **92** have a similar relation to the ends of the pin so that the latter may ride freely along the walls of the slots. The cam pin has a horizontal position as it is carried through the said slots. It is maintained and guided in this position by the longitudinal slots **91, 92** formed in the non-rotatable outer cylinder **29**. The spiral slots **89, 90** represent an angular travelling distance of 180 degrees through one half of a sine curve. The spiral slots are elongated and preferably have a low lead angle, so as to enable a relatively long travelling distance for the cam pin and a consequent gradual rotation of the sleeve through its angle of 180 degrees. This structure insures greater support for the sleeve, so as to reduce the strain of the heavy drill apparatus upon the latter, and consequently insures greater control over the roll rate of the sleeve. Here the lead angle of the spiral slots from each terminal end thereof is 23 degrees.

As the cam pin **87** is drawn rearwardly by the hydraulic cylinder **79** from the forward ends to the opposite ends of the several slots **89–92**, it cooperates with the spiralling walls **105** of the spiral slots to progressively roll or rotate the sleeve **42** through an angle of 180 degrees in one direction as indicated by the arrow in FIGS. 1 and 2; and as the cam pin is returned to its starting forward position, it acts to progressively return the sleeve to its original position through the same angle of 180 degrees in the opposite direction.

The positions of the forward and rear terminal ends, respectively **103, 104** of the spiral slots are obviously reversed relative to the side areas of the sleeve **42**. For example, the forward end of spiral slot **89** is at the left of the sleeve (looking forward in FIGS. 2, 2A) and the rear end thereof is at the right; and the lead angles of this slot are below horizontal at both ends. Accordingly, as the cam pin is drawn rearwardly, the sleeve **42** and the associated rock drill assembly will normally roll to the left (arrow in FIGS. 1 and 2); and as the cam pin is pushed forwardly, the direction of rotation is reversed. This normal direction of rotation may be reversed by sliding out the cam pin angularly reversing the cylinder **79**, and then restoring the cam pin.

The hydraulic flow control unit **30**, schematically shown in FIG. 1, connects supply hose lines to the various hydraulically operated components of the apparatus. Separate three-positional hand levers L of which one is shown in FIG. 1 are associated with the control unit to effect hydraulic operation of the related hydraulic devices of the apparatus. The particular lever L that is shown serves the hydraulic cylinder **79**. This lever is operable in conventional manner, to regulate hydraulic flow through the inlet ports to the hydraulic cylinder **79**. It is operable to control the movement of the latter so as to cause the sleeve **42** to rotate in one direction, or the other, or to be restrained in any selected angular position. The other various hydraulically operated devices of the apparatus are subject to similar control through this control unit by means of other levers L, not shown, so as to move their pistons in one direction or another or to restrain them in a selected position.

An elongated U-bar **106** (FIGS. 1, 2, 6 and 7) fixed to each side area of the outer cylinder protectively covers over the related longitudinal slot **91** or **92** of the outer cylinder **29** so as to guard against entry of dirt. The forward end of the U-bar is spaced as at **107** rearwardly of the forward terminal ends of the several slots to permit lateral removal of the roll pin for purposes of disassembly.

The boom assembly **20** may also be swung in a horizontal plane. To this end, the standard **26** defines a sleeve adapted for swivel movement about a vertical axis defined by an inner fixed post **108**. A hydraulic swing cylinder, not shown, but similar to the left cylinder **32** has a hydraulically powered piston rod pivotally connected by means of a link **110** to a pivot pin **111** carried in side lugs **112** of the forward side area of the outer cylinder **29**. The opposite end of the swing cylinder is pivotally connected in a manner similar to that of the lift cylinder **32**, to a second vertical swivel standard **26'** carried by the tractor in lateral spaced relation to the standard **26**.

The roll-over feature of the boom assembly **20** enables the rock drill **65** to effect drilling operations over the surface area of an upright wall from the top to the bottom of the latter in planes parallel to the ground level. It enables drilling of elongated snake holes in close proximity to and parallel to the base of a wall. The hydraulic lift means **23** enables the boom assembly **20** to be pivoted vertically to various positions from horizontal, thus also enabling angular hole drilling into upright wall areas.

The apparatus described is of particular advantage where low overhead conditions exist, as appears in FIG. 1. When the boom and the rock drill assemblies are brought into a parallel horizontal relation, as in FIGS. 1 and 2, the overall height of the apparatus is relatively low, thus enabling free movement in a low overhead tunnel. Where tilting of the rock drill assembly relative to horizontal is difficult because of low overhead conditions, the roll-over boom assembly **20** will nevertheless enable drilling operations to be made over the upper and lower areas of the upright wall **113**, above and below the horizontal of the boom assembly and also in close proximity to the floor **114** of the tunnel.

While an embodiment of the invention has been illustrated and described in detail, it is to be expressly understood that the invention is not limited thereto. Various changes might be made in the design and arrangement of the parts without departing from the spirit and scope of the invention; and it is our intent, therefore, to claim the invention not only as shown and described but also in all such forms and modifications thereof as may reasonably be construed to fall within the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. A boom assembly for rock drill apparatus comprising a support, an outer cylinder having in diametrically opposed wall areas thereof a pair of elongated longitudinally extending parallel slots and anchored at its rear end to the support; an elongated sleeve disposed in the cylinder for rotation relative to the latter and having in opposed wall areas thereof a pair of spiral slots the terminal ends of which are registered with corresponding terminal ends of the parallel slots; means confining the sleeve within the cylinder against endwise movement relative to the latter, a hydraulic cylinder disposed within the sleeve and axially movable relative to the latter and relative to the outer cylinder, the hydraulic cylinder having a forward and a rear head; a transverse pin carried in the forward head of the hydraulic cylinder for movement with the latter and projecting slidably at its ends through the spiral slots and through the longitudinal slots; a piston within the hydraulic cylinder having a piston rod projecting through the rear head of the hydraulic cylinder

anchored at its free end to the support; and walls in the spiral slots cooperable with the ends of the pin upon axial movement of the latter as a consequence of axial movement of the hydraulic cylinder so as to cam the sleeve angularly relative to the outer cylinder; and external drill mounting means having an axial connection with the sleeve for angular movement with the latter as a unit and having a radial end arm adapted to support a drill member.

2. A boom assembly as defined in claim 1, wherein the piston rod has adjacent to its rear end a pair of inlet ports, one having a passage extending through the rod and opening into the hydraulic cylinder forwardly of the piston so as to communicate hydraulic operating fluid to the hydraulic cylinder forwardly of the piston and the other having a passage extending through the rod and opening into the hydraulic cylinder rearwardly of the piston so as to communicate hydraulic operating fluid to the hydraulic cylinder rearwardly of the piston.

3. A boom assembly as defined in claim 1, wherein the outer cylinder is pivotally anchored at its rear end to the support for pivotal movement in a vertical plane, and the boom assembly having hydraulic lift means for effecting said pivotal movement.

4. A boom assembly as in claim 1, wherein each spiral slot extends about opposed areas of the sleeve for an angular distance of 180 degrees.

5. A boom assembly as in claim 4, wherein the lead angles of the spiral slots are relatively low, lead in one direction at one end of the sleeve, and lead in the opposite direction at the other end of the sleeve.

6. A boom assembly as defined in claim 1, wherein the external mounting means is of right angular configuration having a rearwardly extending arm axially connected with the sleeve and having its other arm defining the said radial end arm adapted to support the drill member.

7. A boom assembly as defined in claim 6, wherein the external mounting means is removably locked to the sleeve by means including a rear axial pin extending slidably into the sleeve, key means received in complementary slots of the sleeve and pin, and fasteners transversely of the pin and key means securing the key means in the slots.

8. A boom assembly as defined in claim 6, wherein a cylindrical shaft is transversely supported by the radial end arm, and saddle means adapted to support the drill member is pivotally supported upon the shaft.

9. In rock drill apparatus, a support, an elongated cylinder, an elongated boom sleeving over the cylinder, means confining the cylinder within the boom against endwise movement relative to the latter, means mounting a rear end of the boom to the support and preventing rotation of the boom about its longitudinal axis, a drill mount disposed externally of the forward end of the boom, means rigidly connecting the drill mount with a forward end of the cylinder, the cylinder and drill mount being rotatable as a unit about the longitudinal axis of the boom, slot means in the cylinder and boom, pin means having longitudinal movement in the slot means relative to the boom and cylinder and cooperable with the slot means to translate such pin movement into rotary movement of the cylinder about the longitudinal axis of the boom, and hydraulic piston means for giving said longitudinal movement to the pin means.

10. In rock drill apparatus a support, an elongated hollow boom open in its forward end, means mounting the boom at its rear to the support and preventing rotation of the boom relative to the support, a rock drill mount disposed externally of the forward end of the boom including an elongated cylinder disposed in the open forward end of the boom for rotation about the longitudinal axis of the latter, means confining the cylinder within the boom against endwise movement relative to the latter, spiral slot means in the cylinder, straight slot means in the boom, hydraulically movable cam pin means disposed transversely of the spiral and straight slot means having movement longitudinally of the spiral and the straight slot means and cooperable with the spiral and the straight slot means in its movement for imparting rotary motion to the cylinder relative to the boom.

11. A boom assembly for rock drill apparatus comprising a support, an outer cylinder having in diametrically opposed wall areas thereof a pair of elongated longitudinally extending parallel slots and anchored at its rear end to the support; an elongated sleeve disposed in the cylinder for rotation relative to the latter and having in opposed wall areas thereof a pair of spiral slots the terminal ends of which are registered with corresponding terminal ends of the parallel slots; a hydraulic cylinder disposed within the sleeve and axially movable relative to the latter and relative to the outer cylinder, the hydraulic cylinder having a forward and a rear head; a transverse pin carried in the forward head of the hydraulic cylinder for movement with the latter and projecting slidably at its ends through the spiral slots and through the longitudinal slots; a piston within the hydraulic cylinder having a piston rod projecting through the rear head of the hydraulic cylinder anchored at its free end to the support; and walls in the spiral slots cooperable with the ends of the pin upon axial movement of the latter as a consequence of axial movement of the hydraulic cylinder so as to cam the sleeve angularly relative to the outer cylinder; and external drill mounting means having an axial connection with the sleeve for angular movement with the latter as a unit and having a radial end arm adapted to support a drill member; wherein the outer cylinder has a cap plate bearing against a forward end of the sleeve and has an internal shoulder bearing against the rear end of the sleeve whereby the sleeve is confined in the outer cylinder against endwise movement.

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