April 19, 1966 L. CHAPPUIS 3,246,705

DRILLING AND BOLTING APPARATUS

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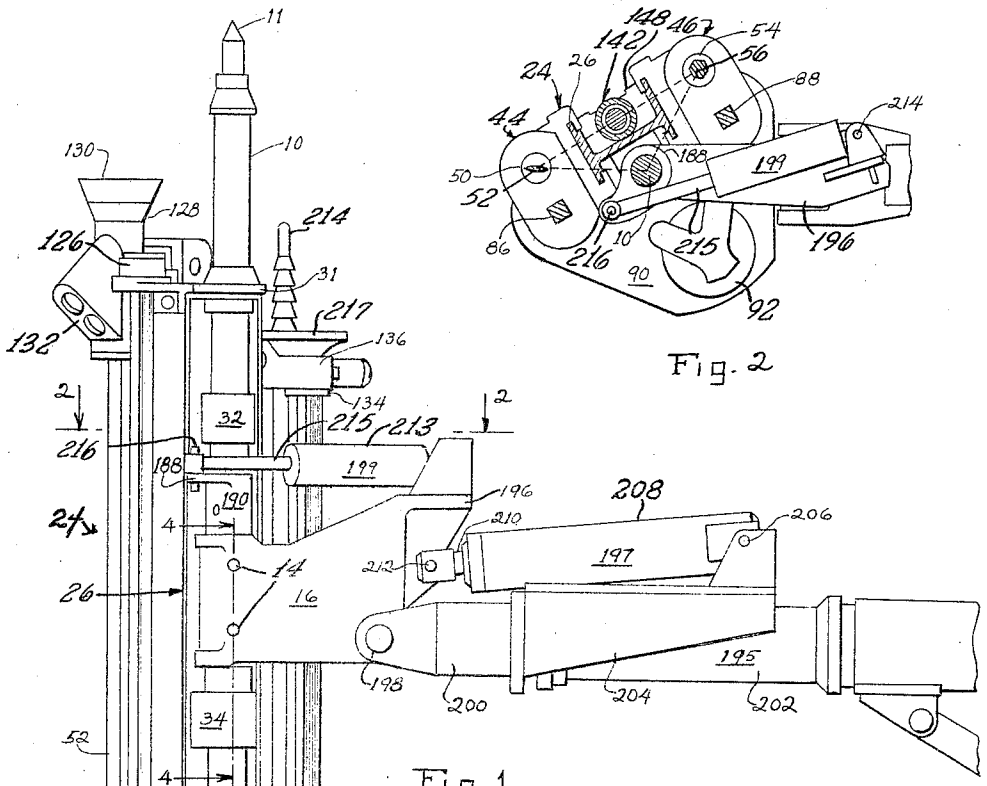


Fig. 1

Fig. 2

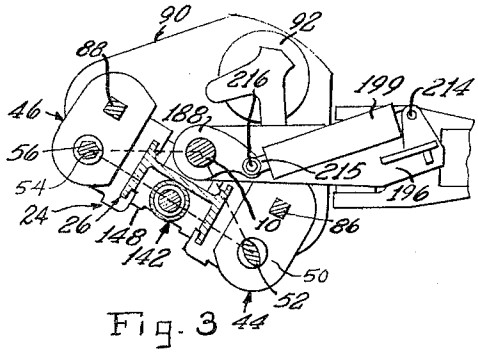


Fig. 3

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DRILLING AND BOLTING APPARATUS

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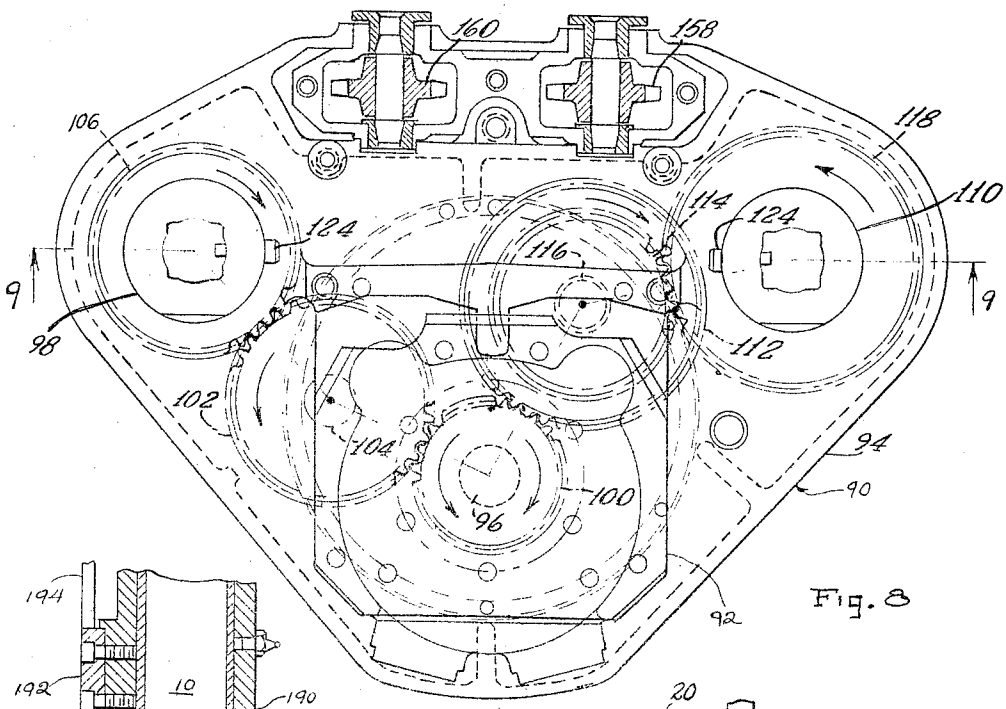


Fig. 8

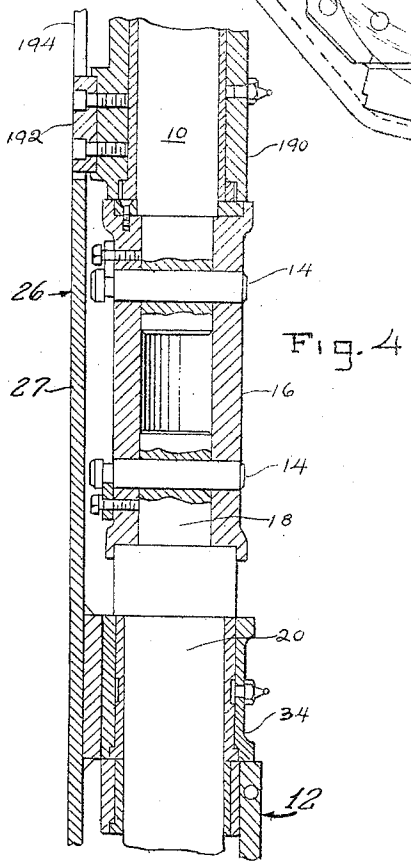


Fig. 4

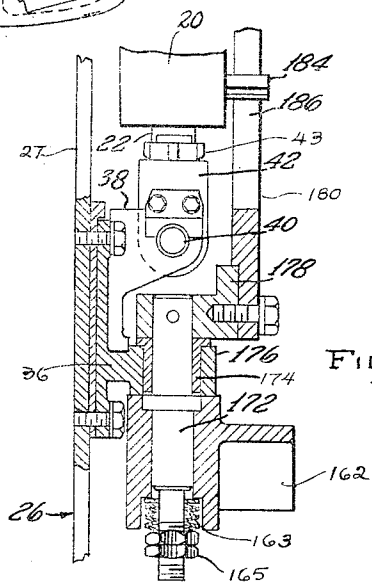


Fig. 6

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DRILLING AND BOLTING APPARATUS

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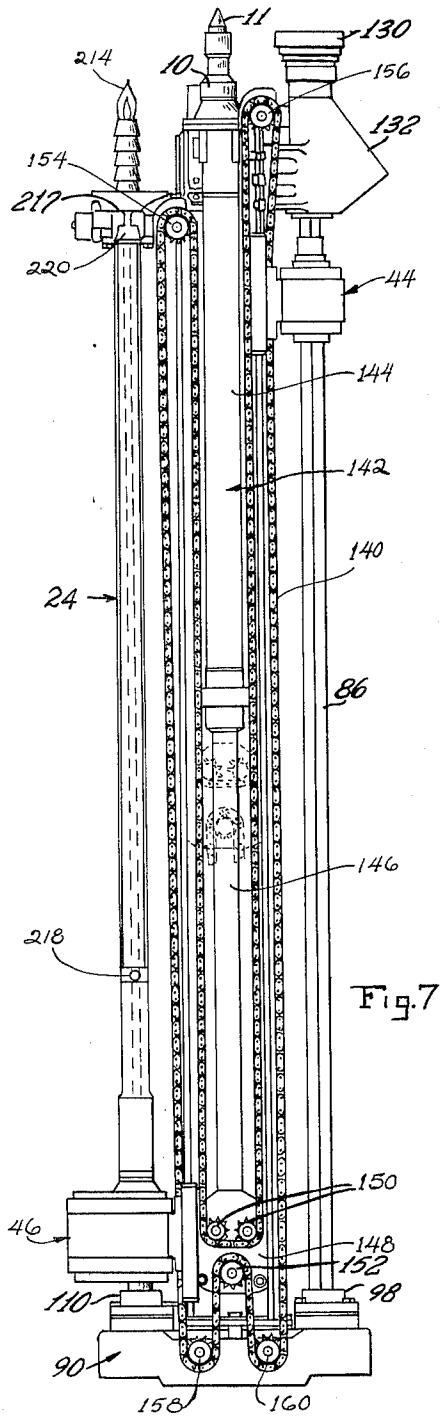


Fig. 7

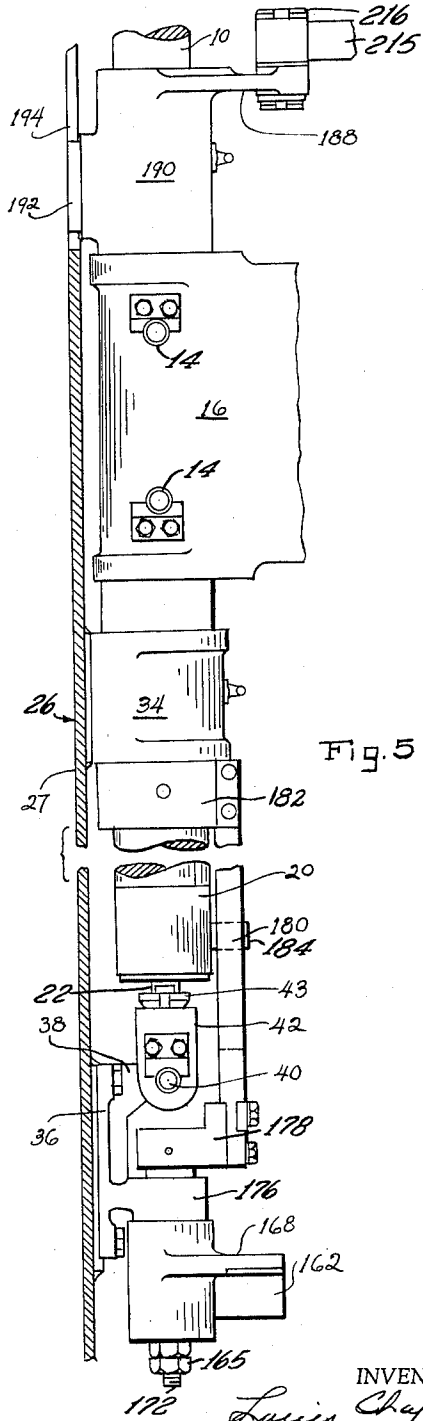


Fig. 5

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DRILLING AND BOLTING APPARATUS

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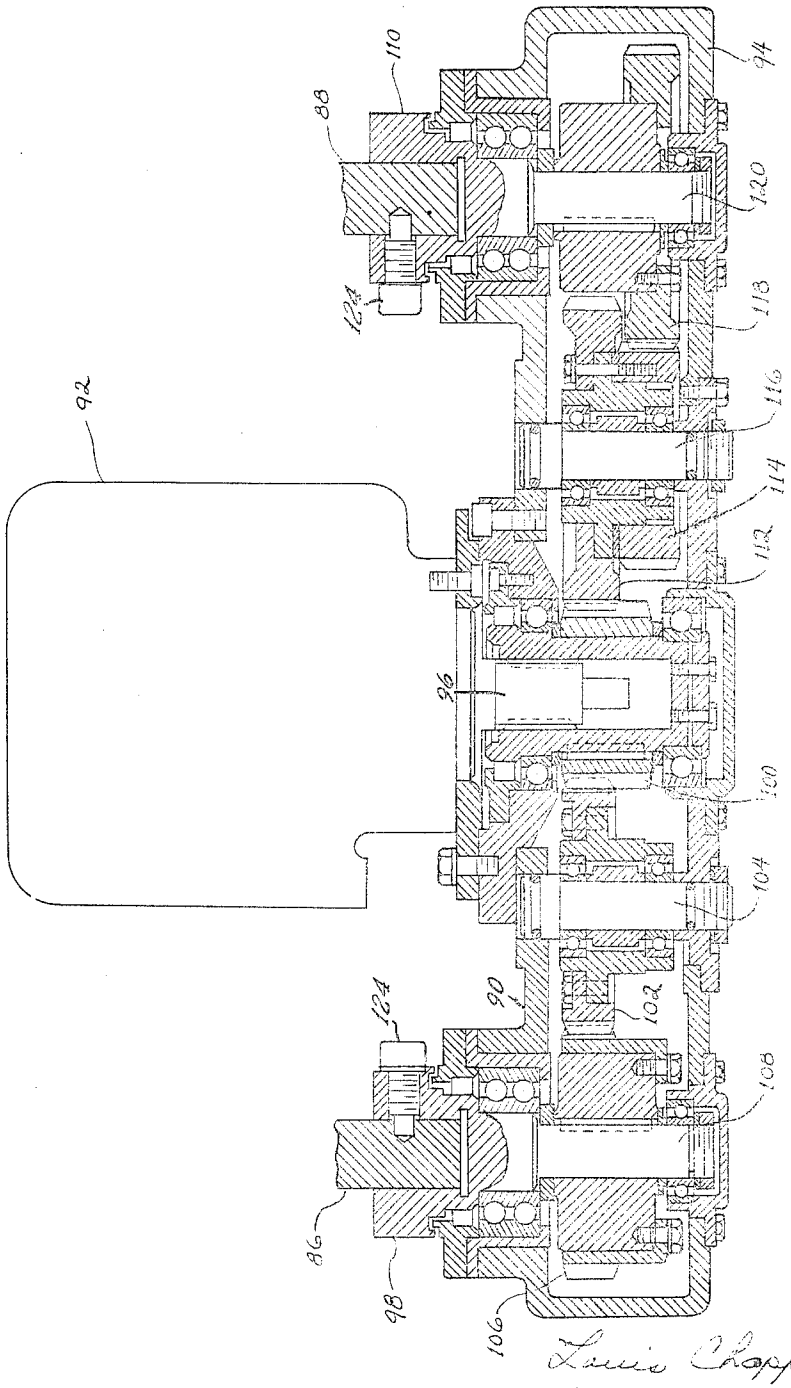


FIG. 9

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DRILLING AND BOLTING APPARATUS

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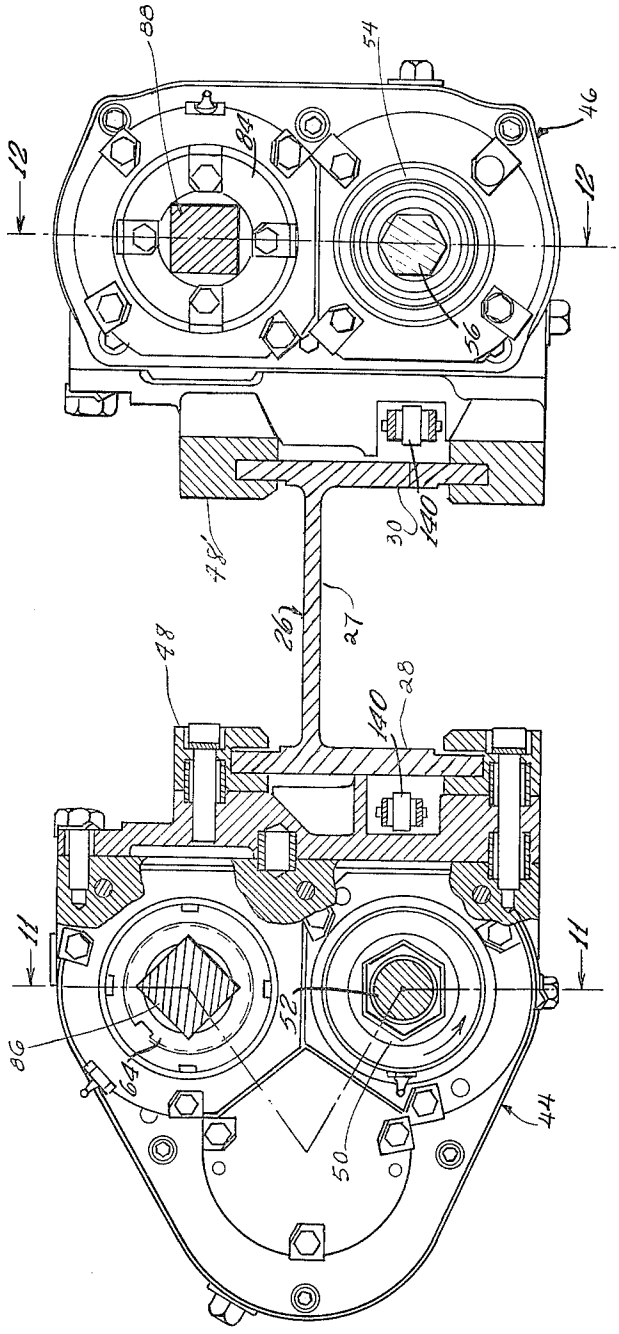


FIG. 10

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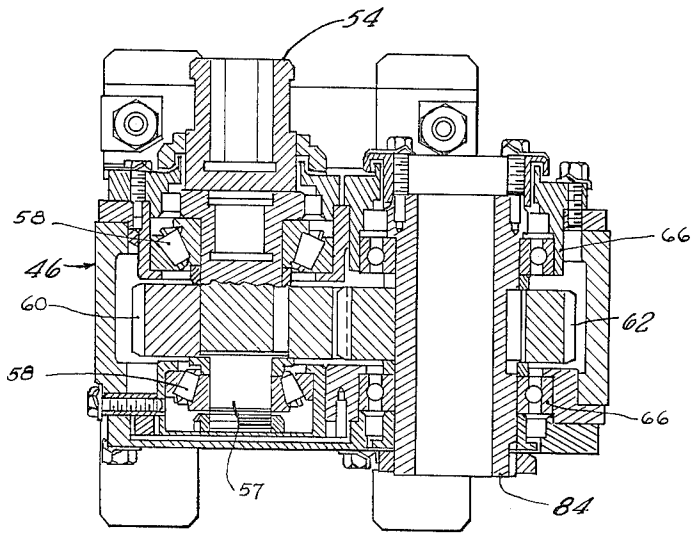


Fig. 12

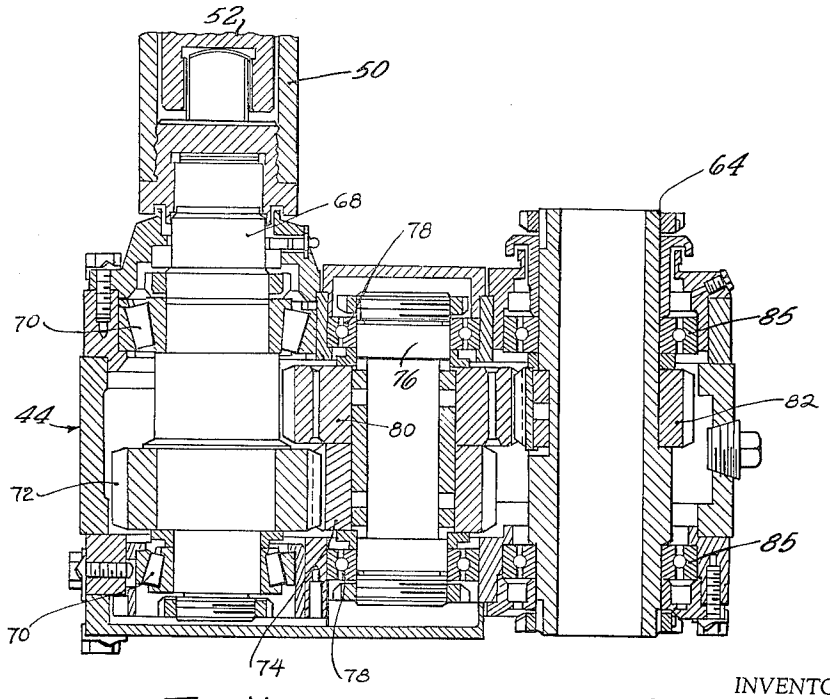


Fig. 11

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DRILLING AND BOLTING APPARATUS

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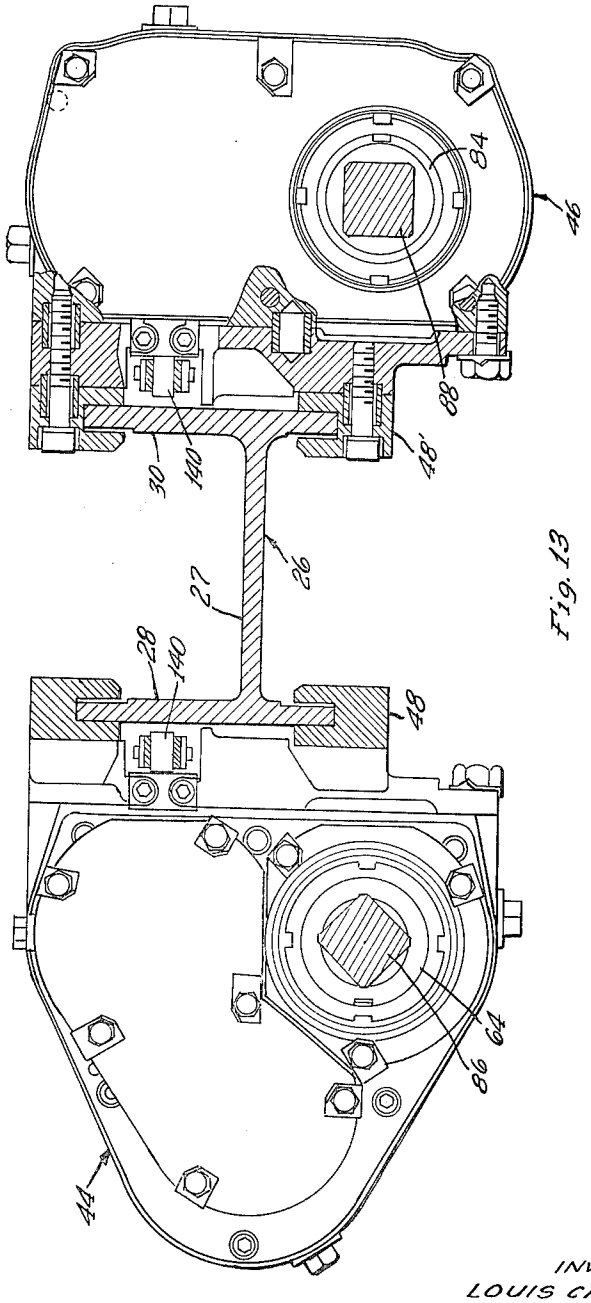


Fig. 13

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United States Patent Office 3,246,705 Patented Apr. 19, 1966

3,246,705

DRILLING AND BOLTING APPARATUS

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Filed Jan. 23, 1963, Ser. No. 253,496
12 Claims. (Cl. 173—44)

The disclosed invention is an apparatus for sequentially drilling a hole and thereafter inserting and securing a bolt within the drilled hole.

The object of the present invention is to provide an apparatus adapted to initially drill a hole, and then insert and secure a bolt within the hole that has been drilled, without the necessity of removing the apparatus from the drilling position. A still further object is an apparatus which may be used at any angle from the horizontal to the vertical. A still further object is an apparatus which permits the drilling, and the bolt securing on extremely uneven surfaces such as are found in tunnels. Another object is an apparatus which is so constructed that it is practically self-cleaning. Another object is an apparatus which is extremely compact, thus permitting its use in relatively confined areas, such as mine shafts or tunnels. Although compact, the apparatus must be and is of rugged construction. Additionally it is of simple construction whereby maintenance is reduced to a minimum.

The objects of the invention are further enhanced by certain features thereof, such as improved means for operating a drill through its full length, with actuating means moving but half the length.

The foregoing and other objects of the invention will be readily understood from the description herein when read in view of the accompanying drawings, wherein:

FIGURE 1 is a view of the drilling and bolting apparatus with the drilling and bolting turret lowered relative to the positioning means;

FIGURE 2 is a view on line 2—2 of FIGURE 1 with the apparatus positioned for drilling;

FIGURE 3 is a view similar to FIGURE 2 with the apparatus in bolting position;

FIGURE 4 is a detail sectional view on line 4—4 of FIGURE 1;

FIGURE 5 is a detail enlarged view of the turret elevating means and turning means;

FIGURE 6 is a detail sectional view of the lower end of FIGURE 5;

FIGURE 7 is reverse view of FIGURE 1, with the turret elevated relative to the positioning means;

FIGURE 8 is a plan view of the motor and gear means;

FIGURE 9 is a vertical sectional view taken on 9—9 of FIGURE 8;

FIGURE 10 is a horizontal sectional view taken on line 10—10 of FIGURE 1;

FIGURE 11 is a vertical sectional view taken on line 11—11 of FIGURE 10;

FIGURE 12 is a vertical sectional view taken on line 12—12 of FIGURE 10; and

FIGURE 13 is a horizontal sectional view taken on line 13—13 of FIGURE 1.

Referring to the drawings, there is provided a positioning post or rod 10, the upper end of which terminates in a point 11 to pierce into the surface upon which the drilling and bolting operation is to be performed. Coextensive and in axial alignment with the positioning rod is in an elevating piston means or jack 12. The lower end of post 10 (see FIGURE 4) is rigidly secured, as by through bolts 14 in the upper portion of a securing sleeve 16. Secured in the lower portion of a securing sleeve is the upper solid end 18 of the elevating jack casing 20

which depends therefrom, and in which a piston operates to actuate the piston rod 22 (see FIGURE 1).

The positioning rod 10 and the hydraulic jack 12 carry a drilling and bolting turret 24, the turret being rotatably and vertically movable relative to the positioning member 10 and the hydraulic jack 12. The turret 24 has a main-supporting frame 26 in the form of an I beam, having a central web 27 (see FIGURE 10) and parallel end flanges 28 and 30 and a top plate 31. For clarity, the face of the central web on which the positioning rod 10 and hydraulic jack 12 are mounted will be considered the rear face. The positioning post 10 extends through top plate 31 and secured to the rear face of the web in any suitable way, is a top sleeve-bearing member 32, an intermediate sleeve-bearing member 34, and a bottom bracket member 36. The top bearing member 32 surrounds the positioning post 10, the intermediate bearing member 34 surrounds the jack casing 20, the bottom bracket member 36 (see FIGURES 5 and 6) has a forwardly projecting lug 38 having a transverse opening therethrough to receive a pin 40, extending through the link 42 pivotally mounted at 43 on the lower end of the piston rod 22. Thus when the piston rod 22 is raised or lowered, the frame 26 will be raised or lowered therewith, the purpose being hereinafter apparent.

The flanges 28 and 30 of the frame 26 constitute bearing surfaces and guides for a drill-carrying carriage 44, which is vertically slidably mounted on the left flange 28 as seen when looking at FIGURE 1, or down on FIGURE 10, and a bolt-carrying carriage 46 which is slidably mounted on the right flange 30. The carriages are equipped with suitable shoes 43, 43' which engage the flanges and slidably secure the carriages thereto. The drill carriage 44 is provided with a forwardly disposed upwardly facing socket 50 for receiving the end of a drill 52 and the bolting carriage 46 is provided with an upwardly facing forwardly positioned socket 54 (see FIGURES 10–12) for receiving the end of a bolt 56. Referring to FIGURE 2, it will be seen that if the centers of the drill socket 50, bolt socket 54, and positioning post 10 are connected, as indicated by the dotted lines, they are positioned to define an isosceles triangle with the apex at the positioning post 10. With this construction the drill socket 50, and bolt socket 54, are equidistant from the center of the positioning post 10 whereby when the frame is rotated in a counterclockwise direction from the position shown in FIGURE 2 to the position shown in FIGURE 3, the bolt socket 54 will be moved to the precise location previously occupied by the drill socket 50. It becomes evident from the foregoing that if a hole is initially drilled with the apparatus in the position shown by FIGURE 2, and the device is then turned or rotated to the position of FIGURE 3, the bolt 56, carried in the bolt socket 54 will be in exact alignment with the drilled hole whereupon it may be inserted therein.

To accomplish the bolting, the bolt socket 54 is secured in any suitable way to the upper end of a stub shaft 57 (see FIGURE 12) rotatably mounted within the bolt-carriage casing 46 as by top and bottom bearing races 58. The shaft has a gear 60 secured thereto, which gear meshes with a gear 62 secured to a drive sleeve 84 rotatably mounted on bearing races 66. With this construction when the drive sleeve 84 is rotated, as subsequently described, the rotation will be transmitted to the bolt socket 54 to rotate the bolt 56 carried therein.

The drill socket 50 (see FIGURE 11) is secured to a stub shaft 68 which is rotatably mounted on bearing races 70 within the drill-carriage 44 casing. The shaft 68 has secured thereon a gear 72 which meshes with a gear 74

secured to an idler 76 mounted on ball races 78. The idler 76 has secured thereto a second gear 80 which meshes with gear 82 secured to the drive sleeve 64, rotatably mounted on bearing races 85. Thus rotation of sleeve 64 will through the described gear chain rotate the drill socket 50.

The respective drive sleeves 64 and 84 have an internal rectangular cross section through which the square drive shafts 86 and 88 respectively extend with sufficient peripheral clearance to permit vertical sliding movement between the sleeves and drive shafts during the rotation of the shafts.

The drive shafts 86 and 88 are driven by a driving means 90 secured to the lower end of frame 26. The driving means includes (see FIGURES 1, 8 and 9) a fluid-operated motor 92, of any conventional type, mounted on top of driving means gear casing 94. The drive shaft 96 of the motor connects to drill drive-shaft socket 98 through a chain of gears 100, 102 mounted on idler shaft 104 and 106 mounted on the socket carrying shaft 108. In similar manner the drive shaft 96 connects to the bolt-drive shaft socket 110 through the chain of gears 100, 112 and 114 mounted on idler shaft 116, and 118 mounted on the bolt-drive socket shaft 120. The drive shafts 86 and 88 are secured in their respective sockets by pin bolts 124.

It thus becomes apparent that upon operation of motor 92 the gear chains will be set in motion as indicated in FIGURE 8, the respective drill and bolt drive shafts 86 and 88 will be rotated to rotate the respective sleeves 64 and 84 through which they pass, with the sleeves respectively transferring their rotation to the drill socket 50 and bolt socket 54.

In order to transmit rotation throughout the vertical travel of the carriages each drive shaft extends to the top of the frame. The drill drive shaft 86 has its upper end secured in a collar 126 journaled in an opening (not shown) in top plate 31 (see FIGURE 1). The top plate 31 also has secured thereon a cylindrical sleeve guide 128 for the drill 52. The guide 128 carries an upwardly and outwardly flexing cone member 130 into which the drilled material may fall, and be withdrawn through the angular projecting outlet 132 provided with a pair of openings to which hoses from a blowing and vacuum source may be attached.

The bolt drive shaft 88 is secured at its upper end in a collar 134 rotatably mounted in bracket 136 which is secured to and projects laterally from the adjacent flange 30 of the frame 26. The bolt 56 also extends through a guide opening in bracket 136. The guide sleeve 128 and guide opening are aligned with the respective drill and bolt carriage sockets.

In order to raise the drill and bolt, there is provided on the forward face of the frame (see FIGURE 7) drive means comprising an endless link chain 140 and actuating means 142. As there seen, the drilling carriage 44 is at the upper end of the travel and bolting carriage 46 is locked in position at the lower end by means subsequently described.

The chain actuating means is a second hydraulic jack having a piston casing 144 secured to the front face of the central web 27 of the frame and a piston rod 146 depending from the casing and terminating in a gear carrier 148. Mounted on the gear carrier are a pair of transversely spaced upper gears or cogs 150 and a lower centrally spaced cog 152. Additionally there is secured to the top of the frame a pair of transversely spaced cogs 154 and 156, and at the bottom a pair of similar cogs 158, 160, in vertical alignment with the upper cogs. As is apparent from FIGURE 7, with the cogs so positioned, when the cog carrier 148 is in mid position of the frame as shown by dotted lines, the chain defines an H with the portion thereof running across the cog carrier 148 being a movable cross member, and having outer left and right vertical runs, a center central depending U run or loop, and a bottom inverted U run or loop.

With this arrangement when carriage 46 is locked and piston rod 146 is lowered the top loop is lengthened and the lower shortened resulting in upward travel of the right vertical run and elevation of the drill carriage 44. Upon raising the piston rod, downward travel of carriage 44 will result. Obviously if carriage 44 is locked in lower position, carriage 46 will be elevated and lowered. It will also be noted that the interior U loops are substantially equivalent in length to the outside runs whereby full vertical movement of the carriages is accomplished by the piston actuating over one-half the same distance, thus providing a compact actuating means measured by the length of the drill.

The locking of the carriages is accomplished by a Z shaped latching member, having (see FIGURE 1) a lower horizontal arm 164 which engages stop 166 on the bolting carriage 46 during drilling, and an upper horizontal arm 168 which engages stop 170 on the drilling carriage, when bolting.

As seen in FIGURES 5 and 6 latch 162 is carried on and non-rotatably secured in any suitable manner (as by a key-way, not shown) to the lower portion of pin 172, this pin being mounted in a bushing 174, carried in the vertical opening of a horizontal arm 176 extending from and integral with bracket 36. The latch 162 is held on pin 172 by a spring 163 and nuts 165 threaded on the lower end of the pin. The upper end of pin is secured to an arm 178, the latter being fixed to the lower end of a connector 180. The upper end of connector 180 is fixed to ring member 182 (see FIGURE 5), which in turn is fixed to the elevator piston casing 20.

With this construction, the latch 162 is retained in fixed axial alignment with the positioning post 10 and elevating jack and the turret turns relative thereto.

As previously stated the lower end of the elevator piston rod 22 and link is pivotally connected at 43 to link 42, and to prevent rotation of the piston rod the latter has a pin 184 projecting laterally therefrom into a vertical slot 186 in the connector 180 (see FIGURE 1).

The rotation of the turret relative to the positioning post may be accomplished in any suitable manner, there here being shown a lever 188, projecting from a collar 190 rotatably mounted on the positioning post 10. The collar 190 is provided with a tongue or key 192 which rides in a vertical groove 194 (see FIGURE 5) in the frame with member 27. Thus when lever 188 is actuated to rotate collar 190 on post 10 it will rotate the turret about the post 10. The groove 194 permits sliding movement of the turret relative to tongue 192.

As earlier described the sleeve 16 is the carrier for the device, and in effect is a part of the positioning post. Herein the sleeve 16 is integral with a laterally extending plate arm 196, to which one end of a series of jacks 195, 197, and 199 are connected. The piston rod 200 of jack 195 is connected at 198 to the arm 196 and is movable in and out of piston casing 202. The piston casing 202 is pivotally carried by any type of vehicle (not shown). Secured to the left end of piston casing 202 is a bracket 204, and pivotally connected to the upper right end of the bracket at 206 is the piston casing 208 of jack 197. The piston rod 210 extends from casing 208 and is pivotally connected at 212 to the lever arm 196 above and to the right of pivot connection 198. The piston casing 213 of jack 199 is pivotally connected at 214 (see FIGURES 1 and 2) to a bracket on the upper right corner of arm 196 with the piston rod 215 pivotally connected at 216 to the end of lever arm 188.

With the above series of jacks it will be seen that jack 195 can extend or retract the entire apparatus relative to the carrying vehicle, jack 197 can angularly pivot the apparatus in the vertical plane, and jack 199 operates lever 188 to angularly rotate the turret from drilling to bolting position.

For purposes of clarity the hose connections to the numerous jacks have been omitted, as the construction is

well-known and within the skill of the art, merely being the type wherein a piston operates in response to fluid pressure on one face thereof.

Briefly summarizing the operation, the inoperative position of the turret is shown in FIGURE 1, that is, lowered relative to the positioning post 10, with the elevating jack 12 having its piston at the lower end of the stroke. The turret is also in the clockwise position of FIGURE 2 and the bolting carriage 46 locked in lower position by arm 164 of latch 162.

The device is now positioned with the positioning post point 11 pierced as far as possible into the surface to be drilled. The elevator jack 12 is now operated to raise the turret until the collar 130 engages the surface to be drilled, which may be somewhat below the point 11, and the device is now in the raised position of FIGURE 7.

The fluid motor 92 is now set into operation to rotate the drive shafts. With the drill 52 being turned, the carriage actuating means 142 (FIGURE 7) are set in operation to raise the drill to perform the drilling operation. The raising speed of the drill may be increased or decreased and readily controlled through control of the piston 146.

When the drilling is complete carriage 44 is lowered, the turret is then rotated counterclockwise to the position of FIGURE 3 aligning the bolt with the drilled hole. In the position of FIGURE 3, the drill carriage 46 will now be locked by engagement of latch arm 168 and stop 170.

The bolt is now raised into the drilled hole and the end 214 of the bolt is of the contact explosive type whereupon the bolt is anchored in position.

Also, as seen in FIGURE 7, a hole closure 217 through which the bolt extends is carried on the frame top plate. The lower end of the bolt carries a nut 218 in a corresponding recess in the top of the bolt socket 54, the bolt socket being of sleeve construction. It is thus seen that when the bolt becomes anchored, the nut 218 will continue to rotate on the threaded bolt to secure the hole closure 216 in position. The hole closure 216 has a reduced neck 220 to which clamps may be secured for the erection of scaffolds; or for such other purpose, as desired.

The bolt carriage is now lowered, as is the turret whereupon the positioning post 10 may be lowered and the entire apparatus moved to another location.

It is obvious that many changes in structure could be made, as for example, the motor drive could be electrical, or the pair of motors could be substituted for the present single motor and gear train.

It will also be noted that the apparatus is practically self-cleaning due to the rotation of the drive shafts, reciprocation of the piston and the use of the chain drive. This is particularly advantageous in view of the density of dust in mining or tunneling operations.

The device having been described, the following is claimed:

1. A drilling and bolting turret comprising a frame member, a drilling carriage and a bolting carriage slidably mounted on said frame member, a drilling bit rotatably mounted on said drilling carriage and having a longitudinal axis, a bolt mounted on said bolting carriage and having a longitudinal axis, means rotatably mounting said frame member and having a longitudinal axis about which said frame member is rotatable, said axes of said drilling bit and bolt being equidistant from said axis of rotation of said frame member, means to rotate said frame member about said axis of rotation thereof from a first position to a second position in the direction from said bolt to said drilling bit through an angle substanially equal to the angle between the axes of said bolt and drilling bit with respect to said axis of rotation of said frame member, a hydraulic jack mounted on said frame member and having a piston rod, pulley means connected to said piston rod, a first chain having one end attached to said drilling carriage and a second end attached to said bolting carriage proximate the upper ends thereof, a second chain having one end attached to said drilling carriage and a second end attached to said bolting carriage proximate the lower ends thereof, said first and second chains contacting said pulley means mounted on said piston rod, whereby movement of said piston rod effects movement of at least portions of said first and second chains, locking means responsive to rotation of said frame member to lock said bolting carriage when said frame member is in said first position and to lock said drilling carriage when said frame member is in said second position, means responsive to movement of said piston rod to act on said chains to alternately raise and lower said drilling carriage when said frame member is in said first position and to alternately raise and lower said bolting carriage when said frame member is in said second position and means to rotate said drilling bit while said drilling carriage is being raised.

2. A drilling and bolting turret comprising an elongated frame member, means rotatably mounting said frame member and having a longitudinal axis about which said frame member is rotatable, a drilling carriage and a bolting carriage slidably mounted on said frame member, a bolt socket rotatably mounted on said bolting carriage and having a longitudinal axis of rotation, a drilling socket rotatably mounted on said drilling carriage and having a longitudinal axis of rotation, said axes of said bolt and drilling bit being equidistant from said first-named axis, means to rotate said frame member about said first-named axis from a first position in the direction from said bolt socket to said drilling socket through an angle equal to the angle between said axes of said sockets with respect to said first-named axis, a pair of drive shafts, means fixed to said frame member rotatably journalling said drive shafts, each of said drive shafts extending through one of said carriages, gearing means mounted in each carriage interconnecting the respective sockets and drive shafts whereby rotation of one of said drive shafts will rotate its respective socket, means to alternately raise and lower said drilling carriage with respect to said frame member and its respective drive shaft when said frame member is in said first position and to alternately raise and lower said bolting carriage with respect to said frame member and its respective drive shaft when said frame member is in said second position and means to drive the drilling carriage drive shaft when said frame member is in said first position and said bolting carriage drive shaft when said frame member is in said second position.

3. In an apparatus of the character described, a positioning member, a frame member rotatable on the positioning member, a drill-carrying carriage slidable, on the frame, a bolt carrying carriage slidable on the frame, means for angularly rotating the frame between two positions, and latching means axially aligned with the positioning member for limiting the angular rotation of the frame, said latching means engaging and restraining movement of the drill-carrying carriage in one angular position of the frame and the bolt carrying carriage in the other, drive means connected to said frame for driving said bolt and drill-bit carriages when in the unrestrained position.

4. In an apparatus of the character described, an I beam frame member having a central web and parallel side flanges, a positioning post, a hydraulic jack secured to the positioning post, in coaxial alignment therewith, means rotatable and slidably mounting the post and jack on one side of the central web of the frame, means connecting the jack piston to the frame member, means rotatable on the post and engaging the frame for rotating it between two alternate positions on the post, latching and stop means in coaxial alignment with the post for limiting rotation of the frame member, a carriage slidable on each of the frame flanges, one carriage being engaged by the latching means when said frame member is in one alternate position and the other carriage being

engaged by the latching means when said frame member is in the other alternate position, means mounted on the other side of the central web for raising and lowering the unlatched carriage.

5. A drilling and bolting apparatus comprising an elongated turret means, means for rotatably supporting said turret means and having a first longitudinal axis about which said turret means is rotatable, a drilling carriage and bolting carriage longitudinally movable on said turret means, a drilling bit having a second longitudinal axis rotatably mounted on said drilling carriage, a bolt having a third longitudinal axis rotatably mounted on said bolting carriage, means connected to said drilling and bolting carriages for rotating said drilling bit and said bolt, said second and third axes being equidistant from said first axis and parallel therewith, means for rotating said turret means about said first axis between a first position in which said second axis defines a line in space and a second position in which said third axis coincides with said line, and means connected to said drilling and bolting carriages for moving said drilling and bolting carriages in a longitudinal direction.

6. An apparatus as set forth in claim 5, wherein said turret means comprises collar means having a longitudinal axis which coincides with said first longitudinal axis, said apparatus further comprising sleeve means rotatably mounting said collar means, said sleeve means rotatably mounted on pivot means for angularly rotating said sleeve means in the vertical plane, said pivot means mounted on translational means for moving said pivot means and turret means in a translational direction.

7. An apparatus as set forth in claim 5, wherein said turret means comprises an elongated frame member, said frame member comprising guide means for guiding the longitudinal movements of the drilling and bolting carriages, said drilling and bolting carriages slidably mounted on said guide means.

8. An apparatus as set forth in claim 5, wherein said means for longitudinally moving said drilling and bolting carriages comprises hydraulic jack means comprising a piston movable in the longitudinal direction, chain means disposed in a predetermined path movably connected to said piston and movably connected to said drilling carriage and said bolting carriage, whereby the movement of said longitudinal piston causes longitudinal movements of said bolting and drilling carriages.

9. An apparatus as set forth in claim 8, wherein said turret means comprises locking means disposed near the lowermost end of said turret means adapted to alternately and selectively lock said drilling carriage and bolting carriage, whereby when one of said carriages is locked by said locking means, the movement of said piston causes a longitudinal movement of the other of said carriages.

10. A drilling and bolting apparatus comprising an elongated frame member comprising an I-beam having two opposed ribs and an interconnecting strut, a support member, an upstanding collar having a longitudinal axis, means rigidly attaching said collar to said support member, a depending hydraulic jack comprising a cylinder and a piston rod, first connecting means rigidly attaching said cylinder to said support member, second connecting means rigidly attaching frame member to said piston rod, a sleeve rotatably mounted on said collar and having an integral rocker arm, an elongated longitudinally extending slot defined by said strut, a tongue rigidly connected to said sleeve and seated in said slot, whereby extension of said piston rod will lower said frame member with respect to said support member and retraction of said piston rod will raise said frame member with respect to said support member, a bolting carriage, means slidably mounting said bolting carriage on one of said ribs, a drilling carriage, means slidably mounting said drilling carriage on the other of said ribs, a bolt, means rotatably mounting said bolt on said bolting carriage, said bolt having a longitudinal axis of rotation, a drilling bit, means rotatably mounting said drilling bit, said drilling bit having a longitudinal axis of rotation, said axes of rotation of said bolt and said drilling bit being equidistant from said axis of said collar and being parallel therewith, a second hydraulic jack comprising a cylinder and a piston rod, means mounting said second hydraulic jack on said support member, means pivotally mounting said piston rod to said rocker arm, whereby operation of said second hydraulic jack rotates said frame member from a first position in which said drill bit axis defines a line in space to a second position in which said bolt axis coincides with said line, means for rotating said drilling bit and said bolt, and means to slide said drilling carriage upward and downward on said frame member when said bolt member is in a first position and to slide said bolting carriage upward and downward on said frame member when said drilling carriage is in a first position, locking means mounted on said frame member to alternately lock from movement said bolting carriage when said frame member is in said first position and said drilling carriage when said frame member is in said second position.

11. An apparatus as set forth in claim 10, said apparatus further comprising pulley means partially mounted on said frame member and partially mounted on said first piston rod for raising and lowering said drilling carriage when said bolting carriage is locked by said locking means and to raise and lower said bolting carriage when said drilling carriage is locked by said locking means.

12. An apparatus as set forth in claim 11, wherein said locking means comprises a Z-shaped flange member having a pair of closed locking faces, each of said carriages comprising a pair of opposed channel members slidably engaging one of said ribs, one of said locking faces overlying the top of one of the bolting carriage channel members when the frame is in said first position and the other of said locking faces overlying the top of one of said drilling carriage channel members when said frame is in said second position.

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