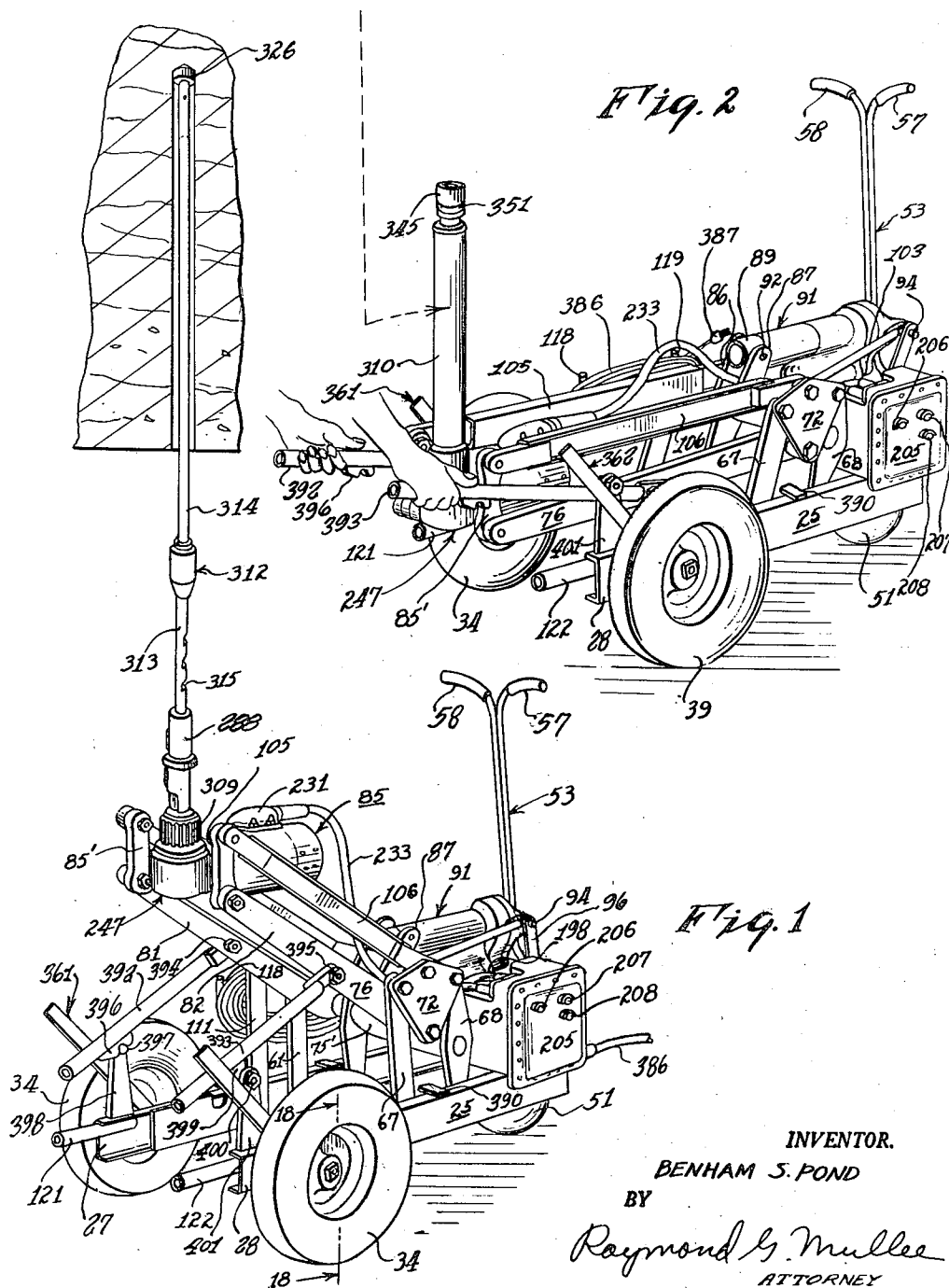


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ROOF BOLTING DRILL

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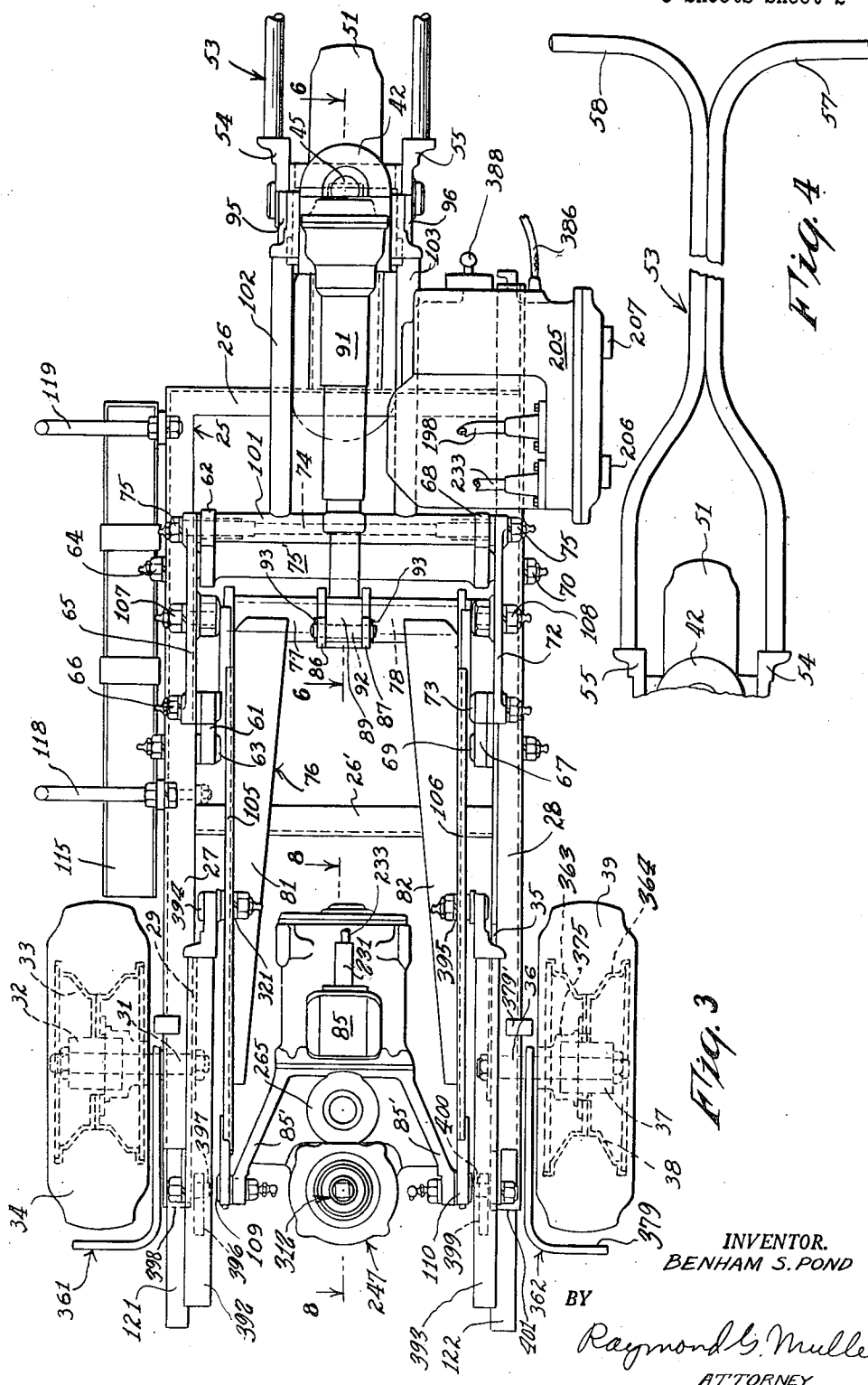
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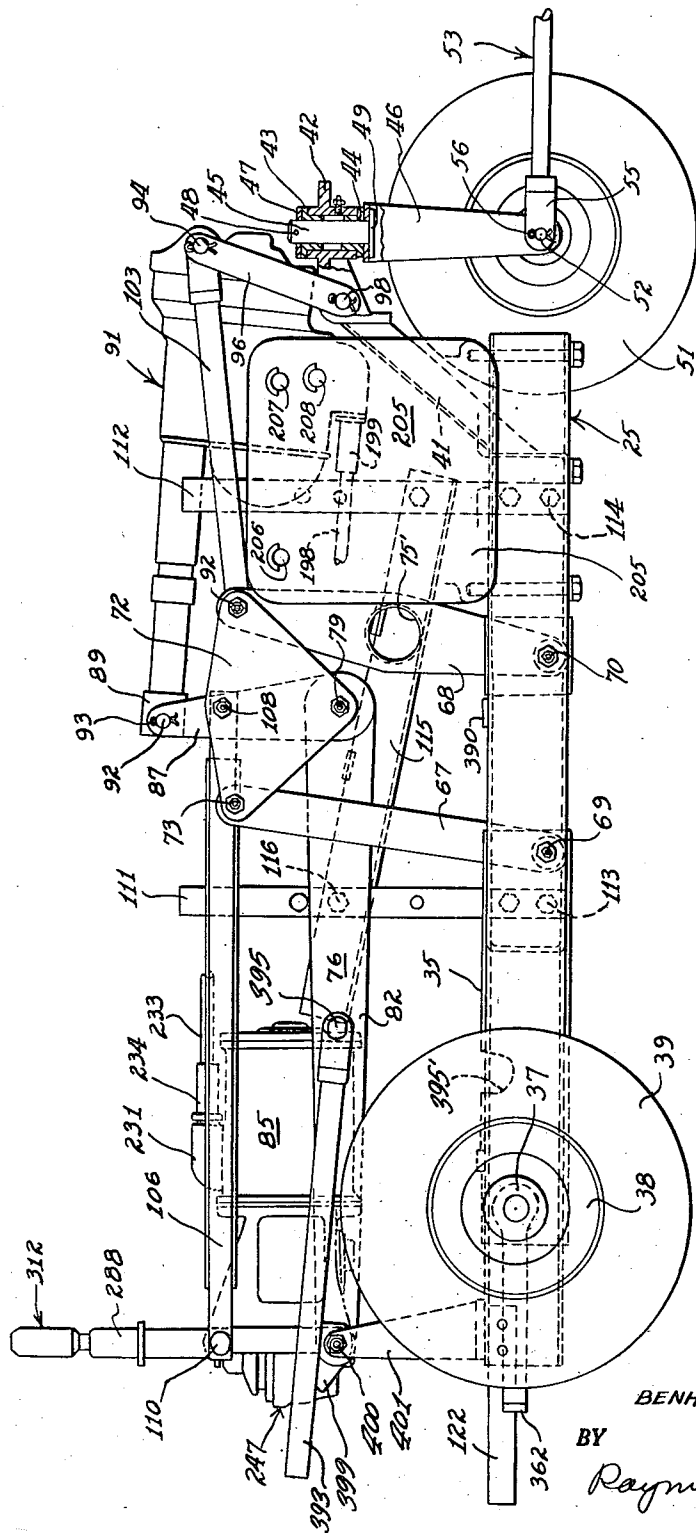
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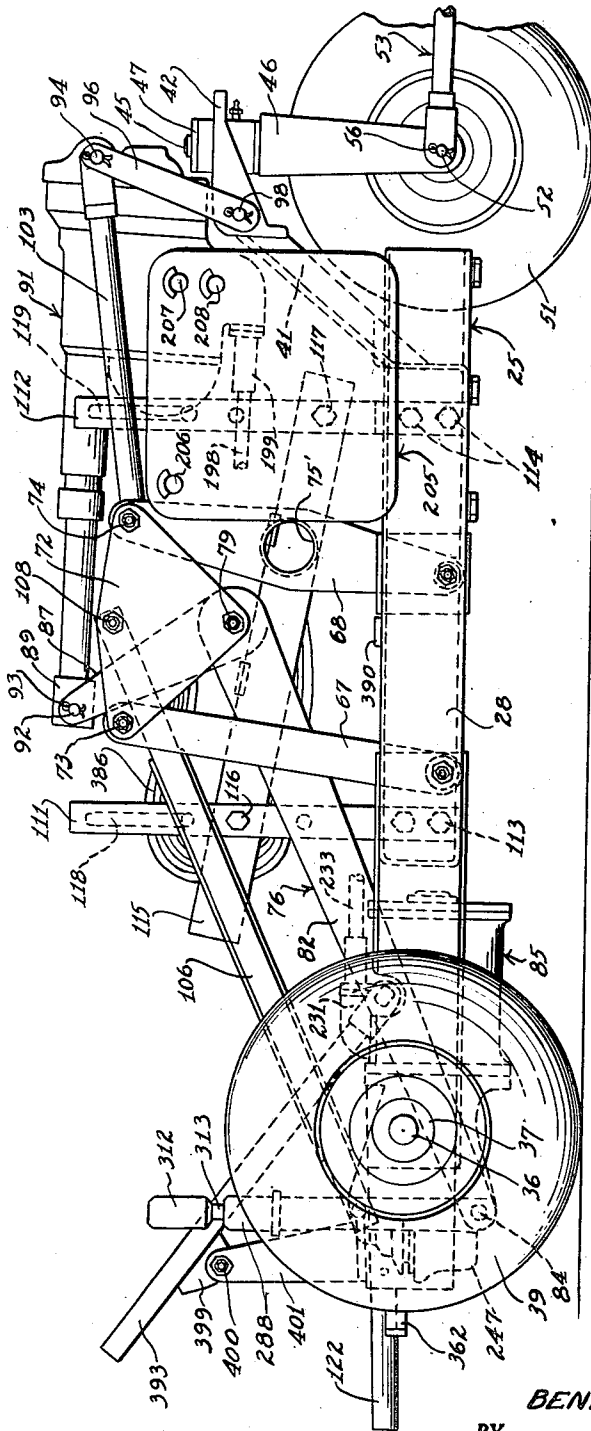


Fig. 5a

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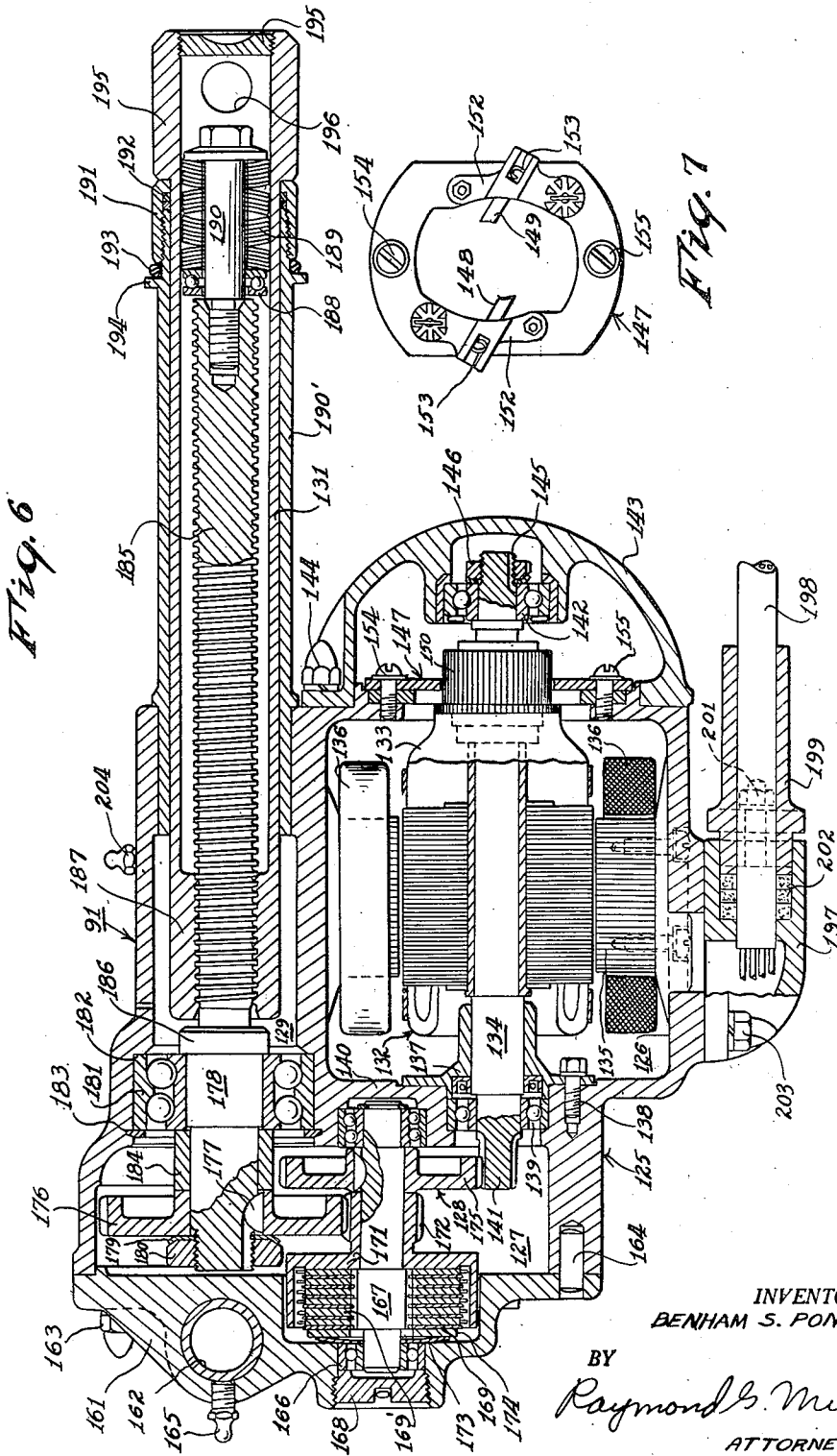
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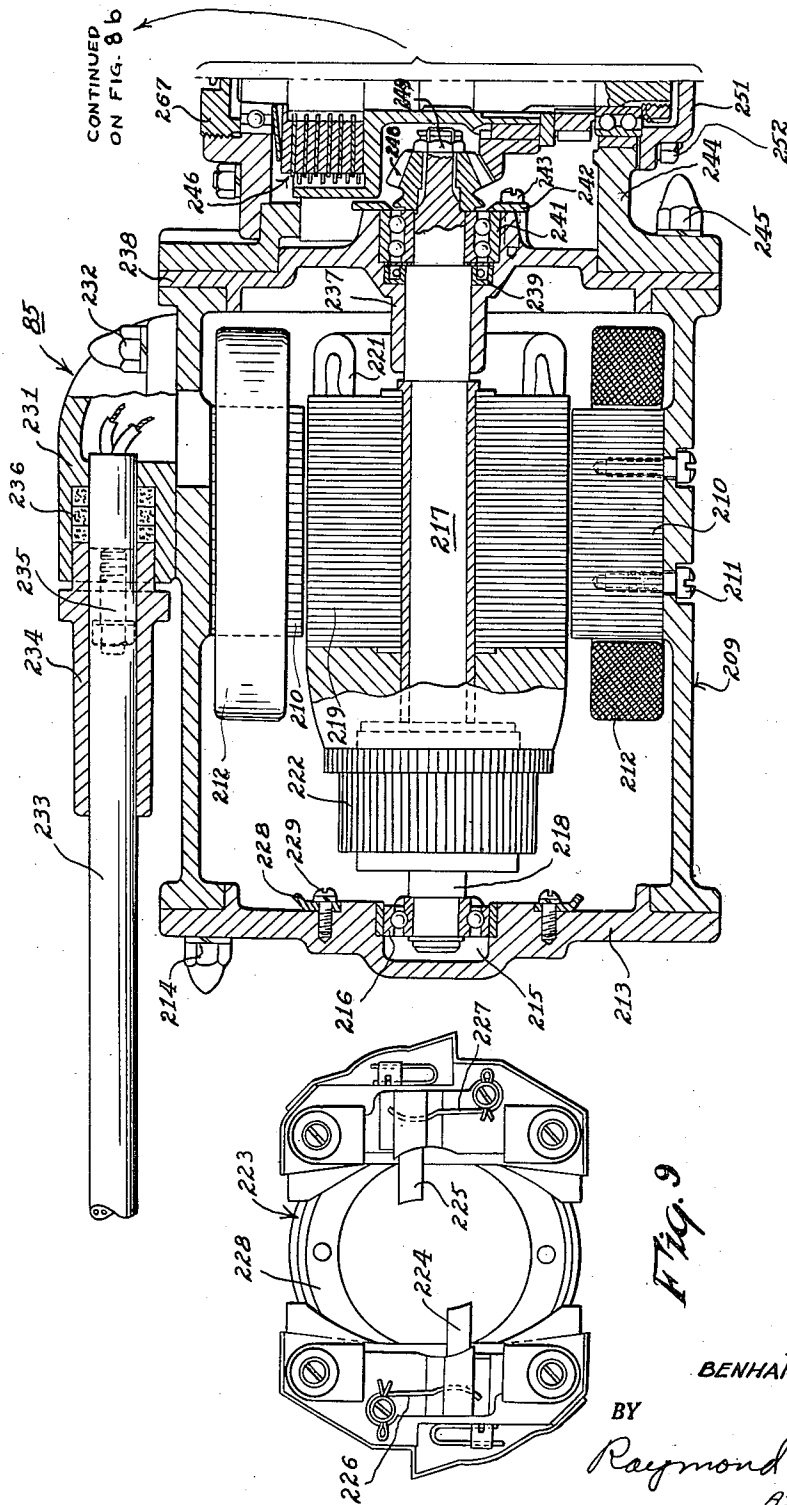
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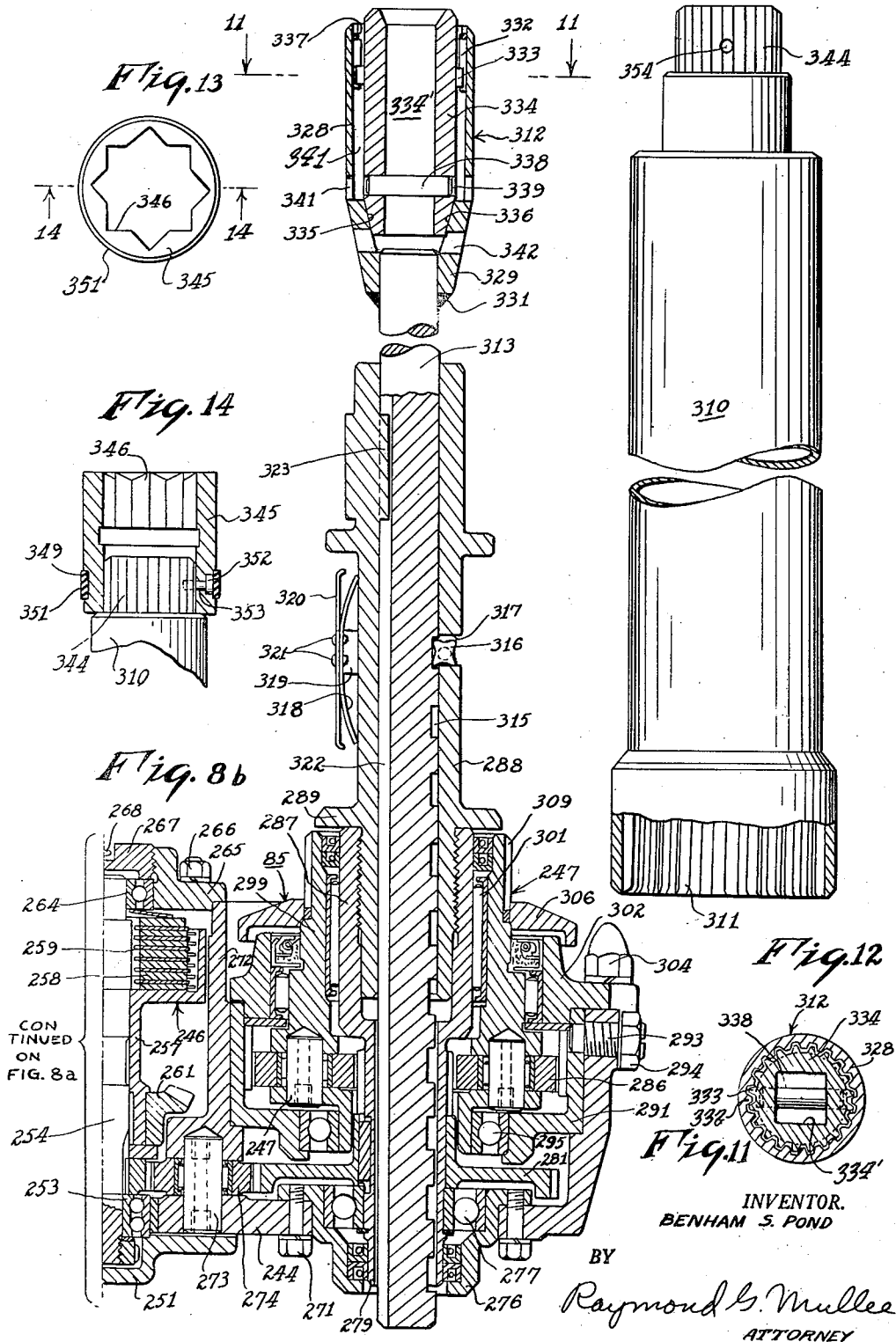
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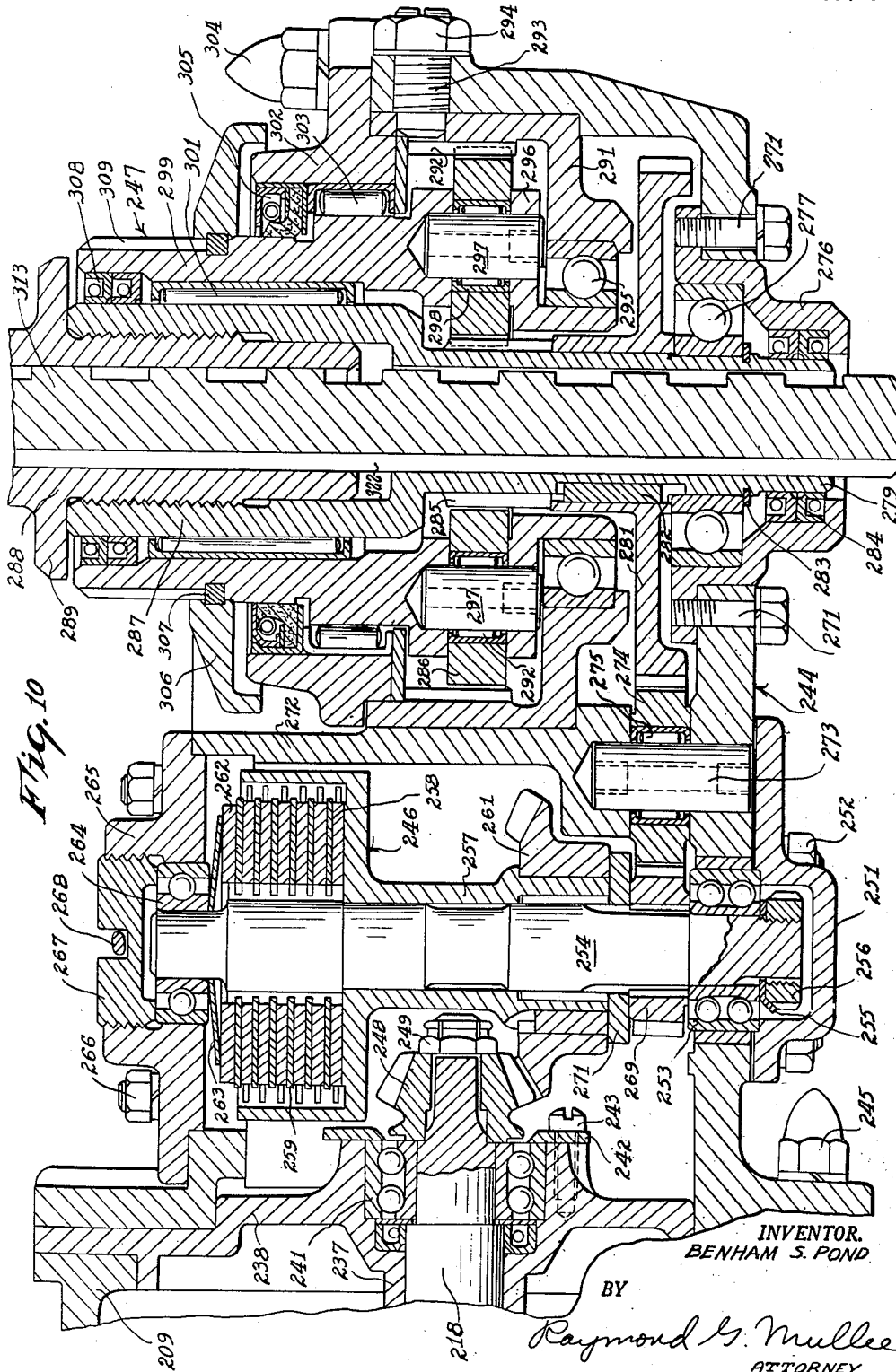
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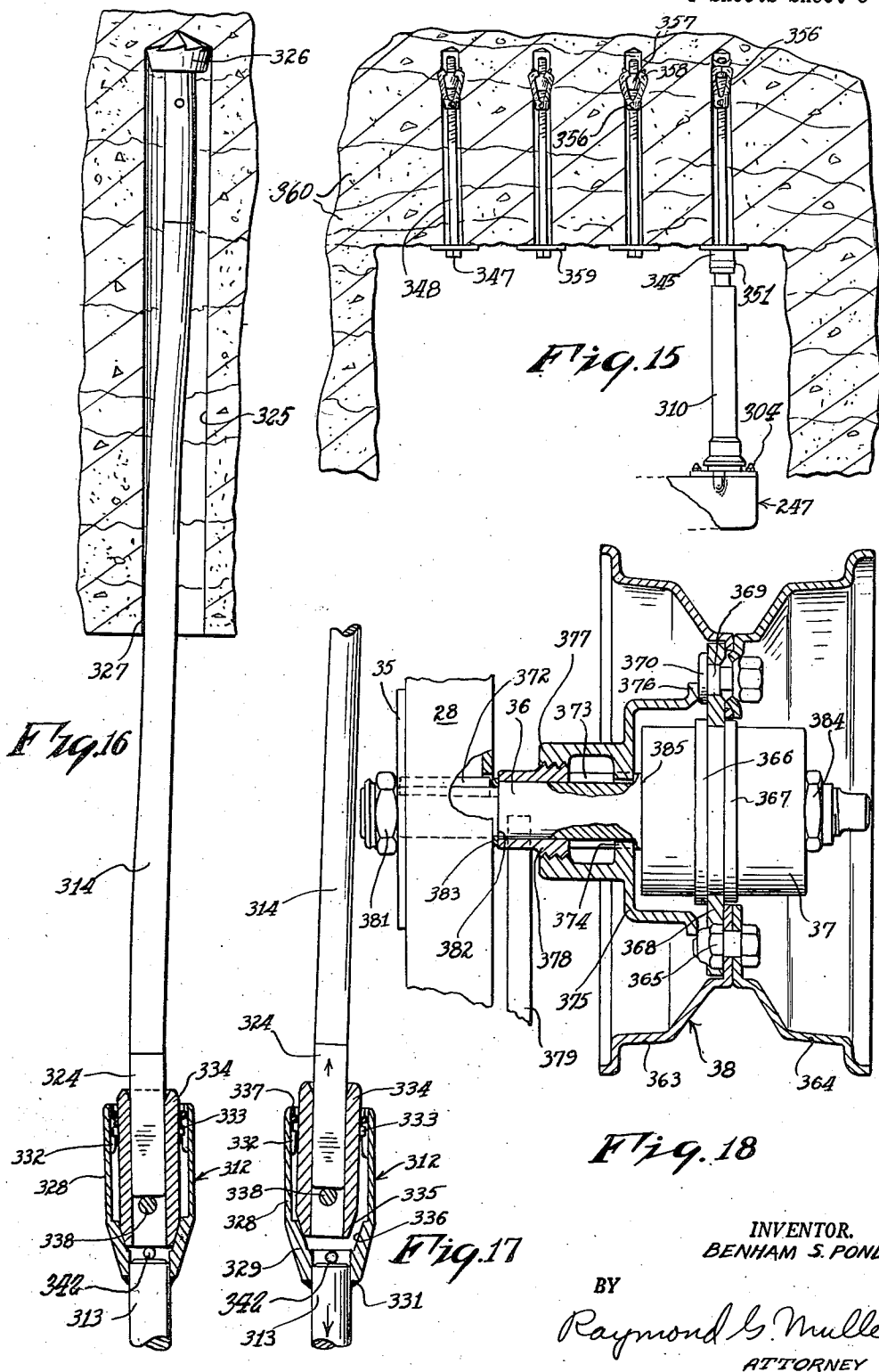
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ROOF BOLTING DRILL

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3 Claims. (Cl. 255—51)

This invention relates to a combined mine roof bolt drilling and bolt setting tool.

In coal mines, the usual mine timbers which have been used to support the mine roof are gradually being replaced with roof bolts that are inserted in long holes drilled with a drill auger, expanded on their upper ends to grip the hole wall and supporting on their lower ends, plates that are held tight against the roof surface by a bolt head or nut. These bolts are placed in the roof at spaced locations and may run either straight upwardly or at an angle extending to the sides of the haulageway or mine space. The roof structure generally consists of slate, shale or sandstone laminations and the fixing or tying of these laminations together with the bolts makes a solid beam-like mass that may extend over the haulageway. As the coal is removed, the drilling and bolting operations are immediately instituted and in order to keep up with modern coal digging and removal equipment used today special power tools are being developed to carry on these operations. The removal of the timbers makes room for handling the heavy modern equipment and reduces the number of roof falls resulting from bumping the timbers. The coal depth and the roof height vary in the different mines as the roof and floor have irregularities that make it difficult to set up the power tool and to properly start and guide the drill auger. Different drill lengths are used to start and complete the roof holes. During the changeover of the different length drills, the setting of the drill chuck should be kept in order to locate the starting hole center with the full length drill. The full length drill auger is about equal in length to the roof height and off center removal of the drill chuck should be had in order to start the full length drill auger in the already drilled starting hole and when the drill auger has been started the drill chuck should be returned to the exact original center location from which the starting hole had been drilled. A similar off center removal of drill chuck should be had to permit the insertion of the roof bolt that also runs about equal in length to the roof height and still permits its return to the center position for ready engagement with the bolt head or nut. Also many times the drill auger will bind and be difficult to remove. In all of these cases, the entire tool is removed.

The roof bolts are generally of two types, the slit rod and wedge type and the expansion bolt type. With the slit rod and wedge type, the slit rod is driven up into the drilled hole with the wedge in the slit upper end and with sufficient force to cause the wedge upon engaging with the upper end of the hole to spread the slit upper end of the rod so that it grips the hole wall firmly. Thereafter, the supporting plate is brought against the roof surface by the setting of the nut on the lower end of the rod. This type of bolt requires the added operation of hammering the bolt. The expansion bolt type has an expandable grip member, the fingers of which are expanded by a wedge as the rod is screwed into the wedge by the bolt setting tool that receives and turns the bolt head. The

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driving or hammering operation is not required with this expansion bolt type.

It is the principal object of the present invention to provide a combined mine roof drilling and bolt setting tool which can be adapted to different roof heights and roof and floor irregularities encountered in a coal mine opening and thus make possible the drilling of a straight and full length roof hole.

It is another object of the invention to provide a combined mine roof drilling and bolt setting tool which has provision for the placing off center of the drill chuck and spindle head without the removal or re-adjustment of the supporting carriage from its set location whereby to permit the easy insertion of the long drill length into the starting hole, the removal thereof and the insertion of the roof bolt into the finally drilled hole.

It is another object of the invention to provide a simple lock wheel mechanism for a mine roof drilling and bolt setting tool wherein the wheel supporting carriage of the tool can be locked against movement on the mine floor.

It is still another object of the invention to provide an adjustable height drill chuck for a mine roof drilling and bolt setting tool to make up for loss of length of the square drill shank, irregularities in the roof surface and to make possible the use of fewer drill lengths.

It is still another object of the invention to provide in a mine roof drilling and bolt setting tool and anti-binding drill chuck comprising an inner drill shank-receiving member that may be made free of an outer drive member to adapt the inner member to the tilted drill shank and whereby to permit the release of the bound drill auger from the drill chuck.

It is still another object of the invention to provide a jack screw drill feed assembly for a mine roof drilling and bolt setting tool with resilient end stop abutments to overcome inertia of the driving motor and parts of the assembly to prevent their breakage and to make easy the reverse movement of the same.

It is still another object of the invention to provide a mine roof drilling and bolt setting tool which is easy to convert the tool set up for effecting the drill operation to a set up for effecting the bolt setting operation and by simply placing a bolt setting sleeve over the drive chuck and in engagement with a concentric setting sleeve driving gear.

It is still another object of the invention to provide a wholly electrically-driven mine roof drilling and bolt setting tool which has a built in push button control of the feed assembly to effect the up and down movements of drill and setting sleeve drive head, with the down speed being faster than the up speed and a built-in push button control for the drill and setting sleeve drive unit motor.

Other objects of the invention are to provide a mine roof drilling and bolt setting tool which is of simple construction, inexpensive to manufacture, has a minimum number of parts, easy to assemble, portable, rubber-tired, easy to manipulate upon the mine floor and to position and lock for use, light in weight to reduce bolting costs and efficient in operation.

For other objects and for a better understanding of the invention, reference may be had to the following detailed description, in which:

Figure 1 is a perspective view of the mine roof drilling and bolt setting tool embodying the features of the present invention, the tool being positioned under the mine roof and effecting a drilling operation thereon;

Fig. 2 is a perspective view of the tool with the positioning levers being lifted and pushed to offset the spindle head so as to permit the insertion of a roof bolt without having to move the tool from its original location on the mine floor, the bolt setting sleeve being in place on the spindle head;

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Fig. 3 is a top plan view of the tool with the handle broken away;

Fig. 4 is a fragmentary plan view of the handle and of its connection with the steerable wheel;

Fig. 5 is a side elevational view of the tool with portions of the same broken away;

Fig. 5a is a side elevational view of the tool similar to Fig. 5 but with the spindle assembly in its lowered position;

Fig. 6 is a longitudinal sectional view of the motor driven jackscrew feeder assembly taken generally on line 6—6 of Fig. 3 and looking in the direction of the arrows thereof;

Fig. 7 is an elevational view of the brush assembly for the feeder motor shown in Fig. 6;

Figs. 8a and 8b are longitudinal sectional views of the spindle head motor assembly, Fig. 8b being a continuation of Fig. 8a, the view being taken generally on line 8—8 of Fig. 3 and looking in the direction of the arrows thereof;

Fig. 9 is an elevational view of the brush assembly for the spindle motor shown in Fig. 8a;

Fig. 10 is an enlarged fragmentary longitudinal sectional view of the spindle head assembly showing the spindle drive gear and slip clutch mechanism and the adjustable drill chuck shank;

Fig. 11 is a transverse sectional view of the drill chuck;

Fig. 12 is a fragmentary elevational view of the bolt setting sleeve, the bottom being broken away to show the spline formations adapted for connection with the low speed outer spindle of the spindle head motor assembly;

Fig. 13 is a top plan view of one socket which is slide fitted on the upper end of the bolt setting sleeve to engage the bolt head or nut to effect the setting of the bolt in the hole;

Fig. 14 is a vertical sectional view of the socket;

Fig. 15 is a fragmentary sectional view of a mine roof and opening with three expansion bolts set in the roof and another bolt being set by the bolt setting sleeve and spindle head;

Fig. 16 is a sectional view of the drill chuck with a drill which has partially completed a hole in the mine roof, but where the drill is binding in the hole and in the chuck;

Fig. 17 is a sectional view of the drill chuck with the inner member thereof released from the outer member and tilted to permit the drill shank to be freed from the chuck; and

Fig. 18 is an enlarged sectional view of one wheel of the tool and of the hand set brake therefor, the view being taken on line 18—18 of Fig. 1.

Referring now particularly to Figs. 1 to 5, 25 represents a U-shaped supporting frame having a front portion 26 and longitudinally-extending side portions 27 and 28. These portions are of channel section. The frame 25 is open at the rear to allow for free movement of various parts between the side portions in a manner which will be apparent as the description proceeds. A transverse tie member 26' holds the side portions together.

On the inner side of the channel side portion 27 is a plate 29 to brace the side portion 27 and to provide adequate support for a stub axle 31 that supports a wheel hub 32 and rim 33. On this rim is an inflatable rubber tire 34, Fig. 3. On the channel side portion 28 is a similar plate 35, a stub axle 36, a wheel hub 37, a rim 38 and an inflatable rubber tire 39. These wheel assemblies support the rear of the frame 25.

Extending upwardly and forwardly from the front portion 26 of the frame 25 is an upwardly and forwardly inclined front wheel bracket 41 having a vertical sleeve bearing portion 42, Fig. 5, for receiving upper and lower flanged bearing sleeves 43 and 44 in which extends a vertical spindle shaft 45 of a dirigible wheel yoke 46. A washer 47 and cotter pin 48 retain the spindle shaft 45 and the yoke 46 against downward displacement from the vertical sleeve bearing portion 42 of the bracket 41. The

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lower end of the spindle shaft 45 has a head 49 that extends through the upper end of the yoke.

Within the yoke 46 is a rubber tired wheel 51 which is retained between the sides of the yoke 46 by a pivot shaft 52. A forked handle 53 has separated end fittings 54 and 55 which are connected to the pivot shaft 52 and retained thereon by cotter pins 56. The handle 53 can be swung up and down and has outwardly turned right and left hand grip portions 57 and 58 and by means of the handle the tool is pulled or pushed to position it under the mine roof and to locate the drill thereagainst.

On the side portion 27 and swinging upwardly therefrom are two upstanding pivot levers 61 and 62 longitudinally spaced from one another and which are parallel and of the same length. These levers 61 and 62 are pivotally connected to the side portion respectively by pivot bolts 63 and 64. Pivotally connected between the upper ends of said levers 61 and 62 is a triangular-shaped plate 65. The lever 61 is connected to the plate 65 by a pivot bolt 66.

On the opposite side portion 28 are similar upstanding levers 67 and 68 respectively connected pivotally to the side portion 28 by pivot bolts 69 and 70. Pivotally connected between the upper ends of these levers 67 and 68 is a triangular-shaped plate 72. The lever 67 is pivotally connected to this plate 72 by a pivot bolt 73.

A transversely extending pivot shaft 74 extends between the upper ends of the levers 62 and 68 at the opposite sides of the frame and through the forward ends of the respective plates 65 and 72 and is held fixed by pivot shaft nuts 75 at the opposite ends of the shaft 74. A large diameter bracing pipe 75' is welded between the levers 62 and 68 to provide a unitary structure.

Pivotally connected between the lower ends of the plates 65 and 72 is an elevating crank arm structure 76 having a sleeve 77 pivotally connected to the plates 65 and 72 by a pivot shaft 78 extending therethrough and held therebetween by nuts 79 secured to the opposite ends thereof, Fig. 3. Extending rearwardly from the sleeve 77 are tapered arms 81 and 82 of angular section and having respectively pivotal connections 84 at their outer ends thereof with side arm portions 85' of a spindle-head motor assembly or unit 85, Fig. 4.

Extending upwardly from the sleeve 77 are laterally spaced arms 86 and 87 between the upper ends of which is pivotally connected a block head 89 of a jackscrew feeder assembly or unit 91. The pivotal connection is made by a pivot pin 92 and cotter pins 93. The forward end of the jackscrew feeder assembly 91 is pivotally connected to a pivot shaft 94 extending through the forward end thereof and supported by parallel links 95 and 96 disposed respectively at the opposite sides of the upstanding bracket 41 and pivotally connected thereto by a pivot shaft 98. On the pivot shaft 74 connected between the plates 65 and 72 is a sleeve 101 rigidly from which extends forwardly, laterally spaced arms 102 and 103 which are pivotally connected at their forward ends to the pivot shaft 94 that extends through the forward end of the jackscrew feeder assembly 91.

Above the arms 81 and 82 of the elevating crank arm structure 76 are respectively parallel links 105 and 106 that are respectively pivotally connected at their forward ends to the plates 65 and 72 by respective pivot bolts 107 and 108 and at their rear ends to the spindle head motor housing 85 by respective pivot bolts 109 and 110 whereby the spindle head motor assembly 85 will be always retained in a horizontal position while the crank structure 76 is moved by the jackscrew feeder assembly 91 and the spindle axis kept normal to the mine roof.

Extending upwardly from the side portion 27 of the frame 25, are longitudinally spaced vertical supports 111 and 112 secured to the portion 27 by fastening bolts 113 and 114. A long inclined tool tray 115 is connected between these supports by fastening bolts 116 and 117

and in which tools can be deposited. Extending outwardly from the respective supports 111 and 112 are respectively outwardly and upwardly bent rods 118 and 119, that serve as supports over which electric supply cable can be wound.

Extending rearwardly from the side portions 27 and 28 of the frame 25 are respectively pipe handle extensions 121 and 122 by which the machine can be bodily lifted if necessary to properly locate the supporting wheels and to locate the drill on a point on the mine roof.

Referring now particularly to Fig. 6, there is shown the jackscrew feed assembly or unit 91. This feed assembly 91 comprises a main housing 125 having a motor chamber 126 and a forward chamber 127 having reduction gear mechanism 128 and a jackscrew chamber 129 out of which jackscrew sleeve 131 is extended.

The motor chamber 126 houses an electric motor 132 having a rotor 133 having a shaft 134 and stator poles 135 fixed to the wall of the chamber and with field coils 136 surrounding the same. The shaft 134 extends through a flanged sleeve 137 fixed to a wall 140 of the chamber by screw bolts 138 and a ball bearing element 139 in the partition wall 140. This shaft 134 has a pinion gear formation 141 that projects into chamber 127.

The opposite end of the shaft 134 is journaled in a ball bearing element 142 carried in a cover 143 fixed to the rear end of the housing 125 by fastening nuts 144. The rear end of the shaft 134 is threaded at 145 and receives a retaining nut 146 that engages the side of the ball bearing element 142 to hold the rotor shaft 134 against forward displacement.

Under the cover 143 and fixed to the housing 125 is a brush assembly 147 having opposing carbon brushes 148 and 149, Fig. 7, that engage with a commutator 150 on the rotor 133. These brushes are respectively carried by adjustable members 152 and are held inwardly by the usual pressure springs 153. This brush assembly 147 is fixed to the housing 125 by fastening screws 154 and 155.

On the front of the housing 125 there is fitted a cover 161 having a transverse pipe bearing 162 to accommodate the pivot shaft 94. This cover 161 is secured to the housing by nuts 163 and centering pins 164 circumferentially spaced around the front end of the housing 125. A fitting 165 supplies grease to the pipe bearing 162.

In the cover 161 is a ball bearing element 166 supporting one end of a clutch shaft 167 and held in the cover 161 by a screw plug 168. This shaft 167 carries slip clutch elements 169, 169' which drive a clutch housing 171 that is journaled on the shaft 167 and has a pinion gear formation 172. The slip clutch elements 169 and 169' are held in friction grip with one another by a pressure spring 173 and a pressure plate 174 reacting against ball bearing element 166.

The pinion gear formation 141 on the motor shaft 167 drives a gear 175 keyed to the shaft 167 so as to drive the shaft and the clutch housing 171. The gear formation 172 on the clutch housing 171 in turn drives a gear 176 which is fixed by a key 177 to a jackscrew shaft 178. The gear 176 is held in place on the jackscrew shaft 178 by a washer 179 and a nut 180. A double ball bearing element 181 is fixed against a shoulder 182 in the jackscrew chamber 128 by a spring retaining ring 183, and the jackscrew is held against rearward displacement by a spacing sleeve 184 disposed between the gear 176 and the ball bearing element 181. The jackscrew shaft 128 has a long threaded portion 185 and a shoulder 186 that reacts against the ball bearing element 181 to prevent the forward displacement of the jackscrew 178. The ball bearing element thereby provides the reaction point against which the jackscrew 178 can react while extending the jackscrew sleeve 131. The jackscrew sleeve has an internally threaded portion 187 that engages the threaded portion 185 of the jackscrew 178.

On the outer end of the threaded portion 186 is a spring washer stop means which is engaged by the threaded

portion 187 of the screw sleeve 131 at the end of its outward stroke. This stop means includes a ball bearing element 188, a collection of spring washers 189 and a bolt 190 for fixing the ball bearing element and the spring washers to the end of the jackscrew 178. As the jackscrew sleeve 131 is extended, the portion 187 will abut the ball bearing assembly and compress the spring washers whereby to stop the movement of the jackscrew 131. The friction of the slip clutch parts is overcome and the motor 132 then drives free until it is cut off from its power supply source. The jamming of the jackscrew and sleeve threads is thereby prevented.

The jackscrew sleeve 131 is surrounded by an outer sleeve 190', that is tightly fitted in the jackscrew chamber 129 of the feeder housing 125. A stop ring 191 is threaded on the outer end of the outer sleeve and contains packing rings 192. This stop ring 191 is tightened against a rubber cushioning ring 193 that is held by an annular shoulder 194 on the outer sleeve 190'. The outer end of the jackscrew sleeve 131 has an enlarged head 195 that abuts the stop ring 191 as the sleeve 131 is retracted. Looseness in the threads of the stop ring 191 is taken up by the rubber ring 193 and this looseness is sufficient to prevent the jamming of the jackscrew and sleeve threads. A plug 195 fits the end of the jackscrew sleeve 131 to keep dirt from entering the jackscrew sleeve. Also, the end of the jackscrew sleeve has a transverse hole 196 for receiving the pivot pin 92 that connects the sleeve 131 with crank arms 86 and 87, Figs. 5 and 6. The sides of the enlarged head 195 are flattened to fit between the arms 86 and 87.

On the motor portion housing is a fitting 197 receiving cable 198 and a fitting sleeve 199. The fitting sleeve 199 is secured by bolt and nut means 201 to the fitting 197 which holds the end of the sleeve against packing rings 202. The fitting 197 is secured to the side of the feed housing 125 by nuts 203. A grease fitting 204 is used for supplying grease to the jackscrew chamber 129. This cable 198 extends to a push button operated control box 205 having push buttons 206, 207, and 208.

Referring now particularly to Figs. 8a, 8b and 10, the spindle-head motor unit 85 includes a motor housing 209 on which are fixed laminated stator poles 210 by screws 211 with field coils 212 surrounding the same. The motor housing 209 has a rear end plate 213 fixed thereto by nuts 214. This end plate 213 has a recess 215 on its inner face which supports a ball bearing element 216 on which one end of motor armature 217 is supported. The motor armature 217 has a shaft 218, core laminations 219, windings 221, a commutator 222 and a brush assembly 223, Fig. 9.

This brush assembly 223 has brushes 224 and 225 adapted to be respectively spring pressed toward the commutator 222 by pressure springs 227 and 226. This brush assembly 223 further has a supporting ring 228 which is attached to the inner face of the rear end plate 213 by screws 229 to support the brushes over commutator 222.

A cables fitting 231 is secured to the top of the motor housing by nuts 232. A heavy duty cable 233 is secured by a flanged bushing 234 and bolts 235 in the cable fitting and against packing rings 236. These packing rings prevent foreign matter from entering the motor housing by way of this fitting 231.

The opposite end of the rotor shaft 218 extends through a sleeve portion 237 of a front plate 238, which supports a packing gland 239 and a ball bearing element 241. The bearing element 241 is held in the sleeve by a retaining ring 242 that is secured by screws 243 to the end of the sleeve portion 237. This plate 238 is held by the connection to the motor housing 209 of a bottom casting 244 which is fixed to the end of the housing by nuts 245. This bottom casting 244 supports a slip clutch assembly 246 and a double spindle assembly 247.

On the end of the motor shaft 218 is a bevel pinion gear 248. This gear is splined to the shaft 218 and held by a nut 249 against the ball bearing unit 241. A re-

cessed bottom plate 251 is fixed to the underside of the bottom casting 244 by nuts 252. Supported by this recessed plate 251 is a ball bearing assembly 253 to which is fixed a vertically-extending shaft 254 by a washer 255 and a nut 256.

The slip clutch assembly 246 includes a housing 257 that is rotatable upon the shaft 254 and contains clutch plates 258. Clutch plates 259 are fixed to shaft 254 and are disposed alternately between the plates 258. Keyed to this housing 257 is a bevel gear 261 that meshes with the pinion gear 248 of the motor shaft 218 whereby the clutch housing 257 will be rotated on the vertical shaft 254. On the top of the clutch plates is a pressure plate 262 that is held in tight engagement therewith by a spring washer 263 reacting against a ball bearing assembly 264 contained in a top plate 265 that is fixed by nuts 266 to the top of the casting 244. A plug 267 is threaded into the top plate 263 which bears against the ball bearing assembly 264. This plug is held against turning movement by a cotter pin 268.

Splined to the lower end of vertical shaft 254 is a small gear 269 that bears against the ball bearing assembly 253 and supports a thrust plate 271 on which the clutch housing 257 rests.

Extending upwardly through the bottom of the casting 244 and engaging with a wall partition 272 is a pivot pin 273 on which an idler gear 274 is journaled by roller bearing assembly 275. This idler gear 274 is driven by gear 269 on the vertical shaft 254. The recessed plate 251 supports the pivot pin 273 against downward displacement from the bottom casting 244. Fitted in a bottom opening laterally removed from the shaft 254, is a bearing plate 276 containing a ball bearing assembly 277. This bearing plate 276 is fixed against upward displacement by screw bolts 278. The bearing plate 278 has a central opening, downwardly through which extends a drive sleeve 279 to which a large gear 281 is fixed by a key 282. This gear 281 and the drive sleeve 279 are driven by the gear 274. The ball bearing assembly 277 is supported on the drive sleeve 279 by a retaining ring 283. The lower end of the drive sleeve 279 is surrounded by packing rings 284 which are contained in the bottom of the bearing plate 276.

The drive sleeve 279 has a sun gear formation 285 that engages planet gears 286. The upper end of the drive sleeve 279 has an internally-threaded enlargement 287 to which a drive sleeve extension 288 is threaded. This drive sleeve extension 288 has a flange 289 that is tightened against the upper end of the enlargement 287.

Seated in the bottom casting 244 is a ring gear 291 that has internal teeth 292 and is fixed against rotation in the casting 244 by a set screw 293 and a lock nut 294. This ring gear 291 is connected through a ball bearing assembly 295 with a planet gear spider 296 which is rotatable relative to the ring gear 291. This planet gear spider 296 carries pivot pins 297 to which the planet gears 286 are journaled by roller bearings 298. This spider 296 has upwardly extending outer sleeve spindle 299 journaled on the drive sleeve enlargement 287 by roller bearings 301 and in a flanged ring 302 by roller bearings 303. This flanged ring 302 is secured to the top of the casting 244 by nuts 304.

A packing ring assembly 305 is provided above the roller bearings and extends between the flanged ring 302 and the outer sleeve spindle 299. Fixed to the outer sleeve spindle 299 is a ring cover 306 that extends outwardly over the packing ring assembly 305 and the flanged ring 302. This cover is fixed by a spring ring 307 to the outer spindle 299. A packing ring assembly 308 is provided in the upper end of the spindle 299 above the roller bearing assembly 301. The upper end of the outer spindle 299 has splines 309 for receiving splined lower end of a socket wrench sleeve 310 having spline formations 311, Fig. 12. The socket wrench sleeve serves to set the bolts or nuts in the mine roof in a manner to be hereinafter fully described.

Extending upwardly from the upper end of the drive sleeve extension 288 is a drill chuck 312 having a depending shank 313 that is adjustable in the drive sleeve extension 288 to elevate the drill auger 314 in order to compensate for roof irregularities, the part of the drill shank that fits the chuck and to reduce the number of auger lengths required. This shank 313 has a series of vertically spaced notches 315 to receive a spring loaded key 316 laterally adjustable in a notch 312 in the drive sleeve extension 288. A spring 317 is fastened to this key 316 by its side portions 319 extending respectively across the opposite sides of the sleeve extension 288 and connected to the respective ends of the key 316. A stop bar 320 having turned ends is secured to the bowed spring 318 by rivets 321 to limit the outward movement of the key 316 and prevent its removal from recess 17 in the drive sleeve extension 288. Upon depressing the spring 318, the chuck 312 may be adjusted and the key 316 can be disposed in any one of the several notches 20 135. The chuck shank 313 has a long keyway 322 and the drive sleeve extension 288 has a key formation 323 that projects into this keyway whereby to provide a driveway connection therewith and at the same time permit the vertical adjustment of the drill chuck. A ten-inch adjustment of the chuck is provided by this arrangement.

The drill chuck 312 is accordingly driven by the drive sleeve extension 288, which is connected to the drive sleeve 279 that has the large driven gear 281. The drill chuck 312 is driven at a relatively high speed compared to the speed of the bolt setting sleeve 310 when it is splined to the outer spindle extension 299 and driven through the planetary gears 286. The drill chuck runs at 400 to 500 revolutions per minute while the bolt setting sleeve runs at about 75 to 100 revolutions per minute.

By having the adjustable drill chuck 312, the vertical stroke of the elevating crank arm structure 76, the overall height and weight of the tool can be kept to a minimum. The adjustable drill chuck 312 adapts the tool for different mine roof heights, reduces the number of drills required for the drilling operation, and provides a make up allowance for squared drill shank 324 in the chuck 312, Figs. 16 and 17.

Occasionally, a starting hole runs off center from the true drilling axis of the tool as shown at 325 in Fig. 16. This is due to the inherent looseness of the drill chuck shank, the spindle assembly and the elevating crank structure 76 when encountering irregularities in the mine roof surface and formation. Such an off centered hole would make it difficult to remove the long final drill auger from the chuck socket opening of an ordinary one piece socket, since the square drill shank 324, Figs. 16 and 17 would bind in the socket opening and keep the drill chuck from being lowered from the shank or the drill auger being lifted out of the drill chuck. Drill cutting head 326 of the drill auger 314 will lie in the upper end of the hole 325 and the side of the drill will lie against the wall of the hole at the lower end as indicated at 327, Fig. 16. This may cause the drill to bend slightly and to bind the squared shank thereof in the drill chuck.

Accordingly, the present drill chuck 312 has been formed in such a manner as to make easy the removal of the chuck 312 from the shank 324 of the drill auger 314 at times when the hole has run off center. A two-piece drill chuck has been provided, Fig. 11. This chuck assembly 312 comprises an outer member 328 having a tapered and thickened lower end 329 which is welded to the drill shank 313 as indicated at 331. The upper end of the outer member 328 has internal spline formations 332 cooperating with short spline formations 333 of an inner drill shank receiving member 334 having a square socket opening 334'. The spline formations 332 are long and the spline formations 333 are short

so as to permit the inner member 334 to be elevated in the outer member 328. The spline of the outer and inner members are loosely fitted so that the inner member 334 may be tilted in the outer member when the inner member is elevated. The inner member 334 has a tapered end 335 that is lifted from a tapered seat 336 on the outer member, Fig. 17. This structure permits the inner member when lifted from the seat of the outer member to adapt itself to the shank 324 of the drill auger 314 so that the drill chuck can be made free and lowered therefrom or the drill auger elevated in the hole 325 and out of the drill chuck. Automatically upon lowering the drill chuck this release of the chuck from the drill can be effected.

The inner member 334 is prevented from leaving the outer member by the engagement of the spline formations 333 with a retaining ring 337 in the upper end of the outer member 328. The amount of movement permitted, however, is sufficient to allow the tapered lower end 335 to be lifted from the tapered seat 336 of the outer member 328 so that the tapered lower end of the inner member can be shifted some distance laterally.

The drill auger shank 324 will rest on a pin 338 extending between transverse aligned opening 339 in the lower end of the inner member 334. The outer member 328 has opening 340 to discharge the drill dirt from the space 341 lying between the inner and outer members. Holes 342 discharge the accumulations of drill dust from the bottom of the squared opening 334' in the inner member 334.

When the bolt setting operation is to be effected, the socket wrench sleeve 310 is fitted over the drill chuck and slid into position with the spline formations 311 of the socket wrench sleeve 310 engaging with the spline formations 309 of the outer spindle sleeve 299 to establish a drive connection therewith, Figs. 2, 8b and 15. The upper end of the socket wrench sleeve 310 has spline formations 344 for receiving a socket wrench 345, Figs. 12, 13 and 14. This socket wrench has an opening 346 for receiving a square head 347 of a roof setting expansion bolt 348, Fig. 15. On the outer surface of the socket wrench 345 is a groove 349 having a rubber band 351 which holds a pin 352 in a hole 353 of the wrench and in a hole 354, Fig. 12, in the splined upper end of the socket wrench sleeve 310 whereby to hold the socket wrench against axial displacement from the socket wrench sleeve 310. Socket wrenches having different size bolt head receiving openings can be placed on the splined upper end of the socket wrench sleeve 310.

Once the hole 325 has been drilled in the mine roof the roof setting expansion bolt assembly 348 is inserted so that it extends the full length into the hole. The bolt may be of the slit type instead of the expansion bolt type as shown in Fig. 15. If it is of the slit type, it is necessary that the bolt be driven home with a hammer in order that the slit portion in the upper end of the bolt will be separated by the wedge and made to grip the side of the hole. A hammering operation is accordingly required. By using the expansion type bolt, as illustrated, the hammering operation is not required. This bolt has an expansible grip member 356 on the threaded upper end of the bolt 348 and this threaded end of the bolt passes through a wedge 357 and as the socket wrench 345 is applied to the bolt head 347 and the wedge 357 is lowered to expand finger portions 358 of the expansible grip member 356 to grip the side of the hole. A retaining plate 359 is disposed above the bolt head 347 and the turning of the bolt 348 continues until the spindle assembly slip clutch 246 releases the drive gears. The hole 325 is made about an inch and one-fourth in diameter and bolt 348 is three-fourths of an inch.

As shown in Fig. 15, the mine roof is formed of layers 360 of shale, slate or sandstone and by the drilling of the holes thereinto and by fixing the upper ends of the

roof bolts in the holes and to the upper layers the lower layers will be supported from above and the collapse of the mine roof will be prevented. The roof of the mine above the coal sides of the haulageway opening will, in effect, be made into a rigid beam with the layers connected together in a tightly supported manner. Accordingly, the collapse of the mine roof is prevented and the mine timbers used heretofore are no longer necessary and by their removal more space is had for the manipulation of the modern mine machinery within the mine.

In Fig. 3 there are shown two brake arrangements 361 and 362 disposed respectively on the opposite sides of supporting frame 25. The brake arrangement 362 at the right side of the machine is shown in section in Fig. 18. The wheel rim 38 comprises two parts 363 and 364 which are held together by bolt means 365. Hub 37 has annular flanges 366 and 367 that secure a rim web 368 upon the hub 37 to which the joined rim parts are connected by bolts 369 having flat heads 370.

The stub axle 36 is held against rotation in the side portion 28 of the frame 25 by a long key 372. The stub axle has spline formations 373 with which cooperates short spline formations 374 of a brake spider cup 375 that has an annular end flange 376 which engages flat heads 370 of the bolts 369 to grip the wheel web 368 and to lock the tool against movement over the mine floor. The tires will thereby be made to frictionally grip the mine floor. This brake spider cup is threaded on its inner end, as indicated at 377, and engages a threaded brake operating member 378 that is rotatable on the stub axle 36 to set or release the brakes. An operating arm 379 is fixed to the brake operating member 378 by which it is turned. The operating arm 379 in one position is brought to rest against a stop projection 379' on the frame side portion 28.

When the arm 379 is lifted, the cup flange 376 will be thrust against the flat heads 370 and when the handle 379 is lowered the brake spider cup will be retracted from the flat heads 370 of the bolts 369. The stub axle 36 is held on the side portion 28 by a nut 381 tightened thereon to draw a shoulder 382 of the sub axle tightly against a washer 383 and the outer face of the side portion 28. The nut 381 is tightened against the stiffening plate 35. The operating member 378 reacts against the washer 383 and the side portion 28. The parts of the hub 37 are held assembled on the stub axle 36 by a nut 384 and these parts are brought against a shoulder 385. It should now be seen that these brake devices 361 and 362 can be set to prevent any shifting movement of the tool over the mine floor when effecting a drilling or bolt setting operation.

To set up the tool for the drilling operation the following procedure is followed. The tool is taken by its handle 53 and is located under the roof at a point where the drilling operation is to be effected. The brake devices 361 and 362, once the tool has been located are set by pulling the operating arms thereof. A cable 386 is removed from the upwardly bent rods 118 and 119, Fig. 2, and its plug 387 is connected to an electric direct current power outlet in the mine opening. The cable 386 is connected to the underside of the switch control box 205 and electric current is supplied thereto, Figs. 1, 2 and 3. A master control knob 388 is turned to a closed position whereby power is made available for the operating feed screw and spindle motors.

By depressing switch button 208 on the control box 205 the spindle head motor assembly 85 is lowered. This brings the spindle head 247 to a low position as shown in Fig. 5a to permit the easy insertion of a short drill auger 314 in the drill chuck 312. Thereafter, the lifting button 207 is pressed to bring the drill head 326 into engagement with the mine roof. The feed screw assembly motor 132 is reversible so the spindle head is both raised and lowered by power. A switch button 206 is depressed to start the drill motor and effect the drilling operation while the operator continues to keep the button 207 depressed. If,

for any reason the drill is jammed then the slip clutch elements 169 and 169' of the feed motor release so that the feed motor drives free until the drill head 376 can catch up with the feed. At any time the drill becomes jammed the spindle motor clutch 246 will release. It can be seen that automatic feed and overload protection has been provided for the drill auger. The feed motor is accordingly prevented from stalling. The need for limit switches and the precise manipulation of the push buttons 207 and 208 is eliminated. When the starting drill has been extended its full length into the mine roof, the push buttons 206 and 207 are released and the button 208 is pressed so that the spindle head is lowered to the low position as shown in Fig. 5a and the starting drill removed from the hole.

The elevating crank structure 76 can lower the spindle head 247 to within about an inch and a half from the mine floor. The jackscrew sleeve 131 of the feed assembly 91 will have come to a stop against the cushioning springs 189 on the end of the jackscrew 178, Fig. 6. The upstanding levers 61, 62, 67 and 68 will have been tilted forwardly about 30 degrees upon the frame 25. As a safety means to hold the spindle assembly 247 in its lowered position upon failure of the stop means or upon release of the feeder assembly 91 from the tool, projections 390 on the side portions 27 and 28 are engaged by the levers 62 and 68, Figs. 1, 2 and 5. The parallel links 105 and 106 act upon the spindle head motor assembly 85 to hold the same so that the drive sleeve extension 288 always extends vertically.

With the starting hole already completed in the mine roof, it is now necessary to insert in that hole a long final drill which usually equals in length the height of the mine opening and in order to make the insertion of the long drill without moving the tool from its already located position on the mine floor, the present tool has been provided with releasable positioning levers 392 and 393 respectively pivotally connected by bolts 394 and 395 to the respective arms 81 and 82 of the elevated crank arm structure 76. The releasable positioning lever 392 has a depending notched projection 396 adapted to releasably connect with a lever trunnion pin 397 of an upwardly projecting support 398 on the rear end of the frame side portion 27. The pivot bolts 394 and 395 may seat in recesses 395' in the side frame portions 27 and 28 upon the crank arm structure 76 being lowered.

The releasable positioning lever 393 has a depending notched projection 399 adapted to receive a trunnion pin 400 extending inwardly from an upwardly projecting support 401 on the frame side portion 28. Normally, these positioning levers 392 and 393 connect with the upstanding projections 398 and 399 of the frame the spindle head 247 is thereby guided in its vertical movement. However, by lifting the positioning levers and pushing upon the ends of them in the manner as shown in Fig. 2, the crank arm structure 76 is released and can be moved forwardly on the levers 61, 62, 67 and 68, taking with them the spindle head 247 so that its axis is out of alignment with the starting hole which has already been made by the short drill auger. It can now be seen that with the spindle head 247 out of the way the long drill auger can be inserted in the starting hole and elevated a distance therein so that its shank can be lowered into the drill chuck 312 of the spindle head upon the spindle head being returned to its original location and the positioning levers 392 and 393 engaging with the respective upwardly projecting supports 398 and 401.

With the long drill auger in place in the drill chuck 212 the elevating button 207 of the control box 205 can be depressed so that the head of the drill auger will be brought to the upper end of the starting hole. Thereafter, the spindle motor button 206 is depressed to start the drilling operation with the long drill auger. Both buttons 206 and 207 are kept depressed until the hole is

finally drilled and the jackscrew sleeve comes to a stop against the cushioning springs 189.

Thereafter, the lowering button 208 is depressed to lower the spindle head 247 to its low position and so that the enlarged head 195 of the jackscrew sleeve 131 engages the link 191. In order to fully remove the long drill auger, the positioning levers 392 and 393 are again grasped so as to move the spindle head 247 forwardly and to provide bottom space into which the drill auger can be lowered.

With the drill auger removed, the expansion bolt 348 is inserted in the completed drilled hole and held therein until the spindle head 247 with the socket wrench receiving sleeve 310 and socket wrench 345 thereon, has been returned to the center position and aligned with the bolt head 347. The spindle head 247 is then raised by depressing the button 207 so that it will engage the bolt head 347 in the manner as shown in Fig. 15. The button 206 is depressed so that the spindle motor will drive the wrench sleeve 310 and the wrench 345 whereby to tighten the expansion bolt in the manner as above described. When this operation has been completed the spindle head will be lowered, the brake devices 361 and 362 released and the tool moved to a new location to drill another hole and set another expansion bolt.

It should now be apparent that there has been provided a mine roof drilling and bolt setting tool which can be once located under the mine roof and thereafter retained while both the complete drilling operation and the bolt setting operation have been completed. It should also be apparent that the spindle head is adapted both for the operation of the drill chuck and for the operation of the bolt setting sleeve, the bolt setting sleeve being driven by a concentric drive member surrounding the driven chuck drive sleeve extension. It will be seen that by the mere lifting of the positioning levers in the manner shown in Fig. 2 that the spindle head can be shifted out of the way and without release of the brakes of the tool or moving the tool to another location.

It will also be apparent that irregularities in the roof structure can be accommodated by the adjustable chuck which can be elevated to different positions to make up for the bolt auger shank length and thereby make possible the use of a less number of drill lengths. It will also be seen that adequate cushioning means is provided in the jackscrew feed assembly to limit the movement of the spindle motor on arriving at the lowered and raised positions and to prevent breakage of the parts thereof.

While various changes may be made in the detailed construction, it shall be understood that such changes shall be made within the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. In a combined mine roof bolt drilling and setting tool of the character described, a carriage frame having side portions, upwardly extending supporting levers pivotally connected to each of the side portions, a crank arm structure pivotally connected to the upper ends of the upwardly extending supporting levers having rearwardly extending lifting arms, a feed assembly connected between the frame and the crank arm structure to raise and lower the same on the upwardly extending supporting levers, a spindle head unit pivotally carried by the rearward ends of the crank lifting arms and movable with the crank arm structure up and down between the frame side portions, parallel links extending between the spindle head assembly and the supporting levers, means operatively associating the parallel links with the feed assembly for constantly pivoting the spindle head to a vertical position on the lifting arms of the crank structure as the latter is raised and lowered, and positioning levers respectively pivotally connected to the respective lifting arms of the crank arm structure, said positioning levers being pivotally and releasably connected to the frame side portions and upon being released therefrom serving

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as handles by which to move the spindle head assembly and the crank arm structure fore and aft with the upwardly extending pivot levers.

2. In a combined mine roof bolt drilling and setting tool, a carriage frame having longitudinally extending side portions, upwardly extending supporting levers pivotally connected at their lower ends to the side portions of the frame, two levers being provided on each side portion of the frame and longitudinally spaced from each other, vertically extending plates pivotally connected between the two levers at each side of the frame, a crank arm structure pivotally connected between the two plates and having laterally spaced crank arms extending rearwardly, a feed screw assembly connected to the crank arm structure to pivot the same upon said plates, supporting links pivotally connected to the frame and to the feed screw assembly to support the forward end thereof, arm means extending between the upwardly extending levers and the supporting links for the forward ends of the feed screw assembly, parallel links respectively vertically spaced above the crank arms and pivotally connected to the vertically extending side plates, a spindle head assembly pivotally connected to the crank arms and to the parallel links to be elevated by the same and retained normal to the mine roof, and positioning levers respectively pivotally connected to the laterally spaced arms of the crank arm structure and releasably connected to the side portions of the frame, whereby upon release of the positioning levers the spindle head assembly can be shifted fore and aft with the crank arm structure and the feed assembly upon said upwardly extending supporting levers therefor so that the spindle head can be adjusted without movement of the carriage frame.

3. In a combined mine roof bolt drilling and setting tool of the character described including a carriage frame and upwardly extending supporting levers pivotally con-

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nected to the carriage frame for fore and aft movement relative thereto, a crank arm structure pivotally supported by said levers at one end and movable fore and aft therewith, a power driven spindle head pivotally connected to the other end of the crank arm structure, a screw feed assembly, means operatively associating the crank arm structure with the latter for pivotally raising and lowering the crank arm structure, means associated with the spindle head and the crank arm structure for constantly pivoting the spindle head on the crank arm structure to vertically disposed position while the crank arm structure is being raised and lowered, and manually operable means for pivoting the supporting levers fore and aft so as to carry the crank structure and associated spindle head in a corresponding direction.

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