May 26, 1953 R. L. GALLO 2,639,895

SELF-PROPELLED DRILLING MACHINE

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Fig. 1

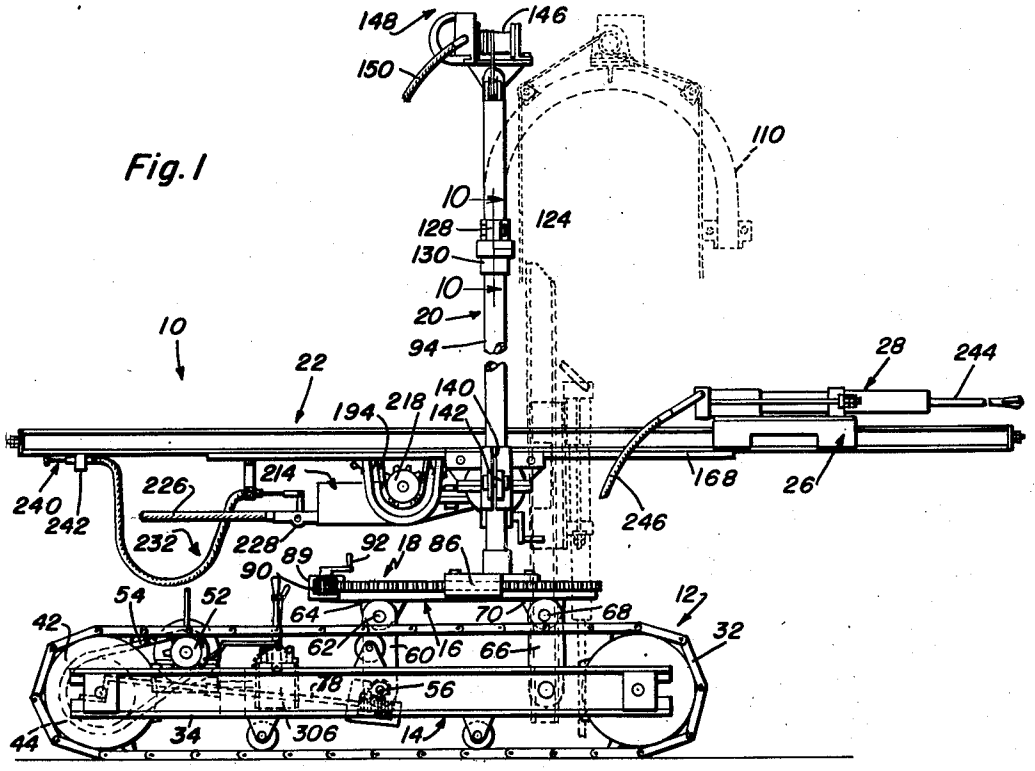
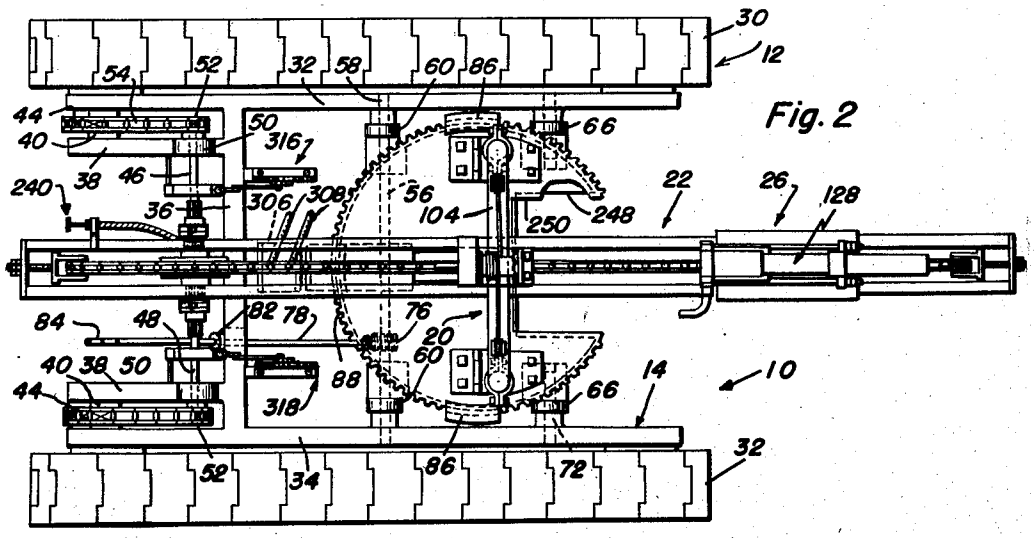


Fig. 2



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SELF-PROPELLED DRILLING MACHINE

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Fig. 3

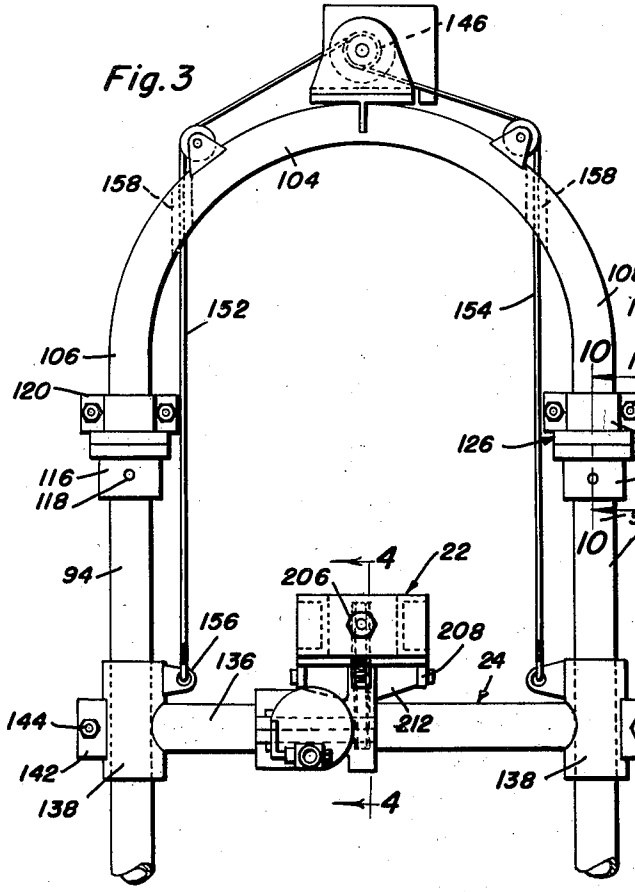


Fig. 7

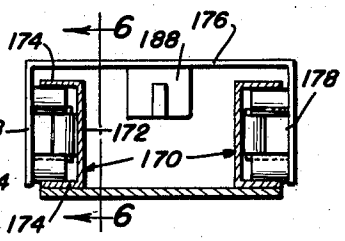


Fig. 9

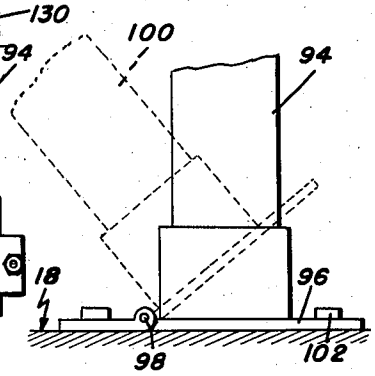


Fig. 6

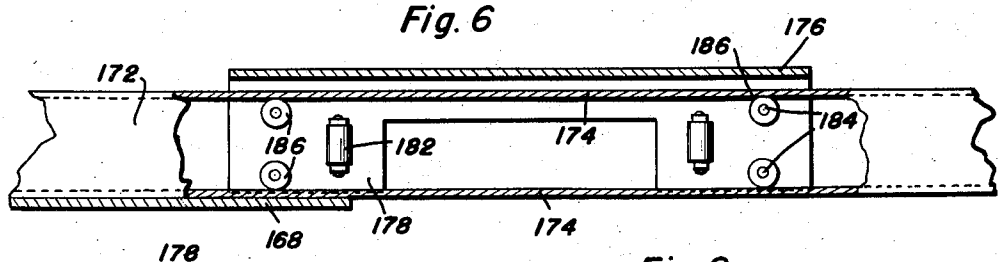
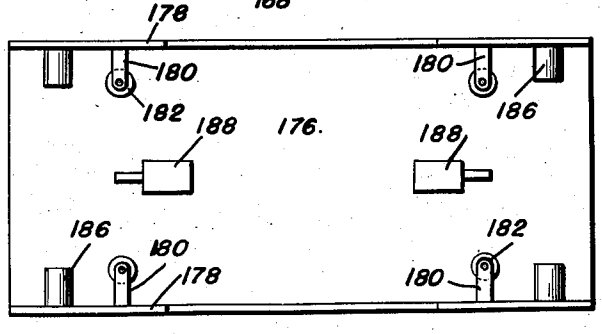


Fig. 8



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SELF-PROPELLED DRILLING MACHINE

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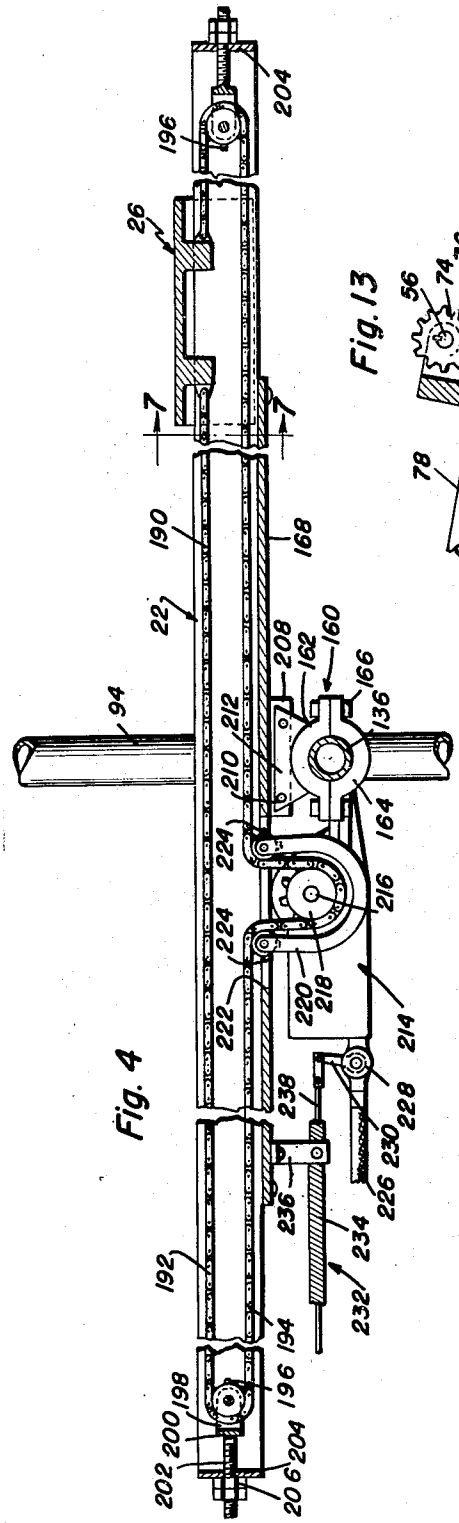


Fig. 4

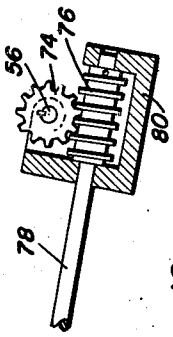


Fig. 13

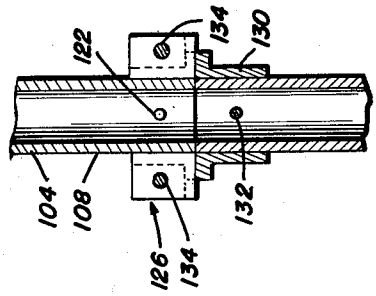


Fig. 10

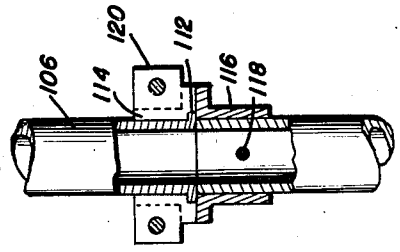


Fig. 12

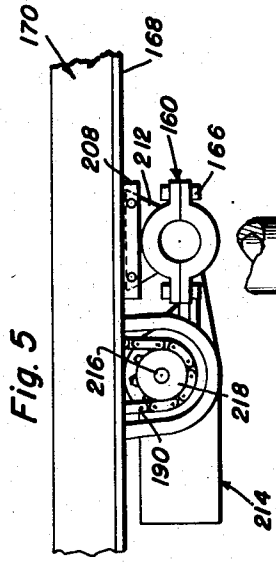


Fig. 5

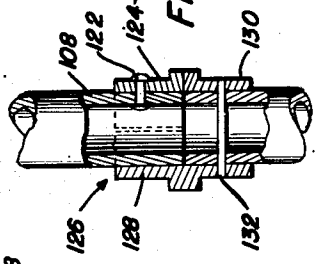


Fig. 11

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SELF-PROPELLED DRILLING MACHINE

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Fig. 14

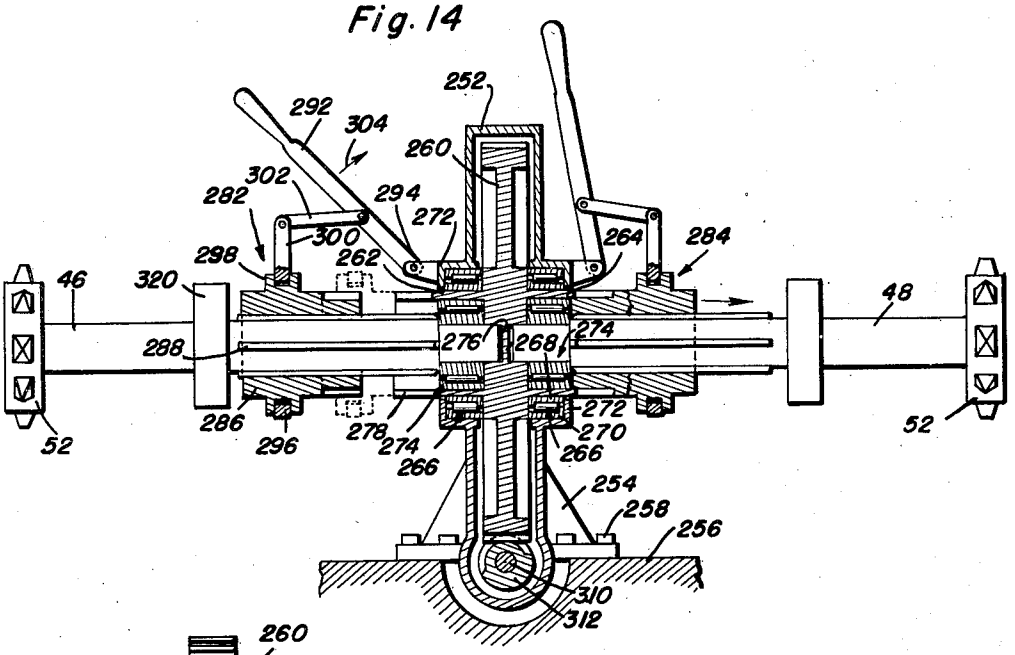


Fig. 15

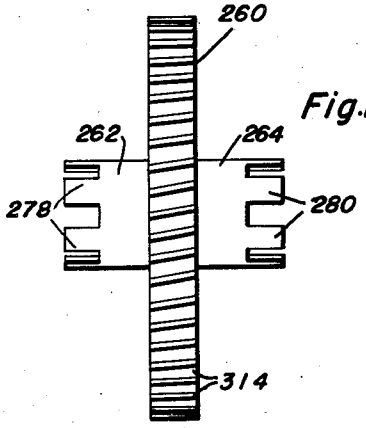


Fig. 17

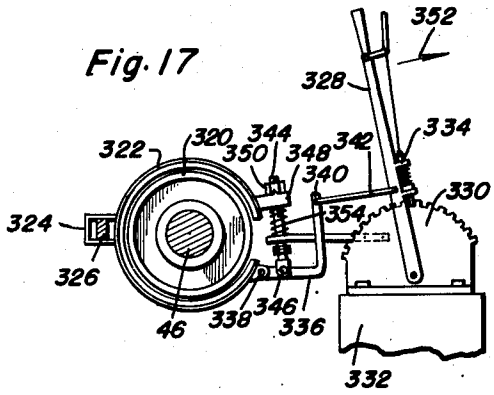
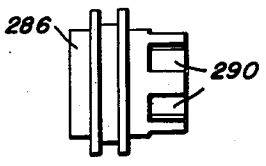


Fig. 16



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UNITED STATES PATENT OFFICE

2,639,895

SELF-PROPELLED DRILLING MACHINE

Richard L. Gallo, Maytown, Pa., assignor of one-half to Charles Bitner, Milton Grove, Pa.

Application March 23, 1951, Serial No. 217,140

12 Claims. (Cl. 255—51)

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This invention relates to new and useful improvements in drilling machines, and more particularly to self-propelled drilling machines especially well adapted for use in quarries.

The primary object of this invention is to provide means whereby holes may be drilled at various vertical and horizontal inclinations and at various heights.

Another important object of the present invention is to enable the operator of the machine to forcibly advance the drill irrespective of the angle of drilling.

A further object of the present invention is to enable the operator to control the drilling from various remote positions for maximum safety when drilling into the breast of a quarry, and to permit the operator to view the drilling operation from a position of vantage.

Still other important objects of the present invention are to provide a machine of this character which may be easily moved to a position of use, and which will be exceptionally flexible in use for drilling a plurality of holes from a single position of the machine, and which machine will also easily remove bits that are binding in the holes.

A meritorious feature of the present invention resides in the means provided for propelling and steering the machine.

A further important feature of the present invention resides in the boom construction, and the manner in which the drill carriage is mounted and driven thereon.

Still another important feature of the present invention is the flexible control means for controlling the advance of the drill carriage, so that the operator may stand clear of the machine so as to avoid falling rocks and the like.

Yet another important feature of the present invention resides in the mast construction and the means by which the boom is mounted on the mast for vertical as well as pivotal movement.

Final important features of the present invention to be set forth specifically herein reside in the mast being supported on a rotatable turntable, which turntable is in turn mounted on a vertically adjustable boom carriage, and the turntable and the boom carriage being provided with registrable openings for the drilling of vertical holes.

These, together with various ancillary features and objects of the invention which will later become apparent as the following description proceeds, are attained with the present invention, a preferred embodiment of which has been illustrated by way of example only in the accompanying drawings, wherein:

Figure 1 is a side elevational view of the drilling machine with portions of the same being shown broken away, and with alternate positions of the arch and the boom being indicated in dotted outline;

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Figure 2 is a top plan view of the machine shown in Figure 1 with the means for rotating the turntable being removed;

Figure 3 is an enlarged rear elevational view of the upper portion of the mast construction, and illustrates particularly the mounting means for the boom and the means by which the boom is elevated relative to the mast construction;

Figure 4 is a detail sectional view taken upon the plane of the section line 4—4 of Figure 3;

Figure 5 is a side elevational detail view of the means by which the boom construction is pivotally secured on the boom mounting means;

Figure 6 is a longitudinal detailed sectional view of the boom construction with portions being broken away, this view being taken upon the plane of the section line 6—6 of Figure 7;

Figure 7 is a transverse sectional view taken upon the plane of the section line 7—7 in Figure 4;

Figure 8 is a bottom plan view of the drill carriage;

Figure 9 is an enlarged detail view illustrating the manner in which the lower ends of the mast standards are pivotally secured to the turntable, with an alternative position of the mast standard being shown in dotted outline;

Figure 10 is a detail sectional view taken upon an enlarged scale and upon the plane of the section line 10—10 of Figure 1;

Figure 11 is another detail sectional view, this view being taken upon a plane at right angles to the plane of the section shown in Figure 10;

Figure 12 is a vertical sectional view similar to that shown in Figure 10; however, this view being taken at the other end of the arch;

Figure 13 is an enlarged sectional detail view of a portion of the means by which the boom carriage is elevated and lowered;

Figure 14 is a detail view, partially in vertical section, of the means provided for selectively driving the individual treads of the machine;

Figure 15 is an elevational view of the drive gear provided with clutch sleeves;

Figure 16 is an elevational view of one of the slidably mounted clutch elements shown in Figure 15; and,

Figure 17 is a side elevational detail view, partially in section, of the means provided for selectively braking one of the treads of the machine.

Reference is now made more specifically to the accompanying drawings, wherein like numerals designate similar parts throughout the various views, and in which the drilling machine is indicated generally at 10.

Before proceeding with the detailed description of the machine 10, it will be seen that the

same comprises broadly a self-propelled vehicle 12, the frame 14 of which supports a boom carriage 16, such boom carriage 16 being vertically adjustable with respect to the frame 14. A turntable 18 is rotatably mounted on the boom carriage 16, and such turntable 18 carries a mast construction 20 for rotation therewith about a vertical axis. A boom construction 22 is pivotally mounted intermediate its ends (see Figures 3 and 4) on a boom mounting means 24, such means 24' being adjustable vertically with respect to the mast construction 20. A drill carriage 26 is mounted for reciprocation along the length of the boom construction 22, and a pneumatic drill 28 is carried by the drill carriage 26 for drilling holes.

From the above general description it will be seen that within the limitations of the movements afforded by the boom carriage 16, the turntable 18, the boom mounting means 24, and the pivotal movement of the boom construction 22 relative to the boom mounting means 24; the drill 28 may be operated and advanced along any line intersecting the vertical axis of rotation of the boom construction within a large spacial region, and that the line selected may intersect such vertical axis at vertically adjusted positions and be vertically inclined thereto.

In detail, the vehicle 12 is self-propelled and includes endless treads of the caterpillar type 30 and 32 suitably mounted upon the opposite sides of the frame 14. The frame 14 includes longitudinally extending side members 34 connected adjacent the rear end of the vehicle 12 by a cross member 36, and a pair of rearwardly extending frame members 38 are formed on the member 34 in spaced relationship to the side members 34. The drive shafts 40 of the drive sprockets 42 for the endless treads 30 and 32 are suitably journaled in the frame members 34 and 38, and sprockets 44 are suitably secured to the shafts 40, in the spaces between the frame members 34 and 38.

Aligned drive shafts 46 and 48 are rotatably mounted for rotation on the frame members 38, as at 50, and are provided with sprockets 52 in the spaces between the frame members 34 and 38. Drive chains 54 are entrained over the sprockets 52 and the respective sprockets 44 in the spaces between the frame members 34 and 38, whereby the action of the treads 30 and 32 may be controlled respectively by the shafts 46 and 48. Means shown in detail in Figures 14–17 to be described presently are provided for selectively driving and braking the shafts 46 and 48.

A transverse shaft 56 is disposed forwardly of the transverse frame member 36 and has its opposite ends suitably journaled in the frame side members 34, as at 58. A rear pair of transversely spaced links 60 have their lower ends fixedly secured to the shaft 56 for rotation therewith, and have their upper ends pivotally secured as at 62 to depending brackets 64 carried by the boom carriage 16. In addition, a pair of forward, transversely spaced links 66 is provided, the upper ends of which are pivotally connected as at 68 to depending brackets 70 carried by the boom carriage 16, the lower ends of the links 68 being pivotally connected, or mounted upon inwardly extending stub shafts 72 carried by the frame members 34. It will be understood that the links 60 and 66 are all of equal length and in parallel relation to each other, whereby the boom carriage 16 may be moved vertically along the arc defined by the links 60 and 66 with the boom carriage itself being retained in a horizontal attitude at all times. Means is provided for elevating and lowering the boom carriage 16, such means comprising a worm pinion 74 suitably fixed or keyed upon the shaft 56 (see Figure 13) whereby the shaft 56 may be rotated to rotate the links 60 to raise and lower the boom carriage 16. The worm pinion 74 is operatively engaged by a worm 76 mounted upon a shaft 78, the end of the shaft 78 adjacent the worm pinion 74 being suitably journaled in a bracket 80 carried by the the frame 14 by means not shown, an intermediate portion of the shaft 78 being suitably journaled in a bearing 82 carried by the transverse frame member 36, and the rear end of the shaft 78 being provided with a crank handle 84, whereby rotation of the shaft 56 may be effected.

The turntable 18 is rotatably positioned on the top of the boom carriage 16, and any suitable means may be provided for retaining the turntable 18 from lateral displacement from the top of the boom carriage 16, and such means may conveniently take the form of retaining flanges 86 carried by the boom carriage 16 that are inturned to overlie the upper surface of the turntable 18. Means is provided for rotating the turntable 18 upon the boom carriage 16, such means comprising gear teeth 88 formed upon the annular periphery of the turntable 18. As best shown in Figure 1, a bracket 89 is carried by the boom carriage 16, in which bracket 89 is rotatably mounted a pinion 90 that is in mesh with the gear teth 88, the arrangement being such that rotation of the pinion 90 will effect rotation of the turnable 18. In order to rotate the pinion 90, the latter is provided with a shaft which projects upwardly from the bracket 89 and has its upper end provided with a crank handle 92.

The mast construction 20 comprises a pair of transversely spaced vertical standards 94, the lower ends of which are provided with mounting flanges 96 (see Figure 9). The mounting flanges 96 are hingedly connected to the turntable 18 as at 98 so that the standards 94 may be swung to a horizontal reclined position as indicated at 100, however, the standards 94 are normally retained in the erect full line position by fastening means 102, such fastening means 102 being of the releasable type to permit angular movement of the standards 94 when desired.

The upper ends of the standards 94 are connected by a transverse arch 104, one end 106 of the arch being pivotally mounted on the corresponding standard 94 for horizontal swinging movement of the arch 104, while the other end 108 of the arch 104 is detachably secured to the other standard 94, the arrangement being such that the arch 104 may be disposed in its full line position or swung to the position indicated in dotted outline at 110 in Figure 1. The purpose of this arrangement will presently appear. While the arch 104 may be secured by any suitable means to function as described above, in the preferred construction, and as shown in Figure 12, the extremity of the end 106 of the arch 104 is flanged at 112 and is rotatably received in the split upper portion 114 of a mounting collar 116 so as to bear upon the upper end of the standard 94. The collar 116 is fixed to the standard 94 by a transverse pin 118, and the flanged end 106 of the arch is retained within the split portion 114 of the collar 116 by a suitable sectional clamp 120 embracing the portion 114, it being understood that normally the clamp 120

will be tightened to only such an extent as to permit rotation of the arch 104.

With respect to the end 108 of the arch 104, it will be seen upon reference to Figures 10 and 11 that the same has fixed by a pin 122 to one side thereof a section 124 of a sectional clamp designated generally at 126. The other section 128 of the clamp 126 is carried above the upper end of the standard 94 by a collar 130 fixedly secured to the standard 94 by means of a pin 132. The arrangement is such that upon the arch 104 being swung to the full line position, the releasable fastening bolts 134 may be secured to the sections 124 and 128 to retain the arch in the full line position.

The boom mounting means 24 comprises a horizontal tubular shaft 136, the opposite ends of which are suitably secured by welding or the like to a pair of upstanding guide sleeves 138 received on the standards 94. The sides of each of the sleeves 138 opposite the shaft 136 are slotted at 140, see Figure 1, and provided with a pair of lugs 142. The arrangement is such that fastening bolts 144 pass through the lugs 142 to adjustably clamp the sleeve 138 to the standard 94 associated therewith. It will thus be seen that the mounting means 24 may be releasably retained at any adjusted vertical position by tightening the bolts 144, and that the means 24 may be moved vertically when the bolts 144 are loosened.

Means is provided for raising and lowering the boom mounting means 24, which in the preferred form of the invention comprises a cable reel 146 suitably mounted on the top of the central portion of the arch 104. The reel 146 is driven by any suitable type of air motor 148 also mounted on the arch 104 and supplied air through the flexible conduit 150. A pair of cables 152 and 154 have their inner ends suitably fixed to the reel 146 and their outer ends secured to brackets 156 carried on the sleeves 138, the intermediate portions of the cables 152 and 154 being guidably received through vertical guide openings 158 provided in the arch 104. As will be apparent upon reference to Figure 3, when the reel 146 is turned to take up the cables 152 and 154, the mounting means 24 is raised, and when the air pressure is relieved from the motor 148 and the bolts 144 loosened, the boom mounting means 24 descends by gravity. It will be understood, of course, that if desired or deemed expedient the air motor 148 may be of any suitable reversable type or employ reversing gearing, not shown, to drive the reel 146 in either direction.

As best shown in Figures 3–5, inclusive, a sectional sleeve 160 is pivotally mounted on an intermediate portion of the shaft 136, the upper and lower sections 162 and 164, respectively, of the sectional sleeve 160 being releasably retained in assembled relation by fastening bolts 166. The boom construction 22 is fixedly secured to the upper section 162 and the drill carriage driving means to be presently described is fixedly secured to the lower section 164 as will be described presently.

As best shown in Figures 3, 4 and 7, the boom construction 22 includes an elongated base plate 168, upon the top of which base plate is suitably secured by welding or the like a pair of channel members 170. The channel members 170 each includes a web portion 172 and vertically spaced flanges 174, and are disposed with the web portions 172 in back to back spaced parallel relation. The drill carriage 26 includes a web portion 176 overlying the members 170 and also includes legs 178 disposed on the opposite sides of the members 170. Brackets 180 are fixed to the adjacent faces of the legs 178, such brackets 180 carrying rollers 182 that rotate about vertical axes and engage the inner faces of the web portions 172 of the members 170 to restrain the carriage 26 against lateral displacement. In addition, the adjacent faces of the legs 178 are provided with sets of vertically spaced stub axles 184, upon which axles 184 are journaled rollers 186 that engage the adjacent faces of the upper and lower flanges 174 of the members 170, the arrangement being such as to support the carrier 26 on the members 170 and to restrain the same against vertical movement.

The web portion 176 of the carriage 26 has a pair of spaced depending brackets 188 which are secured to the opposite ends of a chain 190, as clearly shown in Figure 4. The chain 190 is disposed in upper and lower flights 192 and 194 between and in parallel spaced relation to the members 170, and is entrained over idler sprockets 196 disposed between the opposite ends of the members 170. Each of the sprockets 196 is journaled in a yoke 198, and the bight portion 200 of the yoke 198 is secured to a threaded bolt 202 that extends through end plates 204 connecting the opposite ends of the members 170. The outer or free end of the bolt 202 is provided with a pair of threaded nuts 206 that bear against the end plate 204 to lock the bolt 202 in longitudinally adjusted position, the arrangement being such as to afford means for adjustably tensioning the chain 190.

An intermediate portion of the base plate is provided with depending lugs 208 that are in turn detachably secured by fasteners 210 to brackets 212 formed on the upper section 162 of the sleeve 160, whereby the boom construction 22 rotates on the shaft 136 with the sleeve 160.

Fixedly secured by any suitable means to the lower section 164 of the sleeve 160 is the housing of reversible air motor 214. Upon an output shaft 216 of the motor 214 is fixed a drive sprocket 218. A yoke 220 fixed to the housing of the motor 214 partially surrounds the sprocket 218 in spaced relation thereto and has its free ends extending upwardly into a slot 222 provided in the base plate 168. The upper ends of the yoke 220 are provided with idler sprockets 224 over which the lower flight 194 of the chain 190 is entrained, with the portion of the chain 190 intermediate the sprockets 224 being depressed and entrained under the drive sprocket 218, whereby the chain 190, and consequently, the drill carriage 26 may be driven by the air motor 214.

The air motor 214, which is of any suitable reversable type, is supplied air through the flexible conduit 226, in which conduit 226 is operatively disposed a control valve 228 of any suitable type for controlling the operation of the motor 214. As best shown in Figures 1 and 4, the valve 228 includes a pivoted control lever 230, and means is provided for actuating the lever 230 from a remote position selected at the option of the machine operator. Such actuating means includes a Bowden wire 232, the housing 234 of which is fixedly secured to the base plate 168 by a bracket 236 closely spaced to the lever 230, and the wire 238 of which is operatively connected to the outer end of the lever 230. Finger control means 240 (see Figure 1) of any conventional character for the Bowden wire is provided at the end of the same remote from the lever 230, and

such means 240 are normally retained in a spring clip 242 carried by the base plate 168. The arrangement is such that the means 240 can be operated when the same is supported by the spring clip 242, or the same may be removed from the spring clip 242 and used at any selected position within the range of the flexibility of the Bowden wire, which may, of course, be of any desired length.

Suitable means, not shown, may be provided for tilting the boom construction 22 on the shaft 136, and could conveniently take the form of a manually operable gear journaled for rotation on the air motor housing 214, which gear would mesh with a gear keyed on the shaft 136.

As clearly shown in Figure 1, the drill 28 is suitably mounted in any suitable manner upon the carriage 26 for movement therewith, such drill 28 being of any suitable pneumatically operated character and including a bit 244, with air being supplied to the drill 28 through a flexible conduit 246.

Obviously, the present invention is to be used in conjunction with any suitable means for compressing air, not shown, and that if desired such air compressing means could be conveniently mounted on the vehicle 12. Furthermore, it will be obvious that the air conduits 150, 226, and 246 will be connected to such air compressing means, and suitable control valves will be provided in the conduits 150 and 245 as well as in the conduit 226.

As will be appreciated, the purpose of pivotally mounting the arch 104 upon one of the standards 94 is to permit the boom construction 22 to be swung to a vertical position, and in order that the drill 28 may be utilized when the boom construction is in the vertical position, the boom carriage 16 and the turntable 18 are provided with cut-out openings 248 and 250, respectively. As best shown in Figure 2, the turntable 18 may be rotated to such a position that the openings 248 and 250 are in registry so that the drill 28 may be moved vertically therethrough when the machine is used for drilling vertical holes.

As described, it will be evident that the machine may be utilized for drilling horizontal holes closely spaced above the ground level upon which the machine is supported when the boom carriage 16 is lowered, and that by virtue of the turntable 18 and the slidable mounting of the boom mounting means 24 on the mast construction, extreme flexibility in the use of the machine is afforded.

As mentioned hereinbefore, means are provided for selectively driving and braking the shafts 46 and 48, and such means are clearly shown in Figures 14–17. Upon reference to Figure 14, it will be seen that a drive housing 252 having integral mounting flanges 254 is fixedly mounted on a rearwardly projecting frame portion 256 carried by the frame member 36 by fastener 258. Although not shown as such, it will be apparent that the housing 252 may be sectional in character and detachably held in assembled relation by a pair of peripheral flanges to permit easier assembly of the parts to be described that are retained therein. As will be evident upon inspection of Figure 14, the opposite sides of the housing 252 are open and the reduced adjacent ends of the shafts 46 and 48 project into the housing 252.

A gear 260 is disposed in housing 252 and is provided with oppositely extending integral sleeves 262 and 264 which project outwardly from the housing through the open sides thereof in concentric relation to the shafts 46 and 48. Each of the sleeves 262 and 264 is surrounded by anti-friction bearing 266, with the inner and outer races 268 and 270 thereof respectively engaging the sleeve and the housing 252. It will be noted that lateral movement of the races 268 and 270 is limited by the gear 260 proper and an annular retaining flange 272 carried by the housing 252, it being apparent that a flange 272 is provided for each of the bearings 266. In this manner, the gear 260 is securely mounted for rotation within the housing 252. In a similar manner, antifriction bearings 274 are interposed between the reduced adjacent portions of the shafts 46 and 48 that are disposed in the housing 252 and the sleeves 262 and 264, respectively, whereby the gear 260 securely supports the adjacent ends of the shafts 46 and 48 for relative rotation. It will be noted that the adjacent ends of the shafts 46 and 48 are received in cylindrical pockets 276 formed in the opposite sides of the gear 260 so that the gear 260 limits endwise movement of the shafts toward each other.

The outer ends of the sleeves 262 and 264 are provided with axially extending clutch teeth 278 and 280, respectively, through which the rotary motion of the gear 260 may be communicated selectively to the shafts 46 and 48. Inasmuch as the means 282 for selectively driving the shaft 46 from the gear 260 is substantially identical to the means 284 for driving the shaft 48 therefrom, it is deemed that only a description of the former will suffice for the purposes of this specification. In order to drive the shaft 46 from the gear 260, a sleeve-like clutch element (see Figures 14 and 16) 286 is slidably mounted on the shaft 46 for movement toward and away from the housing 252, the shaft 46 being provided with elongated keys 288 engaged by the element 286 to prevent relative rotation of the latter with respect to the shaft 46. As clearly shown in Figure 16, the outer periphery of the end of the element adjacent the housing 252 is provided with a plurality of circumferentially spaced recesses 290 that open toward the housing 252, the arrangement being such that the clutch teeth 278 on the sleeve 262 are received in the recesses 290 when the element 286 is moved to the dotted line position shown of the same in Figure 14 to establish a positive driving connection between the gear 260 and the shaft 46, as will be apparent to those skilled in the art.

In order to selectively engage the element 286 with the clutch teeth 278, a handle 292 is pivoted to a bracket 294 carried by the housing 252, the handle 292 being connected to the element 286 by means of a ring 296 rotatably mounted on the element 286 and retained thereon by spaced ribs 298, such ring 296 carrying a bracket 300, with a link 302 pivotally connecting the bracket 300 to the handle 292. The arrangement is such that when the handle 292 is swung toward the housing in the direction indicated by the arrow 304, the element moves from the full line position to the clutching position shown in dotted outline in Figure 14.

As thus far described, it will be clear that either one or both of the shafts 46 and 48 may be operatively connected to the gear 260 at the option of the operator by suitable manipulation of the handles associated with the means 282 and 284.

In order to drive the gear 260, a reversible air motor 306 (see Figures 1 and 2) of any suitable conventional type is mounted on the frame mem-

ber 36 by means not shown and is disposed a short distance in advance thereof. Flexible air conduits 308 are connected to the air motor 306 for operating the same, it being understood that suitable valve means, now shown, are provided in the conduits 308 for selectively stopping and running the motor in reverse directions. The motor 306 includes a rearwardly extending output shaft 310 which projects through a suitable opening into the housing 252 and is disposed directly below the gear 260 therein. The portion of the shaft 310 disposed within the housing 252 is provided with a worm gear 312 that is in engagement with complementary gear teeth 314 formed on the periphery of the gear 260, so that the gear 260 is driven from the air motor 306.

Inasmuch as it will frequently be desirable to hold one of the shafts 46 and 48 against rotation while driving the other or to hold both of the shafts against rotation simultaneously, brake means 316 and 318 are provided for the shafts 46 and 48, respectively. Inasmuch as such means are identical, only the means 316 will be described in detail. The means 316 are shown in Figures 2, 14 and 17, wherein it will be seen that the shaft 46 has a brake drum 320 securely attached thereto.

A brake band and mechanical actuating means therefor is provided for use in conjunction with the brake drum 320. Briefly, such construction includes a brake band 322 partially surrounding the drum 320, the intermediate portion of the band 322 being guidingly supported by a U-shaped bracket 324 fixed thereto and slidably embracing a laterally projecting support arm 326 on the frame member 38 adjacent thereto, a hand lever 328 is pivoted on a segmental rack 330 rigidly mounted on a bracket 332 carried by the frame member 36. The lever 328 may be locked in adjusted position by a spring operated latch 334 that engages the rack 330. An L-shaped arm 336 is pivoted at 338 to one end of the band 322 and at 340 is pivoted to a link 342 that has its other end pivoted to the lever 328. A pin 344 is pivoted to the arm 336 at 346 and has its upper end slidably extending through an apertured guide 348 carried on the other end of the band 322, with the upper end of the pin 344 being provided with a nut 350 to limit downward movement of the pin 344 relative to the guide 348. It will be readily apparent that swinging the lever 328 in the direction indicated by the arrow 352 will tension the band 322 about the brake drum 320, and vice versa. In order to free the band 322 from the drum 320, a coiled compression spring 354 embraces the pin 344 intermediate the guide 348 and a guide arm 356 carried by the rack 330 through which the pin 344 slidably extends.

It will thus be seen that the operator may selectively brake or drive either of the treads 30 and 32 in either direction, whereby the machine is very maneuverable to position the same wherever desired.

From the foregoing, the construction and operation of the machine will be readily understood and further explanation is believed to be unnecessary. However, since numerous modifications and changes will readily occur to those skilled in the art after a consideration of the foregoing specification and accompanying drawings, it is not desired to limit the invention to the exact construction shown and described, but all suitable modifications and equivalents may be resorted to, falling within the scope of the appended claims.

Having described the invention, what is claimed as new is:

1. A drilling machine comprising a vehicle including a frame and a boom carriage carried thereby, means for elevating the boom carriage relative to the frame, a turntable rotatably mounted on the boom carriage, an upstanding mast supported on the turntable, boom mounting means movable vertically on the mast and means for elevating and lowering such mounting means, an elongated boom pivotally carried by said mounting means for vertical swinging movement, a drill carriage movably mounted on the boom, and means for advancing the drill carriage and said turntable having registrable vertical openings therethrough permitting vertical drilling along a line closely spaced parallel to the mast.

2. In a drilling machine, a frame and a boom carriage carried thereby, means for elevating the boom carriage relative to the frame, a turntable rotatably mounted on the boom carriage, an upstanding mast pivoted at its lower end to the turntable for vertical swinging movement, means for releasably retaining the mast in an erect position, an elongated boom pivotally supported on the mast for vertical swinging movement, a drill carriage movably mounted on the boom, and means for advancing the drill carriage along the the length of the boom.

3. In a drilling machine, a frame and a boom carriage carried thereby, means for elevating the boom carriage relative to the frame, a turntable rotatably mounted on the boom carriage, an upstanding mast supported on the turntable, said mast comprising a pair of parallel vertical standards connected at their upper ends by a transverse arch, boom mounting means slidable on the vertical standards and extending therebetween, an elongated boom pivotally carried by the mounting means for vertical swinging movement between the vertical standards, means for elevating and lowering the mounting means, a drill carriage movably mounted on the boom, and means for advancing the drill carriage along the length of the boom.

4. In a drilling machine, a frame and a boom carriage carried thereby, means for elevating the boom carriage relative to the frame, a turntable rotatably mounted on the boom carriage, an upstanding mast supported on the turntable, said mast comprising a pair of parallel vertical standards connected at their upper ends by a transverse arch, boom mounting means slidable on the vertical standards and extending therebetween, an elongated boom pivotally carried by the mounting means for vertical swinging movement between the vertical standards, means for elevating and lowering the mounting means, clamping means carried by the mounting means for releasably retaining the latter in a vertically adjusted position on the vertical standards, a drill carriage movably mounted on the boom, and means for advancing the drill carriage along the length of the boom.

5. In a drilling machine, a frame and a boom carriage carried thereby, means for elevating the boom carriage relative to the frame, a turntable rotatably mounted on the boom carriage, an upstanding mast supported on the turntable, said mast comprising a pair of parallel vertical standards connected at their upper ends by an arch, boom mounting means slidable on the vertical standards and extending therebetween, an elongated boom pivotally carried by the mounting

means for vertical swinging movement between the vertical standards, means for elevating and lowering the mounting means, clamping means carried by the mounting means for releasably retaining the latter in a vertically adjusted position on the vertical standards, a drill carriage movably mounted on the boom, and means for advancing the drill carriage along the length of the boom, said boom carriage and the turntable having registrable vertical openings permitting drilling along a line substantially parallel to the standards and closely spaced to the plane of the latter.

6. In a drilling machine, a frame and a boom carriage carried thereby, means for elevating the boom carriage relative to the frame, a turntable rotatably mounted on the boom carriage, an upstanding mast supported on the turntable, said mast comprising a pair of parallel vertical standards connected at their upper ends by a transverse arch, boom mounting means slidable on the vertical standards and extending therebetween, an elongated boom pivotally carried by the mounting means for vertical swinging movement between the vertical standards, means for elevating and lowering the mounting means, clamping means carried by the mounting means for releasably retaining the latter in a vertically adjusted position on the vertical standards, a drill carriage movably mounted on the boom, and means for advancing the drill carriage along the length of the boom, said arch having one end pivotally connected to the upper end of one of the standards for horizontal swinging movement, the other end of the arch being detachably secured to the upper end of the other standard.

7. In a drilling machine, a frame and a boom carriage carried thereby, means for elevating the boom carriage relative to the frame, a turntable rotatably mounted on the boom carriage, an upstanding mast supported on the turntable, said mast comprising a pair of parallel vertical standards connected at their upper ends by an arch, boom mounting means slidable on the vertical standards and extending therebetween, an elongated boom pivotally carried by the mounting means for vertical swinging movement between the vertical standards, means for elevating and lowering the mounting means, clamping means carried by the mounting means for releasably retaining the latter in a vertically adjusted position on the vertical standards, a drill carriage movably mounted on the boom, and means for advancing the drill carriage along the length of the boom, said boom carriage and the turntable having registrable vertical openings permitting drilling along a line substantially parallel to the standards and closely spaced to the plane of the latter, said arch having one end pivotally connected to the upper end of one of the standards for horizontal swinging movement, the other end of the arch being detachably secured to the upper end of the other standard, whereby the arch may be swung to one side to permit alignment of the boom with said openings.

8. In a drilling machine, a mast comprising a pair of vertical parallel standards, a transverse arch connecting the upper ends of the standards, boom mounting means comprising a horizontal shaft extending between the standards and having means at its opposite ends slidably guided on the standards, means carried by the arch for elevating the mounting means, means for releasably securing the boom mounting means against vertical movement, one end of said arch being pivotally connected to the upper end of one of the standards for horizontal swinging movement, the other end of the arch being detachably secured to the upper end of the other standard, an elongated boom pivotally mounted on an intermediate portion of the shaft for vertical swinging movement, a drill carriage movably mounted on the boom, and means for advancing and retracting the carriage along the length of the boom.

9. In a drilling machine, a frame and a boom carriage carried thereby, means for elevating the boom carriage relative to the frame, a turntable rotatably mounted on the boom carriage, an upstanding mast supported on the turntable, said mast comprising a pair of parallel vertical standards connected at their upper ends by a transverse arch, boom mounting means slidable on the vertical standards and extending therebetween, an elongated boom pivotally carried by the mounting means for vertical swinging movement between the vertical standards, means for elevating and lowering the mounting means, carried by said transverse arch, a drill carriage movably mounted on the boom, and means for advancing the drill carriage along the length of the boom.

10. In a drilling machine, a frame and a boom carriage carried thereby, a turntable rotatably mounted on said boom carriage, a boom associated with said turntable for movement about a horizontal axis, said boom carriage and turntable having registerable vertical openings permitting movement of said boom into a vertical position.

11. In a drilling machine, a frame and a boom carriage carried thereby, a turntable rotatably mounted on said boom carriage, a boom associated with said turntable for movement about a horizontal axis, said boom carriage and turntable having registerable vertical openings permitting movement of said boom into a vertical position, said boom having mounted thereon for longitudinal movement a drill carriage.

12. In a drilling machine, a frame and a boom carriage carried thereby, a turntable rotatably mounted on said boom carriage, a boom associated with said turntable for movement about a horizontal axis, said boom carriage and turntable having registerable vertical openings permitting movement of said boom into a vertical position, said boom having mounted thereon for longitudinal movement a drill carriage, said boom being adjustably supported from said turntable by a vertical mast for both pivotal and vertical movement.

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