

May 23, 1961

R. H. GOODRICH ET AL

2,985,250

MOBILE DRILLING MACHINE

Filed June 25, 1957

6 Sheets-Sheet 1

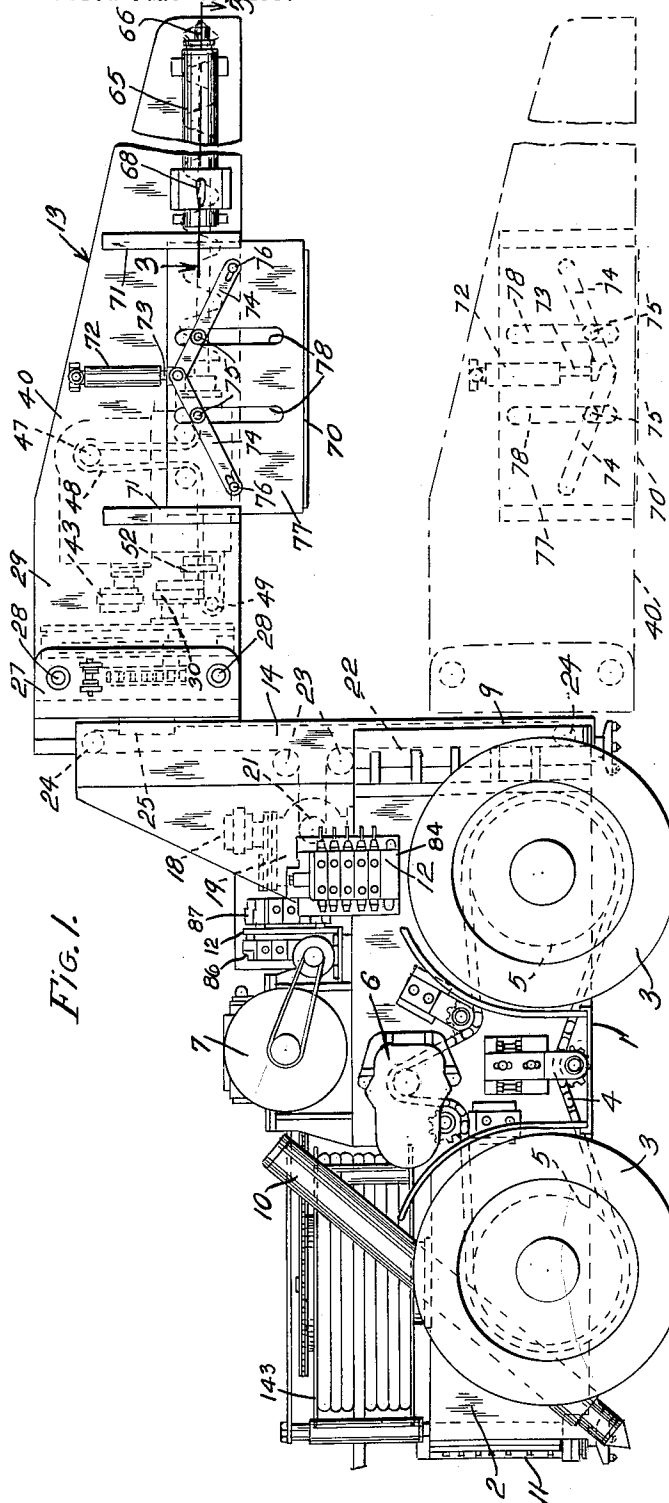


FIG. 1.

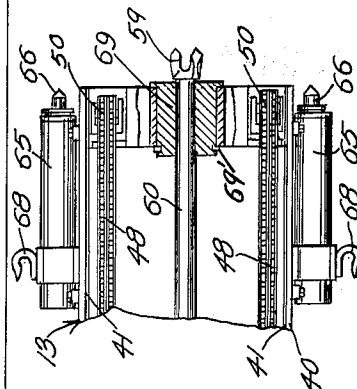


FIG. 3.

INVENTORS:
ROSS H. GOODRICH.
CLYDE P. BALDWIN.
BY
Charles F. Osgood
ATTORNEY.

May 23, 1961

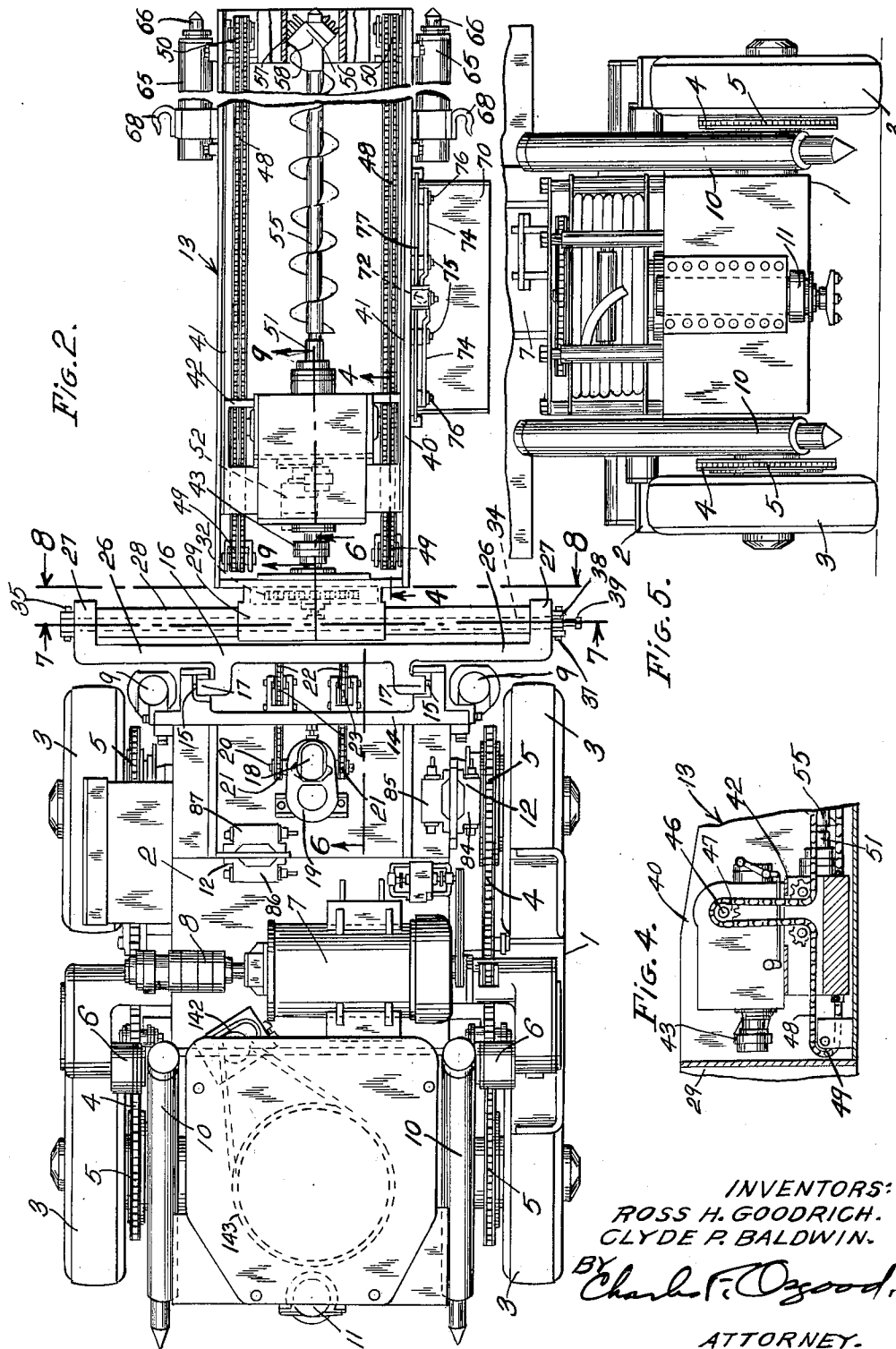
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Fig. 9.

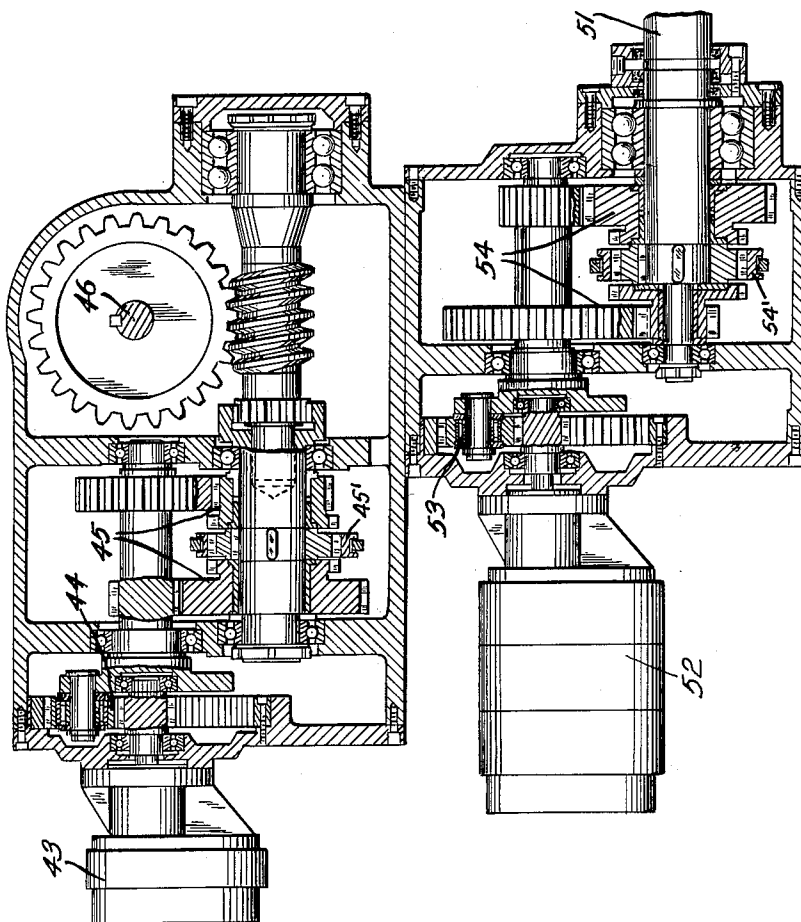
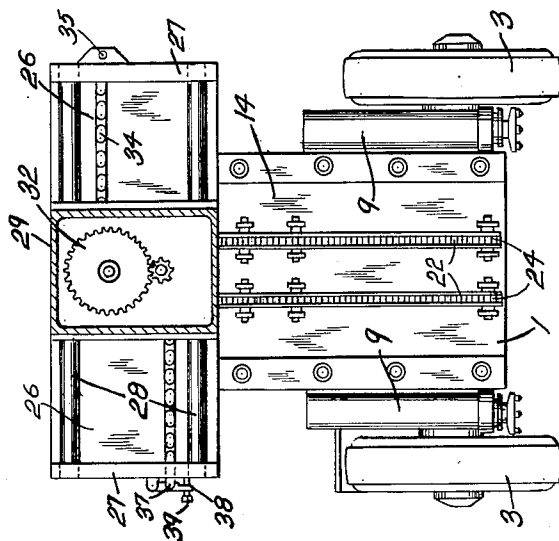


Fig. 8.



INVENTORS:
ROSS H. GOODRICH.
CLYDE R. BALDWIN.
BY
Charles F. Osgood,
ATTORNEY.

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R. H. GOODRICH ET AL
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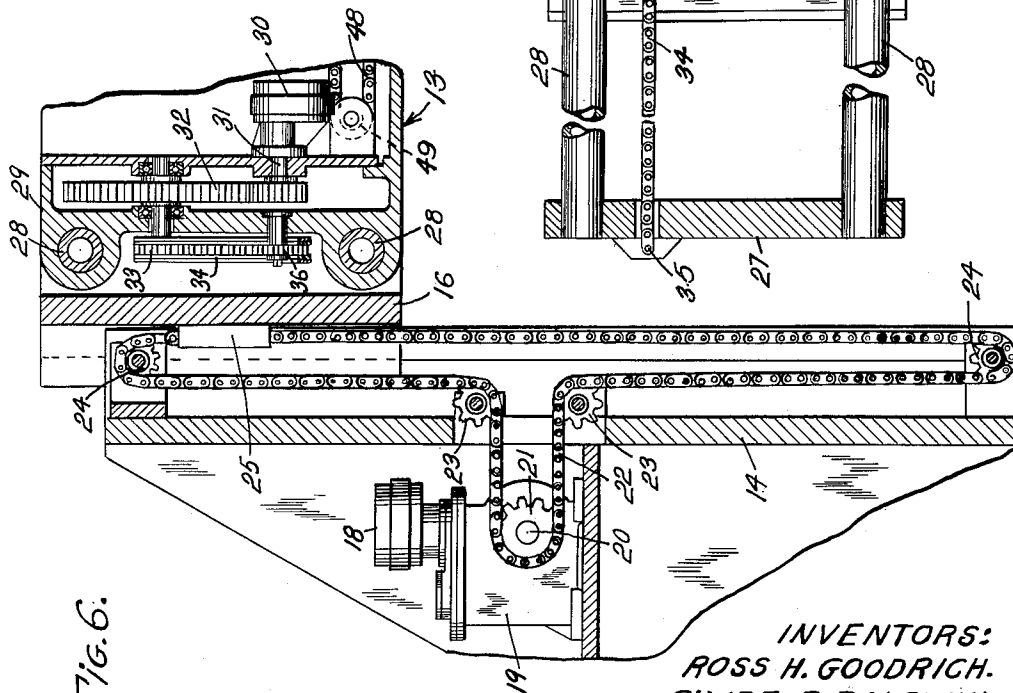
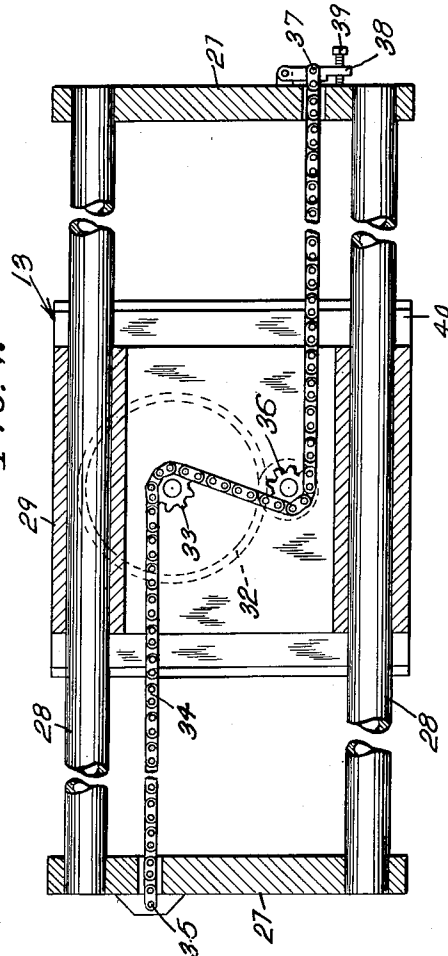


Fig. 6.

Fig. 7.



INVENTORS:
ROSS H. GOODRICH.
CLYDE P. BALDWIN.

BY *Charles F. O'good*,
ATTORNEY.

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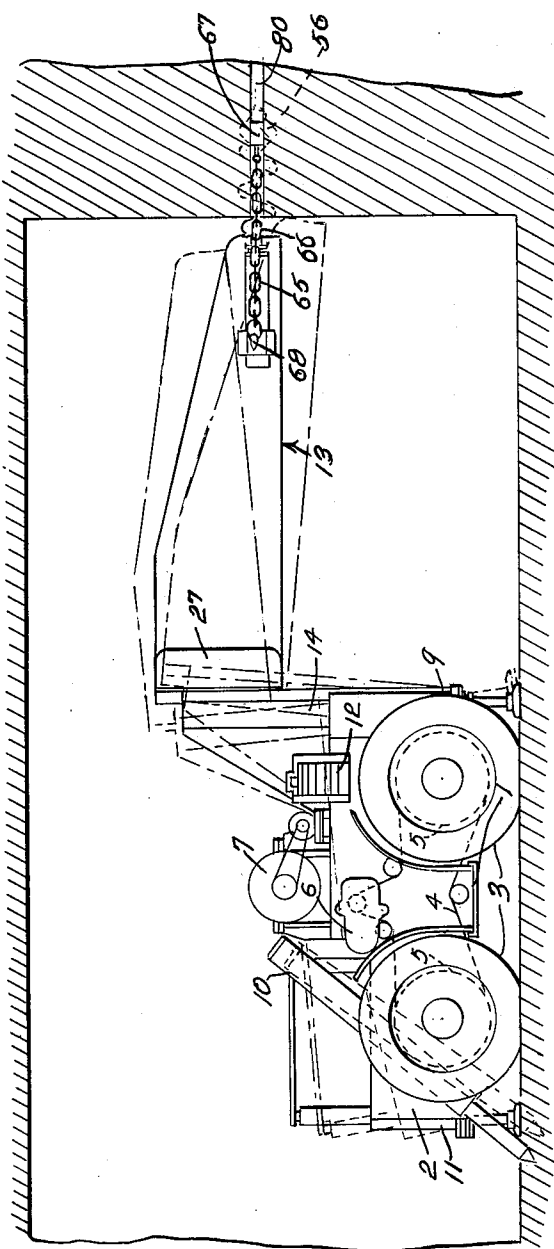


Fig. 10.

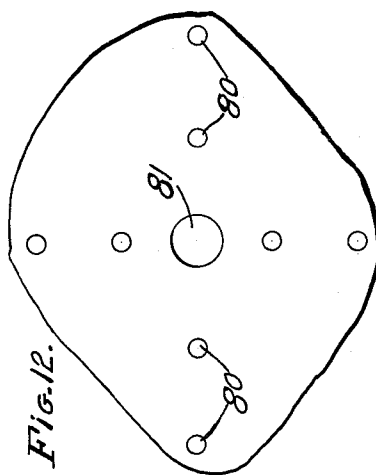


Fig. 12.

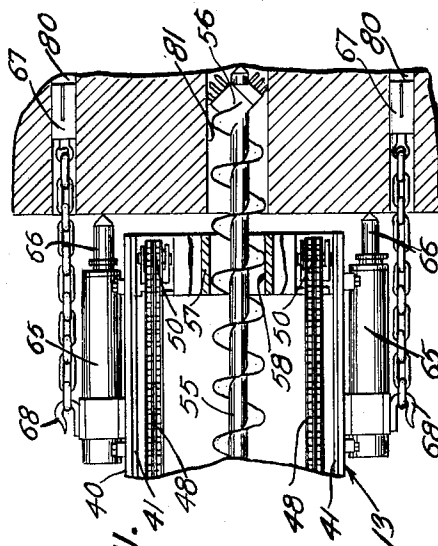


Fig. 11.

INVENTORS:
ROSS H. GOODRICH.
CLYDE P. BALDWIN.

BY *Charles F. Osgood,*
ATTORNEY.

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MOBILE DRILLING MACHINE

Ross H. Goodrich and Clyde P. Baldwin, Claremont, N.H., assignors to Joy Manufacturing Company, Pittsburgh, Pa., a corporation of Pennsylvania

Filed June 25, 1957, Ser. No. 667,903

11 Claims. (Cl. 175-127)

This invention relates to mobile drilling machines and more particularly to a drilling machine for drilling parallel blast holes in rock or other earth formation.

In conventional mobile drill rigs the drilling tool is usually mounted on adjustable supporting means embodying a swingable boom, and with such rigs it has been found difficult accurately to position the tool relative to the work particularly during drilling of a series of parallel holes in different lateral and vertical positions. The present invention contemplates improvements over such known types of drill rigs in that the drilling tool may be quickly and accurately adjusted into parallel positions with respect to the work. The adjustable supporting structure of the present invention embodies vertical and horizontal slides mounted in rectangularly related guides whereby the drilling tool may be accurately positioned to drill a series of parallel holes at different elevations and in different lateral positions and particularly a series of relatively small parallel holes arranged in generally cruciform formation about a centrally located relatively large hole. The drill is designed to drill holes of different diameters alternately with different size bits and to drive and feed any one of the different size bits at different speeds.

It is an object of our invention to provide an improved adjustable supporting means for a drilling tool. Another object is to provide an improved adjustable supporting means embodying vertical and horizontal slides mounted on rectangularly related guides, one vertical and the other horizontal, whereby the drilling tool may have both vertical and horizontal rectilinear adjustments. A further object is to provide an improved mobile drilling machine of the type known as a "burn-hole" drill having an improved adjustable tool mounting whereby a generally cruciform arrangement of parallel blast holes may be drilled in an earth formation in an improved manner. Still another object is to provide an improved drilling machine for selectively drilling holes of different sizes with different size bits, and having improved driving and feeding means for driving and feeding the different size bits at different speeds. A still further object is to provide an improved floor jack arrangement for a drilling machine whereby the drill may be leveled up and tilted to slant the drill upwardly and downwardly, and for aiding in holding the machine up to the work during drilling. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there is shown for purposes of illustration one form which the invention may assume in practice.

In these drawings:

Fig. 1 is a side view of a mobile drilling machine constructed in accordance with an illustrative embodiment of the invention.

Fig. 2 is a plan view of the drilling machine shown in Fig. 1.

Fig. 3 is a detail section taken on line 3-3 of Fig.

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1, showing the front cylinder and drill guide arrangement.

Fig. 4 is a detail vertical section taken on line 4-4 of Fig. 2, showing a portion of the feed.

5 Fig. 5 is a fragmentary rear end view of the drilling machine.

Fig. 6 is a longitudinal vertical section taken on line 6-6 of Fig. 2, showing the vertical guide structure.

10 Fig. 7 is a cross section taken on line 7-7 of Fig. 2, showing the horizontal guide structure.

Fig. 8 is a cross section taken on line 8-8 of Fig. 2.

Fig. 9 is an enlarged detail vertical section taken on line 9-9 of Fig. 2, showing the two-speed transmissions for the drill and feed.

15 Fig. 10 is a diagrammatic view showing the drilling machine in drilling position in a subterranean passageway.

Fig. 11 is a detail section, similar to Fig. 3, showing the drill frame anchored to the face, during drilling with the large size bit.

20 Fig. 12 is a diagrammatic view showing the "burn-hole" drilling arrangement in the working face.

Fig. 13 is a diagrammatic view illustrating the hydraulic fluid system.

25 The improved mobile drilling machine, as shown in the drawings, generally comprises a mobile base 1 having a frame 2 mounted on rubber tired wheels 3 coupled together in pairs by endless drive chains 4 and cooperating drive sprockets 5 and driven by conventional reversible fluid motors 6. The motors are separately controllable so that the pairs of side wheels may be driven in a manner simulating a crawler type tractor, for propelling and steering the machine. A motor 7, desirably an electric motor, drives a conventional pumping means 8 for supplying fluid under pressure to the propelling and steering motors. A pair of upright front fluid operated foot jacks 9, a pair of inclined fluid operated rear anchor jacks 10 and a centrally located upright fluid operated rear foot jack 11 are positionable to engage a ground surface such as a tunnel floor. The foot or floor jacks 9 and 11 serve to level the machine on an uneven surface and to tilt the machine to slant the drill upward or downward, while the inclined rear anchor jacks 10 tend to hold the machine up to the face during the drilling operation. A conventional control valve mechanism 12 mounted on the base frame is connected to a suitable source of fluid supply and serves to control the several fluid motors and fluid jacks of the machine as will later become apparent.

Now referring to the improved adjustable supporting means for a drilling tool generally designated 13, it will be noted that the base frame has at its forward portion a vertical frame portion 14 providing parallel guideways 15 spaced equidistantly from the longitudinal median line of the machine and a frame 16 has lateral guides 17 slidably received in the frame guideways 15, thereby to guide the frame 16 for vertical rectilinear movement relative to the base frame. The means for moving the frame 16 vertically along the guideways of the guide frame 14 may assume various forms but herein, for illustrative purposes, comprises a conventional reversible fluid motor 18. This motor drives through a conventional speed reducer 19 a transverse power shaft 20 to which chain sprockets 21 are secured and these chain sprockets, as shown in Fig. 6, engage parallel feed chains 22. These feed chains are suitably guided by guide sprockets 23 and 24 and are secured at their ends to lugs 25 integral with the sliding frame 16. Thus by properly operating the motor 18 the frame 16 may be moved vertically in either direction along its guideway.

70 The guide frame 16 has oppositely extending lateral or transverse portions 26 carrying at their outer ends longitudinally extending vertical side portions 27 (Figs. 1

and 7) and secured to these vertical side portions 27 are parallel guides in the form of guide rods 28 on which is slidably guided a frame 29 on which the drilling tool 13 is mounted. The parallel guide rods provide horizontal guideways, and the latter and the guideways are arranged rectangularly with respect to each other. The drill frame 29 is guided on the parallel guide rods for horizontal rectilinear movement in a direction at right angles to the direction of movement of the frame 16 along the vertical guideways, and the means for moving this frame along the guide rods, for illustrative purposes, comprises a conventional reversible cross feed fluid motor 30 having its power shaft 31 connected through conventional reduction gearing 32 to a chain sprocket 33. Engaging this sprocket is a feed chain 34 secured at one end at 35 to one of the frame portions 27 and passing around a guide sprocket 36. The chain is connected at its other end at 37 to an adjusting device 38 carried by the other vertical frame portion 27. This adjusting device includes an adjusting screw 39 for adjusting the tension of the feed chain in a well-known manner. Thus by properly operating the cross feed motor 30 the drill frame 29 may be fed transversely along a rectilinear path in either direction.

Now referring to the drilling tool 13, it will be noted that a horizontal guide frame 40 is supported by the adjustable frame 29 and extends longitudinally in advance of the mobile base 1. The frame 40 has parallel longitudinally extending guideways 41 along which is guided a frame 42. The tool feeding means may assume various forms and herein mounted on the frame 42 is a conventional reversible fluid motor 43 operatively connected through conventional planetary speed reducing gearing 44 and a conventional multi-speed selective transmission 45, having a shiftable speed selector 45', to a transverse shaft 46 carrying feed sprockets 47. Arranged longitudinally of the guide frame 41 are spaced generally parallel feed chains 48 which pass around the feed sprockets 47 and are guided by suitable guide sprockets 49 and 50. The opposite ends of the feed chains are connected to the sliding frame 42 (Fig. 4). Journaled within the frame 42 is a drill spindle 51 driven by a conventional fluid motor 52 through conventional planetary speed reducing gearing 53 and a conventional multi-speed selective transmission 54 having a shiftable speed selector 54', and coupled to this drill spindle is a conventional auger drill steel 55 having helical flights and carrying a drill bit 56 of relatively large size. The forward end of the guide frame 40 has a transverse portion 57 providing an opening 58 for receiving the drill bit when the drilling tool is in retracted position on the guide frame, as shown in Fig. 2. By properly operating the motor 52 the drilling tool may be fed rectilinearly back and forth at either of two speeds along the guideways 41 of the guide frame 40 in a longitudinal direction perpendicular to the transverse vertical planes in which the rectangularly related guideways 16 and 28 lie. In Fig. 3, a drill bit 59 of small size is attached to a hollow unfluted drill steel 60 which replaces the auger drill steel during the drilling of the small holes. When a large size hole is being drilled by the large drill bit the drill spindle may be driven at a relatively low speed and during small hole drilling the drill spindle may be driven at a relatively high speed, and the large bit may be fed at a slow speed during large hole drilling and the small bit may be fed at a high speed during small hole drilling. The driving and feeding of bits of different size is well known in the drill art, and therefore further description thereof is deemed unnecessary.

Mounted on the opposite sides of the forward portion of the guide frame 40 are fluid jacks 65 having forwardly projecting stinger bars 66 engageable with the working face for steadying the guide frame 40 during the drilling operation. In order to aid the inclined rear jacks 10 in holding the machine up to the face during large hole drilling, anchors 67 may be secured in certain of the small size holes and chains attached to the anchors are

connectible to hooks 68 so that when the stinger bar jacks are operated the machine is held firmly against the face. Under most cases, these anchors are unnecessary during the drilling of the small holes.

During drilling with the small bit (Fig. 3) a bushing 69 held in position by a split ring 69' serves to guide the drill steel.

As shown in Figs. 1 and 2, the drill guide frame 40 carries a platform 70 for the drill operator and this platform is guided for vertical adjustment along guideways 71. An upright fluid cylinder 72 has its piston rod 73 connected to links 74 pivoted at 75 on the frame and pivotally connected at 76 to a vertically adjustable frame 77 which carries the platform. This frame is vertically slotted at 78 to permit proper functioning of the links as the fluid cylinder is operated. When the drill guide frame is in lowered position, as shown in dotted lines in Fig. 1, the platform may be raised into an out-of-the-way position as shown. When the drill guide frame is elevated as shown in full lines in Fig. 1, the platform may be lowered. This cylinder 72 may be controlled by the valve mechanism 12, in a well-known manner.

Now referring to the hydraulic fluid system shown diagrammatically in Fig. 13 it will be noted that the pumping means 8 has four pump sections or units 80, 81, 82 and 83, and the section 80 is of five gallon capacity, section 81 of thirteen gallon capacity and sections 82 and 83 each of twenty-five gallon capacity. Evidently the discharge capacities of the several pump sections may be varied to suit varying conditions. The control valve mechanism 12 herein desirably consists of four sections or valve box units 84, 85, 86 and 87 having usual return connections leading back to a conventional liquid tank or reservoir, and these valve box units are each desirably of the conventional balance spool slide valve type. The suction sides of the several sections of the pump 8 are connected in the usual manner to the liquid tank, and conduits 88, 89, 90 and 91 respectively connect the discharges of the four pump sections to the four valve box units in the manner shown. Usual branch conduits 92, 93, 94 and 95 respectively connect these discharge conduits to a conventional relief valve bank 96 in turn connected back to the tank.

The valve box unit 84 has bores containing slide valves 96, 97, 98, 99, 100, 101, 102 and 103 respectively, each having a suitable operating handle. The bore containing the slide valve 96 is connected by conduits 104 and 105 to the opposite ends of the double acting cylinder of the rear foot jack 11. The bores containing the slide valves 97 and 98 are respectively connected by conduits 106, 107 and 108, 109 to the opposite ends of the double acting cylinders of the inclined rear anchor jacks 10. The bores containing the slide valves 99 and 100 are respectively connected by conduits 110, 111 and 112, 113 to the opposite ends of the double acting cylinders of the front foot jacks 9. The bore containing the slide valve 101 is connected by conduits 114 and 115 to the opposite ends of the double acting cylinder of the platform adjusting jack 72. The bore containing the slide valve 102 is connected by conduits 116 and 117 to the reversible drill feed motor 43, while the bore containing the slide valve 103 is connected by conduits 118 and 119 to the cross feed motor 30.

The valve box unit 85 has bores containing slide valves 120, 121 and 122 respectively, each likewise having suitable operating handles. The bore containing the slide valve 120 is connected by conduits 123 and 124 to one of the traction wheel driving motors 6. The bore containing the slide valve 121 is connected by a conduit 125 to the drill rotation motor 52, while the bore containing the slide valve 122 is connected by conduits 126 and 127 to the reversible vertical adjusting motor 18.

The valve box unit 86 has bores containing slide valves 128 and 129 respectively, also having suitable operating handles and the bore containing the valve 128 is connected by conduits 130 and 131 to the other reversible

traction wheel driving motor 36. The bore containing the slide valve 129 is connected by a conduit 132 to the drill rotation motor 52 so that a larger volume of liquid under pressure may be supplied to the latter. Another conduit 133 leads from the bore containing the valve 129 to the drill feed motor 43 for fast retraction.

The valve box unit 87 has bores containing slide valves 134, 135 and 136 respectively, similarly having suitable operating handles. The bore containing the slide valve 134 is connected by conduits 137 and 138 to the drill feed motor 143 for slow drill feed. The bore containing the slide valve 135 is connected by conduits 139, 140 to the opposite ends of the double acting cylinders of the stinger bar jacks 65. The bore containing the slide valve 136 is connected by a conduit 141 to a hydraulic motor 142 for driving a conventional electric cable reel 143 for supplying electric power to the electric motor 7.

The general mode of operation of the improved drilling machine will now be described. The drilling machine may be propelled over a ground surface, such as a tunnel floor, by means of the pairs of side traction wheels 3 driven by the motors 6 and by properly controlling these motors the pairs of side wheels may be driven at relatively different speeds to effect steering of the machine. When the working face is reached, fluid may be trapped in the motors 6 to lock the wheels or the wheels may be locked by conventional braking means. The floor jacks 9, 10 and 11 may then be adjusted to engage the floor of the subterranean passageway or tunnel, level up or tilt the machine and to hold the machine firmly in position. The inclined rear jacks 10 hold the machine up to the face during drilling with the large size bit. By properly operating the motor 18 the guide frame 16 may be moved vertically along a rectilinear path relative to the vertical guide frame 14 and by properly operating the motor 30 the guide frame 29 may be moved transversely along a straight horizontal path relative to the guides 28. Thus by rectilinearly adjusting the drill frame 40 along rectangularly related paths the drilling tool may be adjusted through a series of parallel positions. When the drilling tool is properly positioned with respect to the work, fluid may be trapped in the motors 18 and 30 or the sliding frames may be otherwise held against movement, and fluid may be supplied to the stinger-bar jacks 65 to bring the stinger bars 66 firmly against the working face. The drilling and feeding motors 43 and 52 may then be operated by supplying different volumes of liquid under pressure thereto, under the control of the slide valves above described, alternately to rotate the different size drill bits at different speeds and to feed any of such drill bits along a straight horizontal path toward the work at different speeds.

The drilling machine of the present invention is of the so-called "burn-hole" type and by adjusting the drilling tool along rectangularly related paths while maintaining the tool-axis parallel with the median line of the machine a series of relatively small parallel "burn-holes" 80 may be drilled at different radial points in a general cruciform formation (Fig. 12) in parallel relation with and spaced equidistantly from a relatively large central hole 81. Also, the drilling tool may be adjusted through a relatively wide range both vertically and laterally to position the drilling tool to drill parallel holes at various points in the working face in accordance with varying drilling conditions.

As a result of this invention an improved mobile drilling machine of the so-called "burn-hole" type is provided whereby the drilling tool may be accurately positioned to drill a series of parallel holes in the work. By the provision of the rectangularly arranged guideways and power adjusting means of the adjustable tool mounting means the drilling tool may not only be accurately positioned, but may also be expeditiously operated and controlled. By guiding the drilling tool along rectilinear paths relative to the base of the machine the drilling tool may be accurately positioned to drill a series of relatively small parallel blast holes at different radial points in a generally

cruciform formation and spaced equally from a relatively large centrally located hole in accordance with the "burn-hole" blasting method. By the provision of the multi-speed transmissions for the rotating and feeding means for drill bits of different size, holes of different diameters may be drilled in the working face. These and other advantages of the invention will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form which the invention may assume in practice, it will be understood that this form of the same is shown for purposes of illustration and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What we claim as new and desire to secure by Letters Patent is:

1. A drilling machine comprising a mobile base having a frame, a vertical frame mounted on the forward end of said base frame and extending wholly outwardly beyond said base frame, said vertical frame having a vertical guideway, a sliding frame guided for vertical rectilinear movement along said guideway, said sliding frame providing a transverse horizontal guideway, a second sliding frame guided for horizontal rectilinear movement along said horizontal guideway, a drilling tool carried by said last mentioned sliding frame and extending with its median line perpendicular to transverse vertical planes including said rectangularly related guideways, and means for selectively adjusting said sliding frames along their respective guideways.

2. A drilling machine as set forth in claim 1 wherein said drilling tool has a horizontal guide frame extending longitudinally in advance of said base and providing a horizontal longitudinal guideway along which said drilling tool is guided for rectilinear movement toward and from the work, and means for feeding said drilling tool along said last mentioned guideway.

3. A drilling machine as set forth in claim 2 wherein said means for sliding said sliding frames along said rectangularly related guideways and for feeding said tool along said horizontal longitudinal guideway are power operated, and control means is provided on said base for selectively controlling operation of said power operated means.

4. A drilling machine comprising, in combination, a mobile base having a frame, propelling and steering means for said base, an upright guide structure mounted on the forward end of said base frame outwardly of said propelling and steering means comprising rectangularly related guideways disposed in transverse vertical planes, a horizontal guide frame extending longitudinally in advance of said base and adjustably mounted for movement in right angle directions along said guideways, and a drilling tool guided for rectilinear movement along said horizontal guide frame toward and from the work, said horizontal guide frame maintaining the longitudinal median line of said tool perpendicular to said transverse vertical planes during feed thereof.

5. In a drilling machine, the combination comprising a mobile base, an elongated frame supported at the front end of said base and extending vertically with respect thereto, said frame providing a vertical guideway extending from the lower portion of said base to the upper portion of the machine, a support movable vertically along said guideway between a lowered position near the ground and an extreme raised position, said support providing a horizontal guideway extending at right angles with respect to said vertical guideway, a second support movable horizontally along said horizontal guideway between positions at the opposite sides of said base, said guideways disposed in vertical planes extending transversely of said base, an elongated horizontal guide frame supported solely at its rear end on said horizontally movable support and providing a horizontal guideway ex-

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tending longitudinally entirely in advance of said base, a drilling tool guided for horizontal longitudinal movement along said guide frame for drilling a horizontal hole in the work, means for moving said supports along their respective guideways to move said guide frame through a relatively wide range of tool supporting positions including said positions aforesaid, said right angle vertical and horizontal guideways maintaining said guideway of said guide frame perpendicular to said planes in all adjusted positions of the tool, and means for moving said drilling tool back and forth along said longitudinal guideway during the drilling operation.

6. A drilling machine comprising, in combination, a mobile base, a horizontal tool supporting guide frame extending in advance of said base, means for supporting said guide frame for adjustment into different elevated positions with respect to said base, an operator's platform on said guide frame, and means on said guide frame for lowering said platform when said guide frame is elevated.

7. In a drilling machine, a mobile base, a drilling tool carried by said base for drilling holes in the working face, and downwardly inclined rear floor jacks carried by and secured at fixed angles to said base and anchor means engageable with the face and cooperating with said inclined rear jacks for aiding said inclined rear jacks in holding the machine up to the work during the drilling operation.

8. A drilling machine as set forth in claim 7 wherein said anchor means includes a fluid jack on the machine and engaging the working face and an anchor chain actuated by said jack and attached to the face.

9. In a drilling machine, the combination comprising a mobile base, an elongated frame supported at the front end of said base and extending vertically with respect thereto, said frame providing a vertical guideway extending from the lower portion of said base to the upper portion of the machine, a support movable vertically along said guideway between a lowered position near the ground and an extreme raised position, said support providing a horizontal guideway extending at right angles with respect to said vertical guideway, a second support movable horizontally along said horizontal guideway between positions at the opposite sides of said base, said guideways disposed in vertical planes extending transversely of said base, an elongated horizontal guide frame supported solely at its rear end on said horizontally movable support and providing a horizontal guideway extending longitudinally entirely in advance of said base, a drilling tool guided for horizontal longitudinal movement along said guide frame for drilling a horizontal hole in the work, means for moving said supports along their respective guideways to move said guide frame through a relatively wide range of tool supporting positions, said right angle vertical and horizontal guideways maintaining said guideway of said guide frame perpendicular to said planes in all adjusted positions of the tool, means for moving said drilling tool back and forth along said longitudinal guideway during the drilling operation, cooperating power operated jacks on said machine engaging the working face and the floor and cooperating to steady said tool guide frame with respect to the work during the drilling operation, said floor engaging jacks being disposed at the rear end of the machine base and rearwardly and downwardly inclined for urging said guide frame forwardly toward the work, and auxiliary face en-

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gaging means cooperating with said face engaging jacks for holding said guide frame in position on the working face.

10. A drilling machine comprising, in combination, a mobile base, a horizontal tool supporting guide frame extending in advance of said base, means for supporting said guide frame for adjustment into different elevated positions with respect to said base, an operator's platform on said guide frame, and means on said guide frame for lowering said platform when said guide frame is elevated, said platform lowering means comprising oppositely extending links pivotally connected together and having their remote ends loosely pivotally connected to said platform and a fluid jack on said guide frame engaging the pivotally connected ends of said links for swinging the latter.

11. A drilling machine comprising a mobile base having a base frame, a vertically extending frame secured to the forward end of said base frame, said vertically extending frame providing vertically disposed guideways extending in a vertical transverse plane for the full height of said latter frame from a location opposite the bottom of said base frame to a location thereabove, another frame having guides cooperable with said guideways, means for moving said another frame rectilinearly along said guideways to position said latter frame adjacent the lower ends of said guideways or to a position above the top of said base frame including positions therebetween, said another frame having thereon transversely disposed guide members for supporting and guiding still another frame, said still another frame extending longitudinally outwardly beyond said another frame and wholly in advance of said base frame, said last mentioned frame extending with its median line perpendicular to transverse vertical planes including said vertically disposed guides and guideways on said another frame and said vertically extending frame, respectively, said last mentioned frame having horizontal longitudinally extending guideways thereon, a drilling tool supported on said still another frame and having guides cooperable with said guideways on said still another frame, and means on said last mentioned frame for moving said drilling tool rectilinearly along said still another frame toward and from the work in horizontal planes longitudinally of and parallel to the median line of said base frame, cooperable means on said another frame and said still another frame for moving said still another frame transversely with respect to said another frame and said base frame along the transversely disposed guide members to position said drilling tool to either side of the median line of said base frame in planes parallel thereto and perpendicular to the plane in which the vertically disposed guideways of said vertically extending frame lie.

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