

Dec. 16, 1941.

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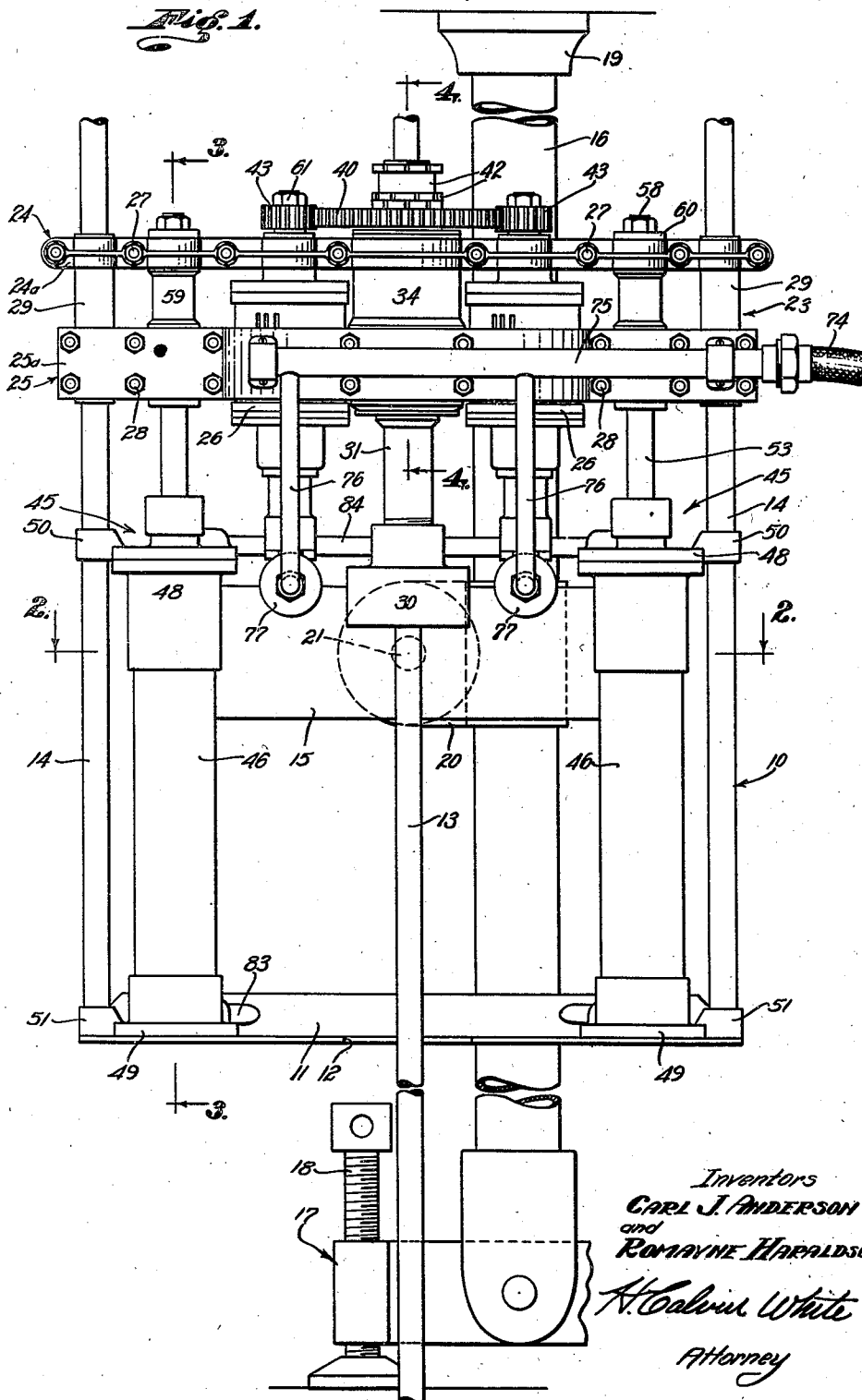
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DRILLING MECHANISM

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4 Sheets-Sheet 1

Fig. 1.



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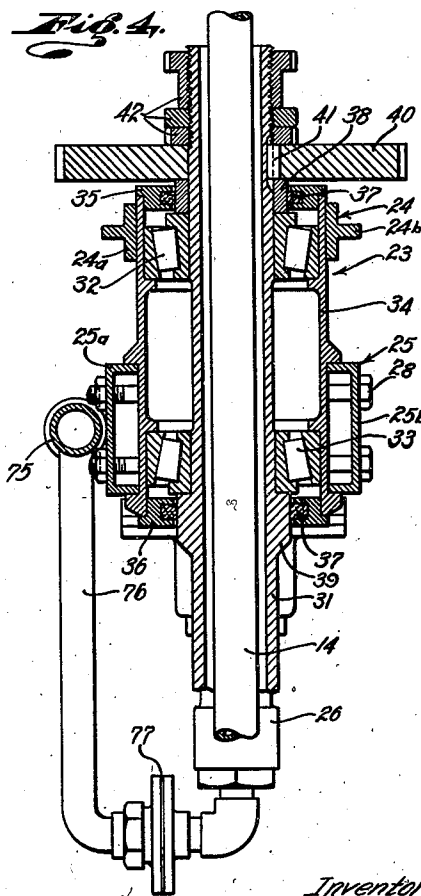
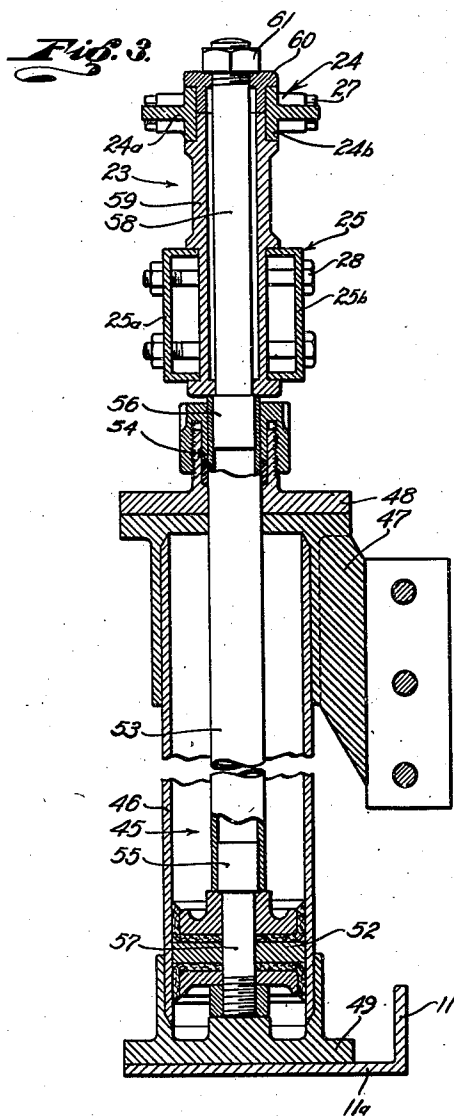
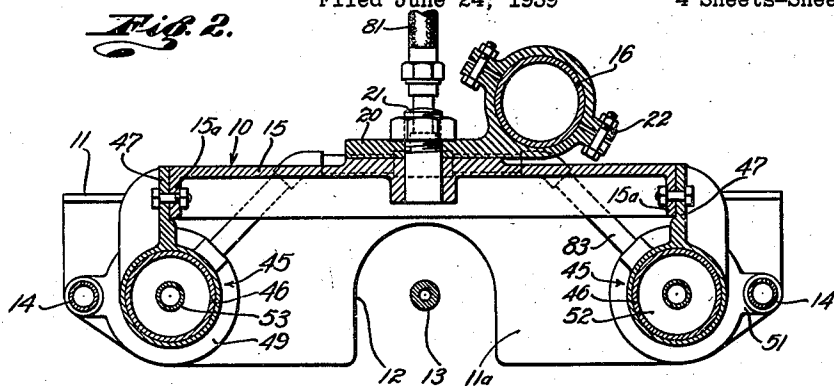
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4 Sheets-Sheet 2



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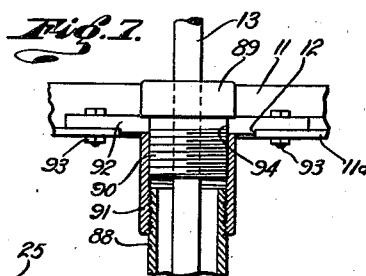
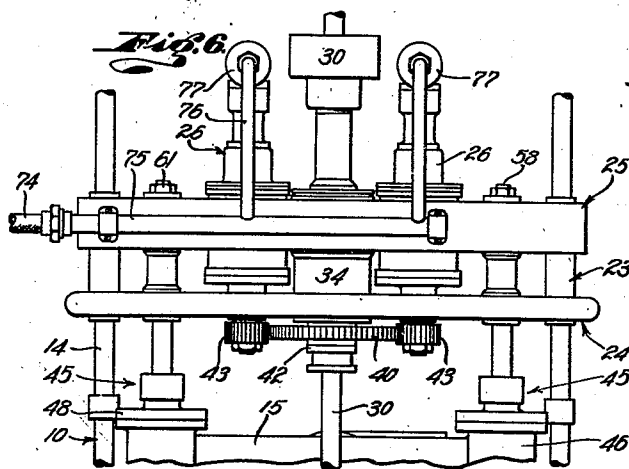
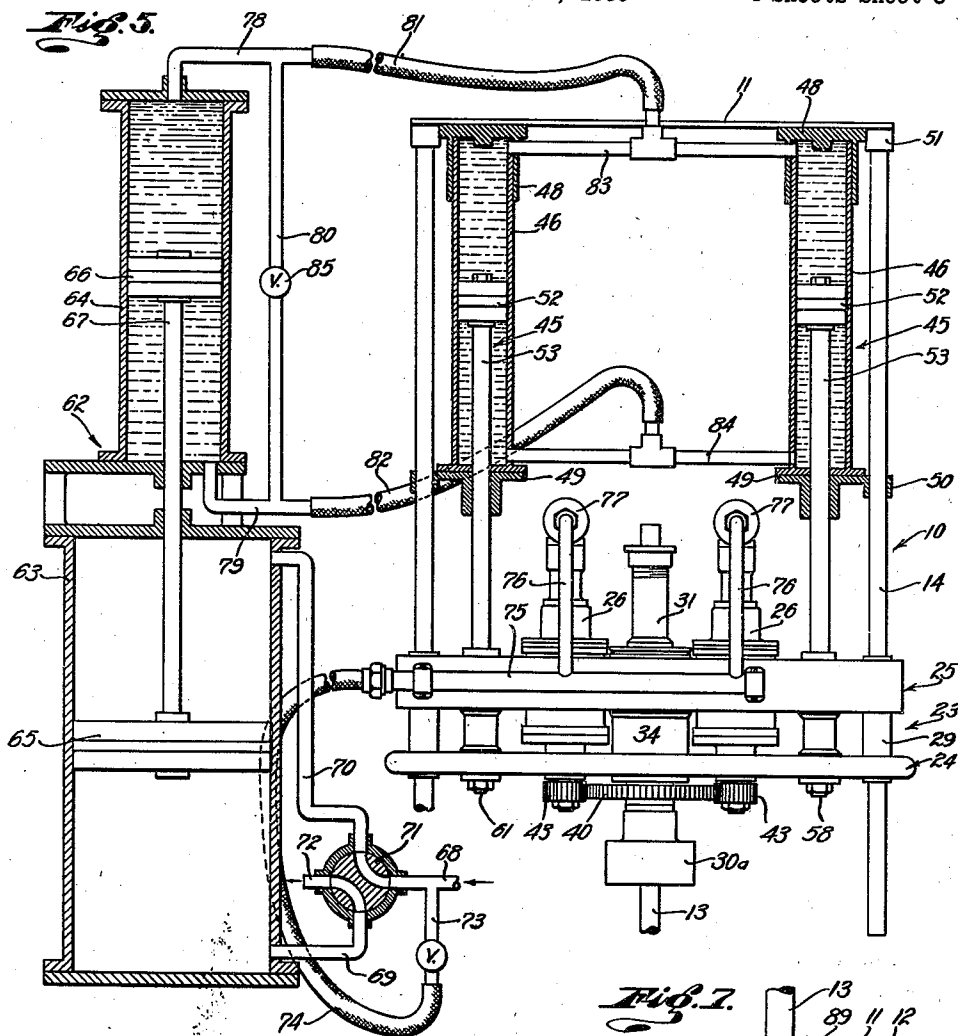
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4 Sheets-Sheet 4

Fig. 8.

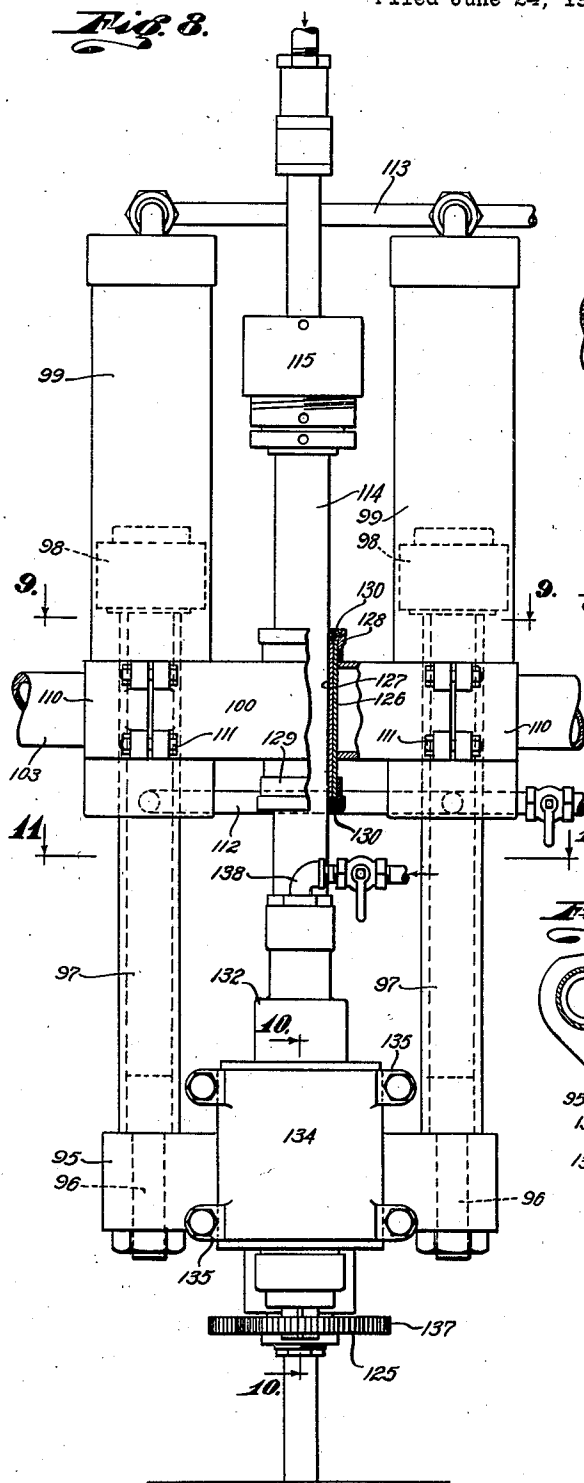


Fig. 9.

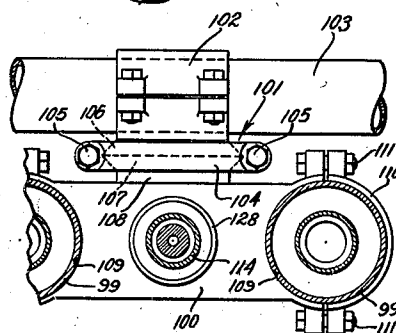


Fig. 10.

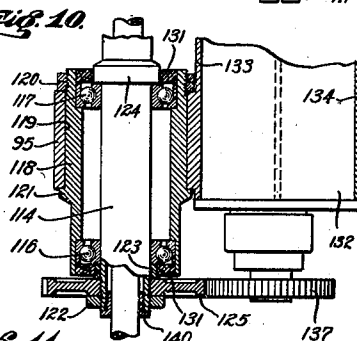
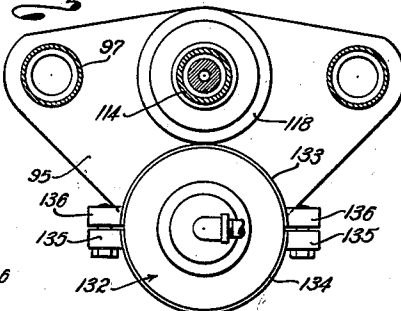


Fig. 11.



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DRILLING MECHANISM

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2 Claims. (Cl. 255—22)

This invention has to do generally with improvements in drilling mechanisms, particularly of the rotary type adaptable for drilling in mine and other underground workings, trenches and on dam faces and various surface locations.

In certain of its broad aspects, the invention deals with drilling machines of the type comprising, in general, a body or frame mounted for angular adjustment, and on which is carried a relatively vertically movable head operated to advance or retract the drill. Heretofore, the general practice has been to support the drill rotating power unit or motor independently of the head, and to employ a relatively complicated drive for transmitting power from a stationary motor to the moving head or drill stem chuck carried by the head. This conventional construction not only complicates and increases the initial and maintenance costs of the machine, but it also limits to a comparatively great extent the convenience and ease of handling and operating the machine and its adaptability to drilling under limited circumstances and at various positions and angles.

One of our major objects is to provide an improved machine of the type generally described above, in which the drill rotating power unit is carried directly by the head so as to be movable therewith relative to the frame, and movable bodily with the entire frame supported parts as the machine is adjusted for various drilling angles. While broadly speaking, any suitable power unit, air or electric, may be employed, we prefer to use air motors because of their light weight, compactness and general adaptability from standpoints of performance as well as structural considerations, to this type of drill. A very compact and efficient head and motor assembly is provided by using a crosshead carrying at its center a rotatable drill rod chuck supporting tube, and mounting on the crosshead one or more air motors having simple lightweight gear connections with a gear carried by the tube. By this construction the weight of all the head supported parts is desirably reduced for shallow drilling, without sacrifice however of the potential and greater power required under other conditions.

Another feature of the invention is the provision, in conjunction with the crosshead supported power unit, of fluid pressure operated means for controllably actuating the advancing, or drilling, and retractive movements of the head assembly within relatively short or long distances of travel to suit the particular circumstances.

In this manner the machine is caused to operate efficiently in pulling rods, since it permits rotation of the tool while maintaining a constantly applied pull, thus eliminating danger of pulling out diamonds set in the bit, where diamond drills are used, and lodging of the tool in impacted or caving rock. In this general connection it may be mentioned that the arrangement of the parts including the hydraulic cylinders, permits the use of a machine having a narrow or flattened construction which has the advantage of making it possible to drill close to a side wall or vertical surface, or in direct proximity to a column on which the machine is supported, where anchorage is not available at the outside of the area being worked.

The invention has a further and particularly distinctive feature with respect to the crosshead mounting whereby the head and its supported parts, including the drill rod chuck, air motors and piston and cylinder assemblies, may be selectively operated in reversed vertical positions, and the positions quickly changed by simple manipulations. The reversibility of the head assembly makes it possible to gain positional advantages relative to the work, and to facilitate changing of drill rod sections within limited space in the direction of the rod. Also it permits maintaining operations at either position of the head with the drill rotating in a given direction, without having to reverse the direction of rotation of the power source.

All the above mentioned features of the invention, as well as various additional objects and details, will be understood most readily and to better advantage from the following description of a typical and illustrative machine embodying the invention. Reference is had throughout the description to the accompanying drawings, in which:

Fig. 1 is a front elevation view of the machine;

Fig. 2 is a cross section on line 2—2 of Fig. 1;

Fig. 3 is a vertical section on line 3—3 of Fig. 1, the piston however being advanced to the end of its stroke;

Fig. 4 is a section on line 4—4 of Fig. 1;

Fig. 5 is a view, partly diagrammatic, showing the machine in inverted position, and its connections with a pressure fluid supply source;

Fig. 6 is a fragmentary view showing the frame of the machine in its normal vertical position, but with the head assembly inverted;

Fig. 7 illustrates an attachment for mounting the machine on a grout pipe;

Fig. 8 shows a variational form of the invention;

Fig. 9 is a fragmentary cross section on line 9—9 of Fig. 8;

Fig. 10 is a fragmentary section on line 10—10 of Fig. 8; and

Fig. 11 is a cross section on line 11—11 of Fig. 8.

Referring first to Fig. 1 of the drawings, the machine comprises a frame, generally indicated at 10, including a base 11, recessed at 12, see Fig. 2, to pass the drill rod 13, also a pair of vertically extending guide tubes 14, and a transverse plate 15. The frame 10 and its supported parts are mounted for vertical and angular adjustment on a suitable support, shown typically as a tubular column 16 having a footing 17 adjustable by screw 18 to bring the head 19 of the column tightly against a ceiling or other overhead surface to anchor the column securely in place. The machine proper is supported on the column by a bracket 20 fastened to the back surface of the plate 15 by bolt 21, and secured to the column 16 by a split clamp 22. As will be apparent, the clamp permits placement of the machine at any vertical position on the column, while the bolt connection 21 between bracket 20 and the plate 15 provides a pivotal adjustment whereby the machine may be maintained at any drilling angle within a 360° range.

Mounted on the frame 10 is a vertically movable and inverted head assembly generally indicated at 23, comprising a pair of elongated crossheads 24 and 25 movable vertically on the guide tubes 14 and supporting the air motors 26 and the power transmission to the drill rod 13. The crossheads 24 and 25 consist of sections 24a, 24b, and 25a, 25b respectively, between which the various parts directly supported by the crossheads are clamped by tightening bolts 27 and 28 which interconnect the sections. The ends of both crossheads are clamped to a pair of sleeves 29 that slide longitudinally on the guide tubes 14.

The drill rod 13 is rotated by a chuck connection 30 with an open end drive tube 31 positioned in axial alinement with the center of the frame and head assembly, the drilling rod being fed through the tube, and advanced toward the work by movement of the head 23 in that direction. As best illustrated in Fig. 4, the rotatable drive tube 31 is journaled on roller bearings 32 and 33 within a housing 34 clamped between the sections of the crossheads 24 and 25, the upper and lower ends of the housing 34 having closures 35 and 36 carrying suitable seal or packing rings 37 engaging sleeve 38 and the upset portion 39 of the tube to exclude dirt and moisture from the bearings. Directly above sleeve 38 the tube 31 carries a spur gear 40 secured thereto by key 41 and clamped against the upper end of the sleeve by nuts 42 threaded on the tube. Tube 31 and the drill rod 13 are driven by air motors 26 through gears 43 carried on the vertical shafts of the motors and meshing with gear 40. From the foregoing it will be seen that the motors, power transmission and driving connection with the drill rod 13, all are supported by and movable with the crosshead assembly relative to the frame, and at all vertical and angular positions of the machine.

The head 23 is operated by a pair of piston and cylinder assemblies 45 at opposite sides of the central axis of the machine. Each of the assemblies 45 comprises a cylinder 46 supported on the base 11 of the frame and attached by web 47 to the ends 15a of plate 15. The heads 48 and bases 49 of the cylinders may be cast integrally with

tubular bosses 50 and 51 to support the guide tubes 14. Each cylinder contains a piston 52 having a tubular rod 53 extending through a suitable packing gland 54 in the cylinder head, the ends of the tube 53 being sweated on the heads 55 and 56 of bolts 57 and 58 connecting the tube with the piston and crosshead assembly. Bolt 58 extends upwardly through a sleeve 59 clamped between the crosshead sections, and through a centering bushing 60 held between sections 24a and 24b of the upper crosshead. By tightening nut 61, sleeve 59 is held against the upper end of the piston rod, and the entire head assembly securely attached to the piston rod for movement therewith in opposite directions.

The pistons 52 are operated by fluid pressure supplied from a unit generally indicated at 62 in Fig. 5 and designed especially for the purpose of obtaining the combined advantages of hydraulic or liquid pressure in the cylinders 46, together with the more flexible and accurately controllable application of that pressure by compressed air or other gas. The unit 62 comprises a pair of cylinders 63 and 64 in tandem arrangement and containing pistons 65 and 66 interconnected by rod 67. The motive piston 65 is of substantially larger area and is operated by compressed air supplied from line 68 through branches 69 and 70 connecting with the opposite ends of the cylinder, under control of a four-way valve 71. At the valve position shown, compressed air is supplied to the inner end of the cylinder through branch 70 and is exhausted from the opposite end through branch 69 to the outlet 72, the air flow to and from the cylinder being reversed by throwing the valve to reverse position. Compressed air may also be supplied from line 68 to the air motors 26 through the valved branch 73 having a hose connection 74 with manifold 75 mounted on the crosshead 25. From the manifold the compressed air is discharged to the motors through pipes 76 and the governors 77.

By virtue of the area differential between pistons 65 and 66, it is possible to develop high liquid pressures in cylinder 64 for operating the pistons of the drilling machine proper, using relatively low air or other gas pressure in cylinder 63. In addition to this feature and the advantage referred to above with respect to the flexibility and accuracy of control using air as the primary pressure source, there is the further and particular advantage that the relatively low pressure air provides an effective cushion against reactive forces transmitted to the crosshead and pistons of the drilling machine. Thus it is made possible to employ the necessary relatively high liquid pressures in the cylinders 46, and at the same time to maintain an effective cushion in applying those pressures, by virtue of the relatively low pressure air in cylinder 63.

In order more clearly to illustrate the connections between the cylinders 46 and the pressure supply cylinder 64, the piping between cylinders 46 is shown somewhat diagrammatically in Fig. 5, the true arrangement of the pipes, however, being illustrated in Fig. 2. Pipes 78 and 79 extending from opposite ends of the cylinder 64 and interconnected by a by-pass line 80, communicate through hoses 81 and 82 with pipes 83 and 84 which interconnect opposite ends of the cylinders 46, thus balancing the pressures communicated thereto. The cylinders 46 and 64, as well as the conduits interconnecting them, are completely filled with a suitable fluid, for example, a low viscosity oil, and the relative displacement volumes

of the cylinders are such that travel of the piston 66 throughout its stroke in one direction will cause pistons 52 to travel the full lengths of their corresponding strokes, to advance or retract the drill, as the case may be. The rate of advancement or retraction of the head assembly and drill under the influence of pressure applied to the pistons 52, may be closely and variably controlled by manual operation of the valve 71.

As previously mentioned, the machine may be adjusted for drilling at any inclination or angle relative to the supporting column 16. In Figs. 1, 5 and 6 of the drawings, the machine is shown to be adjusted for drilling in different positions. Fig. 1 shows the machine in a normal vertical position for down drilling with the drill rod chuck 30 carried on the lower end of the drive tube 31 and the head assembly advanced to an intermediate position in its downward movement relative to the frame. It will be observed that by adjustment of the clamp 32 and the pivotal connection at bolt 21, it is possible to position the machine for drilling at any angle and location about the supporting column 16. Also by virtue of the general flattened or elongated shape of the machine, it is possible to drill close to or directly adjacent the column or other support on which the machine is mounted. Fig. 5 shows the entire machine to be inverted for down drilling, the usual right hand chuck being replaced by a left hand chuck 30a on the lower end of the drive tube 31 opposite from its position in Fig. 1. As will be understood, however, the chuck may be applied to either end of the tube. With the machine thus inverted, it is possible to bring the head closer to the work and also to facilitate changing drill rod sections within limited space beyond the end of the drive tube into which the rod is fed.

We have previously referred to the important feature of mounting the head assembly so as to be invertible on the frame or guides. By removing nuts 61, the entire assembly including cross-heads 24 and 25 and their supported parts, may be lifted from the bolts 58, and the head assembly replaced in inverted drilling position on the bolts 58, the parts then being positioned as shown in Fig. 6. Here the chuck 30, as in Fig. 1, is shown on the extended end of the drive tube 31. With the head assembly, including the motors and their air connections, in inverted position, it is possible as in Fig. 5 wherein the entire machine is shown inverted, to bring the head close to the surface being drilled (assuming the machine to be drilling toward the chuck) since the chuck here is advanced beyond the head parts and may be moved adjacent the work. As will be apparent, the advantages in facilitating changing of drill rod sections are present here, as in the situation previously observed with reference to Fig. 5.

In the foregoing we have described how the machine may be mounted for adjustment to any drilling angle, on a column or other support offset from the drill rod. Under some conditions, and for purposes known to those familiar with the art, it may be desirable to mount the machine on a grout pipe and to drill longitudinally through the pipe. Thus, as illustrated in Fig. 7, instead of mounting the machine on an offset support, it may be mounted on a stationary grout pipe 88 by securing the base 11 of the machine frame thereto by suitable connection. As typical, the head 89 of a clamp nut or bushing 90 threaded into the pipe collar 91, may be

screwed down against a plate 92 bolted at 93 to the frame base flange 11a. Plate 92 has a substantially semi-circular opening 94 smaller than but concentric with opening 12 in the frame base. By tightening the bushing 90, plate 92 and the drilling machine are securely clamped on the collar 91, with the drive tube and drill rod 13 in axial alinement with pipe 88 so that the drill may be operated through the pipe.

The variational form of the invention illustrated in Fig. 8, while generally similar to the first described form, has certain features that adapt it to lighter weight construction, facility in handling and transportation, and balanced support for the drill rod with relation to the mass of the machine and its point of support. In Fig. 8, the machine is shown in its down drilling position, with the crosshead 95 secured by bolts 96 to the tubular rods 97 of pistons 98 contained in the cylinders 99. Here the cylinders are carried by a transverse support 100 having a pivotally adjustable connection 101, see Fig. 9, with a clamp 102 which mounts the machine on a horizontally extending pipe 103 or other support. The connection at 101, which permits bodily adjustment of the machine for drilling at all various angles and inclinations, comprises a pair of split ring clamp sections 104 held together by bolts 105 and engaging and holding together the adjacent angularly faced annular portions 106 and 107 of the clamp 102 and trunnion 108 on the support 100, respectively. The cylinders 99 are received within the recessed ends 109 of the support 100, and are held in place by semi-circular clamps 110 fastened to the support by bolts 111. Opposite ends of the cylinders are interconnected by pipes 112 and 113, through which operating fluid is controllably delivered to the cylinders as in the first described form of the invention.

The drive tube 114 is laterally supported and journaled within both the head 95 and the support 100, and is extended so that the drill rod chuck 115 is positioned beyond the support, or above the latter with the machine positioned as shown in Fig. 8. As shown in Fig. 10, the lower end of the drive tube 114 extends through and is journaled in ball bearings 116 and 117 within a tubular housing 118 contained within an opening 119 in the crosshead 95. The housing is held in place by nuts 120 threaded on the upper end of the housing and bringing flange 121 to bear against the bottom surface of the crosshead. The drive tube is held against longitudinal movement relative to the head, by tightening nut 122 to bring spacer sleeve 123 into engagement with the inner race ring of bearings 116, and the tube flange 124 into engagement with the inner race ring of bearings 117. Suitable packing 131 in the upper and lower ends of the housing 118, excludes dust from the bearings inside the housing. On its lower projecting end the tube carries a gear 125 screwed on the tube with a left hand thread and held in place by nut 122.

Intermediate its ends, the drive tube is guided and journaled within a tubular housing 126 carried by the support 100, the housing containing a bearing sleeve or liner 127 having end closures 128 and 129 containing packing 130 to prevent dust from reaching the bearing. By thus giving the drive tube bearing support independently of the head 95 and within a stationary part of the frame, it is made possible to extend the tube and to position the chuck 115 toward the end of the machine opposite the crosshead. An important advantage is gained in that a greater distribution

of lateral forces and vibrations from the drill rod or drive tube is effected longitudinally of the machine, thereby affording better balance against those forces and less tendency on the part of the machine to turn about its support under lateral reactive forces transmitted through the drill rod. When using drill rods of small diameter as compared with the internal diameter of the drive tube 114, it may be desirable to guide and laterally support the rod within the lower end of the tube as by means of a bushing 140, see Fig. 10, threaded or otherwise inserted in the end of the tube.

The drill is powered by a single air motor 132 carried on the head 95 at a position opposite 15 from its transverse center as illustrated in Fig. 11. The motor is received within a semi-cylindric section 133 welded or otherwise secured to the head 95, and the motor is held in position by an outer semi-cylindric clamp section 134 carrying 20 lugs 135 bolted to corresponding lugs 136 on the inner section. Gear 137 carried on the motor shaft, meshes with gear 125 to rotate the drive tube 114. Compressed air is delivered to the motor through a valve controlled line 138, similar to that previously described.

It is believed that the operation of the drill will be apparent from the foregoing. Selective communication of the operating fluid pressure to the ends of the cylinders 99 through lines 112 and 113, acts to advance or retract the crosshead 95 and the parts carried thereby with relation to the cylinders and stationary support 100. The drive tube 104 of course moves longitudinally through the stationary bearing 127 within the range of movement of the head end of the machine.

It is to be understood that while at least in cer-

tain of the claims reference is made to parts of the machine as being vertically positioned or to have vertical movement, such terminology is used assuming the machine to be in one of its vertical positions, and for convenience and clarity of definition in orienting the parts and their movements, but without any intended limitative effect in so far as the capacity of the machine for operation at various drilling positions and angles is concerned. The claims therefore are to be construed accordingly.

We claim:

1. In a drilling machine of the character described, an angularly adjustable vertically extending frame comprising a pair of guides, a head movable vertically on said guides relative to the frame, drill rotating means carried by the head at the center of said frame, a pair of piston and cylinder assemblies at opposite sides of said center for controllably actuating the head in its said vertical movement, and a pair of motors carried by the head at opposite sides of said drill rotating means and drivingly connected thereto.

2. In a drilling machine of the character described, a vertically extending frame comprising a pair of guides, a head movable vertically on said guides relative to the frame, drill rotating means carried by the head at the center of said frame, a pair of piston and cylinder assemblies at opposite sides of said center for controllably actuating the head in its said vertical movement, a gear carried by said drill rotating means, a pair of air motors mounted on the head at opposite sides of said drill rotating means, and a pair of gears driven by said motors and meshing with the first mentioned gear.

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