

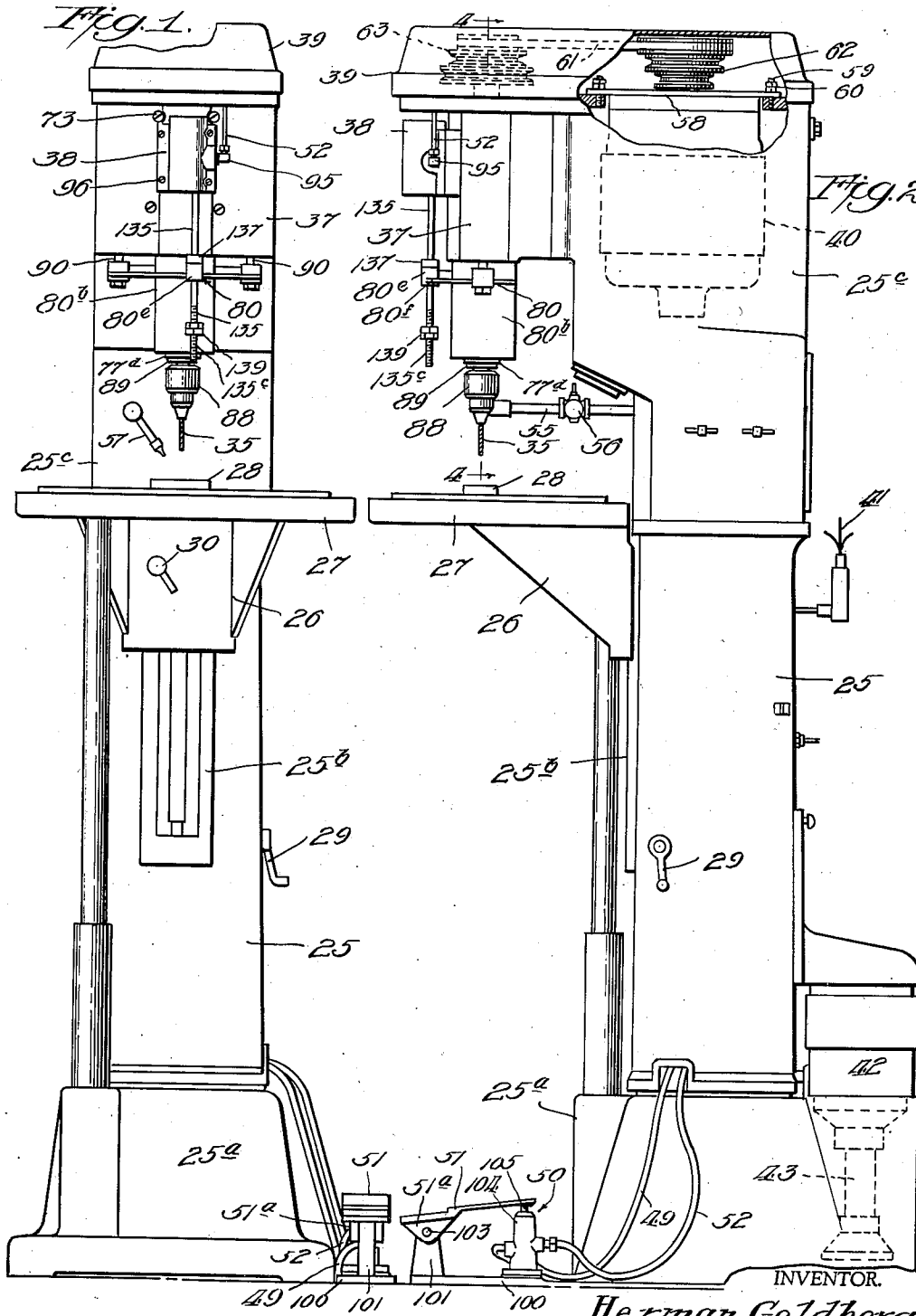
June 14, 1949.

H. GOLDBERG
DRILLING MACHINE

2,472,967

Filed March 13, 1940

10 Sheets-Sheet 1



INVENTOR.
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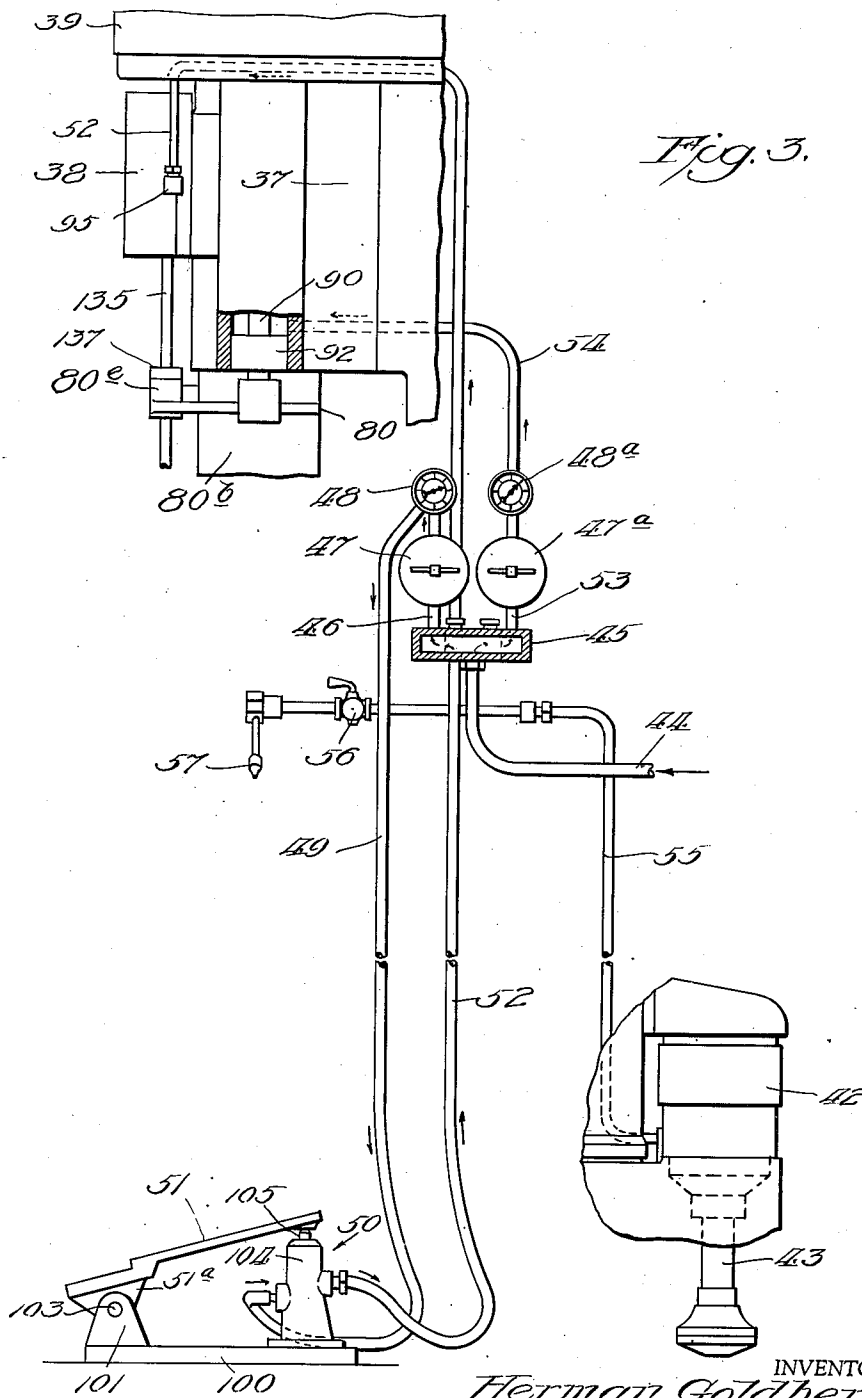
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10 Sheets-Sheet 2



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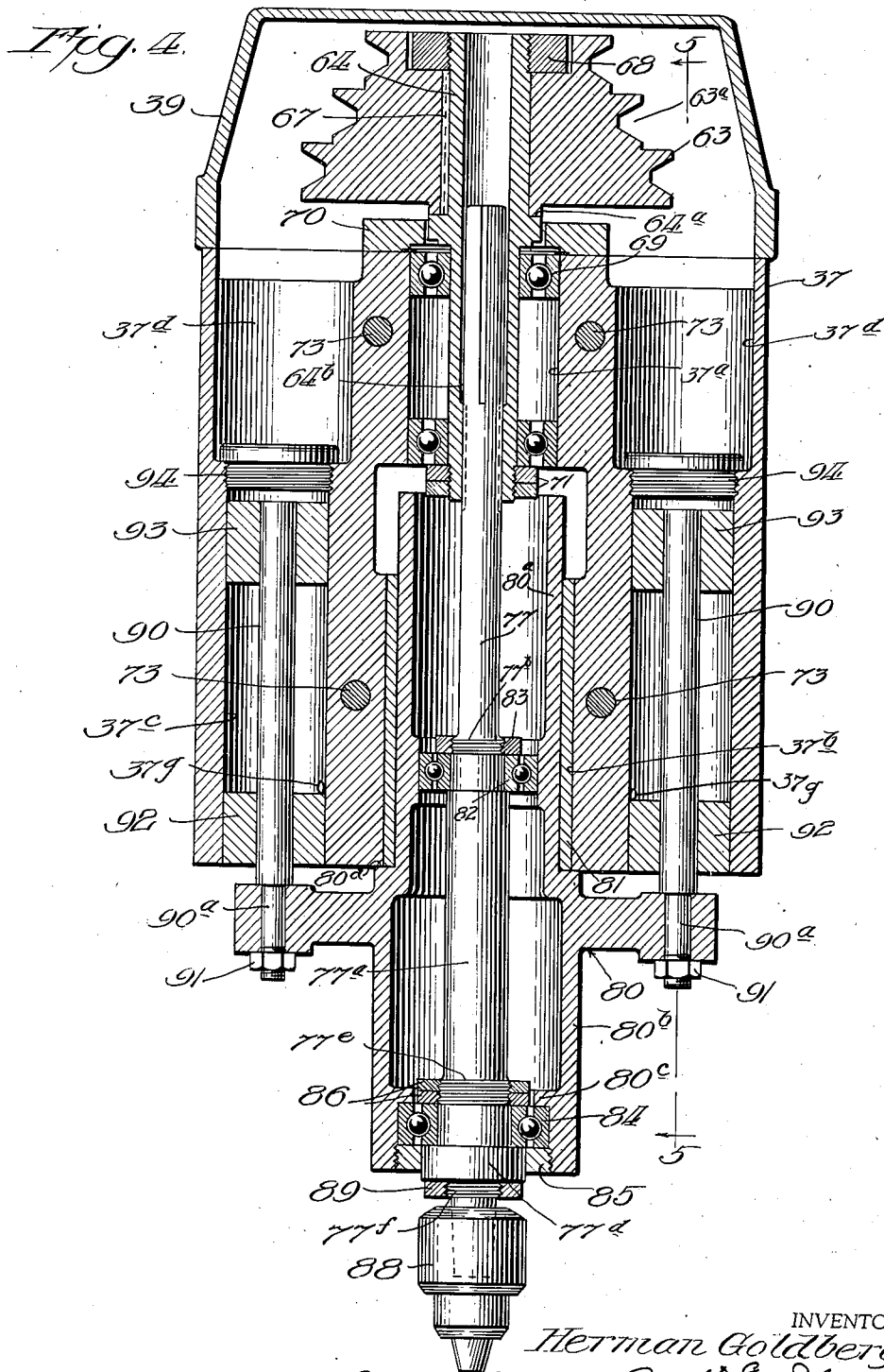
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10 Sheets-Sheet 4



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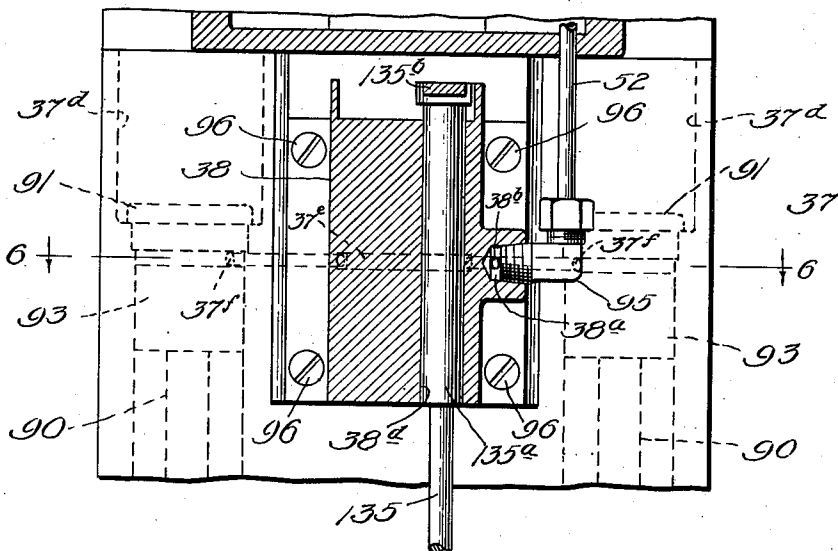
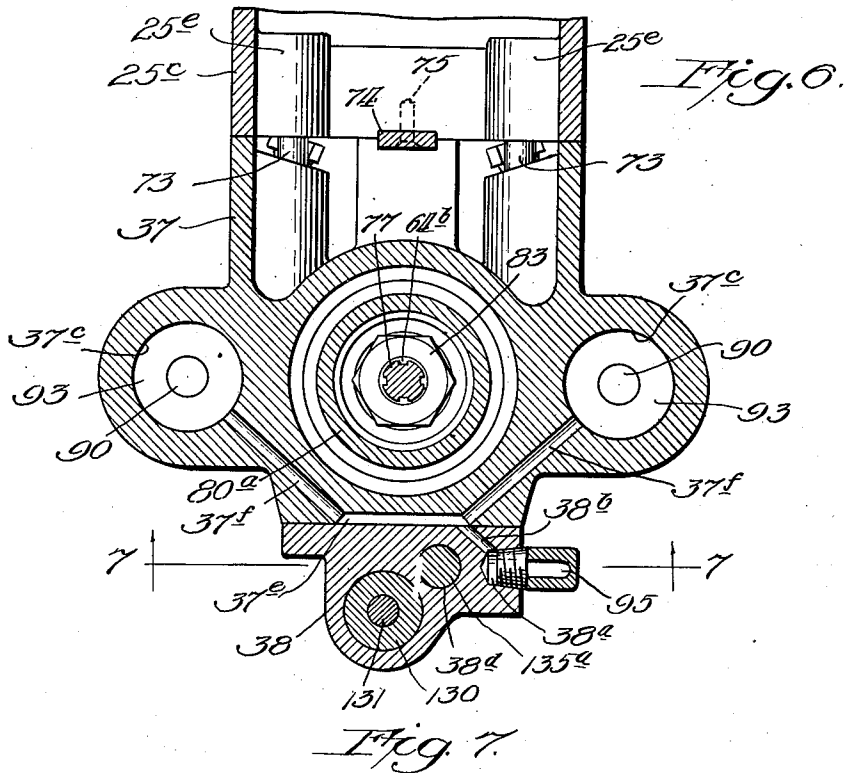
H. GOLDBERG

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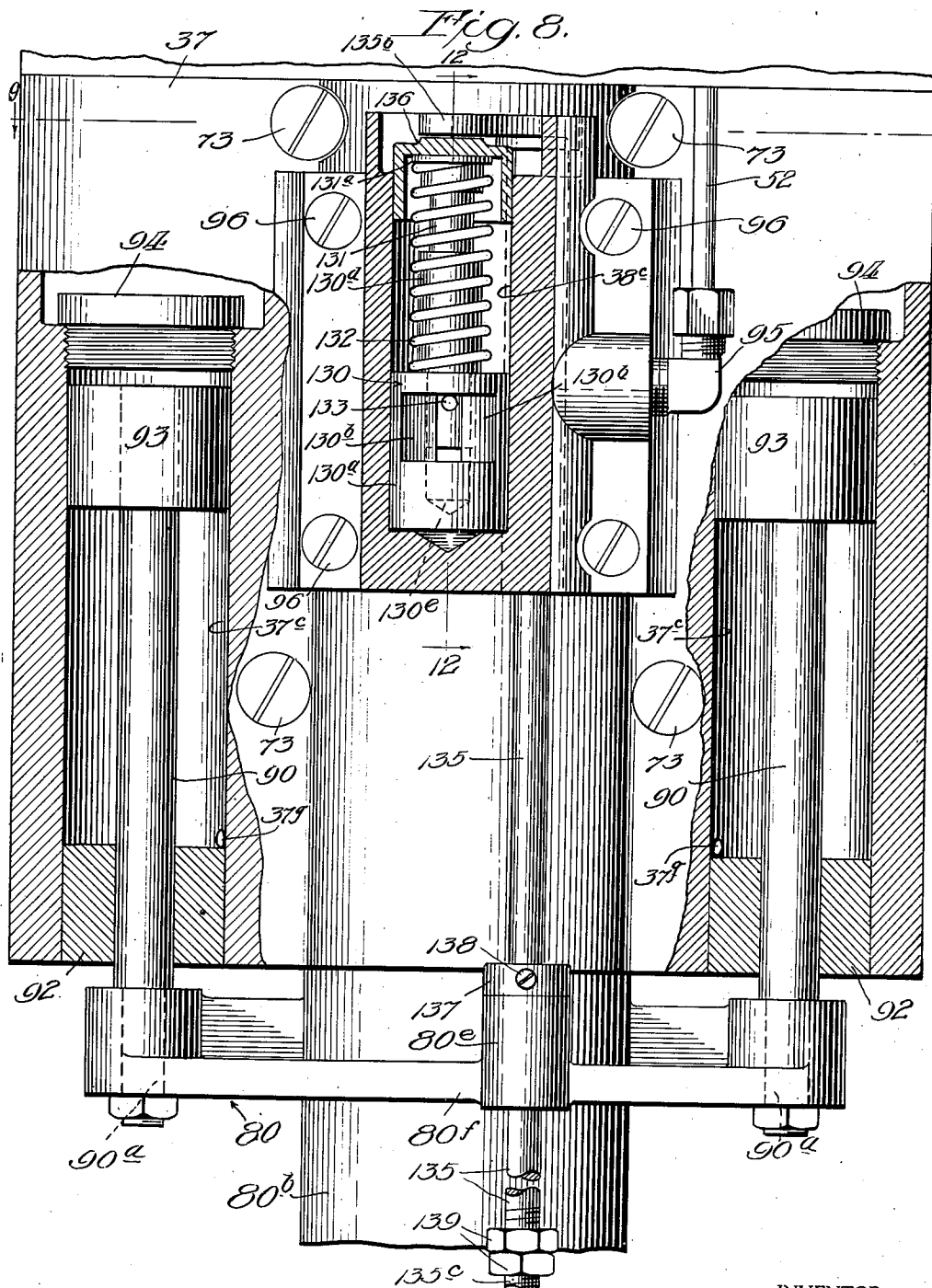
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10 Sheets-Sheet 6



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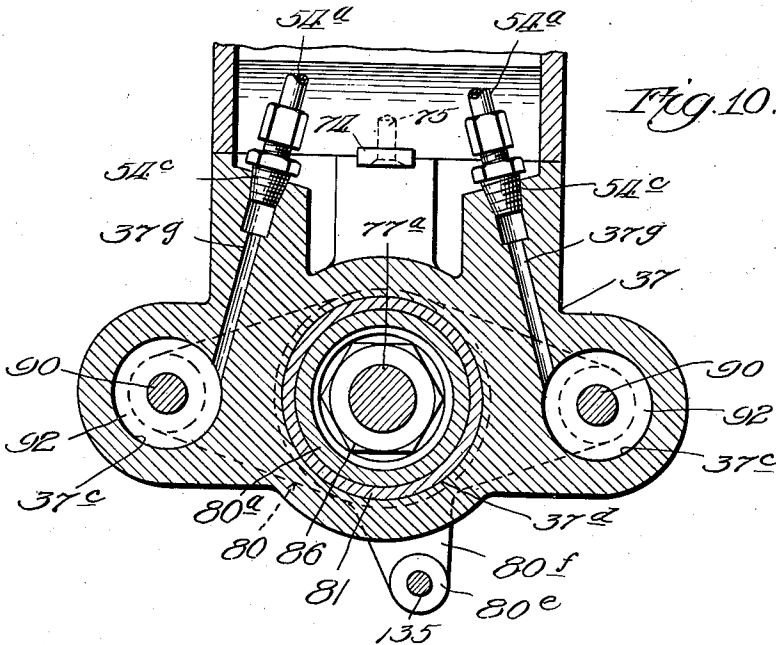
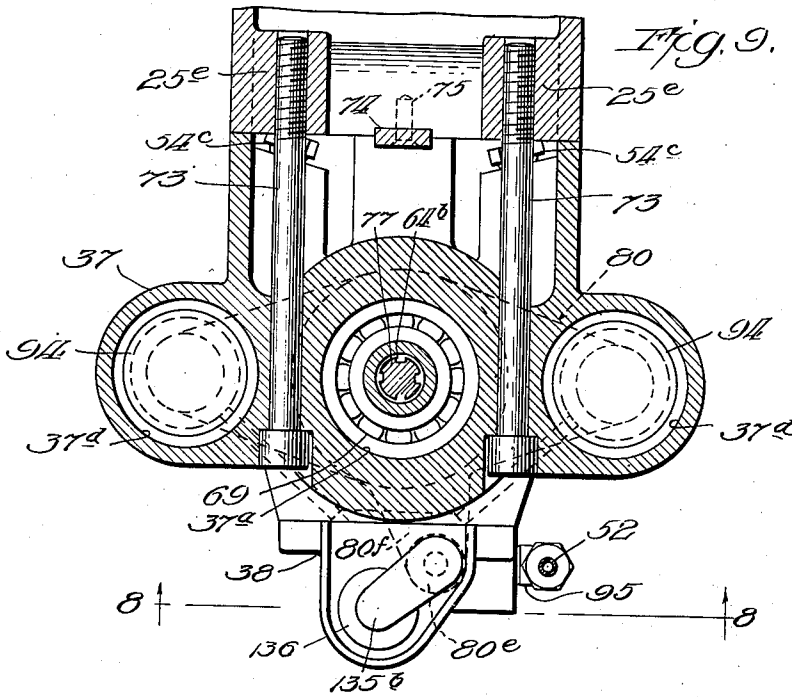
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10 Sheets-Sheet 7



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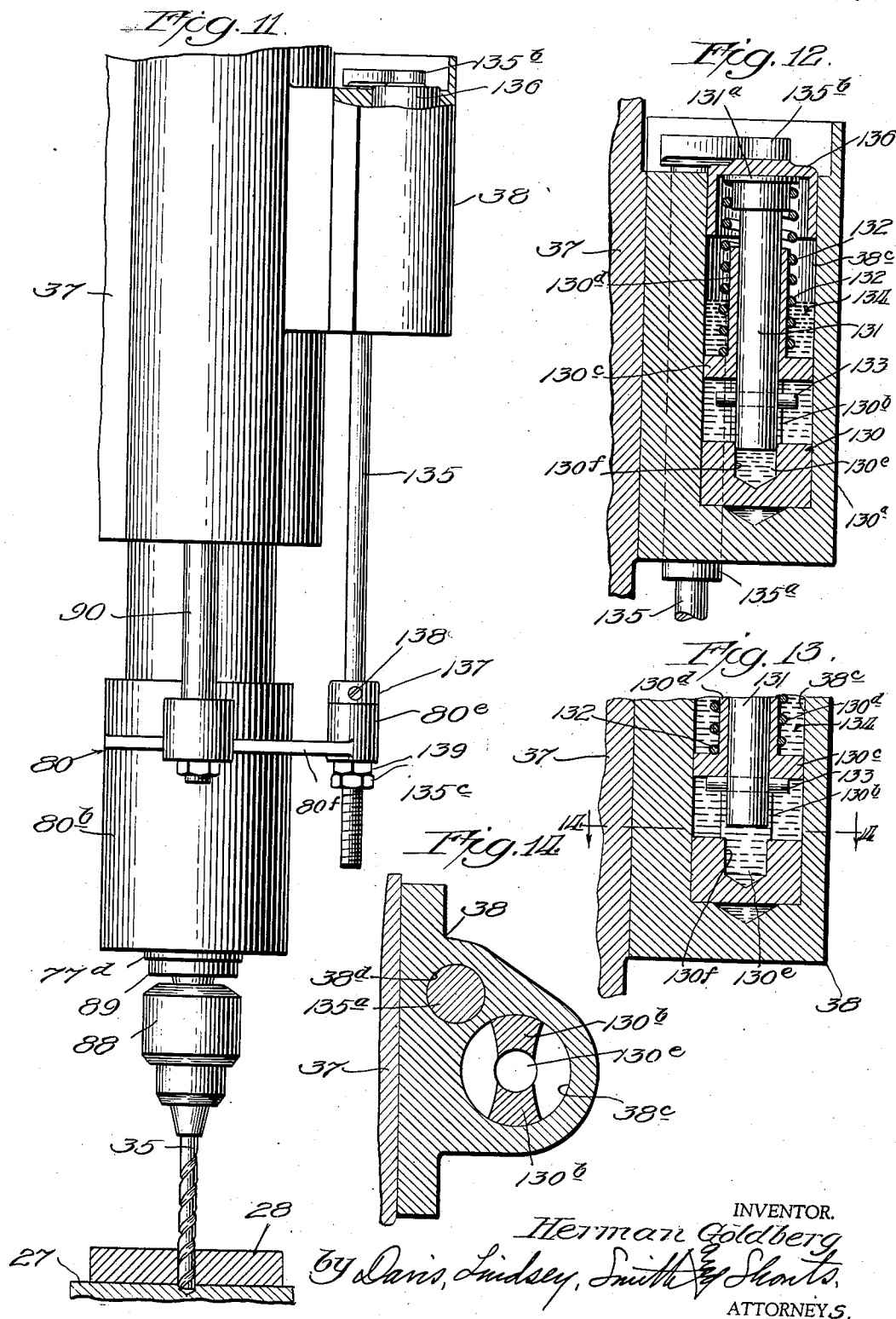
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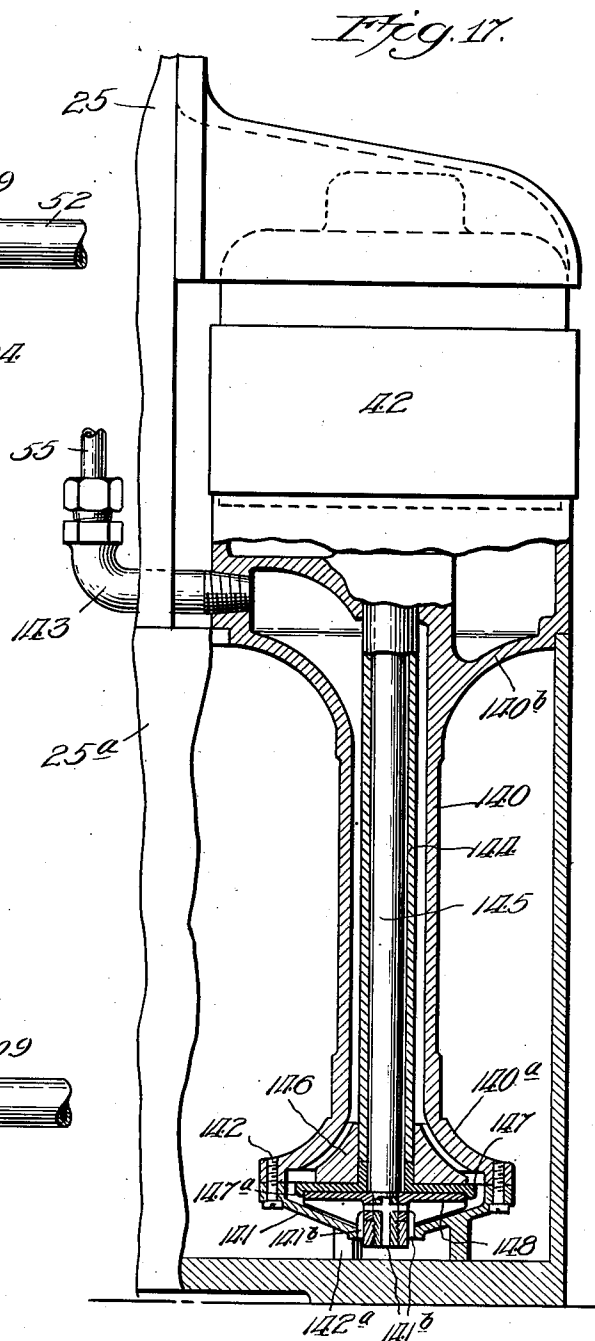
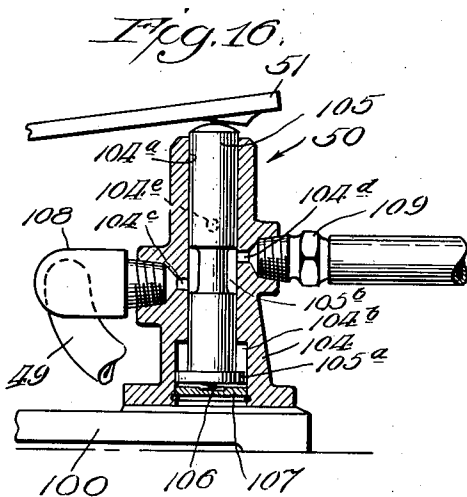
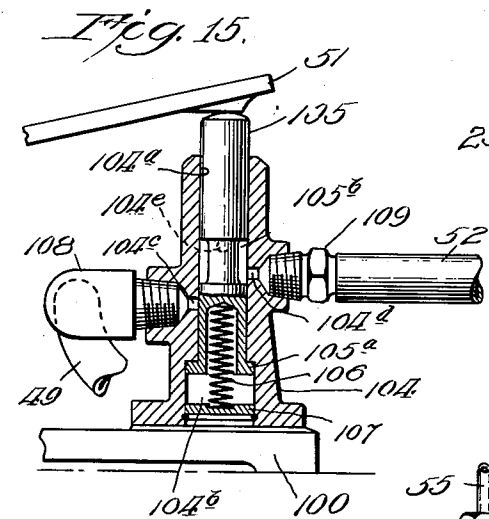
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10 Sheets-Sheet 9



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DRILLING MACHINE

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Fig. 18.

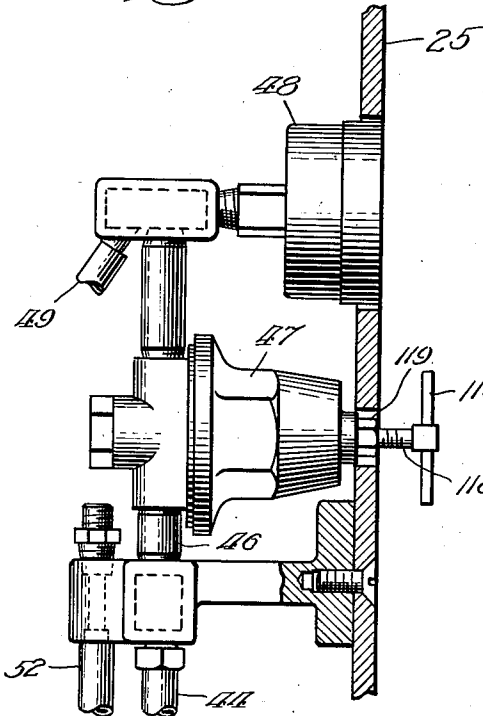


Fig. 19.

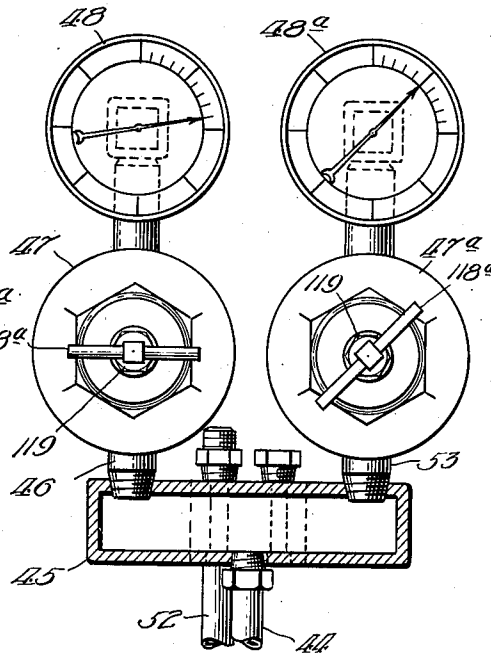


Fig. 20.

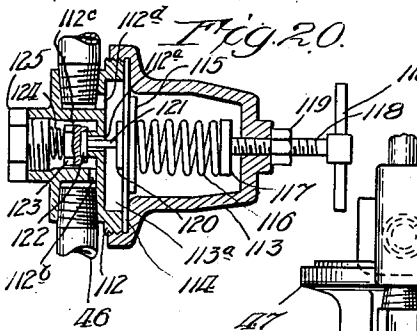
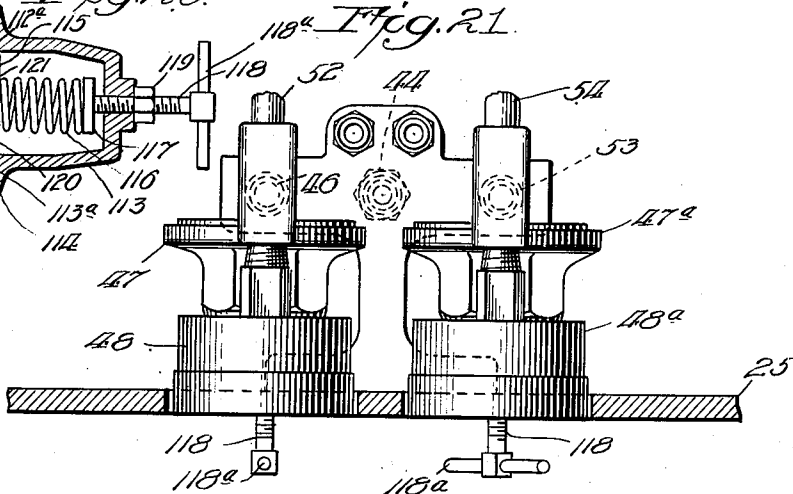


Fig. 21.



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UNITED STATES PATENT OFFICE

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DRILLING MACHINE

Herman Goldberg, Chicago, Ill.

Application March 13, 1940, Serial No. 323,648

5 Claims. (Cl. 77-32)

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This invention relates to improvements in drilling machines and the like and its purpose is to provide an improved machine in which the movements of the drill or other tool in an axial direction, toward and from and through the work are effected by fluid pressure.

In the operation of drilling machines of the types heretofore in general use, the most frequent causes of annoyance and expense have been the breakage of the drills and their tendency to become dull and unfit for use after limited periods of service. These difficulties have arisen largely from the fact that the drills have been caused to engage and penetrate the work by unyielding pressures of too great magnitude, giving rise to frequent breakage when the drills first engage the work and also when they first break through the work piece upon completion of the drilling operations. When the drilling of a hole through a piece of work is substantially completed and the tip of the drill is about to break through, the drill is momentarily supported by fragments of metal engaging the flutes at its sides and if the drill breaks through too rapidly and under too great a pressure, there is a tendency for frequent breakage.

The principal object of the present invention is to provide an improved drilling machine or the like in which the movements of the drill toward the work are effected by improved fluid pressure mechanism capable of being precisely adjusted so that the drill engages and penetrates the work with a yielding pressure which permits the axial movement of the drill to be arrested without damage in the event that any unusual resistance is encountered.

Another object of the invention is to provide an improved drilling machine comprising fluid pressure mechanism for moving the drill toward and through the work and including means for automatically retarding the movement of the drill as it is about to break through the work so that damage to the drill is prevented.

A further object of the invention is to provide an improved drilling machine comprising fluid pressure mechanism for moving the drill axially toward and from the work and for automatically stopping the movement of the drill when the drilling of the hole is completed.

Another object of the invention is to provide a drilling machine having fluid pressure mechanism for effecting axial movement of the drill and including a dash-pot for automatically retarding the axial movement of the drill at the end of its stroke.

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Other objects relate to various features of construction and arrangement which will appear more fully hereinafter.

The nature of the invention will be understood from the following specification taken with the accompanying drawings in which one embodiment of the invention is illustrated. In the drawings,

Figure 1 shows a front elevation of a drilling machine embodying the improvements of the present invention;

Fig. 2 shows a side elevation of the machine illustrated in Fig. 1, with a part of the casing broken away;

Fig. 3 is a somewhat diagrammatic view, with parts showing in section illustrating the fluid pressure connections to different parts of the apparatus for causing forward and reverse strokes of the drill and for operating the pump by which a cooling fluid is circulated to the point where the drilling operation takes place;

Fig. 4 shows an enlarged vertical section taken on the line 4-4 of Fig. 2;

Fig. 5 shows a vertical section taken on the line 5-5 of Fig. 4;

Fig. 6 shows a horizontal section taken on the line 6-6 of Fig. 5;

Fig. 7 is a vertical section taken on the line 7-7 of Fig. 6;

Fig. 8 shows an enlarged front elevation of the piston block and valve block of the machine with the cylinders which actuate the pressure platen by which the drill is carried, and the cylinder of the dash-pot mechanism, shown in section;

Fig. 9 shows a horizontal section taken on the line 9-9 of Fig. 8;

Fig. 10 shows a horizontal section taken on the line 10-10 of Fig. 5;

Fig. 11 shows a side elevation of the forward portion of the cylinder block and the drill actuating mechanism with a part of the valve block of the dash-pot mechanism broken away;

Fig. 12 shows a vertical section taken on the line 12-12 of Fig. 8, illustrating the plunger of the dash-pot mechanism in its lower position wherein it retards the movement of the drill at the end of its downward stroke;

Fig. 13 is a vertical section similar to that of Fig. 12 showing the lower part of the dash-pot mechanism when the plunger has been elevated;

Fig. 14 shows a horizontal section taken on the line 14-14 of Fig. 13;

Fig. 15 shows a vertical section through the cylinder of the foot operated valve by which the drilling strokes of the machine are controlled by

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the foot of the operator, this view showing the plunger of the valve in its upper position.

Fig. 16 is a sectional view similar to that of Fig. 15 showing the plunger of the valve depressed by the foot pedal;

Fig. 17 shows a partial side elevation and partial vertical section through a rotary pump by which cooling fluid is pumped to the place where the drill is operating;

Fig. 18 shows an enlarged side elevation of one of the pressure regulators and its connections for regulating the pressure of the fluid supplied to the cylinders by which the drill is moved;

Fig. 19 shows an enlarged front elevation of the pressure regulators and pressure gauges illustrated in Fig. 18;

Fig. 20 shows a detail sectional view through one of the pressure regulators; and

Fig. 21 shows a top plan view of the structure illustrated in Fig. 19.

The invention is illustrated in the drawings as being embodied in a drilling machine comprising a hollow casing 25 having an enlarged base portion 25^a adapted to be secured upon a floor or other support. The front of the casing 25 is provided with a vertical slotted guideway 25^b on which there is mounted a vertically adjustable bracket 26 formed integrally with a work table 27 on which the piece of work 28 to be drilled is adapted to be held or secured when the drilling operation is being performed. The bracket 26 and the table 27 are adapted to be adjusted vertically by a worm and worm wheel operated by a crank 29 and when the table 27 has reached the desired level, it is secured in adjusted position by a clamp 30. The piece of work 28 is adapted to be engaged by a drill 35 carried by a pressure platen 30 which, in turn, is actuated by fluid pressure mechanism carried by a cylinder block 37 which is secured to the face of the upper part 25^c of the housing 25. The piston block 37 has mounted on the front thereof a valve block 38 which carries the dashpot mechanism by which the downward stroke of the drill 35 is retarded and arrested. The upper end of the cylinder block 37 is closed by a pulley casing 39 which is secured to and also encloses the upper end of the housing 25. Within the upper portion 25^c of the housing 25 there is mounted an electric motor 40 which is connected to effect the rotation of the drill 35 through mechanism hereinafter described. The electric connections 41 for actuating the motor 40 are brought in through the rear wall of the casing 25 and these connections may also serve to supply current to another electric motor 42 which drives a pump 43 mounted in the base portion 25^a of the casing and adapted to pump oil or the like to the point where the drill 35 engages the work 28.

As shown in Fig. 3, a supply conduit 44 leads from an air compressor or other source of compressed fluid to a supply casing 45 from which a pipe 46 leads through a pressure regulator 47 to a gauge 48 adapted to indicate the pressure of the fluid on the discharge side of the regulator 47. From the pressure gauge 48 a supply pipe 49 leads downwardly to a foot operated valve 50 adapted to be actuated by the foot pedal 51. From the foot operated valve 50 a supply pipe 52 leads upwardly through the housing 25 to the valve block 38 by which the cylinder mechanism for effecting the downward movement of the drill 35 is controlled. The casing 45 also supplies compressed fluid through a pipe 53 to another pressure regulator 47^a which in turn is connected to

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a pressure gauge 48^a adapted to indicate the pressure on the discharge side of the regulator 47^a. From the gauge regulator 48^a, a supply pipe 54 leads to the cylinders of the cylinder block 37 for normally causing the pistons in these cylinders to occupy their upper positions corresponding to the retracted position of the drill 35. There is also shown in Fig. 3 a discharge pipe 55 leading from the pump 43 through a valve 56 to a nozzle 57 by which oil or the like is discharged upon the work 28 beneath the drill.

The foregoing description has been intended to give a general view of the principal parts of the machine before describing the details of any of these parts and reference will now be had to the driving connections between the motor 40 and the drill 35 which are best illustrated in Figs. 4 and 5. As there shown, the motor 40 is carried by a plate 58 which rests upon flanges 25^d formed on the upper end of the housing 25 and which is clamped in position on those flanges by studs 59 engaged by lock-nuts 60. By this arrangement, the motor may be shifted on the housing 25 in order to tighten the belt 61 which extends between a pulley 62, fixed upon the shaft 40^a of the motor, and another pulley 63 which is fixed upon a vertical pulley shaft 64. The pulleys 62 and 63 are constructed in the form of truncated cones, being provided with a series of oppositely disposed grooves 62^a and 63^a which are of different diameters, the larger grooves of each pulley being disposed opposite to the smaller grooves of the other pulley so that by shifting the belt 61 to different pairs of grooves the speed of the pulley shaft 64 may be varied to cause a corresponding variation in the speed of the drill 35. The shifting of the belt may be effected by moving the motor 40 on its supporting flanges 25^d, and then restoring the motor to the proper position.

As shown in Fig. 4, the pulley 63 is secured by a key 67 upon the upper end of the pulley shaft 64 and it is arranged to seat upon an annular shoulder 64^a formed on an enlargement of the shaft. The upper end of the shaft is threaded for engagement by a nut 68 which is adapted to seat in a recess formed in the upper end of the pulley 63 and which holds the pulley against endwise displacement on the shaft. The cylinder block 37 is provided at its upper end with a central bore 37^a in which the pulley shaft 64 is journaled through intermediate sealed ball bearing units 69. The upper end of the bore 37^a is closed by a cover plate 70 secured to the upper end of the cylinder block. The lower end of the pulley shaft 64 is threaded for engagement by a pair of lock nuts 71 which hold the pulley shaft against vertical displacement in its bearings. The cylinder block is secured to the face of the housing 25^c by studs 73, shown in Fig. 9, which pass through apertures in the cylinder block and engage threaded holes in the bosses 25^e which are formed on the upper end of the housing. The cylinder block is held against lateral displacement by a vertical key 74 engaging keyways in the cylinder block and in the housing and held against vertical displacement by a screw 75. In this manner, the cylinder block and the pulley shaft 64 are mounted in fixed positions and the shaft is adapted to be operated continuously, when the motor 40 is in operation, for driving a vertically adjustable drill spindle 77 which has a splined engagement with the lower end of the shaft 64 as shown at 64^b in Fig. 4.

The drill spindle 77 extends downwardly

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through the central tubular bore of a pressure platen 80 which is adapted to be actuated for moving the drill spindle 77 longitudinally and thereby moving the drill 35 toward and from the work. The pressure platen comprises an upwardly extending sleeve 80^a adapted to slide vertically in a bushing 81 mounted in the central bore 37^b of the cylinder block, and the drill spindle 77 is journaled in a ball bearing unit 82 secured in the intermediate part of the sleeve portion 80^a of the pressure platen. This ball bearing unit 82 seats against a shoulder at the end of the lower enlarged portion 77^a of the drill spindle and is held in position against that shoulder by a nut 83 engaging a threaded portion 77^b of the spindle 77. The pressure platen 80 is also provided with a downwardly extending sleeve 80^b and the lower part of the drill spindle 77 is journaled in another ball bearing unit 84 which is mounted in the lower end of the sleeve 80^b. The outer ring of this ball bearing unit seats against an annular inwardly extending flange 80^c formed on the surrounding sleeve and it is held in position against that flange by a nut 85 engaging the internal threads on the lower end of the sleeve, as illustrated in Fig. 4. An annular shoulder 77^d is formed on the lower end of the spindle 77 within the nut 85 and the inner ring of the ball bearing is clamped against this shoulder by nuts 86 engaging the threaded portion 77^e of the drill spindle. A standard drill chuck 88 is mounted upon the tapered lower end of the drill spindle for detachably securing in place, in axial alignment with the spindle, the previously described drill 35. A nut 89 is mounted on the threaded portion 77^f of the spindle and may be rotated to force the chuck off of the spindle when desired.

The pressure platen 80 is provided with two similar oppositely extending arms which are apertured for engagement by the reduced extremities 90^a of piston rods 90, nuts 91 being secured to the threaded extremities of the parts 90^a of the piston rods for securing the rods in fixed relation to the pressure platen. The piston rods 90 slidably engage cylinder heads 92 which are mounted in the lower ends of the cylinders 37^c which are formed in the cylinder block 37 at opposite sides of the central bore 37^b. At their upper ends, the piston rods 90 are secured to pistons 93 which have sliding fits within the cylinders 37^c. The upper ends of the cylinders 37^c are closed by detachable threaded plugs 94 and these plugs are accessible through the chambers 37^d which are formed in the upper end of the cylinder block and through which access may be had to the plugs 94 when the pulley casing 39 is removed. The pistons 93 are normally moved to their upper positions, shown in Fig. 4, by the action of compressed fluid admitted to the lower ends of the cylinders from the pipe 54, previously described, which, as shown in Fig. 10, is connected to branch pipes 54^a connected by threaded nipples 54^c with passages 37^e extending through the cylinder block 37 and communicating with the lower ends of the cylinders 37^c, as illustrated in Fig. 4. The upward movement of the pressure platen 80 is limited by the engagement of the annular shoulder 80^d of the pressure platen with the lower end of the cylinder block and when the pressure platen is in this upper position the pistons 93 are spaced slightly below the plugs 94 which are mounted in the upper ends of the cylinders 37^c.

In order to move the pistons 93 downwardly

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against the constantly acting pressure of the fluid admitted to the cylinders 37^c through the pipe 54, compressed fluid having a higher pressure is adapted to be admitted at intervals to the space between the pistons 93 and the plugs 94 at the upper ends of the cylinders and this fluid of a higher pressure is supplied through the previously described pipe 52, the flow through which is controlled by the foot operated pedal 50. The pipe 52 is connected to a coupling member 95, shown particularly in Fig. 6, which threadedly engages an opening 38^a formed in the valve block 38, previously referred to, which is secured by means of screws 96 upon the front face of the cylinder block 37, as shown in Fig. 7. The inner end of the opening 38^a communicates with a passage 38^b, shown in Fig. 6, which leads to a transverse passage 37^e formed in the face of the cylinder block 37 behind the block 38. This passage 37^e communicates with branch passages 37^f which lead to the upper ends of the cylinders 37^c so that when compressed fluid is admitted to the valve block 38 through the pipe 52 the pistons 93 are actuated to move the pressure platen 80 downwardly and thus carry the rotating drill 35 into engagement with the work 28. As the pistons 93 move downwardly the sleeve 80^a of the pressure platen slides in the bushing 81 and the drill spindle 77 slides downwardly within the pulley shaft 64 while maintaining its splined connection therewith.

The downward movement of the pistons 93 and the corresponding downward movement of the drill 35, brought about by the admission of compressed fluid to the upper ends of the cylinders 37^c, are controlled by the valve 50 which is operated by the foot pedal 51, shown particularly in Figs. 3, 15 and 16. The foot operated valve comprises a base 100 adapted to be secured to the floor or other support adjacent the base portion 25^a of the housing 25. This base plate has mounted thereon an upwardly extending pedestal 101 upon which the foot pedal 51 is pivoted to depending ears 51^a by a pivot pin 103. At the other end of the base plate 100, there is mounted an upwardly extending valve block 104 having formed therein a vertically extending cylindrical bore 104^a in which is mounted a cylindrical valve member 105. This valve member is provided with a rounded upper extremity on which the free end of the foot pedal 51 rests so that when pressure is exerted on the pedal the valve member is forced downwardly against the compression of a coil spring 106 which is seated in a recess in the lower end of the valve member and which has its lower end resting in a depression formed in a removable disk 107 detachably secured in the lower end of the enlarged chamber 104^b which communicates with the bore 104^a and which receives the annular flange 105^a formed on the lower end of the valve member. This spring 106 thus normally forces the valve member to its uppermost position, shown in Fig. 15, and thus causes the foot pedal 51 normally to occupy its uppermost position.

The valve block 104 is provided on opposite sides with two offset ports 104^c and 104^d, the first of which communicates through a coupling member 108 with the supply conduit 49 previously described, while the other port 104^d communicates through a coupling member 109 with the conduit 52 leading to the valve block 38. When the valve member 105 is forced downwardly by depressing the pedal 51, the two ports 104^c and 104^d are connected through the chamber formed

by the wide annular groove 105^b which is formed in the valve member 105. Thus, as long as the foot pedal 51 is depressed, there is a continuing supply of compressed fluid to the valve block 38 and to the cylinders 37^c for causing a downward movement of the pressure platen 80 and of the rotating drill 35. The valve block 104 of the foot operated valve is provided on its rear side with a port 104^c leading to the atmosphere from the bore 104^a and when the valve plunger 105 is in its uppermost position, shown in Fig. 15, the pipe 52 is adapted to communicate with this port through the annular groove 105^b of the valve plunger so that air in the cylinders 37^c is then permitted to exhaust to the atmosphere during the return upward strokes of the pistons 93 which are effected by the constant fluid pressure acting upon the undersides of those pistons and admitted to the lower ends of the cylinders 37^c from the pipe 54.

The conduit 49 which supplies compressed fluid to the foot operated valve 50 is in turn supplied with compressed fluid through the pressure gauge 48 from the pressure regulator 47 connected to the supply casing 45 by the pipe 46. This pressure regulator is illustrated particularly in Figs. 18, 19 and 20, and it is similar in construction to the other pressure regulator 47^a which is connected in the pipe 54 leading to the lower ends of the cylinders. These pressure regulators are mounted for convenience adjacent the upper part 25^b of the casing 25 and each pressure regulator comprises two casing elements 112 and 113, which have threaded engagement with each other and which are adapted to clamp between them a resilient diaphragm 114. A plate 115 is mounted on one side of the diaphragm and a coil spring 116 is mounted between this plate and a collar 117 which is mounted on one end of an adjusting screw 118. This adjusting screw threadedly engages the end of the casing 113 and has a handle 118^a which permits the screw to be turned to regulate the compression of the spring 116 and a lock nut 119 may be used to secure the screw 118 in adjusted position. In this manner, it is possible to regulate the initial compression of the spring 116 which must be overcome by the outward movement of the diaphragm 114 under the influence of the compressed air or other fluid which is admitted to the pressure regulator through the pipe 46 (or 53). A disk 120 is secured to the face of the diaphragm 114 and this disk is connected by a valve stem 121 with a valve member 122 which is adapted to control the admission of compressed fluid through the ports 112^a into the chamber 113^a adjacent the diaphragm. The valve member 122 carries a block 123 which is engaged at its opposite end by a coil spring 124 capable of being adjusted by a plug 125 having a threaded engagement with an aperture formed in the end of the casing 112. By adjusting this plug, the compression of the spring 124 may be varied to regulate the pressure with which it normally causes the valve member 122 to engage its seat around the ports 112^a. The compressed air or other fluid which is supplied through the pipe 46 (or 53) is admitted through a port 112^b to the chamber 112^c which is on the inlet side of the valve member 122. The back pressure of the fluid in the pipe 49 (or 54) communicates with the chamber 113^a adjacent the diaphragm through a port 112^d. When this back pressure, which is the pressure at which the compressed fluid is supplied to the foot operated valve 50, falls as a result of the flow of fluid to

the valve block 38, the diaphragm 114 is moved by the spring 116 with the result that the valve 122 opens the ports 112^a, thereby admitting additional compressed fluid from the supply pipe 46 to the chamber 113^a adjacent the diaphragm. The diaphragm is then moved against the compression of the spring 116, thereby causing the valve 122 to be moved again to its closed position. This additional supply of compressed fluid which is thus admitted to the chamber 113^a, passes through the pressure gauge 48 and the pipe 49 to the foot operated valve 50. By suitably adjusting the springs 116 and 124 of the pressure regulator, the frequency and extent of opening of the ports 112^a by the valve 122 may be regulated in order to maintain any desired pressure of the fluid supplied to the foot operated valve 50 and to the lower ends of the cylinders 37^c. These pressures may be conveniently indicated by the pressure gauges 48 and 48^a located immediately above the pressure regulators, as shown in Figs. 18 and 19. The pressure regulators and the gauges may preferably be mounted so that their front faces and operating handles, respectively, are revealed or accessible through openings in the front wall of the casing 25. The pressure regulator 47^a is always adjusted so that the pressure tending to return the pistons 93 to their upper positions will always be less than the pressure which is admitted to the upper ends of the cylinders 37^c for causing downward movements of these pistons against the pressure acting on the lower faces thereof. As the pistons 93 move downwardly, the air in the lower ends of the cylinders 37^c is further compressed, the amount of the compression increasing in degree as the end of the working stroke is approached, thus retarding the movement of the pistons and cushioning their movement at and near the end of the stroke. This further compression takes place even though there may be some leakage where the piston rods 90 pass through the heads 92 but the initial pressures are always so adjusted that there is never a balancing of the pressures on opposite sides of the pistons which are thus always able to complete their working strokes.

When the operator depresses the plunger of the foot operated valve 50 to cause compressed fluid to flow to the upper ends of the cylinders 37^c through the pipe 52 and its connecting passages, the downward movement of the pistons 93 and of the pressure platen 80 continues until the operator releases his pressure upon the foot pedal 51 or until the downward movement of the pressure platen is automatically retarded and eventually arrested by the dashpot mechanism heretofore referred to. This dashpot mechanism which is particularly illustrated in Figs. 5, 7, 8, 9, 10, 11, 12, 13 and 14, is carried by the valve block 38, previously referred to, comprises a cylinder 38^c formed in the valve block and having mounted in the lower part thereof a cylindrical cage-like member 130 comprising a cylindrical bottom portion 130^a connected by opposite upwardly extending webs 130^b, shown in Fig. 14, with a transverse portion 130^c from which a sleeve 130^d extends upwardly. The sleeve portion 130^d and the transverse part 130^c are provided with a cylindrical bore in which there is mounted a cylindrical dashpot plunger 131. The member 131 extends above the upper end of the sleeve 130^d and is provided at its upper end with an outwardly extending flange 131^a. A coil spring 132 is mounted around the sleeve 130^d and around

the upper end of the plunger 131 and it serves normally to maintain the plunger in its uppermost position, shown in Fig. 13, the upward movement of the plunger being limited by a transverse pin 133 mounted in the lower end thereof and adapted to engage the underside of the transverse portion 130^c. The cylinder 38^c is adapted to be partially filled with a body of oil 134 or other substantially incompressible fluid and the bottom portion 130^a of the member 130 is provided with a well 130^e, the outer annular wall 130^f of which is enlarged toward its upper end to a slight extent. When the dashpot plunger 131 moves downwardly from the position shown in Fig. 13 to the position shown in Fig. 12, it is adapted to enter the well 130^e and thus can trap a part of the oil which is contained therein. A part of the oil is adapted to pass out around the lower end of the plunger but, as the plunger continues its downward movement, the fit between the plunger and the annular wall 130^f becomes increasingly tighter and the plunger 131 is eventually brought to rest.

In order to make use of the above described action of the dashpot plunger 131 for retarding the downward movement of the pressure platen 80 and eventually arresting that movement, connections are provided for causing the plunger 131 to be moved downwardly by the pressure platen as it nears the predetermined lower limit of its stroke. For this purpose, there is provided a vertically slidable actuating rod 135 having an enlarged cylindrical upper portion 135^a, shown in Fig. 7, which is mounted to slide in a cylindrical bore 38^d formed in the valve block 38. The upper end of the enlarged portion 135^a has a transverse arm 135^b, shown particularly in Fig. 9, which extends over the upper end of a cup-shaped cap member 136 which is mounted in inverted position over the upper end of the dashpot plunger 131, as shown in Fig. 12. When a downward pull is exerted upon the rod 135, the dashpot plunger 131 is forced downwardly against the compression of the spring 132 to cause the lower end of the plunger to entrap the oil in the well 130^e. When the rod 135 is moved upwardly, the plunger 131 is permitted to return to its normal upper position, shown in Fig. 12, by the action of the spring 132.

The rod 135 slidably engages an aperture in a sleeve 80^e which is carried by a flange 80^f projecting outwardly from the pressure platen 80, as shown particularly in Fig. 5. A collar 137 is secured by a set screw 138 on the rod 135 in such a position that when the pressure platen reaches its uppermost position the sleeve 80^e will engage the collar 137 and thus restore the rod 135 to its uppermost position independently of the action of the coil spring 132 in the dashpot cylinder. The lower part of the rod 135 is threaded as shown at 135^c and this threaded portion is engaged by a pair of nuts 139 which may be secured in adjusted position thereon so that as the rotating drill 35 reaches a position where it is about to emerge from the hole being drilled through the work, the sleeve 80^e will engage the uppermost nut 139 and thus move the rod 135 downwardly so that the dashpot plunger 131 will trap a part of the oil in the well 130^e at the bottom of the dashpot cylinder and thus slow up the movement of the rotating drill in the final stage of its downward movement until, eventually, the drill will be brought to rest when the hole is completely formed. The operator, observing this retardation of the movement of the drill, will then

release his pressure upon the foot pedal 51 so that the air acting upon the upper sides of the pistons 93 will be permitted to exhaust through the foot operated valve 50, as previously described, and the pressure acting upon the undersides of the pistons 93 will then function to return the pistons, the pressure platen and the drill 35 to their uppermost positions. The same operation may then be repeated any number of times upon different parts of the same piece of work or upon different pieces of work by again depressing the foot pedal 51 and causing repeated downward movements of the rotating drill 35.

In order to facilitate the drilling of holes by the drill 35 without injury thereto, a quantity of cutting oil is preferably applied to the surface of the work 28 at the point where the drilling operation occurs through the nozzle 57 heretofore referred to. The construction of the motor operated pump 43, by which this cutting oil circulation is effected, is shown in Fig. 17 where it is illustrated as comprising a tubular casing 140 mounted in the well in the bottom of the pump casing 25. This casing is enlarged at its lower end, as shown at 140^a, for engagement by a face plate 141 which is secured thereto by screws 142. At its upper end the casing 140 is enlarged as shown at 140^b to receive the lower end of the casing of the motor 42 and to form a connection by means of an elbow 143 with the previously described pipe 55 by which the oil is conveyed to the discharge nozzle. Mounted within and spaced inwardly from the upright tubular portion 140 of the pump casing there is an elongated sleeve 144 having located therein an impeller shaft 145 which is driven by the shaft of the motor 42. The lower end of the sleeve 144 is spaced inwardly from the enlarged portion 140^a of the pump casing by a perforated bracket or web 146 which carries on its underside a horizontal disk 147 provided with a depending annular flange 147^a within which there is mounted the rotatable impeller 148 secured upon the lower end of the shaft 145. The face plate 141 is spaced upwardly from the bottom of the well in the housing 25 by the feet 142^a which are formed thereon and when the impeller 148 is rotated, oil is adapted to be drawn into the ports 141^b. This oil is directed outwardly by the vanes of the impeller and discharged upwardly around the outer edge of the disk 147 and thence upwardly through the openings of the bracket 146 and between the casing 140 and the sleeve 144 to the upper enlarged portion 140^b of the pump casing where it flows outwardly through the connecting member 143. The work table 27 of the machine is constructed with a drain channel around its outer edge so that the oil discharged by the the nozzle 57 may be directed back to the well in the bottom of the housing 25.

Although one form of the invention has been shown and described by way of illustration, it will be understood that it may be constructed in various other embodiments coming within the scope of the appended claims.

I claim:

1. The combination in a machine of the class described, of a cylinder block, a pressure platen slidably mounted in said block, a rotatable tool carried by said pressure platen, said block having a cylinder formed therein, a piston mounted in said cylinder and connected to said pressure platen, means for admitting compressed air to said cylinder to move said pressure platen and said tool along the axis of said tool toward the

work, dashpot mechanism carried by said cylinder block, an actuating member associated with said dashpot mechanism, and means carried by said pressure platen for operating said actuating member to cause said dashpot mechanism to retard and then arrest the movement of said pressure platen when said tool reaches the end of its stroke.

2. The combination in a machine of the class described, of a cylinder block, a pressure platen slidably mounted in said block, a rotatable tool carried by said pressure platen, said block having a cylinder formed therein, a piston mounted in said cylinder and connected to said pressure platen, means for admitting compressed air to said cylinder to move said pressure platen and said tool along the axis of said tool toward the work, dashpot mechanism carried by said cylinder block, an actuating member associated with said dashpot mechanism, means carried by said pressure platen for operating said actuating member to cause said dashpot mechanism to retard and then arrest the movement of said pressure platen when said tool reaches a predetermined position, means carried by said actuating member for co-operating with said last named means to restore said dashpot mechanism to its initial position upon movement of said pressure platen away from the work, and means for moving said pressure platen away from the work.

3. The combination in a machine of the class described, of a block having a cylinder formed therein, a piston mounted in said cylinder, a pressure platen slidably mounted in said block and connected to said piston, a rotatable tool carried by said pressure platen, means for rotating said tool in all positions of said pressure platen with respect to said block, a work holder, means for admitting compressed fluid to said cylinder to cause said pressure platen to assume normally a position withdrawn from said work, means for admitting compressed fluid to said cylinder to cause said pressure platen and said tool to move along the axis of said tool toward said work holder, a valve block carried by said cylinder block and having a dashpot cylinder formed therein, a dashpot plunger mounted in said last named cylinder, a rod slidably mounted in said valve block and having a part adapted to actuate said plunger, an adjustable stop mounted

on said rod, and means movable with said pressure platen for engaging said stop member to cause the actuation of said plunger by said rod.

4. The combination in a machine of the class described, of a rotatable tool, means for rotating said tool, means for moving said tool axially toward and through the work during its rotation, a block mounted adjacent the path of movement of said tool and having a downwardly tapered recess therein adapted to contain a quantity of liquid, a plunger slidably mounted in said block and having a lower end adapted to fit said tapered recess after it has been partially inserted therein, means tending normally to force said plunger upwardly, and actuating means operatively connected with said plunger for moving it downwardly to engage said recess after a predetermined axial movement of said tool into the work.

5. The combination in a machine of the class described, of a rotatable tool, means for rotating said tool, means for moving said tool axially, and means actuated by said axial movement of said tool for gradually trapping a quantity of liquid while permitting a part of said liquid to escape through a passage of progressively decreasing area after said tool reaches a predetermined position, thereby progressively retarding and then arresting said movement of said tool.

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