May 31, 1932. W. W. SMITH 1,861,099

MULTIPLE DRILLING MECHANISM

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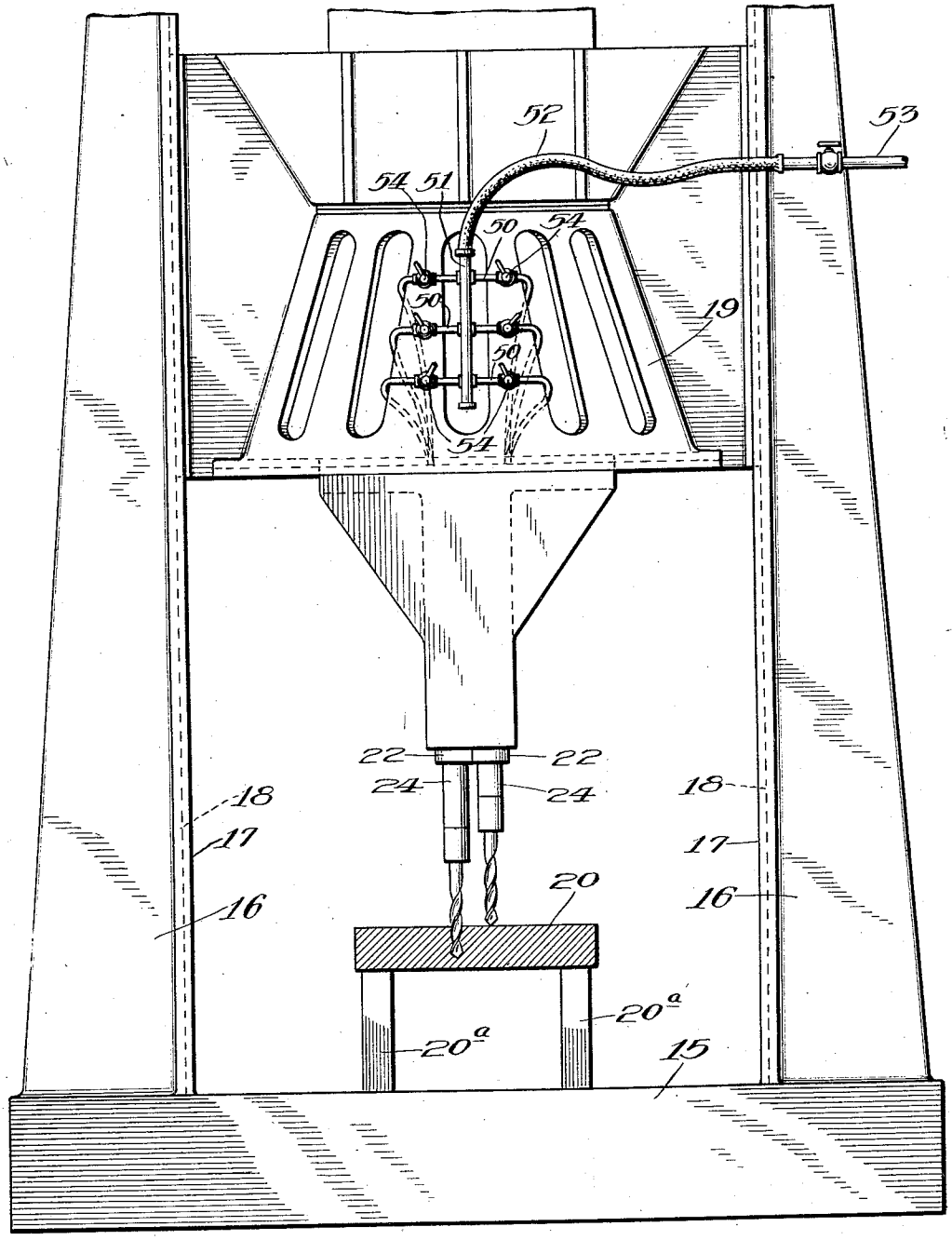

Fig. 1.

Inventor:
Wallace W. Smith,
By Dyrenforth, Lee, Chilton and Wiles
Attys.

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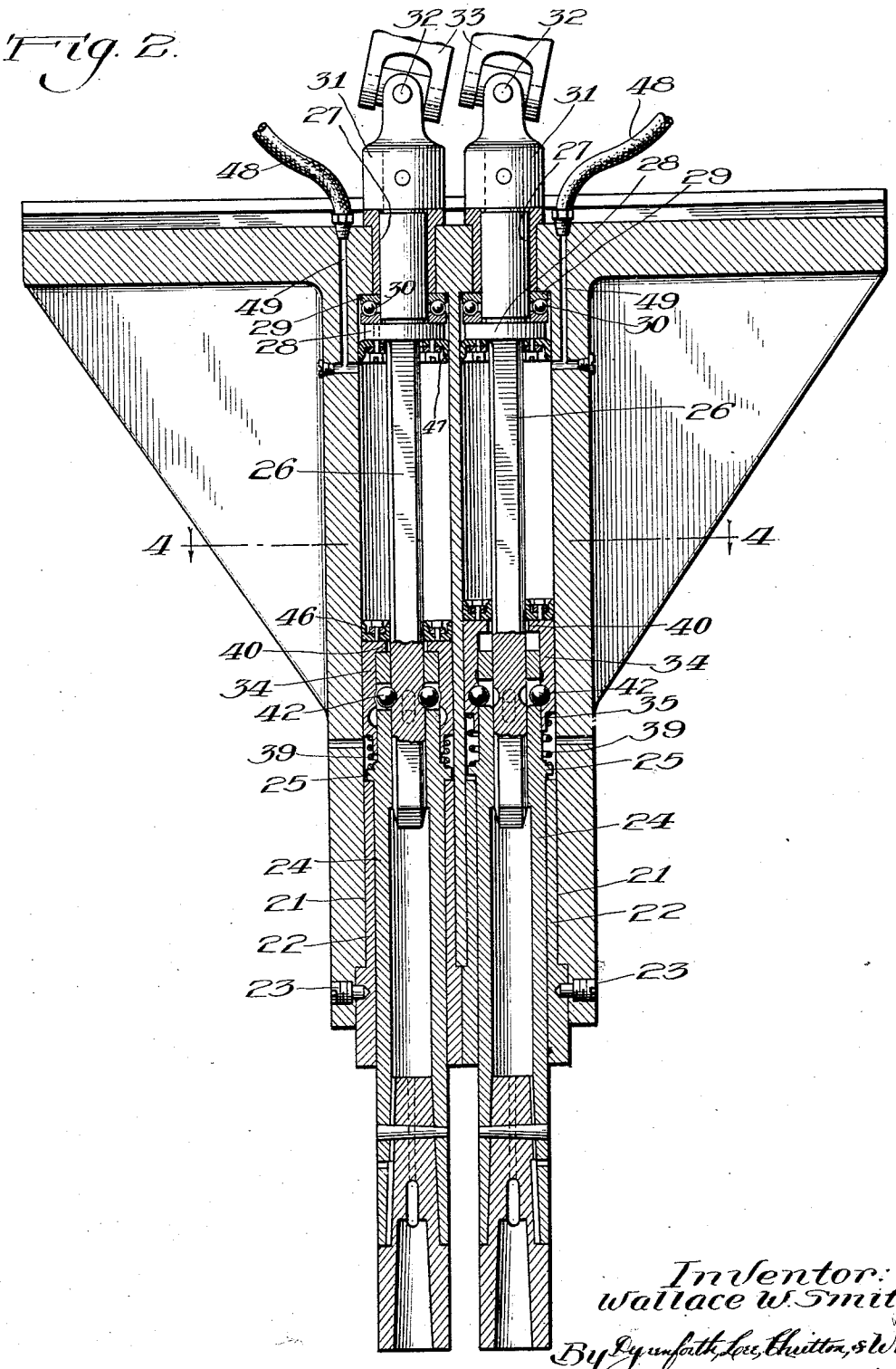
Fig. 2.



Inventor:
Wallace W. Smith,
By Dyrenforth, Lee, Chritton & Wilson
Attys

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Fig. 3.

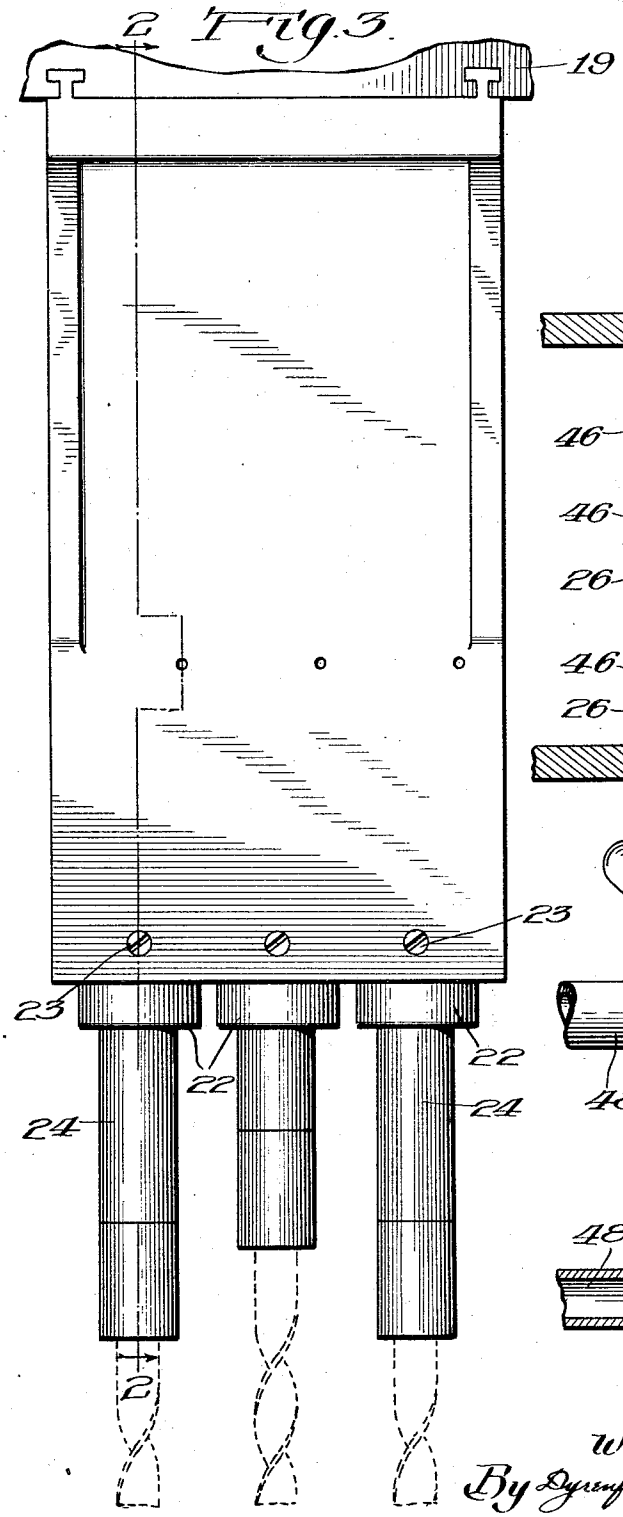


Fig. 4.

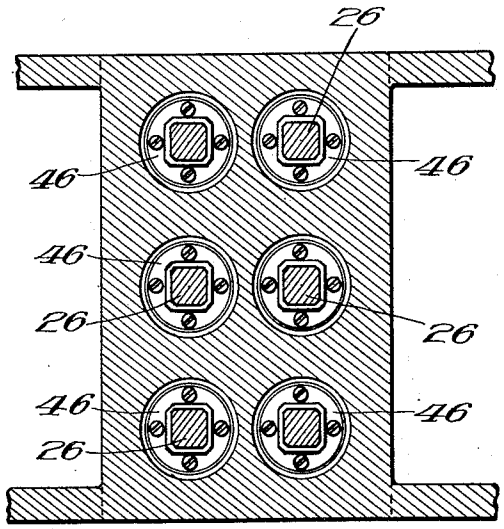


Fig. 5.

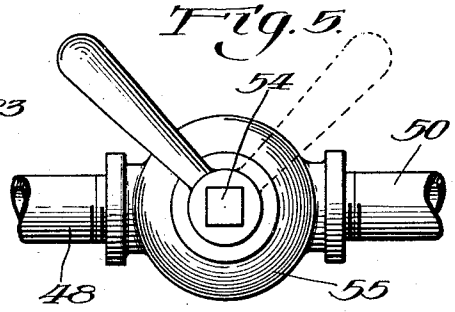
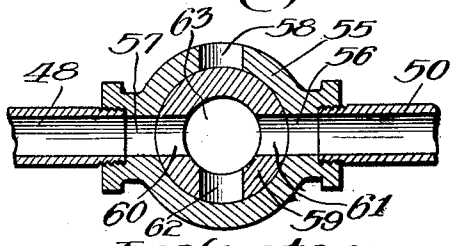


Fig. 6.



Inventor:
Wallace W. Smith,
By Dyrenforth, Lee, Chritton & Wiles,
Attys

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Fig. 7.

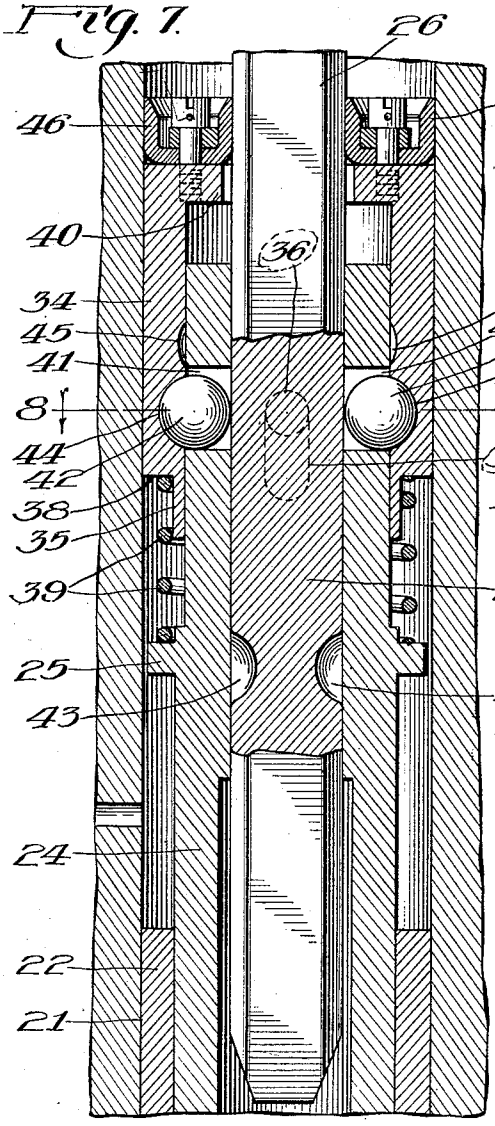


Fig. 9.

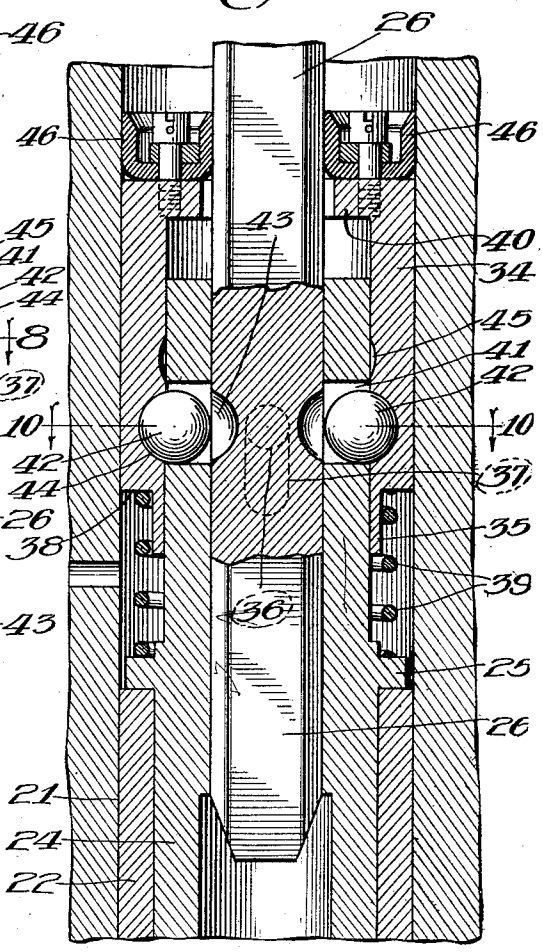


Fig. 10.

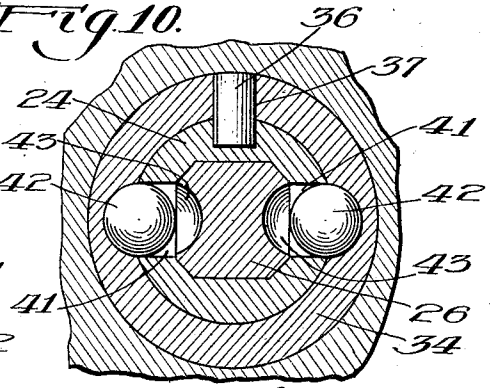
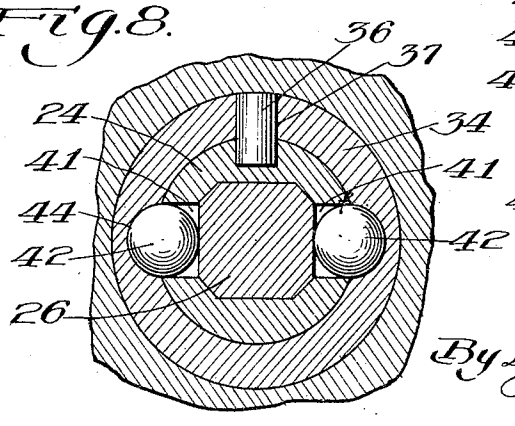


Fig. 8.



Inventor:
Wallace W. Smith
By Dyrenforth, Lee, Chritton & Wiles,
Attys

MULTIPLE DRILLING MECHANISM

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Fig. 11.

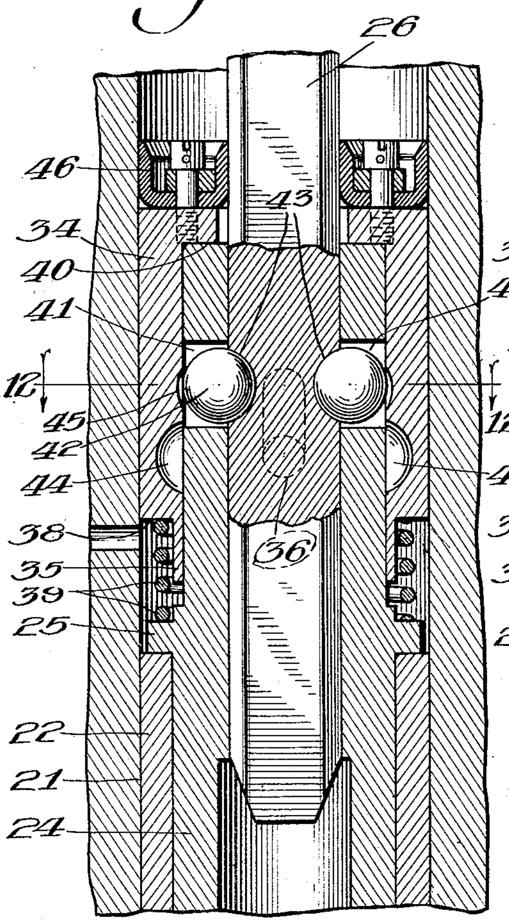


Fig. 13.

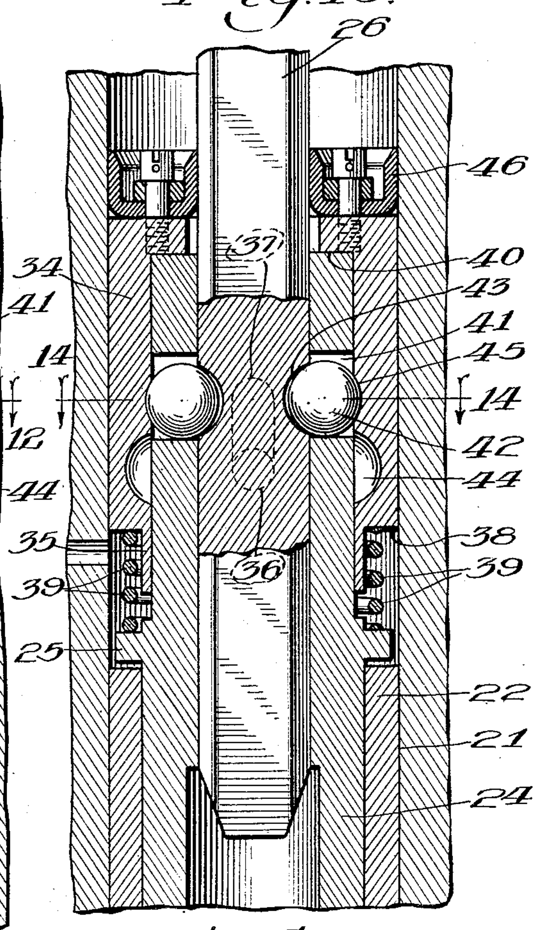


Fig. 12.

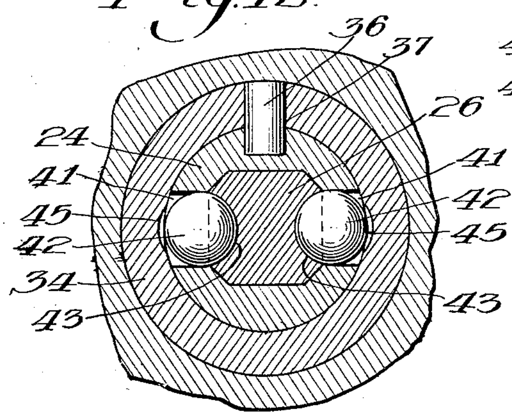
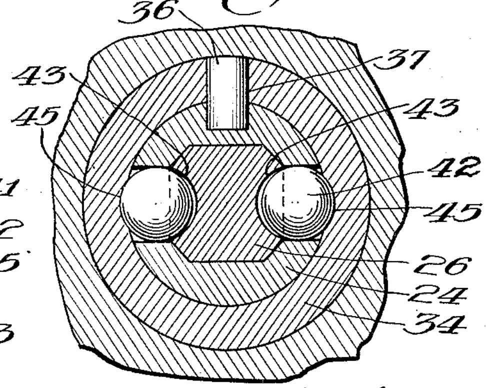


Fig. 14.



Inventor:
Wallace W. Smith
By Dyrenforth, Lee, Chritton & Wiles
Att'ys

Patented May 31, 1932

1,861,099

UNITED STATES PATENT OFFICE

WALLACE W. SMITH, OF CHICAGO, ILLINOIS

MULTIPLE DRILLING MECHANISM

Application filed January 25, 1930. Serial No. 423,439.

My invention relates to multiple drilling mechanism and more particularly to drilling mechanism comprising means whereby selected ones of a gang of drills may be caused to operate and the others thereof be rendered inactive for drilling.

One of my objects is to provide novel, simple, and positively operating mechanism of the general character above referred to; and other objects as will appear from the following description.

Referring to the accompanying drawings:

Figure 1 is a view in front elevation of a drilling machine embodying my invention.

Figure 2 is an enlarged view in vertical sectional elevation of the reciprocable drill-carrying head of the machine.

Figure 3 is a view in side elevation of the head of Fig. 2.

Figure 4 is a section taken at the line 4—4 on Fig. 2, and viewed in the direction of the arrows.

Figure 5 is a view in elevation of one of the plurality of valve devices forming elements of the machine.

Figure 6 is a longitudinal sectional view of the valve device of Fig. 5.

Figure 7 is an enlarged broken longitudinal sectional view of one of the similar drill-holding mechanisms showing it in retracted position.

Figure 8 is a section taken at the line 8—8 on Fig. 7 and viewed in the direction of the arrow.

Figure 9 is a view like Fig. 7 showing the mechanism illustrated therein in a position it assumes after advancing the drill-holding spindle thereon, in the head to operative position under the action of fluid pressure supplied thereto, but before such fluid pressure has conditioned the clutch mechanism in operative position.

Figure 10 is a section taken at the line 10—10 on Fig. 9 and viewed in the direction of the arrow.

Figure 11 is a view like Fig. 9 showing the mechanism illustrated therein in a position assumed by it after the fluid pressure has conditioned the clutch mechanism for operation.

Figure 12 is a section taken at the line 12—12 on Fig. 11 and viewed in the direction of the arrows.

Figure 13 is a view like Fig. 7 showing the mechanism illustrated therein in the position assumed by it when the drill associated therewith is drilling; and

Figure 14, a section taken at the line 14—14 on Fig. 13 and viewed in the direction of the arrows.

I have illustrated my invention as embodied in a conventional drilling machine wherein 15 is a solid base member from which rises horizontally spaced upright frame members 16 formed along their inner, oppositely facing, sides 17 with guide grooves 18 in which a drill-carrying head represented at 19, is vertically reciprocable, the head 19 being associated with any suitable means (not shown) for reciprocating it toward and away from the work represented at 20 and supported on spaced apart uprights 20^a mounted on the base 15 in accordance with common practice.

The head 19, shown as adapted to carry six drills forming a gang thereof, but the number of which may be increased or decreased, as desired, is bored to present stepped bores 21 corresponding in number to the number of drills to be supported in the head.

In the lower portions of the bores 21 are bushings 22 held in place by screws 23, and slidable and rotatable in the bushings 22 are the tubular lower sections 24 of drill-holding rotatable spindles provided between their upper and lower ends with exterior annular flanges 25 which oppose the upper ends of the respective bushings 22.

Telescoped with the upper ends of the spindle sections 24 are solid spindle sections 26, the sections 24 being slidable on the sections 26 and having interlocked driving connection therewith, as by forming the upper portions of the interior walls of the spindle sections 24 of hexagon shape in cross section and the spindle sections 26 of corresponding shape in cross section.

The upper ends of the spindle sections 26 are journalled in bushings 27 positioned in

the upper ends of the bores 21, the spindle sections 26 being provided, below the bushings 27, with annular flanges 28 between which and the adjacent stepped portions 29 of the bores 21, end-thrust-resisting ball bearings 30 are confined.

The spindles thus formed are connected with any suitable means for rotating them such as those illustrated in part and of a common and well known construction, the means shown comprising heads 31 on the upper ends of the spindle sections 26 to which are pivoted at 32 driving elements 33 which in practice would be rotated from any suitable source of power; the heads 31 opposing the upper ends of the bushings 27 and, together with the flanges 28 on the sections 26, preventing vertical movement of these spindle sections in the bushings 27.

Surrounding the upper ends of the spindle sections 24 and slidable therealong are sleeves 34 the lower portions of which are of reduced diameter as represented at 35, pins 36 extending laterally from the spindle sections 26 and into elongated slots 37 in the sleeves 34 limiting upward movement of the sleeves.

Surrounding the reduced portions 35 of the sleeves 34 and confined between the flanges 25 on the spindle sections 24 and shouldered portions 38 of the sleeves 34 are coil springs 39 which tend to hold the sleeves in the elevated position relative to the spindle sections 24 as shown in Fig. 9.

The sleeves 34 are provided at their upper ends with inwardly extending flanges 40 at which the sleeves lap the upper ends of the sections 24 whereby downward movement of the sleeves 34 relative to the sections 24 and against the resistance of the springs 39, is limited.

The spindle sections 24 adjacent their upper ends contains a circumferential series of openings 41 forming pockets in which balls 42 of a greater diameter than the thickness of the walls of the sections 24 and preferably of less diameter than the height of the openings 41, are located, the spindle sections 26 containing a series of shallow pockets 43 of general spherical shape which radially aline with the openings 41 and extend centrally thereof, when the spindle sections 24 are moved downwardly on the spindle sections 26 as hereinafter described, to a position in which the spindle sections 24 seat at their flanges 25 against the upper ends of the bushings 22.

The sleeves 34 contain about their interior surfaces a lower annular series of spherical shallow pockets 44 and an upper annular series of much shallower spherical pockets 45, the pockets 44 radially alining with the openings 41 in the spindle sections 24 when the sleeves 34 are in their maximum elevated position relative to the spindle sections 24 on which they are slidable (Figs. 7 and 9) and the pockets 45 radially alining with, and extending centrally of, the openings 41 when the sleeves 34 occupy the position relative to the spindle sections 24 with which they cooperate, as represented in Fig. 13.

It may be here stated that the projecting of the spindle sections 24 and sleeves 34 downwardly, is effected by fluid pressure, under control as hereinafter described, supplied against the upper ends of the sleeves 34, the fluid pressure being introduced into the spaces defined by the walls of the bores 21, the sleeves 34 which are provided with gaskets 46 to avoid leakage of fluid pressure, and gaskets 47 secured to the undersides of the flanges 28.

A description of the operation of the mechanism above described is as follows: The normal position of the sleeves 34 relative to the spindle sections 24 when not subjected to fluid pressure is that illustrated of the drilling unit at the hight-hand side of Fig. 2 and in Figs. 7 and 9, the sleeves in this position being raised to a position in which the flanges 40 are out of contact with the adjacent ends of the spindle sections 24 and the springs 39 are in extended position, the pockets 44 in the sleeves 34 being in radial alinement with the openings 41 in the spindle sections 24. Upon applying fluid pressure to the upper end of the sleeves 34 the latter are moved relative to the spindle sections 24 to the position shown of the one drilling unit at the left-hand side of Fig. 2 and as shown in Figs. 11 and 13 in which position of the sleeves the shallow pockets 45 thereof are in radial alinement with the openings 41 in the spindle sections 24 and the springs 39 are compressed.

Assuming the spindle section 24 together with its sleeve 34 is in the withdrawn position illustrated in Fig. 7 and atmospheric pressure exists in the space above the bushing, the introduction of fluid pressure into this space causes the sleeve, together with the spindle section 24, to move outwardly in the bore 21, the spindle section 24 sliding on the spindle section 26. In this position of the parts the balls 42 which are located in the openings 41 and in the pockets 44 roll along the spindle section 26. These parts continue their outward movement, as a unit, until the spindle section 24 engages at its flange 25 with the upper end of the bushing 22 in which it is slidable, as shown in Fig. 9, and in which position the openings 41 in the spindle section 24 become radially alined with the pockets 43 in the spindle section 26. When this occurs the outward movement of the spindle section 24 is arrested, but the sleeve 34 is free to continue its outward movement against the resistance of the spring 39 until checked in the position shown in Fig. 11. In the movement of the sleeve 34 relative to the spindle section 24, as stated, the pockets 44 are moved out of radial alinement with the openings 41

in the spindle section 24 and the pockets 45 become radially alined with these openings and thus with the pockets 43 in the spindle section 26.

The drilling unit having thus been positioned in the head it is conditioned to perform the drilling operation.

In the advancing of the head 19 toward the work, the engagement of the rotating drill with the work presents resistance to the free movement of the drill with the head and thus the head in advancing toward the work directs a force against the balls 42 tending to force them radially outwardly from the pockets 43 but inasmuch, however, as the balls, in this position of the sleeve 34 relative to the spindle section 24, are confined against movement out of the pockets 43 the spindle sections 24 and 26 are thus interlocked against relative longitudinal movement and the drill is moved in the work as a unit with the head.

So long as the drill continues to press against the work the ball interlock above described is maintained regardless of the continuing of the supplying of fluid pressure to the space above the sleeve 34. However, upon the release of the fluid pressure above the sleeve 34 when the drill is not engaging the work, the spring 39 is free to expand, causing the sleeve to slide inwardly along the spindle section 24 to the position shown in Fig. 9, which frees the spindle sections of the ball interlocking action as above described whereupon the spindle section 26 is free to move with the head 19 along the spindle section 24.

A drilling unit having concluded its drilling operation in which it remains in the position to which it was projected, this drilling unit may be rendered inactive in the next advancing movement of the head 19, by relieving the space above the sleeve 34 of fluid pressure, the result of which is to permit the sleeve 34 to resume the position shown in Fig. 9 thereby releasing the ball clutching action whereupon the spindle section 26 may advance with the head without exerting a force against the spindle section 24 sufficient to cause the drill carried thereby to drill the work.

Thus any selected one or ones of the various drilling units provided may be selectively conditioned for drilling merely by controlling the supplying of fluid pressure to these drilling units.

In the arrangement shown I have illustrated a system of valve-equipped piping whereby fluid pressure may be supplied to, and exhausted from, the various drilling units as desired. This piping comprises flexible pipes 48, one for each drilling unit which open into passages 49 in the head 19 leading to the respective spaces between the gaskets 46 and 47. The pipes 48 connect with the branch pipes 50 of a manifold 51 rigidly secured to the head 19 and connected, through a flexible pipe section 52, with a pipe 53 leading to any suitable source of fluid pressure, as for example, and preferably, compressed air.

Each branch pipe 50 is provided with a three-way valve 54 which operates when in one position to direct the fluid pressure from the manifold 51 into the pipe 48 associated therewith, and when in another position to interrupt communication between this pipe and open the pipe 48 to the atmosphere for venting the fluid pressure from the drilling unit with which it is associated.

In Figs. 5 and 6 I have shown a desirable construction of such a valve, the valve comprising a casing 55 having three ports 56, 57 and 58 spaced 90° apart, the ports 56 and 57 opening into the pipes 50 and 48, respectively. The valve proper, which is of the rotary type, is represented at 59, this valve containing three ports 60, 61 and 62, spaced 90° apart, and opening into a central chamber 63. In the position of the valve shown in Figs. 5 and 6, the ports 60 and 61 aline with the ports 57 and 56, respectively, and the port 62 extends opposite a closed portion of the casing 55, whereby air pressure is supplied from the pipe 50 to the pipe 48. When the valve proper 59 is rotated 90° in clockwise direction in Fig. 5 to the dotted line position shown therein, the port 61 extends opposite a closed portion of the casing 55 and the ports 60 and 62 register, respectively, with the ports 57 and 58, whereby the fluid pressure previously introduced into the drilling unit connected with the pipe 58 is free to vent therefrom through the port 58 in the casing 55.

It will be understood from the foregoing that the operator may condition any one or more of the drilling units for drilling holes in the work, merely by adjusting such of the valves as are associated with the particular selected spindle units, to direct fluid pressure into these units and maintain it therein until the drills of these selected units start drilling. If in the feed movement of the head 19 toward the work any of the drilling units not selected for operation extend into projected position relative to the head and thus into a position where they engage the work, the rotating drills of these units will not produce any drilling but will remain stationary so far as longitudinal movement thereof is concerned, while the head 19 continues to advance and effect drilling by the selected drilling units.

It will also be understood from the foregoing that as soon as the drill of any selected drilling unit starts to drill the ball clutch of this particular drilling unit becomes automatically positioned to prevent the movement of the spindle section 26 in a direction

lengthwise relative to its cooperating spindle section 24 whereby these spindle sections advance as a unit. Thus as soon as the selected drill starts to drill the supplying of fluid pressure thereto is no longer necessary to complete the drilling operation. This is of advantage as it permits the operator, while the drilling operation is being performed, to condition the mechanism for the desired selected drilling in the next drilling operation.

It will be noted that in the position of the parts represented in Fig. 13 the portion of the sleeve 34 which opposes the balls 42 forms an abutment against which the balls press outwardly in their effort to leave the pockets 43 in the spindle section 26 during the drilling operation, the slight pockets 44 being provided to positively prevent the sleeve 34 from moving, under the action of the spring 39 in expanding should the operator vent the fluid pressure from this particular drilling unit during the drilling operation, to a position in which the pockets 44 register with the balls 42 which would result in the unclutching of the spindle sections 24 and 26.

While I have illustrated and described a particular construction embodying my invention, I do not wish to be understood as intending to limit it thereto as the same may be variously modified and altered without departing from the spirit of my invention.

I claim:

1. In a construction of the character set forth, the combination of a movable holder, a drill-rotating spindle formed of a drive section movable with said holder and a driven section driven by said drive section, said sections being relatively slidable, one of said sections containing an aperture and the other thereof a recess, a clutch member in the form of a ball located in said aperture and in one position of said driven section extending into said recess, and a sleeve slidable on said driven section and containing a recess which in the normal position of said sleeve relative to said driven section registers with said aperture and with the latter receives said ball to render it non-interlocking with said drive section, means for yieldingly holding said sleeve in normal position, said holder containing a recess in which said sections and sleeve are located, and means for directing fluid pressure against said sleeve to move it out of normal position.

2. In a construction of the character set forth, the combination of a movable holder, a drill-rotating spindle formed of a drive section movable with said holder and a driven section driven by said drive section, said sections being relatively slidable, one of said sections containing an aperture and the other thereof a recess, a clutch member in the form of a ball located in said aperture and in one position of said driven section extending into said recess, and a sleeve slidable on said driven member and containing recesses disposed along the length of said sleeve, one of said recesses in the normal position of said sleeve relative to said driven member registering with said aperture and with the latter receiving said ball to render it non-interlocking with said drive section and the other of said recesses being relatively shallow and receiving said ball when said sleeve is advanced to lock said ball to said drive section, means for yieldingly holding said sleeve in normal position, said holder containing a recess in which said sections and sleeve are located, and means for directing fluid pressure against said sleeve to move it out of normal position.

WALLACE W. SMITH.