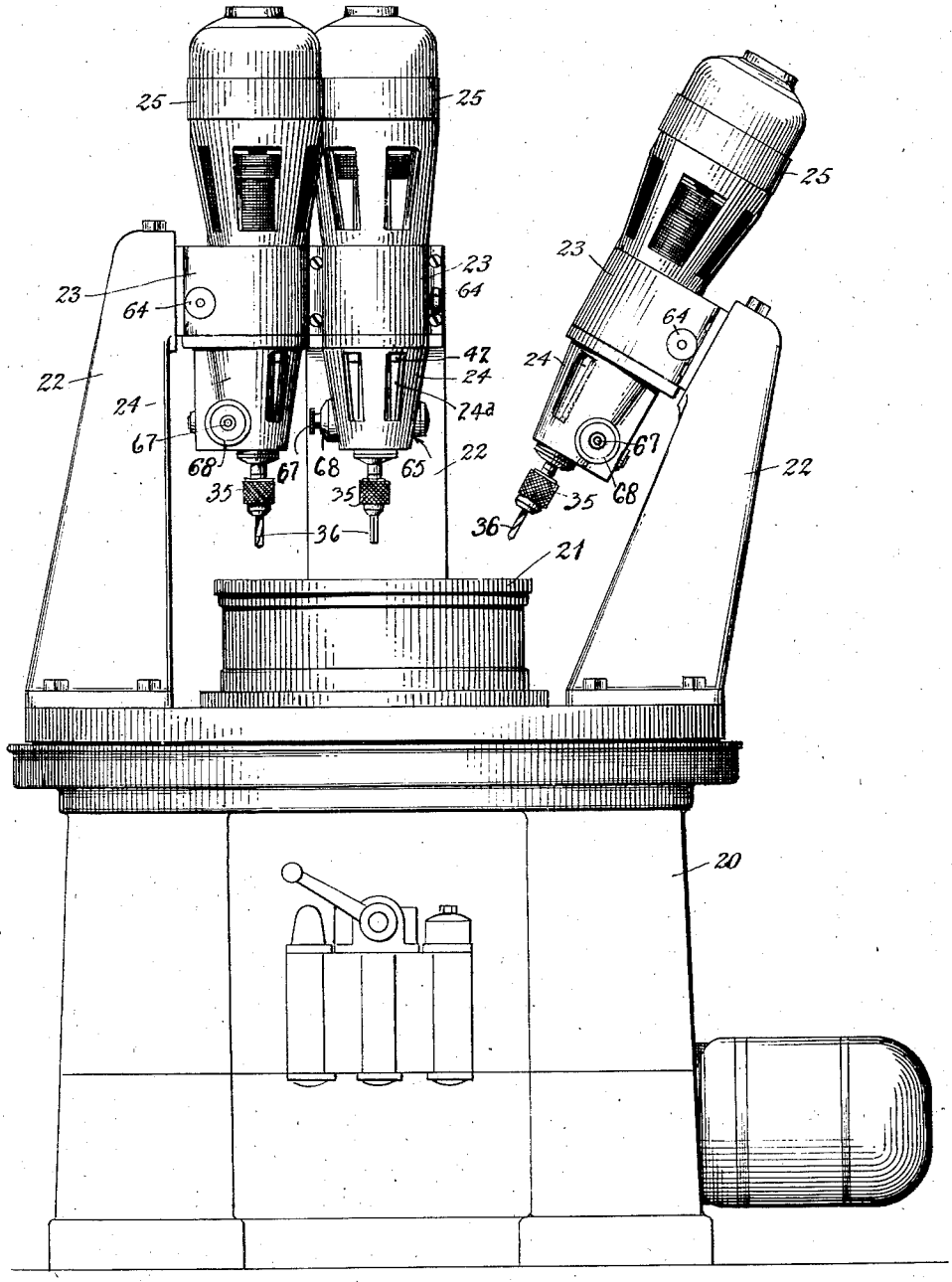
Nov. 16, 1948. E. J. TOMEK 2,454,235

DRILLING MACHINE

Filed Oct. 19, 1943 4 Sheets-Sheet 1

Fig. 1

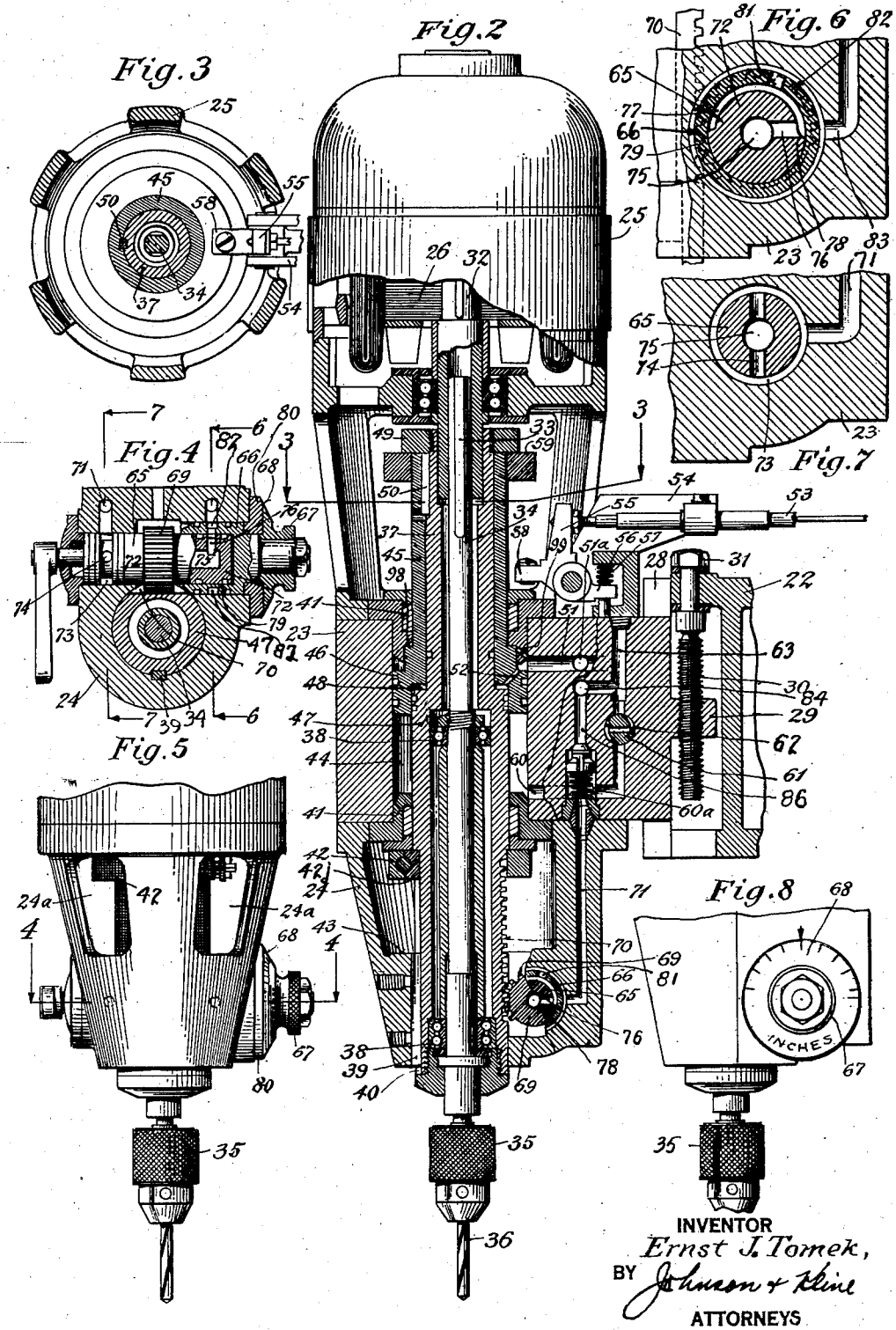


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DRILLING MACHINE

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DRILLING MACHINE

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Fig. 9

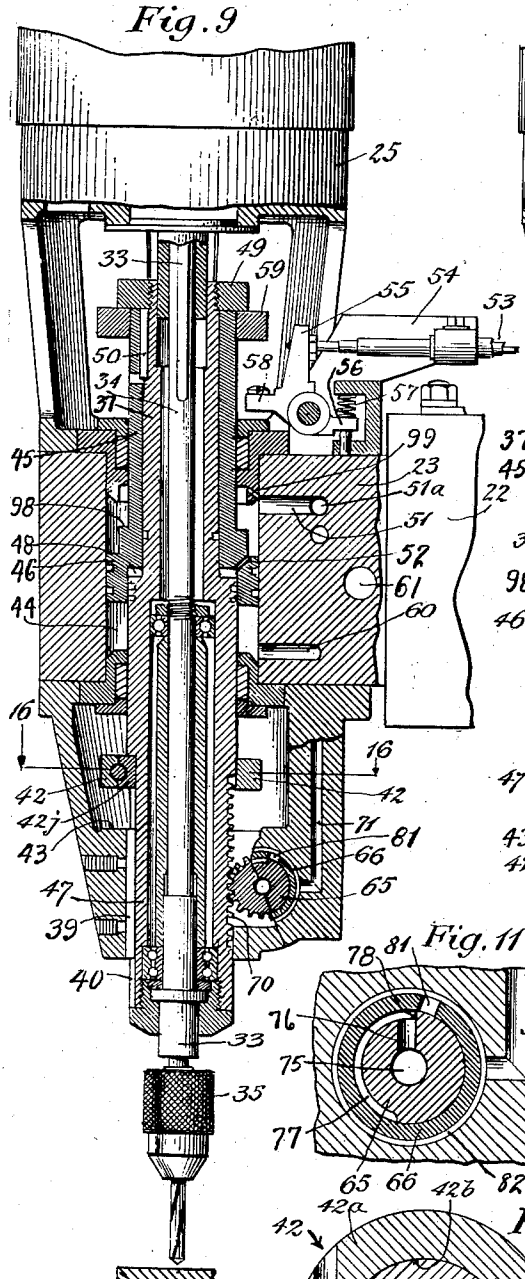


Fig. 10

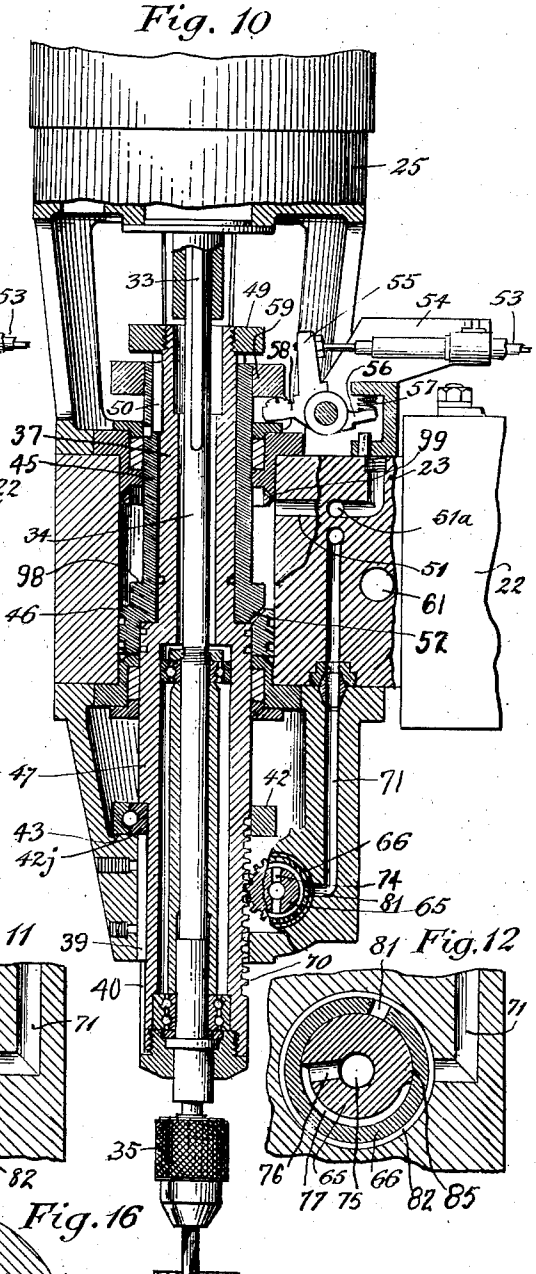
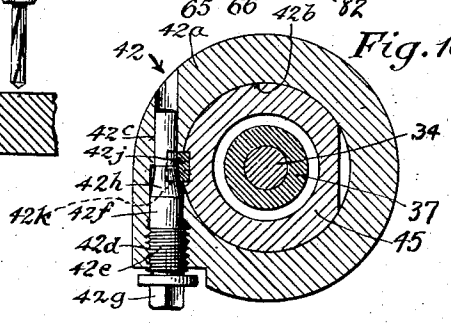


Fig. 11

Fig. 12

Fig. 16



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DRILLING MACHINE

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Fig. 13

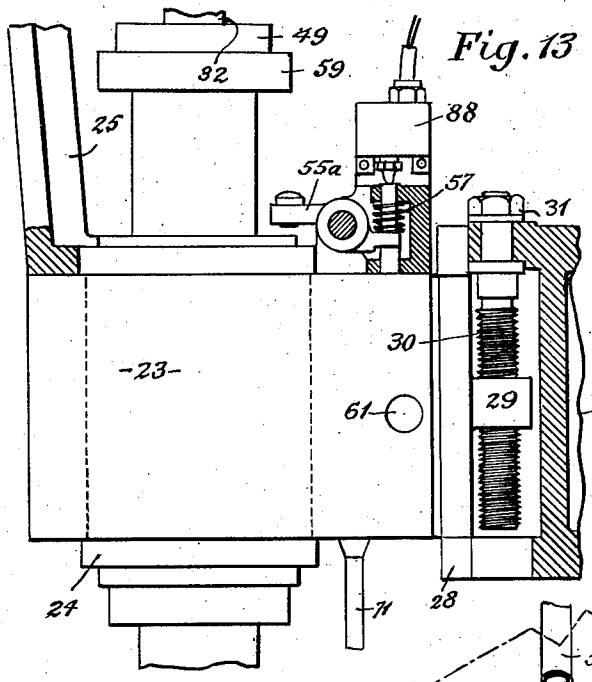


Fig. 14

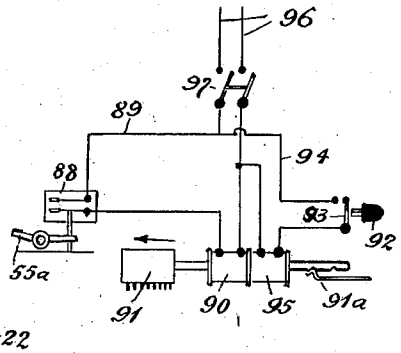
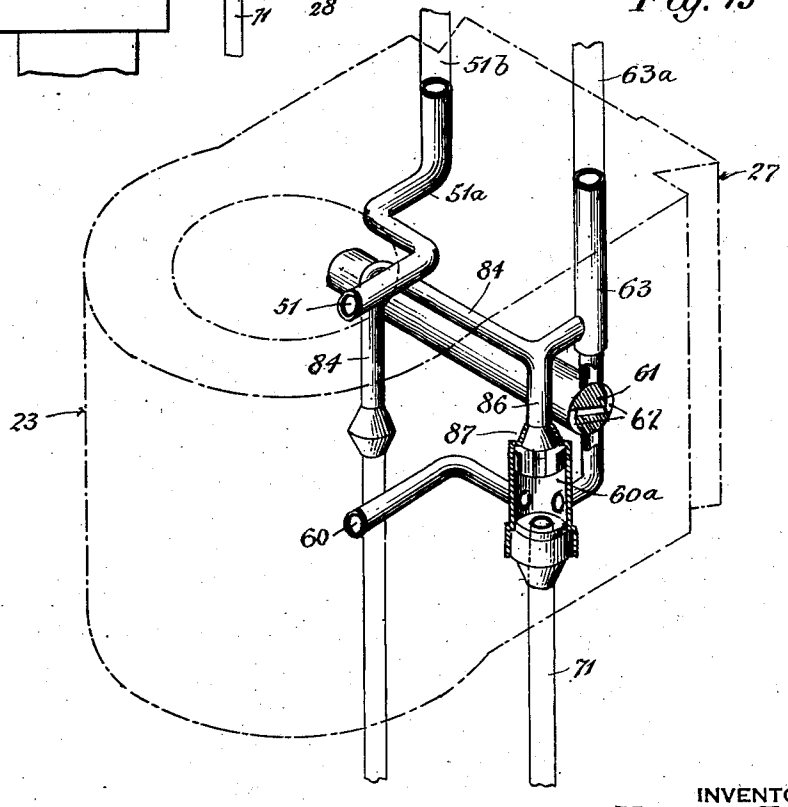


Fig. 15



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Patented Nov. 16, 1948

2,454,235

UNITED STATES PATENT OFFICE

2,454,235

DRILLING MACHINE

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Application October 19, 1943, Serial No. 506,815

12 Claims. (Cl. 77—32)

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This invention relates to drilling machines, and more particularly to the mechanism for rotating and advancing a drill or other suitable tool toward the work and retracting the same therefrom.

In its more specific aspects, the present invention relates to a drilling device in which the drill is rotated by one source of power, for instance that furnished by an electric motor, and is advanced and retracted by another source of power, for instance hydraulic power.

A feature of the present invention is the provision of means for automatically interrupting the feed or the advancement of the tool after the tool has reached the end of its travel as predetermined by suitable adjustments, including, preferably, means for limiting the extent of movement of the tool and/or the spindle on which the same is mounted. By the provision of such means, the travel of the tool many be accurately and definitely controlled to the end that holes of exactly the desired predetermined depth may be made, in contradistinction to the use of known means in which the interruption of the feed is controlled by the last portion of the movement of the tool or its spindle in feeding direction and in which the interruption occurs sooner or later depending upon the accurate adjustment of parts and the drifting movement thereof when the feed is interrupted.

This is accomplished, according to the present invention, by the provision of two relatively movable propelling members, one of which stops when the travel of the spindle is stopped and the other of which thereupon continues to move to actuate the means for removing the feeding force from the tool spindle. When hydraulic means is used as shown, these two relatively movable parts may be in the form of piston heads which move together during the feeding of the tool and one of which moves independently, after the other has been stopped to control suitable valves for interrupting the application of hydraulic pressure to the pistons.

In the preferred form of this invention, the piston or other differentially moved member which is movable after the tool is stopped, not only interrupts the source of feeding power to the spindle but controls a reverse application of the power so that the spindle is returned to starting position.

Another feature of this invention is the provision of means whereby the tool spindle may be advanced rapidly toward the work and then advanced at a slower desired feeding speed while

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the work is being done. Preferably this means includes a manually adjustable member for varying at will the extent of the rapid feed operation of the spindle, and in the preferred form this manually adjustable means is so arranged that it may be preadjusted for a particular length of rapid stroke as shown by suitable graduated indications or by trial and error while the machine is in operation, as desired.

When the invention is embodied in a hydraulically operated device as shown herein, the means for controlling the feed of the work-performing stroke may comprise a manually adjustable valve controlling the operating fluid, and the means for controlling the rapid advancement of the tool toward the work may include an automatic valve by passing said feed controlling valve and operated by the spindle in its advancing movements. To regulate the length of the work-approaching stroke, an intermediate valve may be employed next to the valve member operated by the spindle and this may be manually adjusted to determine the point in the travel of the spindle at which the high speed movement ceases and the desired work performing feed begins.

According to the present invention in its preferred embodiment, an electric motor which rotates the tool is mounted above the spindle and coaxial therewith, and the means for feeding the spindle is in the form of a piston through which the hollow spindle extends, the pistons being slidable in a cylinder block and the entire assemblage constituting a unitary device which may be suitably mounted on a framework preferably for bodily adjustment relative thereto. Several such unitary devices may be used in a single drilling machine, and, being complete both as to driving mechanism and feeding mechanism, may be conveniently mounted in a desired place on a drilling machine and in any desired angle relative to the work support.

The drill feeding and operating mechanism disclosed herein may be controlled by the manual movement or adjustment of stopping or starting valve, or by automatically controlled valves coordinated with the other operations of the machine as more particularly pointed out in my copending application #506,816, filed October 19, 1943, now abandoned.

Other features and advantages will hereinafter appear.

In the accompanying drawings which show the embodiments of this invention at present preferred—

Figure 1 is a front view of a drilling machine on

which are mounted several of the driving and feeding units forming part of this invention.

Fig. 2 is a vertical section through the device of the present invention showing the spindle in its normal raised or starting position.

Fig. 3 is a horizontal sectional view taken on the line 3—3 of Fig. 2.

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 5.

Fig. 5 is an elevation of the lower portion of the drilling unit looking at the front side of the device.

Fig. 6 is a sectional view of the valve for controlling the work-approaching stroke of the spindle taken on the line 6—6 of Fig. 4.

Fig. 7 is a similar view taken on the line 7—7 of Fig. 4.

Fig. 8 is a side view of the lower end of the device showing the adjusting knob and graduated dial for adjusting the valve for controlling the work-approaching stroke of the spindle.

Fig. 9 is a vertical section similar to Fig. 2, but showing the spindle and related parts at the end of the work-approaching stroke.

Fig. 10 is a similar view but showing the spindle and related parts at the end of the working stroke.

Fig. 11 is a view similar to Fig. 6 but showing the spindle controlling valve and the manually adjustable valve in position at the end of the work-approaching stroke of the spindle.

Fig. 12 is a similar view but showing the valves at the end of the working stroke of the spindle.

Fig. 13 is a vertical section of the upper portion of the device showing a modified form of means for interrupting the flow of power to the pistons advancing and feeding the spindle.

Fig. 14 is a diagrammatic view showing the mechanism for use with the modification of the invention shown in Fig. 13.

Fig. 15 is a perspective view of the cylinder block showing the arrangement of the ports and ducts therein.

Fig. 16 is a horizontal sectional view of the locking ring on line 16—16 of Fig. 9.

The device of the present invention is shown as applied to a drilling machine having a main frame 20 and a worktable 21 about which are secured brackets 22 to the upper ends of which the drilling units are attached. The brackets may be so made as to support the drilling units either perpendicularly or at an angle with relation to the plane of the worktable 21.

The drilling device of the present invention comprises a main frame element 23 which is bored to also constitute a cylinder block, a lower frame element 24 secured to the block 23 as an extension thereof, and an upper frame element 25 carrying and constituting part of the casing of an electric motor 26. The block 23 is provided with a dovetail 27 (see Fig. 15) sliding in dovetail slots 28 in the upper end of the bracket 22, and also has a lug 29 forming a nut engaging a screw 30 rotatably mounted on the bracket 22 and, when rotated by a head 31, raises or lowers the drilling device as a unit with relation to the worktable 21.

The end of the motor shaft 32 is hollow and broached to provide a hole to receive the splined upper end 33 of a drive shaft or spindle 34, the lower end of which carries a chuck 35 or other suitable tool holder for receiving a drill 36 or the like. The tool is rotated by power supplied by the motor and may be rotated continuously, especially when the work to be performed is a drilling operation—the operative connections between the motor and the spindle being maintained by the splined end 33 of the spindle in all longitudinal positions of the spindle relative to the motor.

According to the present invention, the spindle 34 is traveled in work-performing direction by power entirely independent of the power for rotating the tool, and provision is made for advancing the tool toward the work rapidly, but feeding the tool through the work at a desired cutting feed.

To advance and feed the spindle, the latter, according to the present invention in its preferred embodiment shown herein, is surrounded by a sleeve 37 which is slidably mounted in the framework comprising the sections 23, 24 and 25. The tool spindle 34 is rotatably mounted in the sleeve 37 on anti-friction bearings 38, and the sleeve is held against rotation while being free for longitudinal movement by a key 39 carried by the frame element 24 and sliding in a slot 40 in the sleeve. The cylinder block 23 carries suitable bearings 41 by which the sleeve is supported and which permit the sleeve to slide longitudinally.

The sleeve is provided with a stop collar 42 which is adjustable longitudinally of the sleeve 37 and which, by engagement with a stop surface 43 on the frame element 24, limits the downward or outward movement of the spindle.

One of the advantageous features of this invention is the provision of this stop collar 42 (see also Fig. 16) which is easily released for adjustment and yet, when tightened in adjusted position, is so securely locked in place that it will maintain its position and accurately limit the movement of the sleeve 37 notwithstanding the repeated blows which it receives at the upper and lower limits of movement of the sleeve.

As shown in Fig. 16, the stop 42 is in the form of a ring 42*a* having a boss 42*b* and a tangential bore 42*c* extending through the boss. The bore 42*c* has threads 42*d* engaged by threads 42*e* on a pin 42*f* which is located in the bore 42*c*, and which has a head 42*g* by means of which it is rotated. The pin 42*f* has a taper portion 42*h* adapted to engage a combined key and clasp member 42*j* fitting in a milled slot 42*k* in the collar 42 and also extending into the slot or keyway 40 in the sleeve 37.

When the pin 42*f* is rotated in one direction, the taper portion 42*h* thereof forces the key 42*j* tightly between itself and the bottom of the key way and thus locks the ring against movement longitudinally of the sleeve. Yet when the pin 42*b* is rotated in the other direction, the taper 42*h* recedes from the key 42*j* and the collar 42 may be easily adjusted to a new position longitudinally of the sleeve.

Since the sleeve is held by the key 39 against rotation relative to the frame and the collar is held by the key 42*j* against rotation relative to the sleeve, slots 24*a* in the frame member may be so placed that the head 42*g* is accessible to a wrench passed through the slots 24*a* to tighten or loosen the stop ring 42. The stop collar 42 strikes a plate on the lower bearing member 41 to limit the upward movement of the sleeve 37 and spindle 34. While the sleeve 37 constitutes a piston against which hydraulic pressure is applied to advance the spindle, it does not directly ride on the walls of the cylinder 44 in the block 23. Instead another sleeve 45 surrounding the upper portion of the sleeve 37 has a piston portion 46 which engages the walls of the cylinder 44. A piston portion 47 on the sleeve 37 is located within the piston portion 46 of

the sleeve 45. It may properly be said therefore that the spindle is advanced by a two-part piston, one part being telescoped within the other. The pistons 46 and 47 may move relatively to each other for a purpose hereinafter described.

Relative movement between the sleeves 37 and 45 is limited in one direction by the upper end of the piston 47 engaging the bottom of a cavity 48 in the piston 46, and in the other direction by a nut 49 threaded on the upper end of the sleeve 37 engaging the upper end of the sleeve 45. The sleeves 37 and 45 are held against rotation relative to each other by a key 50.

In the uppermost positions of the parts as shown in Fig. 2, a chamber between the upper end of the piston 46 and the lower end of the bearing member 41 is provided, and this chamber is in communication with an inlet duct 51 in the block 23. When liquid, preferably oil, is forced under pressure through the duct 51 via feed duct 51*a* connected to a pipe 51*b* (see Fig. 15) it will act to force the pistons 46 and 47 downwardly, the liquid under pressure reaching the piston 47 through a passage 52 in the piston 46. The fluid pressure therefore acts on the piston 47 and causes the latter to descend and carry with it the sleeve 37 supporting the spindle and the sleeve 45 carrying the piston 46 through engagement with the nut 49. This downward motion continues until the stop ring 42 engages the stop surface 43 to arrest the movement of the sleeve and its piston 47.

The hydraulic pressure continues to act, however, and this causes the piston 46 to continue to advance. It is this continued advance movement of the piston 46 and its sleeve 45 which controls the interruption of power for feeding the tool. For this purpose, suitable means for controlling a valve to interrupt the flow of liquid under pressure to the duct 51 are provided. In the form of the invention shown in Figs. 2, 9 and 10, a control valve not shown is operated by a push-pull cable 53 mounted in a bracket 54 and connected to a bell crank 55 pivotally mounted in the bracket 54. Another arm 56 of the bell crank is engaged by a spring 57 which holds it in the position shown in Fig. 2, while another arm 58 is located in the vertical path of a ring 59 carried by the sleeve 45 to be operated thereby.

When the spindle 34, sleeve 37 and sleeve 45 descend to the point where the stop ring 42 arrests the outward movement of the spindle, the ring 59 is located directly adjacent the arm 58 of the bell crank 55. Continued movement of the sleeve 45 causes the ring 59 to rock the bell crank and operate the push-pull cable 53 and close the valve leading to the inlet duct 51.

Thus it will be seen that the power supplied to feed the spindle is interrupted after the spindle has been stopped definitely and mechanically, and therefore the place at which the spindle is stopped may be accurately predetermined without the necessity of relying upon the continued drift of the parts or other impositive means which it would be necessary to employ were the power interrupted during the concluding part of the feeding movement of the spindle.

It is thus possible with the device of the present invention to very accurately control the depth of the drilling or other operation without the necessity of making any involved or cut and try adjustments.

If desired the control valve may reverse the power operating means when the ring 59 engages the bell crank and operates the bell crank.

The present invention also, as stated above, provides means whereby the tool may be rapidly moved toward the work and then fed through the work at a desired slower rate. This is accomplished in the form of the invention at present preferred by retarding the travel of the spindle rather than by varying the power applied to move it. For this purpose, the liquid which is contained within the chamber formed between the lower end of the piston 46 and the upper end of the lower bearing member 41, is more or less retarded in its escape through a passage 60 in the block 23 as the pistons 46 and 47 descend.

The flow of liquid escaping through the passage 60 to a suitable reservoir (not shown) is controlled by two valves. One of these valves is a metering valve 61 having graduated escape passages 62 opening in a passage 63 connected to a pipe 63*a* which, through a suitable valve mechanism not shown, is connected to a reservoir. The valve 61 is rotatably mounted in a bore in the block, and an extension of it at the exterior of the block is provided with a knob 64 (see Fig. 1) by means of which it may be set to permit a faster or slower flow of liquid through it, and thus a faster or slower travel or feed of the spindle.

To control the rapid movement of the spindle toward the work, there is provided a valve 65 (see Fig. 4) which is under the control of the movement of the spindle and a manually adjustable supplemental valve 66 which is provided with a pointer-carrying knob 67 which may be adjusted relative to a graduated dial 68 by means of which the settings may be accurately effected. The valve 65 is provided with a gear 69 which meshes with a rack 70 formed on the sleeve 37 so as to be moved in coordination with the movement of the sleeve and spindle. The valves 65 and 66, as will presently appear, by-pass the metering valve 61 so as to allow a faster flow of liquid from the chamber below the piston 46 when the tool is being moved toward the work.

When the pistons 46 and 47 descend, the fluid in the lower chamber is forced out through the passage 60, and, being partially obstructed by the metering valve 61, goes downwardly along a passage 71 from the chamber 60*a* to the valves 65 and 66. The valve 65 comprises a cylinder 72 which is rotatable in a cavity in the frame portion 24 and has an annular groove 73 and a radial aperture 74 through which the oil passes to a bore 75 in the valve, the other end of which is provided with a radial aperture 76 communicating with a segmental circumferential groove 77. The length of the segment 77 is proportional to the length of the stroke of the spindle and, as the spindle descends, the end 78 of the groove 77 moves counter-clockwise as viewed in Figs. 2 and 6. The valve 66 has a hollow cylinder 79 within which the end of the cylinder 72 having the segmental groove 77 rotates. The hollow cylinder 79 fits snugly within a bore in the frame portion 24 and extends out through a cap 80 where it is secured to the knob 67.

There is a radial aperture 81 in the cylinder 79 which communicates with an annular groove 82 therein, and the portion of the frame member 24 adjacent the annular groove 82 has an escape passage 83 which is constantly in communication with the annular groove 82 and radial aperture 81 in all positions of adjustment of the valve 66. The escape passage 83 is continued up through the cylinder block where it joins, through a

transverse passage 84, with the duct 63 leading to the reservoir.

Assuming the parts to be in the position shown in Fig. 6, when the spindle begins to descend, liquid is forced, as described, to the bore 75 of the valve 65 and then passes to the segmental groove 77 through the radial aperture 81 to the annular groove 82 and then to the outlet passage 83. This permits the spindle to rapidly descend, and as it does so, the cylinder 72 is rotated counterclockwise, and this causes the end 78 of the segmental groove 77 to approach the radial aperture 81 in the valve 66 and finally close the aperture, as shown in Fig. 11, stopping the escape of liquid by this path. The liquid continues to escape through the metering valve and this controls the working feed of the spindle. During the continued movement of the spindle, an ungrooved surface 85 of the valve 65 keeps the passage 81 closed as shown in Fig. 12.

Thus it will be seen that by rotating the valve 66 clockwise from the position shown in Figs. 2 and 6, the end 78 of the groove will shut off the passage 81 that much sooner, thereby reducing the length of the rapid feeding movement of the spindle. Contrarily, by rotating the valve counterclockwise, the aperture 81 is permitted to remain in communication with the segmental groove 77 that much longer, thus lengthening the rapid feed stroke of the spindle.

The dial 68 may be graduated in inches, and by setting the pointer and dial at the required indication the desired length of rapid feeding movement of the spindle will result. If it should be found that the rapid feed portion of the stroke is too long or too short for a particular piece of work, an adjustment may be made while the device is in operation by merely adjusting the knob 67.

To facilitate the adjustment of the stop collar 42, or to check the setting thereof, or to advance the tool by hand should that be desired, the valve cylinder to which the gear is attached may be provided with a handle or lever by means of which it may be rotated to raise or lower the spindle.

After the downward movement of the spindle is arrested and the push-pull cable is operated, the pipe 63*a* (Fig. 15), leading to the passage 63, may be connected by a suitable valve (not shown) to the source of fluid pressure, thereby reversing the direction of flow and causing oil under pressure to flow into a passage 86 past the one-way valve 87 and into the passage 60 in the lower portion of the cylinder, thereby causing the pistons 46 and 47 to be returned to the position shown in Fig. 2, the orifice 51 through passage 51*a* and pipe 51*b* being at the same time connected to the reservoir to permit the desired escape of the liquid from the top sides of the pistons 46 and 47. The pistons remain elevated in the position shown in Fig. 2 until the passage 51 is again connected to the source of oil pressure and the passage 60 is connected to the reservoir to exhaust therein.

This control of the passages 51 and 60 to connect them to exhaust into the reservoir or to a source of oil under pressure may be effected by manually operated valves, or it may be controlled automatically in coordination with other operations to be performed by the drilling machine as disclosed in my companion application filed concurrently herewith.

Electrical mechanism for controlling the valve mechanism for applying pressure to the desired

passages and exhausting from other passages when the valve is to descend, and reversing the flow when the valve is to rise, is shown in Figs. 13 and 14. In these figures, instead of the ring 59 engaging the bell crank 55, it is made to engage a lever 55*a* which operates an enclosed switch 88 which closes a circuit 89 through a solenoid 90 to move a valve of a valve mechanism 91 in the direction of the arrow indicated thereon, which causes the spindle to return to its upper position. When the spindle is to descend, a manually operated button 92 closes a switch 93 in a circuit 94 to operate a solenoid 95 to pull the valve of the valve mechanism 91 and reverse the direction of flow of the liquid. The solenoids 90 and 95 and the valve mechanism 91 are so arranged that the parts remain in the position in which they are placed until the reverse operation occurs.

Thus, when the spindle reaches the end of its stroke, the switch 88 is momentarily closed to move the valve to the left as viewed in Fig. 14, where it stays until the push button 92 is momentarily closed to move it to the right. The valve is yieldingly held in either position by a detent 91*a*. The circuits are supplied with current from feed lines 96 through a main switch 97.

Again referring to Figs. 2, 9 and 10, the pistons 46 and 47 and the valves 65 and 66 are provided with suitable obturating grooves or rings to prevent fluid from passing undesirably between contacting surfaces. In order to break any liquid-seal which might result from the close contact of the upper end of a shoulder 98 on the sleeve 45 with the bearing member 41, a bleeder groove 99 may be provided between this shoulder 98 and the chamber formed by the piston 46.

It will be seen from the foregoing that the present invention provides means for removing the power for advancing the spindle after the spindle has stopped and for controlling and regulating the rapid feeding movement of the spindle toward the work and controlling and regulating the feeding speed of the spindle while the work is being performed.

It will also be noted that the concentric and coaxial arrangement of the driving motor, the feeding means and the spindle makes for simplicity of construction, accurate concentricity of the spindle and tool carried thereby, and convenience in assembling and adjusting the parts. By having the spindle electrically operated and hydraulically fed, each spindle in a multi-spindle machine may perform its work as a separate unit without the necessity of connecting up various drilling units to any common driving of feeding means; thus they may be positioned with convenience and facility with relation to the work to be performed without requiring the extensive adjustment and rearrangement of common driving or operating means.

Variations and modifications may be made within the scope of this invention and portions of the improvements may be used without others.

I claim:

1. In a power driven and fed tool spindle mechanism, a reciprocatory tool spindle; and a hydraulic circuit for controlling the movements of said tool spindle including hydraulic power means for causing the spindle to approach and travel relative to the work, a valve mechanism including a part manually set and a part operated by the spindle in its travel for causing rapid movement of the spindle to work-engaging position and becoming inoperative to control the speed of travel of the spindle after it reaches a predetermined work-engaging position, said manually set part be-

ing adjustable to vary the point in the travel of the spindle at which it becomes inoperative and another valve mechanism manually adjustable for variably controlling the speed of travel of the spindle in the working portion of the stroke thereof; an adjustable stop for engaging the spindle and limiting the outer movement of the spindle; and means operated by the power means after the spindle has stopped for reversing the power means and returning the spindle to starting position.

2. In a power driven and fed tool spindle mechanism, a reciprocatory tool spindle; power means for applying force to the spindle for causing it to move in work-performing direction; hydraulic means for yieldingly resisting said force during the working stroke of the spindle; manually adjustable means for varying the resistance of said hydraulic means to control the speed of travel of the spindle in the work-performing direction; and means, including a valve movable with the spindle and a relatively stationary and manually adjustable valve for rendering said first-speed controlling means ineffective and permitting rapid approach of the spindle toward the work until a predetermined point determined by the position of said manually adjustable valve in its travel is reached.

3. In a power driven and fed tool spindle mechanism, a reciprocatory tool spindle; power means for applying force to the spindle for causing it to move in work-performing direction; a hydraulic control circuit therefor including hydraulic means for yieldingly resisting said force during the working stroke of the spindle and manually adjustable means for varying the resistance of said hydraulic means to control the speed of travel of the spindle in the work-performing direction; manually adjustable stop means for arresting movement of the spindle in its working stroke; and means carried by the spindle and mounted for relative movement thereon, said means moving relative to said spindle and operating hydraulic means for returning the spindle to starting position after the spindle is arrested by said stop means and as a result of the cessation of movement of the spindle.

4. In a power driven and fed tool spindle mechanism, a reciprocatory tool spindle; hydraulic means for applying force to the spindle for causing it to move in work-performing direction; hydraulic means for yieldingly resisting said force during the working stroke of the spindle; and means including a valve operated by the spindle in its travel and moving concurrently therewith for reducing said resistance of said hydraulic means causing rapid movement of the spindle to work-engaging position and becoming inoperative after the spindle reaches the work-engaging position; another valve cooperating with said first-named valve and being manually adjustable to vary the point in the travel of the spindle at which said first-named valve becomes inoperative, said means for resisting said force during the working stroke including another valve manually adjustable for varying the resistance of said hydraulic means for variably controlling the speed of travel of the spindle in the working portion of the stroke thereof.

5. In a power driven and fed tool spindle mechanism, a reciprocatory tool spindle; a hydraulic circuit including power means for applying force to the spindle for causing it to move in work-performing direction, means for yieldingly resisting said force during the working stroke of the spindle, means including a valve operated by the spindle in its travel and moving concurrently therewith for reducing said resistance of said hydraulic means causing rapid movement of the spindle to work-engaging position and becoming inoperative after the spindle reaches the work-engaging position; another valve cooperating with said first-named valve and being manually adjustable to vary the point in the travel of the spindle at which said first-named valve becomes inoperative, said means for resisting said force during the working stroke including another valve manually adjustable for varying the resistance of said hydraulic means for variably controlling the speed of travel of the spindle in the working portion of the stroke thereof; and means for causing the power means to return the spindle to starting position independently of said speed control valve.

6. In a power driven and fed tool spindle mechanism, a reciprocatory tool spindle; hydraulic means for feeding the spindle to the work; means for limiting the feeding movement of the spindle; a valve for reversing the application of hydraulic pressure to said hydraulic means for returning the spindle to starting position; and means, including a piston, movable with said spindle and hydraulically moved after the spindle has been stopped by said limiting means for causing operation of said reversing valve.

7. In a power operated tool spindle mechanism, a reciprocatory tool spindle; hydraulic means, including a piston, for feeding the spindle to the work; means for limiting the feeding movement of the spindle; a valve for controlling said hydraulic means; and means, including another piston carried by said spindle, hydraulically moved after the spindle piston has been stopped by said limiting means and as a result of the cessation of movement of the first-named piston for causing operation of said control valve.

8. In a power operated tool spindle mechanism, a reciprocatory tool spindle; hydraulic means, including a piston, for feeding the spindle to the work; means for limiting the feeding movement of the spindle; a valve for controlling said hydraulic means; and means, including another piston, telescopically arranged with said first-named piston and hydraulically moved after and as a result of cessation of movement of the first-named piston caused by engagement of said limiting means for causing operation of said control valve.

9. The invention as defined in claim 8, in which the control valve when operated applies hydraulic pressure to the other sides of the pistons to return them and the spindle to starting position.

10. In a power driven and fed tool spindle mechanism, a reciprocatory tool carrying spindle, and a hydraulic circuit including hydraulic means connected to the spindle for driving the spindle to and from the work, and means for controlling said power means to cause the spindle to rapidly approach the work and to travel through a working stroke at a predetermined working speed, said circuit including a valve for determining the working speed of the spindle and a by-pass valve therefor controlled in accordance with the movement of the spindle for rendering the first valve ineffective during the approach of the tool to the work, said by-pass valve comprising two parts, one of which is rotatable and connected to the spindle to be driven thereby and the other part being manually adjustable with respect to the first part for varying at will the length of the rapid work-approaching stroke of the spindle.

11. In a power driven and fed tool spindle mechanism, a reciprocatory tool carrying spindle;

power means connected to the spindle for driving the spindle to and from the work; and hydraulic means for controlling said power means to cause the spindle to rapidly approach the work and to travel through a working stroke at a predetermined working speed, said means including a hydraulic circuit having a valve for determining the working speed of the spindle and a cylindrical valve having a rack and gear connection with the spindle and controlled in accordance with the movement of the spindle for rendering the first valve ineffective during the approach of the tool to the work.

12. In a power driven and fed tool spindle mechanism, a reciprocatory tool carrying spindle; power means connected to the spindle for driving the spindle to and from the work; and hydraulic means for controlling said power means to cause the spindle to rapidly approach the work and to travel through a working stroke at a predetermined working speed, said means including a hydraulic circuit having a valve for determining the working speed of the spindle and valve means having a manually controlled part and a part controlled in accordance with the movement of the spindle for rendering the first valve ineffective during the approach of the tool to the work, the

part controlled by the spindle comprising a cylindrical valve having a gear and rack connection with the spindle and the manually controlled part comprising a manually adjustable cylindrical valve coaxial with the other cylindrical valve, said two cylindrical valves having mutually communicating ports.

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