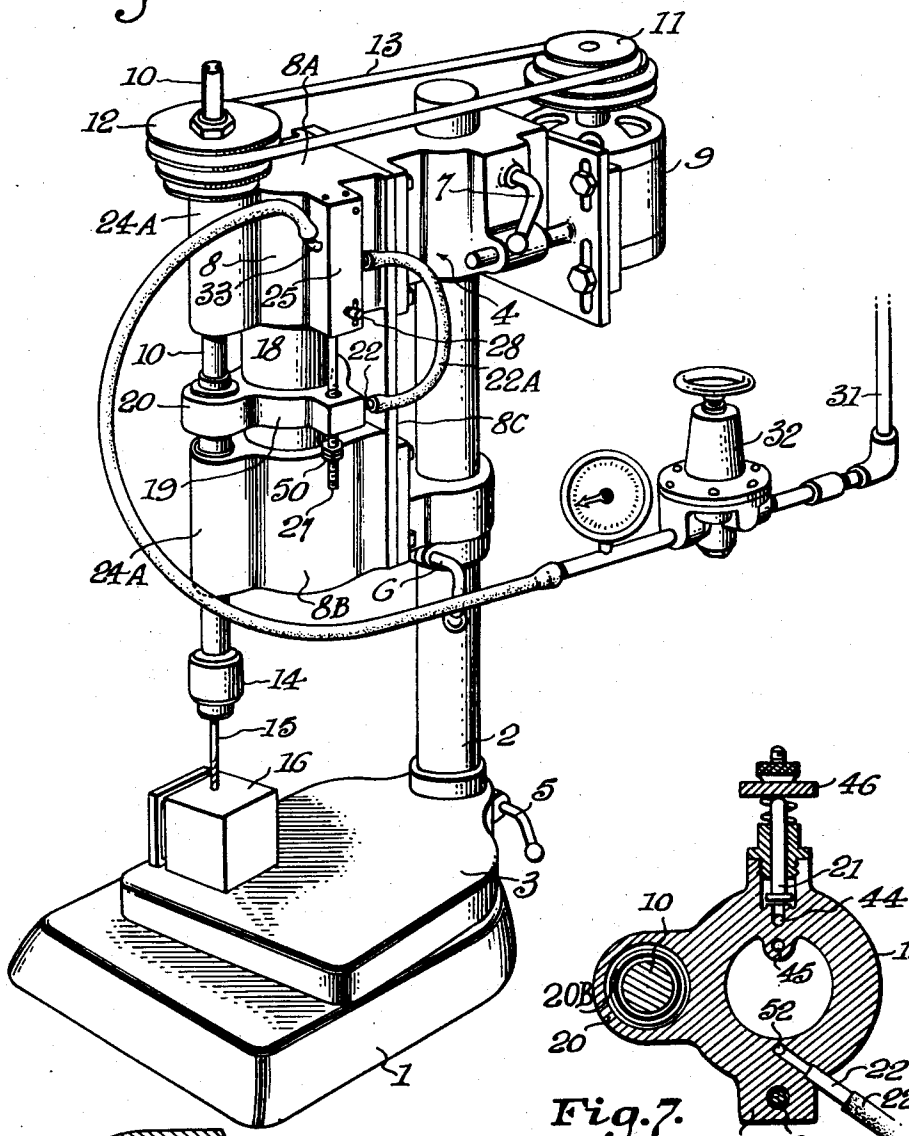
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AIR AND HYDRAULIC DRILL CONTROL

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Fig.1.



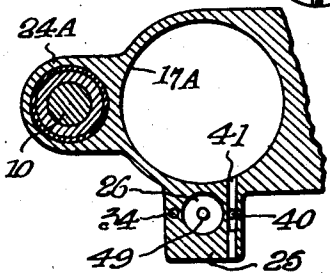


Fig.6.

Fig.7.

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Fig.2.

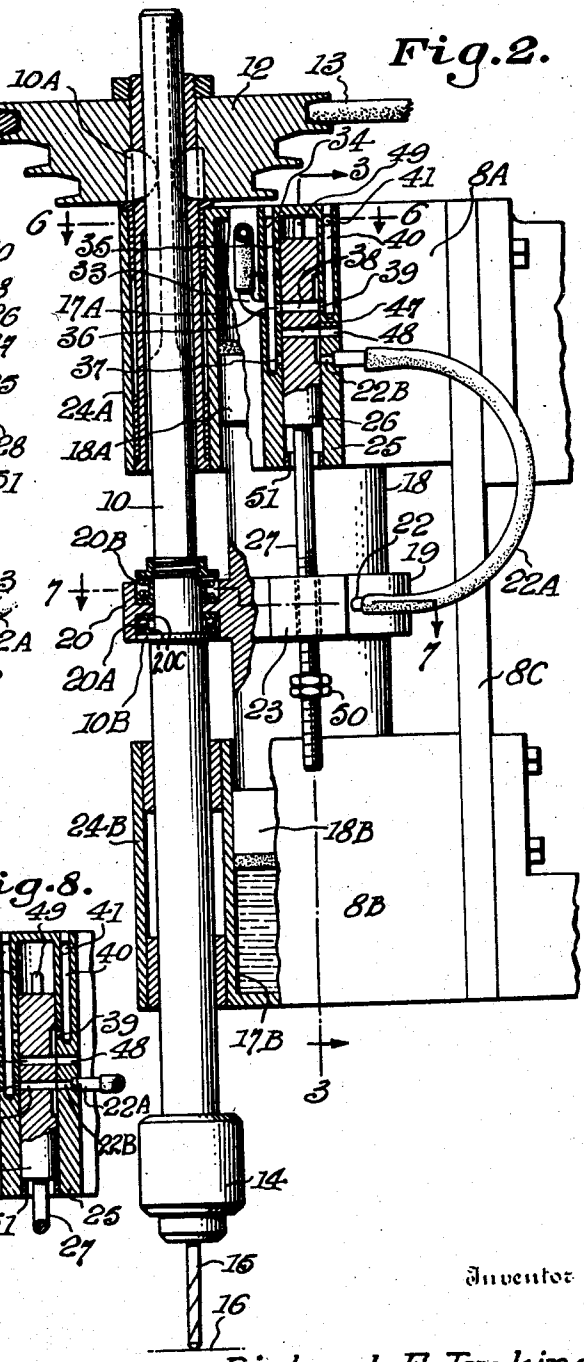


Fig.3.

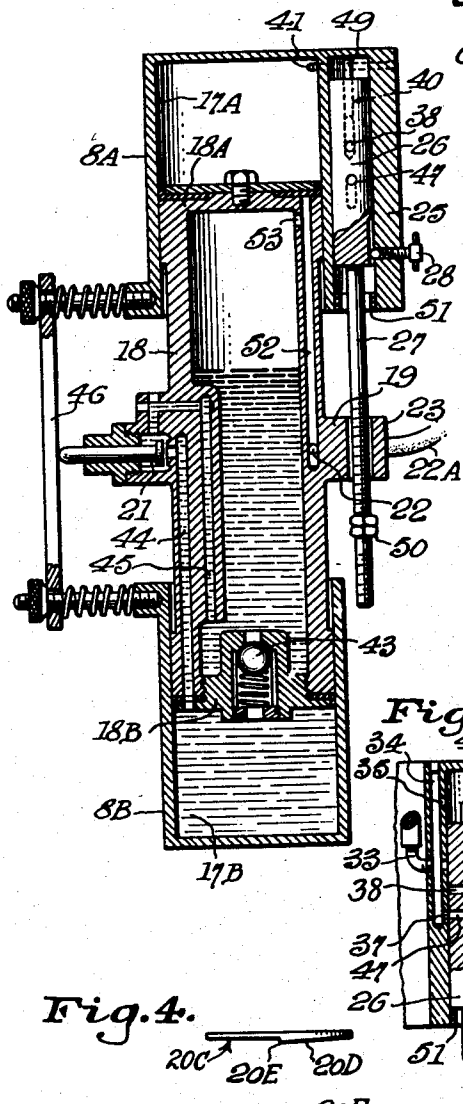
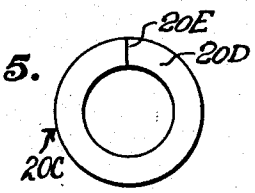


Fig.8.

Fig.4.

Fig.5.



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UNITED STATES PATENT OFFICE

2,430,019

AIR AND HYDRAULIC DRILL CONTROL

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Application October 13, 1944, Serial No. 558,530

4 Claims. (Cl. 77—32)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without payment to me of any royalty thereon.

This invention relates to drilling machines. Some of the objects of the invention are to provide improved means for feeding a machine-driven drill into the work without danger of injury in the event that either excess resistance or a cavity is encountered, to provide improved means for automatic withdrawal of the drill upon the completion of a predetermined advance, and to provide improved means for breaking chips during drilling.

Other objects and advantages of my invention will be apparent to those skilled in the art, as will appear from the following description, with accompanying drawings, showing, by way of illustrative embodiment and not by way of limitation, a preferred form of my invention.

In the drawings:

Figure 1 is a perspective showing my invention applied to a vertical drill;

Figure 2 is an enlarged elevation, with parts in section, showing a portion of the right side of Figure 1 on a larger scale all parts being shown in drilling position;

Figure 3 is a vertical section indicated by the line 3—3 of Figure 2, looking in the direction of the arrows;

Figures 4 and 5 are a side elevation and a bottom plan view, respectively, of a washer forming part of my invention;

Figures 6 and 7 are horizontal sections indicated, respectively, by the lines 6—6 and 7—7 of Figure 2, looking downward; and

Figure 8 is a vertical section through the valve only of Figure 2, showing the valve in position to cause retraction of the drill.

In the drawings, and referring now particularly to Fig. 1, my invention is shown as applied to a generally conventional vertical drill having a base 1 with a vertical post 2 on which a work platform 3 and drill assembly 4 are adapted to be set in position by any suitable means such as clamps 5, 6 and 7. The drill assembly comprises a housing 8 for the mechanism of my invention, and suitable driving means, here represented as a motor 9, adjustably mounted with respect to the housing, for driving a drill spindle 10. By way of example a drive is shown which consists of differentially grooved pulleys 11 and 12, on the motor shaft and drill spindle, respectively, connected by a belt 13. The spindle is splined, as at 10A, for longitudinal movement with respect to the pulley 12. A chuck 14 on the spindle 10 holds a drill bit 15 for operation on a work-piece 16.

The details of the preferred embodiment of my invention are best seen in Figs. 2 and 3. The

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housing, which is generally designated as 8 in Fig. 1, is here shown as comprising an upper portion 8A and lower portion 8B, both integral with or secured to a base 8C. Large vertical cylinders 17A and 17B, mutually axially aligned in the respective housing portions 8A and 8B, and facing one another, receive the suitably packed upper and lower ends 18A and 18B of a hollow piston 18. Oil or other liquid, as conventionally indicated in Fig. 3, fills the lower cylinder 17B and the lower portion of the interior of piston 18. A collar 19, surrounding the piston 18 at midlength, carries a bearing assembly 20 for thrust and retraction of the drill spindle 10, the housing of a valve 21, an air connection 22, and a lug 23, all described hereafter. The bearing assembly 20 comprises a ball bearing 20A, against which a spindle collar 10B is held by the action of a compression spring 20B. If desired, one washer of the ball thrust bearing comprising ball bearing 20A and washers 20C—20C may be provided with an incline 20D, terminating in a stop 20E, for the purpose of giving a short longitudinal vibratory movement to the rotating drill spindle 10, and to the drill bit 15, for the purpose of breaking chips. The action is dependent upon having the balls in the bearing widely enough spaced so that when one is passing off the step 20E the next is on a portion of the washer not substantially thickened. Thus the spindle is pulled back by the compression spring 20B as each ball rides off the step.

The housing 8 is enlarged as shown at 24A and 24B, to accommodate bearings for the spindle 10. The upper portion 8A is also enlarged as at 25, providing a cylinder space in which a piston type slide valve 26 is movable by a depending stem 27. The slide is held in its top position, Fig. 2, by a spring friction plunger 28, which also acts as a spline to keep the piston from turning.

The drill is advanced into the work by pneumatic pressure in the top cylinder 17A, against the dashpot effect of liquid flowing through a restricted passage from inside the piston into the lower cylinder 17B, and is retracted by hydraulic pressure of oil forced out of the piston into the lower cylinder by air pressure in the piston. The cycle of operations is controlled by the valve 26. The valve arrangements, fluid passages and associated elements of my invention will be described in their relation to the operating cycle.

Compressed air or other compressible fluid is supplied from a main 31 through a reducing valve 32 to an inlet 33 at any pressure suitable to the character of the material to be drilled. A passage 34 in the wall of cylinder 25 carries the air to upper, middle and lower parts 35, 36, 37, respectively, of the valve cylinder. In the position of Figs. 1 and 2, which is the drilling position, one end of an upper transverse L-shaped

passage 38 in the valve 26 registers with port 36 and with an opposite port 39 from which a passage 40 and aperture 41 lead air into the upper cylinder 17A, thus forcing down cylinder 18 and so urging the drill spindle downward by the bearing assembly 20. A check valve 43 in the bottom of the piston 18 closes on the down stroke, thus forcing the oil to enter the piston through channels 44 and 45 in the piston wall. These are connected through the valve 21, the stem of which bears against a cam plate 46 extending across the free space between the upper and lower housing portions 8A and 8B. The cam plate shown gives uniform opening of the valve throughout the entire travel of the piston, but a cam plate of any suitable pattern can be substituted, so as to allow variation in the rate of descent at different portions of the piston travel. During the downward movement, air above the oil inside the piston 18 escapes to the atmosphere by a hole 53 near the top of the piston, a passage 52, the connections 22, 22A and 22B, the lower branch of the valve passage 47, and the vent 48.

The length of the feeding stroke is predetermined by the setting of nuts 50 on the valve stem 27, the nuts being struck by the lugs 23 as the piston 18 moves down. It will be noted that a stud 49 so positions the valve 26 at the top of its travel that the upper edge of the valve body barely closes the port 35. Consequently, as soon as the relatively slow movement of the piston starts the valve body 26 down, air pressure admitted at 35 snaps the valve from the position of Fig. 2 to that of Fig. 3, where it is stopped by the retaining collar 51. In this setting, air is admitted into the piston 18 through the path 33, 34, 37, 47, 22B, 22A, 22, 52 and 53, thus driving oil out of the piston through the check valve 43 into the lower cylinder 17B, so raising the piston and retracting the drill. Air simultaneously escapes by the path 41, 40, 39, 38 and 48 to the atmosphere.

To start the next operating cycle, the operator pushes up the stem 27, returning the valve 26 to the position of Fig. 2.

It will be understood that although I have shown and described in detail a preferred embodiment of my invention, my invention is not limited thereto, but is susceptible of being applied in other forms, all within the scope of the following claims.

Having thus described my invention, what I claim as new and wish to secure by Letters Patent is:

1. In a drilling machine, in combination, a drill feeding and retracting mechanism comprising longitudinally spaced opposed cylinders, a piston having its ends operably received in said cylinders, respectively, a drill spindle carried by a thrust bearing connected to said piston between said cylinders, laterally spaced therefrom and having its axis parallel to the piston axis, whereby movement of said piston in one direction advances said spindle towards a work-piece and in the other direction retracts said spindle therefrom, and control means for causing application of pressure selectively to either of said cylinders while releasing it from the other.

2. In a drilling machine, in combination, a pair of longitudinally-spaced opposed cylinders, a unitary hollow piston operable in both cylinders, a slide valve and connections therethrough adapted to govern pressure conditions in both cylinders

and within said piston, and a drill spindle, said cylinders, piston, valve and spindle having parallel axes, said piston having a lateral extension between said cylinders, a thrust bearing in said extension and a thrust journal on said spindle coacting with said bearing, a stem on said slide valve, adjustable stop means on said stem adapted for engagement by said piston extension to impart initial movement to said valve in the direction of piston movement, and valve elements admitting pressure to said valve upon such initial movement to cause immediate full movement.

3. In a drilling machine, in combination, a drill feeding and retracting mechanism comprising upper and lower longitudinally-spaced opposed cylinders, a piston having its ends operably received in said cylinders, respectively, a thrust bearing carried by said piston between said cylinders, a drill spindle parallel to said piston and longitudinally movable by said thrust bearing, and a piston valve parallel to said piston, passages from a source of air pressure to the upper cylinder and to the interior of the piston, said passages being controlled by said valve for selective application of pressure to move said piston in either direction, liquid in said piston and in said lower cylinder, two passages between the interior of said piston and said lower cylinder, a one-way valve in one of said passages and a restricting valve in the other, and a fixed cam plate in controlling relation to said restricting valve whereby rate of flow from said lower cylinder into said piston is controlled, thereby regulating resistance to downward movement of said piston.

4. In a drilling machine, in combination, an upright drill feeding and retracting mechanism comprising upper and lower longitudinally-spaced opposed cylinders, a hollow piston having its respective ends operably received in said respective cylinders, a thrust bearing carried externally by said piston between said cylinders, and a drill spindle parallel to said piston engaged by said bearing, guide bearings externally positioned on said cylinders wherein said spindle is rotatable and is longitudinally movable, a piston valve mounted externally of one of said cylinders and parallel thereto, a stem depending from said valve and having adjustable stop means thereon adapted to be engaged by an element of said piston in downward movement thereof, a pressure port above said piston valve adapted to admit pressure above said valve upon slight initial movement thereof and thereby cause quick full movement thereof from upper to lower position, two passages between said piston and said lower cylinder, a one-way check valve in one of said passages and a constricting valve in the other, a liquid in said piston and in said lower cylinder, a source of supply for gaseous fluid to said upper cylinder and to the upper interior portion of said piston, respectively, said passages being controlled by said piston valve, whereby pressure may selectively be applied to said upper cylinder, thereby driving said piston down with corresponding restricted flow of liquid thereinto, or applied within said piston, with corresponding expulsion of liquid through said check valve into the lower cylinder thereby raising said piston, with corresponding release of pressure from within the piston or from the upper cylinder, as the case may be.

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