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2,657,595

PRESSURE FLUID OPERATED TOOL WITH
PRESSURE FLUID CONTROL FEEDErnest H. Shaff, Spring Lake, Mich., assignor to
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The invention relates to air operated tools and more especially to tools of the type in which the tool body is adapted for attachment to a jig plate or the like in fixed relation to the work to be operated upon and having means for reciprocating a tool spindle with a controlled rate of feed and automatic return to retracted position.

The present invention has for its primary object the provision of a tool of this character which is operated by air or other fluid under pressure and includes a control mechanism of simple character capable of effecting a rapid approach of the tool spindle to the work, then a feed movement of a predetermined length, and finally a rapid return of the spindle to its initial position.

Another object is to provide a tool having a rotary air motor constituting a plunger actuated in one direction by fluid pressure and in the other by a spring, with a simple valve device controlling the supply of fluid pressure, with the exhaust thereof through the motor when the latter is returned by the spring.

A further object is to provide a pressure fluid operated tool having a simple spring biased valve and control mechanism therefor including latch means disengageable at a predetermined point in the advance of the tool spindle to interrupt its feed movement and thereupon effect the return of the spindle.

The objects of the invention thus generally set forth, together with other and ancillary advantages are attained by the construction and arrangement shown by way of illustration in the accompanying drawings, in which:

Figure 1 is a longitudinal sectional view through the tool embodying my invention and showing the control valve in closed position.

Fig. 2 is a transverse section taken approximately in the line 2-2 of Fig. 1.

Fig. 3 is a fragmentary sectional view showing the control valve latched in open position.

I have herein shown my invention for purposes of illustration as embodied in a tool comprising in general a main air or feed cylinder 7 having a rear closure head 8, a rotary air motor 9 in a cylindrical housing 10 constituting a plunger reciprocable within the cylinder, the rear wall of which housing coacts with the head 8 to define a rear pressure chamber 11 and said housing further being provided with an air inlet port 12 to the motor. Valve means 13 carried by the head 8 includes a longitudinal shiftable valve stem 14 spring biased to closed position and arranged to be held in open position by latch means gen-

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erally designated 15. Rapid approaching and feed movements are governed by a control mechanism including an oil cylinder 16, a piston 17 on a control rod 18 equipped with a pair of control dogs 19 and 20 for coaction with an operating member 21 on the motor housing, and a third or feed stop dog 22 for coaction with the latch means 15, the dog 19 serving to terminate the rapid approaching movement of the tool, and the dog 20 to effect the retraction of the piston 17 when the motor housing is returned to its initial position by the action of a return spring 23.

As herein shown the cylinders 7 and 16 are made in the form of a unitary casting, with the latter cylinder disposed at one side of and parallel to the air cylinder near the rear end thereof. At its forward end the air cylinder is in open communication with the atmosphere and carries a fitting 24 for attachment to a jig plate (not shown) and equipped with a drill guide bushing 25. The internal bore of the air cylinder is of uniform diameter throughout its length and the rear closure head 8 has a tight or driving fitting in the rear end of the bore so as to form the rear wall of the pressure chamber 11.

The air motor 9 is preferably of the rotary vane type shown in my prior Patent No. 1,940,024. It is mounted in the cylindrical housing 10 which includes an elongated tubular member or sleeve 26 equipped with suitable end plates. As herein shown the rear end plate of the housing provides an anti-friction bearing support for the rear end of the motor shaft 28 and is equipped with a suitable packing ring 29 for coaction with the internal wall of the cylinder. Thus the rear closure plate coacts with the cylinder closure head 8 to define the pressure chamber 11 so that when air is admitted to the chamber by the operation of the valve means 13 an advancing movement is imparted to the housing and therefore to the drill spindle. Simultaneously, air is admitted to the motor 9 through the inlet port 12. For the escape of exhaust air from the motor, the housing 10 is equipped with a plurality of longitudinal slots 30.

The valve 13 comprises, in the present instance, a tubular valve casing or sleeve 31 mounted in the head 8 and herein disposed axially of the motor housing on the rear end thereof. Its forward end terminates short of an air supply passage 32 and forms a seat for a valve preferably in the form of a disk 33 on the valve stem 14. Rearwardly of this seat the sleeve 31 has a port 34 connected by a passage 35 with the rear pressure chamber 11. The sleeve 31 has a tight fit in

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bore 36 in the closure head 8, the forward end of the bore being closed by a threaded plug 37 countersunk for the reception of a spring 38 interposed between the plug and the valve. Rearwardly of the valve disk, the valve chamber has a portion 39 of reduced diameter and terminating in a cylindrical portion 40 having a close sliding fit in the rear portion of the valve casing.

It will be seen that when the valve stem is moved forwardly from the position shown in Fig. 1 against the action of the spring 38, communication is established between the supply passage 32 and the valve port 34 so as to deliver air through the passage 35 to the pressure chamber 11, thereby causing the plunger and tool spindle to advance toward the work. At the same time air is admitted from the chamber to the motor through the inlet port 12 to impart rotation to the spindle.

In the present embodiment the valve stem 14 is arranged for manual operation. For this purpose it has a push button 41 on the rear projecting end of the stem. The latter also is provided with a peripheral groove 42 for the reception of a latch pin 43 forming part of the latch means 15. This pin is slidable radially in the closure head 8, a hole being provided in the sleeve for the inner end of the pin. At its outer end the pin is pivoted to a lever 44 fulcrumed at 45 in a slot 46 formed in the outer surface of the head. A spring 47 seated in a socket in the head acts upon the forward end of the lever so as to bias the latch pin toward the valve stem. Accordingly, when the stem is shifted forwardly to open the valve, the latch pin enters the groove under the action of the spring 47.

The oil cylinder 16 (which is adapted to be completely filled with oil) is equipped with a liner 48 and end plates 49 clamped together by a plug 50 screw threaded into the rear end of the cylinder. At opposite sides of the piston the rod 18 is provided with ports 51 and 52 connected by a longitudinal passage 53 counterbored to provide a seat for a needle valve 54. The latter extends through an axial bore 55 in the rearward extension 18a of the rod, the rear end of the needle valve being threaded into the bore and having a projecting portion with an adjusting knob 56. It will be obvious that by adjusting the needle valve, the rate of the advancing movement of the piston in the oil cylinder may be regulated.

The dogs 19 and 20 are adjustably mounted on a forward extension 18b of the rod for coaction with the operating member 21. The latter is in the form of a stud screw threaded into the housing 10 (Fig. 2) and projecting through a slot 57 in the air cylinder 7. The dog 19 is positioned on the rod so as to be engaged by the operating member 21 at a predetermined point in the advance of the tool spindle, that is, at the end of the approaching movement of the tool to the work, whereupon the piston 17 becomes effective to govern the rate of advance of the tool as determined by adjustment of the needle valve.

To limit the feeding movement of the tool, the dog 22 on the rear extension of the rod 18 is arranged to disengage the latch member 15 and cut off the flow of air to the chamber 11. To this end the latch member 44 has an arm 58 disposed in the path of travel of the dog 22 (see Fig. 3) so as to be engaged by the latter at the end of the feeding movement with the result that the latch pin 43 is withdrawn and the valve member released to the action of its spring 38 for movement into closed position. Thereupon the motor

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housing together with the tool spindle are returned by spring 23 acting between the fitting 24 and the forward end of the housing 13. During such return movement oil is permitted to flow freely from the rear side of the piston 17 to the forward side thereof through a one-way valve 59 in the piston. Also during such return movement air in the rear pressure chamber 11 is permitted to exhaust to the atmosphere by virtue of the restricted communication therewith through the motor, entering the latter by way of the port 12.

To minimize side pressure on the control rod 18 incident to engagement between the dogs 19 and 20 on the one hand and the operating member 21 the outer end of the latter member is formed with a flared head 60 and the dogs 19 and 20 have their lower portions appropriately notched as indicated at 61 so that the head 60 will engage with the dogs with a hook action. To hold the rod 18 against turning, its forward extension 18b is formed with a flat side 62 (Fig. 2) for coaction with the flat upper surface of the head 60 on the operating member 21.

The forward end of the air cylinder may be formed with one or more side openings 63 to permit of access to a chuck 64 for a drill or the like carried by the forward end of the motor shaft, the spring 23 being disposed in encircling relation to the chuck.

It will be observed that by the construction and arrangement employed the tool spindle is advanced by fluid under pressure and such advance is controlled so as to effect first a rapid approaching movement followed by a feeding movement. The rapid approaching movement occurs independently of the dashpot control means, by reason of the lost motion connection between the motor housing and the control rod, while the length of such approaching movement may be varied by a simple adjustment of the dog 19. Following the rapid approaching movement the tool is advanced at a desired feeding rate as determined by the adjustment of the needle valve 54 and the feeding movement is terminated automatically by the disengagement of the latch pin 43 from the valve stem by the operation of dog 22 which latter is also adjustable to vary the extent of feeding movement. Finally, the tool is retracted by spring 23 at a rapid rate as permitted by the free flow of oil from the rear side of the piston to the forward side thereof. In this operation the exhaust of air from the pressure chamber occurs through the motor thus simplifying the control valve.

I claim as my invention:

1. A pressure fluid operated tool comprising, in combination, a rotary tool spindle, means for driving said spindle, a cylinder in coaxial alignment with said spindle, a plunger slidably mounted in said cylinder and operatively connected with said spindle to produce longitudinal movement thereof, means for controlling the operation of said spindle drive means and for controlling the supply of pressure fluid into said cylinder behind said plunger to advance said plunger and said spindle, the latter means including a valve normally biased toward closed position, and further including means for moving said valve to open position, a latch device automatically operable to hold said valve in open position, a control member arranged for movement by said plunger at a predetermined point in the advancing movement thereof to cause said latch device to release said valve for movement into closed position, said cylinder having an exhaust pas-

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sage therein providing continuous restricted communication with the atmosphere and effective to permit release of fluid pressure in said cylinder behind said plunger when said valve means is closed, and spring means interposed between said cylinder and said plunger, said spring means being compressed upon advancement of said plunger and operative to automatically restore said parts to initial position upon reduction of fluid pressure in said cylinder due to closing of said valve.

2. A pressure fluid operated tool comprising, in combination, a rotary tool spindle, means for driving said spindle, a casing having a cylinder therein, a plunger slidably mounted in said cylinder and operatively connected with said spindle for producing longitudinal movement thereof, said cylinder and plunger cooperating to define an expandable rear pressure chamber, means for introducing pressure fluid into said chamber to advance said plunger and extend said spindle outwardly, a valve for controlling the supply of pressure fluid to said cylinder, means for moving said valve to open position to initiate advancement of said plunger and spindle, a latch device automatically operable to hold said valve in open position for full stroke extension of said spindle, a second cylinder on said casing and disposed alongside said first cylinder, a piston slidably mounted in said second cylinder and having a control member extending out the forward end of the cylinder through a fluid-tight seal, lost motion means interconnecting said control member and said plunger for causing said piston to move forwardly with said plunger after said plunger has traversed a predetermined distance independently of said piston, said second cylinder being adapted to be filled with liquid to serve as governor to control the advancement of said plunger and spindle, an orifice in said piston to permit flow of liquid from one side of said piston to the other, means operable from outside said second cylinder for adjusting the size of said orifice to regulate the speed of advancement of the parts moved forwardly by said plunger, a second control member on said piston and extending out of the rear end of said second cylinder through a fluid tight seal, lost motion means interconnecting said second control member with said valve to close said valve after said plunger has advanced a predetermined distance, and spring means interconnecting said cylinder and said plunger to automatically restore said parts to initial position upon closing of said valve.

3. A pressure fluid operated tool comprising, in combination, a fluid motor having a rotary tool spindle, a feed cylinder, a hollow plunger in said cylinder providing a housing for said motor, valve means controlling the supply of pressure fluid to said motor to effect the operation thereof and to the cylinder to advance the plunger therein and thereby advance the tool spindle, said valve means including a valve member biased toward closed position, a latch operative to hold the valve member in open position, and a control mechanism including an oil cylinder at one side of the feed cylinder having a control rod extending therethrough and a piston on said rod, said control rod having a lost motion connection with the plunger for movement by the latter at a predetermined point in the travel of the plunger, and means on said rod for causing the release of said latch device so that said valve can close to stop said fluid motor and to terminate the advance of the plunger.

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4. A pressure fluid operated tool comprising, in combination, a fluid motor having a tool spindle, a feed cylinder having restricted communication with the atmosphere through said motor, a plunger in said cylinder, said plunger and motor being operatively interconnected so that advancement of said plunger will cause extension of said spindle, valve means controlling the supply of pressure fluid to said motor to effect the operation thereof and to the cylinder to advance the plunger and thereby the tool spindle, said valve means including a valve member biased toward closed position, a latch operative to hold the valve member in open position, and a control mechanism including an oil cylinder at one side of the feed cylinder and having a control rod extending therethrough and a piston on said rod, said control rod having a lost motion connection with the plunger for movement by the latter at a predetermined point in the travel of the plunger, means carried by said control rod engageable with said latch at a predetermined point in the travel of said control rod to release said latch so that said valve can close to interrupt the supply of pressure fluid, and spring means operative upon the closure of said valve member to effect the return of the plunger as said cylinder exhausts.

5. A pressure fluid operated tool comprising, in combination, a tool spindle and a fluid drive motor therefor, a cylinder, a hollow plunger mounted in said cylinder and providing a housing for said motor, said plunger having a face disposed transaxially of said cylinder, said cylinder and plunger defining a rear pressure chamber behind said plunger, a port formed in the face of said plunger and constantly establishing communication between the motor and the pressure chamber, valve means for controlling the supply of fluid to said chamber to advance the plunger and drive said motor, and spring means interconnecting said plunger and cylinder for returning the plunger upon closure of said valve means, the fluid in said pressure chamber exhausting through said motor in the return movement of the plunger by said spring means.

6. A pressure fluid operated tool comprising, in combination, a rotary tool spindle, means for driving said spindle, a feed cylinder, a plunger slidably mounted in said cylinder and operatively connected with said spindle for producing longitudinal movement thereof, said cylinder and plunger cooperating to define an expandable rear pressure chamber, means for introducing pressure fluid into said chamber to advance said plunger and extend said spindle outwardly, a valve for controlling the supply of pressure fluid to said cylinder, means for moving said valve to open position to initiate advancement of said plunger and spindle, holding means operable to maintain said valve in open position for full stroke extension of said spindle, a movement control mechanism disposed alongside said first cylinder and connected thereto, said mechanism including a second cylinder with a piston slidably mounted therein, means for interconnecting said mechanism and said plunger for causing relative movement between said second cylinder and said piston after said plunger has traversed a predetermined distance independently of said mechanism, said last mentioned means including an adjustable lost motion connection to regulate the extent of movement of said plunger independently of said mechanism, a second lost motion connection including an element carried by

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said piston and operative to interconnect said plunger with said holding means for closing said valve after said plunger has advanced to a predetermined point, and means for adjusting the extent of lost motion in said second lost motion connection for adjusting the maximum extension of said spindle under influence of said plunger.

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