April 27, 1926. 1,582,468

J. N. HEALD ET AL

FLUID PRESSURE CONTROLLING AND REVERSING MECHANISM FOR GRINDING MACHINES AND THE LIKE

Filed April 4, 1923 2 Sheets-Sheet 1

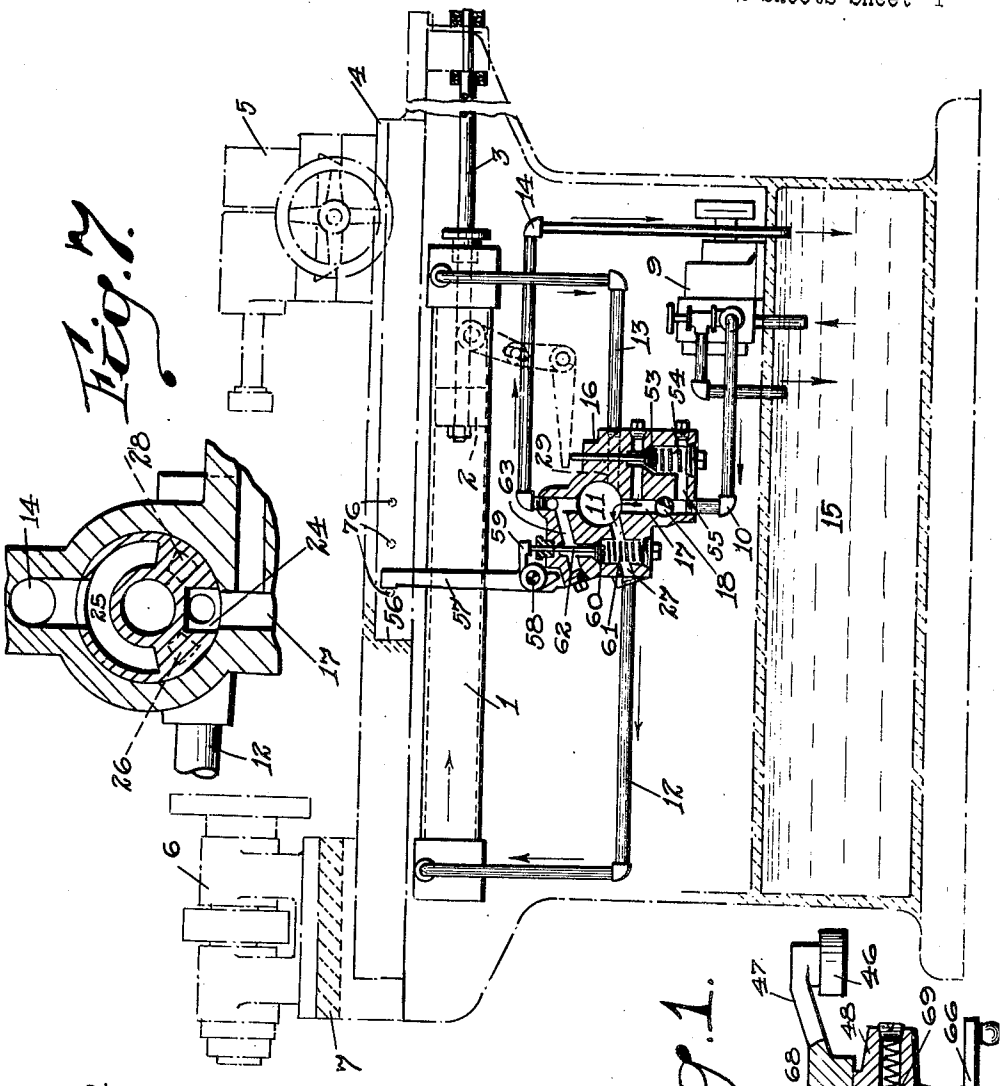


Fig. 7.

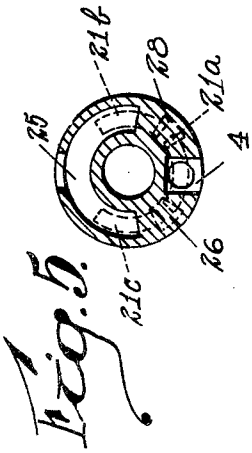


Fig. 5.

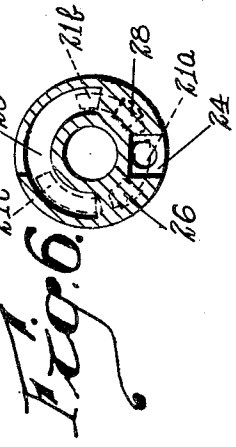


Fig. 6.

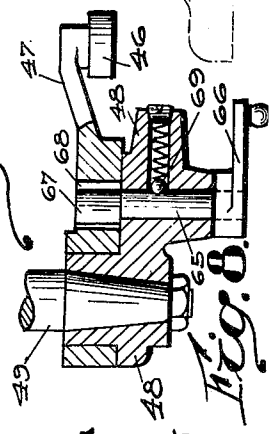


Fig. 1.

Fig. 8.

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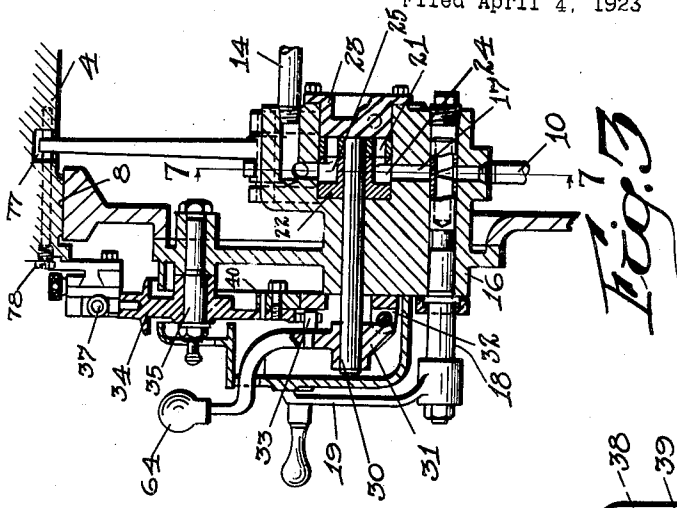


Fig. 3.

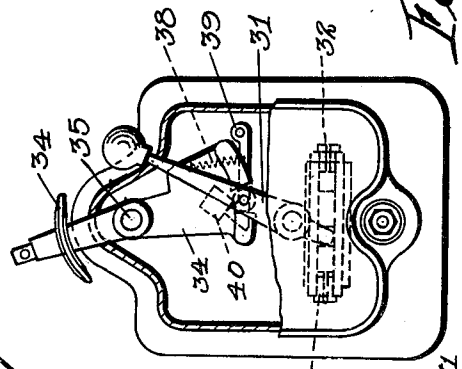


Fig. 4.

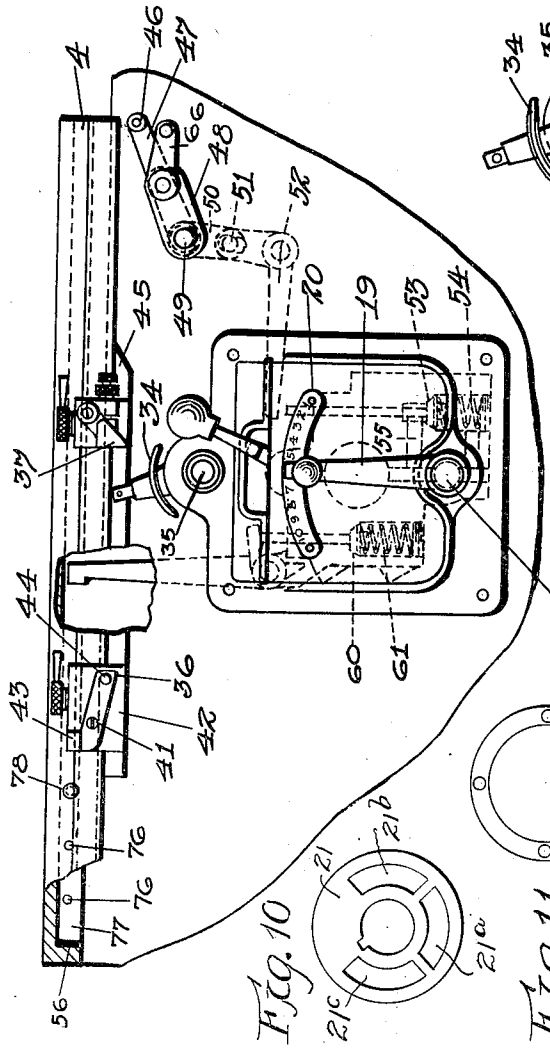


Fig. 2.

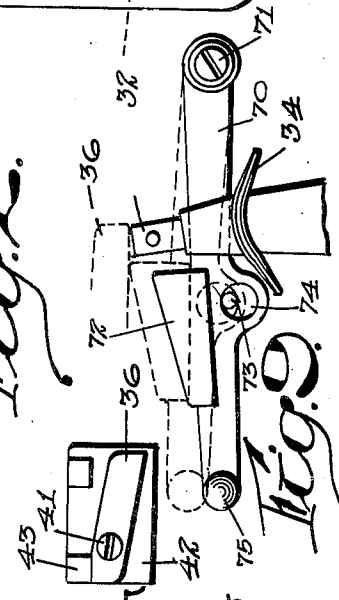


Fig. 5.

Fig. 10

Fig. 11.

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Patented Apr. 27, 1926. 1,582,468

UNITED STATES PATENT OFFICE.

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FLUID-PRESSURE CONTROLLING AND REVERSING MECHANISM FOR GRINDING MACHINES AND THE LIKE.

Application filed April 4, 1923. Serial No. 629,882.

To all whom it may concern:

Be it known that we, JAMES N. HEALD and WALDO J. GUILD, both citizens of the United States, residing at Worcester, in the county of Worcester and Commonwealth of Massachusetts, have invented a new and useful Improvement in Fluid-Pressure Controlling and Reversing Mechanism for Grinding Machines and the like, of which the following, together with the accompanying drawings, is a specification.

The present invention relates to fluid pressure mechanism for controlling and reversing the movements of reciprocatory machine elements,—being here shown and described, by way of example, in operative relation to the wheel slide of an internal grinding machine. The invention, however, is susceptible of application to numerous other and different uses, wherein fluid under pressure, in conjunction with a hydraulic piston and cylinder, serves as the actuating medium to procure and control the reciprocatory movements of various parts of machinery.

The features of the invention are fully set forth hereinafter, reference being had to the accompanying drawings, wherein—

Fig. 1 is an interior view, partly in section, showing a fluid pressure actuating system applied to the table or carriage of an internal grinding machine, and showing our invention in connection therewith.

Fig. 2 is an exterior view, in side elevation, of the control mechanism for said fluid pressure system.

Fig. 3 is a transverse sectional view of said control mechanism.

Fig. 4 is a view similar to Fig. 2, with certain parts broken away or removed to disclose the interior arrangement.

Figs. 5 and 6 are enlarged diagrammatic views, showing the reversing valve device in two different positions, with reference to the stationary seat ports thereof.

Fig. 7 is a sectional view, on an enlarged scale, the section being taken on the line 7—7 of Fig. 3.

Fig. 8 is a fragmentary sectional view of certain valve operating parts shown in Fig. 2.

Fig. 9 is an enlarged fragmentary front view of a dog-lifting device.

Fig. 10 is a plan view of an oscillatory ported member forming part of the valve.

Fig. 11 is a detail view of the valve cap or closure.

Like reference characters refer to like parts in the different figures.

Referring first to Fig. 1, there is shown a fluid pressure cylinder 1, the latter containing the usual double acting piston 2 which is suitably connected, as by a rod 3, with the element 4 to be reciprocated,—here shown as the table or carriage of an internal grinding machine. In such a machine, either the grinding wheel or the work to be ground may be carried on the table 4, the reciprocations of the latter being utilized in either case to produce a relative traversing movement between the grinding wheel and the work. As here shown, the table 4 supports and carries the usual grinding wheel head 5, with the work supporting head 6 carried by a bridge 7, which spans the slideways of the machine frame in which the table 4 moves,— one of said slideways being shown at 8, Fig. 3.

For the back and forth movement of table 4, fluid under pressure is admitted to one end or the other of cylinder 1, the pressure fluid being forced by a pump 9 into a supply pipe 10, the latter leading to a reversing valve, designated generally by the numeral 11, the position of which, as hereinafter described, determines the flow of pressure medium to one end or the other of cylinder 1 by way of pipe 12 or pipe 13, as the case may be. The return of pressure medium from the reversing valve 11 is by way of a pipe 14 which leads to the pump supply chamber or tank 15, here shown as formed in the lower part of the machine frame.

The valve devices for controlling the pressure fluid are conveniently disposed in a suitable casting 16, bolted to the front of the machine frame, and providing a passage 17 to the reversing valve proper from the fluid pressure supply pipe 10. The passage 17 is provided with a rotatable plug or throttle valve 18, adapted to be adjusted by

a handle 19, the position of which, with reference to a suitably graduated scale 20, determines the quantity of pressure fluid flowing through the passage 17 and hence the speed at which the table 4 is reciprocated.

The reversing valve employed herein is substantially the same in construction and operation as that shown and described in the pending application of Drake and Hubbell, Serial No. 528,118, filed January 9, 1922, and consisting of an oscillatory ported member 21 which works between stationary ported seat members 22 and 23. Said seat member 22 has one recess 24 in constant communication with the supply passage 17, and another separate independent recess in constant communication with the return pipe 14. The oscillatory valve member 21 has three apertures therethrough, as indicated by broken lines 21^a, 21^b and 21^c, Figs. 5 and 6; when the valve is rocked clockwise, into the position indicated in Fig. 6, the aperture 21^a connects the recess 24 with a port 26 in the other seat member 23, said port 26 opening through passage 27 to the pipe 12 that leads to the left hand end of cylinder 1. At the same time, the valve aperture 21^b establishes communication between exhaust recess 25 and the port 28 of seat member 23, the latter connected by a passage 29 with the pipe 13 that leads to the right hand end of cylinder 1. In this position of the reversing valve therefore, as shown in Fig. 6, the pressure fluid is delivered by the pump to the left hand end of the cylinder, to force the piston 2 to the right, and the pressure fluid on the right hand side of said piston has a free unthrottled passage back to the supply tank through pipe 13, passage 29, port 28, valve aperture 21^b, recess 25 and return pipe 14.

When the valve member is rocked counterclockwise into the reverse position from that illustrated in Fig. 6, the aperture 21^a connects the recess 24 with port 28, and the flow of pressure fluid is to the right hand end of cylinder 1 through pipe 13. The resulting movement of piston 2 to the left expels the pressure fluid from the left hand end of cylinder 1 through pipe 12, passage 27 and port 26, the latter in this position of the valve being connected to the exhaust recess 25 and the return pipe 14 by the valve aperture 21^c. In the intermediate or neutral position of valve member 21, as shown in Fig. 5, the aperture 21^a overlaps supply recess 24 and also both ports 26 and 28, while the apertures 21^b and 21^c are so disposed as to establish communication between the cylinder ports 28 and 26, respectively, and the exhaust recess 25 and return pipe 14. As a consequence, direct communication is established by the valve between the supply and return of the system, the valve in its neutral position acting as a bleeder, so as to permit circulation of the pressure fluid without building up an excessive pressure. At the same time, the pressure fluid, instead of being locked in the cylinder 1 when the valve is in neutral position, can escape freely through said valve to the return pipe 14, this permitting the table 4 to be shifted by hand, as desired.

Movement of valve member 21 is accomplished by oscillation imparted to a shaft 30, secured to said valve and carrying on its other end a member 31 which works between a pair of limiting stops 32, 32. The member 31 is provided with a pin 33 which is received in a slot provided by the lower edge of a swinging plate 34, pivoted at 35, with its upper end disposed in the path of a pair of spaced adjustable dogs or stops 36 and 37, carried by the table 4. When struck by one or the other of these dogs, the plate 34 is rocked on its axis 35, and the initial movement thereof thus inaugurated to impart reversing movement, through the member 31, to the valve shaft 30, is continued by the action of a spring 38, the latter maintaining the pointed end of a cam lever 39 in contact with the flat angular sides of a projection 40 on the rear of plate 34, as shown in Fig. 4. The initial movement of plate 34 distends said spring by the action of said cam surfaces, and as soon as the apex of projection 40 is reached, the spring is effective through said cam surfaces, to project the plate 34 through the remaining portion of its movement, thus procuring a quick reversal of the valve, irrespective of the speed at which the table 4 may be moving.

To obtain the desired relative traversing movement between the grinding wheel and the work to be ground, the dog 36 is set to engage the plate 34 at the right hand limit of grinding wheel traverse, and the dog 37 is similarly adjusted to engage said plate at the left hand limit of grinding wheel traverse, it being understood that in the normal operation of the machine, with the grinding wheel in contact with the work, the table 4 will be reversed at each successive engagement of said plate 34 by said dogs, which, obviously, are spaced apart on said table a distance substantially corresponding to the working stroke of the grinding wheel. In the use of an internal grinding machine such as here shown, there is frequent necessity for interrupting the grinding operation in order that the operator may size or plug the hole which is being ground; such action by the operator, and also the removal of work from the machine and the introduction of a new piece, requires the wheel and the work to be separated axially or longitudinally, in order to give access to said work. In the machine herein illustrated, this separation is obtained by continuing the move-

ment of table 4 to the right, and for this purpose, the dog 36 is so constructed that it can be passed over the plate 34, whenever desired, without effect on the reversing valve 21, the latter remaining in the position illustrated by Fig. 6, wherein it supplies pressure fluid to the left hand end of cylinder 1.

To this end, the dog 36 is pivoted at 41 to its carrying block 42, with one end normally bearing by gravity against a stop 43 on said carrying block, whereby to dispose the other or striking end of said dog in position to engage the plate 34. Said pivoted dog 36 has a projecting pin or handle 44, by which the operator of the machine can, whenever desired, swing the striking end upwardly, so as to clear the top of plate 34; this, obviously, prevents the reversal of the table which would otherwise take place at its right hand limit of working reciprocation,—the right hand movement being continued so as to withdraw the grinding wheel altogether from the working zone, as shown by broken lines in Fig. 1.

The carrying block 42 of pivoted dog 36 supports also an elongated bar or cam 45, Fig. 2, the right hand end of which is spaced from the dog 36 by a distance slightly less than that between the top of plate 34 and a cam roller 46, carried by the end of an arm 47. In the normal working reciprocation of the table, when the grinding wheel is in contact with the work, the roller 46 is not reached by the bar or cam 45, since the dog 36 will always strike the plate 34 to reverse the table, when the cam and roller are still a little distance apart. However, when the dog 36 is lifted by the operator, as above described, to pass the plate 34 and thereby inaugurate a non-working movement of the table to the right, the bar or cam 45 engages roller 46 to depress the arm 47.

Said arm 47 is normally arranged to cause a corresponding depression of a member 48, thereby to rock a shaft 49 which carries member 48, and also carries an arm 50, the latter having a pin and slot connection 51 with a bell crank lever 52. The latter provides an arm in operative relation to the stem of a poppet valve 53, which is normally held seated by a spring 54 to shut off the flow of pressure fluid through a passage 55 which by-passes the throttle valve 18. The depression of roller 46 by bar or cam 45, which occurs just after the dog 36 has passed over the plate 34, obtains, through the medium of bell cranks 48 and 51, the opening of valve 53, thereby giving a maximum flow of pressure fluid through the reversing valve to the left hand end of cylinder 1. This insures the right hand non-working movement of table 4 at the maximum speed, irrespective of the setting of throttle valve 18, thereby eliminating any unnecessary loss of time in moving the grinding wheel away from the work. The bar or cam 45 maintains its engagement with the roller 46 throughout the entire withdrawal movement, thus automatically maintaining the high speed of table travel until the table is brought to rest in the manner now to be described.

The limit of right hand withdrawal movement of table 4 is predetermined by the engagement of a shoulder 56, on the under side of said table, with a lever arm 57, the latter being pivoted at 58 and having an extension 59 in operative relation to the stem of a poppet valve 60, which is normally held to its seat by a spring 61, so as to close communication through a passage 62 in the casting 16. The passage 62 connects the passage 27 of left hand cylinder pipe 12 with a passage 63 that leads to fluid pressure return pipe 14. When the valve 60 is opened, by engagement of shoulder 56 with lever arm 57, the pressure fluid that would otherwise flow to the left hand end of cylinder 1 is able to escape through passages 62 and 63 into the return pipe 14, and thus the table 4 comes to rest, without need for any shifting of reversing valve 21, the latter simply remaining in the position, indicated by Figs. 2, 4 and 6, which normally involves the continued right hand movement of table 4. In this position of rest of the table, the same as when the valve 21 is brought to the neutral or centered position indicated in Fig. 5, there is a free circulation of the pressure fluid through the system and a consequent absence of any excessive pressure for the pump 9 to work against; thus the relief valve of said pumping system is not called upon for service in this stationary withdrawn position of the table.

For the return movement of the grinding wheel to the work, after the sizing or replacement of the latter has been accomplished, the reversing valve 21 needs to be shifted, counterclockwise, into its other extreme position, so as to direct the flow of pressure fluid through pipe 13 to the right hand end of cylinder 1. The operator inaugurates this return movement by turning the valve shaft 30 counterclockwise, and to facilitate such action, the member 31, secured to said shaft, is extended upwardly to provide a handle 64 in convenient reach of the operator. The instant the valve is shifted, the supply of pressure fluid is diverted from passage 27 to passage 29, so as to enter the right hand end of cylinder 1 and drive the piston 2 and table 4 to the left. As soon as said left hand movement is initiated, the shoulder 56 withdraws from lever arm 57, allowing the poppet valve 60 to close instantly under the action of its spring 61. However, during this return movement of the grinding wheel toward the working

zone, the poppet valve 53 will be held open, owing to the continued engagement of bar 45 with cam roller 46, thus maintaining the high speed travel of the table; just before the grinding wheel reaches the work, the end of bar 45 leaves the cam roller 46, thus allowing the poppet valve 53 to close instantly under the action of its spring 54, whereupon the travel of the table is slowed down to the speed previously fixed by the setting of throttle plug 18. The table 4 thus resumes its normal working reciprocations over the path determined by the two spaced dogs 36 and 37, it being understood that the passage of dog 36 over plate 34 on this left hand return movement of the table requires no action on the part of the operator, since said dog, being pivoted to turn counterclockwise, will of itself yield to permit such action, and will then by gravity resume its normal position for operative engagement with plate 34 on the ensuing right hand movement of the table.

Should it be desired to forego the high speed movement of the table, when the grinding wheel is removed from its working zone, as when withdrawn for the purpose of dressing or truing said wheel, the connection between arm 47 and member 48 may be rendered ineffective, thus to prevent the opening of poppet valve 53, notwithstanding the disposal of bar 45 above cam roller 46. As shown in Fig. 8, the arm 47, which carries cam roll 46, is loosely journalled on the hub of member 48, and the connection between said arm 47 and member 48 is provided by a shaft 65 journalled in member 48 and having on its outer end a handle 66 by which it may be turned. An eccentric or cam 67 on the inner end of said shaft is received within an enlarged aperture 68 of the arm 47, the construction being such that when the handle 66 is rocked counterclockwise into the position shown in Fig. 2, the arm 47 is elevated to maintain the roller 46 in the path of bar 45, the parts being thus connected to transmit the depression of arm 47 to open valve 53, as heretofore described. When, however, the handle 66 is rocked downwardly or clockwise, the cam or eccentric 67 is so turned as to allow the arm 47 to drop, thus moving the roller 46 below the path of bar 45; under these conditions, there is no opening of the valve 53 and hence no acceleration of the table in its non-working zone. As shown in Fig. 8, the operative and inoperative positions of the shaft 65 are frictionally maintained by a spring pressed ball 69, adapted to seat in one or the other of a pair of suitable depressions provided by said shaft.

In order to facilitate the elevation of pivoted table dog 36, in the act of causing the grinding wheel to be withdrawn from its working zone, the construction shown in Fig. 9 may be adopted, in lieu of or in addition to the pin or handle 44 projecting from said dog. As shown in Fig. 9, a lever arm 70, pivoted at 71 to the frame of the machine, provides a rising cam surface 72 at the left hand side of the projecting upper end of plate 34. Said lever 70 in its normal, or inoperative, position, as indicated in full lines in Fig. 9, rests by gravity against a pin or stop 73, said pin projecting from the frame into an enlarged hole or recess 74 of said lever. The loose fit of pin 73 in the hole 74 allows the lever 70 to be lifted into the dotted line position of Fig. 9, when seized by its projecting handle 75, thereby bringing cam 72 into the path of pivoted dog 36, so that, on the right hand movement of the table, said dog will ride upwardly on said cam surface and just clear the upper end of plate 34. In this way the operator, in the act of causing said dog to pass inoperatively over plate 34, is relieved of the necessity for seizing hold of a moving member, i. e., the dog itself,—and is enabled to effect the desired result by elevation of a member which undergoes no change of position along the frame of the machine.

In respect of the stoppage of table 4 by the automatic opening of poppet valve 60, it is to be noted that the actuation of lever arm 57 for this purpose may be effected in advance of the arrival of shoulder 56, on the right hand withdrawal movement of the grinding wheel. To this end, the table is conveniently provided with a series of transverse holes 76, 76, crossing the longitudinal slot 77, which receives the end of arm 57, and which slot is terminated at its left hand end by shoulder 56. The insertion of a bolt 78 into one of these holes 76 furnishes an abutment adapted to engage the lever arm 57 with the same effect as the shoulder 56 and thus serves to bring the table to rest at any desired point short of its extreme limit of right hand travel. This expedient is especially useful when the work that is being ground is so short as not to require, for access thereto, the full right hand withdrawal movement of the grinding wheel.

We claim:

1. Apparatus of the class described, comprising a table reciprocable by fluid under pressure, a reversing valve for the pressure fluid and adjustable stops on said table for operating said valve, in combination with means interposable in the path of one of said stops to render said stop inoperative to allow said table to move beyond said stop when desired.

2. Apparatus of the class described, comprising a table reciprocable by fluid under pressure, a reversing valve for the pressure fluid and adjustable stops on said table for operating said valve, in combination with a normally stationary lever adapted by move-

ment to render one of said stops inoperative to allow said table to move beyond said stop.

3. Apparatus of the class described, comprising a table reciprocable by fluid under pressure, a reversing valve for the pressure fluid, means for throttling the pressure fluid to control the speed of said table, and adjustable stops on said table for operating said reversing valve, one of said stops being susceptible of inoperative disposition, to procure the travel of said table beyond its normal reciprocatory path, in combination with means responsive to such travel for automatically rendering said throttling means inoperative.

4. Apparatus of the class described, comprising a table reciprocable by fluid under pressure, a reversing valve for the pressure fluid, means for throttling the pressure fluid to control the speed of said table, and adjustable stops on said table for operating said reversing valve, one of said stops being susceptible of inoperative disposition, to procure the travel of said table beyond its normal reciprocatory path, in combination with means responsive to such travel for automatically by-passing the pressure fluid around said throttling means, whereby to move said table at maximum speed.

5. Apparatus of the class described, comprising a table reciprocable by fluid under pressure, a reversing valve for the pressure fluid, adjustable stops on said table for operating said valve, and means for procuring the travel of said table beyond the normal reciprocatory path determined by said stops, in combination with means operable independently of said reversing valve for bringing said table to rest at the end of such travel yet allowing free flow of the pressure fluid.

6. In apparatus of the class described, a table reciprocable by fluid under pressure through a predetermined working path, means operable to procure the withdrawal of said table from said working path, and means responsive to such withdrawal through a predetermined distance for bringing said table to rest without disturbing the flow of the actuating pressure fluid.

7. In apparatus of the class described, a reciprocatory table, a fluid pressure cylinder having its piston connected to said table, and a reversing valve for the pressure fluid operable normally by said table to confine the latter's movement to a predetermined working path, in combination with means under the control of an operator for procuring a withdrawal movement of said table, by fluid pressure actuation, away from said working path, and means responsive to such withdrawal movement through a predetermined distance for by-passing the pressure fluid around said cylinder, thereby bringing said table to rest.

8. In apparatus of the class described, a table reciprocable by fluid under pressure, a reversing valve for the pressure fluid normally operated by said table at each end of the latter's predetermined working path, means operable at will to prevent a reversal of said valve, thereby obtaining the withdrawal of said table by fluid pressure actuation from said working path, and means for automatically bringing said table to rest at a predetermined distance from said working path in the absence of movement of said reversing valve.

9. In apparatus of the class described, a table reciprocable by fluid under pressure, a reversing valve for the pressure fluid normally operated by said table at each end of the latter's predetermined working path, means operable at will to prevent a reversal of said valve, thereby obtaining the withdrawal of said table by fluid pressure actuation from said working path, and means for automatically bringing said table to rest at adjustable distances from said working path without changing the position of said reversing valve.

10. In apparatus of the class described, a table reciprocable by fluid under pressure, a reversing valve for the pressure fluid normally operated by said table at each end of the latter's predetermined working path, means operable at will to prevent a reversal of said valve, thereby obtaining the withdrawal of said table by fluid pressure actuation from said working path, means responsive to said withdrawal movement for automatically increasing the speed of said table, and means for bringing said table to rest at the end of said withdrawal movement without decrease in the amount of pressure fluid passing through said reversing valve.

11. In apparatus of the class described, a table reciprocable by fluid under pressure, a reversing valve for the pressure fluid operated by said table at each end of the latter's predetermined working path, a throttle device operable on the pressure fluid to control the speed of said table in said working path, means operable at will to prevent reversal of said valve, thereby obtaining the withdrawal of said table, by fluid pressure actuation, from said working path, means responsive to such withdrawal movement for automatically by-passing the pressure fluid around said throttle device, to procure maximum speed of said table during such withdrawal, and means for automatically bringing said table to rest at a predetermined distance from said working path without changing the positions of said reversing valve or said throttle device.

12. In apparatus of the class described, a table reciprocable by fluid under pres-

sure, a reversing valve for the pressure fluid operated by said table at each end of the latter's normal working path, means operable at will to prevent a reversal of said valve, whereby to procure the withdrawal of said table, by fluid pressure actuation, from said working path, and a normally closed valve, adapted to be opened automatically by a predetermined withdrawal movement of said table, the opening of said valve procuring the escape of pressure fluid and the consequent stoppage of said table.

Dated this 30th day of March, 1923.

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