May 28, 1929. A. P. BURNS 1,714,545

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

Filed April 18, 1925 4 Sheets-Sheet 1

Fig. 1.

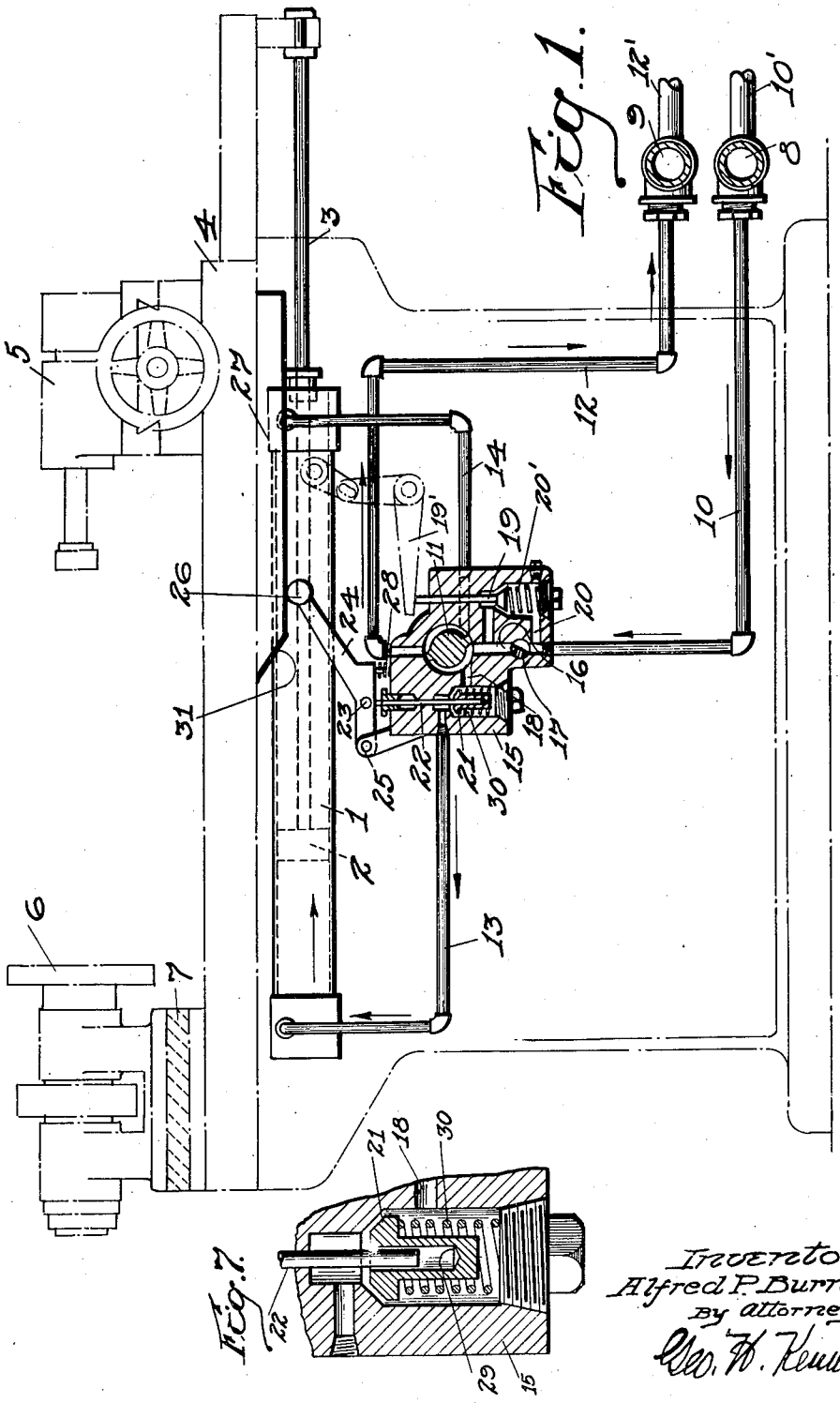


Fig. 7.

Inventor:
Alfred P. Burns
By attorney
Geo. W. Kennedy Jr.

May 28, 1929. A. P. BURNS 1,714,545

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

Filed April 18, 1925 4 Sheets-Sheet 2

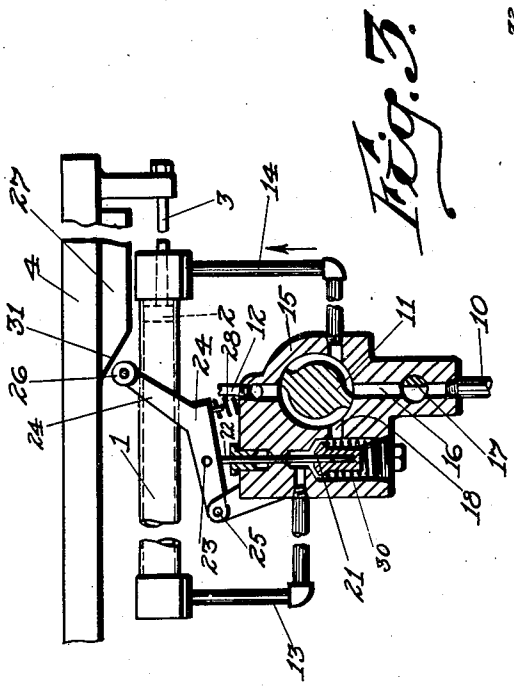


Fig. 3.

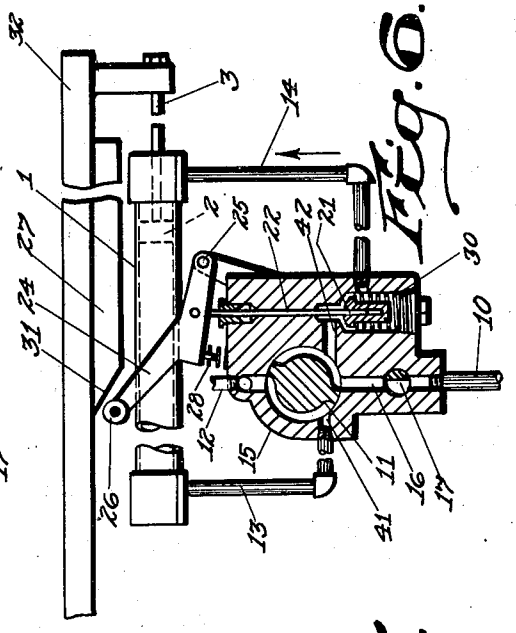


Fig. 6.

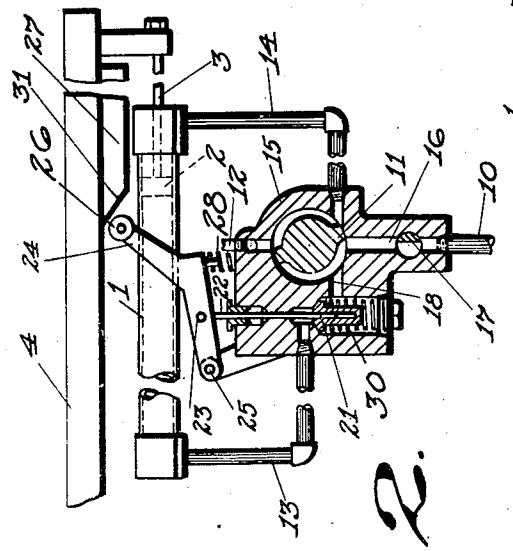


Fig. 2.

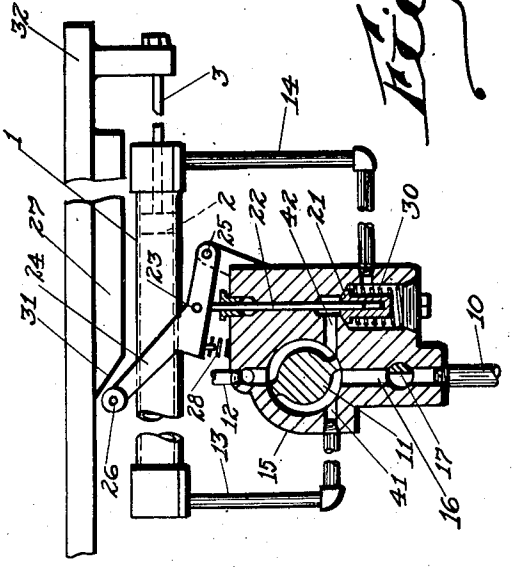


Fig. 5.

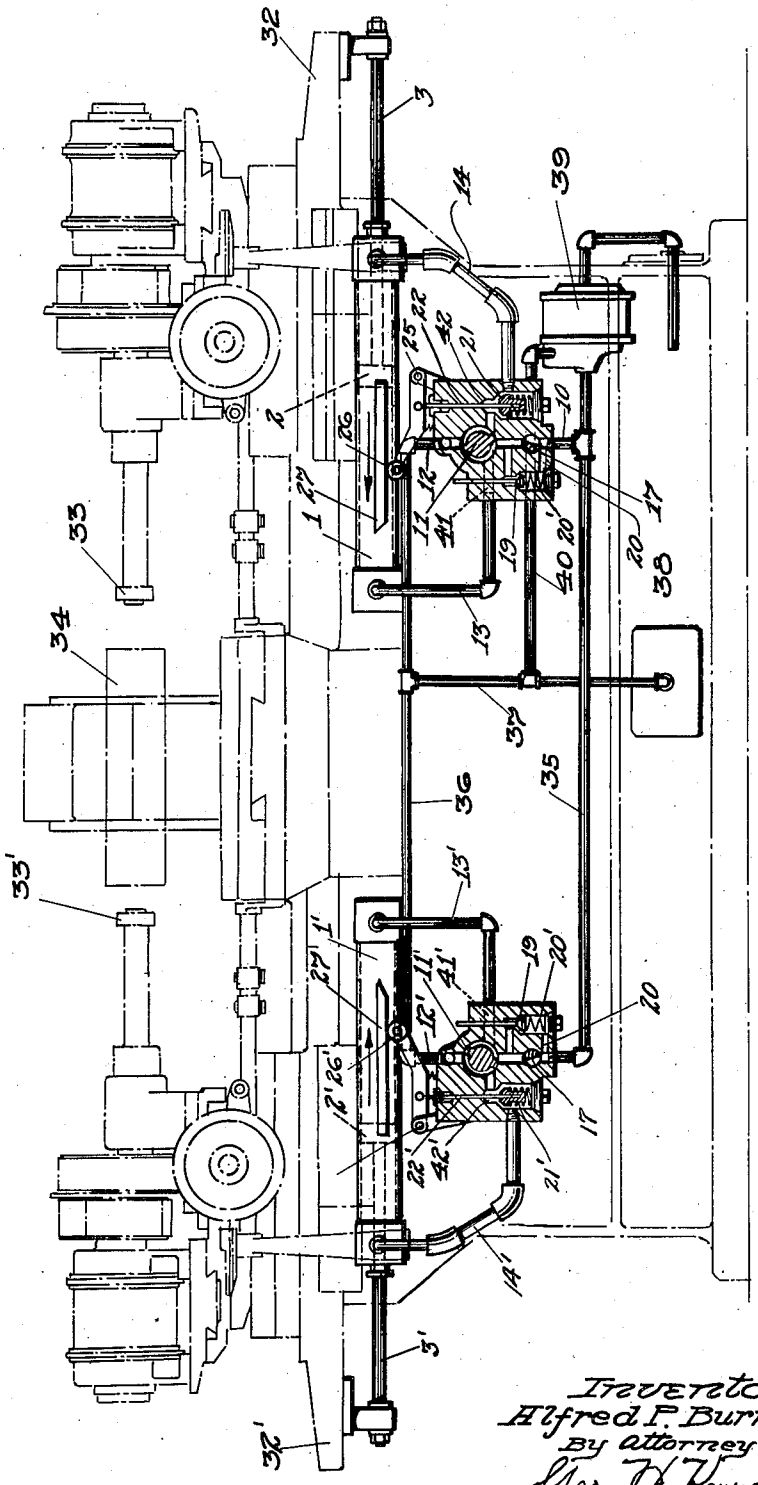
Inventor:
Alfred P. Burns
By Attorney
Geo. H. Kennedy Jr.

May 28, 1929. A. P. BURNS 1,714,545

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

Filed April 18, 1925 4 Sheets-Sheet 3

Fig. 4.



Inventor:
Alfred P. Burns
By attorney
Geo. P. Kennedy Jr.

May 28, 1929. A. P. BURNS 1,714,545

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

Filed April 18, 1925 4 Sheets-Sheet 4

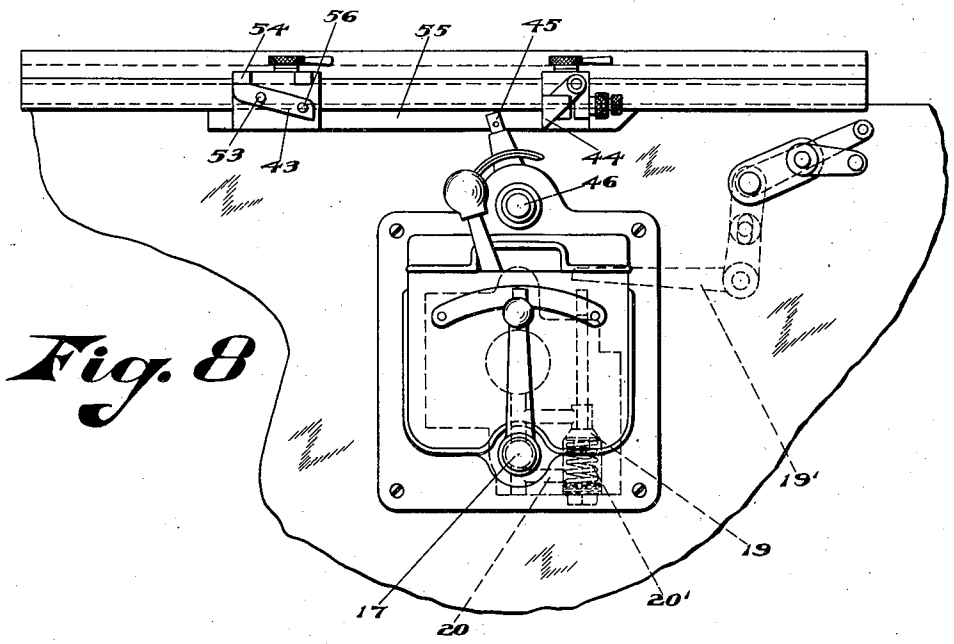


Fig. 8

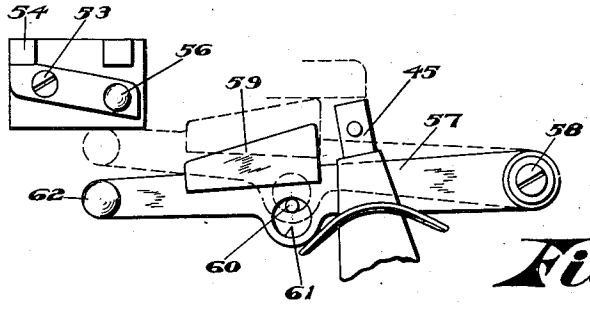


Fig. 9

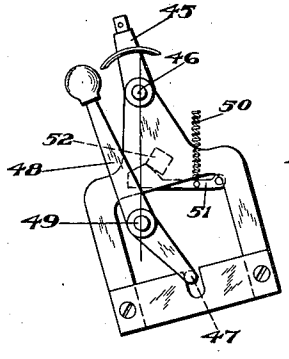


Fig. 10

Inventor

Alfred P. Burns

By Geo. W. Kennedy Jr.

Attorney

Patented May 28, 1929. 1,714,545

UNITED STATES PATENT OFFICE.

ALFRED P. BURNS, OF WORCESTER, MASSACHUSETTS, ASSIGNOR TO THE HEALD MACHINE COMPANY, OF WORCESTER, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

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

Application filed April 18, 1925. Serial No. 24,320.

The present invention relates to fluid pressure mechanism for controlling and reversing the movements of reciprocatory machine elements, as being here shown and described, by way of example, in operative relation to the reciprocatory tables of internal grinding machinery. The invention involves certain modifications in the construction and operation of the fluid pressure controlling and reversing mechanism which is shown and described in the copending application of Heald and Guild, Serial No. 639,882, filed April 4, 1923, now Patent No. 1,582,468, granted April 27, 1926, by way of adapting the principles and capabilities of that mechanism to the operation of a plurality of independent reciprocating machine elements, all actuated by a single source of fluid pressure supply, and embodied either in the same or in different pieces of machinery. The features of the invention are fully set forth hereinafter, reference being had to the accompanying drawings, wherein

Fig. 1 is a view of the interior of a grinding machine, that is to say with the front part of the frame casting removed, certain parts in said interior being shown in section,—said figure also indicating so much of the mechanism of an internal grinding machine exterior to said frame casting as is necessary for the proper disclosure of my invention.

Figs. 2 and 3 are fragmentary detail views, partly in section, showing the valve mechanism of Fig. 1 in different positions, the bypass valve for convenience being omitted.

Fig. 4 is a view similar to Fig. 1, showing a modified form of the invention in relation to a different arrangement of the grinding machine instrumentalities.

Figs. 5 and 6 are fragmentary detail views, partly in section, showing the valve mechanism of Fig. 4 in different positions, the bypass valve for convenience being omitted.

Fig. 7 is an enlarged detail view, partly in section, of one of the valve devices.

Fig. 8 is a fragmentary front elevation of the grinding machine of Fig. 1, showing the mechanical elements of the reversing mechanism.

Fig. 9 is a fragmentary view of one of the table dogs or stops together with a device to cause it to pass over the reversing member when desired.

Fig. 10 is a view of a portion of the mechanism shown in Fig. 8, with the front portion of the casing for the reversing levers broken away to show the connections.

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 by 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, the work supporting head 6 being carried by a bridge 7 which spans the slideways of the machine frame in which the table 4 moves.

For the back and forth movement of table 4, fluid under pressure is admitted to one end or the other of cylinder 1, and for this purpose, the machine here shown is equipped with a fluid pressure controlling and reversing system similar to that disclosed in the aforesaid copending application, which system is connected with a supply main 8, delivering fluid under pressure from a pump, not shown, and also with an exhaust main 9 returning said fluid to a tank, not shown. As contemplated by this invention, the pump and tank above referred to and the supply and exhaust mains 8 and 9 may be common to a plurality of fluid pressure actuating and controlling systems for a variety of movable machine elements; that is, in addition to the branch supply pipe 10, through which fluid under pressure is conveyed from the main 8 to the actuating and controlling devices of table 4, there may be connected to the main 8 additional branch supply pipes such as 10′, for the conveyance of pressure medium to another system or systems, not shown, employed, for example, for the actuation and control of another element of the same machine, or the table of another grinding machine, or the tables of a battery of grinding machines. A detailed description of these additional systems and machines is unneces-

sary, it being sufficient to note that each, in common with the one system herein shown, might provide a reversing valve, such as shown at 11, for the pressure fluid, and in addition, a return pipe 12', corresponding to the return pipe 12 of the system shown, which connects with the exhaust main 9. In each such system, if employed for the actuation of a reciprocating table, pipe connections, corresponding to the pipe connections 13 and 14 from the reversing valve 11 to the opposite ends of the cylinder 1, would be provided, and the operation of all these systems, having the common supply and exhaust mains 8 and 9, would be, as hereinafter described, for the single system illustrated in Fig. 1.

In such system, the various valve devices for controlling the pressure fluid are disposed in a suitable block or casting 15, which provides a passage 16 to the reversing valve 11 from the branch supply pipe 10. Said passage 16 is provided with a rotatable plug or throttle valve 17, the position of which is subject to adjustment to vary the quantity of pressure fluid flowing through the passage 16, and hence the speed at which the table 4 is reciprocated. The reversing valve 11 may be of the form and construction shown for the reversing valve in the aforesaid copending application, or it may be of the simplified form of construction shown diagrammatically herein; in any event, it will be understood that when said valve is oscillated in a counterclockwise direction from its central or neutral position, communication is established, as shown in Fig. 1, between passage 16 and a port or passage 18, the latter communicating with the pipe 13 that leads to the left hand end of cylinder 1. At the same time, this position of the valve 11 also establishes communication between the return pipe 12 and the pipe 14, leading from the right hand end of cylinder 1, so that when the pressure of the fluid is exerted against the piston 2 to drive it to the right, the fluid on the right hand side of said piston has a free and unthrottled passage back to the exhaust main 9 and to the tank, not shown, through the pipes 14 and 12 and the valve 11. In the opposite position of said valve, these conditions are reversed, the pipe 14 being connected to the passage 16, so that the pressure of the fluid is exerted against the right hand side of the piston to drive it to the left, while the fluid on the left hand side of said piston has a free and unthrottled passage back to the exhaust main 9 through pipe 13, passage 18, valve 11 and return pipe 12. The movements of said valve 11 may be effected in the usual or any desired manner by spaced adjustable dogs or stops 43 and 44, Fig. 8 on table 4. The table dogs or stops 43 and 44 are usually spaced apart a distance substantially corresponding to the desired working stroke of the grinding wheel, being alternately brought into action to effect the reversal of an interposed member 45 at the end of each traverse of the table 4 in one direction or the other. The said interposed or reversing member 45 is pivotally mounted at 46 to the machine frame, as shown in Figs. 8 and 10. The lower portion of said member, as shown in Fig. 10, provides a slot in which is received a pin 47 provided by a member 48 that is attached to the shaft 49 of the reversing valve 11. Oscillation of the reversing member 45 is, consequently, transmitted to the reversing valve 11 to control the direction of travel of the table. When the member 45 is struck by one of the dogs 43 or 44, it is rocked on its axis 46, and the initial movement thereof thus inaugurated is continued by the action of a spring 50 which maintains the pointed end of a cam lever 51 in contact with the flat angular sides of a projection 52 on the rear of the member 45, this constituting, of course, merely a particular form of snap over device.

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 of work, 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 causing the movement of the table 4 to the extreme right, to carry the grinding wheel away from its normal reciprocatory working path; for this purpose, as shown in the aforesaid copending application of Heald and Guild, the left hand table dog 43 is rendered inoperative, in any suitable manner, with respect to the reversing valve 11 as by the provision of a pivotal mounting 53 for the dog 43, said dog normally hanging by gravity in the position shown in Fig. 8, and being held in that position by a block or projection 54 which thus supports the dog. When the striking end of the dog 43 is lifted in any manner, it is raised above the top of the reversing member 45, so that the reversing valve 11, instead of being rocked clockwise into its other position at the end of the normal right hand working stroke of the table 4, remains in the position illustrated in Fig. 1. This prevents any interruption to the passage of pressure fluid to the left hand end of cylinder 1 and results, therefore, in an amplified right hand movement of table 4, such movement, as described in the aforesaid copending application of Heald and Guild, taking place at maximum speed, irrespective of the setting of throttle valve 17, because, all during said amplified right hand travel of said table, a cam bar thereon 55 is effective through lever 19', to

maintain in a valve 19 in open position, thus permitting the pressure fluid to by-pass the throttle valve 17. During the normal working reciprocations of table 4, the valve 19 is maintained in contact with its seat by a spring 20', thus keeping the by-pass 20 closed.

In order to facilitate the elevation of pivoted table dog 43 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 a pin or handle 56 projecting from said dog. As shown in Fig. 9, a lever arm 57, pivoted at 58 to the frame of the machine, provides a rising cam surface 59 at the left hand side of the projecting upper end of reversing member 45. Said lever 57 in its normal, or inoperative position, as indicated in full lines in Fig. 9, rests by gravity against a pin or stop 60, said pin projecting from the frame into an enlarged hole or recess 61 of said lever. The loose fit of pin 60 in the hole 61 allows the lever 57 to be lifted into the dotted line position of Fig. 9 when seized by its projecting handle 62, thereby bringing cam 59 into the path of pivoted dog 43 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 reversing member 45. In this way the operator, in the act of causing said dog to pass inoperatively over the interposed upper end of the reversing member 45, is relieved of the necessity of 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.

According to the present invention, the port or passage 18, which connects the reversing valve 11 with the left hand end of cylinder 1, is subject to the action of a valve 21, which is loosely and slidably mounted on a stem 22, said stem projecting outwardly through the block 15 and being pivotally connected at 23 to a lever 24. Said lever 24, which is pivoted on a fixed axis 25, carries at its free end a roller 26 which, all during the normal working travel of the table and also during the right hand withdrawal movement of said table, rides against the horizontal under surface of an elongated cam bar 27, carried by said table. A compression spring 28, acting on lever 24, continuously exerts its force to thrust said lever upwardly, but the contact of roller 26 with cam bar 27 prevents such upward movement, and thus the valve stem 22 is maintained in the depressed position shown in Fig. 1, wherein, notwithstanding the ability of valve 21 to slide on said stem, said valve is prevented from seating in or closing the passage 18, by reason of the stem reaching the bottom of the valve recess 29, best shown in Fig. 7. In other words, so long as the roller 26 rides against the extended horizontal surface of the cam bar 27, the stem 22 acts as a positive abutment against the closure of valve 21, and this notwithstanding the fact that said valve is at all times subject to the action of a spring 30, lighter than the spring 28, tending to move it into closed position.

The cam bar 27 terminates at its left hand end in an upwardly inclined section 31, and when this inclined section 31 arrives above the roller 26, it marks the end of the right hand withdrawal movement of the table 4. The spring 28 forces the roller 26 up said incline, as shown in Fig. 2, and this action raises the stem 22 and allows the valve 21 to close under the action of the light spring 30 and also by the pressure of the fluid on the under side of said valve. This closure of the valve 21 shuts off the supply of pressure fluid to the left hand end of cylinder 1, and thus brings the table 4 to rest. However, the arrangement is such that this stoppage of table 4 does not in any way affect the normal action of any other pressure actuated devices that may be connected up with the supply main 8 and the exhaust main 9, nor does it involve any release throughout the several systems, to which said mains are common, of the pressure normally maintained on the fluid for the operation of such systems. The arrangement thus distinguishes from that shown in the aforesaid application of Heald and Guild, where the stoppage of the table in its fully withdrawn position involves a free circulation of the pressure fluid through the system and a consequent drop in the pressure of said fluid. The closure of valve 21 as above described locks the pressure fluid in the left hand end of cylinder 1 and prevents any movement of table 4 until the reversing valve 11 is swung clockwise by hand into its other position, as shown in Fig. 3. This action opens the right hand end of the cylinder to pressure through branch pipe 10, by-pass 20, and pipe 14, and inaugurates the return movement of the table at high speed. The fluid locked in the left hand end of the cylinder 1 is thus put under sufficient pressure to open the valve 21 against the force of light spring 30, and said fluid makes its return to the tank by way of passage 18, valve 11, return pipe 12 and exhaust main 9. Upon the completion of the high speed return movement of table 4, said table automatically resumes its normal working reciprocations at a speed determined by the setting of throttle valve 17.

Referring now to Fig. 4, the invention is shown in connection with a single grinding machine having two separate independent reciprocatory elements, namely the tables 32 and 32', carrying the grinding wheels 33 and 33' respectively, for operation, simultaneously or otherwise, within the opposite ends of a single rotary work piece 34. Each table has associated therewith a fluid pressure sys-

tem similar to the system disclosed in Fig. 1, the two systems being connected to a common pressure supply main 35 and to a common exhaust main 36, the latter having a return pipe 37 to a tank 38, and the former being supplied by a pump 39 for the circulation, under pressure, of the fluid from said tank. Said pump 39 provides also a relief valve connection 40 to the pipe 37.

The two systems shown in Fig. 4 involve the same mode of operation and the same elements as the system shown in Fig. 1, except for the fact that the valve which is brought into action when the table reaches the end of its withdrawal movement, is differently situated from the valve 21 of Figs. 1, 2 and 3. Referring to Fig. 4, the supply main 35 provides branches 10 and 10′ running to reversing valves 11 and 11′, and from the casings of these valves, return pipes 12 and 12′ connect with the exhaust main 36. The respective systems provide the pipe connections 13, 13′ and 14, 14′ to opposite ends of the cylinders 1 and 1′, the connections 13 and 13′ corresponding to the connection 13 of Fig. 1, and providing for the flow of pressure fluid from the valve casing to the cylinder when the movement of the piston in said cylinder is to carry the associated grinding wheel 33 or 33′ away from the work piece 34. The connections 14 and 14′, like the connection 14′ of Fig. 1, provide for the flow of pressure fluid from valve to cylinder when the associated grinding wheel 33 or 33′ is to be carried toward the work piece 34.

In the present instance however, as distinguished from the arrangement shown in Fig. 1, the connections 13 and 13′ communicate directly with their reversing valve recesses by means of passages 41 and 41′, these last named passages, unlike the passage 18 of Figs. 1, 2 and 3, being at all times open and having no valves whatsoever therein. On the other hand, the passages 42 and 42′, which afford communication between the pipe connections 14 and 14′ and their respective valve recesses, are supplied with valves 21 and 21′, of the same construction and mode of operation as the valve 21 of Figs. 1, 2 and 3, and the operation of this mechanism, referring to Figs. 4, 5 and 6 is as follows:—

In the normal operation of the machine, either one or both of the grinding wheels 33 and 33′ may be making the usual reciprocatory traverse within the work piece 34, the reversals of these movements being effected by the table dogs or stops, not shown, but which may be substantially the same as the dogs 43 and 44, which alternately throw the valves 11 and 11′ to the right and to the left. Under these conditions, when either grinding wheel is working, its associated valve 21 or 21′ is held in open position by the engagement of roller 26 or 26′, as the case may be, with the extended horizontal surface of the cam bar 27 or 27′, this being due to the abutment provided by the lower end of the stem 22 or 22′. Assuming that both grinding wheels 33 and 33′ are operating, as above described, if now it be desired to discontinue the operation of one of them, say the wheel 33, without interrupting the operation of the other, the left hand table dog, not shown, for the reversing valve 11, is rendered inoperative, so that said valve, instead of being rocked clockwise into its other position at the end of the normal right hand working stroke of table 32, remains in the position illustrated in Fig. 4. This prevents any interruption to the passage of pressure fluid through passage 41 and connection 13 to the left hand end of cylinder 1, and results therefore in an amplified right hand movement of table 32, such movement, as heretofore described, preferably taking place at maximum speed, due to the opening of the associated by-pass valve 19.

This amplified right hand movement finally brings the inclined section 31 of cam bar 27 above the roller 26, whereupon the spring 28 raises the lever 24 and stem 22, as shown in Fig. 5, allowing the valve 21 to close the passage 42 under the action of spring 30, and also by the pressure of the fluid on the under side of said valve. Thus, notwithstanding the maintenance of full pressure in the left hand end of cylinder 1, the table 32 is brought to rest, because the outlet of pressure fluid from the right hand end of said cylinder is shut off; it will be seen therefore that this stoppage of table 32, in the manner above described, does not in any way affect the continuing working reciprocation of the table 32′, notwithstanding the fact that said two tables have a common source of fluid pressure actuation. When it is desired to have the grinding wheel 33 resume operation, the reversing valve 11 is swung from the position shown in Fig. 5 to the position shown in Fig. 6; this action brings the full pressure of the fluid directly on the upper side of valve 21, thereby opening said valve and inaugurating the return or left hand movement of the table 32 at high speed.

It will thus be seen that each form of the invention herein disclosed obtains the same result, the difference being that in Figs. 1, 2 and 3, the valve 21 and its associated mechanism is disposed, for the withdrawal stroke of table 1, on the pressure side of reversing valve 11, whereas said valves 21 and 21′ in the arrangements shown in Figs. 4, 5 and 6 are disposed, for the withdrawal strokes of tables 32 and 32′, respectively, on the exhaust side of the valves 11 and 11′, respectively. However, regardless of whether the action takes place in the pressure line to one end of the cylinder, or in the exhaust line from the other end, the results accomplished are one and the same. The main object of this invention is to stop the flow of fluid under pressure in

one direction only without affecting the free passage of the pressure fluid in the opposite direction at the will of the operator, by the natural and accustomed movement of reversing the valve 11. The invention of the aforesaid copending application accomplishes this purpose, but with the loss of pressure in the supply line, while in the apparatus of the present invention, the pressure is retained. It is obvious that other modifications may be made without departing from the spirit of the invention, the scope whereof is set forth in the following claims.

I claim:

1. In apparatus of the class described, a table, fluid pressure means for reciprocating said table, 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, thereby to procure the withdrawal of said table, by fluid pressure actuation, from said working path, a normally open valve independent of said reversing valve, and means adapted to close said valve when the table reaches a predetermined point in its said withdrawal movement, whereby to discontinue the flow of pressure fluid to bring said table to rest.

2. In apparatus of the class described, a table, fluid pressure means for reciprocating said table, 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, said means comprising an independent valve for discontinuing the further flow of pressure fluid through any part of said reversing valve.

3. In apparatus of the class described, a table, fluid pressure means for reciprocating said table, 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, said means comprising a valve, closed in part by the pressure of the actuating fluid, for discontinuing the further flow of said fluid from said reversing valve, and whereby manual actuation of said last-named valve allows the pressure fluid to flow back through said reversing valve from the fluid pressure means for reciprocating said table, in order to resume normal reciprocation of said table subsequent to the withdrawal movement.

4. In apparatus of the class described, a table, a piston and cylinder unit adapted, by fluid pressure actuation, to reciprocate said table, a reversing valve for the pressure fluid operated by said table at each end of the latter's normal working path, said valve having a port leading to each end of said piston and cylinder unit, means operable at will to prevent a reversal of said valve, thereby to procure the withdrawal of said table, by fluid pressure actuation, from said working path, a normally open valve independent of said reversing valve, located between that end of the piston and cylinder unit to which fluid is flowing to cause said withdrawal movement and the port in the reversing valve by which the fluid is led thereto, and means adapted to close said independent valve when the table reaches a predetermined point in its said withdrawal movement, whereby to discontinue the flow of pressure fluid to bring said table to rest.

Dated April 14, 1925.

ALFRED P. BURNS.