

Jan. 26, 1932.

W. LINK

1,842,725

DRIVING MECHANISM FOR MACHINE TOOLS, SUCH AS PLANING
MACHINES, GRINDING MACHINES, AND THE LIKE

Filed April 8, 1929

4 Sheets-Sheet 1

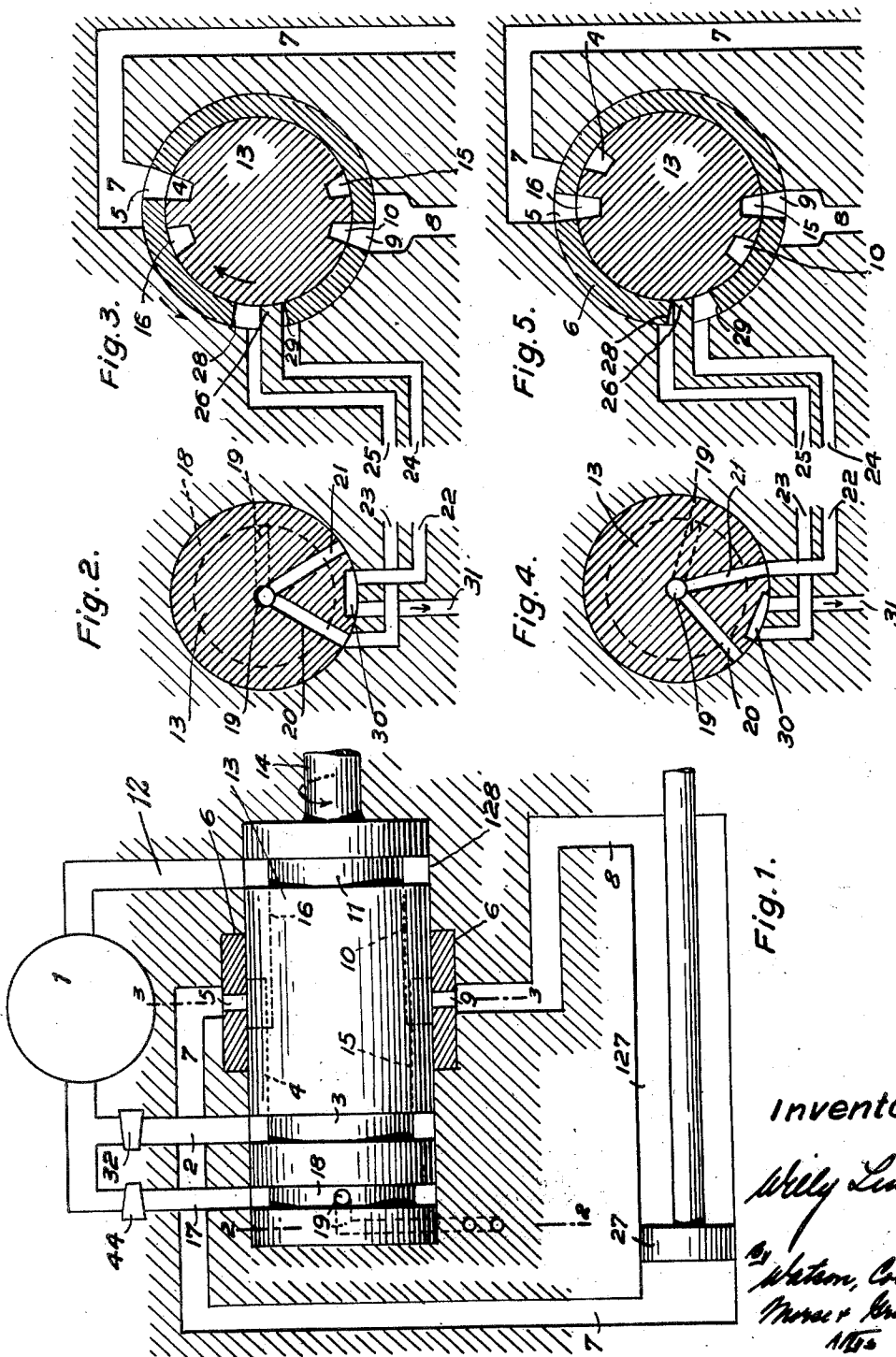


Fig. 1.

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4 Sheets-Sheet 2

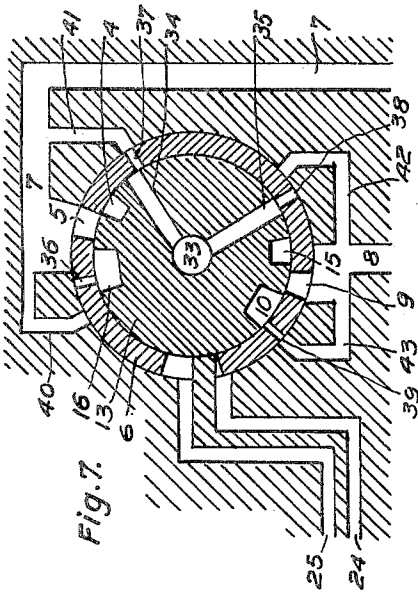


Fig. 7.

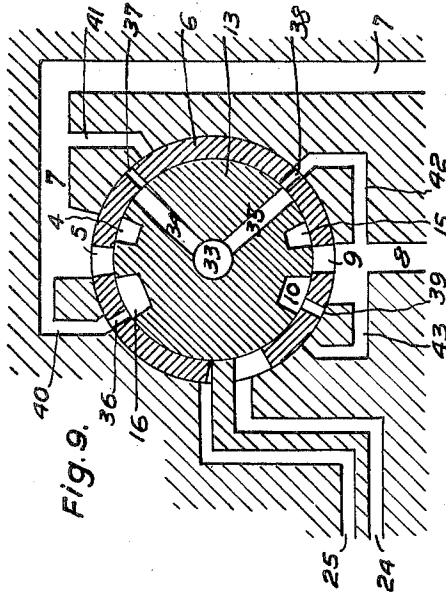


Fig. 9.

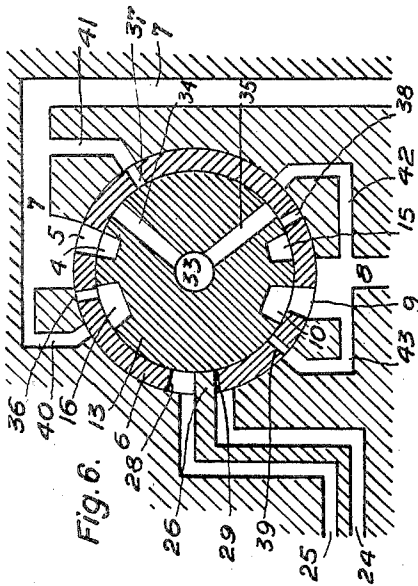


Fig. 6.

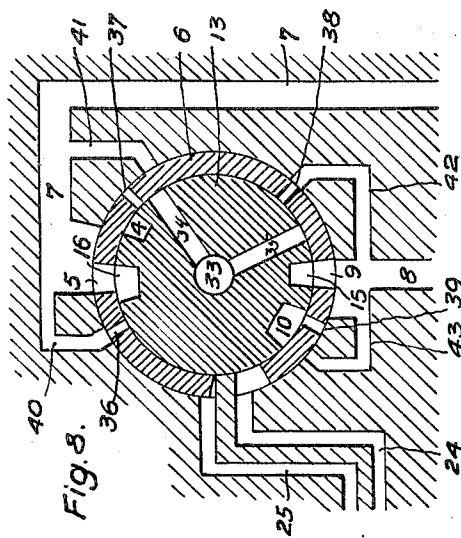


Fig. 8.

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4 Sheets-Sheet 3

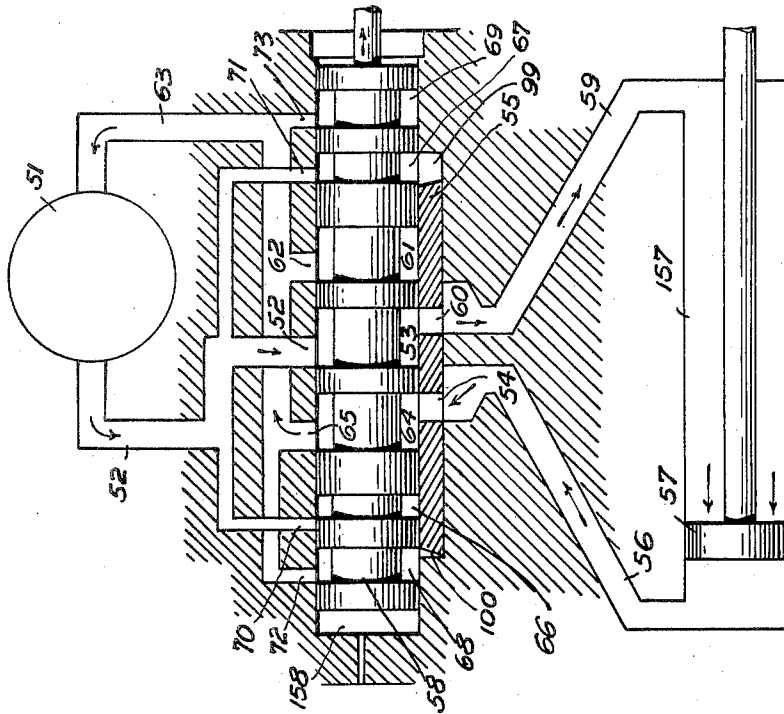


Fig. 11.

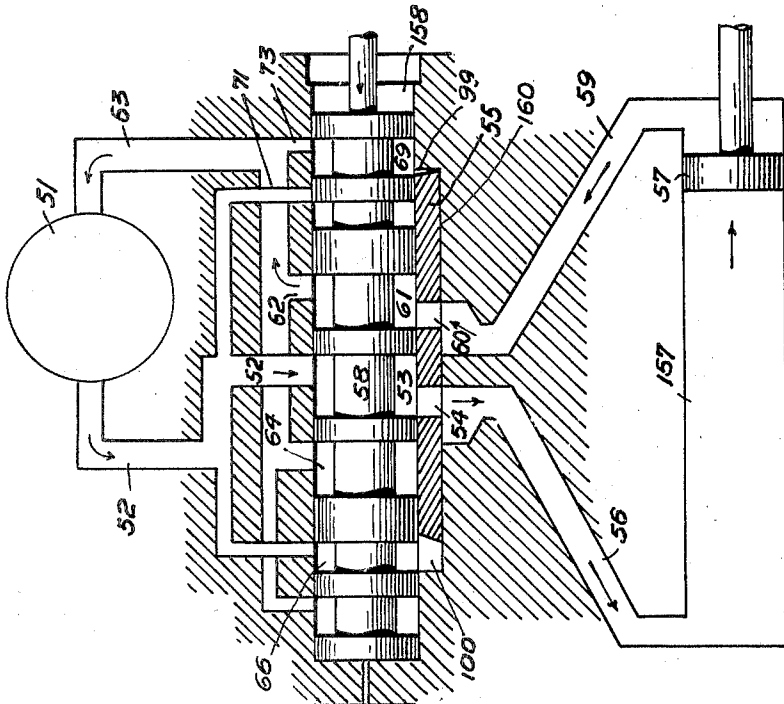


Fig. 10.

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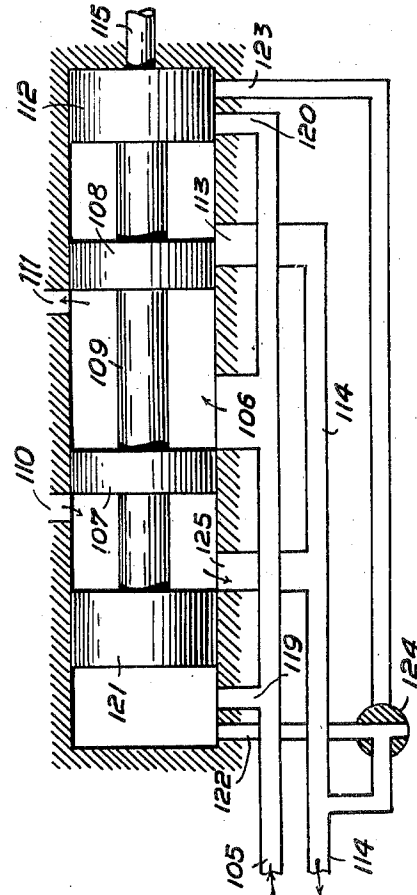
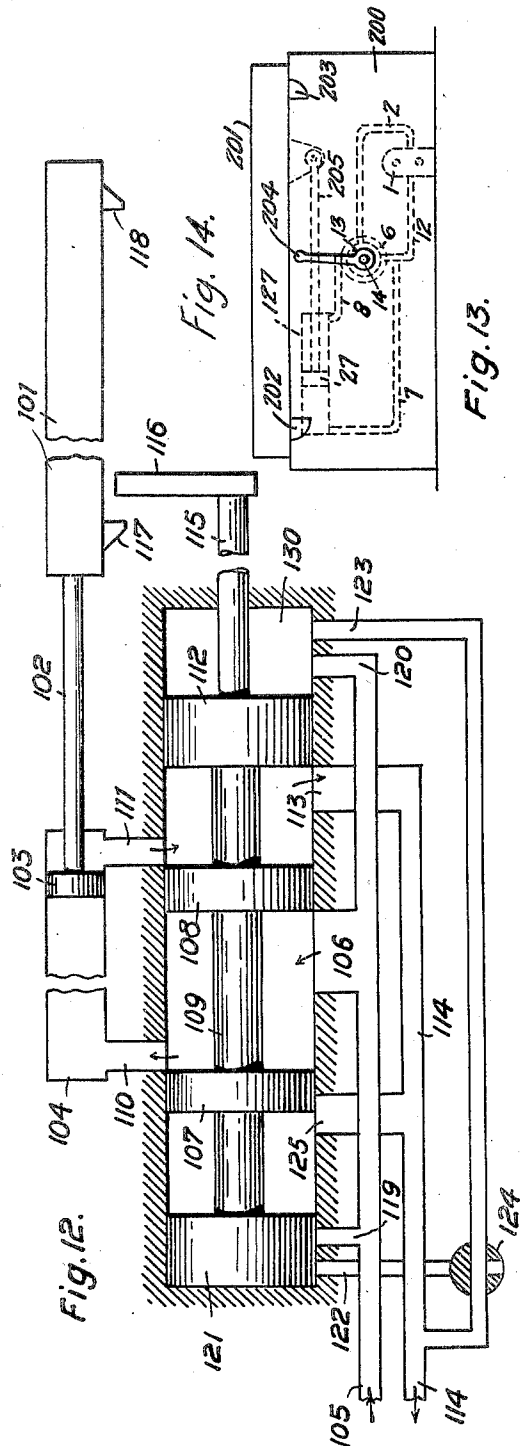
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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DRIVING MECHANISM FOR MACHINE TOOLS, SUCH AS PLANING MACHINES,
GRINDING MACHINES, AND THE LIKE

Application filed April 2, 1929, Serial No. 353,540, and in Germany April 11, 1928.

My invention relates to improvements in driving mechanisms for machine tools such as grinding machines, planing machines, and the like, and more particularly in fluid operated apparatus for driving the slide or table carrying the tool or the work, the said apparatus comprising a cylinder and its piston connected with the said slide or table for imparting reciprocating movement thereto and provided with a main valve controlling the supply of pressure fluid thereto and the reversing operation. In constructions now in use the said main valve is controlled by an intermediate mechanism influenced by the slide or table of the machine tool or a part associated therewith, this intermediate mechanism being provided for insuring correct reversing operation. It is an object of the present invention to provide means for ensuring independence of the velocity with which the reversing operation is effected and the velocity of movement of the slide or table. For this purpose I provide a device in which the main valve is directly operated from the said slide or table or a part associated therewith, the said slide or table imparting initial opening and closing movement to the main valve, whereupon the said opening and closing movement is rapidly completed by additional means. With this object in view my invention consists in providing the additional means in such a manner, that they are controlled by the main valve by the aid of electrical, mechanical or preferably fluid operated means, for performing rapidly the closing and opening of the channels, which are initially opened and closed by the main valve. The valve and the additional means are provided with main ports corresponding to the channels in the casing leading to and from the piston. A further object of the improvements is to provide a controlling mechanism by means of which the velocity of the slide or table is controlled so that it is small and always the same at the

end of the stroke, the slide or table being stopped always exactly at the desired point. With this object in view my invention consists in providing subsidiary ports thrown into communication with the passages controlled by the main valve before the end of the reversing operation for directing the motive fluid under reduced pressure to the cylinder acting on the table or slide.

For the purpose of explaining the invention several examples embodying the same have been shown in the accompanying drawings in which the same reference characters have been used in all the views to indicate corresponding parts. In said drawings,

Fig. 1 is a diagrammatical sectional elevation showing the cylinder and its piston, the main valve, and the additional means comprising a rotatable member,

Fig. 2 is a sectional elevation taken on the line 2—2 of Fig. 1,

Fig. 3 is a sectional elevation taken on the line 3—3 of Fig. 1,

Figs. 4 and 5 are sectional elevations similar to those shown in Figs. 2 and 3 and showing the parts in different positions,

Fig. 6 is a sectional elevation similar to the one shown in Fig. 3 and illustrating a main valve and a rotatable member of similar construction provided with subsidiary ports for reducing the pressure of the motive fluid flowing to the cylinder at the end of the stroke,

Figs. 7 to 9 are similar sectional elevations showing the main valve and rotatable member in different positions,

Fig. 10 is a sectional elevation similar to the one illustrated in Fig. 1 and showing a main valve and a member shiftable in a straight line,

Fig. 11 is a similar sectional elevation showing the parts in a different position,

Fig. 12 is a sectional elevation showing a main valve and the additional means formed as a unit,

Fig. 13 is a similar sectional elevation

showing the parts in a different position, and

Figure 14 is a diagrammatic representation of the component parts of the complete apparatus.

Referring at first to the example illustrated in Figs. 1 to 5, a piston 27 reciprocating in a cylinder 127 is connected with the slide or table of the machine tool for imparting reciprocating movement thereto. Motive fluid, such as oil under pressure is supplied to the cylinder through passages 7 and 8 connected respectively with the opposite ends of the cylinder, and the supply of motive fluid is controlled by a cylindrical main valve 13 adapted to be rocked about its longitudinal axis within a cylindrical valve chamber 128. The rotary main valve 13 is provided with a circumferential groove 3 communicating through a passage 2 with a pump 1 for supplying oil under pressure to the groove 3. The groove 3 is connected with axial passages 4 and 15. In the position of the parts shown in Fig. 1 the oil under pressure flows from the circumferential passage 3 through the passage 4 to a port 5 made in a rotary bushing 6 surrounding the cylindrical valve 13, and the port 5 opens into the passage 7, as is shown in Fig. 3. Near the passage 15 the bushing 6 is formed with a port 9 opening into the passage 8, and in the position of the parts shown in Figs. 1 and 3 the passage 15 is out of communication with the said port 9. Near its right hand end the valve 13 is provided with a circumferential groove 11 communicating with the suction passage 12 of the pump 1, and the said groove is connected with axial passages 10 and 16 extending into position for communication with the ports 5 and 9. As appears more particularly from Fig. 1 the passages 4, 16 and 15, 10 overlap each other respectively so that by rotation of the valve 13 either one of them is adapted for communication with the ports 5 and 9. In the position of the parts shown in Figs. 1 and 3 the circumferential groove 11 communicates through the passage 10 with the port 9 and the passage 8. Thus by the operation of the pump 1 pressure fluid is forced through the passages 2, 4, the port 5 and the passage 7 to the left hand side of the piston 27, and the fluid confined within the cylinder 127 at the right of the piston is free to be returned through the passage 8, the port 9, the passage 10, the circumferential groove 11 and the suction pipe 12 to the pump 1. Thus the piston 27 moves to the right.

Near the end of the stroke of the piston 27 the slide or table of the machine tool acts by suitable mechanism such for example as a lever on the stem 14 of the valve 13 thus imparting a slight rocking movement thereto in clockwise direction, thus starting the reversing operation, and by the said rocking movement of the valve, rocking movement

of the bushing 6 is caused in anti-clockwise direction in the following manner.

As appears from Fig. 3 the bushing 6 is formed with a slot divided by a fixed partition wall 26 into two chambers 28 and 29 communicating respectively with passages 23, 25 and 22, 24. The valve 13 is provided with an auxiliary circumferential groove 18 connected by a passage 17 with the pressure side of the pump 1, and the said groove is connected by an axial passage 19 with two radial passages 20 and 21 disposed angularly of each other, the passage 20 being adapted for communication with the passage 23, 25, and the passage 21 being adapted for communication with the passage 22, 24. Between the intake ends of the said passages there is an outlet passage 31 which is adapted to be communicated through a groove 30 made in the valve 13 either with the passage 22, 24 or with the passage 23, 25. In the position of the parts shown in Fig. 2 the passage 20 communicates with the passage 23, 25, so that motive fluid is supplied to the chamber 28 of the slot made in the bushing 6, and the said bushing has been rocked by the said fluid pressure into the position shown in Fig. 3 in which the end wall of the chamber 29 bears on the partition 26. By the initial reversing movement imparted to the valve 13 by rocking the same from the table of the machine tool the radial passage 20 is brought out of communication with the passage 23, 25, the radial passage 21 is brought into communication with the passage 22, 24 and the groove 30 is set into position for connecting the passages 23, 25 and 31. Thus motive fluid is supplied through the passage 22, 24 to the chamber 29 thus rocking the bushing 6 in anti-clockwise direction and into the position shown in Fig. 5, the motive fluid confined within the chamber 28 escaping through the passage 23, 25, the groove 30 and the passage 31, which passage may be connected with the suction pipe of the pump. By the rocking movement of the bushing 6 the reversing operation is completed, the parts assuming the position shown in Fig. 5 in which the passage 7 communicates through the port 5 and the passage 16 with the suction pipe 12, and the passage 8 communicates through the port 9, the passage 15 and the circumferential groove 3 with the passage 2. Thus pressure fluid is supplied to the right hand side of the piston 27, and the fluid confined within the cylinder 127 at the left of the piston 27 escapes through the passage 7, the port 5, the passage 16 to the suction passage 12 of the pump.

At the end of the stroke of the piston 27 the operation of the parts is performed in the reverse order, so that the parts are again brought into the position shown in Figs. 2 and 3. The pressure passage 2 is preferably provided with a cock 32 for regulating the

fluid pressure supplied to the cylinder 127 and the velocity of the table or slide of the machine tool. Preferably a cock 44 is provided in the passage 17 for throttling the pressure fluid flowing to the groove 18.

In Fig. 1 a piston 27 is shown which has rectilinear reciprocating movement. But I wish it to be understood that my invention is not limited to this feature, and that in lieu of the piston having rectilinear movement, a rotary piston may be provided.

A preferred arrangement of the various parts in their operative relationship is illustrated diagrammatically in Figure 14 in which the invention is shown as applied to a machine tool such as a grinding machine. It will be noted from this figure that the reciprocating carriage 201 is supported on the bed 200, this carriage being moved to and fro by the piston 27 operating in the cylinder 127, this piston being connected to the bed in any conventional manner as indicated by the reference numeral 205. Abutments 202 and 203 are mounted on the carriage, these abutments impinging at opposite ends of the carriage strokes on the lever 204 which is secured to the shaft 14. This shaft is in turn rigidly connected with the regulating valve 13. A pump 1 delivers the motive fluid through the pipe 2 to the valve 13, the fluid being returned to the pump through the pipe 12. The delivery of fluid to the cylinder 127 is effected alternately through the conduits 7 and 8 which are controlled by the valve 13 as described above in detail.

The example shown in Figs. 6 to 9 is similar to the one described with reference to Figs. 1 to 5, and similar letters of reference have been used to indicate corresponding parts, so that it is not necessary to repeat the description of the said parts. But in addition subsidiary passages are provided for supplying fluid under reduced pressure to the cylinder 127 near the end of the stroke thereof. The rotary valve plug 13 is provided with an additional axial bore 33 constantly communicating with the pressure side of the pump 1, and the said axial passage 33 is connected with radial passages 34 and 35. The bushing 6 is provided with four subsidiary ports 36, 37, 38 and 39, and the valve casing is provided with subsidiary passages 40, 41 and 42, 43 communicating respectively with the passages 7 and 8.

In Fig. 6 the valve plug 13 is in the position corresponding to Fig. 3. The subsidiary passages 34, 35 and 36, 37, 38, 39 are closed respectively by the inner and outer walls of the bushing 6.

When the piston 27 has nearly performed its stroke to the right, it rocks the valve plug 13 in clockwise direction, as has been described above, the parts now being in the position shown in Fig. 7. Thereby the flow

of the pressure fluid through the passage 4, the port 5 and the passage 7 to the left hand side of the piston is interrupted, and the pressure fluid flows through the passages 33, 34, the port 37, and the passages 41, 7 to the left hand side of the piston. In a similar way the right hand side of the cylinder 127 is connected through the passages 8, 43, the port 39 and the passage 10 with the suction pipe 12 of the pump. Therefore the piston 27 is able to continue its movement to the right, but the pressure of the fluid is reduced by the reduced cross-sectional area of the ports 37 and 39. Thus the velocity of the piston 27 and the table connected therewith is reduced.

After the valve has been rocked through an angle such that the passage 21 communicates with the passage 22 (Fig. 4) the bushing 6 is rocked in the direction opposite to the rocking movement of the valve plug 13, so that the position of the said valve plug 13 corresponds to the position of the parts shown in Fig. 5, the said position being illustrated in Fig. 8. The piston 27 moves to the left, and the subsidiary passages 34, 35 and 36, 37, 38, 39 are closed.

Fig. 9 shows the position imparted to the valve plug by the piston 27 approaching its left hand dead center, the piston 27 beginning to rock the valve plug in anti-clockwise direction. The main passages 2, 3, 15, 9, 8 heretofore admitting the oil to the cylinder 127 and the passages 7, 5, 16, 11, 12 through which the oil escapes from the cylinder, are closed, and in lieu thereof the oil flows to the cylinder 127, through the passages 33, 35, 38, 42, 8, and it escapes therefrom through the passages 7, 40, 36, 16, 11, 12. Thus the flow of the pressure fluid is throttled in the ports 38 and 36, and the velocity of the work table or slide is reduced.

When the piston arrives in its dead center the parts are returned into the positions shown in Figs. 3 and 6, whereupon the operation is repeated.

If desired, valves are provided for regulating the flow of the oil through the subsidiary passages for increasing or reducing the velocity of the table.

By providing the subsidiary passages and more particularly the throttled ports 36, 37 and 38, 39 the velocity of the table is reduced at the end of the stroke thereof, and the velocity may be regulated by means of valves provided in the passages connected with the said ports.

In the examples so far described the bushing 6 provides a member separate from the valve plug 13 for completing the reversing operation, the said bushing being provided with the ports 5 and 9, and being adapted to be rocked in a direction opposite to the rocking movement of the valve plug 13. As shown, hydraulic means are provided for thus

moving the member 6. But I wish it to be understood that my invention is not limited to this feature, and that other means, for example electrical, pneumatic or mechanical means may be provided for shifting the bushing 6. Further, instead of providing a cylindrical valve 13, I may provide a plane slide valve, in which case in lieu of the bushing 6 a shiftable plate is provided.

10 In Figs. 10 and 11 I have shown a modification in which a valve having rectilinear reciprocating movement is provided.

The piston connected with the table of the machine tool has received the reference character 57, and the said piston reciprocates in a cylinder 157 connected at both ends by passages 56 and 59 with the supply of the pressure fluid. For controlling the supply of pressure fluid to the cylinder 157 a cylindrical slide valve 58 is provided which is axially shiftable in a cylindrical chamber 158 of the valve casing. In a recess 160 made in the wall of the chamber 158 a plate 55 is shiftable axially of the valve 58, which plate is formed at its ends with bevelled walls. The plate 55 is formed with ports 54 and 60 opening into the passages 56 and 59. The pressure fluid is supplied from a pump 51 through a passage 52, and the suction passage 63 of the said pump opens into the chamber 158 through ports 62. The cylindrical valve 58 is provided with circumferential grooves controlling the flow of the pressure fluid. In the position of the parts shown in Fig. 10 the pressure fluid flows from the pump 51 through the passage 52, a circumferential passage 53 of the valve 58, the port 54 and the passage 56 to the left hand side of the piston 57. From the opposite side of the said piston the fluid flows through the passage 59, the port 60, a circumferential groove 61 of the valve 58, the port 62 and the passage 63 to the pump 51.

When the piston 57 approaches the end of the stroke the valve 58 is shifted to the right from the table of the machine tool by suitable mechanism and into the position shown in Fig. 11. Thereby a branch passage 71 of the passage 52 opens into an annular groove 67 of the valve 58 which communicates with the chamber 99 provided at the right hand end of the plate 55. Further, the branch passage 70 of the passage 52, which before communicated with the annular passage 66 of the valve and the chamber 100 provided at the left of the plate 55 is disconnected from the said chamber. Further, a branch passage 72 of the passage 63 communicates through an annular groove 68 with the chamber 100, while a branch passage 73 of the passage 63, which before communicated through the annular groove 69 with the chamber 99 is now disconnected from the said chamber. Therefore, the plate 55 is shifted to the left by the pressure of the fluid transmitted from the passage 52

to the chamber 99, the fluid confined within the chamber 100 escaping through the passage 68 and the branch passage 72.

By thus shifting the plate 55 to the left the ports 54 and 60 thereof are thrown into communication respectively with the circumferential grooves 64 and 53. Now the pressure fluid flows as follows:

From pump 51 through passage 52, circumferential groove 53, port 60, passage 59; right hand end of cylinder 157. From the left hand end of the said cylinder the fluid flows through passage 56, port 54, circumferential passage 64, port 65, suction passage 63, pump 51. Therefore, the piston 57 is forced to the left.

When the piston approaches its left hand dead center the valve 58 is again shifted to the left, whereupon the plate 55 is shifted to the right, the parts being again in the position shown in Fig. 10.

In the modification shown in Figs. 12 and 13 the member for completing the reversing operation is made integral with the controlling valve. The figures show the valve in the positions corresponding to the positions of the piston in its dead centers.

The slide or table 101 of the machine tool is connected by a rod 102 with a piston 103 reciprocating in a cylinder 104, and the cylinder 104 is connected at its opposite ends by passages 110 and 111 with a valve chamber 130. The valve 109 has rectilinear reciprocating movement in the said valve chamber, and it comprises flanges 107, 108, 112 and 121. The stem 115 of the valve carries an arm 116 located in position for engagement by longitudinally adjustable lugs 117 and 118 provided on the table 101. In the position of the parts shown in Fig. 12 the pressure fluid flows from a pump (not shown) through a pipe 105, a port 106, an annular chamber provided between the flanges 107 and 108 and the passage 110 to the left side of the cylinder 104. The pressure fluid flows from the right hand side of the said cylinder through the passage 111, and annular chamber provided between the flanges 108 and 112, a port 113 and a pipe 114 to the suction pipe of the pump.

When the table 101 and the piston 103 approach one of their dead centers the lug 117 or 118 impinges upon the arm 116 and shifts the valve 109 to the right or left. By the movement imparted to the valve either the passage 119 or 120 is opened, so that pressure fluid has access to the end face 112 or 121 of the valve thus throwing the valve 109 into its opposite dead center, the fluid confined within the opposite end of the valve casing escaping through passages 122 and 123 respectively and through a two-way cock 124 to a discharge pipe 114. In lieu of the said two-way cock a slide valve may be provided which is controlled by pressure fluid supplied by

the valve 109 or from the table of the machine tool by suitable lugs.

The operation of the apparatus shown in Figs. 12 and 13 is as follows:

5 When the piston 103 moves to the right and approaches its right hand dead center the lug 117 impinges upon the arm 116 and shifts the valve 109 to the right and into position for opening the valve chamber at the left of the flange 121 relatively to the passage 119. Thus pressure fluid is supplied to the said chamber, and the valve 109 is thrown to the right and into the position shown in Fig. 13, the fluid confined within the right hand part of the chamber 130 at the right of the flange 112 escaping through the passage 123, the cock 124, the passage 114 and to the suction pipe of the pump. Now pressure fluid is admitted from the pipe 105, the port 106, the annular passage provided between the flanges 107 and 108, the passage 111, and the cylinder 104 at the right of the piston 103. The fluid confined within the cylinder 104 at the left of the piston 103 escapes through the passage 110, the annular chamber provided between the flanges 107 and 121, the port 125, the passage 114 and the suction pipe of the pump. Therefore the piston 103 and the slide 101 are shifted to the left, and during such movement the two-way cock 124 is set in the position shown in Fig. 13.

When the piston 103 arrives in its left hand dead center the operation is reversed, the lug 118 first shifting the valve 109 to the left and into the position in which pressure fluid is supplied through the passage 120 to the right hand end face of the flange 112, and the valve being thereafter thrown by the said pressure fluid to the left and into the position shown in Fig. 12.

The valve 109 may also be in the form of a rotary valve performing rotary movement in lieu of the axial movement. Further, a pneumatic pressure fluid may be used.

Also in the construction shown in Figs. 12 and 13 subsidiary passages may be provided for supplying the pressure fluid under reduced pressure to the cylinder 104 near the end of the stroke thereof, for reducing the velocity of the table 101, as has been described with reference to Figs. 6 to 9.

While in describing the invention reference has been made to particular examples embodying the same I wish it to be understood that my invention is not limited to the constructions shown in the drawings, and that various changes may be made in the general arrangement of the apparatus and the construction of its parts without departing from the invention.

I claim:

1. In apparatus for controlling the movement of machine tools, the combination with a cylinder, of a fluid operable piston within said cylinder, and mechanism for automati-

ically controlling the supply of motive fluid to said cylinder, said mechanism comprising valve means having mechanical connection with said piston and movable thereby to either of two positions, a second valve means movable in directions opposite to said first named valve means to cooperate therewith in the control of fluid supply, and fluid operated means controlled by said first named valve means on movement of the latter for moving said second valve means.

2. In apparatus for controlling the movement of machine tools, the combination with a cylinder, of a fluid operable piston within said cylinder, and mechanism for automatically controlling the supply of motive fluid to said cylinder, said mechanism comprising separate valve members rotatable about a common axis to positions in which they cooperate to control the fluid supply, one of said valve members being operably associated with said piston and rotatable in response to piston movement, and fluid operated means controlled by movement of said piston operable valve member for rotating the other of said valve members oppositely thereto.

3. In apparatus for controlling the movement of machine tools, the combination with a cylinder, of a fluid operable piston within said cylinder, and mechanism for automatically controlling the supply of motive fluid to said cylinder, said mechanism comprising valve means operable to either of two positions on movement of said piston, a second valve means movable in directions opposite to said first named valve means to cooperate therewith in the control of fluid supply, fluid operated means controlled by said first named valve means on movement of the latter for moving said second valve means, and means operable by movement of said first named valve means prior to the movement of said second named valve means for reducing the motive fluid supply to said cylinder.

4. In apparatus for controlling the movement of machine tools, the combination with a cylinder, of a fluid operable piston within said cylinder, and mechanism for automatically controlling the supply of motive fluid to said cylinder, said mechanism comprising valve means operable to either of two positions on movement of said piston, a second valve means movable in directions opposite to said first named valve means to cooperate therewith in the control of fluid supply, fluid operated means controlled by said first named valve means on movement of the latter for moving said second valve means, main fluid passages connecting said mechanism and said cylinder, and subsidiary fluid passages of less fluid capacity connecting said mechanism and said cylinder, said first named valve means being operatively associ-

ated with said main fluid passages during the major portion of the piston stroke and with the subsidiary fluid passages during the latter portions of the piston stroke.

- 5 5. In apparatus for controlling the movement of machine tools, the combination with a cylinder, of a fluid operable piston within said cylinder, and mechanism for automatically controlling the supply of motive fluid
- 10 to said cylinder, said mechanism comprising valve means having mechanical connection with said piston and movable thereby to either of two positions, a second valve means movable in directions opposite to said first
- 15 named valve means to cooperate therewith in the control of fluid supply, and fluid operated means controlled by said first named valve means on movement of the latter for moving said second valve means, said mechanism comprising valve means operatively
- 20 connected to said piston for movement thereby at each end of the piston stroke, a second valve means, fluid controlled means for moving said second valve means on completion of
- 25 the movement of said first named valve means, a source of fluid supply, main fluid passages arranged to connect said source and said cylinder on movement of both valve means, and subsidiary fluid passages of reduced capacity arranged to connect said
- 30 source and said cylinder on movement of said first named valve means and before completion of such movement.

In testimony whereof I hereunto affix my
35 signature.

WILLY LINK.

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