E. F. SMITH.

GRINDING MACHINE.

APPLICATION FILED DEC. 17, 1909.

956,208.

Patented Apr. 26, 1910.

4 SHEETS—SHEET 1.

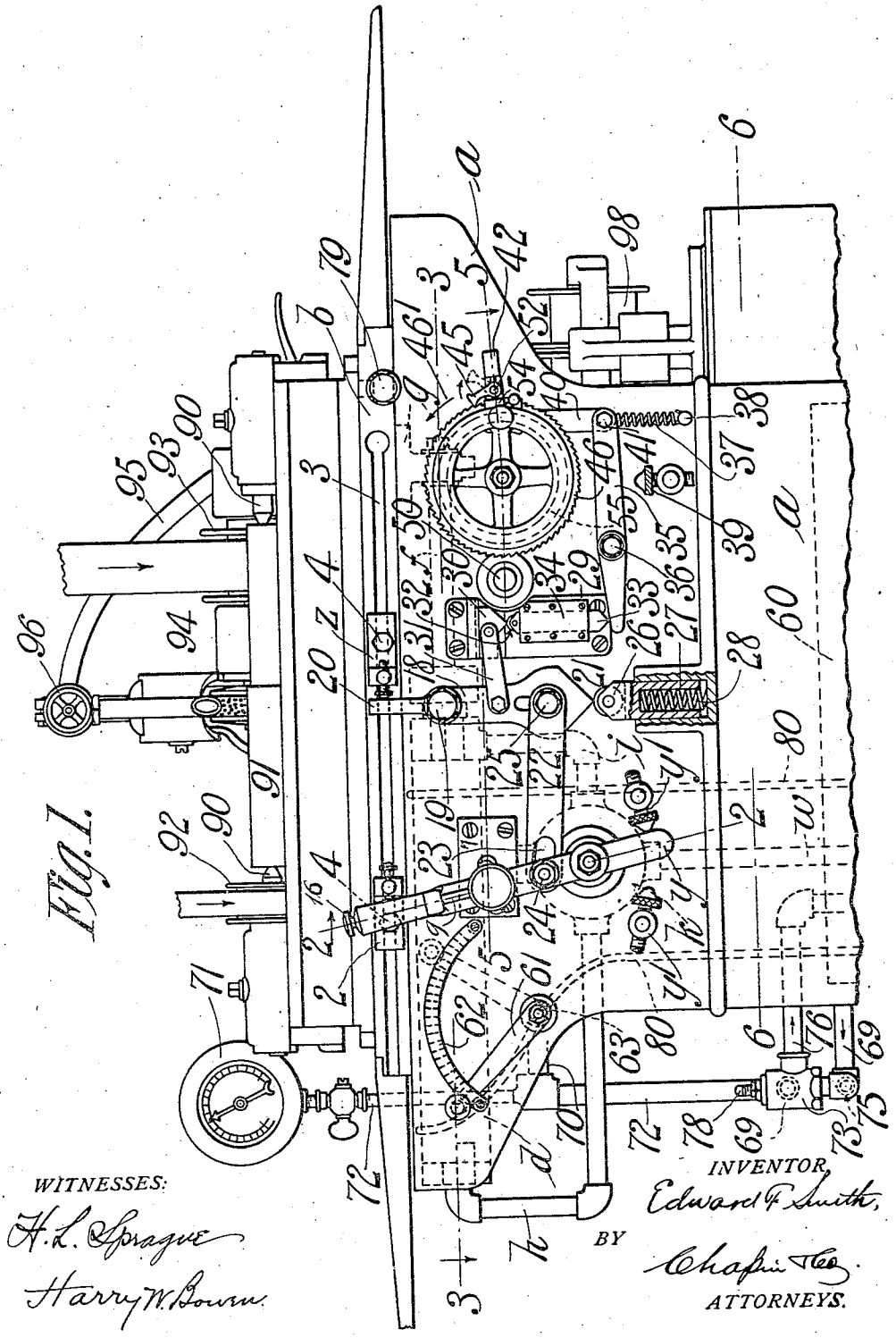

Fig. 1.

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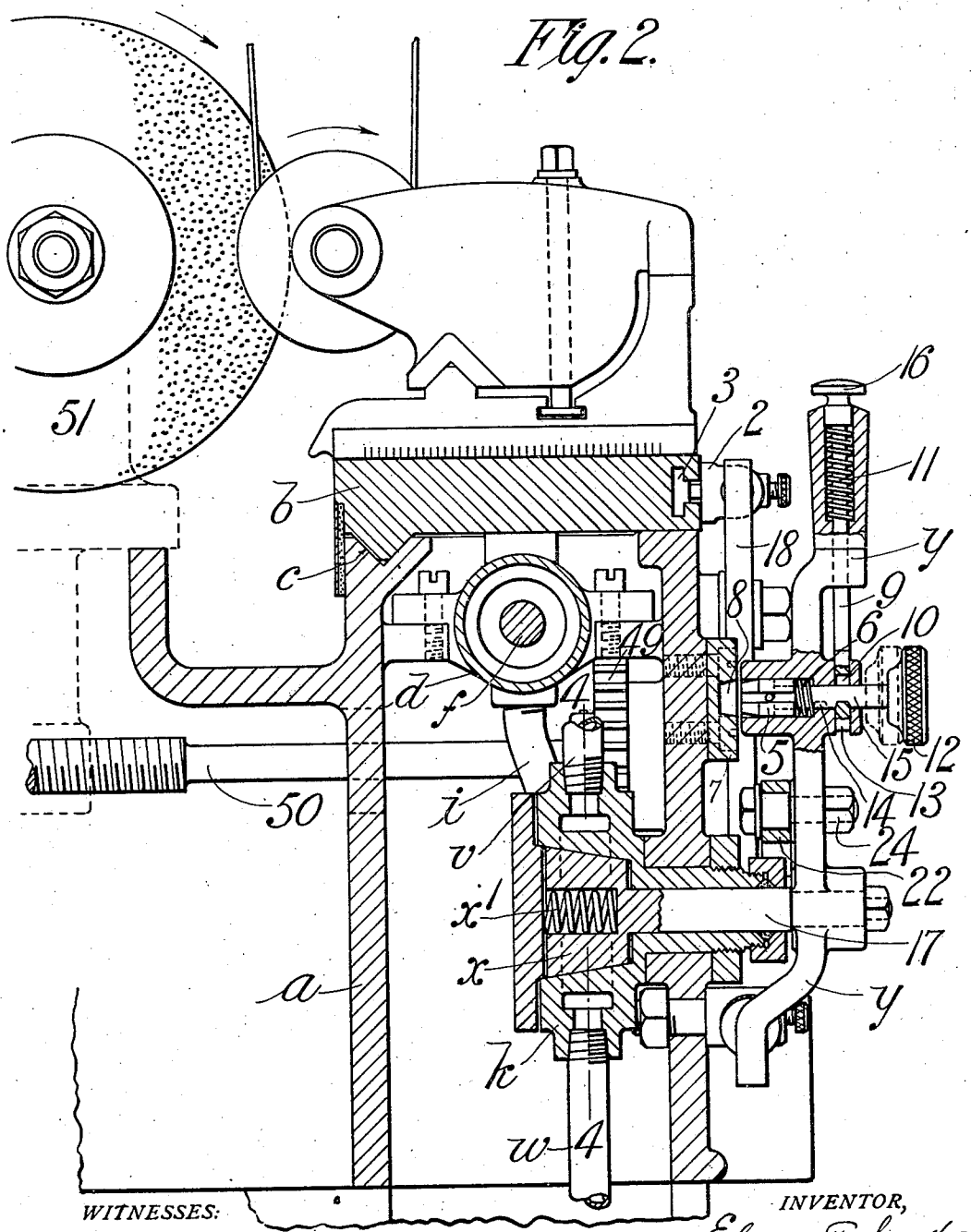
4 SHEETS—SHEET 2.

Fig. 2.



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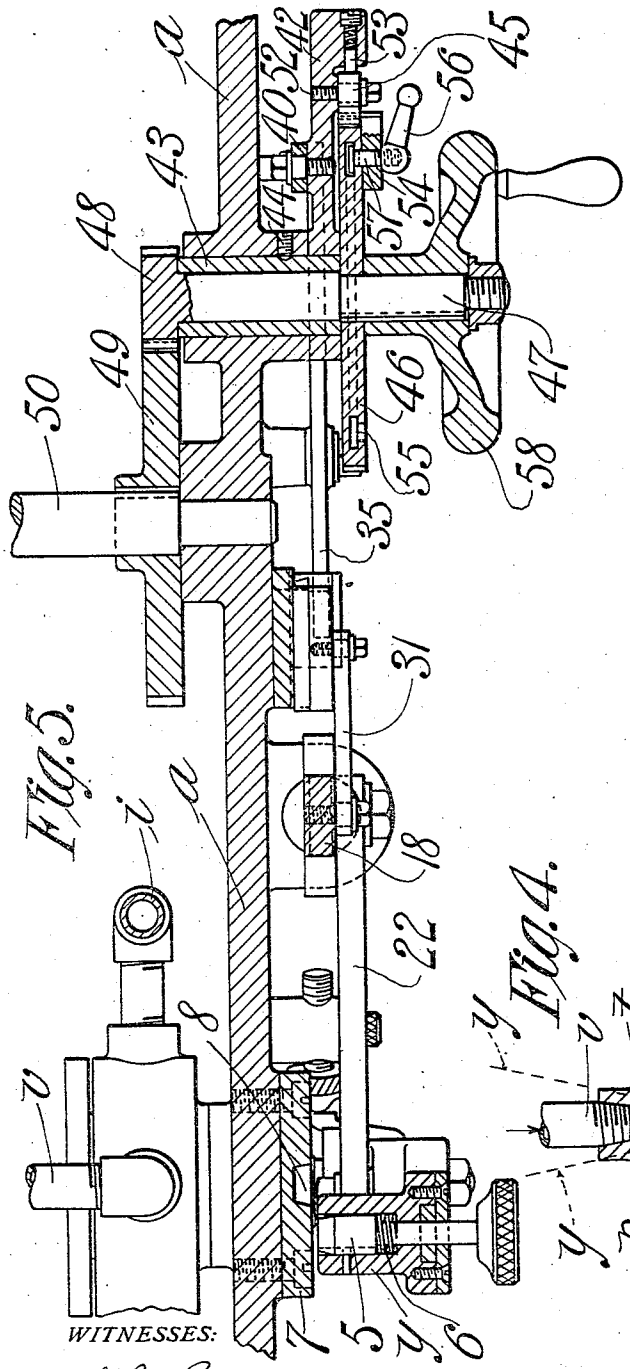

Fig. 5.

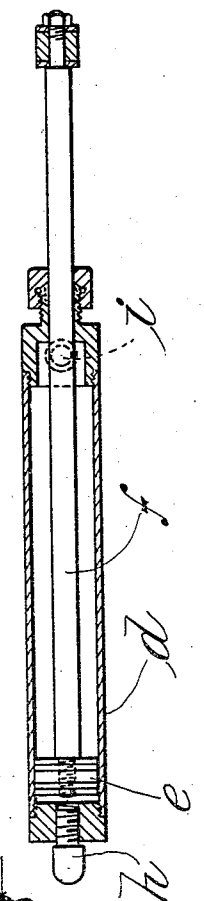

Fig. 3.

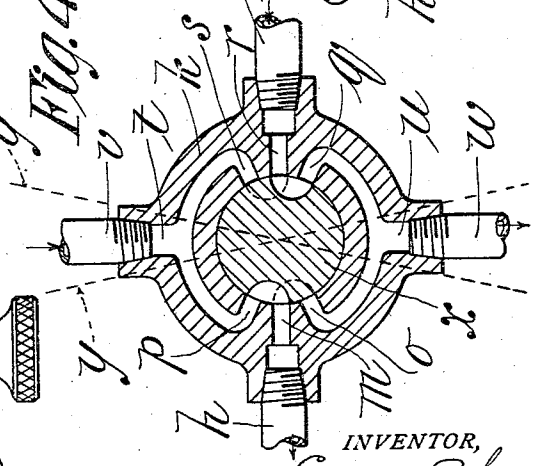

Fig. 4.

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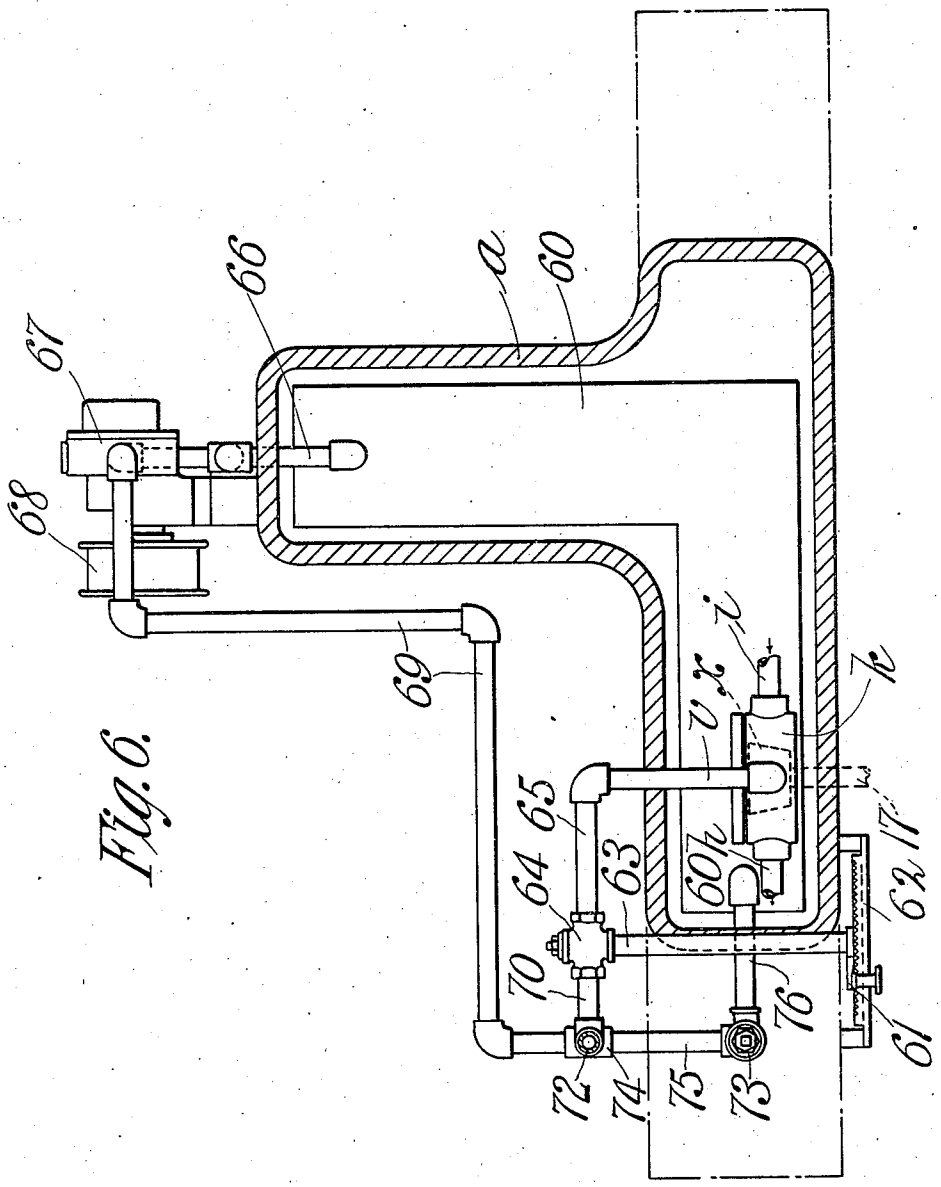

Fig. 6.

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UNITED STATES PATENT OFFICE.

EDWARD F. SMITH, OF GREENFIELD, MASSACHUSETTS, ASSIGNOR TO THE GREENFIELD MACHINE COMPANY, OF GREENFIELD, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

GRINDING-MACHINE.

956,208. Specification of Letters Patent. Patented Apr. 26, 1910.

Application filed December 17, 1909. Serial No. 533,541.

To all whom it may concern:

Be it known that I, EDWARD F. SMITH, a citizen of the United States of America, residing at Greenfield, in the county of Franklin and State of Massachusetts, have invented new and useful Improvements in Grinding-Machines, of which the following is a specification.

This invention relates to improvements in grinding machines and is of the type in which an emery or other grinding wheel is employed to cut away the material of the piece being operated upon in which hydraulic or fluid pressure for automatically moving or reciprocating the work carriage back and forth across the face of the grinding-wheel, is used.

The objects of the invention are, (1) to provide means by which the work carriage can be operated in a steady or uniform manner; (2) to provide means for regulating the rate of motion of the work carriage; (3) to provide means for regulating the fluid pressure that is employed for operating the work carriage; (4) to provide an automatic feed mechanism by means of which the grinding wheel is moved forward or toward the work at each end of the travel of the work carriage; (5) to provide means for automatically directing the flow of the fluid whereby the work carriage is operated; (6) to provide means for accurately gaging or adjusting the amount that the grinding wheel is moved forward at each end of the movement of the carriage; (7) to provide means for releasing and locking the valve mechanism by means of which the direction of flow of the fluid which operates the work carriage may be controlled.

The invention consists, broadly, in providing, in a grinding machine, a cylinder, a piston adapted for movement therein and to which the work carriage is connected, and mechanism operated from the movements of the work carriage for governing or controlling the flow of the liquid to the opposite ends of the cylinder, and connecting means also operated from the work carriage for effecting the automatic movement of the grinding-wheel toward the work.

Other objects of the invention will appear in the body of the specification and be particularly pointed out in the claims.

In the drawings forming part of this application,—Figure 1 is a front elevation of the assembled machine showing particularly the mechanism for operating the automatic feed of the grinding-wheel and the mechanism for operating the valve for controlling the direction of flow of the fluid. Fig. 2 is a partial transverse sectional elevation on the line 2—2 of Fig. 1 showing the lever for operating the valve which governs the flow of the liquid to the opposite ends of the cylinder. Fig. 3 is a detail sectional view on the line 3—3 of Fig. 1 showing the detailed construction of the cylinder. Fig. 4 is a sectional view on the line 4—4 of Fig. 2, showing the construction of the valve which controls the direction of flow of the liquid to and from the opposite ends of the cylinder, the piston of which operates the work carriage. Fig. 5 is a horizontal, sectional view on the line 5—5 of Fig. 1, illustrating the construction of the feed mechanism and also showing the locking mechanism of the valve-operating lever and in outline the casing of the fluid-governing valve. Fig. 6 is a horizontal sectional view on the line 6—6 of Fig. 1, through the base of the machine, illustrating the piping and the pump for forcing and controlling the flow of the oil or other liquid into, and from the cylinder; also showing the means for controlling the volume of flow of the oil and a valve construction for varying the pressure of the oil in the cylinder.

Referring to the drawings in detail, *a* designates the frame or base portion of the machine and *b* the work carriage, shown in section in Fig. 2, that travels back and forth on the base-portion, and *c* the usual V-ways employed in this class of machines.

d designates a cylinder that is suitably supported in the upper portion of the base portion of the machine, shown in section

in Fig. 2, and in dotted lines in Fig. 1. Located in the cylinder *d* is a piston *e*, and attached to this piston is a rod *f* that is connected to the work carriage *b* by means of a bracket, as shown at *g* in dotted lines in Fig. 1. The opposite ends of the cylinder *d* are provided with inlet and outlet pipes *h* and *i* that extend to a valve *k*, a section of which is shown in Fig. 4. The casing of the valve is provided with a plurality of openings with which the pipes *h* and *i* communicate, these openings or ports being designated by the letters *m*, *o*, and *p* on one side, and diametrically opposite are the openings or ports *q*, *r*, and *s*, as clearly shown in Fig. 4. Located between these sets of openings are the openings *t* and *u* with which communicate the supply and discharge pipes *v* and *w*.

The plug of the directing valve *k* is designated at *x* and is adapted to be operated by means of the lever *y* which, in turn, is adapted to be operated by means of the adjustable stops *z* and 2 that are mounted on the carriage *b* in the groove 3 of the carriage, and secured in any fixed position by means of the set-screws 4, whereby the travel of the carriage is limited to the work in question. The valve-operating lever *y* is provided with a plug portion 5 that is normally spring-actuated inward by means of the coiled spring 6 located in a recess behind the plug 5.

7 designates a plate secured to the front of the base-piece *a* in which is formed a recess 8 for receiving the plug 5 when it is desired to lock the valve-operating lever *y* against oscillatory movement for stopping the machine.

In order to retain the plug 5 in an inoperative position so that the valve-operating lever *y* may be actuated, a rod 9 having a notch 10 in the lower end thereof is provided, as shown in Fig. 2, and this rod is normally actuated in an upward direction by means of the coiled spring 11 so that when the plug 5 is withdrawn to the full line position shown in Fig. 2 (by means of the button 12) the lower part 13 of the rod 9 will engage the recessed portion 14 of the stem 15 to which the plug 5 is attached. In order to release the plug 5 it is necessary to only depress the rod 9 by means of the button 16, whereby the coiled spring 6 will move the plug 5 into the recess 8 of the plate 7, thereby bringing the machine to a standstill. The lever *y* is attached to the plug *x* of the valve *k* by means of the rod 17.

Referring now to the mechanism by means of which the plug *x* of the valve *k* is operated so as to automatically direct the flow of the fluid to the opposite ends of the cylinder; 18 designates a lever that is pivotally attached to the front or outer side of the base portion *a* at the point 19, the reduced upper end 20 of which lies in the path of the adjustable stops *z* and 2 that are mounted on the work carriage *b*. The lower end of the lever 18 is V-shaped or pointed, as shown at 21, and this lever is connected to the valve-operating lever *y* by means of a link 22 which is provided with a slot or loose connection 23, where the link is connected to the lever *y* at the point 24. The opposite end of the link 22 is connected to the lever 18 at 25. The V-shaped end 21 of the lever 18 engages an anti-friction roller 26 mounted on the upper end of a plunger 27 normally moved upward by means of the spring 28.

Attached to the base-portion *a* is a piece 29 in which is reciprocally mounted a slide 30 having a pointed or V-shaped edge that is connected to the lever 18 by means of a link 31. This V-shaped slide-block engages the anti-friction roller 32 that is mounted on the upper end of the vertically slidable bar 33, which bar is adapted to be reciprocated on the base-piece 29 and is held in place by means of the plate 34. The lower end of the bar 33 engages a lever 35 pivoted to the base portion *a* at 36, and the opposite end of the lever 35 is connected to a spring 37 which is attached to a pin 38 on the base-portion *a*. An adjustable stop 39 is provided for limiting the vertical movement of the lever 35, that is to say, for accurately determining the number of teeth that the ratchet-wheel is moved forward at the end of each movement of the carriage *b*.

40 designates a link connected to the lever 35 at the point 41, and its opposite end is connected to a lever 42 which is mounted for oscillation on the bushing or sleeve 43 that is securely held in the frame *a* of the machine by means of a set-screw 44 (see Fig. 5). The lever 42 carries a pawl 45 that is adapted to engage the teeth of a ratchet-wheel 46, which wheel is attached to a shaft 47 which passes through the sleeve 43 and rotates therein, and carries on its inner end a pinion 48 that meshes with a gear-wheel 49 which is attached to the feed-screw 50 by means of which the bearing-blocks which support the emery or grinding-wheel, shown at 51, are advanced toward the work mounted in the carriage *b*, as shown in Fig. 1. The pawl 45 is pivotally mounted on the oscillatory lever 42 by means of the pin 52, and is adapted to be held in either an operative or inoperative position by means of a spring-pressed bolt 53, the free end of which engages the pawl as shown in Fig. 1.

In order to disengage the pawl 45 from the teeth of the wheel 46, a stop 54 is adjustably retained in a groove 55 of the wheel 46 by means of the lever 56 which tightens a bolt 57 so that when the wheel 46 has been actuated through a certain arc and the feed-screw 50 rotated so as to move the grinding element a definite distance, the grinding

operation will cease by reason of the pawl 45 being disengaged from the teeth of the ratchet-wheel 46. In this particular machine, each tooth on the wheel 46 represents a movement of the grinding element of one-fourth of one one-thousandths of an inch, or any other desirable movement required. In order to quickly operate the feed-screw 50, a hand-wheel 58 is provided whereby the gears 48 and 49 are operated to move the feed-screw 50, it being understood that the pawl 45 is disengaged at such a time from the teeth of the wheel 46.

Referring now to the construction shown particularly in Fig. 6, by means of which the piston *e* and consequently the work-carrying bed *b* is operated: In the base *a* of the machine is located a tank 60 for containing oil or other suitable liquid. Located on the outer side of the base *a* is an arm 61 that is adapted to sweep over and be locked to a sector 62, as shown in Figs. 1 and 6. Connected with this arm is a rod 63 that extends to the rear side of the base portion *a* to a regulating valve 64 which is located in the pipe 65 that communicates with the valve-casing *k* on the top side thereof. The valve 64 is for the purpose of regulating or varying the rate of flow of the oil to the opposite ends of the cylinder *d* whereby the speed of the work carriage may be controlled. The rack 62 locks the arm 61 after the correct speed of the carriage has been attained, or its motion may be stopped altogether if desired.

66 designates a pipe by means of which the oil is drawn from the tank or reservoir 60 by means of a suitable pump 67, preferably of the gear type, the driving pulley of which is shown at 68. The oil, after leaving the pump, passes, by means of the pipe 69, to the pipe 70, regulating valve 64, pipes 65 and *v*, to the valve-casing *k*, ports *t*, *p*, and *m* to the pipe *h* which leads to the left-hand end of the cylinder *d*, whereby the piston *e* and work-carriage *b* are driven forward toward the right. Meanwhile, the oil is escaping from the opposite or right-hand end of the cylinder *d* through the pipe *i*, ports *r* and *q*, to the pipe *w*, back into the tank 60 (see Fig. 6). A pressure gage 71 is connected, by means of a pipe 72, with the pipes 69 and 70, for the purpose of measuring the pressure of the fluid or oil in the system.

73 designates a pressure-regulating valve by means of which the pressure of the liquid which moves the piston *e* and work carriage *b* may be adjusted. This valve is connected to the pipes 69 and 70 by means of the T-coupling 74.

76 is a pipe extending from the valve 73 to the tank 60 and is for the purpose of conveying the oil from the pipe 69 back to the tank 60 should the valve 64 be closed.

76 designates a pipe connected to the valve 73, by means of which the oil from the pipes 69 and 75 is conveyed back to the tank when the valve 64 is closed and the valve 73 is open. When the valves 64 and 73 are partially opened, a portion of the fluid under pressure flows through the pipes 70, 65, and *h* to the cylinder *d*, and a portion through the pipe 75, valve 73, and pipe 76 back to the tank. It will therefore be seen that by adjusting the valve 73 more or less of the oil may be forced through the valve 64, and the pressure thereby carefully regulated. The valve 73 is an ordinary spring-pressure regulating valve which is operated by means of the stem 78. The plug *x* of the valve *k* is retained in place by means of a spring x^1.

79 designates a screw for adjusting the work-carrier *b* for grinding a taper when it is desired.

Referring now to the manner by means of which the feed-screw 50 is operated: As the carriage *b* is operated by means of the fluid-pressure engaging the opposite sides of the piston of the cylinder through the rod *f*, the stops *z* and 2 engage the lever 18 and rotate the same on its pivot 19. This motion is transmitted to the lever *y* through the link 22; but, it will be observed, the lever *y* will not be operated until the end of the slot 23 engages the pin 24, at which time one side of the V-part 21 of the lever 18 will have passed the apex, and the inclined side engaged by the roller 26, whereby the lever 18 which is under compression, will immediately expand to quickly snap the lever *y* over into the opposite inclined position (see Fig. 4) thus operating the plug *x* of the valve *k* and directing the flow of the liquid into the opposite side of the piston, causing the work-carriage *b* to return, the stops y^1 limiting the throw of the lever. At the same time that the lever 18 is moved, the V-shaped slide 30 is also reciprocated, actuating the bar 33 downward and back again causing the lever 35 to make two oscillations whereby the pawl 45 is drawn downward by the spring 37 over the apex of one or more teeth of the wheel 46, and is pushed back again in the direction of the arrow 46^1 by the bar 33, thus operating the wheel 46, and, through the lever 42, the shaft 47, and the gears 48 and 49, the feed-screw 50 is actuated to move the grinding-wheel forward. This operation takes place at each end of the stroke.

The work centers 90 are indicated in Fig. 1, and a piece of work as shown at 91. The pulley for rotating the piece of work 91 is shown at 92, and the pulley for rotating the grinder is shown at 93. A pipe for supplying water to the grinding-wheel is shown at 94, the supply from the pipe 95, being controlled by the valve 96. In order

to prevent the accumulation of air bubbles in the cylinder *d* between the ends of the cylinder and the opposite sides of the piston, I provide small pipes 80 which lead to the tank 60, whereby any bubbles that may be contained in the fluid may be forced out of the cylinder, together with a small quantity of the fluid into the tank. By permitting the bubbles to escape, the fluid is thus rendered more effective, as a solid mass is thus provided for operating the piston. A suitable pump for forcing water through the pipe 95 is shown at 98.

What I claim, is:—

1. In a fluid-pressure operating mechanism for the work carriage of a grinding machine, stop devices mounted on the carriage for controlling the movements of the fluid, a lever adapted to be engaged by the stops, a spring-actuated anti-friction roller for controlling the direction of the fluid, a ratchet-wheel, a pawl-supporting lever, a link connection between said lever and the lever engaged by the stops, a link connected to the lever that is actuated by the carriage for controlling the movements of the pawl-supporting lever, and a V-shaped slide for imparting oscillatory movements to the pawl-supporting lever, as described.

2. In a grinding machine, a carriage for supporting the work to be ground, a cylinder, a piston, connecting means between the piston and carriage, a valve for directing the flow of a fluid to the opposite sides of the piston, means operable from the carriage for actuating the valve, and pipe connections extending from the valve to the cylinder, a valve in the pipe connections for regulating the pressure of the fluid whereby a uniform motion is imparted to the carriage.

3. A grinding machine having in combination with the work carriage thereof, a cylinder, fluid pressure devices associated with the cylinder for actuating said carriage, and means for maintaining a solid body of the fluid in said devices.

4. In a grinding machine, the combination with the work carriage thereof, fluid pressure devices for actuating said carriage, a lever for directing the flow of the fluid, means including a spring-actuated bolt for locking the lever against movement, and means including a spring-actuated bolt for releasing the locking bolt of the lever, as described.

5. In a grinding machine, the combination with the work carriage, a lever actuated by said carriage, fluid pressure mechanism for actuating the carriage, a ratchet feed mechanism operable from the carriage for advancing the grinding element, said feed mechanism including a V-shaped slide, a bar engaged by said slide, and a lever spring-actuated in one direction but operated by the carriage in the opposite direction to positively actuate the ratchet feed mechanism, substantially as described.

6. In a grinding machine, the combination with a work-supporting carriage, of a lever adapted to be actuated from the carriage, a plate provided with a recess, and a plug on the lever for engaging the recess whereby the carriage may be stopped.

7. In a grinding machine, the combination with a work support, a grinding wheel, mechanism actuated by fluid pressure for reciprocating said support, a valve, a lever controlled from the support and controlling the movements of the valve, and a link mechanism between the lever and the wheel for advancing or withdrawing the wheel from the support.

8. In a grinding machine, the combination with a work carriage, a valve-operating lever, a lever provided with a V-shaped end and operated by the carriage, a link connecting the levers, a spring-actuated roller engaging said end whereby the valve-operating lever is snapped from one position to another by said roller, as described.

9. In a grinding machine, the combination with the work support, a valve-operating lever for controlling the movements of the support, a lever actuated by the carriage at the end of its movements and provided with a V-shaped portion, a spring-actuated roller engaging said portion, a link provided with a slot connecting the levers, whereby the valve-operating lever is moved by the roller, as described.

10. In a grinding machine, the combination with a work carriage, fluid pressure mechanism for operating the carriage, of a lever for controlling the flow of the fluid at each end of the carriage travel, a second lever actuated by the carriage at the end of its travel, a grinding-wheel and link connections between the first mentioned lever, second lever, and the grinding-wheel, said connections including V-shaped surfaces and anti-friction spring-actuated rollers engaging said surfaces, whereby the link connections, levers, and grinding-wheel are actuated.

11. A grinding machine comprising a carriage, fluid-operating mechanism for moving the carriage in opposite directions, and automatically operated means for reversing the movements of the carriage, and spring-actuated devices for moving the grinding element toward the work.

12. In a grinding machine, the combination of work supports, a grinding-wheel, a reciprocating carriage carrying the supports, a reversing mechanism for the carriage, a cross-feed for the grinding-wheel, feed mechanism for the grinding-wheel, a piston for operating the carriage, and spring-actuated means for operating the feed and reversing mechanisms.

13. In a grinding machine, the combination with a grinding-wheel, feed mechanism therefor including a ratchet-wheel, a groove in the face thereof for receiving a stop member, a pawl mounted on a lever and engaging the teeth of the ratchet-wheel, means for actuating the lever whereby when the ratchet-wheel has been driven through a predetermined arc, the pawl will be disengaged.

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