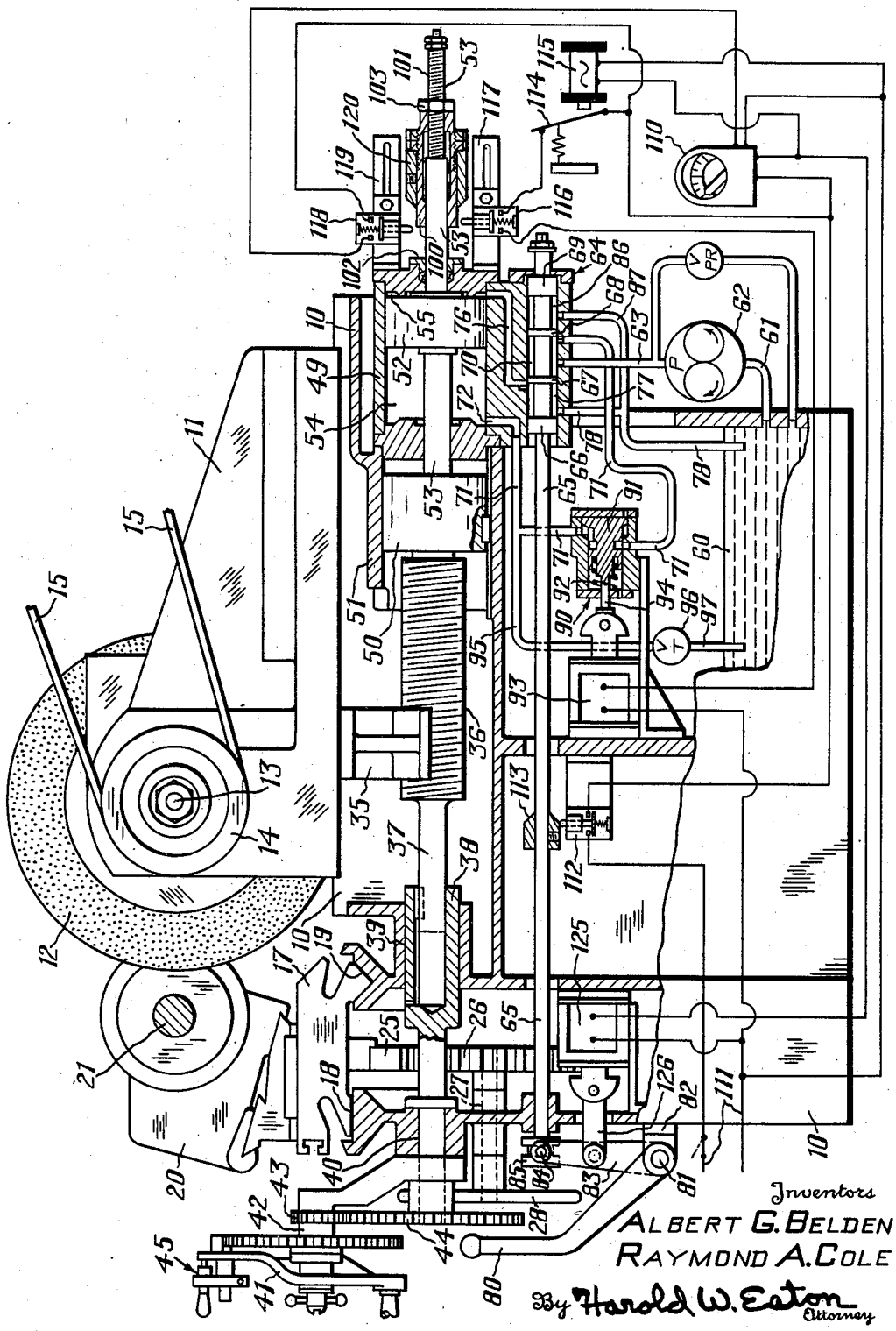
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HYDRAULIC WHEEL FEED

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HYDRAULIC WHEEL FEED

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This invention relates to grinding machines, and more particularly to a fluid operated wheel feeding mechanism.

One object of this invention is to provide a simple thoroughly practical hydraulically operated wheel feeding mechanism for a grinding machine. Another object of the invention is to provide a suitable wheel feed control mechanism so that the infeeding movement of the grinding wheel may be precisely controlled to grind a work piece to a predetermined size. Another object of the invention is to provide a fluid pressure wheel feed control which enables a precise regulation of the infeeding movement and also the dwell after the infeeding movement has stopped. A further object of this invention is to provide an electrical time delay device which serves to allow the grinding wheel to dwell in contact with the work for a definite predetermined time interval after the infeeding movement has stopped, and to thereafter reverse and separate the wheel from the finish ground work piece. Other objects will be in part obvious or in part pointed out hereinafter.

This invention accordingly consists in the features of construction, combinations of elements, and arrangements of parts, as will be exemplified in the structure to be hereinafter described, and the scope of the application of which will be indicated in the following claims.

In the accompanying drawing in which is shown one of various possible embodiments of the mechanical features of this invention,

The figure is an end elevation of a grinding machine, having parts broken away and shown in section to more clearly show the operating construction.

A grinding machine has been illustrated in the drawing comprising a base 10 which supports a transversely movable wheel slide 11 which is mounted on transversely extending ways (not shown) on the base 10. The wheel slide 11 supports a rotatable grinding wheel 12 which is mounted on the end of a rotatable wheel spindle 13. The wheel spindle 13 may be driven by any of the well known mechanisms, such as an overhead belt drive or an electric motor mounted on the wheel slide. As illustrated, a wheel driving pulley 14 is mounted on the opposite end of the wheel spindle 13 and is connected by a driving belt 15 with a source of power.

The base 10 also supports a longitudinally movable work table 17 which is arranged to reciprocate longitudinally relative to the base 10 on a flat way 18 and a V-way 19. The table 17 is provided with a rotatable work support which may comprise a headstock 20 and a footstock (not shown), each of which is provided with work supporting centers to rotatably support a work piece 21 in operative relation with the grinding wheel 12. The table 17 may be traversed longitudinally by a manually operable traverse mechanism which includes a rack bar 25 depending from the under side of the table 17. The rack bar 25 meshes with a gear 26 supported on the inner end of a rotatable shaft 27. A manually operable traverse wheel 28 is mounted on the outer end of the shaft 27 and is arranged to be manually rotated to traverse the table 17 longitudinally relative to the base 10. If desired, a power operated traversing or reciprocating mechanism may be provided, such as for example a mechanism of the type shown in the U. S. patent to Norton No. 762,838 dated June 14, 1904.

A wheel feeding mechanism is provided for manually feeding the grinding wheel toward and from the work, which comprises a half nut 35 depending from the wheel slide 11. The half nut 35 meshes with or engages a rotatable cross feed screw 36. A forwardly extending portion 37 of the cross feed screw 36 is slidably keyed to a rotatable sleeve 38. The rotatable sleeve 38 is formed as an integral part of a rotatable shaft which is mounted in bearings 39 and 40 in the base 10. A manually operable feed wheel 41 is mounted on the front end of a stud 42. The stud 42 carries a pinion 43 which meshes with a gear 44 mounted on the outer end of the sleeve shaft 38 so that a manual rotation of the feed wheel 41 serves to rotate the feed screw 36 in either direction to cause a forward or rearward feeding movement of the grinding wheel 12 and the wheel slide 11. The wheel feed 41 may be provided with a micrometer adjusting mechanism 45 which is substantially identical with that shown in the above-mentioned prior patent to Norton. This micrometer mechanism serves to precisely adjust the stop on the manual infeed to compensate for wheel wear.

In the preferred construction, the wheel slide 11 is arranged so that it may be moved toward and from the work piece 21 to grind the same to a predetermined size by means of a fluid pressure actuated wheel feeding mechanism. As illustrated in the drawing, the rear end of the feed screw 36 is rotatably supported in a slidably keyed bearing 50 which is supported in a casing 51 on the base 10 of the machine. A fluid pressure cylinder 49 is attached to the casing 51 and contains a slidably mounted piston 52 which is

connected by a piston rod 53 with the bearing 50 and is arranged so that when fluid is admitted to a cylinder chamber 54, the piston 52 will be moved toward the right (see figure) into its rearward position, as illustrated in the drawing, transmitting a corresponding movement through the feed screw 36, the half nut 35, to move the wheel slide 11 and the grinding wheel 12 rearwardly to an inoperative position. Similarly, when fluid under pressure is admitted to a cylinder chamber 55, the wheel slide 11 and grinding wheel 12 are caused to move in a forward direction to move the grinding wheel 12 toward the work piece 21 for a grinding operation. When fluid is admitted either to the cylinder chamber 54 or the cylinder chamber 55, a rapid approaching or receding movement of the wheel 12 and wheel slide 11 is provided.

A fluid pressure system is provided to supply fluid under pressure for moving the piston 52 so as to cause an infeeding or outfeeding movement of the grinding wheel 12. This system may comprise a reservoir 60 which conveys fluid through a pipe 61 to a fluid pressure pump 62. The pump 62 forces fluid under pressure through a pipe 63, to a control valve 64. The control valve 64 is preferably a piston type valve comprising a valve stem 65 having formed integrally therewith valve pistons 66, 67, 68 and 69. Fluid under pressure passing through the pipe 63 enters a valve chamber 70 located between the valve pistons 67 and 68 and passes through a pipe 71 and a passage 72, into the cylinder chamber 54, to move the piston 52 to its rearward position with the grinding wheel 12 separated from the work piece 21, as indicated in the drawing. During the rearward movement of the piston 52 toward the right, fluid is exhausted from the cylinder chamber 55, through a passage 76, into a valve chamber 77, between the valve pistons 66 and 67, and out through a pipe 78 which exhausts into the reservoir 60.

The valve stem 65 is arranged so that it may be moved endwise to shift the valve 64 into a reverse position so as to cause either a forward or rearward feeding movement of the grinding wheel 12. A manually operable lever 80 is pivotally mounted on a stud 81 which is supported in a bracket 82 on the front of the machine base. A lever 83 is also pivotally mounted on the stud 81 and is either formed integral with or fixedly attached to move with the control lever 80. The upper end of the lever 83 is connected by a pin 84 with a spool shaped member 85 carried on the outer end of the valve stem 65.

When it is desired to cause a forward feeding movement of the grinding wheel, the lever 80 is moved in a counterclockwise direction, as shown in the drawing, to move the valve stem 65 toward the left and thereby reverse the position of the valve 64 so that fluid under pressure passes through the pipe 63 into the valve chamber 70 and passes through the passage 76, into the cylinder chamber 55, to move the piston 52 toward the left, as viewed in the drawing, to cause an approaching movement of the wheel slide 11 and the grinding wheel 12. During the movement of the piston 52 toward the left, fluid within the cylinder chamber 54 is exhausted through the passage 72, the pipe 71, into a valve chamber 86 located between the valve pistons 68 and 69, and passes out through a pipe 87 and pipe 78 into the reservoir 60. In grinding a cylindrical work piece, it is necessary to separate the grinding wheel from the work piece by a sufficient distance to facilitate loading and unloading of the machine. It is, therefore, desirable to provide a suitable feeding mechanism for causing the wheel slide 11 and the grinding wheel 12 to rapidly approach the work piece 21 and to then slow down to a predetermined grinding feed. A rapid approaching and receding movement is accomplished by the mechanism above described. In order to produce a slow infeeding movement as the grinding wheel approaches the work piece, a valve 90 is interposed in the pipe line 71. The valve 90 contains a valve piston 91 which, in the position illustrated, is arranged to allow a free passage of fluid through the pipe 71 so that when fluid is admitted to the cylinder chamber 55, fluid may be exhausted from the cylinder chamber 54, through the passage 72, the pipe 71, the valve 90, into the valve chamber 86, and out through the pipe 87 and the pipe 78 into the reservoir 60. The valve piston 91 is normally held in the position illustrated in the drawing by means of a spring 92. An electric solenoid 93 is connected to the end of a valve stem 94 and serves when energized to move the valve piston 91 toward the left to cut off the fluid passing through the pipe 71 and valve 90, after which fluid may exhaust from the cylinder chamber 54, through the passage 72, the pipe 71, a pipe 95, and through an adjustable needle valve 96 and through a pipe 97, into the reservoir 60. By adjusting the aperture of the needle valve 96, the exhaust of fluid from the cylinder chamber 54 may be readily controlled so as to control the rate of infeeding movement of the grinding wheel 12 toward the work piece 21 to control the grinding feed.

It is desirable to provide a positive stop to definitely limit the infeeding movement of the grinding wheel to control the approaching movement of the grinding wheel toward the work. In the preferred form, an adjustable stop sleeve 100 is adjustably mounted on a threaded portion 101 of the piston rod 53 and is arranged to engage a stop surface 102 on the head of the cylinder 49. The adjustable stop sleeve 100 is arranged to be locked in adjusted position by means of a nut 103.

It is desirable to provide a controlling mechanism for the wheel feed which is arranged so that when a work piece has been inserted in the machine, it is merely necessary for the control lever 80 to be shifted to initiate an approaching movement of the grinding wheel which continues until the grinding wheel approaches the work piece 21, after which the approaching feed is reduced to a predetermined grinding feed. The infeed continues until the stop 100 engaging the stop surface 102 positively limits the infeeding movement of the grinding wheel. The wheel is then allowed to remain in grinding contact with the work piece for a definite period of time, after which the fluid control valve 64 is reversed to again move the grinding wheel to its rearward or inoperative position. In the preferred construction, the latter is accomplished by providing an electrical control system including an electrical time delay relay 110. Power is provided for the electrical control system from a suitable source of power, as indicated by the power lines 111. A limit switch 112 is provided and is arranged so that in the position of the parts as illustrated in the drawing, that is when the control valve 64 is in a position to cause a rearward feeding movement of the grinding wheel, the limit switch is held open by an adjustable cam 113 mounted on

the valve stem 65. When an infeeding movement of the wheel is initiated by causing the valve stem 65 to move toward the left, the limit switch closes. This limit switch is connected through a relay clapper 114 on an electrical relay 115 with an adjustably positioned limit switch 116 which is adjustably supported on a bracket 117 fixed to the outer cylinder head of the cylinder 49. A similar limit switch 118 is adjustably mounted on a bracket 119 which is also supported on the cylinder head. The limit switches 116 and 118 are arranged to be actuated by a cam sleeve 120 which is adjustably supported on the stop sleeve 100.

In order to automatically reverse the position of the control valve 64 after a predetermined grinding operation, an electrical solenoid 125 is connected by a link 126 with the arm 83. These parts are so arranged that when the solenoid 125 is energized, it moves the lever 83 in a clockwise direction which in turn serves to move the valve stem 65 toward the right to position the valve pistons 66, 67, 68 and 69 in the position as illustrated in the drawing.

The operation of this improved wheel feeding mechanism is readily apparent from the foregoing disclosure. Assuming the various limit switches and valves to have been previously adjusted and the time delay relay has been set to allow the grinding wheel 12 to remain in operative grinding contact with the work for a definite predetermined time interval after the positive stop has been reached, a work piece 21 is mounted on centers and the work and wheel are rotated at proper grinding speed before the control lever 80 is moved to initiate an infeeding movement. The control lever 80 is then moved in a counterclockwise direction to cause the valve stem 65 to move toward the left to shift the control valve 64 so that fluid under pressure passing through the pipe 63 into valve chamber 70 passes through the passage 76, into cylinder chamber 55, to cause a forward feeding movement of the grinding wheel 12 at a rapid approaching rate. During this movement, fluid exhausts from the cylinder chamber 54, through the passage 72, the pipe 71, and passes unrestricted through the valve 90 and into the valve chamber 86, and from there out through a pipe 87 and the pipe 78 into the reservoir 60. When the valve stem is shifted to initiate the infeeding movement, the cam 113 moves toward the left and serves to allow the limit switch 112 to close. The rapid approaching movement continues until the cam sleeve 120 engaging the limit switch 116 and closing the same serves to close the circuit and energize the solenoid 93 which in turn shifts the valve piston 91 toward the left to close the passage in the pipe 71 so that the rapid approaching movement ceases and fluid exhausting from the cylinder chamber 54 must thereafter pass through the pipe 95, needle valve 96, and pipe 97, into the reservoir 60, at a slow controlled infeeding rate to produce the desired grinding action. The infeeding movement of the grinding wheel continues until the stop sleeve 100 engages the stop surface 102 to positively stop the infeeding advance of the grinding wheel 12, but allowing the wheel to remain in operative contact with the work 21 to allow the wheel to spark out or finish grind the work. At the same time the stop sleeve 100 engages the stop surface 102, the cam sleeve 120 engages and closes the limit switch 118, which closes a circuit to start the time delay relay 110 functioning. The wheel remains in grinding contact with the work piece 21 for a finish grinding operation until the time delay relay 110 operates to close a circuit, which serves to energize the electromagnet 115 to move the relay clapper 114 so as to break the circuit and deenergize the solenoid 93 which in turn releases the tension of the spring 92 and thereby moves the valve piston 91 into the position illustrated in the drawing so that fluid may readily pass unrestricted through the pipe 71. At the same time, the time delay relay 110 closes a second circuit, which energizes the solenoid 125 and rocks the lever 83 into the position illustrated in the drawing which shifts the valve stem 65 and the valve 64 into the position of the parts illustrated in the drawing so that fluid under pressure passing through the pipe 63 into the cylinder chamber 70 passes out through the pipe 71, into the cylinder chamber 54, to cause the piston 52 to move rearwardly to separate the grinding wheel 12 from the work piece 21. When the valve stem 65 is moved toward the right into the position illustrated in the drawing, the cam 113 serves to open the limit switch 112, thereby rendering the electrical control apparatus inoperative, allowing the time delay relay 110 to reset, and stopping the cycle after the work piece has been ground to a predetermined size and the wheel 12 has moved to an inoperative position. This cycle of operation may then be continued in grinding successive work pieces to a predetermined size. The electrical time delay relay 110 is a standard electrical time delay relay in which the time interval may be adjusted to vary the final or finish grinding period, as desired.

It will thus be seen that there has been provided by this invention apparatus in which the various objects hereinabove set forth together with many thoroughly practical advantages are successfully achieved. As many possible embodiments may be made of the above invention and as many changes might be made in the embodiment above set forth, it is to be understood that all matter hereinbefore set forth or shown in the accompanying drawing is to be interpreted as illustrative and not in a limiting sense.

We claim:

1. In a grinding machine, a longitudinally movable rotatable work support, a rotatable grinding wheel, a transversely movable slide to support said wheel, a fluid pressure piston and cylinder operatively connected to move said slide, a control valve to control the admission of fluid to said cylinder, a cut-off valve interposed between the control valve and the cylinder, an adjustable throttle valve operatively connected with the cut-off valve and arranged to control the infeeding movement of the grinding wheel when the cut-off valve is closed, a solenoid arranged to close said cut-off valve, an adjustably mounted limit switch, and an adjustable cam movable with said piston and arranged to actuate said switch when the wheel and slide reach a predetermined position to close said cut-off valve and thereby change from a rapid approaching to a predetermined grinding feed.

2. In a grinding machine, a longitudinally movable rotatable work support, a rotatable grinding wheel, a transversely movable slide to support said wheel, a fluid pressure piston and cylinder operatively connected to move said slide, a control valve to control the admission of fluid to said cylinder, a cut-off valve interposed between the control valve and the cylinder, an adjustable throttle valve operatively connected with

the cut-off valve and arranged to control the infeeding movement of the grinding wheel when the cut-off valve is closed, a solenoid to close said cut-off valve, an adjustably mounted limit switch, an adjustable cam movable with said piston and arranged to actuate said switch when the wheel and slide reach a predetermined position to close said cut-off valve and thereby change from a rapid approaching to a predetermined grinding feed, and means including a second adjustably mounted switch which is actuated by said cam to reverse said control valve after a predetermined grinding period to cause a rearward separating movement of the grinding wheel.

3. In a grinding machine, a longitudinally movable rotatable work support, a rotatable grinding wheel, a transversely movable slide to support said wheel, a fluid pressure piston and cylinder operatively connected to move said slide, a control valve to control the admission of fluid to said cylinder, manually operable means to shift said control valve in either direction to cause either a rapid forward or rearward movement of the grinding wheel, means including a solenoid to move said control valve to cause a rearward movement of the grinding wheel, a cut-off valve interposed between the control valve and the cylinder, an adjustable throttle valve operatively connected with the cut-off valve and arranged to control the infeeding movement of the grinding wheel when the cut-off valve is closed, a solenoid arranged to close said cut-off valve, an adjustably mounted limit switch, an adjustable cam movable with said piston and arranged to actuate said switch when the wheel and slide reach a predetermined position to close said cut-off valve and thereby change from a rapid approaching to a predetermined grinding feed, and means including a second adjustably mounted switch which is actuated by said cam to reverse said control valve after a predetermined grinding period to cause a rearward separating movement of the grinding wheel.

4. In a grinding machine, a longitudinally movable rotatable work support, a rotatable grinding wheel, a transversely movable slide to support said wheel, a fluid pressure piston and cylinder operatively connected to move said slide either toward or from the work support, a control valve arranged to control the admission of fluid to said cylinder, manually operable means to move said valve to cause either a forward or rearward movement of said slide, electrically operated means including a solenoid arranged to move said control valve to cause a rearward movement of the slide, a cut-off valve, an adjustable throttle valve associated with said cut-off valve and arranged to control the exhaust of fluid from the system when the cut-off valve is closed, a solenoid operatively connected to close said cut-off valve, an electric switch, a cam actuated by and in timed relation with said piston during the forward movement of the grinding wheel to energize said second solenoid to close the cut-off valve, an adjustable stop to positively limit the forward movement of the grinding wheel, an electric switch actuated by said cam, and a time delay relay operated by said switch to allow the wheel to remain in operative engagement with the work for a definite time interval after the infeeding movement has ceased, said time delay relay serving at a predetermined time interval after the infeeding movement has ceased to energize the first solenoid to shift the control valve so as to cause a rearward movement of the grinding wheel.

5. In a grinding machine, a longitudinally movable rotatable work support, a rotatable grinding wheel, a transversely movable slide to support said wheel, a fluid pressure piston and cylinder operatively connected to move said slide, a control valve arranged to control the admission of fluid to said cylinder, manually operable means to move said valve to produce either a rapid forward or rearward approaching movement of the wheel, means including a solenoid to shift said control valve to cause a rapid rearward movement of the grinding wheel, a cut-off valve, a second solenoid to actuate said cut-off valve, an adjustably mounted switch operated in timed relation with the forward movement of the slide to energize said second solenoid and close said cut-off valve, an adjustable throttle valve associated with the cut-off valve to control the exhaust of fluid from the cylinder when the cut-off valve is closed to produce a predetermined grinding feed, means including an adjustable stop movable with said piston to positively limit the infeeding movement of the grinding wheel, an adjustably mounted switch, an adjustable cam on said stop to actuate said switch, and means including an electrical time delay relay which is rendered operative by said switch to permit a predetermined finish grinding operation after the infeeding movement has ceased and to thereafter energize said first solenoid to shift the control valve and cause a rapid rearward movement of the grinding wheel.

6. In a grinding machine, a longitudinally movable rotatable work support, a rotatable grinding wheel, a transversely movable slide to support said wheel, a fluid pressure piston and cylinder operatively connected to move said slide, a control valve arranged to control the admission of fluid to said cylinder, a manually operable means to move said valve to produce either a rapid forward or rearward approaching movement of the wheel, means including a solenoid to shift said valve to cause a rapid rearward movement of the wheel, a cut-off valve, a second solenoid arranged to actuate said cut-off valve, an adjustably mounted switch operated in timed relation with the forward movement of the slide to energize said second solenoid to close said throttle valve, an adjustable throttle valve associated with the cut-off valve to thereafter control the exhaust of fluid from the cylinder to produce a predetermined grinding feed, means including an adjustable stop to positively limit the infeeding movement of the grinding wheel, an adjustably mounted switch associated with said stop, means including an electric time delay relay which is rendered operative by said switch to permit a predetermined finish grinding operation and to thereafter simultaneously deenergize the second solenoid to open said cut-off valve and to energize said first solenoid to shift the control valve so as to cause a rapid rearward movement of the grinding wheel.

7. In a grinding machine, a longitudinally movable rotatable work support, a rotatable grinding wheel, a transversely movable slide to support said wheel, a fluid pressure piston and cylinder operatively connected to move said slide, a control valve to control the admission of fluid under pressure to said cylinder to cause a transverse infeeding or rearward movement of the slide, a positive stop to limit the infeeding movement of the grinding wheel, a time delay

relay which is set in motion when the positive stop limits the approaching movement of the grinding wheel, and means including a solenoid controlled by said relay to shift the control valve after a predetermined period of dwell to cause a rapid rearward movement of the grinding wheel.

8. In a grinding machine, a longitudinally movable rotatable work support, a rotatable grinding wheel, a transversely movable slide to support said wheel, a fluid pressure piston and cylinder operatively connected to move said slide, a control valve arranged to control the admission of fluid to said cylinder to cause a transverse rapid forward or rearward movement of the slide, means to slow down the rapid approaching movement of the slide to a grinding speed as the wheel approaches the work, means positively to limit the forward movement of the slide and wheel, an electrical time delay relay which is rendered effective when the forward advance of the wheel ceases, and means including a solenoid controlled by said relay to shift the control valve at a predetermined time interval after the forward advance of the wheel has ceased to cause a rapid rearward movement of the grinding wheel.

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