

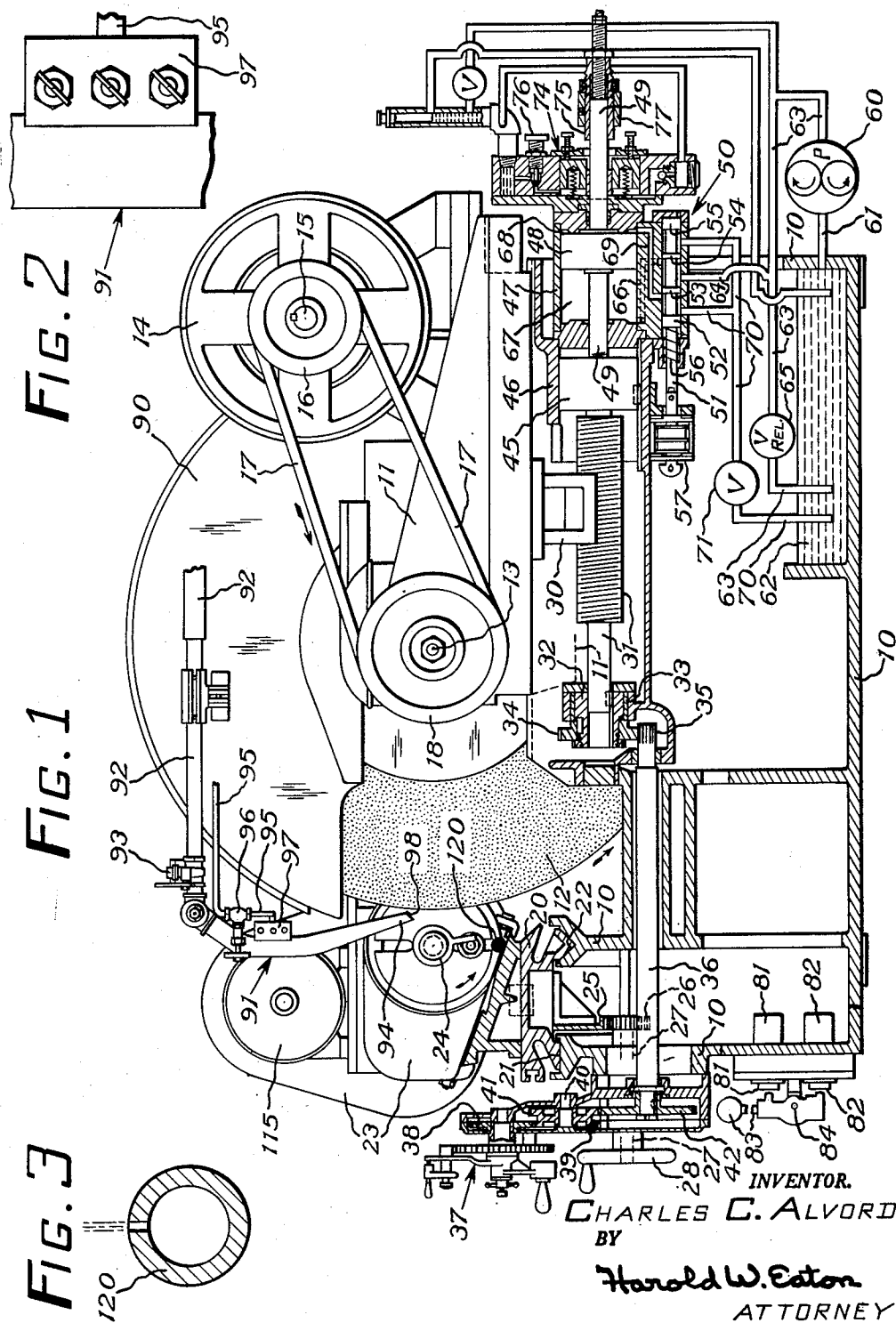
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GRINDING MACHINE

2,567,589

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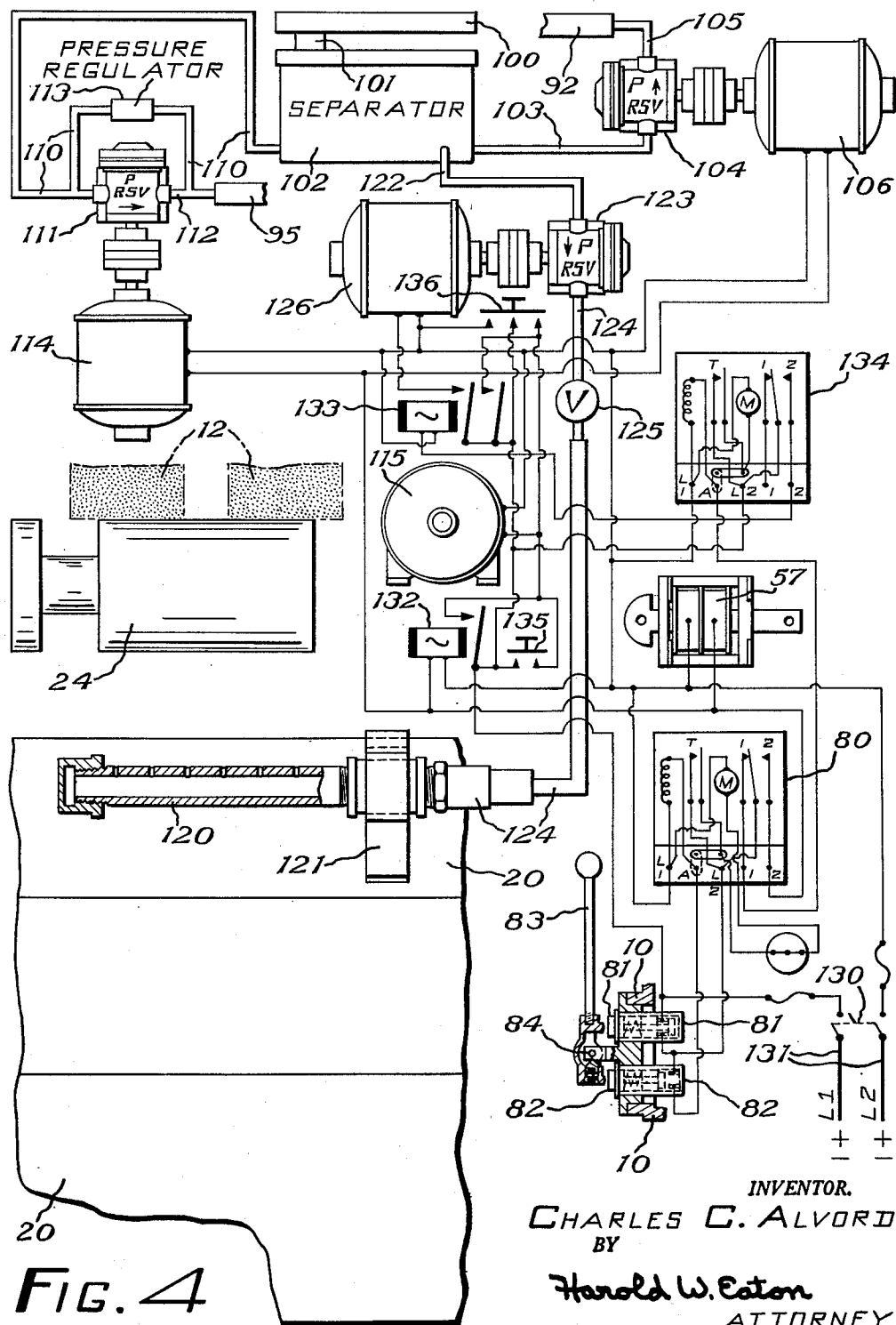
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GRINDING MACHINE

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UNITED STATES PATENT OFFICE

2,567,589

GRINDING MACHINE

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The invention relates to grinding machines, and more particularly to an automatically operated work cleaning or washing apparatus for grinding machines in which a grinding liquid is employed.

In some types of grinding, a grinding liquid is employed to facilitate the grinding operation. In other cases a two-fluid system is provided such as for example that shown in the prior United States Patent No. 2,434,679 to H. W. Wagner et al. dated January 20, 1949, in which a grinding liquid is employed to facilitate the grinding operation and a coolant fluid is supplied for dissipating heat from the work generated by the grinding action. In either case more or less of the grinding liquid and swarf remains on the surface of the work piece after the grinding operation has been completed. It is desirable to remove this coating of grinding liquid and swarf from the surface of the work before removing it from the machine not only to facilitate handling of the ground work piece but also to prevent loss of grinding liquid from the system.

One object of the invention is to provide a simple and thoroughly practical automatic work cleaning or washing apparatus for removing the residual fluid and swarf from the ground work piece before it is removed from the grinding machine. Another object is to automatically stop the flow of grinding liquid and to start the flow of washing or cleaning liquid when the grinding operation has been completed. Another object of the invention is automatically to stop the flow of grinding liquid and to start the flow of washing or cleaning liquid in timed relation with movement of the wheel slide to an inoperative position after a grinding operation has been completed.

Another object is to provide a washing or cleaning fluid nozzle adjacent to the work piece being ground and to provide an independent fluid pump to convey cleaning fluid to said nozzle under sufficient pressure to clean residual liquid and swarf from the rotating work piece after a grinding operation has been completed. Another object is to provide an electrical control means actuated by and in timed relation with movement of the grinding wheel to an inoperative position automatically to start the cleaning fluid pump. Another object of the invention is to provide an electrical timer for controlling the duration of the grinding operation in which the timer serves after a predetermined time interval to reverse the feeding movement of the grinding wheel and to stop the flow of grinding

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liquid and cooling liquid and to energize a second electric timer which serves automatically to start the washer pump and to control the duration of the washing or cleaning operation. Other objects will be in part obvious or in part pointed out hereinafter.

The 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 drawings in which is shown one of various possible embodiments of the mechanical features of this invention.

Fig. 1 is a cross sectional view through a grinding machine embodying the invention, showing the headstock and wheel slide in end elevation;

Fig. 2 is a fragmentary end elevation, on an enlarged scale, of the valves for controlling the grinding fluid;

Fig. 3 is a fragmentary cross sectional view, on an enlarged scale, through the work washing nozzle; and

Fig. 4 is a combined fluid piping and electrical diagram.

A grinding machine has been illustrated in the drawings comprising a base 10 which supports a transversely movable wheel slide 11. The wheel slide 11 is supported on transversely extending ways (not shown) on the base 10. The wheel slide 11 supports a rotatable grinding wheel 12 on one end of a rotatable wheel spindle 13. The wheel spindle 13 may be driven by any of the well known mechanisms, such as, an electric motor 14 mounted on the wheel slide 11. As illustrated, the motor 14 is provided with an armature shaft 15 which supports a multiple V-groove pulley 16 which is connected by multiple V-belts 17 with a multiple V-groove pulley 18 mounted on the end of the wheel spindle 13.

The base 10 also supports a longitudinally movable work table 20 on a flat way 21 and a V-way 22 formed on the base 10. The table 20 is provided with a rotatable work support including a headstock 23 and a footstock (not shown) each of which are provided with work supporting centers rotatably to support a work piece 24 in operative relation with the grinding wheel 12. The table 20 may be traversed longitudinally by a manually operable traverse mechanism which may comprise a rack bar 25 depending from the underside of the table 20. The rack bar 25 meshes with a gear 26 mounted on the right hand end of a rotatable shaft 27. A man-

ually operable traverse wheel 28 is mounted on the outer end of the shaft 27 and is arranged to be manually rotated in either direction to traverse the table 20 longitudinally relative to the base 10 to facilitate positioning the work piece 24 relative to the grinding wheel 12. If desired, a power operated table traversing or reciprocating mechanism may be provided, such as for example a mechanism of the type shown in the expired United States patent to C. H. Norton, No. 762,838 dated June 14, 1904.

A wheel feeding mechanism is provided for manually feeding the grinding wheel 12 toward and from the work piece 24, which comprises a half nut 30 depending from the underside of the wheel slide 11. The half nut 30 meshes with a rotatable cross feed screw 31. A forwardly extending portion of the feed screw 31 is slidably keyed within a rotatable sleeve 32. The rotatable sleeve 32 is journaled in a bearing 33 which is fixed relative to the base 10. A gear 34 is keyed on the sleeve 32 and meshes with a pinion 35 formed on the right hand end of a rotatable shaft 36. A manually operable feed wheel 37 is mounted on the front of the machine base. The feed wheel 37 is arranged to rotate a gear 38 which meshes with a gear 39 supported on a stud 40. A gear 41 preferably formed integral with the gear 39, meshes with a gear 42 which is keyed on the outer end of the shaft 36. It will be readily apparent from the foregoing disclosure that rotation of the feed wheel 37 will be imparted through the gear mechanism above described to rotate the feed screw 31 and thereby transmit a transverse feeding movement to the grinding wheel slide 11 and the grinding wheel 12. The direction of rotation of the feed wheel 37 will determine the direction of movement of the wheel slide 11.

In the preferred construction, the wheel slide 11 is arranged so that it may be moved toward and from the work piece 24 to grind the same to a predetermined size by means of a fluid pressure actuated wheel feeding mechanism. As illustrated in the drawings, the rear end of the feed screw 31 is rotatably supported in a slidably keyed bearing sleeve 45. The sleeve 45 is slidably keyed within an aperture formed in the casing 46. A fluid pressure cylinder 47 is arranged in axial alignment with the feed screw 31. The cylinder 47 contains a slidably mounted piston 48 which is fixedly mounted on a double end piston rod 49. The left hand end of the piston rod 49 is rotatably connected with the bearing sleeve 45.

A piston type control valve 50 is provided for controlling the admission to and exhaust of fluid from the cylinder 47. The control valve 50 may comprise a valve stem 51 having a plurality of valve pistons 52, 53, 54, and 55 formed integrally therewith. A compression spring 56 serves normally to hold the valve stem 51 in its right hand end position as illustrated in Fig. 1. An electric solenoid 57 is operatively connected to the left hand end of the valve stem 51 and is arranged so that when energized, it serves to shift the valve stem 51 toward the left to shift the valve parts into a reverse position.

A fluid pressure system is provided for conveying fluid under pressure to the cylinder 47. This system may comprise a motor driven fluid pump 60 which draws fluid through a pipe 61 from a reservoir 62. The reservoir 62 may be formed within the base 10 of the machine or may be formed as a separate unit if desired. The pump 60 forces fluid under pressure through a pipe 63 and a pipe 64 to the control valve 50. An adjust-

able relief valve 65 is provided in the pipe line 63 to facilitate maintaining the desired operating pressure within the system. The relief valve 65 is arranged so that excess fluid under pressure will be by-passed directly to the reservoir 62.

In the position of the parts as illustrated in Fig. 1, fluid under pressure within the pipe 64 enters a valve chamber located between the valve pistons 53 and 54 and passes through a passage 66 into a cylinder chamber 67 to move the piston 48 together with the wheel slide 11 and grinding wheel 12 toward the right (Fig. 1) into an operative position. During this movement of the piston 48, fluid within a cylinder chamber 68 passes through a passage 69, through a valve chamber located between the valve pistons 52 and 53 and through an exhaust pipe 70 into the reservoir 62. In order to facilitate controlling the speed of movement of the piston 48, a throttle valve 71 is provided in the pipe line 70 to facilitate controlling the exhaust of fluid from the cylinder 70.

The cylinder 47 and piston 48 above described serve to provide a rapid approaching movement for the wheel slide 11 and grinding wheel 12 rapidly to move the grinding wheel 12 into an operative position adjacent to the work piece to be ground. To facilitate slowing down the rapid approaching movement to a slow predetermined grinding feed, a dash pot feed regulator 74 is provided. This dash pot feed regulator will not be described in detail since it is an old and well known feed control means such as for example that shown in the prior United States patent to B. H. Goehring, No. 2,151,660 dated March 21, 1939, to which reference may be had for details of disclosure not contained herein. The rapid approaching movement of the grinding wheel 12 continues until an adjustable sleeve 75 carried on the right hand end of the piston rod 49 engages the dash pot pistons, after which continued movement of the piston 48 toward the left is controlled by a needle valve 76 which serves to regulate the exhaust of fluid from the dash pot cylinders so as to provide a predetermined slow feeding movement of the wheel slide 11 and grinding wheel 12. The grinding feed continues as controlled by the needle valve 76 until a positive stop sleeve 77 engages a stop surface formed on the right hand end face of the dash pot feed regulator 74. This positive stop sleeve 77 serves positively to stop the forward advancing movement of the grinding wheel 12.

In the preferred construction, a time delay relay 80 (Fig. 4) is provided for controlling the shifting movement of the feed control valve 50 so as to control the entire infeed movement of the grinding wheel 12, namely to control the overall cycle including the rapid approaching movement of the grinding wheel 12, the slower grinding infeed of the wheel and the dwell which occurs thereafter before the grinding wheel is moved to a rearward or inoperative position.

A pair of push button switches 81 and 82 are mounted on the front of the machine base 10. The push button switches 81 and 82 are arranged to be actuated by a control lever 83 which is pivotally supported by a stud 84 which is fixedly supported on the base 10 of the machine. The push button switch 81, when actuated, is arranged to cause a rearward feeding movement of the grinding wheel 12 and the wheel slide 11 and the push button switch 82, when actuated, serves to start the grinding cycle. The control lever 83 is moved in a counter-clockwise direction to actu-

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ate the push button switch 82 when it is desired to start a grinding cycle.

A time delay relay 80 may be one of the standard electrically operated adjustable time delay relays, such as that known as the "Microflex" instantaneous reset timer manufactured by the Eagle Signal Corporation of Moline, Illinois. The "Microflex" timer 80 is a synchronous motor operated time delay relay and consists of a clutch operated mechanism and a motor and gear train assembly, with an electromagnetically operated clutch for coupling them together. It is entirely automatic in action and requires only the closing or opening of the timer control circuit to initiate a cycle of operation.

The time relay relay 80 may be adjusted to control the entire approaching and infeeding movement of the grinding wheel, that is the rapid approach, grinding feed and dwell. A grinding cycle may be initiated by actuation of the lever 83 to momentarily close the push button switch 82 which in turn serves to set the timer 80 in motion and simultaneously to energize the solenoid 57 to shift the valve stem 51 toward the left so as to initiate a forward movement of the wheel slide 11 and grinding wheel 12. The infeeding movement continues first as a rapid approaching movement, then a slow grinding feed and thereafter a dwell until a predetermined time interval has elapsed after which the time delay relay serves to deenergize the solenoid 57 thus releasing the compression of the spring 56 to shift the valve stem 51 into the position illustrated in Fig. 1 to cause a rearward movement of the wheel slide 11 and the grinding wheel 12 to an inoperative position.

Closing of the push button switch 82 at the start of a grinding cycle also serves through the timer 80 to start a work drive motor 115 so as to rotate the work piece 24 for a grinding operation.

As illustrated in the drawings, a two-fluid system is provided such as that shown in the prior United States Patent No. 2,434,679 in which a grinding liquid is employed to facilitate the grinding operation and a coolant fluid is supplied for dissipating heat from the work piece generated by the grinding action. A wheel guard 90 is adjustably mounted on the wheel slide 11 and surrounds a portion of the grinding wheel 12. The wheel guard 90 serves as a support for a fluid manifold 91 to be hereinafter described. A pipe 92 (Fig. 1) conveys fluid through a shut-off valve 93 through the manifold 91 to the coolant nozzle 94 which supplies coolant fluid, such as for example water, to the work piece being ground to dissipate heat generated due to the grinding operation. Coolant fluid is supplied in a relatively large volume at a comparatively low pressure from a pump mechanism to be hereinafter described. Grinding fluid, such as for example an oil compound, is pumped through a pipe 95 (Fig. 1) to a shut-off valve 96 and from the shut-off valve 96 to a distributor manifold 97. The grinding fluid is then conveyed from the manifold 97 to a plurality of nozzles 98, only one of which has been indicated in Fig. 1 to supply grinding fluid in a relatively small volume at a comparatively high pressure to the place of contact between the grinding wheel 12 and the work piece 24 so as to lubricate the grinding operation and thereby to facilitate the grinding operation. The pressure of the grinding liquid is such that it keeps the coolant fluid away from the point of grinding contact so that the grinding liquid lubricates the grinding action and the coolant liquid dissipates heat from the work caused by grinding. The de-

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tails of the coolant and grinding liquid nozzles have not been illustrated in the present case since they are not considered a part of the present invention. These nozzles may be identical with that shown in the prior U. S. Patent No. 2,434,679 referred to above, to which reference may be had for details of disclosure not contained herein.

As shown in Fig. 4, a tank or sump 100 is provided to contain coolant and grinding liquid draining from the machine after use. Fluid from the tank 100 flows through a pipe 101 into a separator 102 which has been illustrated diagrammatically in Fig. 4. The separator 102 serves to separate the coolant fluid from the grinding fluid so that they may be independently circulated to the nozzles for a grinding operation.

A pipe 103 draws coolant fluid from the separator 102. A pump 104 pumps fluid from the pipe 103 through a pipe 105 to the pipe 92 so as to convey coolant fluid to the work piece 24. A motor 106 is provided for driving the coolant pump 104.

A pipe 110 draws grinding fluid from the separator 102. A pump 111 draws fluid from the pipe 110 and passes grinding fluid under the desired pressure through a pipe 112 which is connected to the pipe 95 (Fig. 1) to supply grinding fluid under pressure to the point of contact between the grinding wheel 12 and the work piece 24. A pressure regulator 113, shown diagrammatically in Fig. 4, serves to facilitate regulation of pressure of the grinding fluid passing through the nozzles 98. By regulation of the pressure regulator 113, the pressure of the grinding liquid may be regulated as desired. An electric motor 114 is provided for driving the grinding fluid pump 111.

In a grinding machine where grinding liquid, such as oil or oil compounds are used, the work piece becomes coated with a film of grinding fluid and swarf from the grinding operation. If the work piece is removed from the machine in this condition, a certain amount of grinding liquid is lost from the system and also the work is quite messy for the operator to handle. To attain the main object in this invention, it is desirable to provide a suitable washing or cleaning apparatus so that the rotating work piece may be washed or cleaned after a grinding operation and before it is removed from the machine. This mechanism may comprise a washer or cleaning nozzle 120 which as illustrated is adjustably supported by a bracket 121 on the table 20 below the work piece 24. The nozzle 120 has a plurality of small perforations which are arranged to direct a plurality of streams of washing or cleaning fluid, such as water, onto the periphery of the rotating work piece 24 so as to remove any grinding fluid and swarf therefrom before the work piece is removed from the machine. Washing fluid such as for example water is drawn from the separator 102 by means of a pipe 122. A washer pump 123 pumps fluid from the pipe 122 and forces fluid under pressure through a pipe 124 to the nozzle 120. A control valve 125 is placed in the pipe line 124 to facilitate regulation of the amount of fluid passing through the pipe 124 to the nozzle 120.

Electric power is supplied as illustrated diagrammatically in Fig. 4 by means of a main control switch 130 from power lines 131. When the push button start switch 82 is closed to energize the timer 80, a relay switch 132 is closed to start the work drive motor 115 at the start of a grinding cycle. At the same time the solenoid 57 is energized to shift the control valve 50 to start a

forward feeding movement of the grinding wheel 12. At the start of the grinding cycle, the motors 106 and 114 are started to start the flow of grinding liquid and cooling liquid to lubricate the grinding cut and to dissipate heat generated in the work piece 24. After the grinding cycle has continued for a predetermined time interval, as governed by the electric timer 80, the solenoid 57 is deenergized so that the control valve 50 returns to the position illustrated in Fig. 1 to cause a rearward movement of the grinding wheel 12. At the same time, the motors 106 and 114 and the work drive motor 115 are stopped so as to stop the flow of grinding liquid and cooling liquid. When the timer 80 is actuated to terminate the grinding cycle, it also serves to energize a second time delay relay 134 which is arranged to again make a circuit to rotate the work drive motor 115 and at the same time to start the washer pump motor 126 to convey washing or cleaning fluid under sufficient pressure to the nozzle 120 which forces fluid under pressure onto the peripheral surface of the rotating ground work piece 24 to wash off any grinding fluid or swarf remaining thereon. The washing or cleaning cycle continues for a predetermined time interval as governed by the timer 134. After a predetermined time interval has elapsed, the timer 134 serves to break a circuit so as to stop the work drive motor 115 and to stop the washer pump motor 126.

It may be desirable in setting up the machine to jog the work piece. This may be accomplished by means of a jog switch 135 which is arranged to close a circuit so as to start the work drive motor 115. The jog switch 135 is a momentary contact switch so that the work may be jogged manually as desired. A similar jog switch 136 is provided for jogging both the washer pump drive motor 126 and the work drive motor 115 in case it is desired to wash the work piece 24 for a further interval.

The operation of this improved grinding machine will be readily apparent from the foregoing disclosure. Assuming all of the parts to have been previously adjusted, a work piece 24 is placed in the machine. The control lever 83 is rocked in a counter-clockwise direction (Figs. 1 and 4) to actuate the push button start switch 82 which serves to set the timer 80 in motion. The closing of the switch 82 also serves through the timer to energize the solenoid 57 to start a forward movement of the grinding wheel 12 and also serves to start the work drive motor 115 to rotate the work piece 24, and to start the pump motors 106 and 114 so as to start the flow of grinding liquid and cooling liquid. The grinding operation continues for a predetermined time interval as governed by the timer 80. After a predetermined time interval has elapsed, the timer 80 operates to deenergize the solenoid 57 to cause a rearward movement of the grinding wheel 12, also serves to stop the work drive motor 115 and to stop the pump motors 106 and 114 so as to stop the flow of the grinding liquid and the cooling liquid. When the timer 80 is actuated after a predetermined time interval, it serves to energize the timer 134. Energizing of the timer 134 serves to make a circuit so as to start the work drive motor 115 so that the work piece 24 remains in continuous rotation. The energization of the timer 134 also serves to start the washer pump motor 126 automatically to convey washing or cleaning fluid through the nozzle 120 onto the peripheral surface of a ground work piece 24 to wash or clean the surface thereof as soon as the

grinding operation has been terminated. The washing operation continues for a predetermined time interval as governed by the timer 134 after which a circuit is opened to stop the work drive motor and the washer pump motor 126. The ground work piece may then be removed from the machine and replaced with a new piece of work to be ground.

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 drawings is to be interpreted as illustrative and not in a limiting sense.

I claim:

1. In a grinding machine of the type having a longitudinally movable table, a work supporting means thereon, a transversely movable wheel slide, a rotatable grinding wheel thereon, means including a pump for supplying grinding fluid to the place of contact of the grinding wheel and the work piece for promoting grinding action, the combination of a work washing apparatus therefor including a nozzle located adjacent to the workpiece for removing residual liquid film from the work piece after a grinding operation, means including an independent motor driven pump for supplying fluid under sufficient pressure to said nozzle for cleaning a ground work piece before removing from the machine, and electrical means including a switch actuated automatically in timed relation with movement of the wheel slide to an inoperative position to start said latter pump.

2. In a grinding machine of the type having a longitudinally movable table, a work supporting means therefor, a transversely movable wheel slide, a rotatable grinding wheel thereon, means including a pump for supplying a grinding fluid to the place of contact of the grinding wheel and the work piece for promoting grinding action, the combination of a work washing apparatus therefor including a nozzle to remove residual liquid film from the work after a grinding operation, means including an independent motor driven pump to supply liquid under sufficient pressure to said nozzle for cleaning a ground work piece before removal from the machine, and means including an electric timer automatically actuated in timed relation with movement of the wheel slide to an inoperative position to start and stop the pump motor after a grinding operation has been completed to supply washing fluid to said nozzle and work piece for a predetermined time interval.

3. In a grinding machine of the type having a longitudinally movable table, a work supporting means thereon, a transversely movable wheel slide, a rotatable grinding wheel thereon, means including independent fluid pumps for supplying separately to the place of grinding contact of the wheel with the work and to the work piece a grinding liquid and a cooling liquid respectively for promoting grinding action by the grinding wheel and for abstracting heat produced by the grinding operation, the combination of a work washing apparatus therefor including means to remove residual liquid film from the work after a grinding operation including a nozzle on said table, means including an independent motor

driven pump to supply fluid under pressure to said nozzle under sufficient pressure for cleaning a ground work piece, electric control means for the work drive motor to maintain rotation of the work piece being ground during the grinding and washing operations, and means including an electric time relay to facilitate starting said pump motor automatically at the termination of the grinding operation, said relay serving after a predetermined time interval to stop said pump after a predetermined washing operation has been completed.

4. In a grinding machine of the type having a longitudinally movable table, a work supporting means thereon, means including a motor to rotate the work piece, a transversely movable wheel slide, a rotatable grinding wheel thereon, means including independent fluid pumps for supplying separately to the place of grinding contact of the wheel with the work and to the work piece a grinding liquid and a cooling liquid respectively for promoting grinding action by the grinding wheel and for abstracting heat produced by the grinding operation, the combination of a work washing apparatus therefor including means to remove residual liquid film from the work after a grinding operation including a nozzle on said table, means including an independent motor driven pump to supply fluid under pressure to said nozzle under sufficient pressure for cleaning a ground work piece, and means including an electric time relay to facilitate starting said pump motor automatically at the termination of the grinding operation, said relay serving after a predetermined time interval to stop said pump after a predetermined washing operation has been completed, electric control means for the work drive motor to maintain rotation of the work piece being ground during the grinding and washing operations.

5. In a grinding machine of the type having a longitudinally movable rotatable work support, means including a motor to rotate a work piece

to be ground, a transversely movable wheel slide, a rotatable grinding wheel thereon, a hydraulic piston and cylinder to move said slide, a solenoid actuated control valve therefor, means including independent motor driven pumps for supplying separately to the place of grinding contact of the grinding wheel with the work and to the work piece a grinding liquid and a cooling liquid respectively for promoting grinding action by the wheel and for abstracting heat produced by the grinding operation, an electric timer, a manually operable switch simultaneously to energize said timer to initiate an infeeding movement of the grinding wheel, to start the work drive motor and to start the pump drive motors, said timer serving after a predetermined time interval simultaneously to cause a rearward movement of the grinding wheel, to stop the pump motors and to energize a second electric timer, the combination of a work washing apparatus therefor including a nozzle adjacent to the work piece, and means including a motor driven pump to supply fluid under pressure to clean residual liquid from the surface of the ground work piece, the time-out of the first timer serving to start said latter pump motor and to maintain rotation of the work drive motor during a work cleaning operation, said second timer serving after a predetermined time interval simultaneously to stop the work drive motor and to stop the washer pump motor.

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