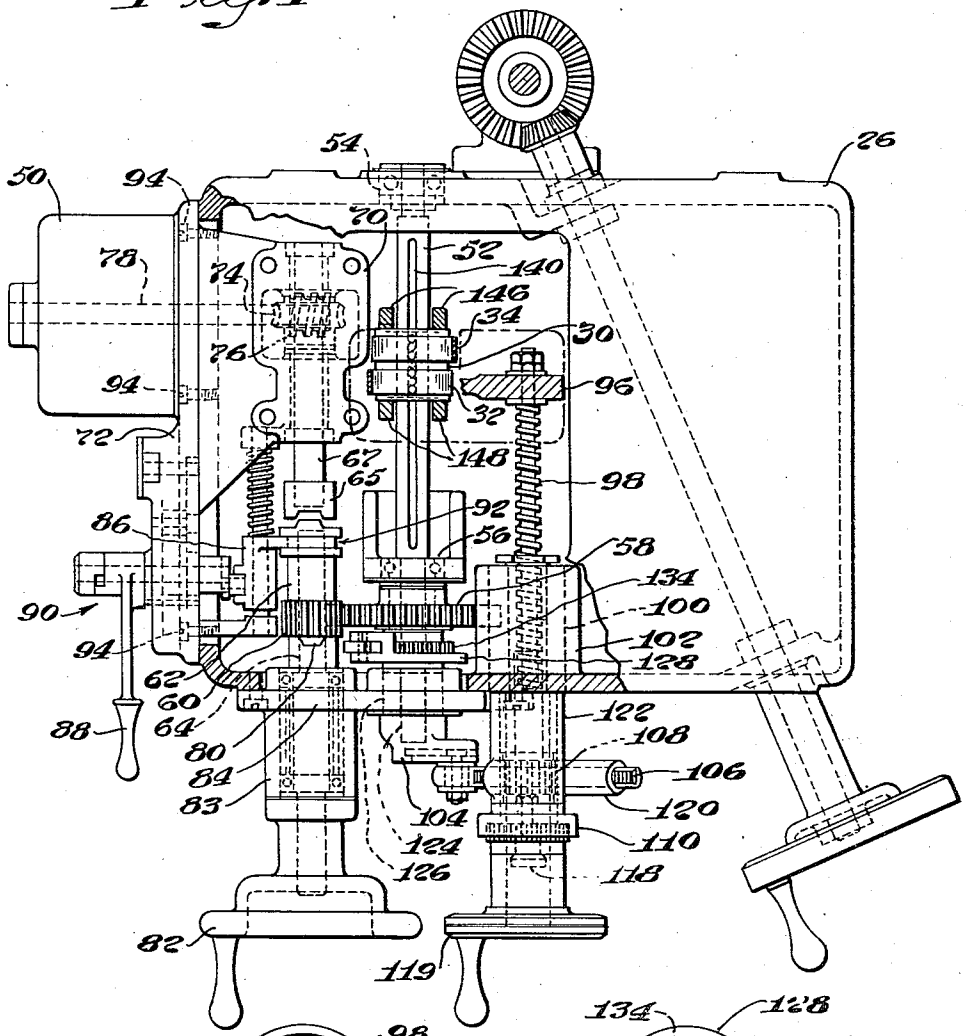
April 10, 1945. W. W. PERKINS ET AL 2,373,336

GRINDING MACHINE

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Fig. 1



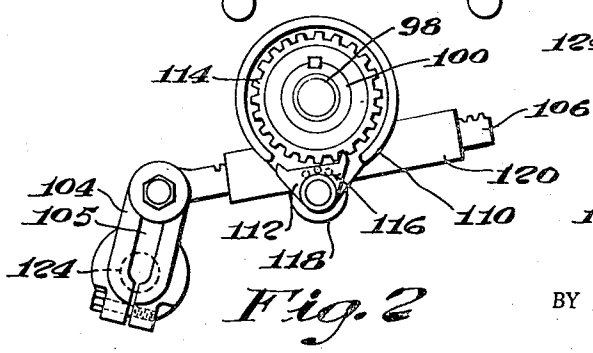


Fig. 2

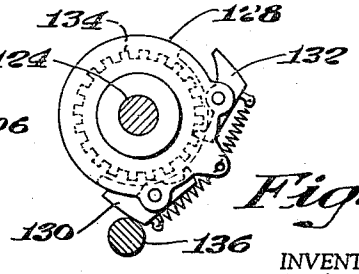


Fig. 3

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GRINDING MACHINE

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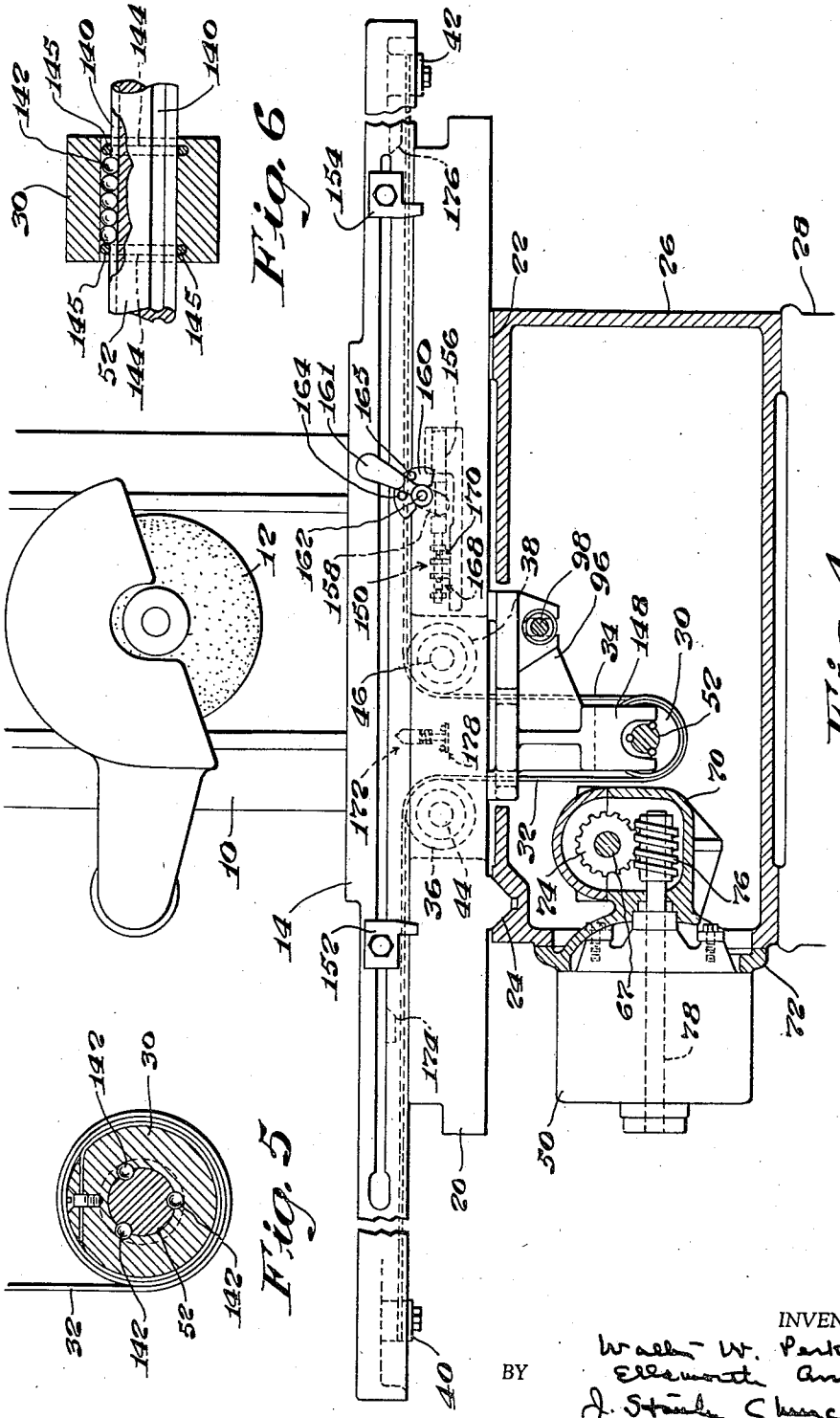


Fig. 4

Fig. 6

Fig. 5

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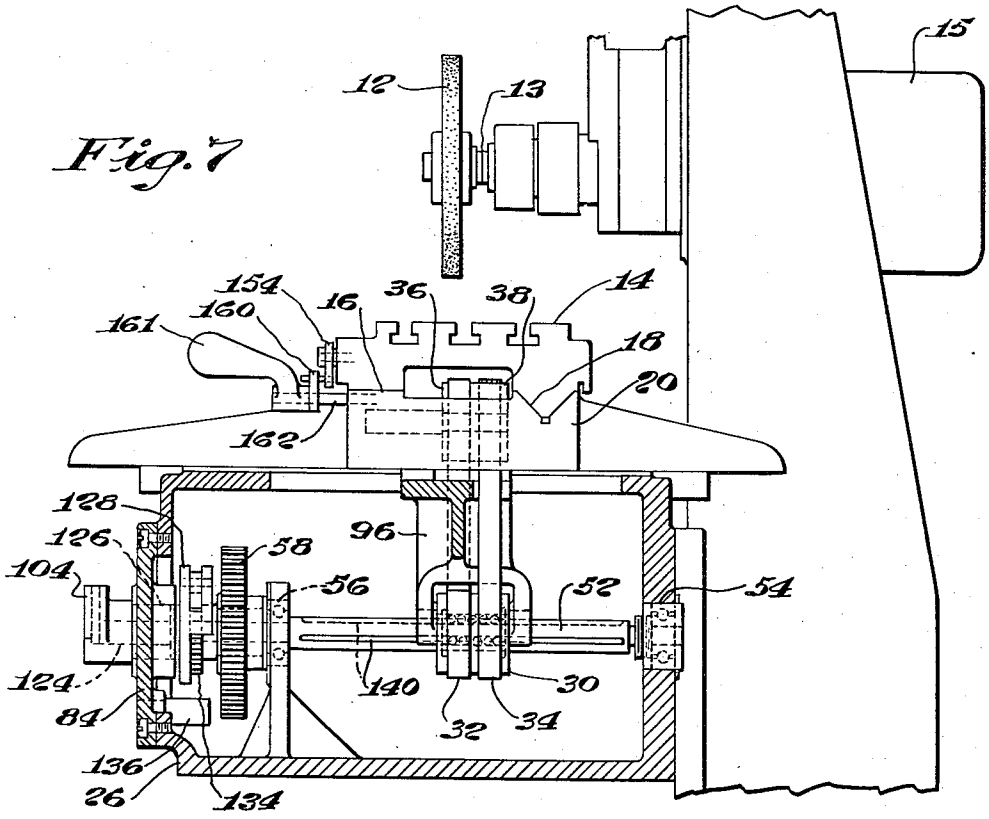
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GRINDING MACHINE

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Fig. 7



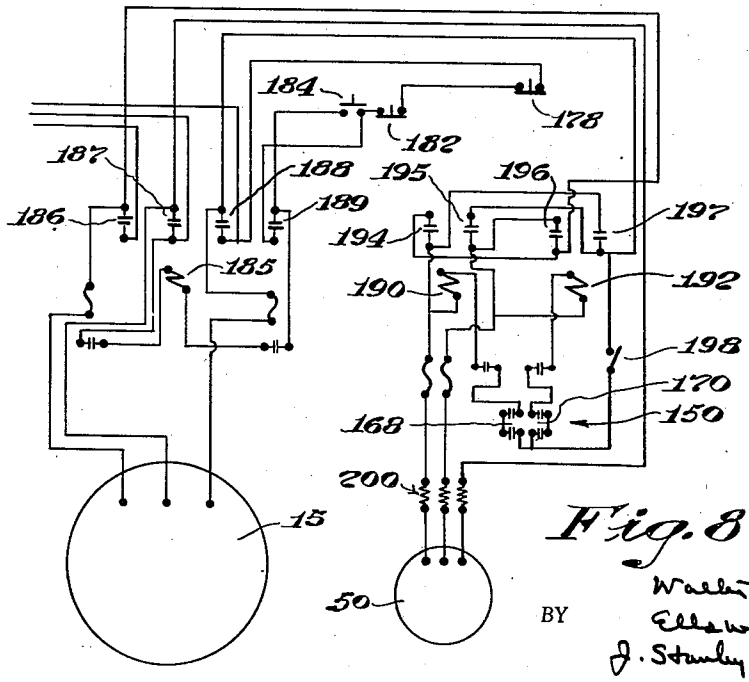


Fig. 8

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2,373,336

GRINDING MACHINE

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Application April 18, 1941, Serial No. 389,184

7 Claims. (Cl. 51—93)

This invention relates to a grinding machine and more particularly to a surface grinding machine.

The invention has for an object to provide a novel and superior surface grinding machine which may be economically manufactured and assembled and is of improved construction embodying novel driving mechanism, whereby to enable the machine to operate in an accurate, positive and smoothly operating manner.

With this general object in view and such others as may hereinafter appear, the invention consists in the grinding machine and in the various structures, arrangements and combinations of parts hereinafter described and particularly defined in the claims at the end of this specification.

In the drawings illustrating the preferred embodiment of the invention, Fig. 1 is a plan view, with portions broken away, of a grinding machine embodying the present invention; Figs. 2 and 3 are detail views of driving connections to the cross feed mechanism, to be referred to; Fig. 4 is a front elevation, partly in cross-section, of the machine shown in Fig. 1; Figs. 5 and 6 are detail views in transverse and longitudinal cross-section respectively of a driving drum forming a part of the driving mechanism, to be referred to; Fig. 7 is a side elevation, partly in cross-section, of the grinding machine embodying the present invention; and Fig. 8 is a wiring diagram illustrating the control mechanism for controlling the driving mechanism, as hereinafter described.

In general, the present invention contemplates a novel and improved surface grinding machine provided with a longitudinally reciprocable work supporting table for holding and moving the parts to be machined relative to a grinding wheel, and which is also provided with cross feed mechanism for progressively moving the work supporting table in a transverse direction relative to the grinding wheel.

In accordance with one feature of the present invention, provision is made for operating the reciprocable work supporting table through connections from a reversing motor arranged to be controlled by the movement of the table. Provision is also made in the motor circuit for decreasing the starting torque of the reversing motor whereby to reduce the shock incident to the change in direction and to contribute in producing smoother table operation. As a further provision for assuring smooth and substantially vibrationless table operation, the connections to the table may include steel bands or straps arranged to be alternatively wound and unwound upon a drum, as will be described.

Other novel features of the present invention, to be hereinafter described, comprise mechanism of novel structure for disengaging the motor driving connections from the table to enable conversion from automatic table movement to manual operation in a simple and efficient manner. Further novel structural features embodied in the present invention, which enable economies in manufacture, and which facilitate assembly, include provision for assembling various portions of the grinding machine as separate units to be attached to the machine in completely assembled form, as will be hereinafter more fully described.

Referring now to the drawings, and particularly to Fig. 4, the grinding machine indicated generally at 10 is provided with a grinding wheel 12 and a longitudinally reciprocable work supporting table 14. The work supporting table is mounted to slide longitudinally upon ways 16, 18 provided in a cross slide 20 which, in turn, is adapted to be moved transversely in ways 22, 24, formed in the top of a casing 26 mounted upon the base 28 of the machine. The grinding wheel 12 is mounted upon a spindle 13 and is independently driven by a spindle motor 15, as shown in Fig. 7.

The work supporting table 14 is arranged to be reciprocated through connections including a driving pulley or drum 30 and two steel bands or straps 32, 34, each of which is connected at one end to the driving drum, as illustrated in detail in Fig. 5. The other ends of the straps extend over idler pulleys 36, 38 respectively, and are connected to lugs 40, 42 depending from the opposite ends of the table, as shown in Fig. 4. The idler pulleys 36, 38 are rotatably mounted upon studs 44, 46 supported in the cross slide 20.

Provision is made for driving and reversing the rotation of the drum 30 to cause the straps 32, 34 to alternately wind and unwind on the drum to effect reciprocation of the table 14 through connections from a reversing motor 50 as shown in Figs. 1 and 4. The drum 30 is mounted upon and arranged to rotate with a driving shaft 52 journaled in suitable bearings 54, 56 mounted in the machine frame. The shaft 52 is provided with a gear 58 fast thereon which is arranged to mesh with a pinion 60 formed integrally with a clutch member 62 rotatably mounted and longitudinally movable upon a shaft 64. The clutch member 62 is arranged to be moved into operative engagement with a clutch member 65 fast on the end of a shaft 67 suitably journaled in a

gear casing 70 formed integrally with the motor supporting bracket 72. The shaft 67 is provided with a worm wheel 74 fast thereon arranged to cooperate with a worm gear 76 secured to the motor shaft 78.

In the illustrated embodiment of the invention, provision is made for disengaging the movable clutch member 62 from the power driven member 65 when it is desired to move the work supporting table manually, and as herein shown, the clutch member 62 is arranged to engage a cooperating member 80 fast on the shaft 64, which latter is provided with a hand wheel 82 at its outer end. The shaft 64 is journaled in a bearing 83 formed in a bracket 84 detachably secured to the casing 26. The movable clutch member 62 is moved longitudinally to engage and disengage the clutch connections 65, 80 by a shifter member 86 adapted to be actuated through connections to a hand lever 88, as illustrated in Fig. 1. The pinion 60 is made wide enough to cooperate with the gear 58 in either of its longitudinally movable positions. As herein shown, the clutch shifter unit, indicated generally at 90, is carried by the detachably mounted motor bracket 72 to form an assembled unit therewith.

From the description thus far, it will be observed that the detachable bracket 72 carries the motor driving mechanism and the clutch shifting mechanism as a completely assembled unit which may be conveniently assembled prior to attachment to the casing 26 of the frame. This feature of the invention saves time in the assembly operation, renders the parts more accessible for replacement and repair, and results in economy and expediency in manufacture. In assembling the unit, it will be observed that the shifter member 86, which may be forked, is arranged to be received in a grooved portion 92 of the member 62. The unit is attached to the casing 26 by screws 94.

Referring now to Figs. 1, 2 and 3, provision is made in the preferred embodiment of the invention for progressively advancing or retracting the longitudinally reciprocable work table in a transverse direction during the operation of the machine. As herein shown, the cross slide 20 is provided with a bracket 96 attached to and depending from the underside thereof. A square threaded screw 98, secured at one end to the bracket 96, is arranged to be received in an internally threaded bushing or hollow shaft which in turn is rotatably mounted in a hub 102 formed in the casing 26.

Provision is made for intermittently rotating the hollow internally threaded shaft 100 in either direction to effect transverse movement of the table during the operation of the machine. As herein shown, the hollow shaft is arranged to be rotated through connections including a crank member 104, a rack 106 connected to and arranged to be reciprocated by the crank, and a gear 108 loosely mounted on the hollow shaft and cooperating with the rack 106. The loosely mounted gear is formed integrally with a pawl carrier 110 upon which is mounted a double pointed pawl 112 arranged to cooperate with a square toothed ratchet 114 keyed to the hollow shaft, as illustrated in Fig. 2. Provision is made for adjusting the double pointed pawl 112 to engage either one or the other of the points with the square toothed ratchet, or to position the pawl in a neutral position. Such adjustment may be effected through a spring pressed ball arranged to be received in depressions in the carrier, as indicated at 116 in Fig. 2, and may be moved from one position to another by rotating the knob 118. A hand wheel 119 also secured to the hollow shaft 100 is provided to permit manual operation of the transverse mechanism when the pawl 112 is in neutral position.

In operation, when it is desired to effect intermittent rotation of the hollow shaft 100 in a counterclockwise direction, the pawl 112 may be positioned as indicated in Fig. 2 so that when the pawl carrier 110 is rotated in this direction by the reciprocating rack 106 and the gear 108, the pawl 112 in engagement with the ratchet will rotate the hollow shaft in a counterclockwise direction. On the return stroke of the rack 106, the pawl will slide over the ratchet teeth. It will be clear that when the pawl is positioned to engage the second point thereof with the square toothed ratchet, rotation of the hollow shaft 100 in the reverse direction will be effected. Thus it will be seen that the internally threaded hollow shaft 100 in cooperation with the square threaded screw is operative to effect transverse movement of the cross slide 20 and the table 14 supported thereon, in either direction during the operation of the machine. As illustrated in Figs. 1 and 2, the reciprocated rack 106 is received in a guide 120 formed integrally with a sleeve 122 loosely mounted upon the hollow shaft 100 to permit relative movement of the supporting sleeve 122 during the angular movements of the rack 106 as reciprocated by the crank 104.

Referring now to Figs. 1 and 3, the mechanism for rotating the crank member 104 will be described. As therein shown, the crank member is clamped fast upon the end of a stud 124, rotatably mounted in a bearing 126 formed in the bracket 84. The stud 124 extends from and is formed integrally with a pawl carrier 128 in which two pawls 130, 132 are mounted and arranged to cooperate with a square toothed ratchet 134. The square toothed ratchet 134 is formed integrally with and is arranged to rotate with the driving gear 58. As above described, the driving gear 58 is arranged to change its direction of rotation during the operation of the machine. Thus, in operation, when the ratchet 134 is rotated in a clockwise direction, the pawl 130, see Fig. 3, will be operative to rotate the crank through a predetermined stroke until the tail of the pawl engages a pawl stop 136 extending from the bracket 84, see Fig. 7, to disengage the pawl 130 from its ratchet 134. Thereafter, during the remainder of the clockwise movement of the ratchet 134, the other pawl 132 will slip over the ratchet teeth. When the direction of rotation is changed, the pawl 132 becomes effective to rotate the crank as above described, until it in turn is disengaged from the ratchet by the pawl stop 136. Thus it will be seen that each time the crank is rocked in either direction the rack 106 is reciprocated to effect rotation of the hollow shaft 100 in the desired direction as determined by the adjusted position of the double pointed pawl 112. The rack 106 is secured to the crank 104 in a T-slot 105 to permit convenient adjustment of the length of stroke.

From the description thus far it will be observed that the detachable bracket 84 carries the crank driving mechanism and the connections for manually operating the machine as a completely assembled unit which may be conveniently assembled prior to affixing the bracket to the casing 26. Thus, the assembly of this portion of the machine is facilitated, the parts ren-

dered more accessible for adjustment or replacement and the structure results in economy in manufacture.

Provision is made for permitting lateral movement of the driving drum 30 on its shaft 52 during the transverse movement of the cross slide 20. As herein shown, the shaft 52 is provided with three raceways 140 in which ball bearings 142 disposed in the drum 30 are arranged to run. As shown in Fig. 6, the ball bearings are retained in the drum by spring wire rings 145 arranged to be received in grooves 144 provided in the drum. The rings may be open to enable them to be contracted and forced into the grooves where they may again expand into a position to prevent escape of the ball bearing members from the drum. Thus, it will be seen that the bearing members 142 serve as a driving connection between the shaft 52 and the drum 30 and also permit lateral movement of the drum in a smoothly operating manner, thus reducing friction and tendency to bind on the shaft to a minimum. As shown in Figs. 1 and 4, the bracket 96, attached to the cross slide 20, is provided with arms 146, 148 arranged to embrace the drum 30 and to move it along the shaft 52 in alignment with the longitudinally reciprocable table 14 as the cross slide is moved transversely.

Referring now to Figs. 4 and 8, provision is made for controlling the reversible motor 50 to effect a change in direction of rotation thereof through connections from the reciprocable work table 14. As herein shown, a reversing switch 150 mounted in the cross slide 20 is arranged to be operated by dogs 152, 154, adjustably supported upon and movable with the table 14. The reversing switch comprises a slidingly mounted stud 156 arranged to be reciprocated by a pivotally mounted arm 158 which is received in a slot in the stud 156. An operating arm 160, fast on the pivot shaft 162 is provided with pins 164, 165, arranged to be engaged by the dogs 152, 154, respectively at the end of the predetermined longitudinal movement of the table. The switch stud 156 is provided with contacts 168, 170 and in operation, when a dog engages the switch 150, it operates to first open the prevailing circuit to the motor 50 and then close a second circuit to operate the motor in a reverse direction. A handle 161 is also provided on the operating arm 160 to permit the switch to be manually operated when desired. A safety switch, indicated at 172, may also be provided to be operative to open the entire circuit in the event the dogs 152, 154 are removed or become loosened. As illustrated in Fig. 4, cam pieces 174, 176 supported on the underside of the table 14 are arranged to engage and depress the switch member 172 to open the circuit at contacts 178 when the table overrides or fails to engage the reversing switch 150. The reversing switch may and preferably will be of standard construction capable of adjustment to control the rapidity of reversal.

As illustrated in Fig. 8, the wiring diagram therein shown includes connections to the grinding head motor 15, and to the reversing motor 50. Stop and start switches 182, 184 are arranged to open and close a circuit to a primary magnetic switch 185 which closes the circuits to the grinding head motor and to the reversing motor at contacts 186, 187, 188 and 189. The reversing switch, indicated at 150 operates to alternately open one circuit and close another to the magnetic switches 190, 192 for alternately opening and closing the circuits to the reversing motor 50 at contacts 194, 195, 196, 197, whereby to reverse the direction of the current through the motor so that its direction of rotation is reversed. The safety switch contacts are indicated at 178 and a manually operated switch, 198 may also be provided for opening the circuit to the reversing switch 150.

As illustrated in Fig. 8, the circuits to the reversible motor 50 are provided with resistors 200 which operate to reduce the starting voltage and thus to decrease the starting torque of the motor whereby the shock at the end of the table movement as it changes directions is reduced to a minimum thus effecting smooth and substantially vibrationless table operation.

From the above description it will be seen that the novel structure of the present surface grinding machine enables the machine to be operated in a smooth and efficient manner whereby to enable accurate grinding operations to be performed. The provision of a reversing motor in the surface grinding machine enables the driving mechanism to be simplified and eliminates the necessity for providing the usual reversing clutch mechanism formerly employed thus effecting an economy in production. The embodiment of the steel bands in the reciprocable driving mechanism assures a substantially smooth and vibrationless movement of the table eliminating the effect of impulses caused by the usual gear and rack, or chain and sprocket forms of reciprocable drive heretofore used. All of the foregoing cooperate to impart the maximum smoothness in operation. The provision of independently assembled units in the machine also effects an economy in the production of the machine.

While the preferred embodiment of the invention has been herein illustrated and described, it will be understood that the invention may be embodied in other forms within the scope of the following claims.

Having thus described the invention, what is claimed is:

1. In a grinding machine, in combination, a grinding element, a work supporting table, driving mechanism for reciprocating said table with relation to said grinding element including a single drum mounted to be capable of rotation in opposite directions, two flat metal bands connected to different ends of said table and to said drum, said bands being arranged to be alternately wound and unwound on said drum during reciprocation of the table by said driving mechanism, control means for effecting reversal of said driving mechanism, and operating connections between said control means and said work supporting table arranged to effect said reversal when the table is moved a predetermined distance in either direction, a cross slide upon which said table is mounted, means operatively connected to said driving mechanism for effecting transverse movement of said cross slide, and connections between said cross slide and said drum for effecting lateral movement of the latter during movement of the cross slide.

2. In a grinding machine, in combination, a reciprocable work supporting table, driving mechanism for reciprocating said table including a reversing motor, a single drum mounted to be capable of rotation in opposite directions, two flat thin and flexible metal bands connected to different ends of said table and to said drum arranged to be alternately wound and unwound on said drum to effect reciprocation of the table, control means for effecting reversal of said driving mechanism, and operating connections between said control means and said work sup-

porting table arranged to effect said reversal when the table is moved a predetermined distance in either direction, a cross slide upon which said table is mounted, means operatively connected to said driving mechanism for effecting transverse movement of said cross slide, and connections between said cross slide and said drum for effecting lateral movement of the latter during movement of the cross slide.

3. In a grinding machine, in combination, a longitudinally reciprocable work supporting table, driving mechanism for reciprocating said table including a reversing motor adapted to be connected to a power source for driving said motor, means for automatically controlling the operation of said motor, and connections between said control means and said work supporting table arranged to effect reversal of said motor when the table is moved a predetermined distance in either direction, a cross slide upon which said longitudinally reciprocable work table is mounted, and means operatively connected to said driving mechanism for effecting transverse movement of said cross slide, an auxiliary means arranged to be engaged by the table for disconnecting said motor from said source of power to stop the machine in the event that the table overrides said predetermined distance, said auxiliary means comprising a single switch disposed substantially centrally of the machine, and connections between said cross slide and said driving mechanism for effecting lateral movement of the latter during operation of said cross slide.

4. In a grinding machine, in combination, a longitudinally reciprocable work supporting table, driving mechanism for reciprocating said table including a reversing motor, adapted to be connected to a power source for driving said motor means for automatically controlling the operation of said motor, and connections between said control means and said work supporting table arranged to effect reversal of said motor when the table is moved a predetermined distance in either direction, a cross slide upon which said longitudinally reciprocable work table is mounted, and means operatively connected to said driving mechanism for progressively advancing or retracting said cross slide transversely during the reciprocation of said table, an auxiliary means arranged to be engaged by the table for disconnecting said motor from said source of power to stop the machine in the event that the table overrides said predetermined distance, said auxiliary means comprising a single switch disposed substantially centrally of the machine, and connections between said cross slide and said driving mechanism for effecting lateral movement of the latter during operation of said cross slide.

5. In a grinding machine, in combination, a longitudinally reciprocable work supporting table, driving mechanism for reciprocating said table, including a shaft mounted to be capable of rotation in opposite directions, a drum mounted to rotate with and to move laterally upon said shaft, two flexible flat metal tension members connected to different ends of said table and to said drum arranged to be alternately wound and unwound on said drum to effect reciprocation of said table, a cross slide upon which said table is mounted, means operatively connected to said driving mechanism for effecting transverse movement of said cross slide, and connections between said cross slide and said drum for effecting lateral movement of the latter upon said shaft.

6. In a grinding machine, in combination, a longitudinally reciprocable work supporting table, driving mechanism for reciprocating said table including a shaft mounted to be capable of rotation in opposite directions, a drum mounted to rotate with and to move laterally upon said shaft, two flat metal bands connected to different ends of said table and to said drum arranged to be alternately wound and unwound on said drum to effect reciprocation of said table, a cross slide upon which said table is mounted, means operatively connected to said driving mechanism for effecting transverse movement of said cross slide, and connections between said cross slide and said drum for effecting lateral movement of the latter upon said shaft, said drum being provided with ball bearings, said shaft being provided with a plurality of longitudinally disposed raceways arranged to receive said ball bearings whereby to provide a driving connection between said drum and said shaft and to facilitate lateral movement of the drum on the shaft.

7. In a grinding machine, in combination, a reciprocable work supporting table, power driving mechanism for reciprocating said table including a motor, a power driven shaft, worm and worm gear connections between said motor and said shaft, a clutch member mounted on said power driven shaft, manually operated mechanism for reciprocating said table including a manually rotated shaft provided with a handle, said manually rotated shaft being separate from and in end to end alignment with said power driven shaft, a second clutch member mounted on said manually rotated shaft, an intermediate clutch member shiftingly mounted on said manually rotated shaft arranged to be moved into operative engagement with said power driven clutch member or said manually operated clutch member, driving connections between said intermediate clutch member and said table, and means for shifting said intermediate clutch member to convert the machine from said power driving mechanism to said manually operated mechanism.

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