Oct. 31, 1933. W. J. GUILD 1,933,213

GRINDING MACHINE

Filed May 21, 1931 2 Sheets-Sheet 1

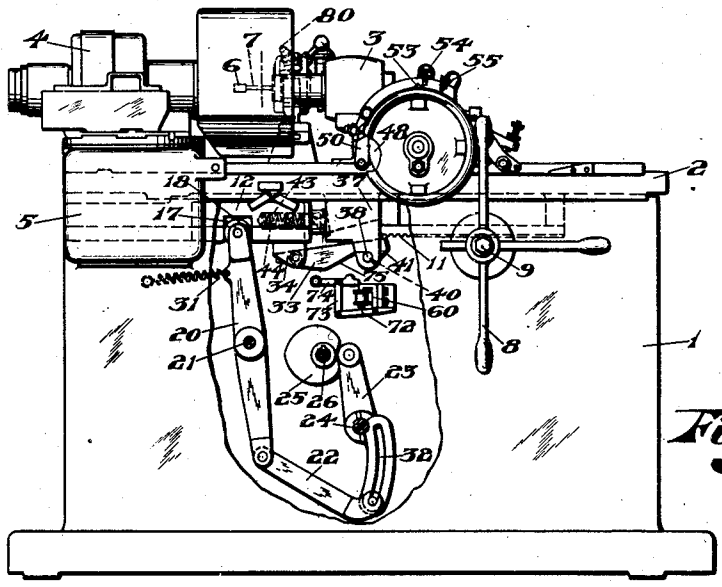


Fig. 1

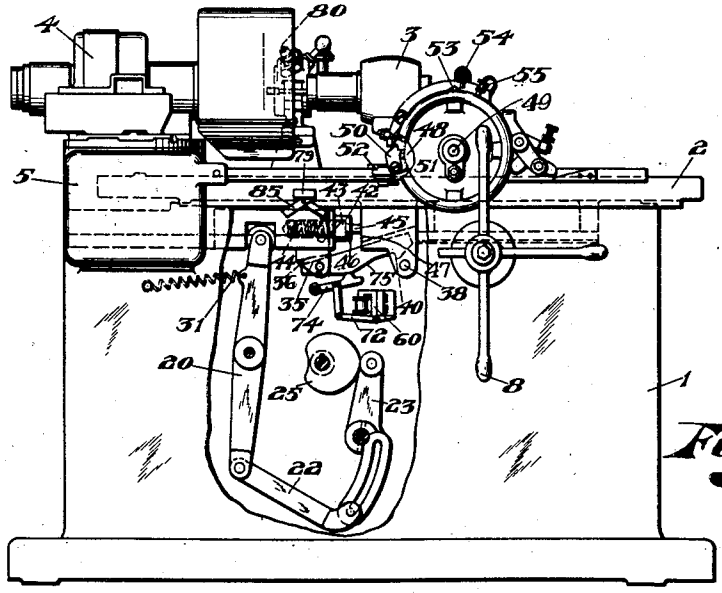


Fig. 2

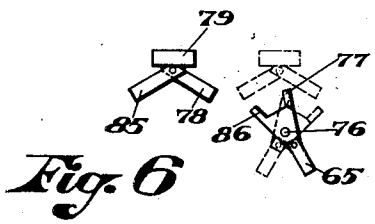


Fig. 6

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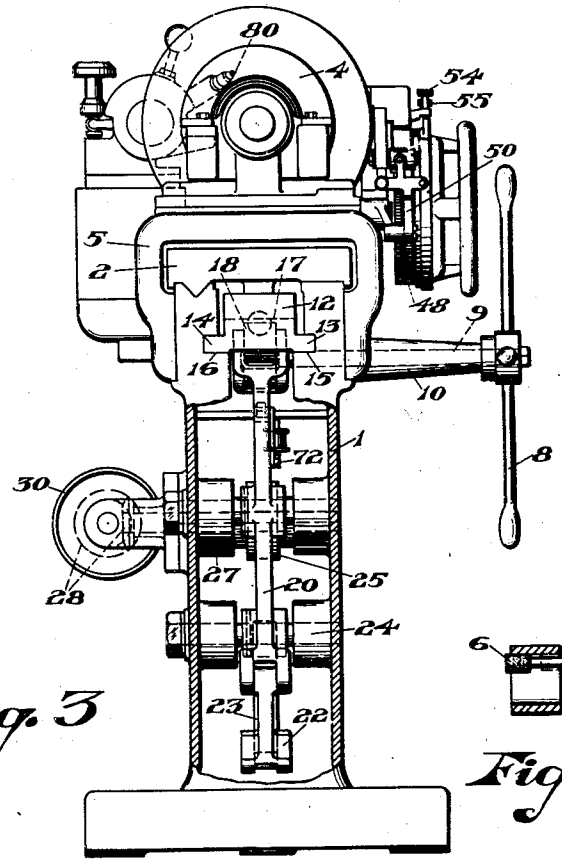


Fig. 3

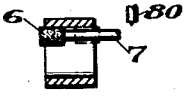


Fig. 4

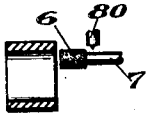


Fig. 5

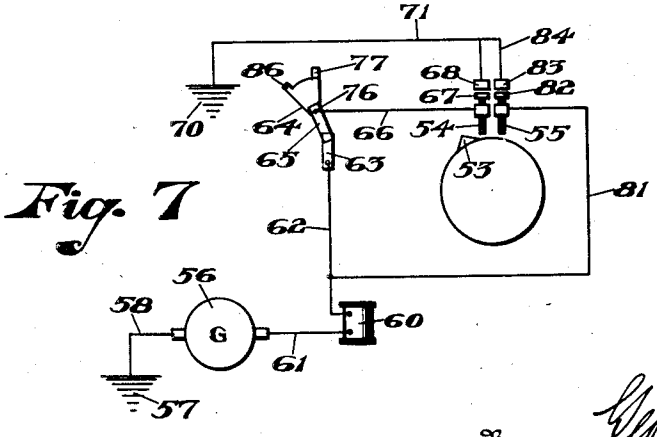


Fig. 7

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1,933,213

GRINDING MACHINE

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18 Claims. (Cl. 51—50)

The present invention relates to grinding machines, and particularly to a machine adapted for grinding the internal conical and cylindrical surfaces of gears, sleeves, bushings and like articles. The invention is directed specifically to the provision of mechanical means by which a traversing movement is obtained between the grinding wheel and the workpiece.

In the constructions now in use, the reciprocation of either a grinding wheel or a workpiece in a grinding machine is obtained by manual, fluid or mechanical means. In manually operated machines, it is difficult to obtain uniform grinding and the operation of such machines requires an unnecessary expenditure of time, especially when a series of duplicate workpieces are to be successively ground. Grinding machines actuated by fluid or mechanical means are generally of complicated construction, making them expensive to build and requiring considerable care in maintaining them in good operating condition. The object of the present invention is accordingly to incorporate automatic reciprocatory means in a grinding machine of simple construction in combination with the advantageous features of the more complicated automatic machines.

According to the present invention, the grinding wheel and workpiece are relatively reciprocated automatically in operative relation and are automatically separated from each other for a dressing operation on the wheel, or when the grinding operation is completed, the wheel being returned to operative relation with the workpiece by manually operated mechanism. Other objects and advantages will appear from the following description, taken in connection with the accompanying drawings, in which—

Fig. 1 is a front elevation view of a grinding machine embodying the invention, parts of the base of the machine being broken away to show the operating mechanism.

Fig. 2 is an elevation view similar to Fig. 1, showing the operating mechanism in a different relation.

Fig. 3 is an end elevation of the machine, parts of the base being broken away to show the mechanism by which the table is reciprocated.

Fig. 4 is a diagrammatic view showing the position of the grinding wheel in operative relation to the workpiece.

Fig. 5 is a diagrammatic view similar to Fig. 4 showing the grinding wheel in inoperative relation.

Fig. 6 is a diagrammatic view showing the relative positions of the operating switch and its actuating mechanism.

Fig. 7 is a wiring diagram.

Like reference characters refer to like parts throughout the drawings.

Referring first to Fig. 1, an internal grinding machine is shown having a base or frame 1 with a reciprocatory table 2 slidable thereon, on which a wheelhead 3 is mounted. The work to be operated upon is held in a workhead 4 carried by a bridge 5 which spans the slideways provided by the machine frame 1 for the back and forth movement of the table 2. A grinding wheel 6 is carried on a spindle 7 rotatably mounted in the wheelhead 3 and is driven in any suitable manner; a workpiece to be ground is suitably held in a chuck which is mounted on the inner end of the workhead 4 and is also rotated by any suitable means preferably at a reduced speed.

The table 2 is arranged to be manually reciprocated by a pilot wheel 8 rigidly mounted on the outer end of a shaft 9 which is journalled in a bushing 10, Fig. 3, integral with the front of the frame 1. The inner end of the shaft 9 carries a pinion, not shown, which is in engagement with a rack 11 horizontally mounted rigidly on the under side of the table 2. Rotation of the pilot wheel 8 clockwise will accordingly move the table 2 to the right, as viewed in Fig. 1, and counterclockwise rotation will move the table to the left.

Mechanism is provided for reciprocating the table 2 automatically when desired. A slide member 12, Fig. 3, is provided with projecting guides 13 and 14 on opposite sides thereof which engage in grooves 15 and 16 formed in the base 1 of the machine, to permit reciprocation of the slide longitudinally of the frame. The slide 12 is provided on the under side with a downwardly extending slot 17 which is engaged by a roller 18 carried on a pin on the upper end of a lever 20. The lever 20 is centrally pivoted at 21 to the frame and is connected at the lower end by a link 22 to a second lever member 23 centrally pivoted at 24 to the frame. A cam 25 is rigidly mounted on a shaft 26, journalled in a bearing 27, Fig. 3, in a portion of the base and is rotated by means of a pair of bevel gears 28 from a pulley 30, the latter being driven in any desired manner. Rotation of the cam 25 reciprocates the upper end of the lever 23 which is in contact therewith, thereby reciprocating the lever 20 and accordingly the slide 12; the cam being preferably of a shape to impart uniform rectilinear motion to the slide. A spring 31, one end of which is connected to the frame and the other end of which

is mounted adjacent the upper end of the lever 20, holds the end of lever 23 in engagement with the cam 25, to obtain a positive driving movement from the cam. Variations in the length of movement of the reciprocatory slide 12 are procured by adjustment of one end of the link 22 along the arm of the lever 23, the latter being provided with a slot 32 for this purpose.

The carriage and slide are releasably connected together in the following manner:—A latch member 33 is pivotally mounted on a depending bearing 34 on the slide 12 and normally held in substantially horizontal position as shown in Fig. 1, by engagement of the upper surface 35, Fig. 2, of the latch with a plane surface 36 on the bearing member 34. The table 2 is provided with downwardly extending supports 37 connected adjacent their lower end by a pin 38 which is adapted to be engaged by the hook portion 40 of the latch 33, the end of said latch being provided at the end adjacent the hook 40 with a slanting surface 41, Fig. 1, which permits the end of the latch to ride up over the pin as the table and slide are brought together. When the table and slide are connected together in this manner, the grinding wheel is reciprocated past the work surface between the limits of the full and dotted lines of Fig. 4, by the reciprocating slide. Release of the table from the slide is effected by upward movement of the latch, said release being obtained in a manner to be hereinafter pointed out, thereby to disengage the hook 40 of the latch from the pin 38.

When the latch is released from the pin, the table 2 is caused to move somewhat beyond the normal reciprocatory stroke in order to move the grinding wheel from the operative reciprocatory limits of Fig. 4, to the position of Fig. 5, in which the wheel is spaced from the workpiece in inoperative relation. A plunger 42 is mounted in an opening 43 in the slide, and a spring 44 engages beneath the plunger resiliently holding said plunger outwardly to the extreme right end of its movement. A pin 45 which acts as a guide for the plunger is mounted on the outer end of the plunger 42 and projects through an opening in the cap 46 which covers the opening in the slide to engage with a vertical surface 47, Fig. 1, on the under side of table 2. As the table and slide are brought together, the table engages the pin and depresses the plunger in the opening in the slide against the pressure of the spring, so that when the latch is subsequently released, the action of the spring on the pin and plunger forces the table away from the end of the slide a distance equal to the amount the spring was previously compressed, during connection of the table and slide.

In grinding machines of this type a cross-feed movement is provided to cause the grinding wheel to be fed transversely, in order to cut progressively deeper and deeper into the workpiece. This may be effected by the mechanism disclosed in the patent to Taylor No. 1,682,673, issued August 28, 1928 and is not of itself the invention in this application. It is sufficient, for the present purposes, to say that a ratchet wheel 48 is operatively connected to a shaft 49, the latter being screw threaded and engaging a threaded nut in a cross-slide on the table 2, said cross-slide carrying the wheelhead 3, so that rotation of the ratchet wheel causes in and out movement of the wheelhead. The ratchet wheel 48 is actuated by a pawl 50 which is pivotally mounted on an arm 51, Fig. 2, a portion of the arm being arranged to engage with an adjustable cam surface 52 mounted on a horizontal extension of the bridge 5. Reciprocatory movement of the table 2 causes engagement of said cam with the pivotally mounted arm 51 thereby actuating said ratchet with each reciprocation of the table to impart a step-by-step rotary movement to the ratchet wheel and, accordingly, a step-by-step cross-feed movement to the grinding wheel carried by the wheelhead 3. A cam 53 is mounted to rotate with said ratchet wheel and is arranged to engage successively with adjustable screws 54 and 55, engagement with the screw 54 closing a circuit whereby the table is released from the reciprocating slide and subsequent engagement with the screw 55 again disengaging the table from the slide.

The separation of the table 2 from the slide 12 by engagement of the cam 53 with the screw 54 is obtained through an electrical circuit in the following manner:—

As shown by the wiring diagram of Fig. 7, the power is supplied by a generator 56, one terminal of which is connected to a ground 57 by a lead 58, the other terminal being connected to one terminal of an electromagnet 60 by a lead 61. The other terminal of the electromagnet is connected by a lead 62 to a stationary plate 63 of a switch 64, the other plate 65 thereof being connected by the screw 54 by a lead 66. Movement of the adjusting screw 54 by the cam surface 53 makes a contact between terminals 67 and 68; terminal 67 being in electrical contact with the adjusting screw 54, the terminal 68 being connected to a ground 70 by a lead 71. When the terminals 67 and 68 are in contact, the circuit through switch 64 to the electromagnet 60 is closed and the magnet 60 is energized, thereby causing attraction of an armature member 72, Fig. 1. This armature 72 is connected through a link 73 to a lever 74 pivotally mounted on the machine frame below the latch 33, attraction of the armature by the magnet 60 raising one end of the lever 74 into engagement with a slanting surface 75 on the latch as shown in Fig. 2. As the latch is carried toward the right, Fig. 1, by the slide 12, the lever 74 raises the latch so that the hook of said latch is disconnected from the pin 38 at the extreme right hand movement of the slide, releasing the table from the slide.

After the latch is disengaged from the pin, the spring actuated plunger 42 moves the table to the right into inoperative position, as above pointed out, moving the grinding wheel into the position shown in Fig. 5. Movement of the table in response to the action of the plunger 42 disconnects the switch 64 thereby to open the above circuit and release the armature of the electromagnet to allow the latch to drop into normal pin engaging position in the following manner. The plate 65 of the switch 64 is pivotally mounted at 76, Fig. 6, and is provided with a lug 77 which is in alignment with the outer end of an arm 78 pivotally mounted at 79 on the frame 1 and hanging by gravity in the position shown in Figs. 1 and 6. As the table moves to the right, the arm 78 engages lug 77 and rotates the plate 65 on its axis to separate the plates 63 and 65 and open the circuit through the electromagnet 60. The position of the arm 78, in the inoperative position of the wheel as in Fig. 5, is shown in the dotted line position of Fig. 6.

With the table 2 released from the slide following engagement of cam 53 and screw 54, a dressing operation is performed on the wheel. A pivotally mounted dressing point 80 which is arranged for manual rotation is moved into line

with the wheel 6 in operative relation thereto, as in Fig. 5, and the wheel is manually reciprocated past the dressing point by rotation of the pilot wheel 8 to procure a smooth and true wheel prior to the finishing cuts on the workpiece.

After the dressing operation the wheel is manually returned to the workpiece by counterclockwise rotation of pilot wheel 8, so that the latch 33 again engages the pin 38 for further automatic reciprocation of the grinding wheel on the work surface to complete the workpiece. This continued reciprocation again actuates the pawl 50 and ratchet 48 and further rotates the cam surface until it engages with and lifts the adjusting screw 55, thereby closing a circuit to actuate again said arm or lever 74 so that the wheel and work are again separated. This separation occurs in the following manner:—

Referring to the wiring diagram of Fig. 7, the adjusting screw 55 is connected to the lead 62 by a lead 81. Movement of the adjusting screw 55 causes contact between two terminals 82 and 83, the terminal 82 being electrically connected to the adjusting screw 55 and the terminal 83 being connected to the ground 70 by a lead 84. Accordingly, connection of the terminals 82 and 83 closes the circuit through an energizes the electromagnet 60 and again actuates the lever 74, as above pointed out, to release the table from the reciprocating slide in the manner above set forth, the wheel being again separated from the work by the spring actuated plunger. The workpiece being now completed, the wheel is manually withdrawn from the workpiece a sufficient distance to permit removal of the workpiece from the work-holding chuck.

When a new workpiece has been inserted, the table is again returned to the normal operating position. During this return movement an arm 85, pivotally mounted at 79 on the frame and held by gravity in the position shown in Fig. 6, engages a lug 86 on the switch 64 returning it to the full line position of Figs. 6 and 7, completing the connections between the screw 54 and the electromagnet 60, so that during a subsequent grinding operation when the adjusting screw 54 is actuated by the cam 53, the circuit is closed through the switch 64 to the electromagnet 60, and the lever 74 is again actuated to release the table from the reciprocating member. Before the return of the wheel into engagement with an unground workpiece, the ratchet wheel 48 is rotated counterclockwise to reposition the wheel for engagement with the surface to be ground of a subsequent workpiece. This repositioning movement withdraws the cam 53 from engagement with screws 54 and 55 and places the cam in a position for engagement with said screws during a subsequent grinding operation in response to clockwise rotation of said ratchet wheel.

I claim,

1. In a grinding machine, a grinding wheel, a reciprocating member, means connecting said member to the wheel to procure reciprocation of the wheel in operative relation to a workpiece, and means to procure separation of said member and wheel.

2. In a grinding machine, a grinding wheel, a reciprocating member, means connecting said member to the wheel to procure reciprocation of the wheel in operative relation to a workpiece, and automatic means governed by the progress of the grinding operation to disconnect said member and wheel to procure cessation of the reciprocation of the wheel.

3. In a grinding machine, a grinding wheel, a continuously reciprocating member, means connecting said member to the wheel to procure reciprocation of the wheel in operative relation to a workpiece, means to disconnect said member and wheel to procure cessation of the reciprocation of the wheel, and means to procure the withdrawal of said wheel from the workpiece upon the cessation of the reciprocation.

4. In a grinding machine, a grinding wheel, a mechanically actuated reciprocating member having an adjustable stroke, means releasibly connecting said wheel and member to procure reciprocation of the wheel in operative relation to a workpiece, means to procure a cross-feed movement of said wheel relative to said workpiece and means responsive to said latter means to procure cessation of the reciprocation of the wheel.

5. In a grinding machine, a grinding member and a workholding member, cross-feed means to procure a transverse feed relative to a workpiece in said workholding member, a reciprocating slide, means to connect said slide to one of said members to procure reciprocation of said wheel in operative relation to the workpiece and means responsive to said cross-feed means to disconnect said slide from the member to which it is connected to procure cessation of the reciprocation and withdrawal of the wheel from the work.

6. In a grinding machine, a grinding member and a workholding member, a carriage upon which one of said members is mounted, means to procure a transverse feed between said members, means to procure a reciprocation between said members comprising a continually reciprocating member and means to connect said carriage thereto, and means responsive to said transverse feed means to disconnect said carriage and reciprocating member to procure cessation of reciprocation between said members.

7. In a grinding machine, a grinding member and workholding member, a carriage carrying one of said members, a reciprocating slide member, means to connect said carriage and slide member to procure a reciprocation of said grinding member in operative relation to the workholding member, and automatic means governed by the progress of the grinding operation to release said carriage from said slide member at one end of the stroke thereof.

8. In a grinding machine, a grinding member and workholding member, a carriage carrying one of said members, a reciprocating slide member, means to connect said carriage and slide member to procure a reciprocation of said grinding member in operative relation to the workholding member, means to release said carriage from said slide member at one end of the stroke thereof, and means operative upon release of said carriage to procure movement of said carriage beyond the normal reciprocatory position.

9. In a grinding machine, a grinding wheel, a reciprocating member, means to connect said wheel to said member to procure reciprocation of said wheel in operative relation to a workpiece, a cross-feed mechanism to procure a transverse movement between said wheel and workpiece, means responsive to the movement of said cross-feed mechanism to discontinue the reciprocation of said wheel by releasing said wheel from said member and means to render said last means inoperative following release of said wheel.

10. In a grinding machine, a grinding wheel,

a reciprocating member, means to connect said wheel to said member to procure reciprocation of said wheel in operative relation to a workpiece, a cross-feed mechanism to procure a transverse movement between said wheel and workpiece, electrical means responsive to movement of said cross-feed mechanism to discontinue reciprocation of said wheel by releasing said wheel from said member, and means to render said electrical means inoperative upon release of said wheel.

11. In a grinding machine, a grinding wheel, a reciprocating member, means to connect said wheel to said member to procure reciprocation of said wheel in operative relation to a workpiece, a cross-feed mechanism to procure a transverse movement between said wheel and workpiece, electrical means including an electromagnet responsive to movement of said cross-feed mechanism to discontinue reciprocation of said wheel by releasing said wheel from said member, means to open a circuit to said magnet upon release of said wheel from said reciprocating member to render said electrical means inoperative and means responsive to further movement of said cross-feed mechanism to close a circuit to said electromagnet means.

12. In a grinding machine, a carriage, a reciprocating member, a latch on one of said parts, a pin engageable therewith on the other of said parts, means on said latch to permit automatic engagement of said latch and pin when said parts are brought together, and automatic means governed by the progress of the grinding operation to actuate said latch to release said pin at one end of the stroke of the reciprocating member.

13. In a grinding machine, a grinding member and a workholding member, a reciprocating slide, means releasably connecting said slide to one of said members to procure the reciprocation of said grinding member in operative relation to a workpiece in the workholding member, and means to procure separation of said slide and the member connected thereto upon release of said connecting means.

14. In a grinding machine, a grinding member and a workholding member, a reciprocating slide, means connecting said slide to one of said members to procure reciprocation of the grinding member in operative relation to a workpiece, and automatic means governed by the progress of the grinding operation to disconnect said slide from the member to which it is connected to procure cessation of the reciprocation of the grinding member relative to the workpiece.

15. In a grinding machine, a grinding member and a workholding member, a reciprocating slide, means connecting said slide to one of said members to procure reciprocation of the grinding member relative to a workpiece in the workholding member, and automatic means operative when the workpiece reaches a predetermined size for disconnecting said slide from the member to which it is connected to procure cessation of the reciprocation of the grinding member relative to the workpiece.

16. In a grinding machine, a grinding member and a workholding member, a continuously reciprocating slide, means connecting said slide to one of said members to procure reciprocation of the grinding member relative to a workpiece in the workholding member, means to disconnect said slide from the member to which it is connected to procure cessation of the reciprocation of the wheel, and means to procure the withdrawal of said grinding member from the workpiece upon the cessation of the reciprocation.

17. In a grinding machine, a grinding member and a workholding member, a reciprocating slide, means to connect said slide to one of said members to procure reciprocation of the grinding member in operative relation to a workpiece in the workholding member, electrical means governed by the progress of the grinding operation to discontinue reciprocation of said grinding member by releasing said slide from the member to which it is connected, and means to render said electrical means inoperative upon release of said slide.

18. In a grinding machine, a grinding member and a workholding member, a reciprocating slide, means to connect said slide to one of said members to procure reciprocation of the grinding member in operative relation to a workpiece in the workholding member, and electrical means operative when the workpiece in the workholding member reaches a predetermined size to discontinue reciprocation of said grinding member by releasing said slide from the member to which it is connected.

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