Dec. 19, 1939. R. E. FLANDERS 2,184,011

GRINDING MACHINE

Filed Aug. 8, 1936 4 Sheets-Sheet 1

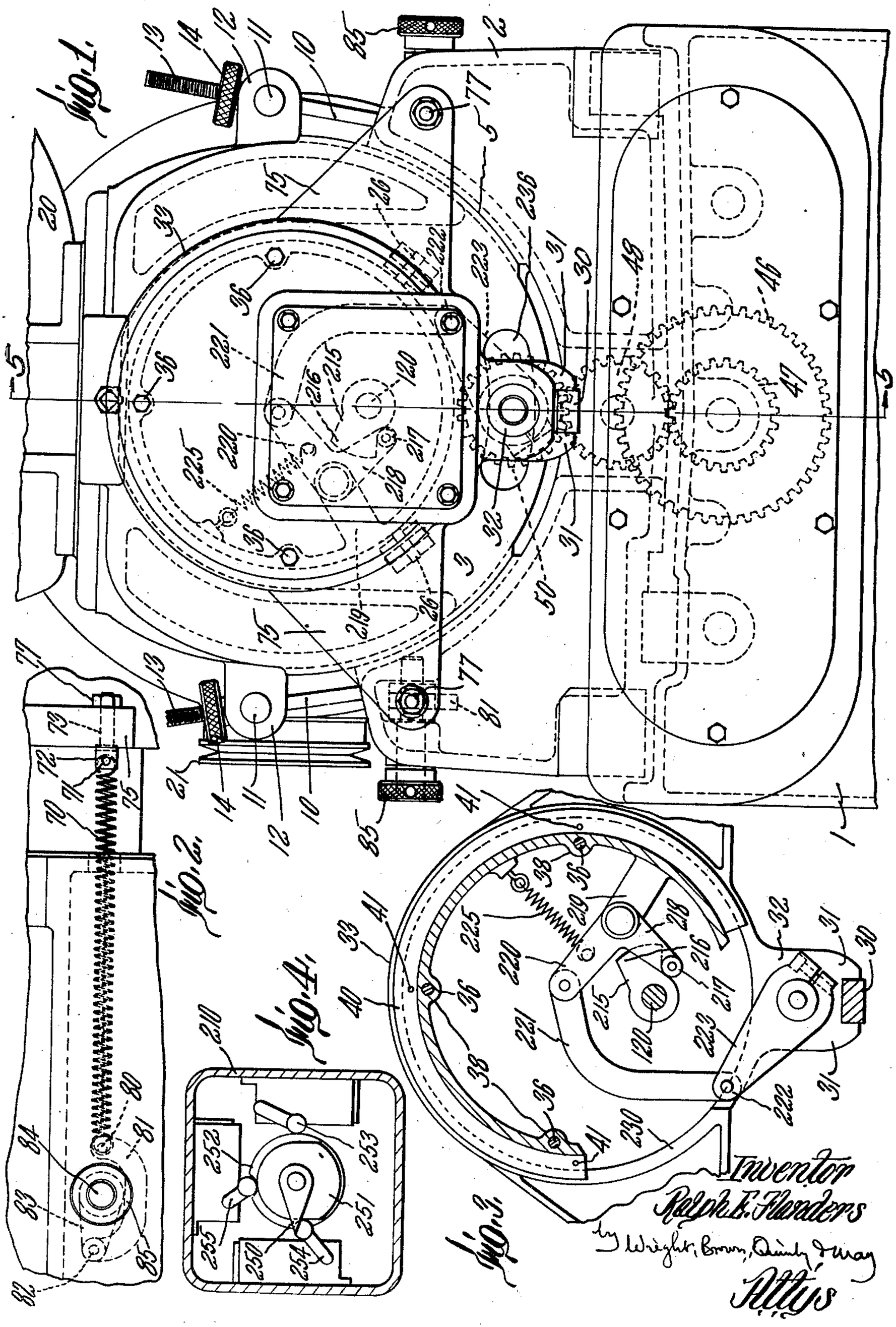


Fig. 1.

Fig. 2.

Fig. 4.

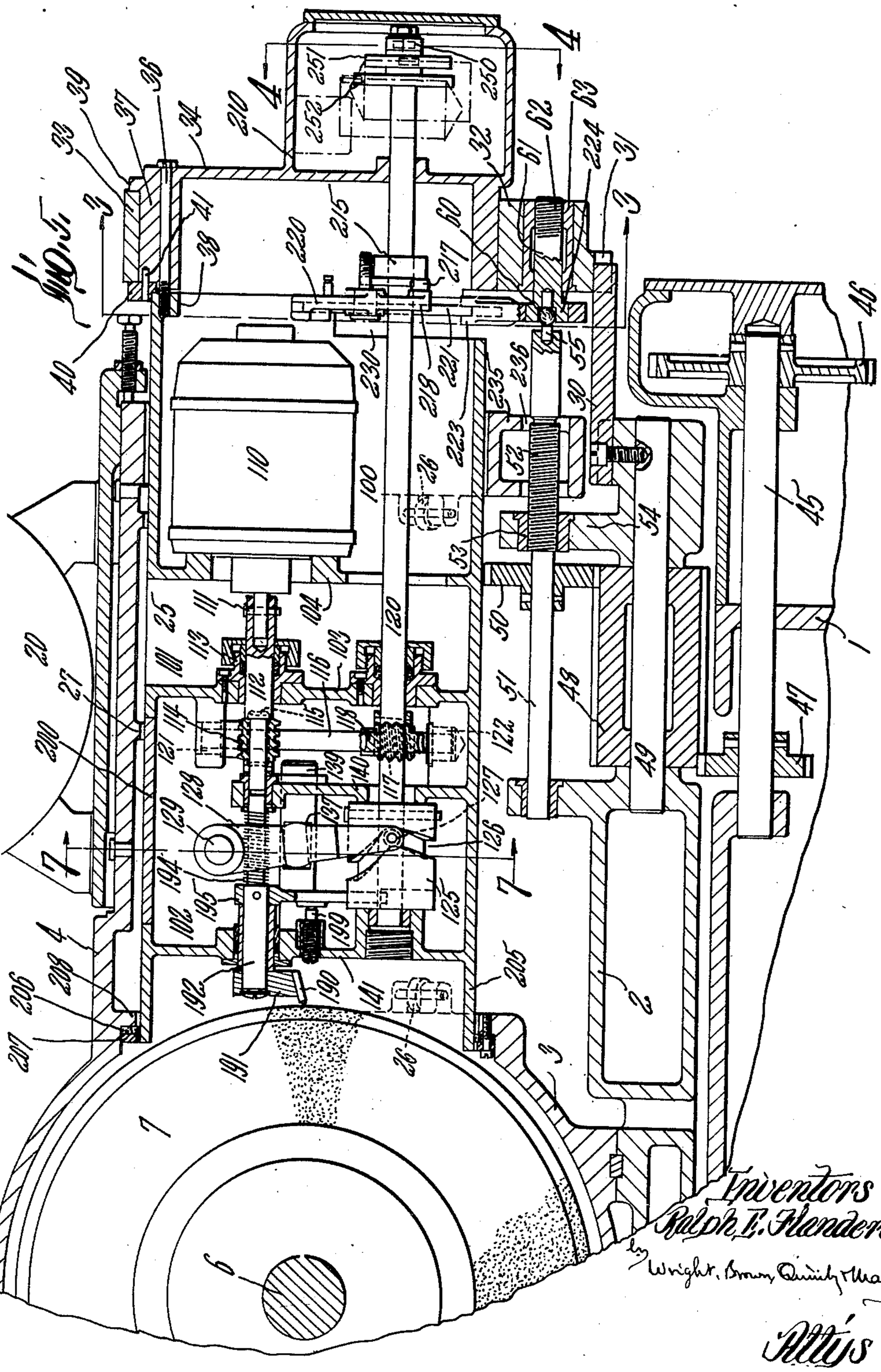
Fig. 3.

Inventor
Ralph E. Flanders
by Wright, Brown, Quinby & Gray
Attys

Dec. 19, 1939. R. E. FLANDERS 2,184,011

GRINDING MACHINE

Filed Aug. 8, 1936 4 Sheets-Sheet 2



Inventors
Ralph E. Flanders
by Wright, Brown, Quinby & May
Attys

Dec. 19, 1939. R. E. FLANDERS 2,184,011

GRINDING MACHINE

Filed Aug. 8, 1936 4 Sheets-Sheet 3

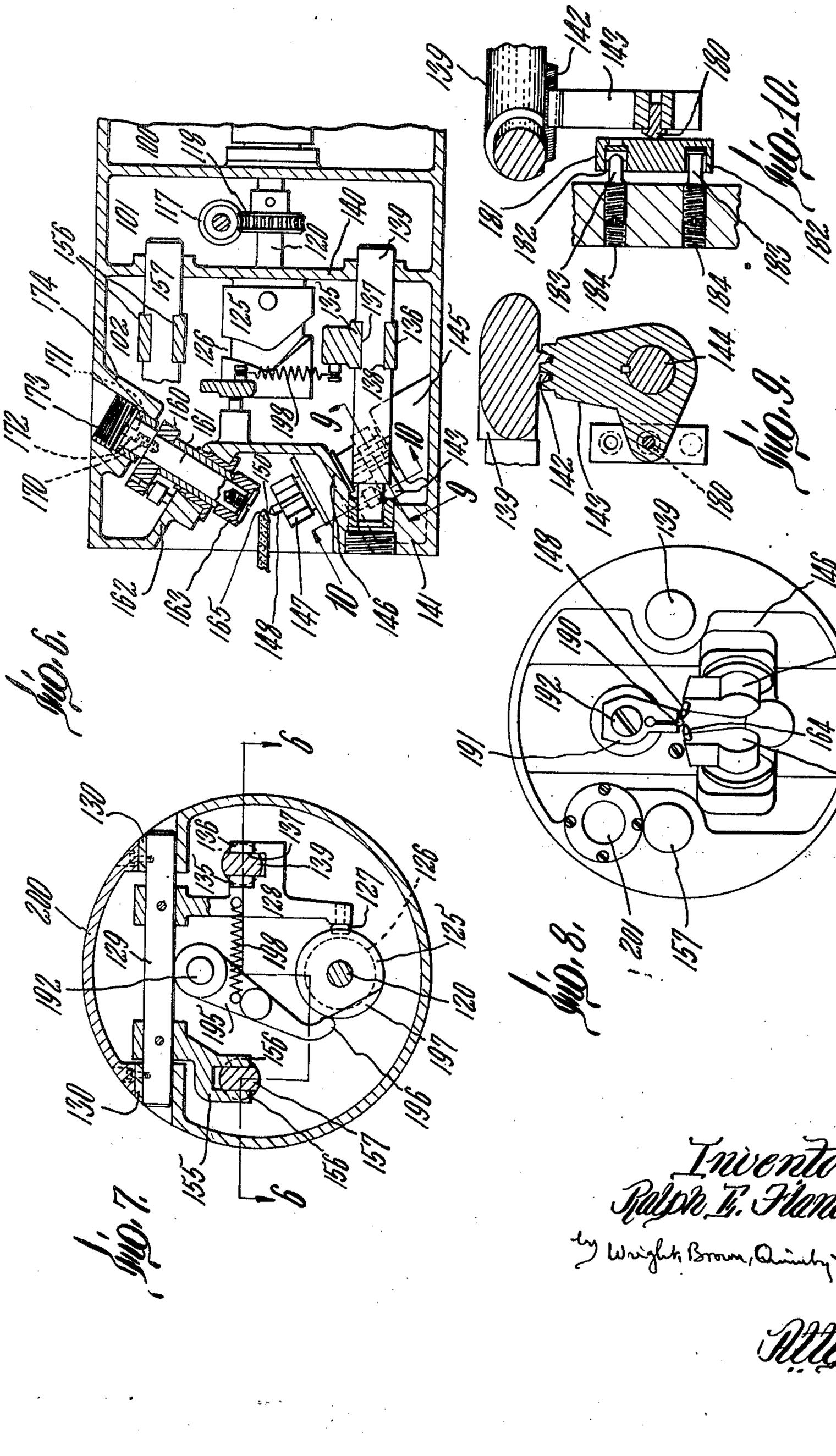


Fig. 6.

Fig. 10.

Fig. 9.

Fig. 8.

Fig. 7.

Inventors
Ralph E. Flanders
by Wright, Brown, Quinby & May

Attys

Dec. 19, 1939. R. E. FLANDERS 2,184,011

GRINDING MACHINE

Filed Aug. 8, 1936 4 Sheets-Sheet 4

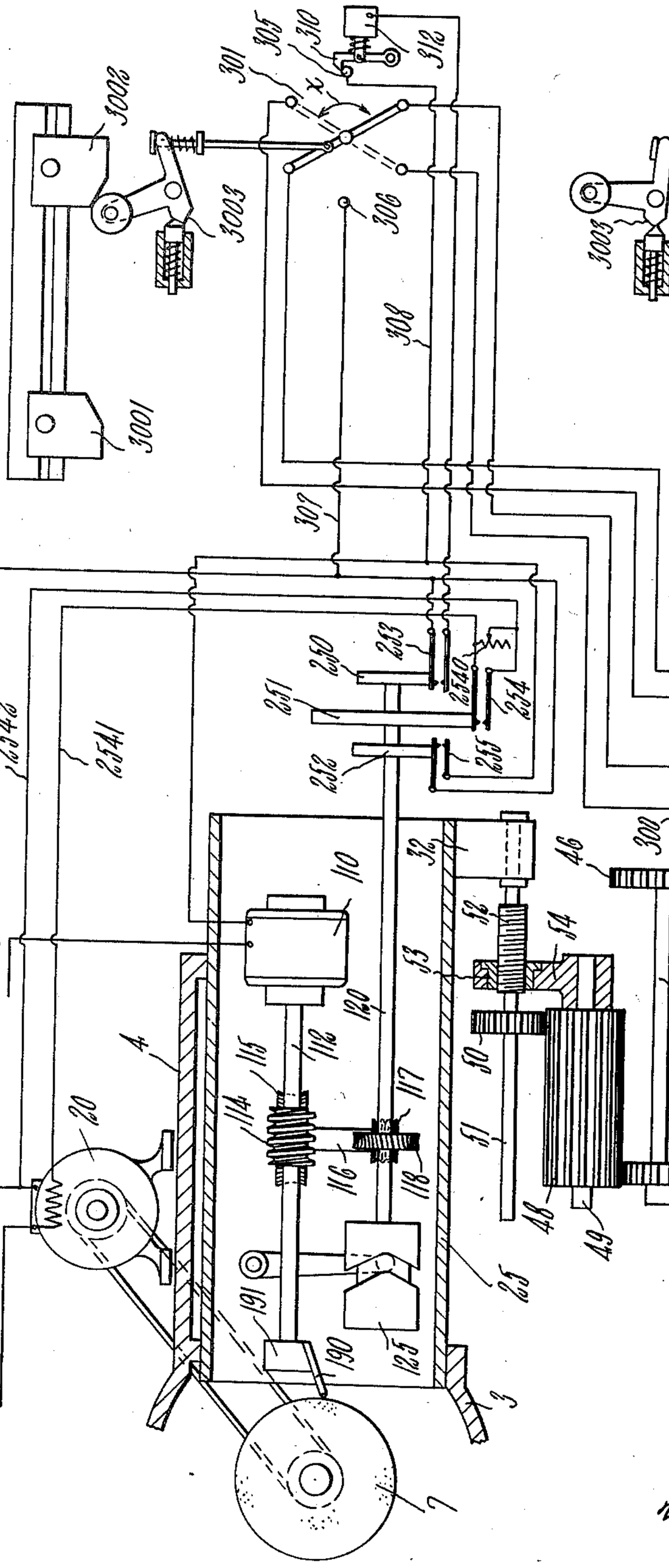


Fig. 11.

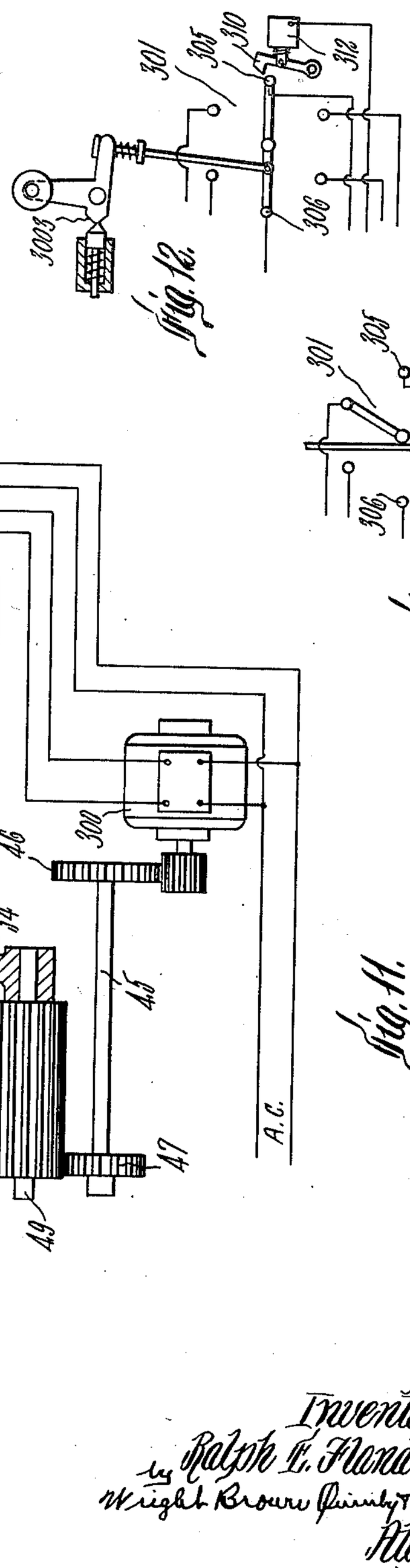


Fig. 12.

Fig. 13.

Inventor
Ralph E. Flanders
by Wright Brown Quinby & May
Attys.

Patented Dec. 19, 1939 2,184,011

UNITED STATES PATENT OFFICE

2,184,011

GRINDING MACHINE

Ralph E. Flanders, Springfield, Vt., assignor to Jones & Lamson Machine Company, Springfield, Vt., a corporation of Vermont

Application August 8, 1936, Serial No. 94,903

25 Claims. (Cl. 51—95)

This invention relates to grinding machines, and more particularly to the grinding wheel truing mechanism and its mounting and control. While in its broadest aspects this invention is not limited thereto, it has been developed more particularly to suit the requirements of machines for grinding threads or the like where the grinding wheel is provided with angularly related grinding edges and where the central plane of the grinding wheel with relation to the axis of the work is adjustable to conform to the helix angle of the threads.

One of the objects of this invention is to provide wheel-truing mechanism which is self-contained so that it can be removed and replaced by another shaped for similar mounting but arranged to dress the wheel edges to any other desired contour.

A further object is to so form the mechanism and mating portions of the machine as to permit the mechanism to be adjusted angularly so that it can be presented properly in accordance with the steepness of pitch of the threads to be cut and if desired to more or less modify the shape and angularity of the cutting faces of the grinding wheel.

For the purpose of attaining the foregoing objects, the truing mechanism, including the actuating and certain of the controlling mechanism for the truing tools may be carried in a unit which may be adjusted and clamped in the desired angular position with reference both to the machine and to the central plane of the grinding wheel in a matingly shaped frame portion of the grinding machine. This unit may also carry control mechanism by which, when truing is to be effected, the machine is automatically conditioned properly for such action. Such conditioning may, for example, slow down the rotation of the grinding wheel to a speed more suitable for truing than its normal grinding speed and may act to delay the traverse between the wheel and the work until after wheel truing has been effected.

Another control may automatically stop the traverse of the truing tools across the face or faces of the grinding wheel and a further control may cause the tools to be relieved from the wheel at the end of the truing operation.

A further object of this invention is to provide improved mechanism for moving and controlling the truing device with relation to the wheel.

Further objects and advantages will appear from a more complete description of an embodiment of this invention shown in the accompanying drawings in which:

Figure 1 is a fragmentary rear elevation of a grinding machine embodying this invention, certain parts being shown in dotted lines.

Figure 2 is a fragmentary side elevation of the machine showing a part of the truing mechanism moving means.

Figures 3 and 4 are detail sections on lines 3—3 and 4—4, respectively, of Figure 5.

Figure 5 is a fragmentary section on line 5—5 of Figure 1.

Figure 6 is a detail section on line 6—6 of Figure 7.

Figure 7 is a detail section on line 7—7 of Figure 5.

Figure 8 is a front elevation of a truing mechanism unit.

Figures 9 and 10 are detail sections to a larger scale on lines 9—9 and 10—10, respectively, of Figure 6.

Figure 11 is a diagrammatic view of certain portions of the mechanism and showing the electrical controls.

Figures 12 and 13 are views similar to a portion of Figure 11, but showing the control and traverse motor reversing switch in different positions.

Referring first to Figures 1 and 5, at 1 is indicated a portion of the frame of a grinding machine on which is mounted a wheel slide indicated generally at 2, the arrangement being such that on motion of this slide the wheel may be moved from and toward the axis of work (not shown) carried by the machine frame, the mechanism in this respect being similar to that shown in the Flanders Patent No. 1,739,753, granted December 17, 1929, for Grinding machine.

On this wheel slide is mounted a cradle 3, which as shown, is provided with a tubular extension 4. This cradle 3 is seated on an arcuate surface portion 5 of the slide 2, as shown best in Figure 1, so that it may be adjusted angularly transverse to the direction of sliding motion of the wheel slide 2. This cradle 3 carries, suitably journaled thereon, a wheel shaft 6 carrying a grinding wheel 7. The angular adjustment of the cradle thus permits the angular position of the central plane of the grinding wheel to be adjusted to conform to the helix angle of the work being ground in the general manner disclosed in the Flanders Patent No. 1,739,753, to which reference has previously been made.

Means may be provided for fixing the cradle in any desired angular position. As shown such means comprises the clamp rods 10 pivotally se-

cured at the lower ends to the slide 2 and extending through pivot pins 11 in ears 12 extending laterally from the side portions of the cradle 3. The upper ends of these rods 10 are threaded as at 13 for the reception of hand nuts 14 by which the positions of the ears 12 may be fixed, thus to determine the angular adjusted position of the cradle.

The grinding wheel may be driven by any suitable means, but as herein shown a motor 20 (see Figures 1, 5 and 11) may be carried on the top of the cradle 3, and a drive belt from this motor may extend about the drive pulley 21 (see Figure 1) of the wheel shaft 6.

Suitable means are provided for effecting traverse of the work past the edge of the grinding wheel, as shown for example, in the Flanders Patent No. 1,739,753. Any suitable means (not shown) may be provided for moving the wheel slide to feed or retract the edge of the grinding wheel with relation to the work, but as this forms no part of the present invention, no special means for performing this function is herein illustrated.

More particularly this invention is concerned with the construction, mounting, and control of the wheel truing mechanism by which the grinding edge of the wheel is maintained in the desired contour. As before noted, the cradle 3 has a tubular portion 4, within which is rockably mounted for axial movement, a wheel truing mechanism unit, including a casing 25. In order to facilitate moving of this unit, more particularly its axial motion, the casing 25 may be supported on anti-friction rolls 26 (Figures 1 and 5). Four such rolls are shown, though preferably two more positioned between the others as on an intermediate rib 27 of the slide extension 4 will be used, these intermediate rolls holding the casing 25 in line when it is too far back to engage the rolls nearest the grinding wheel. The arcuate surface of the casing which is supported by these rolls is substantially concentric to the rocking axis of the grinding wheel cradle and thus substantially perpendicular to and intersecting the wheel axis, and since the cradle extension is tubular, the casing 25 may be cylindrical in outline and be concentrically related to the tubular extension.

In order to maintain the contour of the grinding wheel proper for grinding threads, it is not only desirable to arrange the central plane of the grinding wheel according to the helix angle of the threads being ground, but to arrange the truing devices so as to grind the desired thread contour substantially in a plane passing through the axis of the work being ground. Thus, assuming for example, a 60° V thread, the 60° contour is measured in a plane passing through the work axis rather than in a plane perpendicular to the direction of the thread which would be that of the helix angle. Accordingly means are provided by which the truing mechanism, while carried in the tubular extension of the cradle which supports the wheel, is nevertheless capable of being held stationary during the angular adjustment of the grinding wheel. When grinding hobs or multiple threaded parts, however, where the helix angle may be very large, it is desirable to tilt the truing device as well as the wheel spindle. Moreover, tilting the truing mechanism independently of the wheel spindle makes it possible in some degree to modify the angle of the thread produced without changing the angular relation of the truing devices themselves. To this end, therefore, provision is made by which not only can the truing mechanism be held with the truing devices operating substantially in a plane parallel to the axis of the work, irrespective of the amount of tilting of the grinding wheel, but, if desired, also, the truing mechanism can be adjusted angularly to an extent quite independent of the angular position of the grinding wheel. For this purpose, means are provided by which the casing 25 may be adjusted angularly with reference to the wheel slide and quite independently of the angular adjustment of the cradle which directly carries this casing. The wheel slide, therefore, is shown as provided with a track piece 30 which is engaged between spaced jaws 31 on an extension 32 of a ring member 33. Within this ring member is journaled a casing cap 34 which is shown as secured to the rear end of the casing 25 as by bolts 36. These bolts pass through the outer wall 37 of the cap member 34 and are threaded into lugs 38 integral with the casing 25. At the rear side of the ring member 33, the cap member 34 has a marginal outwardly extending flange 39 and on the other side of the ring member 33 is positioned a clamp ring 40 held in position by pins 41 extending from the inner or left hand face of the cap member 34. By tightening the bolts 36, the cap member 34 is tightened against the rear end of the casing 25, and the ring member 33 is clamped between the flange 39 and the ring 40, which has a portion extending between the member 34 and the casing 25. By loosening these bolts 36, the cap member 34, and with it the casing 25, may be adjusted angularly within the ring member 33 and when this adjustment has been made, tightening of the bolts 36 will retain the casing member 25 in its adjusted angular relation with the wheel slide. This, however, will not prevent the tubular extension 4 of the cradle from being turned angularly and fixed in the desired angular position as by the nuts 14, as previously described. The engagement of the extension 32 of the ring member 33 with the track 30 permits the casing 25 to be given an axial motion within the cradle extension 4 to bring the truing devices from or toward the grinding wheel.

The feed of the casing 25 with its wheel truing devices toward the grinding wheel may be done in time with the grinding machine with particular reference to the traverse of the work relative to the grinding wheel, and as shown in the Flanders Patent No. 1,739,753, mechanism for accomplishing this may be driven from the main drive of the machine, connections to which are shown in Figure 5. Referring to this figure, at 45 is a shaft journaled for rotation in the machine base, this shaft having a gear 46 thereon by which it may be driven. It also carries fixed thereto a gear 47 which meshes with a long gear 48 journaled on a shaft 49 carried by the wheel slide. This long gear permits the driving engagement of the gear 47 therewith to be continuous, whatever the axial position of the wheel slide. This long gear 48 also meshes with a gear 50 pinned to a shaft 51. This shaft 51 has a threaded portion 52 extending through a nut 53 carried by a frame member 54 of the wheel slide, so that as this shaft 51 is rotated it is moved axially. At its outer end is positioned a hardened abutment pin 55 and against this abutment pin is engaged a ball 60 positioned in a socket in the inner end of an element 61 which has threaded engagement, as at 62, with a bearing member 63 secured in the extension 32. The

axial position of the shaft 51 thus normally limits the inward position of the casing 25 with its truing devices, and it is normally held in such limiting position as by means of a pair of springs 70, one of which is shown in Figure 2. The rear or outer end of each of these springs engages a transverse pin 71 in a yoke member 72 provided with a threaded shank 73 which extends through an ear 75 extending laterally from the ring member 33, two such ears being shown in Figure 1. A nut 77 engaging the outer end of the shank 73 serves to secure each yoke member 72 in position. The inner end of each of these springs 70 engages a pin 80 in a curved arm 81, the other end of which is pivoted at 82 on a crank arm 83 fixed to a rock shaft 84, this rock shaft being journaled in a suitable frame member of the wheel slide 2. The outer end of each of these shafts 84 may have secured thereto a knurled knob 85 which facilitates turning of its respective shaft 84 so as to move the arm 83 downwardly and remove the pin 82 from substantially dead center relation with the pin 80 and the rock shaft 84, whereupon the arm 81 is free to be moved backward by the spring, thus releasing the tension thereon so that it can be easily detached from the yoke 72. This facilitates removal of one truing mechanism and the substitution of another therefor. Thus it is possible readily to remove mechanism for truing the wheel to one contour, and to substitute truing mechanism for truing the wheel to another contour whenever this is found desirable.

At suitable times in the operation of the machine as at or adjacent to one or both ends of the carriage traverse, the gear 47 is turned by any suitable means (not shown) through a predetermined angular distance in a direction to turn the shaft 51 and move it axially toward the left as viewed in Figure 5. This allows the springs 70 to advance the entire truing mechanism toward the wheel by the amount of the axial motion of the shaft 51.

As before noted, the casing 25 contains the truing mechanism and certain of its operating and controlling mechanisms. As shown this casing comprises three compartments 100, 101 and 102 set off by transverse partitions 103 and 104. In the compartment 100 is shown positioned a motor 110, the armature of which is connected through a coupling 111 with a shaft 112 which extends through a stuffing box 113 into the compartment 102. Within this compartment the shaft 112 has a worm 114 thereon which engages a worm wheel 115 on a substantially vertical shaft 116. This shaft 116 nearest its lower end carries a worm 117 which meshes with a worm wheel 118 secured to a cam shaft 120. The shaft 116 is journaled at its ends in suitable bearings 121 and 122. Also within the compartment 102 the cam shaft 120 carries a cam 125 which rotates relatively slowly through the reduction gearing comprising the worms 114 and 117 and their worm wheels 115 and 118, respectively, by rotation of the motor 110. The cam drum 125 is provided with a peripheral cam groove 126 within which rides a cam follower 127 (see Figures 5, 6 and 7) carried by one end of a rock arm 128. This rock arm is pinned to a rock shaft 129 extending across the casing 25 and journaled in bearing lugs 130 therein (Figure 7).

At an intermediate point of its length the arm 128 is forked to provide spaced lugs 135 and 136 which engage in oppositely disposed slots 137 and 138 in a slide bar 139 mounted for sliding motion in the partition member 140 and the end wall 141 of the casing chamber 102, so that as the arm 128 is rocked, the bar 139 is moved axially. Toward the forward or left hand end of the bar 139 it is provided on one face with rack teeth 142 inclined to its direction of traverse and these rack teeth mesh with segmental teeth on a rock arm 143 secured to a rock shaft 144. This rock shaft is mounted in an inclined position as in a bearing boss 145 and its forward end extends out through an inclined portion 146 of the forward wall 141. To its outer end is secured in any suitable way an arm 147 which carries one of the side truing tools or diamonds 148, so that as the bar 139 is moved axially, the rock shaft 144 is rocked and the diamond point 148 is swung back and forth to give its traversing movement across one of the inclined faces, as 150, of the grinding wheel. The rock shaft 129 also carries a rock arm 155 having a forked extremity 156, the fork ends riding in slots in a second axially movable rack bar 157 which is provided with rack teeth meshing with segmental teeth on an arm 160 similar to the arm 143 and carried by a tool-supporting rock shaft 161 similar to the shaft 144, but journaled at an angle thereto. It supports on its outer end forwardly of the inclined wall portion 162 an arm 163 carrying the diamond point 164. This diamond point serves to true the inclined wheel face 165. These rock shafts 144 and 161 extend through stuffing box bearings in the corresponding wall portions 146 and 162 and each is normally pressed outwardly as by a spring, such as shown at 170 in Figure 6 in connection with the rock shaft 161, which is spring seated in a socket 171 in the rock shaft and bears against a pin 172 carried by a plug 173 threaded into the outer end of the bearing boss 174. A similar shaft mounting is employed for the rock shaft 144, the spring pressed pin being positioned within the bearing boss 145.

In order that the axial positions of these rock shafts may be varied as desired for various angular positions, by which action the paths traced by the diamonds may be varied within somewhat narrow limits to provide for not only inaccuracies of mounting of the parts, but also for slight changes in angularity of the trued wheel faces, the arms 143 and 160 may each have a cam follower member such as 180 shown in detail in Figures 9 and 10 which rides on a cam block as 181. This cam block may be adjusted with respect to the wall member 162 angularly. For that purpose, it is provided with recesses 182 adjacent to opposite ends which have bearing therein headed pins 183 threaded through openings 184 in the wall members 146 or 162. By relative adjustment of these pins 183 the angularity of the cam plate 181 may be adjusted so as to cause axial movement of the respective rock shaft 144 or 161 during its rocking motions.

A third truing device working upon the apex of the grinding wheel in such a manner as to produce with the side truing tools a shape corresponding to that of the United States standard threads may be employed. This third tool, shown at 190, may be carried by a rock arm 191 secured to the outer end of a rock shaft 192 (see Figures 5 and 8). This rock shaft extends through a suitable bearing in the end wall of the compartment 102 and inwardly of this it has secured thereto a rock arm 195 having a follower end portion 196 which engages the periphery of the cam 125. This cam 125 has a cut away portion 197 in line with the cam follower 196 so that as this cam rotates the shaft 192 may be rocked.

A spring 198 connecting the arm 195 with the arm 128 (see Figures 6 and 7) serves to hold the cam follower portion 196 into contact with the cam 125. A spring 194 surrounding the rear end of the shaft 192 presses the arm 195 into contact with an adjustable plug 199 threaded through the front wall of the compartment 102.

It will be noted that the compartment 102 has an opening at its upper side normally closed by a cover 200 and it is intended to be filled with oil to a sufficient level to immerse the parts therein in an oil bath. Oil which may escape past the operating shafts for the truing devices washes out grit and keeps the mechanism clean. A sight glass 201 may be secured in the forward wall of the chamber 102 in order that the level of the oil may be observed.

In order to prevent access of abrasive particles and grit from the wheel into the extension 4 and to the wheel and truing mechanism feed, the casing 25 is formed with a forward extension 205 which is in engagement with a packing ring 206 secured as by a ring 207 to an annular shoulder 208 within the tubular extension 4.

The cam shaft 120, as shown best in Figure 5, is extended back through the chamber 100 and the cap 34 and into the rear extension 210 of the cap 34. Within the compartment 100 this cam shaft 120 is provided with a cam member 215, the function of which is to provide for relief of the truing devices at the end of the truing action, this being done by retracting the entire truing mechanism and the casing 25 from its normal truing position, as determined by the position of the abutment 55 previously described. This cam 215 has a cam extension 216 thereon, which, when the truing cycle has been completed, engages a follower 217 on a bell crank lever 218 journaled on an inwardly extending arm 219 of the casing 25. The opposite arm 220 of this bell crank lever is pivoted to the upper end of a link 221, the lower end of which at 222 is pivoted to an arm 223. The lower end of this arm is clamped about a head 224 of the threaded element 62 so that as the bell crank lever 218 is rocked by the engagement of the cam part 216 on the follower 217, the arm 223 is depressed and the threaded element is rocked angularly in the direction to cause this threaded element to be unscrewed slightly, thus pressing on the abutment 55 and causing a bodily retraction of the casing 25. Suitable means, such as a spring 225, may be employed to hold the follower 217 into engagement with the cam 215.

It will be noted that the entire cycle is complete in a single complete rotation of the shaft 120 which corresponds to a single pass and return of each of the side truing devices, the active pass of these devices being inwardly from the apex of the wheel, the return traverse being made while the entire mechanism is retracted so that the devices are idle.

In order that this mechanism may be free to operate throughout the angular range of adjustment of the casing 25, this casing is provided with an annular slot 230, and the flange 38 and the adjacent face of the cover member 34 are cut away for a sufficient distance to permit the proper motion of the connections including the link 221 and the retracting rock arm 223. The cradle member 235 through which the threaded abutment shaft 52 passes is likewise provided with an arcuate slot 236 to permit rocking adjustment of the cradle, as previously described.

The cap extension 210, to which reference has previously been made, serves as a housing for certain of the control switch mechanisms by which certain actions of the machine are controlled. The shaft 120 within this housing 210 carries three cams 250, 251 and 252 which operate electric switch arms 253, 254 and 255, respectively. These parts are so positioned that when truing is about to begin, the wheel slide being then at one of its traverse limits, and having actuated a limit switch to start the rotation of the motor 110 of the truing mechanism, the cam 251 first comes into action, moving the switch 254 to a position giving a slow driving speed to the motor 20 so as to reduce the speed of the grinding wheel to a proper low rate for truing. It retains the switch 254 in this position until the completion of the truing action and just before the motor 110 is stopped by engagement of the cam member 252 on the switch 255 allowing the normally open switch 255 to open by bringing the low part of the cam 252 opposite thereto. Just before the end of the truing operation is reached, the cam 250 acts on the switch 253 to start the reverse traverse of the work, and just after this has been effected, the cam 252 permits the switch 255 to open to stop the rotation of the motor 110, which as before mentioned, was brought into operation by the traverse of the work as it approached its traverse limit and then stopped. Before the stopping of this motor 110, the cam 251 has reached such an angular position as to cause the switch 254 to resume its position for full speed rotation of the grinding wheel.

Electrical connections from the switch 254 so that its closing and opening changes the speed of the motor 20, are shown diagrammatically in Figure 11, in which the closing of the normally open switch 254 short circuits a resistance 2540 in the shunt field circuit leads 2541 and 2542 of this motor. This increases the field strength and slows the motor speed.

One manner of insuring this desired sequence of operations of the traverse reverse mechanism and the operation of the truing mechanism motor is shown diagrammatically in Figures 11 to 13, inclusive. In Figure 11 at 300 is shown a reversing single phase motor for traversing the work. At 301 is shown a reversing switch for the motor 300 which is thrown by suitable dogs 3001 and 3002 on the carriage through a load and fire mechanism 3003 at each end of the traverse in the well known manner, the motion of the switch between its reverse positions being shown by the arrow x. This switch has an intermediate position, shown in Figure 12. In this intermediate position where the motor 300 is disconnected from power, contact is made by the switch 301 between the terminals 305 and 306, which closes a circuit between the lines 307 and 308 through a latch 310 and the truing device drive motor 110. In one direction of motion of the switch 301 it is held for a time in this intermediate position by the latch 310. After the motor 110 starts it closes the normally open switch 255 so that the lines 307 and 308 are connected independently of the switch 301. After truing has been completed, normally open switch 253 is closed for a short time by the action of its cam 250 which closes a circuit from the line 307 through the latch release solenoid 312, latch 310, and terminal 305 to the line 308. This releases the latch 310 and allows the load and fire mechanism to complete the reversing motion of the switch 301 to the position of Figure 13, whereupon the motor 300 is energized to begin the reverse traverse of the carriage. The rotation of the

motor 110 then continues until the normally open switch 255 is allowed to open by its cam 252, whereupon the motor 110 stops. On actuation of the switch 301 at the opposite limit of traverse of the work carriage, the latch 310 may be pressed out of the way, and the reverse connections to the motor 300 completed without moving the motor 110 sufficiently to close the switch 255 or to slow the wheel, though if desired, the truing could be made to take place at both ends of the traverse by causing the latch 310 to stop the switch 301 in each direction. Rotation of the motor 110, it will also be noted, causes the truing mechanism to be advanced to truing position for the start of the truing operation, and after it has been completed retracts the truing mechanism from truing position, by rocking of the arm 223 in the proper directions, as heretofore described.

From the foregoing description of certain embodiments of this invention, it will be evident to those skilled in the art that various changes and modifications may be made without departing from the spirit or scope of this invention as defined by the appended claims.

I claim:

1. The combination with a grinding machine having a grinding wheel and a wheel support having a cylindrical opening having its axis substantially perpendicular to the axis of said wheel, of a wheel truing mechanism having a cylindrical enclosing casing, means supporting said casing for axial and angular motions in said opening and with respect to said wheel support, means for fixing the angular position of said casing, and means for moving said mechanism toward and from said wheel.

2. The combination with a grinding machine having a grinding wheel and a wheel support having an arcuate face portion with its lengthwise axis substantially perpendicular to the axis of said wheel, of a wheel truing mechanism having a cylindrical enclosing casing formed with an arcuate portion supported on said arcuate face for rocking and axial motion relative to said face, a member to which said casing may be fixed in angularly adjusted relation, means fixing said member against turning whereby said casing is fixed in adjusted angular relation with respect to said support, and means for moving said member toward and away from said wheel to thereby move said casing lengthwise of said arcuate supporting portion toward and from said wheel.

3. The combination with a grinding machine having a wheel slide, a cradle rockably carried by said slide to rock transversely of the sliding direction of said slide, means for fixing said cradle in adjusted angular position, and a grinding wheel carried by said cradle with its axis substantially perpendicular to said sliding direction, said cradle having a tubular portion substantially coaxial with its rocking axis, of a wheel truing mechanism having a cylindrical enclosing casing rockably carried in said tubular portion and movable axially thereof, a member mounted on said slide for sliding motion substantially parallel to that of said slide, means retaining said member against angular motion relative to said slide, means for securing said casing to said member in adjusted angular position, and means for moving said member.

4. The combination with a grinding machine having a wheel slide, a cradle rockably carried by said slide to rock transversely of the sliding direction of said slide, means for fixing said cradle in adjusted angular position, and a grinding wheel carried by said cradle with its axis substantially perpendicular to said sliding direction, said cradle having a tubular portion substantially coaxial with its rocking axis, of a wheel truing mechanism having a cylindrical casing rockably carried by said cradle with its axis substantially perpendicular to said sliding direction, said cradle having a tubular portion substantially coaxial with its rocking axis, of a wheel truing mechanism having a cylindrical casing rockably mounted in said tubular portion and movable axially thereof, a member mounted on said slide for sliding motion substantially parallel to that of said slide, means retaining said member against angular motion relative to said slide, means for securing said casing to said member in adjusted angular position, means for moving said slide, and means actuated by said slide-moving means for moving said member relative to said slide.

5. The combination with a grinding machine having a wheel slide, a cradle rockably carried by said slide to rock transversely of the sliding direction of said slide, means for fixing said cradle in adjusted angular position, and a grinding wheel carried by said cradle with its axis substantially perpendicular to said sliding direction, said cradle having a tubular portion substantially coaxial with its rocking axis, of a wheel truing mechanism having a cylindrical casing rockably mounted in said tubular portion and movable axially thereof, a member mounted on said slide for sliding motion substantially parallel to that of said slide, means retaining said member against angular motion relative to said slide, means for securing said casing to said member in adjusted angular position, means for moving said slide, an abutment, means actuated by said sliding moving means for moving said abutment, an element carried by said member for engagement with said abutment, and yielding means holding said element against said abutment.

6. The combination with a grinding machine having a wheel slide, a cradle rockably carried by said slide to rock transversely of the sliding direction of said slide, means for fixing said cradle in adjusted angular position, and a grinding wheel carried by said cradle with its axis substantially perpendicular to said sliding direction, said cradle having a tubular portion substantially coaxial with its rocking axis, of a wheel truing mechanism having a cylindrical casing rockably mounted in said tubular portion and movable axially thereof, a member mounted on said slide for sliding motion substantially parallel to that of said slide, means retaining said member against angular motion relative to said slide, means for securing said casing to said member in adjusted angular position, means for moving said slide, an abutment, means actuated by said sliding moving means for moving said abutment, an element carried by said member for engagement with said abutment, means actuated in time with the operation of said truing mechanism to change the relation between said element and said member, and yielding means holding said element against said abutment.

7. The combination with a grinding machine having a wheel slide, a cradle rockably carried by said slide to rock transversely of the sliding direction of said slide, means for fixing said cradle in adjusted angular position, and a grinding wheel carried by said cradle with its axis substantially perpendicular to said sliding direction, said cradle having a tubular portion substantially coaxial with its rocking axis, of a wheel truing mechanism having a cylindrical casing rockably mounted in said tubular portion and movable axially thereof, a member mounted on said slide for sliding motion substantially parallel to that of said slide, means retaining said member against an-

gular motion relative to said slide, means for securing said casing to said member in adjusted angular position, means for moving said slide, an abutment, means actuated by said slide moving means for moving said abutment, an element in line with said abutment and having threaded connection with said member, yielding means acting on said member to hold said element against said abutment, and means acting in time with said truing mechanism for adjusting said threaded connection to thereby cause motion of said truing mechanism independent of the motion of said abutment.

8. In combination with a grinding machine having a grinding wheel, a wheel truing mechanism mounted to move from and toward said wheel, a movable abutment, a part carried by said truing mechanism for engagement with said abutment, a spring engaging said mechanism for normally holding said part against said abutment, and means effective to release the tension on said spring to facilitate disengagement of said spring from said mechanism to permit removal of said mechanism from the machine.

9. In combination with a grinding machine having a grinding wheel, a wheel truing mechanism mounted to move from and toward said wheel, a movable abutment, a part carried by said truing mechanism for engagement with said abutment, a coil spring having one end releasably engaging said mechanism, a rock shaft, an arm carried by said shaft, and a link pivoted to said arm at one end and secured to the opposite end of said spring, said link being offset to permit said spring connection thereto, its pivot to said arm, and said shaft to be moved to substantially dead center relative positions with said pivot connection on the opposite side of said shaft from said spring connection to thereby hold said spring under tension with said part against said abutment, or to permit said pivotal connection to be swung out of said dead center position by rocking said shaft and thereby relieve the tension on said spring to facilitate its disconnection from said mechanism for the removal of said mechanism from the machine.

10. The combination with a grinding machine having a grinding wheel and work traversing means, of a unit wheel truing mechanism having a driving motor for the truing mechanism, means for controlling said motor, means for automatically actuating said motor control means to start said motor at the end of a traverse, means for controlling said traversing means, and means driven by said motor for actuating said several controlling means.

11. The combination with a grinding machine having a grinding wheel and work traversing means, of a wheel truing mechanism having a driving motor, means including a switch for controlling said motor, means including a switch for automatically actuating said motor control means to start said motor at the end of a traverse, wheel-dressing means, means including a switch for controlling said traversing means, a shaft driven by said motor, and cams on said shaft for actuating said switches.

12. The combination with a grinding machine having a grinding wheel and work traversing means, of a wheel truing mechanism unit having a driving motor for the truing mechanism, means including a switch for controlling said motor, means for automatically actuating said motor control means to start said motor at the end of a traverse, means including a switch for controlling the speed of rotation of said grinding wheel, means including a switch for controlling said traversing means, and means driven by said motor for actuating said switches to first slow the wheel, then dress the wheel, then return the wheel to grinding speed and start the return traverse, and then to stop said motor.

13. The combination with a grinding machine having a grinding wheel and work traversing means, of a wheel truing mechanism unit having a driving motor for the truing mechanism, motor control means, means for actuating said motor control means to automatically start said motor at the end of a traverse, means for advancing and retracting said truing mechanism relative to the wheel, means for controlling said traversing mechanism, and means actuated by the rotation of said motor for actuating said advancing and retracting means to dress and then to retract said truing mechanism, to then actuate said traversing mechanism to start the return traverse, and then to actuate said motor control to stop the rotation of said motor.

14. The combination with a grinding machine having a grinding wheel and work traversing means, of a wheel truing mechanism unit having a driving motor for the truing mechanism, motor control means including a switch, means for actuating said motor control means to automatically start said motor at the end of a traverse, means for advancing and retracting said truing mechanism relative to the wheel, means including a switch for controlling said traversing mechanism, and means actuated by the rotation of said motor for actuating said advancing and retracting mechanism and said switches in timed relation to dress and then retract said truing mechanism, to start the return traverse, and then to stop the rotation of said motor.

15. The combination with a grinding machine having a grinding wheel and work traversing mechanism, of a wheel truing mechanism unit, a driving motor for said wheel truing mechanism carried by said unit, means for controlling said motor, means for controlling the speed of rotation of said grinding wheel, means for advancing and retracting said truing mechanism, means for automatically starting said motor at the end of a traverse, and means driven by said driving motor for first actuating said wheel speed controlling means to slow the wheel from grinding to truing speed, for then actuating said advancing and retracting means to advance said mechanism to true the wheel and then to retract said mechanism, to then actuate said speed control to return said wheel to grinding speed and to actuate said traversing means to start the return traverse, and then to actuate said motor control to stop said motor.

16. The combination with a grinding machine having a grinding wheel and work traversing means, of a unit wheel-truing mechanism, a driving motor on said unit for said wheel truing mechanism, means including a switch for controlling said motor, means including a switch for controlling the speed of rotation of said grinding wheel, means for advancing and retracting said truing mechanism, means for automatically starting said motor at the end of a traverse, and means driven by said driving motor for actuating said advancing and retracting means and said switches timed to slow the wheel from grinding to truing speed, to advance said mechanism to true the wheel and then to retract said mechanism and to return said wheel to grinding speed,

to then start the return traverse, and then to stop said motor.

17. In combination, a wheel truing mechanism comprising a casing, truing device operating elements extending through a wall of said casing, truing devices outwardly of said wall and actuated by said elements, actuating mechanism for said elements within said casing, said casing having an opening in its upper portion through which lubricant may be introduced into said casing, a cover for said opening, and a tubular member within which said casing is slidable.

18. In combination, a wheel truing mechanism comprising a casing, truing device operating elements extending through a well of said casing, truing devices outwardly of said wall and actuated by said elements, actuating mechanism for said elements within said casing, said casing having an opening in its upper portion through which lubricant may be introduced into said casing, a cover for said opening, a tubular member within which said casing is slidable, and packing between said tubular member and casing.

19. A self-contained wheel truing mechanism unit, comprising a movable dressing tool, a motor for actuating said dressing tool, means determining a cycle of operation of said dressing tool, connections from said motor for actuating said determining means, a speed controller for the grinding wheel, a work traversing control, a dressing tool motor stop, and means actuated by said determining means for operating said speed controller, said work traversing control and said motor stop.

20. In a wheel truing mechanism for a wheel having angular related grinding faces, a pair of rock shafts arranged substantially perpendicular to said faces, an arm carried by each rock shaft, a truing device carried by each arm, means for rocking such shafts comprising a pair of rack bars arranged in substantially parallel relation and each at an angle to its respective shaft, the teeth of each rack bar being arranged at an angle thereto, segments carried by each rock shaft meshing with the teeth of its bar, a cam, operative connections from said cam for moving said rack bars axially, and means for actuating said cam.

21. In combination with a grinding machine having a grinding wheel, a wheel truing mechanism unit including a truing tool mounted for wheel dressing movement, a motor carried by said unit for imparting such dressing movement to said tool, means for moving said mechanism from and toward said grinding wheel, and means driven by said motor for actuating said mechanism-moving means.

22. The combination with a grinding machine having a grinding wheel and work traversing means, of a wheel truing mechanism unit, a motor carried by said unit, means for automatically starting said motor at the end of a traverse, means actuated by said motor to drive said mechanism to dress the wheel, means for initiating the return work traverse, means for stopping said motor, and means driven by said motor to actuate said truing means to dress the wheel and at the completion of the dressing operation to actuate said initiating means and said stopping means.

23. The combination with a grinding machine having a grinding wheel, wheel driving means, a speed control for said wheel driving means, and work traversing means, of a wheel truing mechanism unit, a motor carried by said unit, means for automatically starting said motor at the end of a traverse, means actuated by said motor to drive said mechanism to dress the wheel, means for initiating the return work traverse, means for stopping said motor, and means actuated by said motor to operate said speed control means to slow the wheel, to then actuate said truing mechanism to dress the wheel, and after the completion of the dressing operation to actuate said speed control to return the wheel to grinding speed and said initiating means to start the return traverse, and then to actuate said stopping means to stop the operation of said motor.

24. The combination with a grinding machine having a grinding wheel and work traversing means, of a wheel truing mechanism unit, means for moving said truing mechanism toward and from said grinding wheel, a motor, means for automatically starting said motor at the end of a work traverse, means actuated by said motor to drive said mechanism to dress the wheel, means for initiating the return work traverse, means for stopping said motor, and means driven by said motor for actuating said mechanism moving means to advance the wheel truing mechanism to the wheel, to then actuate said mechanism to dress the wheel, to then actuate said moving means to retract said mechanism, to actuate said iniating means to start the return work traverse, and then to actuate said stopping means to stop said motor.

25. The combination with a grinding machine having a grinding wheel, wheel-driving means, a speed control for said wheel-driving means, and work-traversing means, of a wheel truing mechanism unit, a motor carried by said unit, means for automatically starting said motor at the end of a traverse, means actuated by said motor to drive said mechanism to dress the wheel, means for initiating the return traverse, means for stopping said motor, and means driven by said motor for first actuating said speed control means to slow the wheel, to then actuate said moving means to advance the wheel-truing mechanism to the wheel, to then actuate said mechanism to dress the wheel, to then actuate said moving means to retract said mechanism from the wheel, to then actuate said speed control to increase the wheel speed, to actuate said initiating means to start the return work traverse, and finally to actuate said stopping means to stop said motor.

RALPH E. FLANDERS.