Aug. 11, 1942. R. E. FLANDERS 2,292,875

INTERNAL THREAD GRINDING MACHINE

Filed Feb. 8, 1941 7 Sheets-Sheet 1

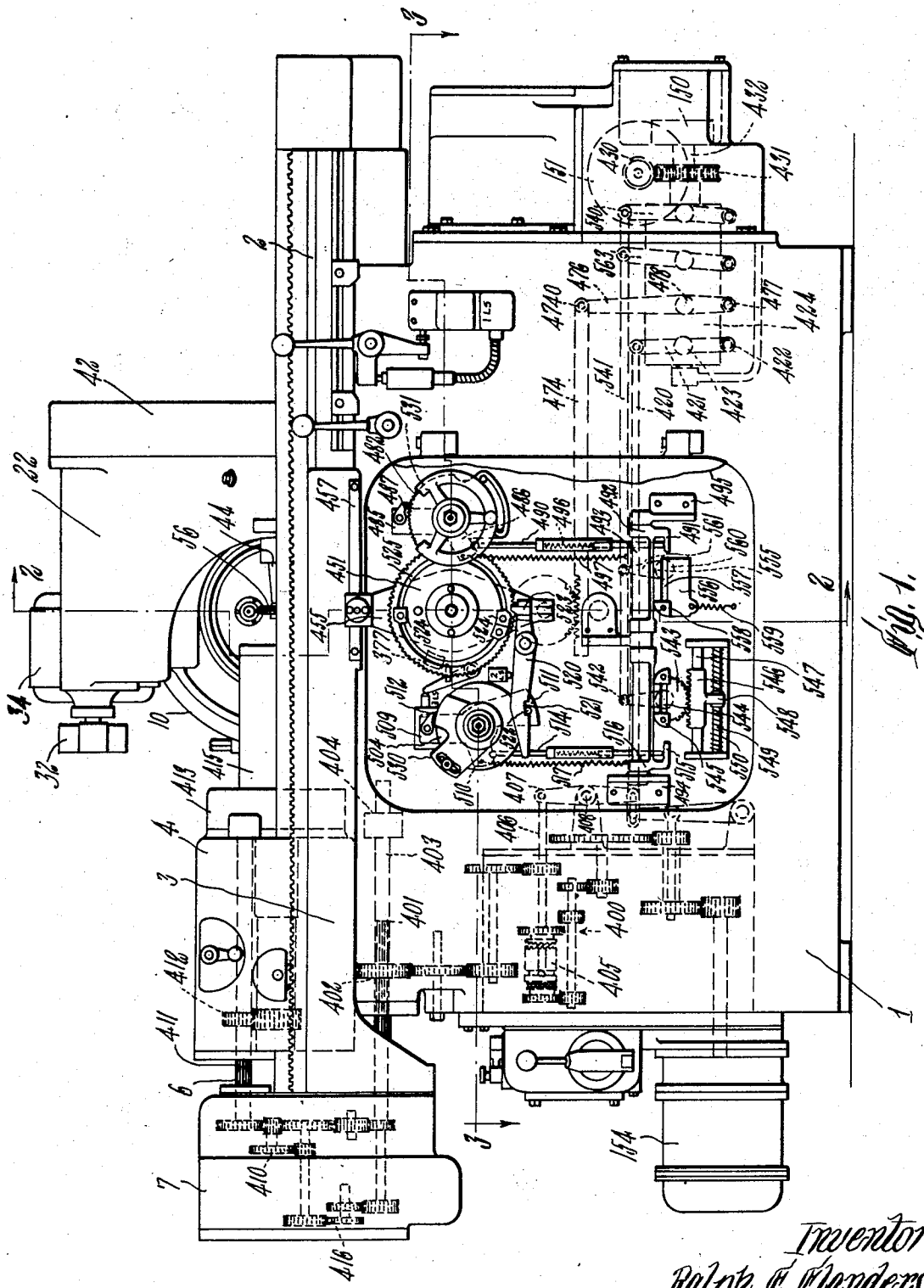


Fig. 1.

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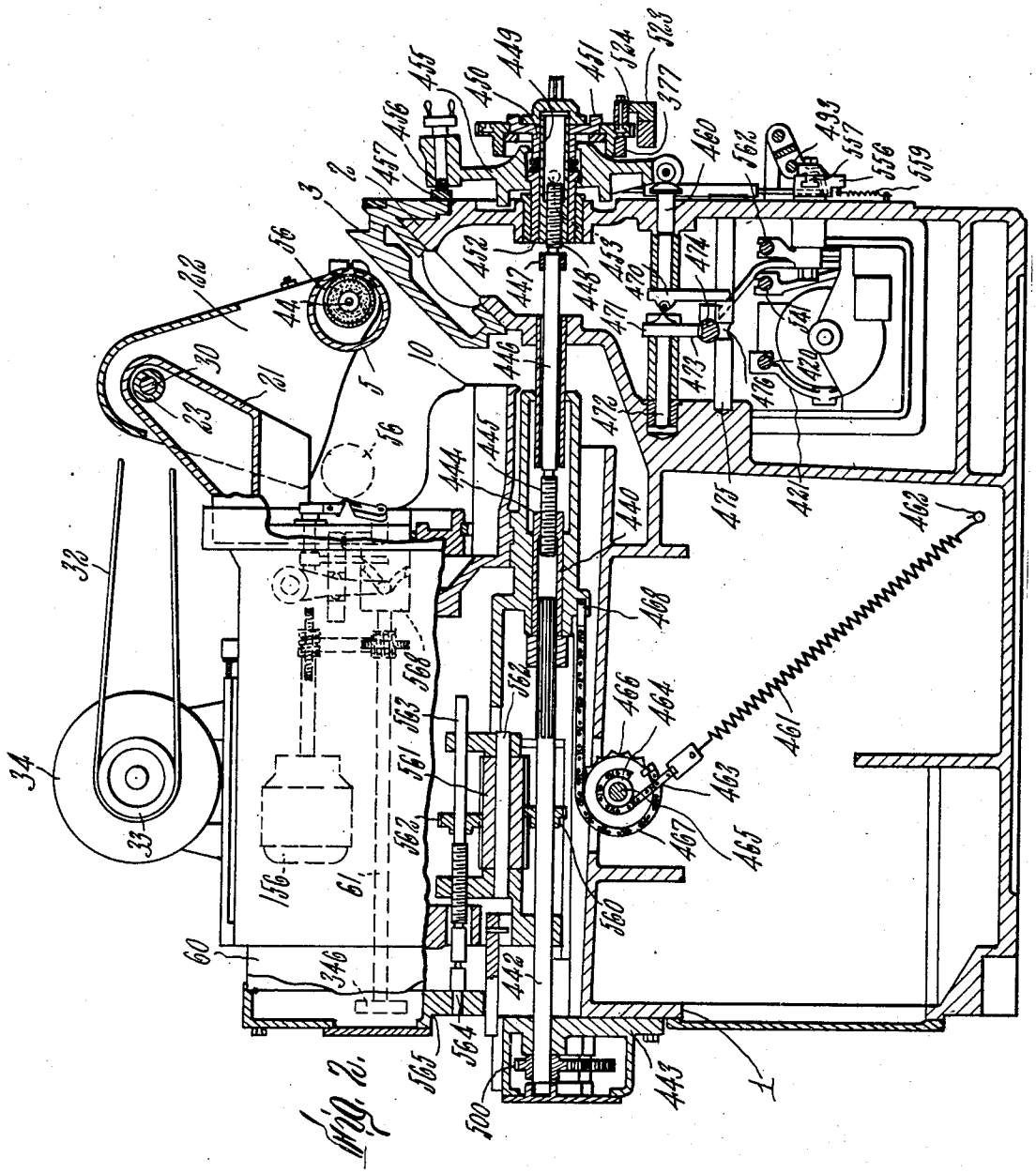


Fig. 2.

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INTERNAL THREAD GRINDING MACHINE

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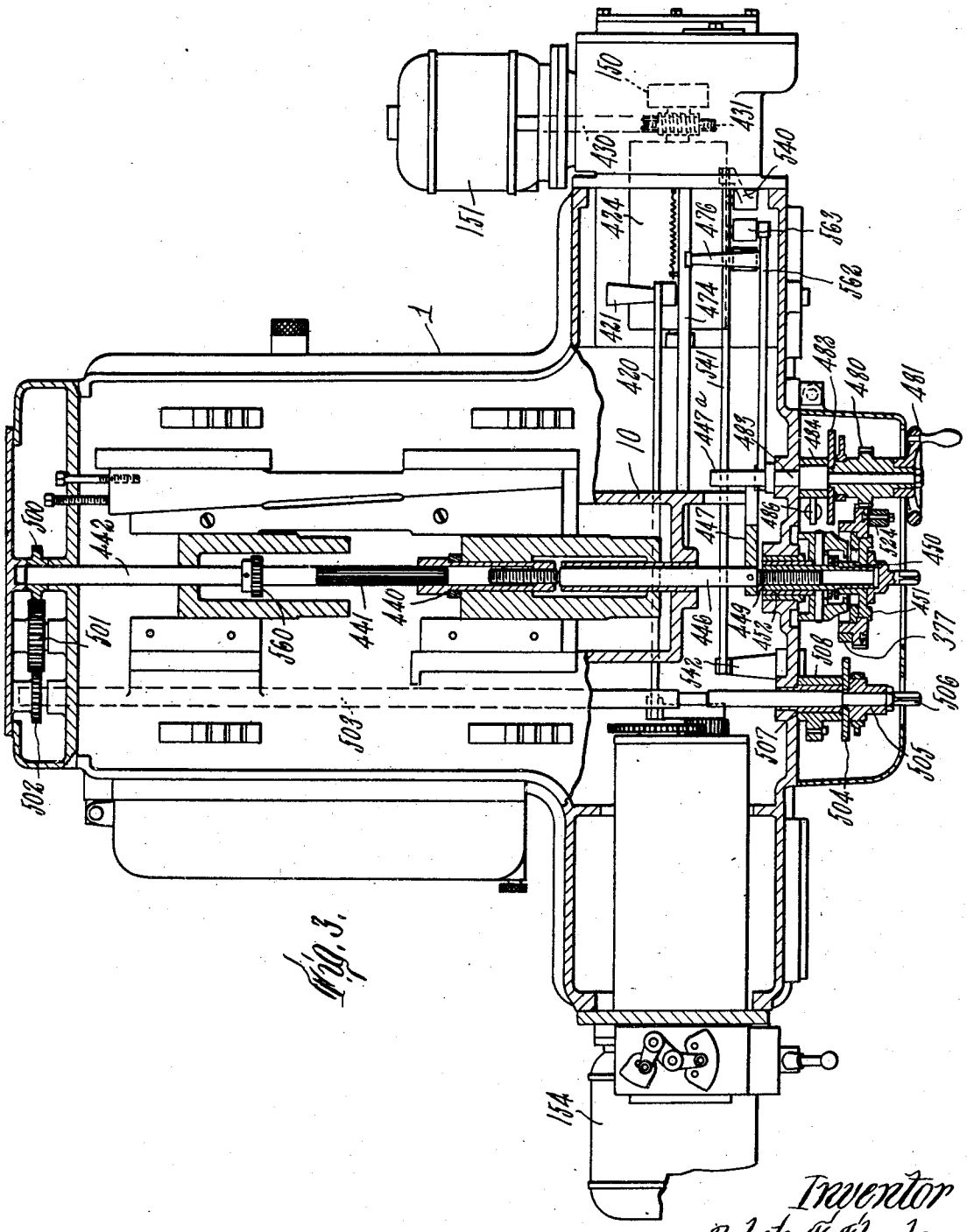


Fig. 3.

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INTERNAL THREAD GRINDING MACHINE

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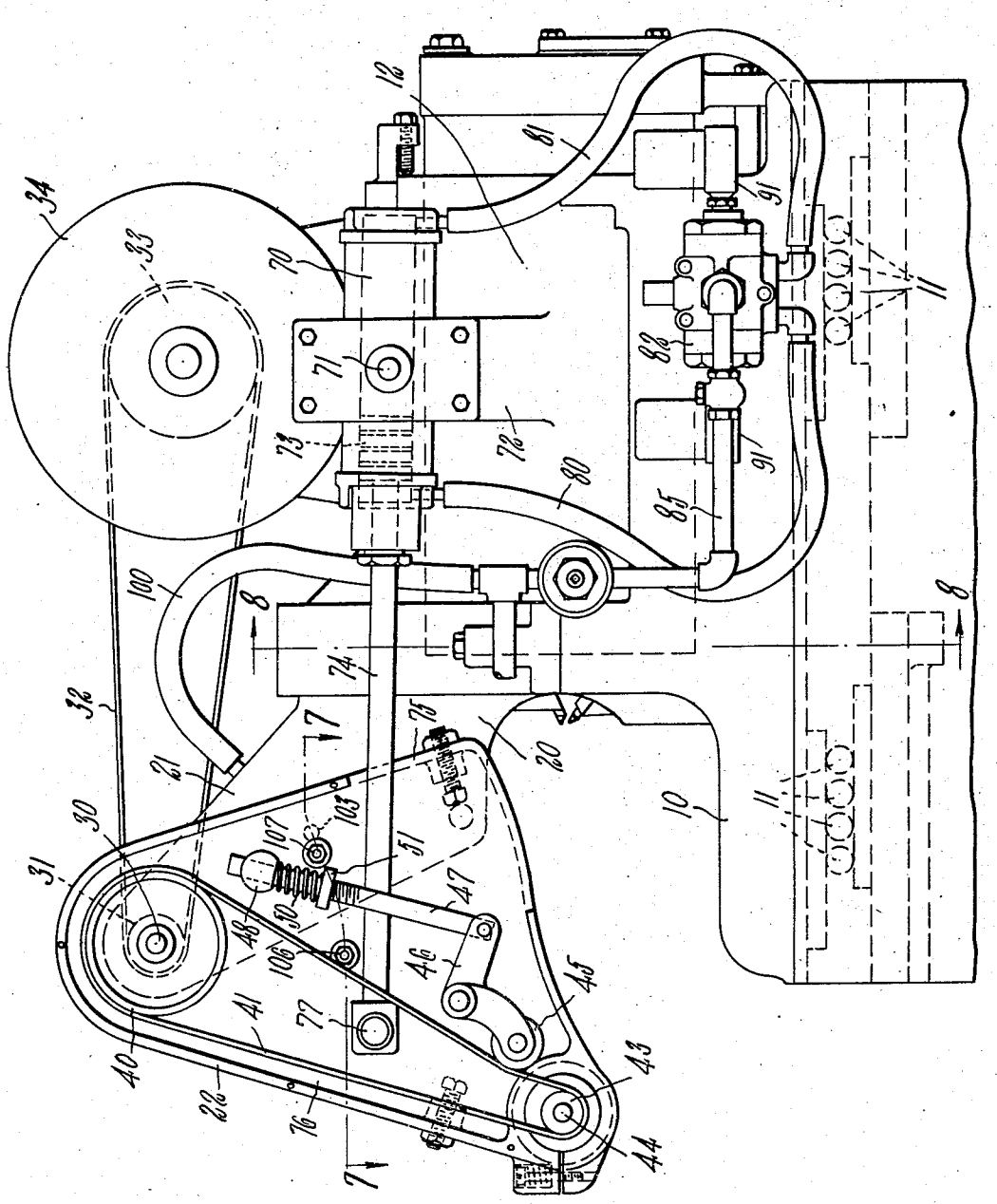


Fig. 4.

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INTERNAL THREAD GRINDING MACHINE

Filed Feb. 8, 1941 7 Sheets-Sheet 5

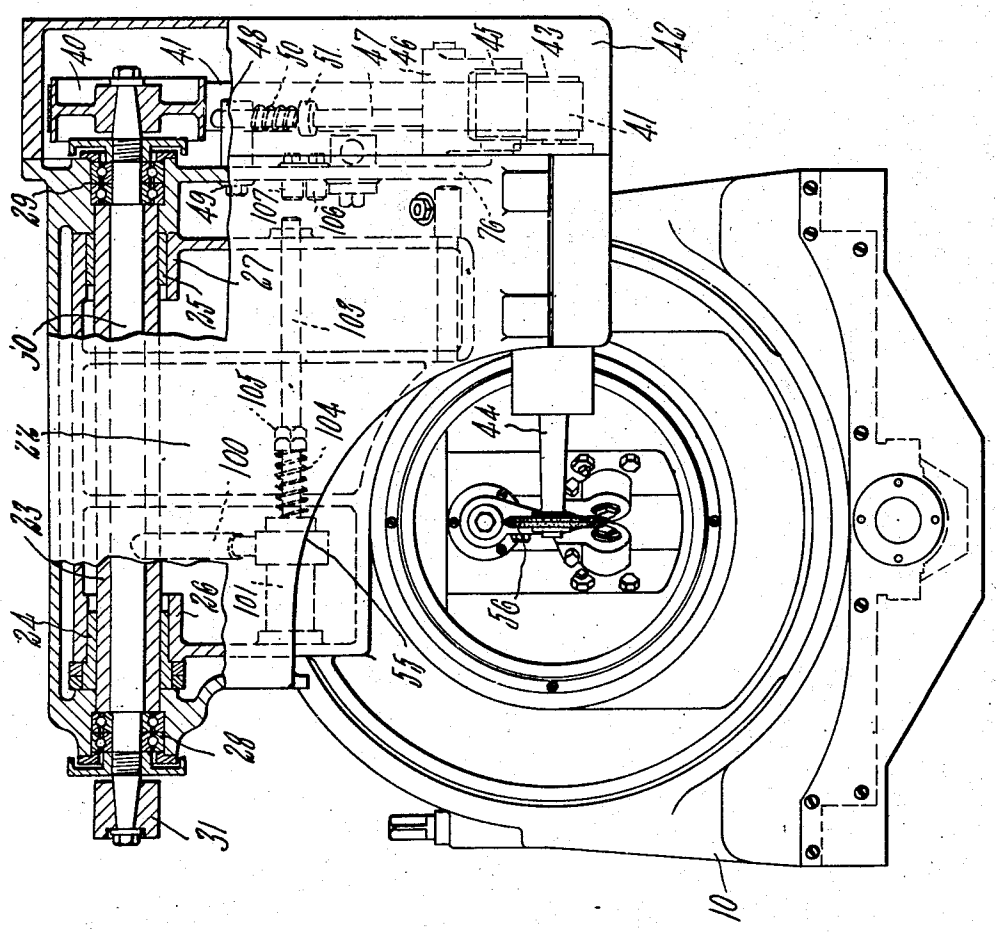


Fig. 6.

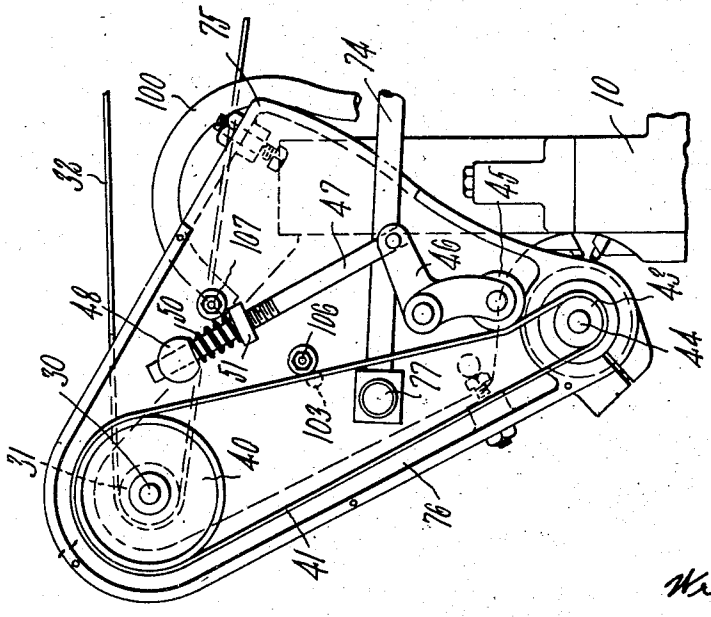


Fig. 5.

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INTERNAL THREAD GRINDING MACHINE

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Fig. 9.

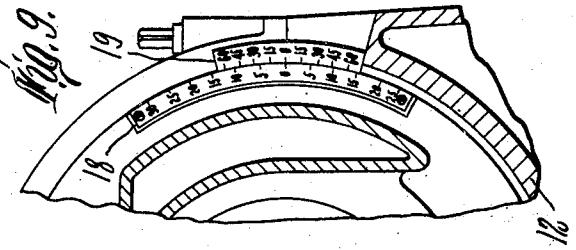
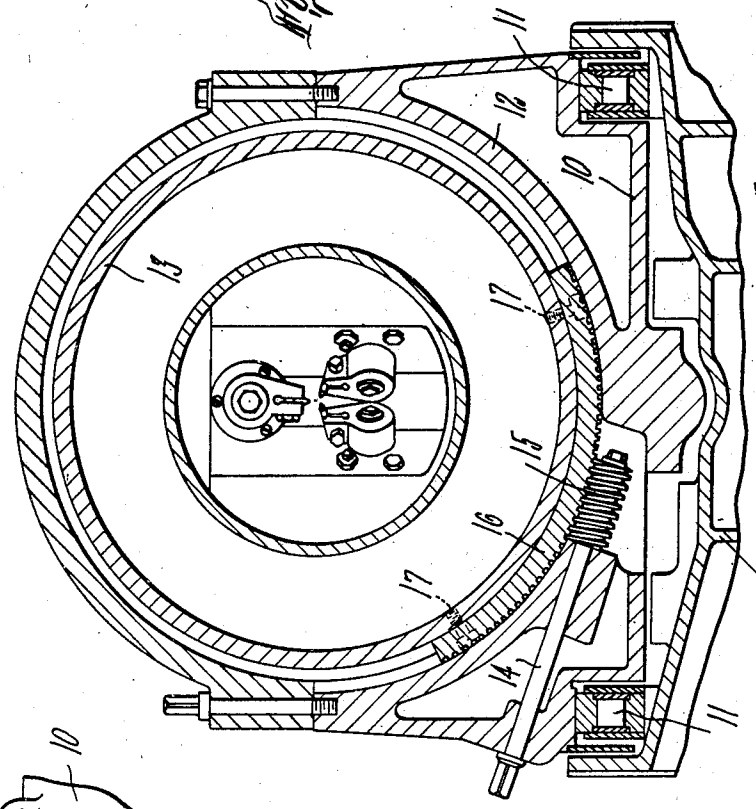


Fig. 8.



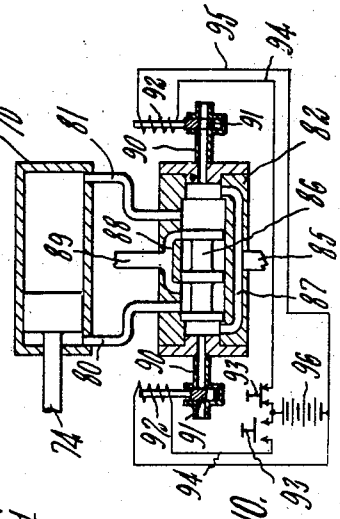


Fig. 10.

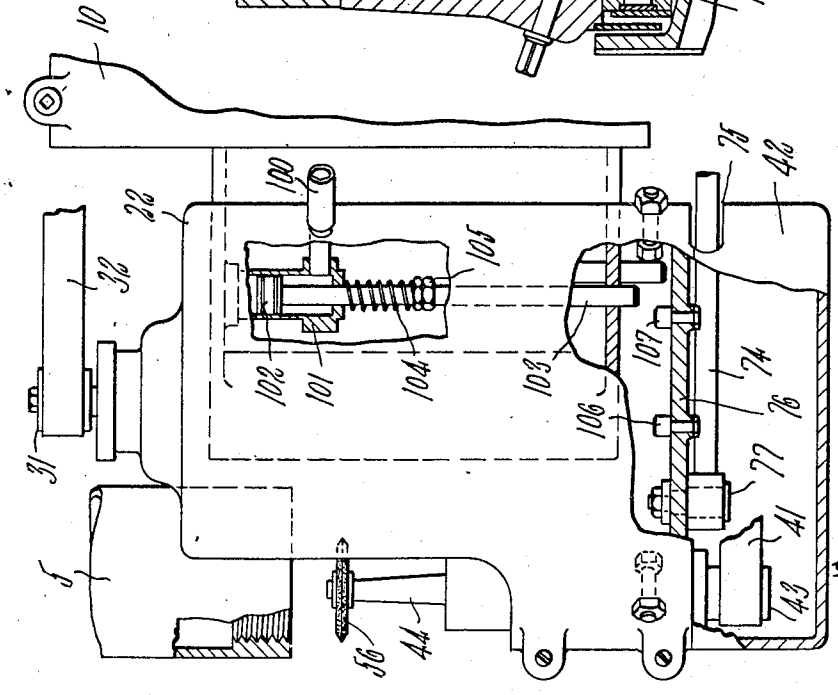


Fig. 7.

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INTERNAL THREAD GRINDING MACHINE

Filed Feb. 8, 1941 7 Sheets-Sheet 7

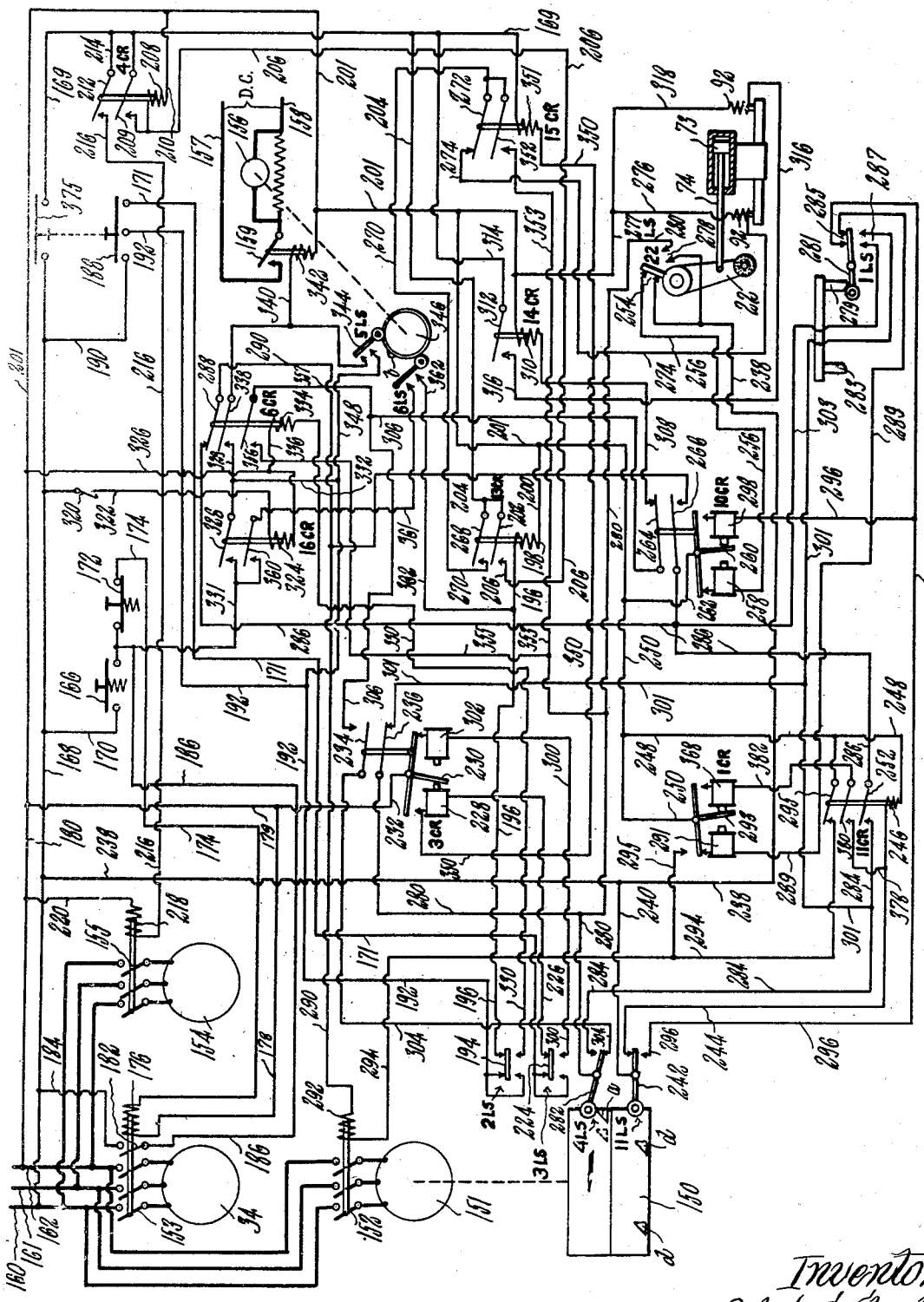


Fig. 11.

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Patented Aug. 11, 1942 2,292,875

UNITED STATES PATENT OFFICE

2,292,875

INTERNAL THREAD GRINDING MACHINE

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

Application February 8, 1941, Serial No. 378,033

20 Claims. (Cl. 51—95)

This invention relates to internal grinding and more particularly to machines for grinding internal threads.

One object of the invention is to obtain automatic and accurate truing of the grinding wheel.

A further object is to obtain automatic sizing of the work.

Still another object is to obtain these results by the use of an attachment applicable to an external grinder of well known type.

For a more complete understanding of this invention, reference may be had to the accompanying drawings in which

Figure 1 is a fragmentary front elevation of a grinding machine embodying the invention.

Figure 2 is a detail section on line 2—2 of Figure 1.

Figure 3 is a horizontal section on line 3—3 of Figure 1.

Figure 4 is a right hand elevation of the same to a larger scale, the wheel being in grinding position.

Figure 5 is a view similar to a portion of Figure 4, but with the grinding wheel in truing position.

Figure 6 is a view similar to a portion of Figure 1, but to a larger scale and with parts broken away and in section and with parts shown in dash lines.

Figures 7 and 8 are sectional views taken on lines 7—7 and 8—8, respectively, of Figure 4, parts being omitted in Figure 8.

Figure 9 is a fragmentary transverse vertical section through the wheel slide showing an indicating mechanism.

Figure 10 is a diagrammatic view of a fluid pressure system and an electrical control circuit therefor.

Figure 11 is a wiring diagram of an automatic control for the machine.

The invention is shown herein as embodied in a grinding machine of the general type shown in my Patent No. 2,187,227 granted January 16, 1940, for Grinding machine, the machine here, however, being provided with a special holder for an internal grinding wheel and means for moving said wheel between either of two positions, in the outer of which it is in grinding position and in the inner of which it is in truing position. As shown, therefore, the machine comprises a bed 1 having longitudinal ways 2 (Figure 2) for the reception of a traversing carriage 3 to which may be clamped a headstock 4 provided with a rotary spindle to which the work 5 may be secured as by some suitable chuck mechanism (not shown). This headstock spindle is connected through a splined shaft 6 to driving mechanism in a casing 7 which may be the same as that in the casing 221 in my patent hereinbefore mentioned.

Movable transversely to the direction of traverse of the work carriage is a wheel carriage 10 which may be mounted on antifriction rolls 11 as shown best in Figure 8 substantially as shown in Figure 13 of Patent No. 2,187,227. This wheel carriage or slide is provided with an arcuate cradle 12 for rockably supporting a wheel support 13 which may be angularly adjusted as by turning a shaft 14 having a worm 15 thereon meshing with teeth in a worm segment 16 secured as by screws 17 to the support 13. Cooperating indices 18 and 19 on the wheel support and carriage, as shown in Figure 9, may be employed to show the angular adjustment at any time. This angular adjustment is to adjust the wheel to the helix angle of the threads to be ground. The casing shown in my prior patent which carries the external wheel shaft is removed for the present invention and a casing 20 is substituted therefor. This casing 20 has a forwardly and upwardly extending arm 21 which has pivoted thereto near its outer upper end a casing 22. The pivotal connection comprises a sleeve 23 having a pair of spaced bushings 24 and 25 thereon (Figure 6) within hub portions 26 and 27, respectively, of the arm 21, and extending through this sleeve 23 and journaled in bearings 28 and 29 at opposite ends of the sleeve 23 is a countershaft 30. At one end of this countershaft is secured a belt pulley 31 for connection by a belt 32 (see Figures 2 and 4) with the drive pulley 33 of a driving motor 34 corresponding to the wheel motor 109 shown in my prior patent. The other end of the shaft 30 has fixed thereto a pulley 40 over which passes a belt 41 extending downwardly within a cover member 42 over a pulley 43 on a wheel shaft 44. An idler 45 bears against the back stretch of the belt 41, being journaled in one arm of a bell crank lever 46, the other arm of which is connected to a rod 47 slideable transversely of a pivot 48 held on a pivot bolt 49 of the casing 22. A coil spring 50 surrounding the rod 47 bears between a flattened face of the pivot 48 and a collar 51 threaded on a portion of the rod 47. The tension of the spring 50 provides the pressure applied to the belt tightener roll 45.

The wheel shaft 44 extends beyond a concaved face 55 of the casing 22 and has secured at its outer end an internal thread grinding wheel 56. The central plane of this wheel 56 is sub-

stantially in the axis of rocking adjustment of the wheel support 13 and in position for its edge to be trued by the truing mechanism carried by a truing mechanism slide 60 mounted for movement in the same direction as the motion of the wheel slide 10 and the wheel support 13. This truing mechanism may be similar to that shown in my Patent No. 2,184,011 granted December 19, 1939, and may be actuated at suitable times by the turning of a shaft 61 corresponding to the shaft 1001 shown in said patent.

The wheel casing 22 is provided with two different angular positions. When the wheel shaft 44 is in its outer position shown in Figures 2 and 4, the grinding wheel is in grinding position relative to the work and out of truing relation to the truing mechanism. However, the casing 22 may be rocked to the position shown in Figure 5 with the grinding wheel in the dotted line position shown in Figure 2, whereupon this wheel is in position to be trued by the truing mechanism.

Means are provided for swinging this wheel casing from one to the other of its positions. As shown best in Figure 4, at 70 is shown a fluid pressure cylinder mounted by suitable trunnions 71 on a bracket 72 carried by the wheel slide 12. This cylinder 70 is provided with a piston therein shown in dotted lines at 73 on a piston rod 74 which extends through a slot 75 in the rear wall of the cover member 42, the forward end of this piston rod 74 engaging over a pivot pin 77 secured to the outer wall member 76 of the casing 22. This cylinder 70 has fluid pressure connections through the pipes 80 and 81 with a control valve 82, these connections being shown diagrammatically in Figure 10. Fluid under pressure, such as air, is supplied from any suitable source through the pressure pipe 85 to the valve casing 82. A valve 86 within this casing controls communication through a pressure passage 87 leading from the pipe 85 to the opposite ends of the piston 86 to either selected of the pipes 80 and 81, discharge taking place to the pipe 80 or 81 through the discharge passage 88 and discharge pipe 89. In the position shown in Figure 10 fluid pressure is admitted through the pipe 81 to the right hand end of the cylinder 70, while the pipe 80 is open to the passage 88 through the discharge pipe 89, the piston rod 74 then being in its outer position with the grinding wheel in grinding position.

In Figure 10 there is illustrated a manually operated electrically actuated control for this valve. At each end of the cylinder 82 is shown a discharge pipe 90 normally closed by a valve 91, which, however, can be opened by energization of a solenoid 92. These solenoids are arranged in series with their respective push button switches 93 through the leads 94 and 95 and the source of electric power 96. By closing either of these push buttons 93, the right hand push button being shown as closed, the corresponding end of the cylinder 82 is open to discharge so that the pressure acting on the opposite end of the valve 86 forces this valve to one or the other end of the cylinder 82, thus to move the piston rod 74 in the corresponding direction and to swing the wheel casing 22 to either truing or grinding position. As soon as the push button 93, which is shown depressed, is allowed to rise, the pressure at each end of the valve 86 equalizes and the discharge from either end of the cylinder 82 ceases.

It is desirable that the wheel be held in either its grinding position or its truing position and provision is therefore made by which should the pressure fail, the wheel will be retained in either position in which it may happen to be when the pressure fails. To this end there is connected to the pressure pipe 85 through the flexible connection 100 a latch cylinder 101 (see Figure 7) having a piston 102 therein provided with a piston rod 103. The outer end of this piston rod 103 is formed as a latch bolt which, when no pressure is in the connection 100, is forced by a coil spring 104 bearing between the cylinder 101 and check nuts 105 threaded on the piston rod, into latching engagement with either one of a pair of stop dogs 106, 107. Should the pressure fail when the wheel is in its dressing position, as shown in Figure 5, this piston rod 103 will engage the stop 106 and retain the wheel in dressing position, or should pressure fail while the wheel is in grinding position as shown in Figure 4, it will engage with the stop 107 as shown in Figure 4 and prevent the wheel from leaving this positon.

Cycle control mechanism

In Figure 11 is illustrated a diagram of an automatic control of the machine by which the feed and truing are produced at desired times in the operative cycle of the machine.

The cycle of operations is at least partly determined by a rotatable control cam drum 150 having switch actuating cams arranged thereon and a second cam drum 424 mounted on the same shaft with the drum 150 and rotatable as a unit therewith and having mechanical controls in accordance with the cycle desired. At each free actuation these drums rotate either continuously or in two steps one half a revolution and then stop and their rotation is started at each end of the work traverse. They provide for motion of the wheel between grinding and truing positions and for an actuating impulse of the truing mechanism when the work is at that end of the traverse where the wheel is retracted from the work. Actual truing, however, takes place only at one or more predetermined times in the sizing cycle, actuating impulses at other times being ineffective for that purpose.

The cam drums 150 and 424 are rotated by a three phase motor 151 controlled by a normally open magnetically closed switch 152. The wheel driving motor 34 is also a three phase motor controlled by the normally open magnetically closed switch 153. The work is rotated and its traverse is produced by the three phase motor 154 controlled by the normally open magnetically closed switch 155. The truing mechanism is actuated by a separate direct current motor 156 and takes power from the direct current lines 157 and 158 controlled by a normally open electrically closed switch 159. The alternating current lines 160, 161 and 162 supply three phase current to the alternating current system.

Work rotating and traversing mechanism

Referring to Figure 1, the work rotating and traversing motor 154 is connected through a suitable train of gearing indicated generally by 400 to a shaft 401. This shaft 401 is journaled for rotation in the work supporting carriage 3 and is axially movable therewith. It is therefore splined so as to be rotatable by but movable axially relative to a driving gear 402 carried thereon and one end portion is formed as a lead screw at 403 for engagement with a nut 404 fixed in the machine bed 1. The train of gearing 400 includes a reverse drive mechanism having the reversing

clutch 405 which is actuated by shifting rod 406 pivoted to the upper end of a lever 407 fulcrumed at 408 in the machine bed. The shaft 401 is connected through a chain of gearing 410 to a drive shaft 411 connected through suitable gearing 412 to rotate the work spindle to which is fixed the chuck 413 of any suitable description to which may be secured for rotation the work 415. The train of gearing 410 includes change gearing indicated generally at 416 by which the ratio of angular rotation of the work to its axial displacement may be adjusted in accordance with the lead of the threads to be ground.

From the foregoing description it will be seen that by reversing the position of the reversing clutch 405 the direction of rotation of the work and also its direction of traverse will be changed simultaneously, and this reversal is effected by rocking the lever 407, for which purpose its lower end is connected as through a rod 420 to an arm 421 fulcrumed at 422 and having a cam follower at 423 actuated by suitable cams (not shown) on the cam drum 424. As shown in Figure 1, this cam drum 424 is carried on the same shaft as the cam drum 150. As shown the drive for both of these cam drums comprises a worm 430 on the shaft of the motor 151, which meshes with a worm gear 431 on the cam drum shaft 432.

Wheel feed and truing feed mechanism

As in my Patent No. 2,187,227, to which reference has heretofore been made, means are provided for moving the grinding wheel toward and from the work and for moving a truing device toward and from the wheel at suitable times. There is also provided means for retracting the wheel from the work, as for relieving the work, or for permitting an idle traverse of the wheel in one direction, and there is also provided means by which after a definite extent of wheel feed, the truing mechanism is fed against the wheel and the feed of the wheel is continued by the same amount so that this final wheel feed has no effect to determine the finished size of the work, but the wheel at that time is in accurate contour so that the work when completed is accurately ground to the size and contour desired. Since the mechanism for the foregoing purposes is somewhat different from that shown in my prior patent, it has been illustrated in Figures 1, 2 and 3 hereof. The wheel carriage 10 has journaled therein but held against axial motion relative thereto a sleeve 440. Its rear end portion slidably engages the splined forward end 441 of a shaft 442 which is journaled at its rear end in a casing member 443 secured to the bed 1, so that as the shaft 442 is turned, the sleeve 440 is rotated with it. The rotation of the shaft 442 also actuates the feed of the truing mechanism. The shaft 442 carries a gear 560 engaging a long gear 561 (Figure 2) carried by a shaft 562 journaled on the wheel carriage. With this gear 561 there meshes a gear 562 secured to a shaft 563 having threaded engagement with the wheel carriage and against the rear end of which engages a part 564 of the truing device casing 565 which is held thereagainst as by a suitable spring (not shown) as in my Patent No. 2,184,011 to which reference has been made. These parts are so proportioned that rotation of the shaft 442 feeds the wheel toward the work and the truing device toward the wheel equally.

The forward end of the sleeve as at 444 is threaded for the reception of the rear threaded portion 445 of a shaft 446 and this shaft 446 is held against rotation as by being pinned to an arm 447 slidably engaging a post 447a. The forward extremity of the shaft 446 as at 448 is threaded into the rear end of a sleeve 449. This sleeve 449 is housed within and secured to a hub 450 of a gear wheel 451. Back of the hub 450 is a sleeve 452 within which the sleeve 449 may rotate and this sleeve 452 has pivoted thereto on the pivots 453 a lever 455. The upper end of the lever 455 is provided with an adjustable abutment member 456 which may ride on a cam plate 457, so that by moving the lower end of the lever inwardly or outwardly, the sleeve 452 is similarly moved but to a less extent and carries with it the shaft 446, the sleeve 444, the wheel carriage 10 and the truing mechanism. The wheel carriage 10 is normally held retracted as far as is permitted by the engagement of opposite ends of the lever 455, its upper end on the plate 457 and its lower end on an abutment 460, by means such as the spring 461 which is connected from a fixed point 462 at the bed of the machine to a sprocket chain 463 engaging over a sprocket wheel 464 on the shaft 465, which shaft has a second sprocket wheel 466 thereon rigid with the sprocket wheel 464 and over which engages a length of chain 467, the forward end of which is attached to the carriage 10, as at the point 468. It will be seen from this arrangement the retraction of the abutment 460 will permit the lower end of the lever 455 to swing backwardly and permit the spring 461 to retract the wheel carriage and the wheel from the work; while rotation of the gear wheel 451 will, through its threaded connection with the shaft 446, move the shaft 446 axially and thus move the wheel carriage. The rotation of the gear 451 is employed to produce the normal feed and retraction of the wheel with respect to the work, while rotation of the sleeve 444 in which the rear end of the shaft 446 is threaded is employed to produce a feed motion of the wheel carriage and a feed of the truing mechanism in order that after the truing mechanism becomes effective to true the wheel, the wheel is fed forwardly an amount equal to the truing so that the final sizing of the work is completed with the wheel trued to proper contour. Truing of the wheel after the normal wheel feed is ineffective to bring the grinding faces of the wheel closer to the axis of the work since these faces are trued off to the same extent as the wheel carriage is fed.

Motion of the lever 455 to effect the withdrawal of the wheel carriage and parts carried thereby necessary for relief, or clearance during an inoperative direction of traverse, is produced by the following mechanism. The plunger 460 has secured to its inner end a cam follower element 470 suitably held against rotation, and cooperating with this cam follower is a rocking cam 471 carried by a rock shaft 472. This cam 471 is a face cam and has high and low portions against which the follower 470 rides. This cam 471 is also provided with a segmental gear portion 473 with which engages rack teeth on a bar 474, one end of which is pivoted as at 474a (see Figure 1) to a lever 476 fulcrumed at 477 and having a follower 478 actuated by suitable cams (not shown) on the cam drum 424. The inner end of the rack bar 474 may be supported in engagement with the segment portion 473 as by means of a bar 475 (see Figure 2) having a neck portion 476 to receive the rack bar, and this bar 475 may also engage in a slot in the

lower end of the cam follower member 470 to hold this follower member against rocking with the cam 471.

As before noted the normal feed of the grinding wheel for work sizing is produced by rotation of the gear wheel 451. For this purpose there meshes therewith a gear wheel 480 (see Figure 3) to the hub of which is secured a hand wheel 481 by which it may be turned when desired. This hub also has secured thereto a ratchet wheel 482 and rockably mounted on the stub shaft 483 on which the gear wheel 480 is journaled is a collar 484 carrying a pair of angularly related arms 485 and 486. The arm 485, as shown in Figure 1, carries a pawl 487 so that by rocking of the collar 484 the ratchet wheel 482 is rotated in one direction step by step, thus to rotate the gear 457 of the main feed shaft.

The rocking of the collar 484 in feeding direction is produced by means of a link 490, the upper end of which is secured to the arm 486 and the lower end of which rests upon an arm 491 of a rocker member 492 journaled on a shaft 493 carried by brackets 494 and 495 on the forward face of the machine bed. This link 491, however, has a yieldable element 496 therein which permits the arm 491 to lift the lower end of the link without the upper end being correspondingly moved, the relative motion of the parts being taken up in compression of the spring 496. After an upward motion of the arm 486, it is pulled down to return the ratchet 487 to starting position as by means of a spring 497.

As previously noted, the feed for the truing is effected by rotation of the sleeve 440 relative to the threaded portion 445 of the non-rotatable shaft 446, and this is effected by rotation of the shaft 442. The rear end of this shaft is connected through the train of gears 500, 501, and 502 with a shaft 503. The forward end of this shaft 503 has secured thereto a ratchet wheel 504 and a hub portion 505 outwardly of which the shaft may be squared as at 506 for the reception of a handle for manual turning. Back of the ratchet wheel 504 there is rockably mounted on a sleeve 507 within which the shaft 503 is journaled a collar 508 having the ratchet dog arm 509, an actuating arm 510, and a latch arm 511 extending therefrom. The arm 509 carries the pawl 512 engaging the teeth of the ratchet wheel 504 and the arm 510 carries the upper end of a link 514 similar to the link 490 and the lower end of which rests upon an arm 515 on a rocker 516 also journaled on the shaft 493. A spring 517 tends to hold the pawl carrying arm 509 in retracted position and, as in the case of the link 490, the arm 515 may be lifted without rocking the ratchet arm if this ratchet arm is prevented from such motion. It may be prevented from such motion by a latch arm 520 having a notch 521 engaging over a pin 522 carried by the arm 511. The opposite end of the arm 520 is provided with a dog 523 which may be struck by one or more suitable dogs 524 adjustably secured in any angular position desired in an annular face groove 525 in the gear 451. Thus after a predetermined extent of rotation of this gear 451 in feeding direction, the latch 520 will be lifted by one of these dogs 524 so that any action while the latch is lifted tending to lift the link 514 will be effective to step around the ratchet wheel 504 so that feed of the truing mechanism as well as the wheel is produced, so that the finished size of the work is predetermined regardless of the amount of truing. Whenever a dog 524 is in position to hold the latch lifted, truing is effected when the arm 515 is next lifted. The extent of truing at each ratchet movement may be regulated by the angular adjustment of a shield 530 and likewise the extent of wheel feed without truing may be determined at each actuation by angular adjustment of a similar shield 531 for the feed ratchet wheel 482 in the well understood manner.

Rocking of the rocker member 516 is produced from cams (not shown) on the cam drum 424 which actuate a lever 540 connected by a link 541 with a rocker arm 542. This rocker arm 542 is provided with a segment 543 provided with a slot 544 across its face in which may be secured as desired a lug 545 in position to engage against the lower face of the rocker 516, so that as the segment 543 is rocked in one direction from a central position, the lug 545 is lifted to rock the member 516. As shown this segment may have a pair of dogs 545 both of which may be used for external grinding but only one is employed when the machine is conditioned for internal grinding as shown herein since truing can take place at only one end of the traverse, when the wheel and its shaft are out of the work. The segment is normally held in its central position with the rocker 516 lowered, as by means of a slide 546 mounted on a rod 547 and having a tail portion 548 guided along a rod 549 on which are positioned centering springs 550 engaging opposite sides of the tail 548.

The wheel feed ratchet mechanism is actuated by the rocking of an arm 555 carrying a plate 556 having a slot 557 for the adjustable securement of a lug 558 for engagement with the rocker 492. A spring 559 tends to hold the lug 558 in downward position so that the arm 491 is down with the feed ratchet dog in retracted position. The arm 555 is carried by a shaft 560 provided with an arm 561 connected through link 562 with a rock arm 563 provided with a follower controlled by suitable cams (not shown) on the cam drum 424.

Automatic electrical controls and operative cycles

Referring particularly to Figure 11, there is shown a wiring diagram of various electrical controls of this machine. In this figure the cam drum 150 is shown developed and the various parts are shown in condition for the start of the machine, but with all the driving mechanisms stopped. The first action is to depress the normally open start switch button 166. This establishes an electric circuit from line 160 through lead 170, the start button switch 166, the normally closed stop switch 172, lead 174, solenoid 176 of the wheel motor switch 153, leads 178 and 179 to line 162. This closes the switch 153 which starts the wheel motor, and at the same time closes a switch arm 182, which completes a holding circuit from line 160, through leads 168 and 184, the switch arm 182, lead 186, closed stop switch 172, lead 174, coil 176, leads 178 and 179 to the line 162, so that on opening of the starter button the wheel motor continues to rotate, but it can be stopped at any time by pressing the stop switch button 172.

At the start of the sizing cycle the work is in position in the work holder and the work holder is retracted in its left hand position as viewed in Figure 1, so that the wheel is out of the work and the wheel itself is in retracted position where it may have been trued in the previous cycle.

Also the feed wheel 451 has been turned backwardly to its starting angular position from which it will rotate in counterclockwise direction until the end of the grinding cycle, the start cycle switch 188 is open and the stop switch 375 is open. To start the cycle, the start switch push button 188 is depressed, this closing the stop switch 375. This closes a circuit from the main line 160 through leads 168 and 190, start push button 188 through lead 192, a switch 2LS having a contact arm 194 closed to lead 196, closing coil 198 of a switch 13CR and leads 200 and 201 to the main line 162. As the solenoid 198 of switch 13CR is energized, it closes the contacts of a normally open two-pole switch, the arm 202 of which then closes a circuit from the main line 160 through lead 168, stop switch 375, leads 169 and 204, switch arm 202, lead 206, solenoid 208 of a normally open two-pole switch 4CR, leads 210 and 201, to the main line 162. As the solenoid 208 is energized, it closes the normally open contacts of the double pole switch 4CR, closing a circuit from the line 160 through lead 168, the closed stop switch 375, leads 169 and 214, switch arm 212, lead 216, coil 218 of the work motor closing switch 155, leads 220 and 201 to the line 162. This closes the switch 155 and starts the work motor 154 rotating.

The closing of the switch 13CR also closes the switch arm 266, which establishes a circuit from the main line 160 through leads 168, closed stop switch 375, leads 169 and 204, switch arm 266, lead 270, closed switch arm 272, lead 274, left hand solenoid 92, leads 276, 277, 201 to the main line 162. The energization of the left hand solenoid 92 opens to discharge fluid pressure from the space to the left of the piston 73, thus moving the grinding wheel to its grinding position, breaking contact at 254 and making contact at 278 in the switch 22LS. The closing of the start button 188 also closes the connection from line 160 through leads 168 and 190, push button 188, leads 171, through the arm 224 of limit switch 3LS to lead 226 through magnet coil 228 of the switch 3CR, and in case the armature 230 of this switch is in engagement with the armature of the electromagnet 302 through the armature 230, leads 179 and 201 to the line 162. This insures the positioning of the switch 3CR as shown in Figure 1 where it would not have been should the stop switch 375 have been opened prior to the hand setting of the limit switch 3LS.

It will be noted that in the position of the cam drum 150, shown in Figure 11, with the switch arm 242 of the switch 11LS in normal position, a circuit is completed from the line 160 through leads 168, 238, 240, switch arm 242 of switch 11LS, lead 244, through the coil 246 of the three-pole switch 11CR, leads 248, 250 and 201 to line 162, so that the switch 11CR is closed. The energization of the coil 246 of the switch 11CR closes the switch arms 295 and 252, this completing the circuit from line 160 through lead 238 to closed contacts 278 of switch 22LS (the grinding wheel now being in grinding position), through the lead 280 to closed switch arm 236 of switch 3CR, lead 301, lead 284, closed switch arm 252 of switch 11CR, lead 286, switch arm 288 of switch 6CR, lead 290, coil 292 of the cam operating motor switch 152, lead 294, closed switch arm 295 of switch 11CR, leads 248, 250 and 201 back to line 162. Thus the cam control motor starts as soon as the grinding wheel reaches grinding position. As the cams 150 and 424 rotate, their motion continues until the left hand cam element *d* on the cam drum 150 actuates the switch 11LS moving the switch arm 242 to break connection between the lead 240 and the lead 244, whereupon the cam drum stops. The cam drum is now at one of its two stopping positions 180° apart. During this rotation, the mechanical connections from the cam drum 424 actuate the wheel feed through the lever 540, as previously described, and the work slide is started to move to the right by the throwing of the clutch 405 in proper direction, and rotation of the work-holder in the proper direction is also started by the same action. The parts are thus conditioned for grinding in one direction and the traverse continues while the cam drums 150 and 154 are stationary.

The slide continues throughout its traverse until the left hand stop dog 283 engages the switch arm 281 of switch 1LS and closes connection between the leads 289 and 296. This connection being made by the switch arm 281 and the switch arm 242 of switch 11LS of the cam drum riding on the cam element closing the connection between the switch arm 242 and the lead 296, a circuit is established from the line 160 through leads 168, 238, 240, switch arm 242 of switch 11LS, lead 296, contacts 285, through the switch arm 281, lead 289 through the coil 291 of the switch 1CR through the armature of this switch, leads 250 and 201 to the line 162. This energizes the coil 291 and swings the armature 293 of the switch 1CR to the left, closing contact between this armature and the lead 295, thus reestablishing the circuit through the cam motor control switch solenoid 292 from line 160, through leads 168 and 238, switch 22LS at the wheel carrying arm, contacts 278, leads 280 and 280, switch arm 236 of switch 3CR, leads 301 and 284, closed switch arm 252, lead 286, through closed switch arm 288 of switch 6CR, lead 290, solenoid 292 of the cam motor controlled switch, leads 294 and 295, armature 293 of switch 1CR, leads 250 and 201, to line 162.

The cam drums then rotate through 180° and are stopped when the right hand cam element *d* actuates the switch 11LS. During this 180° rotation of the cam drum 424, first the wheel may be fed mechanically if a feed at both ends of the traverse is desired, or it may be fed only at the outer end, there being no feed at this time. Thereafter the clutch 405 is actuated by cams on the same drum 424 to reverse the direction of rotation and traverse of the work, after which the drums reach their other 180° revolution points and the switch 11LS is actuated to disconnect the connection between the leads 240 and 244, whereupon the cam control motor again stops.

The reverse traverse then continues until the opposite end of the traverse is approached, whereupon the switch 1LS is again placed in the position shown in Figure 11 by the other stop dog 279. The cam drum now starts again for another 180° revolution which stops the traverse, effects a feed of the work, and starts the traverse in the first direction, just after which the cam drum stops through actuation of switch 11LS to break contact with lead 296. This cycle of operations continues until such time as it is desired to dress the wheel.

When automatic dressing of the wheel is desired, it is first necessary to close the hand operated switch 320 which establishes a circuit from line 160 through lead 168, switch 320, lead 322, coil 324 of switch 16CR, leads 326 and 201 back to line 162. Energization of the coil 324 closes

both switch arms 328 and 360 which conditions the circuits for the automatic truing control, as will now appear. Dressing occurs only when the work is at its inner traverse limit, when the wheel and its shaft are out of work, and when one of the cam blocks 52 on the feed wheel 451 has lifted the latch bar 520, at which time during the rotation of the cam drum 424, a lifting impulse has been exerted on the arm 515. This lifting impulse is then effective to step around the truing feed ratchet wheel 504. The lifting of the latch bar 520 actuates the switch 2LS to move it from the position shown in Figure 11, where it connects the leads 192 and 196 together, to the position where it connects the leads 192 and 330 together. While the switch 2LS is in this position and the drum 150 is still rotating, the switch 4LS is moved by its actuating cam *a* into the position shown in Figure 11, breaking contact between the leads 280 and 284 and making contact between the leads 280 and 304.

These actuations of the switches 2LS and 4LS closes a circuit from line 160 through leads 168 and 190, button 188, line 192, switch 2LS, lead 330, coil 334 of switch 6CR, leads 336, 326 and 201 to line 162. Energization of the coil 334 of switch 6CR actuates the switch arm 288 to open the circuit through the solenoid 292, allowing the cam switch 152 to open, thus stopping the operation of this cam. Energization of the coil 334 also closes the switch arm 338, energizing the truing motor switch closing coil 342. The circuit for this is from the line 160, through lead 184, switch arm 182, leads 186 and 331, the closed switch arm 328, lead 329, switch arm 338, lead 340, solenoid 342, lead 201 to the line 162. This starts the truing motor, since energization of the coil 342 closes the switch arm 159 in the direct current truing motor circuit between the direct current lines 157 and 158 and the switch 5LS is closed, a cam depression of cam 346 riding out from beneath it. Next the wheel is moved to truing position by energization of the right hand fluid valve solenoid 92. This is done by the closing of the switch arm 356 of switch 6CR which closes a circuit from line 160 through lead 238, closed switch 278 (the wheel then being in grinding position), leads 280 and 353, closed switch arm 356 of switch 6CR, leads 357 and 306, closed switch arm 264, lead 308, solenoid 310 of switch 14CR, lead 201 to line 262. Energization of the solenoid 310 of switch 14CR closes switch arm 312 and energizes the right hand solenoid 92 from the line 160 through leads 168, stop switch 375, leads 169 and 314, closed switch arm 312, lead 316, right hand solenoid 92, leads 318, 277 and 201 to line 162. The motion of the truing motor continues until it rotates its cam drum 346 sufficiently to close the switch 6LS by its cam element *b* which completes a circuit from the line 160, lead 184, switch arm 182 of the wheel motor holding circuit, leads 186 and 331 and closed switch arm 360 of 16CR, lead 361, switch 6LS, lead 362, solenoid 198 of switch 13CR, leads 200 and 201 to the line 162. Energization of the solenoid 198 of switch 13CR re-starts the cam drum 150 to complete its 180° and returns the wheel arm 22 to its grinding position for the next inward traversing cycle as previously explained. Continued rotation of the truing motor drum after closing the switch 6LS allows this switch to open after which the switch 5LS opens, the depression in its cam drum riding beneath it, breaking the holding circuit for the solenoid 342, allowing the switch 159 to open, thus stopping the truing motor 156. The closing of the switch 6LS acts to start the cam motor 151 to complete the 180° rotation thereof before the traverse is resumed as it closes the circuit from the line 160 through lead 184, the closed switch arm 182, lead 186, lead 331, closed switch arm 360, lead 361, switch arm 6LS, leads 362 and 196 through coil 198 of switch 13CR, leads 200 and 201 back to the line 262. This closes switch 13CR and thereby energizes the left hand solenoid 92 so as to return the grinding wheel to grinding position, since switch 13CR then closes a connection from the line 160, through lead 168, stop cycle switch 375, leads 169, 204, switch arm 268, lead 270, switch arm 272, lead 274, left hand valve solenoid 92, leads 276, 277 and 201 to the main line 162. As before noted, switch 6LS opens again before the truing cam 346 stops. The swinging forward of the wheel arm 22 to grinding position closes the contacts at 278, which, as previously described, closes the cam motor controlling switch, so that the cam drums 150 and 424 continue their rotation until they complete their 180° travel, whereupon they are stopped by the action of switch 11LS actuated by the cam drum as previously described.

The machine then resumes its grinding traverse as previously described, and if at the end of the next outward traverse, the latch 520 is raised, another truing action takes place as previously described, but if it is not raised, the action proceeds without truing. The cycle of the machine is then repeated until the feed wheel 451 has been turned to an extent sufficient for the limit switch 3LS to be engaged by the lug 377 secured to the feed wheel 451. This stops the rotation of this feed wheel so that further feeding impulses imparted to the link 493 are ineffective. Impact of this lug 377 on the limit switch 3LS moves this switch from the position shown in Figure 11 to break connection between the leads 171 and 226 and to make connection between the lead 171 and the lead 300. The breaking of the connection with the lead 226 acts to disconnect the solenoid 228 of the switch 3CR and the making of contact with the lead 300 acts to energize the opposite solenoid 302 of this same switch 3CR, the circuit then being from the line 160 leads 168 and 190 starting switch 188, lead 171, arm 224 of switch 3LS, lead 300, solenoid 302 of the switch 3CR through the armature 230, leads 179 and 201 to the line 162. This throws the armature 230 to its reverse position, breaking the connection between the armature and the coil 302 and opening the arm 236 of switch 3CR to break connection with the lead 301 and to make connection between the switch arm 234 and the lead 306. The breaking of the circuit at the arm 236 is, however, ineffective to break the circuit through the cam motor drive switch 292 at this time for the reason that bypass connection is made through the switch 282 of switch 4LS which is then making contact between the lead 280 and the lead 284. The lead at 280 connects to the switch arm 236 and the lead 284 connects through the lead 301 to the opposite side of this switch arm. When the switch 4LS is thereafter actuated by its cam dog *a* to break the connection at 284, the connection through the cam motor actuating coil 292 is interrupted and this cam motor stops. The switch arm 282 being then closed to the lead 304, it closes a circuit from the line 160, through leads 168 and 238, the contacts 278 at the wheel arm

(which is now in grinding position), through the lead 280, through the switch arm 282 of switch 4LS, through lead 304, closed switch arm 234 of switch 3CR, through lead 306, through switch arm 264 of switch 10CR, which is now closed, lead 308, coil 310 of switch 14CR, lead 201 to line 162. The energization of the coil 310 closes the switch arm 312 of switch 14CR which closes a circuit from line 160, through lead 168, stop switch 375, leads 169 and 314, switch arm 312 of switch 14CR, lead 316, right hand valve coil 92, lead 318 and 277 to lead 201 and the line 162. By this action the fluid pressure is exhausted from the right hand end of the cylinder 70, whereupon pressure on the other side returns the wheel to truing position, breaking the circuit at 278 and making the circuit at 264.

The sizing cycle is now complete, the work being stationary in retracted position and the grinding wheel retracted in truing position but with the truing motor stopped. The wheel motor and the work motor are still rotating, but the work motor is disconnected from the work. The work motor may be stopped by depressing the stop button 375 which also opens the start button 188, or both the wheel motor and work motors may be stopped by pressing the stop button switch 172. The depression of the stop button 172 stops the work motor since it allows switch 4CR to open the switch arm 212 in the circuit of the work motor closing coil 218.

For the start of a new cycle with the cycle start button 188 closed, the clutch being in neutral, the feed wheel is turned backwardly manually to starting position and the limit switch 3LS is then returned manually to the condition shown in Figure 11. This return of the switch 3LS breaks the connection between leads 222 and 300 and makes a connection between the lead 222 and 220, thus reestablishing a circuit through the left hand coil 228 of the switch 3CR and swinging the armature 230 back to the position shown in this figure, whereupon the new sizing cycle starts. If the stop button 375 has been depressed, closing of the cycle start button is also necessary.

The cam lug *a* which actuates the switch 4LS may be adjusted to either of two positions, in one of which, shown in dotted lines in Figure 11, it is in advance of the truing feed as determined by the cams on the cam drum 424. When it is so positioned, the cam drums are stopped at the end of the sizing cycle before there is any opportunity for truing to be effected, so that the machine stops with a final cut without truing. If, on the other hand, the cam lug *a* is set to actuate the switch 4LS after the time of truing, as in the full line position, truing may be effected if one of the release lugs 524 is in proper position, the truing then taking place after the last cut, after which the cam drums are started again by the action of the truing mechanism until the switch 4LS is actuated by its cam *a*, whereupon the cam drums are again stopped at the end of the sizing cycle. If a dog 524 is positioned at a point where it will release the latch lever 520 intermediate the sizing cycle, truing will be effected at this intermediate point.

From the foregoing description of certain embodiments of this invention, it should be evident to those skilled in the art that various changes and modifications might be made without departing from the spirit or scope of this invention.

I claim:

1. A machine of the class described, comprising a traversing work carriage, a wheel carriage mounted for motion transverse to the direction of motion of said work carriage, a wheel support mounted for motion on said wheel carriage in the general direction of motion of said wheel carriage between limits at one of which limits a wheel carried by said support is in operative position and at the other of such limits said wheel is in truing position, truing mechanism for truing said wheel when said wheel is in truing position, power means for moving said wheel support from one to the other of said positions, means for traversing said work carriage, means for moving said wheel carriage to feed and retract said wheel relative to the work, and means responsive to failure of power for said power means for retaining said wheel support in that position whether operative or truing where it happens to be when such power failure occurs.

2. A machine of the class described, comprising a traversing work carriage, a wheel carriage mounted for motion transverse to the direction of motion of said work carriage, a wheel support pivotally mounted on said wheel carriage and movable in the general direction of motion of said wheel carriage between limits at one of which a wheel carried by said support is in operative position and at the other of which said wheel is in truing position, truing mechanism for truing said wheel when said wheel is in said truing position, means for fixing said wheel support in angularly adjusted position about its pivot, power means for moving said wheel support from one to the other of said positions, means for traversing said work carriage, means for moving said wheel carriage to feed and retract said wheel relative to the work, and means responsive to failure of power for said power means for retaining said wheel support in that position whether operative or truing where it happens to be when such power failure occurs.

3. A machine of the class described, comprisprising a traversing work carriage, a wheel carriage mounted for motion transverse to the direction of motion of said work carriage, a wheel support mounted for motion on said wheel carriage in the general direction of motion of said wheel carriage between limits at one of which limits a wheel carried by said support is in operative position and at the other of such limits said wheel is in truing position, truing mechanism for truing said wheel when said wheel is in truing position, fluid pressure means for moving said wheel support from one to the other of said positions, means for traversing said work carriage, means for moving said wheel carriage to feed and retract said wheel relative to the work, and means responsive to loss of pressure in said fluid pressure means to retain said wheel support in the position it may be in when such loss occurs.

4. A machine of the class described including a carrier, a grinding wheel movably supported on said carrier for motion between an operative and an inoperative position, fluid pressure means for moving said wheel from one to the other of said positions, and means responsive to the loss of fluid pressure acting to retain said wheel in that one of its positions in which it happens to be when such loss of pressure occurs.

5. A machine of the class described including a carrier, a grinding wheel movably supported on said carrier for motion between an operative and an inoperative position, fluid pressure means for moving said wheel from one to the other of said positions, a latch having a bolt biased to

project into holding relation to said wheel in either of its positions, and fluid pressure means for retracting and so retaining said bolt.

6. A grinding machine including a grinding wheel support, a grinding wheel movable on said support between a pair of predetermined positions, in one of which positions it may grind work and in the other of which positions it may be trued, truing mechanism movable with said support, means for moving said support to feed the wheel relative to work, means for advancing said truing mechanism relative to said wheel in its truing position relative to said support, and means acting after a predetermined extent of feed of said support to produce an equal truing movement of said truing mechanism and wheel feed to cause said wheel to be trued by an amount equal to its feed to cause said wheel while in grinding position to grind the work to a predetermined size regardless of wheel wear and truing.

7. A machine of the class described, comprising a work carriage, a grinding wheel, means for rotating said wheel, means for producing relative traverse between said carriage and wheel, means for moving said wheel laterally of the line of traverse between a grinding position and a truing position, wheel truing mechanism for truing the wheel at said truing position, another means for retracting said wheel from grinding position to idle return traverse position after said wheel has traversed the work in grinding position, and means acting when said wheel is retracted from the work in its traverse for actuating said lateral wheel-moving means to position said wheel for truing and said lateral wheel moving means and said other means to return it to grinding position preparatory to another grinding traverse.

8. A machine of the class described, comprising a work carriage, an internal grinding wheel, means for rotating said wheel, means for producing relative traverse between said carriage and wheel to cause the wheel to enter and be retracted from one end of work on said work carriage, means for moving said wheel laterally of the line of traverse between a grinding position and a truing position, wheel truing mechanism for truing the wheel at said truing position, another means for retracting said wheel from grinding position to idle return traverse position after said wheel has traversed the work in grinding position, means acting when said wheel is retracted from the work in its traverse for effecting an impulse to actuate said lateral wheel moving means to position said wheel for truing and to return it to grinding position preparatory to another grinding traverse, means for feeding the wheel toward the work, and means for preventing actual wheel motion to truing position as the result of such impulse until said wheel has been fed to a predetermined position.

9. A machine of the class described, comprising a work carriage, an internal grinding wheel, means for rotating said wheel, means for producing relative traverse between said carriage and wheel to cause the wheel to enter and be retracted from one end of work on said work carriage, means for moving said wheel laterally of the line of traverse between a grinding position and a truing position, wheel truing mechanism for truing the wheel at said truing position, another means for retracting said wheel from grinding position to idle return traverse position after said wheel has traversed the work in grinding position, means acting when said wheel is retracted from the work in its traverse for effecting an impulse to actuate said lateral wheel moving means to position said wheel for truing and to return it to grinding position preparatory to another grinding traverse, means for feeding the wheel toward the work, means for preventing actual wheel motion to truing position as the result of such impulse until said wheel has been fed to a predetermined position, and means effective when said impulse is allowed to move said wheel to truing position to feed said truing mechanism by the amount of said wheel feed.

10. A machine of the class described, comprising a work carriage, a wheel carriage, means for effecting traverse between said work and wheel carriage, means for moving said wheel carriage transverse to the line of traverse, a wheel support pivotally mounted on said wheel carriage and movable in the general direction of motion of said wheel carriage laterally between limits at one of which a wheel carried by said support is in operative position and at the other of which said wheel is in truing position, truing mechanism for truing said wheel when said wheel is in truing position, means for fixing said wheel support in angularly adjusted position about its pivot, means for moving said wheel support from one to the other of said positions, means for moving said wheel carriage to feed said wheel relative to the work, and means for retracting said wheel carriage to remove the wheel from grinding relation for an idle wheel-retracted traverse.

11. A machine of the class described, comprising a work carriage, a wheel carriage, means for relatively traversing said carriages, means for rotating work on said work carriage, a grinding wheel mounted for motion on said wheel carriage transverse to the line of traverse motion between grinding and truing positions, a truing mechanism carried by said wheel carriage for truing said wheel when said wheel is in truing position, means for moving said wheel carriage transverse to the line of traverse for feeding the wheel to the work and for retracting said wheel from the work, a rotary cam means, means for rotating said cam means, means effective adjacent to a limit of traverse for starting said rotating means to rotate said rotary cam means through a definite angular extent, and means on said rotary cam means for controlling said wheel carriage moving means, said wheel moving means, and said wheel truing means in predetermined sequence.

12. A machine of the class described, comprising a work carriage, a wheel carriage, means for relatively traversing said carriages, means for rotating said work on said work carriage, a wheel mounted for motion on said wheel carriage transverse to the line of traverse between grinding and truing positions, motor means for so moving said wheel, a truing mechanism including an actuating motor carried by said wheel carriage for truing said wheel when said wheel is in truing position, means for moving said wheel carriage transverse to the line of traverse for feeding the wheel to the work and for retracting the wheel from the work, a rotary cam drum mechanism, means for rotating said cam drum mechanism, means effective adjacent to a limit of traverse for starting said drum mechanism rotating means to rotate said mechanism for a definite angular extent, and means actuated by said drum mechanism for controlling said motors in predetermined sequence.

13. A machine of the class described, comprising a traversing work carriage, a rotary work holder on said carriage, means for simultaneously rotating and traversing said carriage including a direction reversing mechanism, a wheel carriage mounted for motion toward and from work carried by said work holder, a wheel mounted on said wheel carriage for motion between grinding and truing positions, wheel truing mechanism carried by said wheel carriage in position to true said wheel when said wheel is in truing position, a rotary cam means, means for rotating said cam means to a definite angular extent adjacent to one limit of said traverse, and means controlled by said cam means for retracting said wheel carriage for moving said wheel to truing and then to grinding positions relative to said wheel carriage and to actuate said truing mechanism to true the wheel when said wheel is in truing position.

14. A machine of the class described, comprising a rotary work holder, means for rotating said holder, a grinding wheel, means for driving said grinding wheel, means for effecting traverse between work on said holder and said wheel, a grinding wheel carriage movable transverse to the line of traverse, means for moving said wheel laterally of said traverse and with respect to said carriage between a grinding position and a truing position, wheel truing mechanism for truing the wheel while said wheel is in truing position, and means acting at the end of a traverse to actuate said moving means to move said wheel relative to said carriage to truing position, to actuate said mechanism to true the wheel, and to actuate said moving means to return the wheel to grinding position and to move said carriage toward work on said work holder.

15. A machine of the class described, comprising a rotary work holder, means for rotating said holder, a grinding wheel, means for driving said grinding wheel, means for effecting traverse between work on said holder and said wheel, a grinding wheel carriage movable transverse to the line of traverse, means for moving said wheel laterally of said traverse and with respect to said carriage between a grinding position and a truing position, wheel truing mechanism for truing the wheel while said wheel is in truing position, means for moving said carriage to effect wheel feed and retraction at the ends of traverses, and means acting after a predetermined number of grinding traverses and at the termination of a traverse to actuate said moving means to move the wheel relative to said carriage to truing position and then to stop the grinding cycle of the machine.

16. A machine of the class described, comprising a rotary work holder, means for rotating said holder, a grinding wheel, means for driving said grinding wheel, means for effecting traverse between work on said holder and said wheel, means for moving said wheel laterally of said traverse between a grinding position and a truing position, wheel truing mechanism for truing the wheel while said wheel is in truing position, means acting at the end of each traverse for producing truing feed impulse and for then starting the traverse in the reverse direction, means for preventing such impulses from being effective, means acting after a predetermined number of grinding traverses for rendering inoperative said preventing means, and means conditioned by the action of said rendering means to cause said wheel moving means to move the wheel to truing position, to render said truing mechanism effective to true the wheel, to cause said truing mechanism after a truing action to condition said wheel moving means to return said wheel to grinding position, and the return of said wheel to grinding position to cause resumption of traverse.

17. A machine of the class described, comprising a rotary work holder, means for rotating said holder, a grinding wheel, means for driving said grinding wheel, means for effecting traverse between work on said holder and said wheel, means for moving said wheel laterally of said traverse between a grinding position and a truing position, wheel truing mechanism for truing the wheel while said wheel is in truing position, means for feeding said wheel relative to the work, means acting after a predetermined extent of the wheel feed to condition the machine for stopping, a rotary drum, means for rotating said drum for a predetermined angular extent at the end of each traverse, means controlled by the rotation of said drum for controlling said wheel moving and truing means after a predetermined extent of wheel feed to move said wheel to truing position and true the wheel and to stop its own rotation intermediate to said predetermined angular extent, means actuated by said truing mechanism after a predetermined truing action to restart said drum toward completion of its rotation to said predetermined angular extent, and means acting selectively to stop the rotation of said drum either before or after reaching said truing mechanism actuating position, to stop the grinding action of the machine either without or with a final wheel truing but with the wheel in truing position.

18. A machine of the class described, comprising a rotary work holder, means for rotating said holder, a grinding wheel, means for driving said grinding wheel, means for effecting traverse between work on said holder and said wheel, means for moving said wheel laterally of said traverse between a grinding position and a truing position, wheel truing mechanism for truing the wheel while said wheel is in truing position, means for feeding said wheel relative to the work, a limit switch actuated by said feeding means after a predetermined extent of feed, a switch-controlling rotary drum, means for rotating said drum through a predetermined angular extent at the end of each wheel traverse, electric switches actuated by the rotation of said drum timing the actuation of said wheel-moving means and truing device actuating means at predetermined feed positions of said wheel, and a stop switch in parallel with said limit switch selectively operative by the rotation of said drum for stopping the rotation of said drum and the grinding action of the machine either before or after the time of a truing actuation, whereby the grinding action stops after the actuation of said limit switch either without or with a final wheel truing.

19. A machine of the class described, comprising a rotary work holder, means for rotating said holder, a grinding wheel, means for effecting traverse between said wheel and work on said holder, means for moving said wheel laterally of the traverse between grinding and retracted positions, a rotary drum, means acting at the end of each traverse for rotating said drum for a predetermined angular extent, means

for feeding said wheel relative to the work, a limit device actuated by said wheel feed after a predetermined extent of feed, means actuated on the succeeding rotation of said drum after the actuation of said limit device to actuate said wheel moving means to move said wheel to retracted position, and thereafter to stop its own rotation intermediate said predetermined angular extents and to stop further grinding action of the machine.

20. A machine of the class described including a carrier, a grinding wheel movably supported on said carrier for motion between an operative and an inoperative position, fluid pressure means for moving said wheel from one to the other of said positions, a latch having a bolt biased to project into holding relation to said wheel in either of its positions, and fluid pressure means connected to the supply of fluid pressure for said fluid pressure wheel moving means for retracting and so retaining said bolt only during maintenance of the fluid pressure.

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