Dec. 4, 1928. 1,693,723

R. C. MITCHELL

GRINDING MACHINE

Original Filed Aug. 8, 1921 8 Sheets-Sheet 1

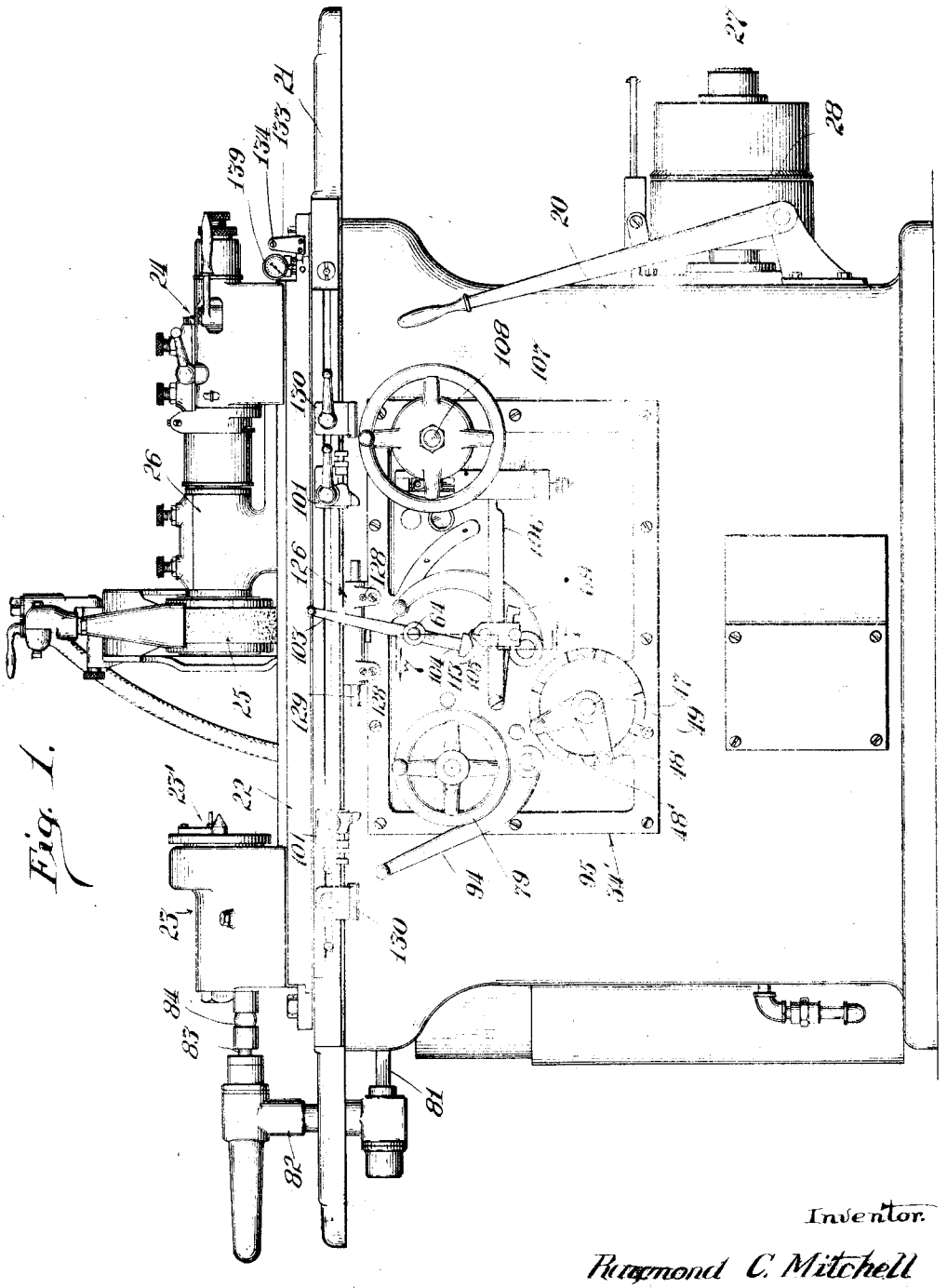


Fig. 1.

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GRINDING MACHINE

Original Filed Aug. 8, 1921 8 Sheets-Sheet 2

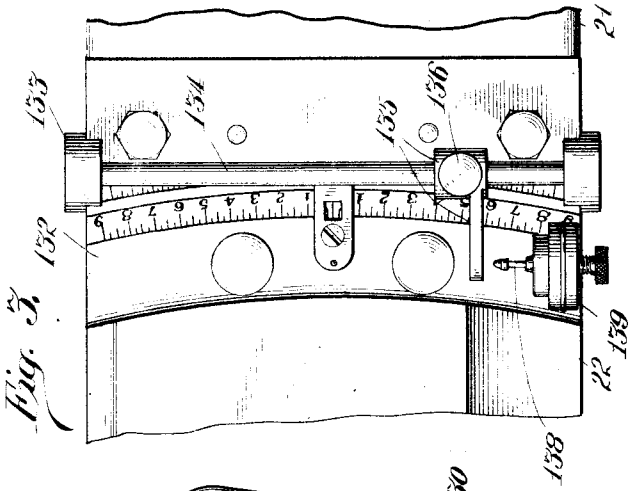


Fig. 3.

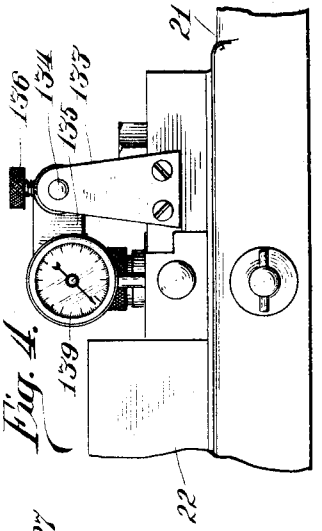


Fig. 4.

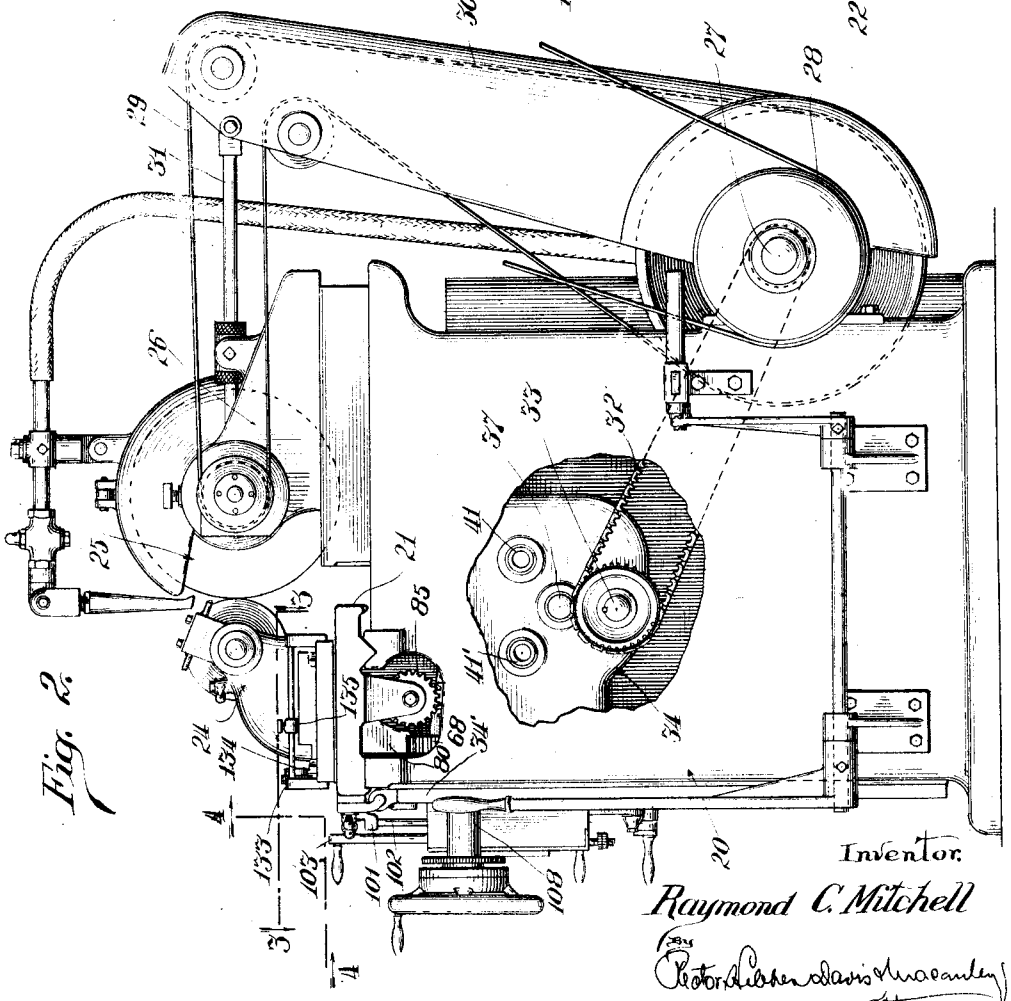


Fig. 2.

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GRINDING MACHINE

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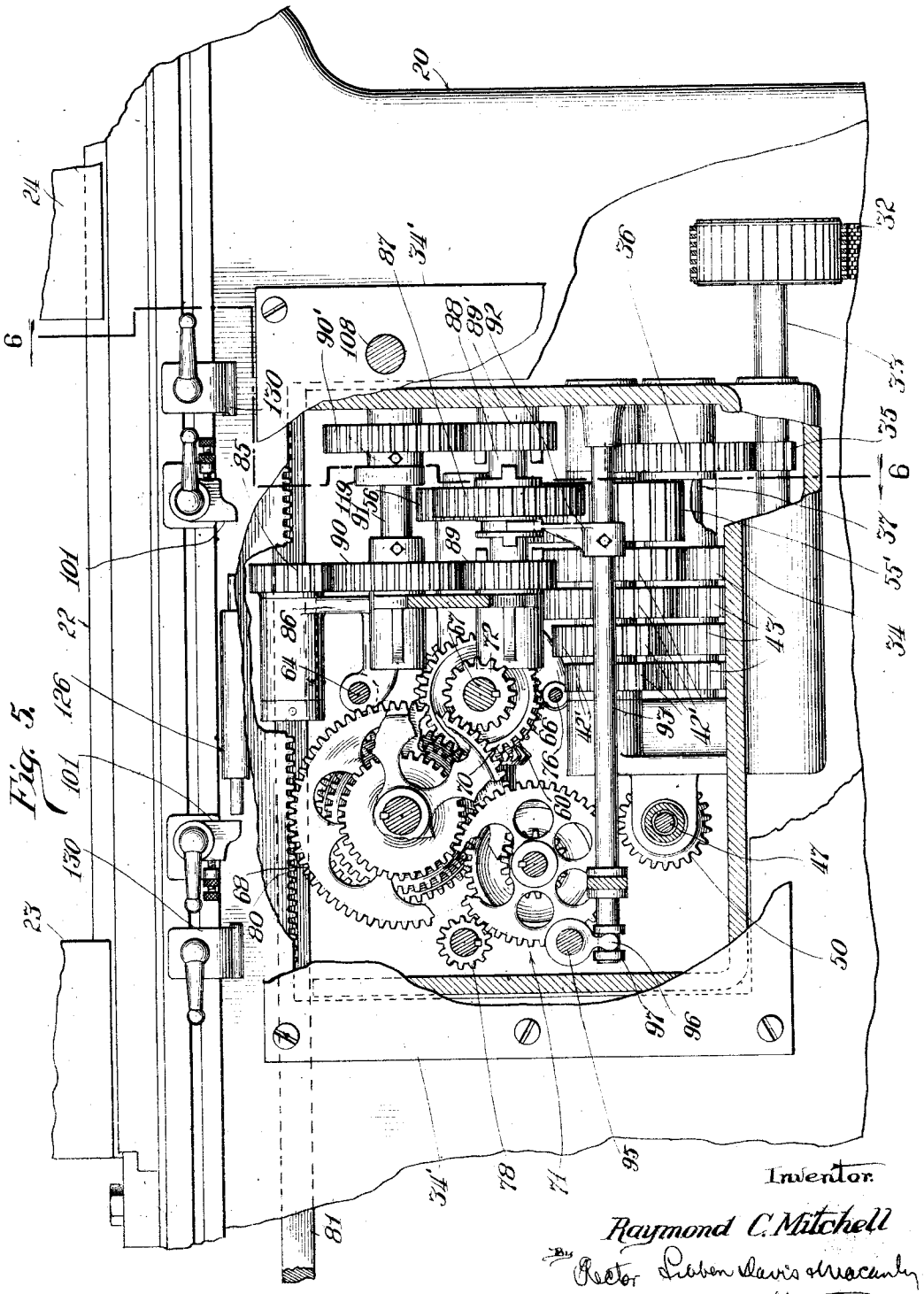


Fig. 5.

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GRINDING MACHINE

Original Filed Aug. 8, 1921 8 Sheets-Sheet 4

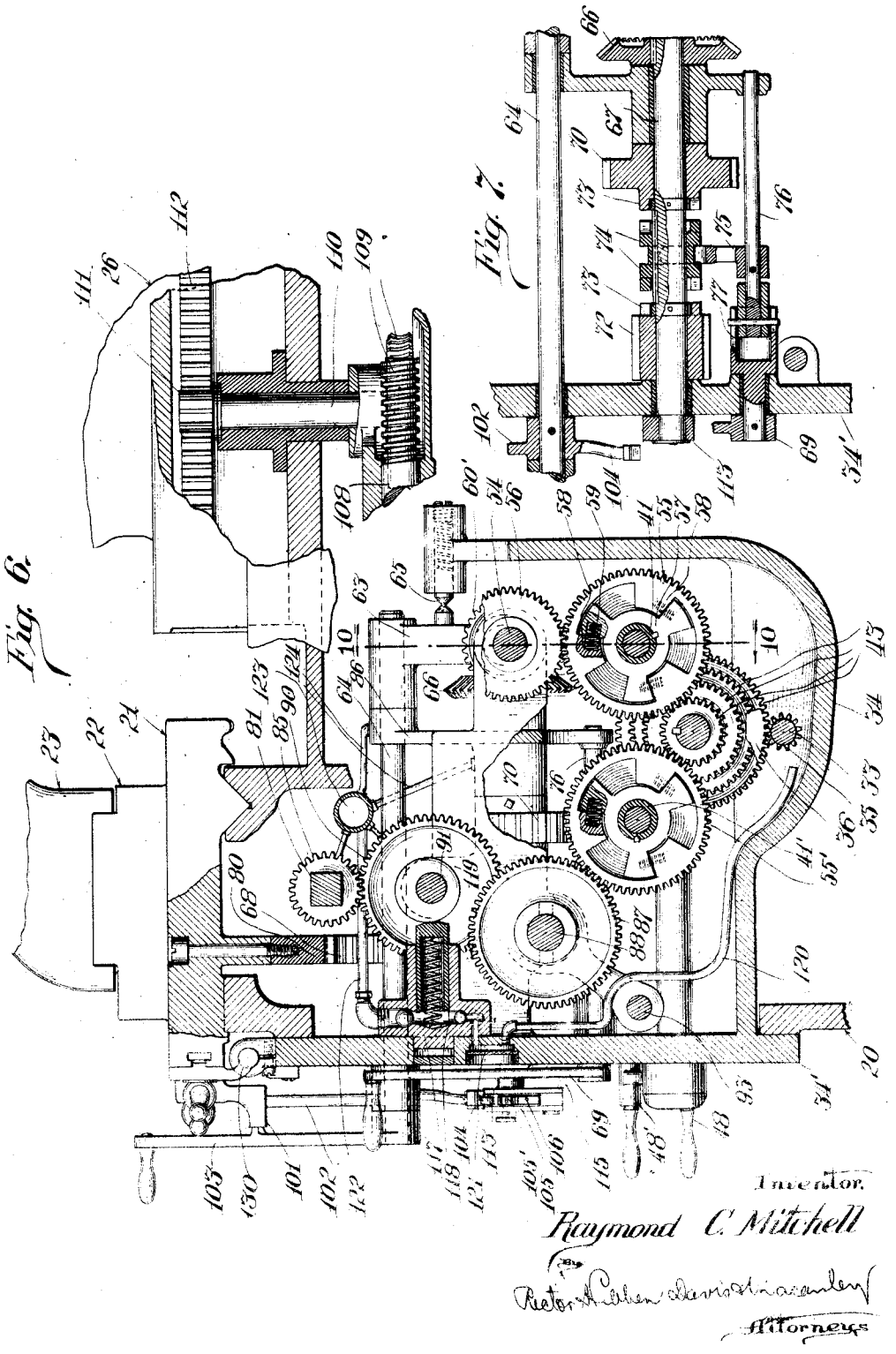


Fig. 6.

Fig. 7.

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GRINDING MACHINE

Original Filed Aug. 8, 1921 8 Sheets-Sheet 5

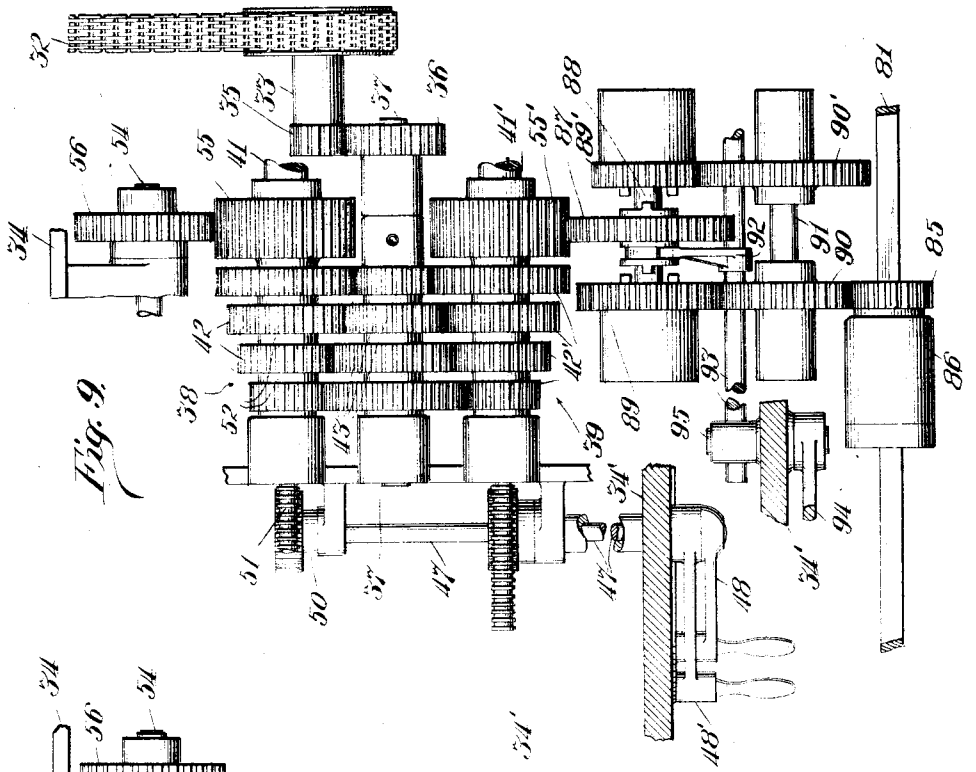


Fig. 9.

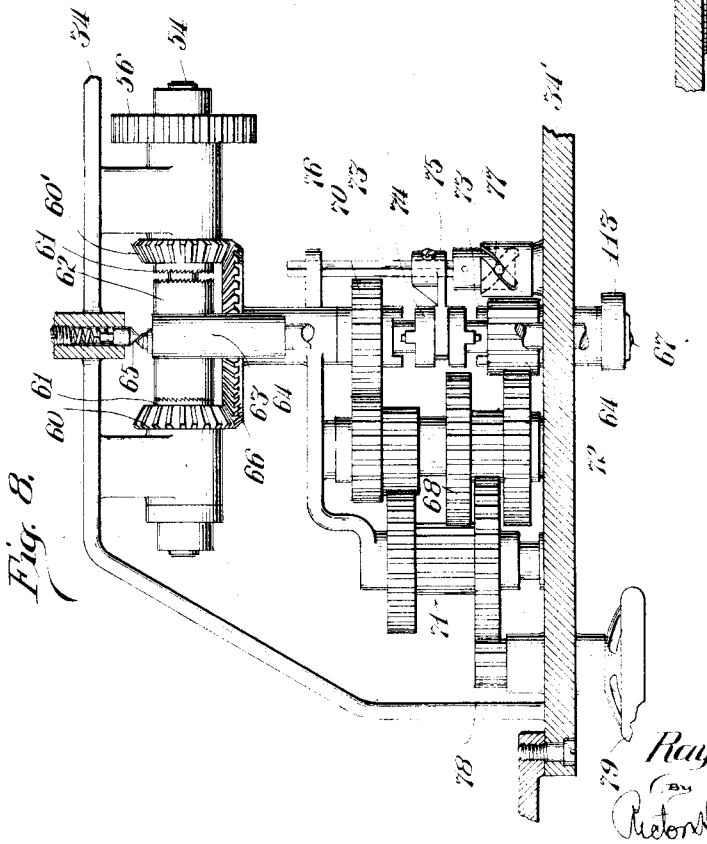


Fig. 8.

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GRINDING MACHINE

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Fig. 10.

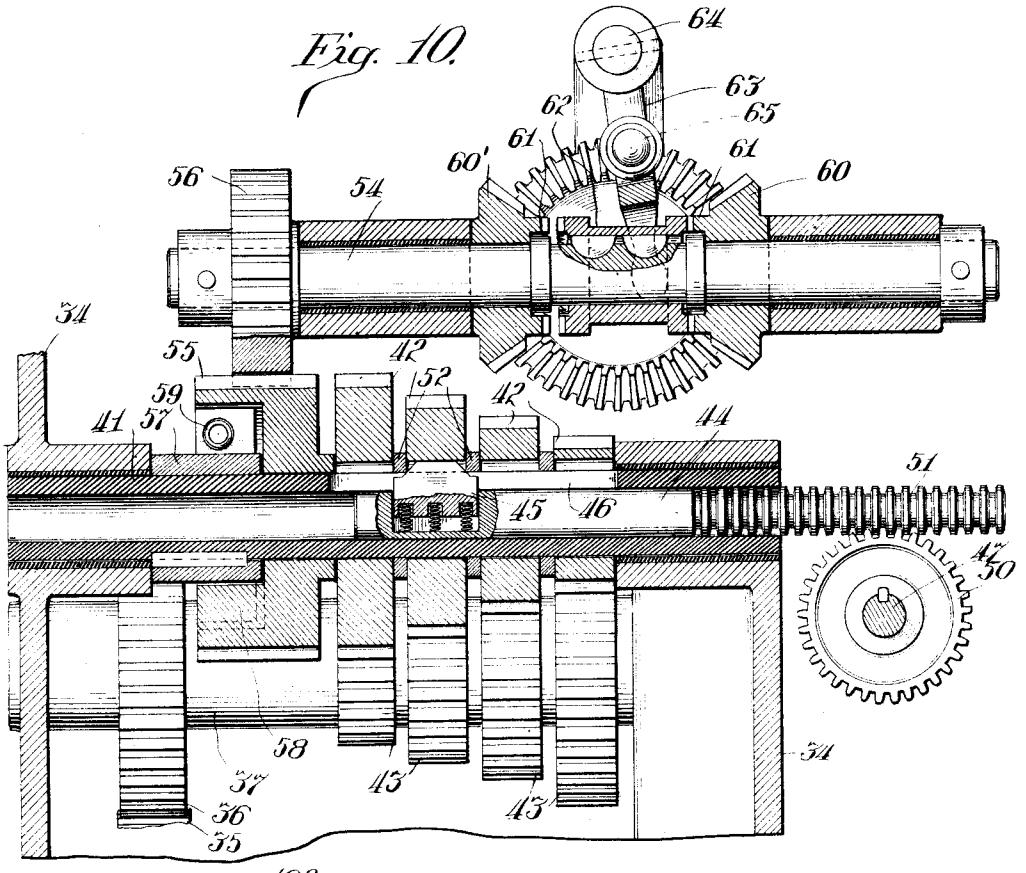
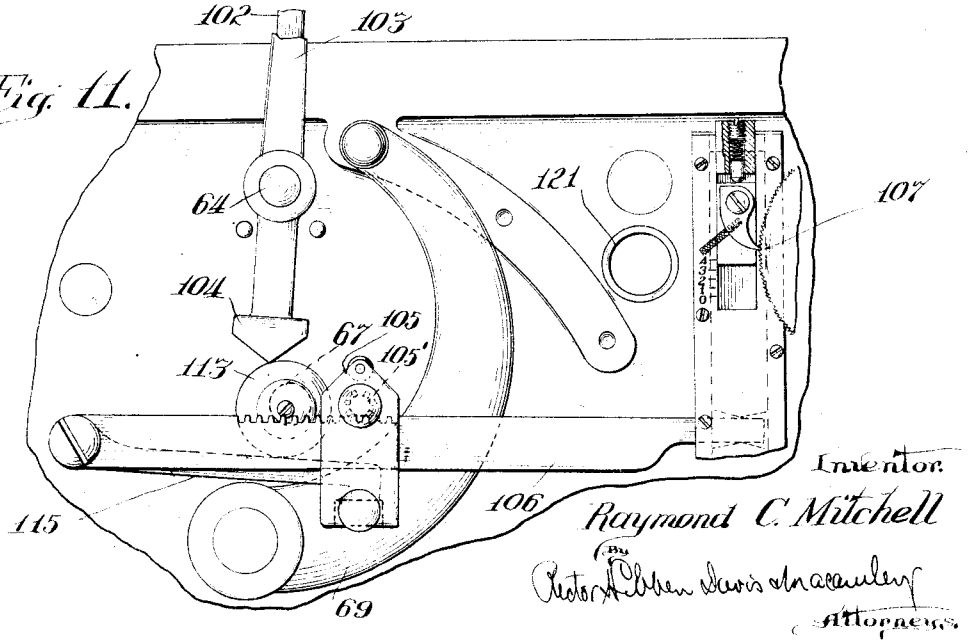


Fig. 11.



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Dec. 4, 1928. 1,693,723

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GRINDING MACHINE

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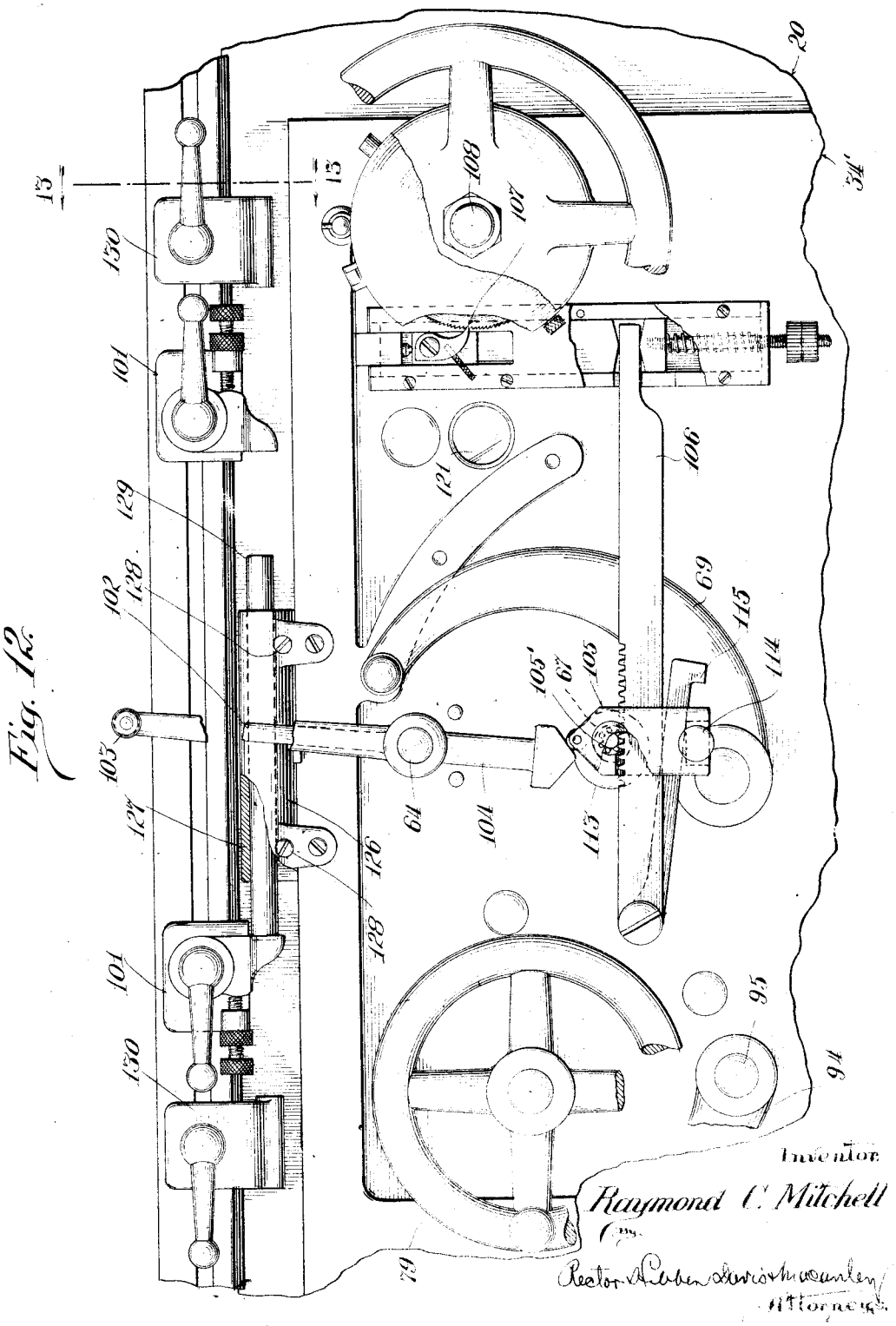


Fig. 12.

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GRINDING MACHINE

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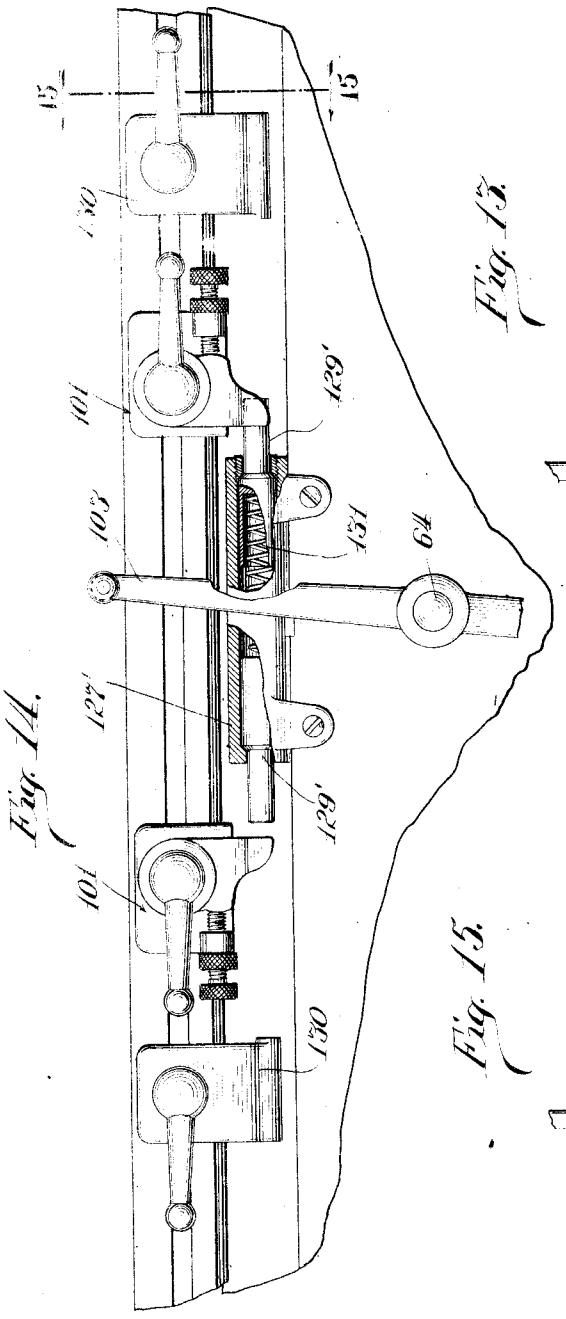


Fig. 14.

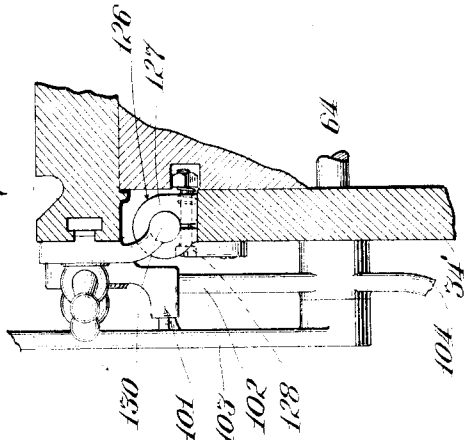


Fig. 13.

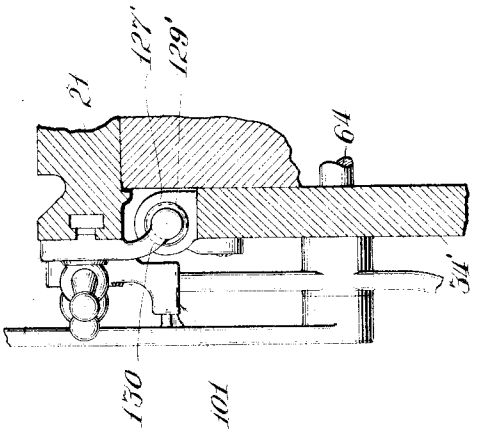


Fig. 15.

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UNITED STATES PATENT OFFICE.

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GRINDING MACHINE.

Application filed August 8, 1921, Serial No. 490,479. Renewed October 1, 1925.

My invention has for its general object to improve grinding machines—and in some of its features more particularly grinders of the sort shown in my prior Patent No. 1,335,905, and my pending application Serial No. 403,999, filed August 16, 1920—in matters affecting flexibility of operation; concerning ranges of speed of the work-rotating and table-traversing operations and cross-feeding without table reciprocation; accuracy of setting for taper grinding; smoothness of operation and avoidance of shock and jars; efficiency and convenience of manual control; and economy and general improvement in mechanical construction making for minimum expense in manufacture.

Other and further objects of my invention will become apparent from the following description, taken in conjunction with the accompanying drawings, wherein I have shown a preferred form of grinder embodying my invention.

In the drawings, which in some respects are diagrammatic, departing from shop-drawing proportions where exaggeration seemed to clarify the construction, Fig. 1 is a front elevation of a grinder embodying my invention; Fig. 2 is a side elevation thereof; Fig. 3 is a plan detail viewed from line 3—3 of Fig. 2; Fig. 4 is a detail in elevation viewed from line 4—4 of Fig. 2; Fig. 5 is a front elevation with parts broken away to show gearing and gear housing; Fig. 6 is a section on line 6—6 of Fig. 5; Fig. 7 is a detailed section on line 7—7 of Fig. 1; Fig. 8 is a plan detail of a portion of the table-driving gearing, Fig. 9 is a schematically extended view in plan of portions of the table-driving and work-rotating gearings; Fig. 10 is a detailed section on line 10—10 of Fig. 6; Fig. 11 is a detail of the hit-or-miss control devices on the front plate; Fig. 12 is an enlarged detail, with parts broken away, of some of the control devices, viewed from the front of the machine; Fig. 13 is a section on line 13—13 of Fig. 12; Fig. 14 is a front elevation with parts broken away of a modified table-check and Fig. 15 is a section on line 15—15 of Fig. 14.

On the main frame 20 the slide table 21 is mounted for longitudinal reciprocation and upon the table the swing plate 22 is centrally pivoted in known fashion, head-stock 23 and foot-stock 24 being mounted on said swing plate for longitudinal adjustment thereon in known manner. Grinding wheel 25 is mounted in the carrier 26, capable of transverse or cross-feeding motion at right angles to the line of table travel, and constructed and mounted for the usual adjustments.

I preferably provide for rotating the grinding wheel, driving the work and reciprocating the table from the common power shaft 27, which itself may be driven in any suitable fashion as by a pulley rigging 28, such shaft being preferably carried in brackets mounted on the exterior of the frame casting 20. It may drive the grinding wheel spindle by belt 29 running over pulleys on the respective shafts and suitable idlers on the belt-trunk 30 that, to accommodate movements of wheel carrier 26, is pivoted on the power shaft 27 and has adjustable link-connection at 31 to the wheel carrier. The power shaft 27 may be connected by a silent chain drive 32 and suitable sprockets with the jack shaft 33, which acts as a driver from which motion may be imparted to both the table-reciprocating mechanism and the work-driving mechanism. Shaft 33 and as much as is possible of the gearing and shafting associated therewith, and the control devices, are all mounted in a sub-frame 34 that is structurally independent of main frame 20, so that assembly of most of the parts as to which nice fitting is necessary, may be made without providing shaft bearings in the main frame. The sub-frame 34 is preferably integral with the front plate 34′ which covers a large orifice in the front of the main frame and is readily demountable with all its mechanism. Preferably the sub-frame is made as a gear box closed at ends and sides to form a convenient oil well.

As is schematically shown in Figs. 8 and 9, jack shaft 33 has its pinion 35 arranged to drive gear 36 on what I may term the main shaft 37 of the gear-nest from which power may be transmitted through one set of speed-changing gearing 38 to drive the table reciprocating mechanism and also, through another speed-changing transmission 39 to drive

the work-rotating mechanism (which, as in my co-pending application No. 403,999, is wholly gear driven).

Table driving mechanism.

For great flexibility in the speed-range of table travel I preferably provide tandem speed changers, one variable speed transmission giving a relatively large number of selective speeds, say four, and the other giving preferably high speed, neutral, and low speed selections, so that any of eight speeds may be selected. The four-speed transmission shown provides a hollow shaft 41 paralleling the main shaft 37 and has loosely mounted upon it the four gears 42 of different sizes constantly meshing with the inversely varying gears 43 on the main shaft. A rod 44 slides in the hollow shaft, carrying a yielding key 45 as shown in Fig. 10, that is spring-pressed laterally to protrude its blade through a slot 46 in a hollow shaft, so that it may clutch into the suitable hub-slot of any one of the gears 42, accordingly as the rod is shifted longitudinally within the shaft. For speed-changing control shaft 47 runs through the face plate 34′ and carries handle 48 co-acting with index dial 49, such shaft having thereon a gear 50 (Fig. 10) meshing with a cylindrical rack 51 on rod 44. Preferably spacing rings 52 between gears 42 present beveled edges to co-act with the beveled ends of plate 45 to insure passage of clutch plate from engagement with one gear 42 with another with a snap action. Said rings serve to prevent the possibility of two being clutched to shaft 41 at the same time. Thus, from constantly running shaft 37 shaft 41 will be run practically constantly at any one of four selected speeds.

Table reversing gearing is provided in conjunction with the change-speed gearing, preferably interposed between the four speed transmission and the high-and-low speed gearing. Reversing gear shaft 54 (Figs. 8 and 9) parallels shaft 41 and is constantly driven therefrom, but in the effective gear-train I preferably provide a shock-absorbing or yielding connection for taking up strains that otherwise might be caused by changing the gear ratio in the four-speed transmission while the machine is running. 55 is a gear on shaft 41, constantly driven thereby and meshing with gear 56 on shaft 54. Gear 55, however, preferably has yielding connection with shaft 41. Fixed on shaft 41 is a three-armed spider 57, (Figs. 6 and 10), between the arms of which spoke-lugs 58 of gear 55 extend, springs 59 being interposed between the spider arms and spoke lugs, to give the tooth rim of the gear the capability to yield in a direction opposed to the driving rotation of the gear, for shock absorption purposes. In short, the spider drives the rim through the spring.

On reverse-gear shaft 54, that is supported in brackets carried by the rear wall of the sub-frame 34 two beveled gears 60—60′ are loosely mounted (Figs. 8 and 10) with their clutch hubs 61 arranged to co-act with a clutch-sleeve 62 slidable on, but non-rotatable with respect to shaft 54. The clutch-sleeve is shifted by a shifter lever 63 on shaft 64 that extends through front plate 34′ and carries the manual and automatic lever means for effecting reversals of the direction of table traveled. A suitable flop-over device 65 of known construction insures that the clutch-sleeve will always stand in one or the other of its clutching positions.

Gears 60—60′ constantly mesh with gear 66 on a cross-shaft 67 from which a rack-gear 68 may be driven through either the high-speed or low-speed train, or allowed to idle, according to the position of the handle 69 on the front plate 34. As diagrammatically shown in Fig. 8, shaft 67 has loosely mounted thereon gear 70 that is in a reducing train leading to pinion 71 that meshes with rack-gear 68, and also carries a loose pinion 72 that is in an accelerating train leading to the pinion 71, these gear-elements 70 and 72 having confronting clutch members 73 for co-action with a clutch member 74 non-rotatably mounted on shaft 67 and slidable thereon from a neutral central position into positive clutch engagement with either of the gear-elements 70 and 72. A shifter lever 75 controlling clutch 74 is mounted on a slide rod 76 to be cammed axially by a pin and slot arrangement 77, the slotted sleeve of which is carried by control handle 69.

One of the gears of the train driving rack-gear 68 may mesh with pinion 78 directly on the shaft of a hand wheel 79 mounted on the front plate 34′ for enabling the table to be moved by hand power. The rack-gear 68, it will be understood, meshes directly with a rack 80 carried by the table as shown in Fig. 5.

It will now be apparent that according to the selective positioning of control handle 69, table travel will be in the higher range of speed or the lower range of speed, or the table may be caused to remain stationary by throwing said handle into middle, neutral position; and in whichever range of speed the machine may be caused to function table travel may be at any one of four selective speeds within that range accordingly with the selective position of handle 48.

Work rotating mechanism.

In my prior application, Serial No. 403,999, gear mechanism for imparting rotation to the driving element 23′ of the head-stock is fully described, and for present purposes it suffices to point out that said driving part is rotated from a shaft 81 arranged below the table said shaft being rotatably mounted in bearings fixed in said table and said shaft 81

being slidable through pinion 85 upon reciprocation of the table. Connection is effected between shaft 81 and driving element 23′ through a gearing in the swiveled housing 82 to drive a shaft 83 that may slide longitudinally through said housing-contained gearing, and that is equipped with a flexible joint 84 acting, in connection with the swivelling operation of the housing, to accommodate lateral displacement of the swing-table. In any position of the head-stock as to axial adjustment on the swing-plate, and lateral adjustment caused by movement of the swing-plate the drive from shaft 81 is effective. This shaft 81 is of square or other non-circular section and slides through a rotatable pinion 85 which is held against longitudinal movement by its mounting in the bracket 86 (Fig. 5) cast in or otherwise secured to the sub-frame 34. This pinion may also be driven in high or low speed ranges, and with a speed-variation in either range, as diagrammatically shown in Fig. 9. To this end the change-speed transmission 39 has gears 42′ and control mechanism worked from handle 48′ identical in substance with the change-speed transmission described heretofore, the yieldingly mounted gear 55′ thereof having a broad toothed surface making constant engagement with a gear 87 that has clutch-hub members on both sides and that is slidable axially on shaft 88. In central position this gear turns the shaft 88 idly. At opposite ends of its sliding throw its clutch members engage clutch elements of gears 89, 89′, loose on shaft 88 and respectively meshing with small and large gears 90—90′ fixed on shaft 91, one of said gears meshing with the pinion 85, so that said pinion is driven in its high speed range when gear 87 is shifted to the left (Fig. 9) and low speed range when the gear 87 is shifted to the right. Shifter arm 92 engages the sliding gear 87 and the slide rod 93 for said arm is worked from control handle 94 on the front plate, the short shaft 95 (Fig. 5) for said arm having a finger 96 engaging between collars 97 on said rod 93.

It will now be apparent that by handle 94 the gearing for work-rotation may be thrown from neutral, inert condition into low-speed or high-speed ratio, and by operation of handle 48′, any one of four selective speeds within the general range may be employed.

Automatic table—Reciprocation and automatic cross-feeding.

In general the mechanism for automatically reversing the direction of table travel and for automatically effecting a cross-feed of the grinding wheel stand 26 are similar to those shown in my prior Patent No. 1,335,905. Adjustable lugs 101 on the table may strike arm 102 (Fig. 6) of a lever fast on the rock-shaft 64 which controls the table reversing clutch 62. A hand lever 103 provides for manual control in known fashion. An arm 104 of lever 102 (Figs. 11 and 12) co-acts with shiftable frame 105 carried on the cross-feed lever 106 to depress the latter at each swing of arm 104 (when frame 105 is suitably positioned), cross-feed lever 106 operating through suitable ratchet and pawl mechanism 107 (as more fully set forth in my said patent) to rotate, step by step, the cross-feed shaft 108. This shaft (Fig. 6) makes worm and worm wheel connection 109 with the vertical shaft 110 on which the wheel stand 26 centers, and the pinion 111 of such shaft meshes with rack 112 of the sliding head of said wheel stand.

It is very desirable, at times, to operate the cross-feed automatically when the table is not reciprocated, and of course under such circumstances cross-feed lever 106 will not be actuated by arm 104. I provide for the condition stated by arranging to drive the ratchet and pawl mechanism from a constantly rotated part of the gearing, at will, preferably by connections associated with the cross-feed lever 106 and so arranged that actuation of said cross-feed lever from the constantly rotating part or from arm 104 are alternative, and cannot possibly be concurrent. For this purpose I bring the constantly rotating cross-shaft 67 of the reversing gear mechanism through the face-plate of the machine and equip it (Figs. 11 and 12) with an eccentric or cam 113 (although of course any constantly operated part, suitably positioned, might be utilized in lieu of shaft 67). The slide frame 105 I make adjustable along the lever 106 as by rock and pinion connection 105′ to a point that takes it out of the range of motion of lever 104, and this frame I equip with a stud or block 114 that, with the frame at said extreme of movement, may serve to elevate into the path of operation of cam 113, a striker member 115 that takes the form of a bar pivoted co-axially with lever 106. As long as frame 105 is in any position where it can be operated on by arm 104, block 114 is moved to the left of the position shown in Fig. 11 allowing the nose of striker member 115 to drop behind it, so removing the striker member from the field of operation of the cam 113. However, with the parts positioned as shown in Fig. 11, each rotation of shaft 67 will cause a depression of lever 106, and consequently a cross-feeding operation.

To insure proper oiling of the mechanism I provide an oil pump 117 (Fig. 6), mounted in proximity to the oil well of the gear casing, and preferably on the front plate 34′. The spring pressed piston 118 is preferably worked by an eccentric 119 on a constantly running shaft of the gearing, and a piping connection 120 to the valved intake side of the pump chamber shown leads through a glass-fronted gauge chamber 121

and to the lower part of the oil well. The valved outlet has piping connection 122 to a distribution header 123 from which pipes 124 run to the various bearings to be oiled, thus insuring adequate lubrication of all of the devices carried by the sub-frame.

For effective checking of the table against over-throwing, particularly where it is being automatically operated at high-speed, I find it to be very desirable to use a mechanical check, of which two alternative forms are shown. The check, 126, Figs. 1 and 13, comprises in substance a circumferentially contractable split-cylinder 127 mounted on the front of the machine, the contracting adjustment of bolts 128 for the split cylinder causing it to grip with desired frictional resistance the solid rod 129. Striker blocks 130 mounted adjustably on the sliding table (preferably in tandem with the lugs 101), may strike the rod 129 in suitably timed relation to the operation of lugs 101 on the table reversing mechanism, so that a portion of the momentum of the table is taken up by the friction check-device, and shocks to the effective mechanism are greatly reduced and smoothness of operation most effectively enhanced. In Figs. 14 and 15 I have shown a modified construction in which spring pressed plungers 129′, held in protruded position in respect to solid cylinder 127′ by the action of springs 131, are employed, either spring resistance or frictional resistance being effective in the checking operation.

In angular, or taper grinding, it is often important to make very minute changes, laterally, in the position of the swing-plate, and I provide means for facilitating the obtaining of greatest nicety in making such adjustments, or securing for a second operation the identical position that was had for the first. As shown in Figs. 3 and 4, the end of the swing-table usually has a graduated scale 132 for aid in determining its adjustment, but micrometric accuracy is difficult to attain. I provide, therefore, on the slide-table and the swing-plate respectively, a micrometer and an adjustable stop so related that the micrometer may be brought into operation at any point in the swing of the table, according to the setting of the movable stop, and adjustments from that point determined with the greatest accuracy. Specifically 133 represents a frame rigid on the slide table and having a cross-bar 134 along which a stop member 135 may be slid and secured in any adjusted position by screw 136. The arm 135 of this stop-device projects into the path of the actuating stem 138 of a suitable rotary micrometer 139. The swing table may be roughly set to approximate position desired and then the stop-device 135 adjusted to press upon micrometer actuating it to show any selected reading. From this setting the operator can work both ways with greatest nicety, and of course by noting the micrometer reading at time of finishing one piece of work, a duplicate can be reproduced with greatest accuracy by maintaining the setting of the stop and working until the micrometer reading is duplicated.

While I have herein described in detail a particular embodiment of my invention that is desirable in many details that I may claim for specific benefits, it will be understood that in the broader aspects of my invention many changes and departures may be made from the specific construction shown within the spirit of my invention and the scope of the appending claims.

I claim:

1. In a grinder, the combination of a slide table, a grinding-wheelstand, cross-feed mechanism for the latter, automatic means for reciprocating the table, said table reciprocating means having operative connections to actuate the cross-feed mechanism, a constantly-moving part and means operatable from said constantly-moving part for actuating said cross-feed independently of table-reciprocation.

2. In a grinder, the combination of a slide-table, a grinding-wheelstand, cross-feed mechanism for the latter, having a shiftable part, automatic means for reciprocating the table, said table reciprocating means having operative connections to actuate the cross-feed mechanism, a constantly-moving part and means operatable from said constantly moving part for actuating said cross-feed independently of table-reciprocation, said shiftable parts being movable to render idle either operating mechanism alternatively.

3. In a grinder, a slide-table, a swing-plate pivoted thereon, and a shiftable stop and a micrometer-gauge operatable by coaction with said stop, one associated with the table, the other with the plate.

4. In a grinder, the combination of a constantly-running shaft, a reciprocable slide table arranged to be reciprocated or stopped at will, a grinding wheel stand, cross-feed mechanism for the latter including a vibratable member (106) and dual means for actuating said member comprising an operating part moved by the slide table, an operating part moved by the constantly running shaft and shiftable means for establishing operative connection between said member and either of said parts at will.

5. Structure as set forth in claim 4, wherein the vibratable arm carries two elements for respective coaction with the two operating parts and one of these elements is arranged, but only when removed from coactive relation to its actuating part, to hold the other element in coactive relation to the other actuating part.

6. Structure as set forth in claim 5, wherein the respective operating parts are a lever

(104) and a cam (113) and the two elements are a slide member (105) on the vibratable arm (106) and a striker member (115) for coaction with the cam, said slide member being arranged, when moved out of the path of said lever (104) to latch the striker member in the path of the cam.

7. In a grinder, a slide-table, a swing plate pivoted thereon, a frame on the table having a stop thereon adjustable transversely of the table, and a micrometer gauge carried by the table having an actuating stem so disposed as to strike said stop when the table is swung.

8. In a grinder, the combination with a frame, a driving shaft and a part to be driven; of a first variable-speed selective transmission, a motion reverser and a second variable-speed selective transmission, connected together in series in said sequence, said first variable speed transmission being adapted to effect a continuous driving relation at one of a plurality of speeds and said second variable speed transmission being adapted to effect a driving relation at either of two speeds or to interrupt the driving relation entirely.

9. In a grinder, the combination with a frame, a driving shaft and a part to be driven, of a gear train connecting said shaft and said part including, in tandem driving relation, two variable-speed selective transmission gear mechanisms, one of said variable speed transmission mechanisms being adapted to effect a continuous driving relation at any one of a plurality of speeds and the other variable speed transmission mechanism being adapted to effect a driving relation at either of two speeds or to interrupt the driving relation entirely.

In testimony whereof I have hereunto subscribed my name this 12th day of July, 1921.

RAYMOND C. MITCHELL.