Aug. 22, 1933. C. C. STEVENS 1,923,762

GRINDING MACHINE

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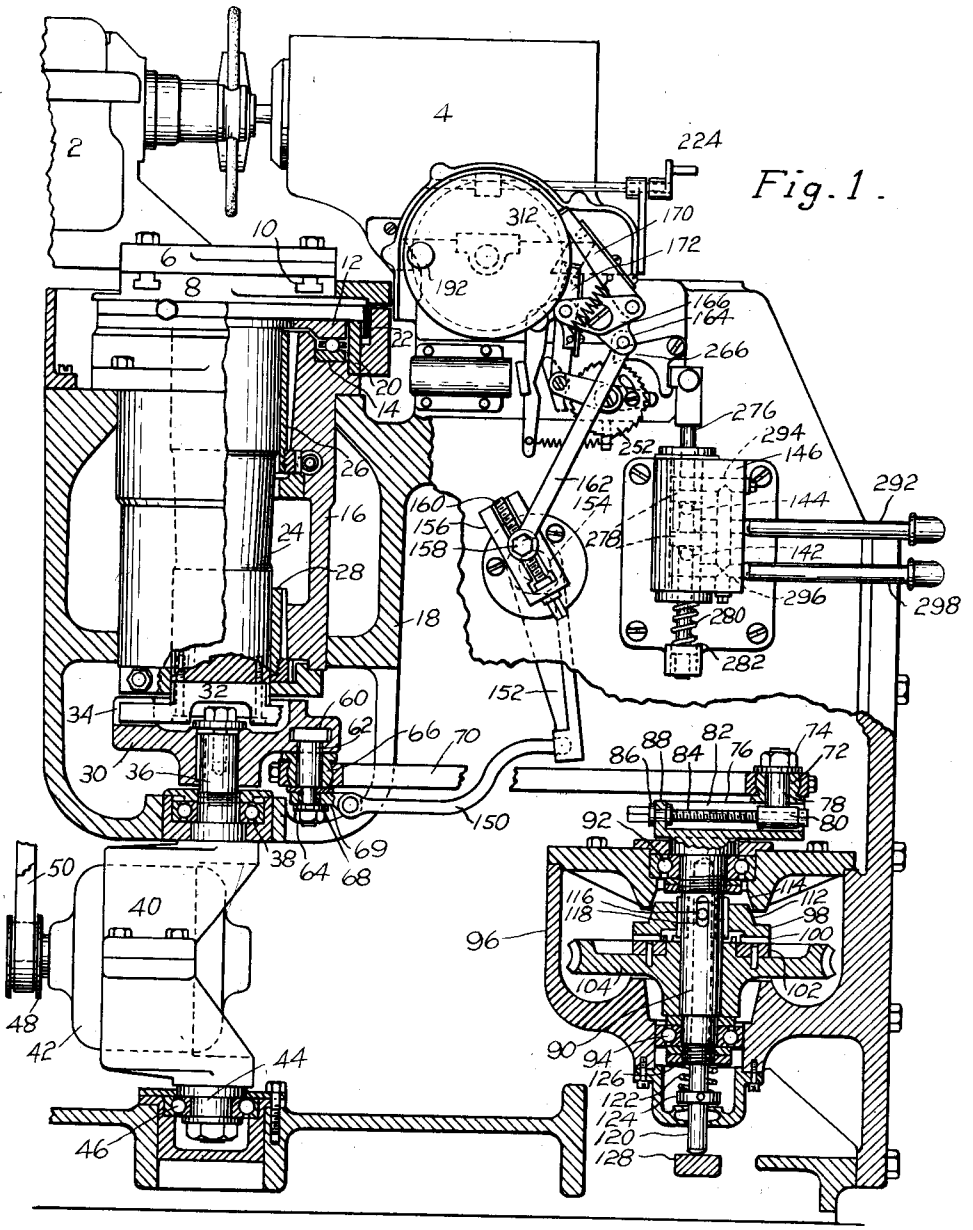


Fig. 1.

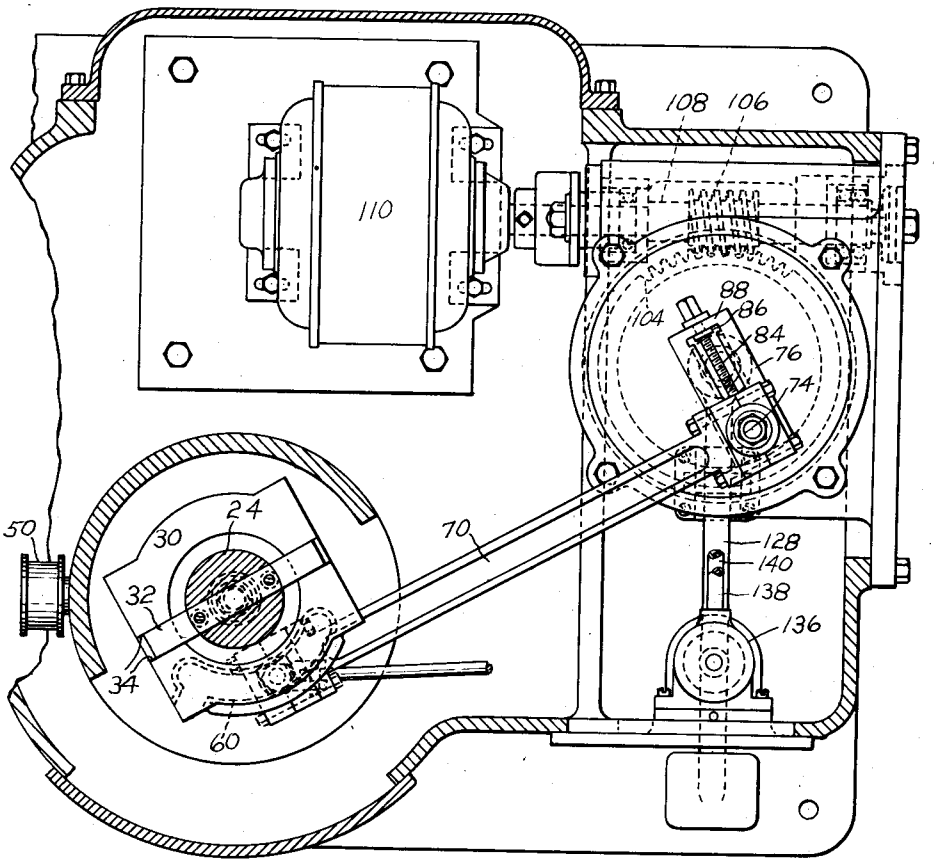
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Fig. 2.



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Fig. 3.

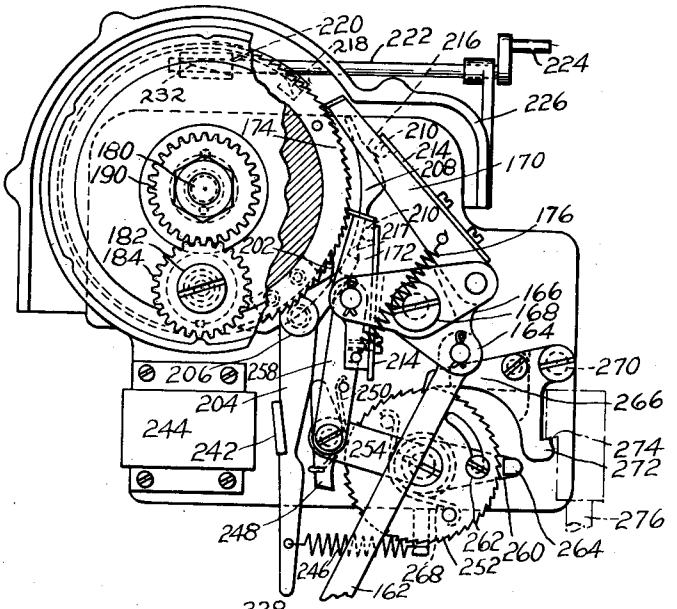


Fig. 4.

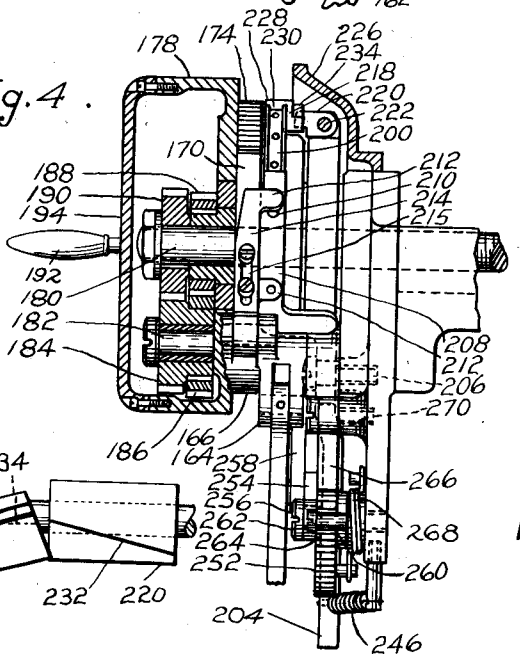


Fig. 5.

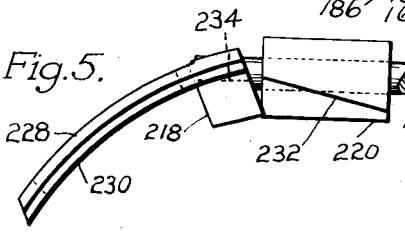


Fig. 6a.

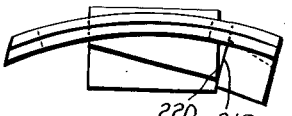
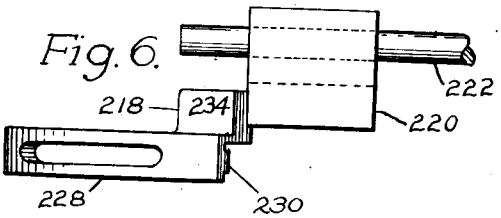


Fig. 6.



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Fig. 7.

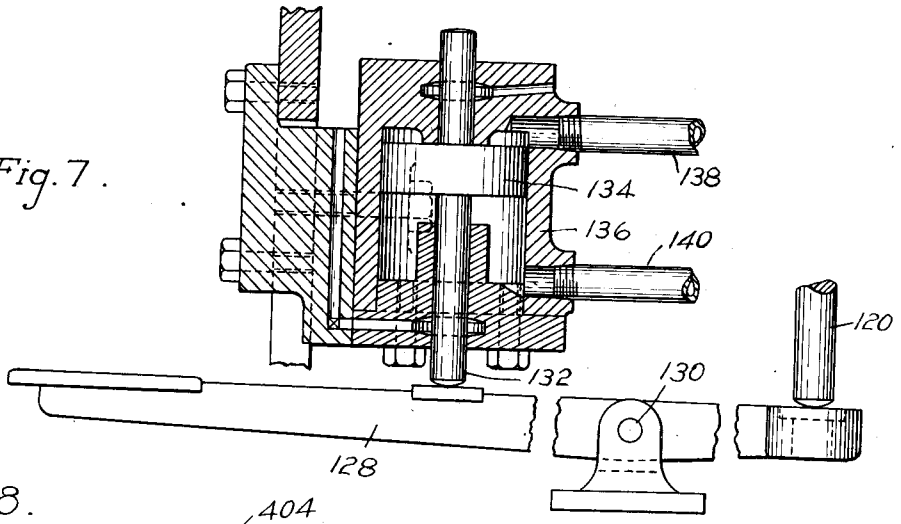
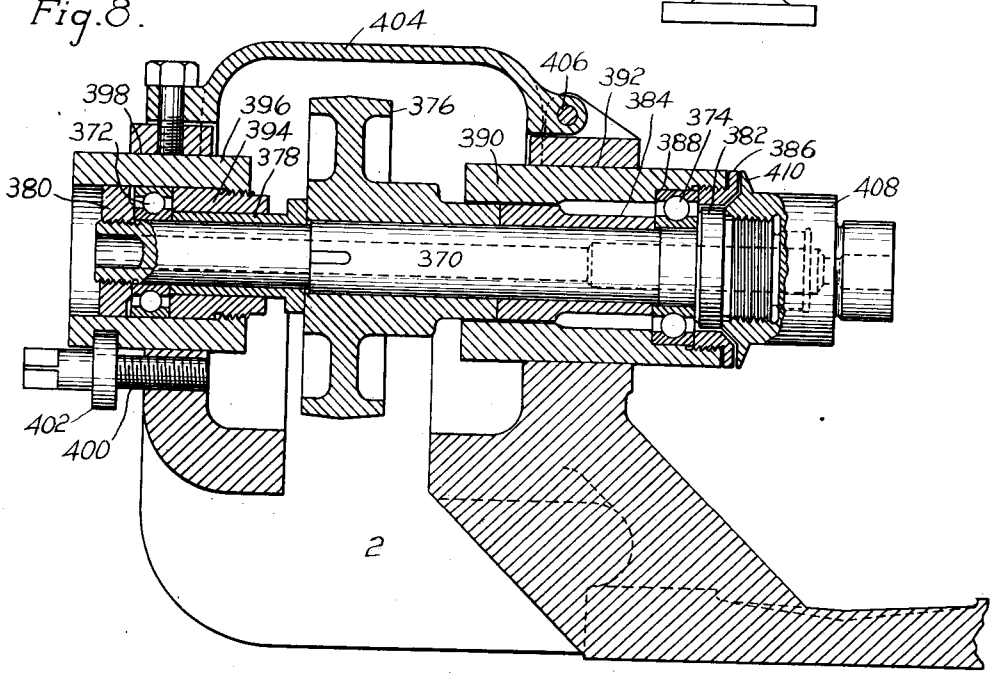


Fig. 8.



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Fig. 9.

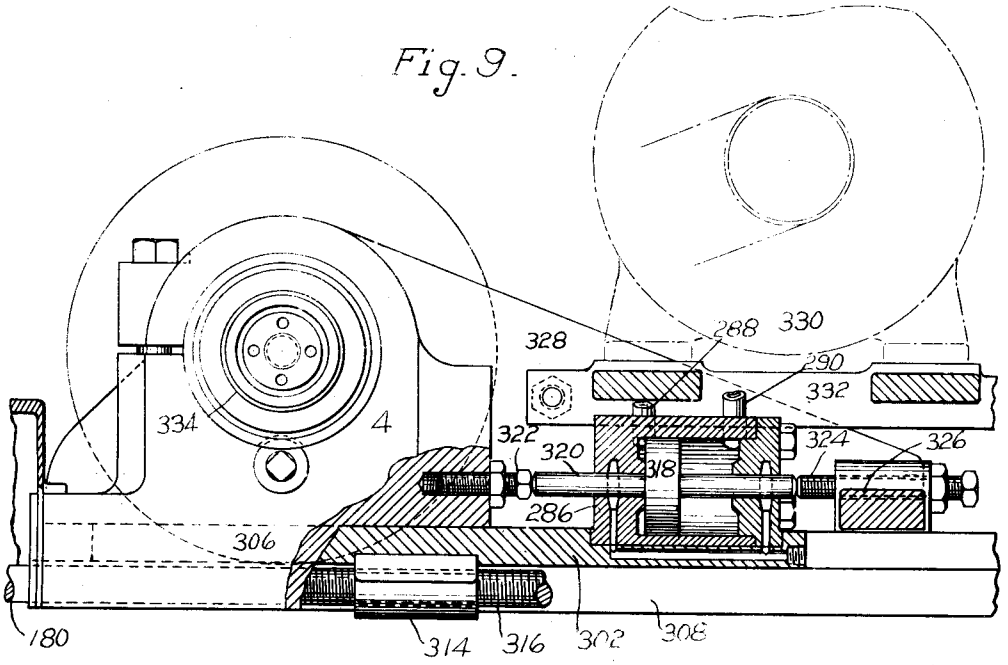
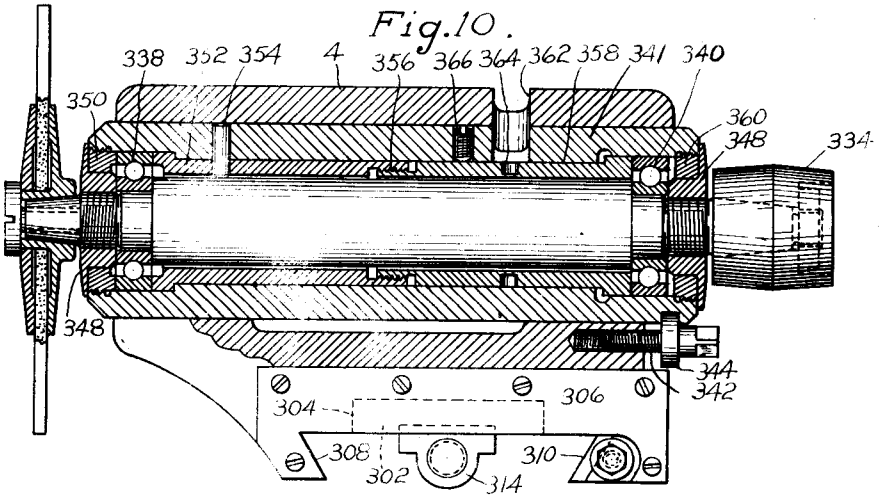


Fig. 10.



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UNITED STATES PATENT OFFICE

1,923,762

GRINDING MACHINE

Clarence C. Stevens, Forestville, Conn., assignor to The New Departure Manufacturing Company, Bristol, Conn., a Corporation of Connecticut

Application November 9, 1927. Serial No. 232,061

21 Claims. (Cl. 51—97)

This invention relates to grinding machines and comprises all the features of novelty herein disclosed. An object of the invention is to provide an improved control mechanism for a grinding machine such that the grinding wheel and work will be held in engagement for a predetermined interval after feed is stopped to produce a fine finish on the work. Another object is to provide mechanism for causing a predetermined number of oscillations of the oscillating head of an oscillating grinding machine after relative movement of approach between the work and grinding wheel has ceased. Another object is to provide improved mechanism for separating a grinding wheel and a work holder at the conclusion of a grinding operation. Still another object is to provide improved mechanism for causing relative feeding movement between a tool and a work holder. Yet another object is to provide, in an oscillating grinding machine of the type wherein one of the heads swings around an axis, improved means to insure the stopping of one head always in the same angular relation to the other head.

To these ends and also to improve generally upon devices of the character indicated the invention consists in the various matters hereinafter described and claimed.

In the drawings, Figure 1 is a front elevation, partly broken away and in section, of the machine.

Fig. 2 is a horizontal sectional view.

Fig. 3 is an enlarged front elevation, partly broken away and in section, of the feed mechanism.

Fig. 4 is a side elevation, partly in section, of parts shown in Fig. 3.

Fig. 5 is an enlarged side view of certain stops in camming relation.

Fig. 6 is a plan view of the stops in camming relation.

Fig. 6*a* is a side view of the stops in abutting relation.

Fig. 7 is a side elevation, partly in section, of the clutch actuating cylinder and associated parts.

Fig. 8 is a vertical section of the work head.

Fig. 9 is a side view, partly in section, of the wheel head and associated parts.

Fig. 10 is a vertical section of the grinding wheel head.

In the present machine there is a work head 2 which oscillates on a vertical axis and a grinding wheel head 4 which can be fed forward horizontally to the work and retracted rearwardly when the work is finished. As will appear, the wheel head is first given a coarse feed, then a fine feed, then stops while the work head continues to oscillate for a predetermined number of strokes to produce a smooth finish on the work, and then the work head stops oscillating as the wheel head retreats rearwardly ready for a subsequent forward feeding movement to a new piece of work.

The work head 2 has a base plate 6 slidably adjustable on an oscillating face plate 8 to enable the work to be properly located with reference to the axis of oscillation. Undercut slots in the face plate are engaged by T-headed bolts 10 on the base plate to clamp the latter in adjusted position. The face plate 8 rests on a ring 12 which oscillates on a ball thrust bearing having a thrust ring 14 supported on an annular ledge of a hollow casting 16 removably mounted in an opening of the main frame 18. The thrust bearing is protected and shielded from grit by a ring 20 and an overlapping annular shield 22, the latter being carried by the face plate 8. The oscillating face plate 8 is integrally secured to a vertical shaft or trunnion 24 oscillating in plain bearings 26 and 28 in the casting 16. The trunnion is removably keyed for oscillation to an oscillating drive disc 30 by an arched cross bar 32 fastened in a slot at the bottom of the trunnion and having its ends extended between pairs of spaced cheeks or lugs 34 on the disc. The drive disc is keyed to a vertical stud 36 rocking in a ball bearing 38, the stud being secured to a bracket or housing 40 which carries an electric motor 42. The bracket or housing has a lower section having a stud 44 turning in a ball bearing 46 housed in a recess of the main frame in line with the axis of oscillation of the work head. The motor shaft carries a pulley 48 from which a driving belt 50 extends upwardly to drive the work spindle. The pulley oscillates with the work head and its trunnion so that oscillation does not interfere with the driving of the work spindle.

The oscillating drive disc 30 has an arcuate slot 60 in which a headed driving pin 62 can be adjustably clamped by a nut 64 to vary the location of the arc of oscillation of the work head. A ball member 66 is also clamped by the nut against the under side of the disc, a sleeve 68 on the pin 62 pivotally supporting a clevis 69 which actuates certain feed mechanism as will later appear. The ball member acts as a pivot pin for one end of a link 70, the other end of the link being pivotally connected to a crank pin in the form of ball member 72 clamped by a nut 74 to a

rotating crank arm 76. The nut 74 is threaded on a stud 78 projecting upwardly from a nut 80 which is guided in a slot 82 of the crank arm. A screw 84 is threaded in the nut and held against endwise movement by collars 86 which straddle a lug 88 on the crank arm, so that, when the nut 74 is loosened and the screw is rotated, the stroke of the link 70 can be adjusted to vary the amplitude of oscillation of the work head.

The crank arm 76 is carried by a vertical shaft 90 which rotates on ball bearings 92 and 94 set in the upper and lower walls of a housing 96 on the main frame. A clutch member 98 is splined to the shaft 90 and has clutch teeth 100 arranged to engage cooperating clutch teeth on a ring 102 attached to a rotary worm wheel 104 which is loose on the shaft and driven by a worm 106 on the shaft 108 of a motor 110. The clutch member 98 has a conical braking surface 112 arranged to engage a similar surface 114 on the fixed lid of the housing 96. To raise or lower the splined clutch member, a cross pin 116 projects from it through a slot 118 in the shaft and the shaft is centrally bored to receive a slidable rod 120 to which the cross pin is also attached. A coil spring 122, interposed between a collar 124 on the rod and a nut 126 on the shaft, tends to pull the rod down to cause the clutch teeth to engage. To unclutch the members and apply the brake, the rod is raised by a lever or pedal 128 pivoted at 130 (Fig. 7) and actuated by a piston rod 132 having a piston 134 in a cylinder 136. Pipes 138 and 140 connect the upper and lower ends respectively of the cylinder to ports 142 and 144 (Fig. 1) at the rear of a valve casing 146 on the front of the main frame. As will appear, the valve in the casing 146 is controlled by the feed mechanism so that the clutch for the work oscillating mechanism is thrown out a predetermined interval after the stopping of the feed mechanism. The valve also controls another piston which, as will later appear, retracts the grinding wheel head when the work oscillating mechanism stops.

The feed mechanism for feeding the grinding wheel head forwardly is actuated by the aforementioned clevis 69 (Fig. 1) which is pivotally connected by a bent link 150 to an arm 152 on a rock shaft 154 journalled on the frame and carrying a crank arm 156. The crank arm has a crank pin 158 projecting forwardly from a nut on a screw 160, the screw being turned to vary the stroke of an actuating link 162 pivoted to the crank pin and to a forked arm 164 (see Figs. 1 and 3) on a three armed lever 166. The three armed lever is pivoted at 168 on the frame and its two remaining arms pivotally support feed pawls 170 and 172 which alternately feed a ratchet wheel 174. A coil spring 176 connecting forwardly projecting pins on the pawls holds the pawls towards the ratchet wheel and a feed occurs at both strokes of the crank mechanism. The ratchet wheel is in the form of a ring and is carried by a rotary housing 178 which is connected to a feed screw shaft 180 through planetary reduction gearing. In the housing is a pin 182 loosely supporting a gear 184, the gear 184 having a hub to which is keyed a gear 186 which is of slightly greater diameter than the gear 184. The larger gear meshes with a fixed gear 188 around which it is carried and by which it is caused to rotate when the housing turns. The smaller gear meshes with a gear 190 keyed to the feed screw shaft 180, the gear 190 being of slightly larger diameter than the fixed gear 188. Thus the rotary motion of the ratchet wheel and its housing produces a much slower rotation of the feed screw shaft. A handle 192 on the cover plate 194 of the housing enables the feed screw shaft to be manually turned.

A peripherally grooved cam carrying disc 200 is frictionally held against the ratchet wheel and turns with the latter up to the point when a cam 202 thereon reaches and engages a certain pawl moving device on a lever 204 to reduce the feed, the ratchet thereafter turning ahead relatively to the friction disc. The lever is pivoted at 206 and has an arcuate arm 208 offset into the path of the cam 202 by which it is swung outwardly into the path of lugs 210 on lateral extensions 212 of plates 214, one plate being adjustably fixed to the back of each pawl by a screw and slot connection 215. The screw and slot connection enables the lugs to be adjusted nearer to or further from cam faces 216 and 217 on the outer edge of the arcuate arm so that the pawls will be held away from the ratchet wheel for a part of their stroke to engage fewer ratchet teeth when the feed is reduced from coarse to fine. To stop the friction disc and the cam 202 at the desired point, a stop 218 is adjustably fixed to the disc in a position to finally engage a stop 220 which can be swung into the path of the first stop by a rock shaft 222 having a crank handle 224, the rock shaft being journalled in lugs on a casing 226. The stop 218 is offset rearwardly from an arcuate attaching plate 228 having a tongue 230 fitting in the groove of the friction disc 200 and the arcuate attaching plate is slotted to receive securing screws threaded in selected holes at the bottom of the groove. The stop 218, moving anti-clockwise in Fig. 3, finally engages and is stopped by the right hand side (in Fig. 5) of the stop 220. When reversing the feed screw, after grinding, to set the wheel head in a position to advance upon a new piece of work, the gear housing is turned clockwise by means of the handle 192 on its cover plate. The stop 220 can at such times be swung manually out of the way of the clockwise movement of the stop 218 by means of the crank handle 224 but preferably the stops are provided with cam faces so that, upon such clockwise movement, the stop 220 will be swung up automatically. Accordingly, the under side of the stop 220 has a cam face 232 inclining downwardly from left to right and the stop 218 has a cooperating cam face 234 on its upper face similarly inclined. This is shown in detail in Figs. 5 and 6.

The feed of the wheel head can be stopped entirely by the full lifting of the pawls which is accomplished by a further swinging of the arcuate arm 208 (further than the fine feed cam 202 can swing it) by means of the lower arm of the lever 204 which carries an armature 242 opposite a magnet 244. The magnet is controlled by any suitable known form of feeler gauge (not shown) which completes a circuit when the work reaches size. Oscillation of the work then continues for a predetermined number of strokes, as will appear, during which the grinding wheel stays in advanced position and imparts a fine finish to the work. As the lower arm of lever 204 swings toward the magnet against the tension of a coil spring 246, a pawl 248 is released and is pressed by a spring 250 towards a ratchet wheel 252. The pawl is pivotally carried at the end of an arm 254 rockably hung on the shaft 256 of the ratchet wheel, the arm being pivotally connected by a link 258 to that arm of the three armed lever which

carries the feed pawl 172. When the magnet is energized to stop the feed, the ratchet wheel 252 begins to rotate and continues to do so for an interval controlled by the setting of an arm 260 on the rear side of the ratchet wheel. A screw 262 in an arcuate slot of the wheel clamps the arm in adjusted position such that an offset lug 264 on the arm is a certain number of teeth away from a dog 266 which holds the wheel against reverse movement due to the tension in a spring 268 which winds up as the ratchet wheel turns. When the lug 264 reaches the dog 266, it lifts the dog around its pivot 270 and removes a latch hook 272 from under a shoulder 274 on a vertically reciprocating valve stem 276. The valve stem carries two pistons 278 (Fig. 1) which control the flow of fluid through the ports 142 and 144. When released, the valve stem is pulled down by a coil spring 280 engaging the valve casing and a guide block 282 fixed on the stem. The upper end of the stem has an enlargement which holds the dog 266 elevated while the coil spring 268 returns the ratchet wheel. The flow of fluid depresses the piston 134 (Fig. 7) and the pedal lever 128 to raise the rod 120 and the clutch member 98 which stops the oscillating mechanism. The oscillating head will always stop in the same angular position which can be controlled by accurate setting of the arm 260 with reference to any selected tooth on the ratchet wheel 252.

Besides controlling the retraction cylinder for the clutch, the valve also controls simultaneously a similar retraction cylinder 286 (Fig. 9) for the grinding wheel head, pipes 288 and 290 at the ends of the cylinder being connected respectively to the ports 142 and 144 of the valve. Pressure fluid from a pump enters the cylinder through a pipe 292 (Fig. 1) to a point between the pistons 278 and goes alternately to the ports 142 and 144. Exhaust fluid passes out from the ends of the valve through connected ports 294 and 296 which lead into a pipe 298 going to the suction side of the pump. The cylinder 286 is horizontally fastened to a slide plate 302 in a slot 304 on the underside of a slide 306 which carries the grinding wheel head 4. The slide 306 has dovetail guide ribs 308 and 310 engaging a dovetail guide tongue 312 (Fig. 1) on the main frame. A feed nut 314 on the slide plate 302 is threaded on a feed screw 316 on the feed screw shaft 180. During forward feed of the wheel head produced by the feed screw, the slide 306 and the slide plate 302 move as one. A piston 318 in the cylinder is secured to a piston rod 320 abutting against adjusting screws 322 and 324 on the wheel head. The screw 322 is on the wheel head proper and the screw 324 is on a cross bar 326 which connects rearwardly extending side ribs 328 on the wheel head, the cylinder being thus in a recess of the head. The port 142 in the valve casing 146 and the pipe 288 admit pressure fluid to the front of the piston 318 when the valve stem 276 is depressed at the end of the grinding operation. The wheel head and its slide are thus retracted rearwardly with respect to the slide plate 302 and feed nut 314 to give free access to the work which is made even more accessible by having the oscillating head stop when the work is facing the front of the machine. When getting ready for grinding a new piece of work, the valve stem 276 is raised and latched and pressure fluid entering the port 144 moves the wheel head and its slide forwardly with respect to the slide plate 302. The adjusting screws 322 and 324 enable the slide plate 302 and slide 306 to be adjusted with respect to one another and, by spacing the end of the screw 324 from the rear end of the piston rod 320, lost motion can be provided which will decrease the amount of wheel retraction.

A motor 330 (Fig. 9) is supported on a base 332 attached to the side ribs 328 of the wheel head and is connected by a belt to a pulley 334 (Fig. 10) on a grinding wheel spindle rotating in ball bearings 338 and 340 in a sleeve 341 which is slidably adjustable on the wheel head. A screw 342 is threaded in the head and has a collar 344 entering a slot in the sleeve to adjust the grinding wheel axially. The inner race rings of the ball bearings are clamped against shoulders on the spindle by nuts 348. The outer race ring of bearing 338 is clamped between a ring nut 350 and a sleeve 352 which is held from rotation by a pin 354. The sleeve 352 is internally threaded at 356 and cooperating external threads on a sleeve 358 enable the latter to be moved axially to adjust the outer race ring of the adjacent ball bearing, space being left between the outer race ring and a ring nut 360 which makes a close joint with a flange on the nut 348. A slot 362 in the head and openings 364 in the sleeve 358 enable the sleeve to be turned. The sleeve is then clamped by a set screw 366 which is also accessible through the slot 362 when the sleeve 341 is moved axially by the screw 342.

As indicated in Fig. 8, the work head 2 has a hollow spindle 370 rotatable in ball bearings 372 and 374 and driven by a pulley 376 which receives its power from the belt 50 (Fig. 1). The inner race ring of the bearing 372 is clamped between a sleeve 378 and a nut 380 threaded on the spindle. The inner race ring of the bearing 374 is held between a flange 382 on the shaft and a sleeve 384. The outer race ring of the ball bearing 374 is clamped by a ring nut 386 against a shoulder 388 in a sleeve 390 which has a sliding fit in an opening 392 of the work head. The outer race ring of the bearing 372 is axially adjustable by a nut 394 threaded in a sleeve 396 which has a sliding fit in an opening 398 of the work head. The sleeves 390 and 396 and the spindle are axially adjustable in the head by a screw 400 threaded in the head and having a collar 402 fitting a slot in the sleeve 396. The pulley is covered by a lid 404 which can be swung upwardly around a pivot 406 to give access to the adjusting nut 394. Any suitable chuck 408 is threaded, on the spindle, the chuck casing preferably having a slinger flange 410.

As grinding of a work-piece proceeds, the grinding wheel head 4 is fed forwardly by the feed pawls 170 and 172, first with a coarse feed and later with a fine feed when the cam 202 on the friction disc 200 engages the arcuate arm 208 of the pawl lifting lever 204 and swings it outwardly to reduce the effective feed stroke of the pawls. The friction disc and cam are stopped by engagement of the stop 218 with the stop 220. Grinding proceeds until any suitable gauge device causes the magnet 244 to be energized and attract the lever 204 thereby causing a greater swinging of the arcuate arm 208 which lifts the feed pawls entirely from the ratchet. Polishing or sparking out occurs without any feed as the lever 204 releases the spring pressed pawl 248 which feeds the smaller ratchet 252 a predetermined number of strokes. When the tripping arm 264 on the ratchet 252 trips the dog 266 and latch hook 272, the valve stem 276 is released and controls actuation of the two pistons 318 and 134, the first retracting the wheel head 4 and the second throwing out the clutch member 98 to stop the oscil-

lating mechanism. The operator then reverses the ratchet wheel 174 and friction disc 200 by the handle 192, removes the work-piece and inserts another in which operation the magnet becomes de-energized. The feed pawls engage the ratchet wheel and the pawl 248 is moved away from its ratchet. To start grinding, the operator lifts the valve stem 276 which causes the actuation of the two pistons 318 and 134 in the reverse direction, the first advancing the wheel head and the second throwing in the clutch to start the oscillating mechanism and the feed mechanism. Lifting of the valve stem also restores the latch hook 272 to latching position with the dog 266 engaging the ratchet wheel 252 which has been restored to its original position by the spring 268.

I claim:

1. In a grinding machine having a work head and a grinding wheel with mechanism for reciprocating one of said members and mechanism for causing a relative feeding movement between the two, mechanism for stopping the feeding movement, a clutch for the reciprocating mechanism, a piston controlling the clutch, a valve controlling the piston, and means for operating the valve subsequently to the stopping of the feeding movement; substantially as described.

2. In a grinding machine having a work head and a grinding wheel with mechanism for reciprocating one of said members and mechanism for causing a relative feeding movement between the two, mechanism for stopping the feeding movement, a piston for separating the wheel and the work head, a piston for controlling the stopping of the reciprocating mechanism, and means for actuating both pistons a predetermined interval after the stopping of the feeding movement; substantially as described.

3. In a machine of the character described, a feed screw having a ratchet wheel, a rocking lever, pawls pivoted to the lever at opposite sides of the axis of rocking and engaging the ratchet wheel to effect a feed movement at each stroke of the rocking lever, a pawl lifting arm movable towards or from the ratchet wheel, and means for swinging the arm to reduce the effective feed of both of the pawls; substantially as described.

4. In a machine of the character described, a feed screw having a ratchet wheel, a rocking lever, pawls pivoted to the lever at opposite sides of the axis of rocking and engaging the ratchet wheel to effect a feed movement at each stroke of the rocking lever, a pawl lifting arm, means for swinging the arm to lift the pawls, and plates engageable with the arm and adjustably secured to the pawls to vary the amount of lifting; substantially as described.

5. In a machine of the character described, a feed screw having a ratchet wheel, a rocking lever, pawls pivoted to the lever at opposite sides of the axis of rocking and engaging the ratchet wheel to effect a feed movement at each stroke of the rocking lever, a pawl lifting arm, means for swinging the arm to reduce the effective feed of both of the pawls, and means for further swinging the arm to move the pawls entirely from the ratchet wheel; substantially as described.

6. In a grinding machine, a work head, a grinding wheel, mechanism for reciprocating one of said members, a feed screw for causing a relative feeding movement between the two members, mechanism for stopping the feed screw, retraction mechanism separate from the feed screw for causing the separation of the grinding wheel and the work head in the line of feed, and mechanism for causing a predetermined number of reciprocations to occur between the stopping of the feed screw and the operation of the retraction mechanism; substantially as described.

7. In a grinding machine, a work head, a grinding wheel, mechanism for reciprocating one of said members, pawl and ratchet mechanism for causing a relative feeding movement of approach between the two members, mechanism for stopping the effective operation of the pawl and ratchet mechanism, a retracting piston for causing separation of the grinding wheel and the work head in the line of feed, and mechanism for causing a predetermined number of reciprocations to occur between the stopping of the feeding movement and the operation of the piston; substantially as described.

8. In a grinding machine, a work head, a wheel head, mechanism for causing a relative feeding movement of approach between the heads, a retracting piston connected to one of the heads for causing a movement of separation between the heads, a valve controlling the piston, mechanism for stopping the operation of the feeding mechanism, mechanism for operating the control valve, and timing means for causing a predetermined interval to elapse between the operation of the two last mentioned mechanisms; substantially as described.

9. In a grinding machine, a work head, a wheel head, mechanism for causing a relative feeding movement of approach between the heads, independent mechanism for actuating one of the heads to effect a separation of the heads, one of said mechanisms comprising a cylinder and piston unit, mechanism for stopping the feeding movement, and timing means for causing the operation of the separating mechanism a predetermined interval after the stopping of the feeding movement; substantially as described.

10. In a grinding machine, a work head, a wheel head, mechanism for causing a relative feeding movement of approach between the heads, a retracting piston connected to one of the heads for causing a movement of separation between the heads, mechanism for stopping the feeding movement, and timing means for causing the operation of the piston a predetermined interval after the stopping of the feeding movement; substantially as described.

11. In a grinding machine, a work head, a wheel head, a slide plate for one of said heads, a cylinder and piston unit connecting the slide plate to its head, means for actuating the slide plate and its head together in the same line of direction to provide relative feeding movement of approach between the heads, and means for controlling admission of fluid to the cylinder to cause a relative movement between the slide plate and its head for separating the heads; substantially as described.

12. In a grinding machine, a work head, a wheel head, a slide plate for one of said heads, a cylinder and piston unit connecting the slide plate to its head, means for actuating the slide plate and its head to provide relative feeding movement of approach between the heads, means for automatically stopping the feeding movement, and timing means for controlling admission of fluid to the cylinder a predetermined interval after the stopping of the feeding movement to separate the heads by relative movement between the slide plate and its head; substantially as described.

13. In a grinding machine, a work head, a

wheel head, a slide plate for one of said heads, a cylinder mounted on the slide plate, a piston, a piston rod, means for adjusting the head with respect to the piston rod, means for feeding the slide plate and its head in the same direction towards the other head, and means for controlling admission of fluid to the cylinder to separate the heads; substantially as described.

14. In a machine of the character described, a machine controlling valve, a latch for the valve, a ratchet wheel, a pawl, means for causing the pawl to turn the ratchet wheel a predetermined distance, means on the ratchet wheel to disengage the latch from the valve when the ratchet wheel has advanced its predetermined distance, and means for actuating the valve when the latch has been disengaged.

15. In a machine of the character described, a machine controlling member, a latch for the controlling member, a timing ratchet wheel, the latch having a dog engaging the ratchet wheel, a pawl, means for causing the pawl to advance the ratchet wheel, a tripping member carried by the ratchet wheel to trip the latch and the dog, and mechanism for actuating the controlling member and for retracting the ratchet wheel upon the tripping of the latch and the dog; substantially as described.

16. In a grinding machine, a work head, a wheel head, mechanism for swinging one of said heads around an axis, mechanism for causing a relative feeding movement of approach between the heads, mechanism for stopping the feeding movement while said one head continues to swing around an axis, and timing mechanism for controlling the final stopping of the swinging head after a predetermined number of strokes; substantially as described.

17. In a grinding machine, a work head, a wheel head, mechanism for swinging one of said heads around an axis, mechanism for causing a relative feeding movement of approach between the heads, mechanism for stopping the feeding movement while said one head continues to swing around an axis, timing mechanism for controlling the final stopping of the swinging head after a predetermined number of strokes, said timing mechanism having an adjustable member for insuring the stopping of the head in a predetermined angular position; substantially as described.

18. In a grinding machine, a work head, a wheel head, mechanism for swinging one of said heads around an axis, mechanism for causing a relative feeding movement of approach between the heads, mechanism for stopping the feeding movement while said one head continues to swing around an axis, mechanism for stopping the swinging movement of the one head, and means for setting the stopping mechanism to become effective when the swinging head is in a predetermined angular position; substantially as described.

19. In a grinding machine, a work head, a wheel head, mechanism for swinging one of said heads around an axis, mechanism for causing a relative feeding movement of approach between the heads, mechanism for stopping the feeding movement while said one head continues to swing around an axis, mechanism for causing a movement of separation between the heads, and timing mechanism for controlling the movement of separation and the stopping of the swinging head after a predetermined number of strokes; substantially as described.

20. In a grinding machine, a work head, a wheel head, mechanism for swinging one of said heads around an axis, mechanism for causing a relative feeding movement of approach between the heads, mechanism for stopping the feeding movement, and automatic mechanism for stopping the swinging head in a predetermined angular position; substantially as described.

21. In a grinding machine, a work head, a wheel head, mechanism for swinging one of said heads around an axis, mechanism for causing a relative feeding movement of approach between the heads, mechanism for stopping the feeding movement, mechanism for separating the heads, and mechanism for stopping the swinging head in a predetermined angular position; substantially as described.

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