Jan. 10, 1933. W. H. CHAPMAN 1,893,837

GRINDING MACHINE

Filed Feb. 12, 1926 4 Sheets-Sheet 1

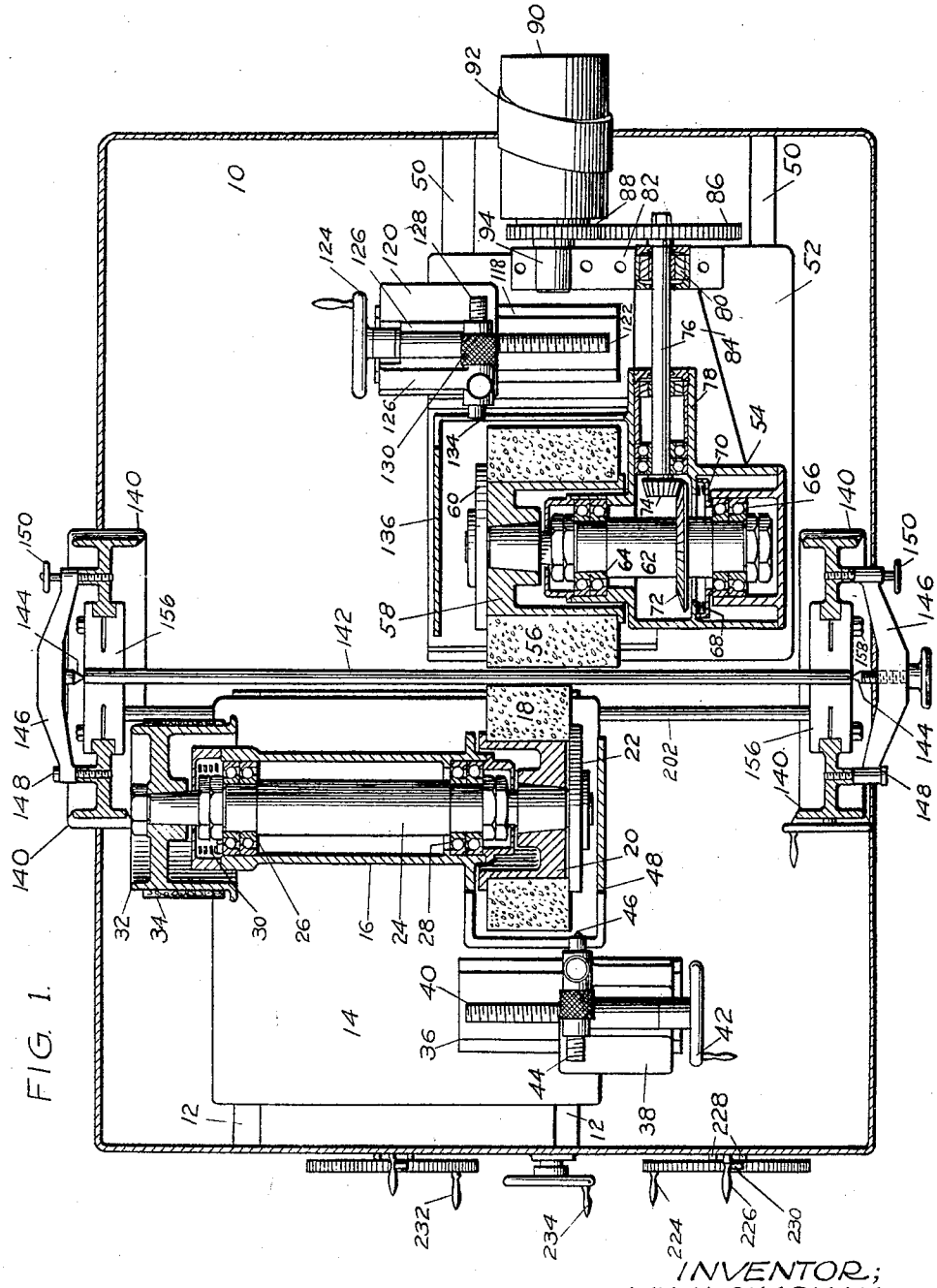


FIG. 1.

INVENTOR;
WM. H. CHAPMAN,
BY Gale G. Thomas
HIS ATTORNEY.

Jan. 10, 1933. W. H. CHAPMAN 1,893,837

GRINDING MACHINE

Filed Feb. 12, 1926 4 Sheets-Sheet 2

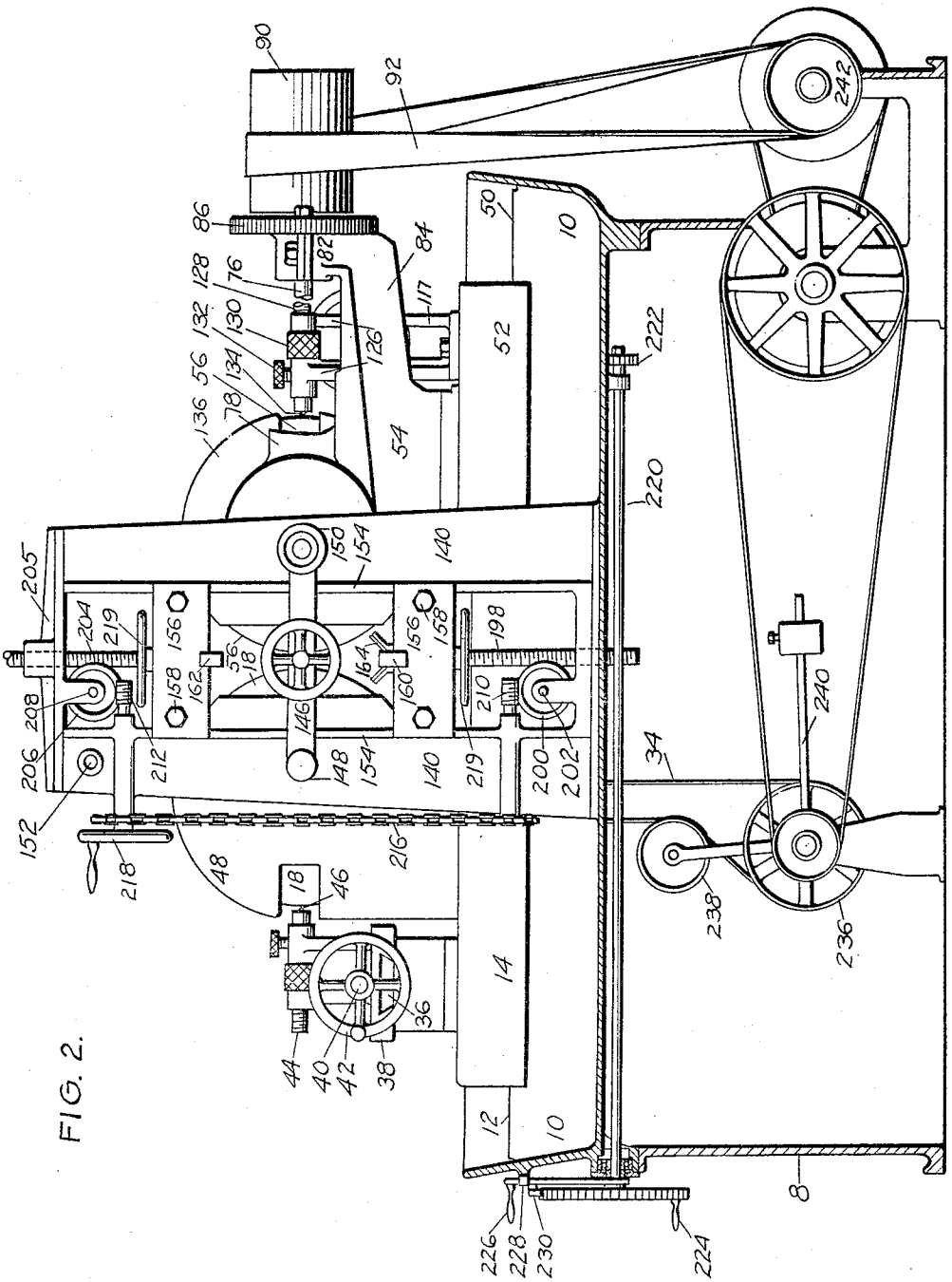


FIG. 2.

INVENTOR;
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Jan. 10, 1933. W. H. CHAPMAN 1,893,837

GRINDING MACHINE

Filed Feb. 12, 1926 4 Sheets-Sheet 3

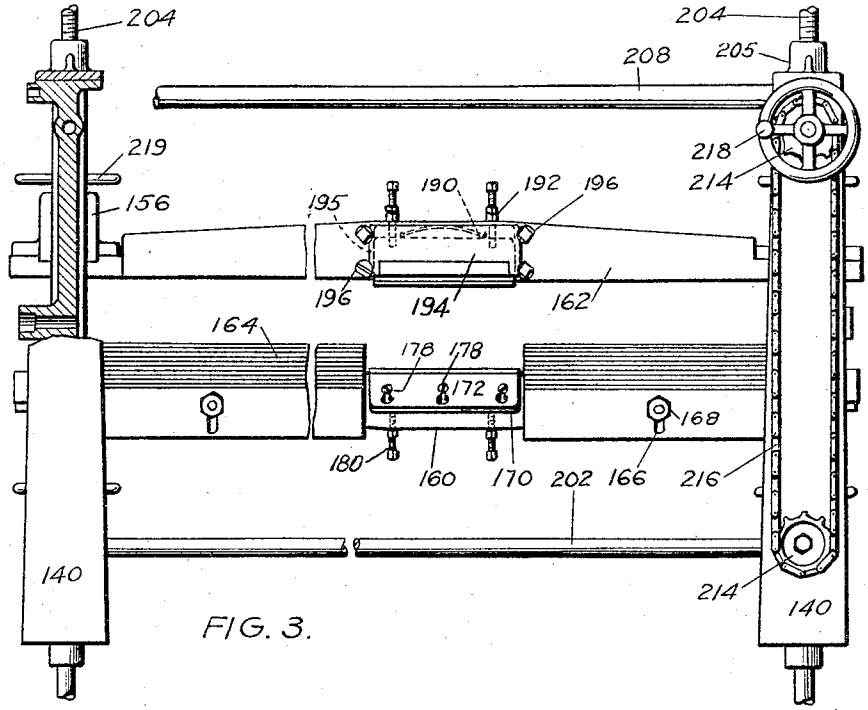


FIG. 3.

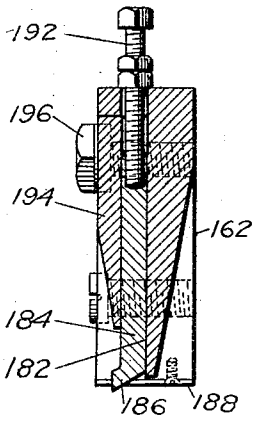


FIG. 4.

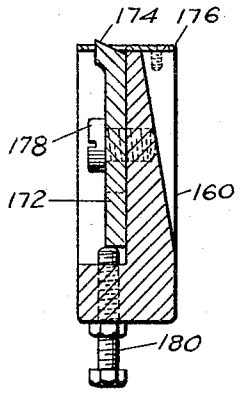


FIG. 5.

INVENTOR;
WM. H. CHAPMAN,
BY [signature]
HIS ATTORNEY.

Jan. 10, 1933. W. H. CHAPMAN 1,893,837

GRINDING MACHINE

Filed Feb. 12, 1926 4 Sheets-Sheet 4

FIG. 6.

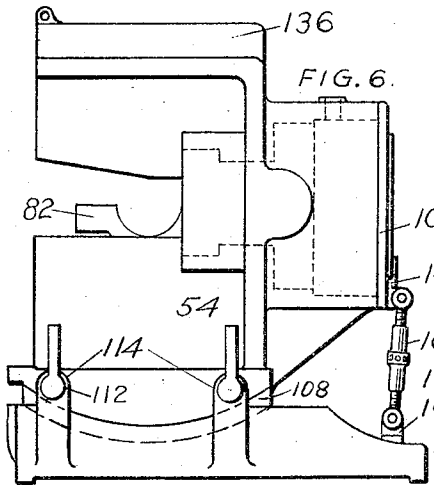


FIG. 7.

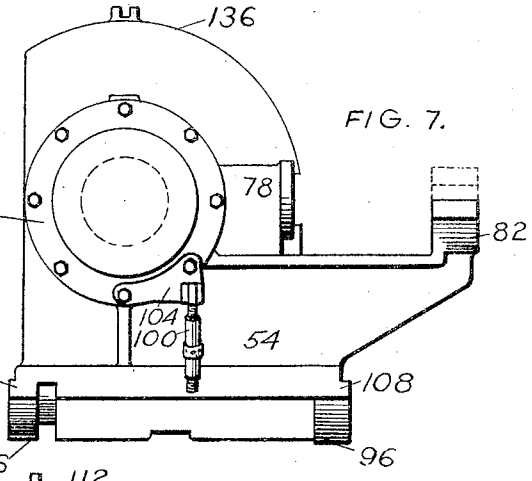


FIG. 9.

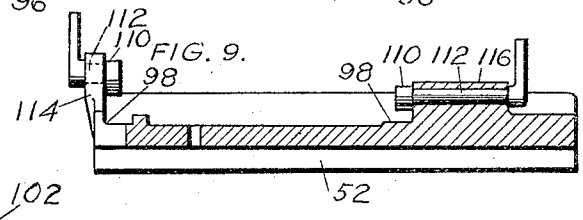


FIG. 8.

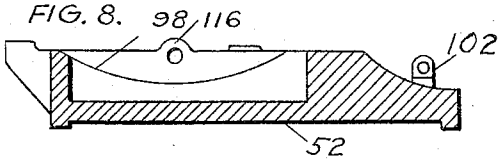


FIG. 10.

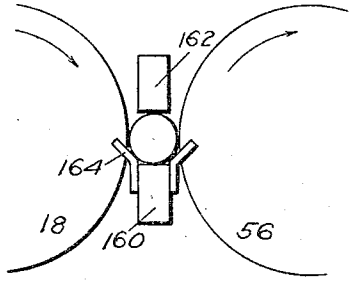


FIG. 11.

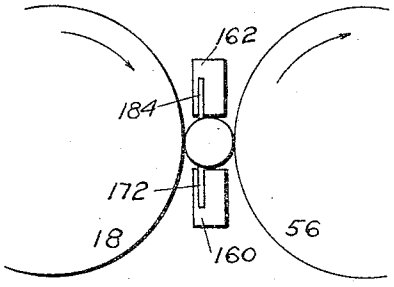
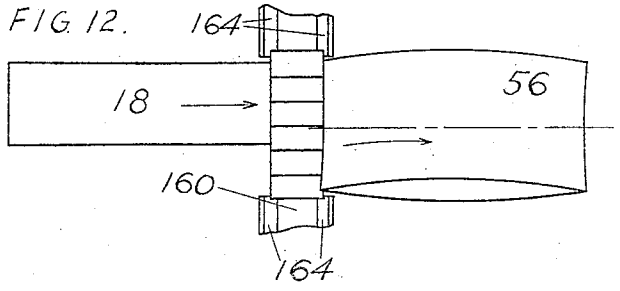


FIG. 12.



INVENTOR;
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Patented Jan. 10, 1933 1,893,837

UNITED STATES PATENT OFFICE

WILLIAM H. CHAPMAN, OF MONTCLAIR, NEW JERSEY, ASSIGNOR TO GENERAL MOTORS CORPORATION, OF DETROIT, MICHIGAN, A CORPORATION OF DELAWARE

GRINDING MACHINE

Application filed February 12, 1926. Serial No. 87,940.

This invention relates to grinding and comprises all the features of novelty herein disclosed, by way of example, as embodied in a centerless grinding machine.

An object of the invention is to provide improved mechanism for controlling the grinding of round work by the centerless method. Another object is to provide simple and fool proof mechanism for truing the wheels and generating the proper work engaging surfaces for any angle of tilt between the work support and the wheel which urges the work axially. Yet another object is to provide improved means for supporting or guiding round articles in or through the machine.

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

The invention, in its broader aspects, is not necessarily limited to the particular embodiment selected for illustration in the accompanying drawings in which;—

Figure 1 is a plan view with some parts in section, the work guides being removed and the set-up mechanism being in operative position.

Figure 2 is a front elevation with some parts broken away.

Figure 3 is a side elevation of the work guides and associated mechanism partly broken away and in section.

Figures 4 and 5 are detail sectional views of the work guides.

Figure 6 is an end view of the slow wheel head and its carriage.

Figure 7 is a front view of the slow wheel head.

Figures 8 and 9 are central sections, taken at right angles to one another, of the carriage for the slow wheel head.

Figures 10 and 11 are diagrammatic views indicating a work piece being guided up to the wheels and passing between them, and Figure 12 is a plan view.

The numeral 8 indicates a hollow base frame supporting a pan or casting 10 having ways or tracks 12 for a slidable carriage 14 which supports a head 16 for an abrading wheel 18. The wheel 18 is the fast wheel having its hub 20 secured in any suitable way, as by the clamp plate 22, to the tapered end of a shaft 24 which rotates on a normally fixed axis in sets of angular contact ball bearings 26 and 28 in the head 16. One set 28 of bearings has its race rings clamped to the shaft and in the head. The other set 26 has its outer race rings slidable in the head and pressed in one direction by springs 30 to prevent play and wear. The shaft 24 has a pulley 32 driven at high speed by a belt 34 which extends down through an opening in the pan 10 to driving mechanism in the base frame.

For generating a cylindrical face on the fast wheel, there is provided a truing tool which is movable parallel to the wheel axis opposite to the line of travel of a work piece. This comprises dovetail ways 36 for a carriage 38 slidable by means of a screw 40 and a hand wheel 42. On the carriage is adjustably secured a threaded shaft or pin 44 having a diamond 46 projecting through a slot in a wheel guard 48 to engage the wheel.

On the other side of the pan are ways 50 for a carriage 52 which adjustably supports a rockable or tiltable head 54 for a wheel 56. The wheel 56 is the slow or control wheel and it is considerably wider than the fast wheel and projects more towards the work receiving side of the machine so that the work will first engage the slow wheel against which it is held while passing to the fast wheel. Wheel 56 has a hub 58 clamped to a shaft 62 by a clamp plate 60, the hub being hollow to embrace a portion of the rockable head 54. Shaft 62 is rotatably supported in sets of angular contact ball bearings 64 and 66 in the rockable head, the outer race rings of the set 66 being constantly pressed in one direction to prevent play and wear by springs 68 interposed between a flange in the head and a ring 70 which abuts against one of the outer race rings.

For driving the wheel 56 in the same direction as the wheel 18 and at slower speed, a bevel gear 72 on the wheel shaft meshes with a bevel pinion 74 on a shaft 76 mounted near one end on ball and roller bearings in a sleeve 78 projecting from the rockable head and

mounted near the other end on roller bearings 80 in a lateral extension 82 on an arm 84 of the rockable head. A gear 86 on shaft 76 meshes with a gear 88 attached to a pulley 90 driven by a belt 92 and rotatably mounted on a stud shaft 94 fastened in the lateral extension 82. The head 54 is tiltably adjustable in curved ways around an axis passing through the center of the slow wheel and through the work contacting portion of the fast wheel to vary the speed of work feed. This axis or center is also in line with the axis of the driving pulley 90 so that the driving gearing will act equally well in whatever tilted position the slow wheel is placed. As shown in Figures 6 to 9 there are curved ways 96 on the under side of the rockable head engaging corresponding tracks or ways 98 in the supporting carriage 52, both sets of ways being curved about the described axis as a center. Adjustment of the head and bracing or support of the overhung parts is effected by a turnbuckle 100 having its right and left threaded portions pivotally connected to a plate 102 on the carriage 52 and to a plate 104 which is fastened to the end cap 106 carrying the ball bearings 66. The sides of the rockable head have lateral extensions 108 engaged by locking eccentrics 110 carried on hand operated shafts 112 journalled in lugs 114 on one end of the carriage 52 and in a single lug 116 near the other end of the carriage. The head can be tilted in either direction from the horizontal so as to be capable of feeding work through the machine in either direction but preferably the work enters at the end shown in Figure 2 and the near end of the slow wheel shaft is tilted upwardly.

When one of the wheels of a centerless grinder is tilted or skewed, proper feed and grinding of straight cylindrical work-pieces between the wheels parallel to the operative portions of the wheels requires that the tilted wheel be slightly concave. To produce the proper shape of wheel initially is a matter of some difficulty and requires a considerable calculation. According to the present invention, the proper shape is produced by a truing tool which is mounted to slide across the tilted wheel always in a line parallel to and on a level with the center of the work path or parallel to and on a level with those lines where the work engages the wheels. The line of travel of the tool is remote from the line where the work engages the wheels so that truing can be accomplished during grinding, and these two parallel lines are so angularly spaced about the tilted wheel that they will both make the same angle with the axis of the tilted wheel. No matter what tilted position the head assumes, the tool generates a curved surface producing a line contact for the work piece. As shown, the carriage 52 has a bracket 117 with ways 118 for a slidable carriage 120 movable by a screw 122 actuated by a hand wheel 124. In standards 126 in the carriage 120 is adjustably mounted a threaded shaft 128 having a knurled operating collar 130 and a clamping screw 132. At the end of the shaft 128 is a diamond 134 which is on a level with the axis about which the head tilts to project through a slot in a wheel guard 136 to engage the wheel. The diamond is thus movable across the slow wheel on a line parallel to the center of the work path and at the same level. Being diametrically opposite the center of the work, the desired curved contour is imparted to the slow wheel such that the wheel presents line contact to a cylindrical work-piece fed parallel to the fast wheel axis at the same level.

For use in setting up the work engaging instrumentalities to produce a given diameter of work and for preserving an unvarying reference axis by which these instrumentalities can be so located that all sizes of work will travel the same path, the following mechanism is provided. Secured to the pan at front and rear are pairs of standards 140 between which a centering rod or arbor 142 can be temporarily supported on taper centers 144 mounted on arms 146 each of which is pivoted at 148 to a standard 140. The front taper center is adjustable by a hand screw to aid in placing the centering rod in the true reference axis of the machine on a level with the wheel centers. The ends of the arms 146 have hand screws 150 arranged to enter tapped openings in the standards to lock the arms in horizontal position when the centering mechanism is in use or to lock the arms in vertical position when the centering rod is removed. The tapped openings 152 for holding the arms in vertical position are on the same standards as the pivots 148 and the others are on the other standards on a level with the pivots. In use, a sleeve of the same size as the finished work desired is sleeved on the centering rod 142 and then the wheels are individually fed into working relation to this reference work-piece which then lies between the wheels at their point of nearest approach. The work supports and guides which will now be described are also moved to work engaging and guiding position and then the centering rod and its reference work-piece are removed.

The standards have opposed ways 154 for upper and lower pairs of vertically slidable blocks 156 which are split at the ends so that they can be secured in adjusted position by clamping bolts 158. The lower blocks carry a lower bar or work guide 160 and the upper blocks carry an upper bar or work guide 162, both guides being movable in unison towards or from each other. To the lower bar are clamped front and rear pairs of guide plates or jaws 164 which are inclined to engage and guide the sides of work pieces as indicated in Figure 10. The vertical webs of the plates are

slotted as at 166 to receive clamping bolts 168 by which the plates may be set to contact with work-pieces of different diameters, the work-pieces also resting on the guide bars so that a three point contact is provided. The pairs of plates or jaws 164 guide the work up to the wheels and away from the wheels.

Opposite the slow wheel, the lower guide bar has a recess 170 for a vertical blade 172 having its upper end bevelled as at 174 to project a little above the bar and above a hardened wear plate 176 which may be detachably secured to the bar. The blade has slots for clamping screws 178 and is vertically adjustable by screw bolts 180 threaded in the bar and abutting against the lower end of the blade. The upper bar has a recess 182 for an upper blade 184 which has its lower end bevelled, as at 186, to project below the upper bar and its wear plate 188. This blade is yieldable upwardly against the tension of a leaf spring 190 interposed between the upper edge of the blade and the top of the recess. Downward movement of the blade is limited by adjustable stop screws 192 threaded in the blade and passing loosely through openings in the bar. The blade is guided by a cover plate 194 abutting a ledge 195 in the recess and held against the ledge by bolts 196 having flats on their heads so that the blade can be removed on a partial turn of the bolts. The bevelled blades tend to hold the work pieces against the slow wheel so that rotation is imparted to the work before the work reaches the fast wheel and hence the likelihood of grinding a flat on the work or the likelihood of the end of the work piece hitting the side of the wheel is eliminated. The upper guide bar 162 normally has a very slight clearance with work-pieces but prevents them from rising or tilting.

The work guiding bars and their slide blocks are movable towards or from each other simultaneously by the following mechanism. The lower slide blocks 156 are carried by rotatable jack screws 198 guided loosely in the base of the standards and supported and fed endwise by worm wheels 200 which are connected for simultaneous rotation by a shaft 202. The upper slide blocks 156 are suspended by rotatable screws 204 guided loosely through cross bars 205 connecting the standards and supported and fed endwise by worm wheels 206 which are connected for simultaneous rotation by a shaft 208. The worm wheels 200 and 206 at the front are driven by worms 210 and 212 respectively and the worm shafts are connected by sprocket wheels 214 and a sprocket chain 216, the upper worm shaft being controlled by a hand wheel 218. The above described mechanism will cause the upper and lower guide bars to approach or recede from one another in equal degree so that work pieces of different diameters will be supported on a level with the wheels. Individual adjustment is however provided for by fixing to the jack screws hand wheels 219 which will enable either screw to be turned individually to feed it past its worm wheel.

The slow wheel is fed towards or from the work by a shaft 220 having a geared connection with the carriage 52 as indicated in part at 222. The shaft has an operating hand wheel 224 for quick rotation. A hand lever 226 is rockable between spaced limit stops 228 and carries a pawl 230 engaging ratchet teeth on the hand wheel to effect a slow feed. The fast wheel carriage 14 is fed in a similar way, the operating wheel being indicated at 232. The numeral 234 indicates a controlling wheel for a central prop or support (not shown) for preventing sag of the lower guide bar. The belt 34 of the fast wheel runs down around a drive pulley 236 in the base and is kept tight by an idler pulley 238 controlled by a weighted arm 240. The belt 92 of the slow wheel is led down around a drive pulley 242 and the drive pulleys receive power from any suitable power transmitting gearing preferably including change speed mechanism.

In setting up, the wheels and work guides are adjusted into contact with a reference work-piece sleeved in the centering rod. The centering rod is then removed and its supporting arms swung up out of the way. The work-pieces are fed in a stream by any suitable mechanism through the work guides until the wheels are reached. The slow wheel, being tilted, then controls the endwise feeding and rotation of the work. In any tilted position, the slow wheel can be dressed and the contour produced is such as to maintain a line contact with the work-pieces.

I claim:

1. In a centerless grinding machine, a fast wheel, a slow wheel, the axis of rotation of one of said wheels being tiltable with respect to the other, a supporting head for said tiltable wheel, said head having, on its underside, curved ways whose centers of curvature lie in a line intersecting the work contacting portion of the other wheel, a support arranged beneath the head and having corresponding ways for the ways on the head, means for tilting said head and comprising a turnbuckle connecting the head to the support and bracing the head in adjusted position, and means for clamping said head in adjusted position; substantially as described.

2. In a centerless grinding machine, a fast wheel, a slow wheel, the axis of rotation of one of said wheels being tiltable with respect to the other, a supporting head for said tiltable wheel, said head having curved ways whose centers of curvature lie in a line intersecting the work contacting portions of both

wheels, a support having corresponding ways for the ways on the head, and driving means for the tiltable wheel comprising a member rotatable on an axis in line with the axis of tilting; substantially as described.

3. In a centerless grinding machine, a fast wheel, a slow wheel, the axis of rotation of one of said wheels being tiltable with respect to the other, a supporting head for said tiltable wheel, said head being mounted to turn on an axis intersecting the axes of both wheels, and wheel driving gearing carried by said head and including a driving member rotatable around the axis of said head; substantially as described.

4. In a centerless grinding machine, a fast wheel, a slow wheel, an upper work guide between the wheels, a lower work guide between the wheels, and mechanism comprising gearing driven from a common source for causing the guides simultaneously to approach or recede from one another in equal degree to maintain the guides in parallelism and at the same distance from a reference axis; substantially as described.

5. In a centerless grinding machine, a fast wheel, a slow wheel, upper and lower work guides extending between the wheels, gearing for moving the guides simultaneously in opposite directions, and means for causing independent movement of the guides; substantially as described.

6. In a centerless grinding machine, a frame, a fast wheel, a slow wheel, standards at the ends of the frame, upper and lower blocks slidable in and guided by the standards, a guide bar connecting the upper blocks, a guide bar connecting the lower blocks, and means for raising and lowering the blocks; substantially as described.

7. In a centerless grinding machine, a fast wheel, a slow wheel, an upper work guide, a lower work guide, and means comprising an edgewise movable blade and a spring for pressing work pieces against the slow wheel; substantially as described.

8. In a centerless grinding machine, a fast wheel, a slow wheel, an upper work guide, a lower work guide, and bevelled blades carried by the guides, the blade on one of said guides being spring pressed to hold work-pieces against the slow wheel; substantially as described.

9. In a centerless griding machine, a fast wheel, a slow wheel, an upper work guide, a lower work guide, and a spring pressed blade carried by one of the guides and arranged to press work pieces towards the other guide and the slow wheel; substantially as described.

10. In a centerless grinding machine, a fast wheel, a slow wheel, a guide bar extending between the wheels for contacting with round work-pieces at points directly below their axes, and a bevelled blade secured to the guide bar near one side of the latter and arranged to contact with the work-pieces at points to one side of their axes for holding said work pieces against the slow wheel; substantially as described.

11. In a centerless grinding machine, a fast wheel, a wide slow wheel projecting beyond the fast wheel on the work receiving side, a work guide along which work pieces are fed axially by the slow wheel, and means on the work guide opposite the projecting portion of the wide slow wheel for holding work pieces against the wide slow wheel; substantially as described.

12. In a centerless grinding machine, a fast wheel, a slow wheel, a guide bar extending between the wheels and arranged to contact with and support work-pieces, a bevelled work engaging blade set into the guide bar, adjusting screws engaging one edge of said blade, and clamping screws for holding said blade to the bar; substantially as described.

13. In a centerless grinding machine, a fast wheel, a slow wheel, a guide bar extending between the wheels, a bevelled blade set into the guide bar, a spring engaging said blade, and means for slidably holding said blade in the guide bar; substantially as described.

14. In a centerless grinding machine, a fast wheel, a slow wheel, a guide bar extending between the wheels, and inclined guide plates adjustably secured to said guide bar at the sides of the wheels and forming with the guide bar a three point support for round work-pieces; substantially as described.

15. In a centerless grinding machine, a fast wheel, a slow wheel, a lower guide bar extending between the wheels, an upper guide bar extending between the wheels, and inclined guide plates adjustably secured to said lower guide bar; substantially as described.

16. In a centerless grinding machine, a fast wheel, a slow wheel, a guide bar extending between the wheels, inclined guide plates secured to the guide bar at the sides of the wheels, and means on the guide bar between the wheels for holding a work-piece against the slow wheel; substantially as described.

17. In a centerless grinding machine, a fast wheel, a slow wheel, an upper work guide, a lower work guide, a spring pressed blade carried by the upper guide and arranged to press work pieces towards the lower guide and the slow wheel, and a bevelled blade carried by the lower guide; substantially as described.

18. In a centerless grinding machine, a grinding wheel and a regulating wheel spaced apart to provide a grinding throat between them, a work support between the wheels, the work support and the axis of one of the wheels having a relative inclination to produce a tendency to urge a work-piece endwise, a truing tool, means for guiding the truing tool across said one wheel on a line parallel to the work support to make the

wheel concave for line contact with a work-piece, the line of contact of the work-piece with the wheel and the line of contact of the tool with the wheel making substantially the same angle with the axis of rotation of the wheel, said lines of contact being separated, and means for adjusting the relative inclination of the axis of the wheel and the work support while maintaining the work support and the path of the truing tool in parallel relation; substantially as described.

19. In a grinding machine, a grinding wheel, a regulating wheel, a work support, the work support and the axis of one of the wheels having a relative inclination to produce a tendency to urge a work-piece endwise, a truing tool, and means for guiding the truing tool across said one wheel, the line of contact of the work-piece with said wheel and the line of contact of the tool with the wheel making the same angle with the axis of rotation of the wheel, and said lines of contact being spaced apart on the periphery of the wheel; substantially as described.

20. In a centerless grinding machine, a grinding wheel, a regulating wheel, a work support extending between the wheels, a supporting bar spaced from the work support, a blade movably carried by the bar to engage a work-piece at a point remote from the regulating wheel, and a spring for causing said blade to urge the work-piece towards the regulating wheel; substantially as described.

21. In a centerless grinding machine, a grinding wheel, a regulating wheel, a work support extending between the wheels, a supporting bar spaced from the work support, a blade carried by the bar and having a bevelled edge engaging the work-piece, and a spring for urging the blade towards the work support; substantially as described.

22. In a centerless grinding machine, a grinding wheel, a regulating wheel, a work support extending between the wheels and upon which a work-piece is urged endwise, the regulating wheel projecting beyond the grinding wheel at the work receiving side to start rotation of the work-piece prior to grinding, and means acting on that side of the work-piece which is remote from the projecting portion of the regulating wheel for holding the work-piece against the regulating wheel; substantially as described.

In testimony whereof I hereunto affix my signature.

WILLIAM H. CHAPMAN.