March 1, 1938.

R. H. CRAMER

2,109,524

GRINDING MACHINE

Filed Jan. 11, 1935

5 Sheets-Sheet 1

FIG. 1

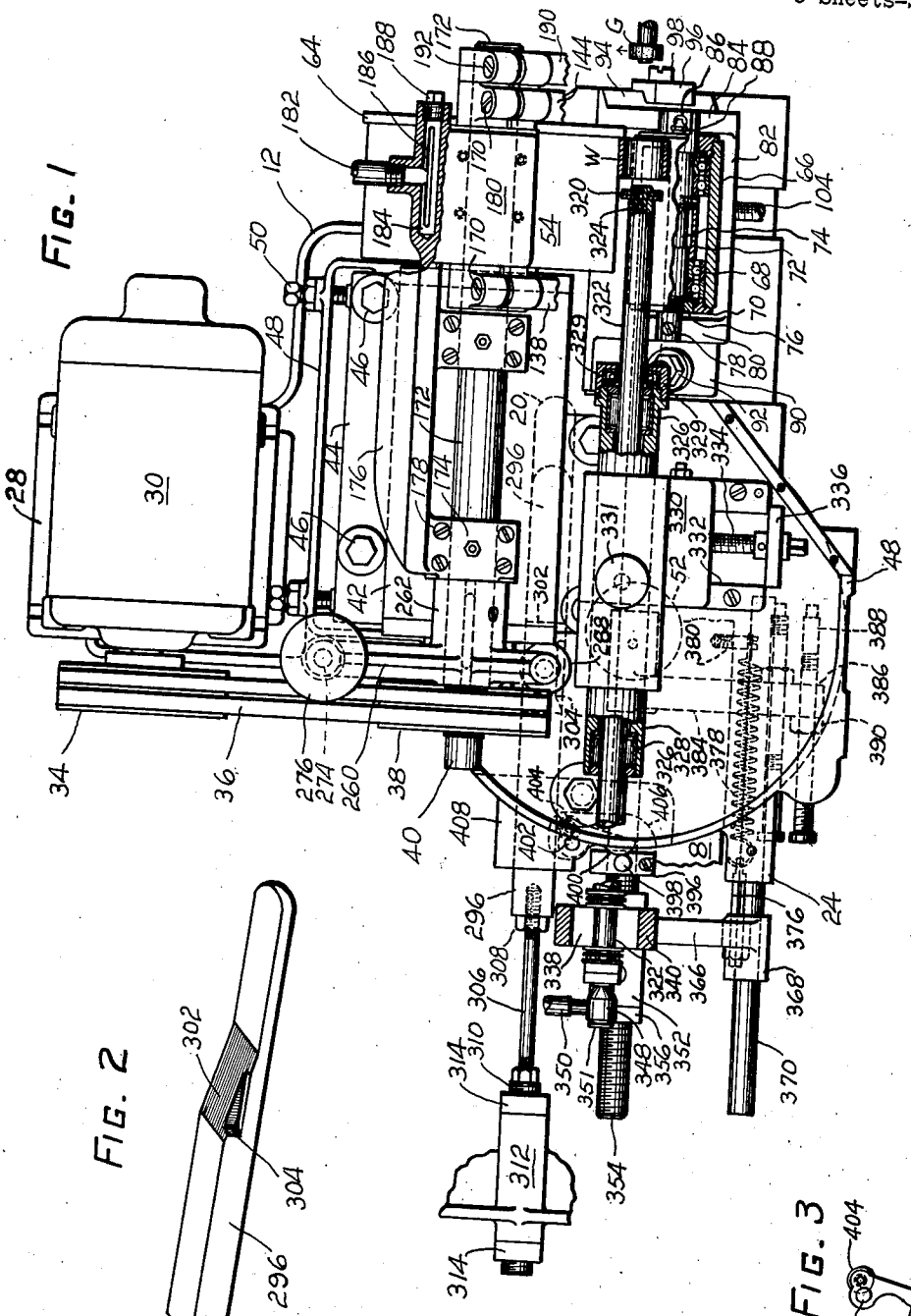


FIG. 2

FIG. 3

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2,109,524

GRINDING MACHINE

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FIG. 4

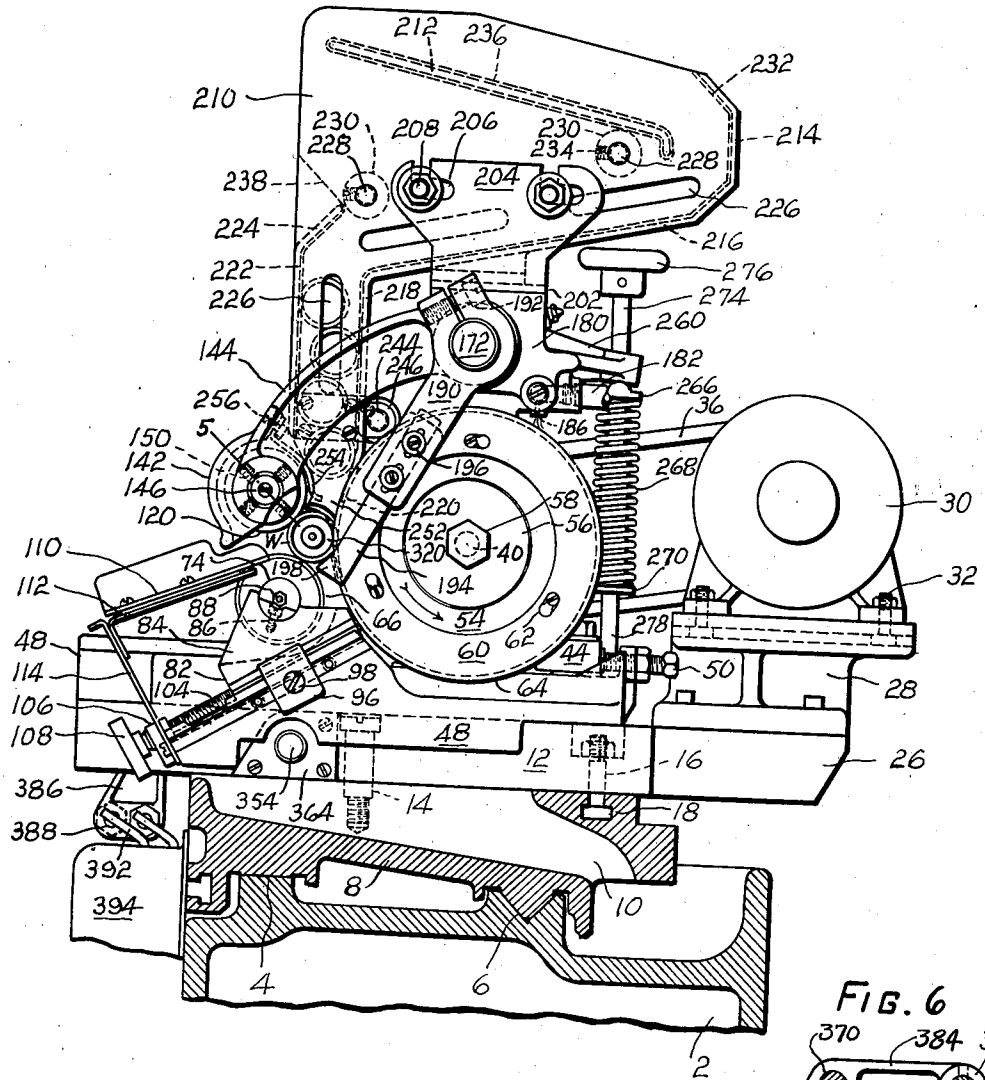


FIG. 5

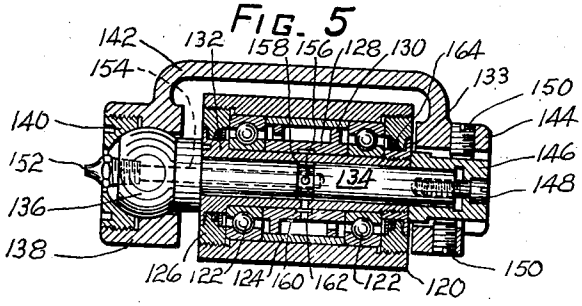
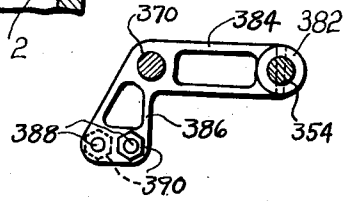


FIG. 6



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GRINDING MACHINE

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FIG. 7

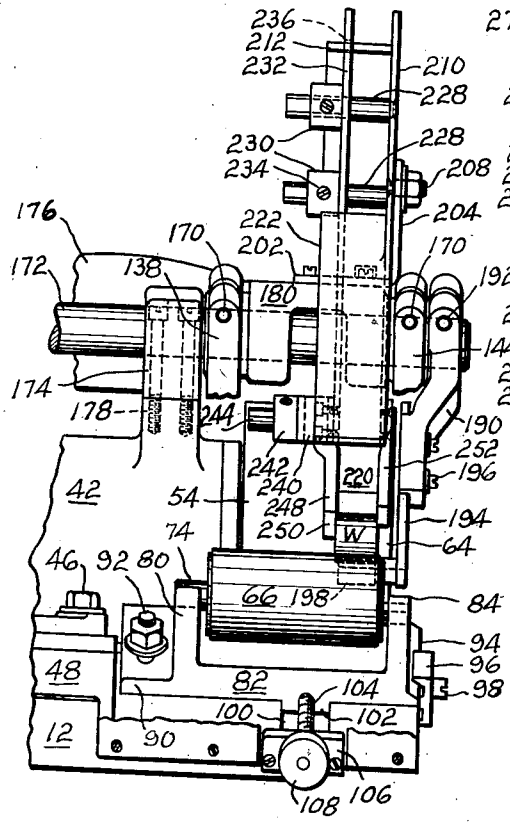


FIG. 8

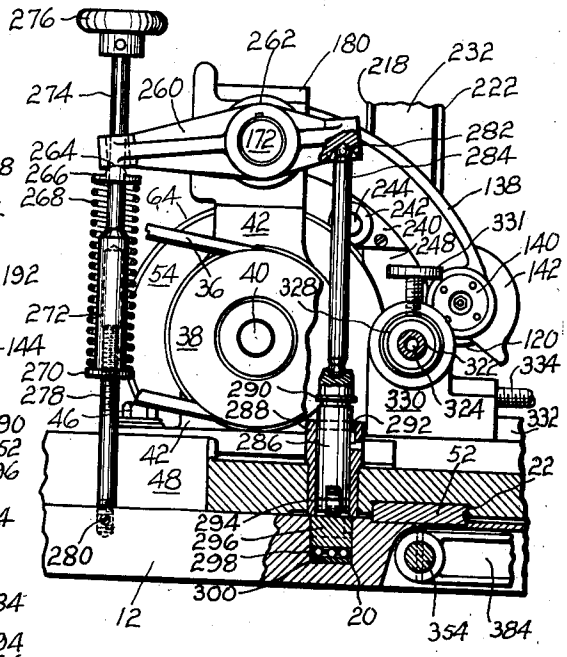


FIG. 9

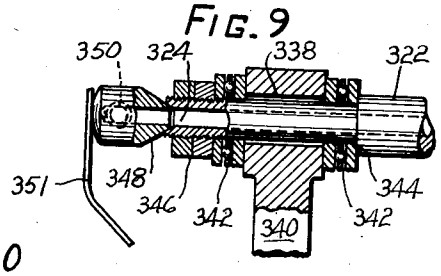
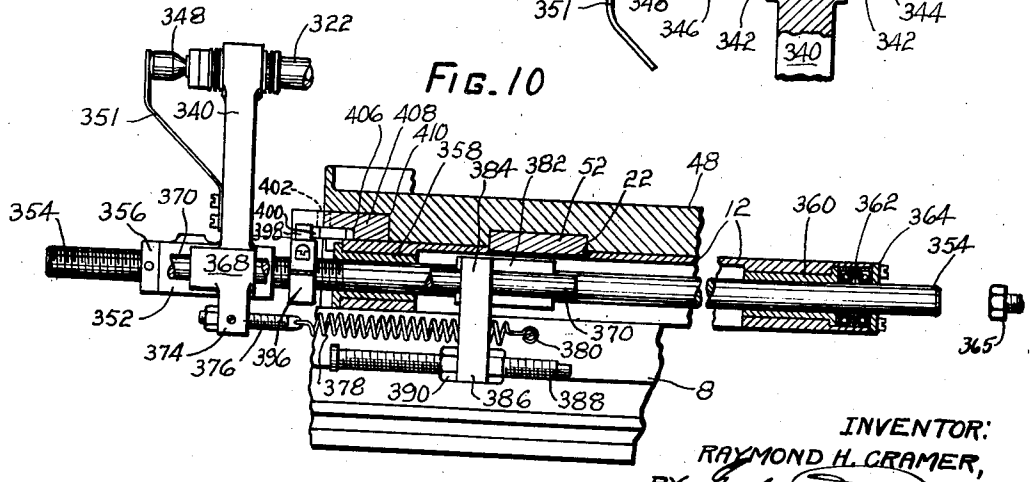


FIG. 10



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FIG. 11

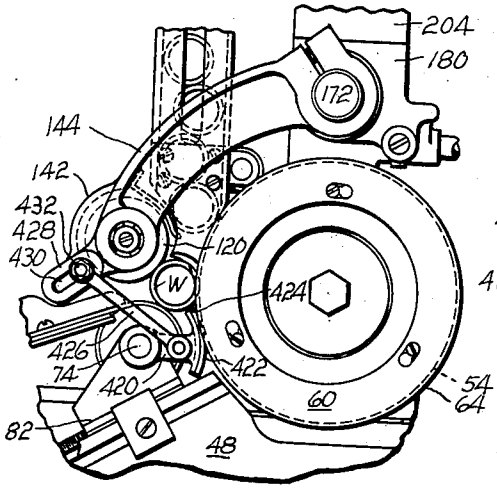


FIG. 12

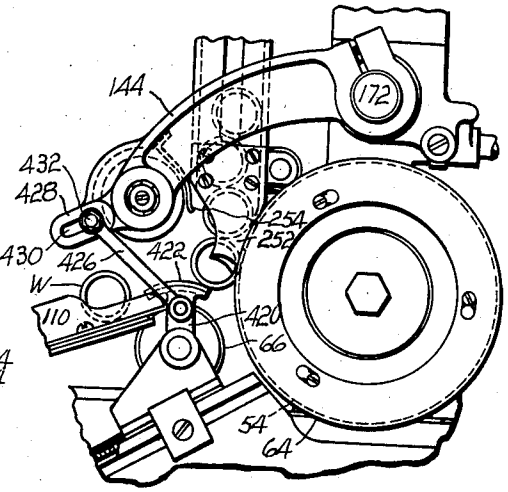
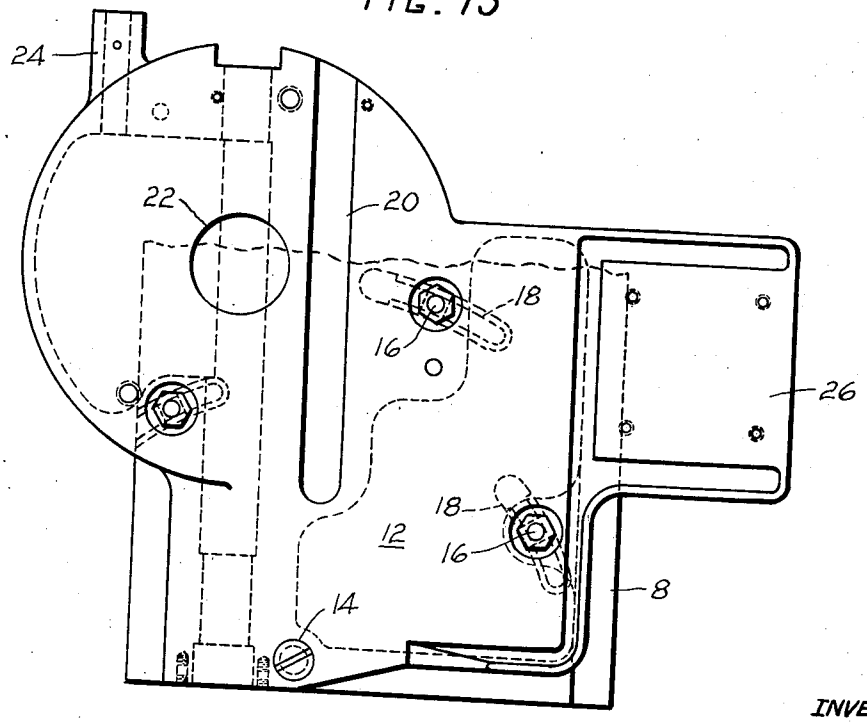


FIG. 13



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GRINDING MACHINE

Filed Jan. 11, 1935

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FIG. 14

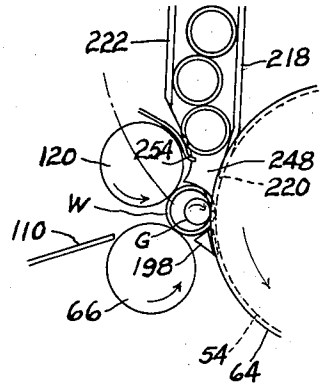


FIG. 15

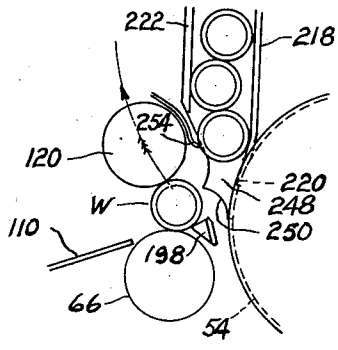


FIG. 16

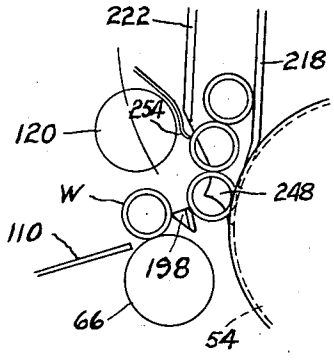


FIG. 17

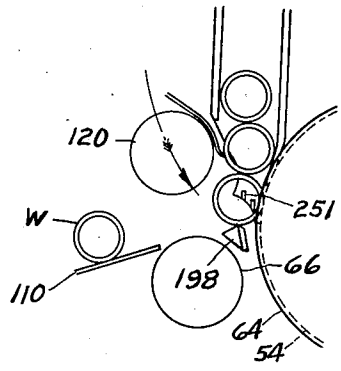


FIG. 18

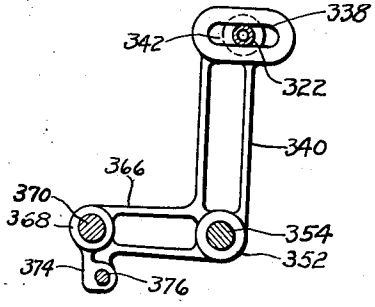
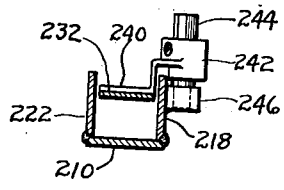


FIG. 19



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Patented Mar. 1, 1938 2,109,524

UNITED STATES PATENT OFFICE

2,109,524

GRINDING MACHINE

Raymond H. Cramer, Newark, N. J., assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

Application January 11, 1935, Serial No. 1,414

43 Claims. (Cl. 51—103)

This invention relates to grinding machines and comprises all of the features of novelty herein disclosed. An object of the invention is to provide an improved machine for internal grinding. Another object is to produce a grinding machine of the chuckless type which is simple and economical to build as well as to operate. Another object is to provide improved loading and unloading mechanism for machines of this general character, such that there is little time lost in exchanging workpieces and the operation being simple, direct and positive with easy setup or adjustment when sizes change. Still another object is to provide an improved idler wheel mounting. Yet another object is to improve the mechanism for controlling the pressure idler, ejector and gauge.

To these ends and also to improve generally upon machines of this character, the invention consists in the various matters hereinafter described and claimed. In its broader aspects, the invention is not necessarily limited to the specific construction selected for illustrative purposes in the accompanying drawings in which—

Fig. 1 is a plan view of the machine with some parts broken away and in section, the pressure idler, ejector and magazine being removed.

Fig. 2 is an isometric view of a cam plate.

Fig. 3 is a plan view of a lever.

Fig. 4 is an end view of the machine with the reciprocating table and a portion of the main frame in vertical section.

Fig. 5 is a sectional view on the line 5 of Fig. 4.

Fig. 6 is a side view of a gauge bracket.

Fig. 7 is a front view of a portion of the machine, the pressure idler being broken off.

Fig. 8 is an end view with parts broken away and in section.

Fig. 9 is a vertical sectional view of a portion of the gauge rod and associated parts.

Fig. 10 is a front view of a portion of the gauge mechanism, some of the associated parts being broken away and in section.

Fig. 11 is an end view of a modification.

Fig. 12 is a view like Fig. 11 but with certain parts in another position.

Fig. 13 is a plan view of a filler plate.

Figs. 14 to 17 inclusive are diagrammatic end views illustrating the work feeding and ejecting mechanism in different positions. Fig. 18 is a side view of a bracket and Fig. 19 is a sectional view of the magazine outlet.

Stated generally, the machine comprises a work head having a series of wheels or rollers which peripherally engage a hollow work-piece and control its rotation while a high speed grinding wheel engages the inner wall of the work-piece to grind the bore. The work-head reciprocates under control of any suitable hydraulic drive, as in the well known Heald internal grinder, while the grinding wheel is fed radially of the work. Gauge plugs repeatedly engage the end of the work and successively enter its bore as the piece is ground to corresponding dimensions, such entry of the gauge plugs controlling successive amplified movements of the work head, as for wheel dressing and unloading the work. The work is fed from a magazine, feeding and ejecting being automatically controlled by the movements of the work head.

A main frame 2 (Fig. 4) is provided with ways 4 and 6 for a reciprocating table or slide 8 which contains a drain opening 10 for cooling medium. A supporting filler plate 12 is secured to the top of the table or slide 8 by a pivot stud 14 and T-headed clamping bolts 16. The pivot stud allows angular adjustment of the filler plate in order that all of the supported parts can be lined up with the table ways or, if desired, it can be angled with respect to the table, as when tapered work is being ground. To allow this angular adjustment, the table is provided with undercut slots 18 which are curved about a center at the pivot (see Fig. 13). The filler plate 12 has a slot 20 to receive a cam, a shallow round recess 22 for a locating plug, and a hollow lug 24 to support a guide rod, all as will later appear in detail.

The filler plate 12 has a rear extension or pad 26 supporting a bracket 28 carrying an electric motor 30, the motor having its feet provided with T-headed clamping bolts 32 to secure the motor in adjusted position. The motor has a driving pulley 34 (Fig. 1) connected by V-type belts 36 to a pulley 38 on a shaft 40 which is rotatably journalled in a head casting 42. The head casting has feet 44 secured by bolts 46 to a base plate 48, screws 50 adjustable in lugs of the base plate abutting against the feet 44 for locating the head casting in adjusting position. The base plate is located on the filler plate 12 by a circular locating plug 52 (Figs. 8 and 10) which enters the beforementioned recess 22 of the filler plate.

That end of the shaft 40 which is opposite to the pulley 38 overhangs the head and supports a regulating wheel 54 (Fig. 4) which is clamped to the shaft by a washer 56 and a nut 58. A ring 60 is detachably secured to the regulating wheel by screws entering bayonet slots 62 in the ring. The ring is a little larger in diameter than the wheel to provide a projecting flange 64 which

forms an abutment for one end of the hollow work-piece W and prevents the work from moving endwise in one direction. The flange is thus made removable so that the regulating wheel 54 can be faced off or trued by reciprocating it axially along the grinding wheel G.

The work W is rotatably supported by a supporting idler wheel 66 which is adjustable along an incline in order to support work of all diameters at the same level, and preferably the axis of the work is in a common plane with the axis of the grinding wheel and the axis of the regulating wheel. The wheel 66 is hollow and contains two separated pairs of ball bearings 68 (Fig. 1) whose outer race rings are retained by ring nuts 70. The inner race rings of these bearings are spaced apart in pairs by a sleeve 72 surrounding a supporting shaft 74. Such inner race rings and sleeve are clamped as a unit against a shoulder of the shaft by a nut 76. One end of the shaft 74 is secured by a screw 78 in an open seat of a standard 80 carried by a slide 82. Another standard 84 has a similar open seat (Fig. 4) in which a segmental extension of the shaft is fastened by a screw 86. This end of the shaft receives a grease fitting 88 communicating with suitable ports to conduct lubricant to the bearings.

One end of the slide 82 has a slotted extension 90 (Fig. 7) for a clamping bolt 92 and the other end of the slide has a bevelled face 94 engaged by a bevelled lip on a clamping plate 96 which is secured by a screw 98 to the base plate 48. The base plate is inclined and has a guide slot 100 receiving a tongue 102 on the slide. The tongue is tapped to receive an adjusting screw 104 which is journalled for rotation without endwise movement in a plate 106 fastened at the front of the base plate. A hand wheel 108 provides for turning the screw to adjust the slide and the supporting idler 66 to the correct position for supporting work of the selected size with the center at a predetermined level. Tangent to the idler 66 and inclined downwardly therefrom, is a discharge chute 110 (Fig. 4) supported on a bent bracket 112 which in turn is supported by a bracket 114 on the base plate.

The remaining work-engaging wheel or roller is a pressure idler wheel 120 (Figs. 4 and 5) urged by spring pressure against the work and automatically raised when the work is ejected from grinding position. The wheel is hollow and contains a pair of ball bearings 122 whose outer race rings are spaced apart by a sleeve 124 while ring nuts 126 clamp the race rings in the wheel. The inner race rings are spaced by a sleeve 128 having flanges 130 with oil passages. The inner race rings and the sleeve 128 are clamped as a unit against a shouldered sleeve 132 by a nut 133. The sleeve 132 is carried by a shouldered supporting shaft 134 having a ball segment 136 at one end. The segment has universal adjustment in a similarly shaped seat in an arm 138, a portion of the seat being formed on a detachable nut 140 threaded in the arm. The arm 138 is connected by a web or guard 142 to a companion arm 144 and the connected arms are mounted for rocking movement on an axis above the regulating wheel, as will appear. The arm 144 has an opening receiving a thimble 146 which is secured to the shaft 134 by a screw 148. The thimble is externally four-sided or provided with flats engaged by two pairs of opposed set screws 150 threaded in the arm 144. By loosening one screw and tightening the opposite one, the shaft 134, and hence the idler wheel 120, can be skewed with respect to the work thereby producing a tendency to urge the work endwise and hold it against an abutment. Thus the work can be held from endwise movement on its supports when the work and the grinding wheel have a relative axial reciprocation.

To lubricate the idler wheel 120, a grease fitting 152 leads to a central passage 154 communicating by a radial port 156 with a peripherally extending groove 158 on the exterior of the shaft 134. The groove 158 communicates by a radial port in the sleeve 132 with a peripheral groove 160 in the interior of the sleeve 128, and a radial port 162 leads from the groove 160 to the space between the flanges 130. Lubricant forced into this space has access through the before-mentioned ports in the flanges 130 to the bearings. The lubricant is retained in the wheel by suitable packings 164 in the ring nuts 126 and by overlapping flanges on these nuts and the nuts 133.

The arms 138 and 144 have their upper ends or hubs split (Figs. 1 and 7) and clamped by screws 170 to a rock shaft 172 which is journalled in lugs 174 projecting forwardly from a bracket 176, the lugs 174 being fastened by screws 178 to upwardly extending lugs on the head casting 42. The bracket 176 has an extended portion 180 between the arms 138 and 144 and, at the rear, a pipe 182 leads to a chamber 184 in the extension. Water admitted from the pipe to the chamber is sprayed down through a slit 186 onto the regulating wheel and keeps its surface and that of the work clean and cool. The chamber is closed at the end by a threaded plug 188. A third arm 190 is clamped by a screw 192 to the overhanging end of the rock shaft 172, one side of the arm being longitudinally grooved to receive an extension arm 194 which is adjustably secured in the groove by screws 196. The extension arm terminates in a laterally directed work ejector 198 of substantially triangular cross section. The ejector has a notch to make it clear the regulating wheel flange 64 and so lies close along the regulating wheel just out of contact with the work. When the shaft 172 is rocked clockwise in Fig. 4, the pressure idler wheel 120 and the ejector are simultaneously raised, the ejector lifting the released work over the supporting idler 66 to the exit chute 110. The ejector then operates as a work loader as will appear.

The work is automatically fed to the machine from a magazine (see Figs. 4 and 7). On the flat top of the extension 180 of the bracket 176 is fastened an angle bracket having a horizontal leg 202 and an upright leg 204. The latter has L-shaped notches 206 at its upper edge to detachably and adjustably receive clamping studs 208 which are riveted to a magazine side wall 210. This side wall has an inclined fin 212 projecting from it laterally, and work pieces placed on the fin roll down it towards a rear fin 214. The rear fin is joined to a bottom fin 216 which inclines downwardly to meet a vertical fin 218. The fin 218 terminates in a lip 220 which fits close up to the regulating wheel 54. The magazine side wall 210 also has a vertical front fin 222 whose upper end is inclined backwardly at 224. The fins are preferably welded to the side wall and slots 226 in the side wall provide for inspection of the work-pieces as the latter roll downwardly over the bottom fin 218 to the discharging extension.

The side wall 210 is also provided with a pair

of supporting studs 228 which are riveted to it and project laterally to slidably receive supporting sleeves 230 on a companion side wall 232 which is parallel to the side wall 210. Set screws 234 provide means to secure the side wall 232 at the desired distance from the side wall 210 to suit the length of the work. The side wall 232 has an inclined slot 236 to clear the inclined fin 212 and has a triangular notch 238 at the front to receive the inclined end 224 of the vertical fin 222. Elsewhere the side wall 232 fits within the fins of the side wall 210. A plate 240 (Figs. 7 and 19) is secured to the lower portion of the side wall 232 and carries a sleeve portion 242 which is slidably adjustable on a stud 244 which is riveted to a little bracket 246 fastened to the rear of the vertical fin 218, thus giving the side wall 232 a third point of support. A bolted-on extension side wall 248 projects downwardly from the side wall 232 and terminates in a curved edge 250 which is arranged to slightly overlap the corresponding end of the work and act as an abutment therefor. This extension takes the thrust induced on the work by the skewed idler 120 and preferably has hardened inserts 251 (Fig. 17) to take the wear. The side wall 210 also has a separate bolted-on extension 252 but this preferably does not overlap the work as the wheel flange 64 is in the same plane and prevents axial movement of the work. An escapement or baffle plate 254 (Fig. 4) projects between the bolted-on extensions 248 and 252, and is attached by a screw 256 to a portion of the guard 142. This escapement or baffle plate co-operates with the magazine lip 220 to retain the articles in the magazine and it is lifted with the pressure idler 120 to release or drop a new piece onto the ejector 198 which then lowers the piece to grinding position as indicated in Figs. 14 to 17.

For actuating the rock shaft 172, a lever 260 (Fig. 8) has its hub 262 keyed to one end of the shaft, the longer arm of the lever having a concave seat for arcuate side ribs 264 on a washer 266 which rests on a coiled expansion spring 268. The spring bears against a flange 270 on a hollow enlargement 272 of an adjusting rod 274 having a hand wheel 276. A rod 278 is threaded in the enlargement 272 and has its lower end anchored by a screw 280 to the filler plate 12. The coil spring urges the rock shaft 172 clockwise in Fig. 8 and its tension can be adjusted by turning the hand wheel. The short arm of the lever 260 has a recessed seat 282 for a ball-ended rod 284 whose lower end is seated in a recess of a plunger 286 which is slidable vertically in a bushing 288 carried by the base plate 48. The downward movement of the plunger is limited by a flange 290 and the plunger is held from turning by a key pin 292 entering a slot in the bushing 288.

The lower end of the plunger carries a cam roll 294 running on the upper surface of a cam plate 296 contained in the previously mentioned notch 20 in the filler plate 12. The cam plate is anchored against shifting movement as will appear while all the adjacent parts reciprocate with the table or slide. The cam plate is accordingly supported on several rows of balls held in openings of a separator plate 298 and running on a flat race plate 300, all these parts being contained in the slot 20. The cam plate has a cam incline 302 (Fig. 2) which co-operates with the cam roller 294 to reciprocate the plunger 286. A notch is formed in one side of the incline and one end of it is provided with a second cam 304 for operating a gauge rod as will appear. To anchor the cam, a tie rod 306 (Fig. 1) is threaded in one end of the cam plate and locked by a nut 308. The other end of the tie rod is threaded in one end of an anchor screw 310 and locked thereto by a nut. The anchor screw is adjustably secured in a bracket 312 on the main frame by nuts 314. This anchors the cam plate from movement although, by turning the nuts 314, the cam plate can be adjusted endwise in order that the cam inclines 302 and 304 will come into action at the proper time in the reciprocation of the work head.

During grinding, the work-piece W is gauged upon every reciprocation of the work head. There are two gauge plugs 320 (Fig. 1) differing slightly in diameter with the smaller in advance. As the work approaches size, the smaller plug enters the work and controls an amplified reciprocation of the work head so that the grinding wheel can be dressed by any suitable mechanism. As grinding is resumed and the work reaches size, the second gauge plug enters and controls a final retreating movement of the work head during which the work is ejected. These amplified movements are effected by suitable trip mechanism acting on a reversing mechanism and are well known in the art. The gauge discs 320 are secured to the end of a shiftable gauge rod 322 which is hollow to provide a passage 324 for liquid cooling medium. The gauge rod is mounted for rotation and for reciprocation in a pair of roller bearings 326 carried in recesses at the opposite ends of a supporting sleeve 328. The bearing nearest the grinding wheel is provided with a suitable packing held in a threaded cap 329. The sleeve is clamped in an opening of a cross slide 330 by a hand screw 331, the slide being adjustable from front to rear on ways 332 under control of a screw 334 which is mounted for rotation without endwise movement in a plate 336. This adjustment is to keep the gauge plugs 320 concentric with the work, it being understood that work-pieces of all sizes are supported at the same level but that larger pieces have their centers farther to the front.

The gauge rod 322 has one end passed through a horizontal slot 338 in an upright bracket 340 (Figs. 1, 9, 10 and 18) having ball thrust bearings 342 at each side, one such bearing engaging a shoulder 344 of the gauge rod and the other bearing being held on the gauge rod by nuts 346. The bearings provide for rotation of the gauge rod, and the horizontal slot permits the before-mentioned horizontal adjustment of the gauge rod by the cross slide 330. The end of the hollow gauge rod is flared to form a conical seat for a conical surface on a hollow head 348 to which cooling medium is supplied by a flexible pipe 350. A leaf spring 351 attached to the bracket 340 holds the conical surfaces seated. The lower portion of the bracket 340 has an enlarged sleeve portion 352 adjustably secured to the threaded end of a control rod 354 by nuts 356, this adjustment depending on the length of the work-pieces. The control rod is slidably mounted in bushings 358 and 360 secured in horizontal openings in the filler plate 12. The opening nearest the grinding wheel is sealed-up by packings 362 held by a cover plate 364. The corresponding end of the control rod 354 is arranged in line with an abutment screw 365 adjustably carried by any convenient stationary portion of the grinding wheel support. This abutment will prevent the gauge plugs 320 from coming in contact

with the grinding wheel as when the work and the gauges finish their strokes towards the grinding wheel. When the work head is retracted to inoperative position, the gauge plugs are moved away from the work, as will appear, but whenever the work head advances to grinding position, the gauge plugs are urged against the end of the work by spring pressure.

An arm 366 projects forwardly from the bracket 340 and is provided with a guide sleeve 368 slidably supported on a guide rod 370 which is fixed by a set screw in the beforementioned lug 24 of the filler plate 12. A lug 374 projecting downwardly from the guide sleeve 368 adjustably supports a threaded rod 376 connected to a coil spring 378 which is anchored at 380 to the reciprocating table or slide 8. A sleeve 382 (Fig. 6) is pinned to the control rod 354 and has a forwardly projecting bracket or arm 384 which is slidably guided by the guide rod 370. The arm 384 has a depending portion 386 in which a pair of knock-off screws 388 are adjustably secured by nuts 390. These screws are arranged to strike successively against dogs 392 (Fig. 4) projecting from a housing 394. The dogs mechanically control the reversing mechanism of the reciprocating table, the first dog being actuated when the smaller gauge plug enters the work and the second being actuated when the larger gauge plug enters. To control the movement of the gauge plugs into yielding contact with the work by means of the coil spring 378, a split collar 396 is clamped to the control rod 354 and has an upwardly projecting roller stud 398 bearing against a cam-operated lever 400. The lever has an upwardly projecting pivot stud 402 and a short arm carrying a cam roller 404 which runs along the vertical side of the cam plate 296 to and from the side cam 304. The lever is contained in a recess 406 of a holding plate 408 which is partially contained in a recess 410 of the base plate 48.

While the cam roller 404 is in contact with the vertical side of the cam plate 296, the gauge plugs are held back a little way from the work but when the work head advances far enough for the cam roller to pass the side cam 304, the smaller plug will yieldingly engage the end of the work piece to test the size of the bore. The plugs will be frictionally rotated by contact with the work. As the gauge plugs continue to advance (while yieldingly held against the advancing work) and approach closely to the grinding wheel, the control rod 354 will strike the adjustable abutment screw 365 and arrest the gauge parts from further advance although the work and its supports will continue the stroke until the remaining surface of the work has traversed over the grinding wheel. As the reciprocating table then reverses, the control rod 354 leaves the abutment screw 365 and the work catches up to and again engages the gauge plugs. When the work is ground down so that the first gauge plug enters the work, one of the dogs 392 is actuated to cause an amplified withdrawal stroke of the table so that the grinding wheel can be dressed. When the second gauge plug enters the completed work, the other dog 392 is actuated and the table makes a final retreat. In this retreat, the gauge plugs are retracted under control of the side cam 304, and the pressure idler 120 is lifted under control of the cam 302. The ejector 198 is of course lifted also and the finished piece thereby pushed over the supporting idler 66 to the exit chute 110. Meanwhile the remaining workpieces in the magazine are held back by the ejector and the escapement or baffle plate 254. In the next grinding cycle, the work head advances and the ejector lowers the next piece down to grinding position while the pressure idler comes down and engages the piece. Then the gauges advance and yieldingly engage the work as before. The preferred directions of rotation of the wheels are indicated by the arrows in Fig. 14.

Figs. 11 and 12 illustrate a modification of the feeding and ejecting mechanism. A swinging arm 420 is pivoted on the shaft 74 and carries an arcuate plate 422 which just clears the regulating wheel 54. One end of the plate forms an ejector 424 for lifting the piece over the idler 66, the arcuate plate thereafter catching the next piece released from the magazine and the ejector subsequently letting the piece down to grinding position. To actuate the arm 420, a link 426 is pivotally connected to it and to an extension 428 of the arm 144. The extension has a slot 430 for an adjustable pivot 432 so that the throw of the link and ejector can be adjusted. With this construction, the ejector is carried by the idler wheel 66 and does not need adjustment with respect to the latter when the slide 82 is moved along its incline.

In both forms, the magazine outlet lies adjacent to the work receiving space and between the pressure idler 120 and the regulating wheel 54 while the ejector normally lies between the supporting idler 66 and the regulating wheel. With a short throw of the ejector to a location directly over the low supporting idler, or between such idler and the magazine, the finished work is pushed through the discharge space to the inclined chute. Meanwhile the baffle plate 254 has released the next following work-piece which drops onto the ejector and regulating wheel. This piece is lowered by the ejector to grinding position, the baffle plate and pressure idler returning to normal position with the ejector, and the baffle plate arresting the remaining workpieces. The ejecting and loading is accomplished simply, directly and quickly by a simultaneous and short movement of ejector, baffle plate and pressure idler, all operated from a single rock shaft.

Assuming a work-piece is in grinding position, the work-head reciprocates to traverse the work across the grinding wheel. On each stroke of the right in Fig. 1, the cam roller 404 reaches the cam 304 and releases the lever 400, the lever releasing the control rod 354. The coil spring 378 urges the smaller gauge plug 320 against the end of the work to test its diameter. The plug cannot reach the grinding wheel because the control rod 354 will previously be arrested by contact with the abutment screw 365. When the smaller gauge plug enters the work, the control rod and the knock-off screws are permitted a little extra movement to the right, sufficient for one of them to operate one of the dogs 392. This results in an amplified withdrawal movement of the work head to the left during which interval the grinding wheel may be dressed and the cross-feed reduced according to the common practice. Grinding is resumed and continued until the second gauge plug enters the work. This gives the other knock-off screw 388 a little further advance to actuate its co-operating dog 392. This controls the final remote retreat of the work head to the left. The cam roller 404 leaves the cam 304 and rides along the side of the anchored

cam plate 296 thus removing and holding the gauge away from the finished work. When the cam roller 298 rides up the cam incline 302, the pressure idler and ejector operate as indicated in Figs. 14 to 17 and described in the preceding paragraph to eject the finished work and introduce a new work-piece.

I claim:

1. In a machine of the character described, a pair of work supporting members at different levels for engaging a round work-piece at angularly spaced locations, a pressure member opposed to the supporting members for holding the work against them, means for moving the pressure member to provide a work discharge space between it and the lower one of the supporting members, and means for pushing the work radially into the discharge space to discharge it over the lower supporting member and laterally thereof; substantially as described.

2. In a machine of the character described, a pair of work supporting members at different levels for engaging a round work-piece at angularly spaced locations, a pressure member opposed to the supoprting members for holding the work against them, means for moving the pressure member to provide a work discharge space between it and the lower one of the supporting members, an ejector between the work supporting members, and means for moving the ejector to a point above said lower supporting member to roll the work over the latter; substantially as described.

3. In a machine of the character described, a pair of work supporting members for engaging a round work-piece at angularly spaced locations, a pressure member opposed to the supporting members for holding the work against them, an arm carrying the pressure member, means for moving the arm to provide a work discharge space between the pressure member and one of the supporting members, an ejector for raising the work radially over one of the supporting members into said discharge space, an arm connected to the ejector, and a common actuating means for moving the arms of the pressure member and the ejector in the same direction to cause the ejector to push the work-piece into said discharge space as said space increases; substantially as described.

4. In a machine of the character described, a pair of work supporting members for engaging a round work-piece at angularly spaced locations, a pressure member opposed to the supporting members for holding the work against them, means for moving the pressure member to provide a work discharge space between it and one of the supporting members, an ejector between the pair of supporting members, means for moving the ejector out from between the supporting members to push the work-piece between the pressure member and said one supporting member, and a magazine having an outlet portion to introduce a work-piece between the pressure member and the other supporting member; substantially as described.

5. In a machine of the character described, a pair of work supporting members for engaging a round work-piece at angularly spaced locations, a pressure member opposed to the supporting members for holding the work against them, means for moving the pressure member to provide a work discharge space between it and one of the supporting members, a magazine having an outlet portion between the pressure member and the other supporting member, and means for ejecting a work-piece radially through said space; substantially as described.

6. In a machine of the character described, a pair of work supporting members for engaging a round work-piece at angularly spaced locations, a pressure member opposed to the supporting members for holding the work against them, a magazine having an outlet portion between the pressure member and one of the supporting members, a mounting for shifting the presure member away from both of the supporting members to provide a space for discharge of a work-piece between the pressure member and the other one of the supporting members and a second space for inserting a new piece between the pressure member and said one supporting member, and means for ejecting a work-piece radially through said first mentioned space; substantially as described.

7. In a machine of the character described, a pair of work supporting members, a pressure member opposed to the supporting members, an ejector, a magazine having an outlet portion between the pressure member and one of the supporting members, and means for shifting the pressure member and the ejector in a direction away from both the supporting members to introduce a new work-piece between the pressure member and said one supporting member and to eject a work-piece radially between the pressure member and the other supporting member; substantially as described.

8. In a machine of the character described, a pair of work supporting members, a pressure member opposed to the supporting members, an ejector between the supporting members, a magazine having an outlet portion between the pressure member and one of the supporting members, and means for shifting the ejector to a location between the other supporting member and the magazine outlet to eject a work-piece transversely over said other supporting member and receive another work-piece on the ejector and said one supporting member from said outlet; substantially as described.

9. In a machine of the character described, a pair of work supporting members, a pressure member opposed to the supporting members, an ejector between the supporting members, a magazine having an outlet portion between the pressure member and one of the supporting members, means for shifting the ejector to a location between the other supporting member and the magazine outlet to eject a work-piece over said other supporting member, and a baffle plate movable with respect to the magazine outlet to release another work-piece from the outlet to the ejector; substantially as described.

10. In a machine of the character described, a pair of work supporting members at different levels for engaging a round work-piece at angularly spaced locations, an ejector between the supporting members, a magazine having an outlet portion adjacent to the work-receiving space, means for reciprocating the ejector to and from a point in the work-receiving space to eject a work-piece over the lower one of the supporting members and to lower another work-piece onto the supporting members, and a baffle plate for retaining work-pieces in the magazine outlet and movable to release said other work-piece onto the ejector; substantially as described.

11. In a machine of the character described, a pair of work supporting members at different levels for engaging a round work-piece at angu-

larly spaced locations, an ejector between the supporting members, means for shifting the ejector into and out of a position directly over the lower one of the supporting members to eject a work piece over said lower supporting member, and means for causing another work-piece to engage the ejector in said ejecting position; substantially as described.

12. In a machine of the character described, a pair of work supporting members at different levels for engaging a round work-piece at angularly spaced locations, an ejector between the supporting members and arranged to engage the periphery of the work-piece, a magazine having an outlet portion adjacent to the work-receiving space, a baffle plate shiftable with respect to the outlet, an inclined exit chute substantially tangent to the lower supporting member, means for shifting the ejector into and out of a position directly over the lower one of the supporting members to discharge the work onto said exit chute, and means for causing the baffle plate to shift simultaneously with the ejector; substantially as described.

13. In a machine of the character described, a pair of work supporting members at different levels for engaging a round work-piece at angularly spaced locations, an exit chute inclined downwardly away from the lower one of the supporting members and substantially tangent to its upper surface, a work ejector between the work supporting members and mounted to shift therefrom to a position over the lower supporting member, and means for actuating the ejector substantially radially against the outer periphery of the work-piece to roll the work-piece transversely over said lower supporting member to the exit chute: substantially as described.

14. In a machine of the character described, a pair of work supporting members one of which is a regulating wheel, a magazine having an outlet portion adjacent to the regulating wheel, one of the side walls of the magazine overlapping one end of a work-piece carried on the supporting members, and means for urging the work-piece against said side wall; substantially as described.

15. In a machine of the character described, a pair of work supporting members one of which is a regulating wheel, a magazine having an outlet portion adjacent to the regulating wheel, the wheel having a projecting flange overlapping one end of a work-piece, and the magazine having a side wall overlapping the other end of the work-piece; substantially as described.

16. In a machine of the character described, a pair of work supporting members one of which is a regulating wheel, a pressure wheel opposing the supporting members, a magazine having an outlet portion adjacent to the regulating wheel, one of the walls of the magazine overlapping one end of a work-piece, and the pressure wheel being skewed with respect to the work-piece to urge it against the overlapping side wall; substantially as described.

17. In a machine of the character described, a pair of work supporting members one of which is a regulating wheel, a magazine having an outlet portion adjacent to the regulating wheel, the rear wall of the magazine having a terminal portion substantially tangent to the wheel, and the magazine also having a side wall arranged to overlap one end of a work-piece carried on the supporting members; substantially as described.

18. In a machine of the character described, a pair of work supporting members one of which is a regulating wheel, a magazine having an outlet portion adjacent to the regulating wheel, the rear wall of the magazine having a terminal portion close to the regulating wheel, a work retaining and releasing member at the front of said outlet, and means for moving said last member towards or from said rear wall; substantially as described.

19. In a machine of the character described, a pair of work supporting members one of which is a regulating wheel, a magazine having an outlet portion adjacent to the regulating wheel, the rear wall of the magazine having a terminal portion substantially tangent to the wheel, the magazine having a side wall overlapping one end of a work-piece carried on the supporting members, and a work retaining and releasing baffle at the front of said outlet and movable towards and from said rear wall; substantially as described.

20. In a machine of the character described, a pair of work supporting members for engaging a round work-piece at angularly spaced locations, a pressure member opposed to the work supporting members, a work ejector between the supporting members, and a rock shaft having arms carrying the pressure member and the ejector; substantially as described.

21. In a machine of the character described, a pair of work supporting members for engaging a round work-piece at angularly spaced locations, an ejector between the supporting members, a rock shaft having an arm carrying the ejector, means for adjusting one of the supporting members with respect to the other, and means for varying the length of the ejector carrying arm; substantially as described.

22. In a machine of the character described, a pair of work supporting members for engaging a round work-piece at angularly spaced locations, a pressure member opposed to the work supporting members, an ejector between the supporting members and adjacent to the periphery of the work-piece, means for moving the pressure member towards and away from the supporting members, and an operating connection between the ejector and said moving means for shifting the ejector substantially radially against the periphery of the work-piece from its position between the supporting members; substantially as described.

23. In a machine of the character described, a pair of work supporting members for engaging a round work-piece at angularly spaced locations, a pressure member opposed to the work supporting members, an ejector, an arm for swinging the pressure member, and a link connecting the arm with the ejector; substantially as described.

24. In a machine of the character described, a pair of work supporting members for engaging a round work-piece at angularly spaced locations, a pressure member opposed to the work supporting members, an ejector having a supporting arm pivotally carried by one of the supporting members, an arm for swinging the pressure member, and a connection between the arms; substantially as described.

25. In a machine of the character described, a pair of work supporting members for engaging a round work-piece at angularly spaced locations, a pressure member opposed to the work supporting members, an ejector having a supporting arm pivotally carried by one of the supporting members, means for adjusting said one supporting member with respect to the other, an arm for swinging the pressure member, and a link

connected to one of the arms and having an adjustable connection with the other; substantially as described.

26. In a machine of the character described, means for rotatably supporting a round work-piece and including a wheel peripherally engaging the work-piece, a shaft rotatably supporting the wheel, a shaft support comprising an arm surrounding the shaft, and means acting between the shaft and the surrounding arm to tilt the shaft transversely therein for skewing the wheel with respect to the work-piece; substantially as described.

27. In a machine of the character described, work supporting means, a pressure wheel opposed to the work supporting means, a shaft rotatably supporting the wheel, a shaft support having a pair of arms surrounding the shaft, and opposed screws threaded in one of the arms to tilt the shaft transversely for skewing the wheel with respect to a work-piece on the work supporting means; substantially as described.

28. In a machine of the character described, means for rotatably supporting a round work-piece and including a wheel peripherally engaging the work-piece, a shaft rotatably supporting the wheel, a shaft support having means for tiltably supporting one end of the shaft, and means for shifting the other end of the shaft with respect to the support to skew the wheel and thereby urge the work-piece endwise; substantially as described.

29. In a machine of the character described, means for rotatably supporting a round work-piece and including a wheel peripherally engaging the work-piece, a shaft rotatably supporting the wheel, a shaft support, one end of the shaft having a ball and socket engagement with the support, and means acting between the support and another portion of the shaft to skew the shaft and wheel with respect to the work-piece; substantially as described.

30. In a machine of the character described, means for rotatably supporting a round work-piece and including a wheel peripherally engaging the work-piece, a shaft rotatably supporting the wheel, a shaft support having a pair of arms, one of the arms providing a tiltable mounting for the shaft, and a pair of opposed adjusting members interposed between the other arm and the shaft; substantially as described.

31. In a machine of the character described, means for rotatably supporting a round work-piece and including a wheel peripherally engaging the work-piece, a shaft rotatably supporting the wheel, a shaft support having a pair of arms, one of the arms having a socket, the shaft having a ball in the socket, the other arm having an opening for the shaft, and means for shifting the shaft crosswise of the opening; substantially as described.

32. In a machine of the character described, work supporting means, a work abutment, a pressure wheel opposed to the work supporting means, a shaft rotatably supporting the wheel, a shaft support comprising a pair of arms, one end of the shaft having a ball and socket engagement with one of the arms, the other arm having an opening for the other end of the shaft, and means for shifting said other end of the shaft crosswise of the opening to skew the wheel with respect to a work-piece on the supporting means; substantially as described.

33. In a machine of the character described, a wheel, a shaft rotatably supporting the wheel, a shaft support having a pair of arms, one of the arms providing a tiltable support for the shaft, the other arm having an opening for the shaft, a thimble on the shaft and having opposite sides provided with flats, and opposed screws in said other arm and engaging the flats; substantially as described.

34. In a machine of the character described, a frame, a work head having a guide slot, a gauge, a cam in the guide slot and anchored to the frame, means for reciprocating the work head with respect to the frame, a cam follower carried by the work head, and means connected to the cam follower for causing the movement of the cam follower along the cam to shift the gauge; substantially as described.

35. In a machine of the character described, a frame, a work head having a guide slot, a cam in the guide slot and anchored to the frame, the work head having a member movable to release a work-piece, a cam follower carried by the work head, and means connected to the cam follower for causing the movement of the cam follower along the cam to shift the movable member away from the work-piece; substantially as described.

36. In a machine of the character described, work holding means having a member movable into or out of holding engagement with a work-piece, a rock shaft for moving the member, an arm connected to the shaft, a pair of opposed abutments, one of the abutments being on the arm and the other abutment being normally stationary, a coil spring engaging the abutments, a rod extending into the coil spring, the rod and said other abutment having a threaded connection whereby relative rotation will shift said other abutment; substantially as described.

37. In a machine of the character described, work holding means having a member movable into or out of engagement with a work-piece, a rock shaft for moving the member, an arm connected to the rock shaft, a rotatable rod extending through the arm and having an abutment, a spring between the abutment and the arm and surrounding the rod, the rod having a portion provided with internal threads, and a screw anchor member engaging said internal threads; substantially as described.

38. In a machine of the character described, work holding means having a member movable into or out of engagement with a work-piece, a rock shaft for moving the member, an arm connected to the shaft, a rotatable member carrying a spring abutment, a spring between the abutment and the arm, and an anchoring member having screw threaded engagement with the abutment carrying member; substantially as described.

39. In a machine of the character described, work supporting and rotating means comprising a rotatable regulating wheel for peripheral rolling engagement with a round work-piece, means for holding the work-piece in rolling contact with the wheel, a grinding member opposed to the regulating wheel, means for causing the grinding member and the regulating wheel to have relative reciprocation to grind the work-piece, a ring at the end of the regulating wheel and forming an annular projection extending beyond the periphery of the wheel, and means for detachably securing the ring to the end of the wheel to provide for facing the periphery of the wheel by the grinding member when the ring is removed; substantially as described.

40. In a machine of the character described, work supporting and rotating means comprising a rotary wheel, a bracket having a chamber with an outlet slot adjacent to the wheel, and means for supplying coolant to the chamber; substantially as described.

41. In a machine of the character described, a magazine having a side wall provided with a laterally projecting work supporting fin, a companion side wall having a slot for the fin, and means for adjustably supporting the companion side wall at selected distances from the first side wall; substantially as described.

42. In a machine of the character described, a magazine having a side wall provided with laterally projecting work supporting fins, one of the fins sloping downwardly towards the rear, another of the fins forming a bottom wall sloping downwardly towards the front, and a companion side wall spaced from the first side wall; substantially as described.

43. In a machine of the character described, a magazine having a side wall provided with laterally projecting work supporting fins, one of the fins sloping downwardly towards the rear, another of the fins forming a bottom wall sloping downwardly towards the front, and another of the fins forming a front wall; substantially as described.

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