Sept. 4, 1934. R. E. W. HARRISON ET AL 1,972,623

GRINDING MACHINE

Filed March 7, 1932 4 Sheets-Sheet 1

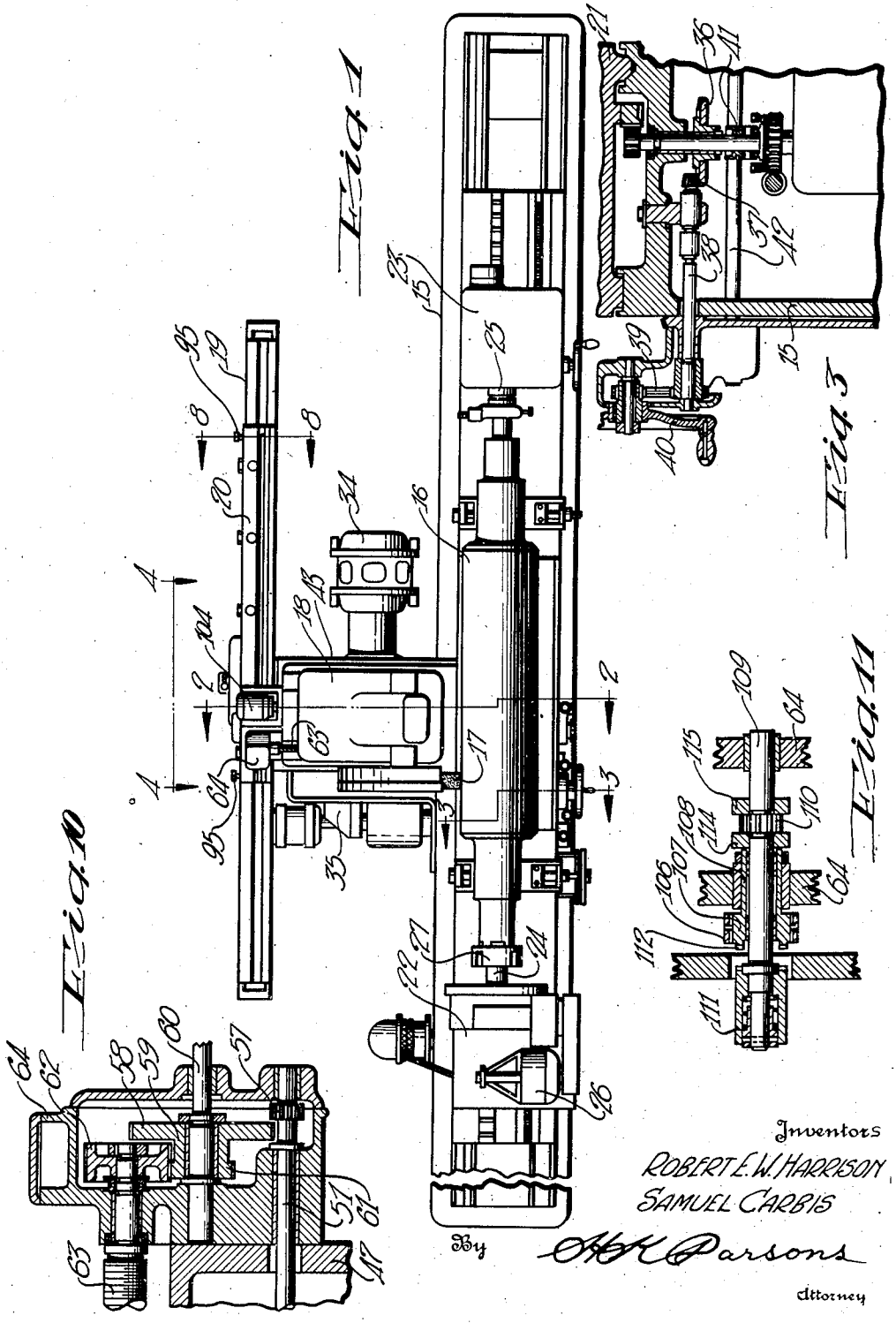


Fig. 1

Fig. 3

Fig. 11

Fig. 10

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GRINDING MACHINE

Filed March 7, 1932 4 Sheets-Sheet 2

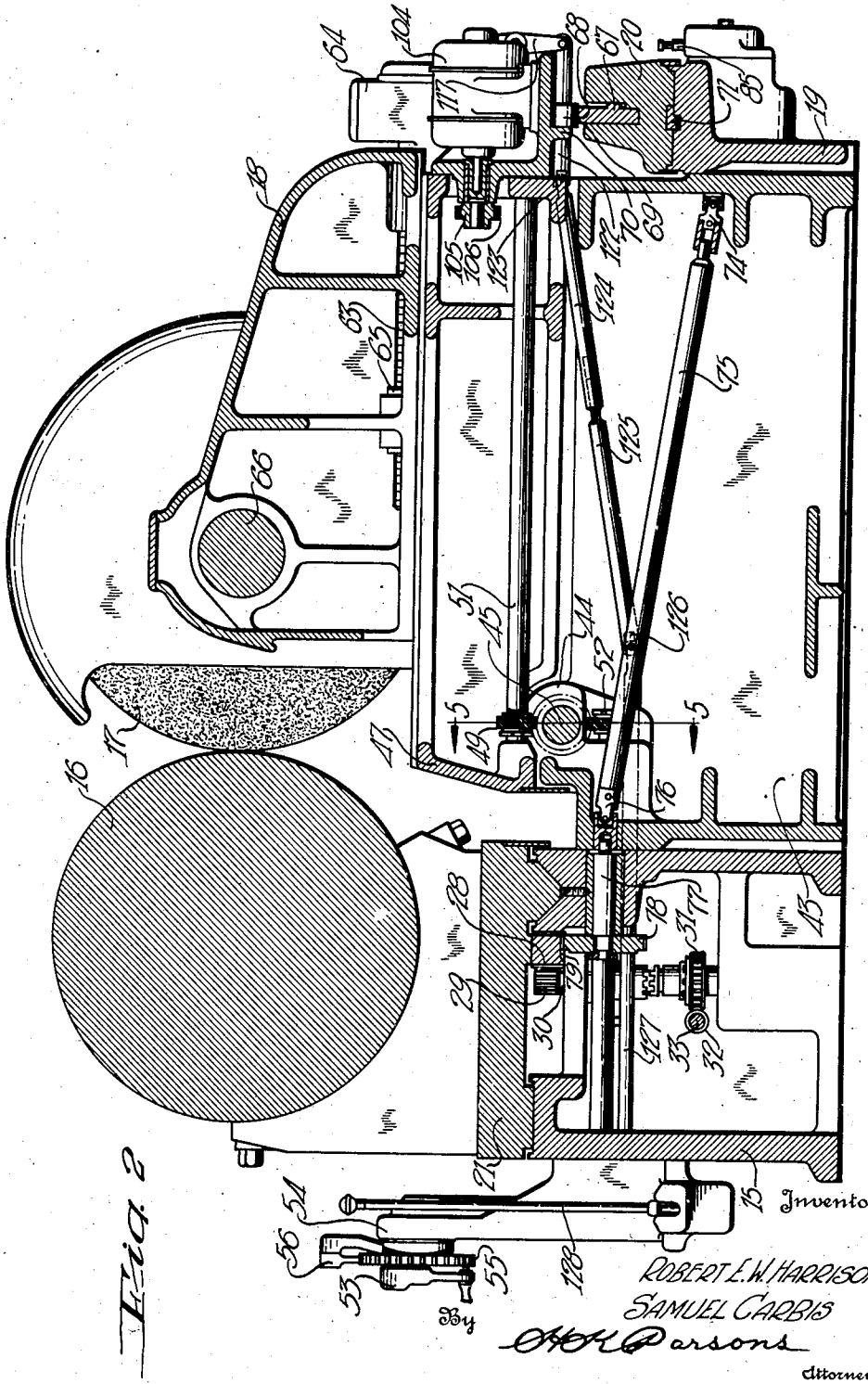


Fig. 2

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GRINDING MACHINE

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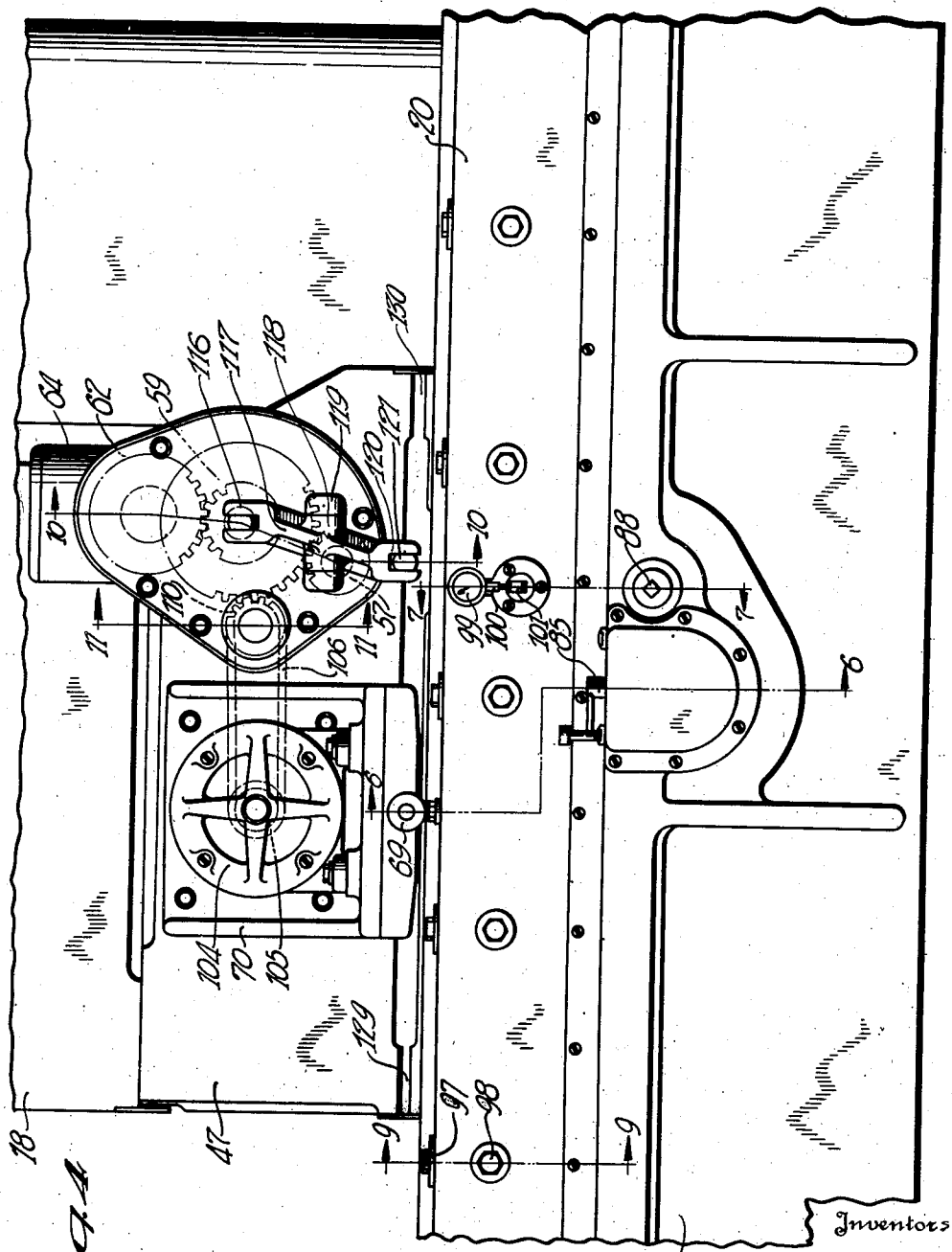


Fig. 4

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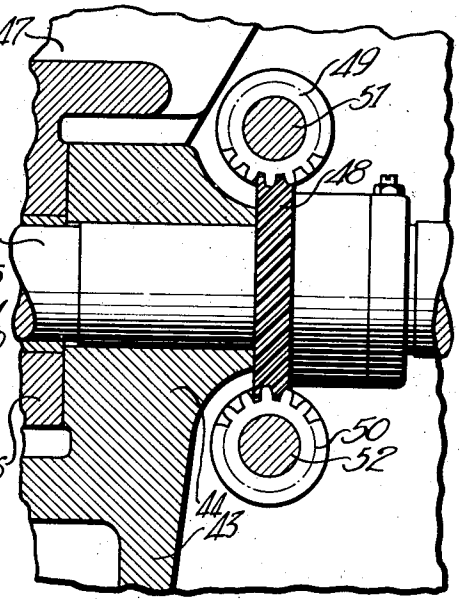
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GRINDING MACHINE

Filed March 7, 1932 4 Sheets-Sheet 4

Fig. 5



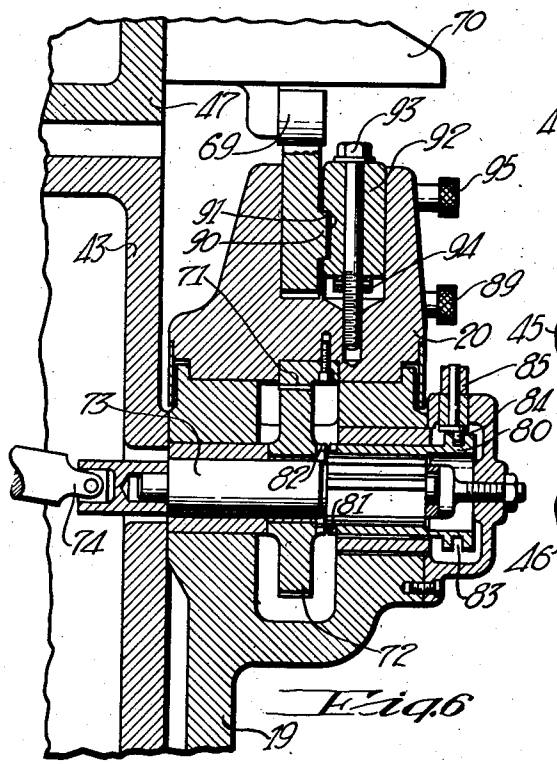


Fig. 6

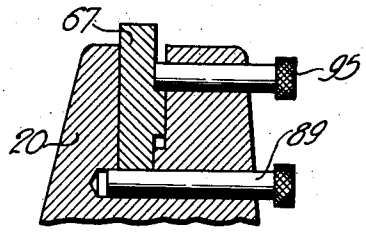


Fig. 8

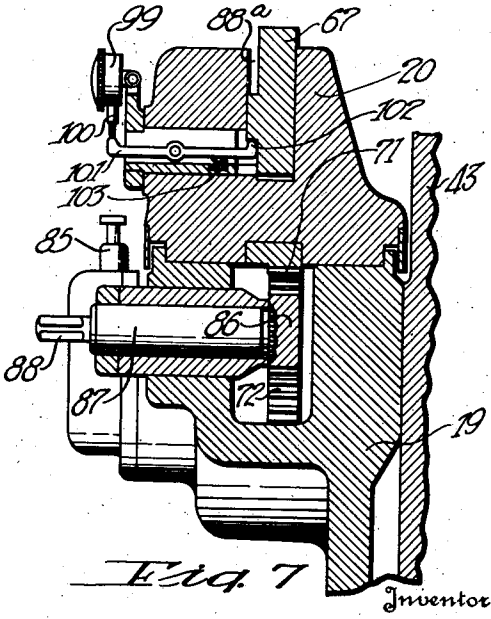


Fig. 7

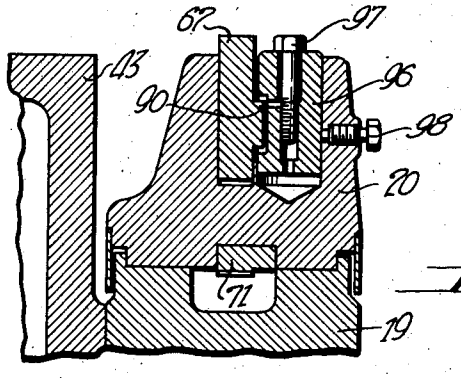


Fig. 9

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UNITED STATES PATENT OFFICE

1,972,623

GRINDING MACHINE

Robert E. W. Harrison, Cincinnati, Ohio, and Samuel Carbis, Tarentum, Pa.; said Harrison assignor to Cincinnati Grinders Incorporated, Cincinnati, Ohio, a corporation of Ohio

Application March 7, 1932, Serial No. 597,272

20 Claims. (Cl. 51—100)

This invention relates to improvements in grinding machines and especially to improvements in a mechanism for effecting contoured grinding of rolls or the like.

An object of the invention is the provision of an improved grinding machine adapted for cambering; that is, for providing various crowns on cylindrical work pieces.

Another object of the invention is the provision of a simple rugged mechanism adapted for crowning or concaving rolls such as used in rolling mills, paper mills, and the like.

A further object of the invention is the provision of a cambering attachment for use with cylindrical grinding machines that can be readily adjusted for changing the setup thereof, whereby different lengths of work pieces may have the same crown or concave formed thereon and whereby the same length of work pieces may have different degrees of crown or concavity and which cambering attachment when once adjusted and clamped in position retains said setting and will produce successive work pieces to the same size and form regardless of wear on the grinding wheel.

A still further object of the invention is the provision of a templet controlled cambering attachment which templet has the desired camber, either crown or concavity formed thereon, which is to be reproduced on the work.

Other objects and advantages of the present invention should be readily understood by reference to the accompanying drawings illustrating one embodiment of the invention and described in the appended specification, and it is to be understood that modifications may be made in the exact structural details there shown and described without departing from or exceeding the spirit of the invention as defined in the appended claims.

In the drawings:

Figure 1 is a top plan view of a grinding machine embodying the improvements of this invention.

Figure 2 is a sectional view taken on line 2—2 of Fig. 1.

Figure 3 is a fragmentary, sectional view taken on line 3—3 of Figure 1.

Figure 4 is a fragmentary, elevational view of certain parts of the machine as seen from line 4—4 of Figure 1.

Figure 5 is a sectional view on line 5—5 of Figure 2.

Figure 6 is a sectional view taken on line 6—6 of Figure 4.

Figure 7 is a sectional view taken on line 7—7 of Figure 4.

Figure 8 is a sectional view taken on line 8—8 of Figure 1.

Figure 9 is a sectional view taken on line 9—9 of Figure 4.

Figure 10 is a sectional view taken on line 10—10 of Figure 4.

Figure 11 is a sectional view taken on line 11—11 of Figure 4.

Throughout the several views of the drawings similar reference characters are employed to denote the same or similar parts.

In the manufacture and finishing of large rolls which are utilized in rolling mills, paper mills and the like, it is frequently necessary or desirable to camber the same by providing either a slight convexity or concavity to the surface thereof. This cambering of the rolls must be very accurately formed and held within extremely fine limits. A device for accomplishing this result is illustrated in the drawings and comprises generally a bed 15 supporting a work piece 16 thereon for presentation to a grinding wheel 17 carried by the usual carriage 18 which is movable toward and from the work to effect a relative feed therebetween. In addition, a second base 19 is provided supporting a reciprocating carriage or table 20 for controlling the movement of the carriage 18 toward and from the work 16, which movement is supplementary to the normal feed thereof.

Specifically, the device comprises a work supporting table 21 mounted upon suitable ways formed on the bed 15 for traversing the work 16 longitudinally past the active face of the grinding wheel 17. The work 16 is held on the table 21 between an adjustable head stock 22 and an adjustable tail stock 23, which are respectively provided with driving spindles 24 and 25. The head stock 22 supports a prime mover or motor 26, whereby motion is imparted to the spindle 24 and through coupling 27 to the work or roll 16. The table 21 is provided on its under surface with a rack 28 meshing on one side with a pinion 29 integral with or secured to vertical shaft 30 which is driven through a worm wheel 31 and worm 32 on shaft 33. The shaft 33 receives its power from the main prime mover or motor 34 through suitable driving coupling and speed changer 35.

From this it will be seen that the work may be traversed at various rates of speed past the tool or grinding wheel while the same is effecting a stock removal from the surface thereof.

By reference to Figure 3 it will be noted that the

said table may be manually adjusted or shifted when the power is cut off therefrom through the bevel gear 36 and pinion 37 integral with or secured to shaft 38. The shaft 38 is coupled at its forward end through silent chain 39 with the manually actuable hand wheel 40. The vertical shaft 30 which carries the pinion 29 may be coupled with either the worm wheel 31 or the bevel pinion 36 by means of a double faced clutch 41 splined or otherwise slidably secured to the said vertical shaft 30. The clutch 41 is adapted to be shifted to either of its operative positions through an oscillatable shaft 42 carrying on its end exteriorly of the bed 15 a suitable shift lever or the like, not shown.

The bed 15 has secured thereto and extending rearwardly therefrom a bed extension 43 which is provided at its end adjacent the main bed 15 with trunnion ears 44 in which is journaled a pivot shaft 45. The pivot shaft 45 also extends through ears or lugs 46 depending from bed plate 47 superimposed on the bed extension 43. The pivot shaft 45, as seen in Figure 5, has secured thereto a spiral gear 48 adapted to mesh on diametrically opposite points with spiral pinions 49 and 50, the former being secured to a shaft 51 extending beneath the bed plate 47 and the latter being secured to a feed shaft 52 extending forwardly through the bed 15. The shaft 52 is coupled in the usual manner with the hand wheel 53 for manually actuating same, as well as with the usual feed mechanism indicated in the drawings by the numeral 54 and terminating in the ratchet 55 and pawl 56 to effect an intermittent feed. The shaft 51 has on its rearward end the shiftable pinion 57 adapted to mesh with gear 58 of compound gear 59 loosely journaled on slidable shaft 60. The pinion 61, of the compound gear 59, meshes with a wide faced gear 62 on the end of a cross feed screw 63 having one end journaled in a housing 64 secured to the bed plate 47 by any suitable or desirable means. The screw 63 is threadedly connected with a nut 65 carried by the grinding wheel carriage 18 which is adapted to be actuated along the ways of the bed plate 47. A grinding wheel spindle 66 is journaled in the carriage 18 and has secured to one end thereof the grinding wheel 17.

From the foregoing it will be noted that the carriage 18 and wheel 17 may be fed toward and from the work along the ways provided on the upper surface of the bed plate 47 either manually through the hand wheel 53 or by power means through the ratchet and pawl 55—56. It should be noted that the feed continues regardless of the angular position of the bed plate 47 to the bed extension 43, due to the oscillation of the bed about the axis of the pivot shaft 45, because as the said plate is oscillated the pinions 49 and 50 maintain constant driving connection with the gear 48, the one being actuated in an arcuate path about the other.

The plate 47, carriage 18 and grinding wheel 17 are oscillated toward and from the work to effect a concaved or convexed surface thereon. This oscillation is effected by means of a cam bar 67 which has its upper surface 68 bent or formed to conform with the desired contour or camber to be reproduced on the work. Contacting with the said surface 68 of the bar 67 is a roller 69 rotatably carried by the motor bracket 70 which is secured to the rear end of the bed plate 47. The cam bar 67 is carried by the carriage 20 which is mounted on the upper surface of the supplemental bed or bracket 19 secured intermediate its ends to the rear surface of the bed extension 43 and resting upon the supporting floor or ground. In order that the contour is uniform throughout the length of the work, the carriage 20 moves at the same rate as the work and throughout the same distance. This movement is accomplished by securing to the under surface of the carriage a rack 71 meshing with a pinion 72 on the end of a stub shaft 73. The shaft 73 is connected by a universal joint 74 with a shaft 75 again connected by a universal joint 76 to a stub shaft 77 journaled in the bed 15. The shaft 77 has secured to it a gear 78 meshing with rack teeth 79 formed on the under surface of the rack 28. It should be noted that the rack bar 28 has formed on one face rack teeth which mesh with the driving pinion 29 and on another face the rack teeth 79 for meshing with the gear 78. These teeth are similar so that actuation of the table 21 through the means above described effect a movement of the cam bar carriage 20 at the same rate that the table 21 is moving.

The end of the stub shaft 73 is provided with splines and has slidable thereon the clutch sleeve 80 having clutch teeth 81 adapted to engage similar clutch teeth 82 on the adjacent end of the gear 72. The other end of the clutch sleeve 80 is provided with a circumferential groove 83 receiving the eccentric pin 84 of clutch shifter 85 whereby the movement of the carriage 20 and bar 67 may be connected or disconnected at will.

Meshing with the gear 72 is a pinion 86 integral with a shaft 87 which extends through and beyond the bed 19 having its outer end milled as at 88 to receive a crank or the like, whereby the carriage 20 and cam bar may be manually adjusted relative to the supplemental bed 19.

To adjust or change the camber to be reproduced on the work 16 the carriage 20 is provided with a slot 88—A in which the cam bar 67 is received. Beneath the slot 88—A and journaled in the carriage 20 there is positioned near the opposite ends thereof a pin 89 limiting the downward movement of the bar 67 through the slot. The slot is provided on one face throughout its length with a lug 90 which is received in a correspondingly shaped opening 91 formed in the adjacent face of adjusting blocks 92. The adjusting blocks 92 are positioned at regular intervals between the supporting pins 89. The blocks 92 have journaled in them and extending therethrough bolts 93 which are threaded into the carriage 20. A collar 94 limits the relative axial movement of the bolts 93 as respects the adjusting block 92 but allows the bolt 93 to swivel therein. As was noted above and as seen in Figures 1 and 4 a plurality of the adjusting blocks 92 and associated parts are provided, being equally spaced between the supporting pins 89. The convexity of the bar 67 is obtained by gradually clamping down on the individual bolts 93 thereby bending the bar uniformly from end to end. In this way the roll is convexed or crowned uniformly from end to end since as the work is traversed past the grinding wheel the carriage 20 will likewise be shifted, thereby oscillating the bed plate 47 about the axis of the pivot shaft 45 as the roller 69 follows the contoured surface of the bar.

In order to concave the rolls the carriage 20 carries at opposite ends thereof and directly above each pin 89 an additional pin 95 which engages with the upper surface of the lug 90 of the bar. In order to therefore convex the bar 67 the contouring screws 93 are actuated upwardly, the bar

to be bent for oscillating which causes the bed plate and parts carried thereby in a counter-clockwise direction or toward the axis of the roll, as the cam bar is actuated therebeneath.

After the cam bar 67 has been adjusted to the desired curvature it is clamped in position by means of blocks 96 and screws 97 and 98. From this it will be seen that successive work pieces are contoured to the exact desired surface regardless of the wear or size of the wheel, since the oscillation takes place about the same center having the operative face of the wheel in the same relation thereto.

To expedite the adjustment in curvature of the bar and to advise the operator of its exact condition there is provided a gauge 99 having a shiftable pin 100 extending therefrom. This pin engages the outer end of the pivotally mounted lever 101, the inner end 102 of which engages the under surface of the cam bar lug 90. To maintain contact between the end 102 and the lug 90 a spring 103 is employed.

Mounted on the motor bracket 70 is a motor 104 having secured to its shaft a silent gear chain pinion 105 for the chain 106 which is in turn trained about gear 107 on sleeve 108. The gear 107 and the sleeve 108 are journaled in the walls of bracket 64 and extending through the sleeve 108 is a sliding shaft 109 having its rear end also slidably mounted in the walls of the bracket 64. The shaft 109 has secured to it a pinion 110 adapted to mesh with the large gear 58 of the compound gear 59. The shaft 109 has keyed or otherwise secured to its forward end clutch member 111 adapted to mesh with clutch teeth 112 extending from the adjacent face of chain gear 107. The compound gear 59, as was noted above, is loosely journaled on the shaft 60, which shaft is in turn slidably mounted in the housing 64 and carries with it during its axial movement the gear 59. As will be noted from Figure 11, the pinion 110 is flanked on opposite sides with collars 114 and 115 which also flank the sides of the large gear 58 of the compound gear 59 so that any movement imparted to the shaft 60 and compound gear 59 is likewise imparted to the pinion 110 and sliding shaft 109.

By this construction the gear 58 may be connected with the pinion 57, as above described, for actuating the screw 63, manually or through the normal intermittent feeding mechanism, as well as, when shifted to the position shown in Figure 10, at which time the clutches 111 and 112 are engaged with the individual motor 104. The motor 104 is adapted to rotate the screw 63 at a rapid rate, thereby rapidly adjusting the carriage 18 and the grinding wheel carried thereby.

In order to shift the shaft 60 it receives on its free end the forked end 116 of lever 117 pivoted intermediate its ends as at 118 to suitable lugs or arms 119 projecting rearwardly from the housing 64. The other end 120 of the lever 117 is likewise furcated, receiving the end 121 of a short shaft 122, journaled in suitable bearings provided on the bed plate 47. The shaft 122 is connected at its inner end by means of a universal joint 123, with an inclined telescoping shaft section 124. Telescoping within the shaft section 124 is the second shaft 125 having its free end likewise connected as by a universal joint 126 with slide rod 127 slidably journaled in bearings provided by the main bed 15. The shaft 127 is suitably connected for axial shifting to a lever 128, which is so connected with the hand feeding and intermittent feeding mechanisms as to cut out said mechanisms when the motor 104 is to be employed.

The connection for effecting the proper cut out is illustrated and claimed in an application of Bernard A. Kearns, filed February 13, 1930, Serial #438,169.

The movement of the telescoping shaft sections 124 and 125 relative to one another is limited to substantially only that amount necessary due to the oscillation of the bed plate 47 so that the shifting thereof through the lever 128 is effective.

In the event it is not desired to utilize the machine for cambering purposes; that is, for grinding crowns or concave contours on the work, either a straight cam bar 67 may be employed, or pillow blocks may be inserted between the bed plate and bed extension 43 at the points 129 and 130 of Figure 4.

It is believed that from the foregoing description, the operation of the improved grinding machine will be readily understood and appreciated.

What is claimed is:

1. In a grinding machine for cambering large rolls the combination of means rotatably supporting the rolls and axially reciprocating same, a rotatable grinding wheel, a carriage therefor, a support for the carriage, means pivotally mounting the support, means for actuating the carriage relative to the support toward and from the work, and additional means for oscillating the carriage and support about its pivot toward and from the grinding wheel.

2. In a grinding machine for cambering large rolls the combination of means rotatably supporting the rolls and axially reciprocating same, a rotatable grinding wheel, a carriage therefor, a support for the carriage, means pivotally mounting the support, means for actuating the carriage relative to the support toward and from the work, and additional means for oscillating the carriage and support about its pivot toward and from the grinding wheel, said means comprising a bendable bar and means connecting the bar and work supporting table for parallel movement at the same rate and in the same direction.

3. In a grinding machine for cambering large rolls the combination of means rotatably supporting the rolls and axially reciprocating same, a rotatable grinding wheel, a carriage therefor, a support for the carriage, means pivotally mounting the support, means for actuating the carriage relative to the support toward and from the work, additional means for oscillating the carriage and support about its pivot toward and from the grinding wheel, said means comprising a bendable bar, means connecting the bar and work supporting table for parallel movement at the same rate and in the same direction, and means for varying the bend of the bar to vary the amount of oscillation of the grinding wheel relative to the work in a given path of travel.

4. A cambering attachment for use with grinding machines comprising a pivotally mounted rotating grinding wheel, a base, a carriage mounted upon the base for movement relative thereto and a distortable bar carried by the carriage for engagement with the grinding wheel support for oscillating same about the axis of its pivot.

5. A cambering attachment for use with grinding machines comprising a pivotally mounted rotating grinding wheel, a base, a carriage mounted

upon the base for movement relative thereto, a distortable bar carried by the carriage for engagement with the grinding wheel support for oscillating same about the axis of its pivot, and means for distorting the bar comprising supports on the carriage for contact with the bar at opposite ends thereof, a lug protruding from one face of the bar for bending same about the end supports an amount representative of the desired camber to be produced.

6. A cambering attachment for use with grinding machines comprising a pivotally mounted rotating grinding wheel, a base, a carriage mounted upon the base for movement relative thereto, a distortable bar carried by the carriage for engagement with the grinding wheel support for oscillating same about the axis of its pivot, means for distorting the bar comprising supports on the carriage for contact with the bar at opposite ends thereof, a lug protruding from one face of the bar, means cooperating with the lug on the face of the bar for bending same about the end supports an amount representative of the desired camber to be produced, means for supporting the work piece for operation thereon by the grinding wheel, means for traversing the work past the grinding wheel, and means connecting the work support and bar carriage for movement in the same direction and at the same rate of traverse.

7. In a grinding machine the combination of a bed, a work supporting table mounted thereon for movement relative thereto, a bed plate pivotably mounted on the bed, a carriage mounted on the bed plate for movement toward and from the work support, a pivot shaft for connecting the bed plate and bed, means for actuating the carriage, power means for energizing the carriage actuating means, a spiral gear on the pivot shaft, a pair of spiral gears contacting with the pivot shaft gear at diametrically opposite points, and a shaft extending from each of the spiral gears and respectively connected with the power means and the grinding wheel carriage actuating means.

8. In a grinding machine the combination of a bed, a work support mounted thereon for translatory movement relative thereto, a rack bar having two sets of rack teeth thereon secured to the work table, a pivotal mounted grinding wheel carriage supported by the bed, a cam bar for engagement with the grinding wheel carriage for oscillating same about its pivot, a carrier for the bar, means engaging one set of teeth on the work table rack for actuating same and the table connected therewith, and means connected with the second set of rack teeth of the rack bar for operating the cam bar carrier.

9. A cambering attachment for use with grinding machines comprising a support, a carriage mounted on the support, a cam bar, the carriage having a groove therein for receiving the cam bar, the cam bar having a lug projecting from one side thereof, means carried by the carriage co-operating with the lug for distorting the cam bar to the desired contour and means for clamping the cam bar in the desired distorted position.

10. A cambering attachment for use with grinding machines comprising a support, a carriage mounted on the support, a cam bar, the carriage having a groove therein for receiving the cam bar, the cam bar having a lug projecting from one side thereof, means carried by the carriage co-operating with the lug for distorting the cam bar to the desired contour, means for clamping the cam bar in the desired distorted position, manual means for actuating the carriage relative to the support, power means for actuating the carriage relative to the support, and means for disconnecting the power means when the manual means are employed.

11. A cambering attachment for use with grinding machines comprising a support, a carriage mounted on the support, a cam bar, the carriage having a groove therein for receiving the cam bar, the cam bar having a lug projecting from one side thereof, means carried by the carriage co-operating with the lug for distorting the cam bar to the desired contour, means for clamping the cam bar in the desired distorted position, manual means for actuating the carriage relative to the support, power means for actuating the carriage relative to the support, means for disconnecting the power means when the manual means are employed, and means indicating the amount of distortion given to the cam bar.

12. In a cambering attachment for use with grinding machines the combination of a support, a carriage on the support, the carriage having a groove therein, a distortable cam bar received in the groove, means carried by the carriage near the opposite ends of the cam bar for forming supports therefor, a lug extending from one longitudinal face of the cam bar, means carried by the carriage in vertical alignment with the supporting means for engaging the cam bar lug and limiting the vertical movement of the bar relative to the carriage groove, and a plurality of distortable means carried by the carriage intermediate the bar supports for effecting the distortion of the cam bar each comprising a block having a groove formed therein and receiving the cam bar lug, and a screw swiveled in the block and threaded into the carriage.

13. In a cambering attachment for use with grinding machines the combination of a support, a carriage on the support, the carriage having a groove therein, a distortable cam bar received in the groove, means carried by the carriage near the opposite ends of the cam bar for forming supports therefor, a lug extending from the longitudinal face of the cam bar, means carried by the carriage in vertical alignment with the supporting means for engaging the cam bar lug and limiting the vertical movement of the bar relative to the carriage groove, and a plurality of distortable means carried by the carriage intermediate the bar supports for effecting the distortion of the cam bar each comprising a block having a groove formed therein and receiving the cam bar lug, a screw swiveled in the block and threaded into the carriage, and additional blocks for engaging the cam bar lug for clamping the cam bar in the desired distorted position.

14. In a grinding machine for cambering large rolls the combination of a bed, a work supporting table mounted thereon for movement relative thereto, a grinding wheel mounted on the bed for movement toward and from the work, a support for the grinding wheel pivotally securing same to the bed for oscillation toward and from the work, means for controlling and effecting the oscillation of the wheel comprising a bendable cambering bar, transmission means between the work supporting table and bendable bar whereby they are simultaneously actuated, and means for connecting and disconnecting the transmission with the bendable bar.

15. In a cambering mechanism for use with grinding machines which include a grinding wheel support and a work support one of which

is traversable relative to the other, the combination of a base, a cambering mechanism including a carriage mounted on the base for movement relative thereto, transmission means for connecting the carriage with the traversable support of the grinding machine whereby said carriage is operated, and means for varying the camber effected by the cambering mechanism comprising a bar, supports associated with the carriage for the bar, a lug extending along one longitudinal face of the bar, means engaging one edge of the lug about which the bar may be bent, and bending means carried by the carriage for engaging the lug for bending the bar about either the supports or the means engaging the said one edge of the lug.

16. In a cambering mechanism for use with grinding machines which include a grinding wheel support and a work support one of which is traversable relative to the other, the combination of a base, a cambering mechanism including a carriage mounted on the base for movement relative thereto, transmission means for connecting the carriage with the traversable support of the grinding machine whereby said carriage is operated, and means for varying the camber effected by the cambering mechanism comprising a bar, supports associated with the carriage for the bar, a lug extending along one longitudinal face of the bar, means engaging one edge of the lug about which the bar may be bent, bending means carried by the carriage for engaging the lug for bending the bar about either the supports or the means engaging the said one edge of the lug, and means for locking the bar to the carriage in its several positions of bend.

17. A feeding mechanism for tiltable grinding wheel carriages comprising a bed, a bed plate pivotally mounted on the bed, a carriage mounted on the bed plate for movement relative thereto, means for actuating the bed plate about its pivot, transmission means including a two-part shaft, one part being journaled in the bed plate and the other part in the bed, and a joint between the two parts of the shaft which includes the pivot for transmitting motion from one to the other parts of said two-part shaft.

18. A feeding mechanism for tiltable grinding wheel carriages comprising a bed, a bed plate pivotally mounted on the bed, a carriage mounted on the bed plate for movement relative thereto, means for actuating the bed plate about its pivot, transmission means including a two-part shaft, one part being journaled in the bed plate and the other part in the bed, a joint between the two parts of the shaft which includes the pivot for transmitting motion from one to the other parts of said two-part shaft, an adjusting screw carried by the bed plate, transmission means between the shaft in the bed plate and the screw, and power means associated with the bed for driving the part of the shaft carried by the bed.

19. A feeding mechanism for tiltable grinding wheel carriages comprising a bed, a bed plate pivotally mounted on the bed, a carriage mounted on the bed plate for movement relative thereto, means for actuating the bed plate about its pivot, transmission means including a two-part shaft, one part being journaled in the bed plate and the other part in the bed, a joint between the two parts of the shaft which includes the pivot for transmitting motion from one to the other parts of said two-part shaft, an adjusting screw carried by the bed plate, transmission means between the shaft in the bed plate and the screw, power means associated with the bed for driving the part of the shaft carried by the bed, and manual means for actuating the two-part shaft when the power means is disconnected therefrom.

20. A feeding mechanism for tiltable grinding wheel carriages comprising a bed, a bed plate pivotally mounted on the bed, a carriage mounted on the bed plate for movement relative thereto, means for actuating the bed plate about its pivot, transmission means including a two-part shaft, one part being journaled in the bed plate and the other part in the bed, a joint between the two parts of the shaft which includes the pivot for transmitting motion from one to the other parts of said two-part shaft, an adjusting screw carried by the bed plate, transmission means between the shaft in the bed plate and the screw, power means associated with the bed for driving the part of the shaft carried by the bed, rapid traverse means connectible with the adjusting screw, and a telescoping shaft for effecting the connection of the rapid traverse means with the adjusting screw and for simultaneously disconnecting the power transmission therefrom.

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