Feb. 3, 1942. A. W. WIGGLESWORTH ET AL 2,271,963

ROLL GRINDING MACHINE

Filed Dec. 5, 1940 4 Sheets-Sheet 1

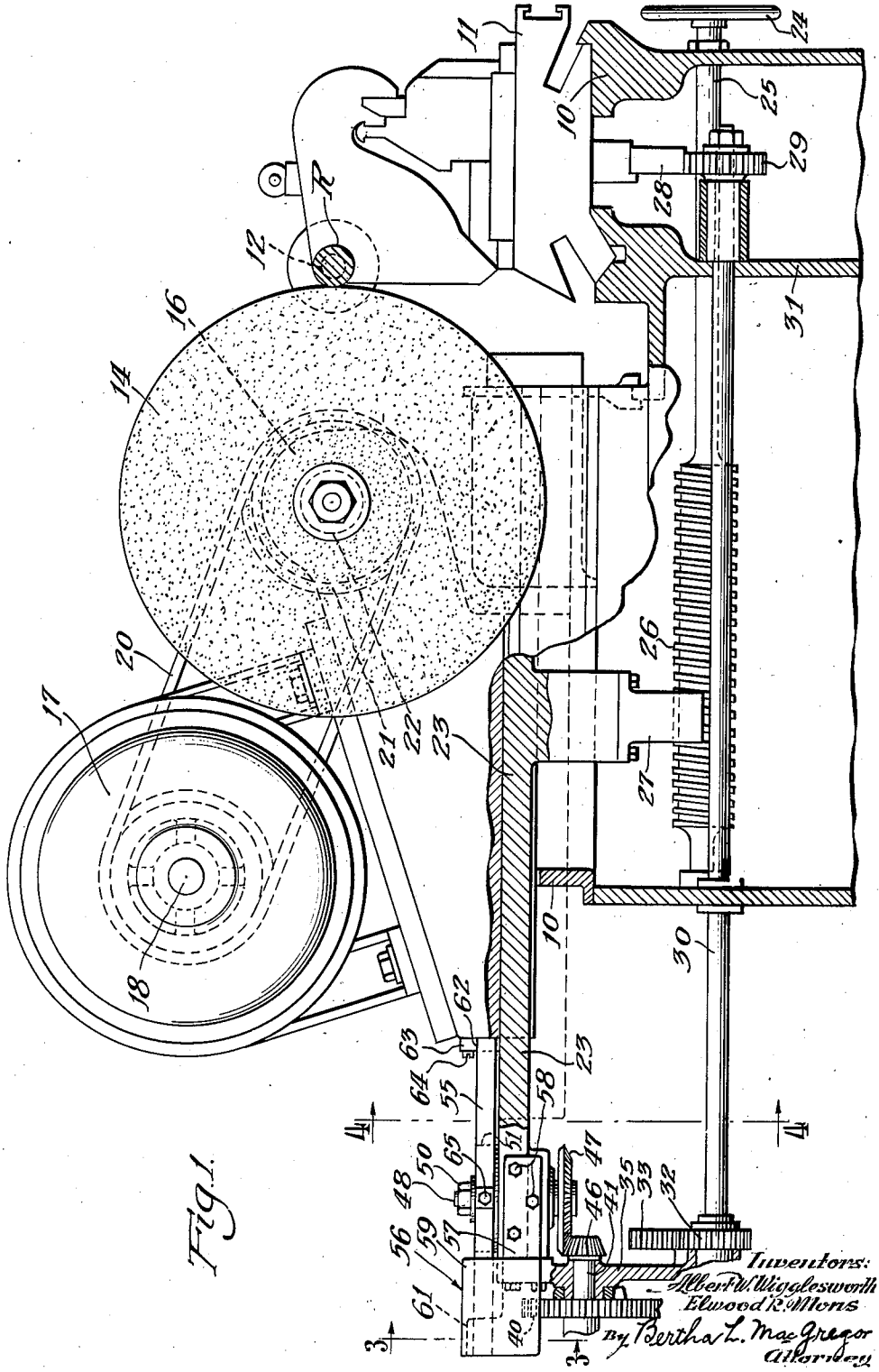


Fig. 1.

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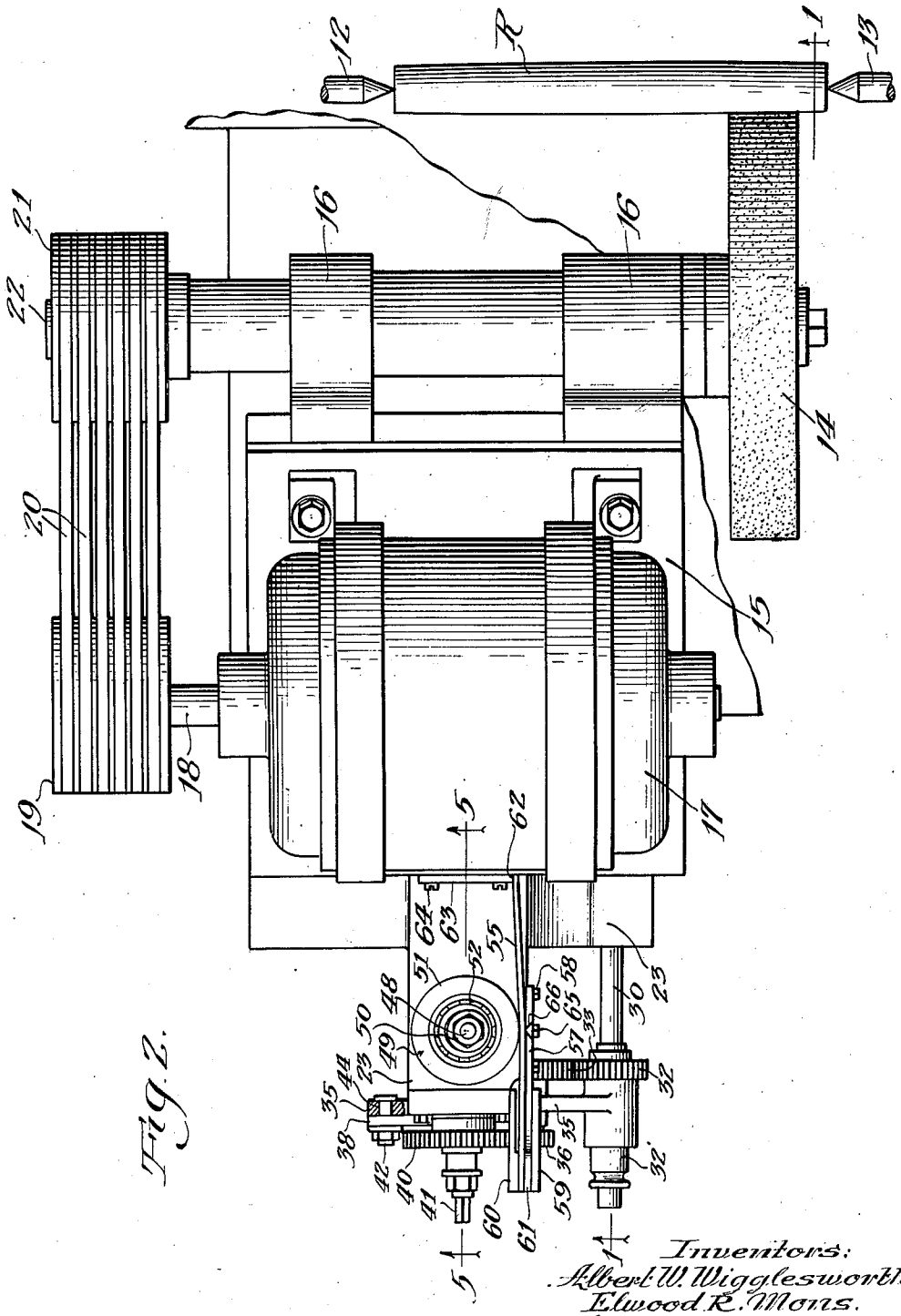


Fig. 2.

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Fig. 3.

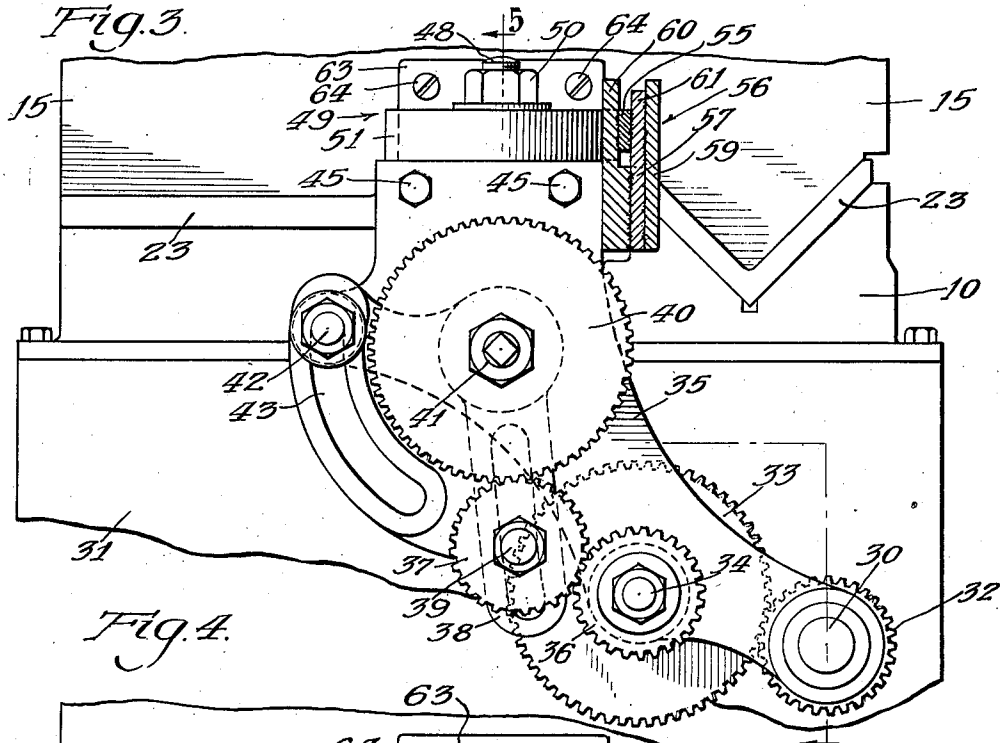
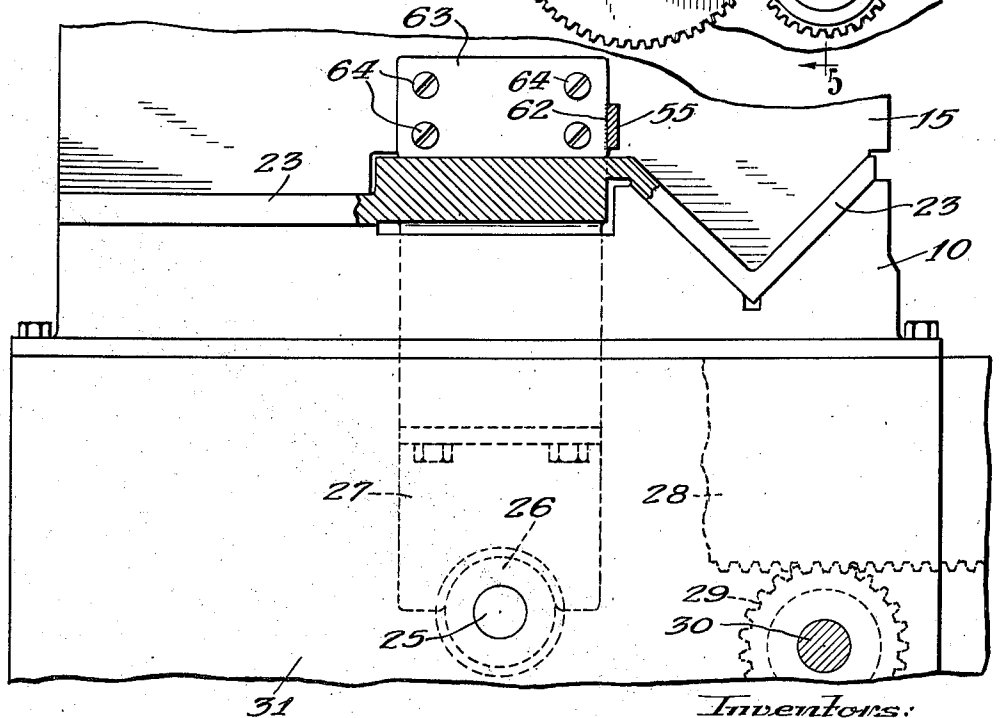


Fig. 4.

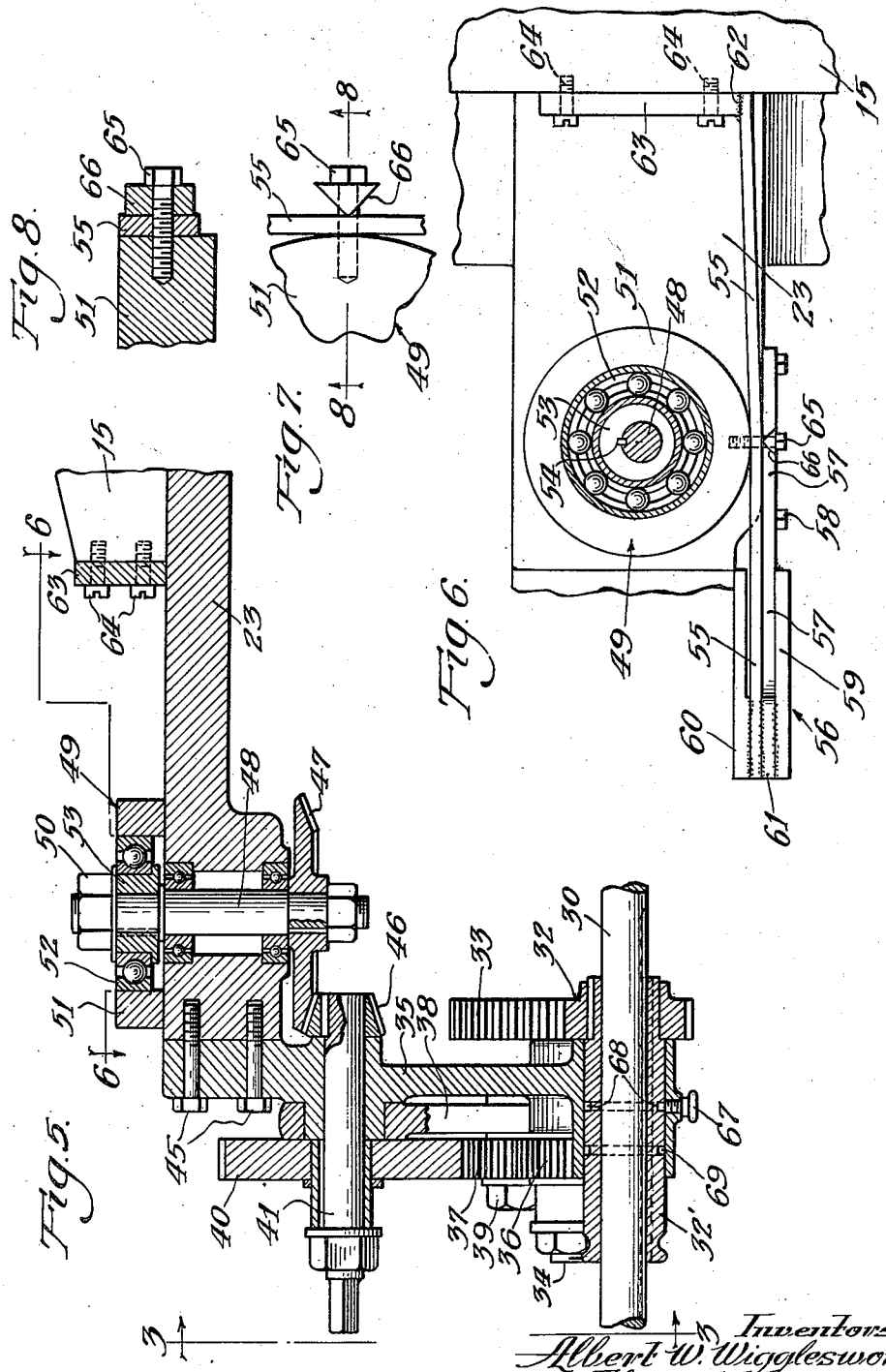


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ROLL GRINDING MACHINE

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UNITED STATES PATENT OFFICE

2,271,963

ROLL GRINDING MACHINE

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Application December 5, 1940, Serial No. 368,632

6 Claims. (Cl. 51—95)

This invention relates to grinding machines and particularly to grinding machines adapted to grind rolls having crowned, concave, or specially formed surfaces.

Grinding machines comprise a base on which are slidably mounted a longitudinally reciprocable work carriage and a transversely movable wheel base on which the grinding wheel and motor are mounted so that the rotatable grinding wheel may be moved, with the transversely movable base, into operative position relatively to the longitudinally reciprocable carriage and the work thereon.

The main object of our invention is to provide grinding machines of the character described with means for automatically grinding rolls having crowned, concave, or specially formed surfaces, said means being embodied in the grinding machines in such manner that the conventional mounting of the grinding wheel on a transversely movable base and the movement of the base in a horizontal plane are not altered, and consequently the efficiency of the machines is not impaired and undue wear of the machine parts is avoided.

Another object is to provide means for automatically changing the position of the grinding wheel relatively to the work while the work is being moved across the grinding wheel, said means being positively connected to the grinding wheel base and to a fixed support in such manner that movement of the grinding wheel both toward and away from the work is positively controlled and variations are avoided. Said controlling means for automatically changing the position of the grinding wheel relatively to the work while the work is being reciprocated relatively to the grinding wheel includes a member adapted to receive relatively long transverse movements whereby relatively short movements in a longitudinal direction are transmitted by said member to the grinding wheel base. The effect of this feature of construction is that very fine adjustments of the position of the grinding wheel can be accomplished.

It has been proposed heretofore to tilt the grinding wheel base intermittently by raising and lowering its rearward end and thereby to change the position of the grinding wheel relatively to the work as the work is being moved past the wheel, but the construction and operation are objectionable in that the wheel base and the wheel mounted thereon are not uniformly and efficiently supported while in the tilted positions and the line contact between the grinding wheel and the work is not in one horizontal plane during the entire grinding operation.

The invention herein described provides means for automatically moving the grinding wheel base transversely and in a horizontal plane while the rotating work is being moved longitudinally a predetermined distance past the rotating grinding wheel on said base, whereby the work is given a concave or convex surface, as desired. Smoothness and regularity of the ground surface as well as true contours of the convex or concave form are insured by the construction herein disclosed. These are qualities in the work which are not obtainable when the grinding wheel and its base are not uniformly supported on the machine base and the grinding wheel trunnions bear the load developed in the grinding operation.

In the drawings:

Fig. 1 is a transverse sectional view, partly in elevation, of a grinding machine embodying our invention, taken in the plane of the line 1—1 of Fig. 2.

Fig. 2 is a plan view of part of the machine shown in Fig. 1.

Fig. 3 is a rear elevation of part of the machine shown in Figs. 1 and 2, partly in section, as indicated by the line 3—3 of Figs. 1 and 5.

Fig. 4 is a longitudinal, vertical sectional view, taken in the plane of the line 4—4 of Fig. 1.

Fig. 5 is a transverse, vertical sectional view, taken in the plane of the lines 5—5 of Figs. 2 and 3.

Fig. 6 is a horizontal sectional view, partly in plan elevation, taken in the plane of the line 6—6 of Fig. 5.

Fig. 7 is a plan view, on an enlarged scale, of a detail shown in Fig. 6.

Fig. 8 is a vertical sectional view taken in the plane of the line 8—8 of Fig. 7.

A complete grinding machine has not been shown in the drawings, but reference is made to Patent No. 2,074,308, dated March 16, 1937, which shows the type of grinding machine in which our invention has been embodied.

In that embodiment shown in the drawings, the machine base 10 supports a longitudinally reciprocable work carriage 11 which is slidable on the base 10. A conventional tail stock is indicated at 12 and a head stock at 13. The head and tail stocks are rotatably mounted on the carriage and are moved therewith. The carriage is reciprocated on the base 10 by any suitable means, not shown, such, for example, as the mechanism described in the aforesaid patent.

A grinding wheel 14 is mounted on a wheel base

15 on bearings 16, and a motor 17 is also mounted on a raised portion of said wheel base 15. The motor shaft 18 has mounted on it a pulley 19 operatively connected by belts 20 to the pulley 21 on the shaft 22 on which the grinding wheel 14 is mounted.

The wheel base 15 is not mounted directly on the machine base 10, as shown in the prior art, but rests on an intermediate base or support 23 which is movable transversely of the base 10. The position of the intermediate support 23 relatively to the machine base 10 is adjusted by means of a hand wheel 24 on a transverse shaft 25 provided with a screw threaded portion 26 which engages the half nut 27 fixed on the bottom of the intermediate support 23. By actuating the hand wheel 24, the position of the support 23, as well as the wheel base 15 and grinding wheel 14, are adjusted to bring the wheel 14 into operative position relatively to the work, such as the roll R shown in Fig. 2.

If the wheel base 15 were fixedly mounted on the intermediate support 23, adjustment of the position of the latter on the base 10 would result in the work contacting portion of the grinding wheel working in one vertical plane parallel to the axis of the work, and consequently the roll or work R would have ground surfaces parallel with the axis of the roll from end to end. In order to produce a crowned surface on the roll, or a concave surface, we have provided means for automatically varying the position of the wheel base 15 on the intermediate support 23 so that the wheel 14 contacts the work in different vertical planes as the work moves across the grinding surface of the wheel.

The means for automatically moving the wheel base 15 relatively to the intermediate support 23, transversely of the base 10, comprises the following mentioned parts. The longitudinally extending rack 28 fixed on the bottom of the work carriage 11 meshes with a gear 29 on the rotatable shaft 30 extending through the frame members 31 of the machine, the gear 32 keyed to a sleeve 32′ on the shaft 30 meshing with a large gear 33 keyed to the stub shaft 34. The sleeve 32′ is slidable on but keyed to the rearward portion of the shaft 30. The stub shaft 34 extends through a bracket 35 which carries the change speed gearing about to be described. The end of the shaft 30 and sleeve 32′ are also mounted in the bracket 35.

Fixed on the outer or rearward end of the shaft 34 is a gear 36 which meshes with an idler gear 37 adjustably mounted in a slotted lever or quadrant 38 by a pin 39. The idler gear 37 meshes with a large gear 40 mounted on a shaft 41 which extends through the bracket 35. The slotted lever 38 is mounted on the rearwardly projecting hub of the bracket 35. The slotted lever 38 and the idler gear 37 can be adjusted in desired position to accommodate different sized gears by means of a nut and bolt 42, the bolt extending through a slot 43 at one side of the lever 38. The bolt extends through said slot 43 and into a hole 44 in the bracket 35.

The bracket 35, carrying the gearing described, is fixedly secured to the intermediate support 23 by bolts 45, in such position that the shaft 41 is slightly lower than the support. On the inner end of said shaft 41 is a bevel gear 46 which meshes with a bevel gear 47 on a vertical shaft 48 which extends through the intermediate support 23.

An eccentric indicated as a whole by the numeral 49 is mounted on the upper end of the shaft 48 and held in position by a washer and nut 50. Preferably the eccentric 49 comprises an outer ring 51, a ball race 52, and an eccentric sleeve 53 keyed to the shaft 48 at 54.

A spring metal bar 55, having its side surfaces vertically disposed, extends longitudinally between a fixed support 56 and the grinding wheel base 15. The fixed support 56 as herein shown comprises a vertically disposed L-shaped plate 57 bolted at 58 to a vertical surface of the intermediate support 23. The bar 55 is welded to the upwardly extending part 61 of the L-shaped plate 57, and plates 59 and 60 are welded, respectively, to the plate 57 and the bar 55. Any arrangement whereby the end of the bar 55 is firmly connected to the intermediate support 23 will suffice.

The opposite end of the bar 55 is welded as indicated at 62 to the end of the plate 63 which is bolted at 64 to the rear surface of the grinding wheel base 15.

About midway between its ends, the bar 55 is firmly connected to the outer ring 51 of the eccentric 49 by a bolt 65 which extends through a triangularly shaped block 66 and through said bar 55 into the ring 51 of the eccentric. This construction affords a very secure connection between the bar 55 and eccentric 49, without impairing the flexing capacity of the bar 55.

The bar 55 or connector between the intermediate support 23 and the grinding wheel base 15 is normally slightly flexed, as indicated in Fig. 6, its length when thus flexed being exactly correct for positioning the grinding wheel base 15 on the intermediate support 23 so that the grinding wheel will be in normal operative position relatively to the work.

By operating the eccentric 49, the bar 55 will be flexed to a greater degree than it is normally, thereby varying the effective length of the bar 55. It will be understood that the operation of flexing the bar 55 by the working of the eccentric, after the said bar has been initially flexed to some degree, will vary the effective length of the bar 55 to a greater degree than if the bar had not been initially flexed.

The means herein described for altering the effective length of the bar 55 is particularly adapted for effecting very fine adjustments of the position of the grinding wheel and its base 15. The extent of the movement transmitted transversely to the bar 55 by the ring 51 of the eccentric 49 through rotation of the shaft 48 and eccentric sleeve 53 keyed thereto can be varied by altering the shape of the eccentric sleeve 53 or by varying the extent of the rotative movement of the eccentric sleeve 53, whereby the movement of the bar 55 longitudinally will also be varied.

The operation of the means for automatically varying the position of the wheel base 15 relatively to the intermediate base support 23 while the work carriage is being moved across the grinding wheel and after the support 23 shall have been moved to adjusted position to bring the grinding wheel 14 into operative position (by actuating the hand wheel 24 and shaft 25—26 engaging the half nut 27 on said support 23) is as follows:

The driven reciprocating carriage 11, through its rack 28 meshing with gear 29, rotates the shaft 30 first in one direction and then in the other, the rotation in one direction continuing while the carriage is being moved in one direc-

tion. The gear 32 on the shaft 30 rotates the gear 33, thus actuating the shaft 34 on which said gear 33 is fixed. The shaft 34 has the gear 36 keyed to it and therefore gear 36 rotates the idler gear 37 which meshes with the gear 40, thereby rotating the shaft 41, beveled gear 46, gear 47, shaft 48 and eccentric sleeve 53. The eccentric sleeve 53 produces reciprocating movement of the ring 51 in directions transversely of the bar 55 to which it is connected. The movements are positive, in both directions, whereby the effective length of the bar 55 is gradually varied during the movements in opposite directions. A spring steel connector may be substituted for the bar 55 herein shown, in which event the connection of the bar to the cam or eccentric by means of the bolt 65 may be eliminated. The spring steel connector will be flexed from the normal in one direction by operation of the cam or eccentric during part of its stroke and will automatically return to normal position during the remainder of the stroke.

Cams of different shapes can be substituted for the eccentric 49 herein shown, and eccentrics of different sizes can be interchanged and thus avoid the necessity for interchanging gears on the bracket 35 to vary the speed of rotation of the eccentric as required by the work to be ground.

When it is desired to use the grinding machine for straight grinding, and movement of the wheel base 15 on the intermediate support 23 is not required, the eccentric 49 can be rendered inoperative by removing the screw 67 which extends through the lower portion of the bracket 35 into the recess 68 in the sleeve 32'. Then the sleeve 32' can be moved forwardly in order to move the gear 32 (slidably mounted on shaft 30) out of mesh with the gear 33. The screw 67 is then reinserted so as to engage the recess 69 in the sleeve 32', thus holding the gear 32 in non-operative position.

The adjustment of the cam or eccentric 49 to its proper operative or starting position for producing rolls of varying contours or profiles is obtained by first disengaging the operative connection between the shaft 30 and gear 33 by moving the sleeve 32' forwardly on the shaft 30. As just explained, this causes the gear 32 to be disengaged from the gear 33. Then the shaft 41 can be turned, thereby actuating the bevel gears 46 and 47, and rotating the shaft 48 to move the cam 49 to desired position. When the sleeve 32' has been returned to operative position so that the gear 32 again meshes with the gear 33, all the parts will be in proper operative position for producing rolls having the profile for which the cam or eccentric 49 has been adjusted. It will be understood, of course, that the shape of the cam or eccentric 49 can be varied so as to produce concave, convex or other special forms. Whenever reference is made herein to "means for automatically grinding convex and concave surfaces on the work", it is intended that this element include means for forming convex, concave or other specially formed surfaces on the work. In using an eccentric such as shown, the grinding wheel may be reciprocated beyond the ends of the work in order to obtain the desired curve on the work.

It will be understood that the adjustment of the position of the intermediate base support 23 can be accomplished by means of the parts 24—27, as explained, without interference with the means for operating the eccentric 49 because of the sliding engagement between the shaft 30 and the sleeve 32' keyed to said shaft. The bar or connector 55 and means for actuating it herein described are designed to function after the grinding wheel and its base have been moved to roll grinding position by adjusting the position of the intermediate base 23, and only during the reciprocatory movement of the work carriage to give the desired contour to the work.

Changes may be made in details of construction without departing from the scope of our invention.

We claim:

1. A grinding machine provided with means for automatically grinding convex and concave surfaces on the work, comprising a machine base, a longitudinally reciprocable work carriage on the machine base, means for reciprocating the work carriage, a grinding wheel base slidable transversely on the machine base, a flexible metal bar extending transversely of the machine and rigidly connected at one end to a fixed part of the machine base and at its other end to the wheel base, and means operatively connected with the work carriage and engaging said flexible bar between its ends transmitting reciprocating movements to the bar and to the wheel base when the work carriage is being reciprocated, the reciprocating movements of the wheel base being in one horizontal plane.

2. A grinding machine provided with means for automatically grinding convex and concave surfaces on the work, comprising a machine base, a longitudinally reciprocable work carriage on the machine base, means for reciprocating the work carriage, a grinding wheel base slidable transversely on the machine base, a flexible metal bar extending transversely of the machine and rigidly connected at one end to a fixed part of the machine base and at its other end to the wheel base, and means operatively connected with the work carriage and engaging said flexible bar between its ends transmitting reciprocating movements to the bar and to the wheel base when the work carriage is being reciprocated, said means comprising a vertical shaft mounted in the machine base, an eccentric sleeve on the shaft keyed thereto, and a ring surrounding the sleeve and supported by said machine base, said ring engaging the flexible bar and being moved in a horizontal plane by the operation of said shaft and eccentric sleeve.

3. A grinding machine provided with means for automatically grinding convex and concave surfaces on the work, comprising a machine base, a longitudinally reciprocable work carriage on the machine base, means for reciprocating the work carriage, a grinding wheel base slidable transversely on the machine base, a flexible metal bar extending transversely of the machine and rigidly connected at one end to a fixed part of the machine base and at its other end to the wheel base, and means operatively connected with the work carriage and engaging said flexible bar between its ends transmitting reciprocating movements to the bar and to the wheel base when the work carriage is being reciprocated, said last mentioned means including an eccentric device and means connecting it to the bar, said connecting means comprising a block having a relatively narrow surface in contact with the side of the bar and a bolt extending through said block and the bar and into the eccentric device.

4. A grinding machine provided with means for automatically grinding convex and concave

surfaces on the work, comprising a machine base, a longitudinally reciprocable work carriage on the machine base, means for reciprocating the work carriage, a grinding wheel base, a grinding wheel rotatably mounted on the wheel base, an intermediate support beneath the wheel base slidable transversely on the machine base, means for adjusting the position of the intermediate support, said wheel base resting on said intermediate support, a flexible metal bar rigidly connected at one end to the intermediate support and at its other end to the wheel base, and means operatively connected with the work carriage and engaging said bar between its ends transmitting reciprocating movements to said flexible bar and to the wheel base when the work carriage is being reciprocated.

5. A grinding machine provided with means for automatically grinding convex and concave surfaces on the work, comprising a machine base, a longitudinally reciprocable work carriage on the machine base, means for reciprocating the work carriage, a grinding wheel base, a grinding wheel rotatably mounted on the wheel base, an intermediate support beneath the wheel base slidable transversely on the machine base, means for adjusting the position of the intermediate support, said wheel base resting on said intermediate support, a flexible metal bar rigidly connected at one end to the intermediate support and at its other end to the wheel base, and eccentrically operated means operatively connected with the work carriage and engaging said bar between its ends transmitting reciprocating movements to said flexible bar and to the wheel base when the work carriage is being reciprocated, said eccentrically operated means comprising a vertical shaft mounted in the intermediate support, an eccentric sleeve on the shaft keyed thereto, and a ring surrounding the sleeve and supported by said intermediate support, said ring engaging the flexible bar and being moved in a horizontal plane by the operation of said shaft and eccentric sleeve.

6. A grinding machine provided with means for automatically grinding convex and concave surfaces on the work, comprising a machine base, a longitudinally reciprocable work carriage on the machine base, means for reciprocating the work carriage, a grinding wheel base slidable transversely on the machine base, a flexible metal bar extending transversely of the machine and rigidly connected at one end to a fixed part of the machine base and at its other end to the wheel base, and means operatively connected with the work carriage and engaging said flexible bar between its ends transmitting reciprocating movements to the bar and to the wheel base when the work carriage is being reciprocated, said flexible bar being normally flexed to a limited extent and said degree of flexing being alternately gradually increased and restored to normal by the said means for transmitting reciprocating movements to said bar.

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