Sept. 17, 1929. W. J. BAUMBERGER 1,728,653

GRINDING MACHINE

Filed Dec. 11, 1926 3 Sheets-Sheet 1

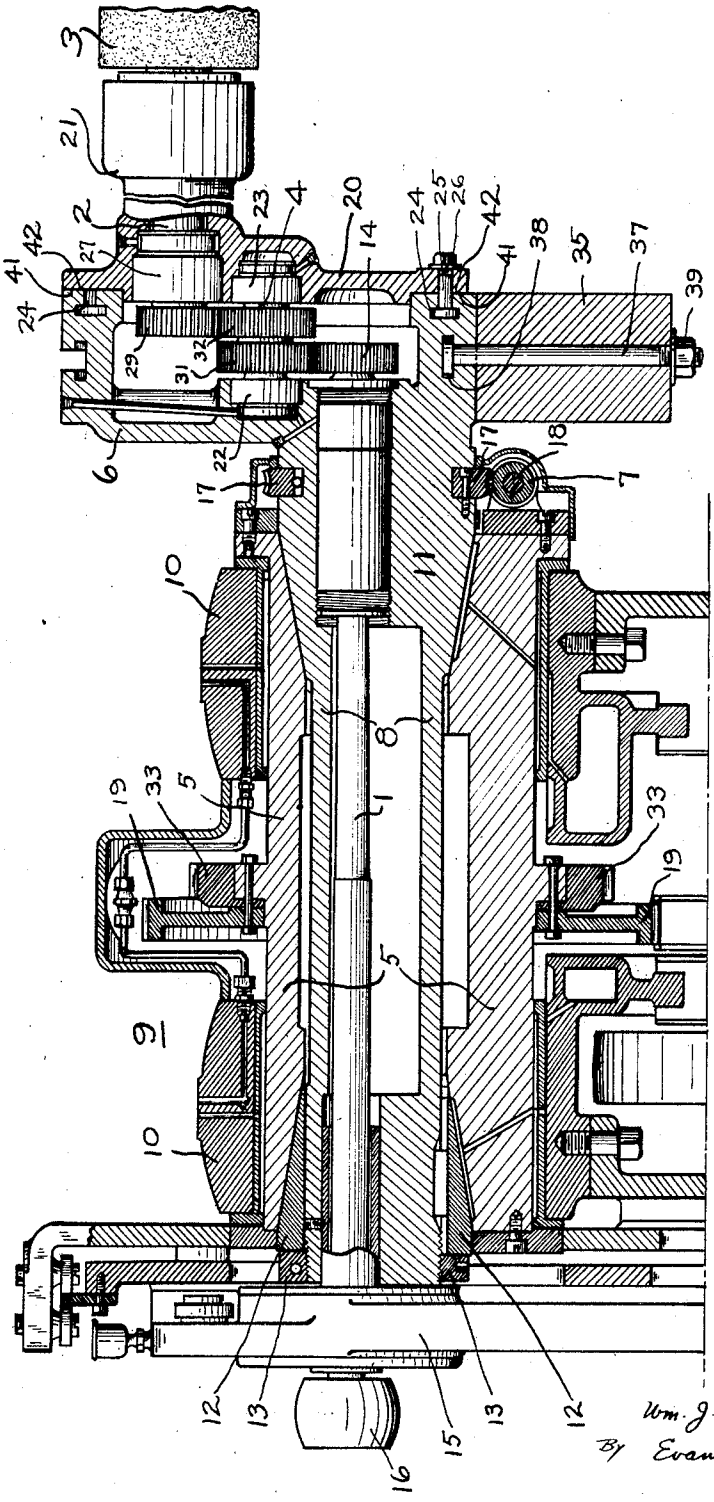


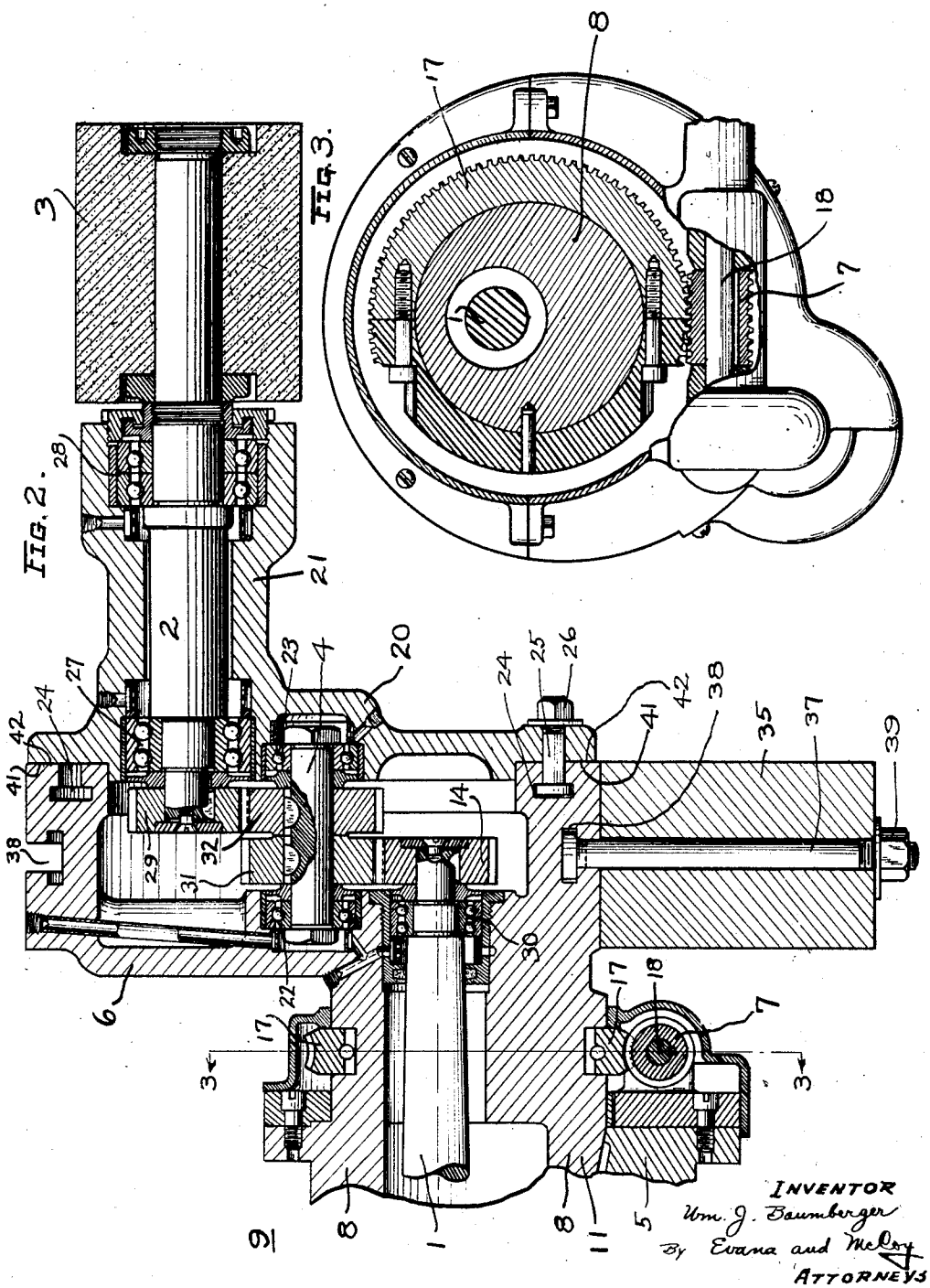
Fig. 1.

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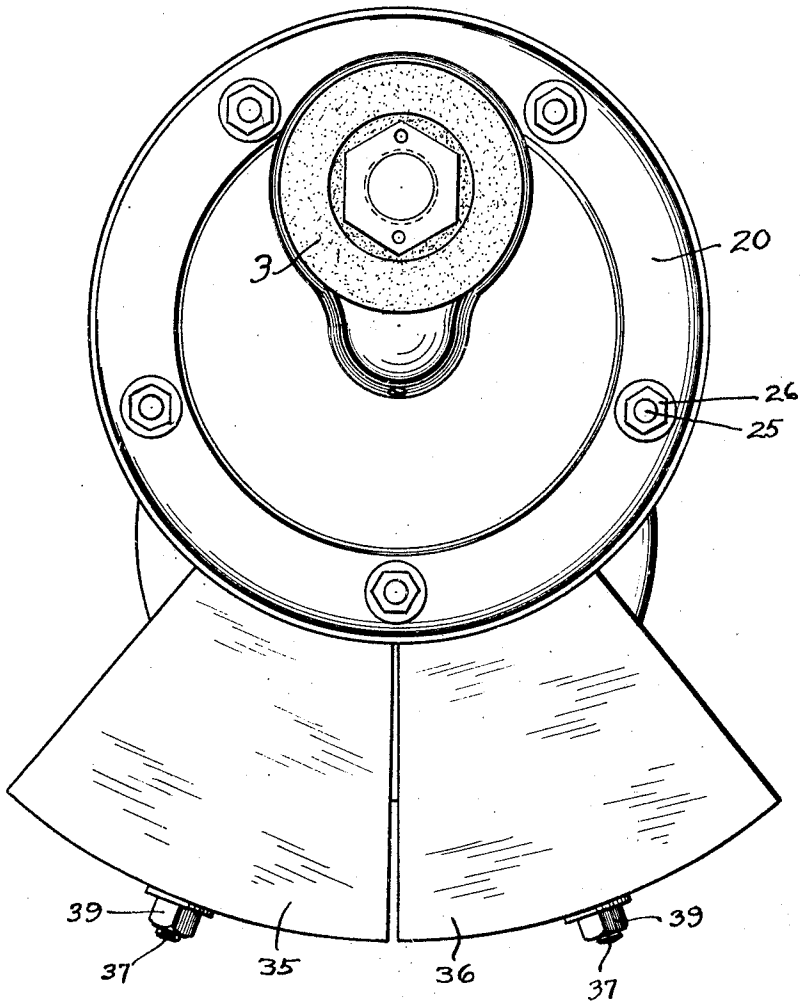


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Fig. 4.



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Patented Sept. 17, 1929 1,728,653

UNITED STATES PATENT OFFICE

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GRINDING MACHINE

Application filed December 11, 1926. Serial No. 154,067.

This invention relates to grinding machines and more particularly to machines for grinding cylinders of a wide range of diameters.

An object of this invention is to provide a grinding machine which may be readily adjusted to grind cylinders of a wide range of diameters.

Another object of the invention is to provide mechanism for the grinding of cylinders of a wide range of diameters, said mechanism including counterbalancing means adjustable for any position of the grinding wheel spindle.

A further object of the invention is to provide a grinding machine adapted to grind cylinders of a wide range of diameters, said grinding machine having means to automatically feed the grinding wheel to the work at every adjusted position of the grinding wheel spindle.

Other objects of the invention will be apparent to those skilled in the art from the description of it hereinafter given.

In the drawings:

Figure 1 is a vertical longitudinal section through my improved grinding machine;

Fig. 2 is an enlarged vertical longitudinal section showing the grinding wheel spindle, the outer end of the headstock spindle, and associated parts;

Fig. 3 is a transverse vertical section on line 3—3 of Fig. 2; and

Fig. 4 is a right hand end elevation of the structure shown in Fig. 2.

I have illustrated in the drawings a grinding machine having a rear or headstock spindle 1, rotatable on its own axis and orbitally about an axis eccentric to its own, namely, the axis of the cylindrical headstock 5. A front or grinding wheel spindle 2, shown as substantially parallel to the rear spindle 1, carries a grinding wheel 3. The said grinding wheel spindle 2 is adjustably rotatable about the intermediate shaft 4 as an axis and thus axially adjustable with respect to the headstock spindle 1 for the size of cylinder to be ground. For the grinding of a particular cylinder, therefore, the grinding wheel spindle 2 may be adjusted relative to the headstock spindle 1 and moreover the headstock spindle 1 may be adjusted relative to the cylindrical headstock 5. By means of these two axial adjustments, therefore, cylinders of a wide range of diameter may be ground, from cylinders of very small diameter substantially equal to that of the grinding wheel to cylinders of a very large diameter obtained by adjusting the headstock spindle 1 and grinding wheel spindle 2 to their maximum eccentricities with respect to the headstock 5, and spindle 1, respectively.

Regardless of the relative adjustment of the rear or headstock spindle 1 and the front or grinding wheel spindle 2, the front spindle 2 may always be rotated on its own axis from the rear spindle 1 by suitable means such as suitable gearing disposed within the casing 6 carried by the outer end of the headstock spindle 1. Furthermore, at any adjusted position of the front spindle 2 relative to the rear spindle 1, the said front or grinding wheel spindle 2 may be rotated in an orbital path about the axis of orbital movement of said rear spindle, namely, the axis of the rotatable headstock 5, simultaneously with the rotation of the spindle 2 on its own axis. Means moreover are provided for automatic continuous feeding of the grinding wheel to the work. Thus, the worm 7 may be automatically driven by means (not shown) to be hereinafter discussed, whereby to automatically vary the eccentricity of the headstock spindle housing 8 within the rotating headstock 5.

Referring particularly to Fig. 1, the head of the grinding machine designated generally at 9 is provided with spaced bearing portions 10 in which the rotating headstock 5 is journaled. The headstock 5 has an eccentric bore which has conical outwardly flaring end portions and which receives the rear or headstock spindle 8. The housing 8 has an integral conical head 11 and carries a conical sleeve 12 at its opposite end, the said sleeve 12 being adjustable longitudinally of the housing 8. The sleeve 12 may be maintained in any desired adjusted position by a nut 13 on the end of the housing 8. By means of said adjustable sleeve 12, therefore, longitudinal play of the housing 8 during operation may be pre-

vented, and furthermore the worm wheel 17 carried by the housing 8 may be maintained in proper cooperative position relative to the worm 7.

The headstock spindle 1 is journaled eccentrically in the housing 8 and projects beyond the forward end of said housing, carrying a gear 14 on its forward end. The rearward end of the spindle 1 projects beyond the end of the frame 15 and has a pulley 16 fixed thereto over which a belt may run to rotate the spindle 1 on its own axis.

The forward end of the headstock spindle housing 8 has a worm wheel 17 fixed thereto which meshes with a worm 7 on a shaft 18, which shaft may be operated manually by conventional means (not shown) to turn the housing 8 in the headstock 5. Since the housing 8 is eccentrically mounted in the headstock 5 and the spindle 1 is eccentrically mounted in the housing 8, said spindle 1 may be adjusted with respect to the axis of the headstock 5 by rotating the housing 8 with respect to the headstock 5. A suitable automatic feed device for adjusting the axis of the spindle 1 relative to that of the headstock 5 is preferably incorporated on this machine to vary the depth of cut of the grinding wheel while the machine is running. Such an automatic feed device is shown and described in the patent to H. M. Jerome 1,522,523, dated January 13, 1925.

The headstock 5 has two external gears 19 and 33 fixed thereto by which it may be rotated by power or by hand by means (not shown) to revolve the headstock 5 bodily and thereby revolve the spindle 1 in an orbital path about the axis of the headstock 5.

The outer conical head 11 at the forward end of the headstock spindle housing 8 is shown as carrying a gear casing having an outer finished surface 41. The cover plate 20 which is provided with a finished surface 42 cooperable with the surface 41 and which is shown as integral with the grinding wheel spindle housing 21 is pivotally secured to the gear housing 6 on the rotatable shaft 4 mounted substantially centrally of the casing 6 and cover plate 20 in suitable bearings 22 and 23 in the housing 6 and cover plate 20 respectively. By reason of its pivotal mounting, the cover plate 20 may be angularly adjusted through 360 degrees or any fraction thereof, the complete range of adjustment of the grinding wheel spindle being obtained by adjustment of the cover plate through 180° and by means of the annular slot 24 in the gear housing 6, bolts 25, and nuts 26, the cover plate 20 may be secured to any pivotal or rotative position thereof. Within the housing 21 is shown the grinding wheel spindle 2 mounted in suitable bearings 27 and 28. On the inner end of the spindle 2 within the gear housing 6 is mounted a gear 29. On the outer end of the spindle 2 is mounted the grinding wheel 3. As previously mentioned, the outer end of the headstock spindle 1 carries a gear 14 which is disposed within the gear housing 6, the outer end of the spindle 1 being supported in a suitable bearing 30.

On the rotatable intermediate shaft 4 and keyed thereto are a pair of gears 31 and 32. The gear 31 is in cooperative relation with the headstock spindle gear 14, and the gear 32 is in cooperative relation with the grinding wheel spindle gear 29. It may be noted that by means of the above mentionel four gears, the headstock spindle 1 is in driving relation with the grinding wheel spindle 2 at all positions of pivotal or rotative adjustment of the cover plate 20 with respect to the gear housing 6. If so desired, a single gear might of course be employed on the intermediate shaft 4 to cooperate with the spindle gears 14 and 29, in place of the pair of gears 31 and 32.

It will moreover be noted that the spindle 1, shaft 4, and spindle 2 are so disposed in relation to each other that the spindle 2 may be disposed in direct axial alignment with the spindle 1 if desired, whereby in such case the orbital movement of the grinding wheel 3 will be obtained entirely from the eccentric position of the spindle 1 with respect to the rotating headstock member 5. Or, if desired, the spindle 1 may be disposed concentrically with the headstock 5 and the entire orbital movement of the grinding wheel 3 obtained from the eccentric adjustment of the spindle 2 with respect to the spindle 1.

For certain cases the spindle 2 may be disposed in actual axial alignment with the spindle 1 and the spindle 1 disposed concentrically with the headstock 5 whereby no orbital movement of the grinding wheel 3 whatsoever will be obtained. For the maximum orbital movement of the grinding machine the spindle 1 is disposed at its maximum eccentricity with respect to the headstock 5 and the spindle 2 disposed at its maximum eccentricity with respect to the spindle 1.

To counterbalance the weight of the grinding wheel 3, spindle 2, housing 21 and associated parts, adjustable counterweighting means are provided. Thus the counterweights 35 and 36 are each secured to the gear housing 6 by a bolt 37 cooperable with the annular slot 38, and a nut 39. By suitably adjusting the counterweights 35 and 36 the centrifugal force of the grinding wheel 3, housing 2 and associated parts may be counterbalanced at any adjusted position of the cover plate 20 with respect to the gear casing 6 whereby to obtain smooth and uniform operation of the grinding mechanism. It will be noted that I have provided grinding mechanism wherein an eccentrically adjustable rotatable rear spindle is in continuous driving relation with an eccentrically adjustable rotatable grinding wheel spindle,

whereby at any adjusted position of said spindles, said grinding wheel spindle may be rotated on its own axis from said rear spindle and whereby said grinding wheel spindle may be rotated in an orbital path about the axis of orbital movement of the rear spindle.

It will moreover be noted that with my improved grinding mechanism the grinding wheel may be automatically fed to the work regardless of the diameter of work for which the mechanism is adjusted.

Furthermore, by means of the adjustable counterweighting means which I have provided, extreme smoothness of operation of my grinding mechanism is obtained, whereby to obtain maximum accuracy in grinding work of any desired size.

It will thus be seen that my machine provides extreme flexibility, accuracy, and smoothness of operation for the grinding of cylinders of a wide range of diameters from very small diameters to very large diameters and all intermediate diameters.

Furthermore, it is to be understood that the particular forms of apparatus shown and described, and the particular procedure set forth, are presented for purposes of explanation and illustration and that various modifications of said apparatus and procedure can be made without departing from my invention as defined in the appended claims.

What I claim is:

1. In a grinding machine, in combination, a longitudinally fixed rotatable cylinder, a rotatably adjustable rear spindle housing eccentrically journaled in said rotatable cylinder, a rotatable rear spindle eccentrically journaled in said rear spindle housing, means for rotating said rear spindle, a gear casing rigidly carried by said rear spindle housing at the forward end thereof, said rear spindle extending forwardly into said casing, a gear casing cover cooperatively associated with said casing at the forward end thereof, a casing shaft parallel to said rear spindle rotatably carried by said casing and cover substantially centrally thereof whereby said cover may be rotatably adjusted through 180 degrees with respect to said casing, means for securing said cover in desired adjusted position, a grinding wheel spindle housing carried by said cover extending forwardly thereof, a grinding wheel spindle journaled in said grinding wheel spindle housing and extending rearwardly into said casing, gearing within said housing operatively connecting said rear spindle and grinding wheel spindle whereby said grinding wheel spindle may be rotated at any adjusted position thereof from said rear spindle, and whereby said grinding wheel spindle may be disposed and rotated in any one of a wide range of adjusted positions to grind surfaces of a wide range of diameters.

2. In a grinding machine, in combination, a longitudinally fixed rotatable cylinder, a rotatably adjustable rear spindle housing eccentrically journaled in said rotatable cylinder, a rotatable rear spindle eccentrically journaled in said rear spindle housing, means for rotating said rear spindle, a gear casing rigidly carried by said rear spindle housing at the forward end thereof, said rear spindle extending forwardly into said casing, a gear casing cover cooperatively associated with said casing at the forward end thereof, a casing shaft parallel to said rear spindle rotatably carried by said casing and cover substantially centrally thereof whereby said cover may be rotataby adjusted through 180 degrees with respect to said casing, means for securing said cover in desired adjusted position, a grinding wheel spindle housing carried by said cover extending forwardly thereof, a grinding wheel spindle journaled in said grinding wheel spindle housing and extending rearwardly into said casing, a pair of gears mounted on said casing shaft and fixed thereto and rotatable therewith, a gear carried by said rear spindle at the forward end thereof in cooperative engagement with one of said shaft gears, and a gear carried by said grinding wheel spindle at the rearward end thereof in cooperative engagement with the other of said shaft gears, and whereby said grinding wheel spindle may be disposed and rotated in any one of a wide range of adjusted positions to grind surfaces of a wide range of diameters.

3. In a grinding machine, in combination, a rear spindle housing, a rotatable rear spindle eccentrically journaled in said rear spindle housing, means for rotating said rear spindle, a gear casing carried by said rear spindle housing at the forward end thereof, a gear casing cover cooperatively associated with said casing at the forward end thereof, a casing shaft parallel to said rear spindle carried by said casing and cover substantially axially thereof whereby said cover may be rotatably adjusted through 180 degrees with respect to said casing, means for securing said cover in desired adjusted position, a grinding wheel spindle housing carried by said cover extending forwardly thereof, a grinding wheel spindle journaled in said grinding wheel spindle housing, gearing within said housing operatively connecting said rear spindle and grinding wheel spindle whereby said grinding wheel spindle may be rotated at any adjusted position thereof from said rear spindle, and a pair of counter weights secured to said casing and independently adjustable peripherally of the casing to counterbalance accurately the grinding wheel spindle and associated parts at any position of adjustment of said grinding wheel spindle.

4. In a grinding machine, in combination,

a rotatable cylinder, a rotatably adjustable rear spindle housing eccentrically journaled in said rotatable cylinder, a rotatable rear spindle eccentrically journaled in said rear spindle housing, means for rotating said rear spindle, a gear casing rigidly carried by the said rear spindle housing at the forward end thereof, said rear spindle extending forwardly into said casing, a substantially circular gear casing cover cooperatively associated with said casing, a casing shaft parallel to said rear spindle rotatably carried by said casing and cover substantially axially thereof whereby said cover may be rotatably adjusted through 180 degrees about said casing shaft with respect to said casing, means for securing said cover in desired position of rotative adjustment, a grinding wheel spindle housing carried by said cover, a grinding wheel spindle journaled in said grinding wheel spindle housing and extending rearwardly into said casing, said rear spindle and grinding wheel spindle being parallel and disposed equi-distant laterally from said casing shaft whereby said spindles may be disposed in longitudinal alignment, a pair of gears mounted on said casing shaft and fixed thereto and rotatable therewith, a gear carried by said rear spindle at the forward end thereof in cooperative engagement with one of said shaft gears and a gear carried by said grinding wheel spindle at the rearward end thereof in cooperative engagement with the other of said shaft gears, whereby said grinding wheel spindle may be disposed and rotated in any one of a wide range of adjusted positions to grind surfaces of a wide range of diameters.

In testimony whereof I affix my signature.

WILLIAM J. BAUMBERGER.