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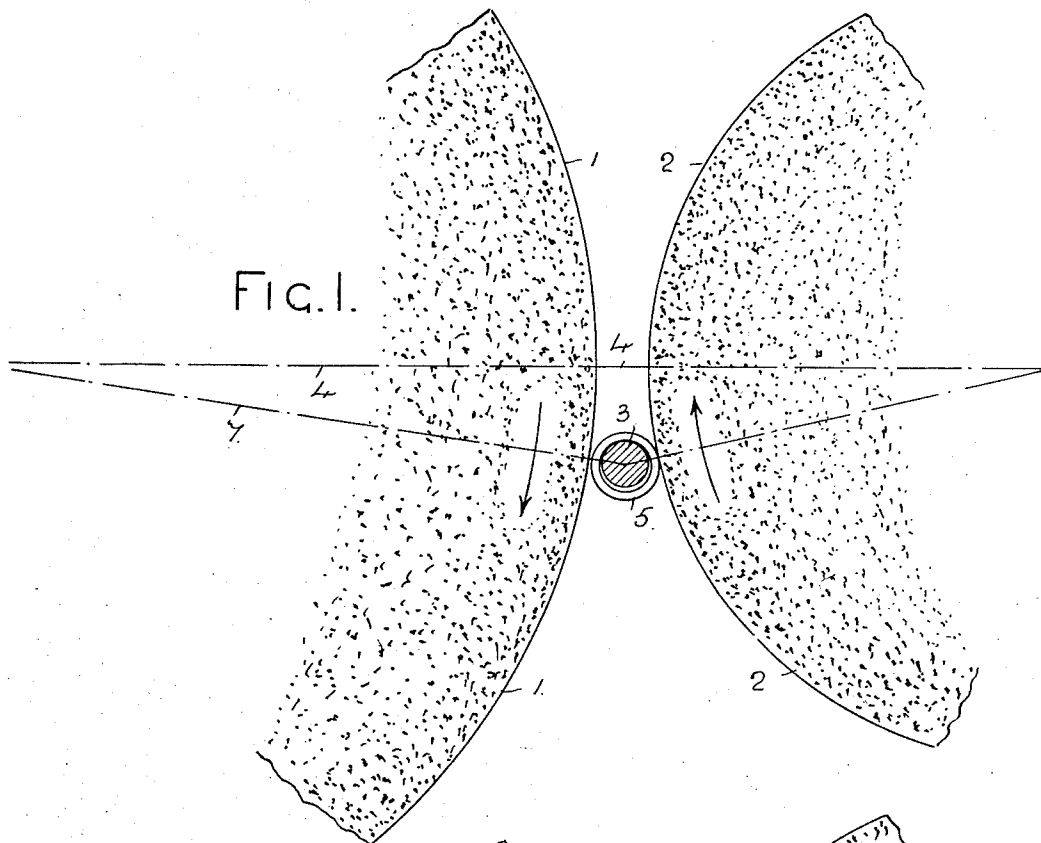
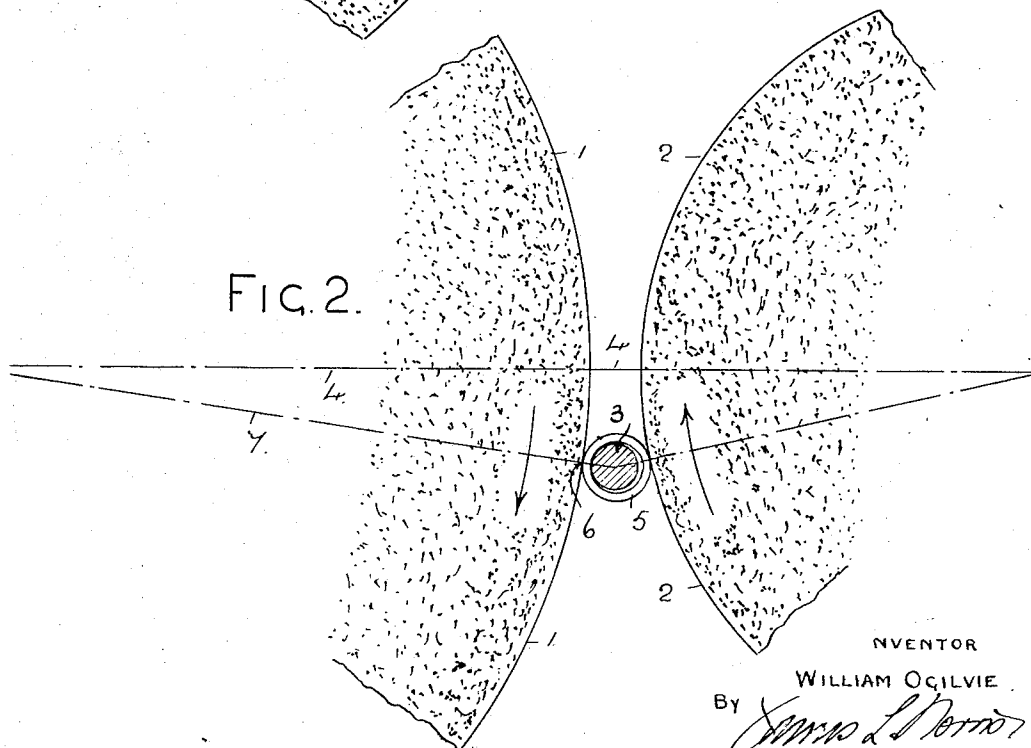
W. OGILVIE

1,948,392

CENTERLESS GRINDING MACHINE

Filed-Dec. 17, 1931

2 Sheets-Sheet 1



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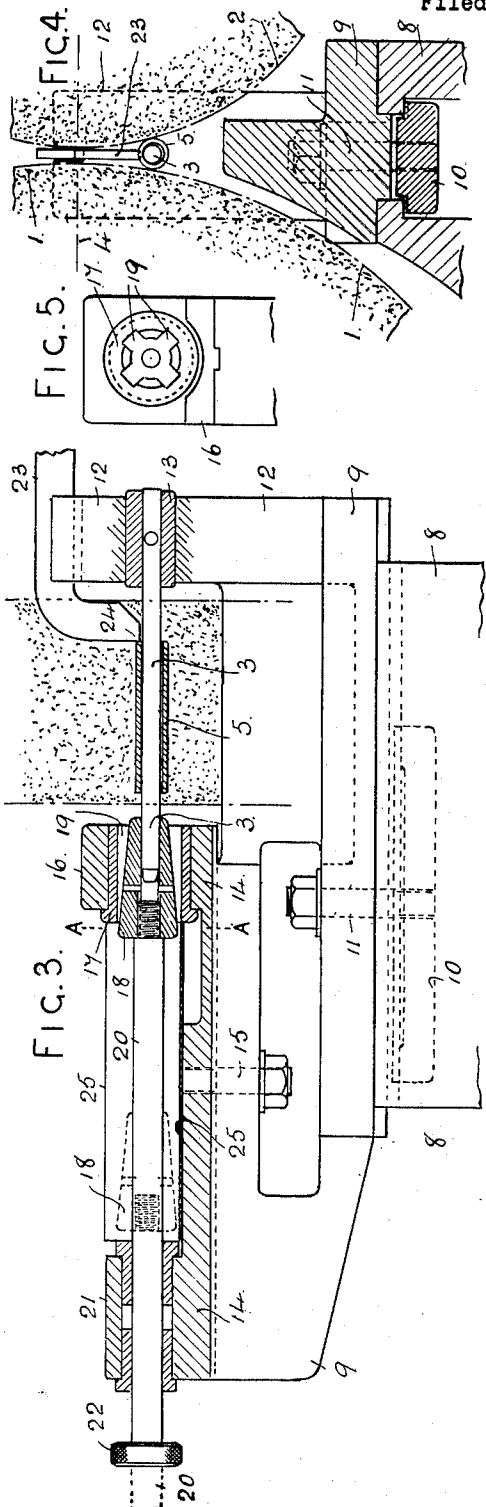
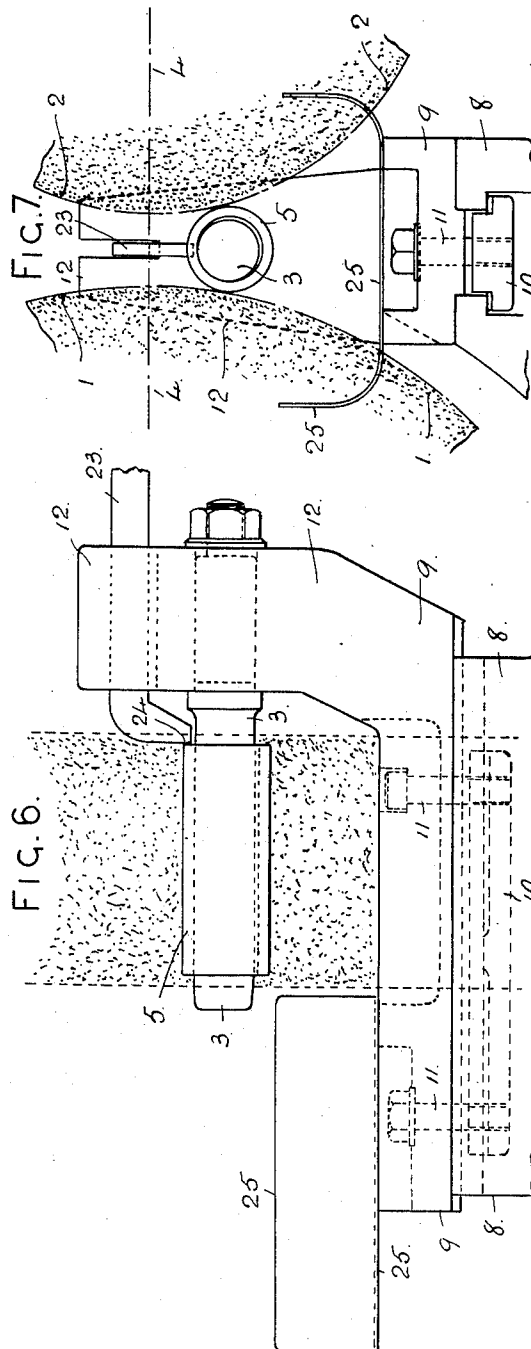
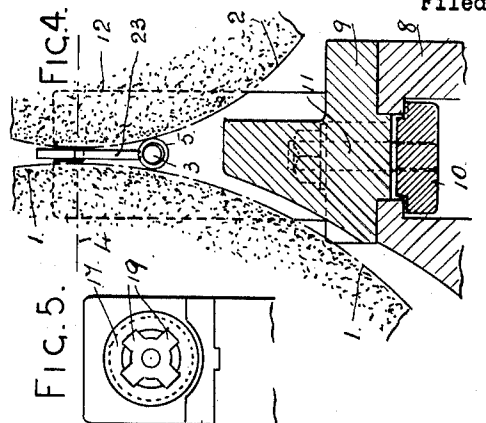
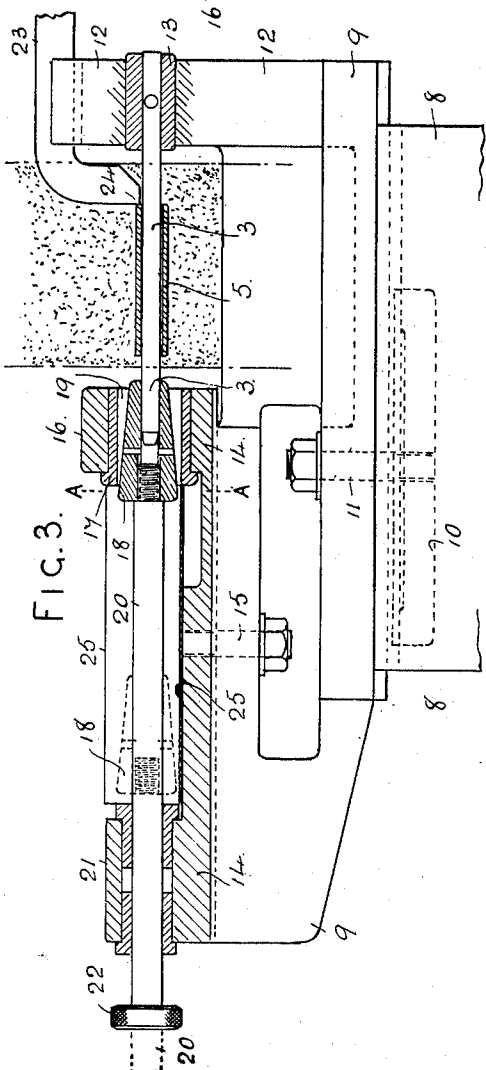
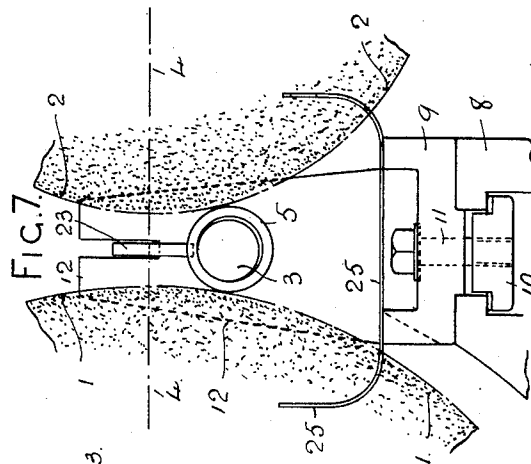
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CENTERLESS GRINDING MACHINE

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2 Sheets-Sheet 2



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1,948,392

CENTERLESS GRINDING MACHINE

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581,671, and in Great Britain January 8, 1931

7 Claims. (Cl. 51—103)

This invention relates to improvements in centerless grinding machines, and refers more particularly to that type of grinding machine wherein the work is supported between the co-acting faces of peripherally opposed grinding and control wheels, whose opposing faces move in opposite directions, and wherein the control wheel is arranged to move at a comparatively slow rate to that of the grinding wheel. The invention has for its object to provide an improved method and/or means for concentric grinding of tubular work pieces, such as bushings or the like, whereby the outer surface of the tubular work piece can be ground concentrically with the inner diameter of the work piece to within very fine limits of accuracy.

A further object of the invention is to provide means whereby the work to be treated can be readily and quickly placed in position between the co-acting faces of the grinding and control wheels, and removed after completion of the grinding operation.

According to this invention the tubular work piece to be ground is freely carried on a mandril which is located between the co-acting faces of the grinding and control wheels, and disposed with its axis well below a plane passing through the centers of the said wheels, and wherein the said mandril or work support is carried on a slide or slides adjustably mounted on the bed of the machine, and adapted to permit of the mandril being moved or adjusted in relation to the periphery of the control wheel.

When the tubular work piece is placed on the mandril, clear of contact with the peripheries of the grinding and control wheels, assuming the internal diameter of the work piece to be ten thousandths of an inch larger than that of the mandril, its inner diameter will rest on the top of the mandril and there will be a space or clearance of ten thousandths of an inch between the underside of the mandril and the work piece, and at each side of the mandril on the center line thereof there will be a space or clearance of about five thousandths of an inch. The control wheel is adjusted to a position in relation to the opposing face of the mandril which will leave a space or clearance between the inner diameter of the work piece and the face of the mandril, which is less than the maximum clearance as above suggested; and when the grinding wheel is moved into contact with the work piece, the latter will be caused to swing over into contact with the periphery of the control wheel, which, moving in an upward direction, takes

control and rotates the work piece. Inward movement of the grinding wheel is continued up to and against a suitable stop, in which position the space between the periphery of the grinding wheel and the mandril corresponds to the required thickness of the wall of the bush or like work piece, and when the grinding is completed, the thickness of the said wall will be uniform, and the outer diameter thus made concentric with the inner diameter of the work piece to within very fine limits of accuracy.

The features of the invention will appear from the following description of the accompanying drawings given by way of example, in which:—

Figure 1 is a diagrammatic view which illustrates the improved method for concentric grinding of tubular work pieces, and shows the position assumed by the work piece before the grinding wheel is moved into contact therewith.

Figure 2 is a view similar to Figure 1, but showing the position assumed by the work piece when in contact with the grinding and control wheels during the grinding process.

Figures 3 and 4 are, respectively, a longitudinal view and a transverse sectional view of means for supporting the tubular work piece between the co-acting faces of the grinding and control wheels.

Figure 5 is a fragmentary sectional elevation taken on line A—A, Figure 3.

Figures 6 and 7 are, respectively, a longitudinal view and an end view of a modified arrangement for supporting the tubular work piece.

According to one practical method of carrying this invention into effect, as illustrated in Figures 1 and 2, between the peripherally opposed faces of the grinding wheel 1 and the control wheel 2 is interposed a mandril or like work support 3, which is disposed with its axis well below a plane 4 passing through the centers of the grinding and control wheels. It has been found in practice that, when using a grinding wheel having a diameter of about twenty inches and a control wheel having a diameter of about twelve inches, the mandril or work support 3 can be placed at a position with its axis about one and one half inches below the centers of the grinding and control wheels to effect the concentric grinding of tubular work pieces in accordance with the improved method.

The mandril 3 is of a diameter slightly less than the internal diameter of the tubular work piece 5, and when the latter is placed in position thereon ready for the grinding operation, and before the grinding wheel 1 is brought into contact with

the work piece 5, as seen in Figure 1, the inner diameter of the work piece 5 rests on the top of the mandril or work support 3, thus leaving a clearance between the underside of the mandril 5 and the internal diameter of the work piece. When the grinding wheel 1 is moved into contact with the tubular work piece 5, the latter is caused to swing over and be pressed into contact with the periphery of the control wheel 2, which, moving in an upward direction, takes control and rotates the work piece, and as seen in Figure 2, the clearance between the mandril or work support 3 and the internal diameter of the work piece 5 will become located adjacent to the point of contact with the control wheel when the operation of grinding has been completed.

During the process of grinding, as any eccentric projection or unequal thickness of the work piece 5 is gradually removed by the grinding wheel 1, the work piece 5, under the influence of the upward moving face of the control wheel 2, will be lifted upward towards the center line 4 and into the narrowing throat between the grinding and control wheels, swinging during such movement about a point of contact which varies from the central vertical position to a point 6 on the line 7 between the centers of the grinding wheel 1 and the mandril 3.

It is found advantageous in practice to use a mandril having a diameter which is only slightly smaller than the internal diameter of the tubular work piece to be ground, but the said clearance must be at least equal to the amount of eccentricity, roughness, or inequalities that it is desired to remove from the work piece in the operation of grinding.

In setting up the machine, the mandril is preferably adjusted to such a fixed position in relation to the periphery of the control wheel that will permit the finished work piece to freely revolve or spin out of contact with the control wheel on the completion of the grinding operation.

According to one practical mode of carrying the invention into effect, as illustrated in Figures 3 to 5, on a main slide 8 which is carried on the bed of the machine and capable of longitudinal adjustment, I mount a work support comprising a base plate 9 which is transversely movable on the main slide 8, and adapted to be fixed in any desired position thereon by a clamping plate 10 and locking bolts 11; and on the said base plate 9 is formed or fitted a bracket 12 in which is fixed a bush 13 having secured therein a mandril 3 arranged to extend between the opposing faces of the grinding wheel 1 and the control wheel 2, and protrude beyond the front faces of the said wheels. On the front end of the base plate 9 is mounted a slide 14 adapted to be fixed in any desired position by a clamping bolt 15; and on the said slide 14 is formed a bracket 16 in which is mounted a tapered bush 17 adapted to receive a correspondingly tapered bush or plug 18 which is adapted to engage with and support the front end of the mandril 3, the said bush 17 having preferably formed therein longitudinal flutes 19 to provide a good and constantly clean contact surface for the removable bush or plug 18. Upon removing the tapered bush or plug 18, a work piece can be readily placed upon or removed from the fixed supporting mandril 3, by passing same through the bush 17 fixed in the bracket 16, such loading of the work piece being effected when the grinding wheel is in the outward or retracted position.

In order to facilitate the introduction and re-

moval of the work piece 5, the tapered bush or plug 18 which engages with and supports the front end of the mandril 3, has fixed thereto a rod 20 which is slidably supported in a bracket 21 formed on a forward extension of the slide 14 which carries the bracket 16, the said bracket 21 being suitably bushed to slidably receive the said rod 20; and the latter is preferably provided with a suitable knob 22 to facilitate the inward and outward movement of same to move the tapered bush or plug 18 into or out of engagement with the bush 17 in the supporting bracket 16 and with the end of the mandril 3.

To effect the ready removal of the finished work piece from its mandril 3, an ejector rod 23 is slidably mounted on the machine, and provided with a depending nose part 24 which is arranged to engage with the inner or rear end of the work piece 5, the said ejector rod 23 being slidable forwardly or backwardly by means of any suitable mechanism adapted to be actuated by a lever conveniently disposed for manipulation by the operator while standing at the front of the machine. When the ejector rod 23 is moved forwardly, the pressure exerted thereby against the work piece 5 forces the tapered bush or plug 18 out of its seating in the bush 17, and moves the rod 20 attached thereto outwardly, and at the same time forces the finished work piece off its mandril 3 into a trough or receptacle 25 provided for its reception. A fresh work piece can then be readily inserted on the end of the mandril 3, and when the tapered bush or plug 18 is moved inwardly to its position in the fixed bush 17, it will engage the end of the work piece 5 and move same to a position between the faces of the grinding and control wheels 1 and 2 respectively.

The nose 24 of the ejector rod 23 may constitute an adjustable stop up to and against which the work piece may be moved in the process of grinding when the work piece is caused to travel along the mandril by reason of a slight angular disposition of the axis of the grinding wheel or the control wheel in relation one to the other, or by a slight angular disposition of the axis of the mandril in relation to the axes of the grinding and control wheels.

In the modified arrangement shown in Figures 6 and 7, which is more particularly adapted for the grinding of tubular work pieces of comparatively large internal diameter and wherein a mandril of large diameter can be employed which is therefore of rigid construction and not liable to vibrate, I may dispense with the support for the front end of the mandril. In this arrangement the mandril 3 is fixed in a bracket 12 formed on a transverse slide 9 mounted on the longitudinally movable slide 8, and is adapted to be fixed thereto, in any desired position, by a clamping plate 10 and clamping bolts 11. In this construction, after the operation of grinding, and when the grinding wheel has been withdrawn, the finished work piece 5 can be removed from the mandril 3, by the ejector 23, into the trough or receptacle 25; and a fresh work piece can then be placed by hand on the mandril 3, and as before described the operation of grinding can be adapted to traverse the work piece along the mandril into contact with the nose 24 of the ejector 23, such being arranged to constitute a stop.

Having fully described my invention, what I desire to claim and secure by Letters Patent is:—

1. In a centerless grinding machine comprising oppositely rotatable grinding and control wheels, the periphery of one of which is adjust-

able for a limited distance toward the periphery of the other, a mandril for a tubular work piece located between the opposed peripheries of said wheels and below a plane extending through the axes of said wheels, said mandril having an arcuate surface located between the periphery of said grinding wheel and a vertical plane located between the peripheries of said control and grinding wheels and intersecting the center of the circle of which said arcuate surface forms a part, said arcuate surface constituting a support on various points of which the inner wall of the work piece rotates and swings upwardly under the action of said wheels, means having the mandril rigidly secured thereto and mounted for adjustment to dispose said arcuate supporting surface from the periphery of said control wheel for a distance greater than the greatest radius of the work piece, and means for rigidly securing said mandril supporting means in adjusted position.

2. A machine for concentrically grinding tubular work pieces, comprising peripherally opposed grinding and control wheels, a mandril or work support located between the peripheries of said wheels at a point below a plane extending through the axes of said wheels, a slide adjustable in relation to the periphery of said control wheel, means for supporting the rear end of said mandril from said slide, a second slide adjustably mounted on said first slide, a bracket carried by said second slide, a tapered bush mounted in said bracket, and a tapered hollow plug removably mounted in said bush and receiving and supporting the front end of said mandril.

3. A machine for concentrically grinding tubular work pieces, comprising peripherally opposed grinding and control wheels, a mandril or work support located between the peripheries of said wheels at a point below a plane extending through the axes of said wheels, a slide adjustable in relation to the periphery of said control wheel, means for supporting the rear end of said mandril from said slide, a second slide adjustably mounted on said first slide, a bracket carried by said second slide, a tapered bush mounted in said bracket, a tapered hollow plug removably mounted in said bush and receiving and supporting the front end of said mandril, a second bracket mounted on said second slide outwardly of said first bracket, and a rod slidable in said second bracket and connected to said plug, said rod providing means by which said plug may be moved into and out of said bush.

4. A machine for concentrically grinding tubular work pieces, comprising peripherally opposed grinding and control wheels, a mandril or work support located between the peripheries of said wheels at a point below a plane extending through the axes of said wheels, means for supporting said mandril from the rear end thereof, and a combined stop and ejector for the work piece on said mandril, said combined stop and ejector being mounted on said means for adjustment longitudinally of said mandril.

5. A machine for concentrically grinding tubular work pieces, comprising peripherally opposed grinding and control wheels, a mandril or work support located between the peripheries of said wheels at a point below a plane extending through the axes of said wheels, means for supporting said mandril from the rear end thereof, an ejector mounted on said means for movement longitudinally of said mandril to displace the work piece therefrom, and a trough or receptacle arranged to receive the work piece as it is ejected from the mandril.

6. A machine for concentrically grinding tubular work pieces, comprising peripherally opposed grinding and control wheels, a mandril or work support located between the peripheries of said wheels and extending forwardly and rearwardly beyond said wheels, means for supporting the rear end of said mandril, a hollow member supported in surrounding relation to the front end of said mandril, said member being large enough internally for the passage therethrough of the work piece during its application to and removal from said mandril, and a member removably mounted in said first member and receiving and supporting the front end of said mandril.

7. A machine for concentrically grinding tubular work pieces, comprising peripherally opposed grinding and control wheels, a mandril or work support located between the peripheries of said wheels and extending forwardly and rearwardly beyond said wheels, means for supporting the rear end of said mandril, a hollow member supported in surrounding relation to the front end of said mandril, said member being large enough internally for the passage therethrough of the work piece during its application to and removal from said mandril, a rod connected to said second member and providing means by which it may be inserted in and removed from said first member, and means for slidably supporting said rod.

WILLIAM OGILVIE.