

1,198,612.

4 SHEETS—SHEET 1.

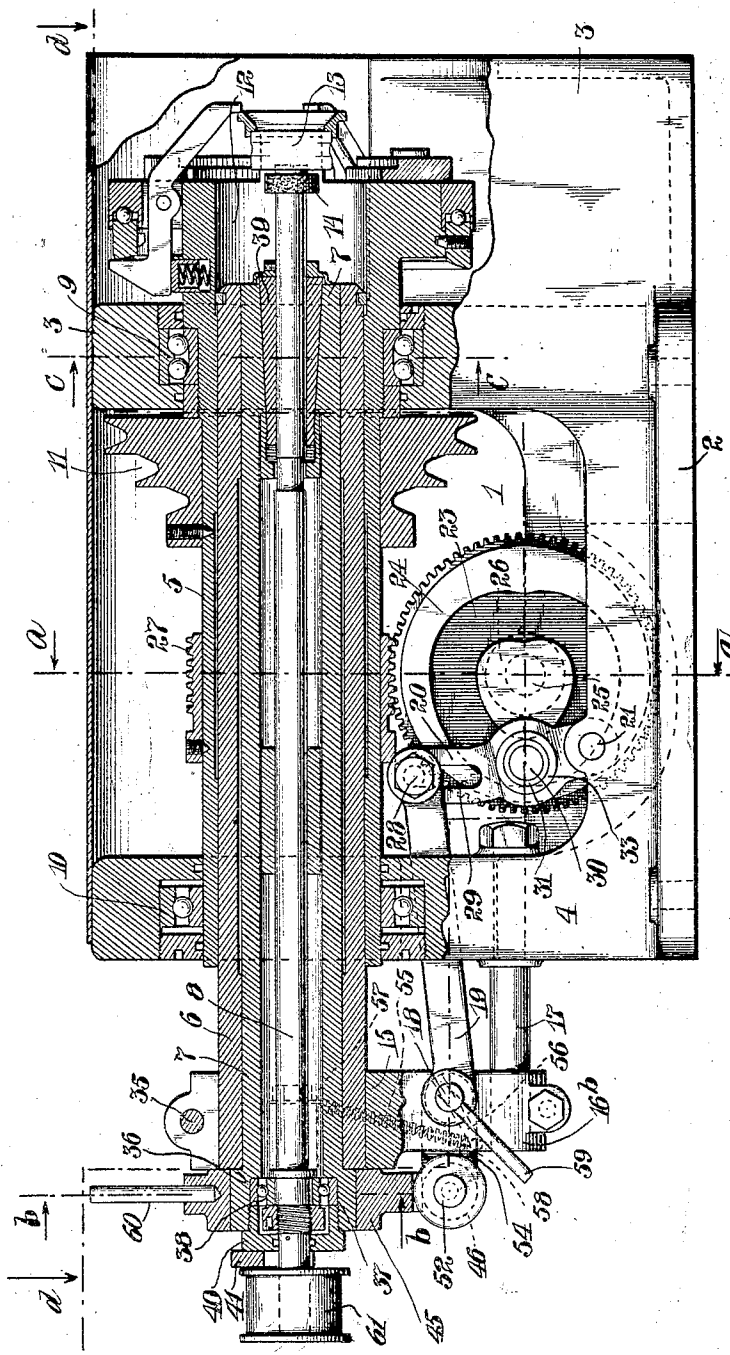


Fig. 1.

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Inventor:
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by Rogers, Kennedy & Campbell Attys.

1,198,612.

Patented Sept. 19, 1916.

4 SHEETS—SHEET 2.

Fig. 3.
ON LINE A-A

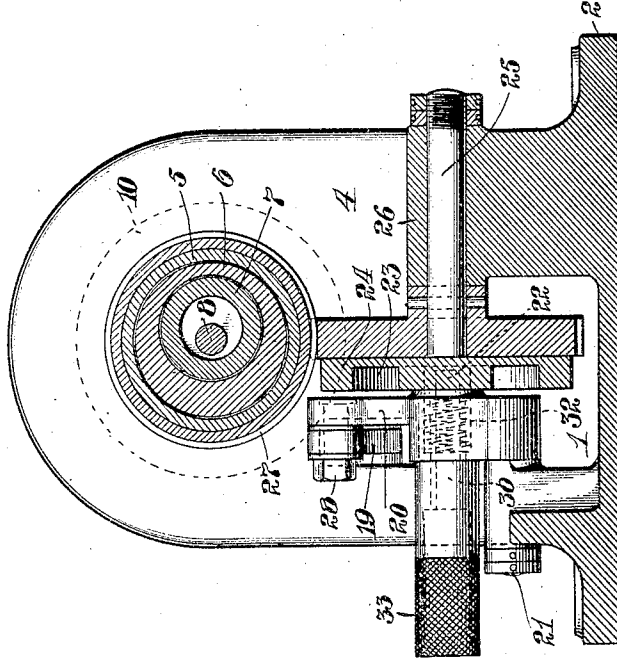
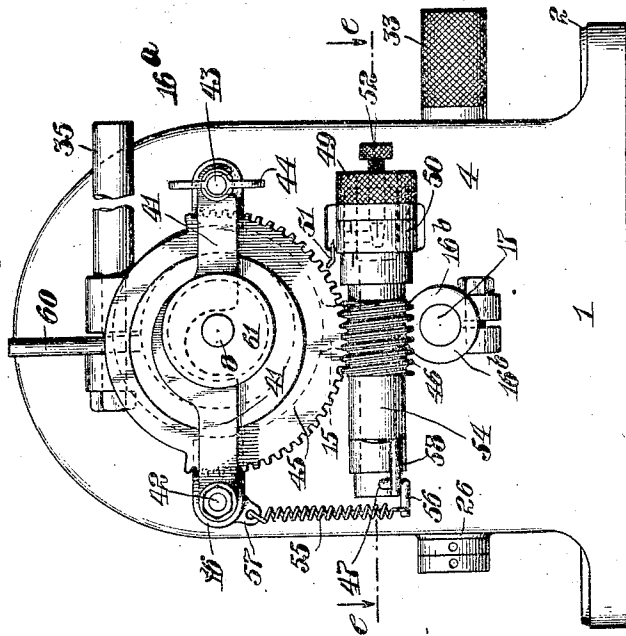


Fig. 2.



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GRINDING MACHINE.
APPLICATION FILED FEB. 2, 1915.

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4 SHEETS—SHEET 3.

Fig. 4.
ON LINE B-B

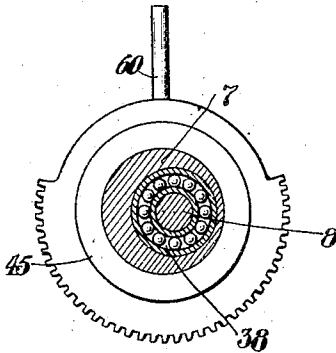


Fig. 5.
ON LINE C-C

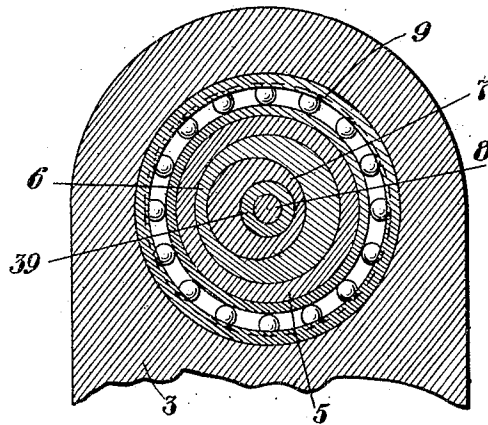


Fig. 7.
ON LINE E-E

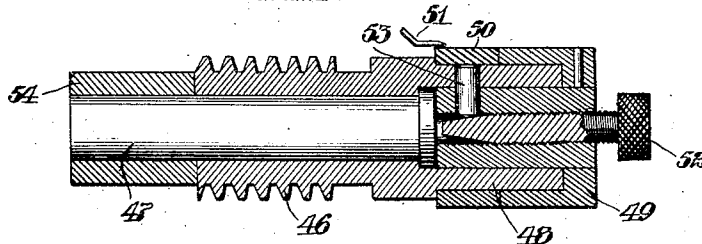
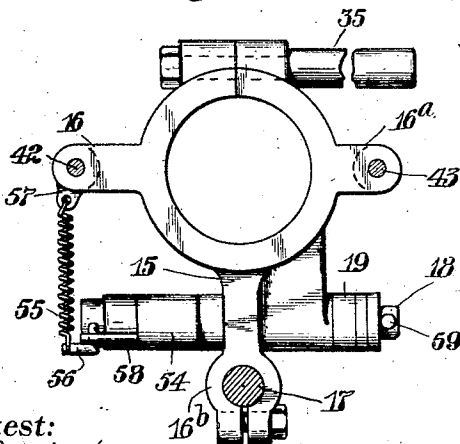


Fig. 8.



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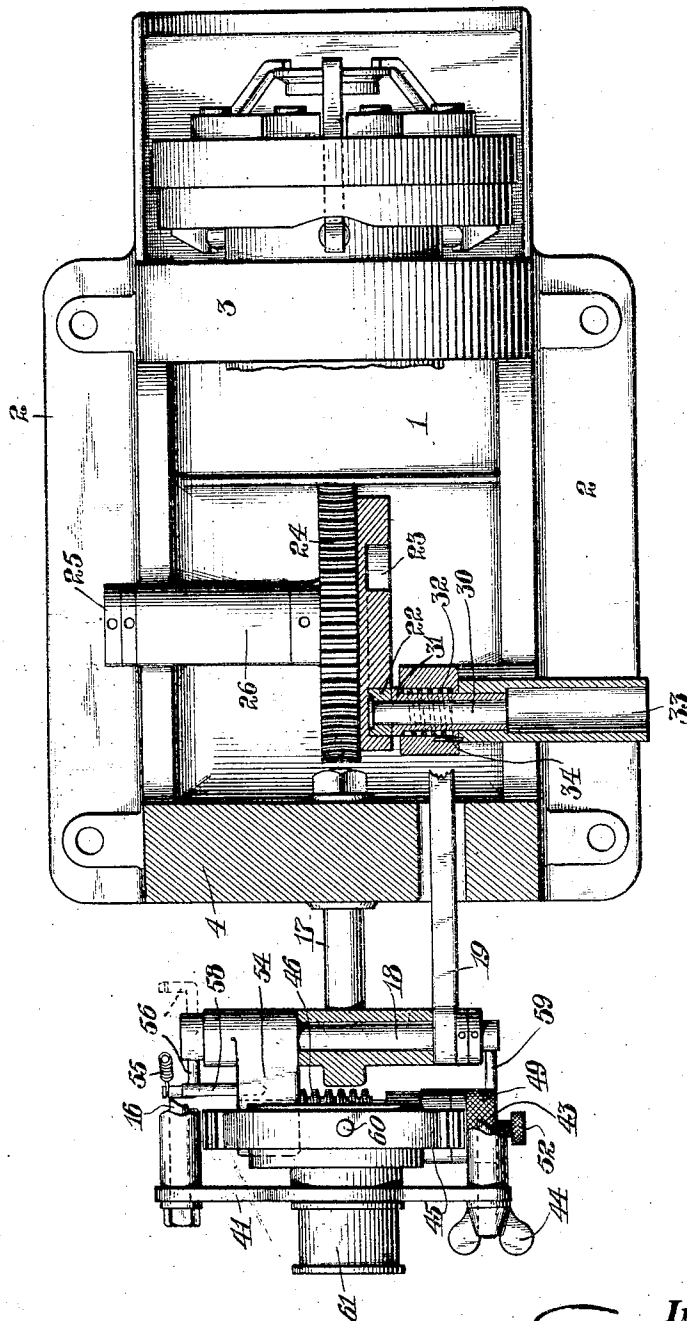
Attys.

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4 SHEETS—SHEET 4.

Fig. 6.
ON LINE D-D



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UNITED STATES PATENT OFFICE.

FRED E. BRIGHT, OF PHILADELPHIA, PENNSYLVANIA.

GRINDING-MACHINE.

1,198,612.

Specification of Letters Patent.

Patented Sept. 19, 1916.

Application filed February 2, 1915. Serial No. 5,325.

To all whom it may concern:

I known that I, Fred E. BRIGHT, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Grinding-Machines, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to grinding or finishing machines, and has reference more particularly to that type of machine in which the work is rotated while being subjected to the action of an operating tool.

The invention is designed with special reference to the handling of annular forms or shapes, such for instance as the casing members or bearing rings of antifriction bearings, the particular form of mechanism here shown as embodying my invention, being adaptable for operating on the bores of the inner casing members of antifriction bearings in order to give the bore its proper and accurate finished condition.

In its general organization, the mechanism embodying my invention comprises a holder for the work, in this instance the inner casing member of an antifriction bearing, which holder is adapted to be rotated so as to correspondingly rotate the work about its central longitudinal axis and expose the bore of the same; a rotary tool arranged relatively to the work holder to enable the tool to operate on the interior of the bore; means for moving the tool axially of the work so that it will traverse the bore lengthwise; and means for imparting a feeding movement to the tool in a radial direction to cause it to enter more deeply into the material of the work.

In the more specific embodiment of the invention, the work holding device is in the form of a chuck carried on the end of a rotatable sleeve, and the operating tool is in the form of a grinding wheel carried by a spindle extending longitudinally within the rotary sleeve and mounted for rotation eccentrically within a surrounding adjusting sleeve, which adjusting sleeve is in turn mounted for rotary oscillation in a supporting sleeve, which latter is mounted for reciprocation within the said rotary chuck-carrying sleeve, the reciprocating movement of the supporting sleeve imparting a traversing movement to the grinding wheel, longitudinally of the bore of the work, and the

oscillating movement of the adjusting sleeve imparting a radial feeding movement to the grinding wheel, due to the eccentric mounting of the wheel-carrying spindle within the adjusting sleeve. The rotary chuck-carrying sleeve, and the wheel-carrying spindle are respectively provided with driving pulleys, by means of which a rotary motion is imparted to said devices from a suitable source of power, the reciprocating movement of the supporting sleeve being imparted to the same automatically by the rotation of the chuck-carrying sleeve, while the oscillating movement of the adjusting sleeve is imparted thereto by hand, through the medium of mechanism which will enable the grinding wheel to be fed radially to the work to predetermined and definite extents.

The mechanism shown in the accompanying drawings is one form of embodiment of my invention, which is illustrated by way of example, and which in practice has been found to answer to a satisfactory degree the objects to be attained. It will be manifest, however, that the constructional details thereof may be variously modified and changed by the skilled mechanic without departing from the spirit of my invention; and it will be understood that the invention is not limited to any particular form or construction of the parts except in so far as such limitations are specified in the claims. In this connection however, I believe myself to be the first to arrange a tool-carrying spindle within a surrounding rotary work-carrying sleeve or member, and to combine therewith, means for effecting a feeding movement of the operating tool transversely or radially with respect to the axis of rotation of the work. Also I believe myself to be the first to arrange a tool-carrying spindle within a surrounding rotary work carrying-sleeve, in combination with means to impart to the tool carrying-spindle a longitudinal motion to cause the tool to traverse the work in like direction.

In the accompanying drawings: Figure 1 is a longitudinal section through my improved machine with parts in elevation. Fig. 2 is a rear elevation of the same. Fig. 3 is a transverse sectional elevation on the line *a-a* of Fig. 1. Fig. 4 is a similar view on the line *b-b* of Fig. 1. Fig. 5 is a similar view on the line *c-c* of Fig. 1. Fig. 6 is a horizontal sectional plan view on the line *d-d* of Fig. 1. Fig. 7 is a sectional view

on the line *c-c* of Fig. 2. Fig. 8 is a rear sectional elevation of the frame and associated parts through which the tool spindle is reciprocated.

Referring to the drawings: The operative parts of the machine are mounted in and sustained by a suitable frame 1, comprising a base or bed plate 2, from which extends upwardly, a front standard 3 and a rear standard 4. These standards are provided with alined horizontal openings, within which extend and are supported, the rotary chuck-carrying sleeve 5, the supporting sleeve 6, the oscillating adjusting sleeve 7, and the wheel-carrying spindle 8, said parts being arranged one within the other in the relations above mentioned.

The chuck-carrying sleeve is rotatably supported near its forward end in the opening in the front standard by means of a ball-bearing 9, and is similarly supported at its rear end in the opening in the rear standard by means of a ball-bearing 10, a driving pulley 11 being fixed to the sleeve and adapted to be rotated from a suitable source of power. The sleeve extends at its forward end beyond the standard, at which point it carries a work-holding chuck 12, of a form and construction to give support to the work to be operated on. In the present instance the inner casing member 13 of an antifriction bearing, which member is held by the chuck in such manner that it will be rotated with the sleeve with the bore of the casing member exposed to the action of the grinding wheel 14 on the forward end of the spindle 8.

The supporting sleeve 6 is mounted axially within the sleeve 5 in such manner that it may be reciprocated back and forth therein in order to impart a longitudinal reciprocating motion to the tool spindle 8, so as to cause the grinding wheel thereon to traverse the work in an axial direction. The reciprocating movements are imparted to sleeve 6 automatically by the rotary movement of the chuck-carrying sleeve, through the medium of operating devices which will now be described. Fixed firmly to the rear end of sleeve 6 is a vertical frame 15 containing a circular opening, in which the end of the sleeve is clamped, and being provided with horizontal arms 16 and 16^a and a depending vertical arm 16^b. The lower end of the arm 16^b is provided with a horizontal fore and aft opening loosely encircling a guide stud 17 fixed to the standard 4, and projecting rearwardly therefrom, the function of this stud being to restrain the frame against a transverse oscillating movement, while permitting the same to move to and from the standard 4, and thereby effect the longitudinal reciprocating movement of the sleeve 6.

18 indicates a rock shaft which is mounted

in the frame 15 above and transversely of the guiding stud 17, and mounted loosely on this shaft is the rear end of a link 19 which extends forwardly and has its forward end connected to the upper end of an upright lever 20, the lower end of which is pivoted on a transverse horizontal axis, as at 21, to the bed plate of the machine, the construction being such that the vibratory movements of the lever 20 will cause the frame 15, carrying the sleeve 6, to reciprocate back and forth on its guiding stud, with the result that the sleeve 6 will be correspondingly moved. The lever 20 is provided on its inner side with a roller 22 extending in a cam groove 23 in the face of a vertical worm wheel 24 mounted on the end of a stud 25 which is journaled in a bearing 26 fixed to the bed plate of the machine. The worm wheel 24 is arranged vertically beneath the chuck-carrying sleeve 5, and is engaged by a worm 27 fixed to said sleeve, whereby the rotary motion of the sleeve will impart a rotary motion to the worm wheel, and through the medium of the vibratory lever, the link, and the frame 15, a reciprocating motion will be imparted to the sleeve 6. The link 19 is adjustably connected with lever 20 by means of a bolt 28 extending through the link and through a slot 29 in the lever, the purpose of this construction being to enable the link to be connected to the lever at varying distances from the axis of the latter, in order to vary the throw of the link, and the extent of movement imparted to the frame 15, and consequently the extent of the traversing movement of the grinding wheel. In order that the traversing movement of the grinding wheel may be arrested, the roller 22 is so mounted on the lever 20, that the former may be disengaged from the cam groove. This is effected in the present instance by mounting the roller on the end of a stud 30 carried by a plunger 31 mounted to slide in a guiding opening in the lever 20. The plunger is reduced in diameter where it slides in the lever, and the reduced portion is encircled by a spiral spring 32 which bears at its inner end against a shoulder on the plunger, and at its outer end against a shoulder on the lever, the tendency of the spring being to maintain the roller yieldingly in the cam groove, but permitting the same to be withdrawn therefrom. The plunger is extended beyond the lever, in the form of a handle 33 which, when pulled outwardly, will withdraw the roller from the cam groove against the influence of the spring, and thereby interrupt the driving connection between the worm wheel and the lever, with the result that the reciprocating frame 15 and the grinding wheel operated thereby will come to rest. The plunger is held outwardly with the roller free of the cam, by means of a pin 34 projecting inwardly from

the handle and normally extending loosely in a socket in the lever, this being the position of the parts when the roller is engaged by the cam as shown in Fig. 6. When the handle is withdrawn to disengage the roller, the pin will be drawn outwardly from its socket, and then by giving the handle a slight circumferential turn, and releasing it, the spring will act to draw the handle inwardly and will seat the pin against the outer side of the lever; whereby the plunger will be held outwardly with the roller disengaged from the cam. When the operating means for the reciprocating frame are thus disconnected, the frame may be reciprocated by hand by means of a handle 35 fixed to the frame at its top and projecting laterally therefrom, as shown more particularly in Fig. 2.

The adjusting oscillating sleeve 7, before alluded to, is mounted in an eccentric opening in the sleeve 6, the effect of which is to dispose the center of sleeve 7 to one side of the center of sleeve 6; and the sleeve 7 is so mounted within sleeve 6 that the reciprocating movements of sleeve 6 will impart a corresponding movement to sleeve 7, but the latter will be permitted to be oscillated circumferentially within sleeve 6. These actions are effected by the following described means. The rear end of sleeve 7 is enlarged and is provided with an annular shoulder 36 which bears against the rear end of sleeve 6, the enlarged end of sleeve 7 being provided with a circular seat or socket 37 which is disposed eccentrically with relation to the center of the sleeve as shown in Fig. 4. In this socket is mounted an annular ball-bearing 38 comprising outer and inner casing members and interposed antifriction balls, the wheel-carrying spindle 8 being mounted centrally within the inner casing member. As a result of this construction and arrangement, the axis of the wheel-carrying spindle will be disposed to one side of the axis of the sleeve 7, the eccentric openings in the sleeves 6 and 7 being oppositely disposed to each other, thereby causing the axis of the wheel spindle 8 to be disposed coincident with the axis of the chuck carrying sleeve 5, for the purpose presently to be described. At its opposite end the bearing spindle 8 is mounted in a bearing sleeve 39 which is tapered exteriorly and firmly seated in a tapered opening in the forward end of sleeve 7, the bearing sleeve 39 being disposed eccentrically with relation to the axis of the sleeve 7 to correspond to the eccentric relation of the bearing at the opposite end of the spindle, to said sleeve. The antifriction bearing 38 at the rear end of the wheel spindle is confined in its seat or socket in the sleeve, by means of a screw cap 40 which is screwed into the end of the enlarged portion of the sleeve and bears against the outer

casing member of the bearing. Engaged with the outer end of the cap 40 is a horizontal transversely extending yoke 41, one end of which is pivoted on a horizontal stud 42 extending rearwardly from the arm 16 of frame 15, while the other end of the yoke is formed with a slot engaging over a stud 43 extending rearwardly from the arm 16, this latter stud being threaded to receive a thumb nut 44 by which the yoke may be held removably in operative position engaged with the outer end of the screw cap 40. The effect of the engagement of the yoke with the screw cap is to form a connection between the reciprocating frame 15, and the sleeve 7 of such character that the forward sliding movement of frame 15 will carry sleeve 7 with it, and the opposite movement of the frame will move the sleeve in the opposite direction due to the engagement of the end of sleeve 6 with the annular shoulder 36. It is seen therefore that by the reciprocating movements of frame 15 and consequently the sleeve 6 clamped thereto, sleeve 7 will be reciprocated in like manner, and the wheel-carrying spindle 8 mounted in sleeve 7, will be likewise reciprocated, these parts all moving together as a unit in an axial direction, with the wheel-spindle capable of an independent rotation within sleeve 7, and sleeve 7 being capable of an independent oscillating movement within sleeve 6.

By reason of the eccentric mounting of the wheel-carrying spindle within sleeve 7 as before described, and by reason of the fact that normally the center of spindle 8 is coincident with the axis of the chuck carrying sleeve 5, when sleeve 7 is oscillated within sleeve 6, the wheel spindle will be moved bodily radially beyond its central position and the grinding wheel on the spindle will be correspondingly fed to the work so as to enter more deeply therein. The mechanism for oscillating the sleeve 7 to effect this radial adjustment of the grinding wheel consists of the following parts. Surrounding the enlarged end of sleeve 7 and firmly fixed thereto, is a segment worm gear 45 engaged at its lower side by a horizontal transversely extending worm 46 mounted for rotation on a supporting stud 47. The worm is provided with an extension or sleeve 48 (Fig. 7) to which is fixedly connected a knurled turning cap 49, by means of which the worm may be turned and through the medium of the worm wheel, will oscillate sleeve 7. Provision is made for determining and regulating the extent of movement of the worm, so as to feed the grinding wheel radially predetermined and known distances. This is effected by providing a collar 50 which loosely surrounds the extension of the worm at the inner end of the turning cap, which sleeve is provided with gradua-

tions preferably to 1/1000 of an inch, adapted to be read in connection with a fixed pointer 51. The graduated sleeve is clamped to the turning cap so as to move with it, and is adapted to be released therefrom, to permit the sleeve to be turned to adjust the same to zero, by means of a clamping screw 52 threaded centrally into the extension on the worm, and having a tapered end which is adapted to engage the inner end of a radially extending locking pin 53 mounted to slide in the extension of the worm and adapted at its outer end to engage and bind against the inner side of the graduated sleeve. Normally the screw 52 is adjusted so as to effect a clamping connection between the worm and the graduated sleeve, so that when the turning cap is operated to rotate the worm, the graduated sleeve will move with it. When the sleeve is to be set to zero for another grinding operation, clamping screw 52 is loosened, which, releasing the graduated sleeve, permits the latter to be freely turned, relatively to the worm.

The stud 47 on which the worm 46 is mounted, is carried by an up and down movable arm 54 pivotally sustained on the shaft 18 before alluded to, so that the worm may be disengaged from the worm wheel by the downward movement of the arm, and may be engaged therewith by swinging the arm upwardly. The arm is held normally in its upper position by means of a spiral spring 55 connected at its lower end with an angular finger 56, projecting rearwardly from the end of the shaft, the spring being connected at its upper end to a washer 57 sustained by the stud 42 on the frame 15. The spring, pulling up on the angular arm, forces the same upwardly against a pin 58 projecting outwardly from the arm 54, and by this means the arm is held yieldingly in its upper position with the worm engaged with the worm wheel. The washer to which the upper end of the spring is connected, is arranged vertically over the axis of the shaft 18, and by swinging said shaft by means of a handle 59 thereon, in a direction to carry the angular arm 56 to the opposite side of the axis of the shaft to the position shown by dotted lines in Fig. 6, the lower end of the spring will be caused to "pass center", and will hold the arm in this position. This action, releasing the swinging arm 54 by disengaging the angular arm from the pin thereon, the arm 54 and the worm carried thereby will swing downwardly by the weight of the parts, and the worm will be disengaged from the worm wheel. This mechanism is employed when it is desired, after the worm has been operated by hand, to gradually feed the grinding wheel to the work, to quickly return the grinding wheel to its former inner position for another op-

eration, and in effecting this action, the handle 59 is swung to the right, which permitting the worm to descend from engagement with the worm wheel, as just described, will leave the worm wheel free to be quickly operated by hand to restore the wheel to its former initial position, an upwardly extending handle 60 being fixed to the upper side of the worm wheel for manual operation of the same.

In the operation of the machine, the casing member of the bearing is held by the chuck, and the grinding wheel occupies the position shown in Fig. 1 with its axis coincident with the axis of the chuck-carrying sleeve 5, and likewise coincident with the axis of the work held by the chuck thereon, the scale on the graduated sleeve 50 being set at zero. Rotary motion being imparted to the chuck-carrying sleeve and to the wheel-carrying spindle, through the medium of the driving pulley 61, the work carried by the chuck will be rotated, and by means of the driving connections between the chuck-carrying sleeve and reciprocating frame 15, the latter will be moved forwardly and will advance the grinding wheel and cause it to act on the interior surface of the bore in the work, the wheel, after its advancing movement, being moved rearwardly and thus reciprocated back and forth within the bore of the work. During such reciprocating movements of the wheel, it is fed radially so as to cut deeper into the work, by means of the turning cap 49 on the end of worm 46, the turning movement of this cap causing the adjusting sleeve 7 to oscillate circumferentially, and by reason of the eccentric mounting of the wheel spindle within this sleeve, causing the latter to move from the center radially outward, transversely of the axis of the chuck carrying sleeve. This action of the parts is continued until the bore in the work has been given its desired and finished surface. When the operation is completed, the work is removed from the chuck, and the handle 59 on shaft 18 being swung to the right, worm 46 will be lowered out of engagement with worm wheel 45, and the latter may be moved by handle 60 in order to return the grinding wheel quickly inwardly to its former central position. Clamping screw 52 is then loosened in order to release the graduated sleeve, and the latter is turned by hand to zero position again. Screw 52 is then tightened up, and handle 59 on arm 18 swung to the left in order to again engage worm 46 with worm wheel 45. The parts are now in condition for operation on another bearing member, which is inserted in the chuck, the foregoing operations repeated.

As the grinding wheel acts on the ends of the bore, for a time but a portion of the surface of the wheel is in grinding engagement

with the material, and consequently at these times it meets with less obstruction to its grinding action, than at intermediate points in the work where the entire surface of the wheel is in action. Consequently if the longitudinal traversing movement of the wheel is uniform, there is danger of producing a "bell-mouthed" bore. To minimize this liability, I propose to so form the mechanism by which the wheel is fed longitudinally, that its traversing movements will be accelerated at the ends of the bore, and consequently will be slower intermediate of these points. I prefer to effect this object by the shape of the cam 23, which is of such contour that a comparatively quick movement will be given as the wheel enters the bore, a slower motion through the middle of the same, and then a quick motion again as it emerges at the other end, these variations being repeated on the return movement of the wheel. In the position of the parts shown in Fig. 1, the wheel is about to enter the bore and the roller 22 is at the high part of the cam. From this point the cam slopes quickly toward its axis so as to produce a comparatively rapid movement of the wheel forwardly. The cam then approaches its axis more gradually so as to reduce the speed of movement, this surface of the cam representing the period when the middle part of the bore is being acted on, and from then on the cam again approaches the axis with a quicker curve so as to produce a corresponding movement of the wheel as it emerges from the bore. On the return movement, the foregoing operations are repeated with like variations in speed of the traversing movement of the wheel.

By the arrangement of the several sleeves carrying the different cooperating parts, one within the other, a very compact and condensed construction is produced, which enables the mechanism to be contained within small limits, and conduces to convenience in handling. The work is supported in such manner that its bore is exposed at both ends, which facilitates the application of a gage within the outer end in measuring the bore to determine as to its proper size and shape.

The yoke 41, in addition to forming in effect a connection between the reciprocating frame 15 and the sleeve 7, as before described, maintains the sleeve 7 removably within the machine, this sleeve with the conjoined tool-carrying spindle, being adapted to be withdrawn bodily rearwardly from the machine, when released by disengaging the yoke from behind the screw cap 40.

While I have shown my improved mechanism as particularly adapted for the finishing of the inner casing members of anti-friction bearings, it will be understood that the mechanism is applicable for operating

on other forms of work, without material change in the construction thereof.

Having thus described my invention, what I claim is:

1. In a machine of the type described, the combination of a rotary sleeve adapted to carry a work-holding device, a rotary tool-carrying spindle extending within the sleeve, and means for effecting a feeding movement of the tool-spindle axially of the sleeve.

2. In a machine of the type described, the combination of a rotary sleeve adapted to carry a work-holding device, a rotary tool-carrying spindle extending within the sleeve and means for imparting feeding movements to the spindle both axially and transversely of the sleeve.

3. In a machine of the type described, the combination of a rotary sleeve adapted to carry a work-holding device, a rotary tool-carrying spindle extending within the sleeve, means for imparting a feeding movement to the spindle axially of the sleeve, and independent means for imparting a feeding movement to the spindle transversely of the sleeve.

4. In a machine of the type described, the combination of a rotary sleeve adapted to carry a work-holding device, a rotary tool-carrying spindle extending within the sleeve and provided with an operating tool, means controlled by the rotary motion of the sleeve for imparting a feeding movement to the spindle axially of the sleeve, and manually operated means for imparting a feeding movement to the spindle transversely of the axis of the sleeve.

5. In a machine of the type described, the combination of a frame, a rotary sleeve mounted therein and adapted to carry a work-holding device, an oscillating adjusting sleeve mounted to reciprocate endwise therein, and a rotary tool-carrying spindle mounted eccentrically within the adjusting sleeve, and movable endwise in the reciprocating movements of the adjusting sleeve.

6. In a machine of the type described, the combination of a frame, a rotary sleeve mounted therein and adapted to carry a work-holding device, a supporting sleeve mounted to reciprocate endwise within the rotary sleeve, an adjusting sleeve mounted for oscillation eccentrically within the supporting sleeve and movable endwise with the supporting sleeve; and a rotary tool-carrying spindle mounted eccentrically within the adjusting sleeve and movable endwise therewith.

7. In a machine for shaping the bores of annular work-forms, the combination of means for holding the work with the bore exposed, an operating tool to act on the bore, means for effecting a relative feeding motion between the work-form and tool in the di-

rection of the axis of the bore, and means for accelerating said feeding motion when the tool is acting at the end of the bore.

8. In a machine for shaping the bores of annular work-forms, the combination of means for rotating the work about the axis of its bore, a rotary operating wheel, means for imparting to said wheel a feeding motion in the direction of the axis of the bore, and means for accelerating said feeding motion when the wheel is acting at the end of a bore; whereby the liability of the production of bell mouthed bores is minimized.

9. In a machine for shaping the bores of annular work-forms, the combination of means for rotating the work about the axis of its bore, a rotary spindle provided with a grinding wheel, said spindle mounted to reciprocate endwise so as to cause the wheel to traverse the bore lengthwise thereof, and driving mechanism for reciprocating said spindle, said driving mechanism including a cam so shaped as to accelerate the endwise movements of the spindle when the grinding wheel is operating at the ends of the bore.

10. In a machine for shaping the bores of annular work forms, the combination of means for holding the work with the bore exposed, an operating tool to act on the bore, and means for effecting a relative feeding motion between the work and tool in the direction of the axis of the bore of the work, said means including a cam, shaped to accelerate the feeding motion when the grinding wheel is operating at the end of the bore.

11. In a machine of the type described, the combination of a frame, a rotary tool spindle adapted to carry an operating tool, a rotary work spindle adapted to carry a work holder, one of said spindles being mounted for endwise reciprocation, a rotary driving cam, a vibratory member operated by the cam and operatively connected with the reciprocating spindle for reciprocating the same, and means for disconnecting the cam from driving engagement with the vibratory member.

12. In a machine of the type described, the combination of a frame, a rotary tool spindle adapted to carry an operating tool, a rotary work spindle adapted to carry a work holder, one of said spindles being mounted for endwise reciprocation, a rotary driving cam, a vibratory member, a roller on said vibratory member engaged by the driving cam, said roller being movable at will to disengage the cam, and operative connections between the vibratory member and the reciprocating spindle for reciprocating the same.

13. In a machine of the type described, the combination of a frame, a rotary tool spindle adapted to carry an operating tool and mounted for endwise reciprocation, a rotary

work spindle adapted to carry a work holder, a worm on the work spindle, a worm wheel engaged and rotated by the worm, operative connections between the worm wheel and tool spindle for reciprocating the same, and means for rotating the work spindle.

14. In a machine of the type described, the combination of a frame, a rotary work sleeve mounted therein and adapted to carry a work holder, a supporting sleeve mounted to reciprocate endwise within the work sleeve, an adjusting sleeve mounted within the supporting sleeve and movable therewith, said adjusting sleeve being removable endwise from the supporting sleeve, releasable means for holding the adjusting sleeve in operative relation within the supporting sleeve, and a rotary tool spindle mounted within the adjusting sleeve and adapted to carry a grinding tool.

15. In a machine of the type described, the combination of a frame, a rotary work sleeve mounted therein and adapted to carry a work holder, a supporting sleeve mounted to reciprocate within the work sleeve, a frame fixed to the supporting sleeve, means for reciprocating said frame to impart a reciprocating motion to the supporting sleeve, an adjusting sleeve mounted within the supporting sleeve and provided with an annular shoulder engaged by the supporting sleeve to cause the adjusting sleeve to be moved with the supporting sleeve in one direction, a yoke carried by the frame and engaging the end of the adjusting sleeve to cause the latter to be moved by the supporting sleeve in the opposite direction, and a rotary tool spindle mounted within the adjusting sleeve and movable therewith in the reciprocations of the same.

16. In a machine of the type described, the combination of a frame, a rotary work sleeve mounted therein and adapted to carry a work holder, a supporting sleeve mounted to reciprocate within the work sleeve, a frame fixed to the supporting sleeve, means for reciprocating said frame to impart a reciprocating motion to the supporting sleeve, an adjusting sleeve mounted within the supporting sleeve and provided with an annular shoulder engaged by the supporting sleeve to cause the adjusting sleeve to be moved with the supporting sleeve in one direction, a yoke carried by the frame and engaging the end of the adjusting sleeve to cause the latter to be moved by the supporting sleeve in the opposite direction, said yoke being movable to disengage the adjusting sleeve to permit the latter to be removed from within the supporting sleeve, and a rotary tool spindle mounted within the adjusting sleeve and movable therewith in the reciprocations of the same.

17. In a machine of the type described, the combination of a main frame, a rotary

work sleeve mounted therein and adapted to carry a work holder, a supporting sleeve mounted for reciprocation within the work sleeve, a tool spindle mounted within the supporting sleeve and reciprocating therewith, a frame applied to the supporting sleeve, a rotary driving member, and operative connections between the rotary driving member and the frame for reciprocating the latter to impart a corresponding reciprocation to the supporting sleeve.

18. In a machine of the type described, the combination of a frame, a rotary work sleeve mounted therein and adapted to carry a work holding device, a supporting sleeve mounted to reciprocate endwise within the work sleeve, an oscillating adjusting sleeve mounted within an eccentric opening in the supporting sleeve and movable endwise therewith, and a rotary tool carrying spindle mounted eccentrically within the adjusting sleeve and movable endwise therewith, the eccentric mountings of the said adjusting sleeve and tool spindle being oppositely disposed.

19. In a machine of the type described, the combination of a rotary work spindle adapted to carry a work holder, a rotary tool spindle adapted to carry an operating tool, one of said spindles being adjustable radially with respect to the other to cause the tool to enter the material of the work, and an adjusting member operatively engaged with the adjustable spindle for adjusting the same, said member being movable to disengage the spindle to permit the latter to be adjusted by hand.

20. In a machine of the type described, the combination of a frame, a rotary work sleeve mounted therein and adapted to carry a work holder, an adjusting sleeve mounted eccentrically within the work sleeve and oscillatable circumferentially therein to effect its radial adjustment, a rotary tool spindle carried by the adjusting sleeve and adjustable with it to cause the tool to enter the material of the work, a gear on the adjusting sleeve, and an adjusting member en-

gaging the gear for oscillating it, said adjusting member being movable to disengage the gear to permit the sleeve to be adjusted by hand.

21. In a machine of the type described, the combination of a frame, a rotary work sleeve mounted therein and adapted to carry a work holder, an adjusting sleeve mounted eccentrically within the work sleeve and oscillatable circumferentially therein to effect its radial adjustment, a rotary tool spindle carried by the adjusting sleeve and adjustable with it to cause the tool to enter the material of the work, a gear on the adjusting sleeve, an adjusting member engaging the gear for oscillating it, said adjusting member being movable to disengage the gear to permit the sleeve to be adjusted by hand, and a handle applied to the adjusting sleeve for adjusting it by hand.

22. In a machine of the type described, the combination of a frame, a rotary work sleeve mounted therein and adapted to carry a work holder, an adjusting sleeve mounted eccentrically within the work sleeve and oscillatable circumferentially therein, a rotary tool spindle carried by the adjusting sleeve and adjustable with it to cause the tool to enter the material of the work, a gear on the adjusting sleeve, a swinging arm, an adjusting member mounted in the arm and engaging the gear for oscillating the latter, said member adapted to be disengaged from the gear by the swinging movement of the arm, and a spring acting on the arm and tending to hold the member yieldingly in engagement with the gear, the relation of the parts being such that when the arm is swung to disengage the member from the gear, the spring will act to hold the same yieldingly disengaged.

In testimony whereof, I have affixed my signature in presence of two witnesses.

FRED E. BRIGHT.

Witnesses:

CHARLES S. BUTLER,
BERTHA KING.