June 17, 1947. M. C. HUTTO 2,422,418

HONING METHOD AND APPARATUS

Filed Sept. 7, 1945 2 Sheets-Sheet 1

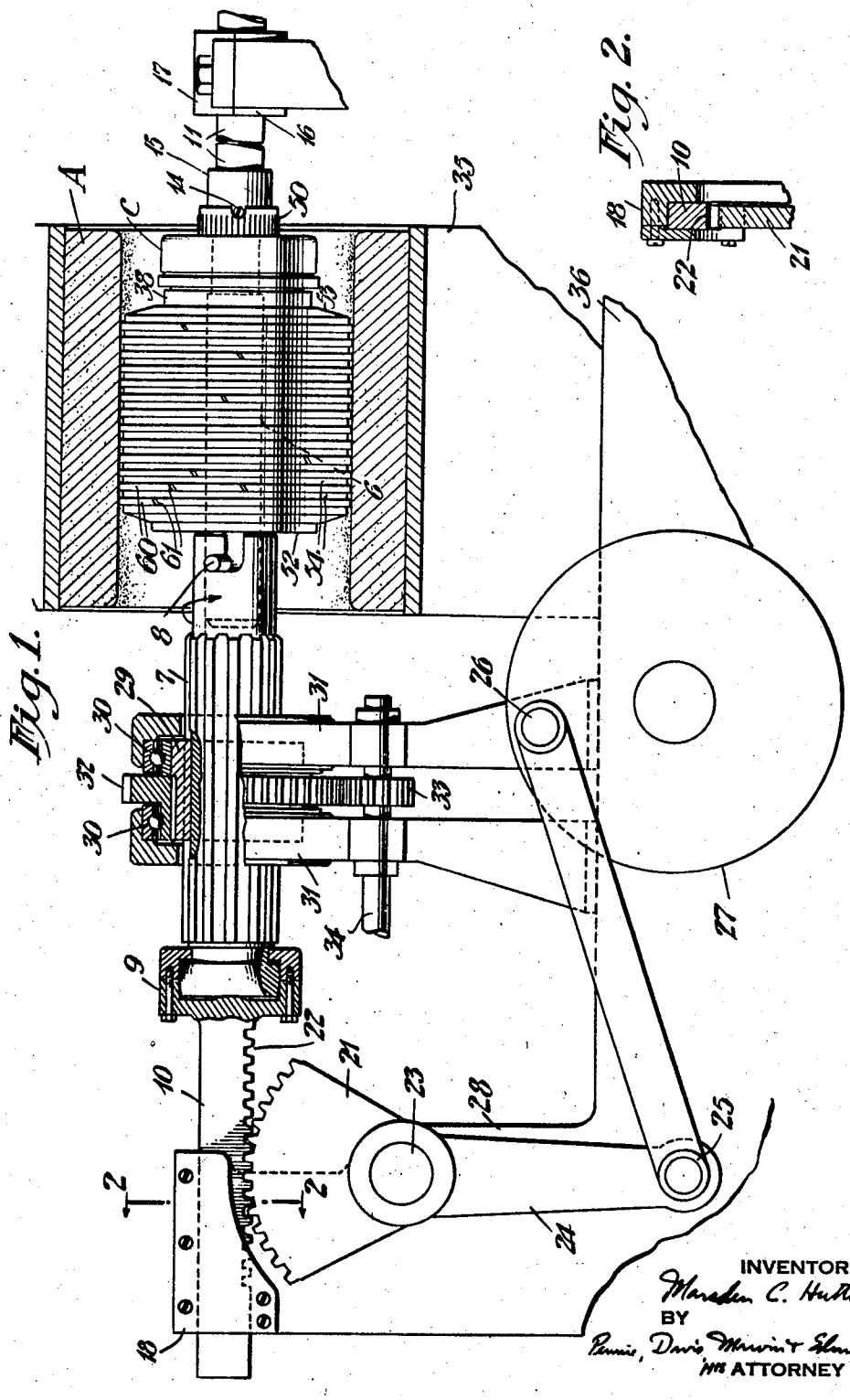


Fig. 1.

Fig. 2.

INVENTOR
Marsden C. Hutto
BY
Pennie, Davis, Marvin & Edmonds
ATTORNEY

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Fig. 3.

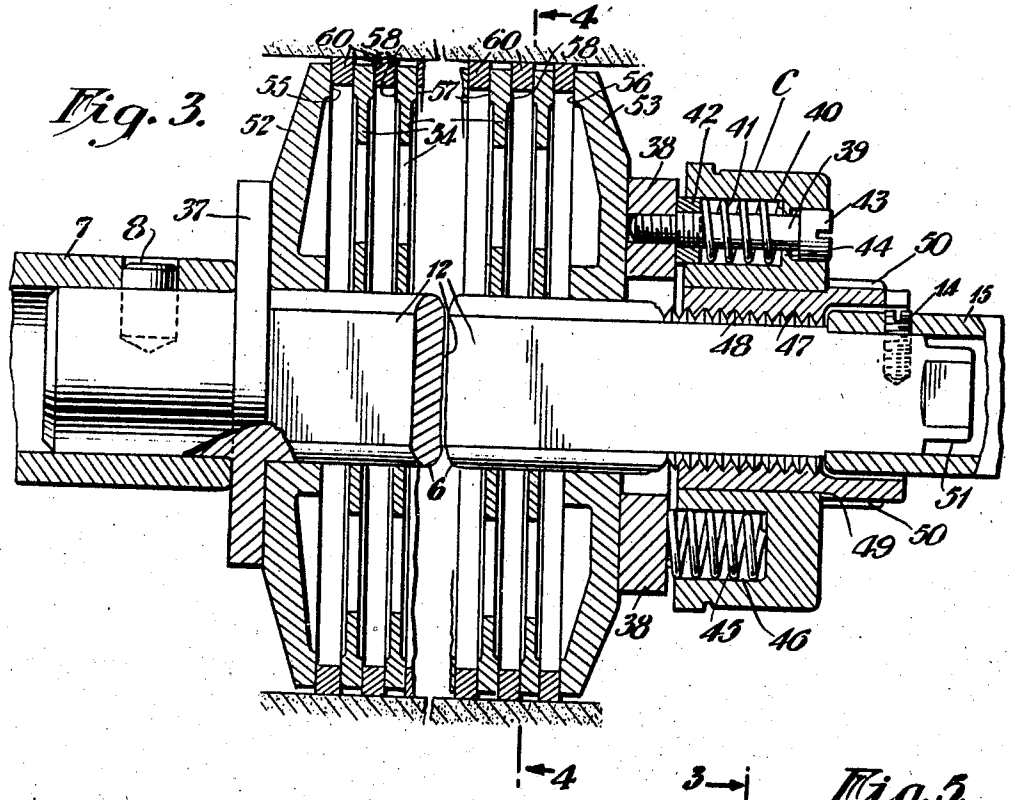


Fig. 4.

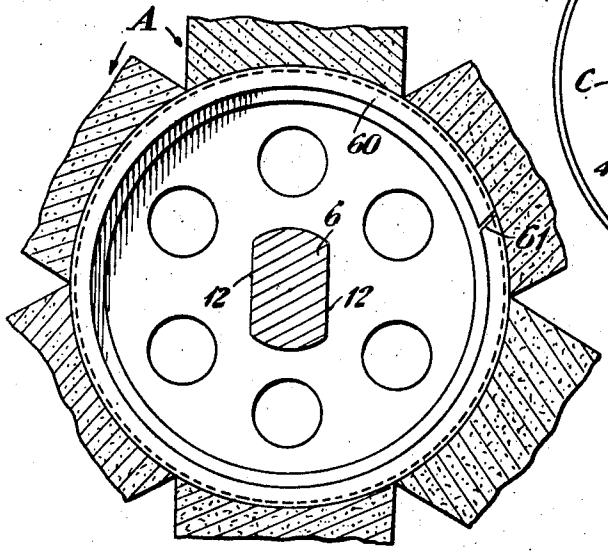
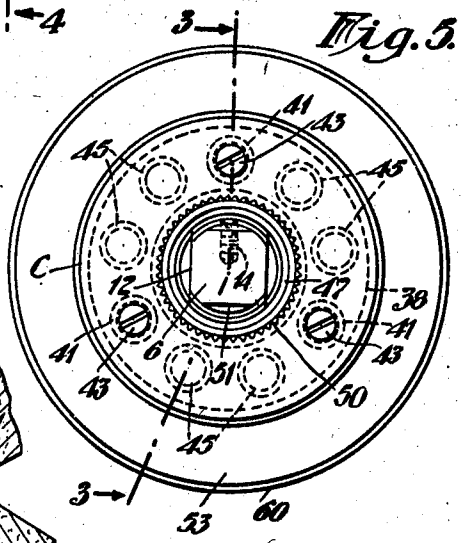


Fig. 5.



INVENTOR
Marsden C. Hutto
BY
Pennie, Davis, Marvin & Edmonds
HIS ATTORNEYS

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HONING METHOD AND APPARATUS

Marsden C. Hutto, Detroit, Mich., assignor to Vinco Corporation, Detroit, Mich., a corporation of Michigan

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6 Claims. (Cl. 51—157)

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This invention relates to the finishing of resiliently radially expansible circular articles such as piston rings, and more particularly concerns a method of and apparatus for carrying out such an operation.

It is desirable that certain circular resiliently expansible articles such as split piston rings be accurately finished so that their peripheral surfaces will continuously and accurately engage the wall of a surrounding cylinder or chamber while such surfaces are pressed against the wall by the resilience of the article. Such finishing operations may be performed by moving the rings relative to grinding or honing surfaces engaging the peripheral ring surfaces. In order to impart such relative movement, it has been the practice to so clamp or secure the rings to propelling mechanism that the resilient expansion of the rings is prevented during the grinding or honing movement thereof. The result is that the ring surfaces are not accurately finished to the exact shape or contour that they should have in order to fit tightly and continuously against the walls of a cylinder when they are free to expand under their inherent resilience.

It is the object of the present invention to provide an improved method for finishing piston rings and like circular articles. More specifically, it is proposed to provide a method of this nature in which the rings are ground, honed or otherwise finished while they are expanding radially under their inherent resilience into yielding engagement with a finishing device which embraces their peripheral surfaces, whereby such surfaces are finished under substantially the same conditions of confinement and resilient expansible stress as obtained when the rings are subsequently used in a cylinder. The objects of the invention further include a method of this nature in which a plurality of rings or like articles may be simultaneously finished. The invention further contemplates the provision of improved apparatus by means of which the method may be performed.

Various additional objects, advantages and characteristic features of the invention will become apparent as the description thereof progresses.

In describing the invention in detail, reference will be made to the accompanying drawing in which apparatus embodying the invention and capable of carrying out the improved method has been illustrated. In the drawings:

Fig. 1 is a diagrammatic and simplified elevation of apparatus embodying the invention and capable of performing the improved method;

Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1 and viewed in the direction of the arrows;

Fig. 3 is a sectional elevation, on an enlarged scale, of the ring supporting portion of the apparatus illustrated in Fig. 1, the section being taken along the line 3—3 of Fig. 5;

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Fig. 4 is a sectional view taken along the line 4—4 of Fig. 3; and

Fig. 5 is an end view of the ring supporting mechanism shown in Fig. 3 with the end supporting shaft removed.

The apparatus disclosed in the drawing generally includes a shaft 6 for carrying the articles to be finished, suitable means for rotating or reciprocating this shaft or simultaneously imparting rotary and reciprocatory movement thereto, and an internal abrasive device A which may comprise a grinding, honing, lapping or other finishing element or elements arranged in circular formation to present inwardly disposed surfaces lying in circumferential alignment which may be disposed around and embrace a piston ring or other circular article being finished. The inner faces of the elements forming the abrasive device A may be arcuate as shown, and the diameter of the circle along which these surfaces are disposed is preferably equal to the diameter of the cylinder in which the rings to be finished are to operate.

As shown, the shaft 6 has oppositely disposed flat parallel surfaces 12 (Figs. 4 and 5) and is so mounted that it can both reciprocate axially and rotate. Any desired known mechanism may be employed to reciprocate and rotate the shaft 6, and the mechanism diagrammatically illustrated in the drawing is merely representative of means which may be employed for this purpose.

In the illustrated mechanism, the shaft 6 is removably connected to one end of a splined shaft 7 and in alignment therewith by suitable means such as a bayonet joint 8, and the other end of the splined shaft 7 is connected by a swivel joint 9 to a rectangular section rack bar 10. A support shaft 11 may be removably connected to the outer end of the shaft 6 in alignment therewith by suitable means such as a set screw 14 passing into the shaft 6 through an opening in a hollow enlarged end portion 15 of the shaft 11 which fits over the end of the shaft 6.

The support shaft 11 may be slidably and rotatably supported in any suitable manner as by a bearing 16 which may be provided with a removable cap 17 to permit removal of the shaft 11 laterally therefrom. The support shaft 11 is not essential and may be omitted, together with the bearing 16. The rack bar 10 is slidably supported and held against rotation by a bracket 18 as shown in Figs. 1 and 2. The rack bar 10, the splined shaft 7, the shaft 6 and the support shaft 11 form an elongated member which is supported to reciprocate in the bracket 18 and the bearing 16, and that portion of this member comprising the splined shaft 7, the shaft 6 and the support shaft 11 when this shaft is used, is

free to rotate during such reciprocatory movement. It will be understood that the described elongated member and its support are so disposed and designed that the shaft 6 is mounted to move axially within the finishing surfaces of the abrasive device A, and to this end, additional bearing means for supporting the elongated member may be provided. The support shaft 11 is of sufficient length to permit the removal thereof from the shaft 6, and the distance between the right hand end of the abrasive device A and the bearing 16 is sufficient to permit removal of the shaft 6 and the apparatus carried thereby from the interior of the abrasive device.

Suitable means are provided for reciprocating the rack bar 10 and for rotating the splined shaft 7. As shown, a toothed gear sector 21 engages the rack teeth 22 on the under side of the bar 10. The sector 21 is pivotally secured at 23 to the bracket support 28, and an arm 24 fixed to or integral with the sector 21 is connected by a link 25 to an eccentric pivot 26 on a rotatably mounted disc or gear wheel 27. The disc 27 may be rotated by any suitable driving means, and serves to rock the sector 21 and so reciprocate the rack bar 10, the splined shaft 7, the shaft 6 and the support shaft 11. The distance through which these shafts are thus reciprocated is preferably arranged not to exceed the axial length of the internal abrasive surfaces of the device A.

Rotation of the shaft 6 is effected through an internally splined collar 29 surrounding the shaft 7 and slidably engaging the splines thereon. The collar 29 is rotatably journaled by suitable bearings 30 in spaced bearing brackets 31 and is driven through a ring gear 32 fixed centrally on the collar and engaged by a pinion 33 fixed to a drive shaft 34 journaled in the brackets 31. The shaft 34 may be driven by any suitable source of power and a common drive for this shaft and for the disc 27 may be employed. The direction in which the collar 29 is rotated is preferably such as to maintain the bayonet joint 8 between the shafts 6 and 7 in locked engagement, and this preferred direction of rotation is illustrated by arrows in Fig. 1.

It will be understood that the bracket support 28, the brackets 31, the housing 35 of the abrasive device A and the bearing 16 are all fixed as by suitable securement to a common base 36.

Referring now to the ring supporting apparatus, the shaft 6 is provided with a flange 37 adjacent the end thereof that is connected to the splined shaft 7. A removable and adjustable tightening collar C is provided adjacent the opposite outer end of the shaft 6 for yieldingly compressing the ring gripping means. A pressure ring 38 is axially movably secured to the inner end of the collar C by a plurality of bolts 39 which are respectively threadedly secured to the ring 38 and slidably engage circumferentially aligned equally spaced openings 40 in the collar. Coiled springs 41 surrounding the bolts 39 are compressed between shoulders 44 on the collar C and lock nuts 42 on the bolts, and thus serve to resiliently bias the ring 38 axially away from the inner face of the collar C. Movement of the ring 38 under the bias of the springs 41 is limited by the engagement of the bolt heads 43 with the shoulders 44 in the collar openings 40. Additional coiled springs 45 are carried in openings 46 in the collar C between the openings 40, and the springs 45 are compressed between the face of the compression ring 38 and the collar C. With the arrangement described, the ring 38 forms a resiliently movable end face abutment at the inner end of the tightening collar C.

The collar C is removably secured to and axially adjustable along the shaft 6 by an internally threaded sleeve 47 engaging threads 48 on the rounded portions of the shaft 6 as shown in Fig. 3. A shoulder 49 on the outer surface of the sleeve 47 engages the outer end face of the collar C, and serrations 50 are provided on the sleeve beyond the shoulder to permit rotation of the sleeve by a suitable wrench to adjust the axial position of the collar C. It will be evident that the collar C may be adjusted axially along the shaft 6 to loosen or tighten its grip upon the ring supporting mechanism by turning the sleeve 47. The outer end of the shaft 6 carries a squared portion 51 to receive a wrench for turning the shaft to release the bayonet joint connection 8.

The ring supporting mechanism shown includes two oppositely disposed circular end plates 52 and 53 and a plurality of circular spacer plates 54, all of these plates being carried on the shaft 6. The end plates 52 and 53 are provided with circumferentially extending oppositely disposed marginal end faces 55 and 56, and each of the spacer plates 54 is provided with similar opposite marginal end faces 57 and 58. The plates 52, 53 and 54 are somewhat smaller in diameter than the diameter to which the piston rings 60 are confined by the embracing abrasive device A. The marginal end faces 55, 56, 57 and 58 of the plates are of sufficient radial extent to engage a substantial proportion of the end faces of the rings 60. All of the plates 52, 53 and 54 have similar central openings of a configuration to receive and closely engage the flat opposite surfaces 12 of the shaft 6, whereby the plates may be rotatively driven by the shaft although they are free to slide along it.

The piston rings 60 are illustrative of the circular radially expansible articles that may be finished. The disclosed rings are of conventional construction, being formed of cast iron, steel or other resilient metal or metallic alloy and having a split or opening 61 therein. Such rings are designed to be radially compressed when in use in a cylinder so that their inherent resilience urges their peripheral surfaces into tight contact with the cylinder walls. In accordance with the present invention, it is contemplated that the peripheral ring surfaces be finished to true circular cylindrical form while the rings are compressed and are resiliently urging their peripheral surfaces radially outward against the surface of the abrasive device.

The operation of the disclosed apparatus in carrying out my improved method will now be described. At the conclusion of a honing operation, the shaft 11, if employed, is removed from the shaft 6 and the bearing 16 is also removed. The shaft 6, with the described plate and ring assembly thereon, is then pushed to the right as shown in Fig. 1 of the drawing out of the abrasive device A. This may be accomplished either by movement of the shaft 7 or by disconnecting the shaft 6 from the shaft 7 and moving it separately. As the piston rings 16 pass out of the abrasive device A, they snap or spring outward and are removed laterally from between the plates 52, 53 and 54 by passing their split ends over the flat parallel surfaces 12 of the shaft 6. The shaft and plate assembly is then loaded with a new set of piston rings by inserting the new rings laterally of the shaft 6 between the plates 52, 53 and 54 and slipping the split ends of these rings over

the flat shaft surfaces 12. The rings of the new batch are radially compressed by suitable means to a diameter slightly less than that of the inner faces of the honing elements 20 of the abrasive device A, this diameter being slightly greater than the diameter of the outer faces of the plates 52, 53 and 54. While the rings are so compressed, the sleeve 47 is tightened up to clamp the rings between the plates against radial expansion, and the shaft 6 with the plate and ring assembly thereon is inserted within the abrasive device A and connected to the splined shaft 7 by the bayonet joint 8. With the ring assembly within the device A, the sleeve 47 is backed off until the axial position of the collar C, and hence the resilient compressive gripping force imposed by the ring 38 on the stacked alternate plates and rings is at a value such that the plates can drive the rings rotatively against the frictional resistance imposed by the contact of the rings with the abrasive device A while at the same time the rings can expand radially due to their inherent resilience and so resiliently urge their peripheries into close engagement with the embracing abrasive device. The resilient gripping force exerted by the springs 41 and 45 of the collar C is substantially equally applied to the opposite end faces of the several rings 60 by the end and spacer plates 52, 53 and 54 which are movable axially along the shaft 6. If a support shaft 11 is used, it is then secured to the outer end of the shaft 6 and is journaled in the bearing 16. The apparatus is then operated by either rotating or reciprocating or both rotating and reciprocating the shaft 6 so as to cause relative movement between the rings 60 and the abrasive device A.

The peripheries of the plates 52, 53 and 54 are maintained in concentric relation with and are spaced inwardly from the inner faces of the abrasive device A by the shaft 6, and the peripheries of the rings 60 extend outward above the plate peripheries and into resiliently expansive engagement with the internal faces of the abrasive device. The movement of the rings 60 finishes their peripheral surfaces to true cylindrical form while the rings expand under their inherent resilience against the embracing abrasive device. Upon completion of the finishing operation, the rings 60 are removed from the device by dismounting the shaft 6 and removing the plates therefrom in a manner which will be readily apparent from the foregoing description.

I claim:

1. The method of finishing a resiliently radially expansible circular article which comprises permitting the article to expand within and yieldably urge its peripheral surface against an embracing abrasive device, gripping the end faces of the article with a force sufficient to impart rotation thereto but insufficient to prevent radial expansion thereof, and drivingly producing relative movement between the article and the abrasive device through such gripping connection.

2. The method of grinding a resiliently radially expansible split ring which comprises supporting the ring by gripping it between elements engaging its opposite end faces with a force sufficient to impart rotative movement to the ring but insufficient to prevent radial expansion thereof due to its resilience, permitting the ring to expand within and so urge its peripheral surface against an embracing abrasive device, and drivingly producing relative movement between the ring and the abrasive device through the gripping means whereby the circumferential surface of the ring is finished while the ring is expanded against the abrasive device by its resilience.

3. The method of grinding a resiliently radially expansible split ring which comprises supporting the ring by gripping it between elements engaging its opposite end faces with a force sufficient to impart rotative movement to the ring but insufficient to prevent radial expansion thereof due to its resilience, permitting the ring to expand within and so urge its peripheral surface against an embracing abrasive device, and drivingly producing relative rotative movement between the ring and the abrasive device through the gripping means whereby the peripheral surface of the ring is ground while the ring expands against the abrasive means due to its resilience.

4. The method of grinding a resiliently radially expansible split ring which comprises supporting the ring by gripping it between elements engaging its opposite end faces with a force sufficient to impart rotative movement to the ring but insufficient to prevent radial expansion thereof due to its resilience, permitting the ring to expand within and so urge its peripheral surface against an embracing abrasive device, and drivingly producing relative rotative and reciprocatory movement between the ring and the abrasive device through the gripping means whereby the periphery of the ring is finished while being expanded against the abrasive device by the resilience of the ring.

5. Apparatus for finishing resiliently radially expansible circular rings comprising an internal cylindrical abrasive device, a shaft movably mounted centrally within said abrasive device, a plurality of circular plates on said shaft having end faces for engagement with the ends of rings to be finished, means for transmitting rotary movement to said plates from said shaft while permitting movement of said plates axially along said shaft, means for resiliently urging said plates together axially of said shaft whereby rings may be gripped between said plates and means for moving said shaft relative to said abrasive device.

6. Apparatus for finishing resiliently radially expansible circular rings comprising an abrasive device including inwardly disposed circularly aligned surfaces, a shaft movably mounted centrally of said surfaces, a plurality of circular plates on said shaft having end faces for engagement with the end faces of rings disposed between said plates, means for transmitting rotary movement from said shaft to said plates while permitting movement of said plates axially of said shaft, means on said shaft adjustably movable axially thereof for compressively gripping said plates whereby rings to be finished may be gripped between said plates, said plate gripping means including resiliently compressible means, and means for rotating said shaft relative to said abrasive device.

MARSDEN C. HUTTO.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,344,924	Ryder	Mar. 21, 1944