June 12, 1956 J. M. HALDEMAN 2,749,672

PROCESS AND APPARATUS FOR GRINDING PISTON AND OTHER RINGS

Filed April 10, 1951 4 Sheets-Sheet 1

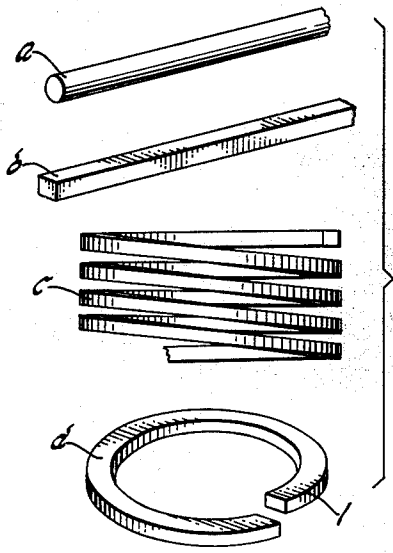


Fig. 1

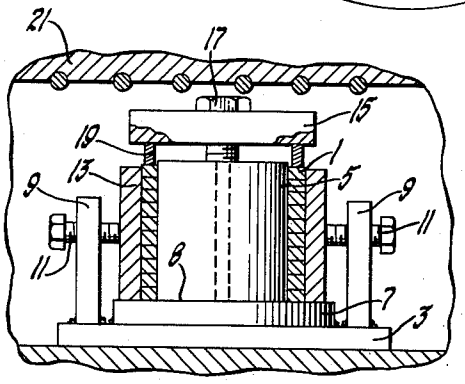


Fig. 2

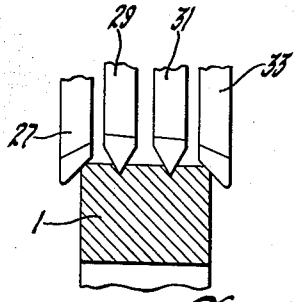


Fig. 4

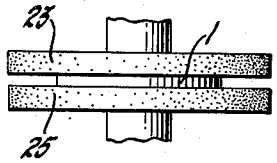


Fig. 3

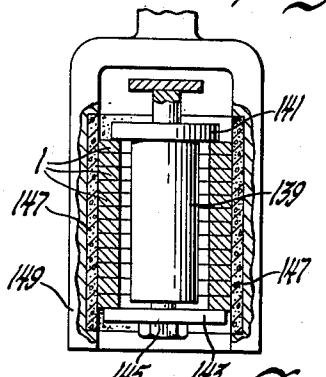


Fig. 5

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PROCESS AND APPARATUS FOR GRINDING PISTON AND OTHER RINGS

Filed April 10, 1951 4 Sheets-Sheet 2

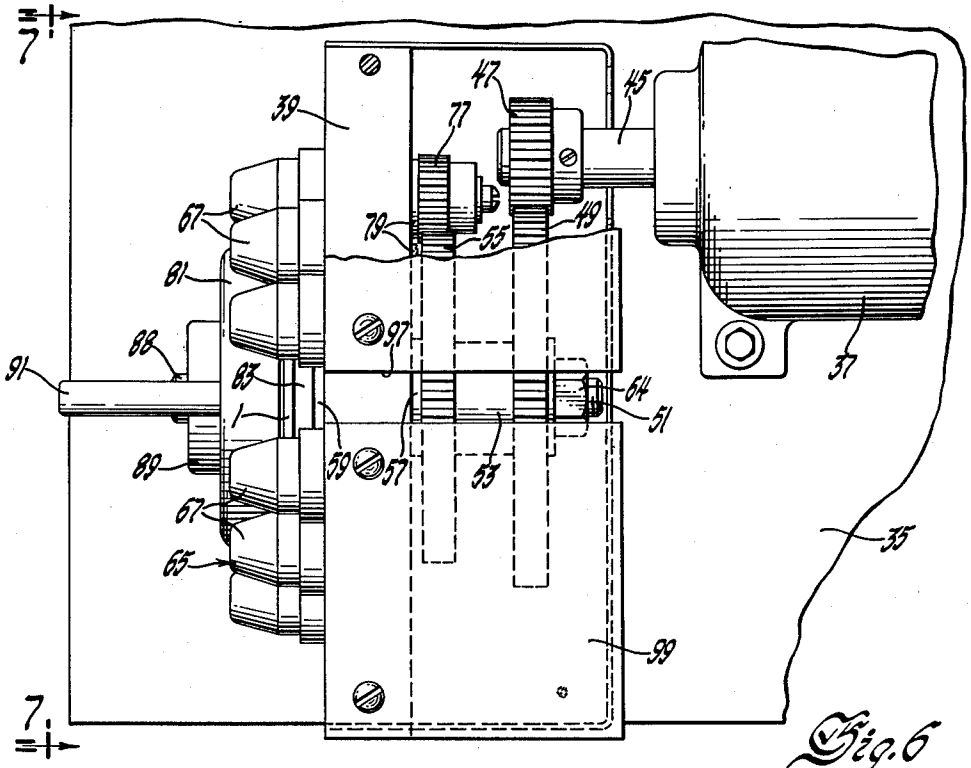


Fig. 6

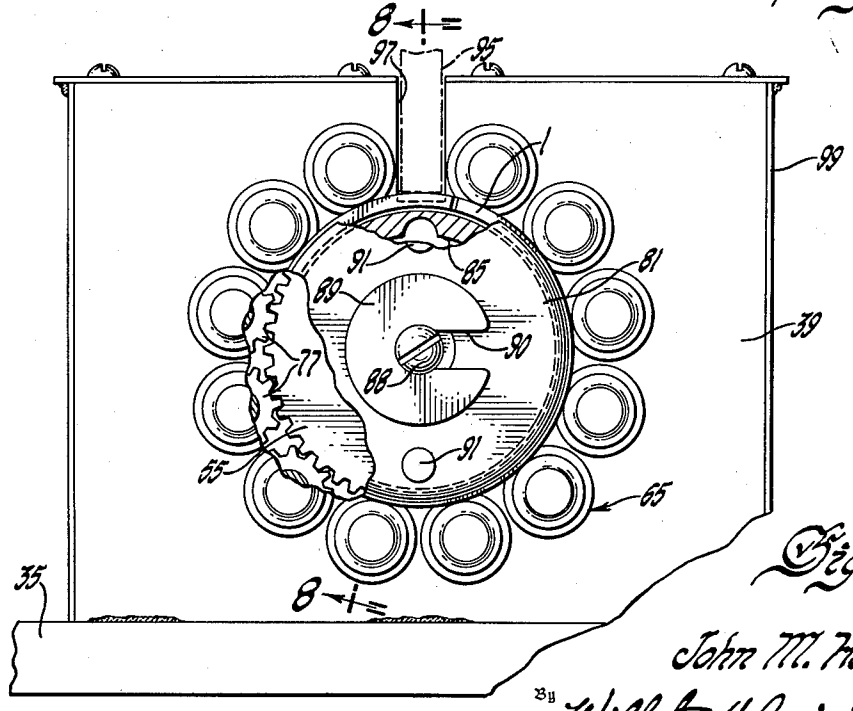


Fig. 7

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PROCESS AND APPARATUS FOR GRINDING PISTON AND OTHER RINGS

Filed April 10, 1951 4 Sheets-Sheet 3

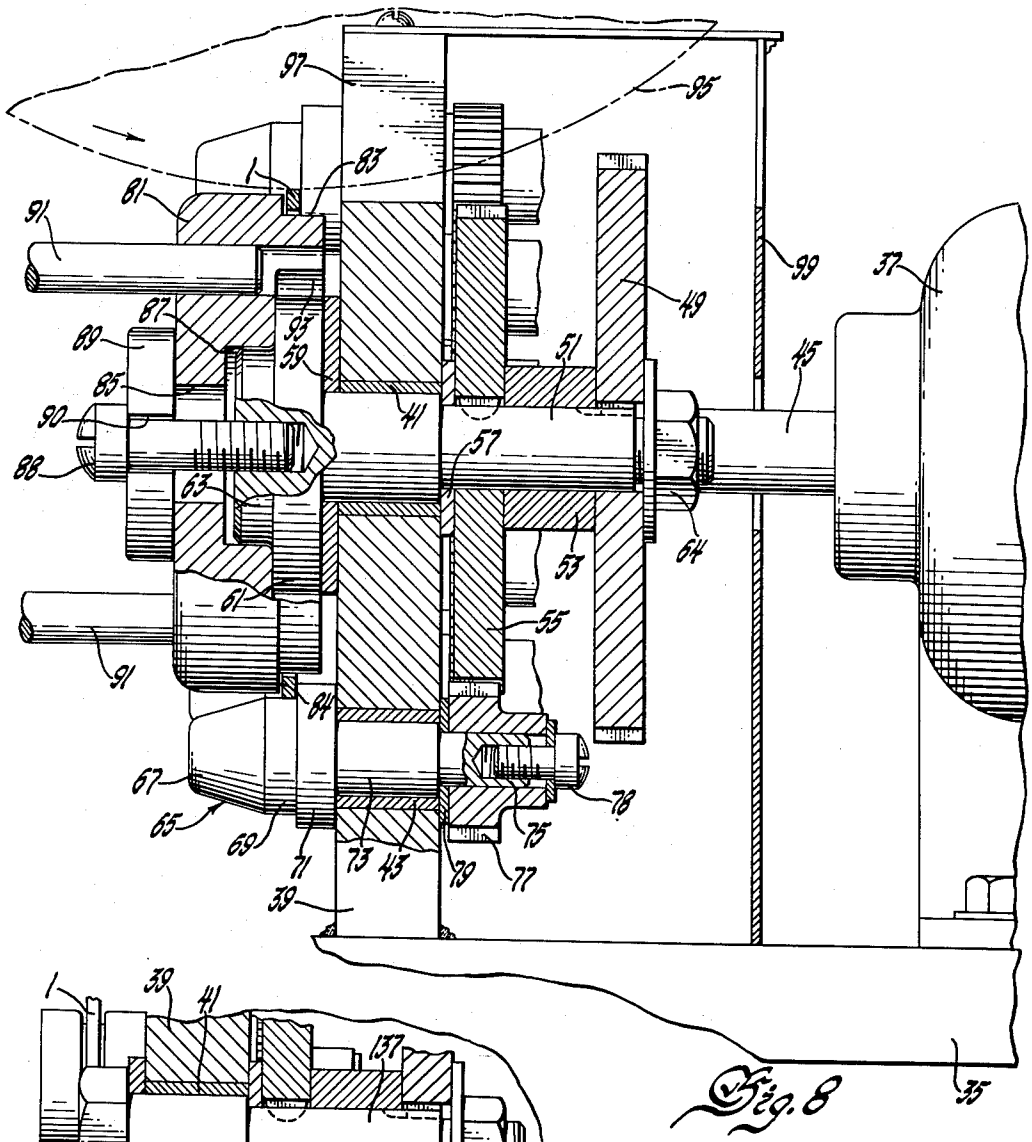


Fig. 8

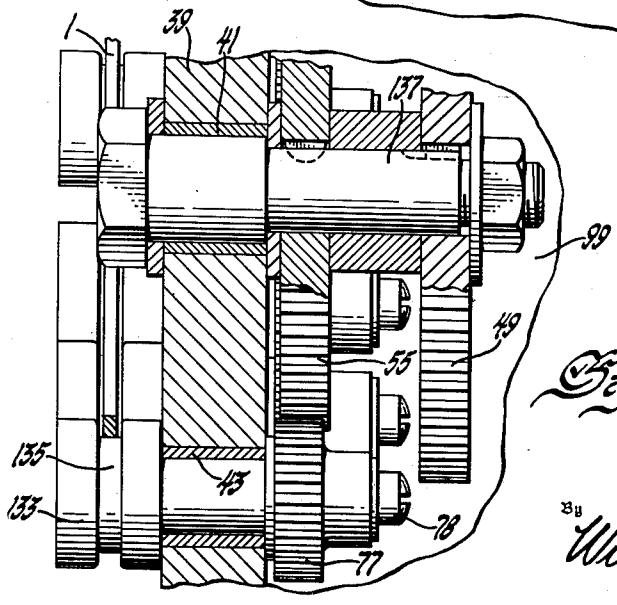


Fig. 9

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PROCESS AND APPARATUS FOR GRINDING PISTON AND OTHER RINGS

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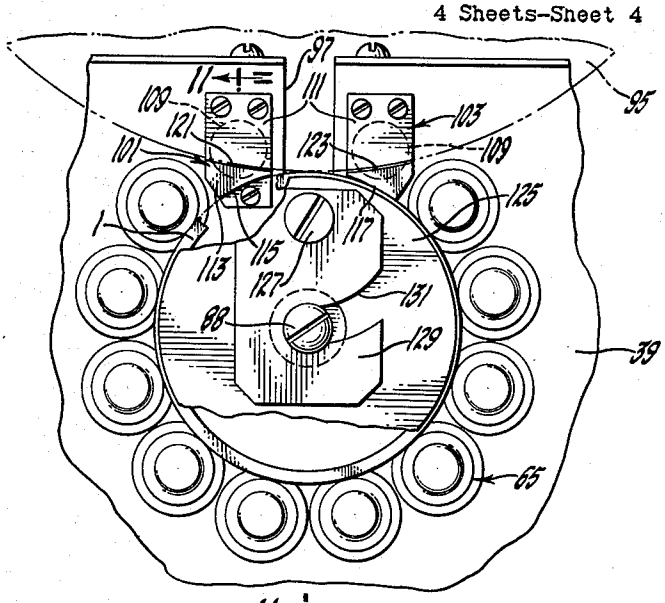


Fig. 10

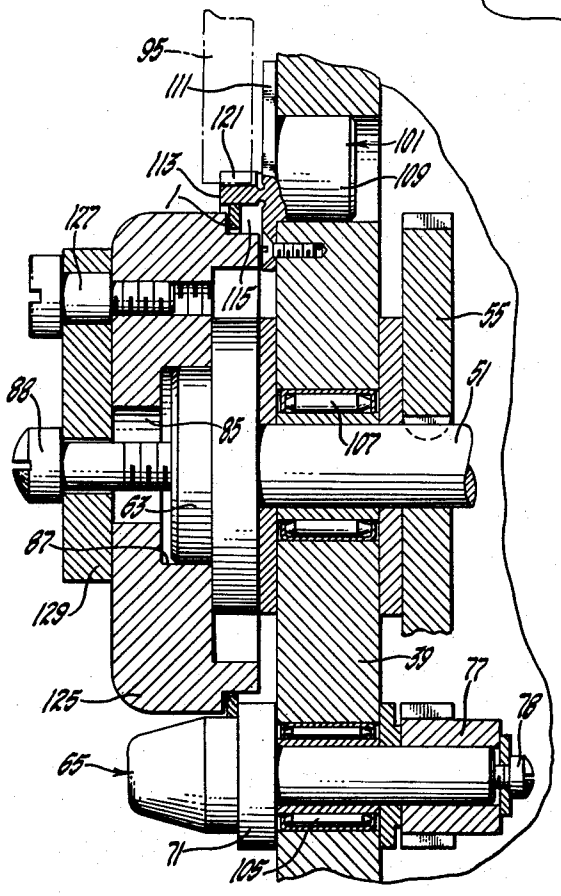


Fig. 11

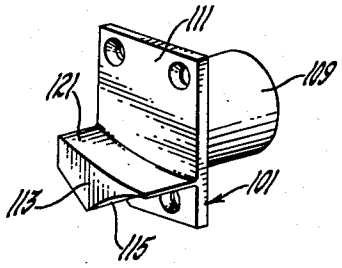


Fig. 12

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2,749,672

PROCESS AND APPARATUS FOR GRINDING PISTON AND OTHER RINGS

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Application April 10, 1951, Serial No. 220,167

21 Claims. (Cl. 51—103)

This invention relates to a process and apparatus for producing resilient packing rings.

The principal object of the invention is to provide a simple process for forming split resilient packing rings and the provision of simple apparatus for carrying out certain steps in this process whereby the surfaces of the resilient ring, so formed, uniformly engage surfaces of relatively movable members in sealing engagement.

The steps in the process and apparatus by which this object is accomplished will be clearly understood by reference to the following detailed description and drawings illustrating this process and apparatus for carrying out this process.

Figure 1 illustrates the form of the steel ring material and the ring in the preliminary steps in the process.

Figure 2 is a schematic view of the apparatus for carrying out one step of the process with parts of the apparatus and rings shown broken away and in section.

Figure 3 is a schematic view of apparatus employed in another step of the process with parts shown broken away.

Figure 4 is a schematic view of apparatus for accomplishing an additional step in the process with the ring shown broken away and in section.

Figure 5 is a schematic view of one form of apparatus for carrying out another step in the apparatus with parts of the apparatus and the rings shown broken away and in section.

Figure 6 is a plan view of another form of apparatus with parts shown broken away and in section, for carrying out the step of the process accomplished by the apparatus shown in Figure 5.

Figure 7 is an end elevation view taken on line 7—7 of Figure 6 with parts shown broken away and in section.

Figure 8 is an enlarged sectional view taken on line 8—8 of Figure 7 with parts shown broken away and in section.

Figure 9 is a view similar to Figure 8 with certain parts of modified form and other parts shown broken away and in section.

Figure 10 is a view similar to Figure 7 of a modification of the apparatus shown in Figure 7.

Figure 11 is a view similar to Figure 8 of the modified apparatus shown in Figure 10.

Figure 12 is an enlarged perspective view of a detail shown in Figures 10 and 11.

As best seen in Figure 1*a*, resilient rings are formed of round steel wire which is rolled to a rectangular section, as shown in Figure 1*b*, and wound in the form of a helix, see Figure 1*c*, after which each coil of the helix is cut to provide circular split rings **1**, see Figure 1*d*, with helical side surfaces and uniform radial thickness.

The rings **1**, in the form shown in Figure 1*d*, are next deflected into oval form with the sides flat and heat treated to retain the rings in this form by the apparatus shown in Figure 2. This apparatus comprises a frame including a base **3** having a vertical mandrel **5** of oval cross section provided with a base flange **7** with a flat

upper face **8**. The mandrel flange **7** is secured to the central portion of the base **3** of the frame. A plurality of upstanding lugs **9** are secured to the base **3** of the frame in concentric relation to the vertical center line of the mandrel **5**. Each of the lugs **9** is provided with a clamp screw **11** threaded radially therethrough, with respect to the mandrel center line. The inner end of each screw **11** engages a separate, vertically disposed clamp bar **13**. A clamping plate **15** is attached by a clamp screw **17** threaded vertically in the upper end of the mandrel **5** on the vertical center line thereof and the clamping plate **15** provided with an annular flange **19** on the lower face concentric to the vertical axis of the mandrel and having an internal diameter slightly larger than the major diameter of the oval mandrel **5** and a flat lower face. A plurality of split rings **1** in the form shown in Figure 1*d* are placed on the mandrel **5** with the ring gaps in vertical alignment, as shown in the dotted lines in Figure 2, along one side of the oval mandrel **5**. The radius of curvature of the mandrel surface at a point immediately opposite the ring gaps is maximum and the radius of curvature of the mandrel decreases progressively from this point toward each end of the ring. The clamp screw **17** extending through the clamp plate **15** is then tightened to draw the annular flange **19** of the clamp plate downwardly onto the stacked rings **1** to thereby retain the sides flat and parallel with the flat, lower end surface of the flange **19** of the clamp plate and the upper flat surface **8** of the mandrel flange **7**, as best shown in Figure 2. The clamp screws **11** are then tightened to deflect the inner surfaces of the rings **1** into uniform engagement with the oval surface of the mandrel **5**. In order to insure uniform engagement of the inner peripheral surfaces of the rings **1** on the mandrel **5** the clamp screw **11** adjacent the point of maximum radius of curvature of the mandrel surface is tightened first and other clamp screws **11** either side of this point and toward the ring gaps are successively tightened. With the ring clamped in the frame **3** in this form, the frame is placed in a heat treating furnace **21** and heated for sufficient time at proper temperature to cause the rings to remain in the form in which they are clamped in the frame.

The rings are made and sprung round in the manner described so that when they are placed in piston ring grooves and contracted within an engine cylinder the outward radial pressure applied by the rings on the interior surface of the cylinder will be relatively uniform throughout the peripheral length of each ring. A more complete explanation of how the rings are made in this form and the apparatus for heat treating the rings to relieve the internal stresses thereof which result from bending the rings into the desired form is disclosed by Haldeman application S. N. 228,207, filed in the United States Patent Office May 25, 1951. The rings are sprung round during the grinding operation herein disclosed so that the expansion of the rings against the grinding wheel employed will finish the rings so that they will apply substantially uniform pressure to the inner surface of the engine cylinder throughout the peripheral length of each ring.

After the rings **1** cool, the sides of each ring are ground flat between two flat rotating grinding wheels **23** and **25**, as shown schematically in Figure 3, in a well known manner.

The next step of the process consists in abrading the outer peripheral surface of the oval split rings **1** while held in contracted circular form by means of apparatus shown in Figures 6 to 12 or by means of the apparatus shown in Figure 5.

The abrading apparatus as best seen in Figures 6 to 12 generally comprises a base plate **35** having a driving motor **37** mounted thereon and an upstanding plate **39**, serving

as a bearing member, is secured to the base 35. As best seen in Figures 6, 7, 8 and 9, the bearing member 39 is provided with a central opening having a bushing 41 therein and twelve openings, of smaller diameter, arranged in a circle around the axis of the central opening. Each of these smaller diameter openings has a bushing 43 therein, as best shown in Figure 8.

The driving motor is provided with a driving shaft 45 having a pinion 47 thereon, shown in Figure 6, in mesh with a gear 49 keyed on the adjacent end of a driven shaft 51, as best illustrated in Figure 8. A spacing collar 53 is located on the shaft 51 between the gear 49 and another gear 55, also keyed to the shaft 51. A thrust washer 57 is placed on the shaft between the gear 55 and the larger diameter bearing portion of the shaft 51, which bearing portion is rotatably supported in the bushing 41 in the central opening of the bearing member 39. Another thrust washer 59 is placed on the opposite end of the bearing portion of the shaft between the bearing member 39 and a shaft flange 61 adjacent the other end of the shaft 51. The flange 61 is provided with a reduced diameter pilot flange portion 63 on the outer end and having a threaded axial opening in the outer end face. A nut 64 is threaded on the shaft 51 adjacent the gear 49 and serves to retain the gears 49 and 55, collar 53 and thrust washers 57 and 59 on the shaft 51 with the thrust washers in running engagement with opposite sides of the bearing member 39. Ring supporting rollers, generally indicated by the reference character 65, are rotatably supported in each of the bushings 43 in the bearing member 39. Each roller 65 is provided with a tapered end surface 67, a cylindrical ring supporting and driving surface 69 adjacent thereto and provided with an enlarged diameter ring guiding flange portion 71 adjacent the supporting surface and a reduced diameter bearing portion 73 and a small diameter opposite end portion 75, as best seen in Figures 6, 7 and 8. The bearing portion 73 of each roller 65 is rotatably supported in one of the bushings 43 in the bearing member 39. A pinion 77 is secured by means of a machine screw 78 to the smaller diameter end portion 75 of each roller and each of these pinions 77 meshes with the gear 55. A thrust washer 79 is placed on the smaller diameter portion 75 of each roller between the pinion 77 and the bearing member 39 to limit end play of each of the rollers 65. A circular ring retaining flange 81 is provided with a reduced diameter end portion 83 forming a ring guiding flange 84 facing the guiding flanges 71 on the rollers 65. The flange 81 is provided with an axial bore 85 and a pilot counter bore 87 in the end face of the retaining flange within the guide flange 84. A clamp screw 88 having a washer 89 thereon, provided with a radial slot 90 for quick removal, is threaded into the axial opening in the outer end of the pilot flange portion 63 of the shaft 51, as best seen in Figures 7 and 8. After placing a split oval ring 1 on the reduced diameter portion 83 of the retaining flange 81 and tightening the clamp screw 88 the external peripheral surface of the ring 1 may be engaged within the tapered ends 67 of the rollers 65 and compressed and contracted into circular form while being moved axially inwardly into frictional driving engagement with the cylindrical supporting and driving surfaces 69 of the rollers 65. During this movement of the ring 1 the counter bore 87 in the flange 81 is piloted on the pilot flange portion 63 of the driving shaft 51 and the inner end face of the flange 81 is clamped in driving engagement with the outer face of the flange portion 61 of the shaft 51. The internal peripheral surface of the ring 1, when the ring is supported and contracted into circular form between the rollers 65, is disengaged from the reduced diameter portion 83 of the retaining flange 81 and the sides of the ring 1 are positioned between the guiding flanges 71 of the rollers 65 and the guiding flange 84 of the retaining flange 81. The ring retaining flange 81, as best shown in Figure 8, is provided with diametrically disposed, axially extending openings through which pilot pins 91 are inserted. The inner ends of the pilot pins 91 are shown projecting into pilot grooves 93 provided in the external peripheral surface of the flange portion 61 of the shaft 51 and these pins pilot the counter bore 87 in the retaining flange onto the pilot portion of the shaft 51 when the clamping screw 88 is tightened. With the ring 1 contracted into circular driving engagement with the rollers 65, when these rollers are driven by means of the driving motor 37, shaft 51 and meshing gears and pinions, the circular contracted ring 1 is rotated about the axis of the shaft 51.

Grinding of the external peripheral surface of the ring 1 to a true cylindrical surface is accomplished by a grinding wheel 95, shown in dotted lines in Figures 7 and 8, and rotatable about an axis at right angles to and in the center plane of the ring 1. The grinding wheel 95 is shown in Figure 7, positioned in a slot 97 provided in the bearing member 39, extending radially with respect to the shaft 51 between a pair of rollers 65, and in abrading engagement with the outer peripheral surface of rotating ring 1. A gear cover 99 encloses the pinions and gears and is removably secured to the base 35 and bearing member 39.

The grinding wheel 95 is preferably rotated in the direction of the arrow shown in Figure 8 which urges the ring 1 into engagement with the outwardly facing end surfaces of the flanges 71 of the rollers 65. The rotating grinding wheel 95 is moved slowly into the slot 97 until the wheel just engages and grinds off any high spots in the external surface of the compressed ring 1, resulting from unequal stresses therein. When these high spots are removed the grinding wheel is fed inwardly a slight amount further, just sufficient to grind the external peripheral ring surface to a true circle after which the wheel is moved out of grinding contact with the ring and the ring is removed. This machine provides circularly disposed driving and supporting rollers to rotate and to retain an oval split ring in circular form with the sides parallel and to grind the outer peripheral surface to a true circular form in which it is to be used whereby the outer peripheral surface of the ring and the flat sides are in uniform sealing engagement with the wall of a cylinder and the sides of a piston ring groove. In that the grinding wheel 95, which, as previously explained, is mounted for rotation about an axis at right angles to the ring 1 and in the vertical center plane thereof, a slightly concave cylindrical external surface is formed in the ring by the grinding wheel. The machine described above is modified slightly as shown in Figures 10, 11 and 12 to permit rotation of the grinding wheel 95 about an axis located in the vertical center plane of the ring and to thereby grind a true cylindrical, external peripheral surface on the contracted ring. As best seen in Figures 10 and 11 this apparatus differs from that described above by locating the axis of the grinding wheel 95 above and in the vertical center plane of the ring 1 and substituting stationary ring guiding members, indicated generally by the reference characters 101 and 103, in place of the two rollers 65 located on opposite sides of the grinding wheel slot 97 shown in Figure 7 in the bearing member 39 and by supporting the other rollers 65 in needle bearing 105 and the shaft 51 in a needle bearing 107, as shown in Figure 11. As best seen in Figure 12, each of the guiding members 101 and 103 is provided with a cylindrical projection 109 on one side of a mounting flange 111 and a ring guiding projection 113 on the other side thereof. Each of these cylindrical projections 109 is inserted in one of the two topmost openings in the bearing member 39 in place of a pair of rollers and machine screws are shown in Figure 10 extending through these openings in the mounting flanges 111 and are threaded into threaded openings in the bearing member 39 on opposite sides of the vertical grinding wheel slot 97. This positions the guide projections 113 in the plane of and above the ring 1, and on opposite sides of the slot 97. Arcuate ring guiding surfaces 115 and 117 are provided in the under

sides of the ring guiding projections 113, which arcuate surfaces contact the ring 1 and are segments of a circle passing through the points of contact of the rollers 65 with the contracted ring 1, as best seen in Figure 11. The upper surfaces 121 and 123 of the guide projections 113 are segments of a circle concentric with and of larger diameter than the grinding wheel 95 to provide clearance therefor when the wheel is lowered into grinding contact with the ring 1 between these upper arcuate surfaces 121 and 123 of the ring guiding projections 113. The guiding projections 113 are preferably made of hard material, as the contracted ring 1 is slidable on the arcuate under surfaces 115 and 117 thereof during grinding of the ring 1, annd are subject to abrasive particles from the grinding wheel 95. A ring retaining flange 125, of identical form to the flange 89 shown in Figure 8, is provided and the flange 125 may,, if desired, be provided with identical openings for pilot pins 91, such as shown in Figure 8. The ring retaining flange 125 is provided with a threaded opening located eccentrically in the outer face, and a pilot pin 127 is threaded therein and a plate 129 is pivoted on the pivot pin 127 and is provided with an arcuate slot 131 by which the plate is engaged by the clamping screw 88 threaded in the end of the shaft 51. As previously described, drawing up of the clamping screw 88 moves the ring retaining flange 125 axially inwardly into the adjacent pilot portion 63 of the shaft 51 and contracts the ring 1 into frictional driving engagement with the rollers 65 and also causes the ring to be slidably engaged with the guiding surfaces 115 and 117 of the ring guiding members 101 and 103.

Grinding out the high spots of the ring 1 and forming a true cylindrical outer peripheral surface on the ring 1 is accomplished by slow downward feed of the grinding wheel 95 into contact with the rotating ring 1 in the same manner as previously described.

The apparatus shown in Figure 9 differs from those previously described and shown in Figures 6, 7, 8, 10, 11 and 12 by providing the ring driving and supporting rollers 133 with an annular ring supporting groove 135 therein. The oval split ring 1 is insertable into frictional driving engagement with the bottom of the roller grooves 135 by bending the ends of the split ring 1 into overlapping relation and letting the ring spring back into contact with the bottom of the grooves 135 in the rollers 133 in which grooves the ring is retained in circular form. No ring retaining flange is necessary with this apparatus and the roller driving shaft 137 is accordingly not provided with a pilot portion therefor. The roller driving shaft 137 is supported for rotation in a bushing 41 and each of the rollers 133 are supported in bushings 43 in openings in the bearing support member 39 in the same manner as that shown in Figure 8. With the apparatus shown in Figure 9 the axis of the grinding wheel is located at right angles to the vertical center plane of the ring in the manner described with reference to the apparatus shown in Figures 6, 7 and 8.

A true cylindrical surface may also be formed on a stack-up of oval split rings 1 by means of the apparatus shown in Figure 5. This apparatus comprises a mandrel 139 having an external flange 141 adjacent one end. A stack of oval split rings 1 with the sides ground flat are stacked on the end of the mandrel 139 adjacent the mandrel flange and a clamping plate 143 is attached by means of a clamping screw 145 threaded in the outer end of the mandrel to retain the rings in contracted circular form in axial compression between the clamping plate 143 and mandrel flange 141 after contraction of the rings by insertion of the mandrel with the rings thereon into a suitable cylindrical jig, not shown. The mandrel 141 with the rings thereon is then insertable axially into abrading relation with a plurality of elongated honing stones 147 arranged in a circle and having internal cylindrical surfaces and secured in a hollow, oscillatable and variable stroke head 149 of a honing apparatus. The mandrel is held stationary within the honing stones and in axial alignment with the head 149. The mandrel clamping screw 145 is then loosened to permit the rings 1 to expand into engagement with the internal cylindrical surfaces of the honing stones and then retightened. The head 149 is then oscillated and reciprocated with a long stroke to remove any high spots of the rings 1. Movement of the head 149 is then stopped and the clamping screw 145 is loosened, to permit further expansion of the rings into tighter engagement with the stones, after which the head is then oscillated and reciprocated with a short stroke with the rings loose on the mandrel. This causes the rings to rotate slightly with respect to the mandrel and thereby causes greater relative reciprocation of the stones past the rings to produce a smooth cylindrical surface to be formed on the external peripheral surface of the rings. After grinding of the external surface of the rings 1 by the apparatus including a grinding wheel, shown in Figures 6 to 8, or either of the modifications thereof, one modification being shown in Figures 10 to 12 and another being shown in Figure 9 or by means of the apparatus shown in Figure 5, including honing stones, the inner periphery of the rings are bored to a true cylindrical surface. This is done in any well known manner by compressing a plurality of the rings in a cylindrical sleeve and boring the internal surface with the rings by a boring tool axially movable with respect to the rings. The rings now have a uniform radial thickness.

After boring of the rings they are mounted in circular form on an arbor and oil grooves are turned in the external peripheral surface and the outer edges of this surface are chamfered by means of forming tools 27, 29, 31 and 33, shown schematically in Figure 4.

After the oil grooves have been turned in the external peripheral surface and the edges of this surface are chamfered, the external surface is finished ground by means of any of the various modifications of the apparatus described, including a grinding wheel or by means of the apparatus including the honing stones.

The gaps in the ends of the rings are next finished by supporting the rings in circular form in a hinged two-part cylindrical fixture and the end surfaces of the rings are milled off.

The rings are next supported in circular form in a mandrel serving as cathode electrode located in a plating bath and the outer peripheral surfaces are plated with chromium or other metal.

The plated external peripheral surfaces of the rings are next abraded to form a smooth cylindrical surface thereon by means of any of the various modifications of the apparatus including a grinding wheel, or by means of the apparatus including the honing stones.

Rings formed in the above described manner when positioned in the ring grooves of a piston and slidable in a cylinder, exert uniform radial force on the cylinder wall and the external peripheral surfaces of the rings accordingly engage the cylinder wall in uniform, sliding, sealing engagement, and the sides of the ring are positioned in sealing engagement with the walls of the ring grooves in the piston.

I claim:

1. In a rotary supporting apparatus, a support member, rollers having tapered end surfaces and external guide flanges intermediate the ends thereof and rotatably supported in a circle on said support member, driving means operatively connected to said rollers for rotating said rollers, and engaging means having a guide flange adapted to be disposed in opposed relation to said roller guide flanges and being movable axially with respect to said roller guide flanges.

2. In a rotary supporting apparatus, a support member, rollers rotatably mounted in a circle on said support member and having tapered end surfaces and external guide flanges intermediate the ends thereof, driving means

operatively connected to said rollers for rotating said rollers, and circular engaging means disposed within and movable axially with respect to said tapered end surfaces.

3. The process of forming a true cylindrical surface on a split resilient ring consisting of moving the ring into frictional driving engagement with converging and parallel surfaces of rotary driving means disposed in a circle, and engaging the exterior peripheral surface of the rotating ring with rotary abrading means.

4. In a rotary supporting apparatus, a support, driving and supporting rollers rotatable in said support about individual axes disposed in a circle, said rollers having guiding flanges located in a plane normal to the surfaces of said rollers and facing outwardly of the frame, a flange axially movable with respect to said guiding flanges and being positioned to extend within said guiding flanges and driving means operably connected to said rollers for rotation thereof.

5. In a rotary supporting apparatus, a support member, supporting means on the support member and having cylindrical guiding surfaces disposed radially and equidistantly around a central axis, certain of said supporting means having external cylindrical guiding surfaces and being rotatably mounted on the support member about axes parallel to the central axis, an adjacent pair of said supporting means being non-rotatably secured to the support means and having internal cylindrical guiding surfaces of segmental form, and driving means operatively connecting the rotatable supporting means for rotation thereof.

6. In a rotary supporting apparatus, a support member, a driving motor, a plurality of driving rollers rotatable on the support member about individual axes parallel to and disposed in a circle about a central axis, each of said rollers having an annular flange located in a plane normal to the rollers, the rollers having tapered end portions tapering radially inwardly, engaging means having a flange movable axially with respect to the tapered portions of the rollers and into a position opposite and in spaced relation to said annular flange, and means operatively connecting the rollers to the driving motor for rotation thereby.

7. In a rotary supporting apparatus, a support member, a shaft rotatably supported therein, a driving motor operably connected to the shaft, retaining flange piloted for axial movement on one end of the shaft, clamping means for moving the retaining flange axially inwardly into endwise engagement with the shaft, a plurality of driving and supporting rollers rotatable on the support member above axes disposed in a circle about the shaft, each roller having an external flange located in a plane normal to the rollers and facing toward the retaining flange and an end surface tapering radially inwardly adjacent the retaining flange, means operatively connecting the rollers with the shaft for rotation thereby and a pair of guide means secured to the support members between adjacent rollers, each of said guide members having an arcuate surface forming a segment of a circle having a radius equal to the radial distance from the axis of the shaft to each of the rollers.

8. An apparatus for abrading split resilient rings which comprises ring contracting means, means engaging the said ring across the outer peripheral surface thereof for supporting said ring in the form established by said contracting means, means for rotating said supporting means for driving said ring in rotation about the axis of said ring by frictional engagement between the outer peripheral surfaces of said ring and said supporting means, and means rotatable on an axis at one side of said rotating means and in a plane parallel to said supporting means and intersecting said ring for abrading said surface of said ring while said ring is so rotated, contracted and supported.

9. An apparatus for abrading split resilient rings which comprises ring contracting means, a plurality of supporting means adapted to engage said ring around the outer peripheral surface thereof for supporting said ring in the form established by said contracting means, means engaging a side surface of said ring for moving said ring from said contracting means to said supporting means, means for rotating said supporting means for frictionally driving said ring by resilient engagement between said outer peripheral surface of said ring and said supporting means, and means for abrading a surface of said ring while so rotated and contracted and supported.

10. An apparatus for abrading split resilient rings which comprises ring contracting means, a plurality of rollers adapted to engage the outer peripheral surface of said ring for retaining said ring in the form established by said contracting means, means disposed at one side of said rollers and adapted to engage a side surface of said ring and movable toward said rollers along the axis of said ring for moving said ring axially through said contracting means and into said rollers, means for rotating said rollers for frictionally driving said ring in rotation about the axis of said ring, and means for abrading said outer peripheral surface of said ring while said ring is so rotated and contracted and supported.

11. An apparatus for abrading split resilient rings which comprises a plurality of rollers arranged about an axis for supporting a ring in contracted form, converging ring supporting means axially aligned with said rollers for contracting said ring to said form, means disposed at one side of said rollers and adapted to engage a side surface of said ring and movable toward said rollers along the axis of said ring for moving said ring axially through said contracting means and into said rollers, diverging supporting means axially aligned with said rollers for expanding said ring to original form upon the movement of said ring axially away from said rollers, means for rotating said rollers for frictionally driving said ring while said ring is supported therein and about the axis of said ring, and means for abrading said ring while said ring is so supported and contracted and rotated within said rollers.

12. An apparatus for abrading split resilient rings which comprises a plurality of supporting rollers arranged in parallel relation to one another about an axis, ring contracting means disposed at one side of said rollers for contracting said ring, means disposed at one side of said rollers and adapted to engage a side surface of said ring and movable toward said rollers along the axis of said ring for moving said ring axially through said contracting means and into said rollers, means for rotating said rollers while said ring is supported therein, and means for abrading said ring while said ring is so rotated, contracted and supported.

13. The process of forming a true surface on a split resilient ring which comprises applying radially directed forces to said ring to radially contract said ring to a predetermined size, applying tangentially directed forces to the outer peripheral surface of said ring while so contracted to rotate said ring about the axis thereof, and abrading the outer peripheral surface of said ring during the rotational movement thereof about said axis.

14. The process of forming a true surface on a split resilient ring which comprises moving said ring axially while applying radially directed forces to said ring to radially contract said ring to a predetermined size, applying tangentially directed forces to the outer peripheral surface of said ring while so contracted to rotate said ring about the axis thereof, and abrading the outer peripheral surface of said ring during the rotational movement thereof about said axis.

15. The process of forming a true surface on a split resilient ring which comprises moving said ring axially while applying radially directed forces to said ring to radially contract said ring to a predetermined size, applying tangentially directed forces to the outer peripheral

surface of said ring while so contracted to rotate said ring about the axis thereof, abrading the outer peripheral surface of said ring during the rotational movement thereof about said axis, and moving said ring axially while removing said radially directed forces to radially expand said ring to the original size thereof.

16. The process of forming a true surface on a split resilient ring which comprises applying radially directed forces to said ring to contract said ring to a predetermined size, supporting the outer peripheral surface of said ring while so contracted on a plurality of rollers having the axes thereof disposed substantially in parallel relation to the axis of said ring, rotating said ring by rotating said rollers about the axes thereof, and abrading the outer peripheral surface of said ring while said ring is so rotated and contracted.

17. The process of forming a true surface on a split resilient ring which comprises applying radially directed forces to said ring to contract said ring to a predetermined size, supporting the outer peripheral surface of said ring while so contracted on a plurality of rollers having the axes thereof disposed substantially in parallel relation to the axis of said ring, rotating said ring by rotating said rollers about the axes thereof, and abrading the outer peripheral surface of said ring between a pair of said rollers and while said ring is so rotated and contracted.

18. A process of forming a true surface on a split resilient ring which comprises applying radially directed forces to said ring to contract said ring to a predetermined size, supporting the outer peripheral surface of said ring while so contracted on a plurality of rollers having the axes thereof disposed substantially in parallel relation to the axis of said ring, rotating said ring by rotating said rollers about the axes thereof, supporting said ring between a pair of said rollers by sliding engagement with guide means adapted to be engaged by the outer peripheral surface of the ends of said ring when said ends tend to expand between said pair of rollers during the rotation of said ring, and abrading the outer peripheral surface of said ring between said pair of rollers and said guide means and while said ring is so rotated and contracted.

19. The process of forming a true surface on a split resilient ring which comprises radially contracting said ring until the outer peripheral surface thereof forms a circular cylindrical surface about the central axis of said ring, rotating said ring about said central axis, and abrading said circular cylindrical surface of said ring while said ring is so rotated and contracted and by arcuate movement of abrading means transversely of said surface and about an axis externally of said ring and extending substantially transversely to said central axis.

20. An apparatus for abrading split resilient rings which comprises a plurality of rollers mounted on a support and having the axes thereof disposed in parallel relation and having the inner surface elements thereof arranged in a circular cylindrical orbit about a central axis, means for rotating said rollers about the axes thereof for rotating a split resilient ring when said ring is contracted within said rollers to expand the outer peripheral surface of said ring into frictional driving engagement with said rollers, and means for abrading the outer peripheral surface of said ring, said abrading means being formed to rotate in a plane intersecting said ring and extending between an adjacent pair of said rollers and rotating about an axis disposed outwardly of said orbit and substantially normally to said axes and to said central axis.

21. An apparatus for abrading split resilient rings which comprises a plurality of rollers mounted on a support and having the axes thereof disposed in parallel relation and having the inner surface elements thereof arranged in a circular orbit about a central axis, means for rotating said rollers about the axes thereof for rotating a split resilient ring when said ring is contracted within said rollers to expand the outer peripheral surface of said ring into frictional driving engagement with said rollers, means for abrading the outer peripheral surface of said ring, said abrading means being formed to rotate in a plane intersecting said ring and extending between an adjacent pair of said rollers and rotating about an axis disposed outwardly of said orbit and substantially normally to said axes and said central axis, and guide means between said adjacent pair of rollers and said abrading means and having arcuate circular cylindrical surfaces formed thereon about said central axis and within said orbit and being adapted to engage the outer peripheral surface of said ring adjacent pair of said rollers.

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