ART OR PROCESS OF MANUFACTURING PISTON RINGS.

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Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.
To all whom it may concern:

Be it known that I, Richard P. Elliott, a citizen of the United States, residing at Lexington, in the County of Middlesex and State of Massachusetts, have invented a new and useful Improvement in the Art or Processes of Manufacturing Piston-Rings, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates to an improved method or process of manufacturing piston rings.

One of the objects of my invention is to provide a method by which rings of long wearing quality are produced.

A further object contemplates a method by which piston rings are produced by which an even pressure at all points of their periphery is not to wear the cylinder of an engine out of a true circular form.

Other objects will be in part obvious and in part pointed out hereinafter.

In the accompanying drawings, Figure 1 represents a rough casting of an individual ring; Fig. 2 represents the slitting operation wherein provision is made for allowing the ring to be contracted in order that it may exert pressure against the walls of the cylinder when in operation; Fig. 3 represents an alternative form of slitting to that shown in Fig. 2; Fig. 4 represents a ring compressed by a contracting device; Fig. 5 represents a number of piston rings in the process of manufacture mounted upon an arbor to facilitate machining the outside of the rings; Fig. 6 represents a number of piston rings in the process of manufacture in a fixture facilitating the machining of the rings.

My improved method contemplates certain steps adapted to produce improved piston rings and I have preferred to illustrate my invention as applied to that form of piston ring wherein the rings are first cast individually or separately and also to rings which have their inside and outside walls substantially parallel; it is to be understood, however, that my invention is not limited to the specific application herein shown but may be applied to rings which are first cast in the familiar “pot” form and cut up later into individual rings, or to rings which do not have their inside and outside walls substantially parallel.

Briefly described, my invention preferably contemplates eight steps beginning with a ring which has been cast individually, and the first operation is the removal of the inequalities from the inner surface. From this point on the steps which I prefer to follow in the process of my method, and which will be more fully described hereinafter, are as follows: Roughing and finishing the edges of the rings, slotting, contracting or closing-in and rough machining the outside diameter, allowing the rings to expand to their normal condition, contracting again and machining the inside diameter while the rings are held in contracted position, allowing them to expand for a second time, contracting again and completing the machining of the outside diameter while held in contracted position.

After what may be termed a blank or ring is produced either by casting the ring separately or severing a ring from a “pot” casting, the first step in my process contemplates the rough machining of the inside wall of the ring indicated at 10, Fig. 1. The second step of my process contemplates the rough machining of the edges of the ring indicated at 11 and 12, in such manner as to remove inequalities and some portions of the scale and bring the edges to a condition where they are substantially parallel, in the case of the individually cast ring. The third step in my process is the finish machining said surfaces 11 and 12 to a smooth, level and substantially parallel relation, and to a predetermined thickness.

The fourth step of my process involves the rough machining of the outside diameter of the rings to remove the scale left by casting. In order to permit of high speed production, a number of rings may be mounted upon a fixture as indicated in Fig. 5, wherein an arbor or mandrel is represented at 13 having an enlarged body 14 and a shoulder 15 at one end. The opposite end of the enlarged body is provided with a retaining flange 16 secured to the body member 14 by means of screws 17 or any other suitable means so as to firmly clamp the rings in their closed condition. It may be seen that such number of rings may be mounted on the body 14 that they fill up the space between the shoulder 13 and the end 18 of the body 14, this body 14 being of such length as to insure that the outer ring of the series, indicated at 19, will project slightly beyond the end 18 so that when the plate or retaining member 16 is drawn into operating position by means of
the screws 17, the series of rings will be confined between the shoulder 15 and the member 16 with sufficient pressure to hold them in their contracted condition. While thus mounted, the outside of the rings are machined roughly and they are then removed for the performance of the fifth step which consists in slotting the rings as indicated at 24 in Fig. 2 or 25 in Fig. 3, as may be desired.

The sixth step of my process involves the use of the flexible closing-in or contracting device, indicated at 26, (Fig. 4) which forms the subject matter of United States Patent No. 1,258,664, granted to me March 12, 1918. By the use of said device I am enabled to close-in or contract the rings naturally and without subjecting them to undue local restraint, to the condition shown in Fig. 4; they may now be again mounted upon the fixture shown in Fig. 5, the rings being maintained in contracted condition by the flexible contracting device as set forth in said patent. When a sufficient number of rings have been mounted, the end plate 10 is secured to the body 14 by means of the screws 17, and when said screws have been tightened firmly, the rings are confined between the shoulder 15 and the end plate 16, the contracting fixtures may then be removed. While thus mounted and retained in contracted position the outside diameters of the rings are machined approximately to finished size. At the close of this step the rings are dismounted and placed in a fixture as indicated in Fig. 6, the inner bore of this fixture, indicated at 20, being truly circular, concentric with the axis of the machine upon which the fixture is mounted when it is desired to make concentric piston rings, and of the size to which the outside of the rings were machined during the fifth step of my process. The fixture shown in Fig. 8 is provided with a shoulder indicated at 21, and a plate 22 is so arranged that when the screws 23 are tightened, the rings are held firmly between the shoulder 21 and the plate 22. It will now be seen that the boring operation can be performed upon the inside diameter of the rings. This constitutes the seventh step and insures that the inside diameter of the rings will be a true circle when the rings are held in contracted position, and also that the inside and outside walls of the rings shall be practically concentric when making the concentric type of piston rings. Upon the completion of the boring operation, the rings are removed and again contracted by means of my closing-in device, before mentioned, and mounted a third time upon the fixture shown in Fig. 5; whereupon the eighth step, a final finishing operation, is performed upon the outside of the rings, bringing them to their predetermined diameter and providing a smooth, round wearing surface.

It will be noted that the rings are allowed to expand and assume their natural position between the steps subsequent to the slotting operation, thus relieving all strains, and by the use of my contracting device the rings are closed-in without undue local restraint, and any deformities caused by inequalities in the material, are thus provided for. The result of the various steps of my method is to produce a piston ring from which all of the scale has been removed, unequal strains eliminated, and which will assume a truly circular form when closed-in to operating position.

Piston rings which are made with their inside and outside walls substantially parallel are desirable because the rings may then be made of sufficient size to fill up, in a great measure, the grooves in the piston, thus preventing the leakage of oil and the accumulation of carbon in the piston ring grooves. It is desirable, furthermore, that the rings exert a uniform pressure in all directions on the walls of the cylinder in order that the wear may be as uniform as possible and that the cylinder walls shall not be worn out of a true circular shape.

By my process or method, piston rings may be produced which have their inside and outside walls substantially parallel or concentric, and which in their natural or expanded position assume an approximately elliptical form with walls on each side of the slot having curves of varying radii. Rings when so made assume a truly circular form when closed.

The reason why rings made by my method have walls with curves of varying radii on each side of the slot is as follows:—The rings are slotted by removing a portion of the ring varying according to the tension desired. The rings are then closed in to bring the ends together at the slot 24. In closing in the rings with my flexible fixtures as shown in Fig. 4, the rings naturally bend or spring in the greatest amount at a point directly opposite the slot 24 as that is the point at which the greatest leverage is exerted. The bending of the walls of the ring is gradually lessened on either side of a point opposite the slot 24 as we approach the slot and to points a short distance either side of the slot. At these points no bending takes place.

After the rings are closed in as described, the rings are machined inside and out to true circles. When allowed to expand after machining and to their natural condition, it is found that the curvature of the walls will have the greater radii where they were bent the most, the radii gradually decreasing to the points nearest the slot where no bending took place, and at these points the radii of the curves equal the radii of the circles of the ring when closed.
In the drawings illustrating the practice of my method and in the description thereof, fixtures or devices are shown for machining a plurality of rings at some of the steps in my method, but it will be understood, however, that my method is applicable as well to rings when machined singly.

I do not confine the practice of my method of making piston rings to the use of the particular form of fixtures or devices illustrated herein, any form of flexible closing-in device may be used that will produce the desired result; and the same is true of the devices for machining the outside and inside of the rings. This application is directed particularly to the method or process herein illustrated and described.

What I claim is:

1. The method of making piston rings, which consists in slotting a closed ring on its opposite sides to split the same and form ends capable of overlapping, applying pressure to the outer circumference of the split ring to close the same, applying pressure to the sides of the ring thus closed to retain it in its closed position, removing the circumferential pressure, treating the outer circumference to render it a true circle while held in its closed position by said side pressure, placing the ring thus treated within a holder whose inner circumference is concentric with the circumference of the ring, allowing the ring to expand into contact with said holder, securing the ring within said holder in fixed relation thereto by pressure applied to the sides of the ring, and treating the inner circumference of the ring to render it concentric with the outer circumference thereof.

2. The method of making piston rings, which consists in slotting a closed ring on its opposite sides to split the same and form ends capable of overlapping, applying pressure to the outer circumference of the split ring to close the same, applying pressure to the sides of the ring thus closed to retain it in its closed position, removing the circumferential pressure, treating the outer circumference to render it a true circle while held in its closed position by said side pressure, placing the ring thus treated within a holder whose inner circumference is concentric with the circumference of the ring, allowing the ring to expand into contact with said holder, securing the ring within said holder in fixed relation thereto by pressure applied to the sides of the ring, treating the inner circumference of the ring to render it concentric with the outer circumference thereof, removing the ring from the said holder, again contracting the ring to close the same, securing it in its closed position by side pressure, removing the circumferential pressure, and machining the outer circumference of the ring.

3. The method of making piston rings, which consists in contracting a split ring into its closed position, holding the split ring in its closed position by pressure applied to the sides of the ring, machining the outer circumference of the closed split ring to a true circle, expanding and contracting the ring thus treated and securing it in its closed position by pressure applied to the sides thereof, machining the inner circumference of the ring to circular form concentric with the outer circumference thereof, expanding and contracting the ring thus treated, and again machining the outer circumference of the ring.

4. The method of making piston rings, which consists in contracting a split ring into its closed position, machining the outer surface of the closed ring to a true circle, expanding and then closing the ring thus treated and machining the inner surface thereof to a true circle concentric with the outer circumference thereof, expanding and then closing the ring thus treated and machining the outer circumference thereof into circular form concentric with the inner circumference thereof.

5. The method of making piston rings, which consists in contracting a split ring into its closed position, machining the outer surface of the closed ring to a true circle, expanding and then closing the ring thus treated and machining the inner surface thereof to a true circle concentric with the outer circumference thereof.

6. The method of making piston rings, which consists in contracting a split ring into its closed position by pressure applied to the outer circumference of said ring and capable of yielding under the influence of a counter pressure exerted against it by movement of the metal of the ring, applying pressure to the sides of the ring to hold it in its closed position and so as to leave the outer circumference thereof free to be machined after the circumferential pressure has been removed, removing said circumferential pressure and machining the outer circumference of the closed ring to practically true circular form, removing said lateral pressure, expanding the ring, closing it again, applying pressure to the sides of the closed ring to hold it in its closed position and so as to leave the inner circumference free to be machined, and machining the inner circumference to practically true circular form concentric with the outer circumference of said ring.

7. The method of making piston rings, which consists in contracting a split ring into its closed position, applying pressure to the sides of the ring to hold it in its closed position and so as to leave one circumferential surface free to be machined, machining said circumferential surface to practically
true circular form, removing the lateral pressure and again applying it to the sides of the ring to hold the ring in its closed position and so as to leave the other circumferential surface free to be machined, and machining the last-mentioned circumferential surface to practically true circular form concentric with the first-mentioned circumferential surface.

8. The method of making piston rings which consists in machining the edges of the rings to size, removing the scale from the outside of the rings, slotting them, closing them in with flexible fixtures, machining them so the periphery is round when contracted, again closing them in to machine and remove the scale from the inside so the inside surface of the rings will be concentric with the outside, again closing-in the rings with flexible fixtures to finally finish their outside surfaces so that when completed the rings will be round when closed-in and elliptical when open to their natural position.

9. The method of making piston rings which consists of removing the scale from the edges and outside of the rings, slotting them and thereafter machining them outside, inside and again outside in the order named and closing said rings before the outside machining operations, by means which permit the rings to contract naturally without undue local restraint and so they will be round when closed-in and elliptical when open, with the long axis of the ellipse at right angles to the slot.

10. The method of making piston rings which consists in contracting into its closed position a ring blank having a substantially wide slot and possessing substantially no spring tension, so as to impart to said slotted ring blank a maximum spring tension, holding said slotted ring blank in its closed position so as to leave first one and then the other of its circumferential surfaces free to be machined while the slotted ring blank is under said maximum spring tension, and machining said circumferential surfaces to true circular form concentric with each other in the closed-in position of the ring and capable of expanding to separate the free ends of the ring by a space substantially equal to the width of the slot in the ring blank before the latter is contracted.

In witness whereof, I hereunto set my hand this fifteenth day of February, 1918.

RICHARD P. ELLIOTT.