United States Patent

Sugahara

[15] **3,683,477**

[45] **Aug. 15, 1972**

[54] **METHOD OF PRODUCING ONE-PIECE CHANNEL SHAPED PISTON RING**

[72] Inventor: **Eisuke Sugahara,** c/o Kohdanjutaku 12-203, 1-1 Akabanedai, Kita-ku, Tokyo-to, Japan

[22] Filed: **Oct. 28, 1970**

[21] Appl. No.: **84,705**

[52] **U.S. Cl.** .....**29/156.6,** 204/15, 204/25, 277/140, 277/224, 277/235 A

[51] **Int. Cl.** **B23p 15/06**

[58] **Field of Search** .....29/156.6, 156.63; 277/223, 277/224, 138, 139, 140, 141, DIG. 6, 235 A; 117/130, 131; 204/25, 15, 43

[56] **References Cited**

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Primary Examiner—John F. Campbell
Assistant Examiner—Victor A. Di Palma
Attorney—Sughrue, Rothwell, Mion, Zinn & Macpeak

[57] **ABSTRACT**

This disclosure provides a novel method of producing a channel shaped piston ring in that a plurality of relatively wide lateral slits are formed by punching together with the oil windows to save time and cost and also to avoid an "end effect" during the electrolytic Cr or Co-W plating treatment of the edge of the ring. The method is carried out by punching a sheet tape to produce the plurality of slits and windows, bending the punched tape into a channel having a C-shaped cross section, curling the C-shaped channel into a ring of larger diameter than the final piston ring, and heat treating the ring after inserting it into a hollow cylinder having an inner diameter slightly smaller than the initial diameter of the curled article. The method is further characterized in that the Cr or Co-W plating of the edges of the ring is carried out either before or after the heat treatment.

2 Claims, 7 Drawing Figures

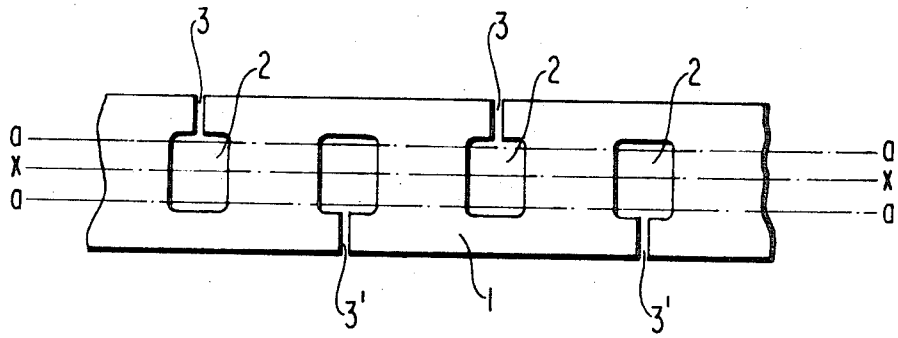


FIG. 1
PRIOR ART

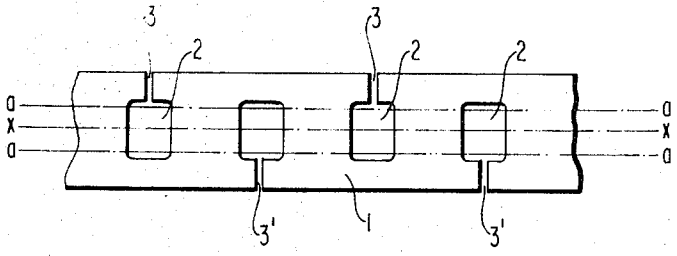


FIG. 2
PRIOR ART

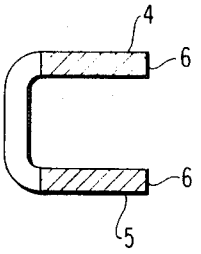


FIG. 3
PRIOR ART

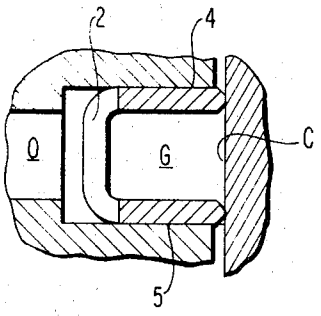
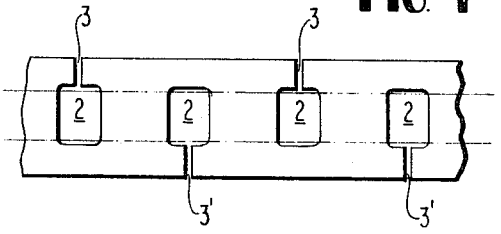


FIG. 4



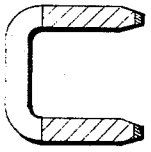


FIG. 6a

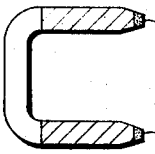


FIG. 6b

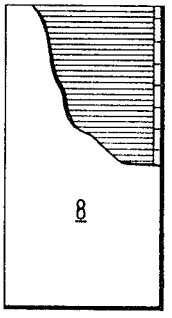


FIG. 5

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METHOD OF PRODUCING ONE-PIECE CHANNEL SHAPED PISTON RING

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to an improved one-piece channel shaped piston ring of the type shown in U.S. Pat. No. 2,932,543, and to a method of producing the same.

2. Description of the Prior Art

The known one-piece oil rings or one-piece channel shaped piston rings are produced by punching a first plurality of same sized oil windows in a thin steel sheet tape at regular intervals along the centerline of steel sheet tape, cutting a plurality of lateral slits from the tape edges to the oil window alternately for every other window by a grinder, bending longitudinally the obtained steel sheet tape along two lines parallel to the centerline of the tape, into a channel shaped article, and forming the obtained channel shaped article into a ring of desired diameter.

The aforesaid slit cutting step requires much time and cost, and wrong slits are often cut at undesired portions of the steel sheet tape. Besides, as the slits terminate on a sliding face which is formed on an end of a side wall of the channel, this causes an "end effect" while the sliding face is subject to the electrolytic Cr plating. This "end effect" is very detrimental to the Cr plating treatment, and accordingly the end face having the slits is hardly subjected to the Cr plating. By these reasons, the conventional channel shaped piston ring does not have favorable durability.

SUMMARY OF THE INVENTION

Therefore, an object of this invention is to provide a novel slit cutting method with saving in cost and working time.

Another object of this invention is to eliminate the "end effect" when the outer surface of the piston ring, especially the sliding face, is subjected to the electrolytic plating treatment. This invention also provides an improved channel shaped piston ring having Co-Mo plated layer on the sliding face with favorable durability.

BRIEF DESCRIPTION OF THE DRAWINGS

More specified embodiments of this invention will be described with reference to accompanied drawings, wherein:

FIG. 1 is a plan view of a steel sheet tape to be formed into the conventional channel shaped piston ring, having a plurality of punched oil windows and lateral slits therefrom, cut by the grinder,

FIG. 2 shows a lateral cross section of a conventional channel shaped piston ring,

FIG. 3 is a cross section of a conventional assembly composed of a piston, a cylinder and the channel shaped piston ring inserted therebetween,

FIG. 4 is a plan view of a steel sheet tape to be formed into the channel shaped piston ring according to this invention, having a plurality of oil windows and slits which are punched in one step,

FIG. 5 shows a partly broken cross section of the steel article bent first to have C shaped cross section and then curled on a drum, and

FIGS. 6*a* and 6*b* are cross sections of an oil ring whose outer edges are coated with Co-W plating layer, according to this invention.

Referring to FIGS. 1—3, the conventional channel shaped piston ring and the method of producing the latter will be first described. The steel sheet tape 1 has a plurality of rectangular oil windows 2 at regular intervals and lateral slits 3, 3' arranged alternately on respective sides of the tape 1. It is bent longitudinally along lines *a*—*a* to form the channel composed of a pair of side walls 4 and 5 and a bottom plate including the oil windows 2. End faces or edges 6 of both said side plates serve as the sliding faces. This channel shaped article is cut into the desired length and bent into a ring form. The obtained piston ring is inserted into an oil ring groove G of a piston so that the upper face 4 and the lower face 5 touch the groove walls and the sliding faces 6 are brought into contact with a surface of a cylinder c which is engaged by the piston.

Thus, the excess oil stuck to the cylinder surface is scraped by the oil ring and drained through the oil windows 2 and oil ducts O in the piston into an oil pan, as shown in FIG. 3.

This conventional channel shaped piston ring has aforesaid defects, and therefore an improved oil ring is produced according to this invention, which is described with reference to FIGS. 4–6. A thin steel sheet tape 1 is first punched to form a plurality of oil windows 2 of the same size arranged at regular intervals and to form also, a plurality of relatively wide lateral slits 3, 3' which are provided alternately on both sides of the tape 1 and connect the oil window 2 with the tape edge. Then, the punched tape is bent along 2 lines a—a and a—a, both being parallel to the tape centerline X—X, to form a channel having the symmetrical C shaped cross section.

The obtained channel article is curled to form a ring having a diameter larger than that of the final oil ring product, and the curled article is inserted into a hollow cylinder having the inner diameter smaller than the curling diameter and heat treated therein.

After that, an electrolytic Cr plating is applied to the outer surface of the curled article to coat a Cr layer 8' thereon.

According to this method, as the oil windows 2 and the slit 3 are punched simultaneously in one step, the slit forming working is much simplified and the cutting of a wrong slit at an undesired point is fully eliminated. The punched slit is wider as compared with the cut slit to reduce the spring characteristics of the resultant oil ring, but the width of the slit can be adjusted during the heat treatment to recover the spring characteristics of the oil ring. Besides, the heat treatment is able to relieve the internal stress caused by the punching to recover the favorable mechanical properties, and the resultant oil ring exhibits mechanical stability for long periods of time.

On the other hand, the wider slits inhibit any formation of the "end effect" during the Cr plating treatment, thus forming a favorable Cr plated layer on the outer edge surfaces of the oil ring. It is more advantageous to effect the brushing plating together with the Cr plating.

In another example of producing the oil ring, Co-W plating is applied to the outer surface of the curled

channel shaped article prior to the heat treatment in the cylinder 8. This heat treatment is conducted at 200°–500° C. to obtain the Co-W layer having a hardness of 800–1200 Hv. As this Co-W plated layer is very smooth, a polishing treatment is not required. This is considered to be dependent on a fact that the uniform electric depositing property of the Co-W layer is excellent and the "end effect" is hardly present due to the relatively wide slits.

While this invention has been described with reference to particular embodiments thereof, it will be understood that the numerous modifications may be made by those skilled in the art without actually departing from the scope of this invention.

Therefore, the appended claims are intended to cover all such equivalent variations as coming within the true spirit and scope of the invention.

What is claimed is:

1. A method of producing a one-piece channel shaped piston ring comprising:

punching a plurality of oil windows of the same size, arranged at regular intervals along a longitudinal centerline within a thin sheet steel tape and simultaneously, a plurality of relatively wide lateral slits alternately in every other window on respective sides of the tape with each of the oil windows connected to a respective tape edge,

bending the punched tape along two lines parallel to the tape centerline to form a channel having a symmetrical C shaped cross section,

curling the channel article into a ring having the diameter slightly larger than that of the final oil ring product,

inserting the curled article into a hollow cylinder having an inner diameter slightly smaller than the initial diameter of the curled article,

heat-treating the curled article therein, and

subjecting the outer edge surfaces of the heat treated article to an electrolytic Cr plating treatment.

2. A method of producing a one-piece channel shaped piston ring comprising:

punching a thin steel sheet tape with a plurality of oil windows of the same size arranged at regular intervals along a longitudinal centerline of the tape and simultaneously with a plurality of relatively wide lateral slits provided alternately for every other window on both sides of the tape for connecting each of the oil windows to respective tape edges,

bending the punched tape along two lines in parallel to the longitudinal centerline of the tape to form a channel having the symmetrical C shaped cross section,

curling the channel article into a ring having a diameter slightly larger than that of the final oil ring product,

subjecting the outer edge surfaces of the curled article to a Co-W plating treatment,

inserting the Co-W plated article into a hollow cylinder having the inner diameter slightly smaller than the initial diameter of the Co-W plated article, and

heat-treating the plated article therein.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,683,477 Dated August 15, 1972

Inventor(s) Eisuke Sugahara

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The priority date was omitted from the patent. It should be:

October 28, 1969

The Assignee's name was omitted from the patent. It should be:

Nippon Piston Ring Co., Ltd.

Signed and sealed this 1st day of May 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents

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