March 14, 1950 H. P. PHILLIPS 2,500,566

METHOD FOR THE MANUFACTURE OF PISTON RING ELEMENTS

Filed May 11, 1944

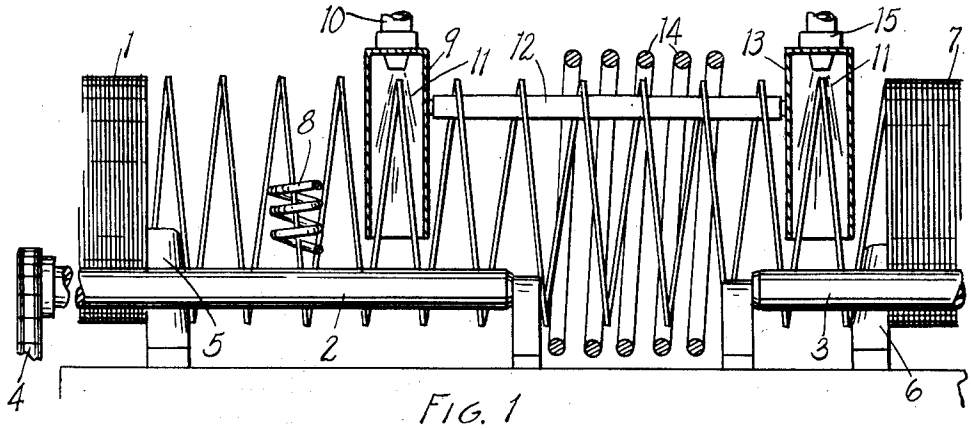


FIG. 1

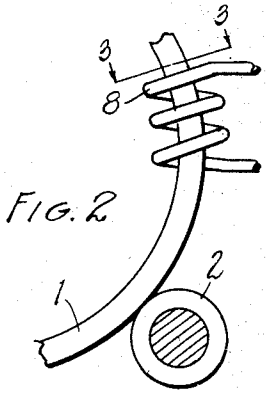


FIG. 2

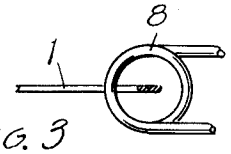


FIG. 3

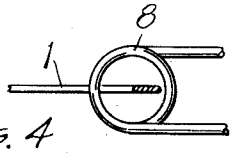


FIG. 4

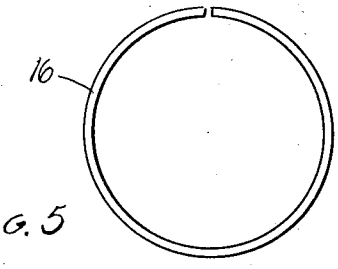


FIG. 5

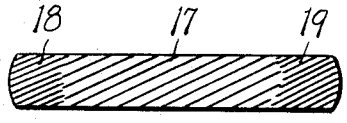


FIG. 6

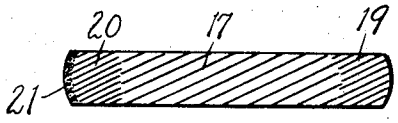


FIG. 7

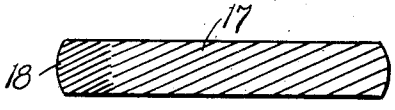


FIG. 8

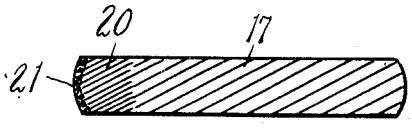


FIG. 9

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METHOD FOR THE MANUFACTURE OF PISTON RING ELEMENTS

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Application May 11, 1944, Serial No. 535,046

4 Claims. (Cl. 148—10.5)

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This invention relates to improvements in Method for the manufacture of piston ring elements.

This invention relates to a method for manufacturing piston ring elements of the type in which the piston ring elements are formed of ribbon steel coiled edgewise and provided with a hardened wear resisting portion on one or both edges and in certain forms this wear resisting portion is provided with a softened or annealed relatively shallow surface facilitating wearing-in of the ring elements. The apparatus hereinafter described for performing the method constitutes the subject matter of my copending application Serial No. 586,153, filed April 2, 1945, now Patent No. 2,487,587.

The main objects of this invention are:

First, to provide a method by which piston ring elements of the character described may be efficiently and economically produced.

Second, to provide a method of the character indicated which may be practiced on a large scale and with relatively little care or attention on the part of the operator and not necessitating the services of persons skilled in tempering.

Objects relating to details and economies of the invention will appear from the description to follow. The invention is defined and pointed out in the claims.

Preferred embodiments of the invention are illustrated in the accompanying drawing, in which:

Fig. 1 is a fragmentary view partially in elevation and partially in longitudinal section of an apparatus adapted for the practice of my method, certain parts being shown mainly in conventional form and no attempt being made to show the parts in exact proportions.

Fig. 2 is an enlarged fragmentary view illustrating an induction heater coil for heating one or both edges of the element to hardening temperature.

Fig. 3 is a fragmentary section on line 3—3 showing the heating coil associated with the work to heat both edges thereof.

Fig. 4 is a view similar to that of Fig. 3 with a heating coil adjusted to heat the outer edge only to hardening heat.

Fig. 5 is a side elevation of a ring element illustrating the general character of the element

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without an attempt, however, to show the hardened edges.

Fig. 6 is an enlarged fragmentary section through one of the ring elements of the movable coil from which it is formed with both inner and outer edges hardened.

Fig. 7 is a view corresponding to Fig. 6 with the outer hardened edge provided with an annealed surface facilitating rapid wearing-in of the ring element.

Fig. 8 is a sectional view through a ring element in which the outer edge only is hardened.

Fig. 9 is a corresponding sectional view in which the hardened outer edge is provided with an annealed or relatively soft wear-in surface facilitating quick wearing-in.

In Fig. 1 of the accompanying drawing, I illustrate an apparatus well adapted for the practicing of the method, only such parts, however, of the apparatus being illustrated as particularly relate to this invention and the practice of the method.

The first step in the practice of the method is to coil a strip of ribbon steel edgewise into a multiple coil spiral designated generally by the numeral 1, the individual coils of which are of substantially uniform diameter and lie in side by side contacting relation. This coil is placed in an apparatus or machine comprising longitudinally spaced pairs of rollers 2, 2 and 3, 3, only one roller of each pair being illustrated. At least one of the rollers 2 is driven, the driving means being indicated at 4.

An abutment 5 is associated with the first pair of rollers and a similar abutment 6 with the second pair of rollers. The coils of the multiple coil are extended axially between these abutments and when the delivery coil 1 is rotated, receiving coil 7 being also rotated, the spiral constituted by the several spaced coils is also rotated and the coils constituting the spiral advanced.

The first induction heater 8 is arranged so that the spiral strip passes therethrough and as the strip is rotated the portions of the spiral are successively brought into the heater and the strip heated on one or both edges depending on the position of the heater relative to the strip. For example, in Figs. 2 and 3, the heater is positioned so that the coil is centrally located relative

thereto while in Fig. 4 it is positioned so that one edge of the strip only is brought to a hardening temperature. The capacity of the heater and the rate of feed is such that the edge or edges of the spiral strip are brought to hardening temperature.

From the heater, the coils of the spiral are passed into the downwardly opening quenching chamber 9 which has a spray nozzle 10 associated therewith for discharging a quenching medium 11 upon the heated work to effectively harden the same. It will be noted that both the first heater 8 and the quenching unit are arranged to act on the work while it is supported by the first set of rollers 2.

At the rear of the first quenching unit, the spirals of the work are passed over the supporting rod 12 which extends between the housing 9 of the first tempering unit and the housing 13 of the second tempering unit. While the work is supported by the supporting rod 12, it is passed axially through the second induction heater 14 which is of such capacity as to anneal the outer edge of the previously hardened portion of the work. From this second heater or annealing heater 14, the work is passed to the quenching chamber 13 which is provided with a spray head 15 for the quenching medium 11. The work passes from the second tempering unit to the coil 7 and this multiple coil spiral with the treated edges is then cut into ring elements 16.

Figs. 6, 7, 8 and 9 are sectional views through the ring elements. In Fig. 6, the ring element 17 is provided with a hardened outer edge 18 and hardened inner edge 19. In Fig. 7, the hardened outer edge 20 is provided with an annealed or relatively soft quick wear-in surface 21. In Fig. 8, the ring element is provided with a hardened surface 18 on its outer edge only. The embodiment of Fig. 9 is the same as that of Fig. 7 except that the inner edge is not hardened.

The ribbon steel is of a character that it may be coiled edgewise and may desirably be from 300 to 500 Brinell test or from 40 to 50 Rockwell test. The tempered portion is preferably from 700 to 900 Brinell test and corresponding generally to 60 to 70 Rockwell test. The hardened portion is preferably in the neighborhood of the order of $\frac{1}{32}$ of an inch in depth although it may vary from $\frac{1}{64}$ of an inch in either direction. The annealed portion or surface is preferably about .003 of an inch in depth although it may vary in the order of from .002 to .004 of an inch. While I prefer to employ induction heaters inasmuch as such heaters may be very effectively controlled and regulated, other forms of heating means might be employed. I have shown the induction heaters and other parts conventionally as the structural details thereof form no part of this invention.

I have not attempted to illustrate various modifications in the apparatus or other apparatus for practicing my invention as it is believed that this disclosure will enable those skilled in the art to embody or adapt my invention as may be desired.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. The method of forming split piston ring elements comprising the steps of coiling a strip of ribbon steel edgewise into a multiple coil spiral, the individual coils of which are of substantially uniform diameter and lie in side by side contacting relation, rotating the multiple coil spiral on its axis and separating the coils thereof into an advancing spiral strip, passing the advancing spiral strip through an induction heater coil whereby the edges of the strip are heated to a hardening temperature to a depth of approximately $\frac{1}{32}$ of an inch, passing the heated advancing spiral strip through a quenching spray where the coils thereof are separated, passing the advancing spiral strip from the quenching spray axially through a surrounding induction heater coil to heat only the outer initial wear resisting portion of the hardened edge portion to an annealing temperature, and while so heated and where the coils thereof are separated passing the spirals through a quenching spray whereby a relatively soft annealed peripheral surface of approximately .003 of an inch is produced on the outer hardened edge, and cutting the multiple coil spiral into split piston ring elements, said separated coils being delivered into side by side contacting relation prior to the cutting thereof into split ring segments.

2. The method of forming split piston ring elements comprising the steps of coiling a strip of ribbon steel edgewise into a multiple coil spiral, the individual coils of which are of substantially uniform diameter and lie in side by side contacting relation, rotating the multiple coil spiral on its axis and separating the coils thereof into an advancing spiraled strip, passing the advancing spiraled strip through an induction heater coil whereby the outer edge of the strip is heated to a hardening temperature, while so heated and where the coils thereof are separated passing the heated advancing spiraled strip through a quenching spray to harden the outer edge to a hardness substantially exceeding the hardness of the ribbon stock, passing the advancing spiraled strip from the quenching spray axially through a surrounding induction heater coil to heat only the outer initial wear resisting portion of the hardened edge portion to an annealing temperature, and while so heated and where the coils thereof are separated passing the spirals through a quenching spray to provide a relatively soft annealed peripheral surface on the outer hardened edge, and cutting the multiple coil spiral into split piston ring elements, said separated coils being delivered into side by side contacting relation prior to the cutting thereof into split ring segments.

3. The method of forming split piston ring elements comprising the steps of coiling a strip of ribbon steel edgewise into a multiple coil spiral, the individual coils of which are of substantially uniform diameter, rotating the multiple coil spiral on its axis and separating the coils thereof into an advancing spiraled strip, passing the advancing spiraled strip through an induction heater whereby an edge of the strip is heated to a hardening temperature, while so heated and where the coils thereof are separated passing the heated advancing spiraled strip through a quenching medium to harden such heated edge to a hardness substantially exceeding the hardness of the ribbon stock, passing the advancing spiraled strip from the quenching medium through an induction heater to heat only the outer initial wear resisting portion of the hardened edge portion to an annealing temperature, and passing the spiraled strip through a quenching medium to provide a relatively soft annealed peripheral surface on the hardened edge, and

cutting the multiple coil spiral into split piston ring elements, said separated coils being delivered into side by side contacting relation prior to the cutting thereof into split ring segments.

4. The method of forming piston ring elements comprising the steps of coiling a strip of ribbon steel edgewise into a multiple coil spiral, rotating the multiple coil spiral on its axis and separating the coils thereof into an advancing spiraled strip, subjecting the advancing spiraled strip to a heating means whereby an edge portion of the advancing strip is heated to a hardening temperature, the major portion of the strip not being heated to a hardening temperature, quenching the heated advancing spiraled strip where the coils thereof are separated to provide a hardened edge of a hardness substantially exceeding the hardness of the ribbon steel, the major portion of the strip being in the condition resulting from coiling, subjecting the advancing spiraled strip to a heating means to heat only the outer initial wear resisting portion of the hardened edge portion to an annealing temperature, and quenching the advancing spiraled strip whereby a relatively soft shallow peripheral surface is provided on the hardened edge portion, and cutting the multiple coil spiral into split ring elements, said separated coils being delivered into side by side contacting relation prior to the cutting thereof into split ring segments.

HAROLD P. PHILLIPS.

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