

PATENT SPECIFICATION

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DRAWINGS ATTACHED



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(54) AN INTERLOCKING RETAINING RING

(71) We, WALDES KOHINOOR INC., of 47-16 Austel Place, Long Island City, State of New York, United States of America, a corporation organized under the laws of the State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to improvements in retaining rings and, more particularly, in interlocking retaining rings.

Continuing experience with interlocking two-part retaining rings of known construction has revealed that they perform satisfactorily and are widely employed in ring-shaft assemblies of a nature requiring or making advisable the use of a retaining ring which is fabricated in half sections capable of being united in their assembly in a shaft groove by being brought together in the plane of the groove.

The known interlocking two-part rings are characterized by the provision of inner-edge arcuate recesses disposed symmetrically with respect to a diameter of the two ring parts or halves which, by decreasing the radial width of each ring half in its middle portion, tended to impart to the ring halves the flexibility necessary to enable the complementary hooks provided at their ends to interengage and interlock with one another during ring assembly, without either of the ring halves deflecting beyond the elastic limit. However, since the edges of the recesses are concentric with the outer edges of the ring halves, the provision of the recesses in an interlocking ring according to the known design has not yielded the expected favourable results.

More particularly, to assemble such a ring, a first one of the ring halves is placed in a positioning groove provided in a semi-cylindrical recess in a support block, the shaft which is to receive the ring is lowered into the block recess so that a groove in the shaft registers with the inner edge of the first ring half located in the positioning groove. A second ring half is then related to the first

ring half by interengaging the inwardly facing hook of the second ring half with the complementary outwardly facing hook of the first ring half and finally, the second half is pushed down towards the first ring half by means of a tapping block which applies to the second ring half a downward force until the first ring half deflects by an amount enabling its inwardly facing hook to ride over and then fully interengage with the complementary, outwardly facing hook of the second ring half. It will be seen that, in such assembly operation, not only is the first ring half exclusively called upon to deflect substantially the full amount necessary to enable the complete interengagement of the complementary hooks of the ring halves to take place, but also, the full amount of deflection takes place only in that half of the recessed portion of the first ring half which extends from the centre of the recess towards the inwardly facing end hook of the first ring half. Since this deflection should be kept within the elastic limit, the permissible amount of deflection is relatively small and imposes serious limitations on the use of retaining rings according to the known design.

According to the present invention, there is provided an interlocking retaining ring for forming a retaining shoulder on a shaft or the like provided with a ring seating groove, comprising ring halves of identical shape adapted to be assembled together with their inner edges seated in the groove and, when so assembled, to form a complete annulus, each ring half having an outwardly facing hook at one end and an inwardly facing hook at its other end and the outwardly facing hook of each ring half being adapted to interlock with the inwardly facing hook of each other ring half when the ends of the ring halves are interlocked, each ring half also having in the middle of its inner-edge a recess which results in the formation of a bridge of lesser radial width than that of the adjacent portions of the ring half on each side of the bridge, each bridge having a radial width which decreases progressively towards the end of the ring half which is provided with

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the inwardly facing hook. Preferably, the end edges of the recess connecting the recess with the inner edge of each ring half extend along radii of different length, the radius at the shallower end of the recess, at which the radial width of the bridge is greatest, being the smaller.

An embodiment of the present invention will now be particularly described with reference to the accompanying drawings, in which:—

Fig. 1 is a plan view of two separate ring halves of the retaining ring embodying the invention;

Fig. 2 is an end view, partly in section, illustrating an interlocking retaining ring assembled on a shaft and seated in a groove of the shaft;

Fig. 2a is a fragmentary view of the recessed edge portion of a ring half on an enlarged scale;

Figs. 3 and 4 are views illustrating successive stages of assembly of a known design of interlocking retaining ring;

Figs. 5 and 6 are views corresponding to Figs. 3 and 4, which illustrate the functioning of an interlocking ring embodying the invention during the assembly of the ring on a shaft.

Referring to the drawings in detail, a two-part interlocking retaining ring comprises the two identical ring halves designated 10, 12 which in assembly are adapted to complement one another in forming a full-circular annulus R (Fig. 2) capable of serving as an artificial shaft shoulder for retaining parts, such as bearing races and gears, in a fixed axial position on the shaft. To provide for their interlocking, the ring halves 10 and 12, which each have an inner-edge diameter substantially equal to that of the base of the shaft groove in which they are to be assembled and which are preferably stamped complete from spring metal, are provided at their opposite ends with complementary hooks shaped to interengage when the halves are assembled together. More particularly, the hooks 10a, 12a and 10b, 12b at the corresponding opposite ends of the ring halves are formed to face in opposite directions, that is to say, the hook 10a at one end of the ring half 10 faces outwardly and the hook 12a at the corresponding end of the other ring half 12 faces inwardly, whereas the hooks 10b, 12b at the other corresponding ends of the ring halves are so formed that they face inwardly and outwardly, respectively.

The ring halves 10 and 12 are provided in their respective middle portions with arcuately extending, inner-edge recesses designated 20, 22. The provision of such recesses results in the formation of so-called bridges 24, 26 of lesser radial width than that of the non-recessed adjacent portions of the ring

halves disposed on each side of the recesses.

However, instead of the bridges 24, 26 having uniform radial width throughout their arcuate length, as in the known ring design, it is a feature of the present invention that the bridges have a radial width which is non-uniform, i.e. progressively decreases, from one end to the other, and further that such progressive decrease is in a direction towards the inwardly directed end hooks 10b, 12a of the respective ring halves.

Such progressive decrease in radial width of the bridges 24, 26 may be simply provided by striking the recess-defining edges, i.e. the edges 20a, 22a, of the recesses from a centre C¹ which is displaced laterally from the centre C from which the outer and inner edges of the ring halves are struck, by a calculated amount determining the taper of the radial width of the bridges. Preferably, the end-defining edges of the recesses, i.e. those edges which connect the recess edges 20a, 22a with the inner edges a and b of the ring halves 10 and 12, rather than being formed as straight end edges, are instead radiussed and have radii r_1 and r_2 , of which the radius r_1 at the shallower end of the recess, at which the bridge has greatest radial width, is small compared with radius r_2 at the deeper end of the recess.

The major advantages of an interlocking retaining ring embodying the present invention over the interlocking retaining ring of the known design can best be explained by a comparison of the functioning of rings of the two designs when being assembled on their respective shafts and to each other. Referring to Figs. 3 and 4, which depict successive stages of the assembly of a ring of the known design, the ring half 110 is shown as already placed in a positioning groove provided in the shaft-receiving recess of a "support block" into which the "shaft" has been lowered to receive the ring-half in its "ring groove". Fig. 3 shows that the complementary ring half 112 has been preliminarily related to the ring half 110 by engaging its inwardly directed or facing end hook 112a with the outwardly facing end hook 110a of the ring half 110. To interengage the end hooks 110b, 112b at the opposite ends of the ring halves, a "tapping block" is lowered onto the outer periphery of the upwardly disposed ring half 112 and by tapping, a downward force is applied on the upper ring half 112, which results in the inwardly facing hook 110b, by its engagement with the outwardly directed hook 112b of the upper ring half, opening the lower ring half by an amount sufficient to enable the hook 110b to ride over and then lockingly engage with the hook 112b.

Thus, to interengage the hooks 110b, 112b, not only must all bending take place in the lower ring half 110, because it is this half which must open or spread sufficiently to

3 permit its inwardly facing hook 110b to ride
over the complementary hook 112b, but also,
because of the uniform radial width of the
bridge 124 resulting from the provision of
5 the recess 122 which enables the lower ring
half to bend and additionally because the
forces applied by the "tapping block" are in
the direction of the vertical centre line of the
ring half 110, which is also the centre line
10 of the bridge 124, the bending required to
interengage the hooks 110b, 112b as de-
scribed actually occurs in that half of the
bridge 124 which extends between its centre
line and its end adjacent the inwardly
15 directed end hook 110b.

Now considering Figs. 5 and 6, which
illustrate the assembly procedure re-
commended for an interlocking retaining
ring embodying the present invention, it will
20 be seen that it is similar to that just de-
scribed for the ring of the known design.
However, when the upper ring half 12 is
tapped down by the "tapping block", the
lower ring half 10, when its hooks 10a, 10b
25 are positioned as shown, slides counter-
clockwise in its "positioning groove" to an
adjusted angular position in which its point
of largest radial width substantially coincides
with the vertical centre line of the shaft-ring-
30 support block assembly. This, in effect,
shifts the line from which bending of the
lower half 10 of the ring will occur toward
the end of the bridge 24 having the greater
radial width, with the favourable result that
35 substantially the entire length of the bridge
can deflect. This in turn increases the
amount of permissible elastic deformation
by the square of the increased length of the
bridge in which bending can occur and, due
40 to the tapered configuration of the bridge,
an additional one-third increase in attainable
without increase of ring stressing, as com-
pared with the bridge of uniform section.
Also, because of the relatively large radial
45 width of the bridge at one end of each recess
(20 or 22) and the large connecting radius
 r_2 between edge of the recess and the inner
edge of the ring at the other recess end, a
much better continuity of the stress lines in
50 bending is achieved, which reduces the stress
concentration factor in the bridge incident
to right-half bending during assembly or
disassembly.

Another advantage of the tapered bridge
55 characterizing the edge-recessed interlocking
ring embodying the invention is that the
shape of the bridge considerably reduces de-
formation and hence changes in the free ring
diameter arising in heat treatment, whereby
60 a better and tighter fit of the rings in their
grooves may be attained.

Yet a further advantage resides in greater
ring-half securement. More particularly, in
a ring according to the present invention,

the forces holding the ring halves together
are much greater than those attainable in
the comparable ring of the known design.

Interlocking rings with tapered bridges
embodying the present invention also have
the advantage of facilitating the design of such
rings, since the arcuate length of the bridge is
related to its maximum radial width. This
is to say that if the bridge is longer, the
maximum radial width of the ring can be
increased, resulting in the same stresses and
the same amount of deflection. On the other
hand, if a stiffer ring with less deflection is
required, that can be accomplished by re-
ducing the bridge length or increasing its
maximum radial width or both. This is of
practical importance, particularly in cases of
rings with smaller outer diameters wherein,
due to the taper of the bridge, the holding
power of the hooks will be sufficient to
assure good functioning of the ring; this
cannot be so easily achieved with a ring
having a bridge of uniform radial width.

Also to be noted is the fact that the ring
halves characterized by the tapered and
hence non-symmetrical bridge embodying
the present invention are just as easily inter-
changeable as ring halves characterized by
the uniform radial width bridge according
to the known design in spite of the long pre-
valent belief held by persons skilled in the
interlocking retaining ring field that, for
interchangeability of ring halves, a sym-
metrical bridge was necessary.

Having regard to the provisions of Section
9 of the Patents Act 1949 attention is di-
rected to the claims of Patent No. 937,479.

WHAT WE CLAIM IS:—

1. An interlocking retaining ring for
forming a retaining shoulder on a shaft or
the like provided with a ring seating groove,
comprising ring halves of identical shape
adapted to be assembled together with their
inner edges seated in the groove and, when
so assembled, to form a complete annulus,
each ring half having an outwardly facing
hook at one end and an inwardly facing
hook at its other end and the outwardly
facing hook of each ring half being adapted
to interlock with the inwardly facing hook of
each other ring half when the ends of the
ring halves are interlocked, each ring half
also having in the middle of its inner-edge
a recess which results in the formation of a
bridge of lesser radial width than that of the
adjacent portions of the ring half on each
side of the bridge, each bridge having a
radial width which decreases progressively
towards the end of the ring half which is
provided with the inwardly facing hook.

2. An interlocking retaining ring accord-
ing to claim 1, wherein the end edges of the
recess connecting the recess with the inner



5 permit its inwardly facing hook 110b to ride over the complementary hook 112b, but also, because of the uniform radial width of the bridge 124 resulting from the provision of the recess 122 which enables the lower ring half to bend and additionally because the forces applied by the "tapping block" are in the direction of the vertical centre line of the ring half 110, which is also the centre line of the bridge 124, the bending required to interengage the hooks 110b, 112b as described actually occurs in that half of the bridge 124 which extends between its centre line and its end adjacent the inwardly directed end hook 110b.

10 Now considering Figs. 5 and 6, which illustrate the assembly procedure recommended for an interlocking retaining ring embodying the present invention, it will be seen that it is similar to that just described for the ring of the known design. However, when the upper ring half 12 is tapped down by the "tapping block", the lower ring half 10, when its hooks 10a, 10b are positioned as shown, slides counter-clockwise in its "positioning groove" to an adjusted angular position in which its point of largest radial width substantially coincides with the vertical centre line of the shaft-ring-support block assembly. This, in effect, shifts the line from which bending of the lower half 10 of the ring will occur toward the end of the bridge 24 having the greater radial width, with the favourable result that substantially the entire length of the bridge can deflect. This in turn increases the amount of permissible elastic deformation by the square of the increased length of the bridge in which bending can occur and, due to the tapered configuration of the bridge, an additional one-third increase in attainable without increase of ring stressing, as compared with the bridge of uniform section. Also, because of the relatively large radial width of the bridge at one end of each recess (20 or 22) and the large connecting radius r_2 between edge of the recess and the inner edge of the ring at the other recess end, a much better continuity of the stress lines in bending is achieved, which reduces the stress concentration factor in the bridge incident to right-half bending during assembly or disassembly.

55 Another advantage of the tapered bridge characterizing the edge-recessed interlocking ring embodying the invention is that the shape of the bridge considerably reduces deformation and hence changes in the free ring diameter arising in heat treatment, whereby a better and tighter fit of the rings in their grooves may be attained.

60 Yet a further advantage resides in greater ring-half securement. More particularly, in a ring according to the present invention,

the forces holding the ring halves together are much greater than those attainable in the comparable ring of the known design.

Interlocking rings with tapered bridges embodying the present invention also have the advantage of facilitating the design of such rings, since the arcuate length of the bridge is related to its maximum radial width. This is to say that if the bridge is longer, the maximum radial width of the ring can be increased, resulting in the same stresses and the same amount of deflection. On the other hand, if a stiffer ring with less deflection is required, that can be accomplished by reducing the bridge length or increasing its maximum radial width or both. This is of practical importance, particularly in cases of rings with smaller outer diameters wherein, due to the taper of the bridge, the holding power of the hooks will be sufficient to assure good functioning of the ring; this cannot be so easily achieved with a ring having a bridge of uniform radial width.

Also to be noted is the fact that the ring halves characterized by the tapered and hence non-symmetrical bridge embodying the present invention are just as easily interchangeable as ring halves characterized by the uniform radial width bridge according to the known design in spite of the long prevalent belief held by persons skilled in the interlocking retaining ring field that, for interchangeability of ring halves, a symmetrical bridge was necessary.

Having regard to the provisions of Section 9 of the Patents Act 1949 attention is directed to the claims of Patent No. 937,479.

WHAT WE CLAIM IS:—

1. An interlocking retaining ring for forming a retaining shoulder on a shaft or the like provided with a ring seating groove, comprising ring halves of identical shape adapted to be assembled together with their inner edges seated in the groove and, when so assembled, to form a complete annulus, each ring half having an outwardly facing hook at one end and an inwardly facing hook at its other end and the outwardly facing hook of each ring half being adapted to interlock with the inwardly facing hook of each other ring half when the ends of the ring halves are interlocked, each ring half also having in the middle of its inner-edge a recess which results in the formation of a bridge of lesser radial width than that of the adjacent portions of the ring half on each side of the bridge, each bridge having a radial width which decreases progressively towards the end of the ring half which is provided with the inwardly facing hook.

2. An interlocking retaining ring according to claim 1, wherein the end edges of the recess connecting the recess with the inner



edge of each ring half extend along radii of different length, the radius at the shallower end of the recess, at which the radial width of the bridge is greatest, being the smaller.

5 3. An interlocking retaining ring substantially as hereinbefore described with re-

ference to Figs. 1, 2, 5 and 6 of the accompanying drawings.

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