

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN OR RELATING TO RADIAL ASSEMBLY-TYPE SPRING RETAINING RINGS

(71) We, WALDES KOHINOOR, INCORPORATION, 47-16 Austel Place, Long Island City 1, State of New York, United States of America, a corporation organized and existing 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:

This invention relates to improvements in radial assembly-type spring retaining rings, i.e. retaining rings designed to be assembled in pre-cut grooves provided for their reception in shafts, studs and similar parts by simple radial movement into these grooves, and which when so installed are capable of securing themselves with spring pressure to the groove bottoms and of serving as shoulders for locating other components on such shafts, studs or similar parts.

Retaining rings designed to be radially so installed in shaft grooves are well known in the art and are commercially available in at least two main structural forms, as follows:

1. "Open" retaining rings characterised principally by the ring body having arcuate length not substantially greater than 180° and hence a width of gap between its free ends as enables the ring to be spread the relatively small amount required for its assembly without unduly stressing the same or taking an a permanent set, disclosed in U.K. Patent Specification No. 621,122.

2. Clip-type retaining rings (sometimes also termed retaining clips), as disclosed in U.K. Patent Specification No. 419,693

While of the two ring forms discussed above, the "open" retaining ring is by far the better known and more widely used, it is nevertheless subject to the objections that the shaft shoulder formed thereby is only segmental and because of the large gap between the free ends of such a ring, its resistance to heavy thrust loads is relatively small.

Furthermore, although the assembly of open retaining rings in their grooves may be readily effected by a conventional applicator, the disassembly of open rings from their grooves is sometimes very difficult, due to the fact that the standard ring applicator is not designed to withdraw a seated ring from its groove. Also, in the absence of provision for their special handling, the smaller sizes of open rings are liable, when improperly handled, to become lost in the instrument or machine during assembly or disassembly and then to interfere with the smooth functioning of the instrument of machine. In machines or assemblies under high electrical voltage, retrieval of such a lost ring can be safely effected only by cutting of the electrical supply or by the use of a special insulated tool of an expensive nature.

The clip-type retaining ring (form 2 above) possesses advantageous features not possible of attainment with "open" retaining rings as above, such as increased arcuate length as compared to the arcuate length of the "open" retaining rings and uniform section height throughout substantially the full arcuate length of the ring body and hence a uniform depth of shaft shoulder. As previously constructed, however, the clip-type retaining ring, because of the short arcuate length of the flexible bending arm connecting the clip segments, and on which the permissible amount of opening of the gap between the free ends of the ring depends, has only a limited resilience.

According to the present invention, there is provided a clip-type retaining ring designed for radial assembly in the groove of a shaft which when so assembled provides a shoulder for retaining a component on said shaft, comprising two circumferentially

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spaced apart and diametrically opposed ring segments and a flexible bending arm extending between and connecting said segments, the inner edges of said segments extending along arcs of a first circle having a diameter somewhat less than that of the groove bottom into which the ring is to be fitted, the outer edges of said segments and the outer edge of said bending arm extending along arcs of a second circle and together defining the outer perimeter of said ring, said perimeter being interrupted by radially inward cut-outs, which are disposed equal arcuate distances from the ring centre line and which determine the arcuate length of the bending arm, said cut-outs being so shaped as to provide the bending arm with outer edge extremity portions which curve inwardly towards one another by a predetermined amount and thereby substantially increase the arcuate length of said bending arm.

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

Fig. 1 is a plan view of a clip-type retaining ring in the unstressed state and embodying the present invention;

Fig. 2 is a vertical section taken along the line 2-2 of Fig. 3;

Fig. 3, which is a vertical section taken along the line 3-3 of Fig. 2, is a view of a circlip fitted to a shaft;

Figs. 4 and 5 are enlarged, partly diagrammatic views (mathematical symbols supplied) which compare the spreading action of the clip-type ring as herein proposed (Fig. 4) with that of a prior art retaining ring or retainer clip (Fig. 5).

Referring to the drawings in detail, a clip-type retaining ring or retainer clip embodying the present invention, comprises two circumferentially spaced-apart and diametrically opposed ring segments or jaws 10 and 12 connected at their corresponding upper ends by a flexible bending arm 14, which extends between and is integral with these segments. The inner edges 10a and 12a and the outer edges 10b and 12b respectively, of the ring segments are preferably concentric. The inner edges 10a and 12a extend along opposed arcs of a circle whose centre C provides the ring centre and whose diameter is somewhat less than that of the circle of the bottom wall G_b of the groove G of a shaft S, in which the ring is to be assembled.

As seen in Fig. 4 in particular, the free ends A of the ring segments 10 and 12 define the ring gap. It will be appreciated that to assemble the present ring in its shaft groove G, the segments are required to be spread to such a degree that the spacing between these points A equals the diameter of the circle of the groove bottom G_b.

The outer edges 10b and 12b of the ring segments or jaws 10 and 12 and the outer edge 14b of the flexible bending arm 14 extend along arcs of the ring circle and hence the ring is basically one having a circular outer perimeter. However, rather than this perimeter being continuous, its continuity is interrupted at two points or locations at equal arcuate distances to the sides of the ring centre line by the provision of two relatively deep and wide notches or cut-outs N₁ and N₂ which extend radially into the ring body and which are so shaped as to provide the bending arm with outer edge extremity positions which curve inwardly towards one another by a predetermined amount. By design, the arcuate spacing of these cut-outs N₁ and N₂ from the ring centre line is such as to substantially increase the arcuate length of the bending arm 14 by comparison with that of the bending arms of the prior art clip-type retaining rings. Further, by tapering the bending arm 14, i.e. providing it with section heights which progressively decrease from its middle section towards its end sections, a clip-type retaining ring may be constructed so as to be more resilient and to possess greater deflection potential.

Referring now to Fig. 4, which is intended to illustrate graphically and by the use of mathematical symbols, the improved functioning of a clip-type retaining ring constructed according to principles embodying the present invention, as compared to that of a prior art form of such a ring shown in Fig. 5, it may be seen that the provision of the two outer-edge notches or cut-outs N₁ and N₂ in the outer periphery of the ring serves to increase the arcuate length of the flexible bending arm 14 by the length of the arc of angle β on each side of the ring centre line. Thus, rather than the bending arm having arcuate length of only 2α as in Fig. 5, the bending arm 14 of the herein proposed ring will have the increased arcuate length of $2\alpha + 2\beta$.

Since the deflection of the bending arm 14, of the prior art ring shown in Fig. 5 can occur only within the angle 2α and since the arcuate length of this bending arm is small, the deflection δ_p is also small. In contrast, because of the increased arcuate length of the bending arm $2\alpha + 2\beta$ the deflection δ of the bending arm 14 will be much greater.

When it is considered further that the amount of increase in gap opening, i.e. the outward movement of points A, which determine the width of gap necessary on a clip-type retaining ring or retainer clip being assembled in its groove, is a function of its flexible bending arm, and further that such movements of the points A during ring spreading is a function of the angle of deflection formed by the tangents to the

neutral diameter curves DC_1 and DC_2 before and after ring expansion, it will be seen that where the angle of deflection is small, as is the case with the prior art ring shown in Fig. 5, the tangent is also small and therefore the permissible movements of points A, which determine the width of ring gap is also necessarily small.

As the bending arm 14 of a clip-type retaining ring according to Fig. 4 has substantially increased arcuate length ($2\alpha + 2\beta$), the deflection will be much greater and the tangent at the neutral diameter will have a considerably larger angle. Accordingly, the spreading movement of the points A, being a function of the tangent, of this angle, can therefore be made much greater without increasing the stresses in the maximum section of the bending arm 14 of the ring in Fig. 4 in comparison with the prior art ring of Fig. 5, if all other overall dimensions are equal.

The greater deflection potential made possible by the substantially longer bending arm 14 provides the ring according to Fig. 4 with numerous advantages. For example, it permits a greater expansion and accordingly it may be assembled in a relatively deep groove and can have a considerably larger section height than the prior art clip-type retaining ring, without increasing the stresses in this section.

Another advantage of the clip-type retaining ring embodying the invention is its increased holding power (push-out resistance) and consequently its improved reliability in use.

Yet another feature of the ring construction as herein proposed, is that the bending arm may be so constructed that in the cause of the initial assembly of the ring in its groove the bending arm is stressed beyond the elastic limit. Thus, one may provide for a predetermined permanent set occurring in the ring during its first application, with no further setting occurring in repeated applications. This pre-setting of the material may be advantageous in that it forms residual stresses in the ring which further increases its ability to pressure-seat itself against the groove bottom.

WHAT WE CLAIM IS:

1. A clip-type retaining ring designed for radial assembly in the groove of a shaft which when so assembled provides a shoulder for retaining a component on said shaft, comprising two circumferentially spaced apart and diametrically opposed ring seg-

ments and a flexible bending arm extending between and connecting said segments, the inner edges of said segments extending along arcs of a first circle having a diameter somewhat less than that of the groove bottom into which the ring is to be fitted, the outer edges of said segments and the outer edge of said bending arm extending along arcs of a second circle and together defining the outer perimeter of said ring, said perimeter being interrupted by radially inward cut-outs, which are disposed equal arcuate distances from the ring centre line and which determine the arcuate length of the bending arm, said cut-outs so shaped as to provide the bending arm with outer edge extremity portions which curve inwardly towards one another by a predetermined amount and thereby substantially increase the arcuate length of said bending arm.

2. A clip-type retaining ring as claimed in claim 1, wherein said bending arm is tapered from its middle section towards its end sections, thereby to increase the capability of said arm to deform without taking on a permanent set.

3. A clip-type retaining ring as claimed in claim 1, wherein said bending arm is so constructed that in the course of the first assembly of the ring in its groove, the stress produced in said bending arm thereby is such as to stress the material of said bending arm beyond the elastic limit, so that the ring takes on a predetermined set during the course of the first assembly thereof in its groove.

4. A clip-type retaining ring as claimed in claim 1, wherein said bending arm is tapered from its middle section towards its end sections and is so constructed that in the course of the first assembly of the ring in its groove, the stress produced in said bending arm thereby is such as to stress the material of said bending arm beyond the elastic limit, so that said bending arm is pre-stressed beyond the elastic limit by a predetermined amount as a result of its first assembly in a groove.

5. A clip-type retaining ring substantially as hereinbefore described with reference to and as illustrated in Figs. 1 to 4 of the accompanying drawings.

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neutral diameter curves DC_1 and DC_2 before and after ring expansion, it will be seen that where the angle of deflection is small, as is the case with the prior art ring shown in Fig. 5, the tangent is also small and therefore the permissible movements of points A_1 which determine the width of ring gap is also necessarily small.

As the bending arm 14 of a clip-type retaining ring according to Fig. 4 has substantially increased arcuate length ($2\alpha + 2\beta$), the deflection will be much greater and the tangent at the neutral diameter will have a considerably larger angle. Accordingly, the spreading movement of the points A_1 , being a function of the tangent, of this angle, can therefore be made much greater without increasing the stresses in the maximum section of the bending arm 14 of the ring in Fig. 4 in comparison with the prior art ring of Fig. 5, if all other overall dimensions are equal.

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Yet another feature of the ring construction as herein proposed, is that the bending arm may be so constructed that in the cause of the initial assembly of the ring in its groove the bending arm is stressed beyond the elastic limit. Thus, one may provide for a predetermined permanent set occurring in the ring during its first application, with no further setting occurring in repeated applications. This pre-setting of the material may be advantageous in that it forms residual stresses in the ring which further increases its ability to pressure-seat itself against the groove bottom.

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4. A clip-type retaining ring as claimed in claim 1, wherein said bending arm is tapered from its middle section towards its end sections and is so constructed that in the course of the first assembly of the ring in its groove, the stress produced in said bending arm thereby is such as to stress the material of said bending arm beyond the elastic limit, so that said bending arm is pre-stressed beyond the elastic limit by a predetermined amount as a result of its first assembly in a groove.

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