



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.06.2001 Bulletin 2001/26

(51) Int Cl.7: **B25B 27/00, B25B 7/02**

(21) Application number: **00311303.2**

(22) Date of filing: **18.12.2000**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

(72) Inventors:
• **Cornwell, Timothy J.**
Bristol, Connecticut 06010 (US)
• **Carey, Patrick R.**
Rockfall, Connecticut 06481 (US)

(30) Priority: **22.12.1999 US 470268**

(74) Representative: **Leckey, David Herbert**
Frank B. Dehn & Co.,
European Patent Attorneys,
179 Queen Victoria Street
London EC4V 4EL (GB)

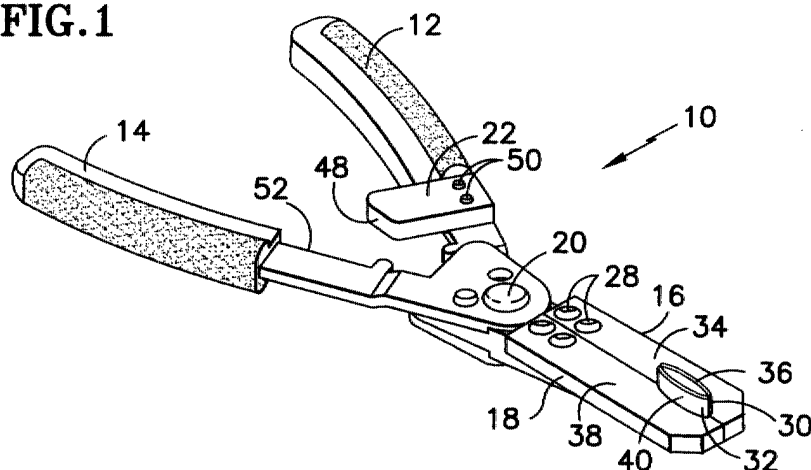
(71) Applicant: **UNITED TECHNOLOGIES
CORPORATION**
Hartford, CT 06101 (US)

(54) **Tool and method for installing an O-Ring**

(57) A tool for installing O-rings in the form of pliers comprises jaws 16,18 that move away from each other in response to movement of the handles 12,14 toward each other. Each jaw 16,18 has a projection 30,32 with

a convex surface 36,40 adapted to engage the inner circumferential surface 44 of the O-ring 46 and stretch the O-ring a predetermined amount with outward-directed force for positioning and insertion into an O-ring groove.

FIG.1



Description

[0001] This invention relates to O-ring seals and more particularly to a tool and method for installing an O-ring in a groove.

[0002] O-ring seals are utilized in a wide variety of applications and are extensively used in gas turbine engines. Such seals are formed from a variety of materials including rubber compositions such as BUNA-N. Premature degradation of the O-ring seal or outright failure can be a costly occurrence and may present a safety issue depending on the particular application.

[0003] One detrimental condition that can significantly reduce the service life of the O-ring and can induce an O-ring failure is referred to as O-ring twist. O-ring twist is a twist or torsion stress in the O-ring such as during installation into the O-ring groove. O-ring twist can result in an O-ring failure commonly referred to as spiral failure and also deterioration known as early stress-aging.

[0004] O-rings are commonly installed manually with the O-ring being rolled over the workpiece with the installer's thumb and fingers into the O-ring groove. This manual rolling method of installation can place a detrimental twist in the O-ring. A prior tool for installing O-rings comprises a cone shaped implement positioned at the end of the workpiece such that the O-ring is slid up the cone to the workpiece. The cone stretches the O-ring outwardly to slide or roll over the end of the workpiece. However, the O-ring is subjected to sliding force on the cone and sliding or rolling force on the workpiece so as to be susceptible to O-ring twist.

[0005] It would be desirable to provide a tool and method of installation of O-rings which reduces or eliminates the occurrence O-ring twist during installation.

[0006] It is an object of the present invention to provide a new and improved tool and method for installing O-rings which minimizes or eliminates the occurrence of O-ring twist during installation.

[0007] A further object of the invention is to provide a hand tool for installing O-rings which is reliable and convenient and easy to use.

[0008] It has been found that the foregoing and related objects are attained and the disadvantages of the prior art are overcome in a tool for installing an O-ring in an O-ring groove. The tool has first and second spaced support members with each support member having a projection forming a convex surface adapted to engage the radially inward circumferential surface of an O-ring. The support members are interconnected for relative movement toward and away from each other between first and second positions. In the first position the projections are sufficiently proximate so as to be insertable in the central opening of the O-ring and the convex surfaces engage opposing portions of the radial inward circumferential surface of the O-ring as the support members are moved from the first position to second position so as to stretch outwardly the O-ring a predetermined amount for insertion into the O-ring groove. An actuator

is interconnected to the support members to actuate relative movement of the support members from the first position to the second position.

[0009] In one embodiment of the invention, O-ring pliers have first and second handles with first and second jaws pivotally connected so that the jaws move away from each other in response to movement of the handles towards each other. Each jaw has a convex surface adapted to engage the radially inward circumferential surface of the O-ring so as to stretch outwardly the O-ring a predetermined amount as the jaws are moved from a closed position to an open position for inserting the O-ring in an O-ring groove.

[0010] In the method of installation of the present invention, outward-directed force is applied to the radially inward circumferential surface of the O-ring to stretch the O-ring sufficient to position a segment of the O-ring in alignment with the groove. After alignment with the groove, the segment of the O-ring is positioned in the groove. Additional outward-directed force is then applied to the radially inward circumferential surface of the O-ring sufficient to position the remainder of the O-ring in alignment with the groove and then the outward-directed force is removed to position the remainder of the O-ring in the groove.

[0011] A preferred embodiment of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figure 1 is a perspective view of O-ring pliers embodying the present invention;

Figure 2 is a plan view of the O-ring pliers of Figure 1;

Figure 3 is an enlarged plan view of one jaw of the O-ring pliers;

Figure 4 is a side view of the jaw of Figure 3;

Figure 5 is a diagrammatic elevational view of a workpiece with an O-ring groove;

Figure 6 is a side view of the workpiece of Figure 5;

Figure 7 is a plan view of the pliers of Figure 2 in an open position with an O-ring in a stretched condition thereon.

[0012] Referring to Figure 1, a pair of O-ring pliers embodying the present invention is generally designated by the numeral 10 and comprise handles 12, 14, jaws 16, 18, pivot connection assembly 20, and stop 22.

[0013] The handle 12 has an extension 24 and the jaw 16 is affixed to the extension 24 by fasteners 28. Similarly, jaw 18 is affixed to extension 26 of handle 14 by fasteners 28. The handles 12, 14 are pivotally connected by pivot assembly 20 for rotational movement. The handles 12, 14 and jaws 16, 18 are relatively positioned and configured so that the jaws move away from each other in response to movement of the handles toward each other. Such a relational movement of the handles and jaws is known in the art and explained in more detail in U.S. Patent 4,476,750, to which reference may be

made for relevant detail.

[0014] The jaws 16, 18 each have a projection 30, 32 respectively. The projection 30 extends outwardly from the planar surface 34 of jaw 16 to form a convex surface 36 and extends generally along the edge 43 of jaw 16. Similarly, the projection 32 extends outwardly from the planar surface 38 of jaw 18 to form a convex surface 40 and generally along the edge 42 as best seen in Figure 3.

[0015] The convex surfaces 36, 40 are adapted to engage the radially inward circumferential surface 44 of an O-ring 46 and apply outwardly-directed force to the O-ring to stretch it for installation (Figure 7). The planar surfaces 34, 38 adjacent the projections 30, 32, abut the side surface of the O-ring 46 to retain the O-ring on the convex surfaces during the installation process. The jaws 16, 18 are preferably formed of a material, such as Delrin, that will not injure the O-ring or mark the workpiece during stretching and installation.

[0016] Referring to Figure 1, the handles 12, 14 are in a first, open or spaced apart position while the jaws 16, 18 are in a closed position wherein the jaws abut along the edges 42, 43 with projection 30 adjacent projection 32 and the respective convex surfaces 36, 40 facing outwardly in opposite directions. Referring to Figure 7, the handles 12, 14 are shown in a second, closed position and correspondingly the jaws 16, 18 are in an open, spaced apart position. In squeezing the handles 12, 14 together, the jaws 16, 18 rotate from the closed position of Figure 1 to the open position of Figure 7. The stop 22 limits the travel of handles 12, 14 towards each other.

[0017] The stop 22 is a projection extending from the handle 12 toward the handle 14 with a distal end 48. The stop 22 is affixed to the handle 12 by fasteners 50 and is positioned so that the distal end 48 engages the inner edge 52 of handle 14 when the handles 12, 14 are squeezed together thereby determining the maximum spaced apart distance of convex surfaces 36, 40. As will be explained below, the dimensioning of the stop 22 is a factor in limiting the maximum amount of stretch to the O-ring.

[0018] Referring to Figures 1 and 7, the O-ring is placed on the jaws 16, 18 so that the projections 30, 32 extend through the central opening of the O-ring and the retainer surfaces 34, 38 engage the side circumferential surface of the O-ring. It is preferable that the O-ring be lubricated with standard lubrication material. At this point, the pliers 10 are in the position of Figure 1. The handles are squeezed together (i.e., actuated) to rotate from the first position of Figure 1, to the second position of Figure 7. As the jaws in turn pivot from the first position of Figure 1 to the second position of Figure 2, the convex surfaces 36, 40 engage oppositely disposed portions of the radially inward circumferential surface 44 of the O-ring to exert an outwardly directed force to stretch the O-ring without imparting twist to the O-ring.

[0019] The O-ring in the stretched position of Figure

7 is in the shape of a quadrilateral identified by the numeral 53, which for purposes of explanation has a linear upper section 54, an opposed linear lower section 56, and convex side sections 58, 60 which engage the convex surfaces 36, 40, respectively. A number of factors determine the degree of stretching imparted to the O-ring including: 1) the positioning of the projections 30, 32 along the edges 43, 42 of the jaws relative to the pivot 20, 2) the arcuate dimension of the convex surfaces 36, 40 and 3) the dimension and positioning of the stop 22. In determining the amount of stretch and configuration desired, it has been determined that the allowable stretch on a nominal or relaxed O-ring should preferably not exceed 80 percent. The configuration of the stretched O-ring is also affected by the dimensions of the workpiece containing the O-ring groove.

[0020] Referring to Figure 6, a workpiece or tube 62 containing an O-ring groove 64 is shown for purposes of explanation. Referring to Figure 5, the workpiece 62 has an outside diameter dimension 66. In determining the configuration of the quadrilateral 53, the linear dimension of upper section 54 is preferably greater than the outside diameter 66 of the workpiece 62 to permit positioning of section 54 in the groove 64. In the illustrated embodiment, the arcuate length of the convex surfaces 36, 40 is approximately the radius of the workpiece. However, the arcuate length may be varied to facilitate installation within the limit that the O-ring shall not exceed a stretch limit of 80 percent.

[0021] To install the O-ring, the tool and O-ring in the configuration of Figure 7 is positioned at the end face 68 of the workpiece such that the O-ring 46 is adjacent the end face 68 and the retainer surfaces 34, 38 face toward the end face 68. Maintaining the handles in a closed position, the pliers 10 are manually positioned to insert upper section 54 of the O-ring into the upper portion 70 of the O-ring groove 64 as viewed in Figure 6. With the O-ring section 54 inserted within the upper portion 70 of the O-ring groove, the tool 19 is moved downwardly (relative to Figure 6) to insert the lower section 56 of the O-ring into the lower portion 72 of the O-ring groove. While positioning the lower section 56 into the O-ring groove, the convex surfaces 36, 40 are gently withdrawn from the O-ring so that it is fully installed in the O-ring groove 64.

[0022] During insertion of the O-ring first into the upper portion 70 and then into the lower portion 72 of the O-ring groove, the planar surfaces 34, 38 adjacent the respective convex surface 36, 40 function to retain the O-ring on the convex surfaces. In moving the tool 10 downward after insertion of the upper section 54 into the upper portion 70, the O-ring engages the inward or bottom surface of the O-ring groove to result in a further outward stretching force being applied to the O-ring as the tool is moved further downward. Since the described forces on the O-ring are outwardly-directed stretching forces, the opportunity for O-ring twist or torsion stress is reduced or eliminated.

[0023] In determining the relative dimensions of the components of the pliers, it is desirable for the pliers to accommodate a discrete range of O-ring and workpiece sizes. Consequently, the spaced apart dimension of the convex surfaces in the open position and the arcuate length of the convex surfaces must be selected so as to accommodate multiple O-ring sizes.

[0024] While the O-ring installation tool of the present invention has been illustrated and described in terms of O-ring pliers, it is understood that other tool configurations may be utilized which have opposed convex surfaces on respective support members. The support members are interconnected for relative movement toward and away from each other with an actuator interconnected to the support members to actuate the support members for movement from a first to a second position.

[0025] In the method of the present invention, outwardly-directed force is applied to opposed portions of the radially inward circumferential surface of the O-ring to stretch it to a predetermined size sufficient to allow a section of the stretched O-ring to be inserted over the workpiece and aligned with the O-ring groove. The section of the O-ring is inserted into the O-ring groove and the O-ring is further stretched slightly by additional force applied outwardly against the radially inward circumferential surface of the O-ring to align the remainder of the O-ring with the groove. The stretching force is then removed to release/insert the remainder of the O-ring into the O-ring groove.

[0026] As can be appreciated from the foregoing, a new and improved tool and method for installing O-rings which minimizes or eliminates the occurrence of O-ring twist have been described. The O-ring tool is reliable and convenient and easy to use.

[0027] Although a specific form of the present invention has been selected for illustration in the drawings, and the preceding description is drawn in specific terms for the purpose of describing these forms of the invention, the description is not intended to limit the scope of the invention which is defined in the appended claims.

Claims

1. O-ring pliers (10) for inserting an O-ring (46) in an O-ring groove (64) formed in a workpiece (62), the O-ring having a central opening and a radially inward circumferential surface (44) bounding said central opening, the pliers comprising:

first and second handles (12,14) pivotally connected for rotation about a pivot (20) for movement towards and away from each other between a first, open position and a second, closed position,

a first and second jaws (34,38) connected to said first and second handles respectively for

rotation about said pivot for movement towards and away from each other between a first, closed position and a second, open position responsive to the rotation of said handles, said jaws moving away from each other in response to movement of said handles toward each other,

said first jaw (34) having a first projection (30) having a first convex surface (36) adapted to engage the radially inward circumferential surface (44) of an O-ring,

said second jaw (38) having a second projection (32) forming a second convex surface (40) adapted to engage the radially inward circumferential surface (44) of the O-ring,

said first and second projections (30,32) being proximate in said first so as to be insertable in the central opening of the O-ring (46) when said jaws (16,18) are in said first, closed position, and

said first and second convex surfaces (36,40) engaging opposing portions of the radially inward circumferential surface (44) of the O-ring and being spaced apart so as to stretch outwardly the O-ring a predetermined amount when said jaws (16,18) are in said second, open position for inserting the O-ring in said groove.

2. The device of claim 1 wherein said first and second convex surfaces (36,40) apply outward-directed force against opposite portions of the radially inward circumferential surface (44) of said O-ring as said jaws (16,18) pivot from said first position to said second position.
3. The device of claim 1 or 2 wherein each said jaw (16,18) has a retaining surface (34,38) adjacent said respective convex surface (36,40) to retain the O-ring on said first and second convex surfaces during insertion in the groove.
4. The device of claim 3 wherein the said retaining surfaces (34,38) of said jaws (16,18) adjoin one side of the O-ring when the O-ring is stretched by said convex surfaces.
5. The device of claim 4 wherein said retaining surfaces (34,38) are configured to face toward said groove (64) when inserting an O-ring in said groove.
6. The device of any preceding claim comprising a stop (22) to limit the movement of said handles (12,14) together to a predetermined position to limit the distance apart of said convex surfaces (36,40) and thus the stretch of the O-ring.
7. A tool (10) for inserting an O-ring (46) in an O-ring

groove (64) formed in a workpiece (62), the O-ring having a central opening and a radially inward circumferential surface (44) bounding said central opening, the tool comprising:

first and second spaced support members (16,18), said first support member (34) having a first projection (30) having a first convex surface (36) adapted to engage a first portion of the radially inward circumferential surface (44) of an O-ring, said second support member (38) having a second projection (32) having a second convex surface (40) adapted to engage a second portion of the radially inward circumferential surface (44) of an O-ring, said first and second support members (34,38) being interconnected for relative movement toward and away from each other between first and second positions with said first and second projections (30,32) being sufficiently proximate so as to be insertable in the central opening of the O-ring in said first position and said first and second convex surfaces (36,40) engaging opposing portions of the radially inward circumferential surface (44) of the O-ring and being spaced apart so as to stretch outwardly the O-ring a predetermined amount in said second position for inserting in said groove, and an actuator (12,14) interconnected to at least one of said first and second support members (16,18) to actuate said members for relative movement from said first position to said second position.

8. The device of claim 7 wherein said first and second convex surfaces (36,40) apply outward-directed force against said first and second portions of the radially inward circumferential surface (44) of said O-ring (46) as said first and second support members move from said first position to said second position.
9. The device of claim 7 or 8 wherein each said support member (16,18) has a retaining surface (34,38) to retain the O-ring (46) on said first and second convex surfaces (36,40) during insertion in the groove.
10. The device of claim 9 wherein the each said support member has a retaining surface (34,38) adjacent said respective projection (30,32) to abut one side of said O-ring.
11. The device of any preceding claim wherein the workpiece has a predetermined outside diameter (66) and each said convex surface (36,40) extends along an arc such that the O-ring forms a quadrilat-

eral shape (53) when stretched by said first and second convex surfaces (36,40) in said second position, said quadrilateral shape (53) having opposed convex side sections (58,60) engaging said convex surfaces (36,40), a linear upper section (54), and a linear lower section (56), said first and second convex surfaces being spaced apart in said second position so that said linear upper section (54) has a predetermined length greater than said outside diameter of said workpiece.

12. The device of any preceding claim wherein said predetermined amount of stretching of said O-ring (46) is less than 80% of said O-ring in a nominal state.

13. A method for installing an O-ring (46) in an O-ring groove (64) formed in a workpiece where the workpiece has an outside diameter dimension (66) and the O-ring has a central opening and a radially inward circumferential surface (44) bounding said central opening, the method comprising the steps of:

applying outward directed force to the radially inward circumferential surface (44) of the O-ring to stretch the O-ring sufficient to position a segment of the O-ring in alignment with the groove (62),
positioning said segment of the O-ring (46) in said groove,
applying additional outward-directed force to the radially inward circumferential surface (44) of the O-ring sufficient to position the remainder of the O-ring (46) in alignment with the groove (64), and
removing the outward-directed force to position the remainder of the O-ring (46) in the groove (64).

14. The method of claim 13 wherein the step of applying outward-directed force comprises applying outward-directed force against opposed sections of the radially inward circumferential surface (44) of said O-ring (46).
15. The method of claim 13 or 14 wherein the step of applying additional outward-directed force comprises applying manual force.
16. The method of any of claims 13 to 15 wherein the step of applying outward-directed force comprises applying force to stretch the O-ring (46) to form a linear section (54) greater than the outside diameter dimension (66) of the workpiece.
17. The method of any of claims 13 to 16 wherein the O-ring (46) is stretched less than 80% of its nominal size.

FIG.1

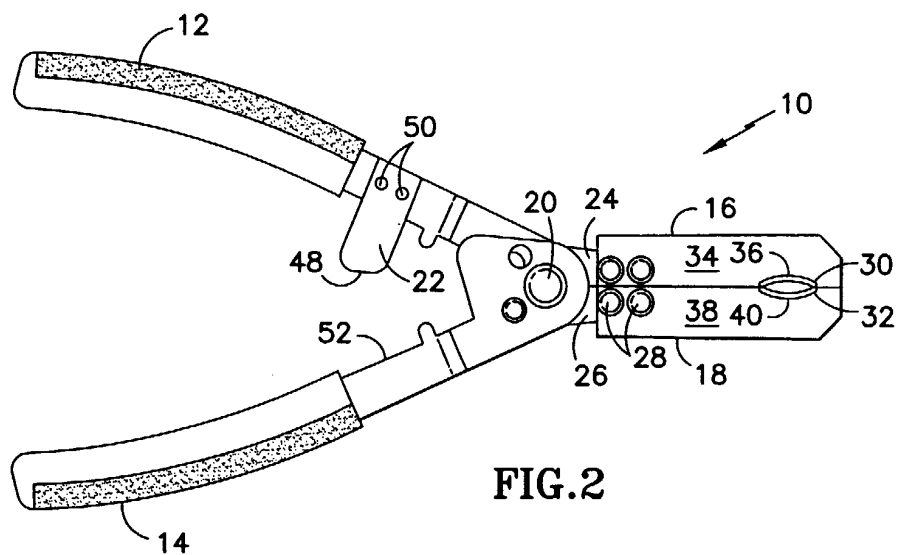
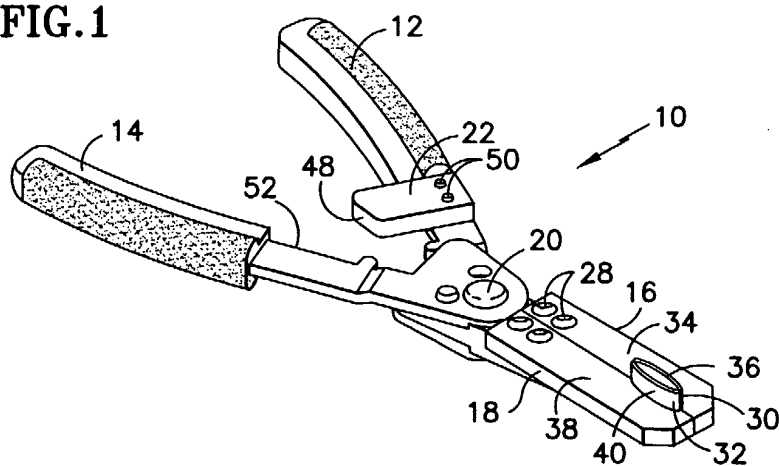


FIG.2

FIG.3

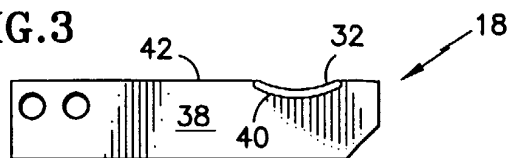


FIG.4

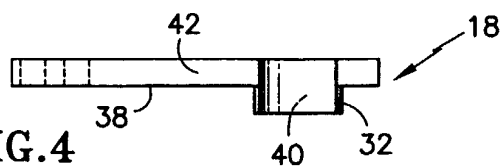


FIG.5

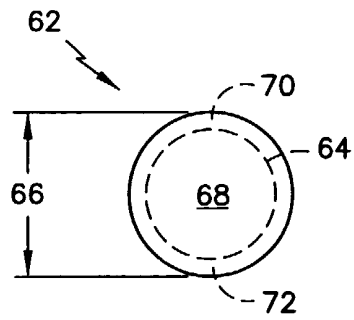


FIG.6

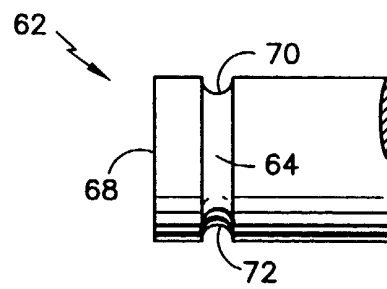


FIG.7

