July 24, 1934. W. G. WILSON 1,967,276

LOCK NUT

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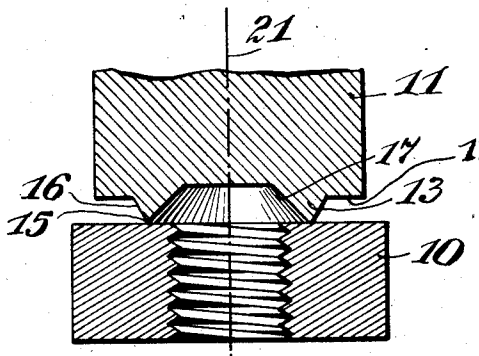


Fig. 1.

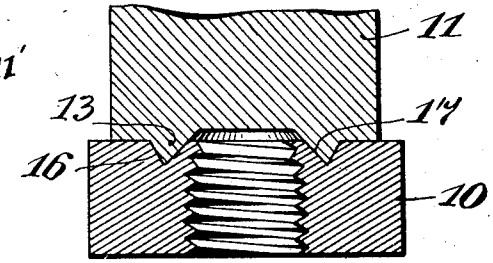


Fig. 2.

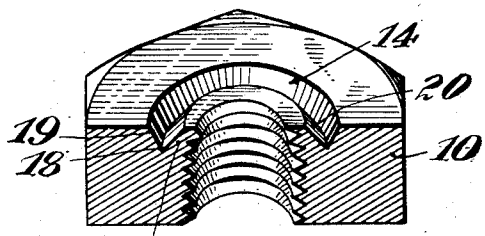


Fig. 3.

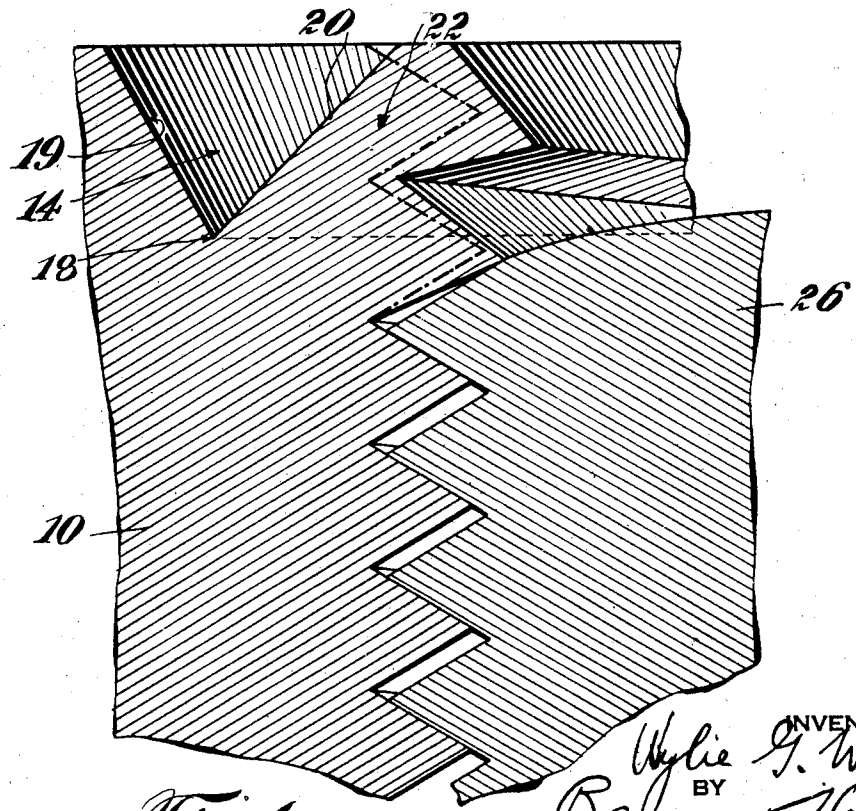


Fig. 4.

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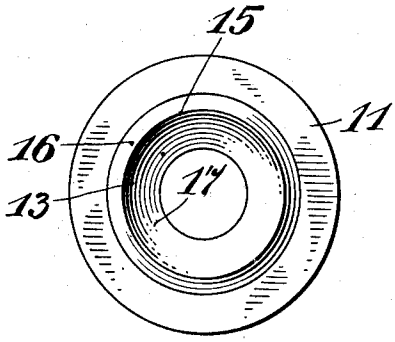


Fig. 5.

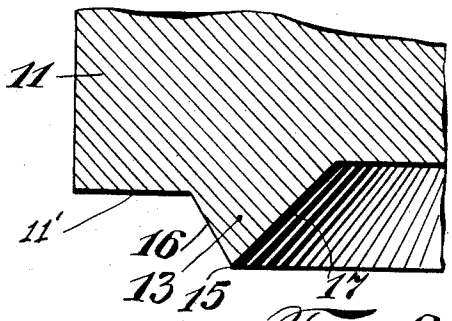


Fig. 6.

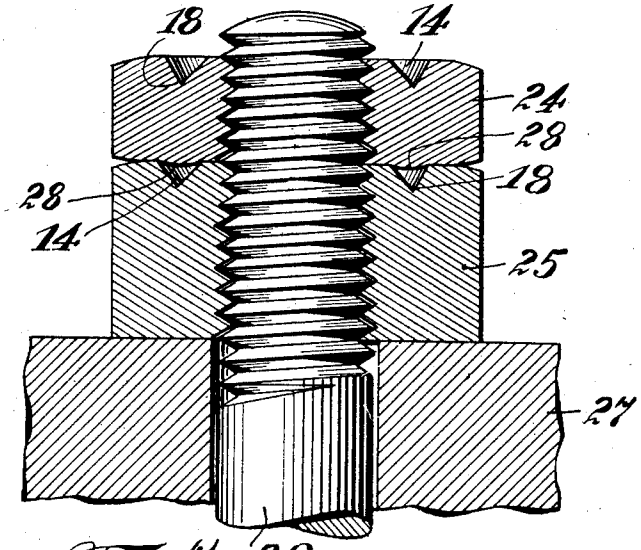


Fig. 7.

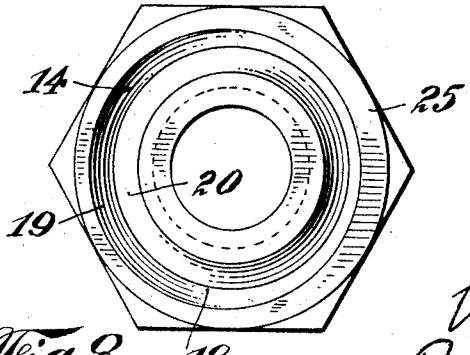


Fig. 8.

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1,967,276

LOCK-NUT

Wylie G. Wilson, Elizabeth, N. J.

Application September 12, 1931, Serial No. 562,467

14 Claims. (Cl. 10—86)

This invention relates to lock-nuts. It possesses a number of important advantages. In the first place, the device is entirely self-contained and unitary, and it is remarkably effective in use. In the second place, it is easy and cheap to manufacture, no more than a single die operation being required to produce it from a standard nut. And the structure is such that no tools, other than a wrench, are required in the application or removal of the lock-nut to or from a bolt, and no practical injury is done to the bolt thread by such application or removal.

In the accompanying drawings, in which I have illustrated an embodiment of the invention as at present preferred:

Fig. 1 is a sectional view illustrating a standard threaded nut in position relatively to the die as it is just before the die operates to convert the nut into a lock-nut;

Fig. 2 is a view similar to Fig. 1, but showing the die or punch in its ultimate descended position relatively to the nut;

Fig. 3 is a view partly in perspective and partly in section, illustrating the nut as it appears after the Fig. 2 operation has taken place;

Fig. 4 is an enlarged fragmentary sectional view, showing the relation between a standard bolt thread and the thread of the nut as the latter appears after the Fig. 2 operation;

Fig. 5 is a face view of the die or punch exhibited in Figs. 1 and 2;

Fig. 6 is an enlarged fragmentary section illustrating the die configuration;

Fig. 7 is a sectional view, with parts in elevation, showing two lock-nuts embodying my invention applied, in tandem relation, to a bolt; and

Fig. 8 exhibits in face view a slightly modified form of my lock-nut, involving in its production a change in the die configuration.

Referring to the numerals on the drawings, a standard threaded nut, whose peripheral dimensions are preferably substantially uniform throughout its length, is shown at 10, in Fig. 1. Such a nut is subjected to the action of a die or punch 11, which has a circular downwardly projecting part 13 which, in the operation of the die, is preferably concentric with the threaded aperture of the nut, and of diameter somewhat larger than the aperture, and under pressure is caused to penetrate the confronting unbroken face of the nut 10, as illustrated in Fig. 2, forming therein a groove 14. Preferably the circular projection 13 is formed with a circular lower edge 15, from which walls 16 and 17 diverge upwardly. Outwardly beyond the indenting portion 13 the tool presents a flat annular surface 11', which acts as a stop against the opposed face of the nut (Fig. 2); and because the wall 17 is longer than wall 16 and ends at a point that is vertically well above the stop surface 11', the central portion of the tool, except for the wall 17, cannot contact with the nut. It follows that the gripping part 22 hereinafter described is formed without mutilation of its end. The result of this arrangement is that the die will form in the nut face a circular groove having a bottom line 18 from which sloping walls 19—20 diverge towards the nut face, with the bottom and both wall surfaces densified and work-hardened. I prefer that both faces 16, 17 of the die shall be at an angle to the axis 21 (Fig. 1), the face 16, for example, at 30°, and the face 17 at 45°; and the walls of the pressure-indented groove 14, of course, will have corresponding angles.

Because of the method employed, i. e., causing a circular die part to penetrate the nut face, about the threaded aperture thereof, the nut of Fig. 1 is converted into the lock-nut of Fig. 2. This is because the effect of the die is to displace the metal of the nut at the face thereof about the aperture, radially towards and away from the center, and also to some extent downwardly, The result is the formation, in the top of the nut, of groove 14, with the circular nut portion 22, defined between groove 14 and the nut aperture, displaced or tilted downwardly (having in mind the relations as shown in the drawings) and towards the nut axis. Consequently the threaded nut aperture at the upper portion thereof is slightly and uniformly constricted on a taper towards the upper face of the nut, with its minimum diameter at the upper end. Consequently also, as seen in Fig. 4, because of the relatively axially and inwardly applied pressure of the die, the constricted threads of the nut are tilted downwardly out of their normal relation to the axis. In Fig. 4 the dotted lines indicate the normal position of nut threads before the Fig. 2 operation has taken place, while corresponding full lines show the position after such operation. The degree of tilt, as will be apparent, varies and corresponds with the taper of the nut aperture. The effect of the tilting of the nut threads, as seen in Fig. 4, is that the apices of the nut threads (i. e., the weakest part of the threads) engage root portions of the cooperating bolt threads, with beneficial result hereinafter set forth.

The nut portion 22, formed as stated, constitutes a circular elastic resistant element, uni-

tary with the nut, and when the nut is applied to a bolt (Figs. 4 and 7) the nut at first engages freely on the bolt, and thereafter as the bolt penetrates further into the nut, grips the bolt with a progressively tighter grip, until, when the bolt has passed through the minimum diameter of the nut aperture, there is the maximum resistance to relative rotation of nut and bolt. This is because of the tapering construction, the circularity of engaging parts, the absence of abrupt distortion in the nut threads, either circumferential or in an axial direction, of part of the nut aperture, plus the fact that the threads of nut and bolt, being initially substantially identical in shape and size (within the limits of commercial machining) have an unusually extended lapping action on each other as the establishment of the cooperative relation proceeds, due to the tapering construction, and the tilting of some of the nut threads. If, however, the nut is forcibly turned off of the bolt, it will be found that the bolt threads are substantially uninjured. This is because, among other reasons, the clamping or gripping portion 22 of the nut is circular and its effect on the corresponding bolt threads is substantially evenly distributed about the bolt, and not localized in highly resistant separated places about the bolt; and also because any thread mutilation which takes place is more likely to be among the nut threads, since, as explained above, the reaction between threads that is most apt to produce mutilation involves the engagement of the weakest part of the nut thread (its apex) with the strongest part of the bolt thread (the root portion).

I prefer that the circular die portion 13 shall exhibit a contained angle of considerable magnitude because if the angle were small, e. g. an acute angle, it would be difficult to harden the tool without cracking.

Furthermore, it is preferable that both sides of the metal-penetrating portion of the die or displacing tool be at an angle to the axis, because with that arrangement the tool will accomplish displacement of the metal of the nut simultaneously away from as well as towards the nut aperture. If the inner side of the metal-penetrating portion were at an angle, and the outer side parallel to the axis, there would be displacement towards the nut aperture; but since the tool would not be as adequately supported on the outer or straight side of the tool (by resistance to expansion of the ring of metal outside the metal-penetrating portion of the tool), there would be liability to break or crack the thin edge of the tool, particularly if the nut were hard. It is apparent that the tool is, necessarily, so hard that the slightest outward yield of the tool will crack it; which yield is liable to take place unless the tool acts to displace simultaneously outwardly as well as inwardly. And where the tool had an outer face parallel to the axis, resistance to displacement of metal outside the tool, and consequent support of the tool against yield in an outward direction, would not occur until after the tool had yielded outwardly.

The depth and width of groove 14, its distance from the nut aperture, the axial dimension of the nut, the cross-axial dimensions of nut and bolt, and the material of nut and bolt are factors to be considered and correlated when predetermining the gripping capacity of the nut.

Thus it will be observed that in the form shown in the drawings the median line of the width of the groove is distinctly nearer to the nut aperture than it is to the outer periphery of the nut. This means that in the movement of the indenting tool there is sufficient resistance to displacement of metal outwardly away from wall 16 so that though the nut aperture is actually contracted, and there is densification of metal radially outward of the groove, there is substantially no expansion of the nut periphery,—at any rate the wrench engaging surfaces throughout the axial length of the processed nut are substantially as they were in the original nut before conversion. And the upper face of the nut remains generally flat, as shown, so that it may make the most effective contact with the lower face of a similar superposed nut (Fig. 7).

Also, in the form shown in the drawings, the width of the indentation is greater than its depth, the inner wall of the indentation extends over the root of the undisplaced thread (Fig. 4), and the angle is about 45°, conditions which are individually important and sometimes collectively essential.

Of course lock-nuts such as described may be superposed one upon another on the same bolt, with good effect. And I have found that by reason of the presence of the groove in the top of the lock-nut, the nut is particularly adapted for use in tandem. Referring to Fig. 7, there are shown two of my lock-nuts 24, and 25, engaged on a bolt 26, lock-nut 25 in tight engagement with the work 27 or the like, and lock-nut 24 turned down tightly against lock-nut 25. The lower faces of the lock-nuts are shown flat, and the lower face of lock-nut 24 is in close contact with the grooved face of lock-nut 25. Depending of course upon the force exerted and the reaction between the contacting faces, there is a tendency for metal on the lower face of lock-nut 24, to flow into the groove of the lock-nut below it, as indicated at 28 in Fig. 7. Since as a practical matter the outer edges of the groove will not be absolutely circular, there will be some locking effect between the protruded metal of nut 24 and groove 14 of the cooperating nut, contributing appreciably to resistance against relative rotation between the nuts. This effect may be increased and/or insured, if the groove-forming and metal displacing die is shaped so that the groove formed by it will be eccentric as to its outer edge (Fig. 8); or otherwise so that the groove, in plan, is non-circular as to its outer edge. The inner groove-edge should preferably be circular, so that the nut portion 22 may present the same cross section along all radii in the same cross-axial plane, for reasons already suggested.

It will be appreciated that what I do in effect is to process an ordinary nut, so that, when applied to the very bolt on which it was originally adapted to turn freely, it will act as a lock-nut. And the gripping portion of the nut is located so that its presence does not compel or involve a change in the axial dimension of the nut, or a sacrifice of any part of the axial length of wrench-engaging surface. In other words the total axial length of the nut is available for wrench-engaging purposes.

The pressure-indenting tool causes a densification and work-hardening of the affected nut-sections and surfaces, giving desired strength and resilience of connection between the gripping part 22 and the portions of the nut that lie radially outward therefrom. And the conversion

of an ordinary nut into a lock-nut is accomplished by a single and very simple operation.

I claim:

1. The method of converting into a lock-nut an ordinary threaded nut, whose peripheral dimensions are substantially uniform throughout its length, which comprises dividing an unbroken end face of the nut into two areas, one completely surrounding the other, by pressure-indenting in such end face, by means of an appropriately shaped axially moving tool, a depression completely surrounding the nut aperture, the configuration and dimensions of the indentation being selected so that the indenting operation effectively contracts the diameter of the nut aperture through a part of the length of the aperture adjacent the indented end of the nut, relatively to another part of the length thereof, without distorting the wrench-engaging surfaces of the nut.

2. The method of converting into a lock-nut an ordinary threaded nut, whose peripheral dimensions are substantially uniform throughout its length, which comprises dividing an unbroken end face of the nut into two substantially concentric areas, by pressure-indenting in such end face, by means of an appropriately shaped axially moving tool, a depression completely surrounding the nut aperture, the configuration and dimensions of the indentation being selected so that nut threads adjacent the indented end of the nut are effectively tilted towards the nut center, without distorting the wrench-engaging surfaces of the nut.

3. The method set forth in claim 1, in which the depression is a groove having distinct inner and outer side walls which are respectively at an angle other than a right angle to a plane perpendicular to the nut axis, and which converge at the groove bottom.

4. The method set forth in claim 1, in which the depression is a groove having distinct inner and outer side walls which are respectively at an angle other than a right angle to a plane perpendicular to the nut axis, and which converge at the groove bottom, and in which the contained angle between the groove walls is about 30° or more.

5. The method set forth in claim 1, in which the depression is a groove with the median line of its width nearer to the nut aperture than to any side wall of the nut.

6. The method set forth in claim 1, in which the depression is a groove having distinct inner and outer side walls which are each inclined to the nut axis and which converge at the groove bottom, the angle of the inner side wall of the groove being different from that of the outer side wall of the groove.

7. The method set forth in claim 1, in which the depression is a groove having distinct inner and outer side walls which are respectively at an angle other than a right angle to a plane perpendicular to the nut axis, and which converge at the groove bottom, the angle of the inner side wall of the groove with respect to the nut axis being greater than that of the outer side wall of the groove.

8. The method set forth in claim 1, in which the depression is a groove, and in which the surrounded area forms the free end surface of an elastic upstanding ring which carries interiorly thereof some of the nut threads arranged on a spiral that diminishes progressively towards the free end of the ring.

9. The method set forth in claim 1, in which the depression is a groove, and in which the surrounded area forms the free end surface of an upstanding ring which carries interiorly thereof some of the nut threads; and in which pressure upon said surrounded area, is prevented in the indenting operation.

10. The method set forth in claim 1, in which the depression is a groove, the ratio of its width to its depth being not less than 5 to 8.

11. The method of treating a nut member having a threaded aperture of normal type, and having a substantially flat end surface adjacent to and around the aperture, which comprises pressure-indenting in such surface by means of an appropriately shaped axially moving tool, a depression bordering the aperture, and curved to conform substantially to the curvature of the adjacent wall of the aperture, the configuration and dimensions of the indentation being selected so that a portion of the threaded wall adjacent the indentation is effectively moved towards the center of the aperture, the walls of the aperture being unsupported against inward radial movement at the affected end of the nut during the indenting operation.

12. The method of converting into a lock-nut an ordinary threaded nut, which comprises pressure indenting in an end face thereof, by means of an appropriately shaped axially moving tool, a depression adjacent the nut aperture and lying wholly within the end face, the location, configuration and dimensions of the indentation being selected so that the tool in the indenting operation exerts a vertical pressure upon and causes axial movement of a portion of the thread and adjacent structure, and also exerts cross-axial pressure upon, and causes movement of such thread and adjacent structure towards the nut axis and thereby contracts the nut aperture through a part of the aperture adjacent the indented end of the nut relatively to another part thereof, without causing detrimental bulging of the wrench-engaging surfaces of the nut, the depression having an outer face that slopes upwardly away from the axis of the threaded aperture, and an inner face which when produced to the axis forms therewith an angle of about 45° on the side next the end face of the nut, the walls of the aperture being unsupported against inward radial movement at the affected end of the nut during the indenting operation.

13. The method of converting into a lock-nut an ordinary threaded nut, which comprises pressure indenting in an end face thereof, by means of an appropriately shaped axially moving tool, a depression adjacent the nut aperture and lying wholly within the end face, the location, configuration and dimensions of the indentation being selected so that the tool in the indenting operation exerts a vertical pressure upon and causes axial movement of a portion of the thread and adjacent structure, and also exerts cross-axial pressure upon, and causes movement of such thread and adjacent structure towards the nut axis and thereby contracts the nut aperture through a part of the aperture adjacent the indented end of the nut relatively to another part thereof, without causing detrimental bulging of the wrench-engaging surfaces of the nut, the width of the depression, measured on a radius of the threaded aperture, being greater than its depth, the walls of the aperture being unsupported against inward radial movement at the

affected end of the nut during the indenting operation.

14. The method of converting into a lock-nut an ordinary threaded nut, which comprises pressure indenting in an end face thereof, by means of an appropriately shaped axially moving tool, a depression adjacent the nut aperture and lying wholly within the end face, the location, configuration and dimensions of the indentation being selected so that the tool in the indenting operation exerts a vertical pressure upon and causes axial movement of a portion of the thread and adjacent structure, and also exerts cross-axial pressure upon, and causes movement of such thread and adjacent structure towards the nut axis and thereby contracts the nut aperture through a part of the aperture adjacent the indented end of the nut relatively to another part thereof, without causing detrimental bulging of the wrench-engaging surfaces of the nut, the depression having a wall that slopes upwards towards the axis and extends over the root of the undisplaced thread, the walls of the aperture being unsupported against inward radial movement at the affected end of the nut during the indenting operation.

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