

Feb. 24, 1942.

D. V. STELLIN

2,274,010

LOCK WASHER

Filed Dec. 16, 1939

2 Sheets-Sheet 1

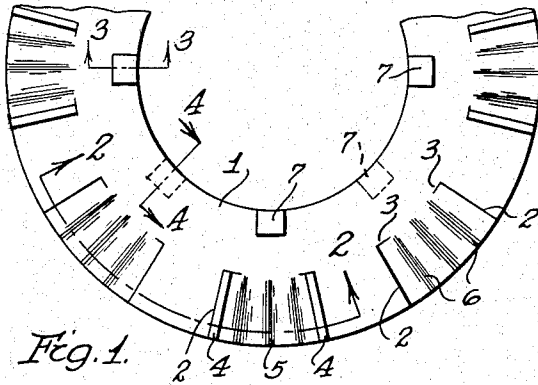


Fig. 1.

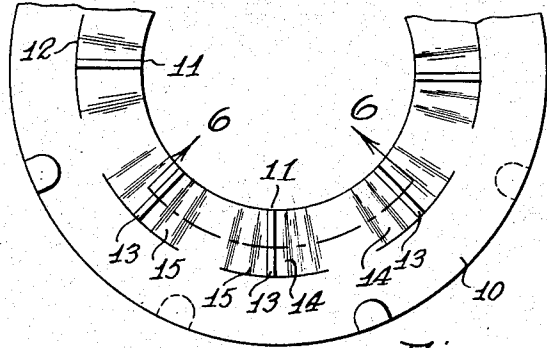


Fig. 5.

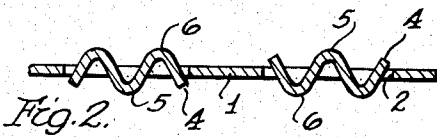


Fig. 2.

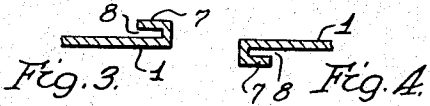


Fig. 3.



Fig. 4.

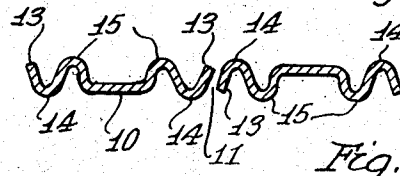


Fig. 6.

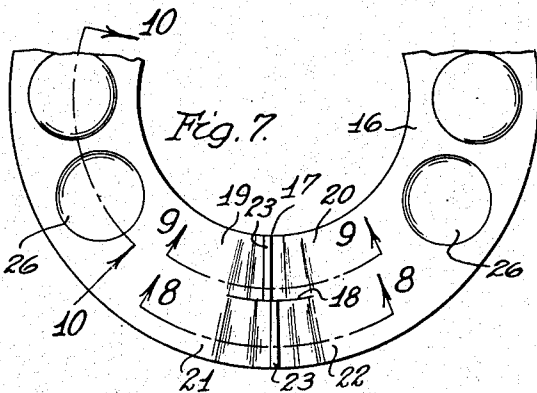


Fig. 7.

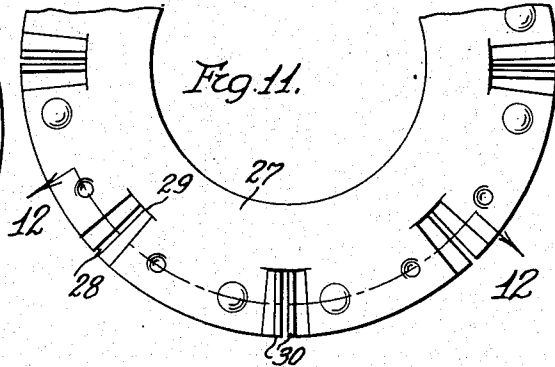


Fig. 11.

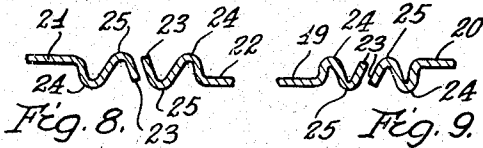


Fig. 8.

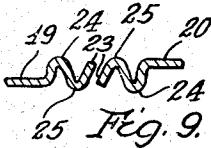


Fig. 9.

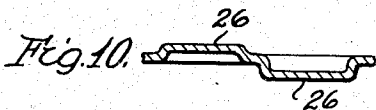


Fig. 10.

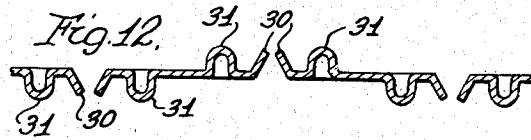


Fig. 12.

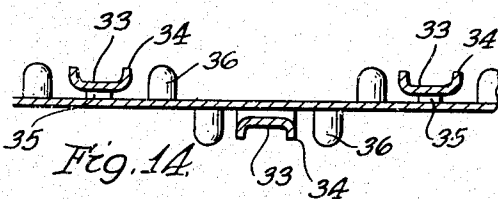


Fig. 14.

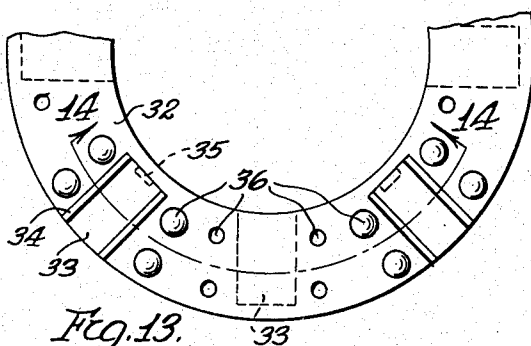


Fig. 13.

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Feb. 24, 1942.

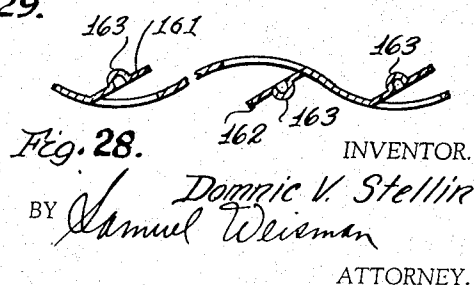
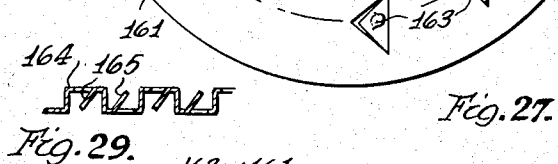
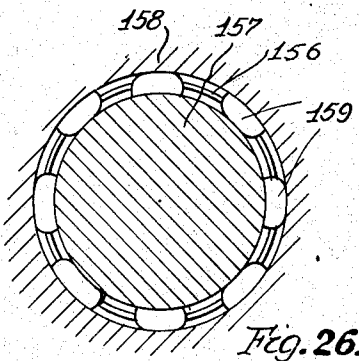
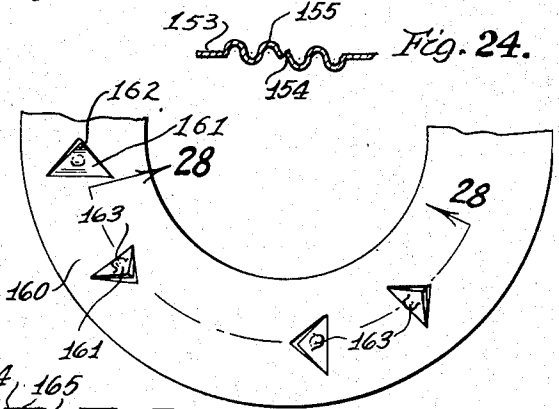
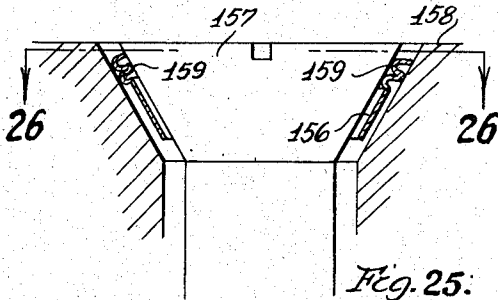
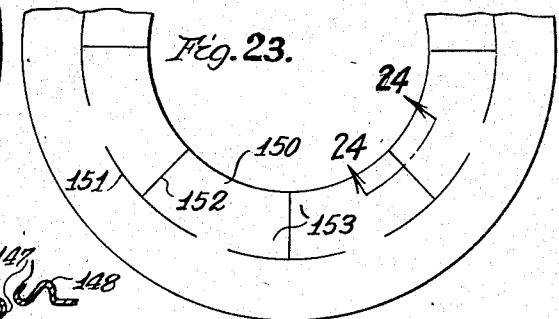
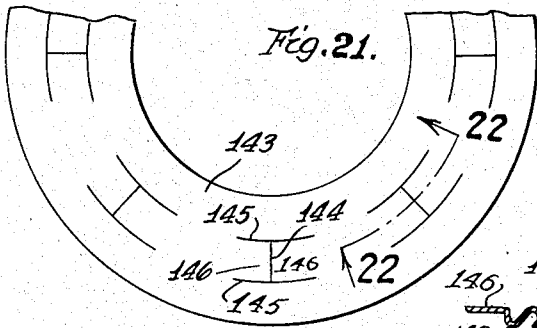
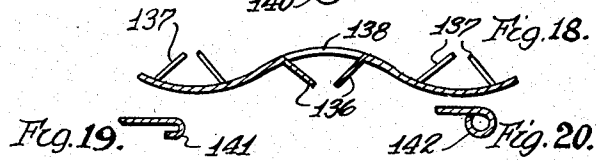
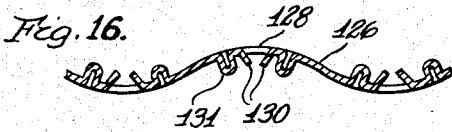
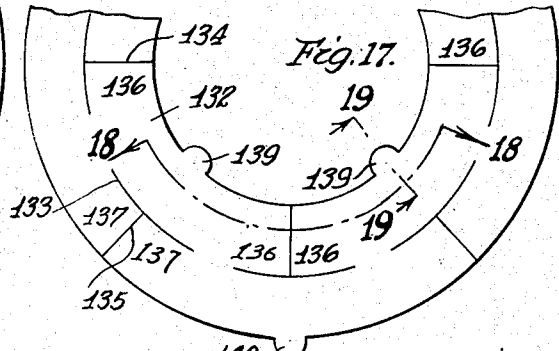
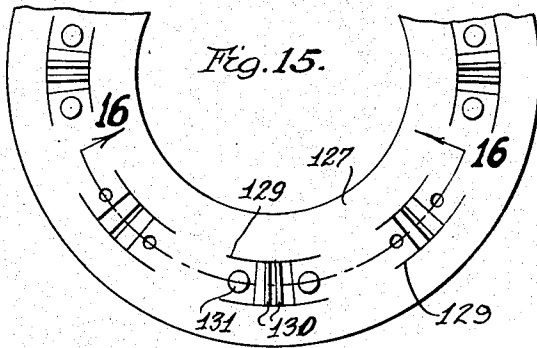
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2,274,010

LOCK WASHER

Filed Dec. 16, 1939

2 Sheets-Sheet 2



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2,274,010

LOCK WASHER.
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Application December 16, 1939; Serial No. 309,525

6 Claims. (Cl. 151-38)

The present invention pertains to lock washers, and the principal object of the invention is to provide various styles of lock washers wherein each locking point of biting edge has a supporting portion associated therewith. The supporting portion is of the nature of a projection formed in the blank and extending therefrom to a plane beyond that of the biting edge. If biting edges are provided on both sides of the washer, as is usually the case, the supporting portions are likewise formed on both sides.

The result of this construction is that the pressure between the nut or the bolt head and the stationary work piece is taken by the supporting portions before the biting edges become engaged. Consequently the biting edges, rather than being subjected to the full and initial pressure, are subjected to a smaller pressure, although sufficient for the biting action, and are further protected or reinforced during the entire tightening operation. In this way the biting edges or locking points are protected from unnecessary strain, and the life of the washer is prolonged so that the washer may be used over and over again and will remain effective after having been used several times. These qualities are not present in washers of previous designs. In addition, the supporting portions increase the resiliency of the washer and add to its locking action when under pressure.

The invention also utilizes in this respect the wavy contour previously applied to washers for the purpose of reinforcement.

According to this invention, the locking points are caused to project from the medial plane of the washer a shorter distance than the waves, whereupon the latter function as supporting portions in the manner described above.

In some embodiments of the invention, the supporting portions are disposed in close proximity to the locking points. It has been found in such cases that one supporting portion for each locking element is sufficient. In prior washers having supporting portions not extending beyond the locking points, a larger ratio of supporting portions is necessary to prevent total crushing of the washer. By requiring proportionately less supporting portions, the washer made according to this invention requires simpler dies which are less expensive to build and to maintain than otherwise.

The invention is applicable to the two-directional washers disclosed in my U. S. Patent No. 2,191,101 of February 20, 1940, on application filed January 23, 1939, as well as to single-handed

washers, whether external, internal, countersunk or of the split ring type. Various styles of locking points and supporting portions are described herein and these are interchangeable as will presently appear.

The invention is fully disclosed by way of example in the following description and in the accompanying drawings in which:
Figure 1 is a fragmentary plan view of one form of washer constructed according to the invention;
Figures 2, 3 and 4 are sections on the lines 2-2, 3-3 and 4-4 of Figure 1;
Figure 5 is a plan view of a modified washer;
Figure 6 is a section on the line 6-6 of Figure 5;
Figure 7 is a plan view of another modification illustrating the use of a single radial slit in the washer to form two or more locking edges;
Figures 8, 9 and 10 are sections on the lines 8-8, 9-9 and 10-10 of Figure 7;
Figure 11 is a plan view of another modification;
Figure 12 is a section of the line 12-12 of Figure 11;
Figure 13 is a plan view of another modification;
Figure 14 is a section on the line 14-14 of Figure 13;
Figure 15 is a plan view of another modification;
Figure 16 is a section on the line 16-16 thereof;
Figure 17 is a plan view of the blank of another modification;
Figures 18, 19 and 20 are sections corresponding to the lines 18-18, 19-19 and 20-20 of Figure 17;
Figure 21 is a plan view of the blank for another modification;
Figure 22 is a section corresponding to the line 22-22 on Figure 21;
Figure 23 is a plan view of the blank for another modification;
Figure 24 is a section corresponding to the line 24-24 on Figure 23;
Figure 25 is a medial section of the washer adapted for countersunk screws;
Figure 26 is a section on the line 26-26 of Figure 25;
Figure 27 is a plan view of another modification;
Figure 28 is a section on the line 28-28, thereof and

Figure 29 is a similar section of a modification thereof.

The washer illustrated in Figures 1 to 4 is formed from an annular blank 1 which has previously been slit radially at 2 into the outer circumference and also to some extent circumferentially at 3 from the inner ends of the slits to permit the formation of locking points and supporting portions. Each tongue defined by a set of slits 2 and 3 is shaped by a suitable die to form two locking points 4 at the radial edges, a central wave 5 extending to the same side of the washer as the locking points, and two end waves 6 at the sides of the wave 5 and extending in the opposite direction. As shown in Figure 2, adjacent tongues have their locking points extending respectively to opposite sides of the washer, or in opposite directions, while the corresponding waves are similarly reversed.

It will also be seen in Figure 2 that the points 4 of any tongue extend a shorter distance from the plane of the washer than does the intervening wave 5 of the same tongue. In like manner, the waves 6 extend from the plane of the washer a longer distance than do the locking points 4 of the next tongue. Thus, the locking points of each tongue are protected by the wave 5 of the same tongue and by the waves 6 of the adjacent tongues. The pressure between the parts to be screwed together is first taken by the supporting portions 5, 6 and next by the locking points 4, with the result that the latter do not receive the initial and total pressure. The pressure finally applied to the locking points is, however, sufficient to cause them to bite into the metal and produce the desired locking action.

Moreover, the distortion or squeezing of the metal at the waves 5, 6, forces the locking points into the metal in a manner to increase the locking action without additional pressure or strain on the locking points. Also, the resiliency of the wavy tongues, or their resistance to being flattened, further increases the locking action by creating pressure laterally against the threads or in the direction of the axis of the threaded member.

To distribute the pressure more uniformly between the circumferences of the washer, a number of tabs 7 are provided at the inner or unformed circumference. These are folded over the body of the washer to opposite sides thereof in succession, as may be seen in Figures 3 and 4. A space 8 is retained between each tab and the body of the washer and the outer surface of each tab is slightly within the level of the waves on the same side of the washer, so that the pressure is taken by the tabs after the waves have been engaged. Thus, the tabs reinforce the locking elements and furnish resiliency which increases the locking action. It will be understood that the locking tongues may be formed on the inner circumference and the tabs on the outer circumference, if desired, and that the other constructions herein described are capable of reversal as well as interchangeability of the forms of locking points and supporting portions, within the scope of the invention.

In the construction shown in Figures 5 and 6, the blank 10 is slit radially at 11 from the inner circumference and circumferentially at 12 along the inner end of each slit 11 and to equal distances in both directions therefrom. The two edges formed by each slit are converted into locking points 13 extending angularly parallel to each other but to opposite sides of the washer.

Immediately adjacent to each locking point is formed a wave 14 extending to the opposite side of the washer from the same point and slightly beyond the immediately adjacent point to form a supporting member protecting the latter in the manner previously described. Adjacent to each wave 14 is formed a wave 15 extending to the other side of the washer and slightly beyond the integral locking point 13 to protect the same.

It will be seen that the constructions shown in Figures 1 to 6 are provided on each side with locking elements extending angularly in opposite directions. Such washers are suitable for either right or left hand threads, as described in my U. S. Patent No. 2,191,101, and this is also true of the remaining washers herein having locking elements so disposed.

In Figures 7 to 10 is shown a washer of the split ring type wherein locking elements are provided only at the radial slit. This washer comprises an annular blank 16 split radially at 17 from edge to edge and circumferentially at 18 across the slit 17, forming tongues 19, 20, 21 and 22. Each tongue is shaped in the manner shown in Figure 6 to form a locking element 23 extending to one side of the washer, a wave 24 extending to the same side, and an intervening wave 25 extending to the opposite side. The locking elements of tongues adjacent to each other, either radially or circumferentially, are parallel to each other but extend in opposite directions. At each side of the washer, the waves extend beyond the locking elements to protect the latter in the manner described.

The remaining area of the blank is formed with suitable protuberances to distribute the pressure uniformly. These may be of any desired shape and are shown in Figure 10 in the form of depressions 26 extending to opposite sides of the blank and slightly below the waves 24, 25.

In Figures 11 and 12, the annular blank 27 is formed with radial slits 28 from the outer circumference and with a circumferential slit 29 across the inner end of each slit 28. The tongues 30 formed by each slit 28 are extended angularly away from the plane of the washer, as shown in Figure 12. Preferably, each pair of tongues converges from the plane of the washer, while adjacent pairs extend to opposite sides of the washer. Adjacent to each tongue the locking element is formed with a circular depression 31 extending to the same side of the washer and slightly beyond the locking elements at that side. Thus, each pair of elements 30 is protected by supporting members 31 at opposite sides thereof.

Figures 13 and 14 show a somewhat different style of washer wherein the angular portion 32 of the blank is not distorted. This portion of the blank is formed originally with radial tabs 33 extending successively from the inner and outer circumferences thereof. Those at one circumference are bent over upon one surface of the part 32, and those at the other circumference are bent over at the other surface. If the tabs are all formed on one circumference, as they may be, they are bent successively over opposite surfaces of the annulus.

In the shaping operation, the radial edges of each tab 33, are bent away from the annulus 32 to form locking elements 34. Also, the free end of each tab is formed with a lug 35 engaging the annulus and thereby maintaining the locking elements. Dents or similar formations 36 may be formed adjacent to the locking members and ex-

tended beyond the same for protection against excessive strain in the manner previously described.

Figures 15 and 16 illustrate a washer of the wavy type which is bent in the form of continuous waves 126 around the entire circumference of the annular blank 127. A radial slit 128 is cut along the crest of each wave between the circumferences, and an arcuate slit 129 is cut across each end of each slit 128. Thus there are formed two fingers 130 at each slit 128, and these are bent angularly into the trough of the wave, providing pairs of such fingers at both sides of the washer, as shown in Figure 16.

Also, the metal is formed with a dent 131 immediately adjacent to each finger and extending slightly beyond the same at the same side of the washer to protect the finger from the initial pressure. The waves themselves serve a similar purpose in addition to furnishing resiliency, and may be utilized without further modification for this purpose as will presently be described.

In Figure 17 is shown the blank for another wavy form of washer. The blank 132 is annular and is formed with a circular series of spaced arcuate slits 133. From these slits are extended radial slits 134 and 135 successively in opposite directions to the inner and outer circumferences. By this means there are formed pairs of fingers 136 at the inner circumference and similar pairs 137 at the outer circumference.

The blank is waved circumferentially as shown in Figure 18, the radial slits occurring at the crests 138 of the waves. The fingers are struck into the troughs in divergent relation and to such an extent that they reach somewhat short of the crests, whereby the latter protect the fingers.

Additional supporting members may be provided in the form of tabs 139 on the inner circumference opposite the outer slits 135 and similar tabs 140 on the outer circumference opposite the inner slits 134. These are bent over the washer to the same side thereof as the radially adjacent fingers. They may lie spaced from the body of the washer as indicated by the numeral 141 in Figure 19 or may be rolled into contact with the body of the washer as indicated by the numeral 142 in Figure 20.

The washer shown in Figures 21 and 22 is somewhat similar to that shown in Figure 15 but is flat. The annular body portion 143 is formed with a series of radial slits 144 between the circumferences, and across the end of each such slit is cut an arcuate slit 145, thereby forming pairs of fingers 146 with their free ends adjacent to one another. Each finger is bent into an S-shape as shown in Figure 22, with adjacent free ends or locking elements 147 extending to opposite sides of the washer and substantially parallel to each other. The bends 148 in the fingers extend slightly beyond the locking elements on the same side of the washer in order to protect these elements from the initial and full pressure.

The annular blank 150 in Figure 23 is formed with a circular series of arcuate slits 151, from the center of which are extended radial slits 152 to the inner circumference, forming pairs of fingers 153.

These fingers are bent to an S-shape as shown in Figure 24, with the locking ends 154 of adjacent fingers extending respectively to opposite sides of the plane of the washer. The dents 155 likewise extend to opposite sides of the washer

plane and sufficiently beyond the locking ends 154 at the same side to protect them from the initial pressure.

Figures 25 and 26 illustrate the application of the invention to a countersunk washer. The washer 156 is of conical shape to be received between the countersunk screwhead 157 and the countersunk member 158. The upper edge of the washer is formed with locking elements 159 cutting alternately into the members 157 and 158. In like manner, any of the various styles of locking elements disclosed herein may be applied to countersunk washers.

Figure 27 illustrates another form of wavy washer. The wavy annular portion 160 is formed at intervals with triangular tongues 161 adjacent to the crests. These are bent into the crests in a manner to have their biting points 162 lie within the planes of the crests to be protected thereby. For additional reinforcement, the tongues may be formed with stamped out lugs 163 extending outwardly from the tongues or away from the body of the washer.

Figure 29 is a modification of Figure 27 in which the blank is formed with right angular waves or channels 164 having their mouths disposed respectively at opposite sides of the washer. The locking members 165, which may resemble the members 162, are struck into the channels from the respective bottoms thereof and extend short of the bottoms of the respectively adjacent channels, whereby these bottoms receive the full pressure in advance of the locking elements.

The washers shown in Figures 21, 23 and 27 are single-handed, that is, they lock against rotation in one direction only, as distinguished from the remaining washers shown herein which are suitable for both right and left hand threads, as described in the above mentioned co-pending application. In this connection, any of the other forms of washers shown herein may, by the elimination of some of the locking elements, be made for locking in one direction only if desired.

It will now be seen that, within the scope of the invention as disclosed herein, I have provided lock washers which not only have the locking points or biting edges protected from the initial and full clamping pressure, but which also are suitable for both right and left hand threads according to the principles disclosed in my U. S. Patent No. 2,191,101. Also, any particular style of washer may be modified for use with only right hand or left hand threads if desired. These washers are simple in construction, efficient in operation and comparatively inexpensive by reason of the fact that they lend themselves to production by comparatively simple dies as stated above.

The invention is not limited to the particular forms as shown herein. Various features of these constructions are interchangeable, as previously pointed out. And, further, they may be applied to various styles of washers such as external, internal, external and internal, countersunk and split ring. Further, the number of locking elements on any washer may be increased or decreased as required, as well as the number of grooves, waves, reinforcing tabs and the like. Also, any of the flat washers may be made wavy, and vice versa.

In connection with the tabs, it will be noted that these, by their resiliency, add to the locking action of the washer and further relieve the locking elements from the initial clamping pressure. These reinforcing members may be provided on

either periphery, or both, or between the peripheries. The projecting tabs, particularly, may be square or may have their corners rounded off. They may be thinner than the body of the washer, and likewise the locking elements may be thinner at certain points, if desired.

The length of the locking elements, the distance of the locking points from the general plane of the washer and the depth of the grooves, ribs, waves and reinforcing tabs may also be varied.

Some of the adjacent locking elements herein are adapted to overlap as in Figures 5 and 7. Such overlapping may be provided, if desired, in any of the other constructions herein disclosed.

What I claim is:

1. A lock washer comprising a body of resilient metal having a radial slit, the body being corrugated radially directly adjacent to said slit, the corrugations extending to both sides of the general plane of said body, said slit defining an edge of the corrugated portion positioned as a locking element at one side of said plane and at a shorter distance therefrom than the crests of the corrugations at said side.

2. A lock washer comprising a body of resilient metal having a radial slit, the body being corrugated radially at both sides of said slit, the corrugations extending to both sides of the general plane of said body, said slit defining edges of the corrugated portions positioned as locking elements at opposite sides of said plane and at a shorter distance therefrom than the crests of the corrugations at the respective sides.

3. A lock washer comprising a body having resilient, radially corrugated segments formed therein, the corrugations extending to both sides of the general plane of said body, said body being slit radially adjacent to each segment and formed at each slit as a locking element in continuation of the segment and radially co-exten-

sive therewith, said elements extending to both sides of said plane and to a shorter distance therefrom than the crests of the corrugations at the respective sides.

4. A lock washer comprising a body having resilient, radially corrugated segments formed therein, the corrugations extending to both sides of the general plane of said body, said body being slit radially adjacent to each end of each segment and formed at each slit as a locking element in continuation of the segment and radially coextensive therewith, said elements extending to both sides of said plane and to a shorter distance therefrom than the crests of the corrugations at the respective sides.

5. A lock washer comprising a body having resilient, radially corrugated segments formed therein, the corrugations extending to both sides of the general plane of said body, said body being slit radially adjacent to each segment and formed at each slit as a locking element in continuation of the segment and radially co-extensive therewith, said elements extending to both sides of said plane and to a shorter distance therefrom than the crests of the corrugations at the respective sides, said elements also converging at each side of the general plane of said body.

6. A lock washer comprising a body having resilient, radially corrugated segments formed therein, the corrugations extending to both sides of the general plane of said body, said body being slit radially adjacent to each end of each segment and formed at each slit as a locking element in continuation of the segment and radially coextensive therewith, said elements extending to both sides of said plane and to a shorter distance therefrom than the crests of the corrugations at the respective sides, said elements also converging at each side of the general plane of said body.

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