

April 5, 1938.

E. C. CROWTHER

2,113,425

SCREW AND LOCK WASHER ASSEMBLY

Filed Oct. 23, 1937

3 Sheets-Sheet 1

FIG. 1.

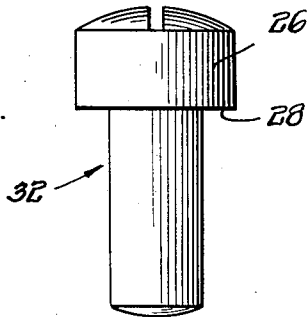


FIG. 2.

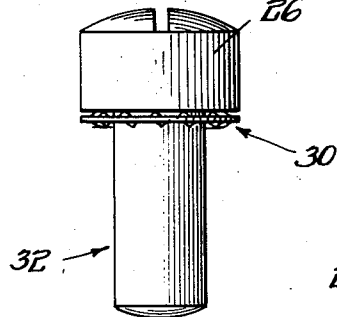


FIG. 3.

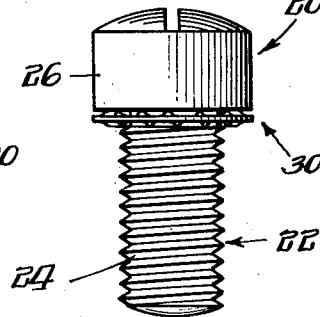


FIG. 4.

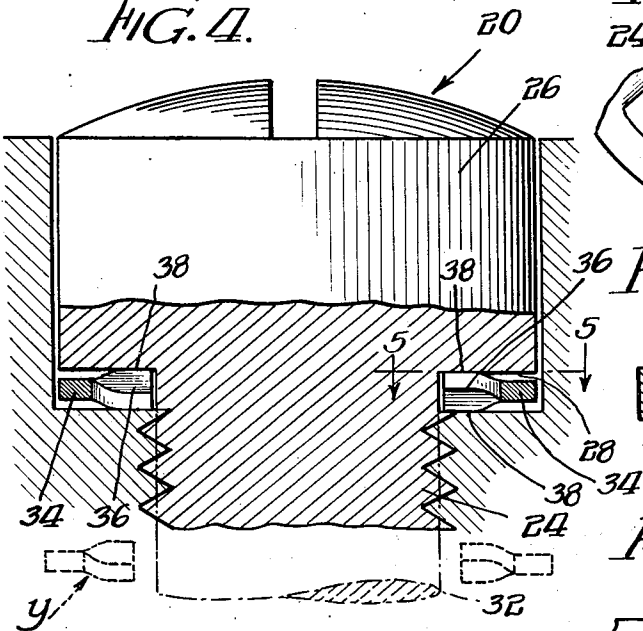


FIG. 5.

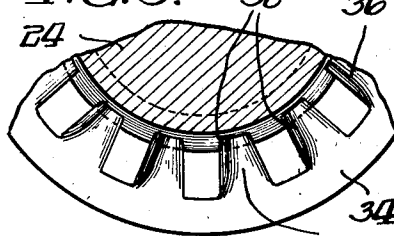


FIG. 6.

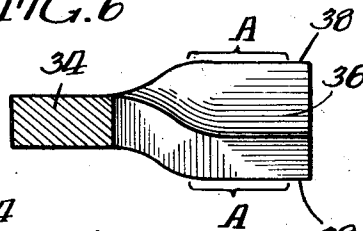


FIG. 7.

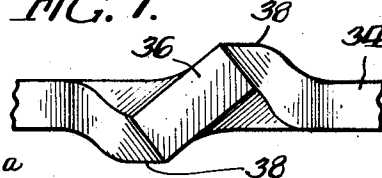


FIG. 8.

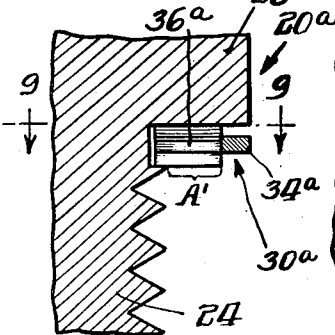


FIG. 9.

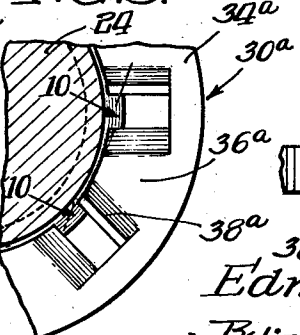
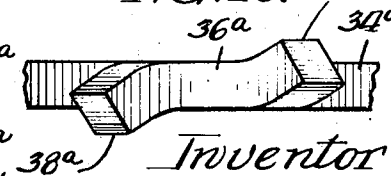


FIG. 10.



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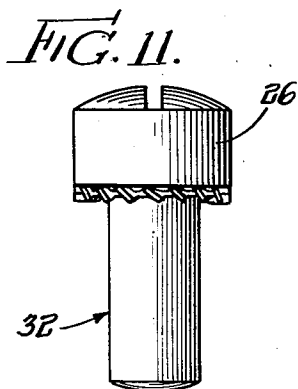
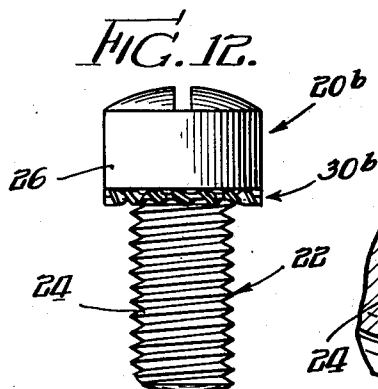
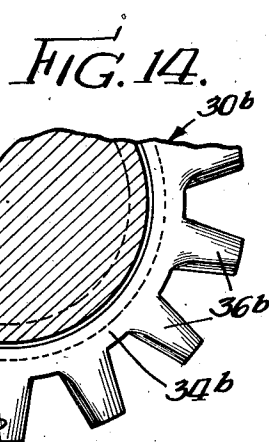
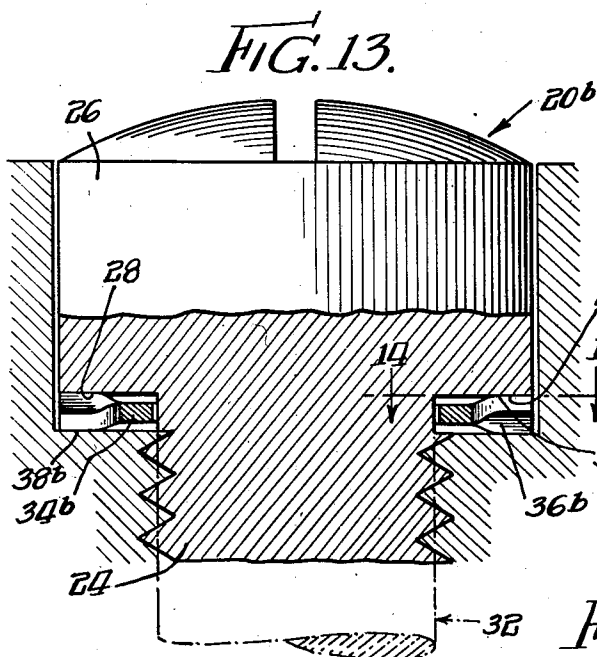
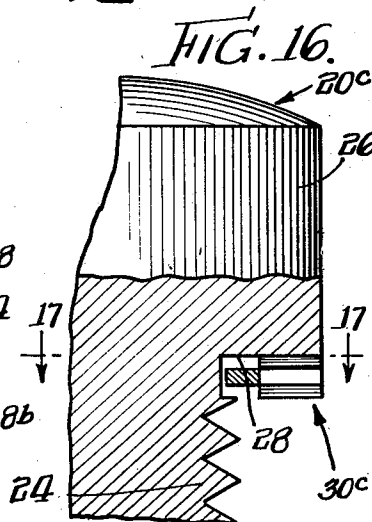
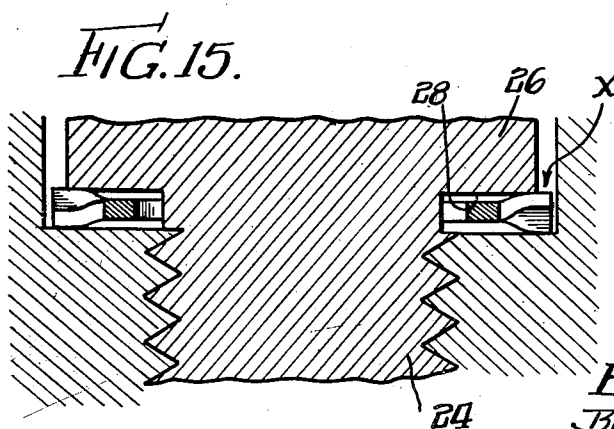
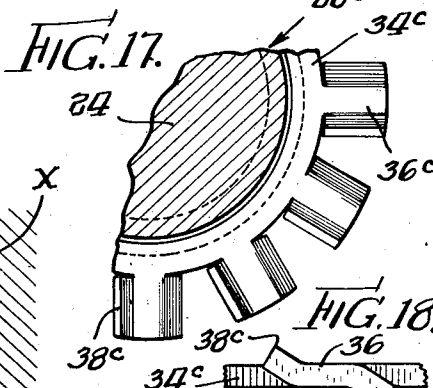
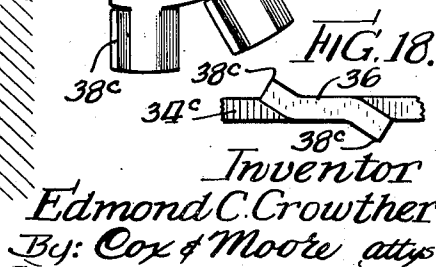
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3 Sheets-Sheet 2



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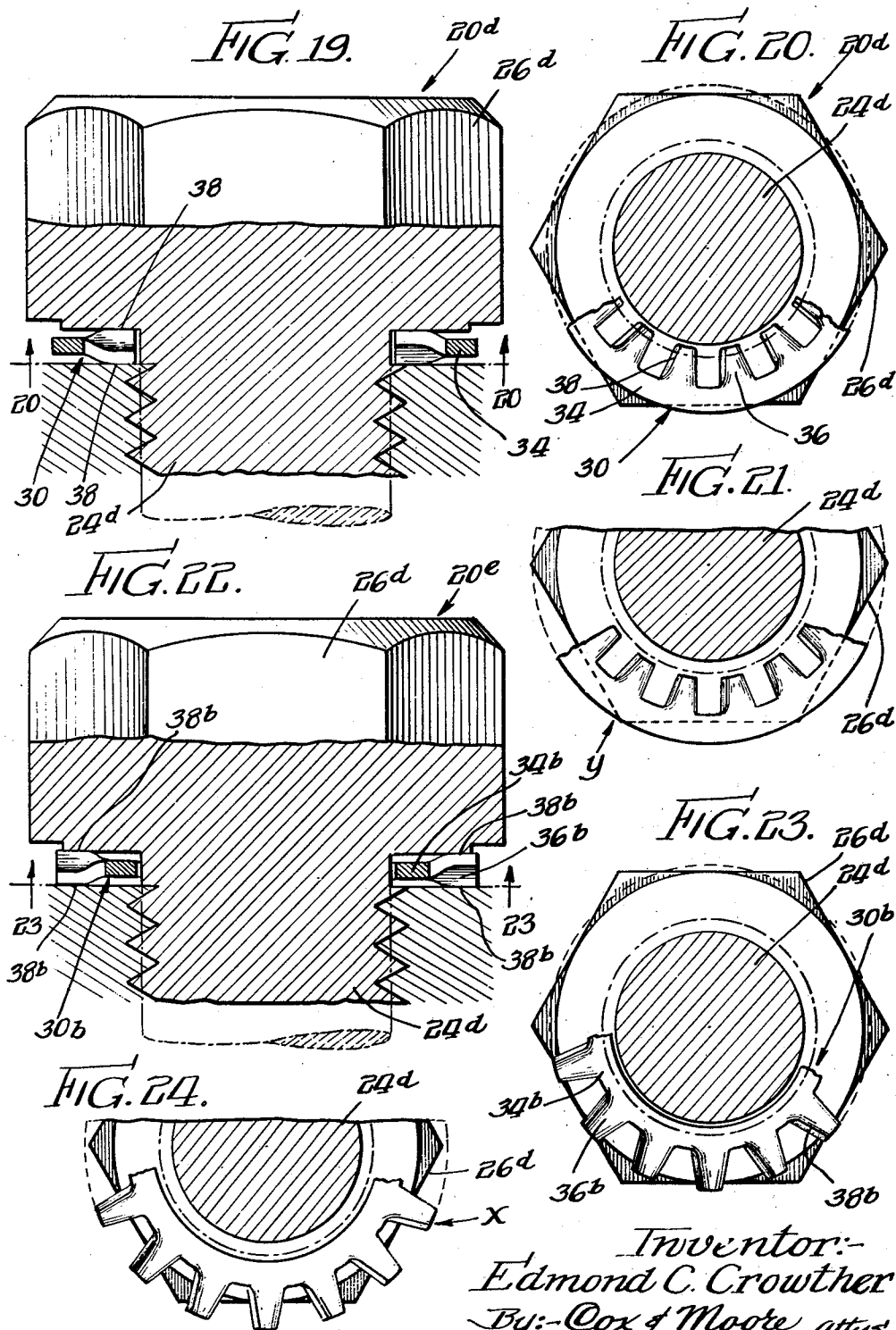
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SCREW AND LOCK WASHER ASSEMBLY

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UNITED STATES PATENT OFFICE

2,113,425

SCREW AND LOCK WASHER ASSEMBLY

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Application October 23, 1937, Serial No. 179,634

11 Claims. (Cl. 151—32)

This invention relates generally to screw and lock washer assemblies and to methods of producing such assemblies.

The usual method of assembling screws and lock washers and subsequently applying the assembly to a work piece, for example, to the structure of an automobile in the process of its construction, consists in manually selecting a screw, manually selecting a lock washer, manually associating the screw and lock washer by relatively moving the threaded shank of the screw and the lock washer axially, and finally applying these associated parts to the work. Under such circumstances the lock washer is not associated or combined with the screw in a manner to secure the washer against axial displacement after it is juxtapositioned with respect to the clamping surface of the screw head. Hence, it has become common practice to position screws with the threaded shank extending upwardly, and then drop lock washers over the screw shanks. In this vertical position these assembled parts must not be disturbed until they are ready for application to the work because the washer is not in any sense secured in axial displacement on the screw shank. The present invention contemplates screw and lock washer assemblies in which the lock washer is secured against axial displacement on the screw shank by the thread convolution which is next adjacent the clamping surface of the screw head. In other words, the present invention contemplates rolling the thread on a screw blank after a washer has been juxtapositioned with respect to the clamping surface of the screw head, thereby enabling the thread convolution next adjacent the washer to serve as an abutment in preventing axial displacement of the lock washer. Assemblies of this kind may be very economically produced, thereby eliminating to a considerable degree the time and expense involved in the manual association of screws and lock washers which is now practiced in the commercial field.

Not only is the present invention concerned with the aforesaid simple and effective method of producing screw and lock washer assemblies, but also with the production of a new and improved screw and lock washer assembly per se. Lock washers which, to my knowledge, have experienced greatest commercial success, have been those of the type having work engaging teeth in the form of corners or edges projecting above and below the body portion of the lock washer. Various types of lock washers of this class have been in use and efforts have been made in the

production of such devices to render them applicable to all sizes of screws. Certain types of screws, for example, fillister head screws and others are equipped with relatively narrow clamping surfaces. This means that, when conventional methods of assembling screws and lock washers are employed, the total radial width of the washer must not exceed the total radial width of the clamping surface of the screw head. Because the work is countersunk to receive a fillister head screw, the lock washer used with such a screw must not extend outward beyond the periphery of the screw head. Difficulty has been experienced in supplying lock washers which will function with equal effectiveness on screws having heads provided with either narrow or relatively wide clamping surfaces. In other words, the standardization of lock washers of the toothed or pronged type for various sizes of clamping surfaces on screw heads has not been satisfactorily accomplished. The present invention overcomes the above mentioned and other disadvantages and inconveniences by presenting a screw and lock washer assembly wherein the standardization of lock washers to accommodate various widths of clamping surfaces on screw heads is accomplished.

More specifically, it is an object of the present invention to provide a screw and lock washer assembly, as set forth above, wherein lock washers having apertures of less diameter than conventional lock washers may be employed to thereby afford increased axial width in the lock washer stock and thus enable the use of locking edges which will lockingly engage with the required effectiveness on screw heads having clamping surfaces of varied sizes. To this end the invention contemplates placing the lock washer with its reduced internal aperture upon a screw blank before the thread has been rolled thereon, and subsequently rolling the thread on the blank so as to increase the external diameter of the screw sufficiently to provide an abutment or shoulder which will secure the lock washer against axial displacement.

It is a further object of the present invention to provide an assembly, as set forth above, wherein lock washers of the internal pronged or toothed type may have all of the internal extremities of the teeth positioned between the underside of the screw head and the thread convolution providing an abutment without affecting or impairing the locking effectiveness of the internal teeth.

The invention contemplates screw and lock

washer assemblies, as set forth above, provided with lock washers having either external or internal teeth which present a plurality of work engaging edges for effectively and lockingly engaging the complementary surfaces of the screw head and work.

The foregoing and numerous other objects and advantages will be more apparent from the following detailed description when considered in connection with the accompanying drawings, wherein—

Figure 1 is a side elevational view of a screw blank which is representative of one of the many types of screw blanks which may be used in following the teachings of the present invention;

Figure 2 discloses the screw blank of Figure 1 with an internal tooth lock washer associated therewith;

Figure 3 discloses the blank of Figure 2 after the thread has been rolled thereon so as to increase the diameter sufficiently to prevent axial displacement of the lock washer;

Figure 4 is an enlarged elevational view of the upper portion of the device shown in Figure 3, a part of the screw and lock washer being broken away to more clearly illustrate the manner in which the lock washer teeth are operatively retained in position beneath the screw head; dotted lines indicate the operative position of a lock washer of conventional design having an internal diameter sufficiently large to permit it to pass over the screw threads;

Figure 5 is a fragmentary transverse sectional view taken substantially along the line 5—5 of Figure 3;

Figure 6 is an enlarged detail view of one of the internal lock washer teeth and associated body portion, the body portion being shown in section;

Figure 7 is an end elevational view of the lock washer tooth or prong shown in Figure 6, said view being taken from the right of Figure 6;

Figure 8 is a fragmentary vertical sectional view similar to Figure 4, disclosing a lock washer having modified locking teeth secured beneath the screw head;

Figure 9 is a fragmentary transverse sectional view taken substantially along the line 9—9 of Figure 8;

Figure 10 is an end elevational view of the washer teeth shown in Figures 8 and 9, said view being taken substantially along the line 10—10 of Figure 9;

Figure 11 discloses an external tooth washer positioned beneath the head of a screw blank before rolling the thread thereon;

Figure 12 discloses the blank of Figure 11 after the thread has been rolled thereon;

Figure 13 is a fragmentary enlarged elevational view of the upper portion of the assembly shown in Figure 12, a part of the screw and lock washer being broken away to more clearly illustrate the manner in which the locking teeth are operatively secured in position beneath the screw head;

Figure 14 is an enlarged fragmentary sectional view of the screw and lock washer assembly taken substantially along the line 14—14 of Figure 13;

Figure 15 illustrates the manner in which lock washers of conventional size when slipped over the thread of a screw, extend radially outward a considerably greater distance than the lock washers assembled with screw heads in the manner disclosed and claimed herein;

Figure 16 is a fragmentary sectional view similar to Figure 13, disclosing an external tooth lock washer of modified form associated with the clamping surface of a screw head as contemplated by the present invention;

Figure 17 is a fragmentary sectional view taken substantially along the line 17—17 of Figure 16;

Figure 18 is a fragmentary side elevational view of the washer of Figure 17 to more clearly illustrate the structural characteristics of the work engaging teeth;

Figures 19 to 24, inclusive, illustrate the advantages afforded by the present invention in the application thereof to screw heads other than fillister heads, Figure 19 disclosing a screw and lock washer assembly contemplated by the present invention, in which an internal tooth lock washer is in operative association with a screw having a hexagon head;

Figure 20 is a transverse sectional view taken substantially along the line 20—20 of Figure 19;

Figure 21 is a fragmentary view, similar to Figure 20, showing the position occupied by a conventional internal tooth lock washer to a hexagon head;

Figure 22 is a side elevational view, similar to Figure 19, disclosing the application of an external tooth lock washer to a screw having a hexagon head;

Figure 23 is a transverse sectional view taken substantially along the line 23—23 of Figure 22; and

Figure 24 illustrates the position occupied by a conventional external tooth lock washer when applied to the hexagon head of a screw.

Referring now to the drawings more in detail wherein like numerals have been employed to designate similar parts throughout the various figures, it will be noted that the invention contemplates the production of a screw and lock washer assembly which is designated generally by the numeral 20 in Figures 3 and 4. This screw and lock washer assembly 20 includes a screw element 22 comprising a threaded shank 24 and a head 26 presenting a clamping surface 28 extending outwardly beyond the periphery of the threaded shank. A lock washer designated generally by the numeral 30 is operatively secured against axial displacement beneath the clamping surface 28 by the uppermost thread convolution of the threaded shank 24. The internal diameter of the lock washer 30 is sufficiently less than the external diameter of said uppermost thread convolution to enable the washer to be secured against axial displacement.

The screw and lock washer assembly 20 is produced by employing a screw blank 32 shown in Figure 1, the shank portion of which has a diameter which is slightly less than the internal diameter of the lock washer so as to permit said parts to be brought into association with each other, as illustrated in Figure 2. After the screw and lock washer have been thus associated, the shank of the screw blank 32 is rolled between threading dies so as to produce the threaded shank 24 shown in Figure 3. During this rolling process the external diameter of the shank is increased sufficiently in the vicinity of the screw head 26 to provide an abutment which precludes axial displacement of the lock washer.

Particular attention is directed to the structural characteristics of the lock washer 30 and the manner in which the lock washer structure cooperates with the screw element in presenting

a new and improved screw and lock washer assembly. The lock washer 30 is of the type commonly referred to as an internal tooth lock washer, and includes an annular body portion 34 of spring stock and a plurality of internal circumferentially spaced locking elements or prongs 36. These prongs are so configured, warped, or twisted as to present work engaging edges 38 positioned on opposite sides of the body 34. It will be noted that these edges 38 in the present embodiment lie in planes spaced from and substantially parallel with the bounding planes of the body portion 34, and are so disposed as to make a line bite in the clamping surface 28 of the screw and the complementary surface of the washer. While the inner extremities of the prongs 36 extend inwardly with respect to the outer periphery of the threaded shank 24 a sufficient distance so as to cooperate with the uppermost thread convolution in securing the lock washer and screw against axial displacement, the locking edges 38 extend radially outward beyond the periphery of the threaded shank. Thus, the portion of each locking edge 38, as indicated by the bracket A in Figure 6, which extends radially outward beyond the periphery of the threaded shank 24, is in a position to embed itself within the complementary surface of the work piece or screw head when the parts are clamped together. That is to say, a small portion of each prong is positioned between the uppermost screw convolution and the inner portion or zone of the screw head, but the major portion of each prong and consequently the locking teeth thereof is positioned radially outward beyond the peripheral limits of the threaded shank in a position to effectively and aggressively perform the intended locking action.

Particular attention is directed to the practical advantages which flow from the use of the above described screw and lock washer assembly. For the purpose of illustrating one of the many practical advantages, a screw equipped with a relatively narrow clamping surface on the head thereof is shown. This type of screw is sometimes referred to as a fillister head screw. A screw of this type is usually inserted within a countersunk aperture in the work, as clearly illustrated in Figure 4. In view of this use, a lock washer cannot be employed which extends to any appreciable degree beyond the peripheral limits of the screw head 26. Furthermore, fillister head screws and other screws in common use have relatively narrow clamping surfaces as aforesaid, and hence make it extremely difficult to provide a suitable lock washer therefor. It is common practice, as previously stated, to use lock washers having an internal diameter which is slightly greater than the external diameter of the threaded shank. Thus, when screws of the type disclosed herein are equipped with a conventional lock washer, a condition exists which is illustrated by the dotted lines in Figure 4. These dotted lines disclose the position of the teeth and annular body of a conventional lock washer when applied to the screw in a conventional manner, the dot and dash lines indicating the screw blank before rolling. Under such circumstances the annular body extends an appreciable distance beyond the periphery of the screw head, and this precludes the use of such lock washers on that type of head.

The present invention solves the problem of providing screw and lock washer assemblies in

which the lock washer element thereof has been reduced in internal diameter sufficiently to, in effect, move the entire lock washer structure inwardly by an amount which brings the outward periphery of the washer in line with the outer periphery of the screw head. In so reducing the internal diameter of the lock washer, the over-all radial width of the washer including the body and prongs is not diminished. In other words, the lock washer 30 has an annular body portion 34 of sufficient radial cross-section to provide the required resilient support for the teeth or prongs, and the teeth 36 occupy an effective work engaging or locking position. It will also be observed that, when the lock washer 30 has been associated beneath the screw head, as previously described, and the inner extremities of the prongs or locking elements 36 become positioned between an innermost clamping zone of the screw head and the uppermost thread convolution, the possibility of the lock washer subsequently becoming unscrewed from the threaded shank is reduced to a minimum. That is to say, the maximum over-all axial width of the lock washer, measured from the plane, including the locking edges 38 on one side to the plane including the locking edges 38 on the other side, is sufficient to preclude the possibility of the lock washer prongs falling into the helical path provided by the screw threads. This is an important feature considered from the standpoint of maintaining the proper assembled relationship of the screw and lock washer from the time the assemblies have been manufactured until they reach the ultimate user thereof. Such parts in transit are subjected to considerable vibration and jarring and, as a result, there is the potential possibility of disassembly of the parts constituting each assembly, if it were possible for the lock washer teeth to pass through or within the helical path provided by the screw threads. The sufficiency in maximum axial over-all width of the washer teeth, as just mentioned, positively prevents the loosening or partial separation of the constituent parts by unscrewing.

Obviously the lock washer 30 is in no sense limited for use with relatively narrow clamping surfaces of screw heads, but is capable of application to either narrow or relatively wide clamping surfaces. Thus one size of lock washer may be used to accommodate a relatively wide range of screw head clamping surfaces. In this way the standardized use of lock washers for screw heads having varied sizes of clamping surfaces is accomplished. From a practical viewpoint, this presents a great saving in time, labor, and materials, and greatly facilitates the use of lock washers in combination with screws, as disclosed herein. The fact that internal tooth lock washers may be applied to a screw blank, as described herein, without the necessity of employing special or auxiliary holding devices to insure free operative functioning of the teeth, greatly facilitates the ease with which the screw and lock washer assembly may be produced. The internal teeth or prongs of the lock washer 30 are so disposed with respect to the screw thread and clamping surface as to insure locking engagement of the portions A of the washer teeth 36 with the clamping side of the screw head and the work surface, even though the inner extremities of each washer prong or tooth extends inwardly of the threaded shank. This feature of construction, coupled with an effective line biting or embedding of oppositely disposed teeth

within the complementary surfaces between which they are clamped, provides a screw and lock washer assembly in which locking efficiency is maintained at its maximum.

Obviously the invention is not limited to any specific form of screw or lock washer, but contemplates structures of varied forms. For illustrative purposes a modified lock washer, designated generally by the numeral 30a (Figures 8 to 10, inclusive) is disclosed. This lock washer is also of the internal tooth or prong type, and includes an annular body portion 34a and internal prongs or elements 36a having oppositely disposed work engaging and biting edges 38a. Each of the teeth 36a has a portion A', as indicated in Figure 8, which extends radially outward from the periphery of the threaded shank corresponding with the portion A of the teeth 36 (Figure 6). A small portion of the inner extremities of the prongs or elements 36 is positioned between an innermost zone of the clamping surface 28 and the uppermost thread convolution, as previously described in connection with Figures 1 to 7, inclusive. Thus, a screw and lock washer assembly is provided, in which locking teeth of slightly different form from the teeth previously described function effectively to secure the screw against retrograde movement, and the internal diameter of the lock washer is sufficiently reduced to enable the use of such washers with screw heads of the type shown herein. Likewise, lock washers of the type designated by the numeral 30a herein may be standardized for use with clamping surfaces of varied widths, thereby greatly facilitating the production of screw and lock washer assemblies. The screw and lock washer assembly equipped with the lock washer 30a is designated generally by the numeral 20a in Figure 8.

Thus far the invention has been described in connection with the use of screw and lock washer assemblies equipped with lock washers of the internally pronged, or toothed type. The invention is equally applicable for lock washers having external prongs or teeth. Thus in Figure 12 a lock washer assembly is disclosed which is designated generally by the numeral 20b. This assembly includes the screw element 22 having the threaded shank 24 and the head 26. The clamping surface 28 extends outwardly beyond the periphery of the threaded shank. A lock washer designated generally by the numeral 30b includes an internal, annular body portion 34b from which radiate a plurality of circumferentially spaced locking elements or prongs 36b. Each of the locking elements or prongs 36b have oppositely disposed work engaging and locking edges 38b which are positioned in parallel planes spaced from and positioned on opposite sides of the bounding planes of the body 34b. The locking elements or prongs 36b are similar in structural characteristics to the locking prongs 36 previously described, the only difference being that the prongs 36b extend outwardly from the annular washer body.

The lock washer 30b is assembled with the screw in the same manner as described in connection with the screw assemblies 20 and 20a. The washer 30b is first applied to the screw blank 32, as illustrated in Figure 11, the internal diameter of the lock washer being just sufficient to receive the shank of the blank 32. The thread on the shank is subsequently rolled, thereby increasing the diameter sufficiently so as to enable the uppermost thread convolution to secure the

lock washer against axial displacement. In Figure 13 the unthreaded blank, as it appears before rolling the thread thereon, is indicated by dot and dash lines.

As previously described in connection with the screw and lock washer assemblies 20 and 20a, the internal diameter of the lock washer 30b is less than the internal diameter of conventional lock washers which have heretofore been employed and hence the entire lock washer stock, including in radial width the internal, annular body 34b and the prongs 36b, is in effect shifted inwardly without reducing the overall radial width. This is best illustrated in Figure 15 wherein a conventional lock washer designated generally by the letter X is disclosed. This lock washer has an internal diameter which is of sufficient size to permit the lock washer to be passed over the threaded shank. The fact that the body portion and prongs of such lock washers are disposed about a relatively large aperture, precludes the satisfactory use thereof in combination with screw heads of relatively narrow width. As shown in Figure 15, if the screw head 26 is associated with the lock washer X, a portion of the locking edges of the prongs will extend outwardly beyond the clamping zone of the screw head. In other words, the locking effectiveness of the lock washer X, when used with the screw head 26, is materially reduced. Furthermore, when it is appreciated that fillister head screws are usually inserted within counter-sunk apertures in the work which have a diameter substantially equal to the diameter of the screw head, it will be apparent that the lock washer X cannot be used because of the extension of the prongs thereof to a considerable degree beyond the periphery of the fillister head, as shown in Figure 15.

Thus, the present invention enables the use in screw and lock washer assemblies of externally toothed or pronged lock washers having apertures of reduced size, and this feature of construction materially enhances the use and manufacture of these lock washers in combination with screw heads. Obviously the lock washer 30b will function effectively with screw heads having a larger diameter than the screw head 26. In other words, a given size of lock washer may be used with complete satisfaction for screw heads having clamping surfaces of varied widths.

The fact is that the present invention enables the use of lock washers which will serve to effectively lock screw heads having a relatively narrow clamping surface (a result heretofore not obtained with complete satisfaction) and will also serve to lock screws having relatively wide clamping surfaces. The fact that applicant employs the innermost zone of the screw, to-wit, the annular area immediately adjacent the neck of the screw extending between the screw head 26 and the uppermost thread convolution, to receive the non-locking portion of the washer, that is, the annular body 34b, permits locking teeth of required radial length to be used without sacrificing the supporting strength provided by the lock washer body. In other words, the zone associated with the underside of the screw head, which otherwise serves no real purpose, is employed in the present invention to receive or accommodate a portion at least of the annular washer body 34b. In so doing, the internal diameter of the washer is reduced without affecting the strength or locking efficiency of the lock washer. When the screw head 26 is tightened

within the work, the oppositely disposed biting edges 38b effectively embed themselves in the complementary surfaces of the screw head and work so as to make an effective line bite and thereby exert maximum resistance to unscrewing.

In Figures 16 to 18, inclusive, I have disclosed the use of a slightly modified external tooth washer designated generally by the numeral 30c. This lock washer includes an inner annular body 34c and a plurality of circumferentially spaced locking elements or prongs 36c. Work engaging or locking edges 38c are positioned in planes spaced from and substantially parallel with the bounding planes of the washer body 34c, and are adapted to make a line bite into the clamping surface of the nut and the complementary surface of the work when the screw is driven home. The screw and lock washer assembly equipped with the washer 30c is designated generally by the numeral 20c. Obviously the invention is not limited to the use of a specific form of washer teeth, but contemplates various modifications whereby the improved results, accomplished by the disclosed embodiments, are obtained.

In Figures 19 to 24, inclusive, I have illustrated the manner in which the present invention facilitates the use of internal and external tooth lock washers with hexagon heads of screws. The clamping surface 28 of the fillister head 26 previously described, is often quite narrow in radial width. As a result, when conventional internal tooth lock washers are employed, a considerable portion of the annular body projects beyond the external periphery of the screw head, and, when external tooth lock washers are employed, a considerable portion of each locking tooth projects beyond the periphery of the hexagon head and thereby materially reduces the locking effectiveness of said teeth. By employing lock washers of reduced internal diameter as previously described, these difficulties are completely overcome.

In Figures 19 and 20 I have shown a screw and lock washer assembly designated generally by the numeral 20d, said assembly including a screw having a threaded shank 24d and a hex head 26d. The assembly 20d is equipped with the internal tooth lock washer 30. Particular attention is directed to the fact that the outer periphery of the annular washer body is well within the maximum diameter of the hexagon head. In other words, the washer body does not appear unsightly, nor does it present any inconvenience to the user of the assembly.

In Figure 21 I have illustrated the manner in which a conventional internal tooth lock washer, designated generally by the letter Y, when applied to the hexagon head 26d in the conventional manner by slipping it over the threaded screw shank, has its outer annular body radially projecting a considerable distance beyond the outer periphery of the hexagon head. This condition is frequently most undesirable. In both Figures 20 and 21 the external diameter of the threaded shank is indicated by a dot-and-dash circle.

In Figures 22 and 23 a screw and lock washer assembly, designated generally by the numeral 20e, includes a threaded shank 24d and hexagon head 26d previously described. The assembly 20e is equipped with the external tooth lock washer 30b previously described and is secured beneath the screw head by the uppermost thread

convolution. It will be noted that, by reason of the reduced internal diameter of the washer body, the locking edges of the washer teeth are all confined within a circumferential zone which renders all of said teeth functionally operable. In Figure 24 the conventional external tooth lock washer X, previously referred to in Figure 15, is applied to the screw shank in the usual manner by passing it over the external diameter of said shank. This causes a large portion of the washer teeth to be positioned in a nonlocking or non-functional zone with respect to the clamping surface of the hexagon head. Thus the locking efficiency of this lock washer is seriously impaired. Comparing this arrangement with that disclosed in Figures 22 and 23, it will be apparent that the present invention materially contributes to the efficient functioning of external tooth lock washers when applied to hexagon heads having the usual relatively narrow clamping surface.

From the foregoing it will be apparent that the present invention contemplates a screw and lock washer assembly of improved practical design which serves to materially enhance the ease with which screws may be applied and locked in position upon the work. The lock washers described herein and contemplated hereby with their reduced inner diameters, whether they be lock washers of the internally or externally toothed variety, when used in combination with screw heads, make for standardization of production, which in turn reduces the ultimate cost and provides a standardized product which has heretofore not been available to the trade.

In practicing the present invention it is preferred to use screw blanks in which the shank portions are substantially cylindrical throughout their length and particularly in the vicinity of the head so as to enable the use of lock washers having minimum internal diameters. In using internally toothed lock washers, it may be advisable in some instances to employ teeth or prongs having a radial length slightly greater than the radial length of similar lock washers which have heretofore been employed. In this manner no loss in locking effectiveness of the teeth will be experienced because the portion of the locking edges at the inner extremities of the teeth, which are rendered functionally ineffective for locking purposes, are compensated for by the slight increase in radial length of the prongs. The method of assembling the lock washers and screws, as described herein, may be practiced with the greatest economy, and this method of assembly makes possible the production of a uniform and standardized product.

Another advantage resulting from the present invention is the proper centering of the lock washer with respect to its associated screw. In using lock washers such as the lock washers X and Y in the conventional manner, that is, by passing them over the threaded shank and then applying the associated screw and lock washer to the work, there is ever present the potential possibility of eccentrically positioning the lock washer when the screw is driven home. This is due to the fact that the inner periphery of the lock washer may enter the valley between the upper thread convolutions, thereby causing the lock washer to be positioned off-center. Under such circumstances the efficiency of the lock washer is materially reduced and the external appearance, after the screw has been driven home, is most unsightly. The present invention positively insures the absolute centering of lock

washers, either of the external or internal tooth type, and thus insures the proper positioning of the locking edges between the clamping surface of the screw head and the complementary surface of the work.

While certain specific structural details of screws and lock washers have been described herein, it will be apparent that the invention is not limited to these specific embodiments, but contemplates other modifications and changes without departing from the spirit and scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A screw and lock washer assembly including a screw member having a shank with an extruded thread and a head presenting a clamping surface extending outwardly from the shank, and a lock washer operatively associated therewith including a body portion and a plurality of work engaging teeth projecting from opposite sides of said body portion, said teeth presenting edges adapted to make a line bite into said clamping surface and the complementary surface of a work piece when the screw is tightened therein, the inner diameter of said lock washer being sufficiently less than the external diameter of the threaded shank to render the thread in the immediate vicinity of the lock washer operable to prevent axial displacement thereof.

2. A screw and lock washer assembly including a screw member having a shank with an extruded thread and a head presenting a clamping surface extending outwardly from the shank, and a lock washer operatively associated therewith including a body portion and a plurality of work engaging teeth projecting from opposite sides of said body portion, said teeth presenting edges positioned in planes spaced from and substantially parallel with the bounding planes of the body portion, the inner diameter of said lock washer being sufficiently less than the external diameter of the threaded shank to render the thread in the immediate vicinity of the lock washer operable to prevent axial displacement thereof.

3. A screw and lock washer assembly including a screw member having a shank with an extruded thread and a head presenting a clamping surface extending outwardly from the shank, and a lock washer operatively associated therewith including a body portion and a plurality of external work engaging teeth projecting from opposite sides of said body portion, said teeth presenting edges adapted to make a line bite into said clamping surface and the complementary surface of a work piece when the screw is tightened therein, the inner diameter of said lock washer being sufficiently less than the external diameter of the threaded shank to render the thread in the immediate vicinity of the lock washer operable to prevent axial displacement thereof.

4. A screw and lock washer assembly including a screw member having a shank with an extruded thread and a head presenting a clamping surface extending outwardly from the shank, and a lock washer operatively associated therewith including a body portion and a plurality of internal working engaging teeth projecting from opposite sides of said body portion, said teeth presenting edges adapted to make a line bite into said clamping surface and the complementary surface of a work piece when the screw

is tightened therein, the inner diameter of said lock washer being sufficiently less than the external diameter of the threaded shank to render the thread in the immediate vicinity of the lock washer operable to prevent axial displacement thereof.

5. A screw and lock washer assembly including a screw member having a shank with an extruded thread and a head presenting a clamping surface extending outwardly from the shank, and a lock washer operatively associated therewith including a body portion and a plurality of external work engaging teeth projecting from opposite sides of said body portion, said teeth presenting edges positioned in planes spaced from and substantially parallel with the bounding planes of the body portions, the inner diameter of said lock washer being sufficiently less than the external diameter of the threaded shank to render the thread in the immediate vicinity of the lock washer operable to prevent axial displacement thereof.

6. A screw and lock washer assembly including a screw member having a shank with an extruded thread and a head presenting a clamping surface extending outwardly from the shank, and a lock washer operatively associated therewith including a body portion and a plurality of internal work engaging teeth projecting from opposite sides of said body portion, said teeth presenting edges positioned in planes spaced from and substantially parallel with the bounding planes of the body portion, the inner diameter of said lock washer being sufficiently less than the external diameter of the threaded shank to render the thread in the immediate vicinity of the lock washer operable to prevent axial displacement thereof.

7. A screw and lock washer assembly including a screw member having a shank with an extruded thread and a head presenting a clamping surface extending outwardly from the shank, and a lock washer associated therewith including a body portion and a plurality of internal work engaging teeth projecting from opposite sides of said body portion, the thread on said shank being rolled and having an external diameter in the vicinity of said clamping surface which is greater than the internal diameter of the lock washer, the inner extremities of said teeth being positioned between said clamping surface and the uppermost convolution of the threaded shank, portions of said teeth extending radially outward beyond the external diameter of said thread convolution in operative position for lockingly engaging said clamping surface and a complementary surface of the work when the screw is tightened within the work.

8. A screw and lock washer assembly including a screw member having a shank with an extruded thread and a head presenting a clamping surface extending outwardly from the shank, and a lock washer operatively associated therewith including a body portion and a plurality of circumferentially disposed marginal sections deflected so as to present work engaging edges positioned in planes spaced from and substantially parallel with the bounding planes of the body portion, the inner diameter of said lock washer being sufficiently less than the external diameter of the threaded shank to render the thread in the immediate vicinity of the lock washer operable to prevent axial displacement thereof.

9. A screw and lock washer assembly includ-

ing a screw member having a shank with an extruded thread and a head presenting a clamping surface extending outwardly from the shank, and a lock washer operatively associated therewith including a body portion and a plurality of circumferentially disposed marginal sections bent in opposite directions out of the plane of said body portion so as to present work engaging edges positioned in planes spaced from and substantially parallel with the bounding planes of the body portion, the inner diameter of said lock washer being sufficiently less than the external diameter of the threaded shank to render the thread in the immediate vicinity of the lock washer operable to prevent axial displacement thereof.

10. A screw and lock washer assembly including a screw member having a shank with an extruded thread and a head presenting a clamping surface extending outwardly from the shank, and a lock washer operatively associated therewith including a body portion and a plurality of circumferentially disposed marginal sections twisted so as to present work engaging edges positioned in planes spaced from and substantially parallel with the bounding planes of the

body portion, the thread on said shank being rolled and having an external diameter in the vicinity of said clamping surface which is sufficiently greater than the internal diameter of the lock washer to secure said lock washer against axial displacement.

11. A screw and lock washer assembly including a screw member having a shank with an extruded thread and a head presenting a clamping surface extending outwardly from the shank, and a lock washer operatively associated therewith including a body portion and a plurality of marginal prongs, each prong being tapered and progressively twisted from the root to the free end thereof so as to present oppositely disposed work engaging edges adapted to make a line bite into said clamping surface and the clamping surface of a work piece when the screw is tightened therein, the inner diameter of said lock washer being sufficiently less than the external diameter of the threaded shank to render the thread in the immediate vicinity of the lock washer operable to prevent axial displacement thereof.

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