

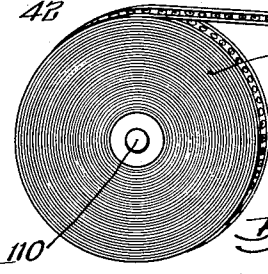
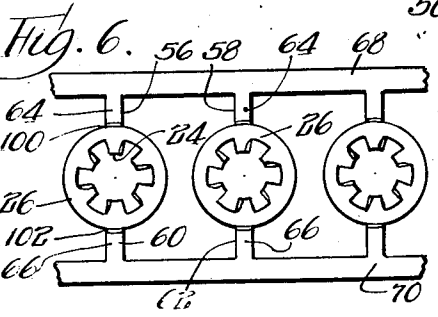
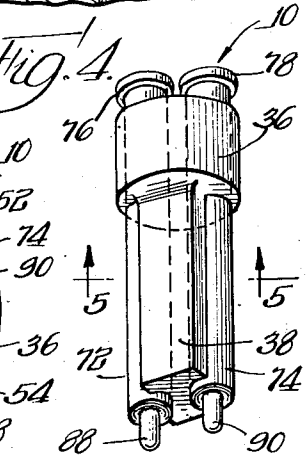
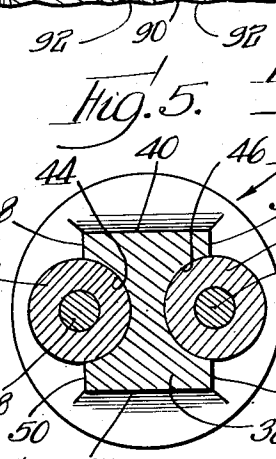
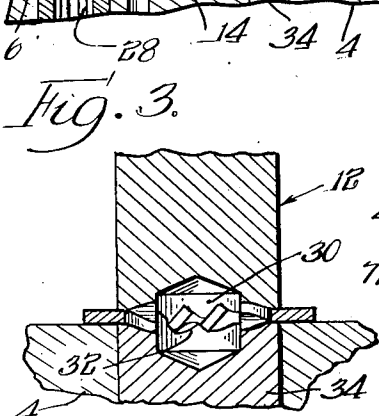
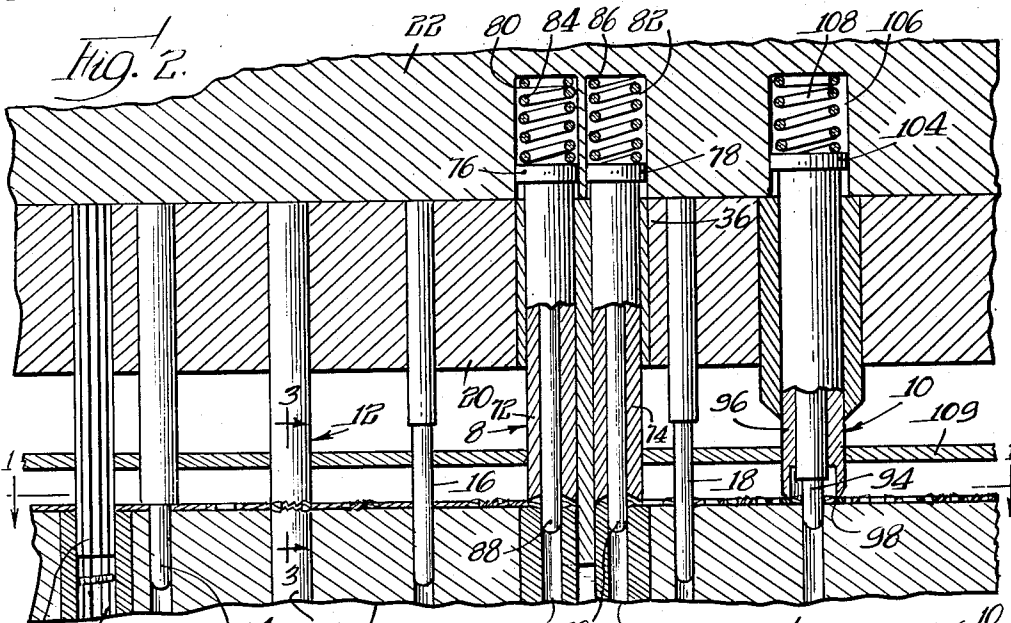
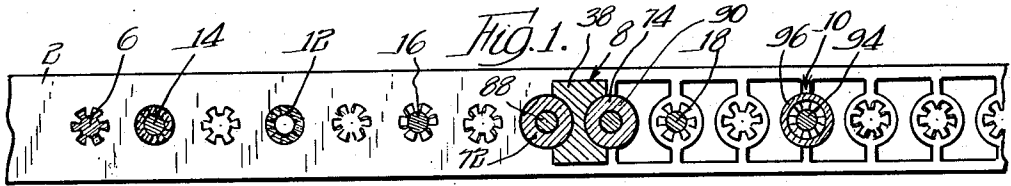
Aug. 18, 1953

O. J. POUPITCH  
WASHER STRIP AND METHOD AND APPARATUS  
FOR PRODUCING SAME

2,649,125

Filed Dec. 11, 1948

2 Sheets-Sheet 1



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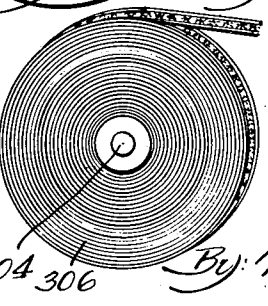
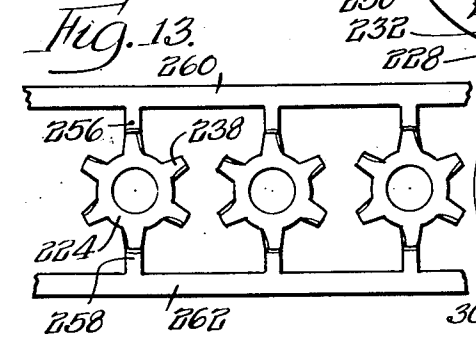
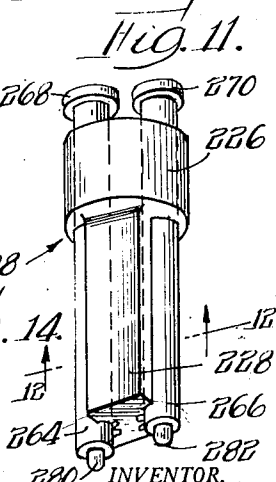
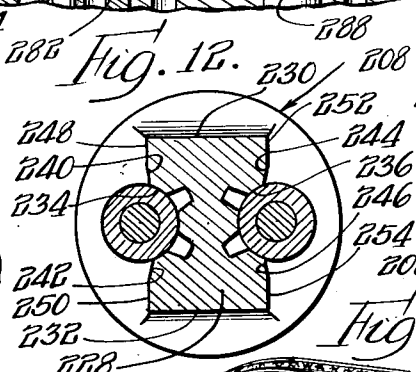
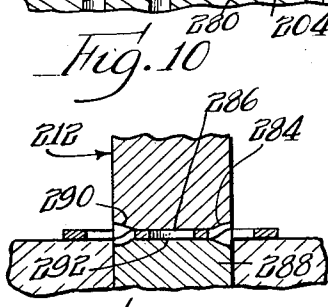
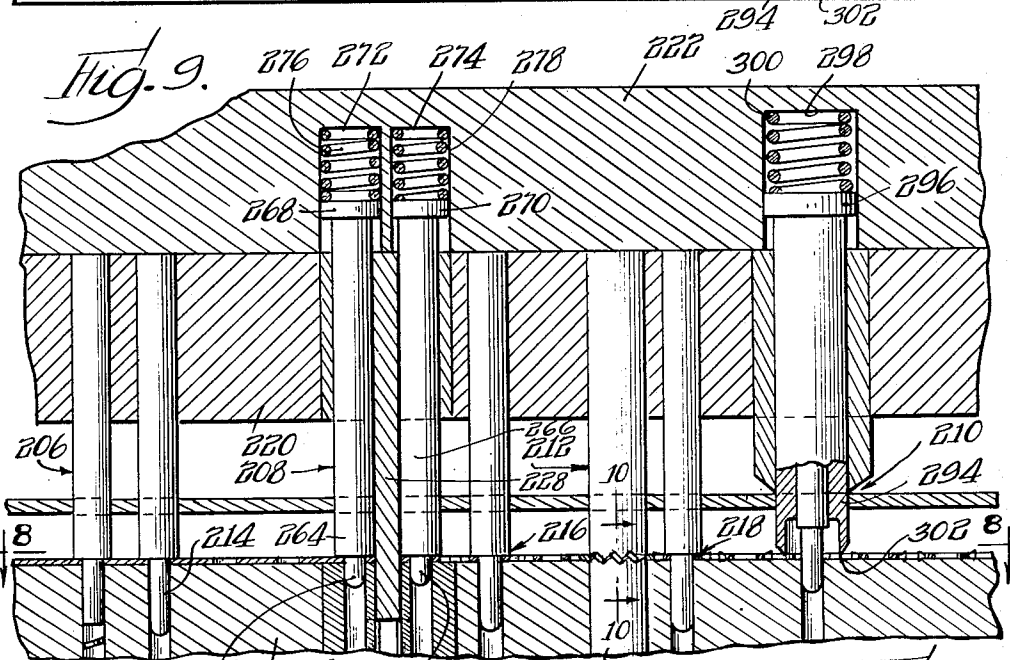
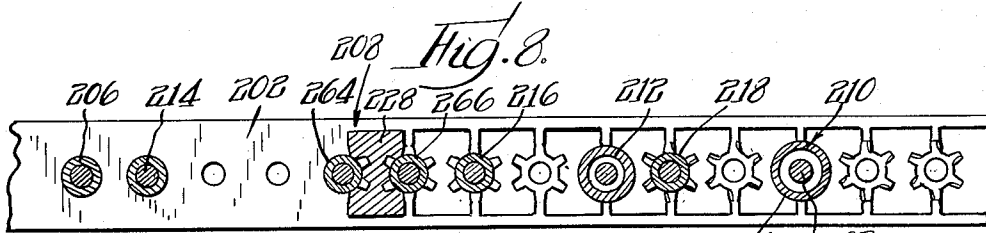
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2 Sheets-Sheet 2



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# UNITED STATES PATENT OFFICE

2,649,125

## WASHER STRIP AND METHOD AND APPARATUS FOR PRODUCING SAME

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Application December 11, 1948, Serial No. 64,876

15 Claims. (Cl. 151—35)

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This invention relates to a washer strip and to the method and apparatus for producing the same.

It is an object of this invention to provide, as a new article of manufacture, a strip of washers wound or readily wound into a roll, and more particularly to provide such a strip or roll of toothed lock washers connected to a marginal band or bands by connecting tabs readily severable for individual use or application of the washers.

It is another object of the invention to provide a method of, and apparatus for, making washers, particularly toothed lock washers, by which substantial savings in distribution and application of the washers may be effected, and the expense of hardening, packaging, handling and applying washers substantially reduced.

In my prior Patent 2,352,118, issued June 20, 1944, I disclosed a wasteless washer strip in which the washers are connected each to each by severable portions of limited cross section. That strip, while eminently satisfactory, particularly in the case of the larger lock washers, for sale, distribution and application in strip form, is not entirely satisfactory, particularly in the case of the smaller lock washers, for sale, distribution and application in and from the roll form. I have found that it is difficult once that strip has been hardened to form it into a roll, and once formed into a roll to unwind the strip, because of the tendency of the teeth of the washers to engage each other and thereby interfere with the winding of the strip into a roll and to become entangled when formed into a roll. I have found that there is at times a tendency of the washers of that washer strip to break apart at the points of adjoining as the inner convolutions of a roll are formed, thereby breaking the continuity of the strip and also a tendency for the washers to break apart at the points of adjoining as the strip is unwound because of the entangling of the teeth of the washers of one convolution with the teeth of the washers of the underlying convolution, thereby breaking the continuity of feed of the strip as it is unwound from the roll.

It is accordingly an object of the present invention to provide a strip of washers in such form that it may be readily wound into a roll for sale and distribution and readily unwound from the roll for use or application, and particularly for feeding to a point of application or to a device for assembling washers of the strip with screws or like fasteners.

I have also found that while such wasteless

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strip of my prior patent is eminently satisfactory from the standpoint of manufacture in the case of the larger sizes of lock washers, it is difficult to manufacture in the smaller sizes of lock washers, and impossible to manufacture in the smallest sizes, by reason of the very small sizes of the pieces which must be removed from the strip, particularly in the case of the internal tooth lock washers, in order to form the strip.

It is accordingly an object of the present invention to provide a washer strip of such construction as to be capable of ready manufacture in the case of washers of the smaller and smallest sizes.

The present invention contemplates as an article of manufacture, a washer strip having a continuous marginal band or tape, and preferably opposite marginal bands or tapes, to which the washers are secured in longitudinally spaced relation by laterally extending, readily severable ears or connecting tabs so that the strip is readily wound into a roll and unwound from the roll.

Other and further objects and advantages of the invention will be apparent from the following description when taken in connection with the accompanying drawings wherein:

Fig. 1 is a plan view, partly in section, and diagrammatically illustrating a method and apparatus for forming a strip of washers according to the present invention;

Fig. 2 is a fragmentary view in vertical section illustrating diagrammatically the apparatus of Fig. 1;

Fig. 3 is an enlarged fragmentary view in section taken along the line 3—3 of Fig. 2;

Fig. 4 is a view in perspective of a blanking and holding die;

Fig. 5 is an enlarged view in horizontal section taken substantially along the line 5—5 of Fig. 4;

Fig. 6 is an enlarged fragmentary plan view of a washer strip embodying the invention;

Fig. 7 is a view in perspective of a roll wound from the strip of Fig. 6;

Fig. 8 is a plan view, partly in section, substantially as seen in the direction of the arrows along the line 8—8 of Figure 9, and diagrammatically illustrating a method and apparatus for producing external toothed lock washers in strip form, according to this invention;

Fig. 9 is a fragmentary view in vertical section illustrating diagrammatically the apparatus of Fig. 8;

Fig. 10 is a fragmentary view in vertical section taken substantially along the line 10—10 of Fig. 9;

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Fig. 11 is a view in perspective of a blanking and holding die forming part of the apparatus of Figs. 8 and 9;

Fig. 12 is an enlarged view in horizontal section taken substantially along the line 12—12 of Fig. 11;

Fig. 13 is an enlarged fragmentary plan view of a strip embodying external toothed lock washers according to this invention; and

Fig. 14 is a roll wound from the strip of Fig. 13.

As shown in Figs. 1 and 2, a strip 2 of washer material, usually metal, is fed intermittently by any suitable or appropriate mechanism (not shown) to a die block 4 supported upon the feed plate of a conventional punch press (not shown). As the strip 2 passes over die block 4 it is operated upon by a stamping die 5, a blanking and holding die 8, a scoring die or plunger 10, a tooth twisting die or plunger 12, and a plurality of positioning or pilot plungers 14, 16 and 18.

The dies and plungers 5 to 13 may be mounted in any suitable known manner in a die block or blocks 20 secured to a reciprocable plate or bracket 22 connected in any suitable known manner to the ram or punch press for actuation thereby.

The stamping die 5 comprises a toothed or "gear" punch of complementary shape in cross section to the internal configuration of the washers. Thus the spaces between the longitudinally extending splines or teeth of the plunger 6 form the internal teeth 24 of each washer 26, Fig. 6, while the teeth or splines form the cut out portions between the internal teeth 24. In forming the internal configuration of the washers the plunger 6 is received in an opening 28 in the die block 4, the block 4 supporting the strip at all points except over the opening 28, which is of an internal diameter substantially equal to the external diameter of the plunger 6.

It should be understood that in the forming of strips of lock washers of larger sizes than that shown in Fig. 6, Fig. 6 being on the order of four times the actual size, the central hole in the washer will be formed by a plunger whose external diameter is equal to the internal diameter of the washer between the internal teeth, and the toothed plunger 6 will function simply to form the teeth but will not be called upon to also remove the center or disk formed by the inner edges of the teeth.

Pilot plungers 14, 16 and 18 comprise cylinders or rods whose lower end portions are equal in diameter to the internal diameter of the washers and are longer than the plunger 6 and rounded at their lower ends so as to be received in the washer holes and accurately control and determine the position of the strip with respect to the plunger 6, the dies 8 and 10, and the tooth twisting die or plunger 12.

The tooth twisting die or plunger 12 is provided with an appropriately raised and relieved lower surface 30 cooperating with a complementary raised and relieved surface 32 of an insert 34 in die block 4 to twist the internal washer teeth 24 after formation thereof by the toothed plunger or "gear" punch 6.

The stamping, or blanking and holding die 8, preferably comprises a cylindrical block 36, Figs. 4 and 5, having an integral depending punch 38 which is formed with opposite plane side edges 40 and 42 and circular recesses or grooves 44 and 46 in the other side edges. These grooves 44 and 46 are circular in form, the diameter of each groove being equal to the diameter of the washer

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26, but the angular extent of each of these grooves being less than 180 degrees so that the circular edges of these grooves form slightly less than one half of the external periphery of each of two adjacent washers. The circular walls of the grooves 44 and 46 are connected with the opposite side surfaces 40 and 42 by plane surfaces 48, 50, 52 and 54, which are substantially normal to the side surfaces 40 and 42. The opposite surfaces 48, 52 and 50—54 are spaced apart a distance slightly less than the spacing between the centers of the washers 26 so that these surfaces of the die or punch 38 form the side edges 56, 58, 60 and 62 of adjacent tabs 64 on one side of the washers and adjacent connecting tabs 66 on the other side of the washers.

The die surfaces 40 and 42 are spaced apart a distance less than the width of the strip of material 2 from which the washer strip is formed so as to form opposite marginal bands or tapes 68 and 70, the band 68 being connected to each washer of the strip by the connecting tabs 64 and the marginal band 70 being connected to the washers by the connecting tabs 66. The die 8 also includes work holding plungers or cylinders 72 and 74 slidably mounted in guide openings in the cylindrical block 36 and extending along the grooves 44 and 46. These plungers are provided with enlarged head portions 76 and 78 which are received in circular openings 80 and 82 in the plate or bracket 22 and the coil springs 84 and 86 are interposed between the heads 76 and 78 of the plungers and the upper wall of the openings 80 and 82 so as to normally urge the plungers 72 and 74 downwardly to a position such that the lower edge of the plungers lie in advance or below the lower edge of the die or punch 38, as shown in Fig. 4. The plungers 72 and 74 are hollow and have force fitted into them pilot plungers 88 and 90. The pilot plungers 88 and 90 are preferably rounded at the lower ends so as to project into the central holes of the washers and accurately position the adjacent openings with respect to the die block 38 and the holding plungers 72 and 74. The hold down plungers 72 and 74 are preferably relieved at the lower ends, as seen in Fig. 2, to accommodate the twisted teeth of the washers 26 and engage the material of the strip in a ring around the base of the teeth so that as the die block 38 blanks out the material between the adjacent openings, the strip material in the vicinity of the die punch 38 will not be twisted out of shape but will be held by the plungers 72 and 74 in cooperation with the subjacent surface of the die block 4 in a true plane. It should be noted that the pilot plungers 88 and 90 of the die 8 are received in suitable openings 92 in the die block 4, and that the surface portions of the die block about these openings are relieved to accommodate the teeth 24 of the washers.

It will be evident that on each operation, the die 8 completes the forming of one washer and one set of connecting tabs 64 and 66 and of slightly less than one half of the external periphery of the next adjacent washer and the next adjacent set of connecting tabs 64 and 66, while at the same time forming those portions of the side margins or bands 68 and 70 which extend between adjacent connecting tabs.

From the die 8 each portion of the strip passes to the scoring die or plunger 10 which comprises a pilot plunger 94 force fitted in a hollow rod or scoring punch 96 and projecting therebelow. The plunger 96 is formed at its lower end with a sharpened circular edge 98,

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the internal diameter of which is equal to the external diameter of the washer so that on downward movement of the plunger the sharpened edge 98 scores an arcuate line or slit 100 at the point where the tab 64 joins the washer 26 and a like line or slit 102 at the point where the washer joins the connecting tab 66.

The plunger 96 is formed at its upper end with an enlarged head 104 received in an opening 106 in the plate or bracket 22 and urged downwardly by coil spring 108 interposed between the head 104 and the bottom of the opening 106. The spring 108 is made sufficiently strong to cause the sharpened end 98 of the plunger 96 to penetrate or score the material to a predetermined depth but is not sufficiently strong to cause it to penetrate entirely through the material so that the circular outline of the washer is completed, yet the washer remains connected to the strip. This permits subsequent, ready detachment of each washer from the connecting tabs 64 and 66 and assures the formation of a truly circular periphery or external margin for each washer.

Thus, by the method and apparatus disclosed in Figs. 1 to 5, the strip 2 will be formed into a washer strip having longitudinally spaced successive washers 26 completed as to internal form and substantially completed as to external form but left connected to opposite marginal bands or tapes 68 and 70 by connecting pieces or tabs 64 and 66 which are scored at their point of connection to the external margin of each washer. A stripper plate 109, Fig. 2, secured in any convenient manner to the stationary die block 4 and suitably apertured to receive the die punches or plungers 6 to 18 serves to assure the stripping of the strip 2 from those die punches or plungers on each upward movement of the reciprocable plate or bracket 26.

From the forming dies the washer strip may be fed to a suitable winding member 110, Fig. 7, by which the washer strip is formed into a roll 112, the marginal bands or tapes 68 and 70 facilitating the winding of the strip and the proper lapping over of one layer or convolution of washers over another, and the resiliency of these marginal bands serving by reason of their resilience radially of the roll to disentangle one convolution of washers from the underlying convolution of washers.

It should further be noted that the tabs 64, or the tabs 66, or both sets of tabs, serve not only as readily severable means connecting the washers to the side margins or bands 68 or 70 but also as feed lugs readily engageable with a sprocket type feed wheel for feeding the strip from the roll for use or application or to an assembly mechanism for assembling screw elements or similar fasteners with the washers of the strip. The strip either before or after winding into a roll, preferably before, is passed through the usual hardening and tempering process by which the washers, as well as the connecting tabs and the side margins or bands, are hardened and tempered. Hardening of the strip has the effect of making the metal somewhat more brittle and therefore more readily fracturable or severable to detach the washers from the strip on use or application or after assembly of the screws or like fasteners with the washers.

Figs. 8 to 12 illustrate the modification of the method and apparatus for forming the washer strip and washer roll of Figs. 13 and 14 in which the washers are of the external toothed type.

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As shown in Fig. 8, the strip 202 of the strip stock block is fed intermittently over the die block 204. As the strip 202 passes over the die block 204 it is operated upon by a stamping or punching die 206, a stamping or blanking and holding die 208, a scoring die or plunger 210, a tooth twisting die or plunger 212, and a plurality of positioning or pilot plungers 214, 216 and 218.

The dies or plungers 206 to 218 are mounted in any suitable known manner in a die block or blocks 220 secured to a reciprocable plate or bracket 222 connected to the ram of the punch press.

The punch 206 is a cylindrical rod or "pierce" punch having an end of a reduced external diameter equal to the internal diameter of the washer 224. The stamping or combined blanking or holding die 208 comprises a cylindrical block 226 fixed in the die block 220 and formed with an integral depending blanking die 228. The die block 228 is shaped to provide opposite plane edges 230 and 232. The other side surfaces of the die block are formed intermediately with grooves 234 and 236 complementary in form to approximately one half of the external configuration of the washer, these grooves each having spaced apart circular surfaces between which are interposed relatively deep grooves complementary in shape to the shape of the washer teeth 238. Adjacent these grooves the side surfaces of the die block are relieved or beveled as at 240, 242, 244 and 246 so as to form the tapered side surfaces of the diametrically opposite teeth of each washer, the surfaces 240 and 242 forming the right tapered side surfaces of the pair of diametrically opposite teeth, while the surfaces 244 and 246 form the left tapered side surfaces of those diametrically opposite teeth. Beyond the surfaces 240 to 246 the said other side surfaces of the die block are formed with plane edges or surfaces 248, 250, 252 and 254 to form the sides of the connecting tabs or lugs 256 and 258 by means of which the washers are integrally connected respectively to the marginal bands or tapes 260 and 262 of the washer strip, the surfaces 248 and 252 forming the opposite edges of the connecting tabs 256 and the surfaces 250 and 254 forming the opposite edges of the connecting tabs 258. The opposite plane edges or surfaces 230 and 232 are spaced apart a distance sufficiently less than the width of the material strip 202 so as to form the margins 260 and 262.

Holding plungers 264 and 266 are slidably mounted in suitable openings in the cylindrical block 226 of the die 208 and are provided at their upper ends with enlarged head portions 268 and 270 slidably received in apertures 272 and 274 in the reciprocable plate or bracket 222. Coil springs 276 and 278 in the openings 272 and 274 are interposed between the heads 268 and 270 and the upper ends of the openings and therefore normally urge the holding plungers downwardly to a position where they extend below the die block 228, as seen in Fig. 11. Hence these holding plungers first engage the strip and retract into the openings 272 and 274 as the punch press ram continues to descend and force the blanking die block 228 through the strip. The holding plungers 264 and 266 have force fitted into them pilot plungers 280 and 282 which project therebelow so as to engage in adjacent washer openings, formed by the punch 206, and thereby accurately position the strip for the forming operation of the block 228. The holding plungers 264 and 266 are preferably of an external diameter sub-

stantially equal to the external diameter of the ring portion of the washer so that they hold the washer which is being completed by the surfaces 252, 244, 236, 246 and 254 of the die block against twisting relative to the plane of the strip and prevent buckling of the strip material as the right hand edge of the next adjacent washer is being formed by the opposite surfaces of the die block 228.

After the washers have been formed by the die 208 they are presented to the tooth twisting die or plunger 212, which may be of conventional structure, having an annular raised and relieved surface 284 circumscribing a circular flat surface 286. The die 212 cooperates with an insert 288 in the die block 240, which insert has at its upper surface an annular raised and relieved surface 290 complementary to the surface 284 of the die plunger and a circular flat surface 292 complementary to the like surface 286 of the tooth twisting die or plunger 212.

It should be noted that the raised and relieved annulus 284 of the tooth twisting plunger 212, and the complementary annular surface 290 of the insert 288, perform a twisting action upon all the teeth of each washer, including the teeth which are connected by the tabs 256 and 258 to the marginal bands or tapes 260 and 262 of the washer strip. The twisting of these teeth which are joined to the connecting tabs serves to partially sever the opposite side edges of these teeth from the connecting tabs but they remain connected thereto by the central edge portions of each such tooth.

From the tooth twisting die or plunger 212 with its complementary die insert 288, the strip passes to the scoring die or plunger 210 which comprises a sleeve or plunger 294 slidably mounted in any suitable manner in the block 220, and having enlarged head 296 received in an opening 298 in the reciprocable plate or bracket 222. A coil spring 300 in the opening 298 normally urges the scoring plunger 294 downwardly with respect to the reciprocating head. The scoring plunger is provided with a sharpened annular lower edge 302, the diameter of which is equal to the external diameter of the washer so that it may perform a scoring action, scoring a circular defining edge for the diametrically opposite teeth which are joined to the connecting tabs 256 and 258. The scoring plunger 294 penetrates the material of the strip sufficiently to insure ready severance of each washer from the connecting tabs and to insure that the teeth which were adjoined to those connecting tabs will have a circular form at their ends and substantially free of burrs or rough edges. The strips of externally toothed lock washers having thus been formed, the strip may be fed to a winding member 304 by which the strip of washers is formed into a roll 306. The roll 306 may be formed before hardening of the strip of washers, although it is preferred to subject the strip to the usual hardening and tempering process prior to rolling of it into the roll 306. This hardening and tempering process, in the usual manner, has the effect of making the metal somewhat more brittle, which serves to enhance the ready fracturability or severability of the washers from the strip.

It will be evident that the connecting tabs 256 and the connecting tabs 258 provide lugs or sprocket engaging portions by means of which the strip may be readily unwound from the roll and fed to the point of use or application or

an assembly mechanism by means of which screws or like fasteners may be assembled with the washers of the strip, and thereafter fed to suitable detaching or severing means by the operation of which the connecting tabs are severed along the arcuate scored lines formed by the scoring plunger 294.

It will be apparent from the foregoing description that applicant has provided, as a new article of manufacture, a strip of washers wound or readily wound into a roll, and more particularly a strip or roll of toothed lock washers connected to a marginal band or bands by connecting tabs readily severable for individual use on application of the washers; a method of, and apparatus for, making washers, particularly toothed lock washers, by which substantial savings in distribution and application of the washers may be effected, and the expense of hardening, packaging, handling and applying washers substantially reduced; a strip of washers in such form that it may be readily wound into a roll for sale and distribution and readily unwound from the roll for use or application, and particularly for feeding to a point of application or a device for assembling washers of the strip with screws or like fasteners; and a washer strip of such construction as to be capable of ready manufacture in the case of washers of the smaller and smallest sizes.

It will be obvious that changes may be made in the form, construction and arrangement of the parts without departing from the spirit of the invention or sacrificing any of its advantages, and the right is hereby reserved to make all such changes as fairly fall within the scope of the following claims.

The invention is hereby claimed as follows:

1. A method of making washers comprising feeding a strip of washer stock longitudinally, removing from predeterminedly spaced areas of the strip pieces of material to form the washer openings, thereafter holding the washer portions against deformation and removing from said strip between said openings other discrete pieces of material of a width less than the width of the strip stock and shaped to form substantially half the external outlines of adjacent washers formed by said openings and the opposite sides of connecting areas of limited size joining each washer to a common band of strip stock left by the removal of said discrete pieces of less width than the stock, and scoring the completed outlines of the washers across the tabs.

2. A method of making toothed lock washers comprising feeding a strip of washer stock longitudinally, removing from predeterminedly spaced areas of the strip pieces of material to form the washer openings, thereafter holding the washer portions against deformation and removing from said strip between said openings other discrete pieces of material of a width less than the width of the strip stock and shaped to form substantially half the external outlines of adjacent washers formed by said openings and the opposite sides of connecting areas of limited size joining each washer to a common band of strip stock left by the removal of said discrete pieces of less width than the stock, and twisting the teeth of the washers.

3. A method of making toothed lock washers comprising feeding a strip of washer stock longitudinally, removing from predeterminedly spaced areas of the strip pieces of material to form the washer openings, holding the washer portions of

said strip against deformation while removing from said strip between said openings other discrete pieces of material of a width less than the width of the strip stock and shaped to form substantially half the external outlines of adjacent washers formed by said openings and the opposite sides of connecting tabs of limited size joining the washers to a marginal band of strip stock left by the removal of said discrete pieces of less width than the stock, forming radially extending teeth concurrently with one of the piece removing steps, twisting the teeth of the washers, and scoring the connecting tabs at points of joining to the washer to complete the external form of the washers.

4. In a machine for making washers from strip stock fed successively to a plurality of forming stations, means at one of said stations for successively removing from the stock pieces of waste material in form complementary to the internal form of the washers, means at another station for removing from the stock between adjacent openings formed in the stock by the first means, pieces of waste material in form corresponding to the opposite substantially half portions of the external outline of the washers, said second removing means being so constructed as to leave the washers joined to a common marginal band of the strip stock by connecting tabs of limited size, and means at a third station for scoring the strip stock across the connecting tabs along arcuate lines of a radius equal to the external radius of the washers.

5. A machine for making a strip of internally toothed lock washers from strip stock fed successively to a plurality of forming stations, means at one of said stations for successively removing from the stock pieces of waste material in form complementary to the internal tooth shape of the washers, means at another of said stations for removing from between adjacent openings formed in the stock by the first means, pieces of waste material of less width than the stock and substantially half circular outlines of adjacent washers formed about the said openings and connecting tabs of limited size joining washers to a marginal band.

6. A machine for making externally toothed lock washers from a strip of washer stock fed longitudinally to a plurality of forming stations, means at the first station for successively removing from the strip stock disks of a diameter equal to the internal diameter of the washers, and at a second station means for holding the washer portions of said stock against deformation and means for successively removing from the strip stock between adjacent openings formed at the first station pieces of waste material of a width less than the strip stock and of a shape complementary to substantially one-half the external toothed outlines of the washers with connecting tabs of limited size joining teeth of the washers to a marginal band, and a plurality of means for indexing said strip of stock at spaced points to insure proper registration of the removing means with said strip.

7. A machine for making a strip of internally toothed lock washers from strip stock fed successively to a plurality of forming stations, means at one of said stations for successively removing from the stock pieces of waste material in form complementary to the internal tooth shape of the washers, means at another of said stations for removing from between adjacent openings

formed in the stock by the first means, pieces of waste material of less width than the stock and substantially half circular outlines of adjacent washers formed about the said openings and connecting tabs of limited size joining washers to a marginal band, and means at a third station for scoring across the connecting tabs arcuate lines completing the external circular outline of the washer across the connecting tabs.

8. A machine for making externally toothed lock washers from a strip of washer stock fed longitudinally to a plurality of forming stations, means at the first station for successively removing from the strip stock disks of a diameter equal to the internal diameter of the washers, means at a second station for successively removing from the strip stock between adjacent openings formed at the first station pieces of waste material of a width less than the strip stock and of a shape complementary to substantially one-half the external toothed outlines of the washers with connecting tabs of limited size joining teeth of the washers to a marginal band, and means at a third station for scoring across the connecting tabs arcuate lines completing the outline of the teeth which are joined by the tabs to the marginal band.

9. In a machine for making washers in strip form from strip stock fed successively along a stationary die block base, a reciprocable die block movable toward and from the stationary block along which the strip stock is fed, a plurality of stamping dies carried by said reciprocable die block, one of said dies comprising a punch of a shape complementary to the internal outlines of the washers, a second of said stamping dies comprising a die punch and a pair of resiliently mounted hold down punches adjacent thereto, said last mentioned die punch being of a width less than the strip stock and of a shape to form the opposite, slightly less than half portions of the external outlines of the washers and the opposite side edges of connecting tabs of limited size joining the washers to the marginal band left unremoved by said die punch.

10. In a machine for making washers in strip form from strip stock fed successively along a stationary die block base, a reciprocable die block movable toward and from the stationary block along which the strip stock is fed, a plurality of stamping dies carried by said reciprocable die block, one of said dies comprising a punch of a shape complementary to the internal outlines of the washers, a second of said stamping dies comprising a die punch and a pair of resiliently mounted hold down punches adjacent thereto, said last mentioned die punch being of a width less than the strip stock and of a shape to form the opposite, slightly less than half portions of the external outlines of the washers and the opposite side edges of connecting tabs of limited size joining the washers to the marginal band left unremoved by said die punch, and a scoring plunger having a sharpened lower edge of a diameter substantially equal to the external diameter of the washers.

11. A machine for making a strip of toothed lock washers from strip stock fed successively to a plurality of forming stations, means at one of said stations for successively removing from the stock pieces of waste material in form complementary to the internal aperture shape of the washers, and at another of said stations means for holding the washer portions of said stock against deformation and means for removing from between ad-



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5 adjacent apertures formed in the stock by the first means, pieces of waste material of less width than the stock and complementary to substantially half the external outlines of adjacent washers formed about the said apertures and connecting tabs of limited size joining washers to a marginal band.

10 12. A machine for making a strip of toothed lock washers from strip stock fed successively to a plurality of forming stations, means at one of said stations for successively removing from the stock pieces of waste material in form complementary to the internal aperture shape of the washers, means cooperable with the apertures so formed for indexing said strip stock, and at another of said stations means for holding the washer portions of said stock against deformation and means for removing from between adjacent apertures formed in the stock by the first means, pieces of waste material of less width than the stock and complementary to substantially half the external outlines of adjacent washers formed about the said apertures and connecting tabs of limited size joining washers to a marginal band.

15 13. As an article of manufacture, a strip of washers comprising transversely spaced marginal ribbons each having tabs projecting inwardly therefrom at longitudinally spaced intervals with the remaining edge portions of each ribbon and the space therebetween being entirely free of waste strip stock material to enhance the flexibility of the strip, and a plurality of washers spaced longitudinally between the ribbons substantially in accordance with the spacing of said tabs with each said washer joined to a single tab

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from each ribbon by a weakened section substantially coincident with the adjacent edge of the washer and with the remaining periphery of each washer between the pair of supporting tabs entirely free of strip stock material to facilitate flexing of the strip and each tab being of such length as to space the adjacent periphery of the supported washer from the inner edge of each ribbon.

10 14. As an article of manufacture, a strip of washers as claimed in claim 13, wherein the washer is provided with external teeth and the tabs form substantial continuations of adjacent teeth.

15 15. As an article of manufacture, a strip of washers as claimed in claim 13, wherein the washer is provided with internal teeth and the weakened section of the tabs is substantially coincident with the edge of the external periphery of the washer.

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