June 8, 1943. W. M. HANNEMAN 2,321,548

WASHER FEEDING MEANS

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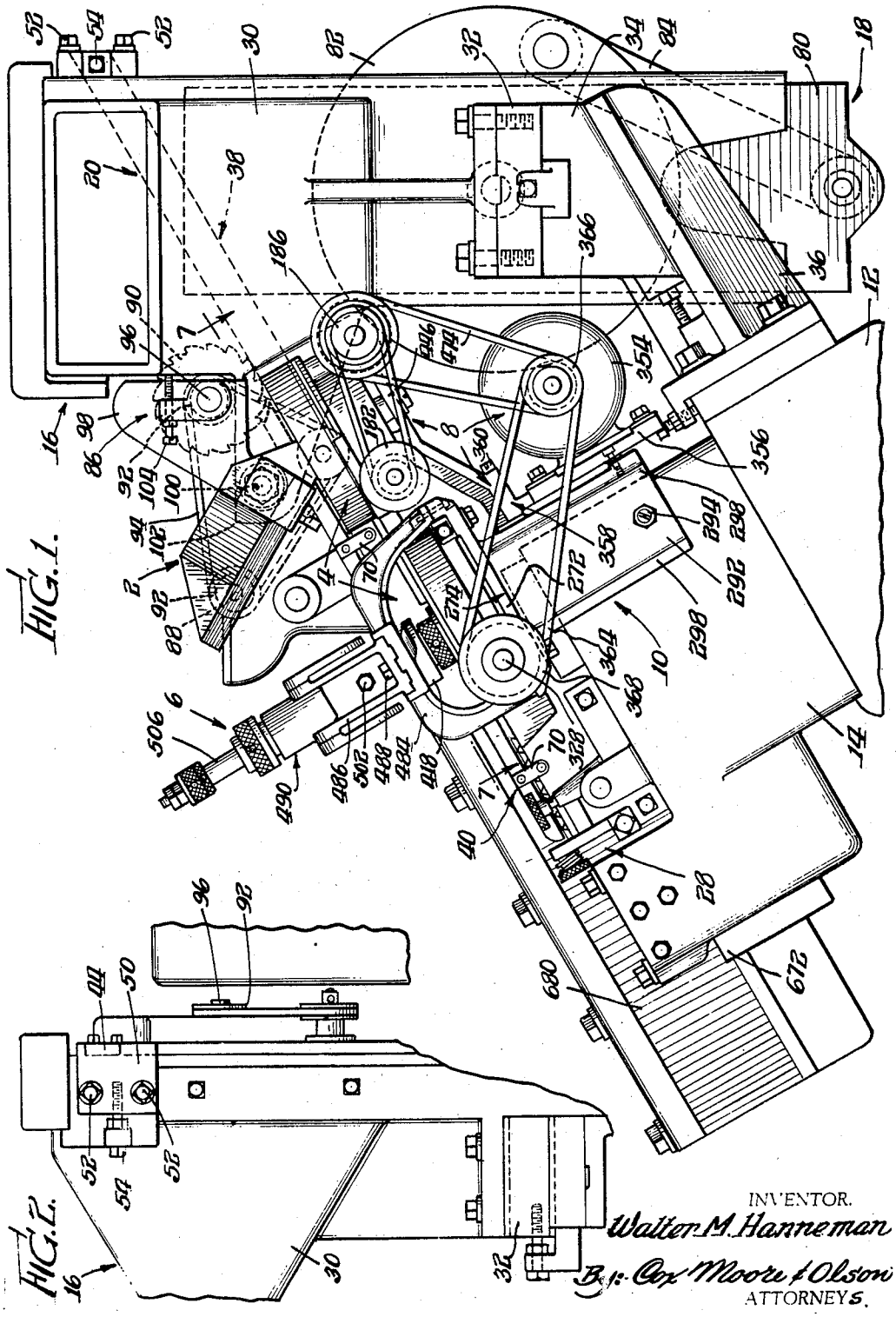


FIG. 1.

FIG. 2.

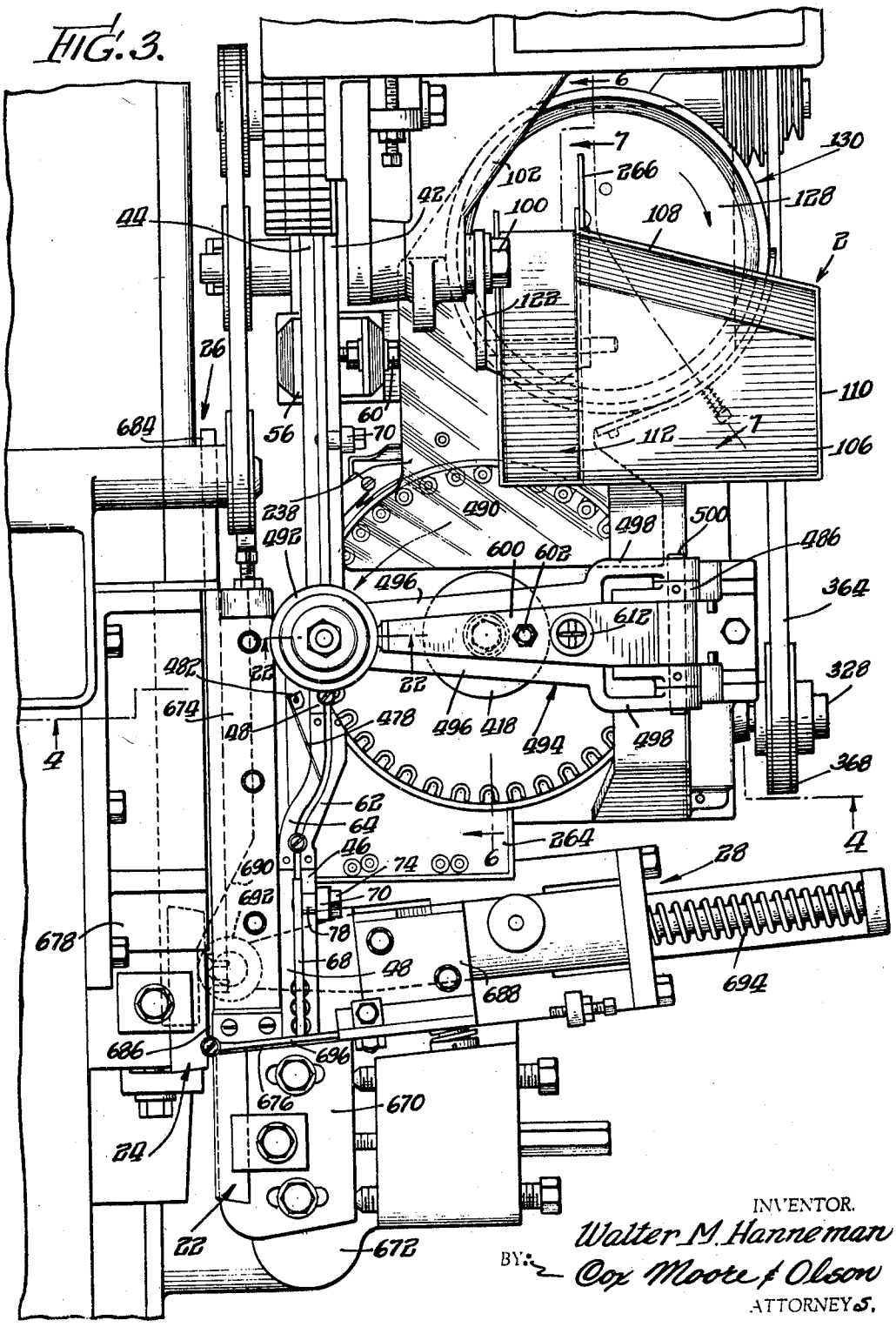
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June 8, 1943. W. M. HANNEMAN 2,321,548

WASHER FEEDING MEANS

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FIG. 3.



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FIG. 4.

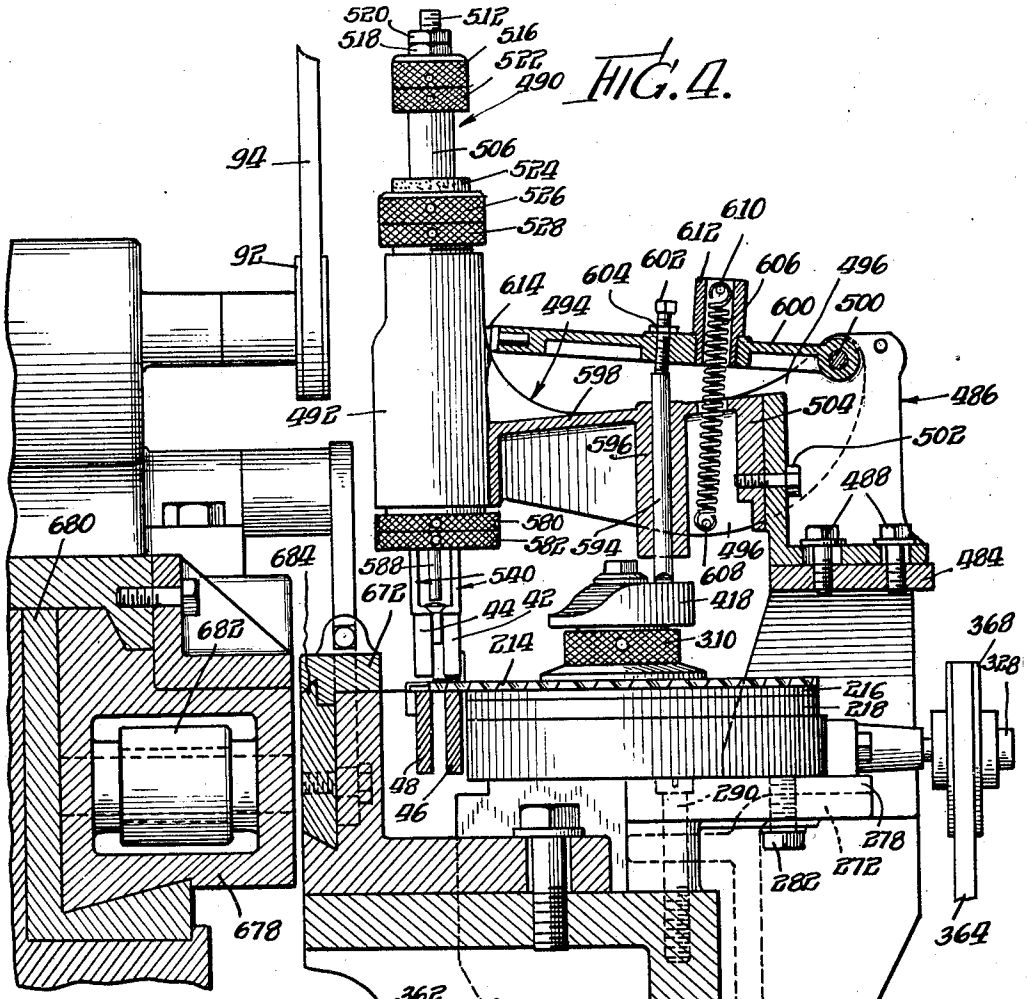
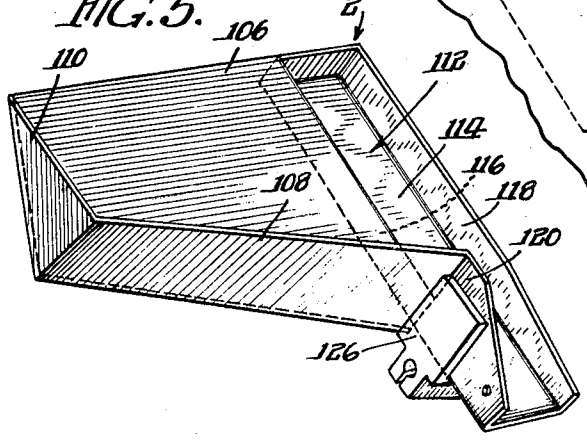


FIG. 5.





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WASHER FEEDING MEANS

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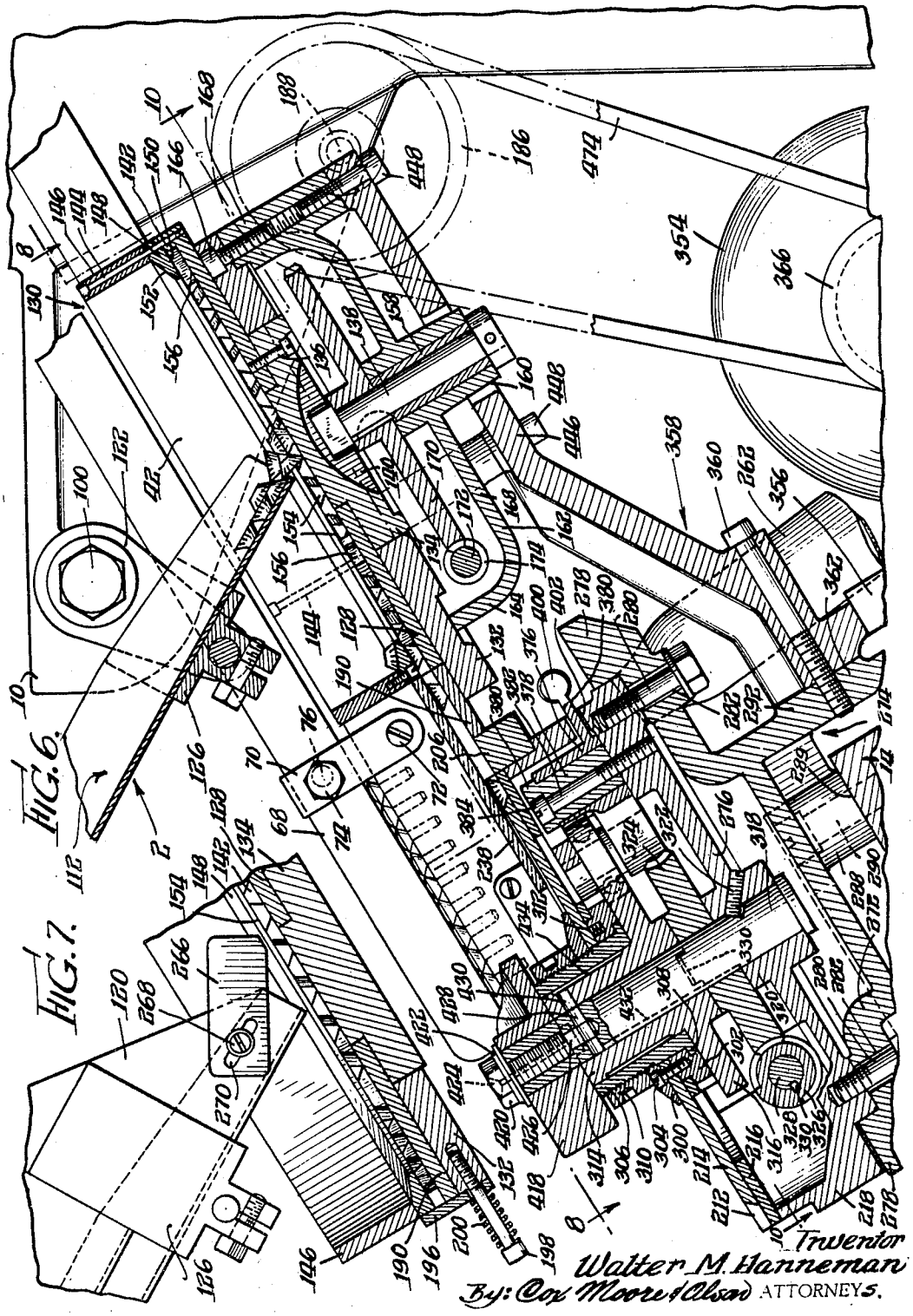


FIG. 6.

FIG. 7.

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WASHER FEEDING MEANS

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FIG. 9.

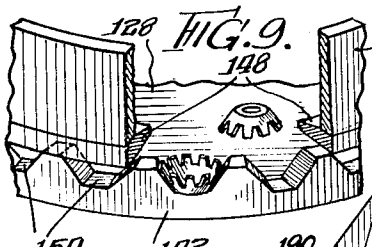


FIG. 8.

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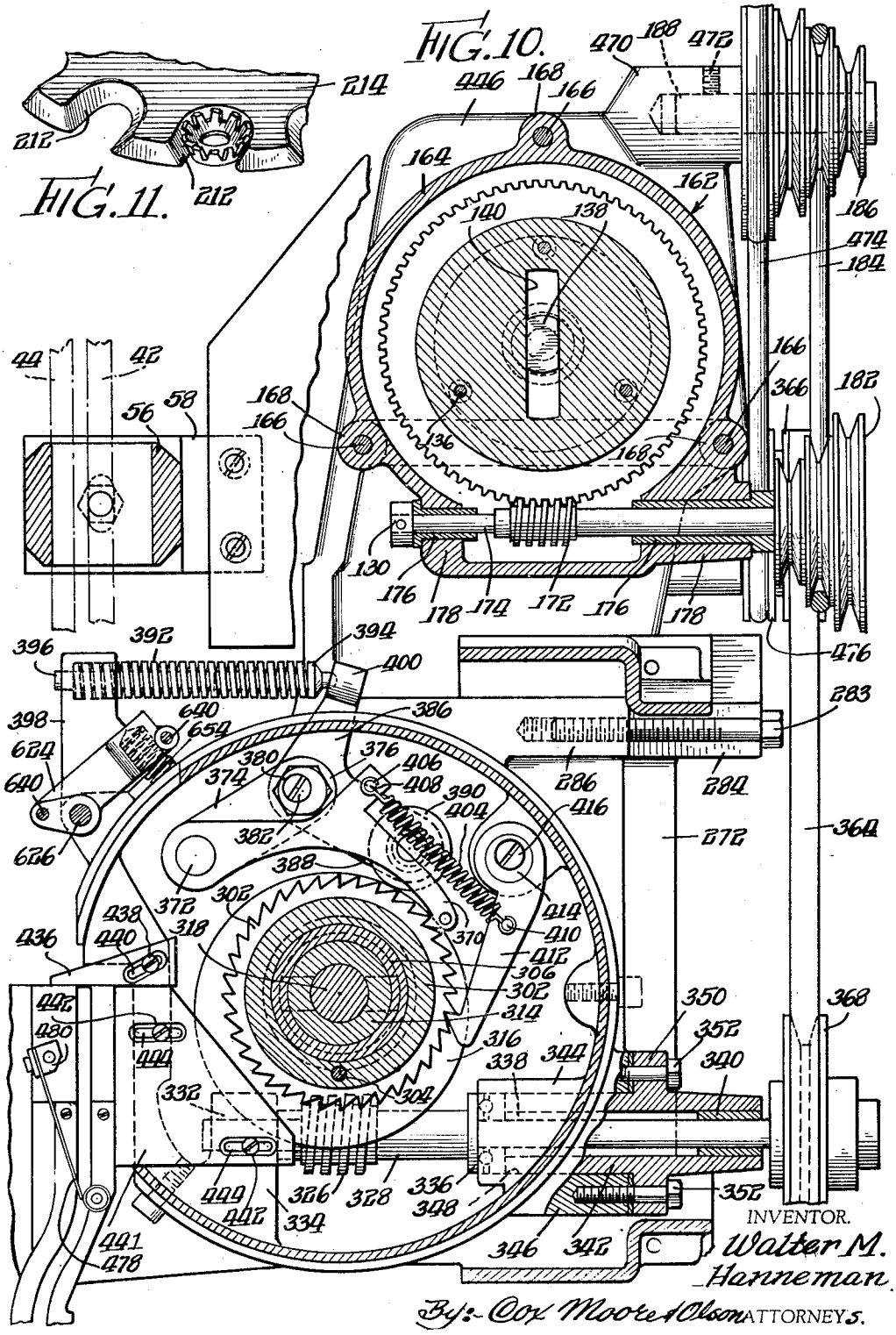
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WASHER FEEDING MEANS

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FIG. 10.

FIG. 11.



INVENTOR.
Walter M. Hanneman

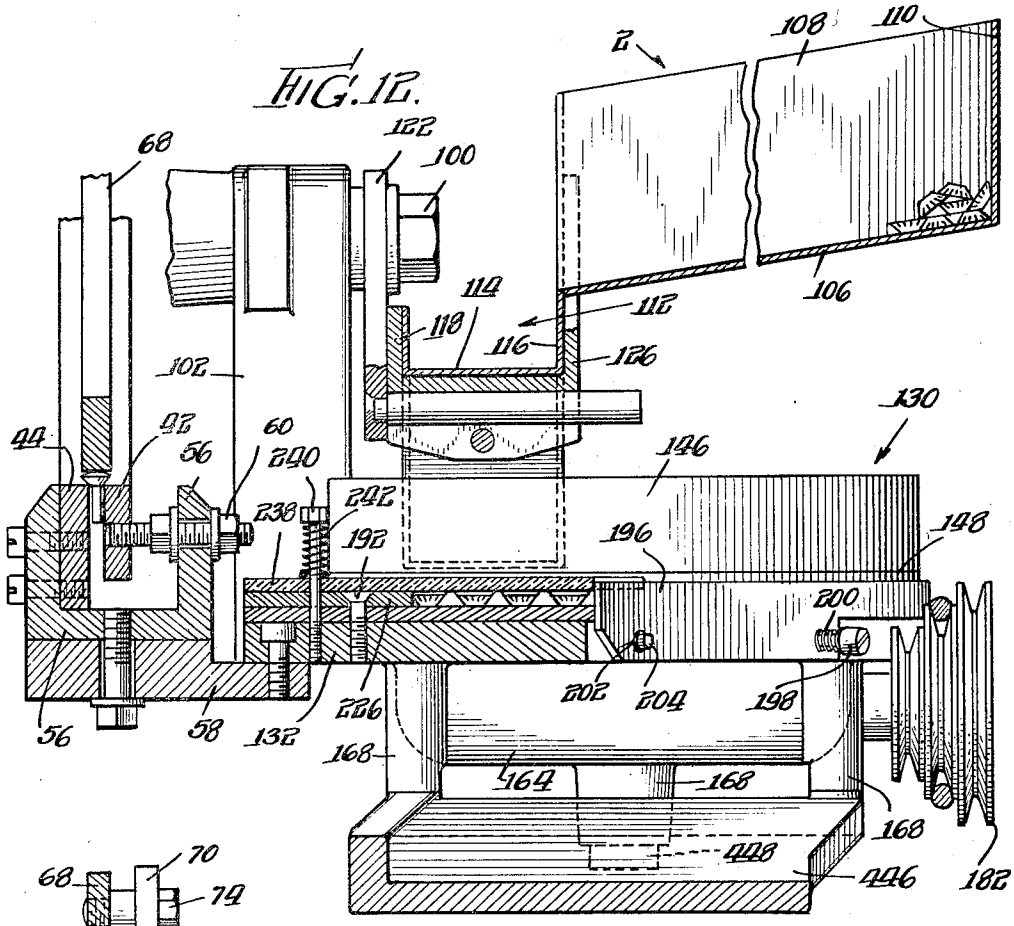
By: Cox Moore & Olson ATTORNEYS.

June 8, 1943. W. M. HANNEMAN 2,321,548

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FIG. 12.



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FIG. 17.

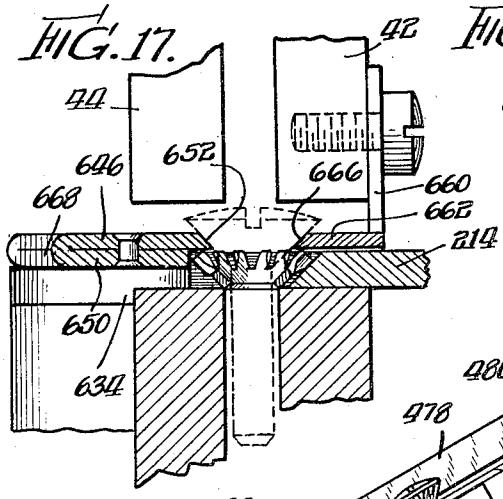


FIG. 16.

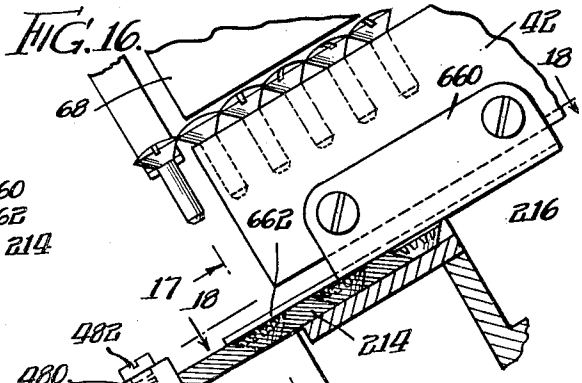
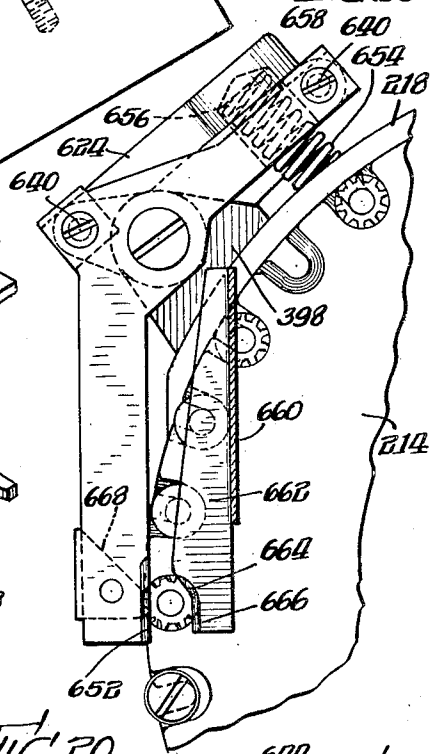


FIG. 18



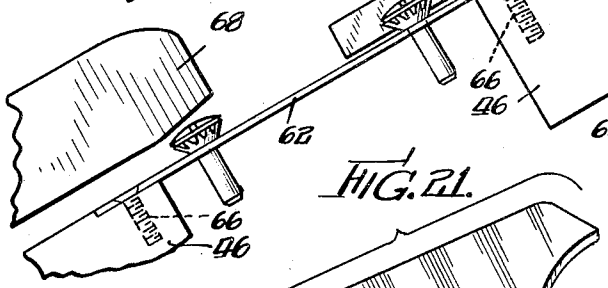


FIG. 21.

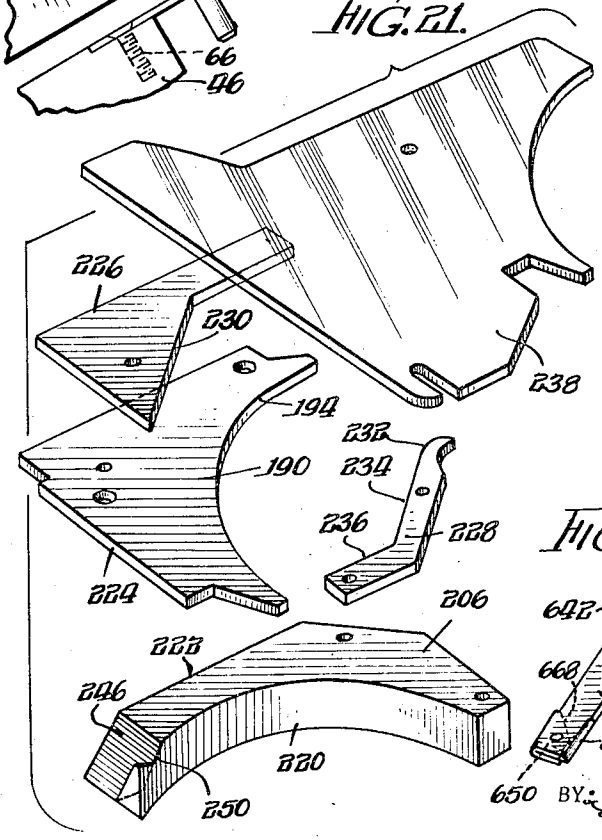


FIG. 20.

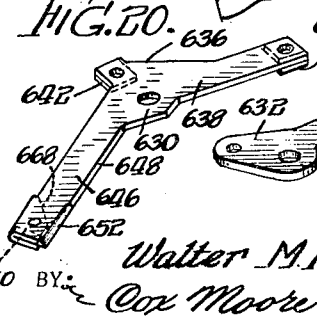


FIG. 19.

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WASHER FEEDING MEANS

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FIG. 22.

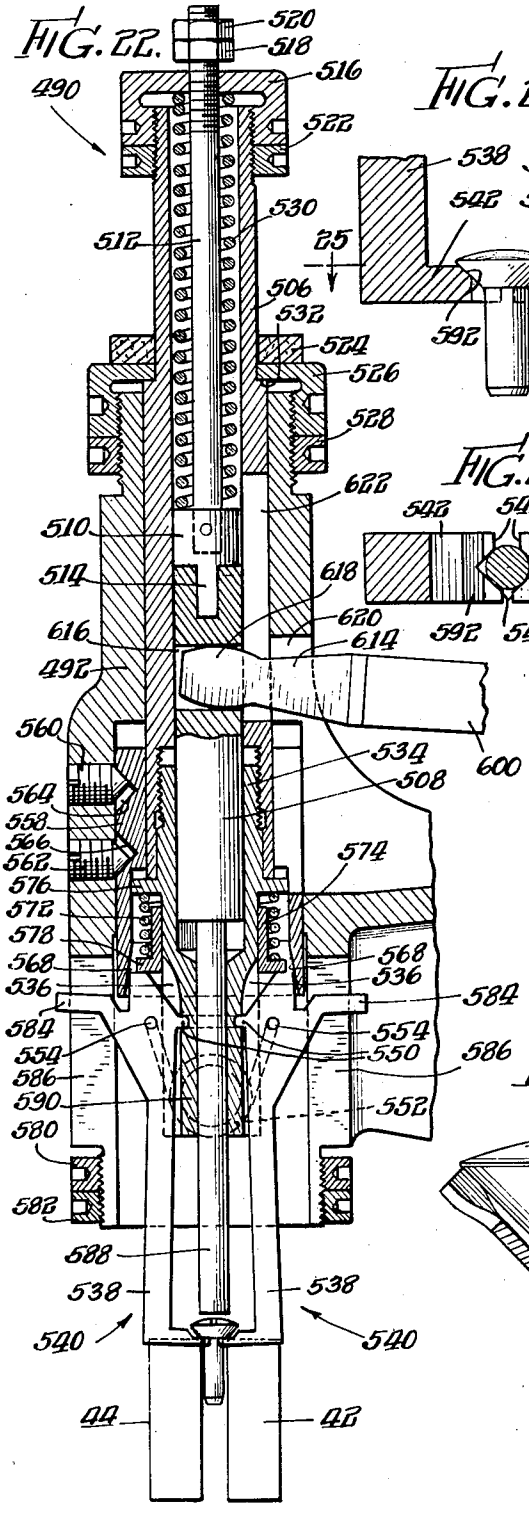


FIG. 24.

FIG. 25.

FIG. 23.

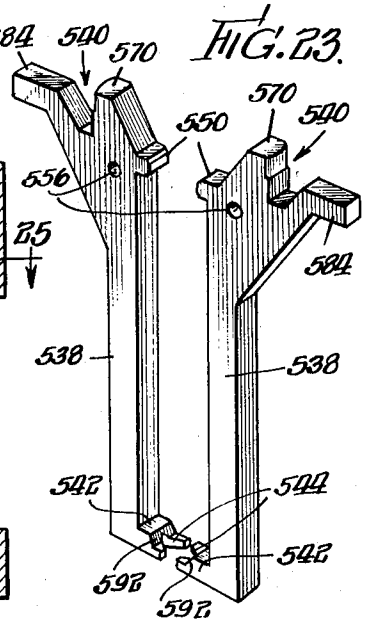


FIG. 26.

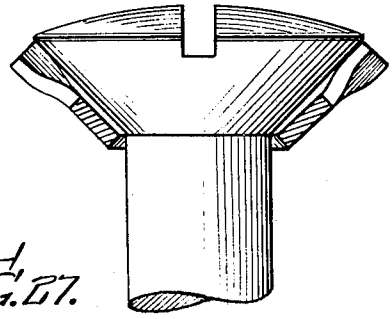
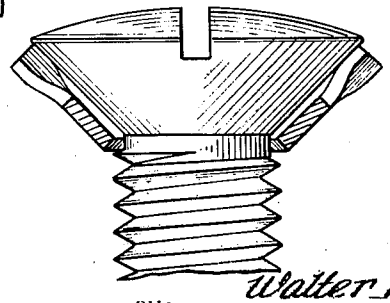


FIG. 27.



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WASHER FEEDING MEANS

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FIG. 28.

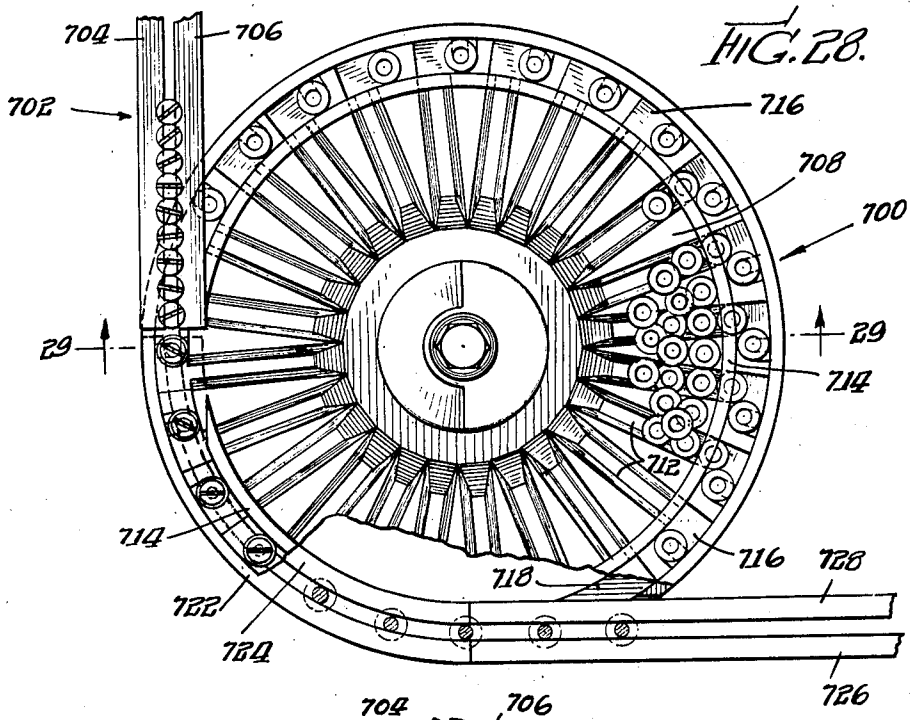


FIG. 29.

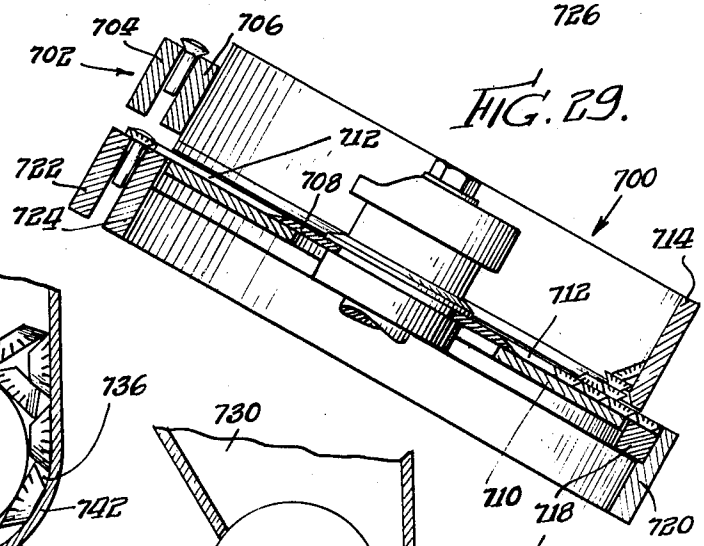


FIG. 30.

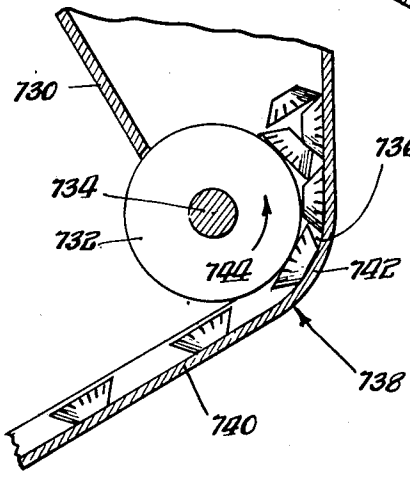
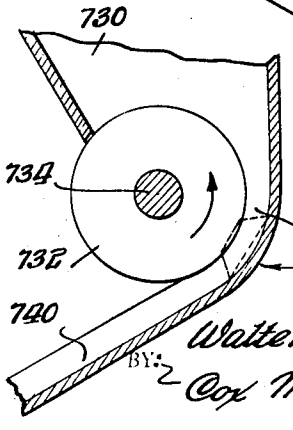


FIG. 31.



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FIG. 32.

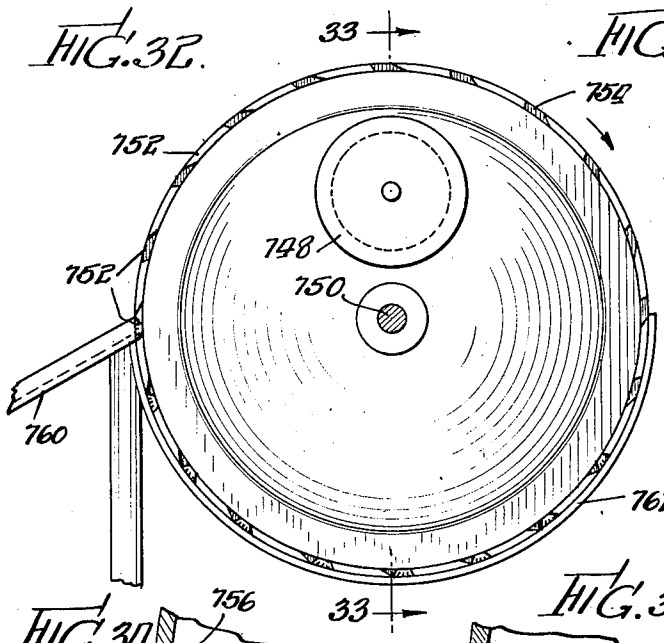


FIG. 33.

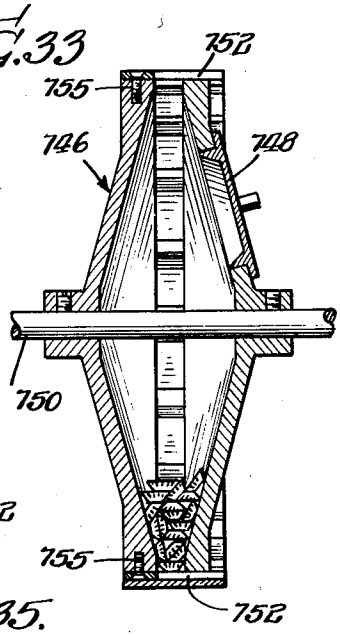


FIG. 34.

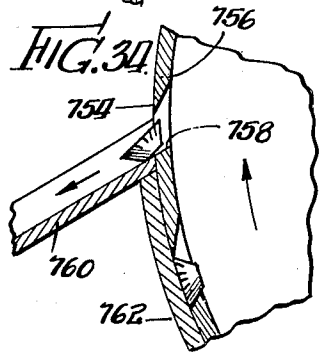


FIG. 35.

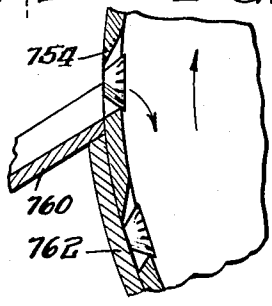


FIG. 36.

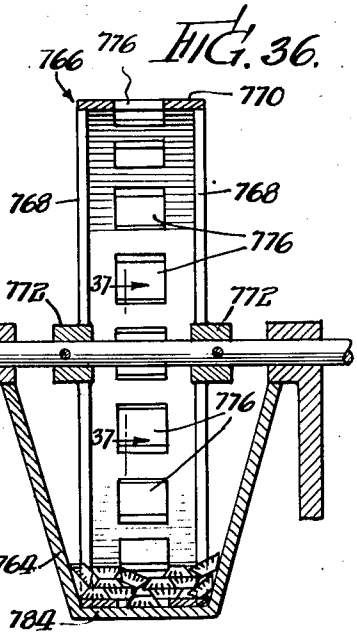


FIG. 37.

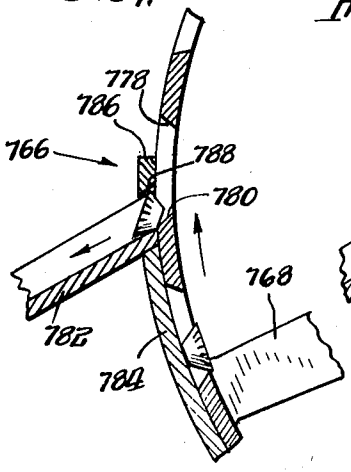
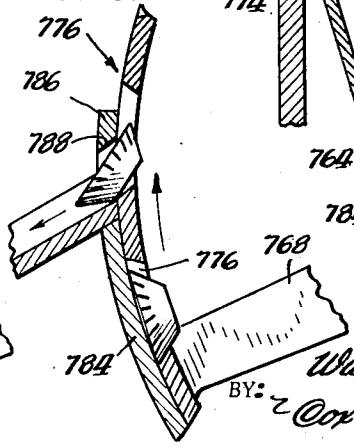


FIG. 38.



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Patented June 8, 1943 2,321,548

UNITED STATES PATENT OFFICE

2,321,548

WASHER FEEDING MEANS

Walter M. Hanneman, Oak Park, Ill., assignor to Illinois Tool Works, Chicago, Ill., a corporation of Illinois

Application July 8, 1940, Serial No. 344,359

16 Claims. (Cl. 10—169)

This invention relates to a machine for assembling screws and washers, and more particularly to a machine or mechanism for assembling screws and countersunk washers.

It is an object of this invention to devise a machine or mechanism for assembling screws and washers, particularly screws and countersunk washers, which shall so anchor such a washer to a screw that the assembly may be handled thereafter as a unit.

It is a further object of this invention to devise a machine or mechanism for producing as an article of manufacture a unit assembly of a screw and a countersunk washer.

Countersunk washers, i. e., washers of frustoconical configuration, have a tendency to bunch up and stack while being fed to a much greater extent than flat washers, and it is therefore an important object of applicant's invention to provide means for automatically feeding countersunk washers from a mass of such washers to deliver the washers each in a predetermined position.

It is also an object of this invention to devise a machine for feeding countersunk washers and screws having frustoconical heads to a mechanism assembling such screws and washers and producing a unit assembly of a countersunk washer and a screw having a frustoconical head.

A further object of the invention is to provide a machine or mechanism for feeding or conveying countersunk washers from a receptacle or hopper containing a random mass of such washers.

It is also an object of applicant's invention to devise a machine or mechanism for feeding countersunk washers and screw elements with frustoconical heads in proper juxtaposition and alinement for assembly.

Other objects and advantages of this invention will be apparent from the following description, when taken in connection with the accompanying drawings, wherein certain preferred embodiments of the invention are illustrated, and wherein—

Figure 1 is a fragmentary view, in side elevation, of a machine emboding my invention;

Figure 2 is a fragmentary view, in elevation, of the rear end of the machine shown in Figure 1;

Figure 3 is an enlarged fragmentary plan view of the machine shown in Figure 1;

Figure 4 is a fragmentary view in vertical section taken along the line 4—4 of Figure 3;

Figure 5 is a view in perspective of the washer hopper;

Figure 6 is an enlarged fragmentary view, in vertical section, taken substantially along the line 6—6 of Figure 3;

Figure 7 is an enlarged fragmentary view, in vertical section, taken along the line 7—7 of Figure 3;

Figure 8 is a fragmentary generally horizontal section taken along the line 8—8 of Figure 6;

Figure 9 is a fragmentary view in elevation and partly broken away, taken along the line 9—9 of Figure 8, and showing a washer feed gate forming part of the washer feeding means;

Figure 10 is a fragmentary view, in generally horizontal section, taken along the line 10—10 of Figure 6;

Figure 11 is a fragmentary view, in perspective, of a washer feeding disk on part of the washer feeding means;

Figure 12 is a fragmentary view, in generally vertical section, taken along the line 12—12 of Figure 8;

Figure 13 is a fragmentary view, in generally vertical section, taken along the line 13—13 of Figure 8;

Figure 14 is a fragmentary view, in vertical section, taken along the line 14—14 of Figure 13;

Figure 15 is a fragmentary view, in perspective, of a conduit receiving excess washers from the washer feeding means;

Figure 16 is a fragmentary view, in generally vertical section, taken substantially along the line 16—16 of Figure 3;

Figure 17 is a fragmentary view, in enlarged vertical section, taken along the line 17—17 of Figure 16;

Figure 18 is an enlarged fragmentary view, in section, taken along the line 18—18 of Figure 17;

Figures 19 and 20 are views, in perspective, of parts of a washer detector mechanism suspending actuation of the assembly mechanism under certain conditions;

Figure 21 is an exploded view, in perspective, of washer directing guides embodied in the machine;

Figure 22 is an enlarged fragmentary view, in vertical section, taken substantially along the line 22—22 of Figure 3;

Figure 23 is a view, in perspective, of the screw clamping jaws of the assembling mechanism shown in Figure 22;

Figure 24 is a fragmentary view, in vertical section, through the jaws illustrating clamping of a screw by the jaws of Figure 23;

Figure 25 is a horizontal section taken along the line 25—25 of Figure 24;

Figure 26 is a view, in vertical elevation, of a screw blank and lock washer assembly prior to the rolling of the threads on the blank;

Figure 27 is a view, in vertical elevation, similar to Figure 26, but with the threads rolled on the blank and holding the washer in position thereon;

Figure 28 is a fragmentary plan view illustrating a second form of washer feeding means;

Figure 29 is a fragmentary view, in section, taken along the line 29—29 of Figure 28;

Figure 30 is a diagrammatic view, in vertical section, showing another form of washer feeding means;

Figure 31 is a view, similar to Figure 30, for explanation of operation of the washer feeding means shown in Figure 30;

Figure 32 is a diagrammatic view, in vertical elevation, illustrating another form of washer feeding means;

Figure 33 is a view, in vertical section, taken along the line 33—33 of Figure 32;

Figures 34 and 35 are enlarged fragmentary views of a portion of Figure 30 showing the operation of this form of washer feeding means;

Figure 36 is a diagrammatic view, in vertical section, of still another form of washer feeding means; and

Figures 37 and 38 are fragmentary views, in vertical section, taken substantially along the line 37—37 of Figure 36 for illustrating the operation of the washer feeding means of Figure 36.

As shown in Figures 1 to 25, inclusive, of the drawings, a machine, which forms one embodiment of the present invention, comprises a screw thread rolling machine of standard type, such as shown in Wilcox Patents 1,584,263, of May 11, 1926, and No. 1,798,919, of March 31, 1931, in which is provided a self-contained, self-powered attachment, by which said machine may be adapted for the production of permanently assembled countersunk washers and screws with frustoconical heads. Auxiliary elements hereinafter described may be provided by way of refinement of this standard screw thread rolling machine to facilitate adjustment of the machine to accommodate the attachment and improve the operation of such machine for this purpose. This attachment preferably comprises a washer hopper container or receptacle 2 (Figure 1), a washer feeding mechanism 4, an assembly mechanism 6, a driving mechanism 8, and a mounting means 10 for the washer feeding mechanism 4, the assembly mechanism 6, and driving mechanism 8.

The screw thread rolling machine comprises a main base or pedestal 12; an auxiliary base or body 14 secured or formed integral with the base 12 and inclined at an angle of approximately thirty degrees to the horizontal; a hopper 16 for receiving a mass of screw blanks; a screw blank feeding mechanism 18 for discharging the blanks from the hopper 16 onto the guide chute 20; a pair of thread rolling dies 22 and 24 (Figure 3); a starter mechanism 26; a transfer mechanism 28; and a driving mechanism, parts only of which are shown, for driving the screw blank feed mechanism 18, the movable thread rolling die 24, the starter mechanism 26, and the transfer mechanism 28.

The hopper and feed mechanism for the screw blanks

As shown in Figures 1 to 3, inclusive, the hopper 16 and feed mechanism 18 for the screw blanks comprise a hopper casting or member 30 fastened to auxiliary block 32 which is provided to raise the level of the casting 30 and the upper portion of the guide chute 20. The block 20 is adjustably mounted on a standard hopper supporting casting 34 for adjustment at right angles to the guide chute 20. The casting 34 is, in turn, adjustably mounted upon a casting 36 for adjustment of the hopper casting and the upper portion of the guide chute parallel to the plane of inclination of the guide chute. The casting 36 is mounted upon the rear of the base or pedestal 12 in a manner to permit adjustment of the castings 36 and 34, the hopper casting 30, and the upper portion of the guide chute vertically at right angles to the guide chute. The guide chute 20 which may comprise the guide bars of the standard machine rearranged in accordance with the following description, or which may comprise substitute guide bars attachable to the standard machine in the following manner, includes an upper section 38 and a lower section 40, each of which sections comprises a pair of laterally spaced bars, the bars of the upper section being indicated by the reference numerals 42 and 44, and the bars of the lower section being indicated by the reference numerals 46 and 48.

The upper section 38 of the guide chute 20 is carried by the hopper casting 30, the outer bar 42 being bolted to the hopper casting, and the inner bar 44 being bolted at its upper end to a plate 50 (Figure 2) adjustably mounted as by bolts 52 passing through enlarged openings in the plate into the hopper casting 30, which casting carries an adjusting screw 54, by which the plate 50 and the bar 44 may be adjusted relative to the casting and to and from the bar 42. The bars 42 and 44 of the upper section are supported intermediate their ends upon a U-shaped bracket 56 (Figures 3 and 10) carried by a bracket 58 (Figure 10) secured to or forming a part of the common mounting means 10, the bar 42 being adjusted in position by a screw 60 (Figure 3).

The guide bars 46 and 48 of the lower section 40 of the guide chute are in two parts (see Figure 16). The upper part is displaced horizontally and vertically from the bars of the upper section of the guide chute, as shown in Figure 3, and the two parts of the bars of the lower section are connected by curved, relatively thin strips 62 and 64 (Figures 3, 8, and 16) spaced apart at all points a distance equal to the spacing between the guide bars 42 and 44 and the guide bars 46 and 48. The strips 62 and 64 are secured each at its opposite ends to the guide bars as by screws 66 (Figure 16). The guide bars 46 and 48 which form the lower section 40 of the guide chute, are mounted for relative adjustment upon a guide bar supporting bracket (not shown) of the standard machine.

A cover plate 68 (Figures 1, 3, 6, 12, and 16) overlies each section of the guide chute 20 so as to extend over the heads of the screw units in each of the sections of this guide chute. To facilitate proper adjustment of the cover plates to accommodate screws having different size heads, there may be provided a strap, or straps, 70 (Figures 1, 3, and 6) for each section of the guide, the strap, or straps, 70 being each secured to the upper guide bar as by a screw 72 (Figure 6). Each strap 70 carries a pin or bolt 74 having a concentric portion rotatably received in a circular opening in the strap and an eccentric portion 76 passing through an opening in the cover plate 68. A spacer sleeve 78 (Figure 3) may be received on a pin or bolt 74 between the cover plate 68 and the strap 70. Upon rotation of the pin or bolt 74 a very fine adjustment of the cover plate relative to the guide bars may be effected.

Screw blanks are fed from the mass in the hopper 16 onto the upper section 38 of the guide chute 20 by a reciprocating plate 80 (Figure 1) slidably mounted in guideways formed in the

hopper casting. The plate 80 is operated by a driving mechanism which includes a crank disk 82 connected to the plate 80 by a link or pitman 84. In raising the hopper casting by the insertion of a block 32, it becomes necessary to substitute a pitman of shorter length, and such pitman may therefore be supplied with the attachment for the conversion of the standard thread rolling machine. A clearing device 86 of conventional structure insures an uninterrupted procession of blanks down the upper section of the guide chute and prevents clogging of the passage from the hopper. It comprises a power actuated shaft 88 driving a clearing wheel or ratchet 90 by means of pulleys 92 and belt 94. The clearing wheel 90 is carried by the shaft 96, in turn carried by a bracket 98 adjustably secured as by bolt 100 to the forwardly projecting arm 102 of the hopper casting, so that the clearing wheel may be adjusted by the screw 104 toward and from the guide bars 42 and 44 to accommodate screws having heads of different sizes.

The hopper and the feed mechanism for the washers

As shown in Figures 1, 3, and 5 to 21, inclusive, the washer hopper and the feed mechanism for the washers comprise the hopper 2 preferably formed of sheet metal, as best shown in Figure 5. As shown in this figure, the hopper has a bottom plate or wall 106, a forward wall 108, and a side wall 110. A portion of the bottom wall is deformed or depressed to form a relatively broad washer conveying channel or chute 112 disposed opposite to the side wall 110. The channel 112 has a bottom wall 114 and opposed side walls 116 and 118, the forward wall 108 of the hopper extending forwardly as at 120 to form a continuation of greater height of the side wall 116. The bottom plate or wall 106 of the hopper is inclined downwardly from the side wall 110 toward the channel 112, so that the washers dumped in the hopper will gravitate along this plate into the channel, and will then gravitate along the channel as a relatively broad stream of washers. The hopper 2 is adapted to be mounted on the hopper casting 30 for convenient angular adjustment in a vertical plane. The mounting means for the hopper comprises a strap, bar or plate 122 (Figure 3) adjustably secured as by the pivot bolt 100 to the forwardly projecting arm 102 of the hopper casting 30 and a generally U-shaped bracket 126 (Figure 5) fastened in a convenient manner to the lower end of the plate 122 and to the walls 114, 118, and 120 of the washer conveying channel 112 of the hopper.

The channel 112 conveys washers from the hopper and dumps them onto the rear surface portion of a rotating disk 128 (Figures 3, 6, 8, and 9) of the washer feed mechanism 4. The rotating disk 128 forms part of an auxiliary hopper 130, as best shown in Figure 6, and is mounted upon the smoothly machined surface of a stationary plate 132 having an enlarged opening, in which is journaled a disk 134 fastened to the disk 128 as by the angularly spaced screw 136, and pinned to the upper end of a stud shaft 138 as by the radial slot 140 receiving the squared end of the shaft.

The stationary plate 132 and the washer feed disk 128 are mounted as will presently be described so as to incline at an angle preferably equal to the angle of inclination of the guide chute 20. The disk 128 has an upstanding annular circumferential flange or rim 142 having threaded angularly spaced openings extending in the direction of the axis of the disk to receive pins or screws 144 (Figures 6 and 8) by which a ring 146 and a ring 148 are fastened in superimposed relation to the rim of the disk 128. The ring 146 forms the enclosing wall of the hopper 130. The ring 148 is interposed between the ring 146 and the rim 142 of the disc 128 and is of a thickness which is substantially greater than the thickness of the rim 146 and the rim or flange 142. The bottom annular surface 150 of the ring 148 therefore overhangs the disk 128 inwardly of its rim 142, and this surface 150 is spaced from the overhung surface of the disk a distance slightly greater than the axial height of the countersunk washers to be assembled. The upper surface 152 of the inner surface of the ring 148 is beveled or tapered downwardly so that washers collecting on this surface will tend to gravitate onto the surface of the disk 128 and will not tend to remain on the surface 152.

The rim or annular flange 142 of the disk 128 is provided with a plurality of angularly spaced openings 154 having opposed oppositely inclined walls so that the openings conform in configuration to the countersunk washers to be assembled. Thus, the rim 142 with the openings 154 provides a washer feed gate permitting countersunk washers properly positioned on the disk 128 with their edge of largest diameter facing upwardly and with their teeth, in the case of countersunk lock washers, extending upwardly to pass from the auxiliary hopper 130 while at the same time preventing washers positioned on any other edge or inverted from passing from the auxiliary hopper 130.

Baffle plates 156, spaced angularly about the hopper wall 146, extend radially inwardly from the inner surface of this wall above the disk 128 and are fastened in any convenient manner, as by welding, to the rim 142. These baffle plates, as the disk 128, the ring 148 and the hopper wall 146 rotate, serve to agitate the mass of washers fed to the disk along the channel 112 so as to free the washers from each other and also serve to pick up washers in the forward lower part of the hopper and return them to the rear upper part of the hopper so that they may again gravitate along the surface of the disk 128 and, if properly positioned, fall into and pass through the openings 154.

The shaft 138, which drives the washer feed disk 128, is journalled by bushing 158 in a boss 160 formed in the bottom wall of a housing casting 162. The housing casting 162 has an annular wall portion 164 supporting the stationary plate 132, which is secured to the housing as by screws 166 received in threaded bosses 168 formed in the annular wall portion 164. The shaft 138 is driven by a worm wheel 170 keyed thereto, the worm wheel 170 being driven by a worm 172 formed on or keyed to a shaft 174. The shaft 174 is journalled by bushings 176 (Figure 10) in opposed bosses 178 formed in opposite wall portions of the housing casting 162. The shaft 174 carries at one end a retaining collar 180 and at the other end a 3-step speed-changing pulley 182. The pulley 182 is driven by the belt 184 from the 4-step speed-changing pulley 186 on the countershaft or stud 188. The speed change, which may be effected by shifting the belt from one complementary set of pulley grooves to another, permits the proper proportioning of the speed of the disk 128 as required for the most efficient feeding of washers of different size. For the feeding of washers of different size, the

disk 128, shown in Figures 6 and 8, is replaced by a like disk having a greater or less number of openings 154 of larger or smaller size depending upon the size of countersunk washers to be fed.

From the auxiliary hopper 130, the washers passing through the openings 154 are received on the smooth surface of a plate 190 (Figure 21) secured to the stationary plate 132 as by screws 192 (Figure 8). The plate 190 has a circular inner edge 194 conforming to the outer edge of the disk 128, contacting therewith and extending about the edge of the disk an angular distance which, as shown in Figure 8, is slightly greater than 90 degrees.

Since the auxiliary hopper 130 is inclined, the washers will not of course pass out of the openings 154 above the transverse center line of the disk 128, and washers are prevented from moving out of the openings 154 except upon the plate 190 by a curved plate or retaining wall 196 secured to the stationary plate 132 and extending about the rim 142 of the disk 128 in the plane of the openings 154. The mounting means for this curved plate or retaining wall member comprises a screw 198 loosely passing through an opening in the plate 196 and threaded into the plate 132. The coil spring 200, interposed between the outer surface of the plate 196 and the head of the screw 198, resiliently urges the plate against the rim of the disk 128. Adjacent its inner end, the curved plate 196 has an enlarged opening 202 through which passes a pin 204, carried by the plate 132. Thus, if a washer becomes jammed in an opening 154 in the rim of the disk 128 so that it exerts an appreciable force against the inner surface of the curved plate 196, this plate may tilt or pivot outwardly about the pin 204 and against the urge of the spring 200 so that the disk will not be held against movement by a washer so positioned but will, upon the yielding of the curved plate 196, carry the washer onto the plate 190.

The washers slide on the edges of smallest diameter downwardly along the surface of the plate 190 onto the upper smooth surface of a bar 206 (Fig. 21) fastened to a supporting bracket as by the screws 208 and 210 (Fig. 8). The upper surface of the bar 206 extends in the same plane with the surface of the plate 190 (see Figure 6) so that the washers may slide across the bar into the countersunk, outwardly opening recesses, notches, grooves or openings 212 of a rotary washer feed disk 214. The recesses 212 are spaced angularly and in a continuous series about the periphery or circumference of the disk 214 (see Fig. 8). The three sides of each recess 212 are tapered or beveled outwardly and downwardly to conform in configuration and size to the countersunk washers to be assembled.

The disk 214 (see Fig. 6) extends in the same common plane with the upstanding annular rim 142 of the feed disk 128 and the disk 214 has its lower surface in the same common plane with the upper surface of the plate 190 and the bar 206. A ring 216, having a hardened, smooth upper surface, rotatably supports the peripheral portion of the disk 214 and is secured in any convenient manner to a housing casting 218. It will be noted that the ring 216 extends beneath the washer-receiving notches of the disk 214 so as hold the washers in these notches as against downward movement and guide the washers during the rotation of the disk. The upper surface of the ring 216 lies in the same plane with the upper surface of the bar 206 and also in the same plane with the upper surface of the guide bars 46 and 48 of the guide chute. The ring 216 is circumferentially relieved (Figure 8) to receive the upper end portions of these guide bars 46 and 48 so that the disk 214 carries the washers from the surface of the ring onto the surface of the guide bars at their upper ends.

The bar 206 has a circular edge portion 220 (Figure 21) to abut the peripheral edge of the ring 216, as shown in Figure 8, and a straight edge portion 222 to abut the straight edge portion 224 of the plate 190.

Guide plates or bars 226 and 228 (Figures 8 and 21) are fastened to the surface of the plate 190 and the bar 206, as by screws 192, 208 and 210, and form a restricted passage or throat for directing the washers toward the notched feed disk 214. The plate 226 is provided with an inwardly directing guiding edge 230 for directing the washers inwardly to this restricted passage or throat. The bar 228 at its upper edge abuts the lower edge of the curved plate 196 and is curved as at 232 to cause the washers to freely pass by the lower edge of the curved plate 196. Below the curved edge 232, which forms with the lower edge of the plate 226, the restricted passage or throat above described, the bar 228 as its inner edge inclines outwardly, as at 234, and then forwardly along a straight line, as at 236, so that the washers may be distributed about a greater portion of the periphery of the recessed feed disk 214.

A cover plate 238, preferably of a transparent material such as "Lucite," extends over the plate 190, the bar 206, the guide plate 226, the guide bar 228, and over the upper portion of the recessed feed disk 214, as shown in Figures 3, 6, 8, and 12 to 14. The cover plate 238 prevents washers from collecting or accumulating one upon the other as they pass along the plate 190 and the bar 206, and also prevents washers from collecting, accumulating, or passing over the surface of the recessed feed disk 214. The transparency of the plate 238 permits the operator to visually observe the feeding of the washers, to take whatever steps may be necessary if the feeding of the washers is interfered with in any way or to stop the machine if the supply of washers becomes exhausted. This plate 238 is secured to the plate 132 and the bar 206, as by the pin or screw 210 and a similar pin or screw 240 (Figures 8, 12 and 13). Coil springs 242 interposed between the heads of the screws 210 and 240, and curved washers 244, resting on the surface of the plate 238, resiliently hold the cover plate 238 on the guide plate 226 and guide bar 228. The thickness of the guide plate 226 and the guide bar 228 is such that the cover plate is spaced from the plate 190 and the bar 206 a distance slightly greater than the normal axial thickness of the countersunk lock washers, and slightly above the surface of the notched feed disk 214. The coil springs 242 permit the cover plate to be displaced or yield upwardly if a washer or object of slightly greater-than-normal thickness should pass onto plate 190, or if washers should become interlocked or pile up so as to jam between the cover plate and the plate 190.

The inner edge 246 (Figures 8, 13, 14 and 21) of the bar 206 is inclined downwardly to direct excess washers into the mouth of the vertically positioned receptacle 248 (Figures 8, 13, 14 and 15). The curved edge surface 220 of the bar 206 is, in line with the end edge 246, notched as

at 250 (Figure 21), so that washers which may be interlocked with washers in the recesses of the disk 214 will be engaged by the forward edge of this notch there to be freed from the other washers and caused to fall onto the surface 246 and into the receptacle 248. The receptacle 248 may be secured to the wall of the housing casting 218, as by a screw 252 (Figure 14) received in a lug 254 struck from the receptacle. The mouth of the receptacle 248 may be formed by the outwardly flaring upper edge portions 256, 258 and 260 so as to catch washers which are tossed from the disk or from the surface of the bar 206. The receptacle 248 is connected by a tube or conduit 262 (Figures 6 and 13) to a receptacle or pan 264 (Figure 3).

In order that the washers may not pass in a mass directly from the bottom of the channel 112 to the bottom forward part of the auxiliary hopper 130, but will be spread over the surface of the dissk 128 at the upper end of the hopper 130, a baffle plate 266 (Figures 3 and 7) is adjustably secured as by a screw 268 passing through a slot 270 into side extension wall 120 of the channel.

The housing casting 218 (Figure 6) is slidably mounted for adjustment toward and from the guide chute 20 on the shelf 272 (Figures 1, 4, 6, 8 and 10) of the bracket 274, which forms part of the common mounting means 16. The bottom wall 276 of the housing 218 is supported upon the surface of the shelf 272 and is received between the outstanding guide flanges 278 of the shelf 272. Screws 280, threaded into the bottom wall 276, are received within the enlarged openings or slots 282 in the shelf 272 and retain the housing in adjusted position. An adjusting screw 283 (Figs. 8 and 10), carried by recessed block 284, secured to the shelf 272, is received in a threaded opening in an outwardly projecting lug or boss 286, formed upon the housing 218 so that upon manipulation of the screw, the housing and parts carried thereby may be moved toward and from the guide chute whereby the washers, when positioned in the upper end of the lower section of the guide chute 20 will be aligned with the common longitudinal center line of the upper and lower sections of the guide chute.

The bracket 274 is supported on the auxiliary base or body 14 by the depending reinforcing portion 288 (Fig. 6), bearing upon the shelf 289 of the auxiliary base or body, and is secured thereto as by screws 290. Bracket 274 has a depending portion 292 extending in overlapping relation to the outer vertical wall surface of the auxiliary base or body 14, and carries an adjustable set screw 294 (Figs. 1 and 4) which bears against this surface of the auxiliary base and is secured in adjusted position as by a clamping nut 296. Side flanges 298 of the depending portion of the bracket provide reinforcing webs for the shelf portion 272.

The recessed feed disk 214 is interposed between the collar 300 (Figure 6) and a ratchet and index wheel 302, to which collar and ratchet the disk is secured for simultaneous rotation as by pins or screws 304. The disk 214, collar 300 and the ratchet 302 are journalled upon a sleeve 306 on which they are held against axial movement by an annular shoulder 308 of the sleeve, and an adjustable collar 310 threaded on the upper end of the sleeve. Springs 312 received in angularly spaced openings in the surface of the ratchet engage the disk 214 to raise the same from the ratchet whereby to facilitate removal of the disk upon removal of the collar 310. The sleeve 306 is in turn journalled upon the upper hub portion 314 of a cam 316, which is in turn journalled upon a fixed stud shaft 318. The stud shaft 318 is mounted in the boss 320 formed in the bottom wall 276 of the housing 218, and is secured thereto as by set screw 322. A worm wheel 324 journalled on the stud shaft 318 is driven by a worm 326, keyed to a shaft 328, the worm wheel 324 being connected to the cam 316 by the key or spline connection 330. The shaft 328 (see Figure 10) is journalled by bushing 332 in the inwardly projecting boss 334 formed with or secured to housing casting 218, and by anti-friction, roller bearing 336, bushings 338 and 340 and a sleeve 342, in an inwardly projecting boss 344 and an outwardly projecting boss 346. Bosses 344 and 346 may be secured to or formed upon housing casting 218. The shaft 328, with the worm 326 attached and the roller bearing 336 mounted thereon, may be inserted into the housing through an opening 348 extending through the bosses 344 and 346. The sleeve 342, with the bushings 338 and 340 pressfitted thereto, is then inserted into the opening 348. This sleeve is formed with an annular flange 350 by which it may be bolted to the boss 346 as by the screws 352. The shaft 328 is driven by an electric motor 354 (Figure 1) through a part of the driving mechanism 8. The motor 354 is mounted upon a depending arm 356 of a bracket 358 (Figures 1 and 6) bolted to the bracket 274 as by screws 360 received in threaded openings in a rearwardly projecting flange 362 (Figs. 1 and 4) of the bracket 274. The motor is connected to the shaft 328 by a belt 364 (Figures 1 and 10) passing about a pulley 366 secured to the motor shaft, and a pulley 368 secured to the outer end of the shaft 328.

The ratchet wheel or index plate 302 is intermittently driven by a dog or pawl 370 (Figure 10) journalled at one end on a pivot pin 372. Pin 372 is in turn pivotally received in one end of a lever 374, the hub portion 376 (Figures 6 and 10) of which is journalled upon a cylindrical bearing member or sleeve 378, having an enlarged adjusting head 380 of preferably hexagonal configuration. The bearing 378 is eccentrically bored to receive a mounting stud 382 threaded into the bottom wall 276 of the housing casting 218, and has an enlarged slotted head 384 to retain the bearing 378 against axial movement and to permit the bearing to be adjusted eccentrically about the axis of the stud 382 by applying a suitable tool to the adjusting head 380 of the bearing. The hub portion 376 of the lever 374 is also formed with angularly spaced arms 386 and 388, the arm 388 carrying a roller or cam follower 390 engaging the surface of the cam 316. The roller or cam follower 390 is held in engagement with the surface of the cam 316, and the tooth of the pawl 370 is held in engagement with the tooth of the ratchet wheel or index plate 302 by a coil spring 392 interposed between the head 394 of a rod 396, and a bracket 398 secured to the housing casting 218. The rod 396 is slidably mounted in an opening in the bracket 398, and its head 394 bears against a block 400 formed on the outer end of the lever arm 386. The lever arm 386 passes from the housing casting 218 through a circumferential slot 402 (Figure 6).

A coil spring 404 is anchored at one end, as by the pin 406, to a projecting lug 408 formed upon the pawl 370, the other end of the coil spring 404

being anchored, as by a pin 410, to an indexing pawl or dog 412. The indexing pawl or dog 412 is pivotally mounted at one end upon a bearing member or sleeve 414 eccentrically bored to receive the threaded mounting stud 416 having an enlarged slotted head retaining the bearing member against axial movement and detachably securing the bearing member to the bottom wall 276 of the housing 218. The peripheral surface of the bearing member 414 beneath the pawl 412 may be provided with tool receiving slots or openings by which the bearing member may be rotated about the eccentric axis of the mounting stud so as to bring the tooth of the indexing pawl into proper mating relation with teeth of the ratchet or index wheel 302.

The worm wheel 324, which drives the cam 316, also through this cam drives a second cam 418 (Figure 6) which drives the assembly mechanism 6, as will subsequently appear. The cam 418 is journalled on the upper end of the fixed stud shaft 318, and is held against axial movement on the stud shaft by resting at its lower surface upon the hub portion 314 of the cam 316 and the sleeve 306, and by a screw or bolt 420 having an annular flange or washer 422 overlying the upper end of the stud shaft and the hub portion of the cam 418. The screw 420 is centrally bored, as at 424, throughout its entire length to permit lubricant to be injected into the axial opening 426 in the stud shaft, which axial opening communicates with a diametrical opening 428 by which the lubricant passes to a radial opening 430 in the hub 314 of the cam 316, and an axial surface groove 432 in the stud shaft 318. By this last groove, lubricant is supplied to the internal bearing surface of the worm wheel 334 and the cam 316. The radial opening 430 communicates with a surface groove 434 in the hub portion 314 of the cam 316, by which groove the lubricant is supplied to the external and internal bearing portion of the cam and the sleeve 306.

Adjustable means are provided for facilitating removal of the washers from the surface of the ring 216 to the surface of the guide bars 46 and 48, and for facilitating the return of the washers from the upper surface of the guide bars to the supper surface of the ring if no screw blank is fed by the assembly mechanism 6 into assembled relation with a washer at the upper end in these guide bars. This means comprises a wedge 436 (Figure 10) slidably mounted in a groove in the ring 216 so that the surface of the wedge lies flush with the surface of the ring and the surfaces of the guide bars 46 and 48, and this wedge is adjustably secured to an inwardly projecting portion of the wall of the tubular housing 218 as by a screw 438 secured to this inwardly projecting wall portion, and received in an elongated slot 440 in the wedge 436. The wedge 436 provides readily adjustable means for supporting the washers as they move from the surface of the ring 216 to the surfaces of the guide bars 46 and 48, and compensates for the usual manufacturing tolerances. Wedge plate 436 also facilitates adjustment of the washer feeding mechanism to accommodate washers of different sizes, for as the external diameter of the washers increases, the housing 218 with the ring 216 and the disk 214 must be adjusted outwardly relative to the inner guide bar 48. A plate 441, adjustably secured to an inwardly projecting portion of the tubular wall of the housing 218, as by screws 442 received in elongated slots 444 in this plate, abuts the outer edge of the guide bar 46 and has its upper surface flush with the upper surfaces of the bars 46 and 48 and the ring 216. This plate 441 provides readily adjustable means for facilitating the movement of washers from the upper surfaces of the guide bars to the surface of the ring 216 so that washers with which screws have not been assembled at the upper ends of the guide bars may be carried off of the surface of the guide bars and dropped into the forward part of the receptacle 264 (see Figure 3).

The auxiliary hopper 130 with its operating mechanism is mounted upon a rearwardly extending arm or shelf 446 (Figures 1, 6, 10 and 12) of the bracket 358 of the common mounting means 10, as by screws 448 passing through the shelf 446 and received in the threaded angularly spaced bosses 163 of the mechanism housing 162.

The stud shaft 188, upon which idler pulley 186 is journalled, is mounted in a boss 479 (Figure 10) formed on the shelf 446, the shaft being fixed by a set screw 472. The pulley 186 is driven by a belt 474 (Figures 1, 6 and 10) which passes about this pulley and about a pulley 476 (Figure 10) secured to the motor shaft.

Means is provided for preventing any washer with which a screw blank has not been assembled from passing down the lower section 40 of the guide chute and for rejecting such washer from this section of the guide chute. This means comprises a resilient strip 478 (Figures 3, 8, 10 and 16) carried by a block 480 fastened to the upper portion of the guide bar 48 as by the screw 482. The strip 478 extends across the lower section of the guide chute, as shown in Figure 3, so as to engage the periphery of the washer passing down the guide chute. If the washer be assembled with a screw blank, the strip will readily yield to permit the assembled screw and washer to pass downwardly of the guide chute, but if the washer be not assembled with the screw blank, the resilient strip will strike it and force it into the washer receiving pan 264.

The washer feeding means or mechanism 4 operates as follows:

Washers are dumped into the hopper 2 (Fig. 3) and move by gravity into the feed channel 112 of the hopper, along which they gravitate in a broad stream onto the surface of the washer feed disk 128. The baffle plate 266 holds back the stream or mass of washers at the bottom of the channel and causes them to spread out on the surface of the disk 128 and be carried upwardly out of the mass by the clockwise rotation of the disk.

Some of the washers pass almost immediately into openings 154 (Figs. 6 and 8) in the rim 142 of the disk 128, while others, probably the greater percentage, slide or gravitate downwardly along the surface of the disk and pass into and through the openings 154 at the forward lower part of the auxiliary hopper 130. The baffle plates 156, which extend between the ring 148 and the disk 128, serve as washer agitating means and as means for returning washers which have not passed through the openings 154 at the forward lower part of the hopper back to the upper part of the hopper. From the auxiliary hopper 130, washers pass through the openings 154 in an arcuate range of slightly greater than 90 degrees, and are directed by the guide plate 226, the guide bar 228, and the forward end of the arcuate bar 196 along the smooth hardened surface of the plate 190 and onto the bar 206. The washers gravitate across the hardened surface

of the bar 206 into the countersunk peripheral recesses, notches, or openings 212 of the rotary feed disk 214, by which they are carried upon the upper surface of the ring 216 to the upper edge of the guide bars 46 and 48 of the lower section 40 of the guide chute 20, and are positioned on these guide bars with the center aperture of each washer aligned with the common longitudinal center line of the upper guide bars 42 and 44 and the upper portions of the lower guide bars 46 and 48. An excess accumulation of washers on the surface of the bar 206 may cause certain of the washers to engage washers seated in the recesses of the disk 214, and these excess washers so engaged will thereby be carried along the surface of the bar to its beveled end edge 246, down which such washers will gravitate into the receptacle 248 and thence through the tube 262 to the washer-receiving pan or receptacle 264. Washers which may have their teeth interlocked with washers seated in the recesses of the feed disk 214 will be carried past the notched part 250 of the bar 206 and will be engaged by an edge of the notch so that as the disk continues to rotate, the washers will be separated and the excess washer fall onto the washer discharging surface 246 of the bar 206.

Interrupted or intermittent movement of the washer feed disk 214 is effected by the cam 316 (Figs. 6 and 10) and the spring 392. As the high point of the cam approaches the cam roller 390, the lever 374 is caused to move in a counterclockwise direction (as seen in Figure 10) and the pawl 370 is moved against the action of the spring 392 in a direction to move freely about the ratchet 362 a distance of one ratchet tooth. As the high point of the cam recedes from the cam roller, the lever 374 and the pawl 370 are moved by the spring 392 in the opposite direction, the tooth of the pawl engaging the ratchet tooth and causing the counterclockwise movement of the ratchet a distance of one tooth. The index pawl 412 is so adjusted that it engages between adjacent teeth of the ratchet at the proper instant to position the feeding disk attached to the ratchet precisely at the point at which the center of the notch 212 of the disk is held at the point of assembly.

The assembly mechanism

As shown in Figures 1, 3, 4, 8, 10, 16, 17, 18 and 22 to 25, the assembly mechanism 6 comprises a strap or bracket 484 (Fig. 1) of substantially inverted U-shape, detachably secured to the flanges 278 of the supporting bracket 274. A bracket 486 (Figs. 1, 3 and 4) is mounted on the bracket 484 for adjustment toward and from guide chute 20, the bracket 486 being secured to the bracket or strap 484, as by screws 488, carried by the strap and received in an enlarged opening or slot in the base of the bracket 486. An assembly head 490 is carried by the outer tubular end portion 492 (Figures 3, 4 and 22) of a casting or bracket 494 having arms 496 diverging from the tubular portion 492 and terminating in parallel arm portions 498 (Figure 3), embracing the bracket 486 and mounted thereon by pin or rod 500 fastened to spaced outstanding arms of the bracket 486. Casting 494 is additionally secured to the bracket 486 as by a bolt 502 (Figure 4) threaded into the web 504 of the casting 494 and passing through the upstanding part of the bracket 486.

The assembly head 490 comprises a tube or sleeve 506 (Figures 1, 4 and 22) slidably mounted in the tubular portion 492 of the head, and embracing a slide rod or plunger 508 relatively slidable within the sleeve 506. The plunger 508 is connected by the coupling 510 to a rod 512. The coupling 510 has an axially extending tongue 514 received in a mating diametrical slot in the upper portion of the plunger 508. The rod 512 passes through a cap nut 516, received on the threaded upper end of the tube or sleeve 506, the rod 512 carrying at its upper end adjustable movement limiting and clamping nuts 518 and 520. The nut 518 in the upper position of the assembly head is spaced a predetermined distance above the cap nut 516. Below the cap nut 516, the tube or sleeve 506 carries an adjustable movement limiting and clamping nut or collar 522 which is adapted upon the downward movement of the assembly to engage a cushioning washer 524 encircling the tube 506, and positioned upon a cap nut 526 carried by the upper end of the tubular portion 492 and clamped in adjusted position by the nut or collar 528. A coil spring 530 embraces the rod 512 and is housed within the upper portion of the tube 506, the spring 530 being interposed between the coupling 510 and the cap nut 516. Upward movement of the tube 506 relative to the tubular portion 492 is limited by the engagement of the shoulder 532 of the tube with the cap nut 526.

Adjacent its lower portion, the tube 506 is provided with an internal thread mating with an external thread of a sleeve or tubular member 534. The sleeve or tubular member 534 is provided with diametrically disposed, axially extending slots or grooves 536 receiving the shank portions 538 of complementary jaw members 540. The jaw members 540 are provided at their lower ends with jaws 542 (Figures 23 to 25) adapted to receive and support the frusto-conical heads of the screw blanks successively fed to the members. The jaws 542 have notches 544 for receiving and clamping the shanks of the screw blanks to the jaw members. As will be seen from Figure 25, the shape of the notches 544 is such that the outer edges 546 are spaced apart a lesser distance than the inner edges 548 so that when the inner edges are spaced apart sufficiently to permit the shank of a screw blank to pass therebetween, the edges 546 are spaced apart a distance less than the diameter of the screw shank and prevent the screw from falling through the jaws from the upper section of the guide chute. Each jaw member 540 is fulcrumed on the sleeve 534 by a protuberance 550 received in a notch extending inwardly from the bottom of the slot 536 (Fig. 22). The jaw members are held in assembled position with the sleeve 534 by a spiral spring 552 having its opposite, outwardly bent ends 554 received in openings 556 in the jaw members.

A sleeve 558, which determines the opening movement of the jaw members as the assembly head approaches its upper limit of movement, is secured to the fixed tubular portion 492 for micrometric adjustment relative thereto by opposed set screws 560 and 562, having frusto-conical end portions received in frusto-conical openings or notches 564 and 566, respectively, in the surface of the sleeve 558. The internal surface of the sleeve 558 at its lower end is tapered outwardly as at 568 and is adapted to engage the outer edge of the head portion 570 of each jaw member so that as the assembly head approaches its upper limit of movement, the tapered surface 568, in engaging the heads 570 of the jaw mem-

bers, causes the jaw members to fulcrum relative to the sleeve 534 about protuberances 550, and thereby move the jaws apart a predetermined distance to the proper position to receive the foremost screw blank from the upper section 38 of the guide chute 20. The jaw members 540 are moved to closed position by a coil spring 572 embracing the lower portion of the sleeve 534, and a sleeve 574 slidably mounted on the sleeve 534 and interposed between an annular flange 576 of the sleeve 534 and an annular flange 578 of the sleeve 574. The annular flange 578 bears upon the upper edges of the heads 570 of the jaw members 540, outwardly of the fulcruming protuberances 550, so that the jaw members when out of engagement with the tapered surface 568 of the fixed sleeve 558 are urged toward each other to clamp the screw blank between the jaws 540. The jaw members are moved to full open position as the assembly head approaches its lower limit of movement by an adjustable stop provided by a nut or collar 580 on the lower end of the fixed tubular portion 492, and held in adjusted position by the clamping nut or collar 582. The heads 570 of the jaw members are provided with outwardly extending lugs or arms 584 which are received in slots or openings 586 in the lower part of the tubular portion 492.

As the assembly head approaches its lower limit of movement, the arms 584 of the jaw members engage the upper edge of the collar or nut 580, and consequently as the sleeve 534 continues its downward movement, the jaw members are rotated oppositely to full open position, releasing the shank of the screw element and permitting the head thereof to pass downwardly between the jaws 542. The reduced part or plunger 588 of the plunger rod 508 is slidably received in the reduced bore of the lower portion 590 of the sleeve 534. The rod 588 extends substantially below the sleeve 534 and in the upper position of the assembly head is spaced a slight distance above the head of the screw resting upon the jaws 542. The distance between this rod and the head of the screw is substantially equal to the distance between the nut 518 on the rod 512 and the cap nut 516 when the assembly head is in its upper limit of movement.

The jaws 542 are provided with oppositely tapering surfaces 592 forming seats for the frusto-conical head of the screw to be assembled.

The assembly head is operated by the previously mentioned cam 418 (Figs. 1, 3, 4, 6 and 8) mounted on the upper end of the stationary stud shaft 318 (Figure 6) of the washer feeding means 4, the cam 418 being driven by the cam 316 as previously described. The cam 418 is formed with an upper cam surface having two active portions, one of which raises a plunger rod 594 (Figure 4) and the other of which permits lowering of the plunger rod, and two dwell portions, one of which maintains the plunger in its upper position for a given period and the other of which allows the plunger to remain in its lower position for another given period.

The plunger rod 594 is slidably mounted in a bushing formed with the shelf portion 598 integrally with the web 504 of the assembly head support casting 494. A lever 600 pivotally mounted on the pin 500 carried by the bracket 486 is raised by the plunger 594 through an adjustable set screw 602 secured in adjusted position by a clamping nut 604 and is lowered by a coil spring 606 anchored at one end to a pin 608 carried by an arm 496 of the head supporting casting 494 and at its other end the spring is anchored to a pin 610 projecting inwardly in a tube 612, press-fitted or otherwise secured at its lower end to the lever 600. The tube 612 permits the use of a relatively large spring 606, notwithstanding the relatively close position of the lever with respect to the casting 494. A ball-headed pin 614 (Figure 22) is press-fitted into the free end of the lever 600 and is seated in a slot 616 in the enlarged portion of the plunger or rod 508. The head 618 of the pin 614 may be formed with flat side surfaces and the slot 616 may therefore take a rectangular configuration. The pin 614 passes through relatively elongated slots 620 and 622 in the tubular portion 492 of the head supporting casting 494 and the tube or sleeve 506 respectively.

The assembly mechanism operates as follows:

The cam 316 (Figures 6 and 10) of the washer feeding means is driven in a clockwise direction as seen in Figure 10 to effect through the spring 392 interrupted or intermittent movements of the washer feeding disc 214 in a counterclockwise direction. Each revolution of the cam 316 effects movement of the washer feeding disc an angular distance corresponding to the distance between successive washer receiving notches. For each revolution of the cam 316, the cam 418 also makes a single revolution, and since the assembly head must necessarily make one complete cycle of movement for each revolution of the cam 418, the head completes one cycle of movement for each interrupted movement of the washer feeding disc. The washer feeding disc having positioned a washer on the upper parts of the guide bars forming the lower section of the guide chute and holding the washers stationary on these guide bars, the plunger 594 is permitted by the cam 418 to move to its lower position so that the spring 606 carries the lever with its ball-headed pin 614 to its lower position. In moving from its upper to its lower position, this lever 600 by means of the pin 614 first causes the plunger 508 to move downwardly a limited distance relative to the tube or sleeve 506 until the plunger rod 588 engages the head of a screw blank in the jaw member 540, or until the nut 518 engages the cap nut 516.

The tube 506 thereafter moves downwardly with the plunger 508 and the jaw members 540. In the preliminary portion of the downward movement of the jaw members, their heads 570 move along the internal tapered surface 568 of the sleeve 558 and coil spring 574 accordingly moves these jaw members toward each other so that the shank of the screw blank is clamped in the notches 544 of the jaws 542.

As the lever 600 approaches its lower limit of movement, the arms 584 of the jaw members engage the stop collar 580 and as the plunger rod 508 and the tube 534 continue their downward movement, the jaw members are rotated by the stop collar in opposite directions to full open position, the shank of the screw blank having meanwhile been inserted through a countersunk washer positioned at the upper end of the upper parts of the guide bars 46 and 48 of the lower section of the guide chute. This opening movement of the jaw members may be so proportioned that in its continued downward movement, the plunger 588 forces the head of the screw between the head centering jaws of a

washer detecting mechanism subsequently described.

A screw blank having been assembled with a washer, the cam 418 causes a raising of the plunger 594 and thereby moves the lever 600 in an upward direction and tensions the spring 606. It is during the consequent upward movement of the assembly head, or during the time the assembly head is resting in its upper position, that the washer feeding disc is moved to carry the assembled screw blank and washer from the point of assembly and to position another washer at the point of assembly. The plunger 508 moves upwardly with the lever 600 and the upward movement of the plunger is transmitted to the tube 506 through the coupling 510 and the spring 530. As the arms 584 of the jaw members 540 move away from the stop collar 580, they are moved to closed position by the spring 552. As the tube 506 approaches its upper limit of movement, as determined by the engagement of the shoulder 532 with the cap nut 526, the heads 570 of the jaw members engage the internal tapered surface 568 of the sleeve 558 and are accordingly moved partially to open position to receive the foremost screw blank on the lower end of the upper section 38 of the guide chute 20. The tube 506 completes its upward movement just before the lever 600 reaches its upper position as determined by the cam 418 and the adjustable set screw 602, and accordingly the plunger 508 continues to move a limited distance relative to the tube 506 so as to clear the head of the screw blank and permit free gravitational movement of the screw blank into position between the jaws 542.

The coupling 510 permits downward movement of the plunger 508 relative to the rod 512 after the nut 518 has engaged the cap nut 516 so as to contact screw heads smaller than normal and also permits the plunger 508 after the tube 506 and the sleeve 534 have been stopped by the engagement of the arms 584 of the jaw members with the limit collar 580 so that the plunger may continue to push downwardly on the screw blank after the jaws have been opened.

Means are provided in cooperative association with the assembly mechanism and the washer feeding means for preventing the feeding of a screw blank if a washer has not been positioned at the point of assembly, that is, if a recess 212 arriving at the point of assembly does not enclose a washer. This means also acts to center the frusto-conical head of a screw in the countersunk washer into which it has been telescoped. This means comprises a block 624 (Figures 10, 13 and 18) secured to the bracket 398 as by the stud or bolt 626. A spacer plate 628 (Figure 19) overlies the block 624 and is interposed between the block and a relatively thin bell crank lever 630 (Figure 20). The spacing plate 628 and the bell crank lever 630 are journalled with the block 624 on the stud or bolt 626. The spacer plate 628 has arms 632 and 634, and the bell crank lever has similar arms 636 and 638, all of which arms are secured to the block as by screws 640. The ends of the arms 636 and 638 of the lever 630 are bent under as at 642 and 644 (Figure 20) to space the body of the lever from the spacing plate 628. The lever 630 also has an arm 646 to which at its free edge is riveted on the underside and inwardly from its inner edge 648 a washer engaging block 650. At its outer end the edge 646 of the lever arm 646 is beveled or tapered as at 652 to conform to the taper of the frusto-conical head of the screw blank to be assembled. A coil spring 654 is seated in an opening 656 in the end 658 of the block 624 and in a similar opening or recess in the annular wall of the mechanism housing 218.

A plate 660, generally L-shaped in elevation (as seen in Figure 17), is fastened to the lower end of the outer guide bar 42 of the upper section of the guide chute and its lateral flange 662 overlies the recessed washer feeding disc 214 as shown in Figures 17 and 18. At the assembly point, that is, beneath the assembly head, the flange 662 is cut away as at 664 so as to permit the shank of the screw blank to be inserted in a washer in a peripheral notch of the disc 214. The forward end of the inner edge of the flange 662 is tapered as at 666 to engage the frusto-conical screw head and in cooperation with the tapered edge 652 of the lever 630 center the screw precisely in relation to the countersunk washer. The flange 662 lies in the common plane with the transparent cover plate 238 and therefore prevents washers from tilting in the recesses of the disc 214 as the washers pass from beneath the cover plate to the assembly point.

If a washer is not positioned in a recess 212 when the recess is brought to the assembly point, the spring 654 causes the block 624 to move in a counterclockwise direction as seen in Figure 18, and through this block causes a similar counterclockwise movement of the lever 630. The washer detecting block 650 therefore moves through the unoccupied recess 612 and the arm 646 of the lever extends in the path of movement of a screw as it is carried downwardly by the assembly head. This stops the downward movement of the screw and through the screw the downward movement of the plunger 508 and the lever 600, and holds the assembly mechanism against operation by the spring 606 (Figure 4).

Since the jaw members 540 are thus stopped before they engage the limit collar 580, the jaws remain in closed position clamping the shank of the screw blank. When a high point of the cam 418 again comes under the plunger rod 594, the assembly head is moved upwardly to its original position with the screw blank still resting in the jaw members. It should be observed that the edge 668 of the washer detecting block 650 is beveled or tapered (Figures 18 and 20), and consequently upon the next movement of the recessed washer feed disc 214, the edge of the disc will engage this surface 668 and move the lever 630 and the block 624 in a clockwise direction as seen in Figure 18. The spring 654 has of course a sufficient tension to cause the block 624 and the lever 630 to move in a counterclockwise direction when not stopped by a washer at the assembly point, but at the same time, the tension of the spring is such that it does not impose by engagement of the block 650 with the edge of the disc 214 a substantial drag upon the disc. It should also be noted that the flange 662 of the L-shaped plate 660 overlies the rim of the washer at the assembly point as shown in Figure 17 and thereby prevents tilting of the washer under the pressure of the spring 654 acting on the washer through the block 650.

The thread rolling mechanism, the transfer mechanism, and the starter mechanism

These mechanisms which form part of a standard thread rolling machine may be conventional in structure and therefore it suffices to note briefly that the fixed die 22 of the thread rolling

mechanism is detachably clamped to a supporting block 670 (Figure 3) adjustably mounted on an upstanding arm 672 of the auxiliary base or body 14 and at its upper transverse edge forms with the upper transverse edge of the block 670 and the lower edge of a cover plate 674 for the starter mechanism and a slide bar guide, not shown, of the starter mechanism, to form an inclined chute 676 along which the assembled screw blank and washer units are transferred from the lower end of the lower section 40 of the guide chute 20 to the thread rolling mechanism.

The reciprocating die 24 of the thread rolling mechanism is detachably clamped to a reciprocating bar 678 (Figures 3 and 4), slidable in a suitable guide 680 (Figures 1 and 4), and operated by the pitman 682 (Figure 4) intermittently driven by the usual or suitable driving mechanism of the thread rolling machine. The starter mechanism 26 comprises a slide bar 684 (Figures 3 and 4), having at its forward end a starter finger 686 (Figure 3) for engaging the shank of the screw blank positioned between the upper end of the die 22 and the lower end of the die 24 so that upon forward movement of the starter bar 684, the screw blank will be firmly forced into engagement with the thread rolling surfaces of the dies 22 and 24. The starter bar 684 is reciprocated in timed relation to the die 24 by the usual driving mechanism of the thread rolling machine.

The transfer mechanism 28 comprises a reciprocating member 688 moved in an outward direction by any suitable mechanism such as a cam 690 engaging the cam roller 692 operatively connected to the reciprocating member 688 and moved inwardly by the coil spring 694. The reciprocating member 688 carries an adjustable transfer finger 696 which engages the shank of a screw blank positioned at the intersection of the chutes 20 and 676 and upon the inward movement of the member 688 carries the assembled screw blank and washer units to the thread rolling dies.

Operation of the machine

Operation of the machine will be apparent from the description heretofore given of the construction and operation of the several mechanisms.

It suffices therefore to set forth briefly the cooperative functioning of these several mechanisms. In the operation of the machine shown in Figures 1 to 25, screw blanks are fed from the hopper 16 (Figure 1) by the reciprocating plate 80 to the upper section 38 of the inclined guide chute 20. The continuously operating clearing wheel 90 controls the passage of the screws down the guide chute as previously described. From the lower end of the upper section 38 of the guide chute, the screw blanks are gravitationally fed in individual succession into the jaws 542 of the jaw members 540 (Figures 4 and 22 to 25), which when the assembly head is in its upper limit of movement, are positioned just slightly below the plane of the upper edges of the guide bars 42 and 44. Upon downward movement of the assembly head 490, a screw blank is carried downwardly in a path extending at right angles to the two sections of the guide chute so that the shank of the screw blank is inserted in the aperture of a countersunk lock washer positioned on the upper end of the lower section 40 of the guide chute and held against movement by the washer feeding disk 214 during insertion of the screw blank therethrough. After the washer and screw blank have been brought into telescoping assembled relation as shown in Figure 26, the washer feeding disc advances the assembled unit along the lower section of the guide chute and the shank of the screw blank in engaging the inner vertical wall surface of the outer guide bar 46 (Figure 8) effects the withdrawal of the assembled screw blank and washer unit from the feeding disc. These assembled units then gravitate down the lower section of the guide chute in succession to the transverse chute 676 (Figure 3) along which the units are carried or pushed by the transfer mechanism 28 into the thread rolling dies 22 and 24, the lock washer resting upon the upper surfaces of the dies and bridging the space therebetween so that the dies roll a thread upon the shank of a screw blank beneath the countersunk washer. In the process of formation of the thread, the surface material of the blank projects outwardly and the external diameter of the thread of the finished screw is greater than the diameter of the shank of the original blank as shown in Figure 27, whereby the thread permanently retains the countersunk lock washer in assembled relation with the screw.

If the washer feeding disk 214 fails to feed a washer to the assembly point, the washer detector lever 630 prevents the delivery of a screw element to the lower section of the guide chute, as previously described.

If the screw feeding means fails to deliver a screw blank to the assembly point, the washer at the assembly point will either be carried from the lower section of the guide chute by the washer feeding disk, or it will slide down the lower section of the guide chute until it is engaged by the resilient strip 478 (Figures 3 and 8). Whichever course the unassembled washer takes, it will be finally discharged into the pan or receptacle 264.

Adjustment of the machine

A number of adjustments are provided so that the washer feed mechanism 4, the assembly mechanism 6, and their drive mechanism 8 may be readily attached to the thread rolling machine and adjusted for proper operative interrelationship, and to accommodate within certain practical limits different sizes of screw blanks and washers. The bars forming the sections of the guide chute 20 may be adjusted toward and from each other in the conventional manner so as to be spaced apart the proper distance required by the shank diameter of the screw blanks.

Adjustment of the washer feeding disk 214 toward and from the guide chute, so that the centers of the washers in recesses 212 will at the assembly point lie in the center of the space between the guide bars 46 and 48, is accomplished upon release of the clamping screws 282 (Figures 4 and 6) by manipulation of the adjusting screw 283 (Figures 8 and 10) which moves the housing casting 218 toward and from the guide chute along the shelf 276 of the common mounting means 10. The washer feeding mechanism may accommodate washers of a limited range of sizes by replacement of the feeding disk 214 without, however, replacing any part of the driving mechanism for this disk; adjustment of the washer feeding means relative to the guide chute, and adjustment of the assembly mechanism being, of course, required. The washers which are not within this limited range of sizes will require the replacement of the washer feeding disk 214 by a similar disk having a greater or lesser number of notches 212. This substitution or replacement of the washer feeding disk by one having a greater or lesser number of recesses 212 requires replacement of the ratchet 302. This replacement may be

readily accomplished by first removing the screw 420 (Figure 6), after which the cam 418 may be readily removed, the nut or collar 310 removed, and the disk and ratchet removed from the sleeve 306 and a replacement unit substituted therefor.

For washers differing in size more than a certain amount from a "medium" or "usual" size, it may be found desirable to replace the cam 316 by a cam having a high point of greater or lesser diameter so as to obtain a greater or lesser pawl throw than can be obtained by adjustment of the sleeve 376 about the eccentric axis of the stud 382. Replacement of the cam 316 may readily be accomplished when the disk and ratchet have been removed by merely sliding the cam and bushing 306 off the upper end of the fixed shaft 318 and inserting the substituted cam thereon, with which cam another bushing 306 may be associated. Adjustment of the index pawl 412 (Figure 10) may be readily accomplished by rotating the sleeve 414 about the eccentric axis of the stud 416. Substitution of pawls 370 and 412 may be required upon replacement of the ratchet 302 for the accommodation of washers of sizes differing more than a certain amount from the "usual" size. These substitutions may be readily effected upon release of the screw headed mounting studs 382 and 416. Adjustment of the wedges 436 and 440 (Figure 10) as may be required is readily accomplished in a manner obvious from this figure of the drawings.

In adjusting the washer feed mechanism and/or the guide chute for the assembling of countersunk washers of differing diameters and differing axial lengths or "thickness," it may become necessary that the washer sensing lever 630 be adjusted vertically. This can readily be accomplished by removing the stud 626 and screws 640 (Figures 10, 13 and 18), and replacing the spacer plate 626 by one of the desired thickness. Adjustment of the assembly head 490 relative to the washer feeding means and to the guide chute so that the jaw members properly insert the screw blanks into the washer and are properly aligned with the upper and lower sections of the guide chute, may be accomplished by releasing clamping screw 488 (Figure 1) and sliding the head supporting casting 486 inwardly or outwardly with respect to the supporting strap or bracket 484. It should be noticed in this connection that in order to permit such relative adjustment of the assembly head, the cam 418 is provided with a plunger engaging cam surface which in every section taken radially of the cam extends parallel to the plane of adjustment of the bracket 486 relative to the strap 484. The set screw 602 (Figure 4) provides readily adjustable means for varying the upper limit of movement of the plunger rod 508 (Figure 22) of the assembly head 490 so that in this upper limit of movement the rod 588 will properly clear the head of a screw blank moving into the jaw members 540. Also the set screw 602 allows the plunger rod to be adjusted to accommodate screw blanks having heads of different depths or thicknesses.

The extent to which the jaw members are moved as the assembly head approaches its upper limit of movement may be micrometrically adjusted by loosening one of the set screws 560—562 and adjusting the other set screw so as to move the sleeve or tube 558 upwardly or downwardly relative to the tubular portion 492 of the head supporting casting 486. The adjustment having been accomplished, the loosened screw is then of course tightened to maintain the sleeve in its adjusted position. This adjustment insures that the jaws 542 in their partially open position when the assembly head is in its uppermost position, are spaced apart properly to permit the shank of the screw blank to pass between the edges 548 of the jaws and the edges 546 are spaced apart a lesser distance to prevent the screw blank from passing through the jaws.

Adjustment of the degree of opening movement of the jaw members as the assembly head approaches its lower limit of movement is readily effected upon release of the clamping nut 582 by adjustment of the stop collar or nut 580. The lower the stop collar, the smaller will be the opening movement of the jaw members and conversely, the higher the stop collar, the greater will be the opening movement of the jaw members so that by this means a proper movement of the jaws to release the heads of the screw blanks is assured, and accommodation offered for screws having heads of different diameters. Adjustment of the tube or sleeve 506 relative to the tubular portion 492 of the head supporting casting 486 to bring the surfaces of the jaws 542 just below the plane of the upper edges of the guide bars 42 and 44 is effected by a manipulation of the cap nut 526 and the set screw 602 to raise or lower the tube 506 in the tubular portion 492.

Adjustment of the position of the assembly head in its lower limit of movement to position the jaws just above a washer in the washer feeding disk at the point of assembly is readily effected by adjustment of the nut or collar 522 axially of the tube 506, for it is this nut or collar which in cooperation with the washer 524 determines the lower limit of movement of the assembly head.

The washer feeding means of Figures 28 and 29

In the form shown in Figures 28 and 29, the countersunk washers are fed directly from the hopper 700 to the assembly point at the lower end of the screw blank feeding guide chute 702 formed by the inclined space guide bars 704 and 706. The hopper 700 comprises a disk 708 supported upon an inclined plate 710 and formed with a series of angularly spaced radially extending grooves or openings 712. Each of the grooves 712 is of frusto-conical shape in cross-section to conform to the configuration of the countersunk washers so that such washers may readily gravitate on their base of smallest diameter along the grooves 712 and to the rim of the disk 708. An annular hopper wall 714 may extend partially or entirely about the circumference of the disk 708 and has its lower edge in such relation to the surface of the disk 708 that only one washer may pass from a groove 712 into a peripheral notch or recess 716 that is extended circumferentially in a direction opposite to the direction of rotation of the disk to provide a pocket into which the washer moves out of the line of the groove 712. The disk is supported at its periphery upon a washer retaining ring 718 along which the washers are moved and from which they are moved onto the upper surface of a guide chute at the assembly point. The washer feeding disk 708 may be intermittently driven in a manner similar to the recessed washer feeding disk 214 of the form shown in Figures 1 to 25.

The washer feeding disk 708 has a plurality of such notches 716 spaced angularly about the ring to conform to the spacing of the radial groove 712. An annular wall plate 720 is nonrotatably

mounted and extends about the periphery of the ring 718 and disk 708, and supports the ring 718. The ring 718 and the stationary annular plate 720 are relieved or cut away in the region of lower inclined arcuate guide bars 722 and 724 to receive said bars and to permit the assembled units to pass from the ring 718 onto these bars with their apertures in alignment with the space between the bars. As the disk 708 rotates to carry the assembled units from the point of assembly at the upper end of the guide bars 722—724, the shanks of the screw elements are guided between the arcuate guide bars 722 and 724, the arcuate guide bars terminating at the upper ends of the inclined straight guide bars 726 and 728. It will be seen that washers which are properly positioned with their edges of smallest diameter downwardly will be properly received in the grooves 712 and will slide along the grooves under the wall 714 and into the notches 716 of the feed disk 708. Washers which are otherwise positioned or inverted will not be properly seated in the grooves 712, and therefore will not pass beneath the wall 714. The disk 708 being rotatably mounted, excess washers in these grooves will be returned to the mass in the lower part of the hopper as the disk 708 rotates.

The washer feeding means of Figures 30 and 31

In the form shown in Figures 30 and 31 the washer hopper 730 has an open bottom in which is mounted a roller 732 on the rotating shaft 734. The roller 732 does not completely close the open bottom of the hopper 730 but leaves a space 736 through which washers may pass to a washer feed chute 738 of frusto-conical shape in cross-section in the straight, inclined portion 740. The chute 738 has a curved portion 742 merging into the rear wall of the hopper 730 and spaced from the axis of the roller along a radial line 744 a distance sufficient to permit a properly positioned washer to pass from the hopper along the curved portion 742 into the straight portion 740 of the chute, but insufficient to permit a mispositioned washer to pass out of the hopper. A properly positioned washer will pass between the roller 732 and the chute 738 along the curved portion 742, as shown in Figure 30, but in other positions the washer, i. e., a washer in which the edge of greatest diameter faces outwardly, as in Figure 31, will be engaged by the roller, and the roller rotating in a counterclockwise direction, as seen in this figure, will move the mispositioned washer back into the mass in the hopper. The chute 738 may, if desired, be formed integrally with the hopper 730. From the chute 738 the washers pass onto an aligned plate, as 190 or 206 (Figures 6 or 8), into a recessed washer feed disk as 214; or the washers may pass directly from the chute 738 into the recesses of the feed disk, as 214.

The washer feeding means of Figures 32 to 35

As shown in these figures, the washer hopper comprises a drum 746 into which washers may be dumped through a cover 748. The drum hopper 746 is secured to the rotating shaft 750 for intermittent or continuous movement in a clockwise direction, as seen in Figure 32. The circular wall of the drum hopper 746 may be formed by a hardened steel continuous or split ring 752 having angularly spaced openings 754 and detachably secured to the circumference of the walls of the drum as by screws 755. The openings 754 may each be defined by edge surfaces 756 and 758 so angularly related that a countersunk washer with its edge of largest diameter facing outwardly may pass through the opening, but a washer with its edge of smallest diameter facing outwardly cannot pass through the opening. Washers properly positioned in the openings 754 may pass therefrom onto an inclined guide chute 760 preferably of frusto-conical shape in cross-section, so that washers may, on their edges of smallest diameter, gravitate down the chute. An arcuate bar or plate 762, preferably of hardened steel, passes about the lower half of the drum 746 and prevents washers from passing out of the lower half of the drum as the drum rotates. As shown in Figure 34, countersunk washers which have their edges of largest diameter facing outwardly may, when the defining edge 758 of an opening 754 is alined with the base of the feed chute 760, pass out of the drum onto the chute. However, as shown in Figure 35, a countersunk washer which has its base of smaller diameter facing outwardly cannot pass through the opening 754, but will be retained in the opening, and as the drum continues to rotate will fall back from the opening into the mass of washers in the bottom part of the drum.

The feed chute 760 may feed the countersunk washers directly to the assembly mechanism, as in the copending application of Carl G. Olson, Serial No. 218,680, filed July 11, 1938, and assigned to the assignee of the present application, or the feed chute 760 may feed the washers onto the surface of a plate, such as the plate 190 or 206, of the form shown in Figures 1 to 25, from which plate the washers may be fed by the disk 214 to the assembly mechanism. For handling different size washers, the split ring 752 may be replaced by a like split ring having openings 754 of different size conforming to the size of the washer to be fed.

The washer feeding means shown in Figures 36 to 38

In the form shown in Figures 36 to 38, the washers may be massed or dumped into the trough 764, in which rotates a washer feed cylinder 766. The washer feed cylinder 766 may be formed by axially spaced circular spiders 768 united by a hardened steel annulus or ring 770. The cylinder 766 is mounted as by the hubs 772 of the spiders 768 on the intermittently or continuously driven shaft 774. The annulus 770 of the feed cylinder has a plurality of angularly spaced openings 776 defined by oppositely beveled or tapered edges 778 and 780. As the feed cylinder rotates through the trough 764, the countersunk washers pass through the spiders 768 into the lower part of the cylinder. Washers seating in the openings 776 are carried by the annulus 770 from the mass to the inclined washer feed chute 782 similar to the washer feed chute 760 of the form shown in Figures 32 to 35. The bottom wall 784 of the trough 764 may be extended arcuately about the bottom half of the circumference of the feed cylinder 766 so as to prevent washers from passing out of the hopper, except along the chute 782. A bar 786 may in any convenient manner be mounted for adjustment arcuately about the periphery of the feed cylinder toward and from the feed chute 782. The bar 786 may have an outwardly and downwardly tapering lower edge surface 788 to permit washers properly positioned in an opening 776 to pass outwardly from the opening when alined

with the feed chute, but to prevent improperly positioned washers from passing out of such opening. Thus washers which have their edges of largest diameter facing outwardly may pass beneath the bar 786 from an opening 776 of the feed cylinder to the feed chute 782, but an improperly positioned washer, i. e., one having its edge of smaller diameter facing outwardly, cannot pass beneath the bar 786, and hence will be retained in the opening 776 of the feed cylinder, and consequently be dropped from the opening, as the cylinder continues to rotate, back into the mass at the bottom part of the cylinder. The openings 776 may be made of any convenient size to accommodate the largest washers likely to be fed, and the bar 786 will be adjusted toward and from the feed chute 782 in accordance with the size of the washers to be fed at any particular time. Thus, in the form shown in Figures 36 to 38, the ring 770 may be permanently secured to the spiders 768 and need not be replaced when it is desired to feed a different size of the washer than those just previously fed.

Thus it will be seen that applicant has provided a machine for assembling screw and countersunk washers, including means for so anchoring the washer to a screw that the machine may be handled as a unit; means to produce as an article of manufacture a unit assembly of a screw and a countersunk washer; means for automatically feeding countersunk washers from a mass of washers to deliver the washers each in a predetermined position; means for feeding countersunk washers and screws having frustoconical heads to a mechanism assembling such screws and washers and producing a unit assembly of a countersunk washer and a screw having a frustoconical head; means for feeding or conveying countersunk washers from a receptacle or hopper containing a random mass of such washers; and means for feeding countersunk washers and screw elements with frustoconical heads in proper juxtaposition and alinement for assembly.

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. Countersunk washer feeding means comprising a rotating disc adapted to receive on its surface a supply of washers to be fed, said disc being inclined and having a plurality of radially extending openings in cross-section conforming to the cross-section of the countersunk washers to be fed, an arcuate washer retaining wall above said disc for retaining washers not positioned in a radial recess, said arcuate wall being located radially within a periphery of the disc whereby washers in said recesses pass beneath said wall to the periphery of the disc, means for rotating said disc to carry the washers to the point of use, and means for holding the washers on the periphery of the disc during such feeding.

2. Countersunk washer feeding means comprising a hopper having an open, bottom wall portion, means providing inclined washer feeding surface merging with the inner surface of a wall of a hopper at the bottom thereof, and a rotating roller in the open bottom wall portion of the hopper, said roller having its periphery spaced from the surface along which the washers move out of the hopper a predetermined distance sufficient to permit countersunk washers in predetermined position on said surface to pass out of the hopper but insufficient to permit washers otherwise positioned from passing out of the hopper, and means for rotating said roller in a direction to return mispositioned washers into the mass of washers in the hopper.

3. Countersunk washer feeding means comprising a drum hopper, said hopper having a rotary rim portion and an end wall with openings therein through which countersunk washers may pass into the hopper, a countersunk washer feed trough in which said hopper is mounted to receive countersunk washers through the openings in the end wall from a mass of countersunk washers in the trough, said rotary rim portion having angularly spaced openings therethrough defined by opposed oppositely tapered edges, means providing an inclined countersunk washer feed surface terminating at one end at the rim portion of said hopper, a control bar positioned above said surface at said end of the chute and extending across the openings in the rim portion of the hopper for permitting countersunk washers facing a predetermined direction when in said opening to pass from the openings onto said feed surface while preventing countersunk washers otherwise positioned from passing out of said openings, said control bar being adjustably mounted for movement toward and from the inclined surface in accordance with the size of the countersunk washers to be fed.

4. Washer feeding means comprising a hopper receiving a collection of countersunk washers, a rotary washer feed disc having spaced recesses opening outwardly of the periphery of the disc to receive and release the countersunk washer by movements substantially radially of the disc and shaped to hold the countersunk washers facing in a predetermined direction while feeding the washers to a discharge position, means providing an inclined surface terminating in the plane of said plate and constructed to deliver into said recesses from the collection of countersunk washers only those countersunk washers facing in said direction, and means providing an opening in said surface adjacent the periphery of said disc for permitting washers interlocked with washers in the recess of the disc to fall out of interlocking relation to thereby free the washers in the disc from other washers on the surface.

5. Washer feeding means comprising a hopper receiving a collection of countersunk washers, a rotary washer feed disc having angularly spaced recesses opening outwardly of the periphery of the disc to receive and release the countersunk washers by movement substantially radially of the disc and shaped to hold the countersunk washers in predetermined orientation while carrying the same to a discharge position, and means for delivering countersunk washers from said collection to the feed disc, said delivery means including an inclined surface, means for feeding a stream of said washers so oriented onto said surface from said collection, and means for directing along said surface a stream of washers so oriented against a section of the periphery of the disc of peripheral length to include a plurality of said recesses to effect simultaneous movements of a plurality of said washers edgewise of the disc into said recesses.

6. Washer feeding means comprising a hopper receiving a collection of countersunk washers, a rotary washer feed disc having angularly spaced recesses opening outwardly of the periph-

ery of the disc to receive and release the countersunk washers by movement substantially radially of the disc and shaped to hold the countersunk washers in predetermined orientation while carrying the same to a discharge position, means for delivering countersunk washers from said collection to the feed disc, said delivery means including an inclined surface, means for feeding a stream of said washers so oriented onto said surface from said collection, and means for directing along said surface a stream of washers so oriented against a section of the periphery of the disc of peripheral length to include a plurality of said recesses to effect simultaneous movements of a plurality of said washers edgewise of the disc into said recesses, and means at one side of said surface for receiving washers of an excess supply from said inclined surface.

7. A washer feeding device comprising a hopper having means forming an inclined rotating feed surface receiving thereon a collection of washers to be fed and a wall upstanding from said surface, said wall and said rotating surface being constructed to form a plurality of washer gates configurated to permit washers facing in a predetermined direction on said surface to slide through the wall along said surface, and a plurality of means each receiving a washer after passing one of said gates for feeding the washers so oriented individually and successively to a discharge position.

8. Countersunk washer feeding means comprising a hopper, and means providing an inclined, relatively wide and flat surface receiving and feeding by gravity countersunk washers randomly positioned in a broad stream and along their base edges of smallest diameter said means being constructed to maintain the washers on their base edges during feeding along said surface, said hopper having a wall member receiving a collection of washers to be fed and rotatable to distribute the washers over the surface thereof and means forming about the periphery of said member a plurality of angularly spaced washer gate openings registering with the surface of said member and said inclined surface and configurated to permit countersunk washers facing in a predetermined direction to pass out of the hopper onto said inclined surface and to prevent the escape of countersunk washers not facing in said direction, said member and openings being constructed and arranged to cause the washers passing the gates to be positioned on said surface with their base edges of smallest diameter engaging the inclined surface.

9. Countersunk washer feeding means comprising a drum hopper receiving a collection of countersunk washers to be fed, said hopper comprising a rotating plate and an annular wall member rotatable with said plate and extending about the periphery of said plate, means providing an inclined washer feed surface extending downwardly from the periphery of the drum, and means including angularly spaced openings through the annular wall member of the drum and constructed to form a washer discharge gate controlling the passage of countersunk washers distributed about the periphery of the drum by the rotation of said plate and annular wall member, said discharge gate being configurated to permit countersunk washers facing in a predetermined direction to pass through said openings onto said inclined feed surface when said openings register with said surface and to prevent countersunk washers not facing in said direction from passing through said openings out of the drum hopper.

10. In a machine for making assembled units of screws and countersunk washers comprising a main washer hopper, an auxiliary washer hopper having an upstanding wall and an inclined rotating bottom wall, means for feeding washers from the main hopper in a random stream into the auxiliary hopper, an inclined rotary washer feed disc having angularly spaced recesses opening outwardly of the periphery of the disc and shaped to receive and hold countersunk washers facing in a predetermined direction, means cooperating with the upstanding wall of the auxiliary hopper to form washer gates constructed to permit washers facing in said predetermined direction to pass from the auxiliary hopper, means directing the washers passing from the auxiliary hopper through said gates against the periphery of said disc for movement edgewise of the disc into said recesses, and means for rotating said disc to convey the washers in said recesses successively to a discharge position for discharge from the recesses of the disc by edgewise movement substantially radially of the disc.

11. Washer feeding means comprising a hopper, means for feeding washers at random from the hopper in a stream, means for spreading out the washers into a broader stream over an extended surface, means providing a washer gate extending across said surface and permitting washers facing in a predetermined direction to pass the gate in a broad stream and preventing other washers from passing through the gate, and means for receiving washers from the stream passing through said gate and feeding the washers in individual succession to a discharge position.

12. Washer feeding means comprising means forming vertically spaced, inclined surfaces, washer supplying means including a washer gate constructed to permit the passage of washers facing in a predetermined direction into the space between said surfaces, said surfaces being spaced sufficiently to permit gravitational movement of the washers on the lower of the surfaces while maintaining the washers so oriented, and means in the path of the washers as they move by gravity between said surfaces for selecting individual washers and feeding the same in succession to a discharge position.

13. Washer feeding means comprising means forming an inclined surface, means for supplying washers in a random stream to said surface, means providing a plurality of individual washer gates constructed to permit a plurality of washers facing in a predetermined direction on said surface to pass through the gates in a broad stream, a rotary disc positioned to receive washers passing through said gates, said rotary disc having means constructed and arranged each to select an individual washer from the broad stream of washers passing through said gates and to convey the washers in succession, as the disc rotates, to a discharge position.

14. Washer feeding means comprising a main hopper, an auxiliary hopper having an upstanding wall and an inclined rotary bottom wall, said main hopper having an inclined bottom wall for gravitationally feeding washers from a collection dumped into said hopper, a relatively broad gravity feed chute receiving the washers from the bottom wall of the main hopper for conveying the washers in a relatively broad, random stream onto the inclined bottom wall of the auxiliary hopper,

means for rotating said inclined bottom wall of the auxiliary hopper to spread out the washers over the surface of said wall, means cooperating with said bottom wall of the auxiliary hopper to form a plurality of washer gates rotating with said bottom wall and constructed to permit a number of washers facing in a predetermined direction to pass through said gates at the same time, confining washers not facing in said direction within said gates until the washers being agitated by the rotating bottom wall are caused to face in said predetermined direction, and a plurality of means each receiving an individual washer from the number of washers passing through said gates for feeding the washers individually to a discharge position.

15. Countersunk washer feeding means comprising a first inclined rotary disc receiving on the surface thereof a collection of countersunk washers to be fed, said disc having an upstanding rim, said rim having spaced openings therein defined by oppositely tapered walls extending upwardly from the surface of the disc for permitting countersunk washers predeterminedly oriented on said disc to pass by gravity through said rim, a second rotary disc having angularly spaced notches each with oppositely tapered edges to hold a washer in predetermined orientation as the disc rotates and opening outwardly of the periphery of the disc to receive and release the washer by movement substantially radially of the disc, and means providing an inclined surface at one edge circumscribing a portion of the first rotary disc to receive washers passing through said rim and at a lower edge circumscribing a portion of said second disc to feed said washers by gravity into the notches of the second disc.

16. Washer feeding means comprising a hopper receiving a collection of washers, a rotary washer feed disc having angularly spaced recesses opening outwardly of the periphery of the disc to receive and release the washers by movement substantially radially of the disc and shaped to hold the washers in predetermined orientation, and means including an inclined surface terminating in the plane of the lower edges of said recesses for delivering washers so oriented in a broad stream from the hopper to the periphery of the disc for individual selection from said surface by the recesses of said disc.

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