Nov. 9, 1943. N. V. KUEHLMAN 2,333,940

ASSEMBLY MACHINE

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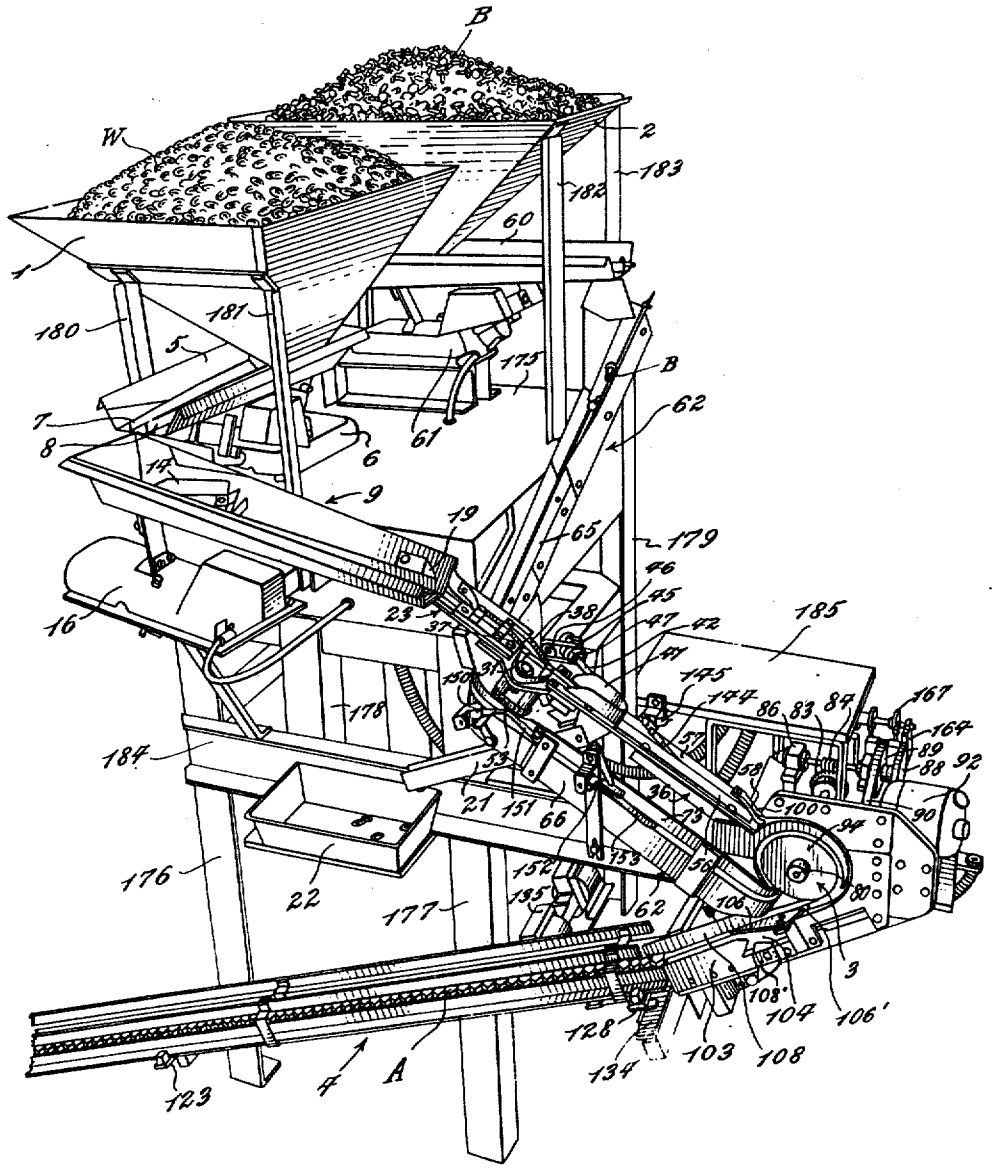


Fig. 1.

INVENTOR.
Norman V. Kuehlman

BY Dyfford, Scull & Burgess
ATTORNEYS

Nov. 9, 1943. N. V. KUEHLMAN 2,333,940

ASSEMBLY MACHINE

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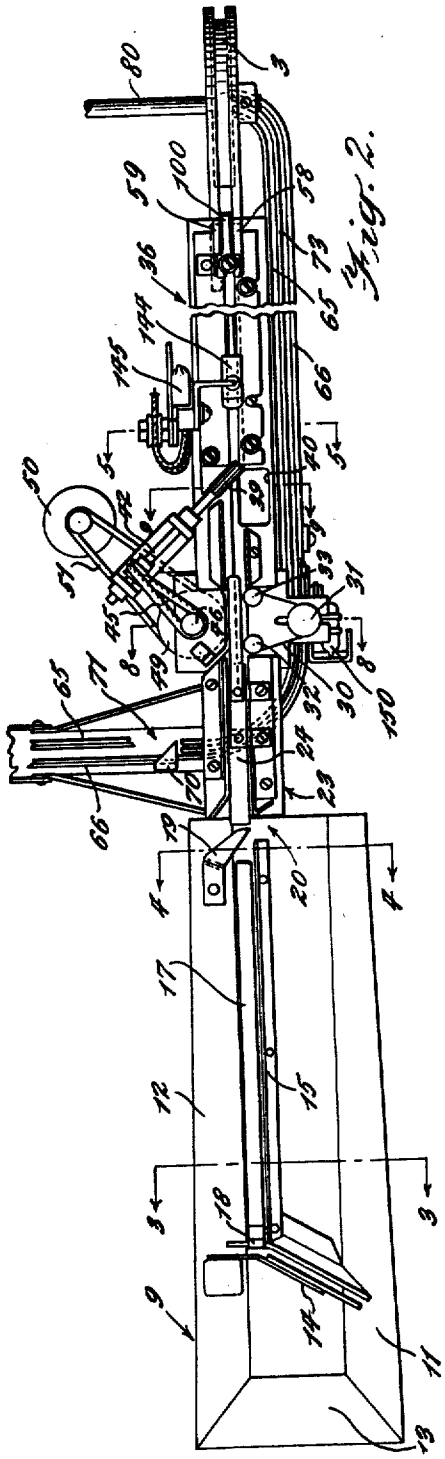


Fig. 2.

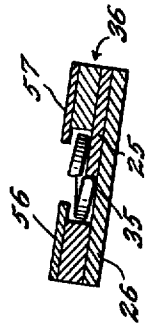


Fig. 5.

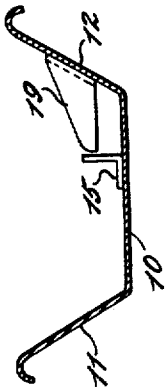


Fig. 4.

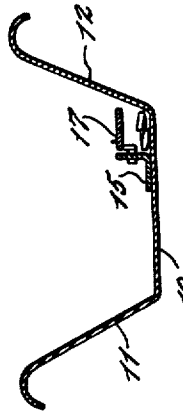


Fig. 3.

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Nov. 9, 1943. N. V. KUEHLMAN 2,333,940

ASSEMBLY MACHINE

Filed July 10, 1941 10 Sheets-Sheet 3

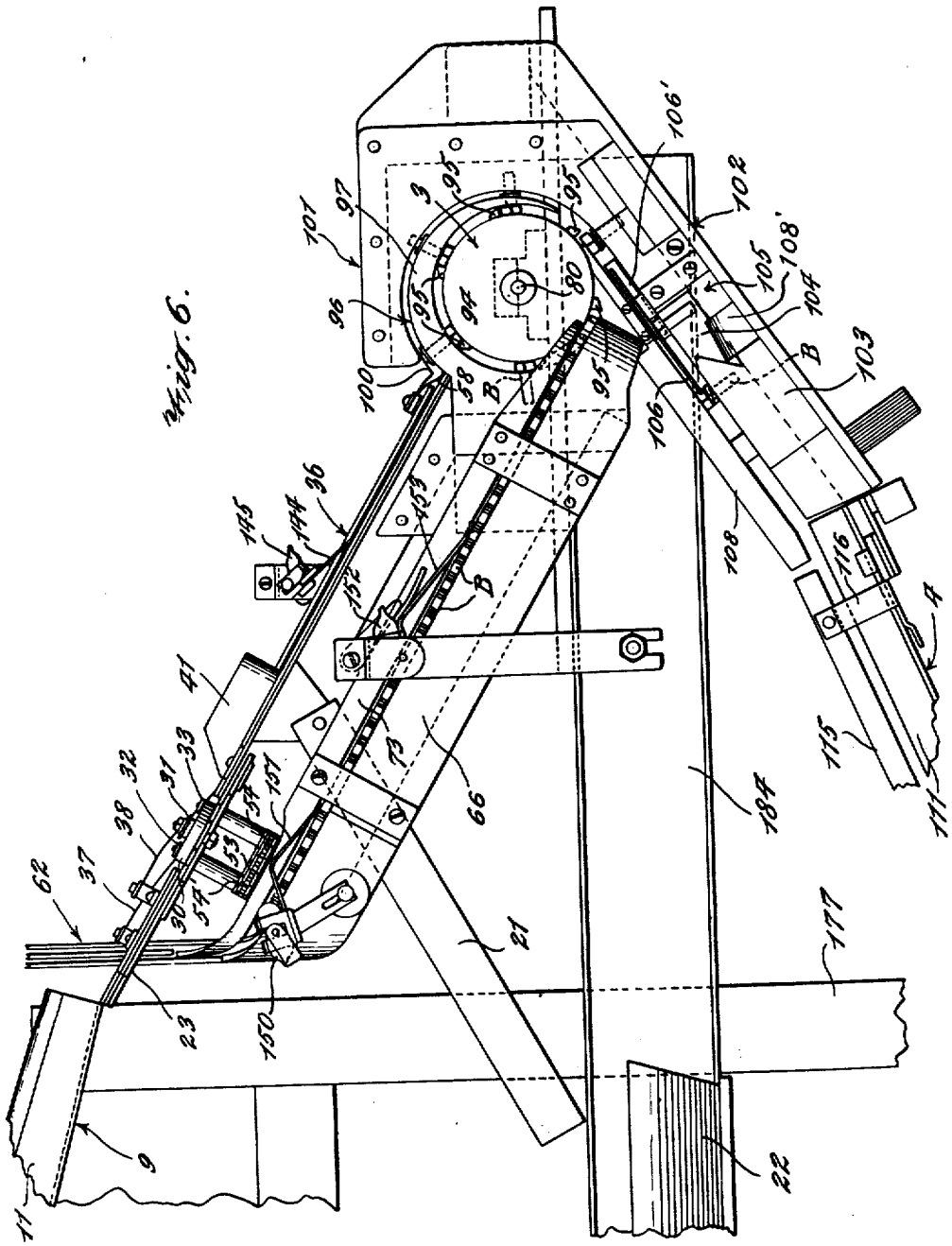


Fig. 6.

INVENTOR.
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Nov. 9, 1943. N. V. KUEHLMAN 2,333,940

ASSEMBLY MACHINE

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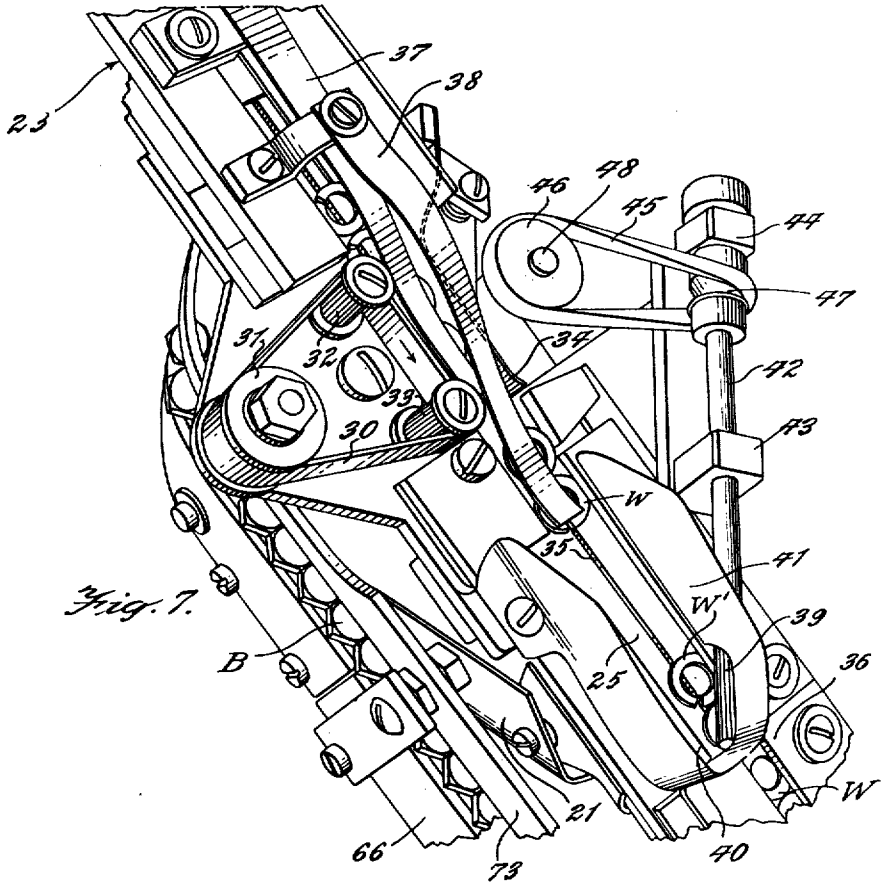


Fig. 7.

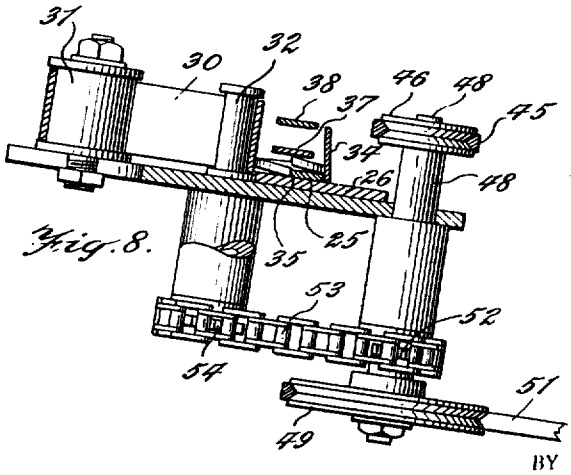


Fig. 8.

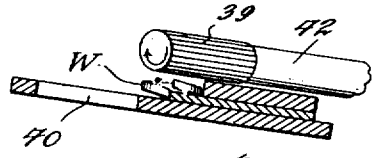


Fig. 9.

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ASSEMBLY MACHINE

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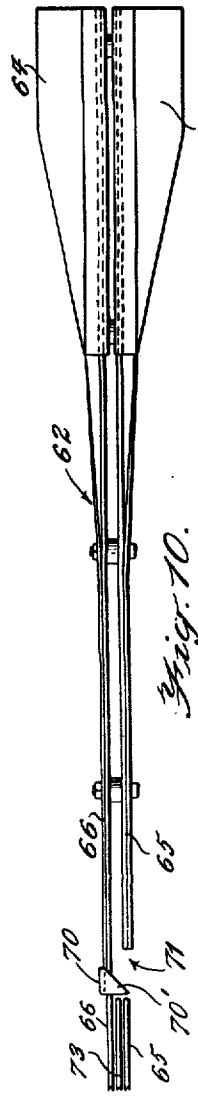


Fig. 10.

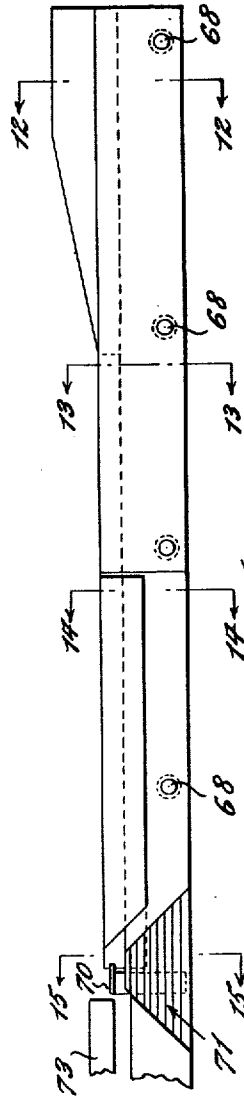


Fig. 11.

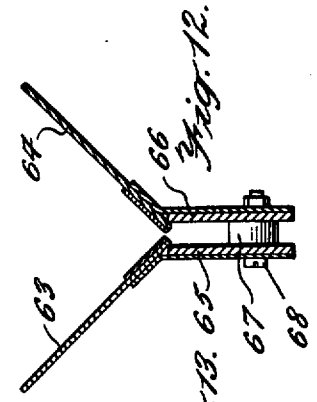


Fig. 12.

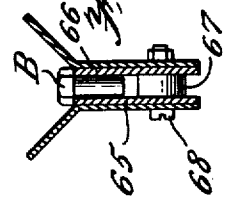


Fig. 13.

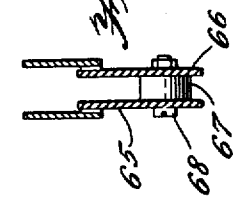


Fig. 14.

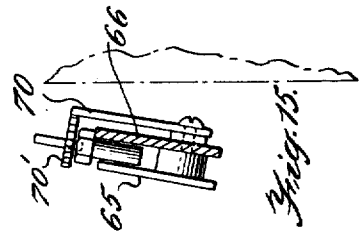


Fig. 15.

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Nov. 9, 1943. N. V. KUEHLMAN 2,333,940

ASSEMBLY MACHINE

Filed July 10, 1941 10 Sheets-Sheet 6

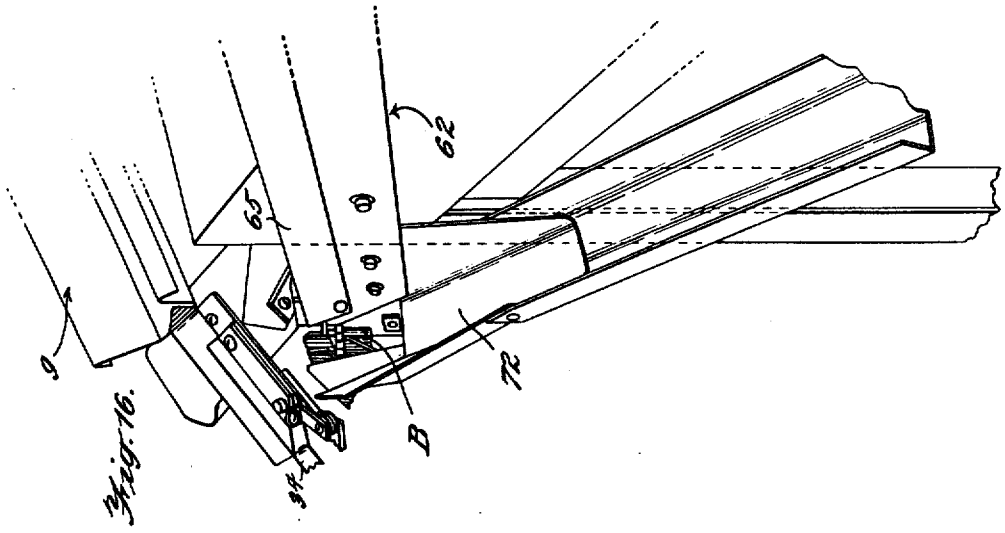


Fig. 16.

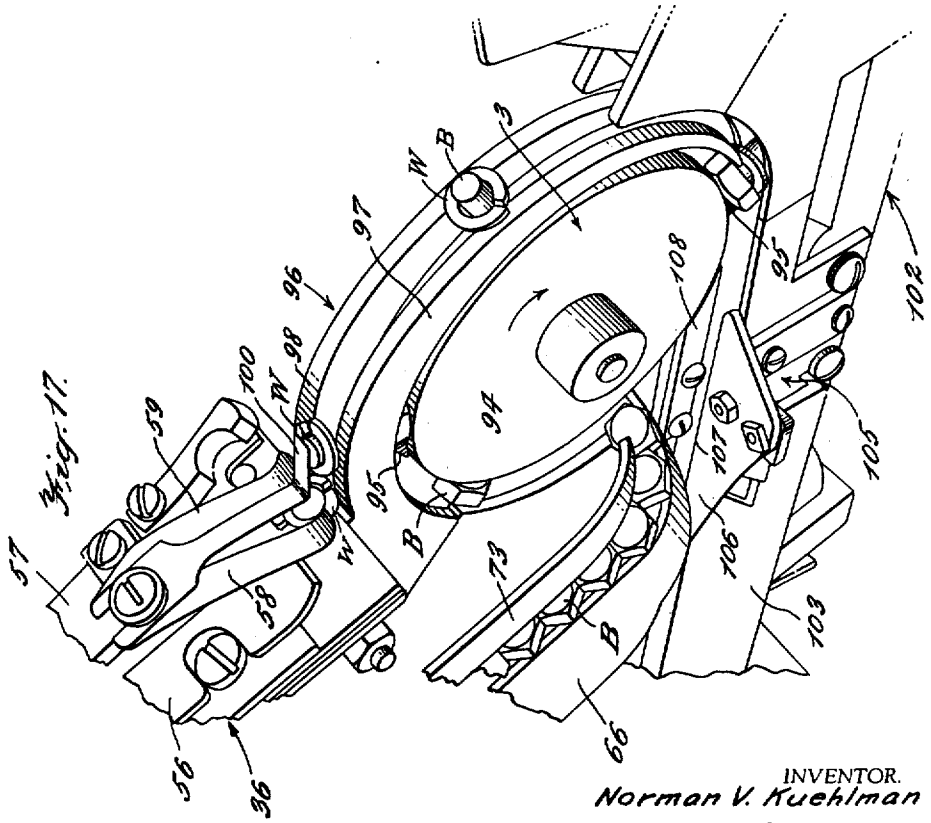


Fig. 17.

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Nov. 9, 1943. N. V. KUEHLMAN 2,333,940

ASSEMBLY MACHINE

Filed July 10, 1941 10 Sheets-Sheet 7

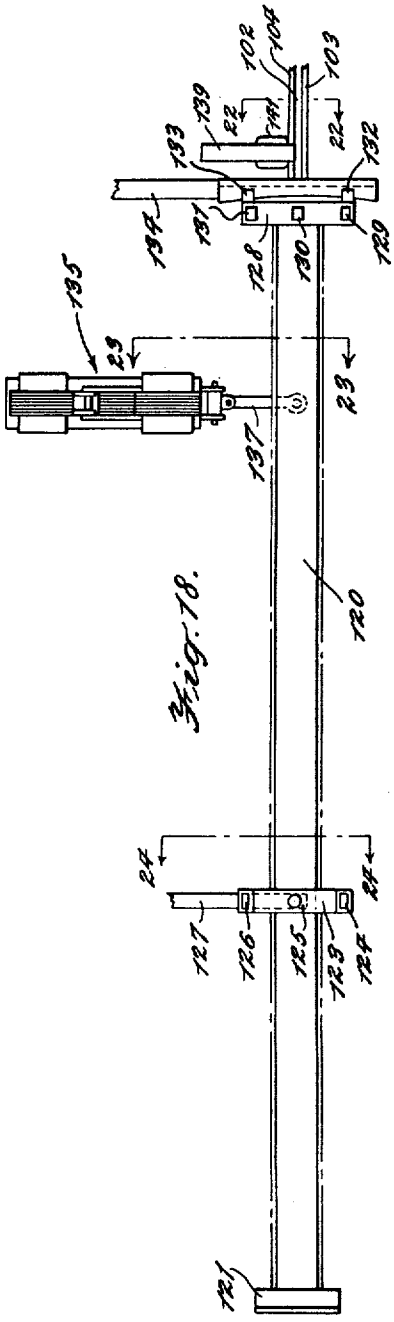


Fig. 18.

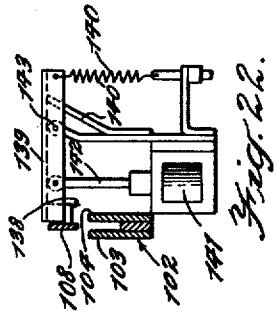


Fig. 22.

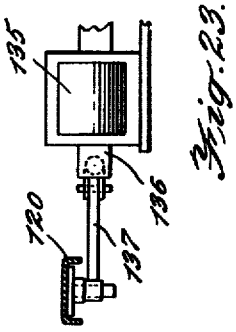


Fig. 23.

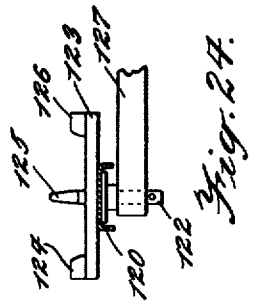


Fig. 24.

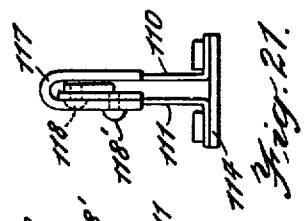


Fig. 21.

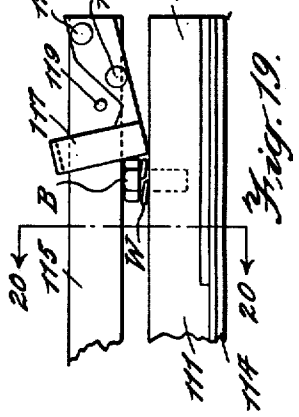


Fig. 19.

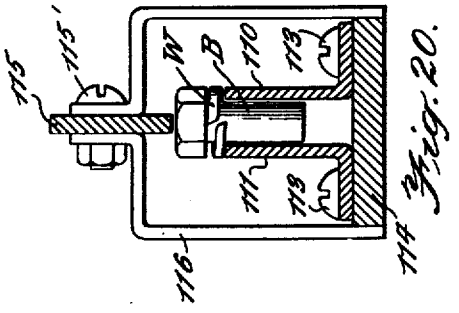


Fig. 20.

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ASSEMBLY MACHINE

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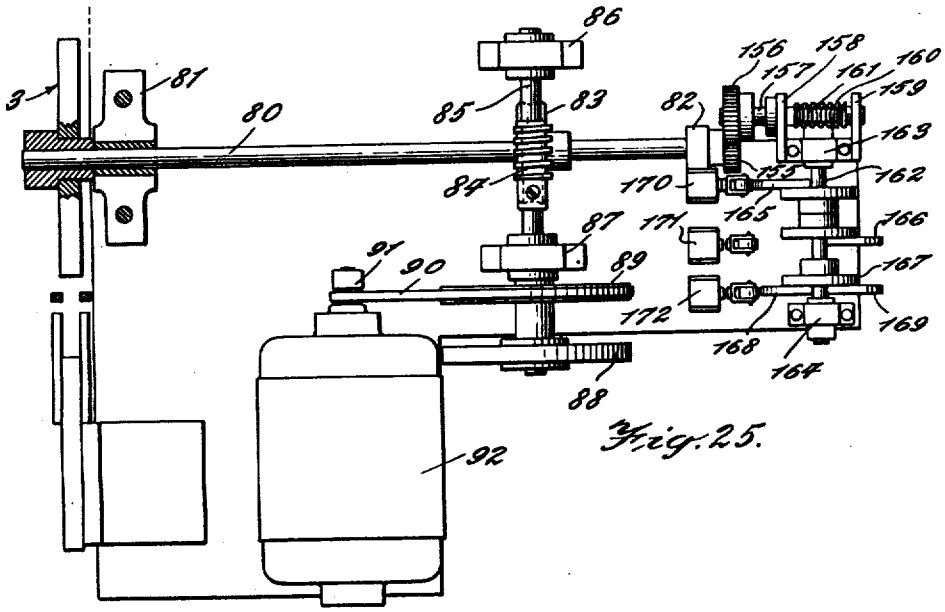


Fig. 25.

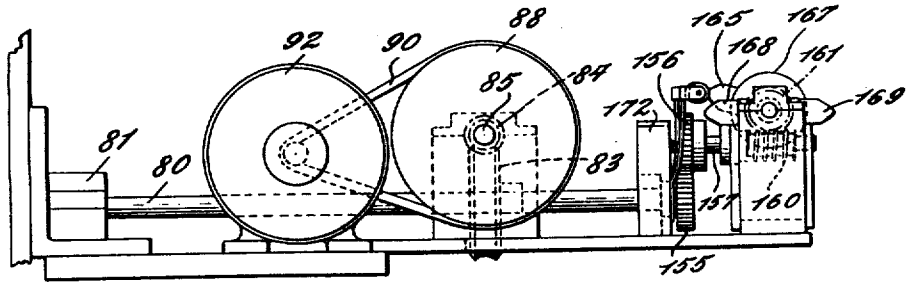


Fig. 26.

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ASSEMBLY MACHINE

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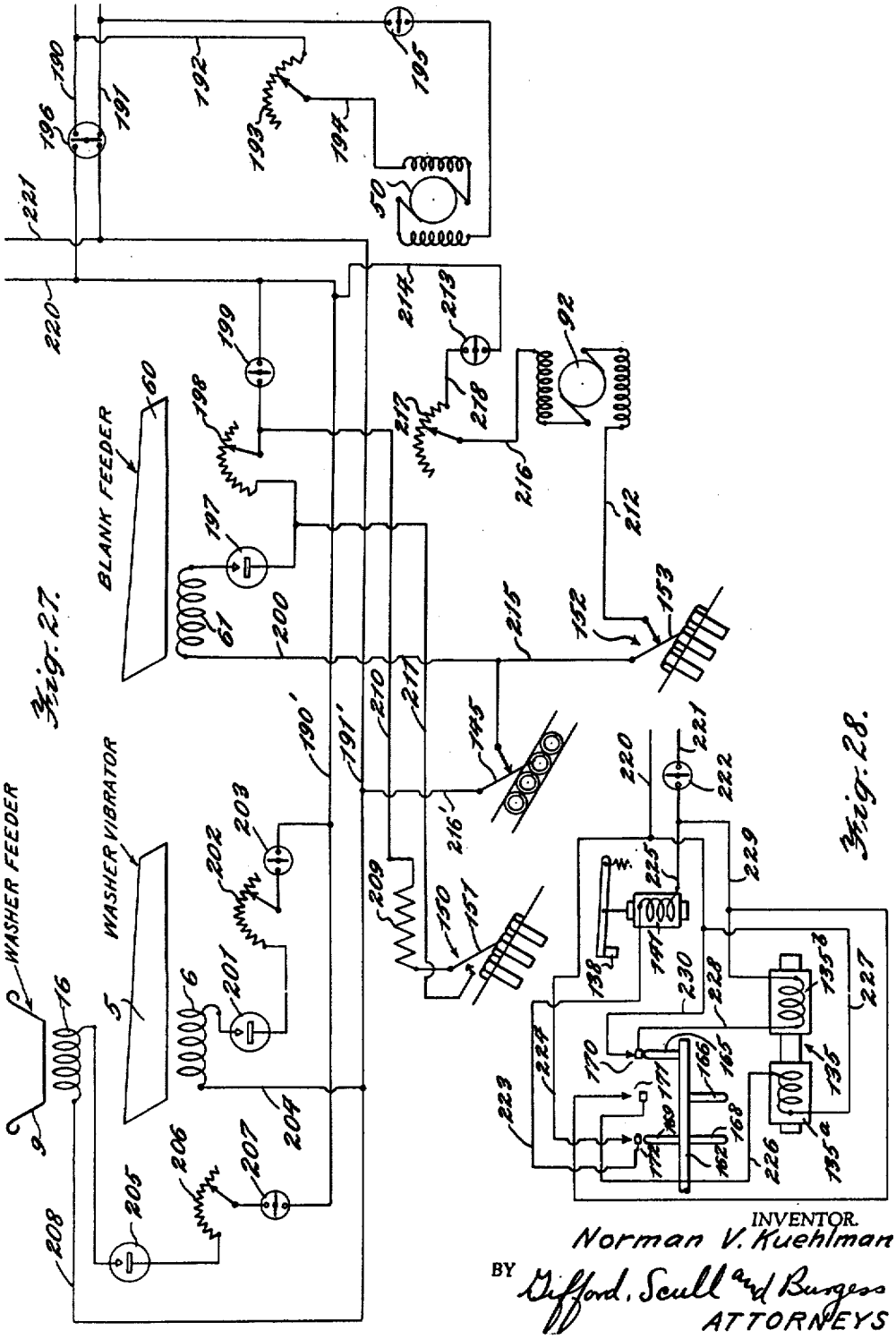


Fig. 27.

Fig. 28.

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Nov. 9, 1943. N. V. KUEHLMAN 2,333,940

ASSEMBLY MACHINE

Filed July 10, 1941 10 Sheets-Sheet 10

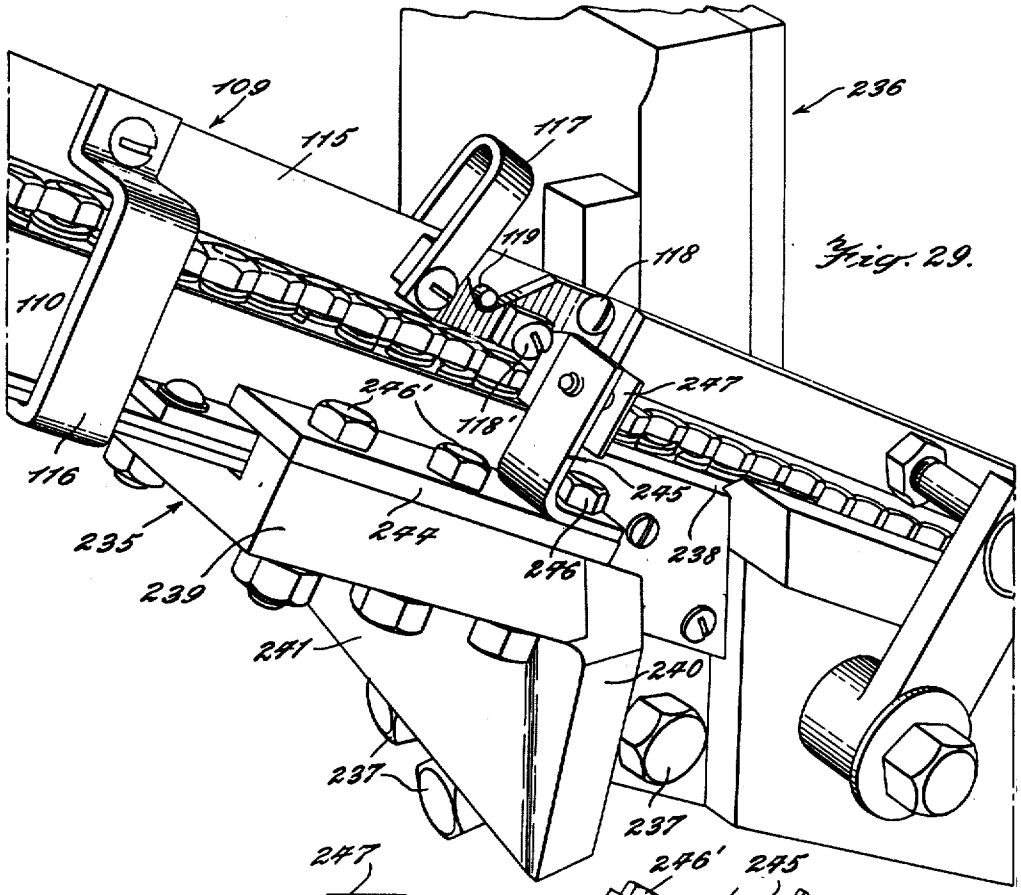


Fig. 29.

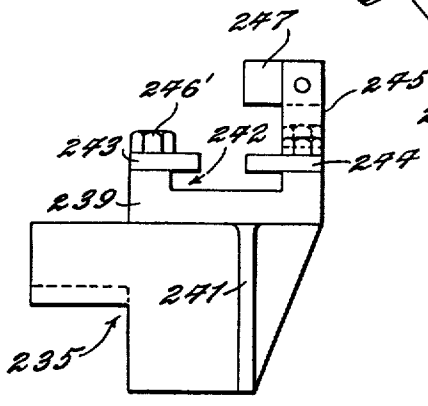


Fig. 30.

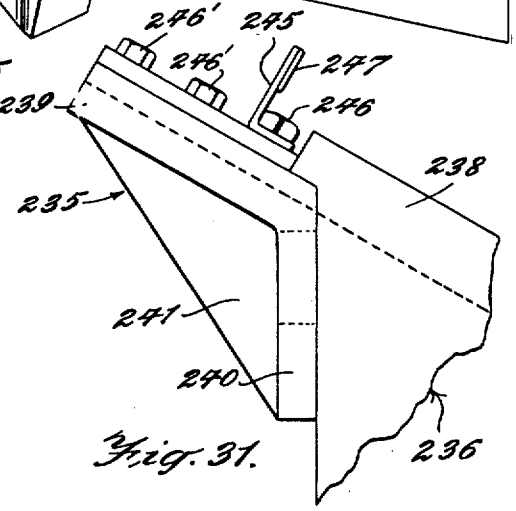


Fig. 31.

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Patented Nov. 9, 1943 2,333,940

UNITED STATES PATENT OFFICE

2,333,940

ASSEMBLY MACHINE

Norman V. Kuehlman, Milwaukee, Wis., assignor to The National Lock Washer Company, Newark, N. J., a corporation of New Jersey

Application July 10, 1941, Serial No. 401,804

2 Claims. (Cl. 29—84)

This invention relates to a machine for placing washers on bolts or screws and particularly on bolt or screw blanks on which the threads are later rolled or otherwise formed. The particular machine illustrated herein shows one embodiment of the invention designed to assemble lock washers, particularly of the split ring type, on bolts or screws, either before or after the threads are formed on the screw blanks.

For various uses, however, it is desirable to have a washer permanently assembled with a bolt or screw with the washer in position to contact with the under side of the bolt head when the bolt is screwed up tight. This may be accomplished by placing the washer on a bolt blank, locating it adjacent the head and then rolling a thread on the shank of the blank, care being taken to have the hole in the washer not much larger than the diameter of the blank, so that the outside diameter of the rolled thread is larger than the hole in the washer. In this way, the washer is kept in place on the bolt and cannot fall off in transit or handling.

The illustrated machine can be utilized to assemble threaded bolts and washers, if this is desired. To do this, it is only necessary to use a washer having an internal diameter large enough to pass over the threads of the bolt.

The particular assembly machine illustrated and described herein is designed to receive both split ring lock washers and bolt blanks, assemble them, and deliver them so assembled into a suitable removable magazine or quill which is adapted to be placed in a thread-rolling machine where the threads may be rolled on the blank. The present invention is directed to the machine for assembling the lock washers and blanks and does not relate to the thread-rolling machine, which may be of any standard or well-known type. It is advantageous to keep the assembly machine and the thread-rolling machine separate because one assembly machine can supply a number of thread-rolling machines.

The illustrative mechanism consists essentially of two hoppers or storage chambers, one for the lock washers and one for the bolt blanks. From each hopper, a suitable path leads to an assembly wheel where a washer and a blank meet and the former is placed on the latter. From the assembly wheel, the assembled blank and washer, hereinafter referred to as the "assembly," is delivered to a magazine or quill where a suitable number of the assemblies ready for subsequent use, as, for instance, a supply of blanks for a thread-rolling machine, are stored. When one quill is filled on the assembly machine, the mechanism is designed to automatically replace it with an empty quill.

The illustrative machine is equipped with suitable control devices to furnish a smooth and even flow of both blanks and washers at a predetermined speed to the assembly wheel. It is also equipped with devices for rejecting imperfectly disposed or aligned blanks or washers so that, when the washers and blanks reach the assembly wheel, they not only arrive at the proper time and in the proper quantity, but also in proper position to be quickly and efficiently assembled together. Suitable automatic controls are provided, not only for regulating the speed of delivery of both the washers and blanks, but also for stopping the machine in case a foreign part or foreign matter finds its way therein, or, if for any other reason, the machine is not functioning as it is designed to do.

Fig. 1 is a perspective view of the washer and blank assembly machine.

Fig. 2 is a plan view of part of the paths of the washers and blanks to the assembly wheel.

Fig. 3 is a section through 3—3 of Fig. 2.

Fig. 4 is a section through 4—4 of Fig. 2.

Fig. 5 is a section through 5—5 of Fig. 2.

Fig. 6 is a side elevation of the assembly wheel and adjacent parts of the machine.

Fig. 7 is a perspective view of the aligning mechanism for the lock washers.

Fig. 8 is a section through 8—8 of Fig. 2.

Fig. 9 is a section through 9—9 of Fig. 2.

Fig. 10 is a plan view of the conveying trough and track leading from the under side of the blank hopper.

Fig. 11 is a side elevation of the trough and track shown in Fig. 10.

Fig. 12 is a section through 12—12 of Fig. 11.

Fig. 13 is a section through 13—13 of Fig. 11.

Fig. 14 is a section throug 14—14 of Fig. 11.

Fig. 15 is a section through 15—15 of Fig. 11.

Fig. 16 is a perspective view of the rejection mechanism in the blank track.

Fig. 17 is a perspective view of the assembly wheel with the upper arcuate guide removed.

Fig. 18 is a plan view of the quill support.

Fig. 19 is a side elevation showing the locking gate at one end of the quill.

Fig. 20 is a right section taken through 20—20 of Fig. 19.

Fig. 21 is an end view of what is shown in Fig. 19.

Fig. 22 is a section through 22—22 of Fig. 18.

Fig. 23 is a section through 23—23 of Fig. 18.

Fig. 24 is a section through 24—24 of Fig. 18.

Fig. 25 is a plan view of the driving mechanism for the assembly wheel and control switches.

Fig. 26 is a side elevation of what is shown in Fig. 25.

Fig. 27 is a diagram of the electric circuits for the assembly machine and its controls exclusive of the quill shifting mechanism.

Fig. 28 is a diagram of the electric circuit for the quill shifting mechanism.

Fig. 29 is a perspective of part of a thread-rolling machine and a quill in place thereon.

Fig. 30 is an end view of a quill adapter of a thread-rolling machine.

Fig. 31 is a side view of a quill adapter for a thread-rolling machine.

A hopper 1 (Fig. 1) is provided to receive a quantity of lock washers W, which, in the illustrative drawings, are of the split ring type, and a similar hopper 2 is provided to receive a quantity of bolt blanks B. These hoppers are shown in the form of inverted pyramids, but may be conical if so desired. From these hoppers, the washers and blanks are conveyed along suitable paths, which will be described in detail, to an assembly wheel 3 where they are put together to form the assemblies A and from which such assemblies are discharged into a quill or magazine 4.

Lock washer hopper to assembly wheel

The bottom of the washer hopper 1 is equipped with two or more baffle plates designed to relieve the mechanism immediately under the opening at the bottom of the hopper from the full weight of the superimposed lock washers. These baffles are not shown because their use in any form of storage device is common.

Underneath the opening in the lowermost part of hopper 1 is a trough 5 which is positioned close enough to the opening in the bottom of the hopper to prevent a rapid and uncontrolled pouring-out of the lock washers through that opening. Trough 5 is mounted upon a vibratory mechanism 6 which serves to vibrate said trough and in this way control the flow of the washers from the hopper. The vibrating mechanism shown is sold under the trade name "Syntron" and made under U. S. Letters Patent Nos. 1,637,401 and 1,637,717.

Washer flow control is obtained by adjusting the activity of the vibrator 6. This feature is utilized to control the flow of the lock washers from the hopper 1 into the track feeder 5.

The action of the vibrating track feeder 5 is such that the washers will move along it between suitable guides 7 and 8 to the open end thereof, from which they will fall into washer vibrator 9 (Figs. 1 to 4), which is made up of a flat bottom portion 10 and two sloping side portions 11 and 12. An end wall 13 closes the left or upper end of the vibrator (as viewed in the figures). The washer vibrator 9 slopes downwardly from the left to the right, as seen in these figures, and is equipped with a suitable baffle 14 and a guide 15 designed to direct and to some extent control the flow of the washers along this vibrator.

Like feeder 5, this trough-like washer vibrator 9 is supported upon a vibrating mechanism 16 which is similar to the mechanism 6 and is so adjusted and designed as to vibrate the member 9 to maintain a steady flow of washers along the length thereof. A light steel drag 17 is pivoted at 18 and designed to rest upon some of the washers in the vibrator 9 so as to steady their movement therealong. This washer vibrator is tilted not only downwardly, as shown in Fig. 1, but also downwardly to the left, as viewed in the direction of travel of the washers, so that the washers will tend to move toward the wall 12 as well as longitudinally of the washer vibrator.

At the lower end of vibrator 9 is a throw-out finger 19 designed to guide any rolling washers out through a discharge opening 20. It will be seen in Fig. 4 that this throw-out finger 19 is raised above the bottom 10 of the vibrator 9 so that washers, when lying flat on the bottom 10, may travel thereunder, but if they are rolling on edge, this throw-out finger will guide the washer which is out of place out through the opening 20 or tip it to a horizontal position, as in Fig. 3.

From the right or lower end of vibrator 9, those washers which do not come in contact with the finger 19 drop into a tilted chute or track 23. This chute is slightly wider and deeper than the washer. The top of this chute is furnished with another light steel drag 24 designed to rest lightly upon the washers to keep them in line, and the inclination of the chute 23 is such that the washers will move along it by gravity.

At the position designated in the figures as the section through 8—8, there is located adjacent to and as part of the washer chute a mechanism for positioning each washer in the same relative position to the chute as each other washer. If the washers are of the split ring type, as illustrated, they are preferably positioned so that the severed ends of each washer will be the leading portion of the washer as it travels down towards the assembly wheel. When so positioned, the line of washers will slide down a chute with little or no tendency for one to ride up on the washer ahead of it. In the machine illustrated, this positioning is accomplished by equipping the bottom of the chute 23 with a central ridge track (Figs. 5 and 8); that is, one side of the chute is stepped up and higher than the other side a distance approximately equal to the thickness of the stock from which the washer is made. This may be accomplished by laying a strip of metal such as at 25, on the bottom of the chute 23. The edge 35 of the strip 25 is used as a guide for one end of the split ring washer, as shown in Figs. 5 and 8.

In order to line one end of the washers against the edge of the strip 25, a suitable aligning mechanism is provided (Figs. 7 to 9). This includes an endless flat belt 30 running over pulleys 31, 32, and 33, which pulleys are arranged in the form of a triangle so that the belt running between pulleys 32 and 33 forms the base thereof. This portion of the belt is arranged parallel to the chute 23 and adjacent thereto. Opposite the rollers 32 and 33 is a flat spring 34 (Fig. 7), the face of which is positioned on one side of the chute 24 opposite to the belt 30. The spring 34 and that part of the belt 30 operating between rollers 32 and 33 are so positioned that washers flowing along the chute 23 must pass therebetween with the outside edges of the washers in contact with both spring and belt (Fig. 8). The spring 34 holds each washer against the belt 30. As each washer passes the belt 30, it is rotated by the belt counterclockwise when viewed from above on an axis vertical to the plane of the washer until the open end thereof comes into contact with the edge 35 of the strip 25, when rotation of the washer is arrested and the posi-

tioned washer slides down along the chute into the washer magazine 36, which may be described as the lower part of the chute 23 immediately above the assembly wheel 3.

A light steel spring finger 37 (Fig. 7) holds the washers flat on the bottom of the washer chute while the washers are passing between the belt 30 and the spring 34. A similar spring 38 holds down the washers as they pass out from between belt 30 and spring 34 and keeps them in position as they move dowwn toward the magazine 36.

If, by chance, one of the washers does not assume the position shown in Fig. 5 in relation to the washer chute and the edge 35 of the strip 25, but becomes tilted up in some manner, this would means that it would be higher than in the position shown in Fig. 5 and the clearing wheel 39 would then strike it, throwing it through a suitable opening 40 and into the discharge chute 21, from which it will drop into the receptacle 22. At 41 is shown a suitable stop or semi-enclosure to guide the discarded washers to the opening 40. The washer chute or track 23 is tilted downwardly to the left as one looks in the direction of travel of the washers or downwardly to the right as seen in the opposite direction (see Fig. 9), and this serves to prevent washers which are properly aligned from falling through the opening 40.

Wheel 39 is part of a shaft 42 mounted in bearings 43 and 44 and driven by belt 45 which operates on pulleys 46 and 47. Pulley 46 is mounted on a shaft 48, to the lower end of which is keyed another pulley 49 belted to a motor 50 (Fig. 2) by belt 51. Shaft 48 has mounted thereon a chain sprocket 52 over which runs a roller chain 53 connected to a pair of sprockets 54 and 54' (Figs. 6 and 8). Sprocket 54' is keyed to the shaft which supports pulley 32, and sprocket 54 is keyed to the shaft which supports pulley 33. In this manner, motor 50 drives the clearing wheel 39 and also the belt 30.

After a washer passes under the clearing wheel without interference therefrom, as shown in Fig. 9, it goes into the washer reservoir 36, which is a chute similar to chute 23, but with two strips of metal running along the top, as shown in Fig. 5 at 56 and 57. As will be seen in this figure, the strips 56 and 57 project over the path of the washers and serve to hold the washers in place as they move toward the assembly wheel.

While it is desirable, it is not essential that all of a series of split-ring washers shall have their ends against the edge 35. Therefore, in practice, it is found convenient to raise clearing wheel 39 and strips 56 and 57 above the positions where they permit the passage of those washers only whose severed ends actually contact edge 35 to a higher position so that washers which are not fully in the desirable position can nevertheless pass into the washer magazine and to the assembly wheel 3.

When a washer reaches the right or lowermost end of chute 36 (Figs. 1 and 2), it rests immediately under a pair of spaced spring fingers, shown at 58 and 59 (Fig. 17). These press lightly upon the trailing half of the washer and hold it in place when it is picked up by a bolt blank B on the periphery of assembly wheel 3, as described hereinafter.

Bolt blank hopper to assembly wheel

Near the bottom of bolt blank hopper 2 are suitable baffles (not shown) to prevent the full weight of the blanks from being imposed upon the apparatus underneath the opening in the lowermost part of the hopper. Under this opening is positioned a blank vibrating feeder 60 mounted upon a vibrator 61 of the same general character as vibrators 6 and 16. Feeder 60 is positioned close enough to the bottom of the hopper 2 to prevent uncontrolled discharge of blanks. Blank flow control is obtained by adjusting the activity of the vibrator 61.

Feeder 60, as seen in Fig. 1, is open at the right end which is positioned above a blank-aligning trough 62 (Figs 10–15). The upper end of trough 62 has wide V-shaped sides 63 and 64 which taper down and separate at the bottom thereof to form a track made up of two parallel vertically disposed rails or surfaces 65 and 66 (Figs. 12–14).

Members 65 and 66 are spaced apart a distance slightly greater than the diameter of the shank of the bolt blank B by means of spacing members 67 held in place by suitable bolts 68. When the blank drops from vibrator 60 into the trough 62, the V-shaped cross section thereof, as shown in Fig. 12, serves to line up the blanks, and, as they pass downwardly and move from the trough, as shown in Fig. 12, onto that part of the blank path which is shown in Fig. 13, the blanks will arrange themselves so as to be supported on their heads between the rails 65 and 66 and then travel downwardly by gravity along these rails. The open space between the rails allows dirt and other foreign matter, such as nails, wire, and chips, to fall out of the track.

As the blanks move down along the track to a position represented by the section of Fig. 15, they approach a blank selector 70 (Figs. 10, 11, and 15) which is designed to discard any blanks which are not properly aligned. The operable portion 70' of this selector extends out over the tracks 65 and 66 and has a sloping face arranged at an angle of about 45° to the path of travel of the blanks and is so spaced in relation to the top of the tracks that the head of a blank disposed in proper position will pass under the selector, but a blank which is not properly aligned or disposed in relation to the tracks will strike the selector and be pushed off through the gap 71 in track 65. In order to prevent properly aligned blanks from dropping through the openings 71, the tracks are tilted in a clockwise direction as viewed in the direction of the path of travel of the blanks and as shown in Fig. 15, so that, as a properly aligned blank passes under the selector 70 and across the gap 71, it is sufficiently supported by track 66 alone, because the shank of the blank can rest against the inside wall of track 66. Discarded blanks will drop down into chute 72 (Fig. 16), from which they can be discharged into a suitable receptacle.

After the blank has passed the gap 71 in the track 65, it passes under a top rail 73 and continues to travel along the path indicated in Fig. 1 on the tracks 65 and 66, down to the assembly wheel (Figs. 1, 6, and 17. That portion of the tracks 65 and 66 which extends upwardly from the assembly wheel 3 for a short distance may be considered the blank reservoir.

Assembly wheel

Assembly wheel 3 is mounted on a shaft 80 (Figs. 25, 26) carried in suitable bearings 81 and 82. A worm wheel 83 keyed to shaft 80 is adapted to be driven by a worm 84 mounted on a shaft 85 supported in bearings 86 and 87. Shaft 85 carries a handwheel 88 at one end

thereof and adjacent thereto a pulley 89 over which runs a belt 90 which is connected to a pulley 91 on the drive shaft of electric motor 92.

A friction clutch member to transmit power between worm wheel 83 and shaft 80, together with a handwheel on the hub of disk 3, has been used and may be of some aid in freeing jams which might occur in the assembling mechanism.

Assembly wheel 3 comprises a disk 94, from the periphery of which project a number of lugs 95 (Fig. 6). The wheel 3 is surrounded by a double track 96 made up of two flat plates 97 and 98 (Fig. 17) spaced apart a little more than the diameter of the shank of a blank B. The assembly wheel 3 moves in a clockwise direction as seen in the figures. Plates 97 and 98 are crescent-shaped in side elevation, their inner sides being the arc of a circle struck from the center of wheel 3 and their outer sides being curved so that the greatest radial width of the plate is adjacent the end of the washer reservoir, this width being selected so that, as the head of the blank rests on the periphery of wheel 3, the other end of the blank will project only slightly above plates 97, 98 at the washer reservoir end. The wheel and track are so designed that when a lug 95 engages the head of a blank at the end of the blank reservoir, the blank is pushed upwardly, the head of the blank passing between the lower edges of plates 97 and 98 and the periphery of wheel 3 and the shank passing between the sides of plates 97 and 98. Thus the blank will be supported radially to wheel 3 and carried around with it.

Consequently, as the upper end of the shank is moved past the lowermost washer in the washer reservoir, the blank end will move into the opening of the washer and carry it out of the reservoir, as will be best understood from Figs. 6 and 17.

Just after the blank engages the lowermost washer and lifts it out of the washer reservoir, the end of the blank comes up under a spring finger 100 which holds the washer in place on the blank. As the blank is about to pass from under the spring finger 100, it passes under the outside assembly track 101, which is also made up of two spaced flat plates spaced far enough apart to permit the shank of the blank to pass therebetween. Track 101 is curved as shown in Fig. 6, to follow the outside curvature of the crescent-shaped plates 97, 98, to form an outside track eccentric to the track followed by the head of the blank. This outside track holds the washer in place on the shank of the blank and, as the wheel 3 rotates the blank, forces it downwardly on the shank of the blank until, when the assembly is discharged from the lower part of the wheel 3, the washer is positioned adjacent the head of the blank, as seen in Fig. 6.

As the assembled blank and washer leave the assembly wheel, they fall onto a discharge track 102 formed as a continuation of the tracks around which the blank and the washer are moved by wheel 3. Track 102 is made up of a pair of rails 103 and 104, very much like the rails 65 and 66. As an assembly A, made up of a blank and washer, travels downwardly by gravity along track 102 between the rails 103 and 104, it reaches a gap 105 in the rail 103 (Figs. 6 and 17). Opposite the gap 105 is a plate 106 disposed at right angles to tracks 103 and 104 and with an edge 107 which is arranged parallel to track 104 and so spaced therefrom as to engage the side of the head of a blank B upon which a lock washer has been properly assembled as said blank and lock washer slide along track 104. Plate 103 is raised far enough above the top of track 104 so that, if a blank without any washer passes down along the discharge track 102, it will pass under the edge 107 of the plate 106 and, when it reaches the gap 105, such blank will have no support on one side thereof and will fall out through the gap 105 to be discarded. If, on the other hand, a blank has a washer underneath the head thereof, the head will be raised sufficiently so that plate 106 will engage the side of the head and, in cooperation with track 104, will support the assembly until it has passed beyond the gap 105. In order to facilitate the discharge of blanks having no washers thereon through gap 105, a flat spring 105' aids in pushing the assemblies out through gap 105. A curved plate 108' offers a slanting surface to a blank without a washer as it drops from the discharge track, to facilitate the disposal thereof through gap 105. A top rail 108 holds and guides the assemblies as they slide down the discharge track.

From the discharge track 102, the assemblies slide down into quills or magazines 4.

Quill

In the illustrative arrangement, the quills or magazines 109 into which the assemblies are discharged comprise a pair of parallel angles which form tracks as shown at 110 and 111 (Fig. 20). These are secured by suitable screws 113 to a base 114 extending the length of the quill. A top guide 115, supported on suitable yokes 116, fastened to and spaced along the base 114, is preferably adjustable vertically, by means of bolts 115', in relation to the top of the tracks 110 and 111 to allow for different thicknesses of blank heads and washers.

Pivotally mounted on one end of each quill or magazine is a pivoting gate 117 made in the form of a yoke straddling the top guide 115 and pivoted thereto on bolt 118. A pin 119 limits the upward movement of gate 117. A pin 118' projects outwardly from the side of gate 117, and its function will be described hereafter. When a quill is in position on the quill holder, the open end will be near the end of the discharge track 102 and the closed end, carrying gate 117, near the opposite end thereof.

When a quill is removed from the assembly machine, the gate 117 will be held by gravity in the closed position shown in Fig. 19 and will prevent the assemblies from sliding out from that end of the quill.

A quill shifter and support is shown in Figs. 18, 23, and 24 and comprises a long, channeled-shape framework 120 upon which a pair of quills are designed to rest side by side. The left end of this framework, as viewed in Fig. 18, is equipped with a stop 121, against which the gate end of the quills may be placed. The quill support is pivoted on pin 122 carried by a fixed arm 127. On framework 120 above pin 122 is a cross arm 123 with three lugs 124, 125, and 126 thereon, between which a pair of quills may be placed. The right end of the quill support, as seen in Fig. 18, is equipped with a similar cross arm 128 with lugs 129, 130, and 131, between which the right end of the pair of quills may rest. A pair of ears 132 and 133 on arm 128 are adapted to slide on a suitable track 134 and give support to this end of the quill carrier 120.

In operation, the quill support is designed to carry two quills resting thereon on arms 123 and

128 between the lugs arranged on these arms. When the machine is first put in operation, one of the empty quills is positioned in alignment with the discharge track 102 and, when this quill is filled, the quill support automatically shifts the empty quill over in alignment with the track 102 and the full quill may then be removed and replaced with an empty one. When the second quill is filled, the quill support is designed to shift back so that the empty quill which replaced the first full quill will then be in alignment with the track 102. This movement of the quill support is accomplished by means of a double solenoid 135, the plunger of which, shown at 136, is connected by a suitable rod 137 to the under side of quill support 120 (Figs. 18 and 23). Solenoid 135 is of the double type so that it can move the quill support first in one direction and then in the other direction.

During the actual movement of the quill support, it is necessary to stop the flow of assembled blanks and lock washers momentarily. Without stopping the assembly wheel, this is done by means of a finger 138 (Fig. 22) which is mounted on a pivot arm 139 so as to be superimposed above the track 102 and, when depressed, moved down to tracks 103 and 104. The right end of pivoted member 139 is loaded by a coil spring 140 tending to pull this end of the member 139 downwardly, as seen in the figure, and thus raise the finger 138 which is attached to the opposite end of member 139. An arm 140' is designed to engage the under side of arm 139 and limit its downward movement on the spring side thereof. A solenoid 141 is connected by a suitable rod 142 to member 139 between finger 138 and the pivot point 143. The operation of this solenoid will be described in detail under the subject of "controls." It will be sufficient to say at this point that immediately before the solenoid 135 is energized to move the quill support either in one direction or the other, the solenoid 141 is energized and moves the stop finger 138 downwardly to the track 102 and momentarily arrests the gravity flow of assemblies. As soon as the quill support has moved and the empty quill has taken its position at the end of track 102, the solenoid 141 is de-energized and spring 140 moves finger 138 upwardly and thus the assemblies are released to flow down into the empty quill.

Controls

It is desirable to control the flow of blanks and washers so that the same number of each will be delivered to the assembly wheel in a given time and, in case of accident, it is desirable to stop the machine automatically. When a quill is filled with assemblies, it should be moved away from the discharge track and replaced with an empty quill. The illustrative machine is designed to perform all these functions automatically. Various control devices may be used for this purpose and the preferred form will now be described.

As the washers move down through the washer reservoir 36 which extends from the clearing wheel 39 to the assembly wheel 3, they pass under a pivoted light spring finger 144 (Figs. 1, 2, and 6). Finger 144 is connected to a mercury switch 145 so that, upon a very slight movement of the finger 144, switch 145 is tilted from the closed to the open position or vice versa. When there is a washer under the end of finger 144, it is lifted sufficiently to maintain the mercury switch 145 in a closed position, but when there is no washer under this finger, it falls enough to tip the mercury switch 145 and open the circuit therethrough. Switch 145 is connected in series with the assembly driving motor 92, a similar blank feeder switch 152, and blank feeder 61 so that, when there is no washer under the spring finger 144, the circuit through the motor 92, switch 152, and blank feeder 61 is opened. In ordinary running, absence of washers is usually momentary and consequently the motor only slows down for a short interval.

Another finger-operated mercury switch is arranged on the blank feed track at 150. This is operated by means of a spring finger 151 which rests lightly upon the blank heads passing thereunder. When there is a blank head under this spring finger 151 and therefore it is raised, the mercury switch 150 is in the "off" position; that is, the switch is open. This switch controls increased activity of the blank feeder vibrating mechanism 61. Normally, this vibrator is manually adjusted from the control panel to permit a rate of flow of blanks slightly lower than the rate at which the assembly wheel demands them. Consequently, the number of blanks in the reservoir will drop and at times there will be no blank under the finger 151 so that it falls, closing mercury switch 150. This completes a circuit which causes an increased supply of current to flow to the blank feeder 61 and therefore an increased supply of blanks will drop into the blank aligning chute. This extra supply of blanks again raises the finger 151 and opens the circuit through switch 150, thus cutting off the increased supply of current to the vibrator 61, permitting it to function in accordance with the normal manual control adjustment.

It has been found nearly impossible to adjust the flow of blanks and washers so that exactly the same number are fed to the assembly wheel. Therefore the manual adjustment of the machine is such that fewer blanks than washers are fed to the wheel, but the difference is taken care of by this automatic feed which produces an additional number of blanks sufficient to maintain the assembly wheel supplied with a supply of blanks equal to the supply of washers.

Lower down on the blank reservoir is positioned mercury switch 152 controlled by a spring finger 153 which also rests on the heads of the blanks passing along the blank reservoir. This switch is very much like switch 145 because it is maintained in a closed position as long as the finger 153 is raised by the blank heads, but when the supply of blanks drops to the point where the spring finger 153 falls, then switch 152 is opened. It is in circuit with motor 92 and therefore will stop the assembly wheel 3.

Quill control mechanism

The mechanism for controlling the shifting of the quills is shown in Figs. 25 and 26 and includes cams operated from shaft 80 on which the assembly wheel 3 is mounted. At that end of shaft 80 which is opposite to the end upon which assembly wheel 3 is mounted, a pinion 155 meshes with gear 156 on shaft 157. Shaft 157 is mounted in suitable bearings 158 and 159 and carries a worm 160 designed to mesh with a worm wheel 161 which is on a transverse shaft 162 which operates in bearings 163 and 164. On this shaft 162 are mounted four cams 165, 166, 168, and 169 designed to close spring-loaded electric switches 170, 171, and 172. The last two cams are mounted 180° apart on disk 167.

The electrical connection of switches 170, 171,

and 172 will be described in detail with the circuit diagram (Fig. 27). It is sufficient to say here that the gear ratio between shaft 80 and shaft 162 is such that 99 assemblies are permitted to slide into an empty quill and then, through the medium of the timing mechanism just described, solenoid 135 is energized so as to shift the quill support to take the filled quill out of alignment with the discharged track 102 and bring an empty quill into alignment therewith. The stop finger 138 is depressed shortly before and during the shifting operation by solenoid 141 and subsequently released. This is accomplished by the above-described timing mechanism.

Frame

The various elements of the machine which have been described are assembled and arranged upon a suitable framework which comprises essentially a flat top 175 supported upon four legs 176, 177, 178, and 179, which can be conveniently made of angle iron as shown. The vibrators 6 and 61 are mounted on the flat top 175 and the hoppers 1 and 2 are supported on angle iron legs resting thereon. Two of such legs for hopper 1 are shown at 180 and 181, and two such legs for supporting hopper 2 are shown at 182 and 183. A projecting horizontal channel 184 serves to support the assembly wheel and the various parts leading thereto and connected therewith. This channel is supported on legs 176 and 177 and projects therefrom as a cantilever beam.

Flat table 185 is designed to receive thereon a suitable panel board for mounting the selector switches and controls. This board is not shown because it forms no part of the present invention and, although it may be conveniently mounted on table 185, it may also be mounted any place else on the machine or any place near the machine.

Electric circuits

Looking at Fig. 27, lines 190 and 191 connect with a source of power such as the commonly used 110-volt alternating current. Wire 192 is connected to line 190 and carries current to an adjustable rheostat 193 which is connected in series by means of wire 194 to the aligning belt and clearing wheel drive motor 50. A hand switch 195 is designed to make or break the circuit through motor 50.

A double throw hand switch 196 controls the current passing through the main lines 190 and 191 to the other parts of the electrical system of the assembly machine. The main line connections from power lines 190 and 191 are shown at 190' and 191'. From these lines the various pieces of electric equipment receive their current.

The blank feeder 60 is designed to be vibrated by the vibrator 61 which is connected through a rectifier 197, an adjustable resistance 198, and a hand switch 199 to power line 190'. The other side of the vibrator is connected to power line 191' through wire 200 and switch 145.

Washer vibrator 5 is actuated by vibrator 6 connected on one side to power line 190' through rectifier 201, adjustable resistance 202, and hand switch 203, and on the other side to power line 191' through wire 204.

The washer feeder 9 is agitated by vibrator 16 which is connected to power line 190' through rectifier 205, adjustable resistance 206 and hand switch 207, and on the other side to power line 191' through wire 208.

Mercury switch 150 is connected in series with a resistance 209 (approximately ¾ the resistance of 198) and both the switch 150 and resistance 209 are connected in parallel with resistance 198 through lines 210 and 211. As pointed out heretofore, switch 150 is designed to remain open when there is a blank under its spring finger 151, but when the supply of blanks falls so low that there are no blanks under this switch, the finger 151 will drop, the switch will close, and additional current will pass to vibrator 61, agitating the blank feeder 60 more rapidly and thus feeding more blanks. Mercury switch 152 is connected in series through wire 212 with assembly motor 92 and this in turn is connected to rheostat 217 by line 216. The other side of rheostat 217 is connected to power line 190' through hand switch 213 by means of wires 218 and 214. The other side of switch 152 is connected by wire 215 to mercury switch 145 and vibrator 61. One side of switch 145 is connected to power line 191' by wire 216'.

Normally, with a sufficient supply of washers under switch 145, this switch remains closed and likewise switch 152 remains closed when there are blanks thereunder. When both of these are closed, motor 92 is connected into the circuit and operates. If, on the other hand, the supply of washers falls so low that there are none under switch 145, then assembly motor 92 and blank feeder 61 will be disconnected from the source of power. Opening of switch 152 will disconnect motor 92 only.

Fig. 28 shows the electric circuit diagram for the quill shifting mechanism. The power lines are shown at 220 and 221. These may be connected into the power lines 190 and 191, as shown in Fig. 27. A hand switch 222 serves to connect and disconnect the electrical part of the quill shifting mechanism with or from the source of power. Shaft 162 is geared to assembly wheel 3 through suitable reduction gears, as shown in Fig. 25. The shaft carries cams 165, 166, 168, and 169. Cam 165 operates electric switch 170. Cam 166 operates switch 171, and cams 168 and 169 alternately operate switch 172 upon rotation of shaft 162. Switch 172 is connected in series by wire 223 with solenoid 141 and to the power line 220 by wire 224. The other side of solenoid 141 is connected by wire 225 to power line 221. It will thus be seen that solenoid 141 is activated when switch 172 is closed and this is accomplished by cams 168 and 169, twice in each revolution of shaft 162.

Shaft 162 is so geared to assembly wheel 3 that enough blank assemblies are permitted to move past the stop finger 138 to fill one quill and then switch 172 is closed and solenoid 141 pulls down the finger 138 to arrest the flow of assembly blanks from the discharge track of the machine into the quill.

Switch 171, which is designed to be closed by cam 166, is connected in series by wire 226 with coil 135*a* of double solenoid 135. The other side of this coil is connected to the power line 220 by wire 227. When cam 166 closes switch 171, coil 135*a* is activated and moves the quill support from one side to the other. Coil 135*b*, which forms the outer side of the double solenoid 135, is connected in series with switch 170 through wire 228 and the other side of the coil is connected to the power line 221 through wire 229. The other side of switch 170 is connected to power line 220 by wire 230. In Fig. 28 switch 170 is shown closed so that coil 135*b* of solenoid 135 is activated.

Quill adapter for thread rolling machine

Figs. 29, 30, and 31 show quill adapter **235** bolted to a thread-rolling machine **236** by means of bolts **237**.

A full quill **109** is shown inserted in the quill adapter **235** so that the track **110** of the quill is lined up with track **238** of the thread-rolling machine. The quill adapter consists of two angularly disposed members **239** and **240** joined together and braced by means of support **241**. Member **239** has a channel **242** (Fig. 30) on the upper surface thereof.

Projecting over the edges of this channel are strips **243** and **244** attached to member **239** by bolts **246'**. The channel and strips form a guideway adapted to receive quill **109**. Secured to the upper side of strip **244** is a right angle arm **245**. This may be held in place by bolt **246**.

Secured to the top of member **245** and projecting at right angles therefrom is a spring finger **247** which is designed to engage pin **118'** of the quill gate **117**, so as to cause said gate to open by pivoting about bolt **118** when the quill **109** is forced downwardly into the quill adapter **235**. Pin **119** on the guard **115** will limit the upward movement of the gate **117**. When the gate **117** is moved upwardly as seen in Fig. 29, the blank assemblies are free to flow by gravity from the quill **109** onto the track **238** of the thread-rolling machine.

In operating the assembly machine in conjunction with a number of thread-rolling machines, it has been found convenient for the operator of the assembly machine to remove the full quills and hang them on a convenient rack where they can be readily obtained by the operator of the thread-rolling machines. When a quill is hanging on a rack, the open end will be upward and the gate **117** will be closed. When the thread-rolling machine operator wishes to insert another quill, it is only necessary for him to remove the empty one from the quill adapter and insert a new one, gate foremost, therein. As the quill is pressed down into its final resting place in the adapter, the spring **247** opens the gate **117** and the assemblies flow into the thread-rolling machine. In this manner, the cycle of operation may continue, with the operator of the assembly machine filling the empty quills and placing them on a suitable rack or other receptacle for the use of the operator of a thread-rolling machine and the latter in turn returning the empty quills to the operator of the assembly machine.

It is contemplated that where the word "blank" is used in the claims, it shall include headed, threaded elements, such as bolts and screws, and where the words "non-circular washers" are used it is intended to include all types of washers except the plain annular type.

While I have shown the invention as embodied in a specific form, it is to be understood that various changes in details may be made without departing from the scope of the invention as defined by the appended claims.

I claim:

1. In an assembly machine of the class described, a wheel having a wide peripheral edge against which the heads of bolts are adapted to abut, a circular member surrounding said wheel and spaced from the edge thereof sufficiently to admit the heads of bolts as they are located between said edge and said member, spaced projections on the periphery of said wheel, said projections spaced considerably more than the diameter of a bolt blank head apart around the periphery of said wheel, means for guiding the headed blank into the path of said projections with the shank of the blank extending away from the center of the wheel, said projections adapted to engage the heads of bolts and carry them with the movement of the wheel, means for holding a washer at an angle to the path of travel of the outer end of the blank as it is moved by one of said projections and positioned across the path of said outer end.

2. In an assembly machine of the character described, an assembly wheel, projecting lugs spaced apart around the periphery of said wheel, spaced tracks surrounding said assembly wheel, inner edges on said tracks spaced from the periphery of said wheel only a sufficient distance to permit bolt blank heads to travel between said edges of the tracks and the periphery of the wheel while holding said blanks in a substantially radial position in relation to the center of said wheel, outside edges to said tracks formed in the shape of an arc so that one end thereof is further from the center of the assembly wheel by about the length of a bolt blank than the other end is, outside tracks cooperating with the last-mentioned tracks and last-mentioned edges thereof to form a space therebetween sufficient to accommodate a washer and permit it to move therebetween when mounted on the shank of a bolt blank and because of the arcuate shape of the space between the two last-mentioned tracks to cause said washer to move from the unheaded toward the headed end of the blank as the blank is rotated on the periphery of the assembly wheel.

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