

May 2, 1944.

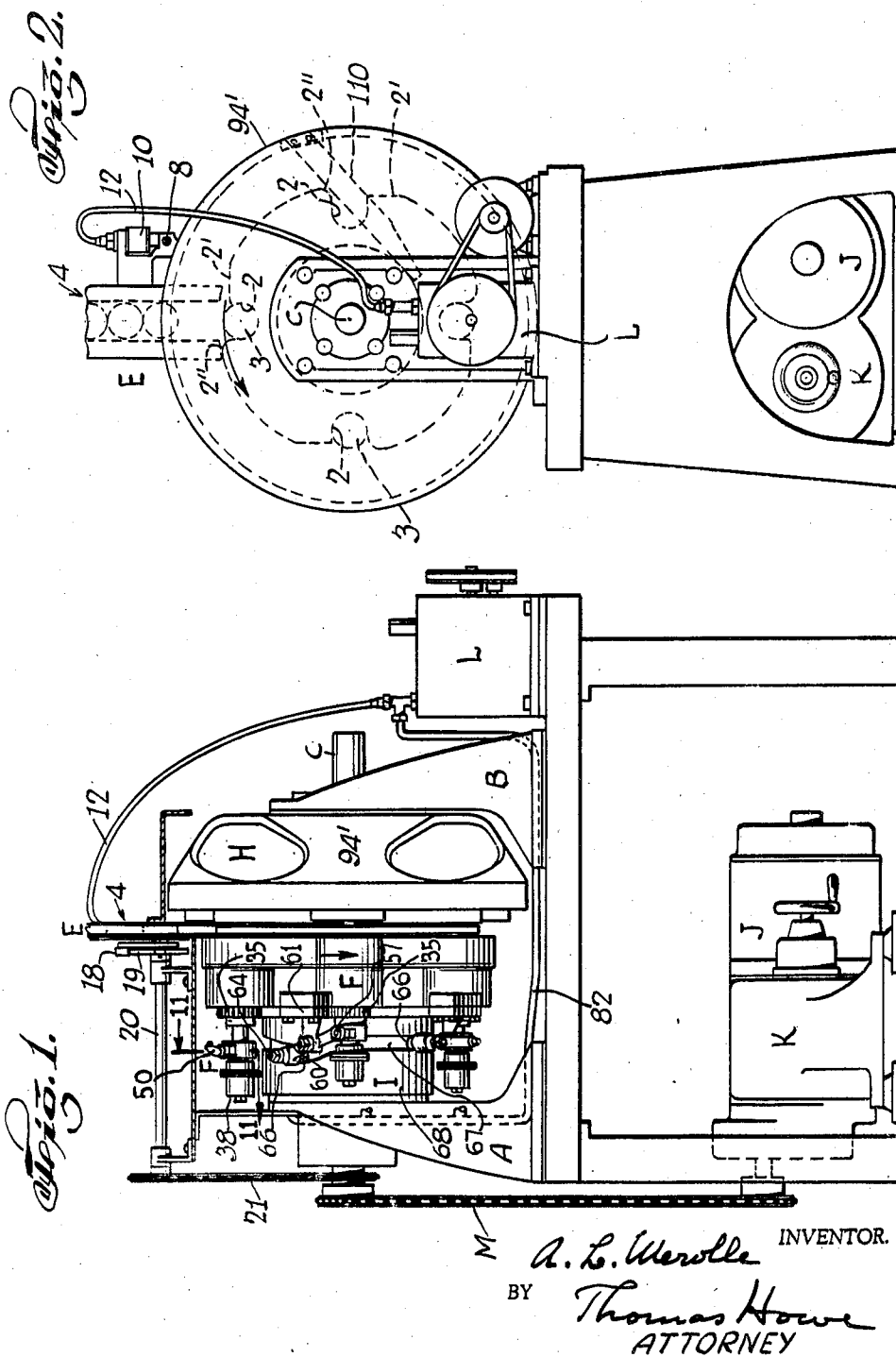
A. L. MEROLLE

2,348,085

MEANS FOR THREADING CLOSURE CAPS

Filed Aug. 2, 1941

9 Sheets-Sheet 1



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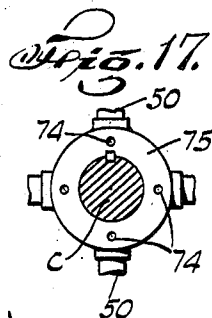
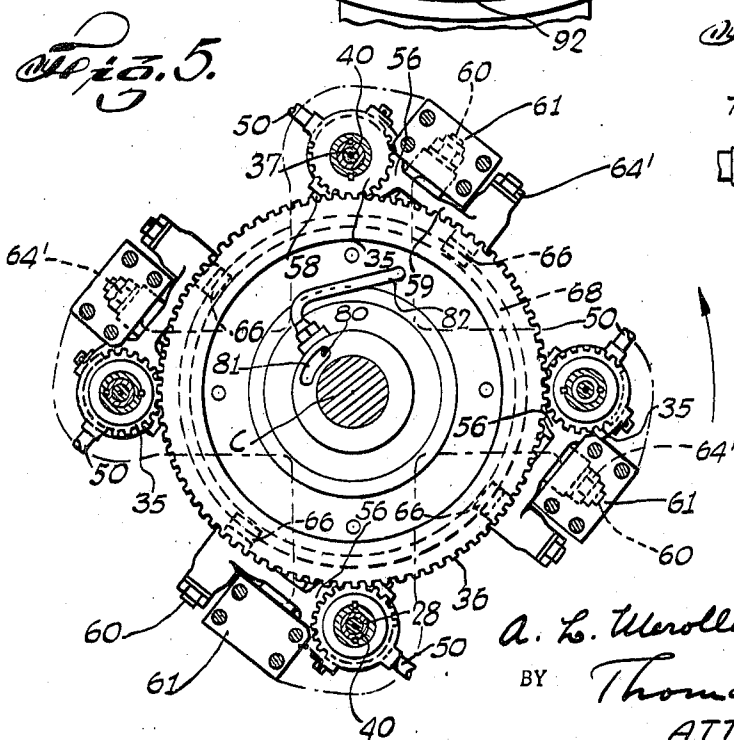
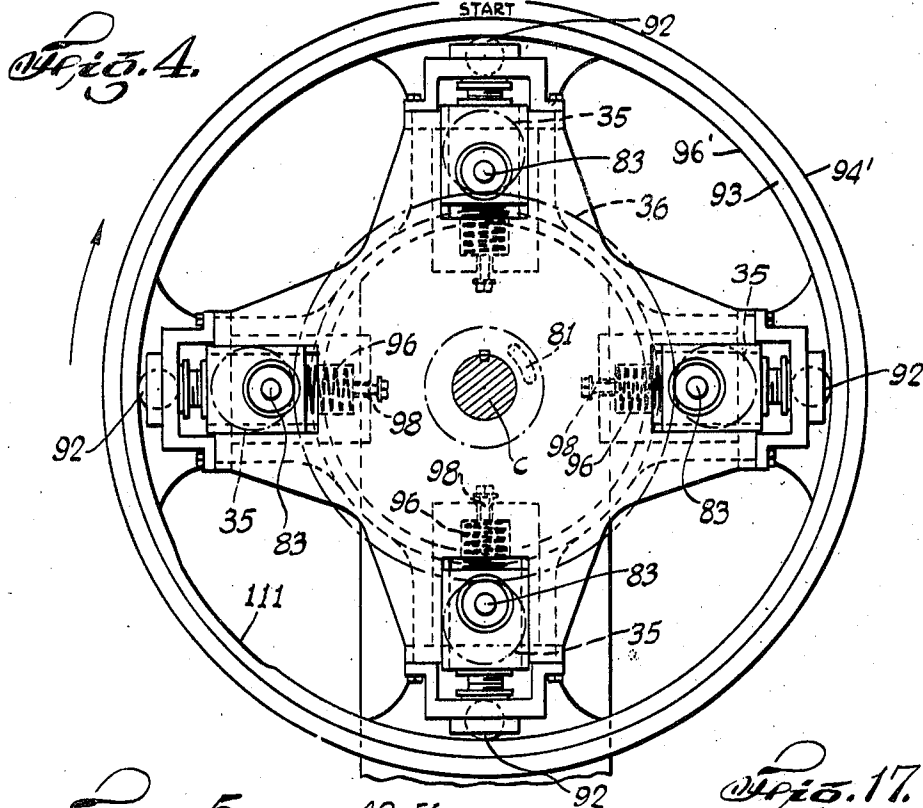
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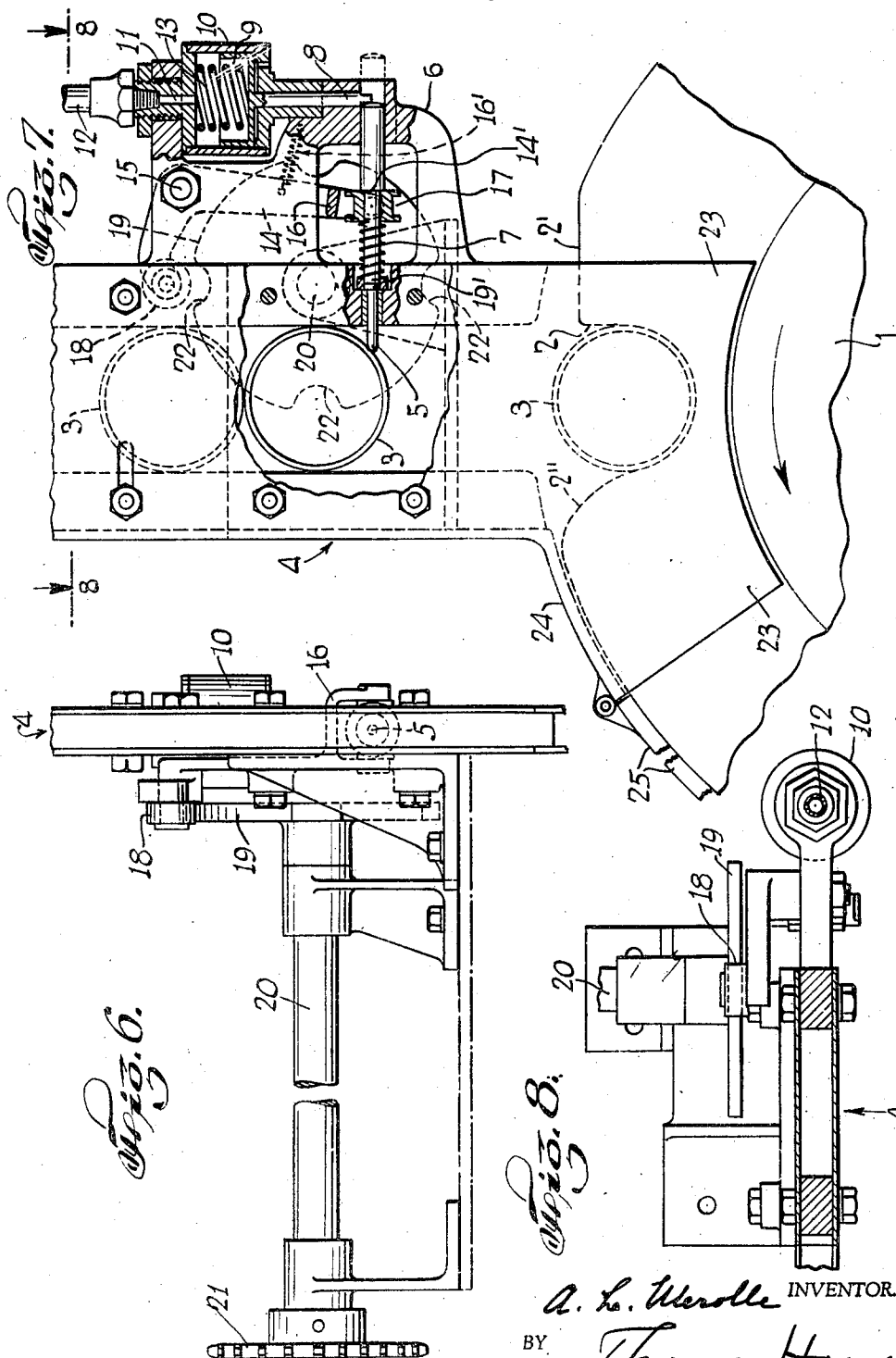
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MEANS FOR THREADING CLOSURE CAPS

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Filed Aug. 2, 1941

9 Sheets-Sheet 5

Fig. 10.

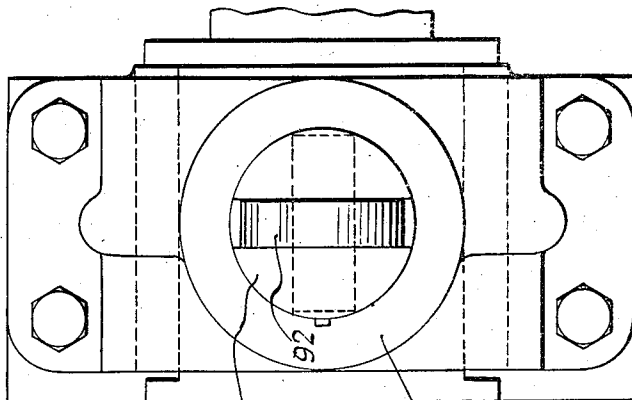
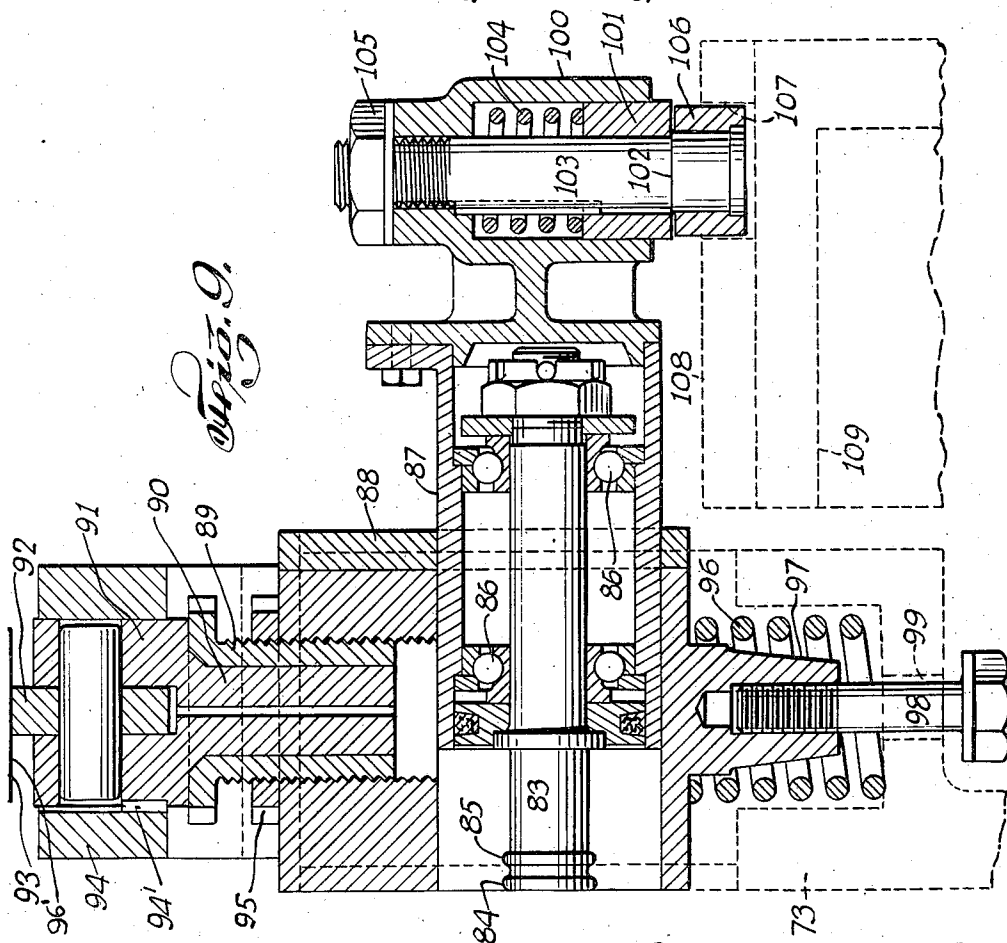


Fig. 9.



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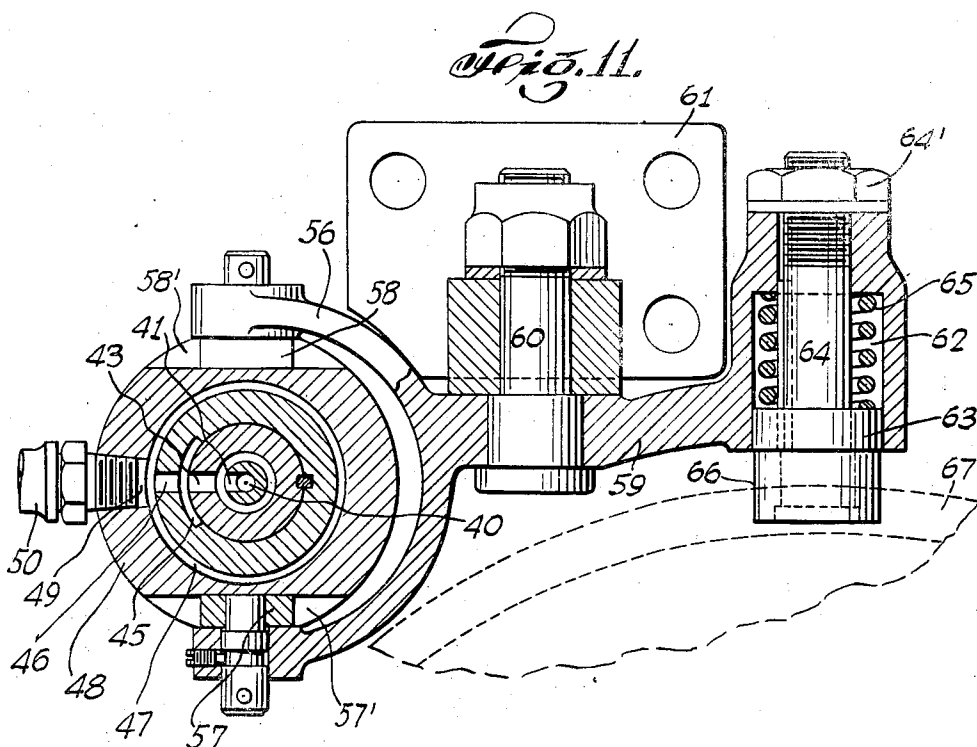
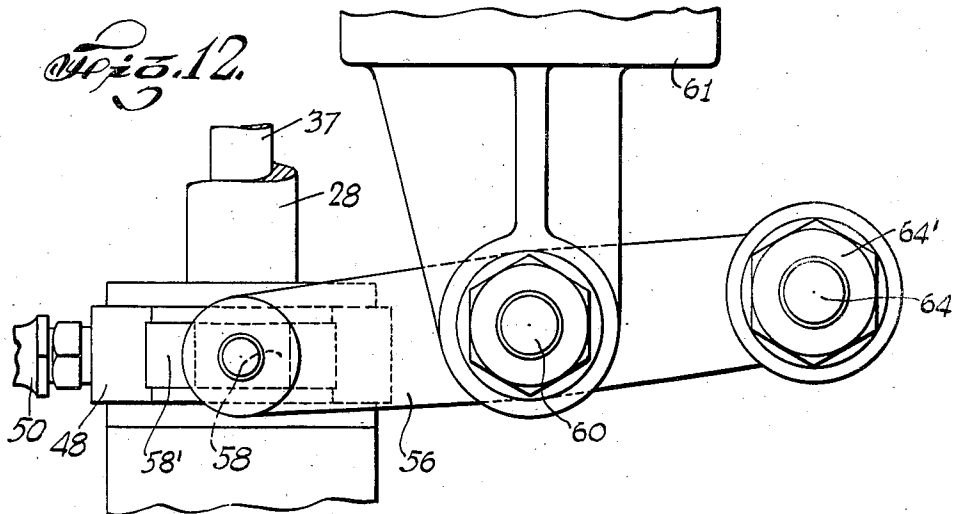
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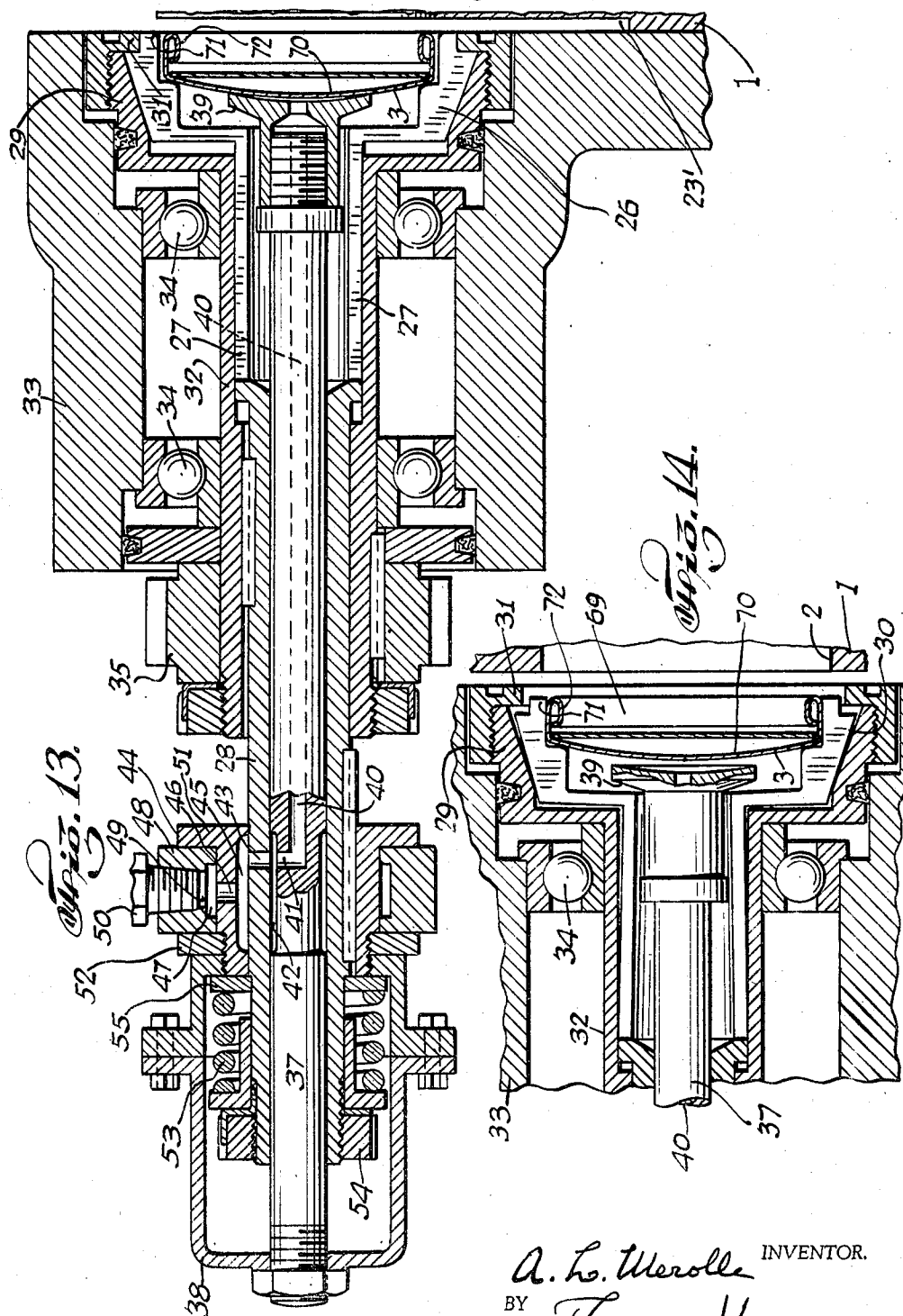
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2,348,085

MEANS FOR THREADING CLOSURE CAPS

Filed Aug. 2, 1941

9 Sheets-Sheet 7



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2,348,085

MEANS FOR THREADING CLOSURE CAPS

Filed Aug. 2, 1941

9 Sheets-Sheet 8

Fig. 16.

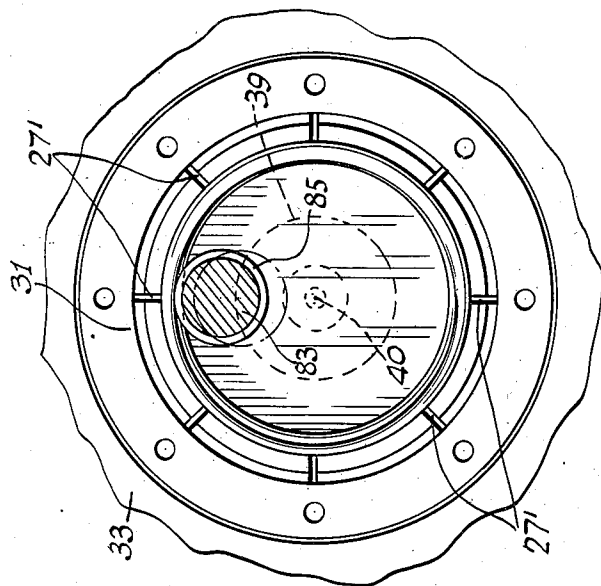
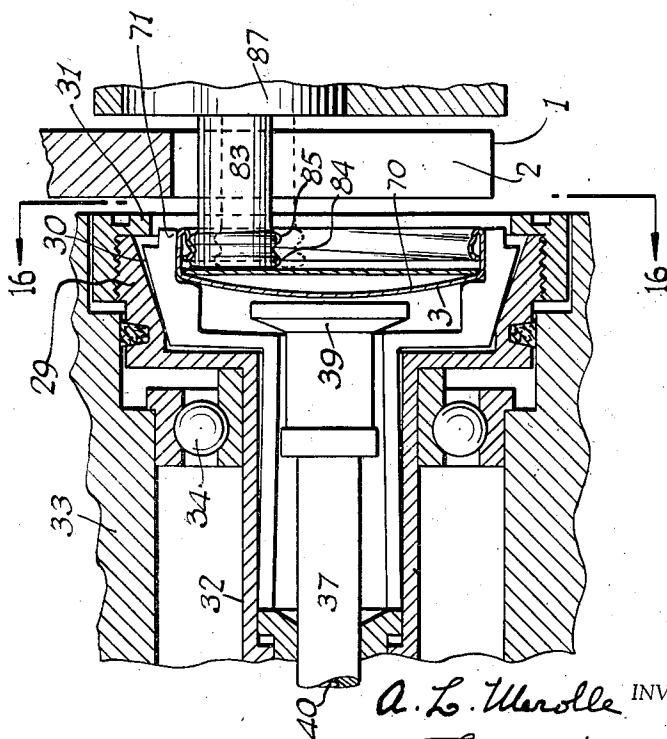


Fig. 15.



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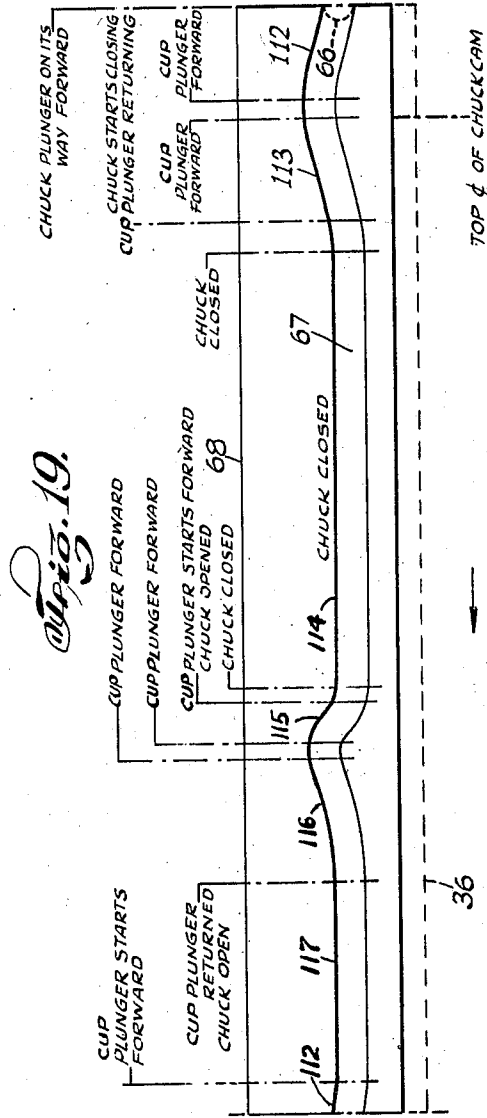
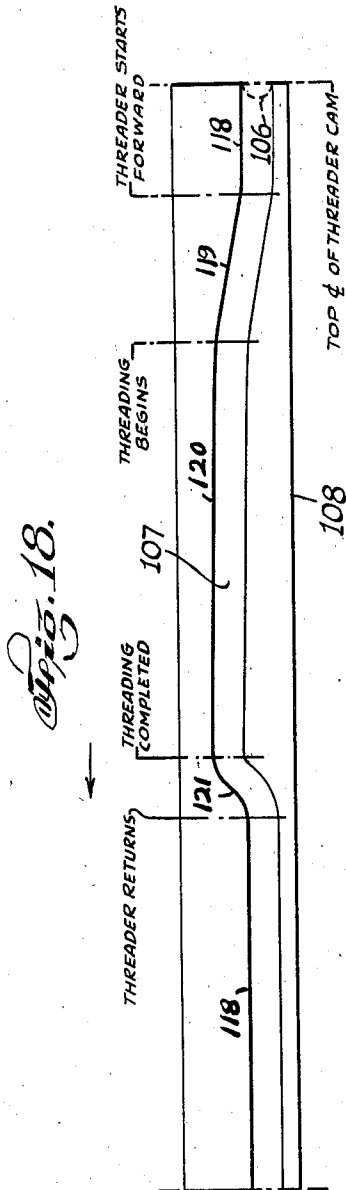
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MEANS FOR THREADING CLOSURE CAPS

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9 Sheets-Sheet 9



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UNITED STATES PATENT OFFICE

2,348,085

MEANS FOR THREADING CLOSURE CAPS

Augustus L. Merolle, Brooklyn, N. Y.

Application August 2, 1941, Serial No. 405,124

4 Claims. (Cl. 153—72)

This invention relates to the threading of closure caps and like articles. While the use in which it is contemplated it will find its widest application is in connection with such caps, it may have uses in relation to other articles to be threaded.

The main object of the invention is to provide an improved threading means whereby the threading of articles may be efficiently, expeditiously and accurately accomplished.

A further object of the invention is to provide an improved means for threading closure caps having interior and exterior side walls wherein the threads are formed in the interior wall, and this in such manner that the outer wall of the cap shall be left smooth and free from any mark or indentation occasioned by the threading and the lower edge of the cap shall be smooth and without mark or indentation entirely about the circumference of the cap.

A further object of the invention is to provide a simple and efficient means for placing the article to be threaded in the chuck and expelling it therefrom and without liability of mutilation of the article.

Other and ancillary objects of the invention will appear hereinafter.

In the accompanying drawings which illustrate the invention—

Fig. 1 is a side elevation of apparatus embodying the invention;

Fig. 2 is an end elevation of the apparatus of Fig. 1 viewed from the right hand end of the figure last mentioned;

Fig. 3 is a vertical, axial section, on an enlarged scale, of the apparatus of Figs. 1 and 2, partly broken away;

Fig. 4 is a section on the line 4—4 of Fig. 3;

Fig. 5 is a section on the line 5—5 of Fig. 3;

Fig. 6 is a side elevation, on an enlarged scale, and partly broken away, of the means for feeding the caps from the supply chute;

Fig. 7 is an end elevation, partly in section, of the apparatus of Fig. 6 viewed from the right-hand side of that figure, Fig. 7 also showing an adjacent portion of the rotating cap receiver plate, partly broken away;

Fig. 8 is a section on the line 8—8 of Fig. 7;

Fig. 9 is an enlarged view of the section as shown in Fig. 3 of the threader and its supporting and operating means;

Fig. 10 is a top plan view, partly broken away, of the apparatus of Fig. 9;

Fig. 11 is a section, partly broken away, on the line 11—11 of Fig. 1;

Fig. 12 is a top plan view of the apparatus of Fig. 11;

Fig. 13 is an enlarged section, on a plane through the axis of the chuck and axis of the machine, of a chuck with its operating sleeve, vacuum cup and plunger thereof with operating parts therefor, in position where the chuck jaws are open and the vacuum cup is in position where the closure cap is fully entered within the chuck;

Fig. 14 is a section similar to Fig. 13, but with parts broken away, and with the parts in a different position, namely where the chuck jaws are closed to grip the cap and the vacuum cup has been further withdrawn to be separated from the top wall of the cap;

Fig. 15 is a section similar to Fig. 14, but with portions of the cap receiving plate and threading means, the parts being in position where the threader has substantially completed the formation of the thread;

Fig. 16 is a section on the line 16—16 of Fig. 15;

Fig. 17 is a section on the line 17—17 of Fig. 3;

Fig. 18 is a development upon a plane surface of the stationary cam drum with the groove therein for actuating the threading means; and

Fig. 19 is a development upon a plane surface of the cam drum with the cam groove therein for operating the vacuum cup and plunger and the chuck to open and close the last.

Referring generally to the drawings, the apparatus comprises a support which includes the stationary pedestals A and B which rotatably support the shaft C, and keyed to the shaft and rotating therewith are the rotating receiver D adapted to receive the caps to be threaded from the feeding means E, the holding means F for the caps while being threaded and comprising circumferentially distributed chucks into which the caps are moved from the cap receiver D by suction or vacuum means, and the threading means G comprising the circumferentially distributed threaders or threading tools, one for each chuck, and supporting and operating means therefor, the tool carriers being shifted radially and longitudinally by a stationary cam structure H and the chuck and appurtenant mechanism being operated by a stationary cam and gear structure I. An electric motor J and a variable speed gear transmission K provide a means for driving the shaft C and other of the mechanism, while the vacuum apparatus L provides the means for producing a suction on certain parts of the apparatus as will hereinafter appear. The shaft C is driven from the motor J through the transmis-

sion gearing K by means of a sprocket chain drive M.

Referring now to the drawings more in detail, the cap receiving means comprises the plate 1 having the recesses 2, each of which is adapted to easily fit a cap 3 to be threaded. The caps are fed one by one to the plate from a vertical chute 4, the caps being so placed in the chute that the closed side or top wall of each cap will be toward the chucks and the open side towards the threading means. In the apparatus illustrated there are four recesses 2 spaced 90° apart but such recesses, and appurtenant apparatus, may be one or more in number distributed about the plate 1.

The lowermost one of a train of caps, one above the other, in the chute is held against downward movement by a pin 5 longitudinally reciprocating in one side of the chute and in the stationary bracket 6.

This pin is moved into position where it projects into the path of the caps within the chute, and is retracted from such position, by a bell crank 14 pivoted at 15 in the stationary arm 6. One arm of the bell crank has a roller 18 while the other end of the crank has a fork 16, the extremities of which have projections extending, on diametrically opposite sides, into the circumferential groove of a grooved collar 17 sliding upon the pin 5. Interposed between the collar 17 and a nut 19' fixed upon the pin 5 is a spring 7 through which, and the collar 17, the bell crank acts to resiliently press the pin 5 forward so as to project it within the chute and restrain the passage of caps downwardly. The resilient pressing forward of the pin 5 into the chute avoids any possibility of the pin being jammed forward so rigidly as to injure any of the caps in the chute. The collar 17 is held by the bell crank in position to cause the pin 5 to be projected into cap-restraining position when the roller 18 rolls upon the exterior periphery of a disk 19 fixed upon the shaft 20 which is rotated from the main shaft C by the sprocket drive 21. The bell crank is held in this position against the tension of the spring 16' which tends to move the bell crank so that the roller will be forced toward the center of the disk 19. In the disk 19 are a plurality of recesses 22, and whenever a recess 22 comes beneath the roller 18 the spring 16' will cause the fork of the bell crank to move the collar 17 to the right (see Fig. 7) against the shoulder 14' on the pin 5 whereupon the pin will be retracted from the path of the caps and the train of caps will drop downwardly. The roller 18, however, will quickly rise out of the recess 22 to the periphery of the disk and cause the crank arm to be moved against the tension of the spring 16' and force the pin 5 into projected position within the chute so as to restrain further feeding of the caps until another recess in the disk 19 has been reached. The apparatus will ordinarily be so adjusted that but one cap can fall between the retraction and projection of the pin 5 so that the caps will be fed one at a time.

In the apparatus shown, the recesses 22 are the same in number and have the same angular spacing as the recesses 2 in the plate 1, and the apparatus is so related that one cap will be fed downwardly at an appropriate time to enter each recess. The plate 1 rotates in the direction of the arrow (see Fig. 7) and the trailing corner 2' of each recess is cut away more than the leading corner 2'' to facilitate the discharge of the cap from the recess, and the leading corner 2'' of the

recess is rounded as shown to facilitate the entry of the cap into the recess.

In order to prevent the caps from feeding into the apparatus when the vacuum suction is not in proper order, which is necessary to the proper operation of the machine as will hereinafter appear, the cylinder 10 is secured to the stationary arm or bracket 6, which cylinder is in communication through a pipe 12 with the vacuum source L. Within the cylinder 10 is a piston 9 having a stop pin 8. The suction applied to the cylinder tends to draw the piston 9 against the pressure of the spring 13 so that the pin 8 is withdrawn from the path of the pin 5 and the last is free to move to permit feeding forward of the caps from the chute. If, however, the vacuum is not in working order, the spring will force the piston 9 to one end of the cylinder 10 so that the pin 8 will project into the path of the pin 5 and prevent the latter from being withdrawn from the chute to feed the caps.

A guard comprising the plates 23 extends from the end of the chute down on both sides of the plate 1 and a top 24 insures that the caps will be certainly guided into and maintained in the plate recesses 2. The plates extend into rabbets 23' and 24' on opposite sides of the plate 1 which rabbets extend entirely around the plate. The plate 25 is a continuation of the top 24 which extends along the circumference of the plate 1, the plate 25 being hinged to the plate 24 so that the former may be raised to inspect the plate 1 or a cap in a recess thereof and possibly permit the removal or adjustment of a cap, if the cap has in any way become jammed.

Alongside of each of the recesses 2 and turning therewith is a chuck for receiving the cap and holding the same during the threading operation, the chuck being rotated on its axis during such operation. Also for each chuck is provided a vacuum means for transferring the cap from a recess 2 into the chuck, means for moving the chuck jaws to grip and release the cap and means for ejecting the cap from the chuck into the recess after the threading, the cap subsequently passing from the recess into a suitable receptacle.

Each of the cap holding chucks comprises a plurality of circumferentially arranged jaws 26 separated by clearances 27', mounted respectively upon the ends of resilient, separated arms 27 fixed to a sleeve 28. The arms 27 flex to permit the jaws to be moved inwardly to grip a cap but the inherent spring of the material tends to force them outwardly (to open the chuck) into the position as shown in Fig. 13. The sleeve 28, arms 27 and chuck jaws may be integrally formed from a single piece of steel with slits cut longitudinally from the chuck jaw and inwardly to the ends of the arms 27 where they join the sleeve 28. Such slits separate adjacent chuck jaws and their respective arms 27 and provide clearances therebetween whereby the chuck jaws may move inwardly to close the chuck and outwardly to open it, the members each comprising a chuck jaw and its arm 27, having a strong inherent spring action tending to force the jaws outwardly. Surrounding the chuck jaws is a circular housing 29 having a conical interior surface adapted to bear against the tapered surfaces 30 of the backs of the jaws 26, so that the jaws may move outwardly when in their right hand position to open the chuck to receive or release the cap (see Fig. 13) and when the jaws are drawn to the left (see Fig. 15) they are forced inwardly to close the chuck and grip the cap firmly. The outer edge of the housing 29

has secured thereto an inwardly projecting flange 31 to retain the clutch jaws within the housing. The clutch housing is mounted on the end of a sleeve 32 rotatably mounted by bearings 34 in the chuck carrier 33 which is keyed to and rotates with the shaft C but may not move longitudinally with relation thereto. This sleeve 32 is keyed to the chuck jaw operating sleeve 28 so that they rotate together but may relatively move longitudinally.

Fixed upon the sleeve 32 is a spur gear 35 which engages with the circumferential stationary gear 36 to rotate the sleeves 28 and 32 and their connected parts as the member 33 rotates with the shaft C.

Within the sleeve 23 reciprocates a plunger 37 which at one end is secured to the housing 38 and at its other end carries a vacuum cup 39 communicating by a bore 40 in the plunger 37 with a radial opening 41 communicating with an elongated annular port 42 in the plunger. This port is at all times in communication with a radial opening 43 in the sleeve 28 which, in all positions of the collar, communicates with an elongated port 45 in a collar 44 sliding lengthwise on the sleeve 28 but keyed against rotation with relation thereto. The port 45 in turn communicates through an opening 46 with an annular port 47 in the ring 48, which port communicates through an opening 49 with the end of a vacuum hose 50 secured to the ring 48 which rotates upon the collar 44 but is restrained against longitudinal movement thereon, the hose 50 being in communication with the vacuum cup 39 at all times.

The vacuum hose 50 communicates with a passage 74 in the hub 75 of the chuck carrier 33. Against this rotating hub is pressed the connecting sleeve 76 by a spring 77, the sleeve 76 being slidable upon the shaft C but being prevented from rotation thereon by the stationary pin 78 engaging the projection 79 on the sleeve 76. As the hub 75 rotates its passage 74 will, for a certain fraction of a revolution, be in communication with the passage 80 in the sleeve 76, there being an elongated passage 81 in the sleeve 76 at the end of the passage 80, the passage 81 extending circumferentially for such distance as to maintain communication between the passages 74 and 80 for such a period of time as is desired to apply vacuum suction and such suction is then cut off by the moving of the duct 74 out of communication with the passage 81. The passage 80 is connected by means of a pipe 82 with a suction or vacuum pump L.

There is a passage as 74 in the hub 75 for each of the chucks which successively are brought into communication with the passage 81 and are cut off therefrom in a manner as described. In the structure illustrated there are four ducts as 74, spaced 90° apart (see Fig. 17) corresponding respectively to the four chucks, and each duct communicates by a hose as 50 with its appropriate chuck as described.

The ring 48 is held against longitudinal movement on the collar 44 by means of a flange 51 on the collar and a nut 52 screwed on the collar against a shoulder. Also fixedly secured to the collar 44 by screw-threading thereon is the housing 38. The spring 53 interposed between the nut 54 on the end of the sleeve 28 and the washer 55 tends to force the washer against the shoulder on the sleeve 28. The collar 44 may be slid longitudinally but is keyed against turning on the plunger 28.

The ring 48 may be shifted longitudinally by means of a fork 56 having the extremities of its

arms pivoted to shoes 57 and 58 sliding in channels 57' and 58' respectively, in the ring 48. The fork 56 is on one end of a lever 59 pivoted at 60 in the bracket 61 fixed to the side of the chuck carrier 33. The other end of the lever 59 carries a socket 62 within which slides the piston 63 upon a bolt 64, the piston being pressed outwardly of the socket by means of a spring 65 and the piston has a portion 66 projecting therefrom and into a groove 67 upon the stationary drum 68 fixed to the pedestal A. A nut 64', by screwing up or unscrewing, furnishes a means for adjusting the projection 66 radially in the groove 67.

The drum 68 as shown comprises an inner portion and an outer circumferential layer with the groove 67 formed in it, the outer layer being fixedly secured to the inner portion of the drum, the drum, being formed of parts as indicated for facility in forming the cam groove and to permit the outer layer to be of heat-treated hardened steel to resist wear against projections 66, while the inner portion may be of cast iron.

The groove 67 extends entirely about the drum 68 and deviates longitudinally at appropriate points to move the projection 66 longitudinally. As, therefore, the chuck carrier, chucks and related parts rotate the roller 66 will be reciprocated longitudinally, one complete cycle for a revolution. Through the lever 59, fork 56 and shoes 57 and 58 this will cause the collar 44 to move the plunger 37 and also the sleeve 28 back and forth. A development of the surface of the drum 68, with the cam groove 67, on a plane surface is shown in Fig. 19 and the operation will be further referred to hereinafter.

In the operation of the chuck and vacuum cup plunger, the parts are shown in Fig. 13 where the collar 44 is in its position of retraction of the plunger 37 where the cap to be threaded has been drawn into the chuck until it abuts against the chuck jaws. Further movement to the left (Fig. 13) of the plunger 37 and the collar 44 compresses the spring 53 against the nut 54 and resiliently draws the chuck jaws to the left whereby they are forced inwardly by the tapered interior surface of the chuck housing 29 until the chuck is closed, that is the chuck jaws are in the position as shown in Fig. 14 to resiliently and firmly grip the cap so that it rotates with the chuck. Also the cap having been stopped by abutment against the chuck jaws as shown in Fig. 13, the movement of the collar 44 to the left (Fig. 13) as described will carry the vacuum cup plunger with it so that it will be pulled away from the cap as shown in Fig. 14. The cup will be in this relation during the threading operation. In the meantime the vacuum or suction will be cut off at a passage 74 so that normal atmospheric conditions will obtain in the vacuum cup and its connections. The collar 44 will then be moved to the right (Fig. 13). This will reduce the pressure of the collar 44 upon the spring 53 whereby the jaws will be loosened from the cap and the vacuum cup 39 will be thrust forward toward the cap until the position of the parts is again as shown in Fig. 13. The collar 44 will then continue its movement toward the right, the vacuum cup plunger 37 and cup 39 moving with it into their extreme right hand (Fig. 13), which is somewhat beyond the outer edge of the chuck, position, the spring action on the clutch jaws and the carrying along of the sleeve 28 with the plunger 37 by reason of friction of the parts causing the chuck jaws to assume their fully outward and open position as shown in Figs. 3 and 13. In this posi-

tion of the vacuum cup, the threaded cap will have been pushed or ejected thereby from the chuck into the recess 2 in the plate 1 so that the threaded cap will be carried by the plate 1 to a point of discharge. The vacuum cup will be retracted from its position just stated to the position as shown in Figs 3 and 13. Subsequently the cup will be again thrust forward so as to be in contact with or in proximity to any cap which may be in the receiving plate and the chuck will be open (see Fig. 3). The chuck and cup being in this condition, and the vacuum having been restored to the vacuum cup at the duct 74, the cap will be drawn to and secured by such vacuum to the cup. The collar 44 will then be moved toward the left (Fig. 13) and the plunger 37 retracted whereby the cap will be drawn into the open chuck against the chuck jaws as before referred to. Further left-hand movement of the collar 44 carrying with it the plunger 37 causes the breaking away of the vacuum cup from the cap and the closing of the chuck jaws upon the cap as described, and so the cycle may be repeated indefinitely.

It will be seen that the cap 69 as presented for threading comprises a top wall 70, somewhat dome-shaped, having the depending marginal side wall 71, entirely about the circular edge of the top, and the lower marginal portion 72 of the side wall is bent inwardly and upwardly within and spaced from the outer circular side wall 71 of the cap. It is in this internal marginal portion forming the inner wall 72 that the thread is to be formed leaving the outer wall 71 entirely free from any indentation or indication of thread whatever, the outside surface being entirely smooth, and also the extreme lower marginal edge of the completed cap being smooth and free from indentations. It will be noted that the free edge of the inner wall is bent outwardly to provide a support for the wall during the threading operation.

To perform the threading operation a threader or threading tool is provided with means for entering the threading tool within the cap to form the thread, and releasing such tool from the thread and withdrawing it from the cap after the threading operation has been performed, so that the threaded cap may be ejected from the chuck back into the recess 2 and eventually roll out therefrom into a discharge chute. On the opposite side of each recess 2 in the cap-receiving disk 1, from each chuck as referred to, is located the threading tool and its operating mechanism, there being one such tool and mechanism for each recess 2 and chuck. All of the threading tools and certain of the operating mechanism, are carried by the tool carrier 73 keyed upon the shaft C so as to rotate therewith. The tools and supporting and operating mechanism, are identical so that a detailed description of one will suffice for each.

As to each of the threaders or tools, the threader or tool 83 of circular cross section has adjacent one end the separate annular beads or ridges 84 and 85 of substantially the same size and shape, each of said ridges having its centre line in a single plane substantially perpendicular to the axis of the tool. The ridge 84 at the end of the tool serves to form the thread as the tool is advanced into the cap, while the ridge 85, the central radial plane of which is separated from the central radial plane of the ridge 84 by a distance equal to the pitch of the

thread, follows in the thread formed by the ridge 84 and serves to aid in holding the thread already formed by the ridge 84 from being deformed by the thrust of the ridge 84 as it forms succeeding turns of the thread.

The tool 83 is rotatably mounted by ball bearings 86 within a plunger 87 but is held against longitudinal movement with relation to such plunger. The plunger 87 slides transversely in a box or frame 88, which box is mounted in the tool carrier 73 so as to slide radially of the machine. Screw-threaded in the other side of the box 88 is a sleeve 89 within which extends the projection 90 of circular cross section and integral with a circular block 91 in which is rotatably mounted a roller 92 bearing against a stationary cam 93 adapted to move the roller and its connected parts radially as will be hereinafter referred to.

The circular block 91 slides radially in the bracket 94 secured to the tool carrier 73, but is held against rotation in such bracket by means of a key 94' whereby the block 91 may move radially but may not turn. The sleeve 89 may be turned upon the projection 90 so as to adjust the radial position of the tool 83 by screwing the sleeve further into or further out of the box 88, a jam nut 95 serving to lock the sleeve 89 in any adjusted position.

A spring 96 interposed between the tool carrier 73 and the box 88 tends to force the box outward radially and the roller 92 against the cam 93. A boss 97 integral with the box 88 extends within and positions the spring 96, and a bolt 98 screwed into the box 97 projects loosely through an opening 99 in the tool carrier 73, the head of the bolt having sufficient clearance between it and the tool carrier 73 so as to permit the necessary movement of the box 88 under the influence of the spring 96 and the contour of the cam 93. This bolt 98 acts to hold the box 88 and its carried parts in approximately assembled position even when the cam 93 is, for any reason, removed.

The box 88 and the tool 83 are thus movable radially by the face (the interior surface) 96' of the cam 93 against the pressure of the spring 96. The cam 93 is fixed on the stationary circular supporting spider 94' fixed upon the pedestal B, and its face 96' is concentric with shaft C and of constant radius, thereby holding the threading tool in proper radial position to thread the cap, except for a lowered or indented part 11 of greater radius which permits the threading tool to move outwardly, transversely of the cap, to clear the cap thread to permit the tool to be withdrawn after the cap has been threaded.

To move the plunger 87 transversely of the box 88, that is longitudinally of the machine, to advance the tool or threader into the cap to thread it and to withdraw the tool from the cap, there is fixed to the plunger 87 a socket 100 within which slides (but does not rotate) a piston 101 forced against the shoulder 102 on the bolt 103 by a spring 104. The bolt is held against the pressure of the spring by means of a nut 105. Upon the end of the bolt is rotatably mounted a roller 106 entering with a groove 107 in an annular shell 108 fixed to the surface of a circular drum 109 fixed to the pedestal B, the shell being of hardened steel to resist the wear of the rollers 106 while the drum 109 may be of cast iron. The engagement of the roller in the groove, which extends entirely about the drum, shifts the plunger 87 and threading tool 83 longitudi-

nally at appropriate times, a development of the surface of the shell 108 with the groove 197, on a plane surface being shown in Fig. 18 and the operation will be hereinafter referred to.

To insure the removal of the caps, after the threading operation, from the recesses 2 so that they will be discharged from the machine, a diagonal, stationary, thin strip 110 is fixed to and carried by the stationary spider 94' and projects into the space formed by the rabbet 24' so that as the threaded caps are carried upwardly (see Fig. 2) against the lower inclined side of the strip they will be cammed from the recesses 2 and fall into the discharge from the machine.

The operation of the vacuum cup and its plunger and the chuck by the cam groove 67 may be traced in connection with the development of such cam on a plane surface in Fig. 19 as follows:

In this figure the adjacent rotating parts are upon that side of the cam and move in the direction as indicated by the arrow. Beginning then with the plunger operating projections in the cam slot at the right-hand end of Fig. 19, the cup plunger will be in process of moving forward and will continue to move forward (to the right, Fig. 13) during the incline 112 of the cam groove. The projection reaching the top of this incline the plunger will have completed its forward movement and will so remain until, with projection 66 in the inclination 113 of the cam groove, the cup plunger will move on its return (left Fig. 13). Shortly before the cup plunger has completed its return movement it will engage by means of the collar 44 with the sleeve actuating spring 53 and, in its further return movement, to the completion of such return movement, the spring will be compressed thereby closing the chuck to grip the cap. The straight portion 114 of the cam slot then ensues and during this course the chuck will remain closed until the inclined slot portion 115 is reached by the projection 66. The cup plunger will then start forward and will continue to move forward during the incline 115. After a short portion of this forward movement of the cup plunger, at the beginning of such movement, the pressure on the spring 53 will be relieved and the chuck will open. At the top of the incline 115 the cup plunger will have completed its movement and remain in this position for a short time. The reverse inclination of the cam groove 116 will then ensue causing the cup plunger to be retracted on its return movement (left, Figs. 3 and 13), the cup plunger being retracted at the end of the incline 116 to the position as shown in Fig. 13, the chuck not being closed. A straight portion 117 of the cam slot will then ensue during which the plunger will be maintained in this retracted position, and at the end of the slot portion 117 the inclined slot portion 112 will be encountered whereby the cup plunger will be started forward, and the inclined slot portion 112 as appearing at the left-hand of Fig. 19 will continue as the slot portion 112 at the right-hand end of Fig. 19, the plunger moving forward until the end of the inclination 112 is reached as before referred to, when the sequence of operations will be repeated. It will be noted that the slot portion 117 is not as low (Fig. 19) as the slot portion 114 so that while the portion 114 moves the cup plunger to the left hand (Fig. 13) limit of its movement thereby only retracting the cup to its limit but also closing the chuck, the cam portion 117 does not retract the plunger

so far but merely retracts the cup to the position as shown in Fig. 13, the chuck being open.

The operation of the threading tool in relation to the cam slot 107 may be traced in connection with the developed view of Fig. 18 as follows:

In this view the right-hand end of the figure is at the top of the cam drum (Fig. 3), the adjacent rotating parts moving in the direction as indicated by the arrow. Beginning at the right-hand end of Fig. 18, the threader or threading tool will, during the straight cam slot part 118 remain in its full retracted position to the right (Figs. 3 and 9). Beginning with the inclined cam slot portion 119 the threader will be moved forward (to the right, Figs. 3 and 9), and will continue such movement to the end of the inclination 119 when the tool will be substantially in position to begin operation upon the cap. The inclination 119 is relatively steep so that the threading tool will be moved forward comparatively quickly. At the end of the cam slot portion 119 the less inclined cam slot portion 120 will be entered upon during which the threading tool will be moved forward at relatively slow speed to perform the threading operation. At the end of the cam slot portion 120 the threading will be completed and the threading tool will be quickly returned to its retracted position (right, Figs. 3 and 9) according to the reverse cam slot portion 121 which is steeply inclined. The threading tool will then remain in its retracted position by reason of the straight cam slot portion 118 at the left of Fig. 18, and which continue at the top of the cam as the cam slot portion 118 at the right of Fig. 18, whence the cycle of movement of the threader, by reason of the cam slot 107, will be repeated as described.

It is to be observed that the threading tool is operated by the cam slot 107 through the projection 106 which is substantially in line with the threader, whereas the cup plunger and associated parts are actuated by the cam slot 67 through a lever arm 59 so that the operating projection in the cam slot 67 lags circumferentially behind the axis of the cup plunger 37. Consequently the cam slots 107 and 67 will be so adjusted circumferentially with relation to each other that a portion of the cam slot 67 designed to produce actions upon the cup plunger and associated parts simultaneously respectively with actions produced upon the threader by parts of the cam slot 107, will be advanced against the direction of rotation of the machine to compensate for the length of the lever so that the actions of the threader and vacuum cup by cam slots 67 and 107 will take place in the desired relations to each other.

To trace the operation upon a cap by the machine as a whole with all its coordinated parts, the cycle may be commenced with a recess 2 in the receiving plate 1, being at the top of the machine, that is, approximately under the cap feeding chute. The cap will have been released from the bottom of the chute by the cap feeding apparatus as before described and will settle into the recess. The cap will then be carried along in the recess of the plate in the direction as indicated by the arrows in Figs. 1, 2, 4, 5, 7, 18 and 19, the open side of the cap facing toward the threading tool and the top or closed side of the cap facing toward the chuck.

As has been indicated, a tool supporting means, a recess 2 and a chuck are in longitudinal line so that the cap may be moved from the recess into the chuck and back again and the threading tool may be moved through the recess to

thread the cap while in the chuck, and be retracted to the other side of the plate 1 after the threading of the cap has been completed. As also previously indicated, the threading tool, recessed cap receiving plate and tool carrier are secured to each other and all rotate together so that the relationship as just referred to is maintained at all times.

Considering the cycle to have been started by the feeding of a cap into the recess 2 at the top of the machine and the machine turning in the direction as referred to, the threading tool at the beginning of this cycle will be wholly retracted, the vacuum cup will be slightly forward of the position as shown in Fig. 13, having just started in its movement forward from that position and the threading tool will be in a radial position in relation to the cap and chuck such that when moved forward longitudinally in a straight line it will contact with the inner wall of the cap and roll the desired thread therein without in any way causing any indentations or marking whatever viewable from the exterior of the cap, the edge of the cap remaining smooth and straight throughout its entire circumference, this radial position of the threader with relation to the cap and chuck being shown in Fig. 15.

As the cap in the recess, the chuck and the threading apparatus continue their movement about the machine axis, the vacuum cup will be moved forward and at the limit of its forward movement will be in contact with or proximity to the cap. The suction having in the meantime been applied to the chuck at the duct 74, the cap will be drawn to and secured to the cup by suction, the chuck being open. The cup will then start on its return movement, drawing the cap into the chuck, and shortly after the time that the cup starts this return movement the threader will start its forward movement. Continued return movement of the vacuum cup enters the cap completely within the chuck against the chuck jaws. The cup plunger will then be moved to draw the cup away from the cap and break the vacuum. During the latter portion of this movement of the cup plunger the chuck will be closed and the threader will have advanced to a point where it is just about to enter upon the threading of the cap. The chuck will be rotating about its axis at all times as before indicated, by reason of the engagement of the gear 33 on the chuck sleeve 32 with the circumferential stationary gear 35. The threading tool will then continue its forward longitudinal movement into the cap at a relatively slow speed, the cap rotating with the closed chuck, and the threading tool rotating by reason of its contact with the rotating cap so that the thread is rolled into the cap inner wall. This will continue until the threading tool has reached the inner limit of the movement in the cap and the thread completed, as shown in Fig. 15. Up to this point the roller 92 has been in contact with the surface 96' whereby the threading tool is held in radial position with relation to the cap to accomplish the threading operation as described. At the completion of the thread, however, the roller 92 will drop into the depression 111 whereby the threading tool will be practically instantaneously transversely moved to the position as shown in dotted lines (Fig. 15) whereby the tool is moved clear of the cap threads and is then quickly returned to its retracted position (Figs. 3 and 9) the chuck, of course, remaining closed until the threading operation is completed. At approximately the time of the completion of

the threading operation the cup plunger 37 starts forward with a comparatively quick motion. During the first portion of such motion the chuck is opened and the continuation of the movement to the forward limit of movement of the suction cup pushes the cap from the chuck into the recess 2 in the cap-receiving plate 1, the suction having been removed from the vacuum cup. The threading tool has meanwhile been quickly withdrawn into its retracted position so as to keep out of the way of the cap being ejected from the chuck. Turning of the machine causes the roller 92 to rise out of the depression 111 on to the face 96' whereby the threading tool is moved into position radially of the chuck so as to be in position to thread when the tool is again thrust longitudinally forward. The threading tool maintains this position both longitudinally and transversely of the chuck during the remainder of the revolution of the apparatus. The cup plunger having ejected the cap from the chuck, it will then be retracted comparatively slowly to the position of Fig. 13 and remain in this retracted position until it is again thrust forward to engage a new cap introduced into the recess to move the cap into the chuck and the cycle is then repeated.

After the cap has been threaded and ejected into the recess 2 and the threading tool has been retracted and positioned for threading a subsequent cap as described, the further turning of the plate 1 brings the cap against the inclined face of the evacuating bar 110 whereby the cap will be cammed from the recess 2 and will be discharged from the machine. The further turning of the plate 1 will bring the vacant recess to the top of the machine beneath the cap-feeding means whereupon a further revolution of the machine will carry out a succeeding cycle during which a cap is threaded and discharged from the machine as described, and this will be repeated indefinitely so long as the machine is operated and caps are supplied.

It will be seen that for receiving and threading a cap there is a set of apparatus comprising a threader, a recess 2 in the plate 1 and a chuck with appurtenant operating mechanism as described. In the apparatus shown there are four sets of such apparatus distributed about the plate 1, these sets succeeding each other in the revolution of the apparatus, successively receiving successive caps respectively from the cap-feeding means and subjecting the cap to the operations as hereinbefore described and traced, and passing through succeeding cycles of operation as referred to, the projections as 66 of the sets of apparatus referred to, succeeding each other in the cam slot 67, the projections 106 of the threading means of the various sets succeeding each other in the cam slot 107 and the rollers as 92 of the various sets succeeding each other about the cam 93.

While four sets of apparatus as described are shown in the machine as illustrated in the drawings, it will be apparent that there may be one or more sets up to any desired number, recesses 22 in the disk 19 of the cap-feeding means being made to correspond in number and position to cause appropriate feeding of the caps.

It will also be apparent that the number of caps fed to the recesses 2 of the plate 1 during a revolution may be reduced by filling one or more of such recesses and also filling the corresponding recesses 22 in the plate 19 of the feeding mechanism. Under such circumstances the caps supplied to the threading operation during a

revolution will correspond in number to the number of recesses 2 which are left open to receive caps from the feeding mechanism.

The machine can be readily adapted to thread caps of different diameters by making certain of the recesses 2 adapted to properly fit caps of one diameter, while other of the recesses 2 are adapted to receive and fit caps of another diameter, the chucks and threading mechanism corresponding to the recesses being adapted to the different sized caps respectively. When it is desired to thread one size of cap the recesses 2 for the other size may be filled up and the corresponding recesses 22 of the plate 19 of the feeding mechanism are also filled up when the machine will operate upon the first-mentioned size of cap, and conversely the machine may be adapted to operate upon the other size of cap by filling the recesses 2 for the first-mentioned size of cap and filling the corresponding recesses 22. Obviously the machine might be adapted in a similar manner to handle any number of different sizes of caps.

While the invention has been illustrated in what is considered its best application it may have other embodiments without departing from its spirit and is not, therefore, limited to the structure shown in the drawings.

What I claim is:

1. In a machine for threading sheet metal by bending operations the combination with a chuck having a circular series of radially movable jaws of rotatably mounted means for supporting said chuck, means for opening and closing said chuck comprising a stationary cam means, a rotary article-receiving means having a recess for an article to be threaded, means for feeding articles to said recess, a threader, rotatable means for supporting said threader, said chuck-supporting means, said article-receiving means and said threader-supporting means being rotatable about a common axis and secured against rotation with relation to each other, said chuck lying upon one side of said recess and said threader being located upon the other side of said recess whereby an article to be threaded may be moved from said recess into said chuck and said threader may be moved through said recess to thread an article in said chuck, means for moving the article from said recess into said chuck, means including stationary camming means for moving said threader longitudinally into said article to thread the same and withdraw the said threader therefrom, means including stationary camming means for moving said threader transversely into position to clear the threads in the article and to move said

threader from the last-mentioned position into its normal threading position transversely of the chuck and means for rotating said chuck comprising stationary actuating means.

2. In a machine for threading sheet metal by bending operations, the combination with means for feeding articles to be threaded, of rotatable means for receiving the articles to be threaded from said feeding means, a plurality of article threading units, each of said units comprising a chuck having a circular series of movable jaws, rotatable about a common axis, for holding said article during the threading operation and means for moving said articles from said receiving means into and ejecting the articles from said chucks, means for successively moving said units past said feeding means, said units being rotatably mounted about an axis external to the chuck, means for moving the several threaders into the articles in substantially straight lines to perform the threading operation on each article in its corresponding chuck, means for moving the threaders transversely of the chucks to clear the article threads, means for withdrawing the threaders from the threaded articles in the chucks, a common support for the several threaders and a common means for moving the several threaders into the articles.

3. The combination with mechanism for threading sheet metal articles by bending operations, comprising a chuck and threading tool and means for moving articles to be threaded into said chuck including fluid-pressure-operating means, of means for feeding articles to be threaded to the threading mechanism, means controlling the feeding of articles to said mechanism, fluid-pressure means for controlling the said feed-control means and a common source of fluid-pressure for said fluid-pressure, feed-controlling means and said fluid-pressure means comprised in the means for moving the articles into the chuck.

4. The combination with mechanism for threading sheet metal articles by bending operations, comprising a chuck and a threading tool and means for moving articles to be threaded into said chuck including vacuum operating means, of means for feeding articles to be threaded to said threading mechanism, means controlling the feeding of said articles to said mechanism and vacuum means for controlling the said feed-controlling means and a common source of vacuum for said vacuum-feed-controlling means and said vacuum means comprised in the means for moving articles into the chuck.

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