June 24, 1930. C. G. ANDERSON 1,766,700

MACHINE FOR SHAPING HOLLOW METAL BLANKS

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Fig. 1.

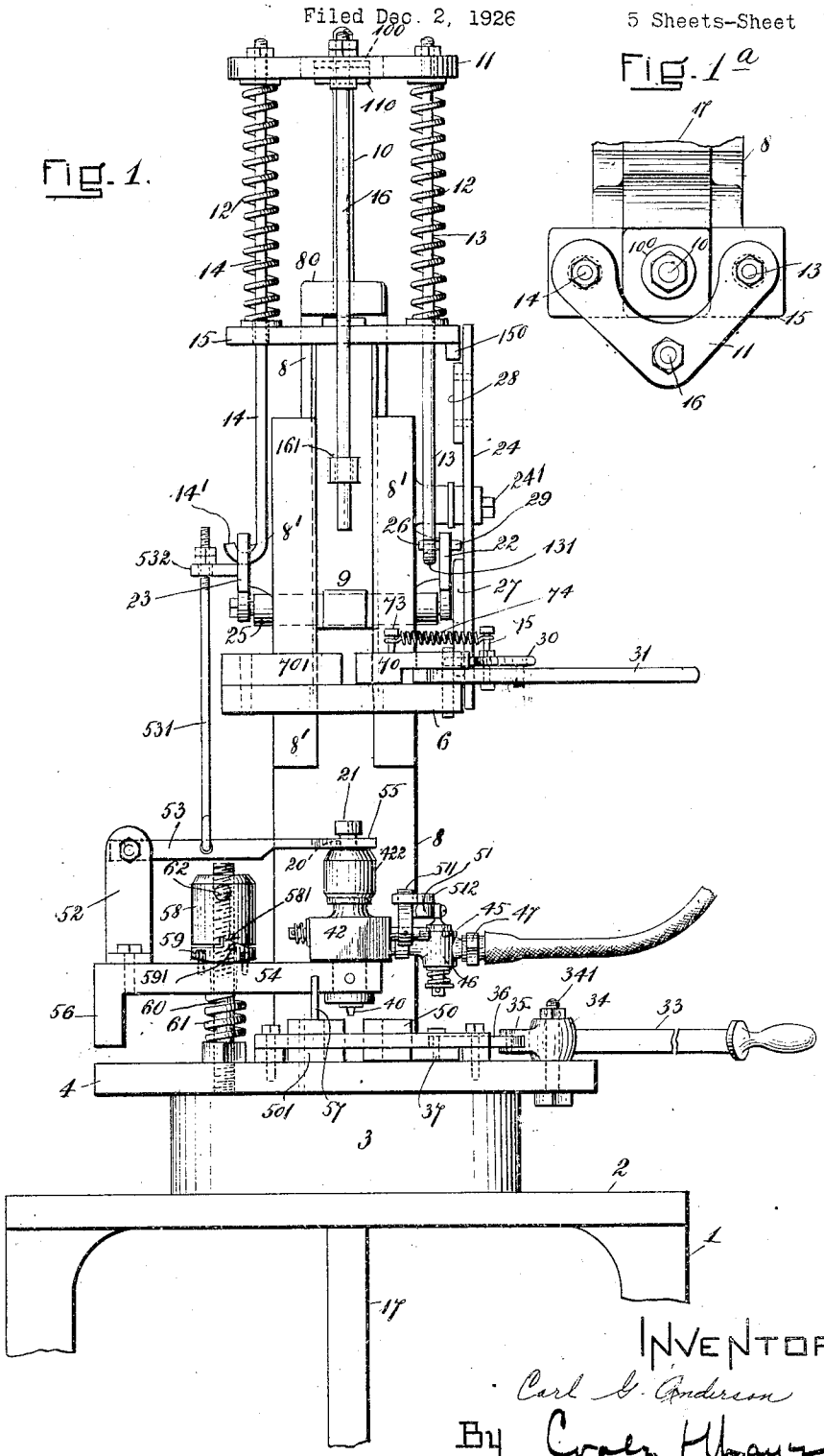


Fig. 1a

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Fig. 2.

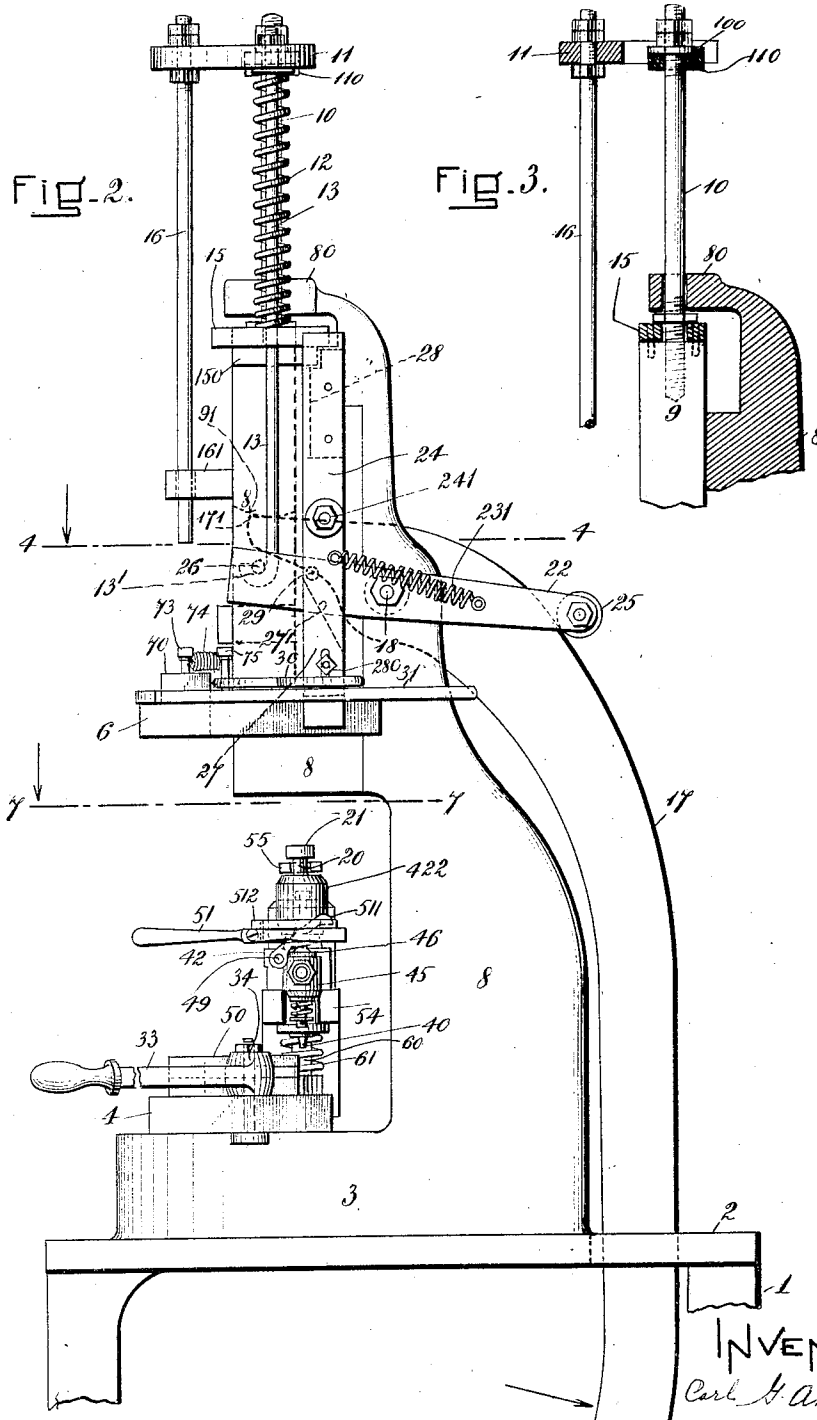


Fig. 3.

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Fig. 4.

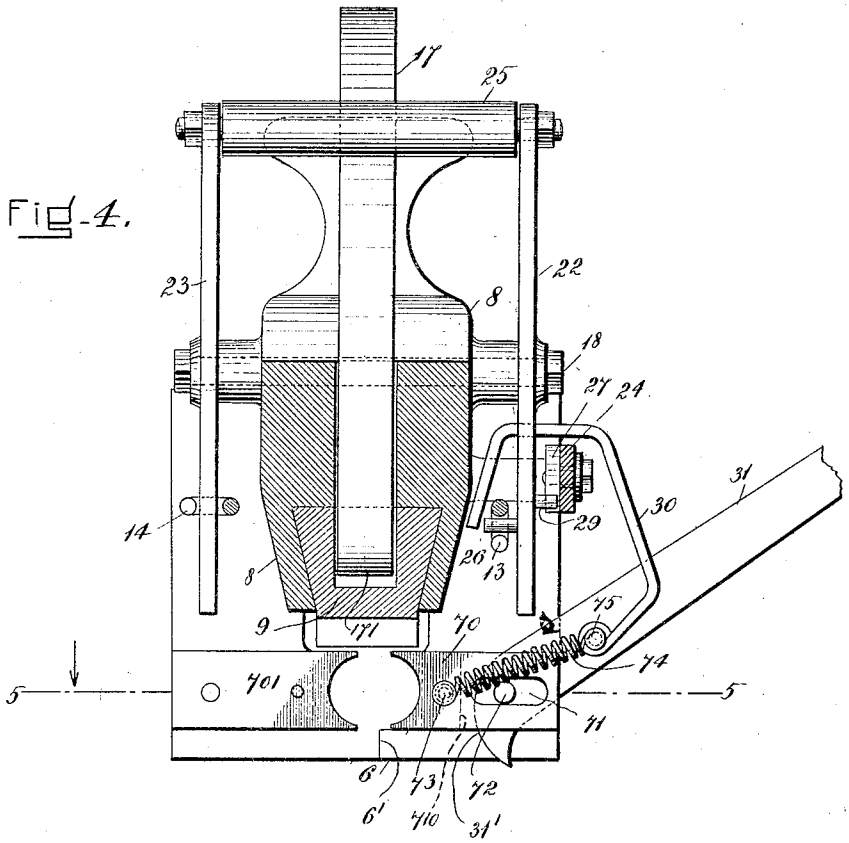


Fig. 5.

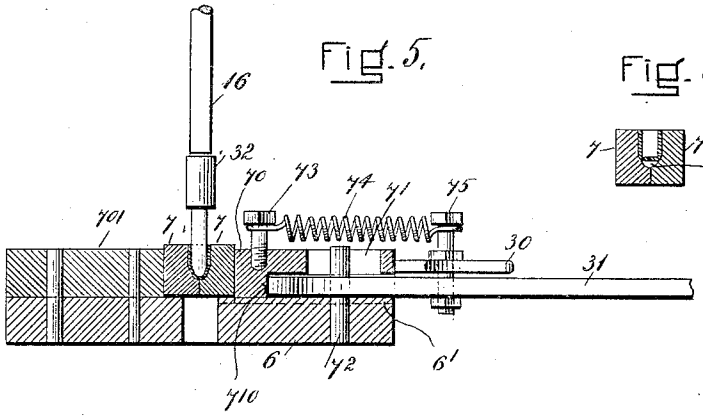


Fig. 6.

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Fig. 7.

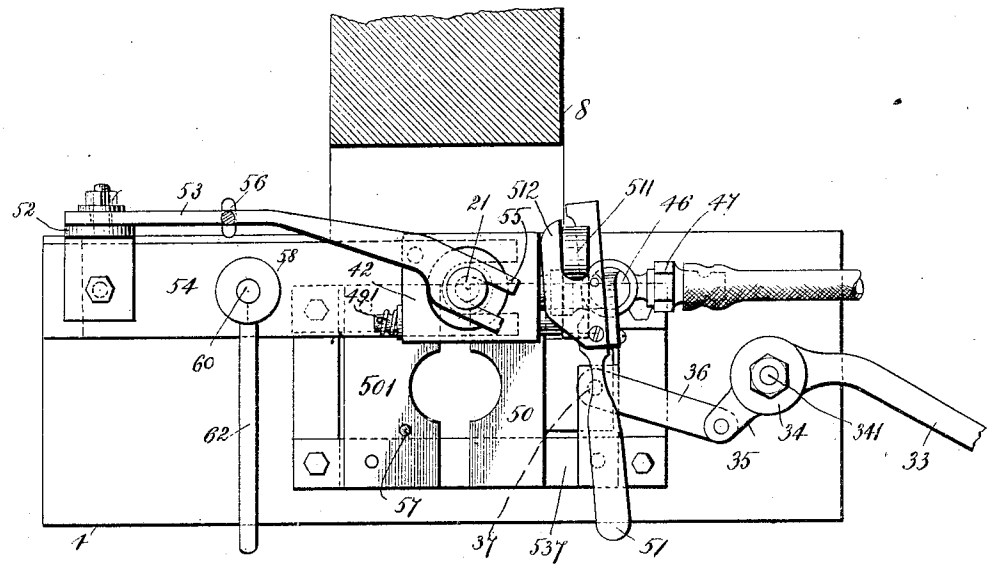
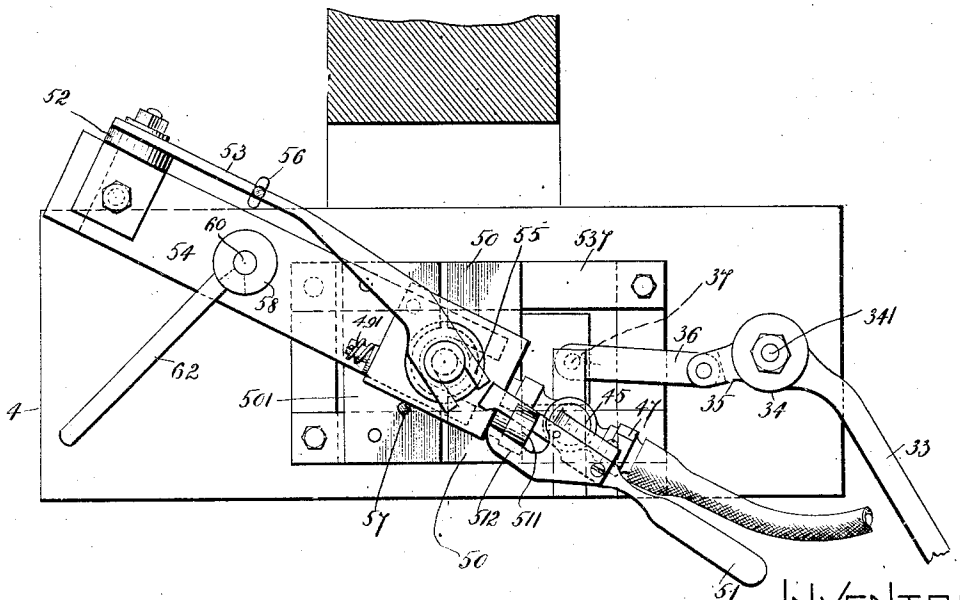


Fig. 8.



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MACHINE FOR SHAPING HOLLOW METAL BLANKS

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Fig. 9.

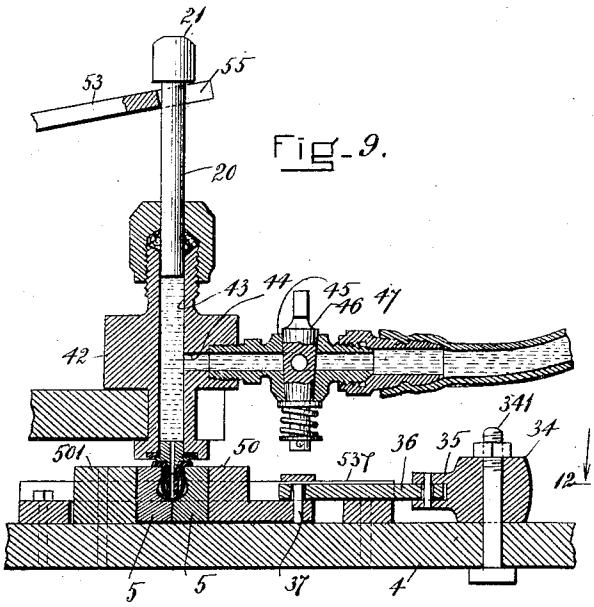


Fig. 11.

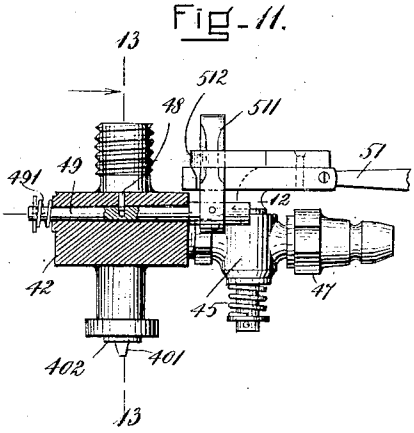


Fig. 10.

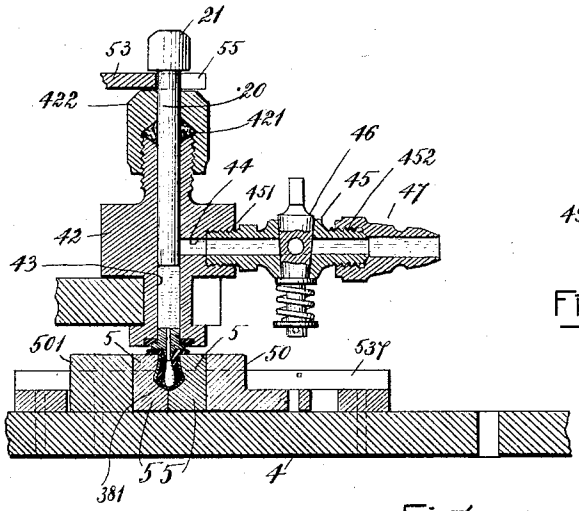


Fig. 12.

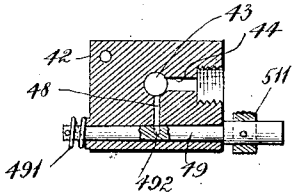


Fig. 13.

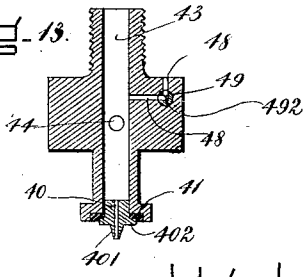


Fig. 15.

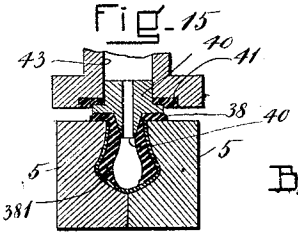
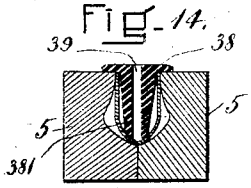


Fig. 14.



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Patented June 24, 1930 1,766,700

UNITED STATES PATENT OFFICE

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MACHINE FOR SHAPING HOLLOW METAL BLANKS

Application filed December 2, 1926. Serial No. 152,149.

The invention relates to a machine for shaping hollow metal blanks and is more especially adapted for making artificial metal tooth crowns though it has other uses. A feature of novelty lies in the use of hydraulic pressure to assist in the shaping of the crown, the crown being made usually of gold or like malleable metal.

The invention will be understood by reference to the drawings in which it is shown in its preferred form.

Figure 1 is a front elevation of a press embodying the invention, the dies not being shown.

Fig. 1ª is a plan of the crosshead.

Fig. 2 is a side elevation of the press, the dies not being shown.

Fig. 3 is a detail of the top portion thereof.

Fig. 4 is a section on the line 4—4 of Fig. 2 taken at right angles to said figure.

Fig. 5 is a section on the line 5—5 of Fig. 4.

Fig. 6 is a sectional view of the die shown in Fig. 5 with the blank in place.

Fig. 7 is a plan of the lower die and its parts in open position taken on the line 7—7 of Fig. 2.

Fig. 8 is a similar plan taken in closed position.

Fig. 9 is a sectional detail showing a way of applying hydraulic pressure.

Fig. 10 is a similar view, hydraulic pressure being applied.

Fig. 11 is a detail showing the air vent.

Figs. 12 and 13 are sections on lines 12—12 and 13—13 of Fig. 11.

Fig. 14 is a section showing the dies holding the blank in position to be formed, and

Fig. 15 illustrates the forming operation.

The machine comprises a frame 1 having a table 2 on which is a support 3 carrying a bottom shelf 4. Above the shelf 4 is a bracket or shelf 6 which projects from an upright or post 8 extending upwardly from the support 3. Above the shelf 6 the post 8 is provided with an inwardly projecting top end 80 below which the post is provided with spaced cheeks 8′ forming between them a way in which is contained a hammer 9 movable vertically within the way. The hammer has attached to it a rod 10 connected to the top end of the hammer and extending upwardly through the end 80 of the post with extension above it. The upper end of the rod 10 is provided with a stop head 100 preferably adjustable on the rod. Beneath the stop head 100 is a bunter 110 to lessen the blow between the stop head 100 and the top of the post on descent of the hammer as the occasion arises.

11 is a crosshead supported on two springs 12 which surround rods 13 and 14 respectively secured to the crosshead and passed downwardly through a plate 15 secured to the top end of the hammer and against which plate the bottom ends of the springs have bearing. The rods 13 and 14 have extension below the plate 15 and the lower ends of the rods make attachment with mechanism later to be referred to by which slight pull is exerted in the normal machine, which tends to slightly compress the springs 12, the springs, in other words, tending to hold up the crosshead and connecting rods 13 and 14 in their uttermost or raised position while under some tension. Secured also to the crosshead 11 is a ram 16 which extends downwardly by the end of the plate 15 through a guide strap 161 on the hammer. 17 is a lever which will hereafter be referred to as the primary lever. It is operated at its lower end by a treadle (not shown) to have a forward and reverse movement. The lever is pivoted at 18 to the post 8 and its outer or resistance end 171 rocks in a suitable slot in the hammer 9. The hammer is provided with an interior surface 91 by which it rests by gravity on the end 171 of the lever 17 so that as the force arm of the lever is moved outwardly as indicated by the arrow in Fig. 2, the hammer will be allowed to drop or raised as the force arm of the lever moves in a reverse direction, the hammer and plate 15 with it being held in a raised position by the lever when at rest.

The primary lever 17 has operative engagement with a secondary lever comprising arms 22, 23 also pivoted at 18 to the post 8. The arms 22 and 23 carry between them at their inner or force ends a roll 25 which rides on the back of the lever 17. The arm 22 has a pin 26 on its power end, engag-

ing which is a hook 13′ on the lower end of the rod 13. A hook 14′ on the lower end of the rod 14 hooks through the power end of the arm 23. The connections thus established between the rods 13 and 14 and the arms 22 and 23 of the secondary lever have also such relative arrangement that the springs 12 which embrace the rods 13 and 14 and bear against the plate 15, will be maintained normally under a slight tension and the tension of these springs will operate to hold the roll 25 of the secondary lever normally in engagement with the back of the primary lever 17 when this lever is in its normal position of rest.

The lowering of the hammer 9 and plate 15 secured to it is prevented by a releasable latch bar 24 assuming such lowering to be otherwise permitted by a forward thrust of the primary lever 17. This bar is pivoted to a post 8 at 241 and carries on its upper end a stop piece 28 which has both lateral and underneath engagement with a stop 150 on the under side of the plate 15. The latch bar is held in normal engagement with its stop by a spring 231 one end of which is attached to the arm 22 of the secondary lever and the other end to the latch bar below its pivotal point or fulcrum.

Provision is made for releasing the latch from its stop by providing the lower end of the bar below its fulcrum with a cam piece 27 presenting a cam surface 27′. The cam is attached to the inner side of the latch bar and adjustable thereon by attaching the cam to the bar by means of a common slot and bolt connection 280. 29 is a pin on the arm 22 of the secondary lever. This pin is located above the cam 27 and is adapted to strike the cam surface 27′ of the cam as the secondary lever is turned, thereby operating to turn the latch bar away from its stop, releasing the hammer and permitting of the fall thereof. The latch bar is also released from its stop by means of a hook 30 which is shaped to pass around the lower end of the latch bar below its fulcrum and which connects with, to be operated by, a lever 31 which forms a part of the upper or primary die mechanism to which attention will presently be directed. As the lever 31 is turned it operates to pull the hook 30 with it and the hook by its engagement with the latch bar below its fulcrum will operate to turn the latch bar and move its engaging end away from its stop.

Referring now to the upper or primary die mechanism: This comprises a die holder 701 fastened to the shelf 6 of the frame. Cooperating with the holder 701 is a die holder 70 slidable within a groove 6′ in the shelf 6 and provided with a slot 71. Extending through this slot and fastened into the table is a pin 72 which allows the die holder 70 to have a limited movement, the pin 72 also acting as a pivot on which the lever 31, previously referred to, is arranged to turn. 31′ represents the resistance or power end of this lever which is cam-shaped. Beyond the cam end of the lever the die holder 70 is provided with a pin 73 to which is attached one end of a spring 74, the other end of the spring being attached to a pin 75 on the lever 31. The arrangement of the parts is such that when the lever 31 is pulled forward the cam-shaped end of the lever will have drawing engagement with a shoulder 710 on the die holder 70, thereby moving the die holder 70 forward into position where it will co-operate with the die holder 701 to compress and rigidly hold between them the preliminary dies 7, 7. It will also be observed that the pin 75 on the lever 31, which assists in the support of the spring functions also as an element to which is pivotally attached the hook 30 which operates to release the latch as the lever 31 is turned, all as previously explained.

The dies 7, 7 form between them a generally cup-shaped cavity 7′ by which an initial form is given to the blank (see Fig. 6) from which the crown is made. The shaping of the blank within the die is obtained by a punch 32 which punch is struck by the ram 16 on the plunger mechanism in the operation of the machine.

The lower table 4 carries the die holder and dies for finally shaping the blank. For this purpose it has die holders 50 and 501 between which the dies 5 are compressed and held. The die holder 501 is fixed to the table 4 and the die holder 50 is slidable in ways 537 thereon whereby it may be moved toward the die 501 for compressing and holding the dies 5 between the two holders. For moving the die holder 50 and maintaining it in position for compressing and holding the dies there is employed a lever 33 having a hub 34 which turns on an axle pin 341 fixed to the table 4. Extending from the hub is a lug 35 pinned to a link 36 which in turn is pivoted to a pin 37 fixed to the die holder 50.

The dies 5 are similar to the dies 7 in outward shape. Their internal shape, however, is that of the final shape to be given to the blank to form it into the required crown.

One difficulty which has not heretofore been successfully overcome is the forming mechanically of a perfect crown, and this is partly due to the fact that the crown is smaller at the neck than it is at the cap portion. In consequence, the crown cannot be formed by an ordinary punch and die. Various expedients have been resorted to for forming the cap portion of the crown, and according to the construction now to be described hydraulic pressure is employed for this purpose.

Arranged above the dies 5 when in place is a hydraulic device consisting of a plunger

casing 42 preferably formed as a casting. This casing is provided with a bore 43 in which slides a plunger 20, 21 representing the head of the plunger. The top end of the bore through which the plunger extends into the plunger casing is sealed by a gasket 421 embracing the plunger and held in place by the usual bonnet 422.

At its lower end the bore of the plunger casing is provided with a nozzle 40 set in a suitable packing 41. The nozzle projects below the plunger casing with a conical shaped projecting end 401 surrounding the base of which the nozzle presents an annular edge portion 402. As will later be explained, mechanism is provided by which the plunger casing in the operation of the machine will be moved to a position where the end 401 of its nozzle will be inserted into the open end of the blank contained within the dies 5 (see Fig. 9). Water accordingly admitted to the chamber of the bore will pass through the nozzle into the hollow or chamber of the blank. When the nozzle is thus positioned a seal is formed between the nozzle and the adjacent top surface of the dies 5 around the nozzle so that water admitted to the hollow of the blank cannot escape therefrom especially when the water is compressed. This seal is preferably made of a flat disk 38 of rubber or other elastic material having a central opening 39 through it, the disk being so arranged and maintained that it will lie and be compressible between the annular shoulder 402 and the adjacent top surface of the dies 5, while the opening 39 in the seal will be coincident with the opening through the nozzle. The seal is positioned by a depending piece 381 of rubber integral with the seal and through which the opening 39 in the seal is extended. The piece 381 is preferably formed, also, or has such extension that it may perform another useful function. In other words, it is preferably made to extend well down into the blank as shown in Fig. 14 so that when water is admitted from the nozzle into its interior the piece 381 will be expanded by the pressure, forming thereby an element upon which the pressure acts for distorting the blank to conform to the interior of the die and assuming its original shape when the pressure is relieved. This elastic piece is preferably employed as a lining for the interior of the blank upon which the water acts for deforming the blank, although the water itself is the actual deforming agent and might operate directly upon the interior of the blank. The advantage of the piece, however, is that it is made to present a very smooth exterior surface which gives a nice surface to the interior of the blank in forming the crown, and is also held securely in place by the water pressure when deformed, thereby acting to assist in maintaining or holding in place the seal 38 to which it is secured during the application of the hydraulic pressure.

Referring now to the provision for admitting water to the plunger casing and hollow of the blank, assuming the nozzle to be in sealed communication with the interior of the blank as just described: Into the bore 43 of the plunger casing opens a passage 44. 45 is a valve casing for a valve or cock 46 turned by a handle 51. The valve casing 45 is provided with threaded extensions 451, 452. Of these the extension 451 makes connection with the plunger casing by which communication is had from the chamber of the valve through the passage 44 into the bore 43, while the extension 452 receives a coupling 47 connecting it with a suitable source of water supply. By this means water is admitted to, for filling the bore of the plunger casing and blank to be formed and afterwards prevented from escaping from the casing as the water is compressed by the plunger following a closure of the valve.

It is desirable that means be provided for the escape of air from the plunger casing as the water pressure is introduced. To this end an air passage 48 is provided through the wall of the plunger casing. This passage is intersected by, or continued through, an opening or socket containing a valve 49 slightly conical in shape by which it may assume a position tightly seated within its socket and in which position it is normally maintained by a spring 491. Extending laterally through the valve is a right-angular opening 492. When the valve is in its normal position the opening 492 is out of line with the air passage 48 through the plunger casing. The valve may be turned, however, to a position where the opening 492 will be coincident with the air passage through the plunger casing when air therein may escape directly to the atmosphere. The valve 49 is turned to a position where the opening 492 therein is coincident with the air passage through the plunger casing by means of an arm 511 attached to it. This arm is straddled by a forked piece 512 mounted on the handle 51 which controls the cock 46, the arrangement being such that when the cock is opened for admitting water to the interior of the plunger casing and associated parts the valve 49 will be turned to a position where there is an open air vent from the bore of the plunger casing to the atmosphere and when the cock is closed shutting off the water, the valve 49 will be turned to a position where it operates to close the air vent.

In order that the water supply nozzle 40 may be moved into a position where it will have proper registration with the dies 5, or rather with the open end of the blank contained within the dies; in order, also, that

the water supply nozzle when it has attained such position of registration may have a vertical movement so that it may be moved into and out of place clearing the die members when moved outwardly and co-operating with the seal 38 to form a watertight joint around the open end of the blank when the hydraulic action takes place, provision is made as follows: The plunger casing 42 is mounted upon a plate 54. This plate is pivotally mounted to turn upon a rod 60 fixed to the table 4 of the frame and extending upwardly through the plate 54. The upper end of the rod 60 is threaded and arranged to turn thereon is a cam member 58 presenting a cam surface 581. Co-operating with the member 58 is another cam member 59 having a cam surface 591. The cam member 59 encircles the rod 60 beneath the cam member 58 and is fixed to the plate 54. A spring 61 arranged beneath the plate 54 keeps the cam members 58 and 59 normally together. Fixed to the cam member 58 is an operating handle 62. With the parts thus arranged it will be assumed that the plate 54 is in the position shown in Fig. 7 where the plunger casing is in an out of the way position and the nozzle carried by it is out of registration with the blank contained within the dies 5. The nozzle 62 is now turned in a clockwise direction. Thereupon the cam member 58 to which the handle is fixed will turn upon the threaded body of the rod 60 until its cam surface 581 contacts with the cam surface 591 of the cam member 59. Thereupon as the turning of the handle is continued the plate 54 and plunger casing with it will be turned to a position where the nozzle 40 will be in exact registration with the blank in the dies 5 which position is defined by a stop 57 on the stationary die holder 501 and which is engaged by the plate 54. With the continued movement of the handle 62, inasmuch as the plate 54 and cam member 59 fixed to it have no longer any permitted turning movement, the cam surface 581 on the cam member 58 will ride over the cam surface 591 on the cam member 59 against the tension of the spring 61. Thereupon, consequent upon the depression of the plate 54, the plunger casing will be moved downward and the nozzle 40 moved into the opening in the top of the blank contained in the dies 5 and the annular shoulder 402 on the nozzle will become hard pressed against the seal 38 for making a watertight joint around the top end of the blank, as previously described. Upon a reverse movement of the handle 62 a reverse movement of the parts will take place. As the cam surfaces on the respective cams are made to clear one another the nozzle will be relieved to move vertically out of the opening in which it is contained and raised to a position where it will clear the top surface of the dies and the plate 38 thereon and afterward be moved with the plunger casing to its out of the way position as the casing is moved to such position by the turning of the plate 54.

Secured to the rear end of the plate 54 is a standard 52 to which is pivoted a lever 53 which is forked at its outer free end 55 to straddle the plunger 20 beneath its head 21. Secured also to the rear end of the plate 54 depending therefrom is a footpiece 56. The lever 53 is connected by an adjustable link 531 with a lug 532 on the arm 23 of the secondary lever beyond its fulcrum. The arrangement of these parts is such that when the plate 54 is turned to a position where the plunger mechanism carried by it will occupy an out of the way position with relation to the dies 50, 501 substantially as shown in Fig. 7, the lever 53 will be turned to where its forked end 55 will occupy a lowered position with relation to the plunger 20 as shown in Fig. 1. When, however, the plate 54 has been turned by the operation of the handle 62 to a position where the plunger mechanism carried by the plate will be in proper registration with the dies as shown in Fig. 8, as the cam 58 rides up on the cam 59 depressing the plate 54 and plunger mechanism carried by it, the footpiece 56 on the end of the plate 54 will be brought into contact with the top surface of the table 4. The connecting link 531 then being quiescent, as there is no operation of the secondary lever, the lever 53 will accordingly be turned upwardly and the forked end thereof will be elevated, thereby lifting the plunger by its bearing against the head of the plunger, the plunger then occupying an elevated position or a position to be struck by the hammer 9. Such operation of the hammer only becomes effective when the secondary lever is turned. Accordingly before the plunger is struck by the hammer the turning of the secondary lever will, by the lowering of the link 531, allow the lever 53 to drop when the forked end 55 thereof will move away from the head 21 of the plunger preparatory to the fall of the hammer. The plunger 20 will not then drop, but will remain in a raised position to receive the blow of the hammer inasmuch as the bore of the plunger casing has been filled with liquid as will be better understood from the description incident to the general operation of the machine.

The general operation of the machine is as follows: It will be assumed that the machine is in its normal position of rest. All the die holders will be open; the primary lever 17 will then be occupying its retracted position as shown in Fig. 2; the hammer 9 and plate 15 secured to it will then be held by the latch 24 in an elevated position, the springs 12 then being slightly compressed thereby holding the roll 25 of the secondary lever hard against the back of the primary lever 17; the

plate 54 will then be turned to where the plunger mechanism carried by it will be occupying its out of the way position as shown in Fig. 7.

The first operation is the primary shaping of the blank shown in Fig. 6 contained in the dies 7, and the operation is to shape this blank into the form shown in Fig. 5 where it will be seen that the crown of the blank has been slightly beveled. This initial operation can be and is done by a simple punch and die mechanism as it is done in the present machine by the punch 32 when struck by the ram 16. The operation, however, requires considerable nicety else the blank will be broken or disrupted by the punch, all of which is provided for in the operation of the machine.

The primary blank is first placed in the dies 7, 7 as shown in Fig. 6 and the dies then placed on the table 6 of the machine between the die holders 70, 701 and the dies afterward compressed between these holders by operation of the lever 31. As this lever is turned for compressing the dies the hook 30 will be pulled forward thereby releasing the latch 24 from the stop on the head of the hammer 9. The hammer and plate 15 secured to it will not then drop because the hammer is then being maintained in an elevated position by the resistance or power end 171 of the lever 17. Accordingly no action takes place until the lever 17 is moved forward in the direction of the arrow shown in Fig. 2. Thereupon as the lever is pushed forward the hammer and plate 15 attached to it are allowed to drop following the resistance end of the lever, while the crosshead 11 and connected parts including the ram 16 will be drawn down as the secondary lever becomes turned by the outward displacement of the primary lever. This action continues until the stop head 100, or rather the bunter 110 beneath it on the end of the hammer rod 10, reaches a point where it engages the top surface of the top end 80 of the frame. This action takes place just about the time that the ram 16 has been moved down to a point where it is about to have active engagement with the punch 32. The moment the stop head on the end of the hammer rod engages the top end 80 of the frame the plate 15 on the top end of the hammer is stopped and accordingly becomes a fixture against which the springs 12 have bearing. Thereupon as the lever 17 is further outwardly displaced it will continue through the operation of the secondary lever to draw down the crosshead 11 carrying the ram and so bring the ram into working engagement with the punch 32 for shaping the blank, but such operation takes place only against the compressed springs 12. In other words, these springs become compressed between the plate 15 fixed to the hammer as aforesaid and the descending crosshead 11 so that the tension of the springs will prevent the descending ram from having else than a very delicate action on the punch as it is operated by the moving forward of the primary lever 17 through the action of the secondary lever and cross-head as aforesaid.

The blank having been thus initially formed by the action of the punch 32, pressure against the primary lever 17 is relieved and the lever swings back to its normal position when the resistance or power arm of the lever will lift the hammer and plate 15 to their original normal position, the rocking of the secondary lever returning the crosshead 11. Simultaneously with such return of the parts, or even before this operation takes place, the lever 31 which controls the die holder 70, 701 is thrown back releasing said holders and the dies contained between them. The release of the lever 31 throws back the hook 30 so that when the parts resume their original position as just described the latch 24 controlled by the spring 231 will be thrown in to engage its stop preventing further descent of the hammer until the stop has again been positively released.

The partially formed blank is now taken out of the dies 7, 7 and placed within the dies 5, 5 together also with the member 38, all as shown in Fig. 14. The dies 5, 5 are then placed between the die holders 501 and 50 and compressed between the holders by pull upon the lever 33, locking the dies in place. The lever 62 is then turned for turning the plate 54 when the plunger casing and connected parts are swung to a position where the mouth 401 of the nozzle will be in direct registration with the opening in the blank contained within the dies 5, 5 or rather with the opening 39 in the member 38 which assists in forming the seal. The position of the nozzle 401 is thus defined by the engagement of the plate 54 with the stop 57. As the turning of the lever 62 is continued, the action of the cams 58, 59 will move the plate 54, plunger casing and nozzle downward when the nozzle will enter the opening in the blank or rather the opening 39 in the elastic member 38 the portion 381 of which is contained within the blank, all as shown in Fig. 15, and a seal will be formed all around the open end of the blank, the elastic member 38 being compressed between the top surface of the dies 5, 5 and the adjacent surface 402 of the nozzle.

Consequent upon the lowering of the plate 54 and plunger casing, by the operation of the cams 58, 59, the lever 53 will as previously described be lifted so that its forked end will elevate the ram 20. Water or other liquid is now admitted to the bore of the plunger casing and hollow of the blank. This is effected by turning the handle 51 which controls the cock 46. Simultaneously with the turning of the cock the valve 49 will be operated to provide an air vent from the bore of the plunger casing so that the liquid

or water will be admitted. In practice the valve 45 is left open until water begins to flow out of the plunger casing through its air vent 48 which indicates that the bore of the casing is filled with water. The valve 45 is then closed and the parts are now in condition whereby hydraulic pressure may be applied to the blank for deforming its crown. This is effected by again moving forward the lever 17. As the primary lever 17 is moved forward the secondary lever comprising the arms 22 and 23 will operate to pull down the crosshead 11 compressing the springs 12, for at this time the plate 15 against which the bottom ends of the springs have bearing and which is secured to the hammer, is held fixed by the latch 24 which still remains unreleased. As the outward movement of the primary lever 17 is continued the compression of the springs 12 will continue by the further turning of the secondary lever. As the secondary lever turns the resistance or power end of its arm 23 turns downward which movement releases the lever 53 so that the forked end 55 of the lever will fall away from the head 21 of the plunger 20 in preparation for the fall of the hammer. The parts now are in position where the lever 17 has been moved out so far that the stop 29 on the arm 22 of the secondary lever will begin to have drawing engagement with the cam surface 27′ of the cam 27 on the latch bar 24. This engagement continues until the secondary lever has been so far moved as to release the latch bar 24 from its stop when the hammer, being released, is thrown violently downward by the compressed springs 12, the whole force of these springs then being thrown on the hammer by reason of their bearing against the plate 15 secured to the top of the hammer. The descending hammer strikes the head 21 of the ram 20 compressing the liquid or water in the plunger casing and in the crown, when the crown by reason of the pressure thus induced will be pressed outwardly to conform with the interior surface of the dies 5, 5 within which it is contained. In practice, I prefer that the hydraulic pressure shall act upon the crown through the elastic member 381 acting as a lining, although this is not necessary.

In connection with the descent of the hammer when thrown down by the springs 12, it will be understood that the resistance or power end 171 of the lever 17 will have been moved downwardly away from the interior surface 91 of the hammer against which it normally has bearing so that the end of the lever will not interfere in any way with the rapid descent of the hammer for causing the hydraulic pressure on the blank. The hydraulic pressure obtained is very great; in practice a pressure approximating about four tons to the square inch is obtained.

After the fall of the hammer the primary lever 17 is allowed to return to its original position of rest. The hammer and plate 15 are then lifted by the power end 171 of this lever to their original elevated position when the latch bar 24 again moves back to engage its stop. At the same time the crosshead 11 will be returned by the permitted turning of the secondary lever to its original position. The plunger casing and nozzle are now lifted and then thrown back to their out of the way position by reverse turning of the handle 62 when the formed crown may be released from the dies 5, 5 after the release of these dies on releasing the lever 33.

Having thus fully described my invention, I claim and desire to secure by Letters Patent of the United States:—

1. In a machine for shaping hollow metal blanks, the combination with a blank-forming mechanism, of a reciprocating hammer, a guide for the hammer, a primary lever having lifting engagement with the hammer, a secondary lever in operative engagement with the primary lever and actuated thereby as the primary lever is moved, releasable means for holding the hammer in an elevated position, a spring, means whereby said spring may be compressed by the secondary lever and the tension thereof be directed against said hammer when the hammer is in its elevated position, and means for releasing the hammer.

2. In a machine for shaping hollow metal blanks, the combination with a blank-forming mechanism, of a reciprocating hammer, a guide for the hammer, a primary lever having lifting engagement with the hammer, a secondary lever in operative engagement with the primary lever and actuated thereby as the primary lever is moved, releasable means for holding the hammer in an elevated position, a spring, means whereby said spring may be compressed by the secondary lever and the tension thereof be directed against said hammer when the hammer is in its elevated position, and means whereby said hammer will be released when said secondary lever has been turned to a determinate position for compressing the spring.

3. In a machine for shaping hollow metal blanks, the combination with a blank-forming mechanism, of a reciprocating hammer, a guide for the hammer, a primary lever having lifting engagement with the hammer, a secondary lever in operative engagement with the primary lever and actuated thereby as the primary lever is moved, a spring, means whereby the spring may be compressed by the secondary lever and the tension thereof directed against the hammer when the hammer is held in an elevated position, a releasable latch for holding the hammer in an elevated position, said latch being provided with a cam, means for normally holding the latch in an engaging position, and means on

the secondary lever adapted and arranged to engage said cam and release said latch when the secondary lever has been turned in a determinate amount for compressing said spring.

4. In a machine for shaping hollow metal blanks, the combination with a blank-forming mechanism, of a hammer, a guide for the hammer, a primary lever having lifting engagement with the hammer, a secondary lever comprising seperate pivoted arms with connection between said arms bearing against the primary lever whereby the secondary lever is turned upon the turning of the primary lever, a crosshead, rods secured to the crosshead and connected to the arms of the secondary lever, a plate on the head of the hammer, a spring tensioned between the crosshead and said plate, a releasable latch for holding the hammer in an elevated position, and means for releasing the latch.

5. In a machine for shaping hollow metal blanks, the combination with a blank-forming mechanism, of a ram, a support bearing the ram, a reciprocating member, a primary lever having lifting engagement with said member for holding the same in an elevated position, a secondary lever in operative engagement with the primary lever and actuated thereby, a connection between the secondary lever and the support for the ram, a spring tensioned between said support and the reciprocating member, and a stop for limiting the downward movement of the reciprocating member as the member is lowered by the turning of the primary lever and before said lever has completed its movement for actuating the secondary lever.

6. In a machine for shaping hollow metal blanks, the combination with separate blank-forming mechanisms, of a ram and a hammer, respectively, a primary lever having lifting engagement with the hammer and operating to hold the hammer elevated when the lever is in its normal position of rest and permitting lowering of the hammer as the lever is moved away from such position, a secondary lever in operative engagement with the primary lever and actuated thereby as the primary lever is moved, a crosshead to which the ram is secured, rods secured to the crosshead and connected to the secondary lever whereby the crosshead and ram may be moved as the secondary lever is turned by the primary lever, a plate on the head of the hammer, springs tensioned between the crosshead and said plate, a releasable latch for holding the hammer in an elevated position, and separate means for releasing the latch one operable only when the primary lever has been moved in a determinate amount away from its position of rest.

7. In a machine for shaping hollow metal blanks, the combination with separate blank-forming mechanisms, of a ram and a hammer, respectively, a primary lever having lifting engagement with the hammer and operating to hold the hammer elevated when the lever is in its normal position of rest and permitting lowering of the hammer as the lever is moved away from such position, a secondary lever in operative engagement with the primary lever and actuated thereby as the primary lever is moved, a crosshead to which the ram is secured, rods secured to the crosshead and connected to the secondary lever whereby the crosshead and ram may be moved as the secondary lever is turned by the primary lever, a plate on the head of the hammer, springs tensioned between the cross-head and said plate, a releasable latch for holding the hammer in an elevated position, means for releasing the latch preliminary to movement of the primary lever from its normal position of rest, and other means for releasing the latch only after the primary lever has been moved in a determinate amount away from its position of rest.

8. In a machine for shaping hollow metal blanks, a die having a cavity for holding a blank to be shaped, an inner surface to give form to the exterior surface of the blank, a plunger casing having within it a compression space with nozzle leading therefrom, a movable support for the plunger casing by which it and its nozzle may occupy an elevated laterally-removed out-of-the-way position with relation to the die cavity or be moved to occupy a position where the nozzle will lie directly above the die cavity and open end of the blank contained in it, means whereby the plunger casing and its nozzle may be moved downward when its nozzle is positioned directly above the die cavity as aforesaid and the nozzle made to enter the cavity and hollow of the blank contained therein, means arranged to form a seal around said nozzle and the open end of the blank when the plunger casing and nozzle are moved downward as aforesaid, means for introducing a liquid into the compression space of the plunger casing and into the hollow of said blank by passage through said nozzle, and means whereby pressure may be applied to the contained liquid.

9. In a machine for shaping hollow metal blanks, a die having a cavity for holding a blank to be shaped, an inner surface shaped to give form to the exterior surface of the blank, a plunger casing having within it a compression space with nozzle leading therefrom, a movable support for the plunger casing by which it and its nozzle may occupy an elevated laterally-removed out-of-the-way position with relation to the die cavity or be moved to occupy a position where the nozzle will lie directly above the die cavity and open end of the blank contained in it, an elastic seal-forming member arranged upon the top surface of the die around the open-

ing in said blank contained within the die as aforesaid, said seal-forming member having an opening through it registering with the opening in said blank, means whereby the plunger casing and its nozzle may be forcibly moved downward when the nozzle is positioned directly above the die cavity as aforesaid and the nozzle made to enter through the opening in the seal-forming member and compress the seal-forming member between it and the top surface of the die forming a seal around said nozzle and open end of the blank, means for introducing a liquid into the compression space of the plunger casing and into the hollow of said blank by passage through said nozzle, and means whereby pressure may be applied to the contained liquid.

10. In a machine for shaping hollow metal blanks, a die having a cavity for holding a blank to be shaped with an inner surface shaped to give form to the exterior surface of the blank, a plunger casing having within it a compression space with nozzle leading therefrom, a movable support for the plunger casing by which it and its nozzle may occupy an elevated laterally-removed out-of-the-way position with relation to the die cavity or be moved to occupy a position where the nozzle will lie directly above the die cavity and open end of the blank contained in it, means operating through said support for normally maintaining the plunger casing and nozzle in their elevated position as aforesaid, a stop for defining the position of the plunger casing and nozzle when the nozzle is positioned to lie directly above the die cavity, means whereby said support, plunger casing and nozzle with it may be moved forcibly downward when the plunger casing and nozzle are in a position defined by said stop, means whereby a seal may be formed around said nozzle and open end of the blank when the said support, plunger casing and nozzle are moved downward as aforesaid, means for introducing a liquid into the compression space of the plunger casing and into the hollow of the blank by passage through said nozzle, and means whereby pressure may be applied to the contained liquid.

11. In a machine for shaping hollow metal blanks, a die having a cavity for holding a blank to be shaped with an inner surface shaped to give form to the exterior surface of the blank, a plunger casing having within it a compression space with nozzle leading therefrom, a support carrying the plunger casing a fixed rod having a top threaded end portion on which said support is arranged to turn whereby the plunger casing and nozzle with it may occupy an elevated laterally-removed out-of-the-way position with relation to the die cavity or be moved to occupy a position where the nozzle will lie directly above the die cavity and open end of the blank contained in it, a stop for defining the position of the plunger casing and nozzle when the nozzle is positioned to lie directly above the die cavity, means for controlling the positioning of said support and plunger casing with nozzle carried by it and for moving the support, plunger casing and nozzle forcibly downward when the plunger casing and nozzle are in a position defined by said stop comprising a spring arranged upon said rod beneath said support, co-operating cam members lying above said support, one fixed to the support and one arranged on the top threaded end portion of said rod, means for turning the cam member arranged on the top threaded end portion of said rod, means whereby a seal may be formed around said nozzle and open end of the blank when the support, plunger casing and nozzle are moved downward as aforesaid, means for introducing a liquid into the compression space of the plunger casing and into the hollow of the blank by passage through said nozzle, and means whereby pressure may be applied to the contained liquid.

12. In a machine for shaping hollow metal blanks, a die having a cavity for holding a blank to be shaped with an inner surface shaped to give form to the exterior surface of the blank, a plunger casing having within it a compression space with nozzle leading therefrom, a movable support for the plunger casing by which it and its nozzle may occupy an elevated laterally-removed out-of-the-way position with relation to the die cavity or be moved to occupy a position where the nozzle will lie directly above the die cavity and open end of the blank contained in it, means whereby the plunger casing and its nozzle may be moved downward when its nozzle is positioned directly above the die cavity as aforesaid and the nozzle then made to enter the cavity and hollow of the blank. means arranged to form a seal around said nozzle and open end of the blank when the plunger casing and nozzle are moved downward as aforesaid, a plunger operating within the plunger casing, means whereby said plunger will be moved upwardly within the plunger casing simultaneously with the downward movement of said casing as aforesaid, means whereby a liquid may be introduced into the compression space of the plunger casing and into the hollow of said blank after the elevation of said plunger, a hammer for striking the plunger, and means for operating the hammer.

13. In a machine for shaping hollow metal blanks, a die having a cavity for holding a blank to be shaped with an inner surface shaped to give form to the exterior surface of the blank, a plunger casing having within it a compression space with nozzle leading therefrom, a movable support for the plunger casing by which it and its nozzle may oc-

cupy an elevated laterally-removed out-of-the-way position with relation to the die cavity or be moved to occupy a position where the nozzle will lie directly above the die cavity and open end of the blank contained in it, means whereby the plunger casing and its nozzle may be moved downward when its nozzle is positioned directly above the die cavity as aforesaid and the nozzle then made to enter the cavity and hollow of the blank, means arranged to form a seal around said nozzle and open end of the blank when the plunger casing and nozzle are moved downward as aforesaid, a plunger operating within the plunger casing, a lifting means in operative engagement with the plunger for elevating the plunger simultaneously with the downward movement of said casing as aforesaid, means whereby a liquid may be introduced into the compression space of the plunger casing and hollow of the blank after the elevation of said plunger, a hammer for striking the plunger, mechanism for operating the hammer, and means controlled by said hammer-operating mechanism for lowering said lifting means preliminary to the fall of the hammer.

14. In a machine for shaping hollow metal blanks, a die having a cavity for holding a blank to be shaped with an inner surface shaped to give form to the exterior surface of the blank, an elastic seal-forming member arranged to rest upon the top surface of the die around the open end of the blank when located in the die cavity, said seal-forming member being provided with an extension into the hollow of the blank to form an elastic lining therein, said seal-forming member and its extension having an opening through it registering with the open end of the blank, means whereby said seal-forming member may be compressed to form a seal around the open end of the blank contained in the die as aforesaid, means whereby a liquid may be introduced into the blank through the opening in said seal forming member to fill the opening in said elastic lining, and means whereby the liquid thus contained may be compressed for shaping the blank to conform to the inner surface of the die through application of pressure to said elastic lining.

15. In a machine for shaping hollow metal blanks, a die having a cavity for holding a blank to be shaped with an inner surface shaped to give form to the exterior surface of the blank, a plunger casing having within it a compression space with nozzle leading therefrom, an elastic seal-forming member arranged upon the top surface of said die around the opening in said blank contained within the die as aforesaid, said seal-forming member having an opening through it registering with the opening into said blank, means whereby the plunger casing and nozzle may be moved downward into a position where its nozzle will be directed through the opening in said seal-forming member and the member will be compressed between it and the top surface of the die forming a seal around said nozzle and open end of the die, a liquid supply pipe leading to the compression space in the plunger casing, a valve controlling the passage through said pipe, said plunger casing having an air passage through it leading out of said compression space to the atmosphere, a valve controlling said passage, means whereby said valves may be opened and closed simultaneously, a plunger adapted to exert pressure on the liquid contained within the compression space of the plunger casing after the closing of said valves and means for operating the plunger.

16. In a machine for shaping hollow metal blanks, the combination comprising a primary blank forming mechanism including a ram, a secondary blank forming mechanism including a hammer, said mechanisms including also a tension device common to both, and means whereby the ram may be operated and its blow restrained by the tension device, and whereby also the hammer may be operated and its blow augmented by the tension device.

17. In a machine for shaping hollow metal blanks, the combination comprising a primary blank forming mechanism including a ram, a secondary blank forming mechanism including a hammer, said mechanisms including also an operating lever common to both, means whereby both ram and hammer may be independently operated by turning said lever, and means for turning said lever.

18. In a machine for shaping hollow metal blanks, the combination comprising a primary blank forming mechanism including a ram, a secondary blank forming mechanism including a hammer, said mechanisms including also a lever and a tension device common to both, and means whereby the ram may be operated and its blow restrained by the tension device on turning the lever, and whereby also the hammer may be operated and its blow augmented by the tension device on turning the lever, and means for turning the lever.

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