June 26, 1962 C. C. HILLGREN 3,040,684

APPARATUS FOR DRAWING DOOR KNOBS

Original Filed July 18. 1955 4 Sheets-Sheet 1

Fig. 1.

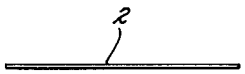


Fig. 2.

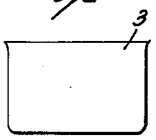


Fig. 3.

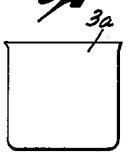


Fig. 4.

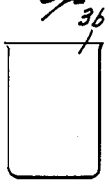


Fig. 5.

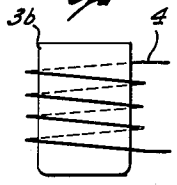


Fig. 6.

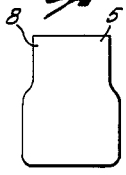


Fig. 7.



Fig. 8.



Fig. 9.



Fig. 10.

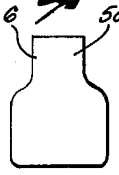


Fig. 11.

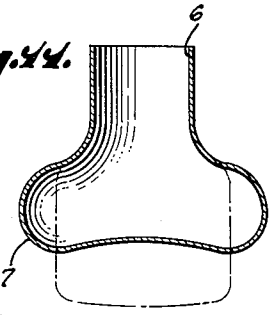


Fig. 12.

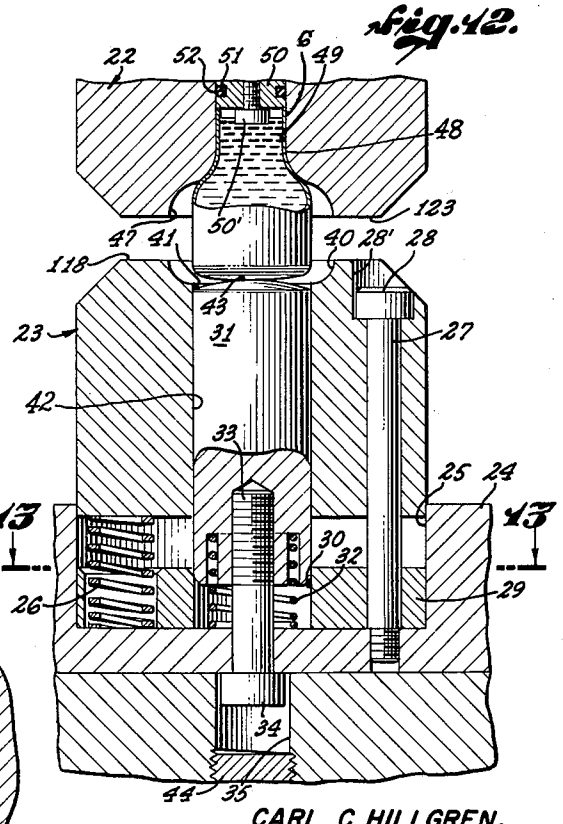
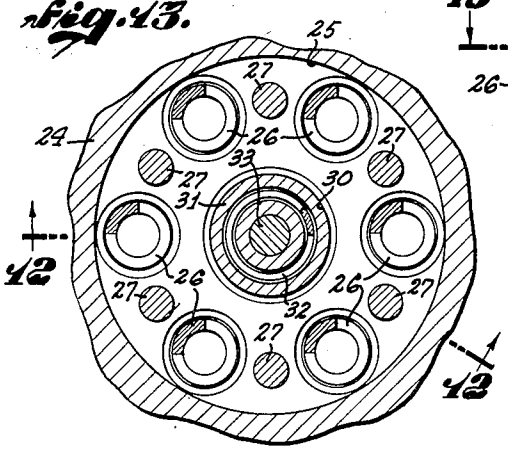


Fig. 13.



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Fig. 14.

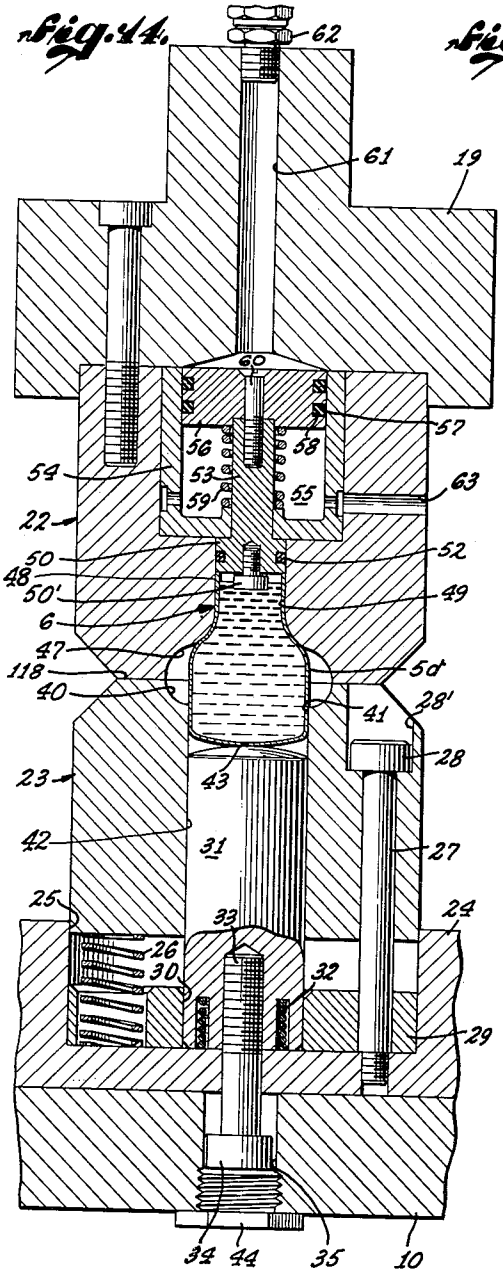


Fig. 15.

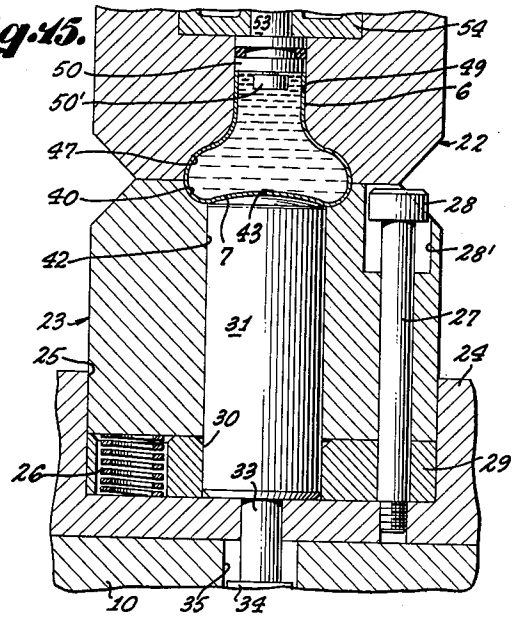
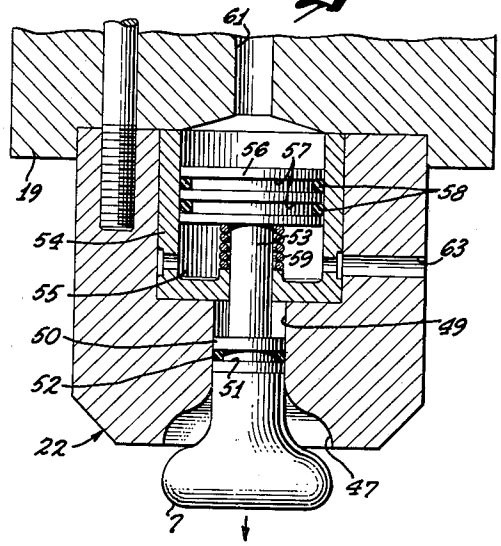


Fig. 16.



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Fig. 17.

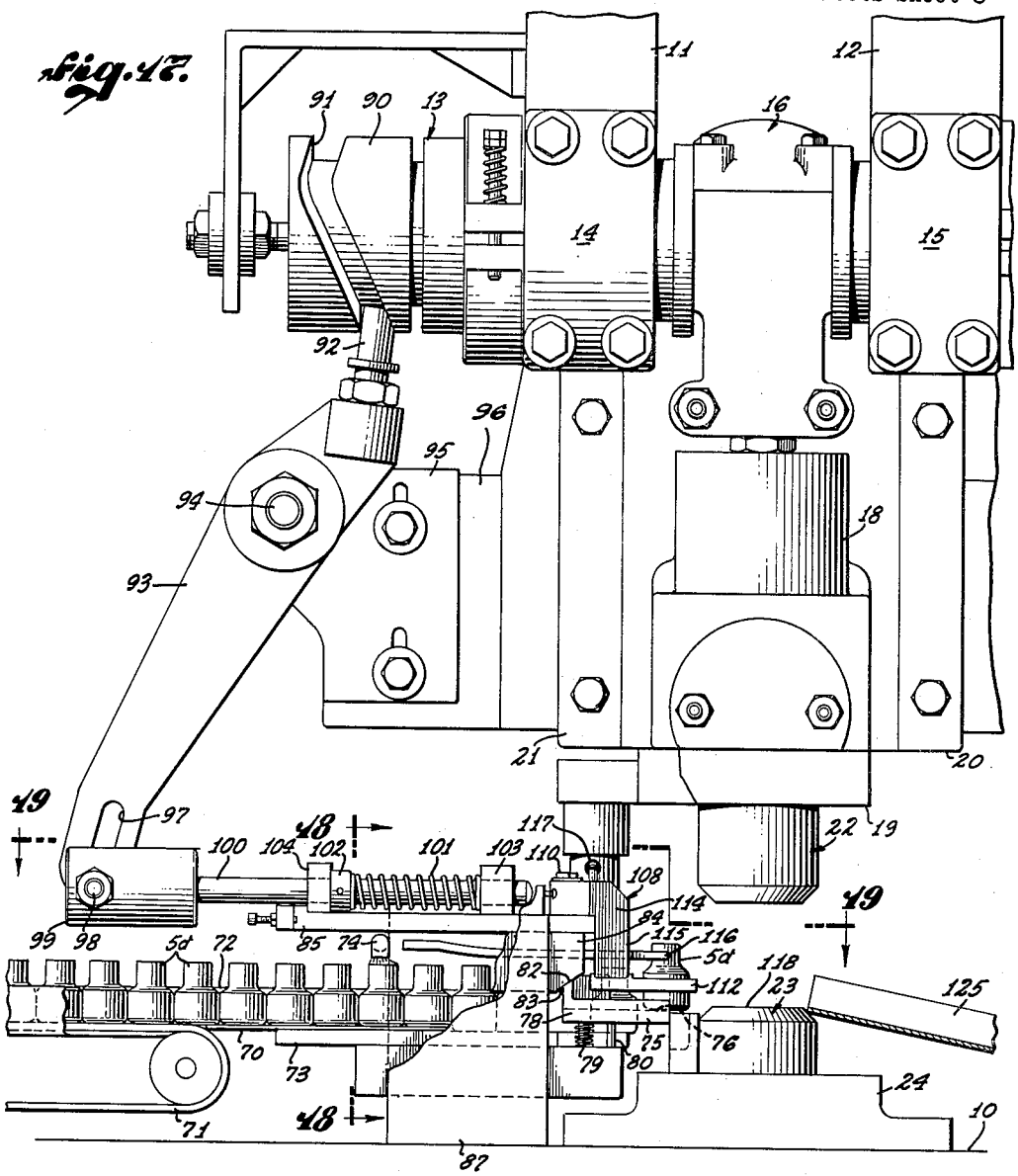
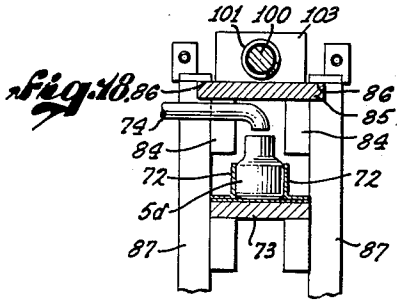


Fig. 18.



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Fig. 19.

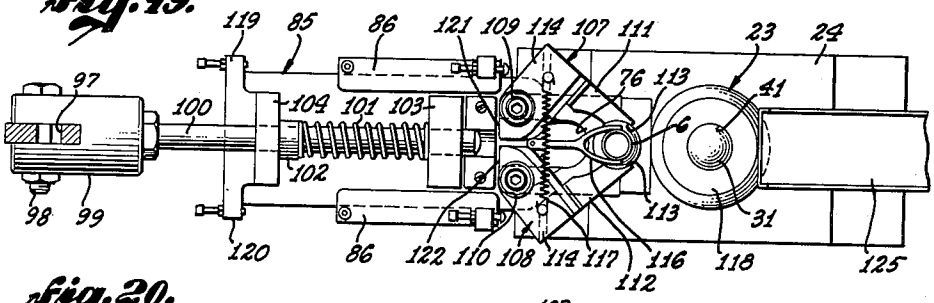


Fig. 20.

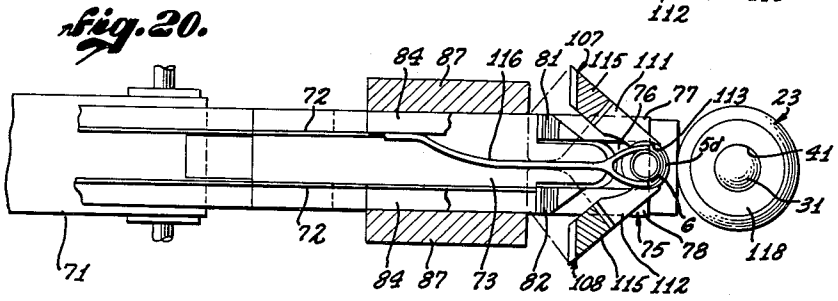


Fig. 21.

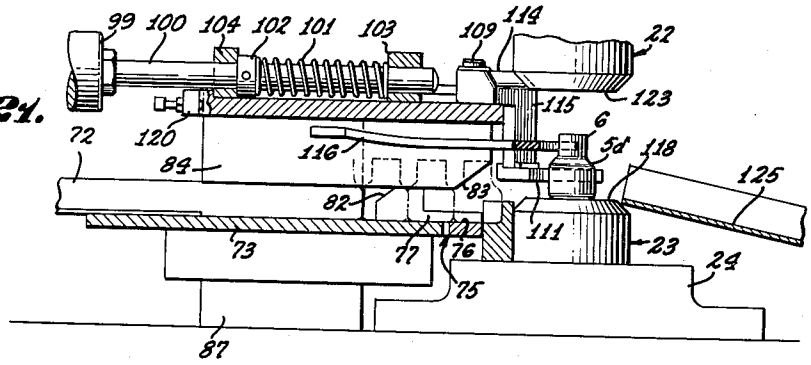


Fig. 22.

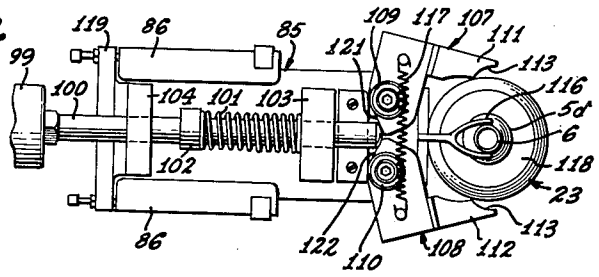
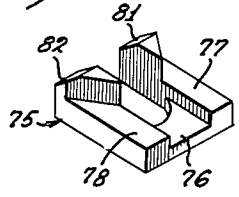


Fig. 23.



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United States Patent Office 3,040,684 Patented June 26, 1962

3,040,684

APPARATUS FOR DRAWING DOOR KNOBS

Carl C. Hillgren, Newport Beach, Calif., assignor to Hillgren Mfg. Co., Huntington Park, Calif., a corporation of California

Original application July 18, 1955, Ser. No. 522,670, now Patent No. 2,972,971, dated Feb. 28, 1961. Divided and this application Nov. 23, 1959, Ser. No. 854,808

9 Claims. (Cl. 113—44)

The application refers to the forming of bulbous articles from a pre-drawn blank by use of a combination involving a die cavity and hydraulic pressure. More particularly the invention relates to an apparatus for expanding a door knob blank into a finished door knob under circumstances wherein the die cavity is closed upon the blank, the blank being filled with a hydraulic liquid and sealed in the cavity whereupon one end of the blank is distorted by external pressure causing the hydraulic liquid to readjust itself and force the walls of the blank outwardly into contact with the inside surfaces of the die cavity. This is a division of copending application Serial No. 522,670 filed July 18, 1955, now Patent No. 2,972,971.

Considerable attention has been given during relatively recent times to quick and inexpensive means of fabricating door knobs. Traditionally lock hardware has been made of brass and with relatively few exceptions emphasis has been placed upon manufacturing techniques intended to result in a sturdy product but without sufficient attention being given to the cost of producing the product. More recently certain innovations have been introduced into the industry which have attempted to make use of hydraulic expansion to produce the finished product. In some instances the hydraulic expansion has been the result of passing into the blank hydraulic liquid under considerable pressure to effect the expansion, the expansion being on some occasions somewhat unrestrained. On other occasions attempts have been made to produce hydraulic pressure by injecting a sealed plunger into the blank and simultaneously distorting the blank and ultimately closing the dies on the expanded blank to exert an external pressure so as to form the exterior of the blank. The technique required in the last mentioned process is somewhat involved and requires very careful preparation of the blank including sizing and polishing both the inside and outside of the open end in order to accomplish the expansion. Moreover the expansion has been sufficiently uncontrolled to result in many rejects wherein the blank has been burst before the dies have been permitted to close.

It is therefore among the objects of the invention to provide a new and improved apparatus for reforming a hollow blank into a finished bulbous smooth-surfaced object by what may readily be defined as hydraulic distortion whereby the finished blank is quickly formed and the operation results in a substantially minimum number of rejects.

Another object of the invention is to provide a new and improved apparatus for forming a hollow necked blank into a bulbous article in the shape of a door knob by employment of dies which close a die cavity before pressure is applied to the blank whereafter mechanical pressure is applied to the exterior of the blank causing the material to reform itself against the interior walls of the cavity uniformly in all directions as a result of hydraulic pressure built up by application of mechanical pressure to the exterior of the liquid-filled hollow blank.

Still another object of the invention is to provide a new and improved apparatus for forming hollow necked blanks into bulbous articles in the form of finished door knobs whereby the hollow necked articles are fed by a new and improved continuous acting feeding mechanism by

means of which one article at a time is enabled to be filled with hydraulic liquid, then placed between dies whereat it is released and the dies closed before the forming operation takes place.

Still another object of the invention is to provide in a mechanical-hydraulic die-forming apparatus a new and improved positive-acting feeding means particularly well adapted to enable each blank adjacent the final stage to be filled with hydraulic fluid and thereafter fed with a swift smooth movement to the die operation whereupon the quantity of hydraulic liquid in the blank is slightly readjusted to full capacity immediately prior to the final combined mechanical hydraulic forming operation.

With these and other objects in view, the invention consists in the construction, arrangement and combination of the various parts of the device whereby the objects contemplated are attained, as hereinafter set forth, pointed out in the appended claims and illustrated in the accompanying drawings.

In the drawings:

FIGURE 1 is a side elevational view of a sheet from which the hollow blank is drawn.

FIGURES 2, 3 and 4 illustrate successive drawing steps.

FIGURE 5 is illustrative of an optional annealing step.

FIGURES 6, 7, 8, 9 and 10 are side elevational views showing successive further drawing steps to accomplish a necking down of the open end of the blank.

FIGURE 11 is a vertical sectional view of the finished bulbous article in the form of a door knob.

FIGURE 12 is a vertical sectional view of a portion of the machine in which the blank is ultimately die formed showing the position of the blank in the die block just prior to the first step.

FIGURE 13 is a cross-sectional view on the line **13—13** of FIGURE 12.

FIGURE 14 is a vertical sectional view similar to FIGURE 12 showing the relative positions of the die blocks immediately prior to the expansion step.

FIGURE 15 is a vertical sectional view similar to FIGURE 12 showing the relative positions of the die blocks and working parts thereof at the completion of the expanding operation.

FIGURE 16 is a vertical sectional view of the upper die block and operating parts thereof illustrating a knock-out apparatus.

FIGURE 17 is a side elevational view of a portion of the machine illustrating the location and operation of a feeding device with respect to the die blocks.

FIGURE 18 is a cross-sectional view on the line **18—18** of FIGURE 17.

FIGURE 19 is a plan view of the feeding device at the first stage of the operation wherein one blank is to be fed to the die blocks.

FIGURE 20 is a horizontal sectional view of the feeding apparatus at the same stage of operation as FIGURE 19.

FIGURE 21 is a fragmentary vertical sectional view of the feeding apparatus at the stage of operation wherein a blank has been placed in position between the die blocks.

FIGURE 22 is a fragmentary plan view of the feeding apparatus showing the step immediately succeeding the step illustrated in FIGURE 21.

FIGURE 23 is a perspective view of a lifting cam associated with the feeding apparatus.

To understand and appreciate the apparatus herein disclosed steps illustrative of the formation of a hollow necked blank are illustrated by the line drawings of FIGURES 1 through 10, inclusive. In performing the steps necessary in the production of the blank illustrated in FIGURE 10, substantially conventional apparatus and technique is employed such as that prevalent in brass drawing operations where shell casings are made and where on occasion

blanks have been formed for the production of door knobs. Ordinarily a flat sheet 2 of brass is fed in strip form through suitable conventional machinery wherein by employment of successive drawing operations the blank is formed first into a wide shallow cup 3 which is then elongated successively into the form of cups 3*a* and 3*b*. Should the brass sheet material or other sheet material chosen be of such thickness or of such character as will respond to an annealing operation, an electric coil 4 may be so formed that the blank 3*b* is passed through it and there subjected to an annealing operation.

Following the formation of an elongated cup such as that illustrated in FIGURE 4, the cup is necked down at the open end. To accomplish this the cup 3*b* is passed through a series of drawing dies of substantially conventional construction which results in the successive formation of hollow necked blanks 5, 5*a*, 5*b*, 5*c*, and 5*d*, as illustrated respectively in FIGURES 6 through 10, inclusive. It will be noted with respect to the last identified figures that the lower portion of the blank remains at substantially the same outside diameter as the elongate cup 3*b* but that a sleeve section, commonly referred to as a neck 6, as illustrated in FIGURE 10, is finally formed having an exterior diameter substantially the same as the exterior diameter of the ultimately formed bulbous article or door knob 7, illustrated in FIGURE 11. The neck 6 is considerably smaller than a neck 8 which is formed on the blank 5, namely, the first formed blank of the successive necking operation.

It will be noted that the apparatus herein constituting applicant's invention is one directed to a reforming of the hollow necked blank 5*d* of FIGURE 10 which is presented to the process and apparatus for further working. An incident in the correct forming of the ultimate bulbous article or door knob lies in providing the blank 5*d* with a cylindrical lower portion, which may for convenience be termed the blank, which has a much smaller diameter than the ultimately formed bulbous portion of the final product but which, on the other hand, is very considerably longer than the finally formed bulbous portion. It has been found that if a door knob, for example, is to have a wall thickness at the portion of greatest diameter sufficient to serve expectations, extra metal must be provided in the blank which will avoid excessive thinning out during the stretching operation. It being impractical to provide the excess amount of metal by increasing the diameter of the lower blank portion 5*d*, the extra metal is provided by increasing its length. The neck 6 is preferably, however, drawn down to about its final shape and size during the conventional drawing and necking down operation so that no further operations are needed with respect to the necked portion except perhaps a slight reforming of the curved area of junction of the neck with the blank portion. Inasmuch as the expanding step is one which should be made rapidly and in a single operation, certain precautions need be taken to assure a minimum of rejects, to assure a full expansion of the blank within the die cavities, and to be sure of a proper confinement of a desired amount of hydraulic liquid to the end that when exterior pressure is applied to the blank it will produce the desired expansion without marring the exterior surface of the finally finished blank.

The invention includes an apparatus adapted for operation with a conventional press of suitable capacity, portions of which are illustrated in FIGURE 17 taken with details of the mechanism illustrated in FIGURES 19 through 23 and details of the die block apparatus illustrated in FIGURES 12 through 16, inclusive.

Generally speaking the press includes a bed 10 designed to support columns 11 and 12.

A composite shaft 13 is supported upon bearings 14 and 15.

Inasmuch as the press as already referred to is of substantially conventional design, details of press construction have been omitted except to the extent of there being illustrated a crank housing 16 on the composite shaft from which a piston (not shown) extends downwardly into engagement with a reciprocating head 18 to which an upper platen 19 is attached. The reciprocating head is adapted to be contained in ways 20 and 21 to guide the reciprocating operation of the head in a proper path. In the upper platen 19 is a die block 22 adapted to cooperate with a lower die block 23 supported upon a base 24 on the bed 10. In the presently disclosed embodiment of the invention the lower die block 23 is essentially the stationary die block and the upper die block 22 is the moving die block. Some limited motion for a specific purpose is, however, present in the lower die block.

As illustrated more particularly in FIGURES 12, 14 and 15, the lower die block 22 reciprocates vertically in a bore 25. Compression springs 26 are normally biased to elevate the lower die block to the uppermost position illustrated in FIGURE 12. To limit movement of the die block upwardly, screws 27 extend slidably through the die block and into the base to a position where heads 28 of the screws engage the bottom of suitable recesses 28′ when the die block is shifted by the spring 26 to uppermost position. A ring 29 fits in the bottom of the bore 25 and is provided with a central cylindrical opening 30 for reception of a plunger 31. A spring 32 of less strength than the spring 26 is located at the bottom of the opening 30 and normally urges the plunger upwardly to the position illustrated in FIGURE 12. To hold the plunger in proper position there is provided a screw 33 extending upwardly through the bottom of the base 24 into threaded engagement with the plunger. A head 34 on the screw reciprocating in a pocket 35 limits movement of the plunger upwardly to the position shown in FIGURE 12.

It is important to note that the die block 23 is provided with a die cavity 40 which forms the outer portion of the finished article. At the bottom of the die cavity 40 is a large central opening 41 communicating with a bore 42 which contains the plunger 31, and in which the plunger is free to reciprocate with a snug sliding fit. The plunger is provided with an upper concave face 43 and in specific positions the concave face forms a portion of the interior wall of the lower die cavity.

In order to protect operation of the plunger 31 and particularly the screw 33 a plug 44 is inserted into the lower end of the pocket 35 to seal off the interior of the pocket.

The upper die block 22 is provided with an upper die cavity 47 formed to the shape of the portion of the door knob adjacent the sleeve section 6. At the center of the upper die cavity 47 is a recess 49 which extends upwardly and is adapted to receive the sleeve section 6 in a snug fit. Within the recess is a piston 50 having an annular recess 51 in which is positioned an O-ring 52 by means of which the piston is given a snug sliding fit in the recess 49. A projection 50′ much smaller in diameter than the piston extends below the piston. The piston 50 serves as a knock-out member and for this purpose the piston is provided with a piston rod 53 shown to good advantage in FIGURES 14, 15 and 16. The piston rod 53 extends upwardly through a hydraulic jacket 54 which provides a cylindrical chamber 55. The chamber is divided into upper and lower sections by means of another piston 56 which is similarly provided with annular recesses 57 in which O-rings 58 are located. A spring 59 tends normally to urge the piston 56 upwardly. The piston may be secured to the piston rod 53 by means of a screw 60, as shown in FIGURE 14.

In the upper platen is a hydraulic passage 61 to which access is had by a fitting 62. Hydraulic fluid entering under pressure into the passage 61 is adapted to move the piston 56 downwardly which in turn moves the piston rod 53 and piston 50 downwardly through a knock-out stroke. To assist the spring 59 in returning the piston 56 to initial position, a hydraulic passage 63 is adapted to

admit hydraulic fluid to the underside of the piston 56 at appropriate intervals and to exhaust hydraulic fluid therefrom on alternate phases of the cycle of operation.

In order to have the device operate properly, an effective feed mechanism need be provided. In the chosen embodiment of the invention the feed mechanism consists of a track or trough 70 to which the blanks are advanced by a belt conveyor 71. The blanks which are being advanced are the blanks 5*d* of FIGURE 10. Guides 72 are spaced one from another forming a channel therebetween just wide enough to permit free movement of the blanks. Constant feed means of a conventional sort is employed to operate the belt conveyor 71. An elongated land 73 supports the last five or six blanks around which they are guided continuously by the guides 72. A hydraulic supply line 74 is located near the mid-portion of the land for supplying hydraulic liquid to the hollow blanks. Immediately adjacent the right-hand end of the land 73, as viewed in FIGURE 21, is an elevator platform 75 just long enough to receive the last blank in line. Details of the construction of the platform 75 are illustrated in FIGURE 23. As there shown a central level portion 76 is the part upon which the blank actually rests. Legs 77 and 78 are attached to the ends of the level portion, these legs being somewhat greater in length than the diameter of the blanks and having a position spaced from the last two or three blanks in line so that the blanks slide between the legs. A spring 79 acts normally to urge the platform in an upward direction guided by posts 80.

When the platform is to receive a blank it must be down in the position illustrated in FIGURE 21. So as to be pressed into that position, cam faces 81 and 82 are provided against which a camway 83 is adapted to press at a certain stage of operation of the feeding mechanism. The camway is carried upon a base 84 of a carriage 85, the carriage being mounted for side to side reciprocation confined within tracks 86. The tracks are supported by upright elements 87 on the bed 10.

The carriage is reciprocated by action of a cam wheel 90 having a cam track 91 therein within which a cam follower 92 is adapted to slide. The shape and configuration of the camway is made to cooperate with rotation of the composite shaft 13 so that the carriage will be reciprocated at proper intervals. The cam 92 is attached to the end of a rocker 93 pivotally supported by a bolt 94 in an adjustable plate 95 attached to a stationary arm 96. The rocker has a slot 97 within which is a bolt 98, the bolt in turn being mounted in a head 99 to which a shaft 100 is attached. Surrounding the shaft 100 is a spring 101 which acts at one end against a collar 102 and at the other end against an abutment 103. The collar in turn is adapted to bottom against another abutment 104.

Also mounted upon the carriage 85 are a pair of arms 107 and 108. These arms are pivotally secured to the carriage by bolts 109 and 110. Fingers 111 and 112 on the arms 107 and 108, respectively, contain curved faces 113 shaped to encompass the last blank in line. The arms as illustrated in FIGURE 21 have each a horizontal portion 114 and a downwardly extending vertical portion 115. The fingers are attached to the lower ends of the vertical portion 115 in each case. To steady the blank while it is being grasped and moved by the arms there is provided a Y-shaped extension 116 which is attached to and moves with the carriage 85.

Normally the spring 117 tends to pull the arms 107 and 108 together as illustrated in FIGURE 19. At the initiation of a stroke of the carriage it is withdrawn to the position of FIGURE 19. In that position the platform 75 is in an upward position wherein it has lifted a blank to position where it can be grasped by the fingers 111 and 112. As the carriage advances from left to right, as viewed in FIGURES 19 through 22, inclusive, the fingers move the blank to the position illustrated in FIGURE 21. The mechanism and timing is such that the blank is centered between the die blocks. The platform it will be understood has been elevated to a position wherein the bottom of the blank is level with an upper face 118 of the lower die block. The blank is thus slid easily into place. Sliding is accomplished by reciprocation of the shaft 100 which in the first instance acting through the spring 101 moves the carriage from left to right. Inasmuch as the fingers are mounted on the carriage, the fingers also with a blank between them are moved from a left position which is the location of the last blank in line to a right position which is centered between the die blocks.

As the shaft 100 continues to be moved from left to right, the base 84 moves from left to right through a distance such that the camway 83 presses against the cam faces 81 and 82 causing the platform 75 to be moved downwardly against pressure of the spring 79 to a position where it can again accept the last blank in line. As the carriage continues to move, the abutment 104 and wings 119 and 120 thereof abut against the tracks 86 and halt further motion of the carriage toward the right. Since the shaft 100 continues to be pressed in a direction from left to right, the spring 101 will compress and the end of the shaft 100 will press against cam faces 121 and 122 on the arms 107 and 108, respectively, causing the arms to move outwardly away from contact of the fingers with the blank. Movement will be such that the fingers entirely clear the faces of the die blocks.

Having released the blank in position between the die blocks, action of the camway 91 and cam 92 will retract the carriage far enough to clear the Y-shaped extension before the dies meet.

As previously noted the blanks are filled with hydraulic liquid from the hydraulic supply pipe 74 as they approach the position last in line. The amount of hydraulic liquid need not be metered so long as a sufficient quantity is injected into the hollow blank to bring the level near the top. The movement of the blank as it is fed to position between the die blocks may spill some of the fluid but any quantity which might be spilled is compensated for when the upper die block 22 is lowered. As the upper die block is so moved, the projection 50′ displaces a sufficient amount of hydraulic liquid to bring the level of the liquid to the top rim of the sleeve section 6. At the same time the piston 50 is lowered into engagement with the rim of the sleeve section. These parts are so positioned that the upper die block moves downwardly until the sleeve section 6 is received within the recess 49 and forms a sufficient seal around the exterior of the sleeve section.

As the upper die block continues to descend, the bottom of the blank will be brought against the concave face 43 of the plunger 31. This will force the plunger downwardly against tension of the spring 32 until the plunger bottoms against the base 24. This will be the position illustrated in FIGURE 14. At this point the face 118 of the lower die block will receive a face 123 of the upper die block and the die cavity formed by the respective die cavities 40 and 47 will be sealed and closed.

Thereafter as the upper die block continues to descend, it forces the lower die block downwardly against tension in the springs 26. Meanwhile the plunger 31 remains stationary and the effect is that of relative movement of the plunger into the lower die cavity while pressing against the bottom of the blank. Inasmuch as the hydraulic liquid is sealed within the blank, the liquid will be displaced outwardly forcing the wall of the blank outwardly until it fills the interior of the die cavity. The final position will be that illustrated in FIGURE 15. Thus, although no hydraulic pressure is injected into the blank, hydraulic pressure is exerted by impressing the plunger against the bottom of the blank and under the chosen circumstances wherein the volume of the hydraulic liquid is substantially the same as the volume of the combined die cavities, the blank will be forced into engage-

ment with the interior of the die cavities and a smooth, substantially finished knob will be the result.

As the composite shaft continues to rotate through the cycle just described, the upper die block 22 will recede upwardly and at the same time hydraulic liquid under pressure will be injected into the hydraulic passage 61 forcing the piston 56 downwardly and hence the piston rod 53 and piston 50 downwardly so as to eject the finished knob. When the finished knob falls upon the lower die block, feeding of the next blank into place will push the knob off the die block so as to roll it down an exit chute 125. At this point the cycle begins to repeat in order to advance the next blank to position between the dies where it will be formed in the manner just described.

There has accordingly been described herein a simple and effective combined feeding apparatus and die forming apparatus for making door knobs from an expanded necked blank, the apparatus being relatively simple in its structure and operation and the process involved therein being simple and effective so as to produce dependable expanded products with a minimum of rejects. Expansion into a closed cavity in the manner described is productive of the dependable product of the system.

While I have herein shown and described my invention in what I have conceived to be the most practical and preferred embodiment, it is recognized that departures may be made therefrom within the scope of my invention, which is not to be limited to the details disclosed herein but is to be accorded the full scope of the claims so as to embrace any and all equivalent apparatus.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A machine for expanding a hollow substantially cylindrical blank into a bulbous expanded end product by employment of a combination of mechanical and hydraulic pressure comprising a lower die block having a die cavity in an upper face, a cylindrical bore extending centrally downwardly from the cavity having a size adapted to receive a portion of said cylindrical blank, a resiliently supported plunger slidably mounted in said bore, an upper die block having a matching die cavity in a lower face, said die blocks being movable relative to each other, a conveyor for moving said blanks one at a time into alignment with said die cavities comprising a track, blank moving members located near a discharge end of the track and mounted adjacent the die blocks, power means operably connected to one of said dies, a drive from said power means to said members including timing means adapted to place and release a blank before movement of said die blocks, and a liquid supply means adapted to fill each blank with liquid before the positioning of the blank in the die cavities, said die blocks being movable into engagement with each other in a sequence wherein the blank enters said bore as the die blocks are moved together closing said cavity, said plunger thereafter having an upward movement adapted to force the liquid-filled blank out of the bore and into the die cavities whereby the blank is forced by displacement of the hydraulic liquid to expand into engagement with the walls of the cavities.

2. A machine for expanding a necked hollow substantially cylindrical blank into a bulbous expanded end product by employment of a combination of mechanical and hydraulic pressure comprising a lower die block having a spring support and having a die cavity in an upper face thereof, a cylindrical bore extending centrally downwardly from the cavity having a size corresponding to a lower portion of said blank, a plunger slidably mounted in said bore and a spring supporting the plunger of lesser resistance than the spring for the die block, an upper die block having a matching die cavity in a lower face thereof and a centrally upwardly extending neck-receiving recess, one of said die blocks being movable relative to the other between open and closed positions, a hydraulic cylinder in the upper die block and a piston in said cylinder, a piston rod on said piston and a plunger on said piston rod having a sealed sliding fit in said recess and movable under hydraulic pressure from an initial position adjacent the upper rim of the blank to a downwardly extended knock out position and a liquid displacement projection on the plunger of smaller diameter than the neck of the blank receivable freely in said blank, a conveyor adapted to move said blanks one at a time into alignment with said die cavities comprising a track; a pair of blank moving fingers at the end of the track adjacent the die blocks, power means operably connected to one of said dies, a mechanical drive from said power means to said fingers including timing means, said fingers being adapted to place a blank in position between said die blocks before movement of said die blocks to closed position and release said blank in said position, and a hydraulic liquid injection spout mounted in the machine in a position over said track adapted to fill each blank with liquid before the positioning of the blank in the die cavities, said die blocks being movable to closed position in a sequence wherein after the said recess receives the neck and the blank enters said bore in position depressing the plunger in said bore the die blocks are moved together closing said cavity and thereafter said die blocks are subjected to further movement wherein said lower die block moves relative to the plunger therein and said last plunger forces said blank from the bore into the die cavities whereby the blank is forced by pressure of the hydraulic liquid to expand into engagement with the walls of the cavities.

3. A machine for expanding a necked hollow substantially cylindrical blank into a bulbous expanded end product by employment of a combination of mechanical and hydraulic pressure comprising a resiliently supported lower die block having a die cavity in an upper face, a cylindrical bore extending centrally downwardly from the cavity, a forming plunger slidably mounted in said bore supported by spring pressure, an upper die block having a matching die cavity in a lower face and a centrally upwardly extending neck-receiving recess, a hydraulic cylinder in the upper die and a piston in said cylinder, a knock-out plunger on said piston having a sealed sliding fit in said recess and movable under hydraulic pressure from an initial position adapted to engage the upper rim of the blank to a knock-out position and a liquid displacement projection on the knock-out plunger receivable loosely in said blank, a conveyor for moving said blanks one at a time into alignment with said die cavities; blank moving means adjacent the die blocks, power means operably connected to one of said dies, a mechanical drive from said power means to said blank moving means including timing means, said drive being adapted to place a blank in position between said die blocks before movement of said die blocks and release said blank in said position, and liquid supply means adapted to fill each blank with liquid before the positioning of the blank in the die cavities, said die blocks being movable into engagement with each other in a sequence after the neck enters said recess and the blank enters said bore and the die blocks are thereafter moved to positions closing said cavity and thereafter upon further movement of said die blocks relative to the forming plunger said last plunger forces said blank from the bore into the die cavities wherein the blank is forced by displacement of the liquid to expand into engagement with the walls of the cavities.

4. A machine for expanding a hollow substantially cylindrical blank into a bulbous expanded end product by employment of a combination of mechanical and hydraulic pressure comprising a lower die block having a die cavity in an upper face thereof, a cylindrical bore extending centrally downwardly from the cavity complementary in shape and size to the shape and size of a lower portion of said blank, a resiliently supported plunger slidably mounted in said bore, an upper die block having a matching die cavity in a lower face thereof, a

conveyor adapted to move said blanks one at a time into alignment with said die cavities comprising a track; blank moving members at the end of the track adjacent the die blocks, power means operably connected to one of said dies, a mechanical drive from said power means to said blank moving members including timing means, said drive being adapted to place a blank in position between said die blocks before movement of said die blocks and to release said blank in said position, and hydraulic injecting means for injecting hydraulic liquid into each blank, said die blocks being movable into engagement with each other in a sequence wherein after the blank enters said bore said plunger is depressed and the die blocks are then moved together closing said cavity and thereafter subjected to further movement toward said plunger whereby the plunger forces said blank from the bore into the die cavities and the blank is forced by internal pressure of the hydraulic liquid to expand into engagement with the walls of the cavities.

5. A machine for expanding a hollow substantially cylindrical blank having a neck and a bulbous portion into a bulbous expanded end product by employment of a combination of mechanical and hydraulic pressure comprising a resiliently supported lower die block having a die cavity in an upper face, a cylindrical bore extending centrally downwardly from the cavity having a shape and size complementary to the shape and size of a lower portion of said blank, a resiliently supported plunger slidably mounted in said bore, an upper die block having a matching die cavity in a lower face and having a neck recess therein, liquid supply means adapted to fill each blank with liquid before the positioning of the blank in the die cavities, said die blocks being movable into engagement with each other in a sequence wherein the neck enters said neck recess and wherein the blank enters said bore to depress the plunger, said die blocks thereafter having a movement to relative positions closing said cavity, said die blocks subsequently having relative movement to positions wherein said plunger assumes a position substantially coincident with the wall of the respective die cavity forcing said blank from the bore into the die cavities whereby the blank is forced by displacement of the hydraulic liquid to expand into engagement with the walls of the cavities.

6. A machine for expanding a necked hollow substantially cylindrical blank into a bulbous expanded end product by employment of a combination of mechanical and hydraulic pressure comprising a resiliently supported lower die block having a die cavity in an upper face, a cylindrical bore extending centrally downwardly from the cavity, a forming plunger slidably mounted in said bore supported by spring pressure, said plunger when depressed leaving a space in said base complementary in shape and size to the shape and size of a lower portion of said blank, an upper die block having a matching die cavity in a lower face and a centrally upwardly extending neck-receiving recess, a hydraulic cylinder in the upper die block and a piston in said cylinder, a knock-out plunger on said piston having a sealed sliding fit in said recess and movable under hydraulic pressure from an initial blank limiting position adapted to engage the upper rim of the blank to a knock-out position and a liquid displacement projection on the plunger receivable loosely in said blank, liquid supply means adapted to fill each blank with liquid before the positioning of the blank in the die cavities, said die blocks being movable into engagement with each other in a sequence wherein the neck enters said recess and the blank enters said bore, said die blocks thereafter having a movement to relative positions closing said cavity and thereafter to positions wherein said forming plunger forces said blank from the bore into the die cavities whereby the blank is forced by displacement of the liquid to expand into engagement with the walls of the cavities.

7. In a die forming machine for hollow blanks comprising upper and lower mutually reciprocating die blocks having contacting faces and matching die cavities therein the combination of a frame, a first feed mechanism on the frame extending to the die blocks and a conveyor adapted to retain a moving line of blanks in lateral contact, liquid supply means adapted to introduce hydraulic liquid into the blanks, means adapted to advance said blanks to the die blocks, and a second feed mechanism for shifting individual blanks from the last blank position to the die cavities comprising spring-pressed members adapted in initial position to engage a blank, a carriage for the spring pressed members, said carriage and said members being movable from initial position to a position wherein said members are between said die cavities, an advancer for said carriage, a reciprocator for one of said die blocks and a timing cam operably connected to said reciprocator and connected to said advancer in a relationship wherein the members and a die blank are advanced to position between the dies before the dies are closed and the members removed therefrom, a releasing means on the fingers, a shaft on the carriage engageable with the releasing means and adapted to effect release of said members from contact with the blank, a yieldable connection between the shaft and the carriage adapted on the advance stroke to transfer shaft movement to the carriage before movement of the shaft relative to the carriage, said connection being subject to further movement whereby to release said members and effect release of the blank to the die blocks before the die blocks are closed.

8. In a die forming machine for hollow blanks comprising upper and lower mutually reciprocating die blocks having contacting faces and matching die cavities therein the combination of a frame, a first feed mechanism on the frame extending to the die blocks below the level of the face of the lower die block and a conveyor adapted to retain a moving line of blanks in lateral contact, a hydraulic liquid feed spout at a blank position before the final blank position, means adapted to advance said blanks along the trough, and a second feed mechanism for shifting individual blanks from the last blank position to the die cavities comprising a pair of spring-closed fingers adapted in initial position to engage a blank on respectively opposite sides of the blank, a carriage for the fingers having a reciprocating mounting on the frame, said carriage and fingers being movable from initial position to a position wherein said fingers are between said die cavities, an advancer for said carriage, a reciprocator for one of said die blocks and a timing cam operably connected to said reciprocator and connected to said advancer in a relationship wherein the fingers and a blank are advanced to position between the die blocks and removed therefrom before the die cavities are closed, spreading cams on the fingers, a shaft on the carriage engageable with the spreading cams to spread said fingers from contact with the blank, a spring connection between the shaft and the carriage adapted on the advance stroke to transfer shaft movement to the carriage before movement of the shaft relative to the carriage, said spring being compressible upon further movement of the shaft whereby said shaft is extended to a position of spreading and releasing said fingers and releasing the blank to the die blocks before the die cavities are closed.

9. In a die forming machine for hollow blanks comprising upper and lower mutually reciprocating die blocks having contacting faces and matching die cavities therein the combination of a frame, a first feed mechanism on the frame extending to the die blocks below the level of the face of the lower die block and a conveyor adapted to retain a moving line of blanks in lateral contact, a platform adjacent the lower die block in line with the conveyor, spring means normally urging said platform upwardly to a position level with said face of the lower die block, a hydraulic liquid feed spout having an outlet over one of the blanks, means for advancing said blanks

to the platform, and a second feed mechanism for shifting individual blanks from the last blank position to the die cavities comprising a pair of spring-closed fingers adapted in initial position to engage a blank on the platform on respectively opposite sides of the blank, a carriage for the fingers having a reciprocating mounting on the frame, said carriage and fingers being movable from initial position to a position wherein said fingers are between said die cavities, cam means on the platform and complementary cam means on the carriage adapted to depress the platform on motion of the carriage toward the die block and to release the platform for spring-urged elevation thereof on motion of the carriage away from the die block, an advancer for said carriage, a reciprocator for one of said die blocks and a timing cam operably connected to said reciprocator and connected to said advancer in a relationship wherein the fingers and a die

blank are advanced to positions between the die blocks before the die cavities are closed, cooperable means respectively on the fingers and the carriage adapted to spread said fingers from contact with the blank, means adapted to move the carriage before movement of the cooperative means on the carriage, said last means being adapted upon further movement to spread said fingers and release the blank to the die before the die blocks are closed.

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