METHOD AND APPARATUS FOR FORMING SCREW THREADS

Filed April 10, 1964

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 4A

Fig. 5.

Fig. 6.

Fig. 7.
This invention relates to the manufacture of cylindrical, thin walled threaded members and more particularly to a method and apparatus for forming screw threads in the sidewalls of light gauge metal closure elements such as caps, plugs, nozzles, container necks and the like. It has been the common practice in the art to form threads in the cylindrical sidewalls of elements such as those above mentioned by rotating a thread forming die member against the outer surface of the element while backing up the inner surface of the sidewall with a rotating anvil member disposed within the element. The resulting rotation of the cylindrical sidewall between such members causes the formation of a continuous helical screw thread in said sidewall. Although a high degree of success has been achieved with this method of thread rolling, it nevertheless has certain inherent disadvantages. Notable among these is that such method of thread rolling does not readily lend itself to the formation of threads on an integrally formed neck or flange on a container or container top. To do so requires a very slow and cumbersome piece of machinery not at all compatible with present high speed mass production methods. Another disadvantage of the commonly employed process of thread rolling lies in the unsuitability of this method as a continuous step in a progressive die operation. Here again, by present mass production standards, the movement of parts being worked from a press operation to a thread rolling operation and back again to another press operation introduces substantial inefficiency into the method of manufacture.

The invention successfully overcomes the above mentioned disadvantages, plus others inherent in the various prior art practices, by providing a method and an apparatus for imparting a continuous helical screw thread formation to the cylindrical sidewall of a member while the same is positioned in an ordinary punch press. The invention consequently effectively eliminates the need for relative rotary movement between the workpiece and a die and gives rise to advantages in terms of efficiency and flexibility hitherto unknown in this art.

It is accordingly a principal object of the invention to provide a novel method for imparting a helical thread formation to relatively thin walled tubular members. Another object of the invention is to provide a novel method for forming screw threads in the cylindrical sidewalls of light gauge metal closure elements.

A further object is to provide a novel method for forming a continuous screw thread in an integrally formed upstanding neck extending up from a container wall surrounding an opening therein.

A still further object is to provide a novel method of imparting a continuous helical thread formation to a thin walled tubular member by utilizing an ordinary punch press.

A still further object is to provide apparatus for carrying out the method of the invention.

A more detailed object is to provide a method and apparatus for threading light gauge metal closure elements as one of the steps in a progressive die operation. Further and more detailed objects will in part be obvious and in part be pointed out as the description of the invention taken in conjunction with the accompanying drawing proceeds.

In that drawing:

FIG. 1 is a part sectional, part elevational view of a characteristic cylindrical workpiece prior to the thread forming operation.

FIG. 2 is a vertical section, including the workpiece of FIG. 1, of die elements for performing the method of thread forming in accordance with the invention.

FIG. 3 is a vertical section similar to FIG. 2 but with the die elements moved into position with the workpiece therebetween ready for the commencement of the thread forming.

FIG. 4 is a vertical sectional view showing the die element moved into position where the thread has been formed in the workpiece.

FIG. 4A is a part sectional, part elevational view similar to FIG. 4 but with thread formed in accordance with the method of the invention in a workpiece having a closed end.

FIG. 5 is part sectional, part elevational view of a completed nozzle and screw cap both formed in accordance with the invention.

FIG. 6 is part sectional, part elevational view of a closure flange and plug both formed in accordance with the invention.

FIG. 7 is an exploded sectional view of apparatus in accordance with the invention for performing the method in accordance with the invention.

A cylindrical workpiece generally indicated by the numeral 1 is shown in FIG. 1. The significant aspect of the workpiece 1 in order that the thread forming method of the invention may be performed on it is that it include a thin walled cylindrical portion preferably of light gauge metal. As will be hereinafter described, the workpiece 1 may be an intermediate formation in the manufacture of any thin walled, cylindrical member including principally a threaded portion. The method and apparatus of the invention are particularly advantageous whenever employed in the manufacture of various closure elements such as container necks, nozzles, flanges, caps and plugs. In FIG. 1 the workpiece 1 is shown as having a laterally extending base portion 2 which may represent the surrounding container wall from which the cylindrical neck or workpiece 1 has been upwardly drawn as a prior operation, or may simply be a flange to be further formed in a subsequent operation.

In FIG. 2 the workpiece 1 is shown assembled together with means for forming the thread in accordance with the invention. This thread forming means comprises a pair of die members each having the form of a helical coil spring. The inner spring 3, when in relaxed condition, has a diameter slightly smaller than the internal diameter of the cylindrical workpiece while the outer spring 4, when in relaxed position has a diameter slightly greater than the outside diameter of the workpiece. As here shown the springs and the workpiece are coaxially aligned either as shown in FIG. 2 with the workpiece positioned between them. Alternately it is also contemplated that the springs would be in a nested relationship and be positioned adjacent the free upper end 8 of the workpiece. In either case, the thread forming die members 3 and 4, before being moved
into engagement with the workpiece, are telescoped about that workpiece so as to encase the same as shown in FIG. 3.

In the FIG. 3 position the springs 3 and 4 are still in relaxed condition with the difference in diameters as above described allowing just enough radial clearance for the springs to move easily about the workpiece. What is significant to note from the FIG. 3 showing is that the inner and outer springs need to be axially aligned relative to each other so that the coils of one spring lie in radial opposition to the coils of the other spring. The necessity of this relationship becomes obvious upon considering the actual thread forming step of FIG. 4, which shows the spring die members 3 and 4 brought into forming engagement with the cylindrical wall portion lying therebetween. This deformation is brought about by contracting the outer spring 4 radially inward in an amount equal to one-half the desired thread depth while at the same time the inner spring 3 is radially expanded by an amount equal to one-half the desired thread depth. Added to this movement is the small additional required to take up and the clearance allowed for easy insertion and removal of the workpiece as above mentioned. On completion of the contraction and expansion of the spring die members, the workpiece will be seen to have a rounded thread form imparted thereto with the thread roots formed radially inwardly at 5 by the outer spring die member 4 and the thread crests 6 formed radially outwardly by the inner spring die member 3.

From the showings of FIGS. 3 and 4, it is to be noted that the cross-sectional diameter of the wire forming the inner spring 3 is slightly smaller than that of the wire forming the outer spring 4. This arrangement has been found to give a desirable thread form as here shown, however, the relative cross-sectional diameters of the wire forming the spring die members may be varied without departing from the invention in order to provide a particular thread contour.

The length of the spring die members 3 and 4 is dependent upon the number of threads it is desired to form in the workpiece. It is to be noted, however, that the contraction of the outer spring 4 will cause a slight endwise elongation thereof while the expansion of the inner spring 3 will cause the same to be correspondingly shortened. One end of each spring helix must be left free to provide for this length differential. The use of a suitable surface lubricant in the forming step facilitates this endwise movement.

An apparatus for actuating the springs for practicing the method of the invention as just described is shown in FIG. 7. The inner spring member 3 is held in a helical channel 26 of a formed shell die member 25. The spring 3 is fixed at one end, such as at its outer end 27, in its jaw groove 26. The rest of the spring is free to move lengthwise with respect to the groove. This arrangement allows for slight rotational movement of the spring helix in its groove 26 as the spring expands and contracts. The jaws 25 are radially expanded by the actuating spindle 28 which has an inclined cam surface 29 engaging the inclined cam follower surface 29 provided on the interior of the jaws 25. The outer, and as here shown upper, spring 4 is held in a similar manner in a segmented upper die formed of a plurality of radially contractable jaws 31. The jaws 31 are each formed with portions of a helical groove 32 extending into their interior surfaces and within which the spring 4 is seated. The spring 4 preferably has its bottom end fixed in the overlying jaw groove 32 as shown at 33 permitting slight rotational movement of the rest of the spring with respect to its groove. The jaws 31 are urged radially inwardly by engagement of their inclined cam follower surface 34, located on the exterior of the jaws, with the inclined cam surface 35 provided on the interior surface of the actuating ring 36.

The operation of the thread forming die, as just described, is as follows: First, with the die in its open position as shown in FIG. 7, the workpiece is inserted between the upper and lower die members in coaxial alignment to provide the relationship illustrated in FIG. 2. The die is then moved to its operative position with the springs 3 and 4 telescoped about the workpiece as shown in FIG. 3. At this point the springs 3 and 4, together with their respective supporting jaws 25 and 31, have completed their relative axial movement. Actuation of the die continues by the continuing opposed axial movement of the spindle 28 and the actuating ring 36. This additional axial movement causes the cam surface 30 acting on its follower surfaces 29 to force the jaws 25 radially outwardly. At the same time the cam surface 35 engages its follower surface 34 and forces the jaws 31 radially inwardly. Eventually then the springs 3 and 4 assume the position shown in FIG. 4.

The inner spring 3 acts upon the interior surface of the cylindrical workpiece to form the helical groove 6 radially outwardly while at the same time the outer spring 4 acts upon the exterior cylindrical surface to form the helical groove 5 radially inwardly. The result is a smooth, accurate, helical screw thread formation. Removal of the finished workpiece from the die is accomplished by simply opening the die by reversing the above described steps. FIG. 4A shows the same thread forming as in FIG. 4 except that here the forming is being performed on a cylindrical workpiece 10 having a closed end wall 11. This workpiece represents an intermediate stage in the formation of a closure element such as a screw cap or a screw plug. In this embodiment the surrounding flange 12 may have been given its final configuration at this point or it may still be part of a strip being worked upon in a progressive die operation. In the latter case, the workpiece would be blanked out of the strip and the flange 12 finally formed in a subsequent die station.

FIGS. 5 and 6 illustrate various types of closure element readily capable of being threaded by employing the method of the invention. FIG. 5 shows a screw cap 15 applied to a nozzle 16 which in turn is secured to a container wall at 17 in a well known manner. FIG. 6 shows a screw plug 20 threadedly engaged within a flange 21. The flange is also secured at 22 in a well known manner to a container wall forming an opening therein.

As can be seen from the foregoing a simple method, performed by employing a relatively simple, inexpensive apparatus can be used for forming threads as compared to the more complicated thread rolling machines normally employed. This die of the invention can be employed in any ordinary punch press thus providing the often sought after advantage of manufacturing flexibility. The employment of the method and apparatus of the invention is also particularly advantageous in those instances where it is desirable to impart threads to a neck formed up as an integral part of a container wall. The present cumbersome machinery employing rotating and threading screw rollers required for accomplishing such threading are clearly eliminated. Another inherent advantage lies in the suitability of the method and apparatus herein disclosed for performing a threading operation as one stage in a progressive die operation. In other words, the apparatus as shown in FIG. 4 can easily be employed as one station in a multiple station punch press where it can be used as a single station die but arranged together with the other punch press operations so that the workpiece can be carried in the strip form from one step to the next and then blanked out of the skeleton in the last operation. The various closure elements shown in FIGS. 5 and 6, and other comparable parts can be readily formed in this manner hence greatly increasing manufacturing efficiency by avoiding the necessity for transferring part or finished parts from a punch press operation to a thread rolling operation and possibly back again to another press operation.
3,322,086

5. Though, in the foregoing, a particular die arrangement has been described with reference to the showing in the accompanying drawing, it is to be understood, of course, that the invention is not considered to be limited by the particulars of such showing. Various devices can be employed for the practice of the method of the invention including, but without limitation to, different arrangements for moving the helical thread forming means as shown into engagement with the workpiece. Other variations in apparatus may well suggest themselves to those skilled in the art without departing from the spirit and scope of the invention. It is accordingly to be understood that the steps, relationships and structures shown in the accompanying drawing and described in the foregoing description are to be considered as illustrative of the invention and are not set forth in a limiting sense.

I claim:

1. The method of imparting a continuous helical screw thread to a straight relatively thin cylindrical wall which comprises forming a continuous helical surface portion of said wall inwardly with respect to the original contour thereof to form a half thread therein and forming a continuous helical surface portion of said wall intermediate said inwardly formed portion outwardly to form the remaining half thread therein, whereby said wall has a full screw thread formation imparted thereto.

2. The method as in claim 1 and including effecting said forming by engaging the outer surface of said wall with first unitary helical forming means, engaging the inner surface of said wall with second unitary helical forming means positioned in zones between the turns of said first helical forming means, contacting said first helical forming means and expanding said second helical forming means.

3. The method as in claim 2 and permitting said first and second helical forming means to move circumferentially as said contacting and expanding actions are effected.

4. The method of forming screw threads in the cylindrical sidewalls of light gauge metal closure elements comprising the steps of coaxially locating a cylindrical wall intermediate an axially spaced inner and outer thread forming means, axially displacing said inner and outer thread forming means to a telescoped position radially encompassing the inner and outer surfaces of said cylindrical wall, radially displacing said inner and outer thread forming means in opposed directions in continuous helical surface engagement with said intermediate cylindrical wall and forming said cylindrical wall between the foregoing steps thereby imparting a continuous uninterrupted helical thread form to said wall.

5. Apparatus for imparting a screw thread formation to the wall of thin walled cylindrical members which comprises outer thread forming means including inwardly facing continuous thread forming means having first spaced portions, an inner thread forming means concentric with and radially inwardly spaced with respect to said outer thread forming means and including an outwardly facing thread forming surface having second spaced portions formed for positioning between said first spaced portions, an inner thread forming means concentric with and radially inwardly spaced with respect to said outer thread forming means, means for contracting said outer thread forming means to reduce the radius of the same and means for expanding said inner thread forming means to increase the radius of the same with said outwardly facing thread forming surfaces protruding radially outwardly as far as said inwardly facing thread forming surfaces whereby a cylindrical thin walled member positioned between said inner and outer thread forming means will be formed into a continuous helical screw thread formation with said formation extending both interiorly and exteriorly of the normal cylinder of said wall, said outer and inner thread forming means being open helix coil springs, each of said springs having a plurality of turns, said turns being spaced apart a sufficient distance to enable the wall of cylindrical members being worked upon to be forced into said spaces.

6. Apparatus for imparting a thread formation to the wall of thin walled cylindrical members, which comprises a segmental contractable die member formed of a plurality of segments positioned around an axis and formed to come together as a complete cylinder when in contracted position, means for contract said segments, a cylindrical pocket formed into said segmental die member from one end thereof and being concentric with respect to the axis thereof, exterior thread forming means carried by the side wall of said pocket and a mated expandable segmental die member axially positioned with respect to said segmental contractable die member, said expandable die member being formed with an exterior cylindrical surface, said surface being provided with interior thread forming means positioned about the same, said die members adapted to be positioned in telescoping relationship with a cylindrical wall positioned between said interior thread forming means and said exterior thread forming means, means for contracting said exterior thread forming means and means for expanding said interior thread forming means so that said interior thread forming means and said exterior thread forming means lie in radially overlapping relationship and the cylindrical wall positioned therebetween is worked into a thread formation extending exteriorly and interiorly with respect to the untreaded cylindrical form of said wall, said thread forming means being open helical springs, said die members being formed with channels for receiving and seating opposed surface portions of said springs, said surface portion of said springs being seated in said channels, each of said springs having one end secured against movement in said channel receiving the same and each of said springs having its other end free for movement along its said channel as said springs are expanded and contracted.

7. Apparatus for imparting a screw thread formation to the wall of thin walled cylindrical members which comprises outer thread forming means including inwardly facing continuous thread forming means having first spaced portions, an inner continuous thread forming means concentric with and radially inwardly spaced with respect to said outer thread forming means and including an outwardly facing thread forming surface having second spaced portions formed for positioning between said first spaced portions of said outer thread forming means, means for contracting said outer thread forming means to reduce the same and means for expanding said inner thread forming means to form a radius of the same whereby a cylindrical thin walled member positioned between said inner and outer thread forming means will be formed into a continuous helical screw thread formation with said formation extending both interiorly and exteriorly of the normal cylinder of said wall.

8. Apparatus for imparting a screw thread formation to the wall of thin walled cylindrical members, which comprises a segmental contractable die member formed of a plurality of segments positioned around an axis and formed to come together as a complete cylinder when in contracted position, means for contracting said segments, an axially extending cylindrical pocket formed into said segmental die member from one end thereof exterior thread forming means carried by the side wall of said pocket and moveable with respect thereto a mated expandable segmental die member axially positioned with respect to said segmental contractable die member, said expandable die member being formed with an exterior cylindrical surface, interior thread forming means carried by said exterior cylindrical surface and moveable with respect thereto, said die members adapted to be positioned in telescoping relationship with a cylindrical wall positioned between said interior thread forming means and said exterior thread forming means, means for contracting said exterior thread forming means and means for expanding
ing said interior thread forming means so that said interior thread forming means and said exterior thread forming means lie in radially overlapping relationship and the cylindrical wall positioned therebetween is worked into a thread formation extending exteriorly and interiorly 5 with respect to the unthreaded cylindrical form of said wall.

9. Apparatus as in claim 7, said outer and inner thread forming means being open helixes each having a plurality of turns.

References Cited
UNITED STATES PATENTS
2,254,924 9/1941 Williams ................ 113—116
2,320,435 6/1943 Hood .................... 72—393
2,442,965 6/1948 Thomas ................. 72—393

CHARLES W. LANHAM, Primary Examiner.
RICHARD J. HERBST, Examiner.