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METHOD AND APPARATUS FOR FORMING THREADED ARTICLES

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Fig. 1

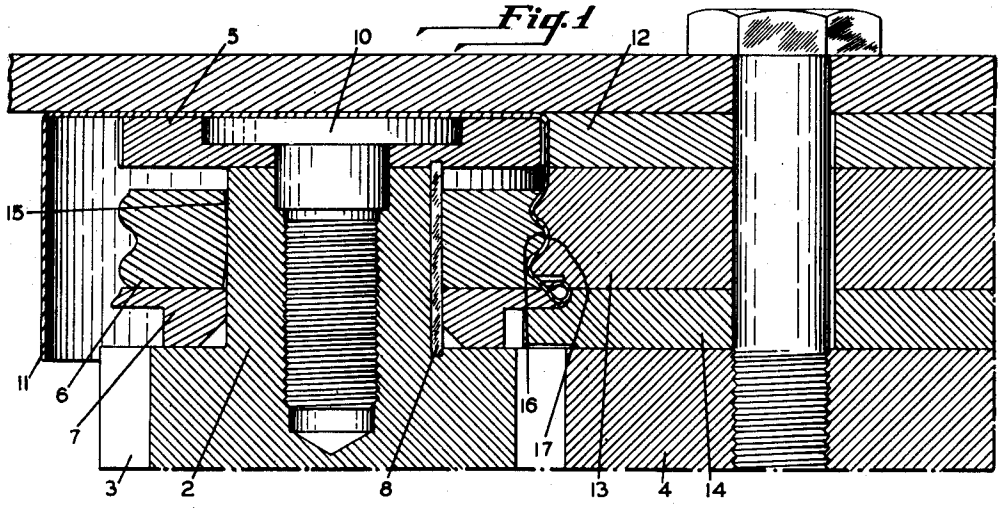


Fig. 2

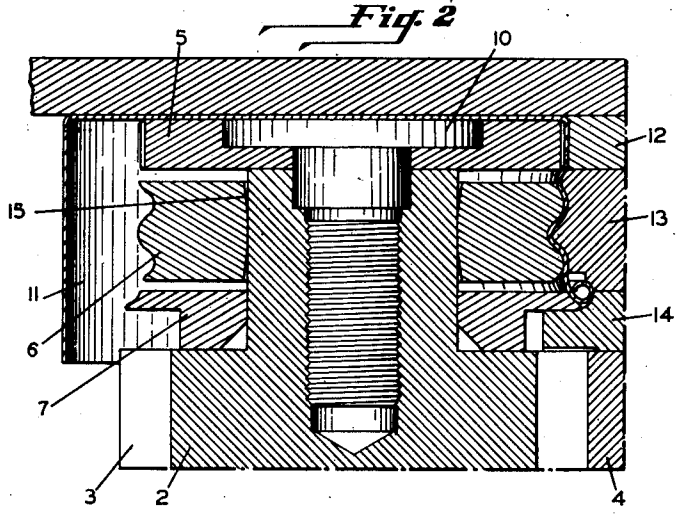
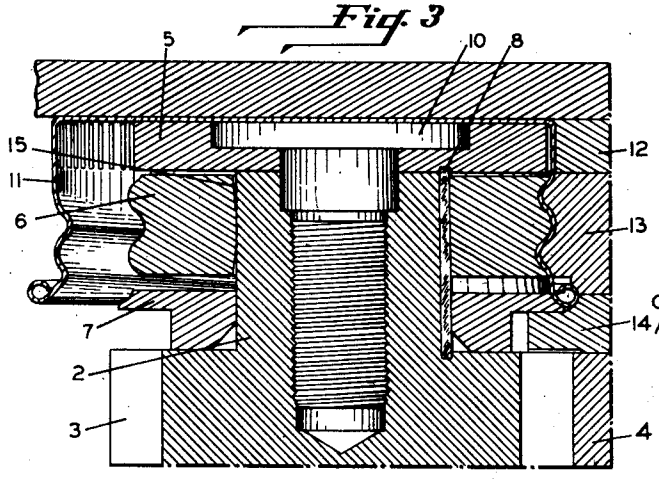


Fig. 3



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Fig. 4

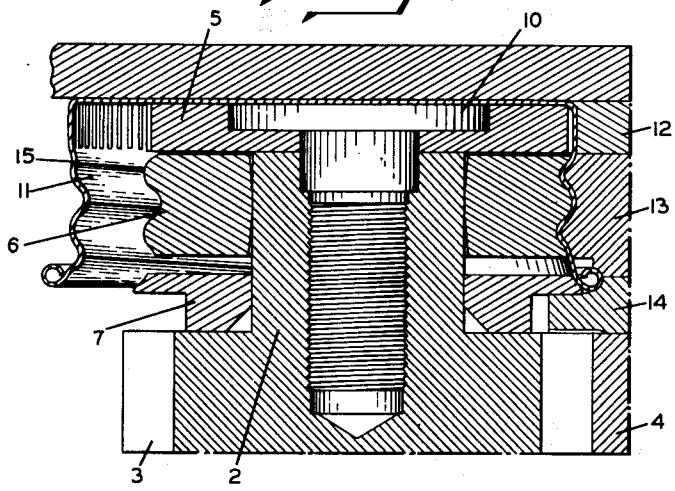


Fig. 5

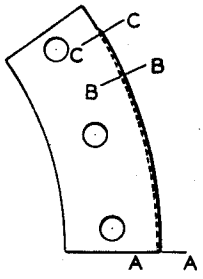


Fig. 6

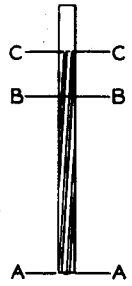


Fig. 7



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METHOD AND APPARATUS FOR FORMING THREADED ARTICLES

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Application September 28, 1950, Serial No. 187,266

6 Claims. (Cl. 153—71)

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This invention relates to a thread-forming device and more particularly to a device for forming threads on metal objects such as screw closures for bottles and the like.

In the manufacture of threaded metal closures, it has been common practice to produce the same on threading machines which roll the closure skirt between internal and external tools to form the thread on the closure.

In a machine of this type, the metal blank from which the cap is to be formed is placed on a mandrel. The mandrel is comprised of a plurality of tools of the proper configuration to form the interior of the metal blank to the desired shape. The actual formation of the metal blank is accomplished by rotating the mandrel with the metal blank positioned thereon in the proximity of an external forming tool in such manner that the internal and external tools cooperate to form the metal blank to the desired shape.

In order to facilitate feeding the metal blanks to the mandrel and remove the same therefrom, the mandrel on which the metal blank is carried is of a diameter less than the diameter of the metal blank. It will be obvious to those skilled in the art that an arrangement of this type does not roll a truly helical thread on the blank being formed. The imperfect thread is formed by reason of the fact that the tool on the mandrel is of a smaller diameter than the metal blank on which the thread is being rolled. Therefore, the internal tool makes a complete revolution before the blank makes a complete revolution and, if a thread of the desired helix angle is machined on the mandrel tool, the finished article will not have a thread of a uniform helix angle. This irregularity results in a finished product having a flat portion in the thread, or a portion in which the thread does not have the same helix angle as the remainder of the thread. When closures having a thread as described above are applied to a bottle, the threads on the closure do not correspond to the threads on the bottle, and an imperfect seal results. Even though the seal obtained with such closures is satisfactory in most instances, there is need for a better seal.

In order to overcome the disadvantages of the prior art apparatus and method of threading metal objects, we have developed a device in which the external tool has a thread of the same pitch and the same helix angle as that desired on the article being threaded, and the threaded portion of the internal tool is machined with a thread of the same pitch as the external tool but with a greater helix angle. The threaded portion of the

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internal tool is positioned on the mandrel in such manner that it is free to move in a direction parallel to the longitudinal axis of the mandrel while the threading operation is being performed.

An object of this invention is to provide a method of forming metal closures having a rolled-on thread in which the entire thread has the same helix angle.

Another object of this invention is to provide a thread-rolling die in which the thread-rolling portion of the internal tool is free to move in a direction parallel to the axis of the article on which the thread is being rolled so as to provide a closure having a screw thread with a uniform helix angle.

In order that our invention may be more readily understood, it will be described in connection with the attached drawing in which:

Figure 1 is a cross-sectional view of a thread-rolling device showing the position of the tools at the start of the thread-rolling operation;

Figure 2 is a view similar to Figure 1 showing the position of the tools after the internal tool has made one-half revolution;

Figure 3 is a view similar to Figure 1 showing the internal tool after it has made one complete revolution;

Figure 4 is a view similar to Figure 1 showing the position of the internal tool after the cap has made one complete revolution;

Figure 5 is a top plan view of the stationary die segment;

Figure 6 is an elevational view of the stationary die segment; and

Figure 7 is an elevational view of the internal threading tool.

Referring to Figures 1 to 4 inclusive, there is shown a rotatable mandrel 2 carried by a conventional rotary threader such as disclosed in Merolle Patent 2,245,042. The mandrel 2 has a gear 3 which is in engagement with a stationary gear 4. The mandrel 2 is carried by a rotating spider (not shown) so that as the mandrel revolves with the spider, the stationary gear 4 causes the mandrel 2 to rotate. A set of internal forming tools is carried by the mandrel. This set comprises a knurling tool 5, a threading tool 6, and a beading tool 7. These tools are keyed to the mandrel 2 by a key 8 which fits in a key-way in the mandrel and complementary key-ways in the tools. The knurling tool is secured to the mandrel by means of a screw 10 which is in threaded engagement with the end of the mandrel. The closure blank 11 is carried on the mandrel in such position that the internal tools

engage the inside surface of the skirt of the blank. It will be noted that the blank is of a larger diameter than the internal tools **5**, **6**, and **7** so that the blank can be readily placed on the mandrel and removed from the mandrel without necessity of performing an unscrewing operation.

Positioned on the stationary part of the machine along the path of travel of the moving mandrel is a set of stationary die segments which cooperate with the internal tools **5**, **6**, and **7** to form the blank to the proper configuration. These segments comprise a knurling segment **12**, a thread forming segment **13**, and a beading segment **14**.

The internal mandrel threading tool **6** is designed so that it does not entirely fill the space between the knurling tool **5** and the beading tool **7**. This leaves the tool **6** free to move in a direction parallel to the longitudinal axis of the mandrel **2** and parallel to the central axis of the blank **11** being formed. The relative position of the threading tool **6** with respect to the other tools is shown in Figures 1, 2, 3, and 4 as the threading operation progresses. Figure 1 shows the threading tool **6** in engagement with the beading tool **7** at the start of the threading operation. As the threading operation progresses, the threading tool moves away from the beading tool **7** toward the knurling tool **5**. Figure 2 shows its relative position after the threading tool **6** has made one-half revolution. Figure 3 shows the position of the threading tool **6** after it has made one complete revolution. However, it will be borne in mind that, inasmuch as the threading tool **6** is of a diameter less than the diameter of the blank **11**, the blank has not made a complete revolution at the time the threading tool has completed a revolution. Figure 4 shows the position of the threading tool **6** after the blank **11** has made one complete revolution. It will be noted that the threading tool **6** is practically in engagement with the knurling tool **5** in Figure 4. While the threading tool **6** is free to move along the shaft of the mandrel **2**, it is keyed thereto so that it rotates with the mandrel. In order to facilitate sliding action of the tool **6** along the mandrel **2**, the bore of the threading tool **6** is curved or chamfered as shown at **15** so that the tool can actually rock to a slight extent as well as slide on the mandrel to insure that the screw thread projection **16** on the threading tool **6** will always conform with its complementary screw thread recess **17** in the die segment **13**.

In order to roll a true thread on the blank, the external or stationary die segment **13** is provided with a thread of the desired helix angle and pitch. This die segment is shown in Figures 5 and 6 with the proper thread machined thereon. The internal threading tool **6** has a thread which is of the same pitch but of a different helix angle than the stationary die segment **13**.

In order to roll a thread having a uniform helix angle throughout on a blank, the external die segment **13** is provided with a thread of the desired helix angle and pitch. In the case of the external tool for a rotary threading machine such as the one here under consideration, this thread is machined on a die segment as shown in Figure 6. The thread in Figure 6 is a development of the thread desired in the closure. The portion of the tool between lines A—A and B—B is equal to the circumference of the cap, and the portion between lines B—B and C—C is an overlap.

The internal tool shown in Figure 7 is of a diameter less than the diameter of the metal blank being formed; and, therefore, in order to have a thread of the same pitch, the helix angle of the thread must be greater than the helix angle of the thread on the external tool.

As an example, in a 24 mm. diameter closure having an 8-pitch thread, the external tool shown in Figures 5 and 6 is made with the distance between lines A—A and C—C being equal to the outer circumference of the skirt of a 28 mm. diameter closure. The 8-pitch thread is machined on the tool. For a tool of this size, the helix angle of the pitch line of the thread is 2°—29′—46″.

The internal tool shown in Figure 7 for a 24 mm. diameter cap is 21.681 mm. in diameter. Therefore, in order to machine an 8-pitch thread on this smaller diameter tool, the helix angle must be greater than the helix angle of the thread to be formed on the metal blank. In matching the internal tool for producing 24 mm. closures, the helix angle of the pitch line of the thread is 2°—44′—10″. From this it will be observed that the helix angle of the pitch line of the thread on the internal tool is 14′—24″ greater than the helix angle of the pitch line of the thread on the external tool.

In an arrangement of this kind, it will be obvious to those skilled in the art that, in order to have the internal tool **6** mesh with the external tool **13** during the thread-rolling operation, it is essential that the internal tool **6** be free to move in a direction parallel to the longitudinal central axis of the mandrel on which it is carried. The distance the internal tool moves axially during the thread-rolling operation is determined by the length of the helical thread being formed on the closure blank. In the case of the 24 mm. closure here being described, this axial movement is in the neighborhood of .020″.

The above description is directed to the tools used in producing metal screw closures on so-called rotary threaders; however, it will be understood that the same principle can be used on any other type threaders in which a thread is rolled on the skirt of a metal blank, such as, for example, the "Bliss" type threaders currently used in which the metal blank is rolled between two rotating tools. The metal blank is placed on one rotating tool, while the other rotating tool engages the exterior of the blank. In utilizing our invention on a device of this type the external rotary tool would be machined to the same diameter as the metal blank and would carry a thread of the same pitch and helix angle as that desired on the finished closure. The internal tool would be machined to the same dimension as the one described in connection with the rotary threader.

This invention is particularly suited for the manufacture of relatively small diameter closures, inasmuch as the error in the helix angle is much more pronounced in the smaller closures. As the diameter of the closure increases, the error in the helix angle is less pronounced due to the fact that the percentage of difference between the diameter of the internal tool and the metal blank is less.

It will be observed from the above description that we have developed a machine for threading metal objects which overcomes the disadvantage which has been present in the prior art machines. This is accomplished by utilizing tools which are easy to make and which may be operated at the high speeds currently used in this manufacturing operation.

We claim:

1. In a device for rolling a thread on metal articles, a pair of cooperating threading tools and a mandrel for supporting the article to be threaded in such position that the cooperating tools engage the portion of the article to be threaded, one of said cooperating threading tools being carried by the mandrel, said mandrel-carried tool being of a diameter less than the diameter of the article to be threaded and having a thread of the same pitch but of a different helix angle from the thread on the other threading tool, said mandrel-supported tool being keyed to the mandrel for rotation therewith and being free to move in a direction parallel to the longitudinal axis of the mandrel.

2. In a device for rolling a thread on metal articles, a pair of cooperating threading tools, one of said threading tools having a thread of the same pitch and helix angle as that desired on the article to be threaded, and the other tool being of a diameter less than the diameter of the article to be threaded and carrying a thread of the same pitch but a helix angle different from that desired on the article, and means for supporting the article to be threaded so that the portion to be threaded will be positioned between the two cooperating tools, said second-mentioned tool being free to move in the direction parallel to the central axis of the article while the thread-rolling operation is being performed.

3. In a device for rolling a thread on metal articles, a pair of cooperating threading tools and means for supporting the article with the portion to be threaded disposed between the two cooperating threading tools, one of said threading tools carrying a thread of the same pitch and helix angle as that desired on the article, and the other tool being of a diameter less than the diameter of the article to be threaded and carrying a thread of the same pitch but a helix angle different from that desired on the article, said latter tool being mounted for limited movement in a direction parallel to the central axis of the article.

4. In a device for rolling a thread on metal articles, a pair of cooperating threading tools and a mandrel carrying one of said cooperating tools, said mandrel supporting the article in such manner that the portion to be threaded is disposed between the two cooperating threading tools, the tool carried by said mandrel being of a diameter less than the article to be threaded and having a thread of the same pitch but of a helix angle different from that desired on the article, the other tool carrying a thread of the same pitch and helix angle as that desired on the article, said mandrel-carrying tool being mounted for axial movement with respect to the other threading tool.

5. In a device of the class described, the elements comprising a rotating internal threading tool carried by a mandrel and a cooperating stationary threading tool, said mandrel supporting the article to be threaded in such position that a portion of the article is disposed between the two cooperating threading tools, said rotating internal threading tool having a thread machined thereon which is of the same pitch but of a different helix angle than that of the thread desired on the article, said rotating threading tool being of a diameter less than the diameter of the article, and said stationary threading tool having a thread thereon which is of the same pitch and helix angle as that desired on the article, said mandrel-carrying tool being mounted for axial movement with respect to the other threading tool.

6. In a method of threading metal articles, the steps comprising placing the article to be threaded over an axially movable internal spirally threaded threading tool which has a diameter substantially less than the interior diameter of the article to be threaded in such manner that only a minor portion of the inner circumference of the article is in engagement with the internal threading tool, bringing the internal threading tool into juxtaposition with an external threading tool having threads of different helix angles with the portion of the article to be threaded positioned between the threading members and producing relative rotary movement between the threading tools, a resultant rotation of the article, and movement of the internal threading member relative to said external threading member axially in a plane parallel with the axis of the external threading member.

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