Seamless metal bottles, for example aerosol bottles, can be manufactured by first producing by impact extrusion a cup-shaped hollow body in which that end which provides the bottle opening is brought into the form of a bottle neck by drawing it in or reducing it, the neck being headed if required. Basically, this method does not offer any difficulties. However, difficulties arise when, for example, the metal bottles are to be lacquered inside and printed on the outside.

The procedure previously adopted has been first to finish-shape the bottles and then carry out the necessary washing, internal lacquering and printing. In this case, however, owing to the reduced bottle neck, both the necessary washing to remove grease remnants, the internal lacquering and the printing are difficult. It is not possible in this case to adopt the procedure used with tubes, which are simply pushed on to a cylindrical mandrel and printed, but a complicated off set mandrel or pierres which hold the cans at the valve seat, as well as a supporting part applied against the base of the bottle, are required as abutments. In this way, plants operating fully automatically become complicated and susceptible to breakdowns so that the working rate is impaired.

Moreover, it is not readily possible to lacquer the bottles at the rounded portion, i.e., the drawn-in shoulder. This must be done either with separate shaped rolls or by subsequently spraying the rounded portion, it being necessary to proceed very carefully so that the beaded bottle neck serving as a seal is not covered and sprayed with paint in addition. Furthermore, it is not possible to have the neck on the drawn-in shoulder and, therefore, this has heretofore had to be left bare or only lacquered in a single colour.

Printing on the cup-shaped body before the final shaping has not previously been readily possible, as the tools customarily employed for drawing in the bottle neck and bending result in frictional heating of the bottle neck so that the lacquer is damaged. Moreover, there is a danger that the lacquer of the printed bottles will be damaged or scratched when they are conveyed from one treatment position to the other during the shaping process.

The object of the invention is to provide a method of producing seamless metal bottles, more particularly aerosol bottles, in which a cup-shaped hollow body preferably produced by impact extrusion is brought into bottle shape by drawing in that end which contains the opening and is also lacquered and/or printed, and in which the foregoing problems do not arise.

According to one feature of the invention, a cup-shaped hollow body is first lacquered and/or printed on, then that end which provides the opening is drawn in in several stages by means of rectilinearly moved shaping elements and, if required, the base is rendered convex and, finally, the formed bottle neck is cut to length and beaded by means of tools which are also moved rectilinearly.

Another object of the invention is to provide a method by which the shaping of the hollow bodies, namely both the shaping of the but end which contains the opening and the shaping of the base, can be effected in a simple and economic manner, as well as the provision of an apparatus for carrying the method into effect.

According to another feature of the invention, the cup-shaped hollow body is introduced for further shaping into a workpiece holder, receiving it in a vertical position, whereupon the base of the hollow body is then rendered convex in the open workpiece holder by means of a shaping element and, finally, the hollow body is clamped by closing the workpiece holder and held by the latter until its shaping is complete. In this way, the finish-shaping of the hollow body can be effected without the necessity of intermediate conveyance between different workpiece holders.

According to a further feature of the invention, apparatus for carrying the method of the invention into effect has two horizontally disposed carrying plates which are arranged coaxially in a relatively rotatable manner and are also adapted to be moved rectilinearly one towards the other, the upper one of said carrying plates serving to accommodate the tools and the lower one to accommodate workpiece holders receiving the workpieces.

Preferably, each of the workpiece holders arranged on the lower carrying plate contains a shaping element rendering the base of the hollow body convex and a clamping device which engages the hollow body at its periphery and is closed only after the base has been rendered convex.

It is advantageous to provide a plurality of similar tools for each stage of the treatment in order the purpose of working on a plurality of workpieces simultaneously.

An example of embodiment of the invention is described in detail hereinafter, by way of example, with reference to the accompanying drawings, in which:

FIGURE 1 is a diagrammatic side view of an apparatus according to the invention,

FIGURE 2a is a detail view of one of the shaping tools used for the drawing-in process,

FIGURES 2b and 2e illustrate the hollow body to be shaped before working (c) and after working (b) with the shaping tool of FIGURE 2a.

FIGURE 3 shows a holding device for receiving the workpieces during the various treating or working operations, FIGURE 3a showing the hollow body inserted, but not clamped, and FIGURE 3b showing the hollow body clamped after the base thereof has been shaped.

FIGURE 4a is a detail view of the tool for effecting bending of the bottle neck,

FIGURES 4b to 4e show the shaping of the bottle neck during the individual stages of the bending process,

FIGURE 5 illustrates diagrammatically the interchangeable method of fixing a carrying plate accommodating the tool holders, and

FIGURES 6a, 6b, and 6c show a device for cutting the bottle neck in side view, longitudinal section and during the cutting operation.

In FIGURE 1, the reference 10 designates a carrying plate which accommodates a workpiece holder 11 and is adapted to be rotated by means of a motor 12 and worm gearing 13. A plurality of workpiece holders 11 is arranged, evenly distributed, on the carrying plate 10 and to them there are fed in any known manner the hollow bodies 14 which, for example, are produced in an impact extrusion press and then degreased and lacquered and/or printed.

The workpiece holders 11 are arranged, evenly distributed, substantially at the periphery of the carrying plate 10, and they hold the individual workpieces 14 until the latter have been finally shaped.

The carrying plate 10 is adapted to be indexed by means of the motor 12 and the toothed wheel gearing 13 in each instance through an angle corresponding to the spacing of the workpiece holders 11. After each indexing movement, the carrying plate 10 is fixed by means of centering devices (not shown).

Above the carrying plate 10 there is arranged coaxially therewith a carrying plate 15 on which the diagram-
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Mattematically illustrated tools 16 are mounted. On the carrying plate 15 there is arranged a motor 17 which is designed to drive a cutting or milling device 18 which effects cutting of the bottle neck to a certain length. The carrying plate 15 with the clamped tools 16 and the motor 17 is mounted interchangeably on a support 19. Devices are provided for ensuring accurate central fixing of the carrying plate 15 on the support 19.

The support 19 is connected to a piston rod 20 which is moved up and down by means of a piston 21 of a hydraulic press 22.

The apparatus operates in the following manner. The workpieces 14 are fed to the apparatus at one point as cup-shaped hollow bodies. Thus, at this point, a cup 14 is inserted in each instance in that workpiece holder 11 which happens to be located at said point. The carrying plate 15 is therupon moved towards the carrying plate 10 by means of the hydraulic press 22, whereby the tools 16 come into contact with the workpieces 14. FIGURE 3a and 3b show a workpiece holder 11 to a larger scale. The workpiece holder contains a shaping element 23 in which the hollow body 14 is placed. Furthermore, a clamping device 24 is provided which is not closed until after the first stage of the treatment, that is when the cup 14 is to be used. The hollow body 14 has been removed upwardly convex by axial pressure against the shaping element 23. The shaping element 23 is formed with a conical lead in so that, despite the fact that the clamping device 24 is still open, the hollow body 14 is not forced off-centre of the workpiece holder.

The drawing-in or reducing tools 16 consist of dies by which the upper end of the cup 14 providing the opening thereof is gradually shaped in a plurality of stages into a bottle neck. After lowering of the carrying plate 15 on to the workpieces 14, it is raised again and the carrying plate 10 is unlocked and rotated by one indexing division or space, so that a particular workpiece 14 comes into contact with the tool provided for the next stage of the treatment when the tool carrier 16 is next lowered.

FIGURE 2a shows such a tool. It contains a shaping element 25 and a central mandrel 26, against which elements the bottle neck is pressed. FIGURE 2a shows a hollow body 14 before shaping and FIGURE 2b after shaping by the tool of FIGURE 2a. Those surfaces of the mandrel 26 and of the shaping element 25 of the rectilinearly moved tool which come into contact with the hollow body 14 are made smooth so that the friction on the hollow body is slight and the adhering lacquer is not damaged.

Preferably, a plurality of tools is provided for each stage of the treatment, so that a plurality of workpieces can be operated on simultaneously. In this way, productivity can be raised without increasing the working rate. This is particularly important, since a high working rate must be avoided if the workpieces 14 are not to be shaped inaccurately or the lacquer thereon damaged.

After the bottle neck has been drawn in, it is cut to a predetermined length by means of a tool 18 driven by the motor 17 (FIGURES 1 and 6). The cutting tool 18 comprises a milling cutter 31 and a rotary guide 32 which is moved only rectilinearly with respect to the bottle neck 29 after it has been introduced, so that relatively slight friction occurs at the bottle neck 29 and the protective internal lacquer adhering to the neck is not damaged. The spindle 33 carrying the milling cutter has a reduced diameter part 36 at its lower end and carries the cylindrical guide 32 which is easily rotatable on a ball bearing 34.

A packing 35 provided on the guide 32 prevents cuttings reaching the inside of the bottle, which cuttings, if the bottle is to be used as an animal bottle, could later block the valve and make the bottle unusable. On the upward movement of the tool 18 after the cutting operation, the cuttings contained in the space 37 are brought out of the bottle neck by the packing 35. After the packing 35 has left the bottle neck, it gradually assumes the speed of the spindle 33, whereby the cuttings are thrown outwardly by centrifugal force. Preferably, a suction device (not shown) is provided which carries the cuttings away.

The bottle neck, which has now been cut, is headed by means of a device 27 also held by the carrying plate 15 and illustrated separately in FIGURE 4. This device likewise performs only rectilinear movements and shapes the bottle neck as shown in FIGURES 4b to 4e. The surface 28 which contacts the bottle neck is so machined that it produces relatively slight friction and the lacquer adhering to the bottle neck 29 is not damaged.

After a revolution of the carrying plate 10, the finish shaped bottle 14 is removed in any known manner from the workpiece holder 11 on which it is mounted. Preferably, after the finished bottles 14 have been removed, they are delivered directly to a packing machine in which a plurality of bottles lying one behind the other are wrapped in paper, so that they form together a roll having a length corresponding to the number of bottles contained therein. These separate rolls can be packed in simple manner in cartons or the like so that division of the cartons into compartments which has previously been customary is avoided.

As an alternative to the hydraulic press illustrated in the drawings, a press of another type, for example a mechanical press, can if desired be employed to move the tool carrier 16.

In order to enable the apparatus to be changed over rapidly to hollow bodies of different diameters, the carrying plate 15 for the tools 16 is preferably mounted interchangeably on the support 19 of the press 22, as shown in FIGURE 5. The exact position of the carrying plate 15 is ensured by means of guide pins 29, and fixing is effected by means of screws 30.

We claim:

1. A method of making a seamless container having a body portion of uniform diameter and a neck portion of substantially reduced diameter comprising the steps of:
   (a) forming by extrusion a seamless uniform diameter tubular member open at one end thereof and closed at the other end thereof,
   (b) applying a protective coating to the tubular member, said coating being applied at least to the outer surface of said tubular member,
   (c) placing the coated tubular member in a holder in axial alignment with the axis of shaping tools to be applied to said member, with said open end facing the shaping tools,
   (d) moving shaping tools solely in a direction parallel to the axis thereof into contact with the open end of the tubular member to substantially reduce the diameter at said open end, said diameter reducing step being performed exclusively by tools moving in said direction parallel to the axis of said tubular member.

2. A method of making a seamless container having a body portion of uniform diameter and a neck portion of substantially reduced diameter comprising the steps of:
   (a) forming by extrusion a seamless uniform diameter tubular member open at one end thereof and closed at the other end thereof,
   (b) applying a protective coating to the tubular member, said coating being applied at least to the outer surface of said tubular member,
   (c) placing the coated tubular member in a holder in axial alignment with the axis of shaping tools to be applied to said member, with said open end facing the shaping tools,
   (d) applying axial pressure to said closed end against a said shaping element to render said closed end upwardly convex,
   (e) clamping said tubular member in said holder to prevent relative axial movement thereof, and
   (f) moving shaping tools solely in a direction parallel...
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5 to the axis thereof into contact with the open end of the tubular member to substantially reduce the diameter at said open end, said diameter reducing step being performed exclusively by tools moving in said direction parallel to the axis of said tubular member.

3. A method of making a seamless container having a body portion of uniform diameter and a neck portion of substantially reduced diameter comprising the steps of:

(a) forming by extrusion a seamless uniform diameter tubular member open at one end thereof and closed at the other end thereof,

(b) applying a protective coating to the tubular member, said coating being applied at least to the outer surface of said tubular member,

(c) placing the coated tubular member in a holder in axial alignment with the axis of shaping tools to be applied to said member, with said open end facing the shaping tools,

(d) moving shaping tools solely in a direction parallel to the axis thereof into contact with the open end of the tubular member to substantially reduce the diameter at said open end, said diameter reducing step being performed exclusively by tools moving in said direction parallel to the axis of said tubular member.

(e) moving a cutter carrying guide towards the said tubular member solely in a direction parallel to the axis thereof into said reduced diameter open end, (f) rotating said cutter to cut said reduced diameter open end to a predetermined length.

4. A method of making a seamless container having a body portion of uniform diameter and a neck portion of substantially reduced diameter comprising the steps of:

(a) forming by extrusion a seamless uniform diameter tubular member open at one end thereof and closed at the other end thereof,

(b) applying a protective coating to the tubular member, said coating being applied at least to the outer surface of said tubular member,

(c) placing the coated tubular member in a holder in axial alignment with the axis of shaping tools to be applied to said member, with said open end facing the shaping tools,

(d) moving a first shaping tool into contact with the open end of the tubular member to substantially reduce the diameter at said open end,

(e) moving a second shaping tool solely in a direction parallel to the axis thereof into contact with the open end of the tubular member to substantially reduce the diameter at said open end, said beading step being performed exclusively by tools moving in a direction parallel to the axis of said tubular member.

7. A method of making a seamless container having a body portion of uniform diameter and a neck portion of substantially reduced diameter comprising the steps of:

(a) forming by extrusion a seamless uniform diameter tubular member open at one end thereof and closed at the other end thereof,

(b) applying a protective coating to the tubular member, said coating being applied at least to the outer surface of said tubular member,

(c) placing the coated tubular member in a holder in axial alignment with the axis of shaping tools to be applied to said member, with said open end facing the shaping tools,

(d) moving shaping tools solely in a direction parallel to the axis thereof into contact with the open end of the tubular member to substantially reduce the diameter at said open end, said beading step being performed exclusively by tools moving in a direction parallel to the axis of said tubular member.
(f) moving shaping tools solely in a direction parallel to the axis thereof into contact with the open end of the tubular member to substantially reduce the diameter at said open end, said diameter reducing step being performed exclusively by tools moving in said direction parallel to the axis of said tubular member,

(g) moving a second shaping tool solely in a direction parallel to the axis thereof into contact with the open end of the tubular member to bead the edge of said reduced diameter open end, said beading step being performed exclusively by tools moving in a direction parallel to the axis of said tubular member.

9. A method of making a seamless container having a body portion of uniform diameter and a neck portion of substantially reduced diameter comprising the steps of:

(a) forming by extrusion a seamless uniform diameter tubular member open at one end thereof and closed at the other end thereof,

(b) applying a protective coating to the tubular member, said coating being applied at least to the outer surface of said tubular member,

(c) placing the coated tubular member in a holder in axial alignment with the axis of shaping tools to be applied to said member, with said open end facing the shaping tools,

(d) moving shaping tools solely in a direction parallel to the axis thereof into contact with the open end of the tubular member to substantially reduce the diameter at said open end, said diameter reducing step being performed exclusively by tools moving in said direction parallel to the axis of said tubular member,

(e) moving a cutter carrying guide towards the said tubular member solely in a direction parallel to the axis thereof into said reduced diameter open end,

(f) rotating said cutter to cut said reduced diameter open end to a predetermined length,

(g) moving a second shaping tool solely in a direction parallel to the axis thereof into contact with the open end of the tubular member to bead the edge of said reduced diameter open end, said beading step being performed exclusively by tools moving in a direction parallel to the axis of said tubular member.

10. Apparatus for making seamless metal containers having a body portion of uniform diameter and a neck portion of substantially reduced diameter comprising:

(a) a first carrier disk provided with a plurality of circumferentially spaced means for holding, in vertical disposition, a uniform diameter tubular member which is closed at its bottom end and open at its top end,

(b) said holding means including a shaping part which confronts and is designed to shape the closed bottom of the tubular member into a configuration complementary to that of the shaping part upon the application of pressure applied axially of the tubular member,

(c) and said holding means also including a clamping means for holding the tubular member exteriorly thereof,

(d) a second carrier disk provided with a plurality of circumferentially spaced tools, said second carrier disk being disposed above said first carrier disk and being mounted for downward rectilinear movement toward said first carrier disk whereby the tools on said second carrier disk move downward upon said tubular members in a direction parallel to the axis of said tubular members,

(e) one of said tools in said second carrier being a milling cutter for cutting the open end of the tubular member, said milling cutter having a rotary guide with a packing for engagement with the inside wall of the tubular member.

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