

The invention relates to a method and an apparatus according to the preambles of the corresponding independent claims for the manufacture of aluminium cans having threads, particularly deep-drawn, deep-drawn and ironed or extruded, internally and externally varnished aluminium cans with a bottle thread, such as is known e.g. from GB-A-1445758.

It is in accordance with the prior art to shape flat, round aluminium portions by drawing to cylindrical cans, to externally and internally varnish the same and then narrow the can opening by drawing in and flanging and making same ready for the fitting of a closure. Such cans are e.g. further processed to aerosol monoblock cans. The varnishing and in particular the printing on of inscriptions or decorative patterns prior to drawing in is advantageous, because the varnish can only be rolled onto cylindrical cans. Even internally, where the varnish is sprayed on, this is easier on the still cylindrical can.

The varnishing of the inside of aluminium containers is necessary for all those uses in which a bare aluminium surface would be attacked by the content of the can. Wherever during the use and storage process the can content comes into contact with the inner surface of the can, it is important for the internal varnish to cover in a completely uninterrupted manner the aluminium surface.

For the methods for the manufacture of varnished aluminium cans according to the prior art, varnishes have been developed, which are so adhesive, elastic and slidable, that cylindrical, varnished aluminium cans can be drawn in in bottle-like manner without the varnish being damaged.

As aluminium is a good and inexpensively recyclable packaging material, it would be appropriate and desirable if containers could be made from aluminium onto which could be screwed, in the same way as plastic or glass bottles, e.g. a hand pump with a riser or a screw cover. The aluminium container could e.g. be filled and marketed closed by means of the screw cover. The pump, designed for multiple use, would merely have to be screwed onto and then unscrewed from the aluminium container by the consumer and said container, without extraneous material, could be supplied for recycling or

alternatively refilled. For this purpose it would be advantageous to have aluminium cans with corresponding threads, advantageously standardized threads.

The set problem is consequently to provide a method and an apparatus making it possible to apply to aluminium cans, particularly those varnished on the inside and outside, a thread, especially a standardized thread. It is particularly important that the varnish and more especially the internal varnish, is not damaged by the application of the thread, because during the use of such a can the thread would internally be in contact with the content of the can. The method and apparatus must be integratable into known production lines for the production of deep-drawn, deep-drawn and ironed or extruded, varnished aluminium cans, i.e. the thread must be manufacturable in the same fixing in which the other working steps such as drawing in the neck, cutting to length the can, etc. are performed and specifically in a cycle time of approximately 0.3 to 0.6 sec and an effective working or machining time of 0.035 to 0.07 sec. Following the application of the thread there must be no need to clean the cans, i.e. either the method and apparatus avoid the addition of any lubricant, or a lubricant is used, which neither impairs the can content, nor the appearance of the can.

This problem is solved by the method and apparatus according to the independent claims. Variants are disclosed by the dependent claims.

Reference will now be made to the most important features of the method according to the invention. The thread is produced by a tool rolling on the external neck side and a quasi-stationary tool supporting the can material from the inside and located on the inside of the neck. The two tools operate in forcibly controlled manner in such a way that a slit occurs between the neck and the tool. This largely prevents any accumulation of neck material upstream of the tools and is displaced in the tool movement direction, which would lead to oval threads and would stress and damage the varnish to a considerable extent.

The method and apparatus according to the invention, as well as the aluminium can manufactured by the method are described in greater detail hereinafter

relative to the drawings, wherein show:

- Fig. 1 A diagrammatic overall view of the individual method steps of the method according to the invention.
- Figs. 2a A detail representation of the method step of thread rolling
and b in the form of a plan view of the can and the tools used before
 (fig. 2a) and during (fig. 2b) thread rolling.
- Figs. 3a Like figs. 2a and 2b, but as a section along the can rotation
and b axis.
- Fig. 4 A diagrammatic representation of an exemplified embodiment of the apparatus according to the invention along the rotation axis of the can to be machined.
- Fig. 5 An aluminium can manufactured by the method according to the invention represented along its rotation axis.

Fig. 1 shows the method steps of the method according to the invention. It is represented in the form of a method block diagram and it is possible to diagrammatically see the shape changes on the can produced by the individual method steps, namely as a plan view and as a longitudinal section through the neck part of the can.

Cylindrical cans are manufactured from flat, usually round portions of a deep-drawable or extrudable aluminium alloy in known manner by deep-drawing, deep-drawing and additional ironing or by extrusion. The can wall thickness is max 20% of the pitch of the threads provided for the can.

Following the drawing, drawing and ironing or extrusion the cans are cleaned for removing the lubricant required during drawing. Then, in a first step A of the method according to the invention (varnishing) they are internally and externally varnished and optionally printed, whilst they still have a cylindrical shape. The varnishes used are e.g. polyester or epoxy phenolic varnishes. For increased flexibility, increased adhesiveness and better sliding

characteristics, they are mixed with one or more additives, known to the expert in the form of softeners, catalysts and lubricants. The equipment used for varnishing corresponds to known equipment, with which the internal varnish is applied by spraying and the external varnish with a corresponding roller. After varnishing the varnishes are correspondingly dried and polymerized.

For the following method step the cans are fixed to a rotary table, whose stepwise rotation passes them into the vicinity of successive tools, which are installed on a tool plate. A corresponding apparatus is e.g. described in Swiss patent 394,998/65 (Lechner) and is assumed to be known.

In the two following method steps B and C each can is drawn in stepwise, the two method steps, as a function of the diameter of the can, as a function of the desired can shape and as a function of the material, can consist of a random number of effective drawing in steps using different tools. During the first drawing in B the can is given a narrowing shoulder and a substantially cylindrical, first neck portion 10, during the second drawing in C on the first neck portion 10 is connected a second, narrower and substantially cylindrical neck portion 20. The external diameter d_1 of the first neck portion substantially corresponds to the external diameter of the thread to be produced and the external diameter d_2 of the second, narrower neck portion 20 is somewhat smaller than the minor diameter d_3 of the thread to be produced.

The shape of the drawn-in shoulder is not relevant for the method according to the invention. It is obviously also possible to have a can without a shoulder, i.e. to provide a substantially cylindrical can with a thread and in such a case method step B is avoided.

Methods and tools for drawing in aluminium cans are known to the expert. He can also adapt them for drawing in to the described neck shape, so that there is no need for a description thereof here.

In a following method step D onto the first neck portion 10 or onto the part of the first neck portion 10 facing the second neck portion 20 is rolled a

thread 30. The thread is produced by a thread roll, which is pressed against a quasi-stationary screw-pitch gauge in the interior of the neck. The thread is consequently pressed inwards from the outside of the neck, so that the external diameter of the rolled thread corresponds to the original neck diameter d_1 . Its minor diameter d_3 is somewhat larger than the external diameter d_2 of the second neck portion 20. The thread runs out against the second neck portion 20, i.e. it does not extend up to the neck edge, which ensures that the latter is not deformed from its precise circular cylindrical shape by the thread rolling operation.

The apparatus according to the invention used for method step D will be described in greater detail in conjunction with figs. 2, 3 and 4.

In a following method step E the can neck is cut to length, e.g. directly over the upper runout of the thread. If the can is to be used in conjunction with a hand pump, the connection between the neck edge and the pump connection must be tight. As a function of the seal used it can be advantageous to make the end face of the can neck straight or slightly sloping. Methods and apparatuses for cutting to length can neck are known and consequently do not need further description here.

In order to ensure a continuous, rapid and economic production, it is necessary to perform the method steps B, C, D and E with the same fixing of the can. Thus, the method steps must be dependent on a basic clock cycle given by a corresponding production machine. If the thread is to be rolled in such a cycle, this means that with the presently conventional production rate of between 100 and 200 cans per minute, for thread rolling purposes a cycle time is available between 0.6 and 0.3 seconds in which the can is moved to the corresponding location, the tools are brought into the working position and the thread is rolled. For the effective process of thread rolling there is a working time available between 0.035 and 0.07 sec.

Figs. 2a and b show in plan view and in detail the method and the tools used for rolling the thread. Fig. 2a shows the tools before the thread rolling process and fig. 2b during said process.

All that can be seen of the can is the circular end face 21 of the second neck portion 20 with the external diameter d_2 and the first neck portion 10 with the external diameter d_1 . For the thread rolling process a substantially cylindrical or slightly frustum-shaped screw-pitch gauge 40 is introduced into the can neck. The largest diameter of the gauge is such that it can be introduced without difficulty through the second neck portion 20. On its lateral face the gauge carries a slightly distorted, negative image 41 of the thread to be rolled and which is indicated in broken line form in the present plan view. During the introduction process the can neck and gauge are positioned coaxially, i.e. their rotation axes S and T coincide.

Advantageously simultaneously with the introduction of the screw-pitch gauge into the can neck, outside the latter is positioned a thread roll 50, which is given a thread shape (in the form of a collar 51 drawn spirally round the roll) in such a way that it can roll the entire thread without having to be moved axially. During the introduction process the thread roll is spaced from the neck in such a way that it does not come into contact with the latter.

For the effective thread rolling process the gauge 40 and the thread roll 50 are so moved against one another by the displacement of their axes T and U that the gauge 40 comes into contact with the inner surface of the first neck portion at the point where the thread roll 50 is externally positioned and the thread shape 51 of the thread roll 50 is pressed into the neck material by the depth of the thread to be rolled. Simultaneously the thread roll 50 is rolled on the neck and therefore in coordinated manner the rotation axis of the gauge is so rotated about the rotation axis of the can that the gauge always engages on the neck and supports the neck material where the thread roll has just rolled.

In this closed state the two tools are moved at least once around the can neck and in this way the thread is produced. When the thread has been rolled the gauge 40 and thread roll 50 are again brought into the position described for introduction (fig. 2a) and are axially removed from the can.

During the rolling of the thread the thread roll 50 is so forcibly rolled

that the circumferential path rolled on the roll is larger than that rolled on the neck. Between the thread roll and neck this leads to a slip, so that although the thread roll rolls in a single direction over the neck circumference, it always slips in the opposite direction on the neck surface. As a result of this slip, which leads to a force counter to the movement direction of the thread roll 50 on the neck material, it is ensured that the roll does not accumulate the neck material upstream thereof and moves it in the rolling direction.

As the circumference of the screw-pitch gauge 40 is smaller than the internal circumference of the first neck portion 10 and which it has to support during the thread rolling process, a slip is formed between the gauge 40 and the inner surface of the first neck portion 10 in such a way that the gauge 40 slips on the neck inner surface in the movement direction of the thread roll 50.

As a result of this two-sided slip particularly advantageous method circumstances are obtained, which leads to the concentricity of the thread being ensured and to the can not being damaged by the varnishing operation. The sliding of the thread roll and the gauge leaves behind on the varnish tracks, which can be detected as slight surface modifications to the varnishing in the vicinity of the thread.

Corresponding to figs. 2a and 2b, figs. 3a and 3b show the tools used for the thread rolling process before (fig. 3a) and during (fig. 3b) said process, namely as a section along the can rotation axis, only one side of the can neck being shown. These drawings clearly show the designs of the screw-pitch gauge 40 and the thread shape 51 of the thread roll 50. The channels or threads 41 of the screw-pitch gauge need only correspond to the shape of the finished thread and regards the depth and pitch thereof, but where they come into contact with the shaped or deformed inner surface must not have sharp edges. However, the thread shape 51 of the thread roll 50 must correspond to the thread shape to be produced. Advantageously the screw-pitch gauge 40 is such that it not only supports the inner surface of the first neck portion 10, but at least partly also the inner surface of the second neck portion 20, although no thread is rolled thereon.

Fig. 4 diagrammatically shows the relevant parts for the invention of an apparatus for thread rolling on cans in the form of an exemplified embodiment. Fig. 4 is a section along the can rotation axis S. The two neck portions 10 and 20 of the can are visible. The screw-pitch gauge 40 and the thread roll 50 are in a position corresponding to the position thereof in figs. 2b and 3b. The axis T of the gauge 40 is not on the can rotation axis S and the thread roll 50 presses into the neck material.

It is more particularly possible to see the means 60 with the aid of which the slip is produced between the thread roll 50 and the can neck. These means are constituted by a gear rim 61, which is fitted to the shaft 42 of the gauge 40, and a second gear rim 62, running in the gear rim 61 and which is fitted to the thread roll 50. If the axis U of the thread roll 50 is now moved round the axis T of the gauge 40, the said thread roll rolls on the can neck forcibly guided by the tooth drive 60. As the rolling off radius r of the thread roll 50 on the can neck is smaller than the rolling radius R of the gear rim 61, a slip is formed between the thread roll 50 and the can neck in such a way that the thread roll 50 slides against its runoff direction on the neck material. It has proved advantageous to choose the two radii r and R in such a way that $R : r \geq 1.1$.

The drawing does not show the drives for the axial movement of the apparatus parts before and after the effective thread rolling process and for the rotary movement of the thread roll 50 around the can neck and the circular movement of the axis T coupled therewith. Advantageously for the axial movement use is made of the timed movement of the tool plate, on which the tools for the other method steps are installed. The circular movement of the thread roll is e.g. driven with a belt drive.

The coupling of the movement of the thread roll 50 and the axis T of the gauge 40, as well as the control of the relative movement of the two axes T and U before and after the effective thread rolling process can be achieved by corresponding, asymmetrical wedge or key arrangements, the relative movement of the two axes being brought about by a relative movement in the axial direction of said arrangements.

The movement of the axis T about the axis S can be brought about in such a way that the axis T describes a cylinder jacket about the axis S, or the axis T describes a cone around the axis S. For the case of the cylinder movement the gauge 40 must be cylindrical and for the case of the conical movement the gauge 40 must be frustum-shaped with a tapering end directed into the can.

Fig. 5 shows a can closed with a hand pump and to which a thread has been fitted by the method according to the invention. The thread can comply with any standard for such a thread, e.g. the European standard. It has been found that a thread produced according to the method of the invention has an accuracy of approximately ± 0.1 mm, which far exceeds the accuracy of corresponding plastic or glass threads. Therefore, as shown in fig. 5, there is no need to improve the centring of the screwed-down pump by a corresponding recess on the can neck end facing the shoulder. The shape of the can bottom is not relevant for the method according to the invention. The can shown e.g. has an inwardly curved bottom.

CLAIMS



1. Method for the manufacture of aluminium cans having a thread, particularly aluminium cans with a thread which are varnished on the inside and outside, by producing a cylindrical can by means of deep drawing, deep drawing and ironing or extruding, by varnishing the cylindrical can and subsequent drawing in, thread rolling and cutting to length, characterized in that the method steps drawing in, thread rolling and cutting to length are all performed with the same fixing of the can and that during the rolling of the thread the tools (40,50) are guided in such a way that a slip occurs between the tools (40,50) and the can material.
2. Method according to claim 1, characterized in that the thread is rolled between a screw-pitch gauge (40) positioned in the neck and a thread roll (50) rolling round the neck, the thread roll (50) pressing the neck material into the gauge (40) and the latter merely supports the neck.
3. Method according to claim 2, characterized in that the thread roll (50) is rolled in forcibly controlled manner around the neck so that a slip is produced between the neck material and the thread roll (50).
4. Method according to claim 3, characterized in that the thread roll (50) slides on the neck in opposition to its rolling direction.
5. Method according to any one of the claims 1 to 4, characterized in that a slip occurs during thread rolling between the gauge (40) and the inner surface of the neck.
6. Method according to claim 5, characterized in that the gauge (40) slides on the neck inner surface in the direction of the rolling movement of the thread roll (50).



7. Method according to any one of the preceding claims, characterized in that for varnishing cans use is made of varnishes modified by additives in such a way that they have an increased adhesiveness, increased flexibility and improved sliding characteristics.
8. Method according to claim 7, characterized in that the additives are catalysts, softeners and/or lubricants.
9. Method according to any one of the preceding claims, characterized in that prior to thread rolling the can is drawn in to at least one, substantially cylindrical neck portion (20) and that the external diameter of this neck portion essentially corresponds to the minor diameter of the thread to be rolled.
10. Apparatus for rolling threads on varnished aluminium cans according to the method of any one of the claims 1 to 9, characterized in that it has a screw-pitch gauge (40) for supporting the neck from the inside, a thread roll (50) for rolling the thread from the outside and that it also has control means coordinating the movement of the gauge (40) and the thread roll (50) and allowing the movements of the tools to take place in such a way that a slip is formed between the can neck and the tools.
11. Apparatus according to claim 10, characterized in that the control means for producing the slip comprise a gear rim (61) on the shaft (42) of the gauge (40) and a gear rim (62) on the thread roll (50) and that the rolling circle of the gear rim (61) on the shaft (42) of the gauge (40) is larger than the rolling circle of the thread roll (50) on the can neck.



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12. Apparatus according to claim 11, characterized in that the radius (R) of the rolling circle of the gear rim (61) towards the rolling radius (r) of the thread roll (50) on the can neck is chosen in such a way that $R : r \geq 1.1$.
13. Apparatus according to any one of the claims 10 to 13, characterized in that the control means for coordinating the radial movement of the gauge (40) and the thread roll (50) have wedge systems and means for producing a relative axial movement of said wedge systems against one another.