Aug. 9, 1966 L. R. KOHAN ETAL 3,265,239

COATED METAL CONTAINER

Original Filed Oct. 23, 1962

Fig. 1.

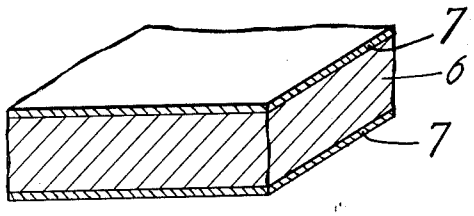


Fig. 2.

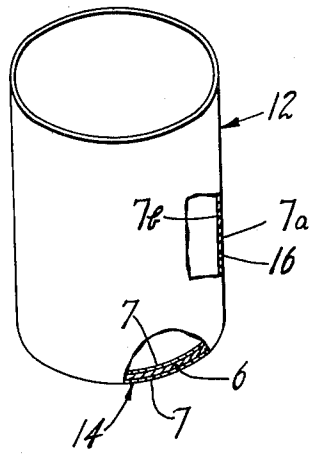
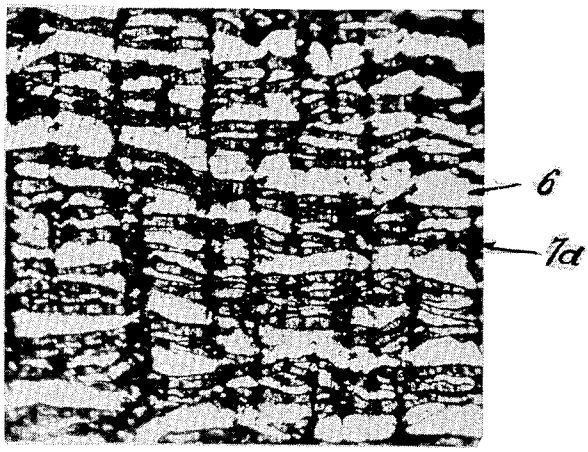


Fig. 3.



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COATED METAL CONTAINER

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Original application Oct. 23, 1962, Ser. No. 232,559. Divided and this application Sept. 2, 1965, Ser. No. 484,625

6 Claims. (Cl. 220—64)

This application is a division of my co-pending application, Serial No. 232,559, filed October 23, 1962, now Patent No. 3,180,928.

This invention relates to a coated seamless aluminum container and more particularly to an aluminum container having a form of aluminum oxide coating on the surface thereof.

Many devices and processes are presently being used for forming seamless aluminum containers from flat blanks. One of these procedures involves first drawing the blank into a cup form by forcing the blank through a drawing die by means of a punch mounted upon a press. After drawing, the cup is passed through an ironing die, whose inside diameter is slightly smaller than the outside diameter of the cup.

As drawn, the cup usually has bottom and sidewall thicknesses substantially equal to the thickness of the blank. Ironing thins the sidewall of the drawn cup and forces the metal back, thereby also increasing the height of the container. A plurality of ironing steps may be performed to achieve a desired body wall thickness and container height.

Prior to the advent of these seamless containers, both interior and exterior decoration of metal cans, e.g., tin cans, had usually been done upon the flat sheet prior to forming the cylinder. This was especially true of the outside coating. However, with containers produced by the drawing and ironing method, coatings were applied to the surface of the container subsequent to its formation. This necessitated the use of complex equipment to insure proper coverage and also precise registration when designs or lettering were utilized to decorate the container.

In addition, aluminum, which is used for many of these seamless containers, often requires a primer coat for adherence of subsequent organic coating. Even then, on occasion, considerable deterioration of adhesion between the coating and the aluminum occurs on the interior of the containers used to package certain products, especially potable liquids. This results in corrosive attack upon the inner sidewall by the product and eventual spoilage of the contents of the container.

It is well known that aluminum is frequently anodized in order to form an aluminum oxide on the surface, which promotes organic coating adhesion and resistance to corrosion. This oxide coating may also be colored for aesthetic purposes. The aluminum oxide formed in the anodizing process is generally porous and has a lower density than conventional Al_2O_3 which is used as an abrasive. This porous oxide may subsequently be sealed by means of hydration in boiling water.

It is therefore an object of the present invention to provide a thin-walled aluminum cup-shaped container having a coating of aluminum oxide thereon.

Another object is to provide an aluminum container which may be decorated prior to forming.

A further object is to provide an oxide coated aluminum container which is more readily receptive to an adherent organic coating.

Numerous other objects and advantages of the invention will be apparent as it is better understood from the following description, which, taken in connection with the accompanying drawings, discloses a preferred embodiment thereof.

The above objects are accomplished by providing a drawn and ironed one-piece aluminum container whose end has an as-anodized aluminum coating thereon and whose sidewall is thinner than the thickness of the end. A discontinuous anodically formed aluminum oxide coating covers at least one surface of the sidewall and the oxide coating comprises a plurality of discontinuous microscopic particles of aluminum oxide adhering to the aluminum basis metal, although the aluminum oxide coating appears continuous to the naked eye.

Referring to the drawings:

FIGURE 1 is a fragmentary, enlarged, cross-sectional view of an anodized aluminum sheet;

FIG. 2 is a perspective view of a coated container with parts broken away and partly in section; and

FIG. 3 is a photomicrograph of the exterior sidewall of the container formed by drawing and ironing.

As a preferred or exemplary embodiment of the instant invention, a sheet of aluminum alloy 3003H–O is chemically anodized according to procedures well known to those skilled in the art. If desired, it may also be color dyed by conventional procedures. FIGURE 1 shows a cross-section of the aluminum **6** with the anodic aluminum oxide **7** covering its surface.

A circular blank is cut from the coated aluminum and is formed into a container according to the method described in my copending application Serial No. 232,559, filed October 23, 1962, or by other suitable means.

As shown in FIG. 2, the drawing and ironing process produces a container, generally designated **12**, having an integral end **14** and a seamless sidewall **16**. The thickness of the end **14** is greater than the sidewall **16**. For example, the end **14** may be 0.023 inch thick and the sidewall **16** may be 0.008 inch thick. This variation in thickness will depend greatly upon the height and diameter of the container.

The bottom end **14** of the container **12** retains essentially the original structure of the as-anodized aluminum sheet and thus comprises the aluminum basis metal **6** coated with the anodized aluminum oxide **7**.

On the other hand, the aluminum oxide coatings on the interior and exterior wall surfaces of the container **12** have been subjected to substantial mechanical deformation during the drawing and ironing operation. The internal sidewall surface has been forced to undergo a 90° tensional bend during the drawing phase and a tensional force during ironing, whereas the exterior sidewall surface underwent a 90° compressive bend in the drawing and was then exposed to an extrusion or "squeezing" action when being ironed.

As was noted hereinbefore, the bottom end **14** of the container **12** was essentially undeformed during the drawing and ironing operation. During ironing the sidewall **16** had been thinned substantially and elongated. Thus the sidewall **16** is thinner than the bottom end **14**, although being integral therewith.

Since the aluminum oxide coating **7** produced by anodizing aluminum metal **6** is generally considered to be quite brittle and barely amenable to even slight bending, without fracturing, it is quite unexpected that this coating **7** could withstand extreme bending or an extrusion type deformation such as is encountered in drawing and ironing, without exfoliating from the aluminum metal **6**. Although the deformed oxide **7***a* on the aluminum metal sidewall **16** does indeed remain adherent during the drawing and ironing process, it nevertheless does not form a continuous, intact coating as found in undeformed anodized aluminum. However, the anodic coating **7** on the bottom end **14** of the container **12**, which has not undergone deformation, remains essentially intact in the as-anodized condition.

Although the oxide coated surface of the exterior sidewall **16** appears as a shiny continous coating, metallographic examination reveals that the aluminum oxide *7a* has been fractured during drawing and ironing and microscopic particles of aluminum oxide appear as islands adhering to the aluminum basis metal. FIG. 3 shows the darker dyed oxide formation *7a* in relation to the exposed lighter aluminum **6**. Even though the dull surface appearance of the anodized metal has been converted to a shiny surface, somewhat lighter in shade than the as-anodized and dyed color, the oxide is microscopically rough and discontinuous. This ironed surface not only resists "fingerprinting," which is a serious problem in handling uncoated aluminum, but in addition exhibits a remarkable resistance to atmospheric corrosion.

On the other hand, the oxide coating *7b* on the interior sidewall of the container has not been ironed and therefore does not exhibit the bright surface characteristic of an ironed anodically coated aluminum. As mentioned hereinbefore, the interior side wall coating *7b* has only been forced to undergo a 90° tensional bend in the drawing operation and then elongation during ironing. However, its microscopic appearance is quite similar to the exterior surface oxide *7a* of the container **12**. It is probable that the separation of the oxide *7b* on the interior sidewall is due to metal stretching rather than extrusion or "squeezing" as in the exterior sidewall.

It should be noted, however, that both the interior and exterior surfaces of the bottom end **14** of the container **12**, which has neither been drawn nor ironed, retain the as-anodized aluminum oxide coating, without the fractures found in the anodic coatings *7a*, *7b* on the sidewall **16** of the container **12**.

Even though the interior oxide coating *7b* on the container sidewall **16** is not intact, it has been found that this surface provides more adherent bonding for the subsequent application of organic coatings than a plain aluminum surface. This is especially true when the container is used for holding an alcoholic potable liquid.

It is thought that the invention and many of its attendant advantages will be understood from the foregoing description and it will be apparent that the various changes may be made in the form, construction, and arrangement of the parts without departing from the spirit and scope of the invention or sacrificing all of its material advantages, the form hereinbefore described being merely a preferred embodiment thereof.

We claim:

1. A drawn and ironed one-piece aluminum container, comprising:
- an end having an anodized aluminum oxide coating thereon;
- a seamless sidewall, said sidewall having a thickness substantially thinner than said end;
- and a discontinuous anodic aluminum oxide coating covering at least one surface of said sidewall, said oxide coating comprising a plurality of discontinuous microscopic particles adhering to the aluminum basis metal, although said aluminum oxide coating appears continuous to the naked eye.

2. The container of claim **1** wherein two surfaces of said sidewall are coated with aluminum oxide.

3. The container of claim **1** wherein said aluminum oxide is dyed.

4. An aluminum container, comprising:
- an end having a continuous anodized aluminum oxide coating thereon;
- a seamless body whose sidewall is integral with said end, said sidewall having a thickness substantially less than the thickness of said end;
- and a discontinuous aluminum oxide coating on at least one surface of said sidewall, said oxide coating comprising a plurality of discontinuous microscopic oxide particles adhered to the aluminum basis metal.

5. The container of claim **4** wherein the thickness of said end is greater than twice the thickness of said body sidewall.

6. A cup-shaped aluminum article of manufacture, comprising:
- a bottom coated with an adherent continuous chemically anodized aluminum oxide coating;
- and an integral side coated with an adherent microscopically discontinuous mechanically deformed aluminum oxide coating appearing continuous to the naked eye.

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