United States Patent

Kibler

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[54] **METHOD OF FORMING A HOLLOW COMPOSITE ARTICLE BY EXTRUSION**

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[52] **U.S. Cl.** **29/420,** 29/197, 29/DIG. 31, 29/DIG. 47, 72/258, 264/111, 264/112

[51] **Int. Cl.** **B22f**

[58] **Field of Search** .....29/420, 197, DIG.31, DIG. 47; 72/258, 267; 264/111, 112

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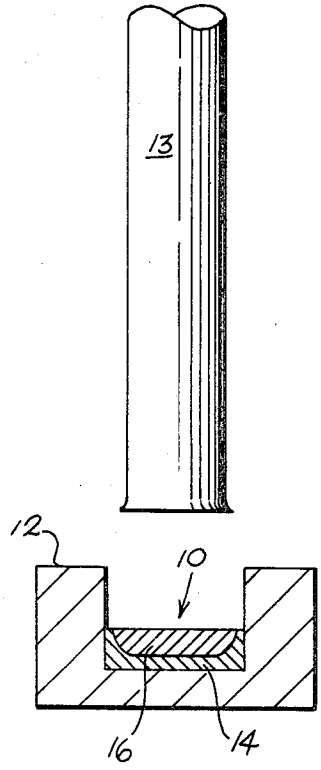
[57] **ABSTRACT**

This disclosure pertains to a method for impact extruding multimetal hollow articles by placing a slug of such metals in a die cavity, bringing a punch to forcefully bear on the slug and extruding the article between the cavity-punch clearance whereby the various metals are selectively disposed in laminar form through the article, including the sidewall portions, and articles so produced.

7 Claims, 4 Drawing Figures



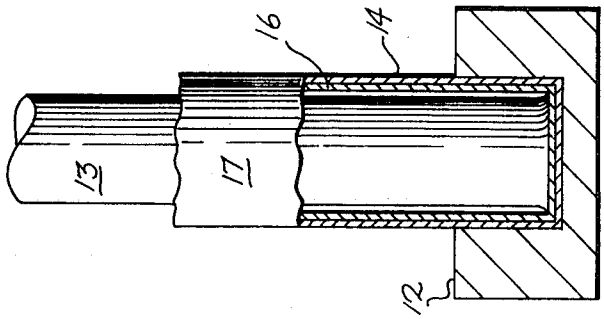


FIG. 3

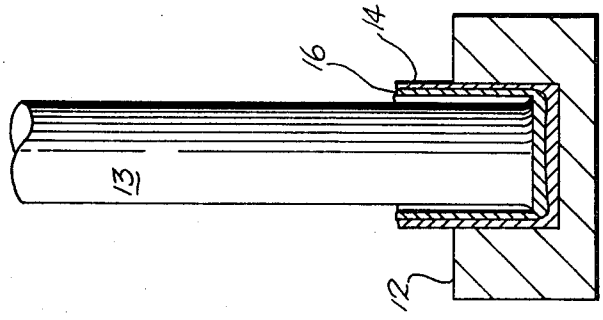


FIG. 2

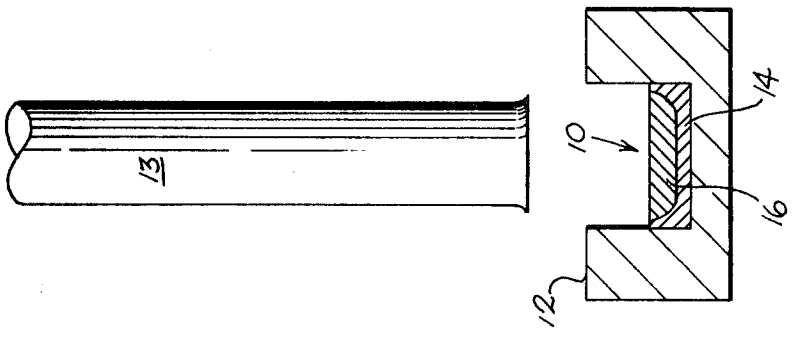


FIG. 1

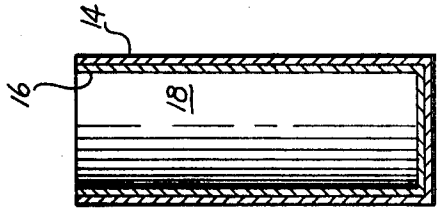


FIG. 4

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METHOD OF FORMING A HOLLOW COMPOSITE ARTICLE BY EXTRUSION

This application relates to a method of forming multimetal hollow objects wherein the metals are present in determinable layer form essentially as desired throughout the object, including the wall portion. More particularly, this invention relates to a method of impact extruding containers from slugs of multimetal configuration to form containers having layered walls of the metals.

Impact extrusion involves forming materials by forcing, for instance, metal through a small clearance between the walls of a die cavity defined in a die block and a punch forcefully moved into the die cavity. Usually, a flat cylindrical slug of a single metal is placed at the bottom of the die cavity. When the punch bears upon the slug with great force, the metal of the slug, which is more easily flowed than the metal of the die block or punch, extrudes between the walls of the die cavity and the punch. Thus, the exterior configuration of the formed article is determined by the shape of the die cavity and the interior configuration of the formed article is determined by the shape of the punch, and particularly the punch head. Though the die cavity and punch may be of various cross-sectional shapes, the punch and cavity must be substantially complementary in configuration and have clearance therebetween such that the article extrudes at a substantially equal linear rate throughout to avoid large longitudinal shear stress in the relatively thin walls of the article.

Localized pressure is employed to induce the necessary flow of metal through the punch-die block clearance. Once the metal extrudes through the clearance, it is largely relieved of the great pressure and immediately becomes self-supporting. Thus, the punch is usually formed with receding walls above the bottom portion to reduce friction between the punch and the formed article as well as to facilitate removal of the formed article from the punch.

Impact extrusion has been employed to produce composite extrusions such as discussed in U.S. Pat. No. 3,197,857. However, heretofore such extrusions have combined different metals only as bottom plates, top rings, or other portions essentially transverse of the walls of the article. In counterdistinction thereto, it is an object of this invention to provide a method of forming multimetal hollow articles having wall portions in whole or part formed of layers of different metals.

Another object of this invention is to provide a method of forming by impact extrusion an article having an interior primarily of one metal and an exterior of another metal.

Yet another object of the instant invention is to provide a method of forming composite metal articles in which the layers are securely fused to form an integral article.

Still another object of this invention is to provide a method of forming by impact extrusion a hollow article formed of a plurality of metals wherein the various metals are arranged in a predetermined manner throughout the wall portions.

Still yet another object of this invention is to provide a composite metal article in which substantial portions of the article walls are formed of differing metals in laminar form, and in which the differing metals are securely bonded together.

Other objects of this invention will be apparent from the following discussion and the drawings.

According to the instant invention, a composite multimetal article can be produced from a simply constructed multimetal slug. As the slug deforms and extrudes into the hollow article, the different metals in the slug are evenly distributed in the extruded article thereby forming, in effect, laminated wall portions of the different metals. However, because of the great forces involved in inducing the extrusion, the metals in the extruded wall portion are most securely fused together.

This will be more readily appreciated upon consideration of the drawings in which,

FIG. 1 is a simplified schematic representation of a multimetal slug disposed in a cross section die block before the punch is brought to bear;

FIG. 2 is a simplified schematic representation as in FIG. 1 wherein the extrusion process has been initiated;

FIG. 3 is a simplified schematic representation, partially cutaway, showing the completion of extrusion; and

FIG. 4 is a cross-sectional view of a hollow object produced according to this invention.

As shown in FIG. 1, slug 10 is disposed in die block 12. Punch 13 is positioned to forcefully descend and bear upon slug 10. Slug 10 is uniquely composed of at least two differing materials illustrated as exterior metal 14 and interior metal 16.

The significance of utilizing a composite arrangement in slug 10 will be apparent upon reference to FIG. 2 wherein it may be noted that as the metal extrudes between die block 12 and punch 13 as a result of the large force brought to bear by punch 13, exterior metal 14 and interior metal 16 flow to form the exterior-interior portions of the hollow container, respectively, and are present throughout the walls thereof in substantially constant thickness layers. Further, the interface between the metal 14 and metal 16 is even and securely bonded.

When punch 13 completes its forming stroke, as shown in FIG. 3, the metal is extruded to such an extent that a completely extruded hollow object 17 is formed with the exception of a somewhat ragged top surface. By design, the extruded article is somewhat longer than desired in order that the top portion may be evenly severed to produce a smooth upper surface. The result of this process is the trimmed can 18 shown in FIG. 4 wherein the exterior is entirely formed of metal 14 and the interior is entirely formed of metal 16. This is true even at the bottom of can 18.

Can 18 is unique in that it cannot be produced by other conventional methods of producing composite articles. Plating, either by electro or electroless deposition, or dipping in molten metal, requires a base metal and provides only a relatively thin layer of the additional metals. According to the instant invention, a wall may reverse the metal configuration throughout its length. Sweat-fitting a first can of one metal within a second can of another metal is not practical because, for instance, of the thin wall dimensions. The advantages of the instant invention can readily be appreciated by envisioning the various configurations easily produced by this invention and attempting to identify other means for duplicating the articles. In fact, the articles are novel and can be produced only by the method of the instant invention.

While the process has been illustrated in terms of constant layer wall extrusions utilizing two metals, it is equally useful to extrude containers having dissimilar metals only in specified portions, containers having differing metals in varying layer thicknesses, and containers having more than two differing metals in the structure.

One skilled in the art of impact extrusion can predict with a substantial degree of accuracy the correlation between the location of metal in an extrusion slug and in a container extruded from such slug. Thus, it is not difficult to formulate a slug which produces an article closely approximating the desired end article. However, because of such characteristics as differing flow rates for differing metals, differing die cavity and punch configurations and sizes, and other differences between various applications, it is often necessary that the final slug configuration be determined empirically. That is, a limited number of trials under actual operating conditions utilizing different slug configurations are carried out to determine the "fine tuning" of the process. Actually, the empirical process of determining slug configuration is not particularly demanding and, in view of the fact that most impact extrusion articles are items produced in large volumes, the effort in properly programming the slug is negligible when prorated over an extended production run and when compared to the advantages accruing from the process of the instant invention.

Slugs of unusual configurations may be produced by stamping, casting or otherwise forming a preslug having selected depressions in the surface. A powder of a second metal may be placed in the depressions to form a composite slug. The powder may then be sintered to unitize the slug or in some instances, the impact extrusion step may be employed to form the powder into solid metal as the article is formed.

A particularly useful example of the use to which the instant invention can be put is the conventional battery can. Conventionally, battery cans are impact extruded entirely of zinc. Though zinc is a rather expensive material, substantial excess amounts of zinc over that required for galvanic action are employed merely to lend structural support to the can. According to the instant invention, the zinc can be largely replaced with a less expensive material, such as aluminum, and the can formed with an interior galvanic surface of zinc and an exterior structural can of aluminum. Such a composite battery can not only is cheaper, but is also lighter in weight and less likely to exude damaging materials from exhausted batteries. By making minor changes in the illustrated slug configuration, it is possible to produce a battery can having zinc only at the interior sidewall portions and aluminum at the exterior sidewall portions and the entire bottom portion.

It will be apparent from the above description and drawing that various modifications of the method and article may be made within the scope of the invention. Therefore, the invention is not intended to be limited to the particular examples or illustrations employed except as may be required by the following claims.

I claim:

1. A method of forming hollow articles of a plurality of metals by impact extrusion comprising placing a multimetal slug in a die cavity defined in a die block, said slug having at least two distinct layers, one of said layers being of aluminum and the second of said layers being of zinc, bringing a punch to bear upon the slug, extruding the slug between a clearance between the die cavity walls and the punch with the zinc forming a lamination of at least a portion of the inner sidewall of the article, the laminations being fused and bonded together as a result of the extrusion.

2. A method of forming articles as set forth in claim 1 wherein the slug is comprised of zinc and aluminum metals, the aluminum being extruded to form substantially the entire exterior area of the article and the zinc being extruded to form substantially the entire interior area of the article.

3. A method of forming articles as set forth in claim 1 wherein the die cavity and die punch are both round in cross section whereby a cylindrical article is impact extruded therebetween.

4. An article produced according to the process of claim 1.

5. A method of forming a bonding composite metal articles by impact extrusion comprising placing a slug comprised of a first metal, said first metal being configured with depressions in the surface thereof, and a second metal in powder form in said depressions, in a die cavity defined in a die block, bringing a punch to bear upon the slug, fusing and bonding the slug into a unitary article by extruding through a clearance between the die cavity walls and the punch with each of the metals forming a lamination of at least a portion of the sidewall of the article.

6. A method of forming a hollow article of two metals comprising zinc and aluminum by impact extrusion comprising placing a slug having distinct portions of zinc and aluminum in a cylindrical die cavity defined in a die block, bringing a punch of round cross section and of a diameter somewhat smaller than the die cavity to bear upon the slug, fusing and bonding the slug into a unitary article by extruding through the clearance between the die cavity and the punch with the aluminum forming substantially the entire exterior portion of the article and the zinc forming at least a portion of the interior portion of the article.

7. A method as set forth in claim 6 wherein the aluminum form the bottom portion of the interior of the article.

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