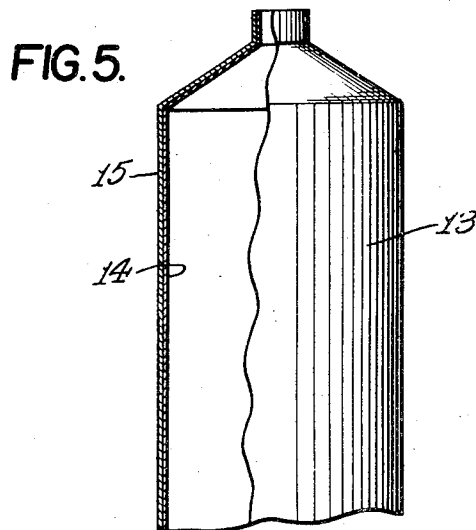
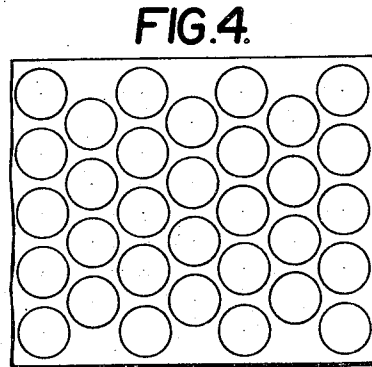
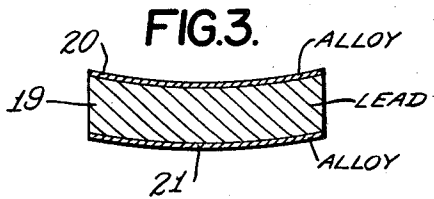
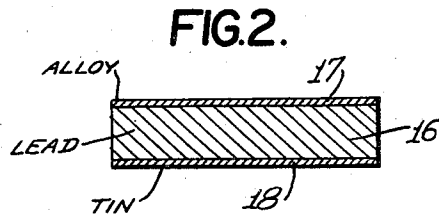
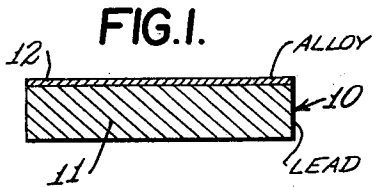


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COLLAPSIBLE TUBE HAVING METALLIC LINING WITH LOW-
LEAD PICKUP AND METHOD OF MAKING SAME
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LINING WITH LOW LEAD PICKUP AND
METHOD OF MAKING SAMEJohn H. Friden, Maplewood, N. J., assignor to
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This invention relates to an improved form of slug adapted for extrusion by impact to produce a collapsible tube of the type used in the packaging of toothpaste and the like. It relates also to such collapsible tubes. Tubes of this character are provided with a thin walled tubular portion, sufficiently flexible to be readily collapsed, and a relatively rigid, inwardly extending member adjacent one end serving as a full or partial closure for said end. This inwardly extending member is integrally connected with the tubular wall and is generally in the form of a frusto-conical shoulder extending into a threaded neck adapted to be sealed by a screw threaded cap. However, in some instances the closure member is of other forms, adapted for example to completely seal the end of the tube, and arranged to be punctured or otherwise opened or removed to discharge the contents of the tube. The invention relates to all tubes of this general character which are produced by impact extrusion.

An object of the invention has been to produce a collapsible tube of the character indicated which is formed largely of lead but has most, if not all, of the desirable characteristics of a pure tin tube, although its tin content is as low as 3 to 5%. A primary consideration has been to produce such a tube which is suitable for use in the packaging of products intended for oral or internal use. Toward this end the tube must be of such character that its contents will have a relatively low lead pick-up. Other considerations have been the production of such tubes with the requisite strength and flexibility, and yet with sufficient rigidity and stiffness, to adapt it for conventional treatment and handling in the course of manufacture and in use.

A further object of the invention has been to provide a tube which is particularly adapted for sealing, after filling, by electronic means. It has been found that ordinary lead tubes, for example, are not suited for sealing by electronic means, i. e., by high frequency or ultra-high frequency currents. Tubes formed in accordance with the present invention, however, having a coating or layer on their inner surfaces, formed of an alloy having a somewhat lower melting point than lead, have been found to form a good tight seal when the ends of the tubes are squeezed flat and subjected to electronic welding.

Another object has been to provide an improved form of slug adapted for the production of tubes of the foregoing character.

Suggestions have been made heretofore of pro-

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viding a laminated slug comprising a main body of lead and a layer or coating of tin on one surface so that a tube formed therefrom will have an inner lining of tin. These tubes, however, have not been suited for the purposes of the present invention. The tin is not capable of extrusion with the same rapidity as the lead and, therefore, when such a slug is used in a conventional extrusion press, an imperfect or incomplete lining or coating is provided at the interior of the tube. Obviously, such a lining is not an adequate safeguard against lead pick-up.

In accordance with the present invention the slug, formed primarily of lead, is provided on at least one surface with an alloy which has substantially the same extrusion characteristics as pure lead and which is capable of forming a complete lining over the entire interior surface of the tube, with no cracks, pinholes, or other defects. The alloy, moreover, is of such character as to provide adequate protection against lead pick-up, even though the alloy itself is formed largely of lead.

Through the use of the invention a tube highly satisfactory for the packaging of toothpaste, for example, may be produced with a total tin content of as little as 2%. Exceptionally good results are obtainable with a total tin content of 3.6% and no objectionable results are obtained when it runs higher, say 5% or even somewhat more.

If an adequate supply of tin is available and usable it is preferred to provide a very thin layer of pure tin on the opposite face of the slug to that which carries the alloy, so that the outward appearance of the tube will be substantially the same as a pure tin tube. The coating formed will be imperfect but particularly at the usually exposed portions, such as the shoulder, the imperfections will not be noticeable to the naked eye. The metal in this portion of the tube is not required to flow far from its original location in the slug. The special alloy, which has an appearance closely approximating that of pure tin when extruded, may be used on both surfaces of the slug if desired, the layer on the surface forming the outside of the tube being, in that case, preferably thinner than that forming the protective inner lining.

It is desirable to form the slugs with a slight concavity on that face which is to form the inside of the tube and a slight convexity on the other face to facilitate the correct positioning of the slugs, by automatic means, in the die of an extrusion press.

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Other objects, features, and advantages of the invention will appear from the detailed description of certain illustrative embodiments thereof which will now be given in conjunction with the accompanying drawings, in which:

Fig. 1 is a schematic view in the nature of an enlarged section through a slug embodying the invention;

Fig. 2 is a similar view of a modified form of slug;

Fig. 3 is a similar view of a further modified form of slug;

Fig. 4 is a plan view of a section of a strip from which the slugs have been stamped; and

Fig. 5 is a view, partly in elevation and partly in vertical section, through a collapsible tube extruded from the slug of Fig. 1.

Referring now to Fig. 1, there is illustrated a slug 10 which may be of any conventional form in so far as its configuration is concerned. Most commonly, it will be of a relatively flat, cylindrical or disc-like form and will be produced as a stamping from a flat rolled strip of the desired composite metal. The strips from which the slugs are stamped may be rolled at a suitable temperature from cast slabs of the composite metal. Thus in the production of the slug 10 of Fig. 1, the original slab may be formed by first pouring lead into the mold to a sufficient depth to provide a layer constituting about 95% of the weight of the complete slab. A layer of the improved alloy may then be poured over the layer of lead, after the latter has at least partially solidified, this alloy layer constituting 5% of the entire weight of the slab. The slab is subsequently rolled, at an elevated temperature, if desired, to simplify the rolling process, until a strip having the desired thickness of the final slug is produced. It is important that no cracking should occur in either of the layers of the strip in the course of this rolling process and it has been found that the improved alloy, in conjunction with the lead base, lends itself readily to this requirement. The strip formed from the slab by the rolling operation will maintain the same proportion of lead base to alloy coating, throughout its area, as was provided in the pouring of the original slab. It has been found that the improved alloy has such similar rolling characteristics to those of the lead base that a substantially uniform distribution of the alloy coating over the lead base is provided.

In lieu of producing the slug forming strips in the foregoing manner, they may be formed by separately casting the lead and the alloy into slabs and separately rolling the alloy slab into a strip of the desired thickness and then combining this strip with a slab of lead and rolling the strip and slab together to form the laminated strip. Thus after separately casting slabs of the lead base and the alloy, the alloy slab is rolled into a relatively thin strip having a thickness bearing the desired relation to the thickness of the lead slab. To produce slugs of the character indicated, it will be rolled to a thickness of substantially 5% of the thickness of the lead slab or, more exactly, such as to provide 5% by weight of the combined slab and alloy strip. The alloy strip is then cut to conform with the area of the lead slab and is applied to the surface of the latter and rolled, either cold or at an elevated temperature, with the lead slab to produce a laminated strip having the thickness of the desired slugs. The alloy strip and the lead base will, as the result of this rolling, become firmly

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bonded together and produce a strip in which the lead base is coated with a 5% layer of the alloy.

The slugs may be formed from the rolled strips in any suitable way, preferably by a multiple punch press adapted to stamp a series of the slugs from the strip upon each operation. Each slug will have a main body 11 formed essentially of lead and a coating or top layer 12 formed of the improved alloy. The punch and die of the press may be adapted to provide simply a flat slug of the type shown in Fig. 1, or it may provide a concavo-convex configuration, as shown in Fig. 3, or any other desired shape. The concavo-convex form provides a simple means of insuring the correct insertion of the slugs, by automatic means, in the extrusion press which forms the slugs into collapsible tubes. Any other scheme for accomplishing this result may, however, be employed. In the stamping of the slugs the strip is preferably placed with its alloy coating uppermost, i. e., toward the punch.

The stamping of the slugs from the flat strips is ordinarily carried out in such a way that 50% of the metal of the strips goes into the slugs, while 50% remains in the skeleton strip and becomes scrap, as illustrated in Fig. 4. This scrap is, of course, remelted and used in subsequent runs. Since the scrap is 95% lead and 5% alloy, the lead content of which is also high, the scrap is simply used in lieu of lead to make up a portion of the lead charge entering not only into the alloy but also into the main body of the slab and slug. It will be apparent that in the course of a long series of runs in which the scrap is constantly being returned for use in the next run to constitute about one-half of the lead component, there will be a constantly increasing amount of tin and antimony upon successive runs, in both the main body portion of the slab, strip, and slug and in the top coating layer of these members. This increase in the tin and antimony content of the two parts of the final slug will be such that the total tin and antimony content will approach double the amount provided in the original alloy. For example, assuming that in the original operation the main body of the slug is formed of pure lead and the top layer of coating is formed of 61% lead, 36% tin, and 3% antimony, and assuming that this layer constitutes 5% of the total weight of the slug, the content of the slug will be 98.05% lead, 1.8% tin, and .15% antimony. Now as the scrap from the slug forming strip is continuously used to make up 50% of the lead charge, the main body of the slug will gradually approach an alloy composed of 98.05% lead, 1.8% tin, and .15% antimony. The complete slug having the same coating layer as the original slug, except for the fact that the lead ingredient will carry with it the same percentage of tin and antimony, as above indicated, will gradually approach a composition of 96.1% lead, 3.6% tin, and .3% antimony. The addition of sufficient antimony to the lead forming the main body of the slug and resulting tube to provide an antimony content of about 3% in the main body, will improve the tube, principally by way of giving it greater stiffness and resistance to deformation in the course of manufacture and subsequent handling.

Slugs having the composition above indicated are admirably suited for the purposes of the invention. Even when formed from the early charges in which substantially pure lead is used for the main body of the slabs, the slugs will be

capable of uniform extrusion under impact at speeds ranging between 1 and 5 feet per second. However, as more and more of the scrap enters into the lead charge, used both for the main body of the slug and for the top coating, even superior results are obtained. The presence of the relatively small amounts of tin and antimony in the main body of the slug seems to bring about even more closely corresponding flow characteristics for the main body and the coating layer of the slug. As a result, a coating layer comprising not more than 5% of the total weight of the slug will be found to provide an excellent, continuous, impervious layer 14 on the inner surface of the extruded tube which will protect the contents of the tube against the danger of lead pick-up from the main body of the tube. Very good results have been obtained with alloy coatings of a thickness to form between 3 and 7% of the total weight of the tube, but with either less or greater percentages the tendency to form cracks or pinholes becomes more serious. It will be understood that the alloy coating is faced toward the punch of the extrusion press in forming the tube.

The exterior surface 15 of the tube will, in the circumstances under consideration, be relatively dull since this in the early batches will be pure lead and after a series of operations will contain a maximum of 1.8% tin and either .15% or 3% antimony, depending upon whether the additional amount of this constituent is provided as suggested. If it is desired to provide a brighter exterior surface, comparable with that of a pure tin tube of the type used extensively heretofore, this may be accomplished by adopting a slug of the character illustrated in Fig. 2. This slug, which may suitably be formed by the procedure outlined with reference to Fig. 1, may comprise a main body portion 16 consisting initially of pure lead, a top layer 17 composed of the improved alloy, and a bottom layer 18 composed of pure tin. It will be understood that in the casting of the original slabs the tin will first be poured into the molds, the lead then poured, and the alloy finally poured over the top of the lead. Or, if desired, the tin and alloy may each be cast separately into slabs and then rolled into strips having the desired thickness in relation to the lead base slab. These strips may then be cut to the size of the lead slab and the section of the tin strip applied to one face and the alloy strip to the other face of the lead slab and the three elements then rolled together to the thickness of the desired slugs. For the production of slugs having the alloy applied to both faces, as herein-after suggested, the relatively tin alloy strip may be wrapped completely around the lead base slab and this may then be rolled to the desired thickness. If it is desired to provide a thicker coating of the alloy on one face of the slug than the other, the wrapping of the alloy strip may, for example, be arranged to place a double thickness on one face of the slab and a single thickness on the other face. In slugs formed from this combination, the main body 16 may constitute 93 to 95% of the total weight of the slug. The layer 17 may constitute 5% of the total weight and the layer 18 may constitute between 1 and 2% of the total weight. It has been found that in order to insure a continuous, impervious coating on the inner surface of the tube, the layer of alloy to form it cannot safely be reduced below about 5% of the total weight of the slug. It will be understood that in producing successive batches of slugs of this character, the total tin content of

the slug will gradually rise to double that of the original slug.

In the extrusion of the slug of Fig. 2, the same results as explained above in connection with the Fig. 1 slug will be produced. A uniform impervious coating of the alloy will be provided over the entire inner surface of the tube. On the outer surface the tin layer will be substantially continuous in the region of the neck and shoulder portion of the tube but will become progressively poorer toward the open end of the tube. In fact, adjacent the open end there may be no exterior coating at all. This is because the tin is not capable of extrusion with the same rapidity as the lead or the alloy. The imperfect coating provided in this manner will serve the purpose of providing the desired bright appearance to the tube. The imperfections in the coating will hardly be noticeable, particularly in the neck and shoulder region of the tube. As the main body of the slug acquires a fair percentage of tin and antimony from the scrap, its extrusion characteristics will be modified somewhat so that the tin will follow it more closely and form a more nearly continuous coating.

In Fig. 3 there is shown a further modified slug having the improved alloy at both of its surfaces. In other respects this slug may be substantially the same as the other slugs described and it may be formed in the same manner. It is illustrated, however, as having the concavo-convex form mentioned above. The main body 19 of this slug may in the first run be pure lead, but in succeeding runs it will acquire a certain amount of tin and antimony and any other ingredients of the scrap. The top layer 20, preferably at the concave side of the slug, is formed of the improved alloy and may constitute, as in the first embodiment, about 5% of the total weight of the slug. The bottom layer 21, formed of the same alloy, may constitute only 1 or 2% of the total weight of the slug. A layer of the alloy of this small amount will not produce a perfect, impervious coating on the exterior surface of the tube, but the imperfections will not be noticeable to the naked eye. If it is desired to make the coating more nearly perfect, an alloy layer forming from 3 to 5% of the total weight may be used at the exterior surface of the tube. An advantage of using the alloy rather than pure tin for the outer surface of the tube is that the exterior coating will be coextensive with the entire main body of the tube since the alloy responds to impact extrusion in substantially the same manner as the lead itself, particularly when the lead base contains 3% antimony.

While, as indicated above, the preferred alloy used for the production of the coatings 12, 17, 20, and 21 consists essentially of 61% lead, 36% tin, and 3% antimony, its content may be varied within reasonable limits without departing from the general principles and scope of the invention and without losing substantially the benefits of the invention. The tin content may be varied between 30 and 40%, or even up to 50% if ample tin is available, and the antimony may be between 2½ and 5%, while the remainder is substantially all lead. It is possible, however, to add small amounts of other metals which may serve as hardening and stiffening agents or as brightening agents. For example, up to about 1% silver has been found to make an excellent addition to the alloy, from all of the standpoints indicated. Moreover, its presence in the scrap serves to

improve the main body portion of the slug and tube.

While several illustrative embodiments of the invention have been disclosed in considerable detail, it will be understood that various changes may be made in the form and composition of the alloy, the slug, and the collapsible tube formed therefrom.

I claim:

1. A metallic collapsible tube comprising an integral unit having a thin, flexible tubular wall and a relatively stiff member extending inwardly from said wall adjacent one end to at least partially close said end of the tube, said wall and member being formed primarily of substantially pure lead but having on the inner surface thereof a thin, substantially uniform, impervious coating of an alloy consisting essentially of 30 to 50% tin, 2.5 to 5% antimony and the balance substantially all lead.

2. A metallic collapsible tube comprising an integral unit having a thin, flexible tubular wall and a relatively stiff member extending inwardly from said wall adjacent one end to at least partially close said end of the tube, said wall and member being formed primarily of substantially pure lead but having on the inner surface thereof a thin, impervious coating of an alloy consisting essentially of 30 to 50% tin, 2.5 to 5% antimony and the balance substantially all lead, said coating comprising about 5% of the thickness of the metal of the tube at all points.

3. A metallic collapsible tube comprising an integral unit having a thin, flexible tubular wall and a relatively stiff member extending inwardly from said wall adjacent one end to at least partially close said end of the tube, said wall and member being formed primarily of substantially pure lead with not more than 2.5% tin and 3% antimony, but having on the inner surface thereof a thin, impervious coating of an alloy composed of about 61% lead, about 36% tin and about 3% antimony, said coating comprising about 5% of the thickness of the metal of the tube at all points.

4. A method of producing a metallic collapsible tube consisting of at least 95% lead and not more than 5% tin but having a lead pick-up characteristic below the maximum permitted for the packaging of toothpaste which comprises forming a slug having a main body portion consisting essentially of lead and not more than 2.5% tin and having a layer firmly bonded throughout its area to one surface of said main body portion

and forming about 5% of the thickness of the slug, said layer being formed from an alloy consisting essentially of 30 to 50% tin, 2.5 to 5% antimony and the balance substantially all lead, and extruding said slug by placing the same in a die and subjecting it to impact by a punch, the punch being driven against said coated surface of the slug, said alloy forming said layer having substantially the same extrusion characteristics as said body portion and thereby serving to form a substantially uniform, impervious coating over the entire inner surface of the tube.

5. A method of producing a metallic collapsible tube consisting of at least 95% lead and not more than 5% tin but having a lead pick-up characteristic below the maximum permitted for the packaging of toothpaste which comprises forming a slug having a main body portion consisting essentially of lead and not more than 2.5% tin and having a layer firmly bonded throughout its area to one surface of said main body portion and forming about 5% of the thickness of the slug, said layer being formed from an alloy composed of about 61% lead, about 36% tin, and about 3% antimony, and extruding said slug by placing the same in a die and subjecting it to impact by a punch, the punch being driven against said coated surface of the slug, said alloy forming said layer having substantially the same extrusion characteristics as said body portion and thereby serving to form a substantially uniform, impervious coating over the entire inner surface of the tube.

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