Feb. 22, 1938. S. L. INGERSOLL 2,109,010

METHOD OF MAKING LAMINATED METAL BLANKS

Filed May 16, 1935

Fig. 1.

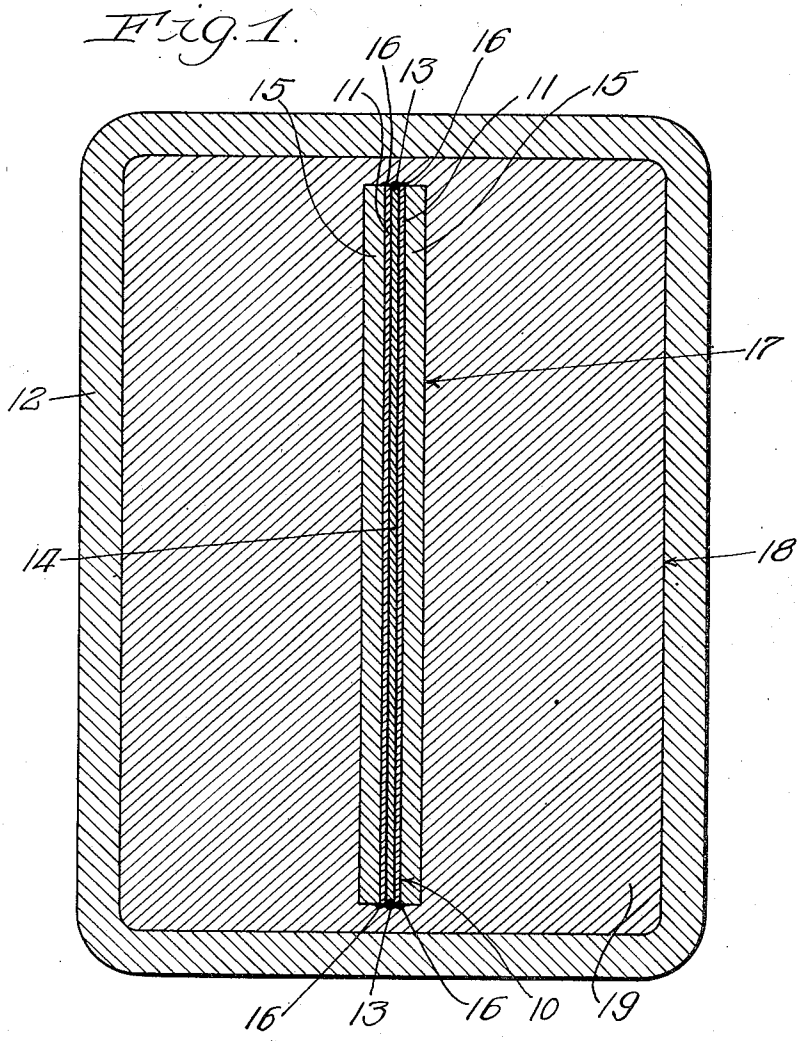
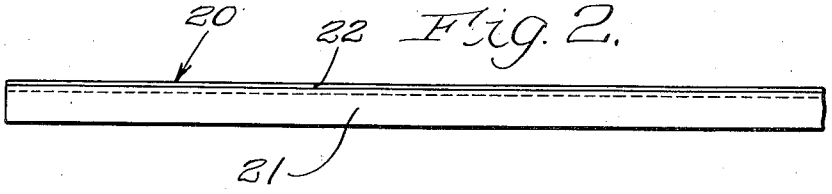


Fig. 2.



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METHOD OF MAKING LAMINATED METAL BLANKS

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11 Claims. (Cl. 29—189)

This invention has to do with the making of composite metal blanks clad with a section of a selected metal, and relates particularly to an improved welding process whereby the clad section of a blank can be made extremely thin in comparison with the main body thereof.

Many uses are found for blanks comprising a surface section of special metal such as one having particular qualities of hardness, toughness or resistance to corrosion, or other chemical reaction. Such blanks are especially adapted for fabrication into all kinds of metal wear, tubs, tanks, barrels, vats and the like, whose contents are chemically active. When the composite metal blank is made into a container, the special metal surface may be exposed interiorly of the container. The main body of the blank and of the container wall may be of a less expensive metal. Other instances are readily conceivable where the use of an expensive metal is required, but may be employed as effectively and with greater economy in the form of a thin surface section upon a slab having a main body of a less expensive metal.

A more advanced method presently employed for forming blanks having a main body of inexpensive metal such as mild steel and a clad section of more expensive metal such as stainless steel, includes the steps of forming an ingot by casting a body of mild steel about an envelope having opposed side walls of stainless steel separated by a weld-preventing material, rolling the ingot until the sections of the different steels are of a desired thickness, and thereafter trimming the edges from the rolled ingot and dividing it at a plane between the envelope side walls. Details of the method thus summarized may be had by reference to United States Patent No. 1,868,749, issued to me July 26, 1932, for "Process of making laminated metal."

The presently known and applied ingot processes of making laminated blanks are unadapted to making a laminated blank having an extremely low ratio of special metal thickness to thickness of the body of base metal. It has been found that when the thickness of the walls of the envelope of special metal is less than substantially fifteen per cent. of the combined thickness of such walls and of the ingot sections of metal cast thereto, the separating compound within the envelope becomes excessively heated and permits portions of the opposed walls of the envelope to become welded together, thus frustrating the process. In some instances the envelope walls become heated to the fluid stage permitting them to be completely pervaded by or intermingled with constituents of the poured metal and thereby deprived of their special qualities. For example, when the envelope walls are of stainless steel and the poured metal contains considerable carbon, the carbon transgresses the melted walls of the envelope and destroys their corrosion resistive properties. Such a limitation upon the contemporary ingot process thwarts the making of a slab or sheet having a layer of the more expensive metal of a thickness less than approximately fifteen per cent. of the total thickness of the finished article. The thinner the clad section of special metal with respect to the thickness of the whole blank, the less expensive will be the blank.

For many purposes a blank having a very thin clad section has a usefulness coextensive with or greater than that of a blank clad with a thicker section or made entirely of the more expensive metal. The advantage to be had from a process yielding a composite metal blank having a main body or base of relatively inexpensive metal clad with a thinner body than heretofore possible of a selected more expensive metal will be readily apparent.

The provision of such a process is the primary object of the present invention.

Another object of the present invention is the provision of an improved ingot process of making metal blanks having laminations of different physical characteristics and whereby the ingredients of a relatively thick lamination are prevented from affecting the properties of a relatively thin lamination.

The description hereinafter set forth of my improved process will be fully understood when read with reference to the accompanying single sheet of drawings hereby made a part of this specification, and wherein:

Figure 1 is a cross sectional view taken through an ingot mold and ingot therein formed in accordance with certain steps of the invention; and

Figure 2 is a fragmentary side elevation of a blank made by the improved process.

Like reference numerals are used in the drawing and throughout the following description of the invention.

The process will be described as it may be applied to the making of blanks having a main body or base of ordinary iron or of steel and a clad section of one of the so-called stainless steels containing chromium and/or sometimes a small quantity of nickel. First, an envelope 10 is formed of a pair of similar sheets 11 of stainless steel. Usually the sheets 11 will be substantially rec-

tangular, although they may be any other configuration. It is expedient to the process to use sheets 11 of dimensions approximating those of a vertical central section of a mold 12 so that when later the sheets are inserted into the mold all points upon their edges may be uniformly spaced from the walls of the mold. The envelope may be sealed by welding together the adjacent edges of the sheets or side walls 11. The sealed joint between the side walls of the envelope 10 is indicated by the reference character 13. The material forming the joint 13 is preferably identical with the material of the sheets 11 or one having closely allied physical properties. The joint 13 may be formed by spot welding. Such joint extends entirely about the peripheries of the opposed side walls 11.

Enclosed within the envelope 10 is a body of weld-preventing material 14. The function of the material 14 is to prevent the envelope walls 11 from becoming welded together during succeeding steps of the process. A compound of chromium trioxide (CrO_3) has been found to serve effectively as a weld-preventing material. It is to be understood, however, that this compound is mentioned but illustratively. Other weld-preventing materials may be used without departing from the scope of the invention.

The outer surfaces of side walls 11 of envelope 10 are thoroughly cleaned in any suitable manner as by pickling, and plates 15 of iron or steel placed against the cleaned sides thereof. The faces of plates 15 contiguous to the envelope are likewise cleaned. Plates 15 may be secured to the envelope 10 by joints 16, which may extend continuously about the edges of said plates. In addition to securing the plates 15 to the envelope 10, the joints 16, if continuous, serve to seal the plane-like interstice between the cleaned adjacent surfaces of the plates and the envelope. The joints 16 may be formed by welding adjacent sections of the plates 15 and of the envelope directly together, or additional metal may be used as a bonding element for the joint. If desired, the plates 15 may be otherwise supported within the mold in close proximity to the envelope 10. Ordinarily it is more convenient to first assemble the envelope and the plates 15 into a unit and arrange them within the insert mold by a single operation.

The unit assembled from the envelope 10 and plates 15 will be referred to as an insert and designated by the reference numeral 17. Because of the solid connections between the component parts of the insert 17, said insert may be easily handled for accurate arrangement within the mold 12. Usually the insert will occupy a central vertical plane of the mold in the manner illustrated in the drawing. Any means, well known in the art, may be employed for supporting the insert within the mold. Various supporting means are shown in my co-pending application Serial No. 712,893, filed February 26, 1934, for "Method of making bimetal".

After the insert 17 has been suitably placed within the mold 12, an ingot 18 is formed by pouring molten metal 19 into the mold and completely enveloping the insert 17 by the poured metal. The poured metal may or may not be of the same kind as the plates 15. It is at this stage of the process that the office of the plates 15 is performed. The plates serve to absorb a portion of the heat of the molten metal, thus augmenting the heat absorbing effect of the wall sections 11, and preventing complete melting of the wall sections 11. Additionally, the wall sections 11 and the plates 15 absorb sufficient heat to prevent the separator material from reaching a temperature at which it will break down and permit the side walls 11 or sections thereof to become welded together.

When the blanks made by the present process are to possess great strength as for example when their intended use is in the fabrication of automobile bumpers, or when that portion of the blank formed of the poured metal is to be subjected to friction in its subsequent use, the poured metal will be of relatively high carbon content. In such case plates 15 containing little or no carbon will be selected so that they can absorb such carbon from the poured metal as tends to migrate to and intermix with the stainless steel parts 11. In this manner the stainless qualities of those parts are preserved.

As the process is presently employed the welding connection between the side walls of the envelope and the plates 15 are between the molten metal and the plates 15 is perfected incident to a subsequent rolling operation of the ingot, which operation is now to be described. Manifestly, however, if such quantity of metal is poured to adequately prolong its high temperature the weld between the molten metal and the entire outer surface of the insert may be formed while in the mold.

After the ingot 18 has solidified, it is taken from the ingot mold 12 and passed between rolls (not shown) whose axis of rotation extends in substantial parallelism with the plane defined by the flat envelope 10. The ingot is hot-rolled until the sections of different kinds of metal therein are flattened to a desired thickness, and have become thoroughly welded to one another over their adjacent surfaces. Thereafter, the rolled ingot which has become flattened and of increased area is trimmed about its edges, the trimming extending slightly into the envelope so that the flattened ingot may be separated at the plane between the envelope side walls 11. The separating material 14 between side walls 11 permits of the ready separation of the ingot into two counterparts. Each counterpart constitutes a blank 20 comprising a main body 21 of the ordinary iron or steel and a comparatively thin section 22 of stainless steel; see Figure 2. That portion of main body 21 adjacent to the clad section 22 is composed of the material of a plate 15 while the remainder of said main body is formed of the metal cast about the insert. The dotted line in Figure 2 indicates the dividing plane at the juncture of metal originally in a plate 15 and poured metal.

The minimum thickness of metal plates 15 is determined both by the thickness of the envelope walls 11 and by the thickness of the body of molten metal. A molten body of predetermined dimensions will require an insert 17 having roughly the same thickness of solid metal between the interior of the envelope 10 and the outer faces of plates 15. It follows that if the walls 11 of the envelope 10 are comparatively thick, the plates 15 may be thinner and vice versa. If the dimensions of the molten body 18 are increased, an increase in thickness either of envelope walls 11 or plates 15, or both, will be necessary. Envelope walls of any gauge are possible to be combined into the ingot by simply using protective plates 15 of an adequate gauge. Hence, it will be conceived that the ratio of special metal thickness

in the finished blank to the total thickness of the blank may be made as low a figure as desired.

The term "blank" where used in the specification and in the appended claims is to be construed as including any composite body of metal regardless of its thickness or gauge.

Reference herein to specific metals has been made to provide concrete exemplification of my new process; manifestly, other metals may be used according to the teachings of this specification without departing from the fundamental principles underlying the invention.

What I claim as new and desire to secure by Letters Patent is:

1. The method of making laminated metal blanks, each having a thin surface lamination of a selected metal, comprising the herein described steps of forming a metal insert including a flat envelope having opposed side walls of such selected metal separated by a weld-preventing substance, and slabs of a different metal upon the side walls of said envelope and having their peripheral edges secured to said envelope, forming an ingot by pouring a body of molten metal about said insert, the thickness of a side wall of said envelope being less than, but the thickness of said insert at each side of said substance being at least equal to, the critical percentage of the perpendicular distance from said substance to the corresponding outer surface of said ingot, to prevent breakdown of said substance by the heat from the molten metal, flattening said ingot by hot rolling upon opposite surfaces in substantial parallelism with the side walls of said envelope, and cutting into the body of said flattened ingot preparatory to separating the same at the plane section between the side walls of said envelope.

2. The method of making laminated metal blanks, each having a main body of iron and a surface layer of stainless steel, comprising the herein described steps of forming a metal insert including a flat envelope having opposed side walls of such stainless steel separated by a weld-preventing substance, and iron slabs upon the side walls of said envelope and having their peripheral edges welded to said envelope, forming an ingot by pouring a body of molten iron about said insert, the thickness of a side wall of said envelope being less than, but the thickness of said insert at each side of said substance being at least equal to, the critical percentage of the perpendicular distance from said substance to the corresponding outer surface of said ingot, to prevent breakdown of said substance by the heat from the molten metal, flattening said ingot by hot rolling upon opposite surfaces in substantial parallelism with the side walls of said envelope, cutting into the body of the flattened ingot preparatory to separating the same at the plane section between the side walls of said envelope, and separating the ingot at such plane section.

3. The method of making laminated metal blanks, each having a surface section of stainless steel and a base portion of a relatively inexpensive steel, comprising the herein described steps of forming a metal insert including a flat envelope having opposed side walls of stainless steel separated by a weld-preventing substance and plates of such relatively inexpensive steel upon the side walls of said envelope and having their peripheral edges welded to said envelope, forming an ingot by pouring a body of molten steel about said insert, the thickness of a side wall of said envelope being less than, but the thickness of said insert at each side of said substance being at least equal to, the critical percentage of the perpendicular distance from said substance to the corresponding outer surface of said ingot to prevent breakdown of said substance by the heat from the molten metal, flattening said ingot by hot rolling upon opposite surfaces in substantial parallelism with the side walls of said envelope, cutting into the body of the flattened ingot preparatory to separating the same at the plane section between the side walls of said envelope, and separating the ingot at such plane section.

4. The method of making laminated metal blanks, comprising the steps of forming a metal insert including an envelope having opposed side walls of a selected metal separated by a weld-preventing substance, and a slab of a different metal joined to a side wall of said envelope, forming an ingot by pouring a body of molten metal about said insert, the thickness of the selected metal adjacent the slab being less than, but the thickness of said insert at each side of said substance being at least equal to, the critical percentage of the perpendicular distance between said substance and the corresponding outer surface of said ingot to prevent breakdown of said substance by the heat from said molten metal.

5. The method of making laminated metal blanks, comprising the steps of forming an envelope having opposed side walls of a selected metal separated by a weld-preventing substance, covering a side wall of said envelope with a metal plate, and forming an ingot by pouring molten metal about the insert comprising said envelope and plate, the thickness of the selected metal adjacent the plate being less than, but the thickness of said insert at each side of said substance being at least equal to, the critical percentage of the perpendicular distance between said substance and the corresponding outer surface of said ingot to prevent breakdown of said substance by the heat from said molten metal.

6. The method of making laminated metal blanks, comprising the steps of arranging two plates of selected metal in opposed relation with a weld-preventing substance therebetween, placing a plate of a different metal adjacent to and parallel with one of said opposed plates, forming an ingot by pouring molten metal about the insert comprising all of said plates, the thickness of the selected metal plate adjacent the plate of different metal being less than, but the thickness of said insert at each side of said substance being at least equal to, the critical percentage of the perpendicular distance between said substance and the corresponding outer surface of said ingot to prevent breakdown of said substance by the heat from said molten metal.

7. The method of making laminated metal blanks, comprising the steps of arranging two plates of stainless steel in opposed relation with a weld-preventing substance therebetween, covering one of the opposed plates with a heat absorbing metal plate adjacent to and in parallelism with the opposed plates, forming an ingot by pouring a molten metal about the insert comprising all of said plates, and flattening said ingot upon a plane parallel with said plates, the thickness of the stainless plate covered by the heat absorbing plate being less than, but the thickness of said insert at each side of said substance being at least equal to, the critical percentage of the perpendicular distance between said substance and the corresponding outer surface of said ingot to prevent breakdown of said substance by the heat from said molten metal.

8. The method of making laminated blanks from an ingot, comprising the steps of forming an envelope having opposed side walls of stainless steel separated by a weld-preventing substance adapted to break down from heat of molten metal when protected from the molten metal by solid metal of a thickness less than a critical percentage of the combined thickness of said solid and molten metals at each side of said substance covering one of said walls with a metal plate of low carbon content, and forming an ingot by pouring a body of molten metal of higher carbon content about the insert comprising said envelope and plate, the thickness of the wall covered by the plate of low carbon content being less than, but the thickness of said insert at each side of said substance being at least equal to, said critical percentage of the perpendicular distance between said substance and the corresponding outer surface of the ingot.

9. The method of making laminated metal blanks, comprising the steps of forming an envelope having opposed side walls of stainless steel separated by a weld-preventing substance, placing adjacent one of said side walls a plate of metal substantially void of elements deleterious to the stainless steel side walls, and forming an ingot by pouring about the insert comprising said envelope and plate molten metal containing an element adapted to have a deleterious effect on the substance-engaging surface portion of said stainless steel wall if united therewith, the thickness of the stainless steel wall adjacent the plate being less than, but the thickness of the insert at each side of said substance being at least equal to, the critical percentage of the perpendicular distance between said substance and the corresponding outer surface of the ingot to prevent breakdown of said substance by the heat from said molten metal.

10. A method of making laminated metal blanks, each having a relatively thin surface lamination of stainless steel not exceeding in thickness 15 per cent. of the combined thickness of the blank, comprising the steps of forming a flat envelope from a pair of sheets of stainless steel whose juxtaposed faces are separated only by non-metallic weld-preventing material adapted to break down from the heat of molten metal when protected from the molten metal by solid metal of a thickness less than 15 per cent. of the combined thickness of the solid and molten metal on each side of said substance, covering the outer faces of said sheets with relatively thick iron slabs secured to the envelope so as to form therewith an insert, forming an ingot by pouring a body of molten metal, high in carbon content relative to the slab metal, about the insert to such an extent that the thickness of the insert at each side of said substance is at least equal to, but the thickness of each sheet is less than, substantially 15 per cent. of the perpendicular distance from said material to the corresponding outer face of the poured metal, flattening said ingot by hot rolling upon opposite surfaces in substantial parallelism with said envelope, and dividing the flattened ingot at the plane section between the sheets of the envelope to provide a plurality of blanks.

11. The method of making laminated metal blanks, comprising the steps of forming an envelope having opposed side walls of a selected metal separated only by non-metallic weld-preventing material, shielding a side wall of said envelope with a metal plate, and forming an ingot by pouring molten metal about the insert comprising said envelope and plate, the thickness of a wall of said envelope being less than, but the thickness of said insert at each side of said material being at least equal to, the critical percentage of the perpendicular distance between said material and the corresponding outer surface of said ingot to prevent breakdown of said substance by the heat from the molten metal.

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