

April 26, 1949.

W. L. KEENE ET AL

2,468,206

BIMETALLIC BILLET

Filed April 7, 1945

Fig.1.

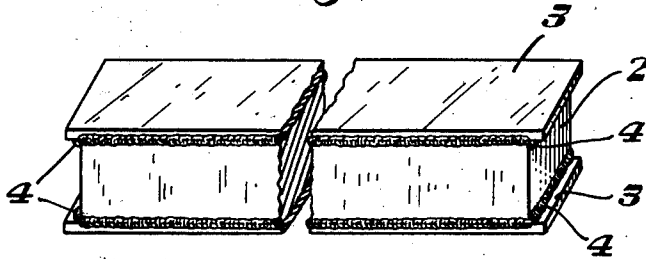


Fig.2.

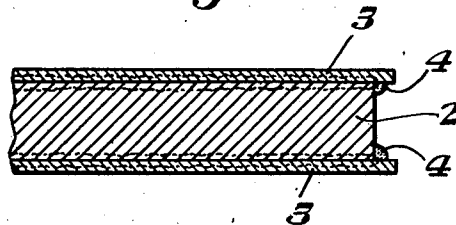
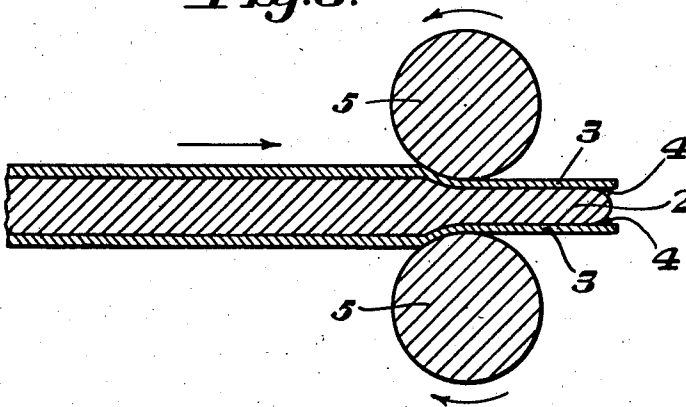


Fig.3.



INVENTORS

Walter L. Keene and
William A. Carlson

by *Edmund Benson and Webb*
their attorneys

UNITED STATES PATENT OFFICE

2,468,206

BIMETALLIC BILLET

Walter L. Keene, Dormont, and William A. Carlson, Pittsburgh, Pa., assignors to Superior Steel Corporation, Pittsburgh, Pa., a corporation of Virginia

Application April 7, 1945, Serial No. 587,116

7 Claims. (Cl. 29—187.5)

1

This invention relates to bimetallic billets. It relates particularly to bimetallic billets whose components are welded together. It relates still more particularly to welded bimetallic billets comprising metals having substantially different longitudinal extensibilities upon hot rolling. The term "bimetallic billet" is used herein to denote any billet comprising at least two components of different metals which are assembled and heated together and then hot rolled to form so-called "clad" sheet or strip metal; the billet may comprise two, three or more components.

In making clad metal it is common to first form a bimetallic billet consisting of a backing member and either one or two facing members applied to the backing member and then heat the composite billet and roll the same to form strip. One way of making a bimetallic billet is to provide a backing member flanged along longitudinal edges thereof and apply a facing member or facing members to one or both of the broad faces of the backing member and turn down the flanges of the backing member to hold the facing member or facing members in place thereon. That method of billet formation has proved highly satisfactory, but there are certain cases in which it is important to exclude air and other gases from between the billet components in order to prevent the formation therebetween during heating of the billet of oxides which interfere with proper bonding of the billet components during hot rolling, and in those cases it is desirable to weld the billet components together either completely about the periphery of the billet, or, as when a longitudinally flanged backing member is employed as above described, at least at the ends of the billet. Normally when exclusion of air and other gases is important a plain rather than a flanged backing member is employed and the backing and facing members are welded together completely about the periphery of the billet.

For example, in the making of clad strip consisting of plain carbon steel clad with stainless steel considerable difficulty has been encountered by reason of the formation on the stainless steel component of the bimetallic billet during heating of the billet preliminarily to hot rolling of oxides which prevent bonding together of the plain carbon steel and the stainless steel during rolling. Hence it is desirable in making a composite billet comprising components of plain carbon steel and stainless steel to exclude air and other gases from between the billet components and this, as known to those skilled in the art, may effectively be done by welding together the billet components as above described.

We have found that the way in which billet components having substantially different longitudinal extensibilities upon hot rolling are welded

2

together at the ends of the billet, and particularly at the end of the billet which is the leading end in the first pass in the hot rolling mill, is of great importance as bearing upon the maintenance of the integrity of the billet during rolling. To illustrate, when a bimetallic billet consisting of a backing member of plain carbon steel and a facing member of stainless steel is hot rolled the plain steel backing member elongates to a greater extent than does the stainless steel facing member. This differential elongation places a strain upon the welds at the ends of the billet and particularly upon the weld at the leading end of the billet in the first hot rolling pass. If the billet components have their ends flush with one another and welded together by a flush weld there is grave danger that the weld will rupture when the leading end of the billet enters the first hot rolling pass. The tendency of the plain steel backing member to elongate relatively to the stainless steel facing member places the flush weld under tension and under shear and it is likely to give way. If the plain steel backing member projects longitudinally from the leading end of the billet beyond the end of the stainless steel facing member and the facing member is welded to the backing member by a fillet weld acting between a side face of the plain steel backing member and the end face of the stainless steel facing member, which weld we term an "outside" fillet weld, there is also danger of rupture of the weld since the projecting end of the backing member enters the rolls first and the rolls tend to pull forward the backing member and to roll rearwardly thereover the forward end of the facing member. This places the outside fillet weld under tension and shear so that its rupture is likely.

We have found that the disadvantages above referred to incident to use of a flush weld and an outside fillet weld at the leading end of a plain carbon steel-stainless steel billet can be overcome by making the stainless steel facing component project somewhat beyond the plain steel backing component lengthwise of the billet and welding the components together by what we term an "inside" fillet weld which joins the end face of the backing member and a side face of the facing member. When the components are thus joined together by an inside fillet weld and the billet is heated and entered into the hot rolls the projecting forward end of the facing member enters the rolls first and the tendency of the rolls is to turn the projecting end of the facing member somewhat toward the backing member, thus tending to close and consolidate the leading end of the billet. When the backing member of the bimetallic billet elongates to a greater extent than the facing member the inside fillet weld is not subjected simply to tension and shear but is under

substantial compression. The weld may be turned through an appreciable angle as the backing member elongates relatively to the facing member but it is better adapted to maintain the integrity of the bimetallic billet than a flush weld or an outside fillet weld. Whatever the reason, we have found that plain carbon steel-stainless steel billets made as just described roll much more satisfactorily than when made otherwise and that there is very little danger of rupture of the weld in hot rolling. Our billet structure is especially desirable in the making of strip consisting of carbon steel clad with 17% chromium stainless steel although it is of great advantage in the making of carbon steel clad with other stainless steels.

Our improved billet is also of great utility in the making of other clad metals. It may be made using any billet components which can satisfactorily be welded together to form a usable billet. While our invention is especially adapted for use in billets composed of components of metals having substantially different longitudinal extensibilities upon hot rolling, billets may be made in accordance therewith out of components of metals having similar longitudinal extensibilities upon hot rolling, although the advantage of such billets over flush welded billets is less pronounced. We prefer to have a billet component which has a relatively small longitudinal extensibility upon hot rolling extend lengthwise of the billet beyond the end of a component having a relatively great longitudinal extensibility upon hot rolling and to weld a side face of the former to an end face of the latter. A weld which joins a side face of a billet component having a relatively small longitudinal extensibility upon hot rolling and an end face of a billet component having a relatively great longitudinal extensibility upon hot rolling is what we term an inside fillet weld. Sometimes the component having the greater longitudinal extensibility upon hot rolling will be a backing component and sometimes it will be a facing component.

Other details, objects and advantages of the invention will become apparent as the following description of a present preferred embodiment thereof proceeds.

In the accompanying drawings we have shown a present preferred embodiment of the invention, in which

Figure 1 is an isometric view of a bimetallic billet with a portion cut away;

Figure 2 is a fragmentary vertical longitudinal cross-sectional view through the billet shown in Figure 1; and

Figure 3 is a diagrammatic vertical longitudinal cross-sectional view illustrating the passage of the leading end of the billet through the first pass in the hot rolling mill.

Referring now more particularly to the drawings, the composite billet shown in Figure 1 comprises a backing component 2 of plain carbon steel which may, for example, be a low carbon steel of any common analysis. Disposed at the opposed flat faces of the backing component 2 are facing components 3 of stainless steel and which may, for example, be of 17% chromium stainless steel (commercially known as type 430). The relative thickness of the backing and facing components will vary depending upon the purpose for which the clad metal is to be used. Normally the backing component is relatively thick and the facing components are relatively thin. A bimetallic billet having two opposed facing components will produce strip clad on both sides. If

strip clad on one side only is desired one of the facing components will be omitted.

The width of the backing and facing components is shown as being substantially the same. However, the facing components project substantially beyond the backing component at at least the end of the billet which is to be the leading end when the billet is introduced into the first pass in the hot rolling mill. In the structure shown in Figure 1 the facing members project longitudinally beyond the end of the backing member at both ends of the billet. Such a billet is especially well adapted for rolling in a reversing mill in which the respective ends of the billet alternate as the leading end in successive roll passes.

Each of the facing components is welded to the backing component completely around the periphery of the billet. This is done to exclude air and other gases from between the components. If air and other gases are not excluded an oxide tends to form on the surfaces of the facing members which lie against the backing member, which oxide prevents proper bonding of the facing members to the backing member during rolling. In preparing the billet components for assembly their faces which are to lie in contact with one another are made smooth and clean so that when they lie against one another there is no room between them for any substantial amount of air or other gas. The peripheral welding prevents ingress of air and other gases during rolling and while the weld may become ruptured at some stage of the rolling it will maintain its integrity long enough to exclude from the contacting surfaces of the billet components air and other gases in such quantities as to form oxides which will interfere with proper bonding together of the components. In other words, the components will become bonded to one another before the effectiveness of the peripheral weld as a seal is impaired.

Along the longitudinal edges of the billet the edges of the components are welded together by flush welds since the components are of the same width. However, at the ends of the billet each facing member is welded to the backing member by an inside fillet weld, that is, a weld between an end face of the steel backing member and a side face of the stainless steel facing member. The inside fillet welds are designated 4 in the drawings.

Figure 3 shows the action upon the billet of the rolls constituting the first pass in the hot rolling mill, the rolls being designated 5. The billet as a whole and each component thereof is substantially reduced in thickness. However, during reduction and prior to bonding together of the backing and facing members the steel backing member 2 elongates to a greater extent than do the stainless steel facing members 3. Whereas in the original billet the stainless steel facing members project longitudinally substantially beyond the plain steel backing member, the backing member is elongated in the first pass to such an extent that its leading end extends to a point relatively close to the leading ends of the facing members. The metal at and adjacent the end face of the backing member between the welds 4 tends to force its way longitudinally of the billet relatively to the facing members and relatively to the welds and this apparently somewhat turns or rotates the welds. The welds are, nevertheless, still maintained largely in compression; whatever the precise action, we have found the inside fillet welds to be definitely superior in preventing

5

the formation between the backing and facing members during rolling while the billet components are being bonded together of oxides impairing proper bonding.

If flush or outside fillet welds were employed at the leading end of the billet the greater elongation of the backing member would immediately place such welds under tension and shear with the consequent danger of their rupture as above explained. Rupture of the welds releases the ends of the facing members which under the action of the rolls tend to curl outwardly away from the backing member.

While we have shown and described a present preferred embodiment of the invention it is to be distinctly understood that the invention is not limited thereto but may be otherwise variously embodied within the scope of the following claims.

We claim:

1. A billet comprising opposed layers of stainless steel with a layer of carbon steel therebetween, said layers being superposed but unbonded, the layers of stainless steel projecting beyond the layer of carbon steel at one end of the billet, and continuous peripheral welds between the carbon steel layer and the respective stainless steel layers excluding air from between the layers, said welds including opposed separate spaced apart fillet welds joining the end face of the carbon steel layer at said end of the billet and the respective inner faces of the stainless steel layers.

2. A billet comprising opposed layers of stainless steel with a layer of carbon steel therebetween, said layers being superposed but unbonded, the layers of stainless steel projecting beyond the layer of carbon steel at one end of the billet, the layers of stainless steel being welded to the layer of carbon steel completely about the billet, opposed separate spaced apart fillet welds joining the end face of the carbon steel layer at said end of the billet and the respective inner faces of the stainless steel layers, the billet being free from air between the layers.

3. A billet comprising a layer of stainless steel and a layer of carbon steel, said layers being superposed but unbonded, the layer of stainless steel projecting beyond the layer of carbon steel at one end of the billet, and a continuous peripheral weld between the stainless steel layer and the carbon steel layer excluding air from between the layers, said weld including a fillet weld joining the inner face of the stainless steel layer and the adjacent portion only of the end face of the carbon steel layer at said end of the billet.

4. A billet comprising superposed but unbonded layers of different metals having different longitudinal extensibilities upon hot rolling, a layer of metal having a lesser longitudinal extensibility upon hot rolling projecting beyond a layer of metal having a greater longitudinal extensibility upon hot rolling at one end of the billet, and a fillet weld joining the face of the first

6

mentioned layer disposed toward the last mentioned layer and the adjacent portion only of the end face of the last mentioned layer at said end of the billet.

5. A billet comprising opposed layers of metal having a relatively small longitudinal extensibility upon hot rolling with a layer of metal having a relatively great longitudinal extensibility upon hot rolling therebetween, said layers being superposed but unbonded, the first mentioned layers projecting beyond the second mentioned layer at one end of the billet, and opposed separate spaced apart fillet welds joining the end face of the second mentioned layer at said end of the billet and the respective inner faces of the first mentioned layers.

6. A billet comprising superposed but unbonded layers of different metals having different longitudinal extensibilities upon hot rolling a layer of metal having a lesser longitudinal extensibility upon hot rolling projecting beyond a layer of metal having a greater longitudinal extensibility upon hot rolling at one end of the billet, said layers being welded together completely about the periphery of the billet, the portion of the weld at said end of the billet joining the face of the first mentioned layer disposed toward the last mentioned layer and the adjacent portion only of the end face of the last mentioned layer.

7. A billet comprising superposed but unbonded layers of carbon steel and stainless steel, the carbon steel layer having a greater longitudinal extensibility upon hot rolling than the stainless steel layer, the stainless steel layer projecting beyond the carbon steel layer at one end of the billet, a weld joining the face of the stainless steel layer disposed toward the carbon steel layer and the adjacent portion only of the end face of the carbon steel layer at said end of the billet, and means at the longitudinal edges of the billet and at the opposite end of the billet sealing the joint between said layers, the billet being free from air between the layers.

WALTER L. KEENE.

WILLIAM A. CARLSON.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
543,192	Rodig	July 23, 1895
574,488	Kinsey	June 5, 1897
792,099	Williams	June 13, 1905
1,896,411	Maskrey	Feb. 7, 1933
2,064,684	Ostendorf	Dec. 15, 1936
2,144,915	Derby	Jan. 24, 1939
2,225,868	Huston et al.	Dec. 24, 1940
2,286,091	Carlson	Oct. 2, 1945
2,395,878	Keene	Mar. 5, 1946

Certificate of Correction

Patent No. 2,468,206.

April 26, 1949.

WALTER L. KEENE ET AL.

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 5, line 46, claim 3, for the word "unbounded" read *unbonded*; column 6, list of references cited, after the date "Jan. 24, 1939" insert the following:

2,160,559 *Orr, Jr.*.....*May 30, 1939*

line 61, same column, for the patent number "2,286,091" read *2,386,091*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 11th day of October, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.