

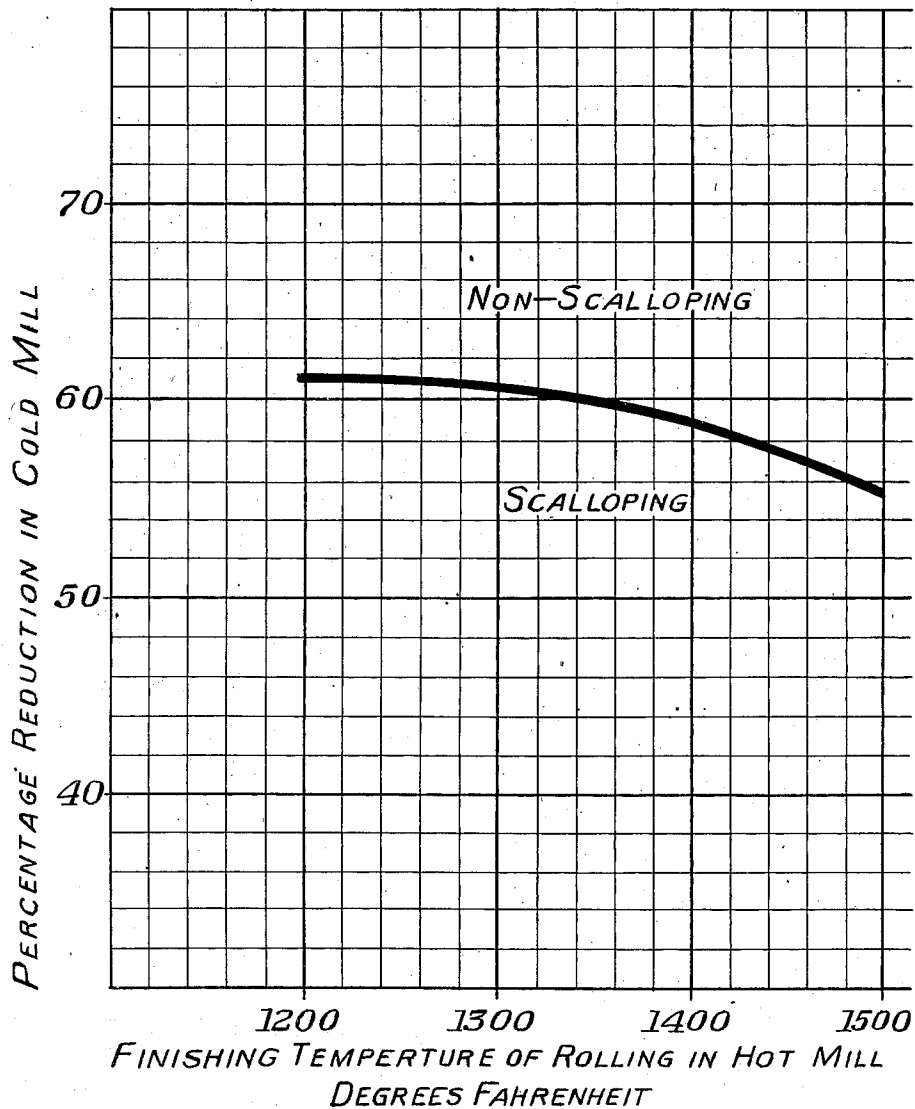
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MAKING SUBSTANTIALLY NON-SCALLOPING BIMETALLIC SHEET METAL

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MAKING SUBSTANTIALLY NONSCALLOPING
BIMETALLIC SHEET METAL

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This invention relates to making substantially non-scalloping bimetallic sheet metal. It relates more particularly to a method of making substantially non-scalloping bimetallic sheet metal having a steel component and one or more other components having a relatively low melting point. This application is in part a continuation of our copending application Serial No. 434,342.

Non-scalloping sheet metal is desired for various uses, principally deep drawing. Non-scalloping sheet metal is especially useful in the drawing of ammunition components such as bullet jackets, cartridge cases, etc., where the metal is subjected to severe cold drawing operations. By "non-scalloping" is meant the quality of drawing uniformly about a die without the formation of the well known objectionable "ears." The metal should be of so-called "equi-axed" grain structure, substantially free from "directional" properties.

Bimetal is used for certain of the purposes for which non-scalloping sheet metal is demanded, as, for example, the making of bullet jackets. Bullet jackets are made of bimetal consisting of a backing of steel faced on both sides with a relatively soft corrosion resistant alloy such, for example, as gilding metal, which consists of in the neighborhood of 90% copper and in the neighborhood of 10% zinc. It is therefore important to produce substantially non-scalloping bimetal sheet of this type.

It is known that non-scalloping steel can be produced if the steel is hot rolled at such a temperature that the hot rolling is finished while the steel is above the upper critical temperature or A_3 point. Non-scalloping cold rolled steel may be made out of such hot rolled steel by cold rolling the hot rolled steel and then annealing the cold rolled steel according to well known practice.

When, however, the melting point of a component employed in making bimetallic sheet is relatively low (e. g., of the order of the melting point of gilding metal, which is in the neighborhood of 1913° F.) it is not possible to hot roll the bimetal so that the hot rolling is finished before the metal cools below the upper critical temperature of the steel. This is because the hot rolling cannot be commenced with the bimetal at a high enough temperature to insure completion of the hot rolling before its temperature drops below the upper critical temperature of the steel as to do so would necessitate initially heating the bimetal to a temperature above the

melting point of the relatively low melting point component, which would result in reducing the relatively low melting point component to molten state in which it obviously could not be rolled. While non-scalloping bimetal can be obtained by normalizing this is sometimes undesirable as it results in increase of the grain size of the non-ferrous component.

We have discovered how to make substantially non-scalloping bimetallic sheet metal having a layer of steel and another layer or layers of metal having a relatively low melting point without normalizing. When the melting point of the second mentioned layer or layers (ordinarily the facing) is so low that it is impossible to hot roll the bimetal so that the hot rolling is finished while the metal is at a temperature above the upper critical temperature of the steel it is possible to obtain substantially non-scalloping bimetallic sheet metal by carrying out the rolling in the hot rolling mill so that the temperature of the metal at the conclusion of the rolling in such mill is below the upper critical temperature of the steel and following such rolling in the hot rolling mill by rolling in the cold rolling mill to effect at least a predetermined reduction in gauge by such rolling, as will be described below, depending upon the temperature of the metal at the conclusion of the rolling in the hot mill, and then annealing the rolled metal.

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

The accompanying drawing consists of a curve showing the relation between the finishing temperature of rolling of bimetallic sheet metal in the hot mill and the minimum percentage of reduction in the cold mill to which the sheet metal previously rolled in the hot mill should be subjected in order to obtain, after subsequent annealing, substantially non-scalloping bimetallic sheet metal.

The invention will be described for purposes of explanation and illustration as employed in the making of bimetallic strip consisting of a component of steel faced on both sides with gilding metal.

The term "sheet metal" as used in the claims is intended to comprehend both sheets and strip. In making, for example, bimetallic strip consisting of steel faced on both sides with gilding metal there is first prepared a bimetallic billet having a steel backing and opposed facings of gilding metal secured to the steel backing. This bimetal-

lic billet is heated, rolled in a hot mill, rolled in a cold mill and annealed. It cannot be heated to the usual temperature for the hot rolling of steel because the melting temperature of gilding metal is so low that if this were attempted the gilding metal would melt. Consequently the bimetallic billet must be rolled in the hot mill at temperatures considerably lower than the usual hot rolling temperatures for steel and the finishing temperature of the work in the hot mill is below the upper critical temperature of steel. For example, the bimetallic billet may be heated to, say, about 1750° F. and the work may be at a temperature of from 1200 to 1500° F. at the conclusion of rolling in the hot mill, depending upon the reduction in gauge desired in the hot mill and other factors encountered in rolling.

After the work has been rolled in the hot mill it is then rolled in the cold mill. The extent of reduction by rolling in the cold mill in relation to the finishing temperature of rolling in the hot mill determines whether after the subsequent anneal the bimetallic strip will be substantially non-scalloping. The accompanying curve shows the minimum percentage of reduction to which the work should be subjected in rolling in the cold mill for various finishing temperatures of rolling in the hot mill in order to produce non-scalloping strip. The curve is clear upon its face and needs no further explanation except that it is to be considered approximate rather than exact due to the factors of variation entering into the process. Generally speaking, if the finishing temperature of rolling in the hot mill is 1350° F. the percentage reduction by rolling in the cold mill should be at least 60% in order that after the final anneal the bimetallic strip will possess substantially non-scalloping properties. It can be said in general that if the finishing temperature of rolling in the hot mill is not substantially below 1200° F., and if the percentage reduction in the cold mill is above 60%, substantially non-scalloping bimetallic strip will result after the final anneal. If the finishing temperature of rolling in the hot mill is in the neighborhood of 1300° F. the work should be reduced by rolling in the cold mill at least about 60%. If the finishing temperature of rolling in the hot mill is about 1500° F. the results desired can be obtained by a reduction of at least about 55% in the cold rolling mill.

The anneal to which the bimetal rolled as above described is subjected after completion of rolling in the cold mill is preferably the practice ordinarily followed commercially in annealing low carbon steel. This practice is of course known to persons skilled in the art. For a steel having about .10% carbon a batch anneal in coils at about 1250 to 1300° F. for in the neighborhood of eight hours at temperature is satisfactory. If it is desired to continuously anneal the strip it may be passed through an annealing furnace maintained at a temperature in the neighborhood of 1360° F., each portion of the strip being in the furnace for about four minutes. For example, the strip may be passed through a furnace about 32 feet long at a speed of about eight feet per minute. It is to be understood that we prefer to employ the ordinary commercial anneal for low carbon steel and that no novelty for the anneal per se is claimed. The above examples of anneals which have been found satisfactory are given purely by way of illustration.

The invention is not limited to the making of bimetallic sheet metal in which one of the components is gilding metal. Other relatively low

melting point metals or alloys may be employed instead of gilding metal and comparable results obtained. For example, cupro-nickel or silver may be employed. The melting point of cupro-nickel having in the neighborhood of 85% copper and in the neighborhood of 15% nickel is about 2147° F. The melting point of silver is about 1760° F.

We are aware that some authorities consider the term "hot rolling" to mean rolling which is finished while the steel is above the upper critical temperature or A_{c3} point. For this reason and to avoid ambiguity we have not used the expression "hot rolling" to describe the rolling of the bimetal in a hot mill described and claimed herein since according to our invention the finishing temperature of rolling in the hot mill is below the A_{c3} point. Such point for steel containing about .10% carbon is in the neighborhood of 1605° F. Consequently the rolling to which we subject the bimetal in the hot mill may be partly at such a temperature that it would commonly be called "hot rolling" and is always at least partly below the A_{c3} point. The rolling to which we subject the bimetal in the cold mill is always at temperatures below the A_{c3} point.

It is to be understood that the invention is not limited to the particular method above described by way of example and may be otherwise variously practiced within the scope of the following claims.

We claim:

1. A method of making substantially non-scalloping bimetallic sheet metal having a layer of steel and a layer of non-ferrous metal having a relatively low melting point comprising heating to a temperature suitable for rolling in a hot rolling mill but below the melting point of the non-ferrous metal a bimetallic billet comprising a component of steel and a component of said non-ferrous metal, rolling said billet into sheet metal in a hot rolling mill, finishing such rolling at a temperature below the upper critical temperature of the steel but not substantially below 1200° F., rolling the thus rolled sheet metal in a cold rolling mill and thereby reducing its gauge over 60% and annealing the rolled sheet metal.

2. A method of making substantially non-scalloping bimetallic sheet metal having a layer of steel and a layer of non-ferrous metal having a relatively low melting point comprising heating to a temperature suitable for rolling in a hot rolling mill but below the melting point of the non-ferrous metal a bimetallic billet comprising a component of steel and a component of said non-ferrous metal, rolling said billet into sheet metal in a hot rolling mill, finishing such rolling at a temperature below the upper critical temperature of the steel, rolling the thus rolled sheet metal in a cold rolling mill and thereby reducing its gauge at least about the percentage shown on the accompanying curve for the finishing temperature of the rolling in the hot mill and annealing the rolled sheet metal.

3. A method of making substantially non-scalloping bimetallic sheet metal having a layer of steel and a layer of non-ferrous metal having a relatively low melting point comprising heating to a temperature suitable for rolling in a hot rolling mill but below the melting point of the non-ferrous metal a bimetallic billet comprising a component of steel and a component of said non-ferrous metal, rolling said billet into sheet metal in a hot rolling mill, finishing such rolling at a temperature in the neighborhood of 1300° F.,

rolling the thus rolled sheet metal in a cold rolling mill and thereby reducing its gauge at least about 60% and annealing the rolled sheet metal.

4. A method of making substantially non-scalloping bimetallic sheet metal having a layer of steel and a layer of gilding metal comprising heating to a temperature suitable for rolling in a hot rolling mill but below the melting point of gilding metal a bimetallic billet comprising a component of steel and a component of gilding metal, rolling said billet into sheet metal in a hot rolling mill, finishing such rolling at a temperature below the upper critical temperature of steel, rolling the thus rolled sheet metal in a cold rolling mill and thereby reducing its gauge at least about the percentage shown on the accompanying curve for the finishing temperature of the rolling in the hot mill and annealing the rolled sheet metal.

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5. A method of making substantially non-scalloping bimetallic sheet metal having a layer of steel and a layer of dissimilar metal whose melting point is so low that it cannot be rolled at usual starting hot rolling temperatures for steel comprising heating to a temperature suitable for rolling in a hot rolling mill but below the melting point of the dissimilar metal a bimetallic billet comprising a component of steel and a component of dissimilar metal, rolling said billet into sheet metal in a hot rolling mill, finishing such rolling at a temperature below the upper critical temperature of steel, rolling the thus hot rolled sheet metal in a cold rolling mill and thereby reducing its gauge at least about the percentage shown on the accompanying curve for the finishing temperature of the rolling in the hot mill and annealing the rolled sheet metal.

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