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PATENT REQUEST : STANDARD PATENT

I/We, being the person(s) identified below as the Applicant(s), request the grant of a Standard Patent to the person(s) identified below as the Nominated Person(s), for an invention described in the accompanying complete specification.

Applicant(s) and Nominated Person(s): MANNESMANN AKTIENGESELLSCHAFT

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Invention Title: METHOD OF MANUFACTURING ROLLED MATERIAL FROM OXYGEN-FREE COPPER

Name(s) of Actual Inventor(s): LEV PETROVICH FREEDMAN; YERMEK B KHAFIZOV; DR.-ING ELMAR BUCH; KURT SIEBEL; HERBERT BERENDES

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BASIC CONVENTION APPLICATION DETAILS

Application No:	Country:	Application Date:
P4136085.0	DE	30 October 1991

Drawing number recommended to accompany the abstract: 1

DATED: 28 October 1992

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Regulation 3.1(2)

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NOTICE OF ENTITLEMENT

We MANNESMANN AKTIENGESELLSCHAFT

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being the applicant(s) in respect of an application for a patent for an invention entitled METHOD OF MANUFACTURING ROLLED MATERIAL FROM OXYGEN-FREE COPPER (Application No. 27387/92), state the following:

1. The nominated person(s) has/have, for the following reasons, gained entitlement from the actual inventor(s):

   THE APPLICANT AND NOMINATED PERSON WOULD BE ENTITLED TO HAVE ASSIGNED TO IT A PATENT GRANTED TO THE ACTUAL INVENTOR IN RESPECT OF THIS INVENTION.

2. The nominated person(s) has/have, for the following reasons, gained entitlement from the basic applicant(s) listed on the patent request:

   THE APPLICANT AND NOMINATED PERSON IS THE BASIC APPLICANT.

3. The basic application(s) listed on the request form is/are the first application(s) made in a Convention country in respect of the invention.

DATE: 28 March 1995

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(54) Title
METHOD OF MANUFACTURING ROLLED MATERIAL FROM OXYGEN-FREE COPPER

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(56) Prior Art Documents
US 4290283

(57) Claim

1. A method for producing rolled stock from oxygen-free copper, in particular wire, in a cast-rolling plant, consisting of a smelting plant, a casting mould and a subsequent continuous rolling mill, characterised in that a bar which leaves the casting plant in rectilinear fashion is bent off in a substantially horizontal direction once it has been reduced in at least one deformation pass, with the deformation pass of the bar and the smelting and casting operations taking place in a protective gas atmosphere.

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COMPLETE SPECIFICATION

STANDARD PATENT

Applicant(s):

MANNESMANN AKTIENGESELLSCHAFT

Invention Title:

METHOD OF MANUFACTURING ROLLED MATERIAL FROM OXYGEN-FREE COPPER

The following statement is a full description of this invention, including the best method of performing it known to me/us:

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a method of manufacturing rolled material of oxygen-free copper, particularly wire, in a casting and rolling plant which includes a melting plant, a casting plant with inclined following mold, as well as a subsequently arranged continuous rolling mill. The invention further relates to an arrangement for carrying out the method.

2. Description of the Related Art

For manufacturing copper wire, plants have been built for approximately 25 years which manufacture the copper wire in a continuous sequence from liquid melt through a casting machine with following molds and a continuous rolling mill with subsequently arranged wire scouring path. This copper wire is wound at the end of the plant into coils of up to 10 tons.

During melting, casting and subsequent rolling, the copper billets or the copper wire takes up oxygen which is harmless for some purposes, but has a damaging effect in many types of applications, particularly when used in the electronics industry. For this particular purpose, it is absolutely necessary to reduce the oxygen content in the copper wire or to completely eliminate the oxygen content.

SUMMARY OF THE INVENTION

Therefore, it is the primary object of the present invention to provide a method, and an arrangement for carrying out the method, which makes it possible to produce oxygen-free copper wire in-line in a casting and rolling plant of the above-described type.

The present invention is based on the finding

that the phenomena of hydrogen embrittlement known to those skilled in the art is not relevant in oxygen-free copper.

In copper which contains oxygen, the oxygen reacts with the hydrogen contained in the copper to form heated steam. This reaction produces very high pressures which lead to cracks along the grain boundaries and ruptures and finally to breaking up of a cast warm copper billet. In connection with the accompanying elements contained in the copper, such as impurities, the danger of cracks and breakage is further increased, particularly when bending the cast hot billet.

Even when melting and casting are carried out under gas shrouding, oxygen-free copper still contains defined amounts of hydrogen. However, it must be prevented that the combination of small hydrogen blisters results in large hydrogen blisters at the grain boundaries and hot shortness must be prevented, particularly when simultaneously bending the hot copper billet. The possibility of the formation of undesired large hydrogen blisters increases with increasing time available from the solidification of the liquid copper.

The invention provides a method for producing rolled stock from oxygen-free copper, in particular wire, in a cast-rolling plant, consisting of a smelting plant, a casting mould and a subsequent continuous rolling mill, characterised in that a bar which leaves the casting plant in rectilinear fashion is bent off in a substantially horizontal direction once it has been reduced in at least one deformation pass, with the deformation pass of the bar and the smelting and casting operations taking place in a protective gas atmosphere.

The first shaping pass is advantageously carried out closely following the casting plant. Bending of the copper

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billet following the first reducing pass or several reducing passes in inert gas atmosphere is not harmful after the grain size has been reduced and no longer leads to the cracks which it was impossible in the past to prevent.

It has been found that particularly favourable results are obtained if the reduction in the first shaping pass is between 10 and 50%, preferably 35%.

The invention also provides a cast-rolling plant for producing rolled stock from oxygen-free copper in particular wire, consisting of a smelting plant, a strip-casting mould and a subsequent continuous rolling mill, characterised by at least one deformation stand located after the strip-casting mould, the at least one deformation stand having a rolling axis coaxial to the central longitudinal axis of the strip-casting mould, and the region between the smelting furnace and strip-casting mould and between the strip-casting mould and the deformation stand(s) being located under a shroud which is provided with means for producing a protective gas atmosphere in the interior thereof.

Accordingly, the shaping unit arranged closely adjacent to the casting machine is arranged with the same inclination as the casting plant, wherein additional units for preparing the billet, such as, side trimming unit, driver, etc., may be arranged between the casting plant and the first shaping stand.

It is considered to be a particular advantage of the present invention that the arrangement can be used for manufacturing oxygen-free copper as well as for

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manufacturing oxygen-containing copper.

Other objects and features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

In the Drawing:

The single figure of the drawing is a schematic illustration of the arrangement according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As illustrated in the drawing, the casting and rolling plant according to the present invention includes a melting furnace 1, a holding furnace 2, a runner 3, a tundish 4, a pouring lip 5 of the tundish 4 extending into the region of a continuous casting mold 6. The plant further includes a driver 7, a side trimming device 8 and a shaping stand 9.

As is well known, in order to prevent the melt from taking up oxygen, the melt is covered with charcoal in the melting furnace 1 as well as in the holding furnace 2. The present invention additionally provides shrouding of the melting furnace 1, the holding furnace 2, the runner 3 and the tundish 4 and operating these units in an inert gas atmosphere. The shrouding is designated with H in the drawing. All units are as tight as possible. Contrary to the conventional gas heating, all units are inductively heated. Nitrogen is preferably blown in in the travel direction of the material and flows toward the tundish

where it exits together with the molten copper.

Because of its specific gravity as compared to air, the nitrogen flowing out of the tundish 4 protects the inlet region of the continuous casting mold 6 from taking up oxygen. In addition, laterally arranged protective plate constructions can have the effect that the nitrogen has a longer dwell time in this region and, thus, safely protects against oxygen.

Even though the strand which has solidified in the continuous casting mold 6 is no longer subject to the danger that the strand interior picks up oxygen, it is still necessary to prevent as much as possible the oxygen from combining with the strand surface which is hot from rolling. For this purpose, the shrouding is continued following the continuous casting mold 6 and includes the driver 7, the side trimming or bevelling device 8 and the shaping stand 9 and possibly the bending area 10. As provided by the teaching of the present invention, following the shaping stand 9, the billet is deflected in the bending area 10 from the casting direction into the horizontal direction.

The arrangement operates as follows: The copper melt in the melting furnace 1 is subjected to intermediate storage in the holding furnace 2 and is conducted through the runner 3 into the tundish 4. All units are sealed by a shrouding H, so that an inert gas atmosphere is provided in the interior of the shrouding H. From the tundish 4 through which nitrogen is conducted, the copper melt reaches the continuous casting mold in which copper billets are cast between strip-shaped mold sides and the copper billet leaves the continuous casting mold 6 in casting direction after solidification. The copper billet which has a temperature of 980 to 1000°C is introduced by means of a driver 7 into the edge processing device 8, i.e. a

bevelling machine, where the edges of the billet are bevelled. Subsequently, the copper billet prepared in this manner is introduced into the shaping stand.

Since the method according to the present invention requires a short distance between continuous casting melt 6 and the shaping stand 9, the shaping stand must have structural features which are usually not used in roughing stands in copper wire plants. Thus, the front end of the copper billet which still includes the dummy bar must be able to pass the shaping stand 9 without deformation. For this reason, the rolls of the shaping stand 9 are initially moved apart. When the desired strand speed has been reached, the rolls are automatically moved toward each other until the preselected reduction is reached. For this purpose, it is necessary that the speed of the rolls is determined and controlled in dependence on the respective deformation. This can be achieved by measuring the speed and the current consumption of the driver 7.

A pass reduction of approximately 35% takes place in the shaping stand 9. After leaving the shaping stand 9, the reduced copper billet is deflected in the bending area 10 of the plant on a roller conveyor into the horizontal direction and is further reduced in additional rolling stands of the continuous rolling train 11 in order to obtain wire. The copper wire produced in this manner is placed into coils at the end, not shown, of the casting and rolling plant.

It should be understood that the preferred embodiments and examples described are for illustrative purposes only and are not to be construed as limiting the scope of the present invention which is properly delineated only in the appended claims.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method for producing rolled stock from oxygen-free copper, in particular wire, in a cast-rolling plant, consisting of a smelting plant, a casting mould and a subsequent continuous rolling mill, characterised in that a bar which leaves the casting plant in rectilinear fashion is bent off in a substantially horizontal direction once it has been reduced in at least one deformation pass, with the deformation pass of the bar and the smelting and casting operations taking place in a protective gas atmosphere.

2. A method according to claim 1, characterised in that the first deformation pass is effected closely after the casting plant.

3. A method according to claims 1 and 2, characterised in that the reduction in the first deformation pass is between 10 and 50%.

4. A cast-rolling plant for producing rolled stock from oxygen-free copper, in particular wire, consisting of a smelting plant, a strip-casting mould and a subsequent continuous rolling mill, characterised by at least one deformation stand located after the strip-casting mould, the at least one deformation stand having a rolling axis coaxial to the central longitudinal axis of the strip-casting mould, and the region between the smelting furnace and strip-casting mould and between the strip-casting mould and the deformation stand(s) being located under a shroud which is provided with means for producing a protective gas atmosphere in the interior thereof.

5. A method of producing rolled stock substantially as hereinbefore described with reference to the accompanying drawings.

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6. A cast-rolling plant substantially as hereinbefore described with reference to the accompanying drawings.

Dated this 20th day of February 1995

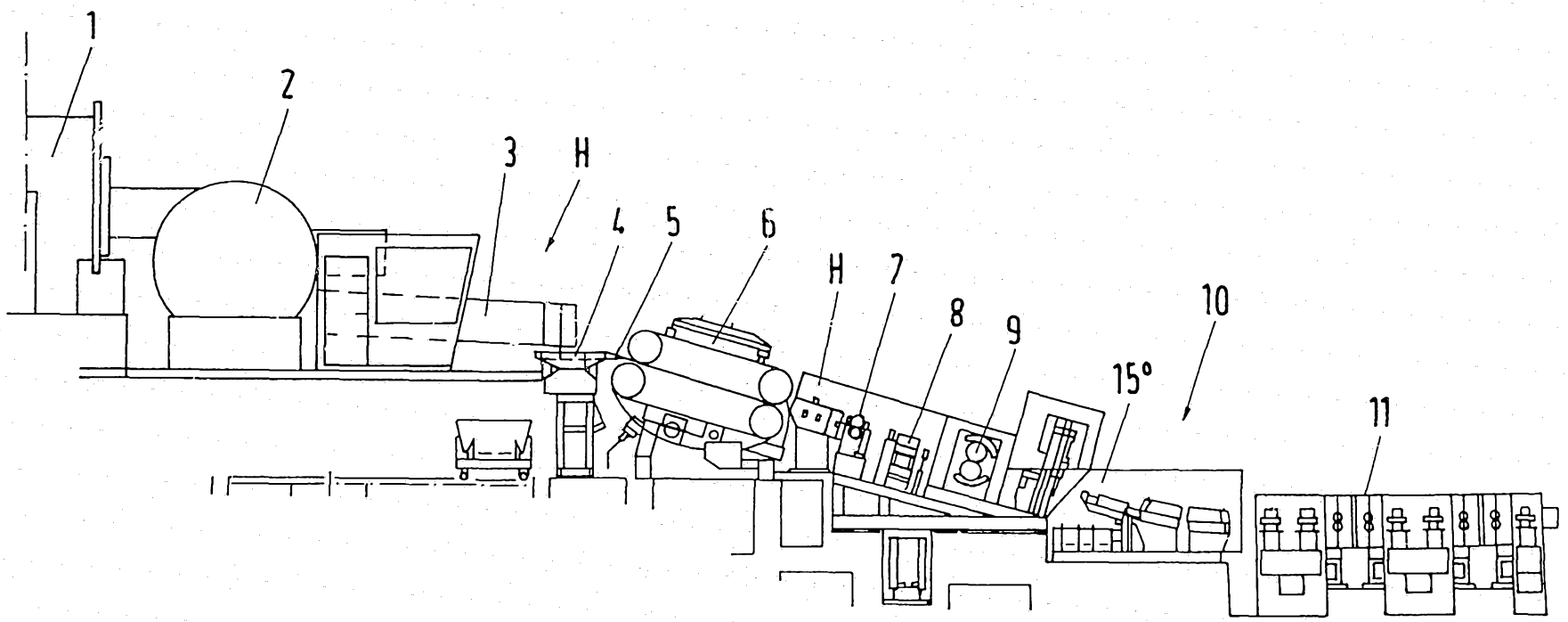
MANNESMANN AKTIENGESELLSCHAFT
By Its Patent Attorneys:

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ABSTRACT OF THE DISCLOSURE

A method of manufacturing rolled material of oxygen-free copper, particularly wire, in a casting and rolling plant composed of melting plant, continuous casting mold and a subsequently arranged continuous rolling mill. The method includes bending a billet leaving the casting plant along a straight line into the horizontal, after the billet has been reduced in at least one shaping pass. The arrangement for carrying out the method includes at least one shaping stand arranged following the continuous casting mold, wherein the rolling axis of the shaping stand coincides with the longitudinal center axis of the continuous casting mold. The region between melting furnace and continuous casting mold and the region between continuous casting mold and the shaping stand are arranged under gas shrouding.

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