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(54) **A METHOD FOR MANUFACTURING AN ULTRA-HIGH-TENSILE, STRETCH FORMED OR STRETCH BENT SHEET METAL PRODUCT OF STEEL**

VERFAHREN ZUR HERSTELLUNG EINES ULTRAHOCHZUGFESTEN RECKGEFORMTEN ODER RECKGEBOGENEN BLECHPRODUKTS AUS STAHL

PROCEDE DE FABRICATION D'UN PRODUIT EN TOLE D'ACIER A ULTRA HAUTE RESISTANCE FORME PAR ETIRAGE OU ALLONGEMENT

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EP 1 490 187 B1

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Description

[0001] The present invention relates to a method for manufacturing an ultra-high-tensile stretch formed or stretch bent sheet product of steel.

[0002] When manufacturing stretch formed or stretch bent sheet products one usually starts from metallic work pieces, preferably of a soft steel with good forming properties. During the forming operation one achieves a certain degree of deformation hardening, which however is insufficient for obtaining an ultra-high-tensile final product. In the case one should start from a material that usually is ultra-high-tensile with a yield point preferably more than 700 MPa, this material would not have sufficient ductility to be formed to any greater extent during the stretch forming or stretch bending operation. This is so because the material would brake during the forming operation.

[0003] It is known from the the document "Thelning Karl-Erik: "1.8.4 Deformationshärdning, Stål och Värmebehandling", Volume No 2, 1985, pages 62-63, figure 1.46" to reach a higher yield point of a material through cold working and heating of the same to a predermined temperature. However, a drawback when heating a cold worked carbon steel to a range of 100-300°C is the resulting deformation ageing due to the precipitation of carbides and nitrides.

[0004] Furher, US6162308 describes a process for producing a cold-rolled sheet strip made from carbon steel, lacking chromium content.

[0005] The object of the present invention is to provide a method for manufacturing an ultra-high-tensile stretch formed or stretch bent product of steel, that has initially been alloyed with chromium, nickel and carbon in predetermined proportions. The features of the invention are set forth in claim 1.

[0006] The dependent claims describe further embodiments of the invention.

[0007] Thanks to the invention one has now provided a method for manufacturing an ultra-high-tensile stretch formed or stretch bent sheet product of steel, which in an excellent matter fulfills its object at the same time as the manufacturing and take place rather rationally when using already existing machines and in modifying the design of certain parts of the tool and/or built in a temperature regulator in the whole or parts of the tool. During stretch forming or stretch bending is now achieved according to invention a final product, in which parts or the whole product has an yield point more than 700 MPa and also values far away over that, for example 1500 MPa. This result with a strong and controlled deformation hardening of the whole or parts of the product is achieved during the stretch forming or stretch bending operation by that the product is plastically cold worked at least in one step in one or more directions in combination with that the alloy maintains a good ductility during the stretch forming operation with a temperature adapted to the yield point of the final product wanted and at the same time to a deformation degree adapted to the yield point of the final product also wanted. If one has a low or not so high deformation degree and would like a high tensile this can be compensated using a lower temperature, i.e. by cooling the metal work piece before, during or after the working operation by cooling the whole or parts of the stretch forming or stretch bending tool, or by a combination of these criteria during the working operation. If one has a high deformation degree, a deformation hardening can be abstracted in that the work piece and/or the tool is allowed to keep a higher temperature.

[0008] The invention is described in more detail below with aid of an embodiment example.

[0009] In a preferred embodiment example of the invention the stretch formed or stretch bent sheet product manufactured according to the invention is constituted of a work piece of iron, which as been alloyed with chromium, nickel and carbon in predetermined proportions. In the example chosen the iron has been alloyed with 17% Cr, 7% Ni and 0,1% C or alloys closely related to these and the temperature of the work piece before and/or during the manufacturing operation has been kept or is kept at a controlled level, whereby a strong but controlled deformation hardening is achieved during the stretch forming or stretch bending operation when a plastic cold working of the work piece takes place in combination with maintaining a good ductility of the alloy. Furthermore the temperature of the finally formed stretch formed or stretch bent sheet product can be controlled directly after the working operation itself. The alloyed metal work piece, that forms the initially work piece according to the invention, can be formed or plastically cold worked in traditional machines but using modified tools for stretch forming or stretch bending in order to increase its yield point from an original, low yield point about 300 MPa to a final product that completely or partially obtains a yield point on more than 700 MPa.

[0010] The method functions also in the case you start from for example a medium high yield point i.e. 700 MPa up to a higher i.e. 1000 MPa or higher.

[0011] A stronger deformation hardening is obtained during all examples described above if the operation of forming or bending is made in two or several steps.

Claims

1. A method for manufacturing an ultra-high-tensile sheet product of steel, at which the initial work piece used is constituted of a metal work piece of iron, alloyed with 17 % chromium, 7 % nickel and 0,1 % carbon or alloys closely related to these, wherein the initial work piece is wholly or partially plastically could worked by stretch forming or stretch bending at a predetermined temperature and/or deformation degree, that determines and is determiming for the yield point of the final product, in providing a strong deformation hardening, that gives the final product a to-

tally or partially many times increased strength or higher yield point, as compared to the yield point of the initial work piece, wherein the original low yield point is about 300 MPa and the higher yield point is more than 700 MPa or the original medium high yield point of about 700 MPa and the higher level is about 1000 MPa or higher simultaneously when the temperature, to which the work piece completely or partially has been coiled to, or the temperature that totally or partially is maintained during the forming operation is -196° <= T<= 70°C in obtaining a controlled strength increasing, independently of the degree of the deformation.

2. A method according to claim 1, **characterized in that** the alloyed work piece is formed in traditional machines for stretch forming or stretch bending, but by aid of a modified tool to have an adapted deformation of said metal work piece in order to increase its yield point from an originally low yield point to a final product, that completely or partially obtains a high yield point.

3. A method according to claim 1 or 2, **characterized in that** the alloyed work piece is formed in traditional machines for stretch forming or stretch bending that by aid of a modified, partly temperature regulate tool to have an adapted temperature in relation to the deformation which takes place during the stretch forming or stretch bending operation in order to increase its yield point from an originally low yield point to a final product, that completely or partially obtains a high yield point.

4. A method according to any of the preceding claim, **characterized in that** the stretch forming or stretch bending is made in two or several steps, whereby a stronger deformation hardening is achieved.

5. A method according to any of the preceding claims **characterized in that** the initial work piece is completely or partially cooled or is kept at a controlled temperature before and during forming operation to obtain a controlled, high strength independently of the degree of the deformation during the forming operation.

6. A method according to any of the preceding claims, **characterized in that** the final sheet product is totally or partially cooled or is kept at a controlled temperature in obtaining a controlled strength increasing independently of the degree of the deformation during the forming operation.

7. A method according to claim 6, **characterized in that** the temperature, to which the final product completely or partially is cooled to or the temperature that is maintained after the forming operation is -196° <= T<= 7°C.

Patentansprüche

1. Verfahren zum Herstellen eines ultrahochzugfesten Blechprodukts aus Stahl, bei dem das anfängliche verwendete Werkstück aus einem Metallwerkstück aus Eisen besteht, legiert mit 17 % Chrom, 7 % Nikkel und 0,1 % Kohlenstoff oder Legierungen, die nah mit diesen verwandt sind, wobei das anfängliche Werkstück ganz oder teilweise durch Reckformen oder Reckbiegen bei einer vorbestimmten Temperatur und/oder einem Verformungsmaß plastisch kalt bearbeitet wird, das die Streckgrenze des Endprodukts bestimmt und dafür bestimmend ist, indem es eine starke Verformungshärtung bereitstellt, die dem Endprodukt eine insgesamt oder teilweise um das Vielfache erhöhte Festigkeit oder, im Vergleich zur Streckgrenze des anfänglichen Werkstücks, eine höhere Streckgrenze verleiht, wobei die ursprüngliche niedrige Streckgrenze ungefähr 300 MPa und die höhere Streckgrenze mehr als 700 MPa beträgt oder die ursprüngliche, mittelhohe Streckgrenze bei ungefähr 700 MPa und das höhere Niveau gleichzeitig bei ungefähr 1000 MPa oder höher liegt, wenn die Temperatur, auf die das Werkstück vollständig oder teilweise abgekühlt worden ist, oder die Temperatur, die ganz oder teilweise während der Formungsoperation -196° <= T < = 70 °C beträgt, indem es eine gesteuerte, zunehmende Festigkeit erhält, unabhängig vom Maß der Verformung.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das legierte Werkstück in herkömmlichen Maschinen zum Reckformen oder Reckbiegen gebildet wird, aber mithilfe eines modifizierten Werkzeugs, um eine angepasste Verformung des Metallwerkstücks zu haben, um seine Streckgrenze von einer ursprünglich niedrigen Streckgrenze zu einem Endprodukt zu erhöhen, das vollständig oder teilweise eine hohe Streckgrenze erhält.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das legierte Werkstück in herkömmlichen Maschinen zum Reckformen oder Reckbiegen gebildet wird, das mithilfe eines modifizierten, teilweise temperaturgesteuerten Werkzeugs, um eine angepasste Temperatur in Bezug auf die Verformung zu erhalten, die während der Reckform- oder Reckbiege-Operation auftritt, um seine Streckgrenze von einer ursprünglich niedrigen Streckgrenze zu einem Endprodukt zu erhöhen, das ganz oder teilweise eine hohe Streckgrenze erhält.

4. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das Reckformen oder Reckbiegen in zwei oder mehreren Schrit-

ten ausgeführt wird, wobei eine stärkere Verformungshärtung erzielt wird.

5. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das anfängliche Werkstück ganz oder teilweise abgekühlt wird oder vor und während der Formgebungsoperation bei einer gesteuerten Temperatur gehalten wird, um eine gesteuerte, hohe Festigkeit unabhängig vom Maße der Verformung während der Formgebungsoperation zu erhalten.

6. Verfahren nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das endgültige Blechprodukt ganz oder teilweise abgekühlt wird oder bei einer gesteuerten Temperatur gehalten wird, wobei eine gesteuerte Festigkeit erhalten wird, die unabhängig von dem Maß der Verformung während der Formgebungsoperation zunimmt.

7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** die Temperatur, auf die das Endprodukt vollständig oder teilweise abgekühlt wird, oder die Temperatur, die nach der Formgebungsoperation beibehalten wird, -196° <= T < 70 °C beträgt.

Revendications

1. Procédé de fabrication d'un produit en tôle d'acier à ultra haute résistance, dans lequel la pièce à usiner initiale utilisée est constituée d'une pièce métallique à usiner en fer, alliée avec 17 % de chrome, 7 % de nickel et 0,1 % de carbone ou des alliages étroitement apparentés à ceux-ci, dans lequel la pièce à usiner initiale est totalement ou partiellement déformée plastiquement à froid par étirage ou allongement à une température et/ou un degré de déformation prédéterminés, qui détermine et est déterminant pour la limite élastique du produit final, en fournissant un fort durcissement par déformation, qui donne au produit final une résistance ou une limite élastique supérieure augmentée totalement ou partiellement de nombreuses fois, par rapport à la limite élastique de la pièce à usiner initiale, dans lequel la faible limite élastique d'origine est d'environ 300 MPa et la limite élastique plus élevée est supérieure à 700 MPa ou la limite élastique moyennement élevée originale est d'environ 700 MPa et le niveau plus élevé est d'environ 1000 MPa ou plus simultanément quand la température, à laquelle la pièce à usiner a été complètement ou partiellement refroidie, ou la température qui est totalement ou partiellement maintenue pendant l'opération de formate est de -196° <= T <= 70 °C en obtenant une augmentation contrôlée de la résistance, indépendamment du degré de déformation.

2. Procédé selon la revendication 1, **caractérisé en ce que** la pièce à usiner en alliage est formée dans des machines traditionnelles de formage par étirage ou par allongement, mais à l'aide d'un outil modifié pour avoir une déformation adaptée de ladite pièce métallique à usiner de façon à augmenter sa limite élastique d'une limite élastique faible à l'origine à un produit final, qui obtient complètement ou partiellement une haute limite élastique.

3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** la pièce à usiner en alliage est formée dans des machines traditionnelles de formage par étirage ou par allongement qui à l'aide d'un outil modifié, à la température partiellement régulée pour avoir une température adaptée relative à la déformation qui a lieu pendant l'opération de formate par étirage ou par allongement de façon à augmenter sa limite élastique d'une limite élastique faible à l'origine à un produit final, qui obtient complètement ou partiellement une haute limite élastique.

4. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le formage par étirage ou par allongement est fait en deux ou plusieurs étapes, ce par quoi un durcissement par déformation plus élevé est obtenu.

5. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la pièce à usiner initiale est complètement ou partiellement refroidie ou est maintenue à une température contrôlée avant et pendant l'opération de formage pour obtenir une résistance élevée contrôlée indépendamment du degré de déformation pendant l'opération de formage.

6. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** le produit en tôle final est totalement ou partiellement refroidi ou est maintenu à une température contrôlée en obtenant une augmentation contrôlée de la résistance indépendamment du degré de déformation pendant l'opération de formage.

7. Procédé selon la revendication 6, **caractérisé en ce que** la température, à laquelle le produit final est complètement ou partiellement refroidi ou la température qui est maintenue après l'opération de formage est de -196 ° <= T <= 70 °C.

REFERENCES CITED IN THE DESCRIPTION

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