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(54) **A METHOD FOR MANUFACTURING AN ULTRA-HIGH-TENSILE PRESSURE TURNED SHEET METAL PRODUCT OF STEEL**

VERFAHREN ZUR HERSTELLUNG EINES STAHLBLECHES DURCH FLIESSDRÜCKEN

MÉTHODE DE PRODUCTION D'UNE TÔLE EN ACIER À HAUTE RÉSISTANCE MÉCANIQUE PAR FLUOTOURNAGE

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- **'Forming of stainless steel and heat-resisting alloys' METALS HANDBOOK, ASM HANDBOOK COMMITEE vol. 8, 1969, pages 353 - 371, XP002903056**
- **THELNING KARL-ERIK: '1.8.4. Deformationshardning' STAL OCH VARMEBANDLING/AV 1985, pages 62 - 63, XP002964106**

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Description

[0001] The present invention relates to a method for manufacturing an ultra-high-tensile pressure turned sheet metal product of steel.

[0002] Cold forming results in general are referred to in THELNING KARL-ERIK: '1.8.4. Deformationshardning' STAL OCH VARMEBANDLING/AV 1985, pages 62 - 63. Technical details of cold deformation of stainless steels type 301 are disclosed in "Forming of stainless steel and heat-resisting alloys"METALS HANDBOOK, ASM HANDBOOK COMMITEE, vol. 8, 1969 , pages 353-371.

[0003] Cryoforming of stainless steel sheets of type 301 starting from a sheet, plate or a preform amongst them by die forming are disclosed in:

J. Opoku "Strengthening of an austenitic stainless steel alloy by cryoforming", Journal of Materials Science 16, pp.844-849, 1981 Chapman & Hall Ltd, in

T.W.Orange "Evaluation of special 301-type stainless steel for improved low-temperature notch toughness of cryoformed pressure vessels" NASA technical note NASA TN D-3445 - Washington DC - May 1966, or in

CRYOGENIC FORMING OF TYPE 301 STAINLESS STEEL from Imgram A G PUB : Redstone Scientific Information Center (RSIC) Report, 21.04.1965, VOL - RSIC-408/AD467050 - unclassified.

[0004] When manufacturing pressure turned sheet metal products one usually starts from metallic work pieces, preferable of 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 initially 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 pressure turning operation. This is so because the material would brake during the forming operation.

[0005] The object of the present invention is to provide a method for manufacturing an ultra-high-tensile pressure turned sheet metal product of steel, that has initially been alloyed with chromium, nickel and carbon in predetermined proportions. The characterizing features of the invention are stated in the subsequent claims.

[0006] Thanks to the invention as defined in claim 1, one has now provided a method for manufacturing an ultra-high-tensile pressure turned sheet metal product of steel, which in an excellent manner fulfils its object at the same time as the manufacture can take place very rationally with already existing machines to a low cost. During the pressure turning a final product is obtained according to the invention, in which parts of or the whole product has an yield point more than 700 MPa and also values far away over that, for example 1.500 MPa. This result with a strong and controlled deformation hardening of the whole or parts of the product is achieved during the pressure turning by that the product is plastically cold worked in combination with that the alloy maintains a good ductility during the pressure turning 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 before, during or after or in combination of these criteria during the working operation. If one has a high deformation degree, a deformation hardening can be obstructed in that the work piece is allowed to keep a higher temperature.

[0007] The invention is described in more detail below with the aid of an embodiment example described below.

[0008] In a preferred embodiment example of the invention the pressure turned sheet metal product manufactured according to the invention is constituted of a work piece of iron, which has 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, wherby a strong but controlled deformation hardening is achieved during the pressure turning when a plastic cold working of the work piece in combination with maintaining a good ductility of the alloy. Furthermore the temperature of the finally formed pressure turned 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 for pressure turning in order to increase its yield point from an original, low yield point of about 300 MPa to a final product that completely or partially obtains a yield point of more than 700 MPa.

Claims

1. A method for manufacturing an ultra-high-tensile sheet metal 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, **characterized in that** the initial work piece is plastically cold worked by pressure turning at a predetermined temperature and/or deformation degree that determines and is determining for the yield point of the final product, in providing a strong deformation hardening, that gives the final product a totally or partially many times increased strength or higher yield point, as compared to the yield point

of the initial work piece, which original low yield point is about 300 MPa and the higher one is more than 700 MPa, simultaneously as the temperature T to which the initial work piece has completely or partially been cooled to or the temperature T that is maintained completely or partially during the forming operation is -196°C <= T <= 70°C, in obtaining a controlled high strength independently of the degree of deformation.

2. A method according to claim 1, **characterized in that** the alloyed work piece is formed in traditional machines for pressure turning 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 initial work piece is cooled completely or partially to or is kept at a controlled temperature before and during the forming operation to obtain a controlled, maximal strength independently of the degree of deformation during the forming operation.

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

5. A method according to claim 4, **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°C <= T<= 70°C.

6. A method according to any of the preceding claims, **characterized in that** or those pressure rolls used during the pressure turning operation being force- or position guided.

Patentansprüche

1. Verfahren zum Herstellen eines ultra-hochfesten Metallblechprodukts aus Stahl, bei welchem das verwendete Ausgangswerkstück aus einem Metallwerkstück aus Eisen, legiert mit 17% Chrom, 7% Nikkel und 0,1% Kohlenstoff besteht, **dadurch gekennzeichnet, dass** das Ausgangswerkstück durch Fließdrücken bei vorbestimmter Temperatur und/oder Umformgrad, welche/welcher den Fließpunkt des Endprodukts bestimmt und bestimmend dafür ist, plastisch kaltverformt wird, indem eine starke Umformhärtung bereitgestellt wird, die dem Endprodukt eine gänzlich oder zum Teil vielfach erhöhte Festigkeit oder einen höheren Fließpunkt verleiht, verglichen mit dem Fließpunkt des Ausgangswerkstücks, dessen ursprünglicher niedriger Fließpunkt ungefähr 300 MPa beträgt, und wobei der höhere mehr als 700 MPa beträgt, wobei gleichzeitig die Temperatur T, auf welche das Ausgangswerkstück vollständig oder zum Teil gekühlt worden ist, oder die Temperatur T, die durchgehend oder zum Teil während der Formgebung aufrechterhalten wird, -196°C <= T <= 70°C beträgt, indem eine kontrollierte hohe Festigkeit unabhängig von dem Umformgrad erhalten wird.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** das legierte Werkstück in herkömmlichen Maschinen zum Fließdrücken geformt wird, um seinen Fließpunkt von einem ursprünglich niedrigen Fließpunkt zu einem Endprodukt zu erhöhen, das gänzlich oder zum Teil einen hohen Fließpunkt erhält.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Ausgangswerkstück gänzlich oder zum Teil gekühlt wird auf eine oder gehalten wird bei einer kontrollierten Temperatur vor und während der Formgebung, um eine kontrollierte, maximale Festigkeit unabhängig von dem Umformgrad während der Formgebung zu erhalten.

4. Verfahren nach einem der voranstehenden Ansprüche, **dadurch gekennzeichnet, dass** das Metallblech-Endprodukt aus Stahl gänzlich oder zum Teil gekühlt wird auf eine oder gehalten wird bei einer kontrollierten Temperatur, wobei eine kontrollierte Festigkeit erhalten wird, die unabhängig von dem Umformgrad während der Formgebung zunimmt.

5. Verfahren nach Anspruch 4, **dadurch gekennzeichnet, dass** die Temperatur, auf welche das Endprodukt gänzlich oder zum Teil gekühlt wird, oder die Temperatur, die nach der Formgebung aufrechterhalten wird, -196°C <= T <= 70°C beträgt.

6. Verfahren nach einem der voranstehenden Ansprüche, **dadurch gekennzeichnet, dass** jene Druckwalzen, die während des Fließdruckbetriebs verwendet werden, kraft- oder positionsgeführt sind.

Revendications

1. Procédé de fabrication d'un produit en tôle d'acier à très haute résistance mécanique, la pièce à travailler initiale étant constituée d'une pièce à travailler métallique en fer, allié à 17% de chrome, 7% de nickel et 0,1% de carbone, **caractérisé en ce que** la pièce à travailler initiale est écrouie par fluotournage à une température et/ou un degré de déformation prédéterminé qui détermine et est déterminant pour la li-

mite d'élasticité du produit final, assurant un durcissement solide contre la déformation, qui donne au produit final une résistance totale ou partielle fortement accrue ou une limite d'élasticité supérieure par comparaison à la limite d'élasticité de la pièce à travailler initiale, ladite limite d'élasticité initiale réduite étant d'environ 300 MPa et la limite supérieure étant de plus de 700 MPa, de façon simultanée au refroidissement total ou partiel de la pièce à travailler à la température T, ou au maintien total ou partiel à la température T pendant l'opération de formage à -196° C ≤ T ≤ 70° C, pour obtenir une résistance élevée contrôlée indépendamment du degré de déformation.

2. Procédé selon la revendication 1, **caractérisé en ce que** la pièce à travailler alliée est formée dans des machines traditionnelles de fluotournage afin d'accroître sa limite d'élasticité d'une limite d'élasticité initiale faible à un produit final qui présente totalement ou partiellement une limite d'élasticité élevée.

3. Procédé selon la revendication 1 ou la revendication 2, **caractérisé en ce que** la pièce à travailler initiale est totalement ou partiellement refroidie ou est maintenue à une température contrôlée avant et pendant l'opération de formage pour obtenir une résistance maximale contrôlée indépendamment du degré de déformation pendant l'opération de formage.

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

5. Procédé selon la revendication 4, **caractérisé en ce que** la température à laquelle le produit final est totalement ou partiellement refroidi ou la température maintenue après l'opération de formage est de -196° C ≤ T ≤ 70° C.

6. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** les rouleaux presseurs utilisés pendant l'opération de fluotournage sont guidés en force ou en position.

REFERENCES CITED IN THE DESCRIPTION

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- Strengthening of an austenitic stainless steel alloy by cryoforming. **J. OPOKU.** Journal of Materials Science. Chapman & Hall Ltd, 1981, vol. 16, 844-849 **[0003]**
- **T.W.ORANGE.** Evaluation of special 301-type stainless steel for improved low-temperature notch toughness of cryoformed pressure vessels. *NASA technical note NASA TN D-3445,* May 1966 **[0003]**
- CRYOGENIC FORMING OF TYPE 301 STAINLESS STEEL from Imgram A G PUB. Redstone Scientific Information Center, 21 April 1965, vol. RSIC-408 **[0003]**