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A SHEET STRUCTURAL MATERIAL

27 DEC 1996

The invention relates to manufacture of articles made of a metal, for example manufacture of such articles in the rolling production or powder metallurgy industries, and can be suitably used in the metalworks utilized in the construction and mechanical engineering industries, and in other types of metalworks.

The following references can be considered as the prior art of the proposed device:

1. «Hot-rolled sheets» standard GOST 19903-74, comprising, in cross-section, boundaries of the front and rear sides.

Disadvantages of this reference are: absence of a structurally-predetermined thickness variation in a sheet structural material as effected by the shaping operations, a low level of manufacturability, and an high consumption of materials in manufacture of the articles made of a sheet structural material. Implementation of a sheet structural material without a structurally-predetermined thickness variation does not allow to provide a required thinning of the articles by the shaping operations.

The «shaping operations» term should be understood as those of bending, twisting, beading, straightening, drawing, moulding, flanging, embossing, reduction in cross-sectional area, rearing, etc. [1].

2. «Cold-rolled sheets», standard GOST 199904-90, comprising, in cross-section, boundaries of the front and rear sides.

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Disadvantages of this reference are: absence of a structurally-predetermined thickness variation in a sheet structural material as effected by the shaping operations, a low level of manufacturability, and an high consumption of materials in manufacture of the articles made of a sheet structural material. Implementation of a sheet structural material without a structurally-predetermined thickness variation does not allow to provide a required thinning of the articles by the shaping operations.

In respect of the technical essence, the most pertinent prior art of the proposed device is a sheet structural material obtained according to an embodiment of «A method for rolling a metal sheet» of US patent N 4 238 946, publ. 16 12 80, cl. B 21 B 1/00, comprising, in the cross-section, boundaries of the front and rear sides.

Disadvantages of this reference are: absence of a structurally-predetermined thickness variation in a sheet structural material as effected by the shaping operations, a low level of manufacturability, and an high consumption of materials in manufacture of the articles made of a sheet structural material. Implementation of a sheet structural material without a structurally-predetermined thickness variation does not allow to provide a required thinning of the articles by the shaping operations.

In the course of the shaping operations, a metal is thinned in the places determined by the final article structure, and in this connection the implementation of a final article is



carried out not in the optimal way in terms of a rational distribution of the used material.

In light of the foregoing, the objective of the invention
5 is to manufacture a sheet structural material that provides a structurally-predetermined variation of its thickness to be effected by the shaping operations. Implementation of a sheet as having a structurally-predetermined thickness variation will allow to improve manufacturability of the articles made of a
10 sheet structural material and reduce the amount of materials consumed in manufacturing thereof.

In course of the shaping operations, for example a die-stamping, areas of a structurally-increased thickness of a blank are advantageously positioned in the areas where thinning
15 in manufacture of a final article will be of the greatest degree, thereby ensuring the most rational strength distribution of a material in a manufactured metalwork.

Said technical result of the invention is to be attained through that a sheet structural material has, in cross-section,
20 boundaries of the front and rear sides. The material is implemented with a structurally-predetermined thickness variation to be effected by a shaping operation. Further, on the boundary of the front and/or rear side, and/or at least on one of the cross-section vertices, at least a portion of the
25 cross-section boundary line is implemented in the form of a fragment of a conic section of a right circular cone.

The term «vertex» should be understood as a portion of the material section, which portion is contiguous to the place of



interface of the front and rear sides, or to the place of interface of one of the sides with the boundary of the section that connects the front and rear sides.

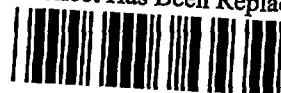
5 The term «conic section» should be understood as the line that is defined by the surface of a right circular cone and by a secant plane that does not pass through the cone vertex [2].

10 A sheet structural material can be implemented as forming an angle by at least one of the vertices of a section, and being less than 180° , which allows to facilitate further machining of the sheet structural material.

15 The sheet structural material can be implemented as having a variable thickness, which circumstance will allow to ensure a structurally-predetermined thickness variation of the sheet structural material to be effected by the shaping operations.

20 The sheet structural material can be implemented as having a thickness that increases in the direction from one edge of the cross-section to another one, which circumstance will allow to ensure a structurally-predetermined thickness variation of the sheet structural material to be effected by the shaping operations.

25 The sheet structural material can be implemented as having a thickness that increases in the direction from the section inner portion towards at least one of the edges, which circumstance will allow to provide a structurally-predetermined thickness variation in the sheet structural material to be effected by the shaping operations.



The sheet structural material can be implemented as having a thickness that decreases in the direction from the section inner portion towards at least one of the edges, which
5 circumstance will allow to provide a structurally-predetermined thickness variation in the sheet structural material to be effected by the shaping operations.

The sheet structural material can be implemented as having a thickness that varies multiple times, as increasing and
10 decreasing, which circumstance will allow to provide a structurally-predetermined thickness variation in the sheet structural material to be effected by the shaping operations.

The sheet structural material can be implemented as having a thickness that varies multiple times and periodically, which
15 circumstance will allow to provide a structurally-predetermined thickness variation in the sheet structural material to be effected by the shaping materials.

The sheet structural material can be implemented as having a convex portion of the length of the line being the boundary
20 of at least one of the sides with respect to the section median line, which circumstance will allow to provide a structurally-predetermined thickness variation in the sheet structural material to be effected by the shaping materials.

The sheet structural material can be implemented as having
25 a concave portion of the length of the line being the boundary of one of the sides with respect to the section median line, which circumstance will allow to provide a structurally-



predetermined thickness variation in the sheet structural material to be effected by the shaping materials.

5 The sheet structural material can be implemented as having a step-shaped portion of the length of the line being the boundary of at least one of the sides, which circumstance will allow to facilitate assembling of structures made of a sheet structural material.

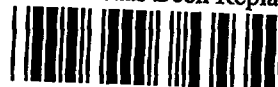
10 The sheet structural material can be implemented as having steps that can have an increase or decrease of the material thickness in transition from one step to another, which circumstance will allow to facilitate assembling of structures made of a sheet structural material.

15 The sheet structural material can be implemented as having a bend and/or a bended form of at least one edge of the material, which circumstance will allow to facilitate assembling of structures made of a sheet structural material.

20 The sheet structural material can be implemented as having multiple bends and/or bended forms, including a change of concavity also to the opposite one, which circumstance will allow to facilitate assembling of structures made of a sheet structural material.

25 The sheet structural material can be implemented as having at least one recess on a portion of the length of the line being the boundary of at least one of the sides, which circumstance will allow to facilitate assembling of structures made of a sheet structural material.

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The sheet structural material can be implemented as having at least one protrusion on a portion of the length of the line being the boundary of at least one of the sides, which
5 circumstance will allow to facilitate assembling of structures made of a sheet structural material.

The sheet structural material can be implemented as having at least one recess on at least one of the section vertices, which circumstance will allow to facilitate assembling of
10 structures made of a sheet structural material.

The sheet structural material can be implemented as having at least one protrusion on at least one of the section vertices, which circumstance will allow to facilitate assembling of structures made of a sheet structural material.

15 The sheet structural material can be implemented as having at least one of the section vertices and/or a portion of the length of the boundary of at least one of the section sides, comprising, in the section, fragments and/or combinations of fragments of: a polygon, a conic section of a right circular
20 cone, which circumstance will allow to improve precision of assembling of structures made of a sheet structural material, when a protrusion and recess are joined.

The sheet structural material can be implemented as having at least one discontinuity of its thickness. The thickness
25 discontinuities can be multiple and periodic, which circumstance will allow to facilitate assembling of structures made of a sheet structural material.

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Study of the prior art has shown that the claimed set of the essential features as set forth in the invention claims is not known heretofore. This allows to conclude that the invention complies with the «novelty» criterion of patentability.

For checking of compliance of the claimed invention with the «inventive step» criterion, an additional search through the known technical approaches has been carried out for the purpose to find the features that would coincide with claimed approach features that are distinct from the most pertinent art. It has been ascertained that the claimed technical approach is not obvious from the prior art. Consequently, the claimed invention complies with the «inventive step» criterion.

The disclosure confirming the possibility to embody the invention is stated below.

The essence of the invention and the possibility of its practical realization is explained with reference to the accompanying drawings, wherein Fig. 1 shows a cross-section of a sheet structural material; Figs. 2-7 show examples of structural implementation of a cross-section of a sheet structural material; Figs. 8-18 show examples of structural implementation of portions of a sheet structural material cross-section.

A sheet structural material (Fig. 1) comprises, in its cross-section, boundaries of front 1 and rear 2 sides, at least a portion of the section boundary line at boundary 1 of the front side, and/or at boundary 2 of the rear side, and/or at

least on one of vertices 3 of the cross-section being implemented in the form of a fragment of conic section 4 of a right circular cone. The material is implemented with a structurally-predetermined thickness variation as effected by a shaping operation.

In the examples of structural implementation of a sheet structural material as shown in Figs. 1 and 2, angle 5 formed by vertices 3 can be implemented as being less than 180° .

10 In the examples of structural implementation of a sheet structural material as shown in Figs. 1-13, the material has a variable thickness.

In the example of structural implementation of a sheet structural material as shown in Fig. 2, thickness of the material decreases in the direction from one edge 6 of the cross-section towards another edge 7.

20 In the example of structural implementation of a sheet structural material as shown in Fig. 3, thickness of the material increases in the direction from inner portion 8 of the cross-section towards edges 6 and 7.

In the example of structural implementation of a sheet structural material as shown in Fig. 4, thickness of the material decreases in the direction from inner portion 8 of the cross-section towards edge 7.

25 In the example of structural implementation of a sheet structural material as shown in Fig. 5, thickness of the material varies multiple times, as increasing and decreasing.

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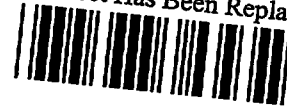
Thus, the use of the above-described sheet structural material will allow to attain the objective of the invention.

References

- 5 1. Masterov V.A., Berkovskiy V.S., Theory of Plastic Deformation and Pressure Treatment of Metals, M., Metallurgiya publishers, 1989, p. 399.
2. Reference Dictionary of Mathematics, M., «Sovetskaya Entsyclopedia» publishers, 1988, p. 847.

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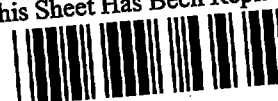
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CLAIMS

- 5 1. A sheet structural material, comprising, in cross-section, boundaries of front and rear sides, wherein said material is implemented as having a structurally-predetermined thickness variation as effected by a shaping operation, and on the boundary of the front and/or rear side, and/or at least on
- 10 one of vertices of the section at least a portion of the section boundary line is implemented in the form of a conic section of a right circular cone.
2. The sheet structural material as claimed in claim 1, wherein an angle of at least one of the vertices is less than 180° .
- 15 3. The sheet structural material as claimed in any one of claims 1 and 2, wherein said material has a variable thickness.
4. The sheet structural material as claimed in claims 3, wherein thickness of the material increases in the direction from one edge of the section to another one.
- 20 5. The sheet structural material as claimed in claim 3, wherein thickness of the material increases in the direction from the inner portion of the section at least towards one of the edges.
6. The sheet structural material as claimed in claims 3, wherein
- 25 thickness of the material decreases in the direction from the inner portion of the section at least towards one of the edges.

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7. The sheet structural material as claimed in claim 3, wherein thickness of the material varies multiple times, as increasing and decreasing.
- 5 8. The sheet structural material as claimed in claim 3, wherein thickness of the material varies multiple times and periodically.
9. The sheet structural material as claimed in any one of claims 1 - 8, wherein a portion of the length of the line being the
10 boundary of at least one of the sides with respect to the section median line is implemented as convex.
10. The sheet structural material as claimed in any one of claims 1 - 8, wherein a portion of the length of the line being the boundary of at least one of the sides with respect
15 to the section median line is implemented as concave.
11. The sheet structural material as claimed in any one of claims 1-10, wherein a portion of the length of the line being the boundary of at least one of the sides is implemented as having steps.
- 20 12. The sheet structural material as claimed in claim 11, wherein the steps can be made both as with an increase of the material thickness in transition from one step to another, and with a decrease.
13. The sheet structural material as claimed in any one of
25 claims 1 - 12, wherein at least one edge of the material is implemented as having a bend and/or bended form.





14. The sheet structural material as claimed in claim 13,
wherein the bend and/or bended form of the material can be
implemented including a multiple change of the concavity,
5 inclusive of that to the opposite one.

15. The sheet structural material as claimed in any one of
claims 1 - 14, wherein a portion of the length of the line
being the boundary of at least one of the sides is
implemented as having at least one recess.

10 16. The sheet structural material as claimed in any one of
claims 1 - 15, wherein a portion of the length of the line
being the boundary of at least one of the sides is
implemented as having at least one protrusion.

15 17. The sheet structural material as claimed in any one of
claims 1 - 16, wherein at least one of the vertices of the
section is implemented as having at least one recess.

18. The sheet structural material as claimed in any one of
claims 1 - 17, wherein at least one of the vertices of the
section is implemented as having at least one protrusion.

20 19. The sheet structural material as claimed in any one of
claims 9-18, wherein at least one of the vertices of the
section and/or a portion of the boundary length of at least
one of the section sides are implemented of a group
comprising, in the section, fragments and/or combinations of
25 fragments of: a rectangle, a conic section of a right
circular cone.



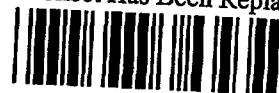


20. The sheet structural material as claimed in any one of claims 3-13, wherein thickness of the material has at least one discontinuity.

5 21. The sheet structural material as claimed in claim 20, wherein the thickness discontinuities are multiple and periodic.

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