



9906649-0

THE SHEET LAYERED STRUCTURAL MATERIAL

27 DEC 1999

The invention relates to production of articles that comprise metallic parts, e.g. by rolling methods, powder metallurgy, or by welding methods, inclusive of the explosion methods, and can be suitably used in the structures utilized in the construction, mechanical engineering industries, and in other types of structures.

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

1. A sheet layered structural material obtained in embodiment of «A method for producing three-layer sheets and strips» RF patent N 2 063 852, publ. 20 07 96, cl. B 23 K 20/04, comprising, in cross-section, at least two layers.

Disadvantages of this prior art are as follows: absence of a structurally-predetermined thickness variation of at least one of layers of a sheet layered structural material as effected by shaping operations, an insufficient level of manufacturability and an high consumption of materials in manufacture of the articles made of a sheet structural material. Implementation of a sheet layered structural material without a structurally-predetermined thickness variation does not allow to provide a required thinning of at least one of the article layers as effected by shaping operations.

The term «shaping operations» should be understood as the following ones: bending, twisting, beading, straightening, drawing, moulding, flanging, embossing, reduction in cross-sectional area, heading, etc. [1].

2. «A bimetallic strip, for example for welded pipes, and a method for manufacturing the same», RF patent N 2 068 324, publ. 27 10 96, cl. B 23 K 20/00, comprising, in cross-section, at least two layers.

Disadvantages of this prior art are as follows: absence of a structurally-predetermined thickness variation of at least one of layers of a sheet layered structural material as effected by shaping operations, an insufficient level of

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manufacturability and an high consumption of materials in
manufacture of the articles made of a sheet structural
material. Implementation of a sheet layered structural material
without a structurally-predetermined thickness variation does
5 not allow to provide a required thinning of at least one of the
article layers as effected by shaping operations.

In respect of the technical essence, the following
reference can be considered as the most pertinent prior art of
the proposed device: «A sheet structural material» according to
10 RF patent N 2 010 690, publ. in 1994, cl. B 23 K 20/04,
comprising, in cross-section, at least two layers.

Disadvantages of this prior art are as follows: absence of
a structurally-predetermined thickness variation of at least
one of layers of a sheet layered structural material as
15 effected by shaping operations, an insufficient level of
manufacturability and an high consumption of materials in
manufacture of the articles made of a sheet structural
material. Implementation of a sheet layered structural material
without a structurally-predetermined thickness variation does
20 not allow to provide a required thinning of at least one of the
article layers as effected by shaping operations.

In the course of the shaping operations, thinning of at
least one layer of a sheet layered structural material takes
place in the places and shaping operation parameters determined
25 by the structure of a manufactured article, and in this
connection, manufacture of a final article is carried out not
in the optimal way in terms of a rational distribution of a
material.

The objective of the invention consists in providing a
30 sheet layered structural material ensuring a structurally-
predetermined thickness variation of at least one layer
effected by shaping operations, an improved manufacturability,
a low consumption of materials in manufacture of articles, an
high corrosion resistance and sound-proofing of structures made
35 of a sheet layered structural material.

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Sail technical result of the invention is to be attained through that a sheet layered structural material comprises, in cross-section, at least two layers, and at the boundary of the front and rear sides of at least one of the layers and at least on one of the vertices of at least one of the section layers, at least a portion of the section boundary line is implemented in the form of a fragment of a conic section of a right circular cone. Thereby a structurally-predetermined thickness variation of at least one layer of a sheet layered structural material as effected by the shaping operations, an improved manufacturability and a reduced consumption of materials in manufacture of the articles made of a sheet layered structural material are provided.

The term «vertex» should be understood as a portion of section of at least one material layer, which portion is contiguous to the place of interface of the front and rear sides of this layer, or to the place of interface of one of the sides of this layer with the boundary of a portion of section of this layer that connects the front and rear sides of this layer.

A front side of a layer should be understood as the layer side disposed closer to the front side of a sheet layered structural material; and a rear side of a layer should be understood as the layer side disposed farther from the front side of a sheet layered structural material.

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

A sheet layered structural material can be implemented with formation of an angle of at least one of the section vertices of at least one of the layers, which angle is less than 180° , and this circumstance will allow to facilitate further machining of a sheet layered structural material.

A sheet layered structural material can be implemented as having at least one of the layers of a variable thickness, which circumstance will allow to provide a structurally-



predetermined thickness variation of a sheet layered structural material to be effected by the shaping operations.

5 A sheet layered structural material can be implemented as having a thickness of at least one of the layers as increasing in the direction from one edge of the section towards another one, which will allow to provide a structurally-predetermined thickness variation of a sheet layered structural material to be effected by the shaping operations.

10 A sheet layered structural material can be implemented as having a thickness of at least one of the layers as increasing in the direction from the section inner portion towards at least one of the edges, which will allow to provide a structurally-predetermined thickness variation of a sheet layered structural material to be effected by the shaping operations.

15 A sheet layered structural material can be implemented as having a thickness of at least one of the layers as decreasing in the direction from the section inner portion towards at least one of the edges, which will allow to provide a structurally-predetermined thickness variation of a sheet layered structural material to be effected by the shaping operations.

20 A sheet layered structural material can be implemented as having a thickness of at least one of the layers as varying multiple times, as increasing and decreasing, which will allow to provide a structurally-predetermined thickness variation of a sheet layered structural material to be effected by the shaping operations.

25 A sheet layered structural material can be implemented as having a thickness of at least one of the layers as varying multiple times and periodically, which will allow to provide a structurally-predetermined thickness variation of a sheet layered structural material to be effected by the shaping operations.

30 A sheet layered structural material can be implemented as having a convex portion of the length of the line being the



predetermined thickness variation of a sheet layered structural material to be effected by the shaping operations.

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A sheet layered structural material can be implemented as having a thickness of at least one of the layers as varying multiple times and periodically, which will allow to provide a structurally-predetermined thickness variation of a sheet layered structural material to be effected by the shaping operations.

A sheet layered structural material can be implemented as having a convex portion of the length of the line being the



assembling of structures made of a sheet layered structural material.

5 A sheet layered 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 of at least one of the layers, which will allow to facilitate assembling of structures made of a sheet layered structural material.

10 A sheet layered structural material can be implemented as having at least one metallic layer, as well as having any portion of any other layer as metallic or non-metallic one, which circumstance will allow to improve the corrosion resistance of structures made of a sheet layered structural material.

15 A sheet layered structural material can be implemented as having at least one cavity at least on a portion of the length of the line being the boundary between at least two adjacent layers, which will allow to improve the sound-proofing properties of structures made of a sheet layers structural material.

20 A sheet layered structural material can be implemented as having periodic cavities at least on a portion of the length of the line being the boundary between at least two adjacent layers, which will allow to improve the sound-proofing properties of structures made of a sheet layers structural material.

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

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

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

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

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 essence of the invention and the possibility of practical realization thereof is explained with reference to the accompanying drawings, wherein Fig. 1 shows a cross-section of a sheet layered structural material; Figs. 2-7 show examples of a structural implementation of a cross-section of a sheet layered structural material; Figs 8-21 show examples of a structural implementation of portions of a cross-section of a sheet layered structural material.



A sheet layered structural material (Fig. 1) comprises, in cross-section, at least two layers 1 and 2, having boundaries of front 3 and rear 4 sides, at least a portion of the section boundary line of at least one of the layers at boundary 3 of the front side and at boundary 4 of the rear side, and at least on one of vertices 5 of at least one of the section layers being implemented in the form of a fragment of conic section 6 of a right circular cone.

In the examples of a structural implementation of a sheet layered structural material as shown in Figs. 1 and 2, angle 7 formed by vertices 5 can be implemented as being less than 180° .

In the examples of a structural implementation of a sheet layered structural material as shown in Figs. 1-13, one of layers (2) is implemented as having a variable thickness.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 2, thickness of layer 2 increases in the direction from one edge 8 of the section to another edge 9.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 3, thickness of layer 2 decreases in the direction from section inner portion 10 towards edges 8 and 9.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 4, thickness of layer 2 decreases in the direction from section inner portion 10 towards edge 9.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 5, thickness of layer 1 varies multiple times, as increasing and decreasing.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 6, thickness of layer 1 (2) varies multiple times and periodically.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 7, a portion of



the length of the line being the boundary of front side 3 with respect to the median line of section of layer 1 is implemented as convex, and a portion of the length of the line being the boundary of rear side 4 with respect to the median line of section of layer 1 is implemented as concave.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 8, a portion of the length of the line being the boundary of front side 3 of layer 1 (the same is also rear side 4 of layer 1) is implemented as having steps 11. Steps 11 can be implemented (Fig. 9 both with an increase of thickness of at least one of layers 1) of a sheet layered structural material in transition from one step to another one, and with a decrease.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 10, the material has a bend and/or bended form 12.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 11, bend and/or bended form 12 of the material is implemented as being multiple, including a change of concavity to the opposite one.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 12, a portion of the length of the line being the boundary of front side 3 of layer 1 is implemented as having recess 13.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 13, a portion of the length of the line being the boundary of front side 3 of layer 1 is implemented as having protrusion 14.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 14, layer 2 of the material is implemented as a metallic one, and layer 1 is implemented as having non-metallic portion 15 and metallic portion 16.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 15, between layers 1 and 2 of the material, cavity 17 is implemented.



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In the example of a structural implementation of a sheet layered structural material as shown in Fig. 16, between layers 1 and 2 of the material periodic cavities 17 are implemented.

5 In the example of a structural implementation of a sheet layered structural material as shown in Fig. 17, vertex 5 of layer 1 of the material is implemented as having recess 18.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 18, vertex 5 of layer 1 of the material is implemented as having protrusion 19.

10 In the example of a structural implementation of a sheet layered structural material as shown in Fig. 19, edge of layer 1 of a sheet layered structural material comprises a fragment of circumference 25. In the sheet layered structural material at least one of vertices 5 of the section, and/or a portion of
15 the length being the boundary of a side of section 3 (4) can comprise, in cross-section, fragments and/or combinations of fragments of: a polygon (square 20, rectangle 21, trapezoid 22, rhomb 23, triangle 24, etc.), a conic section of a right circular cone (circumference 25, ellipse 26, etc.).

20 In the example of a structural implementation of a sheet layered structural material, as shown in Fig. 20, thickness of layer 1 of the material has discontinuity 27.

In the example of a structural implementation of a sheet layered structural material as shown in Fig. 21,
25 discontinuities 27 of layer 1 are multiple and periodic.

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

References

- 30 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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CLAIMS

1. A sheet layered structural material, comprising, in the cross-section, at least two layers, wherein at the boundary of a front and rear sides of at least one of the layers, and at least on one of vertices of at least one of the section layers, 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 layered structural material as claimed in claim 1, wherein an angle of at least one of the vertices of at least one of the section layers is less than 180° .
3. The sheet layered structural material as claimed in any one of claims 1 and 2, wherein at least one of the layers is implemented as having a variable thickness.
4. The sheet layered structural material as claimed in claim 3, wherein thickness of at least one of the layers increases in the direction from one edge of the section towards another one.
5. The sheet layered structural material as claimed in claim 3, wherein thickness of at least one of the layers increases in the direction from the section inner portion towards at least one of the edges.
6. The sheet layered structural material as claimed in claim 3, wherein thickness of at least one of the layers decreases in the direction from the section inner portion towards at least one of the edges.
7. The sheet layered structural material as claimed in any one of claims 3 - 6, wherein thickness of at least one of the layers varies multiple times, as increasing and decreasing.
8. The sheet layered structural material as claimed in any one of claims 3 - 6, wherein thickness of at least one of the layers varies multiple times and periodically.
9. The sheet layered structural material as claimed in any one of claims 1 - 8, wherein a portion of the length of the line



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being the boundary of at least one of the sides of at least one of the layers with respect to the median line of the section of the layer is implemented as convex.

- 5 of claims 1 - 8, wherein a portion of the length of the line being the boundary of at least one of the sides of at least one of the layers with respect to the median line of the section of the layer is implemented as concave.
- 10 11. The sheet layered 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 of at least one of the layers is implemented as step-shaped.
- 15 12. The sheet layered structural material as claimed in claim 11, wherein the steps can be implemented both as with an increase of the layer material thickness in transition from of step to another one and with a decrease.
13. The sheet layered structural material as claimed in any one of claims 1 - 12, wherein at least one edge of the material is implemented as having a bend and/or bended form.
- 20 14. The sheet layered structural material as claimed in claim 13, wherein the bend and/or bended form of the material can be implemented as also being multiple, with a change of concavity, including the change to the opposite concavity.
- 25 15. The sheet layered 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 of at least one of the layers is implemented as having at least one recess.
- 30 16. The sheet layered 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 of at least one of the layers is implemented as having at least one protrusion.
- 35 17. The sheet layered structural material as claimed in any one of claims 1 - 16, wherein at least one of the layers is



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implemented as a metallic one, and any portion of any other layer being implemented as a metallic or nonmetallic one.

18. The sheet layered structural material as claimed in any one of claims 1 - 17, wherein a portion of the length of the line being the boundary between at least two contiguous layers is implemented as having at least one cavity.

19. The sheet layered structural material as claimed in claim 18, wherein the cavities are implemented as being periodic.

20. The sheet layered structural material as claimed in any one of claims 1 - 19, wherein at least one of the vertices of at least one of the section layers is implemented as having at least one recess.

21. The sheet layered structural material as claimed in any one of claims 1 - 20, wherein at least one of the vertices of at least one of the section layers is implemented as having at least one protrusion.

22. The sheet layered structural material as claimed in any one of claims 9 - 21, wherein at least one of the vertices of at least one of the section layers, and/or a portion of the length of the boundary of at least one of the sides of at least one of the section layers are implemented from a group comprising, in cross-section, fragments and/or combinations of fragments of: a polygon, a conic section of a right circular cone.

23. The sheet layered structural material as claimed in any one of claims 1 - 22, wherein thickness of at least one of the layers has at least one discontinuity.

24. The sheet layered structural material as claimed in claim 23, wherein the thickness discontinuities are multiple and periodic.

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