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(54) **PRODUCING A PRODUCT FROM A ROLLED STRIP MATERIAL**

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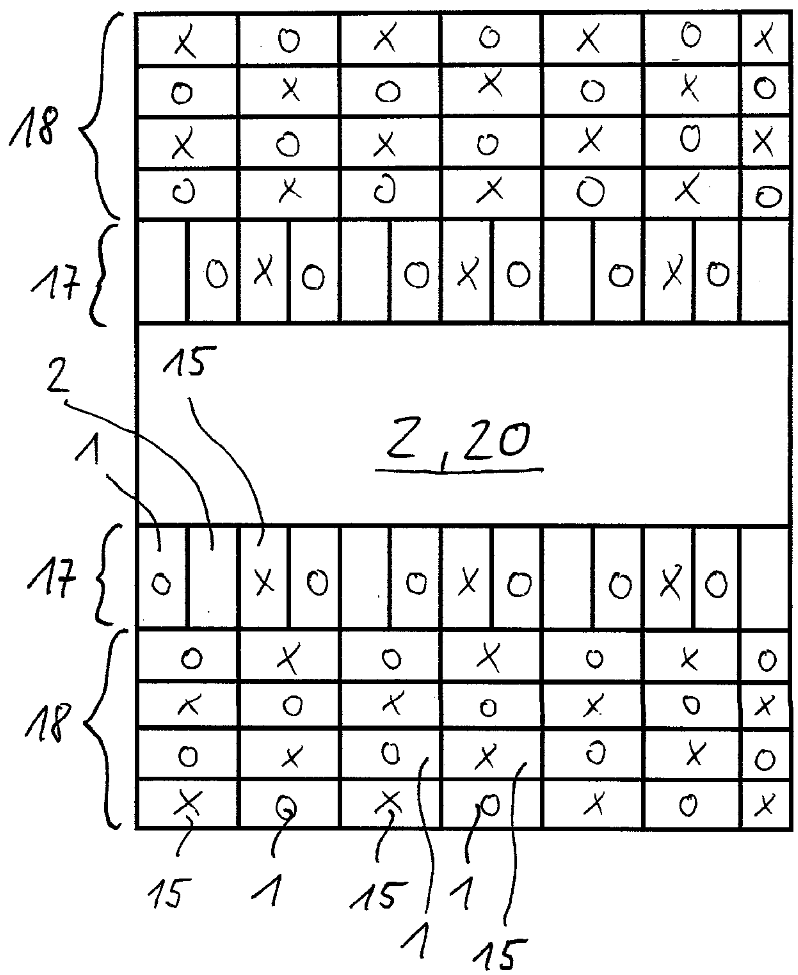
(57) **ABSTRACT**

A product is produced from a rolled strip material with the steps: providing a substrate in form of a strip material from sheet steel, rolling of the substrate in form of strip material, electrolytic coating of the substrate with a first metal coating material, wherein the electrolytic coating is carried out after the rolling, applying of a second coating material as a scaling protection coating on the substrate coated with the first coating material, and hot-forming of the substrate, wherein the hot-forming is carried out after the application of the second coating material.



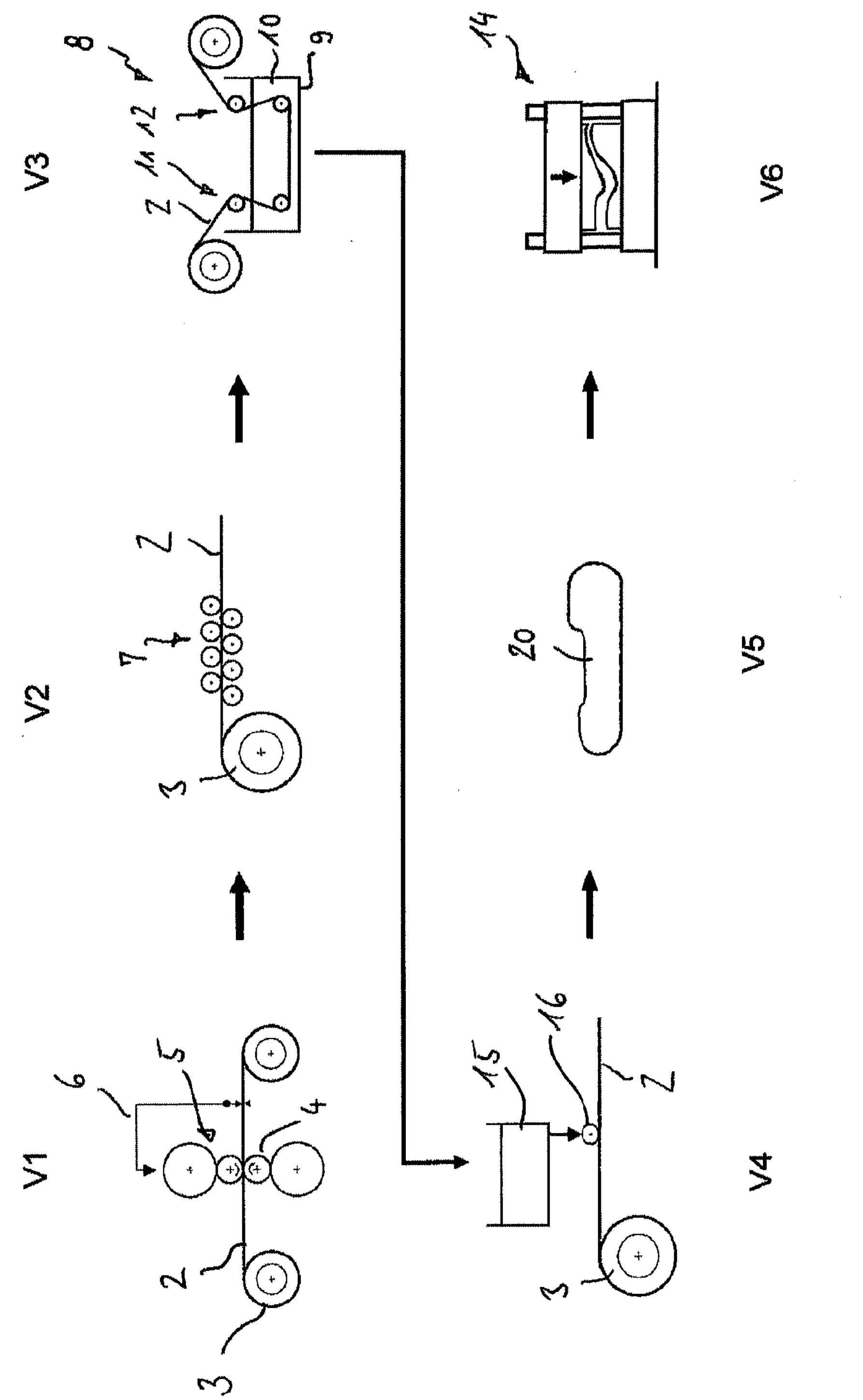


Fig. 1

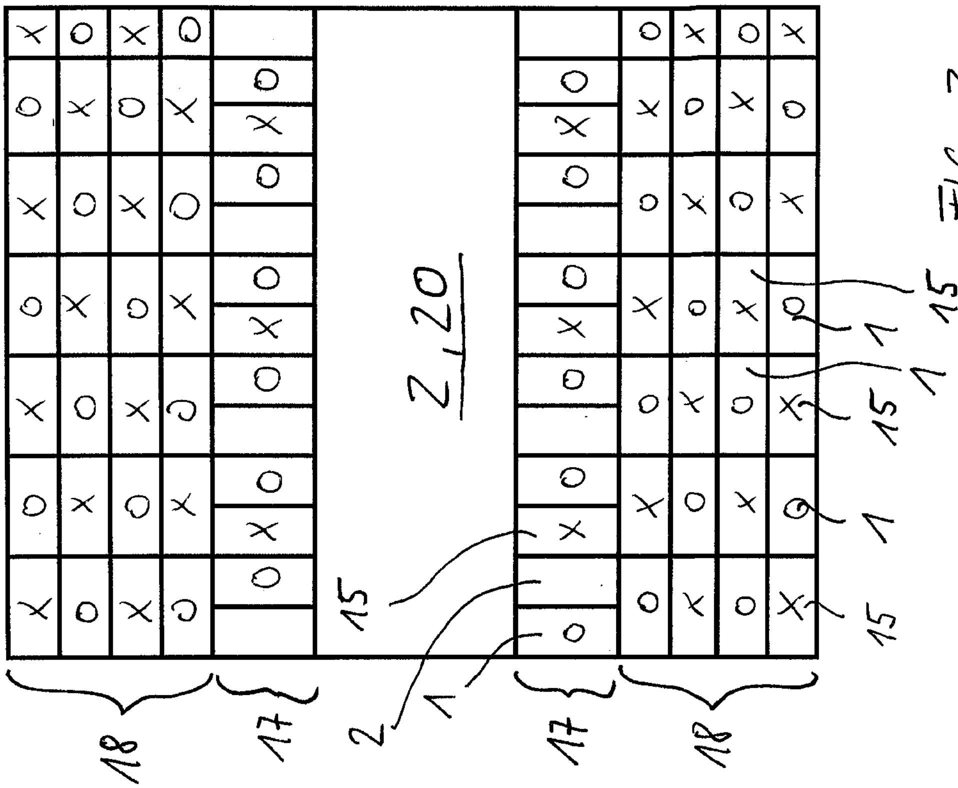


FIG. 3

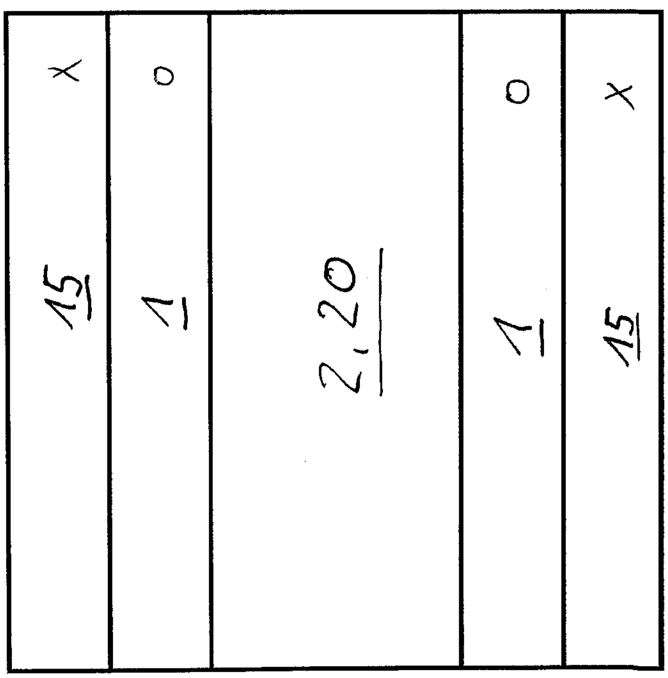


FIG. 2

PRODUCING A PRODUCT FROM A ROLLED STRIP MATERIAL

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to German Application No. DE 10 201 5 202 642.6 filed on Feb. 13, 2015, which application is hereby incorporated herein by reference in its entirety.

BACKGROUND AND SUMMARY

[0002] The present disclosure relates to a method for producing a product from a rolled strip material with the steps: providing a substrate in form of a strip material from sheet steel; rolling of the substrate in the form of a strip material, electrolytic coating of the substrate with a first metal coating material, wherein the electrolytic coating is carried out after the rolling; applying a second coating material as scaling protection coating on the substrate coated with the first coating material; and hot-forming of the substrate, wherein the hot-forming is carried out after the application of the second coating material. The present disclosure relates further to a product, produced according to the method and made from rolled strip material.

[0003] Different methods for coating components made from steel with a zinc- or zinc-alloy layer are known, like hot-galvanizing (hot dip galvanizing) or galvanic (electrolytic) zinc-plating. Hot-galvanizing is the coating of steel components with a massive metallic zinc coating by dipping the pre-processed steel components into a melt of liquid zinc. During the electrolytic galvanizing the components (work pieces) are dipped into a zinc electrolyte. Electrodes of zinc act, because of their more ignoble metal compared to the work piece, as a "sacrificial anode". The work piece to be galvanised acts as a cathode, because of which the coating is also designated as cathodic corrosion protection.

[0004] The document AT 412 403 B relates to a method for producing a corrosion protected sheet steel and a sheet steel object, protected with a coating against corrosion, wherein according to the process it is provided to apply in a first step at least one electrolytically produced zinc layer and at least one layer consisting of aluminium on a sheet surface, after which the sheet steel is heated in a second step in a targeted manner and is cooled. The corrosion protected sheet steel or an object formed therefrom has a surface layer with more than 0.1 percent of mass and has less than 5.0 percent of mass of aluminium, wherein the layer is formed from two intermetallic iron-zinc-aluminium phases.

[0005] From the document DE 10 2012 110 972 B3 a method for producing a product from flexible rolled strip material is known with the steps: providing a strip material from sheet steel; flexible rolling of the strip material, wherein a variable thickness is produced along the length of the strip material; electrolytic coating with a metallic coating material, which contains at least 93 mass percent of zinc, wherein the electrolytic coating is carried out after the flexible rolling; heat treating at temperatures larger than 350° C. and below a solidus line of the coating material, wherein the heat treatment is carried out after the electrolytic coating; and working a blank from the flexible rolled strip material; and cold- or hot-forming of the blank.

[0006] A thermodiffusion treatment, for example in an annealer, is carried out to enable a direct hot-forming. Otherwise, a too low iron content can lead to the effect of solder cracking during direct hot-forming. Furthermore, the iron rich intermetallic phases are brittle and tend at mechanical loading, for example by bending, to cracks, which can continue into the hardened material, so that a disadvantageous large bending angle results according to test specification VDA 238-100 of the material. A further disadvantage is that zinc has a lower vapour pressure and, thus, during thermodiffusion treatments, or a following heating in the course of the hot-forming, leads to a zinc loss. Especially the areas of the galvannealing coating, which is close to the surface and rich in iron, tend increasingly to an evaporation, which leads to an only small increase of the layer thickness after the hot-forming and to a high iron content in the layer.

[0007] Disclosed herein is a method for producing a product made from flexible rolled strip material, and a product made from flexible rolled strip material, in which a heat treatment before the hot-forming can be omitted for forming an alloy.

[0008] The method according to the present disclosure for producing a product from rolled strip material comprises the following steps:

[0009] providing a substrate in form of a strip material from sheet steel;

[0010] rolling of the substrate as strip material;

[0011] electrolytic coating of the substrate with a first metal coating material, wherein the electrolytic coating is carried out after the rolling;

[0012] applying a second coating material as a scaling protection coating on the substrate coated with the first coating material; and

[0013] hot-forming of the substrate, wherein the hot-forming is carried out after applying the second coating material.

[0014] According to the present disclosure, the second coating material is provided as a compound with metallic components. In the context of the present disclosure, metallic components refer to components made from elements which belong to the metals and/or, as the case may be, to the semimetals. The metallic components can be present as pure materials or as an alloy. The composition of the second coating material is selected such that the metallic components comprise predominantly elements, which are more ignoble than the sheet steel of the substrate to provide a cathodic corrosion protection. "Predominantly" in the context of the present disclosure shall be understood in particular such that a portion of more than 50 percent of mass of the total metallic components consists of elements which are more ignoble than the sheet steel of the substrate. Said mass percentage may refer to the mass in the second coating material before being applied to the substrate and/or to the mass of the second coating after having been applied to the substrate. At least one of the elements, aluminium or manganese, belongs to the elements, which are more ignoble than the sheet steel of the substrate and which can be used.

[0015] The cathodic corrosion protection can be achieved in an advantageous manner with the method according to the present disclosure, as the addition of elements, which are more ignoble than the sheet steel of the substrate, is prevented in the first coating material and as, furthermore, no separate method step for heating between the step of coating and the step of hot-forming is necessary.

[0016] A further advantage of the coating produced by the method according to the present disclosure is, that in the course of the final hot-forming a reduction of the strength in the boundary area between the coating and the substrate is achieved, so that the boundary area has an increased ductility, as compared to the hardened substrate. Advantageously, by selecting an alloy composition of the coating in a suitable manner, a step of decarburization can be omitted. In total the duration of the process for producing the product is shortened, which has an advantageous effect on the manufacturing costs. A separate method step of heating the product between the coating and the hot-forming is may not be provided in the method according to the present disclosure.

[0017] The term substrate in the context of the present disclosure shall refer in particular to at least one of a steel strip, rectangular blanks and/or form cuts, which are worked from the rolled steel strip by means of cutting, for example mechanically or by laser cutting. The step of working the blanks from the steel strip is preferably carried out after the second coating step and before the hot-forming step. Alternatively, the step of producing the blanks, i. e. cutting can also be carried out after the rolling and before the first coating step, so that the step of coating is already carried out by way of batch processing of the blanks. As strip material for the rolling, hot-strip or cold-strip can be used, wherein these terms shall be understood in the sense of common technical terminology. Hot-strip is a rolling steel final product (steel strip), which is produced by means of rolling after previous heating. A cold-strip refers to a cold rolled steel strip (flat strip), wherein the last thickness reduction is carried out by rolling without previous heating.

[0018] The rolling of the substrate can be carried out as flexible rolling, wherein a variable thickness is produced along a length of the strip material. The disclosed method is particularly suitable for flexible rolled strip material in that also in the thin portions of the strip material a high ductility is achieved in the boundary area between the coating and the strip material, thus leading to a reduced risk of micro cracks.

[0019] Still further steps can be carried out between the above individual method steps. For example, after the rolling a straightening of the strip can be provided. The working of the blanks from the strip material can be carried out before or after the coating. In connection with the present disclosure, the term working blanks from the strip material shall cover all technical kinds of producing blanks from the strip material. In particular, the term working shall include cutting or punching the sheet blanks from the strip material, i.e., such that an edge remains on the strip, which is not further processed, as well as, that a simple cutting to length of the strip material into partial pieces is carried out, especially by means of a cutting process.

[0020] In the proposed method according to the present disclosure it is advantageous that a formation of an alloy takes place between the steel substrate and the coating, with the coating comprising the first electrolytically deposited coating material and the second coating material as a scaling protection layer. Said formation of an alloy takes place in the course of the heating to a temperature above Ac1, i. e., the temperature at which the formation of austenite starts. In the course of a press hardening process, the formed alloy has a hardness which can be at least 50 HV (Vickers Pyramid Number) below the core hardness of the hardened steel substrate. The coating has thus an increased ductility. Furthermore, micro cracks, which might be formed during the hot-forming on the surface, are prevented by the plastic deformation in the more ductile coating as well as of the adjacent alloy layer, which enables a local formation of strain.

[0021] Furthermore, advantageously, in the two-layered structure of the first, electrolytically deposited coating material and the second coating material applied thereon, as a scaling protection layer, metallic particles can be introduced into the scaling protection lacquer layer, which cannot electrolytically be deposited, like, for example, particles of the elements aluminium and/or manganese. Because of a diffusion barrier, for example by adding aluminium to the coating, it is achieved that, in contrast to a pure zinc-iron-alloy, a further enrichment with iron is prevented during the austenitization, whereby a reduction of the corrosion protection potential compared to a pure zinc coating after the hot-forming is prevented.

[0022] Furthermore, it is possible that the composition of the second coating material is selected such that the metallic components have a proportion of metallic particles, wherein the proportion of metallic particles, in relation to the total metallic components of the second coating material, is especially at least five percent of mass and at the most 95 percent of mass. The metallic particles contained in the second coating material, the scaling protection lacquer, have a cathodic corrosion protection compared to the steel substrate. Furthermore, the coating tends, during a heating to approximately 900° C. in the course of an austenitization, only to a small extent to an oxidation or evaporation. It is possible that the proportion of metallic particles has especially one or more of the carbide forming elements titanium, niobium and vanadium. Furthermore, in addition or as an alternative, the proportion of metallic particles can comprise especially particles of one or more of the ferrite forming elements chromium, aluminium, titanium, tantalum, molybdenum, vanadium and silicon. The metallic particles can also contain particles from a semi-metal, like in this case silicon, insofar as the corresponding characteristics of the semi-metal are present. The metallic particles have preferably a grain size of at least 100 nanometers and at the most ten micrometers.

[0023] According to an embodiment, zinc can be used as first coating material, wherein the amount of zinc is preferably at least 50 mass percent of the first coating, which includes the possibility that pure zinc can be used in particular.

[0024] Furthermore, according to an embodiment, the hot-forming can be carried out as an indirect process with the following partial steps: cold pre-forming of the substrate; heating at least one partial area of the component, preformed from the substrate in a cold condition, to an austenitizing temperature; hot-forming of the component to produce a final outline.

[0025] Alternatively, the hot-forming can be carried out as a direct process with the following partial steps: heating at least a partial area of the substrate to an austenitizing temperature; and hot-forming of the substrate to produce a final outline.

[0026] At a suitable stage of the process, blanks or form cuts are produced from the preferably flexible rolled strip material, which can be carried out for example by mechanically cutting or by laser cutting. Blanks are to be understood as especially rectangular sheet boards, which are separated from the strip material. Form cuts are to be understood as sheet elements worked from the strip material, which outer profile is already adapted to the shape of the final product. Here, the term "blank" is used uniformly for rectangular blanks as well as form cuts.

[0027] The sheet blanks are hot-formed according to a first variant of the disclosed method. Hot-forming means forming processes, in which the work pieces are heated to a temperature in the region of hot-forming before the forming takes place. The heating is carried out in a suitable heating device, for example a furnace. The hot-forming is carried out according to the first possibility as an indirect process, which comprises the partial steps cold pre-forming of the blank to a preformed component, following heating of at least partial areas of the cold pre-formed component to the austenitizing temperature as well as following hot-forming for producing the final outline of the product. The austenitizing temperature shall refer to a temperature range, in which at least a partial austenitization takes place, i.e., wherein a microstructure in the two phase region ferrite and austenite is present. Furthermore, it is also possible to only austenitize partial areas of the blank, to enable for example a partial hardening. The hot-forming can also be carried out according to the second possibility as a direct process, which is characterised in that at least partial areas of the blank are directly heated to the austenitizing temperature and then are hot-formed to the required final profile in one step. A previous (cold) pre-forming does not take place in this case. Also during the direct process, a partial hardening can be achieved by austenitizing partial areas. For both processes it applies, that a hardening of partial areas of the component is also possible by means of differently tempered tools, or by using several tool materials, which enable different cooling velocities. In the latter case the whole blank or the whole component can be completely austenitized before the hot-forming process.

[0028] According to a further embodiment it is provided that, in the course of hot-forming, a ductile alloy layer is produced in a boundary area of the substrate, said ductile alloy layer being produced from elements of the substrate, of the first coating material and of the second coating material, wherein the ductile alloy layer has an increased ductility compared to the substrate. Furthermore, in the course of the hot-forming, an outer alloy layer can be produced in a boundary area between the first coating material and the second coating material, said outer alloy layer being produced from elements of the first coating material and of the second coating material. Preferably, the ductile alloy layer is produced from elements of the substrate and of the outer alloy layer.

[0029] Further disclosed is a product made especially from flexible rolled strip material made from sheet steel with a coating of a first coating material and of a second material, produced according to the inventive method described herein. Thus, in relation to the product, the above named advantages are achieved by a reduction of the strength achieved by means of the coating during the final hot-forming, in the boundary area between the coating and the substrate, by means of which the boundary area has an increased ductility compared to the hardened substrate. The above mentioned features relating to the preferred method steps, especially with regard to the coating, are transferrable to the product, so that concerning the features of the product and the advantages relating thereto it is referred to the above description.

SUMMARY OF THE DRAWINGS

[0030] Following, the present disclosure is described in more detail using a preferred embodiment with reference to the attached drawings. The explanations relate likewise to the method according to the present disclosure as to the product. In this case the explanations are only exemplary and do not limit the claimed invention.

[0031] FIG. **1** is a schematic flowchart of a method for producing a product according to an embodiment;

[0032] FIG. **2** illustrates a schematically represented layer structure of a product during the method of FIG. **1** before the hot-forming; and

[0033] FIG. **3** illustrates the layer structure of FIG. **2** after the hot-forming.

DETAILED DESCRIPTION

[0034] FIG. **1** shows a method according to the present disclosure for producing a product from preferably flexible rolled strip material **2**. In the method step V**1** the strip material **2**, which is also generally designated as substrate **2** and is wound on a coil **3** in the starting condition, is worked in a rolling manner, i.e., possibly by flexible rolling. For this, the strip material **2**, which has a substantially constant sheet thickness along the length before the flexible rolling, is rolled by rollers **4**, **5** such, that it receives a variable sheet thickness along the rolling direction. During the rolling the process is monitored and controlled, wherein the data determined by a sheet thickness measurement **6** are used as an input signal for controlling the rollers **4**, **5**. After the flexible rolling the strip material **2** has a variable thickness in rolling direction. The strip material **2** is wound after the flexible rolling again to a coil **3**, so that it can be transferred to the next method step.

[0035] After the flexible rolling the strip material **2** is smoothed in the method step V**2**, which is carried out in a strip aligning device **7**. The method step of smoothing is optional and can also be omitted.

[0036] After the flexible rolling (V**1**) or smoothing (V**2**), respectively, the strip material **2** is provided with a first coating material **1** in a method step V**3**. For this, the strip material **2** runs through an electrolytic strip coating device **8**. It can be seen that the strip coating is carried out in a continuous process, i.e. the strip material **2** is wound off the coil **3**, passes through the coating device **8** and is again wound to a coil **3** after the coating. This process management is advantageous, as the handling effort for applying the first coating material onto the strip material **2** is low and the process velocity is high. dip tank **9** of the strip coating device **8**, which is filled with an electrolytic liquid **10**, through which the strip material **2** passes, can be seen. The guiding of the strip material **2** takes place by sets of rollers **11**, **12**.

[0037] In the present embodiment, the electrolytic coating takes place with a metallic first coating material, which contains preferably at least 50 mass percent of zinc. By a high content of zinc, an especially good corrosion resistance is achieved. It is possible that the zinc content is 100% (pure zinc). For example, for the coating anodes (not shown) made from zinc can be used, which emit during applying a current zinc ions to the electrolyte **10**. The zinc ions are deposited on the strip material **2**, which is connected as a cathode, as zinc atoms and form a zinc layer. Alternatively also inert anodes and a zinc electrolyte can be used.

[0038] After the electrolytic coating (V**3**) the strip material **2** wound to a coil **3** is provided with a second coating material **15** in the method step V**4**, wherein the second coating material **15** has a composition of metallic components. The second coating material **15** is provided as a compound with metallic components in order to provide a cathodic corrosion protection. The composition of the second coating material is configured such that the metallic components consist mostly of elements that are more ignoble than the material of the sheet steel of the strip material **2**. More particularly, the second coating material **15** can be a scaling protection lacquer **15** with a high content of metallic components. The metallic components can be provided in form of particles in a base material of the lacquer, wherein the metallic particles can comprise at least one of titanium, niobium and vanadium particles. The metallic particles comprised in the second coating material **15** can react with the base steel material of the substrate **2** within a depth of up to 100 micrometres, for example. Thereby, a ductile intermediate layer is formed between the electrolytic coating, i.e., first coating material, and the steel substrate.

[0039] The scaling protection lacquer **15** can be applied onto the electrolytically deposited layer of the first coating material for example by coil coating, spray painting, brushing and so on. In the present embodiment the scaling protection lacquer **15** is supplied from a reservoir of an application roller **16** and so applied. If necessary, a baking of the lacquer **15** is carried out. Besides the protection against oxidisation, a further advantage of the scaling protection layer is that the surface has a high quality. Furthermore, the frictional value can be positively influenced by the scaling protection during the hot-forming as well as the heat absorption behaviour. A further advantage of the scaling protection is that the adhesion of the cathodic corrosion protection layer arranged below is improved.

[0040] After applying the second coating material (V4), individual sheet blanks **20** are worked from the strip material **2** in the next method step V5. Working, i.e., producing the sheet blanks **20** from the strip material **2** can be carried out by punching or cutting. Depending on the shape of the to-be-produced sheet blanks **20**, these can be punched from the strip material as form cuts, wherein an edge remains on the strip material, which is not further used, or the strip material **2** can simply be cut to length to partial pieces. A sheet blank **20** worked from the strip material, which also can be designated as three-dimensional sheet blank (3D-TRB), is shown schematically. The term substrate is used for the strip material **2** as well as for the blank **20**.

[0041] After producing the blank **20** from the strip material **2**, a forming of the blank **20** to the required final product can be carried out in the method step V**5**. According to a first possibility the blanks **20** can be hot-formed directly or according to a second possibility can be hot-formed indirectly.

[0042] In other words, the hot-forming can be carried out as a direct or indirect process. During the direct process the blanks **20** are heated to the austenitizing temperature before the hot-forming, which for example can be carried out by induction heating or in a furnace. In this regard, austenitizing temperature refers to a temperature range in which at least a partial austenitization (micro structure in the two phase region ferrite and austenite) is present. However, also only partial areas of the blank can be austenitized to enable a partial hardening, for example. After the heating to the austenitizing temperature the heated blank is formed in a shape giving tool **14** and at the same time cooled with a high cooling velocity, wherein the component **20** receives its final shape and is hardened at the same time.

[0043] During the indirect hot-forming, the blank **20** is pre-formed before the austenitization. The pre-forming is carried out in the cold condition of the blank, which means without previous heating. During the pre-forming the component receives a contour, which still does not correspond to the final shape, however is approximated thereto. After the pre-forming then, as in the direct process, an austenitization and hot-forming is carried out, whereby the component receives its final shape and is hardened.

[0044] The steel material should, insofar as a hot-forming (direct or indirect) is provided, have a proportion of carbon of at least 0.1 percent of mass up to 0.35 percent of mass.

[0045] It is to be understood that the process according to the present disclosure can be varied. For example between the described steps intermediate steps, which are not shown individually here, can additionally be provided. For example, before the step of electrolytic coating, the strip material can be provided with an intermediate layer, especially with a nickel-, aluminium- or manganese layer. This intermediate layer forms an additional protection of the surface and improves the adhesiveness of the afterwards applied coating containing zinc.

[0046] Furthermore, it is to be understood that the process management according to the present disclosure can be adapted in the sequence of the steps carried out. For example, the cutting of blanks can also be carried out at a different position, for example before the electrolytical coating. If necessary, at the end a blasting of the produced component can be provided.

[0047] FIGS. **2** and **3** show schematically the layer structure of the product, comprising the substrate **2**, **20**, i.e., in form of the strip material **2** or the blank **20**, the first electrolytic coating material **1**, and the second coating material **15** in form of a scaling protection lacquer. In FIG. **2** the layer structure is shown before the hot-forming (V**6**), which is compared in the following to the layer structure after the hot-forming (V**6**) shown in FIG. **3**. Before the hot-forming (V**6**) separate phases of the three layers, the steel substrate **2**, **20**, the first electrolytic coating material **1** and the second coating material **15**, in form of a scaling protection lacquer, are present. The representation is not to scale. To differentiate the material of the layers before and after the hot-forming, markings have been drawn in FIGS. **2** and **3**, wherein crosses schematically symbolize the second coating material **15**, circles schematically symbolize the electrolytic coating material **1** and a blank, i.e., no marking, schematically symbolizes the strip material **2**, **20**. By austenitization in method step V**6** an alloy formation is achieved on the respective boundary faces of the layers. Metallic components of the scaling protection lacquer **15**, for example aluminium, merge with the electrolytic coating **1**, for example from zinc, to an alloy **18**. This alloy **18** forms together with the steel substrate **2**, **20** a further alloy **17**. After the hardening, said further alloy **17** has a lower hardness than the hardened steel substrate **2**, **20**. This leads advantageously to an improved bending angle. Typical layer thicknesses before step V**6** are, for the scaling protection lacquer **15** two to twenty micrometers, for the electrolytic zinc-coating **1**, two to ten micrometers. The layer thickness after the hardening in step V**6** can amount to four to thirty micrometers for the alloy layer **18** that comprises the electrolytic zinc coating **1** and the scaling protection lacquer **15**. The layer thickness for the ductile alloy layer **17**, that is made from the scaling protection lacquer **15**, the electrolytic zinc coating **1** and the steel substrate **2**, **20**, can amount to two to fifty micrometers.

1.-**12**. (canceled)

13. A method for producing a product from a rolled strip material, comprising:

providing a substrate in form of a strip material from sheet steel;

rolling the substrate to produce a rolled strip material;

performing an electrolytic coating of the substrate with a first metal coating material, wherein the electrolytic coating is carried out after the rolling;

applying a second coating material as a scaling protection coating on the substrate coated with the first coating material; and

hot-forming of the substrate, wherein the hot-forming is carried out after applying the second coating material;

wherein the second coating material is a compound with metallic components, wherein the composition of the second coating material is selected such that the metallic components include predominantly elements which are more ignoble than the sheet steel of the substrate, thereby providing a cathodic corrosion protection.

14. The method of claim **13**, wherein the composition of the second coating material is such that the metallic components have a proportion of metallic particles.

15. The method of claim **14**, wherein the proportion of metallic particles of the second coating material, in relation to a total of metallic components of the second coating material, is at least 5 percent of a total mass and not more than 95 percent of a total mass of the second coating material.

16. The method of claim **15**, wherein the composition of the second coating material is such that the proportion of metallic particles has particles of one or more of the carbide forming elements titanium, niobium and vanadium.

17. The method of claim **15**, wherein the composition of the second coating material is such that the proportion of metallic particles has particles of one or more of the ferrite forming elements chromium, aluminium, titanium, tantalum, molybdenum, vanadium and silicon.

18. The method of claim **15**, wherein the composition of the second coating material is such that the proportion of metallic particles has particles with a grain size of at least 100 nanometers and not more than 10 micrometers.

19. The method of claim **13**, wherein zinc is used as the first coating material.

20. The method of claim **13**, wherein, during the hot-forming, a ductile alloying layer is produced in a boundary portion of the substrate from the elements of the substrate of the first coating material and of the second coating material, wherein the ductile alloying layer has a higher ductility as compared to the substrate.

21. The method of claim **13**, wherein, during the hot-forming, an outer alloying layer is produced in a boundary portion between the first coating material and the second coating material from elements of the first coating material and of the second coating material.

22. The method of claim **21**, wherein the ductile alloying layer is produced from elements of the substrate and of the outer alloying layer.

23. The method of claim **13**, wherein rolling the substrate is carried out as a flexible rolling, wherein a variable thickness is produced along a length of the strip material.

24. A product from a rolled strip material made of sheet steel with a coating from a first coating material and a second coating material, produced according to the steps of:

providing a substrate in form of a strip material from sheet steel;

rolling the substrate to produce a rolled strip material;

performing an electrolytic coating of the substrate with a first metal coating material, wherein the electrolytic coating is carried out after the rolling;

applying a second coating material as a scaling protection coating on the substrate coated with the first coating material; and

hot-forming of the substrate, wherein the hot-forming is carried out after applying the second coating material;

wherein the second coating material is a compound with metallic components, wherein the composition of the second coating material is selected such that the metallic components include predominantly elements which are more ignoble than the sheet steel of the substrate, thereby providing a cathodic corrosion protection.

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