A sheet metal component for a vehicle comprising a metal sheet having thickened portions integrated into the metal sheet that reinforces local areas of the sheet metal component. The metal sheet has integrally formed longitudinal members and cross-members. A method of manufacturing a sheet metal component is also disclosed that comprises selecting a planar sheet metal blank that is cut to size to define an outer contour. At least one reinforcing layer is provided on the blank to form thickened portions of the blank. The method also includes the steps of heating the blank, forming the blank into the desired geometric shape of the sheet metal component, and hardening the sheet metal component.
METHOD OF MANUFACTURING A STRUCTURAL ULTRA-THIN SHEET METAL PART WITH PATCH WELDED REINFORCEMENTS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of PCT application Ser. No. PCT/EP2012/072674 filed Nov. 15, 2012, which claims the benefit of DE 10 2011 086 813.5 filed Nov. 22, 2011, the disclosures of which are hereby incorporated by reference in their entirety.

TECHNICAL FIELD

[0002] This disclosure relates to a method of manufacturing sheet metal parts for vehicles from a blank that has locally thickened areas that are formed into integral reinforcements.

BACKGROUND

[0003] In commercially available motor vehicles, sheet metal components having a large surface area may be reinforced by means of rails and/or longitudinal members and cross-members to produce a self-supporting assembly.

[0004] For example, a floor structure consisting of a front sheet metal part and a rear sheet metal part for a motor vehicle is disclosed in U.S. Pat. No. 5,102,187. The sheet metal parts are provided with a plurality of reinforcing elements in the form of supports that are positioned on and welded to the sheet metal body. Welded components are produced that form the floor region of the motor vehicle.

[0005] A similar structure is disclosed in European Patent No. EP 1 525 132 B1 that discloses a floor plate that is reinforced by means of a longitudinal member and a laterally applied web plate.

[0006] A sheet metal component produced in one piece is disclosed in U.S. Pat. No. 7,111,900 B2 that is utilized to perform a load-bearing function. This component is, however, of exceptionally complicated construction and has curved regions that are partially provided with undercuts and are very difficult to produce.

[0007] This disclosure is directed to solving the above problems and other problems as summarized below.

SUMMARY

[0008] The object of this disclosure is to provide a one-piece, self-supporting sheet metal component for a motor vehicle that may be easily produced, has a high degree of strength and forms a relatively lightweight structure.

[0009] According to one aspect of this disclosure, the component is exclusively configured as a sheet metal part made of high-strength metal and is provided with stiffening portions and/or reinforcements in the regions that are subjected to particularly high loads. A high-strength sheet metal part having geometric stiffness is used to manufacture sheet metal parts having a large surface area and relatively low wall thickness. The sheet metal parts are substantially more lightweight than the known components and also have at least the same stability.

[0010] A plurality of load paths may be integrated in a single component having a large surface area to permit more uniform load.

[0011] The sheet metal blank used to manufacture the component is produced from high-strength heat-formed boron steel. Boron steel sheet metal plates may have a thickness of 0.7 mm or less. Geometrically complex components for motor vehicles may be produced from heat-formed boron steel to obtain a very high degree of strength in the component. The advantages of using heat-formed boron steel are considerable savings of weight and a reduction in the number of parts resulting in a reduction in production costs.

[0012] Alternatively, the sheet metal plates may be made from high-strength aluminum alloys that may be heat-formed and press-hardened. If the component is designed to be easily cold-formed, the sheet metal plates may, for example, also consist of ductile high-strength steels, such as for example FeMn steel, FeAl steel or other high-grade steels.

[0013] According to one embodiment, a one-piece component is provided that includes a sheet metal part that has thickened portions forming stiffening portions or reinforcements in the regions that are subjected to particularly high loads. The local thickened portions may be produced using “patch weld technology.” The sheet metal part with patch welded portions is then subsequently hot-formed. In this case, small planar sheet metal plates are welded (for example by laser welding or spot welding) onto the planar base plate made of boron steel, in the “soft” state before the forming process. The small planar sheet metal plates are heated together with the base plate to approximately 950°C, formed and hardened. The structural properties of the component may be accurately adjusted by changing the small planar sheet metal plates to accommodate the respective structural requirements.

[0014] Reinforcing layers made of high-strength material welded to the sheet metal part may also be provided as stiffening portions or reinforcements. The reinforcing layers are welded, pressed or rolled onto the sheet metal part and are provided as thickened portions. Alternatively, at least some of the reinforcing layers may be formed as sheet metal plates having a flexible thickness distribution (also known as “tailor rolled blanks”) that have a thickness and strength progression that is obtained by varying the roll gap when the sheets are rolled.

[0015] Alternatively, reinforcing layers made of high-strength material that has been pressed or rolled onto the sheet metal part may also be provided as thickened portions.

[0016] The reinforcements of the sheet metal part may also be obtained by local hardening, for example by means of a heat process. This process may also be used in a targeted manner to adapt to the requirements of different vehicle models.

[0017] The reinforcing regions may be integrally formed in the sheet metal plate as U-shaped channels and/or ribs in the longitudinal direction and/or transverse direction of the sheet metal part. To achieve optimal stability, the U-shaped channels and/or ribs may be provided with closure plates. It is possible to adapt to the load requirements of different vehicle models by using closure plates of different thickness or strength. A one-piece floor plate may be produced for different vehicle models that are adapted to different load requirements later in the production process.

[0018] The U-shaped channels may also be reinforced with structural foam or plastic parts to achieve optimal stability. The reinforcements, stiffening portions, closure plates, structural foams or plastic inserts may be adapted to the load requirements of different vehicle models. Flexible regions may also be provided in the component by varying the arrangement of the reinforcing regions.
The one-piece sheet metal component may be used in motor vehicle construction for different regions of the vehicle. The floor plate may be provided with a plurality of integrated load paths. Alternatively, it is also possible to make a component for the front wall, the bulkhead, the side regions and roof regions of a motor vehicle body. The stiffening portions, reinforcements, or thickened portions of the floor plate may be selected to perform the function of the longitudinal members or cross-members. Considerable weight savings may be achieved in the floor structure of the vehicle by subdividing the part in the longitudinal direction or in the transverse direction into at least two parts, for example, into a front floor plate, and a rear floor plate.

The thickened portions of the sheet metal part may be obtained by using flexibly rolled plates (“tailor rolled blanks”) in which the thickness progression and optionally the strength progression is obtained by varying the roll gap.

The above aspects of this disclosure and other aspects are described in greater detail below with reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded perspective view of a conventional prior art structure of a rear floor part.

FIG. 2a is a perspective view of a sheet metal blank plate with locally thickened portions applied by patch welding to produce a rear floor part.

FIG. 2b is a perspective view of a fully formed rear floor part formed from the sheet metal blank plate shown in FIG. 2a.

FIG. 3a is a perspective view of a sheet metal blank plate with locally thickened portions applied by patch welding to produce an alternative embodiment of a rear floor part.

FIG. 3b is a perspective view of a fully formed alternative embodiment of a rear floor part formed from the sheet metal blank plate shown in FIG. 3a.

DETAILED DESCRIPTION

The illustrated embodiments are disclosed with reference to the drawings. However, it is to be understood that the disclosed embodiments are intended to be merely examples that may be embodied in various and alternative forms. The figures are not necessarily to scale and some features may be exaggerated or minimized to show details of particular components. The specific structural and functional details disclosed are not to be interpreted as limiting, but as a representative basis for teaching one skilled in the art how to practice the disclosed concepts.

Referring to FIG. 1, a conventional rear floor part assembly for a motor vehicle is shown that is constructed according to a prior art construction. The floor part assembly consists of a sheet metal part 1 that is cut to size and is formed to the required geometric shape to provide the required functional parts and connecting regions. A supporting frame 2 is positioned below and subsequently assembled to the sheet metal part.

Referring to FIG. 2a, a rear floor part of a vehicle is shown to include a sheet metal part 3 having an outer contour that is cut to size. The sheet metal part 3 is a thin-walled boron steel having a thickness of 0.7 or 0.65 mm, or less. Local thickened portions 4 are applied onto the planar sheet metal part 3. The local thickened portions 4 are attached, for example, by patch welding technology. The small planar sheet metal plates 4 in the “soft” state before forming are welded, expediently by laser welding or spot welding, or pressed onto the planar base plate made of boron steel to form the thickened portions.

Referring to FIG. 2a, the sheet metal part 3 is shown in a final shape obtained after further forming. The thickened portions 4 and the sheet metal part 3 are heated together in a furnace to 950 °C. and are then formed and hardened. The structural properties of the component are accurately adjusted to the respective structural requirements.

The structure obtained may be similar to the arrangement shown in FIG. 1 that has longitudinal members and cross-members that provide a conventional rear floor structure. The rear floor structure formed by the sheet metal part 3 does not require the separate supporting frame 2 of the prior art as shown in FIG. 1, but obtains the required properties from the thickened portions 4 that are directly and integrally formed with the sheet metal part 3. The same approach would naturally also apply if the component were used as a front floor part that is designed to absorb a head-on collision and side impacts.

Referring to FIG. 3a, a rear floor part 5 is illustrated that corresponds to the sheet metal part 3 of FIG. 2a. Thickened portions 6 are applied to the planar sheet metal blank 5 and are fastened by laser welding or spot welding to the sheet metal part 5. In this case, the sheet metal plate consists of boron steel but alternatively may be formed of more easily formed FeMn steel, FeAl steel or other high-grade steels.

Referring to FIG. 3b, the rear floor part 3 is shown after being provided with the thickened portions 6, subjected to heat treatment, geometrically formed and hardened. This structure is self-supporting and does not require an additional supporting frame. Longitudinal ribs 7 are incorporated in the structure that provide good energy absorption properties in the event of a rear collision. The rear floor plate provides an entirely novel energy absorption mechanism that is substantially more efficient than conventional structures that have separately formed and subsequently assembled longitudinal members. In the event of a crash, the loads are not introduced locally but in a planar manner to achieve a more uniform load distribution.

The above-described novel structural solutions may be integrated into the vehicle structure using conventional joining techniques. No further cost in terms of production technology is required.

The embodiments described above have specific examples that do not describe all possible forms of the disclosure. The features of the illustrated embodiments may be combined to form further embodiments of the disclosed concepts. The words used in the specification are words of description rather than limitation. The scope of the following claims is broader than the specifically disclosed embodiments and also includes modifications of the illustrated embodiments.

What is claimed is:

1. A sheet metal component for a vehicle comprising: a metal sheet having thickened portions integrated into the metal sheet that reinforce local areas of the sheet metal component, wherein the metal sheet has integrally formed longitudinal members and cross-members.

2. The sheet metal component of claim 1 wherein the metal sheet is selected from a group consisting essentially of: boron steel; FeMn steel;
FeAl steel; and
aluminum alloy.

3. The sheet metal component of claim 1 wherein the metal sheet is boron steel having a thickness of less than or equal to 0.7 mm.

4. The sheet metal component of claim 1 wherein the integrally formed longitudinal members further comprise at least one U-shaped channel formed in a longitudinal direction in the sheet metal component.

5. The sheet metal component of claim 1 wherein the cross-members further comprise at least one rib formed in a transverse direction in the sheet metal component.

6. A method of manufacturing a sheet metal component comprising:

selecting a planar sheet metal blank that is cut to size defining an outer contour;

providing at least one reinforcing layer to the blank to form thickened portions on the blank;

heating the blank;

forming the blank into a geometric shape of the sheet metal component; and

hardening the sheet metal component.

7. The method of claim 6 wherein the step of providing at least one reinforcing layer further comprises assembling small planar sheet metal plates to the blank and welding the small planar sheet metal plates to the blank.

8. The method of claim 6 wherein the step of providing at least one reinforcing layer further comprises assembling small planar sheet metal plates to the blank and pressing the small sheet metal plates into the blank.

9. The method of claim 6 wherein the step of providing at least one reinforcing layer further comprises rolling the reinforcing layer onto the blank by varying a roll gap.

* * * * *