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ANONYMOUS: "TAILOR-WELDED ARMOR COMPONENTSSS", BENTELER DEFENCE WEBSITE , 6. August 2011 (2011-08-06), XP002694495, Gefunden im Internet: URL:<http://web.archive.org/web/20110806092025/http://www.benteler-defense.com/englis h/benteler-defense/products/tailor-welded- armor-components/index.html> [gefundet am 2013-03-25]

Description

The invention deals with a vehicle floor designed as a tailored blank in particular for a vehicle floor of a mine-protected vehicle in particular and it relates to a method for producing a vehicle floor of a mine-protected vehicle, wherein the vehicle floor consists of multiple individual metal sheets of armour steel that are joined to one another. The invention moreover relates to a vehicle floor produced by the method according to the invention. The important thing here is that first of all the welding of the individual plates occurs, followed by a heat treatment in the form of a combination of hardening and tempering, and finally the heat-treated sheet metal blank is shaped by hot forming into the final vehicle floor and/or intermediate floor. Vehicle floors of mine-protected vehicles must be designed such that on the one hand the vehicle floor is not ripped open by a mine explosion and on the other hand the dents in the vehicle floor caused by a mine explosion do not damage the equipment installed in the vehicle. Furthermore, the vehicle floor must offer protection against ballistic threats, namely, protect against shrapnel from exploding mines on the one hand and protect against gunfire on the other hand, especially in the transitional zone between the vehicle floor and the vehicle side.

In known vehicle floors of mine-protected vehicles, tempered individual sheets of armour steel are usually welded with the aid of a MIG (metal-inert gas) method, with the individual sheets sometimes having different wall thicknesses overlap in the region of the weld seam. Such weld seams form weak sites, as they have a lower strength than the armour steel. Furthermore, the welding process causes embrittlement of the material in the respective zone of thermal influence, so that these regions are especially prone to cracking in event of a mine explosion.

It is therefore known from EP 1 564 520 A2 how to cover the weld seams plus their zones of thermal influence with protective plates, although this involves both increased weight and a more time-intensive fabrication process of the corresponding vehicle floor.

EP 1 291 610 B1 deals with an armoured vehicle which affords a protection of the interior space against the action of mines by simple measures. For this, the floor region of a side wall recess of the interior space is connected to the vehicle roof by at least one bending-stiff or structurally rigid support element. The edge of a floor wall of the floor region curves upward and overlaps a wall region of the vehicle side wall, which is welded to another wall region. The latter has a wavy profile. This is supposed to prevent a ripping of the weld seam.

DE 10 2007 001 720 A1 describes a seat fixture for fastening a vehicle seat, comprising an elongated seat cross beam configured as a rolled profile.

5 EP 2 028 435 A1 shows a three-dimensionally shaped structural part made from a steel blank for the armouring of a vehicle, which is designed such that the steel blank is divided into a region with reduced wall thickness and a region with increased wall thickness and the steel blank has in the region of a bending angle or radius an increased wall thickness as compared to a flat region of the structural part, or a region with reduced wall thickness lies in a region of the three-
10 dimensionally shaped structural part installed in the vehicle which is struck by a shell only at an angle not equal to 90° or is covered by another structural part. Tailored blanks are used for this, which are divided into regions with larger wall thickness and regions with smaller wall thickness for example by a flexible rolling, a joining of different steel sheets, or a chip-removing machining.

15 US 6,971,691 B1 describes a bumper for a vehicle, made of metal sheets having different material properties.

EP 1 705 257 A1 indicates a method for armouring a vehicle with a structural part made from
20 hardened steel, as well as a hardened structural part made of steel with a wall thickness of 4 to 15 mm for armouring a vehicle.

The problem which the invention proposes to solve is to indicate a method of the kind mentioned above which prevents in simple manner a ripping open of the vehicle floor in the area of weld
25 seams during a mine explosion, without this requiring a reinforcement of the weld seam areas by means of additional metal sheets. Moreover, a vehicle floor produced by this method shall be disclosed.

This problem is solved according to the invention with respect to the method by the features of
30 claim 1 and with respect to the vehicle floor by the features of claim 4. Moreover, a vehicle with such a vehicle floor is proposed according to claim 6. Other particularly advantageous embodiments of the invention are disclosed by the dependent claims.

The invention is based substantially on the use of tailored blanks. In the case of a tailored welded
35 blank (TWB), the individual preferably tailored sheet metal blanks are welded to each other. This generally occurs as a butt joint by means of laser welding. The diverse material combinations and geometries are an advantage. In one modification, these consist of armour steel, from which the

contour of the respective vehicle floor is then produced by hot forming. To produce the tailored blanks, individual normalized plates of corresponding wall thicknesses are used, being joined together with the aid of laser beam welding. Such an approach for the automotive industry can be found in, among others, <http://www.thyssenkrupptailoredblanks.it/default.asp?page=8&titolo=1> or <http://www.thyssenkrupptailoredblanks.it/default.asp?page=2&titolo=1>.

However, for purposes of the present invention, the tailored blanks are heat treated only after the welding process and then the final vehicle floor is produced by forming.

Thanks to the heat treatment after the welding, preferably the said laser welding, an almost homogeneous transition is produced between the metal plates, preventing a weakening by subsequent welding. At the same time, it becomes easier to combine plates of different thickness and/or quality, so that there is a potential for weight savings, and also because overlapping is avoided and the minimally required plate thicknesses are used in the correct location.

The heat treatment which is preferred in this case is a heat treatment as for steels, that is, a combination of hardening and tempering. When the steels are being hardened, initially at temperatures above $A_c(3)$ the carbon in the austenite is dissolved and subsequently quenched to temperatures below $M(s)$ or $M(f)$. The tempering procedure is a procedure of reheating after the quenching procedure to temperatures below $A_c(1)$ in order to achieve a conversion into cubic martensite, and also to separate out fine carbide particles and where appropriate to further coagulate these particles.

Further details and benefits of the invention will emerge from the following exemplary embodiment, discussed with the aid of figures. There are shown

Fig. 1

a perspective representation of a vehicle floor produced according to the method of the invention from a sheet of armour steel for a mine-protected vehicle, and

Fig. 2

a longitudinal section through a sheet metal blank (tailored blank), which is assembled from individual plates of different wall thickness, for producing the vehicle floor shown in Fig. 1.

Fig. 1 shows, denoted as 1, a vehicle floor (vehicle hull) and / or intermediate floor of a mine-protected vehicle, not otherwise represented, comprising substantially two U-shaped sections 2

and 3. The two U-shaped sections 2, 3 respectively comprise an outer leg 4 and an inner leg 5, the two inner legs 5 of the U-shaped sections 2, 3 forming a tunnel-shaped section 6.

Now, it is provided for the vehicle floor 1, consisting preferably of armour steel, that the tunnel-shaped section 6 protruding into the interior of a mine-protected vehicle, not shown, has a wall thickness of 10 mm, for example, and the floor sections 7 between the two legs 4, 5 of the U-shaped sections 2, 3 each have a wall thickness of 12 mm, since they are especially strongly affected by the shock wave of a mine explosion and furthermore are supposed to protect the interior of the corresponding vehicle against shrapnel.

The outer legs 4 of the two U-shaped sections 2, 3 are each composed of two partial sections 8, 9. The first partial section 8 likewise has a wall thickness of 12 mm, for example, and the adjoining second partial section 9 has a wall thickness of 15 mm, since the partial section 9 is especially endangered by direct gunfire.

Fig. 2 shows the longitudinal section through a sheet metal blank (tailored blank), denoted by reference 10, prior to the forming or after the welding and heat treatment, from which the vehicle floor 1 (Fig. 1) according to the invention is produced by forming.

For this purpose, the sheet metal blank 10 is composed of seven individual sheets 11-17. The respective width as well as the wall thickness of the individual sheets 11-17 correspond to the sections designated as 8, 9, 7 and 6 in Fig. 1. The individual sheets 11-17 are preferably correspondingly welded together by means of laser welding (preferably as a butt joint) at their abutting sides, so that the weld seams designated as 18-23 in Fig. 2 are produced.

After fabricating the sheet metal blank 10, the blank is heat treated in the traditional way.

List of reference numbers

	1	Vehicle floor
	2, 3	U-shaped sections
5	4	(Outer) leg
	5	(Inner) leg
	6	(Tunnel-shaped) section
	7	Floor section
	8	(First) partial section
10	9	(Second) partial section
	10	Sheet metal blank, tailored blank
	11-17	Individual sheets
	18-23	Weld seams

Patentkrav

1. Fremgangsmåde til fremstilling af et køretøjsgulv og/eller et mellemliggende gulv af et køretøj, hvor køretøjsgulvet (1) udført af adskillige enkeltplader (11-17), der er svejset sammen og danner en metalplade (10) **kendetegnet ved, at** den derved fremstillede metalplade (10) bratkøles og tempereres ved hjælp af en varmebehandling i form af en kombination af hærkning og temperering; og den bratkølede og tempererede metalplade (10) omformes ved hjælp af varmomodannelse til det endelige køretøjsgulv og/eller mellemliggende gulv (1).
2. Fremgangsmåde ifølge krav 1, **kendetegnet ved, at** enkeltpladerne (11-17) forbindes til hinanden ved hjælp af lasersvejsning.
3. Fremgangsmåde ifølge krav 1 eller 2, **kendetegnet ved, at**, under hærkning af stålet ved temperaturer over $A_c(3)$, opløses kulstoffet i austenittet og efterfølgende bratkøles til temperaturer under $M(s)$ eller $M(f)$, og tempereringen er genopvarmning efter bratkølingen til temperaturer under $A_c(1)$ for at opnå en omdannelse til kubisk martensit, og samt for at separere fine karbidpartikler og hvor egnet til yderligere at koagulere disse partikler.
4. Køretøjsgulv og/eller mellemliggende gulv (1) af et køretøj, hvor køretøjsgulvet og/eller mellemliggende gulv (1) består af flere individuelle metalplader (11-17), der forbindes til hinanden ved hjælp af svejsning for at danne en metalplade (10), **kendetegnet ved, at** køretøjsgulvet og/eller mellemliggende gulv (1) fremstilles ved hjælp af en fremgangsmåde ifølge et hvilket som helst af kravene 1-3.
5. Køretøjsgulv og/eller mellemliggende gulv ifølge krav 4, **kendetegnet ved, at** enkeltpladerne (11-17) består af panserstål.
6. Køretøj med et køretøjsgulv og/eller mellemliggende gulv ifølge krav 4 eller 5.
7. Køretøj ifølge krav 6, **kendetegnet ved, at** køretøjet er et minesikret køretøj.

