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(54) **METHOD FOR PRODUCING A PAINTED LOAD-BEARING STRUCTURAL MEMBER OF A LOAD HANDLING APPLIANCE FOR USE ON A ROAD VEHICLE**

(57) A method for producing a painted load-bearing structural member (1) of a load handling appliance for use on a road vehicle, wherein the method comprises the following steps:
a) providing a structural member (1) of steel and one or more reinforcement plates (2a-2d) of steel;
b) applying at least one first corrosion protection layer and an outer layer of paint to the structural member (1) and to the reinforcement plate or plates (2a-2d); and
c) securing the painted reinforcement plate or plates (2a-2d) to the painted structural member (1) by means of acrylate adhesive, preferably methyl methacrylate adhesive, applied over the interface between each reinforcement plate (2a-2d) and the structural member (1).

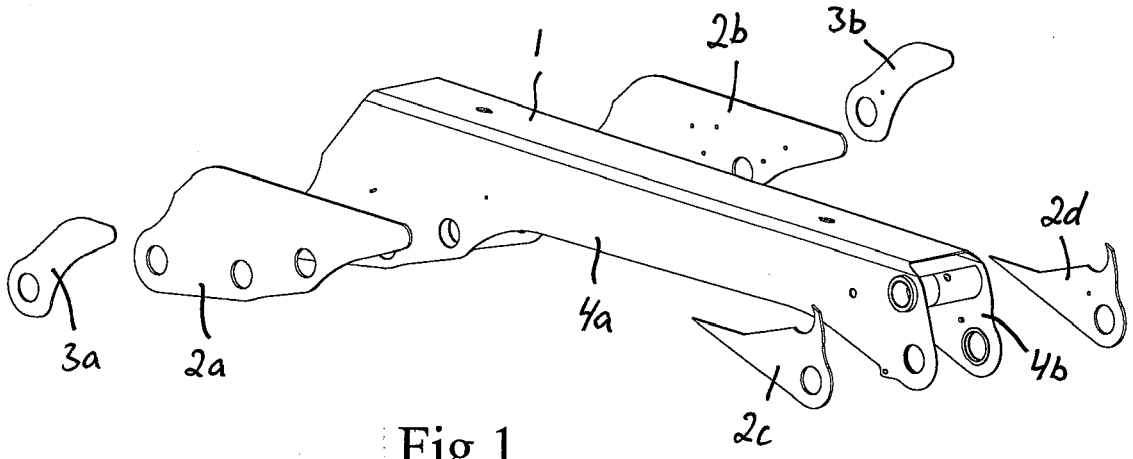

Fig 1

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Description

FIELD OF THE INVENTION AND PRIOR ART

[0001] The present invention relates to a method for producing a painted load-bearing structural member of a load handling appliance for use on a lorry or other road vehicle.

[0002] A load-bearing structural member in the form of a crane boom of a loader crane or forestry crane to be mounted to a lorry is normally made of steel. Reinforcement plates of steel may be secured to the crane boom at specific areas where the crane boom is subjected to particularly high strains and stresses, such as for instance around through holes in the crane boom where shafts included in pivotal connections between the crane boom and other parts of the crane are received. The reinforcement plates are normally secured to the crane boom by welding before the final finishing and painting of the crane boom, wherein each reinforcement plate is secured to the crane boom by a welding seam extending around the reinforcement plate along the outer rim thereof.

OBJECT OF THE INVENTION

[0003] The object of the present invention is to provide a new and favourable method for producing a painted load-bearing structural member of a load handling appliance for use on a lorry or other road vehicle.

SUMMARY OF THE INVENTION

[0004] According to the present invention, the above-mentioned object is achieved by a method having the features defined in claim 1.

[0005] The method of the present invention comprises the following steps:

a) providing a structural member of steel and one or more reinforcement plates of steel;
b) applying at least one first corrosion protection layer and an outer layer of paint to the structural member and to the reinforcement plate or plates; and
c) securing the painted reinforcement plate or plates to the painted structural member by means of acrylate adhesive, preferably methyl methacrylate adhesive, applied over the interface between each reinforcement plate and the structural member.

[0006] It has been found that a painted reinforcement plate of steel may be secured to a painted load-bearing structural member of steel with sufficient bonding strength by means of acrylate adhesive. Hereby, it will be possible to join the reinforcement plates and the structural member at a late stage in the production process when they are already painted. Furthermore, the use of adhesive for securing the reinforcement plates to the structural member implies that each reinforcement plate may be bonded to the structural member over the entire interface surface between the reinforcement plate and the structural member, in contrast to the previously used welding technique which only allows a reinforcement plate to be bonded to the structural member along the outer rim of the reinforcement plate. The increased bonding area makes it possible to reduce the size of the reinforcement plates. Another advantage associated with the use of adhesive for securing the reinforcement plates to the structural member is that the adhesive does not impair the fatigue strength of the steel material at the joints between the reinforcement plates and the structural member, in contrast to the previously used welding technique which results in a reduced fatigue strength of the steel material at the joints between the reinforcement plates and the structural member. The fact that the fatigue strength of the steel material remains unaffected when a reinforcement plate is secured to the structural member by means of adhesive implies that higher stresses can be tolerated, which in its turn implies that thinner reinforcement plates can be used as compared to the case when the reinforcement plates are secured to the structural member by welding. Thus, with the method according to the invention, the material consumption and material cost for a produced structural member and the weight thereof may be reduced as compared to a corresponding structural member where the reinforcement plates are secured to the structural member by welding.

[0007] According to an embodiment of the invention, the first corrosion protection layer applied to the structural member and to the reinforcement plate or plates is a nano-ceramic coating, wherein the nano-ceramic coating is applied to the structural member and to the reinforcement plate or plates by dipping the structural member and each reinforcement plate into an aqueous or solvent-based solution comprising organo-ceramic nanoparticles, preferably organo-silane nanoparticles. The nano-ceramic coating technique is a well-known type of coating technique for forming a thin and dense coating on a metal surface. The strong chemical bond between the nanoparticles of the nano-ceramic coating and the metal surface of the structural member and the reinforcement plate or plates will, along with the ultra dense structure of the coating, significantly improve the corrosion resistance of the metal surface. The material of the nano-ceramic coating will also form a strong chemical bond with the next layer of coating material applied to the structural member and to the reinforcement plate or plates and will thereby contribute to an excellent adhesion of the outer layer of paint to the structural member and to the reinforcement plate or plates.

[0008] According to another embodiment of the invention, a second corrosion protection layer is applied by means of cathodic electrodeposition onto the first corrosion protection layer of the structural member and the reinforcement plate or plates in step b. The second corrosion protection layer will further enhance the corrosion

resistance of the metal surface of the structural member and the reinforcement plate or plates.

[0009] According to another embodiment of the invention, the outer layer of paint applied to the structural member and to the reinforcement plate or plates is a powder coating which is applied electrostatically to the structural member and to the reinforcement plate or plates. The powder coating will create a hard and durable finish which is capable of withstanding harsh working environments and which will constitute an excellent contact surface for the adhesive to be applied over the interface between each reinforcement plate and the structural member.

[0010] Further advantages as well as advantageous features of the method according to the present invention will appear from the description following below and the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] With reference to the appended drawings, a specific description of preferred embodiments of the invention cited as examples follows below. In the drawings:

Fig 1 is a perspective view of a structural member in the form of a crane boom and reinforcement plates to be secured to it,

Fig 2 is a perspective view of the structural member of Fig 1, as seen with the reinforcement plates secured to the structural member, and

Fig 3 is a perspective view of a loader crane comprising the structural member of Fig 2.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0012] Fig 1 shows a load-bearing structural member 1 in the form of a crane boom of a hydraulic loader crane. Reinforcement plates 2a-2d to be secured to the structural member 1 and reinforcement plates 3a, 2b to be secured to one of the first-mentioned reinforcement plates 2a-2d are also shown in Fig 1. A first reinforcement plate 2a is to be secured to an outer surface of a first lateral wall 4a of the structural member 1 at a rear end of the wall, a second reinforcement plate 2b is to be secured to an outer surface of an opposite second lateral wall 4b of the structural member 1 at a rear end of the wall, a third reinforcement plate 2c is to be secured to an inner surface of the first lateral wall 4a at a front end of the wall, a fourth reinforcement plate 2d is to be secured to an inner surface of the second lateral wall 4b at a front end of the wall, a fifth reinforcement plate 3a is to be secured to an outer surface of the first reinforcement plate 2a and a sixth reinforcement plate 3b is to be secured to an outer surface of the second reinforcement plate 2b.

[0013] The structural member 1 and the reinforcement plates 2a-2d, 3a, 3b are made of steel.

[0014] Fig 2 shows the structural member 1 with the first, second, third and fourth reinforcement plates 2a-2d secured to the structural member by means of acrylate adhesive and with the fifth and sixth reinforcement plates 3a, 3b secured to the first reinforcement plate 2a and the second reinforcement plate 2b, respectively, by means of acrylate adhesive. The acrylate adhesive is preferably methyl methacrylate adhesive.

[0015] The structural member 1 and each reinforcement plate 2a-2d, 3a, 3b are coated with at least one first corrosion protection layer and an outer layer of paint before the reinforcement plates are secured to the structural member or to another reinforcement plate.

[0016] Before being coated, the surfaces of the structural member 1 and the reinforcement plates 2a-2d, 3a, 3b are thoroughly cleaned in a suitable manner. The structural member 1 and the reinforcement plates 2a-2d, 3a, 3b may for instance be subjected to cleaning in a first step, followed by blasting in a second step and then final cleaning in a third step. The blasting will remove welding impurities and any remaining corrosion or layers of scale from the surfaces of the structural member 1 and the reinforcement plates 2a-2d, 3a, 3b. The blasting will also enhance the adhesion properties of the surfaces of the structural member 1 and the reinforcement plates 2a-2d, 3a, 3b and thereby improve the adherence between these surfaces and the coatings to be applied to them.

[0017] The first corrosion protection layer applied to the structural member 1 and to the reinforcement plates 2a-2d, 3a, 3b is a nano-ceramic coating, which is applied to the structural member 1 and to the reinforcement plates 2a-2d, 3a, 3b by dipping the structural member and the reinforcement plates into an aqueous or solvent-based solution comprising organo-ceramic nanoparticles, preferably organo-silane nanoparticles. The nano-ceramic coating technique is a well-known coating technique which may be carried out by means of suitable chemical compositions marketed by different suppliers. The nano-ceramic coating technique applied to the structural member 1 and to the reinforcement plates 2a-2d, 3a, 3b will result in the formation of a thin and dense coating on the surfaces of the structural member 1 and the reinforcement plates 2a-2d, 3a, 3b and with a strong chemical bond between the nanoparticles of the nano-ceramic coating and the surfaces of the structural member 1 and the reinforcement plates 2a-2d, 3a, 3b.

[0018] According to a preferred embodiment of the invention, a second corrosion protection layer is applied by means of cathodic electrodeposition onto the first corrosion protection layer of the structural member 1 and the reinforcement plates 2a-2d, 3a, 3b, wherein the cathodic electrodeposition is carried out in a CED tank (CED = cathodic electrodeposition) with the component to be coated immersed in a suspension comprising water, preferably in the form of demineralized water, and epoxy resin coating particles. When a component in the form of said structural member 1 or one of said reinforcement plates 2a-2d, 3a, 3b has been coated using the cathodic elec-

trodeposition technique, excess coating particles are rinsed off from the component by spraying while the component is held above the CED tank, whereupon any surplus coating material that is not electro-chemically adhered to the surface of the component is removed from the component in a conventional manner in an ultra-filtration unit. The component is then baked, for instance by means of convection heating at a temperature of 200-220° C, whereupon the component is allowed to cool down to ambient temperature before an outer layer of paint is applied to the component.

[0019] The outer layer of paint applied to the surfaces of the structural member 1 and to the surfaces of the reinforcement plates 2a-2d, 3a, 3b is a with advantage a powder coating which is applied electrostatically to the structural member 1 and to the reinforcement plates 2a-2d, 3a, 3b in a conventional manner. When paint powder has been applied to a component in the form of said structural member 1 or one of said reinforcement plates 2a-2d, 3a, 3b using the electrostatic powder coating technique, the paint powder is baked onto the component under heat, for instance by means of convection heating at a temperature of 150-190° C, so as to allow the paint powder to form a uniform coating on the component, whereupon the coating is allowed to cure at room temperature until it has attained its maximum hardness.

[0020] Before securing the painted reinforcement plates 2a-2d, 3a, 3b to the painted structural member 1, the reinforcement plates and the structural member are subjected to degreasing. After degreasing, the first, second, third and fourth reinforcement plates 2a-2d are secured to the structural member 1 by means of acrylate adhesive, preferably methyl methacrylate adhesive, applied over the entire, or at least essentially the entire, interface between each reinforcement plate 2a-2d and the structural member 1, and the fifth and sixth reinforcement plates 3a, 3b are secured to the first reinforcement plate 2a and the second reinforcement plate 2b, respectively, by means of acrylate adhesive, preferably methyl methacrylate adhesive, applied over the entire, or at least essentially the entire, interface between the first and fifth reinforcement plates 2a, 3a and between the second and sixth reinforcement plates 2b, 3b. The application of the acrylate adhesive to the structural member 1 and to the reinforcement plates 2a-2d, 3a, 3b and the subsequent curing thereof may be carried out at room temperature.

[0021] The structural member 1 shown in Figs 1 and 2 is a so-called inner boom to be included in a load handling appliance in the form of a hydraulic loader crane 5 of the type illustrated in Fig 3. This loader crane 5 is intended to be mounted to a road vehicle, for instance in the form of a lorry. The loader crane 5 further comprises a rotatable column 6 and an outer boom 7, wherein the inner boom 1 at its inner end is articulately connected to the column 6 and at its outer end is articulately connected to the outer boom 7. The inner boom 1 is pivotable in relation to the column 6 by means of a first hydraulic cylinder 8 and the outer boom 7 is pivotable in relation to the inner boom 1 by means of a second hydraulic cylinder 9. The column 6 and/or the outer boom 7 and/or any other load-bearing structural member of the loader crane 5 may also be produced by the method according to the present invention.

[0022] A painted load-bearing structural member 1 produced by the method according to the present invention may also be a part of another type of load handling appliance, such as for instance a part of a forestry crane or other type of vehicle crane, a part of a hooklift, a part of a truck-mounted forklift or a part of a tail lift.

[0023] The invention is of course not in any way restricted to the embodiments described above. On the contrary, many possibilities to modifications thereof will be apparent to a person with ordinary skill in the art without departing from the basic idea of the invention such as defined in the appended claims.

Claims

1. A method for producing a painted load-bearing structural member (1) of a load handling appliance (5) for use on a road vehicle, wherein the method comprises the following steps:

   a) providing a structural member (1) of steel and one or more reinforcement plates (2a-2d) of steel;
   b) applying at least one first corrosion protection layer and an outer layer of paint to the structural member (1) and to the reinforcement plate or plates (2a-2d); and
   c) securing the painted reinforcement plate or plates (2a-2d) to the painted structural member (1) by means of acrylate adhesive, preferably methyl methacrylate adhesive, applied over the interface between each reinforcement plate (2a-2d) and the structural member (1).

2. A method according to claim 1, **characterized in that** the first corrosion protection layer applied to the structural member (1) and to the reinforcement plate or plates (2a-2d) is a nano-ceramic coating, wherein the nano-ceramic coating is applied to the structural member (1) and to the reinforcement plate or plates (2a-2d) by dipping the structural member and each reinforcement plate into an aqueous or solvent-based solution comprising organo-ceramic nanoparticles, preferably organo-silane nanoparticles.

3. A method according to claim 2, **characterized in that** a second corrosion protection layer is applied by means of cathodic electrodeposition onto the first corrosion protection layer of the structural member (1) and the reinforcement plate or plates (2a-2d) in step b.

4. A method according to claim 3, **characterized in that** the cathodic electrodeposition is carried out in a suspension comprising epoxy resin coating particles.

5. A method according to any of claims 1-4, **characterized in that** the outer layer of paint applied to the structural member (1) and to the reinforcement plate or plates (2a-2d) is a powder coating which is applied electrostatically to the structural member (1) and to the reinforcement plate or plates (2a-2d).

6. A method according to any of claims 1-5, **characterized in that** the structural member (1) is a part of a loader crane (5) or forestry crane.

7. A method according to claim 6, **characterized in that** the structural member (1) is a crane boom of a loader crane (5) or forestry crane.

8. A method according to any of claims 1-5, **characterized in that** the structural member is a part of a hooklift.

9. A method according to any of claims 1-5, **characterized in that** the structural member is a part of a tail lift.

10. A method according to any of claims 1-5, **characterized in that** the structural member is a part of a truck-mounted forkl ift.

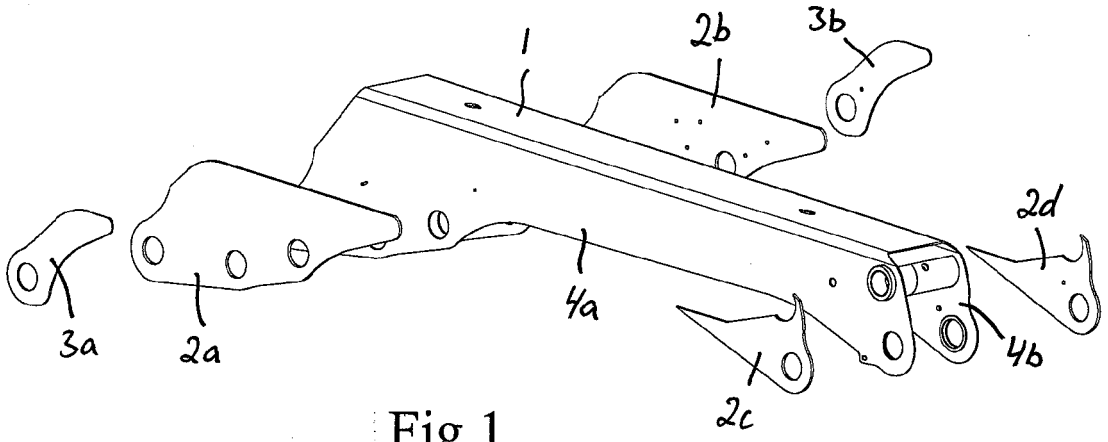

Fig 1

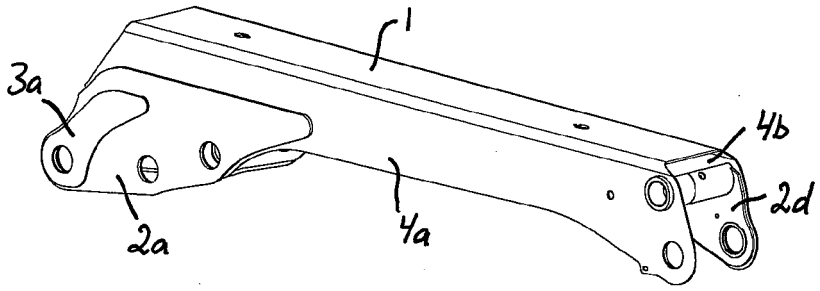

Fig 2

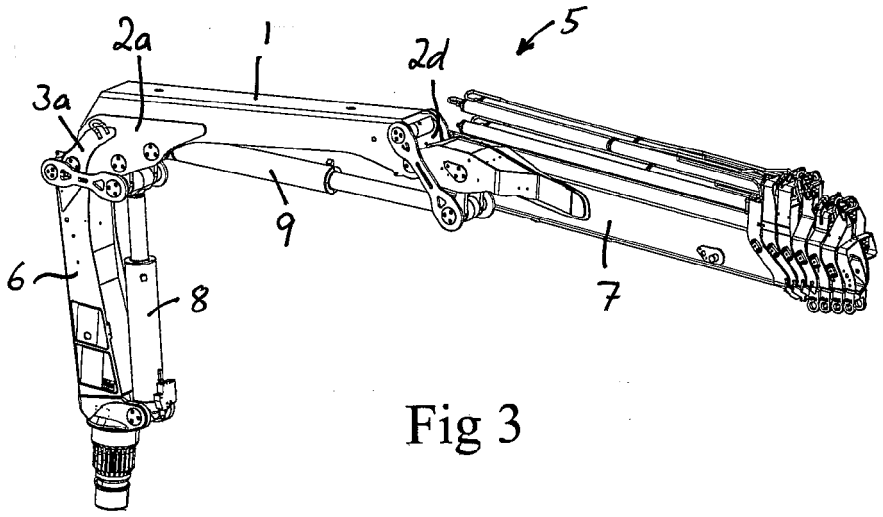

Fig 3

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EUROPEAN SEARCH REPORT

Application Number
EP 15 18 6778

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2013/048425 A1 (THOMPSON JESSE L [US]) 28 February 2013 (2013-02-28) * abstract * * paragraph [0028] - paragraph [0030]; figures * * paragraph [0039] *	1	INV. B66C23/64
A	GB 1 193 544 A (JONES CRANES LTD) 3 June 1970 (1970-06-03) * page 2, right-hand column, line 88 - line 103 * * page 2, right-hand column, line 108 - line 130 *	1	
A	DE 20 2010 003617 U1 (LIEBHERR HYDRAULIKBAGGER [DE]) 28 October 2010 (2010-10-28) * paragraph [0009] - paragraph [0010] * * paragraph [0049] * * paragraph [0051] * * figures *	1	
A	EP 0 723 819 A2 (NAT CRANE CORP [US]) 31 July 1996 (1996-07-31) * claim 1 * * figures 2, 3 *	1	TECHNICAL FIELDS SEARCHED (IPC) B66C E02F B66F B05D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	10 March 2016	Guthmuller, Jacques

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 18 6778

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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