REQUEST FOR A STANDARD PATENT AND NOTICE OF ENTITLEMENT

The Applicant identified below requests the grant of a patent to the nominated persons identified below for an invention described in the accompanying standard complete patent specification.

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[54] Invention Title “LAMINATE STRUCTURE AND METHOD OF CONSTRUCTION”

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Applicant states the following:

1. The nominated person is the assignee of the actual inventor.
2. The nominated person is the applicant.
3. The nominated person is not an opponent or eligible person described in Section 33-36 of the Act.

Dated: 14 October, 1998

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A laminate structure applicable as a wear liner (1) for supporting a coupling mechanism (M) of a rail wagon (W). The structure includes a metallic layer (2), a polymeric layer (3), and a cured elastomeric layer (4) therebetween bonding the layers together. The laminate structure is formed by assembling together the metallic layer (2), the polymeric layer (3), and the elastomeric layer (4) in an uncured state. The layers (2,3,4) are pressed together into face-to-face contacting relation, and the elastomeric layer (4) is cured thereby bonding the layers together.
Invention Title: "LAMINATE STRUCTURE AND METHOD OF CONSTRUCTION"

Applicant: MACKAY CONSOLIDATED INDUSTRIES PTY. LTD.

The following statement is a full description of this invention, including the best method of performing it known to me:
This invention relates generally to a laminate structure and its method of formation, and more particularly to formation of a metal-polymer material laminate incorporating a high wear resistant layer. The laminate structure is applicable as a wear liner for supporting rail wagon or carriage coupling mechanisms, and it will be convenient to hereinafter disclose the invention in relation to that application. However, it should be appreciated that the invention is not limited to that exemplary application.

Railway rolling stock typically has a wear liner mounted on the draft gear of a rail wagon or carriage immediately beneath a mechanism for coupling the wagon or carriage to an adjacent wagon or carriage. The wear liner has a bearing surface on which the coupling mechanism bears for support and location. The coupling mechanism is able to slide over the bearing surface during articulated movement of the coupled wagons or carriages. The continuous relative movement between the coupling mechanism and wear liner, during rolling stock operation, leads to wear of the wear liner at the bearing surface. Replacement of the wear liner is part of routine maintenance of the rolling stock.

Wear liners have traditionally been of a laminate configuration with a layer of highly wear resistant material providing the bearing surface. Typically, the wear liners have been constructed from all metallic layers, with one such construction involving a steel support layer on to which is welded a wear resistant alloy steel layer. Manganese steel is one such wear layer material.

Alternate laminate configurations have been developed involving a polymeric wear layer, providing the bearing surface, bonded directly to the steel supporting layer. These polymeric wear layers have tended to exhibit superior wear resistance.
However, the direct bonding of the polymeric layer to the steel layer has been subject to "debonding" leading to delamination of the layers. The reason for that debonding is believed to be due to shear forces acting at the metal-polymer layer interface. Those shear forces develop from differential expansion between the metal and polymer, as well as mechanical forces applied to the wear liner in service. In any event, wear liner replacement prior to the life limit of the polymer layer is often required.

An object of the present invention is to provide a metal-polymer laminate structure suitable for use as a wear liner, and which exhibits an improved service life.

Another object of the present invention is to provide an efficient and effective method of forming a metal-polymer laminate structure having improved layer bond characteristics.

According to one aspect of the present invention, there is provided a laminate structure, including: a metallic layer, a polymeric layer, and a cured elastomeric layer therebetween bonding the layers together.

In another aspect of the present invention, there is provided a method of forming a laminate structure, including: assembling together a metallic layer, a polymeric layer, and an uncured elastomeric layer therebetween, pressing the layers together into face-to-face contact relation, and curing the elastomeric layer thereby bonding the layers together.

Preferably, each of the metallic and polymeric layers has a bonding surface. The layers are assembled together so that the elastomeric layer extends in face-to-face contacting relation and bonds to each of those surfaces. The bonding surfaces are preferably planar, and bonding of the layers is continuous over the entire extent of the surfaces.

Preferably, the elastomeric layer has a thickness of between about 2 and 6mm.
Preferably, the metallic layer is composed of steel or an alloy steel, and the polymeric layer is composed of high or ultra high molecular weight polymeric material. The elastomeric layer is preferably composed of natural or synthetic rubber.

Preferably, the bonding surfaces are roughened, such as by grit sand blasting, prior to assembling the layers. The elastomeric layer has opposed bonding surfaces at which the elastomeric layer is bonded respectively to the metallic and polymeric layers, and preferably those surfaces are cleaned with a cleaning solvent prior to assembling the layers.

Preferably, a coating of heat activated bond enhancing substance is applied to each of the bonding surfaces prior to assembling the layers.

The following description refers to a preferred embodiment of the laminate structure and its method of construction according to the present invention, and forming a wear liner for supporting a rail wagon coupling mechanism. To facilitate an understanding of the invention, reference is made in the description to the accompanying drawings where the laminate structure is illustrated in that preferred embodiment. It is to be understood that the laminate structure and its method of construction are not limited to the preferred embodiment as hereinafter described and as illustrated in the drawings.

In the drawings:

Fig. 1 is a simplified end view of a railway wagon with a coupling mechanism bearing on a wear liner incorporating a preferred embodiment of the present invention;

Fig. 2 is a perspective view of the wear liner of Fig. 1;
Fig. 3 is a side view of the wear liner of Fig. 2; and

Fig. 4 is a perspective view of another wear liner incorporating a preferred embodiment of the present invention.

Referring initially to Fig. 1, there is generally shown in a simplified form a railway wagon W mounted on rails R. The wagon W has draft gear G supported on the rails R through bogie B. The wagon W is coupled to an adjacent wagon (not shown) through conventional coupling mechanism M, which is connected to the draft gear G. A wear liner 1 is also mounted on the draft gear G immediately beneath the mechanism M in order to support and locate the mechanism M. In particular, the mechanism M is able to slide over the wear liner 1 during articulated movement of the coupled wagons W.

The wear liner 1, shown in more detail in Figs. 2 and 3 is formed of a bonded laminate structure having a metallic layer 2, polymeric layer 3 and an intermediate elastomeric layer 4.

In this embodiment, the layers 2, 3, 4 are at least substantially planar, and in the form of plates or sheets with flat bonding surfaces 5 at which adjacent layers 2, 3, 4 bond together in face-to-face relation. However, it should be appreciated that the layers 2, 3, 4 may have other configurations depending on the application of the laminate structure. Thus, for example, one or more of the layers 2, 3, 4 may be otherwise three dimensional rectilinear including block like (as shown by the metallic layer 3 in the alternative embodiment of Fig. 4) or three dimensional curvilinear including tubular such as cylindrical.

The material composition of the layers 2, 3, 4 is selected according to a number of parameters, including an ability of adjacent layers to satisfactorily bond together, and also the intended application of the structure. As wear liner 1, the metallic layer 2 provides a support plate 6 composed of steel or an alloy steel, and the polymeric layer 3 provides a wear resistant plate 7, having a bearing
surface 8 for the mechanism M, composed of high or ultra high molecular weight polyethylene, polytetrafluoroethylene (teflon) or similar polymeric materials. In this embodiment, the intermediate elastomeric layer 4 is provided by a bonding sheet 9 composed of natural or synthetic rubber.

The bonding surfaces 5 are each provided by one face of the plates 6, 7 and sheet 9. Moreover, the elastomeric bonding sheet 9 extends over the bonds to the surfaces 5 of the metallic and polymeric plates 6, 7. That bonding is continuous over the entire surfaces 5, in this embodiment, although in alternate embodiments the bonding may be discontinuous over one or both pairs of face-to-face bonding surfaces 5.

In constructing the laminated wear liner 1, the layers 2, 3, 4 are assembled or "layered up", and then placed in a press assembly (not shown) for application of pressure in order to force the opposing bonding surfaces 5 into intimate contact. In one form, the press assembly is a jig press.

The assembled and pressed layers 2, 3, 4 are placed into an autoclave for curing the elastomeric layer 4 and activating bonding of the layers 2, 3, 4. Both curing of the elastomeric layer 4 and bonding of the layers 2, 3, 4 together are carried out together while the assembled layers 2, 3, 4 are in the autoclave, in this embodiment.

It will be appreciated that during curing, there will be a degree of flow of the elastomeric layer 4 as a result of the heat and pressure being applied to that layer. The heat and pressure levels should be selected and controlled to achieve effective curing and bonding while ensuring that elastomeric layer flow is not so excessive as to cause significant loss of elastomeric material from between the other layers 2, 3.

The bonding surfaces 5 of the metallic and polymeric layers 2, 3 are treated prior to assembly in order to enhance subsequent bonding. That treatment involves cleaning and roughening the surfaces 5, such as by grit or sand blasting.
The bonding surfaces 5 of the elastomeric layer 4 are also treated prior to assembly in order to enhance subsequent bonding. That treatment includes cleaning the surfaces 5 with a solvent, such as methyl ethyl ketone or xylene.

Treatment of the layers 2, 3, 4 also includes applying to each bonding surface 5 a coating of heat activated bond enhancing substance, such as that known as CHEMLOK marketed by Lord Corporation.

One exemplary method of forming the wear liner 1 as shown in the drawings includes the following steps:

1. Preparing the polymeric wear resistant plate 7 by machining to size and degreasing.

2. Treating the bearing surface 5 of the polymeric plate 7 by grit or sandblasting to a roughness value of 2.5 to 3.0 as measured by a KEANTATOR grit comparator.

3. Preparing the metallic support plate 6 by machining to size.

4. Treating the bearing surface 5 of the metallic plate 6 by grit or sandblasting to a roughness value of 2.5 to 3.0 as measured by a KEANTATOR grit comparator.

5. Preparing uncured elastomeric bonding sheet 9 by cutting to size. The sheet 9 will have a thickness of 2-6 millimetres, and a shape and size the same as the polymeric wear resistant plate 7.

6. Treating the bonding surfaces 5 of the elastomeric sheet 9 by cleaning with Trichloromethlene, methyl ethyl ketone or xylene.

7. Treating the bonding surfaces 5 of the polymeric and metallic plates 7, 6 and elastomeric sheet 9 by applying a coating of CHEMLOK substance.

8. Assembling the plates 7, 6 and sheet 9 into a laminate arrangement with the elastomeric sheet 9 intermediate the polymeric and metallic plates 7, 6 and their opposing bonding surfaces 5 in face-to-face contact.

9. Placing the assembled laminate arrangement into a jig press and adjusting so as to apply a pressure thereeto of approximately 0.5 kgf/cm².

11. Operating autoclave at approximately 140-170°C and 500-600 kPa for about 10-60 minutes to cause curing of elastomeric sheet 9 and bonding of that sheet 9 to the polymeric and metallic plates 7, 6.

12. Removing laminated structure from autoclave and jig press.

The elastomeric layer located between the polymeric and metallic layers allows shear forces acting between the polymeric and metallic layers to be distributed across the elastomeric layer. That tends to reduce the scale of shear forces acting at the bonding surfaces between the layers and thus reduces the likelihood of debonding. As a result, the exemplary application of the laminate structure as a wear liner is expected to reduce liner maintenance and replacement requirements.

Finally, it is to be understood that various modifications and/or additions may be made to the laminate structure and its construction method without departing from the ambit of the present invention as defined in the claims appended hereto.
The claims defining the invention are as follows:

1. A laminate structure, including: a metallic layer, a polymeric layer, and a cured elastomeric layer therebetween bonding the layers together.

2. A laminate structure as claimed in claim 1, wherein each of the metallic and polymeric layers has a bonding surface, and the elastomeric layer extends in face-to-face contacting relation and bonds to each of the bonding surfaces.

3. A laminate structure as claimed in claim 2, wherein the bonding surfaces are planar, and bonding together of the layers is continuous over the entire bonding surfaces.

4. A laminate structure as claimed in any preceding claim, wherein the elastomeric layer has a thickness of between about 2 and 6mm.

5. A laminate structure as claimed in any preceding claim, wherein the metallic layer is composed of steel or an alloy steel.

6. A laminate structure as claimed in any preceding claim, wherein the metallic layer is a support plate of a wear liner for supporting a rail wagon or carriage coupling mechanism.

7. A laminate structure as claimed in any preceding claim, wherein the polymeric layer is composed of high or ultra high molecular weight polymeric material.

8. A laminate structure as claimed in claim 7, wherein the polymeric material is high or ultra high molecular weight polyethylene, or polytetrafluoroethylene.

9. A laminate structure as claimed in claim 7 or 8, wherein the polymeric layer is a wear resistant plate of a wear liner for supporting a rail wagon or carriage coupling mechanism.

10. A laminate structure as claimed in any preceding claim, wherein the elastomeric layer is composed of natural or synthetic rubber.

11. A laminate structure substantially as hereinbefore described with reference to any one of the embodiments as shown in the accompanying drawings.

12. A method of forming a laminate structure, including: assembling together a metallic layer, a polymeric layer, and an uncured elastomeric layer therebetween, pressing the layers together into face-to-face contact relation, and curing the elastomeric layer thereby bonding the layers together.
13. A method as claimed in claim 12, wherein each of the metallic and polymeric layers have a bonding surface, and the layers are assembled together so that the elastomeric layer extends in face-to-face contacting relation with the bonding surfaces.

14. A method as claimed in claim 13, and further including roughening the bonding surfaces prior to assembling the layers together.

15. A method as claimed in claim 14, wherein roughening the bonding surfaces includes grit sand blasting to a roughness of about 2.5 to 3.0 as measured by a KEANTATOR grit comparator.

16. A method as claimed in any one of claims 12 to 15, wherein the elastomeric layer has opposed bonding surfaces at which the elastomeric layer is bonded respectively to the metallic and polymeric layers, and further including cleaning those bonding surfaces with a cleaning solvent prior to assembling the layers together.

17. A method as claimed in claim 16 when appended to claim 13, and further including applying a coating of heat activated bond enhancing substance to each of the bonding surfaces prior to assembling the layers together.

18. A method as claimed in any one of claims 12 to 17, wherein the assembled layers are pressed into contacting relation with a pressure of approximately 0.5 kgf/cm².

19. A method as claimed in any one of claims 12 to 18, wherein the elastomeric layer is cured whilst the layers are pressed together.

20. A method as claimed in any one of claims 12 to 19, wherein the elastomeric layer is cured at a temperature of approximately 140 to 170°C and a pressure of approximately 500 to 600 kPa for a period of about 10 to 60 minutes.

21. A method of forming a laminate structure substantially as hereinbefore described with reference to any one of the embodiments as shown in the accompanying drawings.

22. A laminate structure when formed by the method as claimed in any one of claims 12 to 21.
23. A laminate structure as claimed in claim 22 for use as a wear liner for supporting rail wagon or carriage coupling mechanism, the metallic layer being a support plate and the polymeric layer being a wear resistant plate having a bearing surface for the coupling mechanism.

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ABSTRACT

A laminate structure applicable as a wear liner (1) for supporting a coupling mechanism (M) of a rail wagon (W). The structure includes a metallic layer (2), a polymeric layer (3), and a cured elastomeric layer (4) therebetween bonding the layers together. The laminate structure is formed by assembling together the metallic layer (2), the polymeric layer (3), and the elastomeric layer (4) in an uncured state. The layers (2,3,4) are pressed together into face-to-face contacting relation, and the elastomeric layer (4) is cured thereby bonding the layers together.