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None

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(54) **Protective sheet**

(57) A protective sheet (13) for a resin pre-impregnated fiber board (prepreg) (11a, 11b, 11c) is ferromagnetic. This permits effective and safe manipulation of the fiber board in processing (trimming) and in the manufacture of fiber components. In use the prepregs are placed over a mould protected by the sheet 13. A magnetic field is generated within the mould and the sheet is removed after heat and pressure has been applied to the assembly.

FIG.3

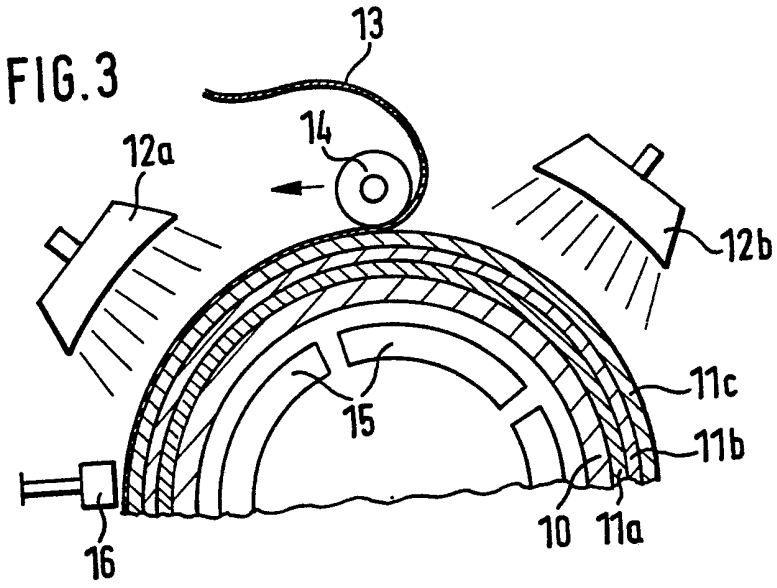

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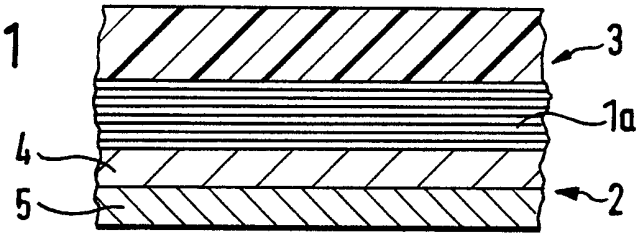
FIG.1



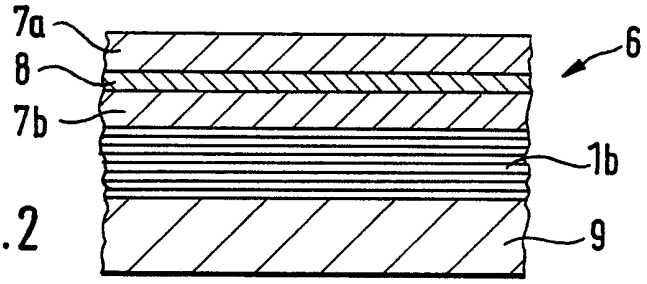
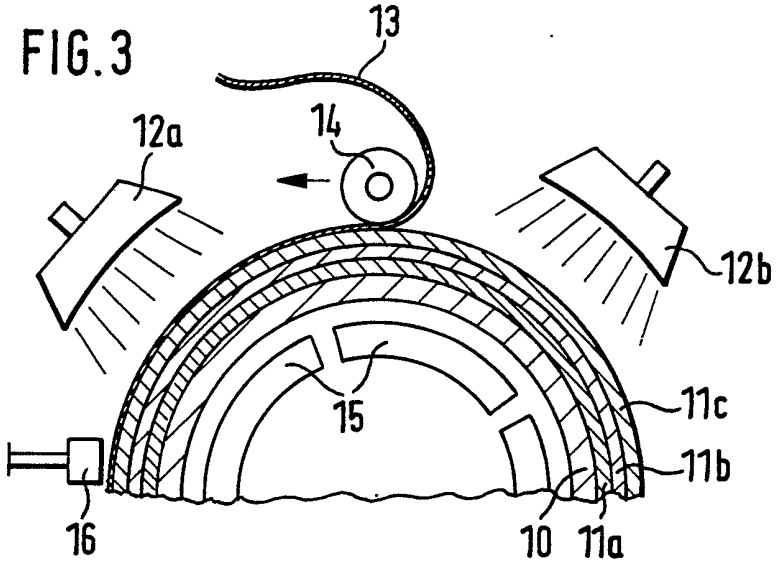


FIG.2

FIG.3



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Protective Sheet

This invention relates to protective sheet for resin prepregs.

Prepegs are resin preimpregnated mats, fabrics or layers composed of unidirectional elementary fibers. For manufacturing fiber components from prepregs, the latter are spread over a mould and caused to adhere by means of heat and presure. For components of complex geometries these prepregs have to be trimmed to size before they are spread on moulds.

To protect them from contamination and damage when being worked with trimming tools, the carbon, glass or aramid fiber prepregs are provided on both sides with a protective sheet. When being trimmed to size the prepregs are held, together with the protective sheet, by mechanical means (clamping) or they are fixed on a smooth table by means of negative pressure (suction), where a vacuum is created under the prepreg with its, protective sheet. For this purpose, the table is provided with holes, or consists of plastics brushes in a very dense arrangement to prevent the necessary suction pressure from being diminished by leakage flows.

The trimming tools are operated automatically or manually, use being made of knives, or of lasers, high-pressure water jets or ultrasonic cutters. During cutting the prepreg can be sectioned together with only one of the two protective sheets, with the individual blanked-out prepregs remaining together, or both sheets are sectioned to produce separate individual precut parts.

The known procedure for fixing the prepregs in position either requires relatively elaborate mechanical fixing means on the processing tool, or else comprehensive vacuum devices, the latter additionally being suceptible to contamination, where the suction holes may be blocked or the plastics brush seals closed off. Also, the hold-down force breaks down when the prepregs lift off the support underneath, no matter by how little.

An object of the present invention is to provide a protective sheet for a resin prepreg such that it can be fixedly positioned in a simple manner for processing (trimming) on the cutter, for transport to the component to be manufactured, and for the manufacture of the component.

The invention provides a protective sheet as claimed in claim 1.

Thus, this permits the advantageous fixing of the protective sheet and the prepregs thereon by magnetic forces. This provides an advantage over the vacuum-type fixing means in that contamination, e.g. by filings, is prevented. Stepping or linear type electric motors can be used to transport in a simple manner the prepregs after trimming, or robots can be used to pick-up and re-deposit the prepregs.

Another substantial advantage is provided in that magnetization of the protective sheet also helps to improve manufacture of the fiber components. A magnetic field in the interior of the mould, e.g., can be used to position the prepregs on the bed such that their position can be shifted and, thus, corrected.

A further substantial advantage provided by the inventive protective sheet is that like a magnetic tape or a computer floppy disk, it can be designed to carry electronic information, such as numbers for correlating the fiber layer. In this manner, automatic production of a fiber component is substantially assisted and simplified.

In a preferred aspect of the present invention the protective sheet consists of a nonmagnetic, flexible substrate joined to a ferromagnetic layer. This

advantageously provides adequate protection of the prepreg from mechanical action. The substrate preferably consists of paper or plastics, while the ferromagnetic layer is preferably formed by metallic gauze, metallic sheet or powdered metal. In a preferred aspect of the invention the ferromagnetic layer takes the form of metallic gauze imbedded in the substrate.

A particularly simple manner of manufacture would be to deposit the ferromagnetic layer on the substrate by vapour deposition, spraying or electroplating.

In a further advantageous embodiment of the present invention the prepreg is covered with the ferromagnetic protective sheet on one side only, while on the other side a conventional sheet is provided which merely serves for protection. This reduces costs with the functionability substantially unchanged.

A suitable material for the ferromagnetic layer would be specifically iron, nickel, cobalt or alloys thereof exhibiting ferromagnetic properties. The ferromgnetic layer is applied in thicknesses of preferably 1/100 mm to 1 mm. With powdered metal layers the thickness may be about 1/100 mm to 2/100 mm, while with metal gauze or similar flexible layers, the layers will have greater thickness.

In a further advantageous embodiment of the invention the powdered-metal ferromagnetic layer is provided between two substrate layers to prevent metal powder particles from separating from the protective sheet.

A preferred method of manufacturing components by laminating resin prepregs is to cover the prepregs on at least one side with a ferromagnetic protective foil. In the interior of the mould, means are provided for generating a magnetic field, and with the magnetic field activated a prepreg to be applied is positioned on the mould with the protective sheet on the outside. After aligning the prepreg its temperature is raised by, e.g. an infrared emitter such that the resin turns tacky and adheres to the mould or the previously deposited laminate under a specified contact pressure. The magnetic sheet can be peeled off and the next layer deposited either before or after contact pressure is applied.

For the purpose, the magnetic field in the interior of the mould can be deactivated by means of, e.g., electromagnets.

The magnetic sheet of the present invention is suited especially well for peeling by automatic means in the form of, e.g., magnetic or magnetizable rollers.

A further substantial advantage provided by the present invention is that state-of-the-art protective sheeting for prepregs can be modified by subsequent application of the inventive ferromagnetic layer by electroplating, vapour deposition, spraying or rolling to achieve the above-mentioned advantages and advantageous effects.

An embodiment of the invention will now be described by way of example with reference to the accompanying drawing, in which:

Figure 1 is a schematic sectional view of a prepreg,

Figure 2 is a schematic sectional view of another prepreg, and

Figure 3 is a schematic sectional view of a mould covered with prepregs.

In Figure 1 a prepreg 1a is covered on both sides with protective sheets 2 and 3. In this arrangement the protective sheet 2 consists of a flexible substrate 4 adhering to the prepreg 1a and of a ferromagnetic layer 5 applied to the substrate 4.

The protective sheet 3 applied to the other side of the prepreg 1a consists of a combined

substrate/ferromagnetic layer achieved by imbedding ferromagnetic elements, e.g., a fabric, in the substrate. In this arrangement the two different protective sheets 2, 3 are shown for ease of demonstration. In practice it will be preferable to provide the same type of protective sheet on both sides of the prepreg.

In Figure 2 a protective sheet 6 is applied to one side of the prepreg 1b and consists of two substrates 7a, 7b arranged one on the other with an intervening ferromagnetic layer 8 in the form of, e.g., powdered metal. The other side of the prepreg 1b is provided with a conventional non-magnetic protective sheet 9.

In Figure 3 a preferred use of the protective sheet of the present invention is shown by way of example. Several layers of prepregs 11a, b, c are applied to a mould 10. The layers have already been made to conform to the mould under pressure and heat. Heat is applied by infrared emitters 12a, b. The outermost fiber layer 11c is additionally provided on its outer side with a ferromagnetic protective sheet 13, which is peeled off by means of a magnetizable roller 14. In the interior of the mould 10 several, preferably disconnectible magnets 15 are provided. An electromagnetic write/read means 16 is provided to read information stored on the

protective sheet 14 and accordingly control the processing or positioning of the prepreg 11c.

Claims:

1. A protective sheet for resin prepregs, wherein the sheet is ferromagnetic.

2. A protective sheet as claimed in claim 1, wherein the sheet comprises a non-magnetic, flexible substrate joined to a ferromagnetic layer.

3. A protective sheet as claimed in claim 2, wherein the ferromagnetic layer is imbedded in the substrate.

4. A protective sheet as claimed in claim 2, wherein the ferromagnetic layer and the substrate are bonded to each other.

5. A protective sheet as claimed in claim 2, wherein the ferromagnetic layer is applied to the substrate by vapour deposition, spraying, rolling or electroplating.

6. A protective sheet as claimed in any one of claims 2 to 5, wherein the substrate consists of paper or plastic material.

7. A protective sheet as claimed in any one of claims 2 to 6, wherein the ferromagnetic layer is formed by metallic guze.

8. A protective sheet as claimed in any one of claims 2 to 6, wherein the ferromagnetic layer consists of powdered metal.

9. A protective sheet as claimed in claim 7 or 8, wherein the ferromagnetic layer is provided between two substrates.

10. A protective sheet as claimed in any one of claims 2 to 6, wherein the ferromagnetic layer is a metal sheet.

11. A protective sheet as claimed in any one of claims 2 to 10, wherein the substrate has a thickness of substantially 0.01 to 0.15 mm.

12. A protective sheet as claimed in any one of claims 2 to 11, wherein the ferromagnetic layer has a thickness of substantially 1/100 to 1 mm.

13. A protective sheet as claimed in any one of claims 2 to 12, wherein the material of the ferromagnetic layer is iron, nickel, cobalt or alloys thereof.

14. A protective sheet as claimed in any one of the preceding claims, wherein the sheet covers a prepreg on both sides.

15. A protective sheet as claimedin any one of claims 1 to 13, wherein the sheet covers the prepreg on one side and a conventional sheet is provided on the other side of the prepreg.

16. A protective sheet as claimed in any one of claims 2 to 15, wherein the ferromagnetic layer or a portion thereof is designed such that information can be stored by means of electromagnetic write/read means.

17. A protective sheet for resin prepregs substantially as herein described with reference to any one of the embodiments shown in the accompanying drawing.

18. A method of manufacturing components by laminating resin prepregs over a mould, wherein the prepregs are covered on one side with a ferromagnetic protective sheet, a magnetic field is generated in the interior of the mould, a fiber layer is deposited with the protective sheet on its outside, and the protective sheet is removed before or after contact pressure is applied.

19. A method as claimed in claim 18, wherein the magnetic field is disconnectible.

20. A method as claimed in claim 18, wherein the

protective sheet is peeled off by means of magnetic devices, preferably rollers.

21. A method of manufacturing components by laminating resin prepregs over a mould substantially as herein described with reference to the accompanying drawings.

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