A multi-layer oversewn system having at least two flat electric conductors. A protective layer made of an elastic material is located at least in an oversewn region between the flat electric conductors. The material of the protective layer is selected in such a way that it prevents a short-circuit between the flat electric conductors during the oversewing process by sealingly engaging the needle during the oversewing process.
MULTI-LAYER OVERSEWN SYSTEM

[0001] The invention relates to a multi-layer oversewn system with at least two inter-insulated flat electric conductors.

[0002] One application for such a system is, for example, a capacitive occupant recognition system integrated in the seat of a motor vehicle. This is constructed of two flat conductors made from metallized fabric, which are insulated from one another by a spacing material e.g., a knitted or nonwoven fabric. In addition to the insulation property, the assurance of a minimum distance between the flat electric conductors and a sufficiently fleecy quality, the spacing material should frequently also possess a high degree of air permeability to ensure a comfortable seat temperature. This leads to the use of adequately "open" and soft spacing materials, which, however, do not provide sufficient protection from short circuits in oversewn regions.

[0003] With such systems it is frequently necessary for textile sandwich structures, which contain two or more conducting layers, to be oversewn with one another, as is the case, for example, with FDS field detection sensor mats integrated in the seat of a motor vehicle. The problem arises that such sandwich structures can be oversewn only in regions that do not have conductive layers located above one another in order to avoid short circuits between the conductive materials due to the sewing process. In the case of multi-layer systems with a large area, oversewing is often necessary not only in the edge region with no conductive layers, but also in other regions of the multi-layer system. The flat electric conductors thus form separate regions in the multi-layer system, which must be conductively connected with one another by means of cable bridges. The disadvantage here is that special care must be taken in placing the flat electric conductors in their separate regions and they must be electrically connected with one another after the sewing process by means of complicated and error-prone bonding.

[0004] The object of the invention is to provide a multi-layer oversewn system with several inter-insulated flat electric conductors arranged above one another, whose production is simple, thus largely avoiding the risk of short circuits between the conductive materials caused by the sewing process.

[0005] To achieve this objective, a multi-layer system is proposed, in which is arranged, at least in an oversewn region between the inter-insulated flat electric conductors, a protective layer made of an elastic material, which prevents a short circuit between the flat electric conductors during the oversewing process.

[0006] Such a multi-layer oversewn system makes it possible to change from a complex production of the system from several smaller systems, with their subsequent bonding with one another, to a simpler production of the system of any given size in one piece. The protective layer according to the present invention can, in addition to ensuring suitability for oversewing, also act as an electric insulation and/or spacing layer.

[0007] The dependent claims 2 through 11 present preferred embodiments of the multi-layer system according to the present invention.

[0008] Three exemplary embodiments of the multi-layer oversewn system according to the present invention are explained in greater detail below. Shown are:

[0009] FIG. 1 a cross-section through a multi-layer system with two flat electric conductors, with the layers shown spaced apart from one another;

[0010] FIG. 2 a top view of a multi-layer system with an end-to-end protective layer; and

[0011] FIG. 3 a top view of a multi-layer system with a protective layer arranged in places.

[0012] FIG. 1 shows a cross-section through a preferred embodiment of a multi-layer system 10, with the individual layers shown spaced apart from one another. The lowermost layer of the system forms a backing material 2, comprising a non-conducting, elastic, smooth, tensile-loadable and non-buckling material, e.g., of a knitted, charmuese or nonwoven fabric.

[0013] On the nonwoven backing 2 is a flat electric conductor 3, comprising a conducting fabric, such as a silver-coated nylon knit. On the electric conductor 3 is located a spacing material 5, comprising, for example, of a nonwoven or knitted fabric and having a predetermined thickness.

[0014] Over the spacing material 5, a protective layer 4 is applied, comprising silicone rubber. The protective layer 4 can also comprise other elastomers, rubber, silicone, polymer gel and/or polymer foam or leather. The material of the protective layer 4 ensures that fibers from the conductive fabric of the conductor 3 or 3' below or above this layer that are pulled along or ripped out by a needle or thread during the sewing process are stripped off. It is essential that the material of the protective layer 4 exhibits an elasticity, which ensures that the material closes around the needle when pierced, thus preventing material fragments of the conductive fabric of the flat electric conductor 3 and 3' from being pulled through. The protective layer 4 can exhibit the following parameters: a modulus of elasticity between 200 and 15,000 N/mm², preferably between 1,000 and 5,000 N/mm², a thickness between 0.2 and 2 mm, preferably between 0.5 and 1.5 mm, a tear resistance between 20 and 500 N/mm, preferably between 50 and 100 N/mm and/or a sliding friction coefficient in relation to the material of the conductor 3, 3' between 0.2 and 1.0, preferably between 0.2 and 0.6.

[0015] The flat electric conductor 3' above the protective layer 4 comprises the same material as the upper flat electric conductor 3, but can also be made of another conductive fabric.

[0016] The multi-layer oversewn system is closed off by a cover layer 1 above the flat electric conductor 3', achieving a sufficient mechanical protection of the conductive fabric of the conductor 3'. The cover material 1 comprises a knitted fabric. Charmuese and nonwoven fabrics can also be used.

[0017] The multi-layer system shown in FIG. 1 can also be composed without the spacing material 5 if the protective layer 4 has sufficient electrical insulating properties.

[0018] FIG. 2 shows a top view of the multi-layer system with a protective layer 4 extending continuously from the left edge region of the system to the right edge region. This embodiment is especially preferred for the case in which good air permeability of the multi-layer system is required. In this case, the protective layer 4 is used only in the oversewn region 6.
FIG. 3 shows another embodiment of the multi-layer system according to the present invention, which is distinguished from the embodiment shown in FIG. 2 in that the upper flat conductor 3' in the oversewn region 6 is recessed except for a small region ensuring the electric conductivity. The length of the protective layer 4 embodied in strip form is accordingly reduced to the length of the oversewn region 6 crossing over the recessed flat conductor 3'. To prevent possible short circuits between the flat conductors 3, 3', it is advantageous if the length of the protective layer 4 slightly exceeds the length of the oversewn region 6 crossing over the flat conductor 3'. Alternatively, both flat conductors 3, 3' in the oversewn region 6 can be recessed [except for] a narrow region ensuring the electric conductivity. This embodiment makes it possible to further reduce the critical oversewn area considerably.

1. A multi-layer oversewn system comprising at least two inter-insulated flat electric conductors, and a protective layer of self-sealing elastic material is arranged at least in an oversewn region between the flat electric conductors, which prevents a short circuit between the flat electric conductors during an oversewing process.

2. The system according to claim 1, wherein the elasticity, the sliding friction coefficient, the texture, the geometry, the density or the tear resistance of the elastic material is selected in such a way that, upon passage of a needle and thread during the oversewing process, material from a flat electric conductor is stripped from these the needle and thread by the sealing engagement of the protective layer.

3. The system according to claim 1, wherein the flat electric conductors are textile sensor electrodes.

4. The system according to claim 1, comprising of an electrical insulating material layer of a predetermined thickness, arranged between the two flat electric conductors.

5. The system according to claim 4, wherein the flat electric conductors are electrically insulated from one another by the protective layer or the electrical insulating material layer.

6. The system according to claim 1, wherein the lowermost layer is a nonwoven backing and the uppermost layer is a nonwoven cover.

7. The system according to claim 4, wherein the protective layer or the electrical insulating material layer extend substantially over the entire surface between the flat electric conductors.

8. The system according to claim 1, wherein at least one of the flat conductors in the oversewn region along a direction of the oversewing is shorter than at a point outside the oversewn region, and wherein the protective layer covers only the oversewn region covered by the shortened flat conductor.

9. The system according to claim 1, wherein the protective layer between the flat electric conductors is at least partly omitted in regions located outside the oversewn region.

10. The system according to claim 1, wherein the protective layer comprises at least one of: a modulus of elasticity between 200 and 15,000 N/mm²; a thickness between 0.2 and 2 mm; a tear resistance between 20 and 500 N/mm; or a sliding friction coefficient in relation to the material of the conductor between 0.2 and 1.0.

11. The system according to claim 1, wherein the protective layer comprises at least in part leather, rubber, silicone, polymer gel or polymer foam.

12. A multi-layer oversewn system comprising at least two inter-insulated flat electric conductors capable of being pierced during an oversewing process by a needle and thread, and a protective layer arranged between the flat electric conductors, the protective layer sealingly engaging the needle and thread to substantially prevent material fragments of either electric conductor from being passed through said protective layer.

13. The system according to claim 12, wherein the flat electric conductors are textile sensor electrodes.

14. The system according to claim 12, comprising of an electrical insulating material layer of a predetermined thickness, arranged between the two flat electric conductors.

15. The system according to claim 14, wherein the flat electric conductors are electrically insulated from one another by the protective layer or the electrical insulating material layer.

16. The system according to claim 14, wherein the protective layer or the electrical insulating material layer extend substantially over the entire surface between the flat electric conductors.

17. The system according to claim 12, wherein at least one of the flat conductors in the oversewn region along a direction of the oversewing is shorter than at a point outside the oversewn region, and wherein the protective layer covers only the oversewn region covered by the shortened flat conductor.

18. The system according to claim 12, wherein the protective layer between the flat electric conductors is at least partly omitted in regions located outside the oversewn region.

19. The system according to claim 12, wherein the protective layer comprises at least one of: a modulus of elasticity between 200 and 15,000 N/mm²; a thickness between 0.2 and 2 mm; a tear resistance between 20 and 500 N/mm; or a sliding friction coefficient in relation to the material of the conductor between 0.2 and 1.0.

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