CONDUCTIVE PRESSURE SENSITIVE TEXTILE

[0001] The present invention relates to methods of constructing one or more pressure activated electrical switches or sensors in fabric, in the preferred embodiment as integral elements of a single fabric sheet.

[0002] Electrically conductive fabric sheets are known in the art and are described, for example in the applicant's earlier British patent application 2,339,495. The known conductive fabric sheets typically comprise two conductive layers separated by an insulating layer which can be bridged upon application of pressure on the conductive layers. Although such fabric assemblies can function well, there are inevitable drawbacks with having to have three or more fabric layers, including additional cost, fabric thickness, need to maintain alignment between the various layers, movement of the layers during use and so on.

[0003] The present invention seeks to provide an improved conductive textile.

[0004] According to an aspect of the present invention, there is provided a fabric as specified in claim 1.

[0005] The preferred embodiment provides a woven, knitted, non-woven or plaited fabric including in its woven, knitted, non-woven or plaited construction a first elongated electrical conductor crossed by a second elongated electrical conductor, the conductors being normally biased apart at the crossover point with an air gap between them whereby the application of pressure normal to the plane of the fabric causes the conductors to make contact.

[0006] Preferably, the fabric includes a plurality of spaced first conductors and/or a plurality of spaced second conductors thereby forming a plurality of said crossover points. The conductors may comprise electrically conductive filaments or fibres.

[0007] Advantageously, the fabric is a woven fabric; the warp of which may include at least one said first electrical conductor and the weft may include at least one said second electrical conductor.

[0008] A number of means may be employed, separately or in combination, to bias the conductors apart at the crossover points; in one preferred embodiment this being achieved by including insulating fibres or filaments in the fabric. For example, the biasing apart may be effected by employing, as at least one of the electrical conductors, an electrical conductor having insulating filament or fibre wound round it to leave the surface of the conductor exposed at the crossover point. In another example, the biasing apart is effected by twisting at least one of the electrical conductors together with insulating filament or fibre. Alternatively, the biasing apart may be effected by employing, as at least one of the electrical conductors, an electrical conductor which is supported on and between deformable protuberances of an insulating filament or fibre. In another embodiment, the biasing apart may be effected by including in the weave warp and/or weft floats over more than one yarn.

[0009] It is preferred that the electrical conductors have an electrical property which is proportional to or reproducible from the length of the conductor. The length of a conductor or plurality of connecting conductors may then be determined from measurement of that property. Advantageously, the electrical property is resistance.

[0010] For some applications, it will be advantageous for the fabric to have at least one set of spaced electrical conductors, at least some of said set being electrically connected together to form at least one bus bar. Where said set of spaced electrical conductors comprise electrically conductive filaments or fibres in the warp or weft of a woven construction, electrical connection between conductors of that set may be provided by one or more electrically conducting filaments or fibres in the weft or warp, respectively. Alternatively, said electrical connection may be effected after the weaving process.

[0011] In a preferred embodiment, there is provided a fabric including a plurality of weft fibres and a plurality or warp fibres, first and second conductive fibres within the weft and warp fibres and at least one insulating fibre within the weft and/or warp fibres, the insulating fibre acting to bias apart said first and second conductive fibres so as to provide space therebetween.

[0012] The fabric may include a plurality of insulating fibres within one of the weft and warp fibres, which insulating fibres provide a bridge for a conductive fibre in the other of the weft and warp fibres, such that said conductive fibre floats over one or more conductive fibres in the one of the weft and warp fibres.

[0013] In another embodiment, one or more insulating fibres is provided around at least one of the conductive fibres, for example helically disposed therearound. Alternatively, one or more conductive fibres could be provided around at least one insulating fibre, with the insulating fibre including portions, for example projections, extending beyond the perimeter of the conductive fibre or fibres. The insulating fibre can thus provide the spacing means for spacing the conductor from other conductors within the fabric layer.

[0014] It will be apparent that the invention can provide a conductive textile for a pressure sensor or switch or other conductive device within a single layer of fabric. This can obviate the problems discussed above.

[0015] In addition, it is possible to reduce the edge effect (non-linearity of resistance relative to position) which is intrinsic to three-layer structures and which must be corrected for to provide accurate measurements. Moreover, it is possible to have significantly higher resolution, possibly ten times or more, relative to the three layer device; the resolution being dependent upon weaving techniques and fibre dimensions.

[0016] With the preferred embodiments, it is possible to provide for contact of the conductive fibres upon the application of a specific pressure or pressures to the fabric and this can be determined by the size of the air gap, the tension of the weave, the deformability of the conductors and the compressibility of the insulators. Moreover, it is possible to provide a range of pressure sensitivities within a single fabric structure. For example, with the embodiment of floating conductor (described with reference to **FIG. 3** below) different pressure sensitivities can be provided with a plurality of bridges having a different number of conductors below the bridges and/or different insulating fibres, such as different thicknesses or compressibilities. Similar effects can be envisaged with respect to the other embodiments of fibre disclosed herein.