KNITTED SENSOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to improving the uniformity of the response of a sensor to a mechanical interaction, in particular to improving the uniformity of the sensitivity of a sensor having at least one conductive textile knitted layer.

2. Description of the Related Art

In many applications of manually operable touch sensors, the sensor is required to be flexible and sensitive to applied pressure within predetermined tolerances. A type of fabric touch sensor having a three layer construction comprises two outer conductive textile layers and a central separator layer defining a plurality of apertures. The separator layer is configured to space the conductive textile layers apart when no pressure is applied to the sensor, and to allow electrical contact between the layers under a mechanical interaction.

A problem with this type of textile sensor is that the frequency of undesirable triggering of the sensor may be unacceptable for some applications. Undesirable triggering may be caused by bending or flexing of the sensor, or by internal forces within the sensor arising from deviations from the sensor pattern during manufacture, creases or other set within one or more layers accrued during manufacture or use of the sensor.

US patent publication U.S. Pat. No. 4,659,873 discloses a textile sensor comprising two outer conductive textile layers and a central insulating separator layer, in which the layers are stretched across a frame such that the layers are held flat across the apertures of the separator layer. This arrangement is not suitable for applications of touch sensors in which flexibility is required, and the frame may impart unacceptable variations in sensitivity to mechanical interactions at different locations across the sensing area.

International patent publication WO 00/072239 describes a type of textile sensor constructed from five layers, which provides improved sensitivity and resistance to undesirable triggering. The cost of production of this more complex sensor, however, is considered to diminish the viable range of applications of the sensor.

It is thus desirable to provide a sensor that is flexible, displays uniform sensitivity and is economical to manufacture.

BRIEF SUMMARY OF THE INVENTION

According to an aspect of the present invention, there is provided a sensor comprising: a first knitted conductive textile plane, a second conductive textile plane, and an intermediate separating plane penetrable by the first knitted conductive textile plane to allow the first conductive textile plane and the second conductive textile plane to make electrical contact under a mechanical interaction; the intermediate separating plane defines the structural perimeter of each of a plurality of apertures from which the first knitted conductive textile plane deforms towards the second conductive textile plane under a mechanical interaction; wherein: the first knitted conductive textile plane has conductive yarn knitted to form a repeating pattern of stitches each comprising a stitch looping portion SLP having a looping portion footprint LPF, the separating plane defines apertures A having an aperture footprint AF, and at least one looping portion footprint LPF is wholly containable within at least one aperture footprint AF.

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BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. **1** shows an exploded view of a position sensor;

FIG. **2** shows a cross section of the sensor of FIG. **1**;

FIG. **3** shows a flexible detector;

FIG. **4** illustrates steps in a sensor test routine;

FIG. **5** shows a sensor constructed from three layers;

FIG. **6** shows a weft knit;

FIG. **7** shows a warp knit;

FIG. **8** shows a mesh;

FIG. **9** shows deformation of a layer of a sensor;

FIG. **10** shows a mesh having extension portions;

FIG. **11** shows deformation of a layer of a sensor;

FIG. **12** illustrates a first dimensional relationship between features of layers of a sensor;

FIG. **13** illustrates a second dimensional relationship between features of layers of a sensor;

FIG. **14** illustrates a third dimensional relationship between features of layers of a sensor;

FIG. **15** illustrates a fourth dimensional relationship between features of layers of a sensor;

FIG. **16** shows the sensor of FIG. **14** responding to manually applied pressure;

FIG. **17** shows a cross section of a sensor;

FIGS. **18**A and **18**B show a force concentration device of a sensor;

FIG. **19** shows a force concentration device;

FIG. **20** shows different types of yarn.

WRITTEN DESCRIPTION OF THE BEST MODE FOR CARRYING OUT THE INVENTION

FIG. **1**

An exploded view of a position sensor is shown in FIG. **1**. Sensor **101** utilises a three layer construction including a first electrically conducting layer **102**, a second electrically conducting layer **103** and an intermediate separating layer **104**, in this example a mesh fabricated from electrically insulating material, disposed between the two conductive textile layers **102**, **103**.

The electrically conducting layers are preferably in the form of fabrics machined from a mixture of electrically