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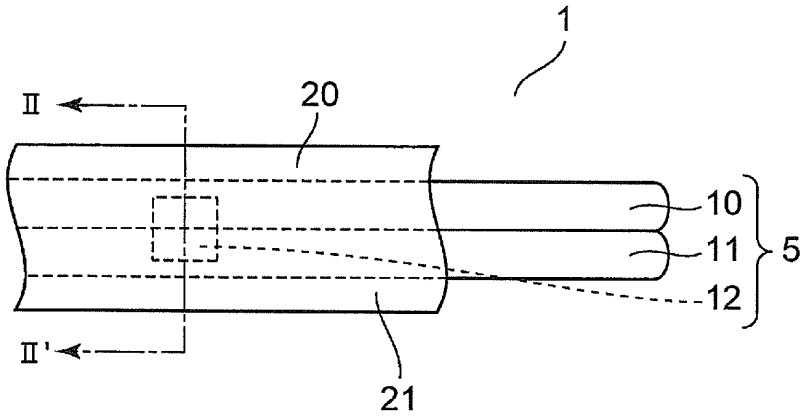
(54) TEXTILE PRODUCT AND PRODUCTION METHOD THEREFOR

(57) The present invention provides a textile product and a method of manufacturing thereof, the textile product being applicable also to a target product having a complicated shape because an electric/electronic function is given to the textile product. The present invention is a textile product manufactured by using a knitted or woven fabric, wherein the knitted or woven fabric comprises a knitted or woven filamentous electronic-function member in at least part of the knitted or woven fabric, wherein the electronic-function member comprises a core portion comprising at least two metal wires, an insulating layer that covers the at least two metal wires so as to expose part of the at least two metal wires, and an electronic-function portion electrically conducted to each of the at least two metal wires and a sheath portion comprising a knitted fabric that covers the core portion, and wherein a yarn containing thermoplastic resin is included in at least part of the knitted fabric of the electronic-function member, and/or the yarn containing thermoplastic resin is interwoven with the electronic-function member.

Fig.1



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Description

Technical Field

[0001] The present invention relates to a textile product and a method of manufacturing thereof, and specifically relates to a textile product having an electric/electronic function and a method of manufacturing thereof.

Background Art

[0002] Conventionally, various sensors such as a vibration sensor, a temperature sensor, and a pressure sensor have been attached to industrial equipment for the purpose of detecting abnormality of the industrial equipment. In order to achieve the above purpose, for example, a packaged rectangular sensor (for example, Patent Literature 1) is used for industrial equipment serving as a measurement target (hereinafter, referred to as "target product").

[0003] However, the packaged rectangular sensor can be disposed in a case where the target product has a flat portion, but, in a case where the target product has a complicated shape such as a curved surface, the sensor cannot be easily attached to the target product. Thus, it is problematic in that measurement is difficult.

Citation List

[0004] Patent Literature 1: JP 2008-03087 A

Summary of Invention

Technical Problem

[0005] In a case where the sensor can also be attached to a target product having a complicated shape, it is possible to easily measure vibration, temperature, pressure, and the like, regardless of a shape of the target product. It is also possible to give an electric/electronic function including not only a sensor function but also a control function such as temperature control and a communication function.

[0006] The inventors of the present invention have focused on a stretchable textile product and have intended to provide a textile product and a method of manufacturing thereof, the textile product being applicable also to a target product having a complicated shape because an electric/electronic function is given to the textile product.

Solution to Problem

[0007] In order to achieve the above-mentioned object, a textile product according to a first aspect of the present invention is a textile product manufactured by using a knitted or woven fabric, in which: the knitted or woven fabric comprises a knitted or woven filamentous electronic-function member in at least part of the knitted or woven fabric; the electronic-function member comprises a core portion including at least two metal wires, an insulating layer that covers the at least two metal wires so as to expose part of the at least two metal wires, and an electronic-function portion electrically conducted to each of the at least two metal wires and a sheath portion including a knitted fabric that covers the core portion; and a yarn containing thermoplastic resin is included in at least part of the knitted fabric of the electronic-function member, and/or the yarn containing thermoplastic resin is interwoven with the electronic-function member.

[0008] According to the above-mentioned first aspect, the thermoplastic resin existing in the vicinity of the electronic-function member can be melted and solidified by heating a region including the electronic-function member. With this configuration, it is possible to form the region including the electronic-function member in accordance with a shape of the target product. This makes it possible to easily attach the electronic-function member also to a target product having a complicated shape.

[0009] Further, a textile product according to a second aspect of the present invention is a textile product manufactured by using a knitted or woven fabric, in which: the knitted or woven fabric comprises a knitted or woven filamentous electronic-function member in at least part of the knitted or woven fabric;
the electronic-function member includes a core portion including at least two metal wires, an insulating layer that covers the at least two metal wires so as to expose part of the at least two metal wires, and an electronic-function portion electrically conducted to each of the at least two metal wires and a sheath portion including a knitted fabric that covers the core portion; and at least part of the knitted fabric of the electronic-function member and/or at least part around the electronic-function member contains solidified thermoplastic resin.

[0010] According to the above-mentioned second aspect, it is possible to form the region including the electronic-function member in accordance with the shape of the target product. This makes it possible to easily attach the electronic-

function member also to a target product having a complicated shape.

[0011] Further, in the textile product according to a third aspect of the present invention, the core is sealed from outside in a region in which the core portion is covered by the knitted fabric.

[0012] According to the above-mentioned third aspect, it is possible to improve water resistance of the sheath portion of the electronic-function member.

[0013] Further, in the textile product according to a fourth aspect of the present invention, the sheath portion includes a first covering portion that is made from the knitted fabric and is provided on a side of the core portion and a second covering portion that covers at least part of the first covering portion and presses the first covering portion to the core portion.

[0014] According to the above-mentioned fourth aspect, it is possible to further bring the first covering portion of the electronic-function member into tight contact with the core portion.

[0015] Further, in the textile product according to a fifth aspect of the present invention, the second covering portion is a long member helically wound around the first covering portion.

[0016] According to the above-mentioned fifth aspect, in the electronic-function member, it is possible to bring the first covering portion into tight contact with the core portion, without damaging the core portion.

[0017] Further, in the textile product according to a sixth aspect of the present invention, the electronic-function portion is selected from the group consisting of a chip component, an electronic-function-substance containing film, a battery, an input element, a display element, a sensor, an antenna, a composite element thereof, and an integrated circuit thereof.

[0018] According to the above-mentioned sixth aspect, it is possible to further reduce size and thickness of the electronic-function member to be mounted. This makes it possible to further thin the electronic-function member.

[0019] Further, in the textile product according to a seventh aspect of the present invention, the core portion includes a plurality of the electronic-function portions, and the plurality of electronic-function portions form a circuit by being connected to each other with the at least two metal wires.

[0020] According to the above-mentioned seventh aspect, it is possible to further reduce the size of the electronic-function member by using a circuit, instead of a component such as a chip.

[0021] Further, in the textile product according to an eighth aspect of the present invention, the circuit includes sensor portions as the electronic-function portions.

[0022] According to the above-mentioned eighth aspect, it is possible to use the electronic-function member as measuring tools.

[0023] Further, in the textile product according to a ninth aspect of the present invention, the circuit further includes, as the electronic-function portions, a control portion that controls operation of the sensor portions, a communication portion that outputs information from the sensor portions to outside, and a power supply portion that supplies power to the sensor portions, the control portion, and the communication portion.

[0024] According to the above-mentioned ninth aspect, it is possible to further reduce the size of the electronic-function member serving as measuring tools.

[0025] Further, an invention according to a tenth aspect of the present invention provides a method of manufacturing the textile product according to the first aspect, the method comprising a step of manufacturing a knitted or woven fabric at least part of which is interwoven with an electric-function member, the step comprising interweaving the electric-function member including the thermoplastic resin filament in at least part of the knitted fabric and/or interweaving the electronic-function member and the thermoplastic resin filament in at least part of a region of the knitted or woven fabric.

[0026] According to the above-mentioned tenth aspect, it is possible to provide a textile product having an electric/electronic function, the textile product being a product in which a region including the electronic-function member is formable in accordance with the shape of the target product.

[0027] Further, an invention according to an eleventh aspect of the present invention provides a method of manufacturing the textile product according to the fourth aspect, the method comprising: a step of manufacturing a knitted or woven fabric at least part of which is interwoven with the electric-function member, the step including interweaving the electric-function member including the thermoplastic resin filament in at least part of the knitted fabric and/or interweaving the electronic-function member and the thermoplastic resin filament in at least part of a region of the knitted or woven fabric; and a step of melting and solidifying the thermoplastic resin filament interwoven into the knitted or woven fabric.

[0028] According to the above-mentioned eleventh aspect, by melting and solidifying the thermoplastic resin existing inside or in the vicinity of the electronic-function member, it is possible to form the region including the electronic-function member in accordance with the shape of the target product. This makes it possible to provide a textile product having an electric/electronic function and being applicable also to a target product having a complicated shape.

Advantageous Effect of Invention

[0029] According to the present invention, it is possible to provide a textile product having an electric/electronic function and being applicable also to a target product having a complicated shape.

Brief Description of Drawings

[0030]

Fig. 1 is a partial cutaway plan view showing an example of a structure of an electronic-function member for use in a textile product according to Embodiment 1 of the present invention.
Fig. 2 is a schematic vertical-sectional view of the electronic-function member shown in Fig. 1.
Fig. 3 is a developed diagram showing an example of a structure of knitted fabric for use in the electronic-function member shown in Fig. 1.
Fig. 4A is a schematic plan view showing an example of a structure of knitted goods for use in the textile product according to Embodiment 1 of the present invention.
Fig. 4B is a schematic vertical-sectional view of the electronic-function member shown in Fig. 4A.
Fig. 5A is a schematic plan view showing another example of the structure of the knitted goods for use in the textile product according to Embodiment 1 of the present invention.
Fig. 5B is a schematic vertical-sectional view of an electronic-function member shown in Fig. 5A.
Fig. 6A is a schematic plan view showing another example of the structure of the knitted goods for use in the textile product according to Embodiment 1 of the present invention.
Fig. 6B is a schematic vertical-sectional view of an electronic-function member shown in Fig. 6A.
Fig. 7 is a partial cutaway plan view showing an example of a structure of an electronic-function member for use in a textile product according to Embodiment 3 of the present invention.
Fig. 8 is a schematic vertical-sectional view of the electronic-function member shown in Fig. 7.
Fig. 9 is a partial cutaway plan view showing an example of a structure of an electronic-function member for use in a textile product according to Embodiment 4 of the present invention.
Fig. 10 is a schematic vertical-sectional view of the electronic-function member shown in Fig. 9.
Fig. 11 is a partial cutaway plan view showing an example of a structure of an electronic-function member for use in a textile product according to Embodiment 5 of the present invention.
Fig. 12 is a schematic vertical-sectional view of the electronic-function member shown in Fig. 11.
Fig. 13 is a schematic diagram showing an example of a structure of an electronic-function member for use in a textile product of the present invention.
Fig. 14 is a block diagram showing an example of an internal circuit of the electronic-function member for use in the textile product according to Embodiment 5 of the present invention.

Description of Embodiment

[0031] Hereinafter, embodiments of the present invention will be described in detail with reference to the drawings as appropriate.

Embodiment 1

[0032] A textile product according to this embodiment is a textile product manufactured by using a knitted or woven fabric, in which: the knitted or woven fabric comprises a knitted or woven filamentous electronic-function member in at least part of the knitted or woven fabric; the electronic-function member comprises a core portion including at least two metal wires, an insulating layer that covers the at least two metal wires so as to expose part of the at least two metal wires, and an electronic-function portion electrically conducted to each of the at least two metal wires, and a sheath portion including a knitted fabric that covers the core portion; and a yarn containing thermoplastic resin is included in at least part of the knitted fabric of the electronic-function member, and/or the yarn containing thermoplastic resin is inter-woven with the electronic-function member.
[0033] The present invention provides the textile product manufactured by using a knitted or woven fabric that is obtained by weaving or knitting yarns of natural fibers, semisynthetic fibers, or synthetic fibers. A shape, dimensions, thickness, and the like thereof are not particularly limited.

(Electronic-function member)

[0034] Fig. 1 is a partial cutaway plan view of an electronic-function member for use in this embodiment. Fig. 2 is a vertical-sectional view taken along line II-II' of Fig. 1. An electronic-function member 1 includes a core portion 5 and a sheath portion 20 covering the core portion 5. The core portion 5 includes a first insulation-covered metal wire 10 and a second insulation-covered metal wire 11 extending in a longitudinal direction thereof and an electronic-function portion 12 electrically conducted to each of the first and second insulation-covered metal wires 10 and 11. Knitted fabric 21 is

used as the sheath portion 20. Further, a chip component is used as the electronic-function portion 12.

[0035] As shown in Fig. 2, the first insulation-covered metal wire 10 includes a metal wire 10a covered by an insulating layer 10b, and the second insulation-covered metal wire 11 includes a metal wire 11a covered by an insulating layer 11b. Part of the insulating layer 10b is removed, and a joining portion 16 is formed to be in contact with the exposed metal wire 10a. Further, part of the insulating layer 11b is removed, and a joining portion 17 is formed to be in contact with the exposed metal wire 11a. The electronic-function portion 12 has a rectangular shape and includes a pair of external electrodes 12a and 12b serving as electronic-function portions at both end portions. By connecting the external electrode 12a to the joining portion 16 and connecting the external electrode 12b to the joining portion 17, the electronic-function portion 12 is electrically connected to the metal wire 10a and the metal wire 11a. The electronic-function portion 12 and the metal wires 10a and 11a, which are electrically connected to each other as described above, are covered by the knitted fabric 21. Note that the joining portions 16 and 17 may be formed as a structure different from joining material by plating or the like. However, in a case where the insulating layers 10b and 11b are thin, joining material such as solder or a conductive adhesive can form the joining portions 16 and 17. Further, in a region in which the core portion 5 is covered by the knitted fabric 21, the core portion 5 is sealed from the outside.

[0036] Copper wires and nickel wires can be used as the metal wires forming the core portion. Copper wires are preferable. A diameter of each metal wire is not particularly limited, as long as the metal wire can be formed into knitted fabric. However, the diameter is 1 μm or more and 1 mm or less, and is preferably 1 μm or more and 0.5 mm or less. Further, the insulating layer prevents the metal wires from being brought into direct contact with each other, and polyurethane resin, acrylic resin, or a long insulating sheet or tape can be used. In this embodiment, the insulating layer exposes part of each metal wire in order to secure electrical conduction with the electronic-function portion. Herein, the part of the metal wire merely means "not the whole surface of the metal wire", and an area of the part is not particularly limited.

[0037] Further, the electronic-function portion has a function of an active element such as a transistor, a diode, or a Peltier element and a function of a passive element such as a resistor, a capacitor, an inductor, or a thermistor and can be selected from the group consisting of a chip component, an electronic-function-substance containing film, a battery, an input element, a display element, a sensor, an antenna, a composite element thereof, and an integrated circuit thereof.

[0038] The passive element may be a chip component or may be an electronic-function-substance containing film, such as a thick film resistor, a thin film resistor, a thin film capacitor, or a thin film inductor. Further, the passive element may be organic material, composite material, or paste material containing an electronic-function substance. The electronic-function-substance containing film can be formed by applying a solution containing element material, for example, dielectric material to surfaces of the plurality of metal wires by using a publicly-known thick-film printing method such as spin coating or screen printing and performing heat processing. Further, it is also possible to use an electronic-function-substance containing film patterned by a thin film process. In that case, for example, it is possible to use a lift-off method, vapor deposition, spattering, or the like. In the lift-off method, after a resist is applied to the surfaces of the plurality of metal wires, the resist is patterned by lithography, then a solution containing element material is applied, and the resist is removed thereafter. This makes it possible to leave an intended thin film pattern. Specific examples of the electronic-function portion encompass an NTC thermistor, a PTC thermistor, and a Peltier element. In a case where those elements are used for clothing including the electronic-function member, for example, the NTC thermistor is used, it is possible to measure temperature of the clothing. Further, in a case where the PTC thermistor is used, it is possible to warm the clothing. Furthermore, in a case where the Peltier element is used, it is possible to cool the clothing.

[0039] Further, the electronic-function portion includes a plurality of terminal portions that exchange signals with an external device. Specific examples of the terminal portions encompass an external electrode, a terminal, and an electrode pad. For example, in a case where two terminal portions are two terminals, one terminal can be connected to one metal wire, and the other terminal can be connected to the other metal wire.

[0040] The sheath portion includes knitted fabric covering the core portion and can be formed as one or more covering portions laminated on a periphery of the core portion. Although knitted fabric can be used as any covering portion, it is preferable to use knitted fabric as a first covering portion that is provided on a side of the core portion and at least part of which is in contact with the core portion. In this embodiment, there will be described an example where the sheath portion includes only the first covering portion made from knitted fabric.

[0041] Fig. 3 shows a developed diagram of the knitted fabric 21. The knitted fabric 21 can be formed as tubular knitted fabric covering a periphery of the core portion 5 by weft knitting using a knitting yarn. Weft knitting is preferable because stitches thereof are finer than those of warp knitting. Further, in weft knitting, stitches are formed by wrapping the knitting yarn around the vertical core portion, and thus the core portion can be fastened comparatively strongly by the knitting yarn of the sheath portion. This makes it possible to bring the sheath portion into tight contact with the core portion.

[0042] In this embodiment, a yarn containing thermoplastic resin is included in at least part of the knitted fabric of the electronic-function member, and/or a yarn containing thermoplastic resin is woven with the electronic-function member. By heating a region including the electronic-function member, it is possible to melt and solidify the thermoplastic resin existing in the vicinity of the electronic-function member. With this configuration, it is possible to form the region including

the electronic-function member in accordance with a shape of the target product. This makes it possible to easily attach the electronic-function member also to a target product having a complicated shape.

[0043] In a case of an electronic-function member in which the yarn containing thermoplastic resin (hereinafter, also referred to as "thermoplastic filament yarn") is included in the at least part of the knitted fabric of the electronic-function member, for example, the knitted fabric can be manufactured by using the thermoplastic filament yarn as a knitting yarn of at least part of the knitted fabric. Examples of thermoplastic resin encompass polyurethane resin, polyethylene resin, polyester resin, polyamide resin, and polypropylene resin. It is preferable to use a thermoplastic synthetic filament yarn made from thermoplastic resin such as polyethylene resin, polyester resin, polyamide resin, and polypropylene resin. Further, the thickness of the knitting yarn is preferably 33 dtex or more and 250 dtex or less. In a case where the thickness is less than 33 dtex, the core portion is not sufficiently covered by the knitted fabric. Meanwhile, in a case where the thickness is more than 250 dtex, it is difficult to knit the knitted fabric by using a knitting machine because the knitting yarn is too thick. It is also possible to use a plurality of thermoplastic filament yarns made from thermoplastic resins having different melting points or a composite filament yarn including a thermoplastic filament yarn, a non-thermoplastic yarn, and other yarns.

[0044] Also in a case where the thermoplastic filament yarn is woven with the electronic-function member, it is possible to weave or knit the knitted fabric by using the similar thermoplastic filament yarn.

[0045] Further, the number of stitches in a single course of the knitted fabric is not particularly limited, but is preferably two or more and eight or less. A diameter of the tubular knitted fabric can be reduced, and thus it is possible to further improve the tight contact of the knitted fabric to the core portion.

[0046] Further, the number of stitches per natural length of 1 cm in a single wale of the knitted fabric is not particularly limited, but is preferably six or more and fourteen or less. Herein, the term "natural length" means length of the knitted fabric to which no tension or the like is given, i.e., length of the knitted fabric that is naturally placed on a table as it is. In a case where the number of stitches per natural length of 1 cm in a single wale of the knitted fabric is six or more, it is possible to improve coverage of the core portion with the knitted fabric. Further, in a case where the number of stitches per natural length of 1 cm in a single wale of the knitted fabric is fourteen or less, it is possible to restrain a defect from occurring, the defect being caused by a tuck defect of stitches of the knitted fabric because the stitches are too fine.

[0047] In a case where the thermoplastic filament yarn is used as a knitting yarn of the knitted fabric, the thermoplastic filament yarn existing in the vicinity of the electronic-function member is melted and solidified as described above. This makes it possible not only to form a region including the electronic-function member in accordance with the shape of the target product but also to obtain the following effects. Specifically, heating and melting the thermoplastic filament yarn included in the knitted fabric improves the coverage of the core portion with the cooled and solidified knitted fabric and the tight contact of the cooled and solidified knitted fabric to the core portion. This makes it possible to protect the electronic-function member and the metal wires from moisture at the time of washing or sweating. Further, by heating the thermoplastic filament yarn while applying pressure thereto, it is possible to further improve the tight contact between the core portion and the sheath portion. In a case where a composite filament including a plurality of thermoplastic filament yarns having different melting points is used as a knitting yarn, the composite filament is heated at temperature that is higher than a melting point of a thermoplastic filament yarn having a low melting point but is lower than a melting point of a thermoplastic filament yarn having a high melting point. Thus, the thermoplastic filament yarn having the high melting point maintains a state of the knitted fabric, and only the thermoplastic filament yarn having the low melting point is melted. This makes it possible to improve durability.

[0048] Further, the electronic-function member can be manufactured by using, for example, the following method. Specifically, the method includes: a step of forming a core portion including at least two metal wires, an insulating layer that covers the at least two metal wires so as to expose part of the at least two metal wires, and an electronic-function portion electrically conducted to each of the at least two metal wires; and a step of forming a sheath portion that covers the core portion, in which the step of forming the sheath portion includes at least a step of knitting knitted fabric around the core portion by weft knitting and covering the core portion.

[0049] The step of forming the core portion can further include: a step of forming a conductive pattern on a plurality of metal wires; and a step of mounting at least one electronic-function portion on the plurality of metal wires. In a case where, for example, two metal wires are used, as shown in Fig. 2, part of the insulating layer on a surface of each metal wire is removed to expose a surface of the metal wire, and a joining portion to which a conductive pattern is given is formed. The number of conductive patterns can be selected in accordance with the number of input/output terminals of the electronic-function portion or the number of electronic-function portions. Further, the conductive pattern can have various shapes such as a line, a rectangle, a circle, and a dot. In a case where the electronic-function portion is mounted on a plurality of metal wires, it is preferable, in view of stretchiness and durability, that the electronic-function portion be mounted on the plurality of metal wires parallel to each other in a direction perpendicular to a longitudinal direction of the plurality of metal wires. Further, in a case where a plurality of electronic-function portions are mounted in the longitudinal direction of the metal wires, it is possible to form a plurality of conductive patterns at predetermined intervals in the longitudinal direction of the metal wires. The conductive patterns can be formed by a printing method using a

conductive paste or an electroplating method.

[0050] In the step of covering the core portion, tubular knitted fabric covering the periphery of the core portion can be formed by weft knitting using a knitting yarn by using a circular knitting machine. The circular knitting machine can be a publicly-known circular knitting machine as disclosed in, for example, JP S60-193993 U.

(Method of manufacturing a knitted or woven fabric)

[0051] A knitted or woven fabric for use in this embodiment can be manufactured by supplying the electronic-function member to a weaving machine and manufacturing a woven fabric or supplying the electronic-function member to a knitting machine and manufacturing knitted goods. Specifically, a method of manufacturing a knitted or woven fabric for use in this embodiment comprises a step of manufacturing a knitted or woven fabric at least part of which is interwoven with the electronic-function member, and the step comprises interweaving the electronic-function member including the yarn containing thermoplastic resin in at least part of the knitted fabric and/or interweaving the electronic-function member and the yarn containing thermoplastic resin in at least part of a region of the knitted or woven fabric.

[0052] Hereinafter, a case of a knitted fabric will be described. An electronic-function member including a yarn containing thermoplastic resin (thermoplastic filament yarn) as a knitting yarn of knitted fabric is supplied alone to a knitting machine (knitting method 1). Alternatively, an electronic-function member including no thermoplastic filament yarn as a knitting yarn of knitted fabric and one or more natural filament yarns, semisynthetic filament yarns, synthetic filament yarns, or the like including at least a thermoplastic filament yarn are combined and are supplied to a knitting machine (knitting method 2). Alternatively, an electronic-function member including a thermoplastic filament yarn as a knitting yarn of knitted fabric and one or more natural filament yarns, semisynthetic filament yarns, and synthetic filament yarns including at least a thermoplastic filament yarn are combined and are supplied to a knitting machine (knitting method 3). A method of combining the electronic-function member and a normal synthetic filament yarn is, for example, supplying the electronic-function member and the normal synthetic filament yarn from different yarn paths of face yarns and forming knitted fabric or supplying the electronic-function member and the normal synthetic filament yarn from the same yarn path of a face yarn, arranging the electronic-function member and the normal synthetic filament yarn in parallel, and forming knitted fabric. The knitted fabric can be formed by flat knitting, rib knitting, interlock knitting, pearl knitting, pile knitting, or the like. Further, the electronic-function member and the normal synthetic filament yarn can be supplied from a yarn guide of a face yarn and a yarn path of a back yarn, respectively, and can be subjected to plating knitting. Further, in view of an economical point, the electronic-function member can be interwoven only into a specific necessary part by intarsia knitting (interlock knitting).

[0053] The knitting method 1 is a method of supplying the electronic-function member including a thermoplastic filament yarn as a knitting yarn of knitted fabric alone to a knitting machine. However, a plating yarn and/or a back yarn can also be used as necessary. In that case, a natural filament yarn, a semisynthetic filament yarn, or a synthetic filament yarn including no thermoplastic filament yarn can be used as the plating yarn and the back yarn. With this configuration, at the time of heat processing, it is possible to prevent a melted thermoplastic filament yarn from falling.

[0054] Next, the knitting method 2 will be described. In the knitting method 2, a plating yarn and/or a back yarn are/is used. Fig. 4A is a schematic plan view showing an example of a structure of knitted goods, and Fig. 4B is a schematic vertical-sectional view of the woven fabric. Knitted goods 70A is knitted by using an electronic-function member 71, a back yarn 72, and a plating yarn 73. The kind of yarn for use in knitted fabric forming a sheath portion of the electronic-function member 71 is not particularly limited and can be, for example, a natural filament yarn, a semisynthetic filament yarn, or a synthetic filament yarn including no thermoplastic filament yarn. Further, a natural filament yarn, a semisynthetic filament yarn, or a synthetic filament yarn including at least a thermoplastic filament yarn is used as the plating yarn and the back yarn. In a case where one of the plating yarn and the back yarn includes a thermoplastic filament yarn, the other yarn can be omitted, or a non-melted filament yarn, for example, a regenerated filament yarn such as rayon or a thermoplastic filament yarn that is not melted at temperature at which the one of the yarns is melted can be used as described below. Further, both the plating yarn and the back yarn may include a thermoplastic filament yarn.

[0055] In Figs. 4A and 4B, a thermoplastic filament yarn is used as the plating yarn 73. The back yarn 72 has a function of, at the time of heat processing of the knitted goods, preventing the melted plating yarn 73 from falling and holding the melted plating yarn 73. The plating yarn 73 is melted and solidified by the heat processing, and thus rigidity is increased. By performing the heat processing with respect to a region including the electronic-function member in the knitted goods in accordance with a predetermined mold so that the region matches with the shape of the target product, it is possible to melt and solidify the region and form the region in a predetermined shape.

[0056] Figs. 4A and 4B show an example where the plating yarn 73 is interwoven into the whole surface of the knitted goods 70A. However, the plating yarn 73 may be interwoven only in a predetermined region. Further, Figs. 4A and 4B show an example where a thermoplastic filament yarn is used only as the plating yarn 73. However, a thermoplastic filament yarn melted at a melting point of the plating yarn 73 or less may also be used as the back yarn 72. It is possible to form a plane resin region covering a periphery of the electronic-function member.

[0057] Fig. 5A is a schematic plan view showing another example of the structure of the knitted goods, and Fig. 5B is a schematic vertical-sectional view of the knitted goods. Knitted goods 70B is knitted, by moss stitch, by using a face yarn 74, the back yarn 72, and the plating yarn 73 including a thermoplastic filament yarn. An electronic-function member is used as the face yarn 74. By knitting the knitted goods 70B by seed stitch, it is possible to interweave the plating yarn 73 in a pattern. For example, in the knitted goods 70B, a region in which the electronic-function portion is to be disposed is formed by interweaving the plating yarn 73 and the back yarn 72, and the other parts are formed by interweaving the face yarn 74 and the back yarn 72. Further, the face yarn 74 and the plating yarn 73 seem to be cut at an end portion 74a and an end portion 73a. However, in an actual knit structure, the face yarn and the plating yarn are provided crosswise by a technique of floating the face yarn and the plating yarn on a reverse side of the knitted fabric, which is also referred to as "float stitch". In other words, a part in which the face yarn 74 is woven and the plating yarn 73 is caused to pass on the reverse side and a part in which the plating yarn 73 is woven and the face yarn 74 is caused to pass on the reverse side are disposed in a moss-stitch shape.

[0058] Further, as shown in Fig. 5B, in a case where the knitted goods 70B is formed by moss stitch, the plating yarn 73 is formed in a mesh shape, and the knitted fabric and the plating yarn are subjected to heat processing, it is possible to further restrain the region including the electronic-function portion from being easily folded or broken. Further, by using the transparent plating yarn 73 containing no matting material and not using the back yarn 72 or using a transparent thermoplastic filament yarn containing no matting material also as the back yarn 72, it is possible to cause the region including the electronic-function portion to be transparent.

[0059] Fig. 6A is a schematic plan view showing another example of the structure of the knitted goods, and Fig. 6B is a schematic vertical-sectional view of the woven fabric. Knitted goods 70C is knitted, by cut-boss stitch, by using the face yarn 74, the back yarn 72, and the plating yarn 73 including a thermoplastic filament yarn. An electronic-function member is used as the face yarn 74. By knitting the knitted goods 70C by cut-boss stitch, it is possible to interweave the plating yarn 73 in a pattern. For example, in the knitted goods 70C, a region in which the electronic-function portion is to be disposed is formed by interweaving the plating yarn 73 and the back yarn 72, and the other parts are formed by interweaving the face yarn 74 and the back yarn 72. Further, the face yarn 74 and the plating yarn 73 are cut in a part 75 where the face yarn 74 and the plating yarn 73 overlap. This is different from the case of moss stitch shown in Fig. 5A.

[0060] Next, the knitting method 3 will be described. In the knitting method 3, an electronic-function member including a thermoplastic filament yarn as a knitting yarn of knitted fabric, a plating yarn, and/or a back yarn are used. A natural filament yarn, a semisynthetic filament yarn, or a synthetic filament yarn including at least a thermoplastic filament yarn is used as the plating yarn and the back yarn. In a case where one of the plating yarn and the back yarn includes a thermoplastic filament yarn, the other yarn can be omitted, or a non-melted filament yarn, for example, a regenerated filament yarn such as rayon or a thermoplastic filament yarn that is not melted at temperature at which the one of the yarns is melted can be used as described below. Further, both the plating yarn and the back yarn may include a thermoplastic filament yarn.

[0061] Further, the knitted or woven fabric can include at least one power supply portion that is electrically connected to the electronic-function portion. The electronic-function portion and the power supply portion can be electrically connected by the metal wires forming the core portion. Thus, it is unnecessary to additionally provide a lead wire and connect the electronic-function portion and the power supply portion. With this configuration, it is possible to easily connect the electronic-function portion and the power supply portion. An external device that can be electrically connected to the electronic-function portion is not limited to the power supply portion and can be a signal generator, a transmitting device, a receiving device, a detecting device, a measuring device, a display device, an input device, or the like.

[0062] According to this embodiment, it is possible to provide a textile product having an electric/electronic function and being applicable also to a target product having a complicated shape. Further, in the electronic-function member to which the electric/electronic function is given, an external device such as a power supply portion and the electronic-function portion can be electrically connected by the metal wires forming the core portion. This makes it possible to easily connect the external device and the electronic-function portion.

Embodiment 2

[0063] A textile product according to this embodiment is a textile product obtained by melting and solidifying thermoplastic resin contained in the textile product according to Embodiment 1. The textile product according to this embodiment is different from the textile product according to Embodiment 1 in that at least part of knitted fabric of an electronic-function member and/or at least part around the electronic-function member contains solidified thermoplastic resin.

[0064] In the textile product according to this embodiment, at least part of the knitted fabric of the electronic-function member and/or at least part around the electronic-function member contains solidified thermoplastic resin, and, by melting and solidifying thermoplastic resin, it is possible to form a region including the electronic-function member in accordance with the shape of the target product. Further, by fusing the solidified thermoplastic resin to another knitting yarn, it is possible to integrate the electronic-function member with a knitted or woven fabric. With this configuration,

even in a case where the knitted or woven fabric is expanded or contracted, the electronic-function member does not crack or peel off the knitted or woven fabric. Further, it is possible to improve rigidity of a region in which the electronic-function portion is disposed, increase strength thereof, and reduce elongation thereof. This makes it possible to restrain the region from being deformed and improve durability of the electronic-function portion.

[0065] Hereinafter, a method of manufacturing thereof will be described. A method of manufacturing the textile product according to this embodiment, the method includes: a step of manufacturing a knitted or woven fabric at least part of which is interwoven with the electronic-function member, the step including interweaving the electronic-function member including the yarn containing thermoplastic resin in at least part of the knitted fabric and/or interweaving the electronic-function member and the yarn containing thermoplastic resin in at least part of a region of the knitted or woven fabric; and a step of melting and solidifying the yarn containing thermoplastic resin interwoven into the knitted or woven fabric.

[0066] In this method, in a case where the electronic-function member is interwoven with the yarn containing thermoplastic resin (thermoplastic filament yarn), the thermoplastic filament yarn may be a thermoplastic filament yarn having a melting point lower than that of another knitting yarn or a thermoplastic filament yarn having a melting point equivalent to that of another knitting yarn. In a case where the thermoplastic filament yarn having the melting point lower than that of another knitting yarn is used, it is preferable to use a thermoplastic filament yarn having a melting point that is lower by 30°C or more than a melting point of another knitting yarn and is more preferably lower by 50°C or more than the melting point.

[0067] Note that heating temperature for melting and solidifying the thermoplastic filament yarn can be appropriately set in accordance with a melting point of a thermoplastic filament yarn to be used. However, it is necessary that the heating temperature do not exceed an upper limit of heat resistant temperature of the electronic-function portion included in the electronic-function member.

[0068] Regarding a combination of knitting yarns, in the example of Fig. 4A, the knitted goods is knitted by using a natural filament yarn or a synthetic filament yarn having a comparatively high melting point (a synthetic filament yarn having a melting point higher than that of the thermoplastic filament yarn) as the sheath portion of the electronic-function member and using a fiber having a comparatively high melting point (a filament yarn having a melting point higher than that of the thermoplastic filament yarn) such as nylon or polyurethane as the back yarn. After knitting, by heating only the region in which the electronic-function portion is disposed or the whole surface of the knitted goods while applying pressure to the region or the whole surface as necessary, only the thermoplastic filament yarn having the lowest melting point is melted and solidified.

[0069] Table 1 shows exemplary combinations of thermoplastic filament yarns to be melted and serving as a knitting/weaving yarn for use in a knitted or woven fabric and other knitting/weaving yarns. Herein, non-melted fibers in Table 1 are fibers other than thermoplastic fibers to be melted and indicate fibers for use in the sheath portion of the electronic-function member or the back yarn, and melted fibers indicate thermoplastic fibers to be melted.

[Table 1]

Non-melted fibers	Melted fibers	Difference in melting point
Polyester fiber (Melting point: 260°C)	Nylon 6 fiber	Approximately 50 degrees
	Polyvinyl chloride fiber	Approximately 50 degrees
	Vinylon fiber	Approximately 30 degrees
	Polypropylene fiber	Approximately 100 degrees
	Polyethylene fiber	Approximately 130 degrees
	Low-melting polyester fiber	Approximately 150 degrees
	Low-melting nylon fiber	Approximately 150 degrees
Polyurethane fiber (Melting point: 230°C)	Polypropylene fiber	Approximately 50 degrees
	Polyethylene fiber	Approximately 80 degrees
	Low-melting polyester fiber	Approximately 100 degrees
Nylon 6 fiber (Melting point: 215°C)	Polypropylene fiber	Approximately 50 degrees
	Polyethylene fiber	Approximately 80 degrees
	Low-melting polyester fiber	Approximately 100 degrees
	Low-melting nylon fiber	Approximately 100 degrees

(continued)

Non-melted fibers	Melted fibers	Difference in melting point
Cotton (Decomposition point: 235°C)	Polypropylene fiber	Approximately 70 degrees
	Low-density polyethylene fiber	Approximately 100 degrees
Hemp (Decomposed at 200°C)	Polypropylene fiber	Approximately 40 degrees
	Polyethylene fiber	Approximately 70 degrees
Rayon (Decomposition is started at 260°C or more)	Nylon 6 fiber	Approximately 50 degrees
	Polyvinyl chloride fiber	Approximately 50 degrees
	Vinylon fiber	Approximately 30 degrees
	Polypropylene fiber	Approximately 100 degrees
	Low-density polyethylene fiber	Approximately 130 degrees
	Low-melting polyester fiber	Approximately 150 degrees
	Low-melting nylon fiber	Approximately 150 degrees
p-aramid resin (Carbonized at 400°C or more)	Polyester fiber	Approximately 140 degrees
	Nylon 6 fiber	Approximately 190 degrees
	Polyvinyl chloride fiber	Approximately 190 degrees
	Vinylon fiber	Approximately 170 degrees

[0070] Combinations of the melted fibers and the non-melted fibers are not limited to the range shown in Table 1, and melting points of the non-melted fibers only need to be higher by 30°C or more than melting points of the melted fibers.

Embodiment 3

[0071] A textile product in this embodiment has a configuration similar to that of a textile product in Embodiment 1, except that the sheath portion including a first covering portion that is made from knitted fabric and is in contact with the core portion and a second covering portion that covers at least part of the first covering portion and presses the first covering portion to the core portion is used as the electronic-function member.

[0072] Fig. 7 is a partial cutaway plan view of the electronic-function member according to this embodiment, and Fig. 8 is a vertical-sectional view taken along line VIII-VIII' in Fig. 7. Hereinafter, a part common to Embodiment 1 will not be described, and only a different part will be described.

[0073] An electronic-function member 2 includes a core portion 5 and a sheath portion 20 covering the core portion 5. The sheath portion 20 further includes a first covering portion 22 made from knitted fabric and existing on a side of the core portion 5 and a second covering portion 23 wound around the first covering portion 22. The second covering portion 23 presses the first covering portion 22 to the core portion 5, thereby further bringing the first covering portion 22 into tight contact with the core portion 5.

[0074] The second covering portion can be a long member. The long member can be as follows: a natural filament yarn made from cotton, hemp, wool, or the like; a semisynthetic filament yarn made from cellulose or the like; a synthetic filament yarn made from nylon, acryl, polyester, polyurethane, or the like; or a composite yarn, a tape, a string, or the like obtained by combining a plurality of fiber materials. By using the long member, it is possible to bring the first covering portion into tight contact with the core portion, without damaging the core portion. Further, in a case where a synthetic filament yarn containing thermoplastic resin is used as the first covering portion, a synthetic filament yarn containing thermoplastic resin can also be used as the second covering portion. By covering the first covering portion with the second covering portion and thereafter heating and melting the synthetic filament yarn, it is possible to further improve the tight contact of the first covering portion to the core portion after cooling.

[0075] Further, the following examples can also be used as a combination of the first covering portion and the second covering portion. For example, in a case where a synthetic filament yarn containing thermoplastic resin is used as the first covering portion, it is possible to use a yarn made from the above-mentioned non-melted fiber (hereinafter, referred to as "non-melted filament yarn") as the second covering portion. Further, it is possible to use a non-melted filament yarn as the first covering portion and use a synthetic filament yarn containing thermoplastic resin as the second covering portion. Also in those cases, it is possible to improve the tight contact of the first covering portion to the core portion.

[0076] The electronic-function member for use in this embodiment can be manufactured by using a method including a step of helically winding the long member around the first covering portion after the first covering portion is formed. By using a publicly-known sheath yarn winding apparatus disclosed in, for example, JP S63-282304 A, the second covering portion can be formed by drawing a string wound around a bobbin while rotating the bobbin and winding the string around the electronic-function member while moving, in an upward direction or downward direction, the electronic-function member on which the first covering portion has been formed. Note that winding intervals of the second covering portion in a longitudinal direction of the electronic-function member can be adjusted as necessary. By reducing the winding intervals (or increasing the number of times of winding), it is possible to further improve the tight contact of the first covering portion to the core portion. Further, it is also possible to further improve the tight contact of the first covering portion to the core portion by increasing a diameter of the yarn forming the second covering portion to reduce the winding intervals.

[0077] According to this embodiment, in addition to the effect of Embodiment 1, the following effects can be obtained by providing the second covering portion: it is possible to further improve the tight contact of the first covering portion to the core portion and further improve durability of the electronic-function member.

[0078] Note that, although this embodiment shows an example where the second covering portion is provided, it is also possible to provide another covering portion as necessary. For example, the second covering portion is helically wound in the longitudinal direction of the electronic-function member, and, in addition, a third covering portion can be wound around the second covering portion in an opposite direction of a direction of the second covering portion so as to cross the second covering portion. By providing the third covering portion, it is possible to further improve the tight contact of the first covering portion to the core portion.

[0079] Further, a paralleled yarn including a synthetic filament yarn containing thermoplastic resin may be provided between the core portion and the first covering portion. Also in this case, it is also possible to improve the tight contact of the first covering portion to the core portion. In this case, combinations of the first covering portion and the second covering portion can be as follows: a case where synthetic filament yarns containing thermoplastic resin are used as both the first covering portion and the second covering portion; a case where non-melted filament yarns are used as both the first covering portion and the second covering portion; and a case where a synthetic filament yarn containing thermoplastic resin is used as one of the first covering portion and the second covering portion and a non-melted filament yarn is used as the other.

Embodiment 4

[0080] A textile product according to this embodiment has a configuration similar to that of the textile product in Embodiment 1, except that an electronic-function member including an electronic-function-substance containing film is used as the electronic-function portion, instead of a chip component.

[0081] Fig. 9 is a partial cutaway plan view of an electronic-function member according to this embodiment, and Fig. 10 is a vertical-sectional view taken along line X-X' of Fig. 9. Hereinafter, a part common to Embodiment 1 will not be described, and only a different part will be described.

[0082] An electronic-function member 3 includes a core portion 6 and a sheath portion 20 covering the core portion 6. The core portion 6 includes a first insulation-covered metal wire 10, a second insulation-covered metal wire 11, and an electronic-function portion 13 including an electronic-function-substance containing film and provided to be electrically conducted to each of the first and second insulation-covered metal wires 10 and 11.

[0083] As described above, the electronic-function-substance containing film can be formed by applying a solution containing element material, for example, dielectric material to surfaces of a plurality of metal wires by using a publicly-known printing method such as spin coating and performing heat processing. Further, it is also possible to use a patterned thin film. Herein, the electronic-function substance encompasses dielectric material, conductive material, magnetic material, piezoelectric material, semiconductor material, pyroelectric material, and the like.

[0084] According to this embodiment, in addition to the effect of Embodiment 1, the following effects can be obtained by using the electronic-function-substance containing film: size and thickness of the electronic-function portion to be mounted on the metal wires can be flexibly changed, and thus it is possible to provide a textile product that can be optimally designed in accordance with use of the electronic-function member.

Embodiment 5

[0085] A textile product according to this embodiment has a configuration similar to that of the textile product in Embodiment 1, except that a long insulating member is used as the insulating layer covering the metal wires and an electronic-function member including an electronic-function-substance containing film formed to cover a periphery of the plurality of metal wires in a strip shape is used as the electronic-function portion, instead of a chip component.

[0086] Fig. 11 is a partial cutaway plan view of an electronic-function member according to this embodiment, and Fig.

12 is a vertical-sectional view taken along line XII-XII' of Fig. 11. An electronic-function member 4 includes a core portion 7 and a sheath portion 20 covering the core portion 7. The core portion 7 includes: metal wires 10a and 11a extending in a longitudinal direction and between which an insulating member 15 is interposed; and an electronic-function-substance containing film 14 formed to cover a periphery of the metal wires 10a and 11a in a strip shape and provided to be electrically conductible to the metal wires 10a and 11a. Knitted fabric 21 is used as the sheath portion 20.

[0087] An insulating member of the electronic-function member for use in this embodiment can be a long insulating sheet interposed between the metal wires, an insulating tape attached in the longitudinal direction of the metal wires, an insulating layer formed in the longitudinal direction of the metal wires, or the like. The insulating layer can be made from polyurethane resin, acrylic resin, or the like.

[0088] As described above, the electronic-function-substance containing film can be formed by applying a solution containing element material, for example, dielectric material to surfaces of a plurality of metal wires by using a publicly-known printing method such as spin coating and performing heat processing. Further, it is also possible to use a patterned thin film element.

[0089] According to this embodiment, in addition to the effect of Embodiment 1, the following effects can be obtained by using the electronic-function-substance containing film: size and thickness of the electronic-function portion to be mounted on the metal wires can be flexibly changed, and thus it is possible to provide a textile product that can be optimally designed in accordance with use of the electronic-function member.

[0090] Examples of a single electronic-function portion have been described in Embodiments 1 to 5. However, the electronic-function member for use in the textile product of the present invention can also include a plurality of electronic-function portions. For example, the electronic-function member may include: a first electronic-function portion provided to be electrically conductible to each of at least two metal wires included in the first wiring portion; and a second electronic-function portion different from the first wiring portion and provided to be electrically conductible to each of at least two metal wires included in a second wiring portion. Similarly, the electronic-function member may further include a third wiring portion and a third electronic-function portion, a fourth wiring portion and a fourth electronic-function portion, a fifth wiring portion and a fifth electronic-function portion, and the like. The first electronic-function portion may be different from the other electronic-function portions, or all electronic-function portions may be the same. For example, a temperature sensor element (for example, NTC thermistor) is used as the first electronic-function portion, and a heater element (for example, PTC thermistor) is used as the second electronic-function portion.

[0091] Fig. 13 is a schematic diagram showing an example of a structure of the above-mentioned electronic-function member including the plurality of electronic-function portions, and the sheath portion is not shown. A core portion 30 includes metal wires 31, 32, 33, 34, 35, and 36, each of which is covered by an insulating layer. The two metal wires 31 and 32 form a first wiring portion 37, the two metal wires 33 and 34 form a second wiring portion 38, and the two metal wires 35 and 36 form a third wiring portion 39. A first electronic-function portion 41 is joined to a joining portion 31a obtained by exposing part of the metal wire 31 and a joining portion 32a obtained by exposing part of the metal wire 32. Further, a second electronic-function portion 42 is joined to a joining portion 33a obtained by exposing part of the metal wire 33 and a joining portion 34a obtained by exposing part of the metal wire 34. Further, a third electronic-function portion 43 is joined to a joining portion 35a obtained by exposing part of the metal wire 35 and a joining portion 36a obtained by exposing part of the metal wire 36. Although Fig. 13 shows an example where six metal wires are disposed in parallel, the six metal wires can also be bundled while preventing the first to third electronic-function portions from being brought into contact with each other.

[0092] Further, the electronic-function member for use in the textile product of the present invention may form a circuit by connecting a plurality of electronic-function portions to each other with at least two metal wires. This form will be described in more detail in the following Embodiment 6.

Embodiment 6

[0093] In an electronic-function member for use in a textile product according to this embodiment, a core portion includes a plurality of electronic-function portions, and the plurality of electronic-function portions forms a circuit by being connected to each other with at least two metal wires (hereinafter, the circuit will also be referred to as "internal circuit"). Fig. 14 is a block diagram showing an example of a configuration of the internal circuit. A circuit 60 includes a plurality of circuit element portions forming the circuit, and the circuit element portions correspond to the electronic-function portions. The circuit 60 includes, as the circuit element portions, a passive element portion 61, an active element portion 62, a control portion 63 that controls operation of the passive element portion 61 and the active element portion 62, a communication portion 64 that exchanges a communication signal with the outside, a power supply portion 65 that supplies power to each portion, an A/D converter portion 66 that A/D-converts a data signal received from the passive element portion 61 and outputs the converted data signal to the control portion 63, a D/A converter portion 67 that D/A-converts a control signal received from the control portion 63 and supplies the converted control signal to the active element portion 62, a transmitting/receiving antenna portion 68 that performs wireless transmission/reception with respect

to the outside, and a wireless charging portion 69 that receives an electric wave for power from the outside and outputs power generated from the electric wave for power to the power supply portion 65. Further, the circuit 60 includes, as an external device, a display portion 70 that displays predetermined image information received from the control portion 63.

[0094] The passive element portion 61 can be, for example, a sensor as a passive element. In that case, the passive element portion will also be referred to as "sensor portion". The sensor can be a temperature sensor, an infrared sensor, a humidity sensor, a sound sensor, an optical sensor, a magnetic sensor, a pressure sensor, an acceleration sensor, a position sensor, or the like. Further, the active element portion 62 can be, for example, a heater element or an oscillating element as an active element. A combination of the passive element and the active element can be variously selected in accordance with use of the electronic-function member. For example, it is possible to give a temperature adjusting function to the electronic-function member by using a temperature sensor as the passive element and a heater element as the active element. Further, the power supply portion 65 can be, for example, a capacitor or a secondary battery.

[0095] The plurality of electronic-function portions can be connected to each other by, for example, disposing the plurality of electronic-function portions in a longitudinal direction of the two metal wires and electrically conducting the electronic-function portions to the respective metal wires.

[0096] The electronic-function member for use in this embodiment can also be formed as knitted goods by using a method similar to the method described in Embodiment 1. That is, it is possible to manufacture knitted goods by supplying the electronic-function member including the internal circuit to a knitting machine and using the electronic-function member as a normal yarn.

[0097] According to this embodiment, in addition to the effect of Embodiment 1, the following effect can be obtained by using a circuit, instead of a plurality of components such as chips: it is possible to provide a textile product including a smaller electronic-function member.

[0098] Note that, in this embodiment, circuit element portions other than the passive element portion and the active element portion can also be provided as external devices, instead of being included in the electronic-function member. In that case, although the external devices are held by the knitted goods, the circuit element portions other than the passive element portion and the active element portion and the external devices can be electrically connected with the metal wires forming the core portion, as described in Embodiment 1.

[0099] Further, the circuit element portions shown in Fig. 14 are merely an example, and it is possible to use various circuit element portions in accordance with use.

[0100] Hereinabove, embodiments of the present invention have been described. However, a person skilled in the art can understand that those embodiments are merely examples and various modification examples can be made within the scope of the present invention. For example, Embodiment 3 shows an example where a knitting yarn is helically wound around the first covering portion as the second covering portion. However, the second covering portion may be formed by using knitted fabric or may be formed by employing plating knitting.

Industrial Applicability

[0101] According to the present invention, it is possible to provide a textile product having an electric/electronic function and being applicable also to a target product having a complicated shape.

Reference Signs List

[0102]

1, 2, 3, 4 electronic-function member
5, 6, 7 core portion
10 first insulation-covered metal wire
11 second insulation-covered metal wire
10a, 11a metal wire
10b, 11b insulating layer
12, 13, 14 electronic-function portion
12a, 12b external electrode
15 insulating member
16, 17 joining portion
20 sheath portion
21 knitted fabric
22 first covering portion
23 second covering portion
30 core portion

31, 32, 33 metal wire
34, 35, 36 metal wire
31a, 32a, 33a joining portion
34a, 35a, 36a joining portion
37 first wiring portion
38 second wiring portion
39 third wiring portion
41 first electronic-function portion
42 second electronic-function portion
43 third electronic-function portion
60 circuit
61 passive element portion
62 active element portion
63 control portion
64 communication portion
65 power supply portion
66 A/D converter portion
67 D/A converter portion
68 transmitting/receiving antenna portion
69 wireless charging portion
70A, 70B, 70C knitted goods
71 electronic-function member
72 back yarn
73 plating yarn
73a end portion of plating yarn
74 face yarn
74a end portion of face yarn
75 part in which face yarn and thermoplastic fiber overlap

Claims

1. A textile product manufactured by using a knitted or woven fabric, wherein
the knitted or woven fabric comprises a knitted or woven filamentous electronic-function member in at least part of the knitted or woven fabric, wherein
the electronic-function member comprises a core portion comprising at least two metal wires, an insulating layer that covers the at least two metal wires so as to expose part of the at least two metal wires, and an electronic-function portion electrically conducted to each of the at least two metal wires and a sheath portion comprising a knitted fabric that covers the core portion, and wherein
a yarn containing thermoplastic resin is included in at least part of the knitted fabric of the electronic-function member, and/or the yarn containing thermoplastic resin is interwoven with the electronic-function member.

2. A textile product manufactured by using a knitted or woven fabric, wherein,
the knitted or woven fabric comprises a knitted or woven filamentous electronic-function member in at least part of the knitted or woven fabric, wherein
the electronic-function member comprises a core portion including at least two metal wires, an insulating layer that covers the at least two metal wires so as to expose part of the at least two metal wires, and an electronic-function portion electrically conducted to each of the at least two metal wires and a sheath portion including a knitted fabric that covers the core portion, and wherein
at least part of the knitted fabric of the electronic-function member and/or at least part around the electronic-function member contains solidified thermoplastic resin.

3. The textile product according to claim 1 or 2, wherein the core portion is sealed from outside in a region where the core portion is covered by the knitted fabric.

4. The textile product according to any one of claims 1 to 3, wherein the sheath portion comprises a first covering portion that is made from the knitted fabric and is provided on a side of the core portion and a second covering portion that covers at least part of the first covering portion and presses the first covering portion to the core portion.

5. The textile product according to claim 4, wherein the second covering portion is a long member helically wound around the first covering portion.

6. The textile product according to any one of claims 1 to 5, wherein the electronic-function portion is selected from the group consisting of a chip component, an electronic-function-substance containing film, a battery, an input element, a display element, a sensor, an antenna, a composite element thereof, and an integrated circuit thereof.

7. The textile product according to any one of claims 1 to 6, wherein the core portion comprises a plurality of the electronic-function portions, and wherein
the plurality of electronic-function portions form a circuit by being connected to each other with the at least two metal wires.

8. The textile product according to claim 7, wherein the circuit comprises sensor portions as the electronic-function portions.

9. The textile product according to claim 8, wherein the circuit further comprises, as the electronic-function portions, a control portion that controls operation of the sensor portions, a communication portion that outputs information from the sensor portions to outside, and a power supply portion that supplies power to the sensor portions, the control portion, and the communication portion.

10. A method of manufacturing the textile product according to claim 1, the method comprising:

a step of manufacturing a knitted or woven fabric at least part of which is interwoven with the electronic-function member, wherein
the step comprises interweaving the electronic-function member including the yarn containing thermoplastic resin into at least part of the knitted fabric and/or interweaving the electronic-function member and the yarn containing thermoplastic resin in at least part of a region of the knitted or woven fabric.

11. A method of manufacturing the textile product according to claim 2, the method comprising:

a step of manufacturing a knitted or woven fabric at least part of which is interwoven with the electronic-function member, the step comprising interweaving the electronic-function member including the yarn containing thermoplastic resin in at least part of the knitted fabric and/or interweaving the electronic-function member and the yarn containing thermoplastic resin in at least part of a region of the knitted or woven fabric; and
a step of melting and solidifying the yarn containing thermoplastic resin interwoven into the knitted or woven fabric.

Fig.1

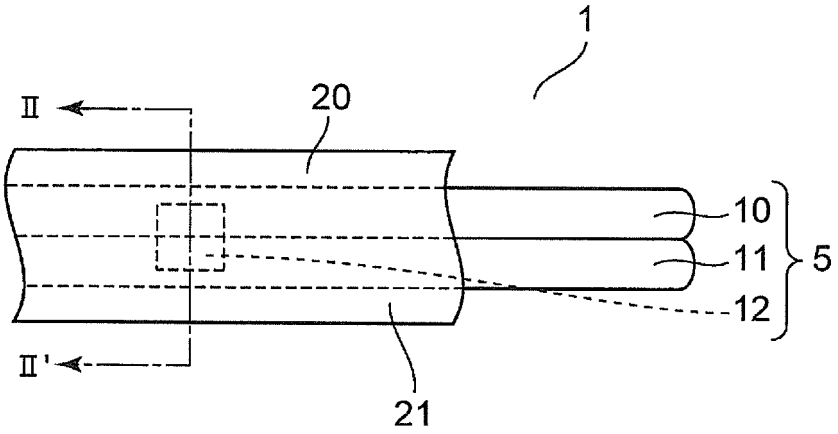


Fig.2

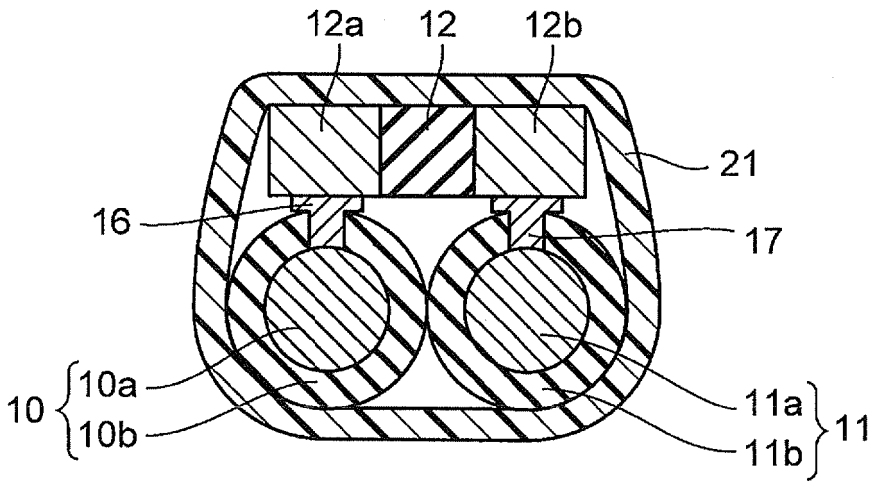


Fig.3

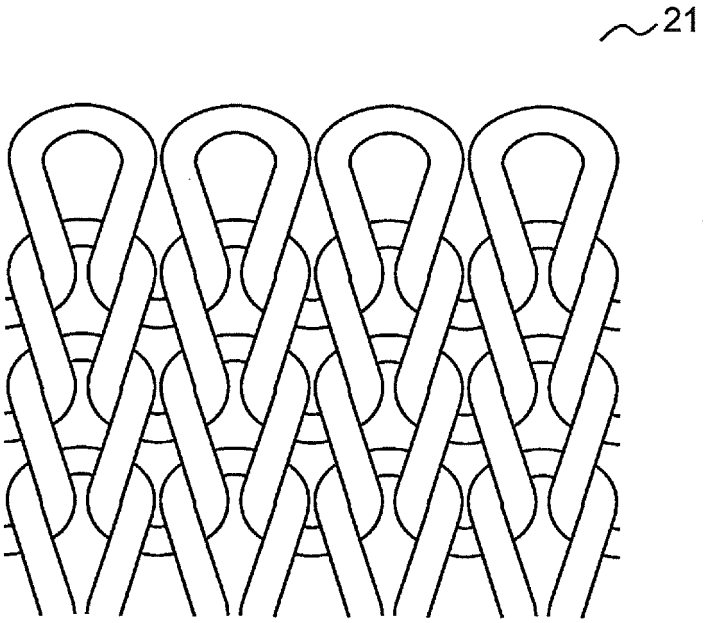


Fig.4A

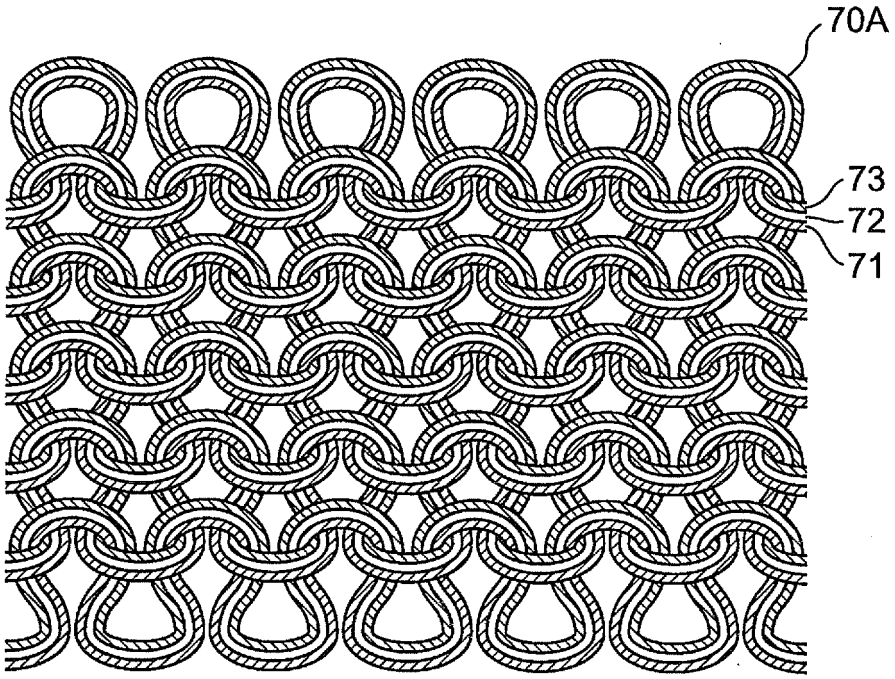


Fig.4B

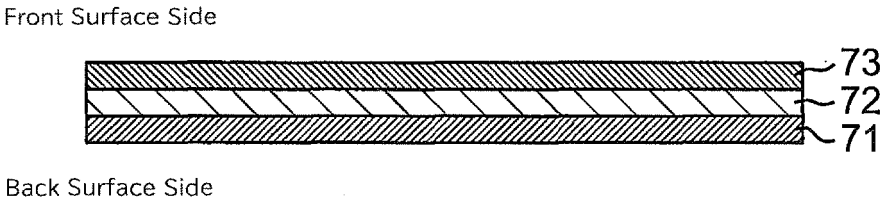

Front Surface Side
73
72
71
Back Surface Side

Fig.5A

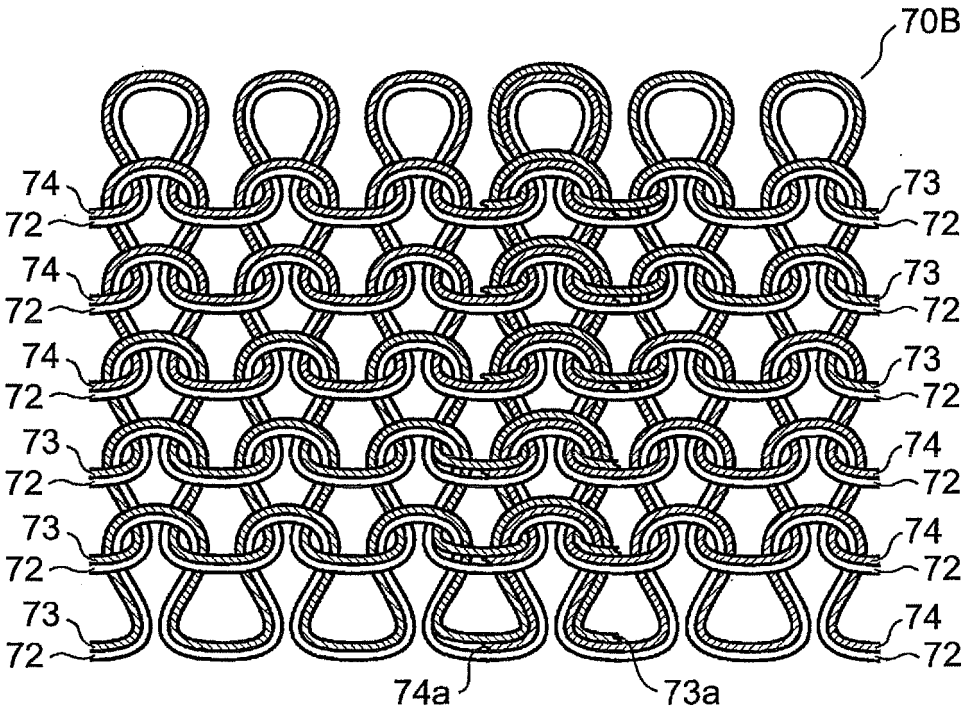

70B
74
72
73
72
74a
73a

Fig.5B

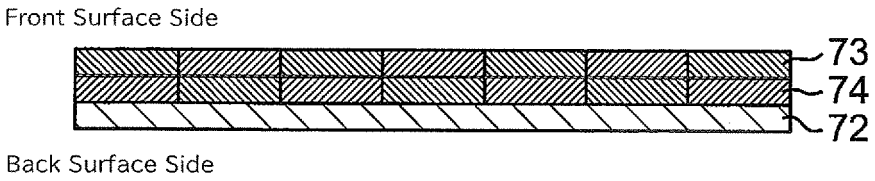

Front Surface Side
73
74
72
Back Surface Side

Fig.6A

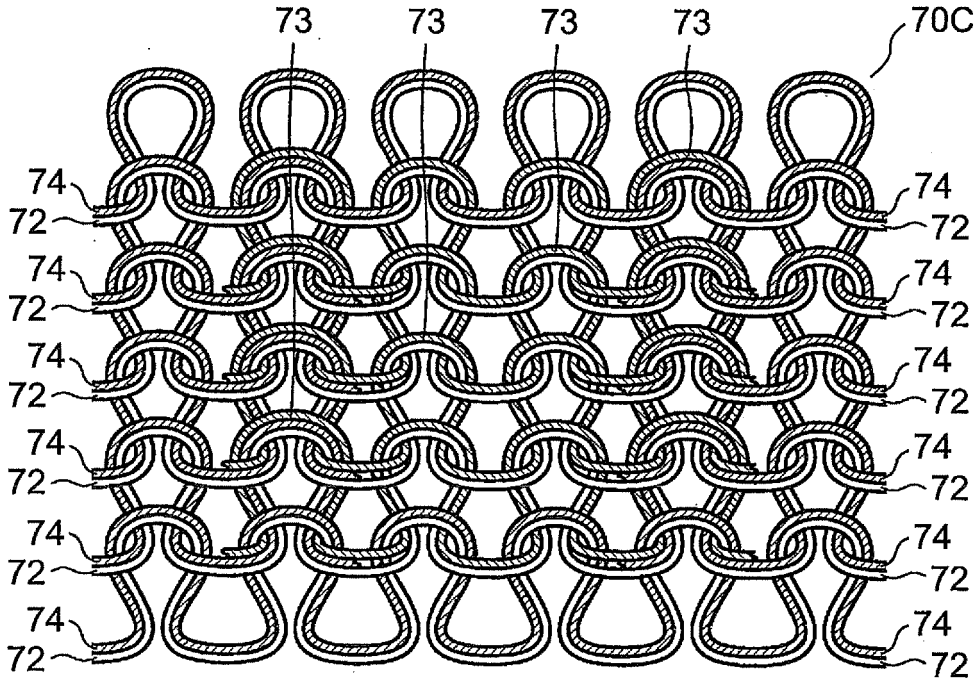

73
73
73
73
70C
74
72

Fig.6B

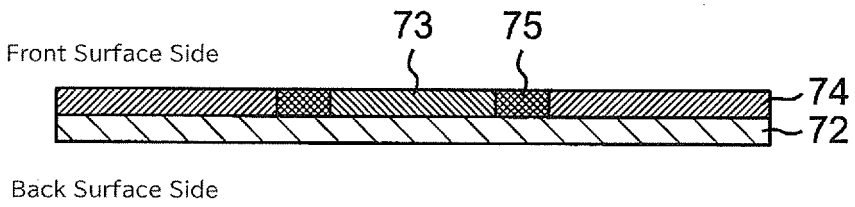


Fig.7

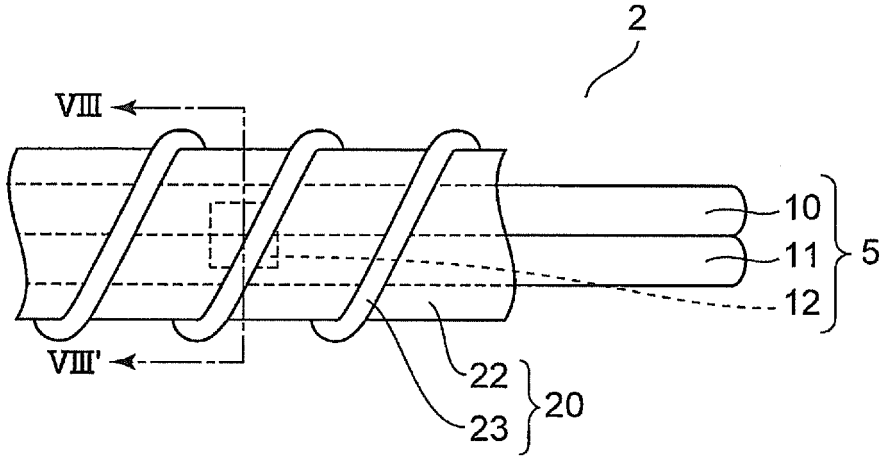


Fig.8

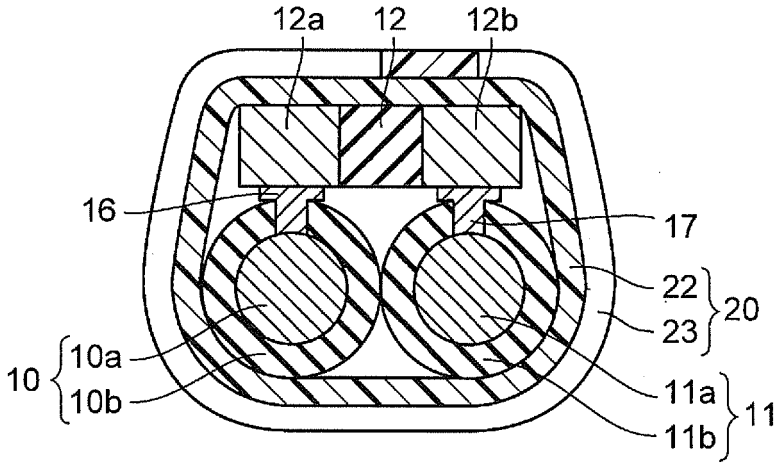


Fig.9

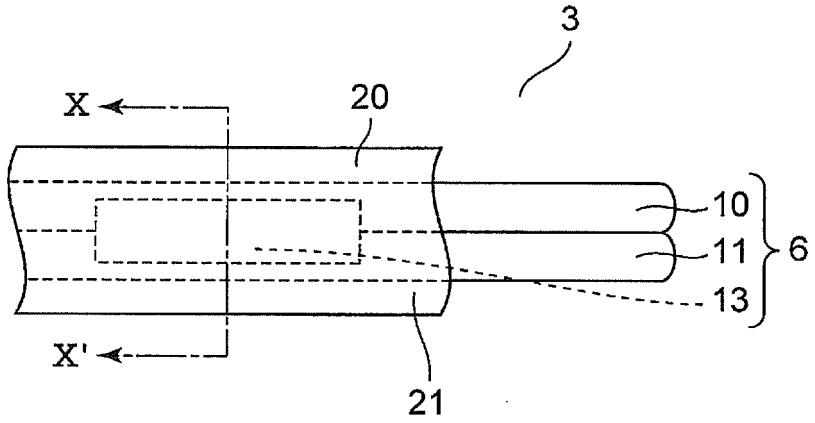


Fig.10

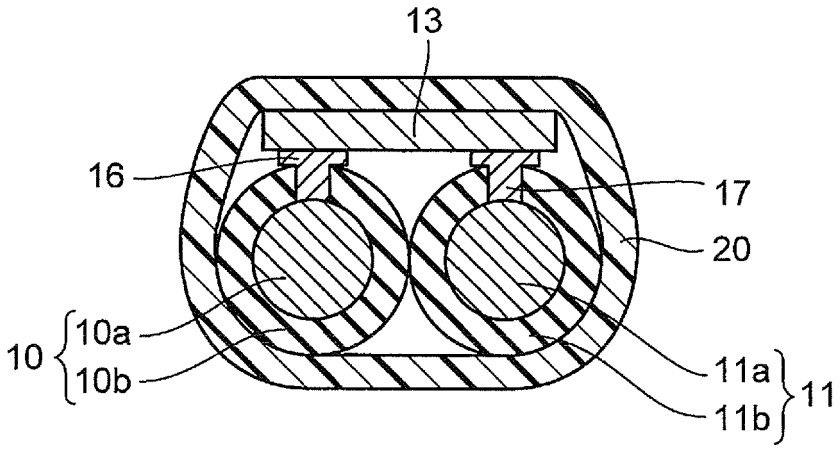


Fig.11

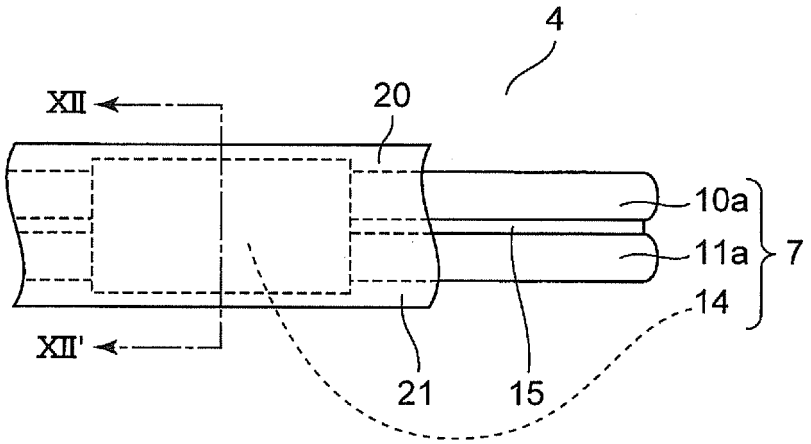


Fig.12

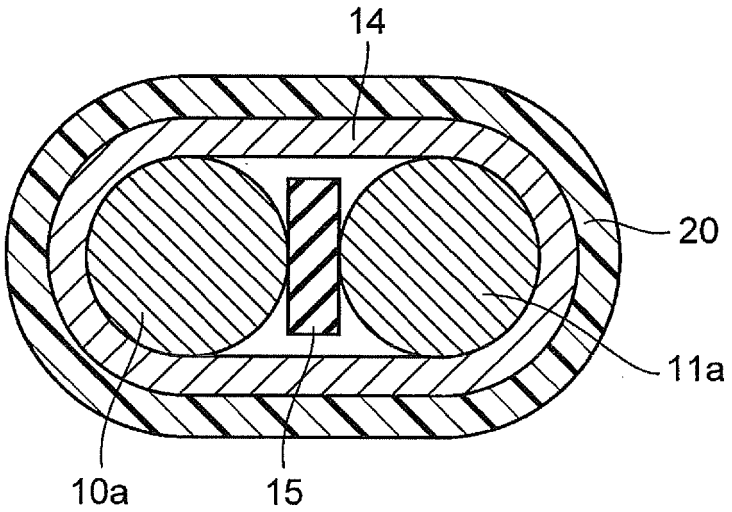
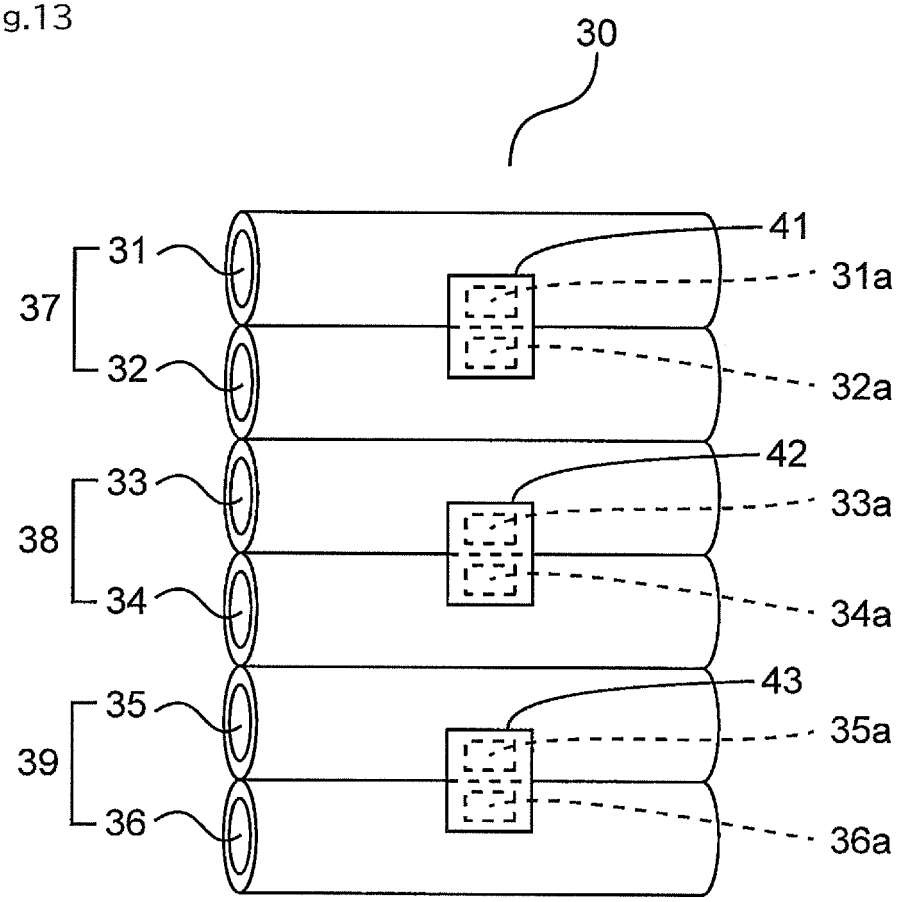


Fig.13



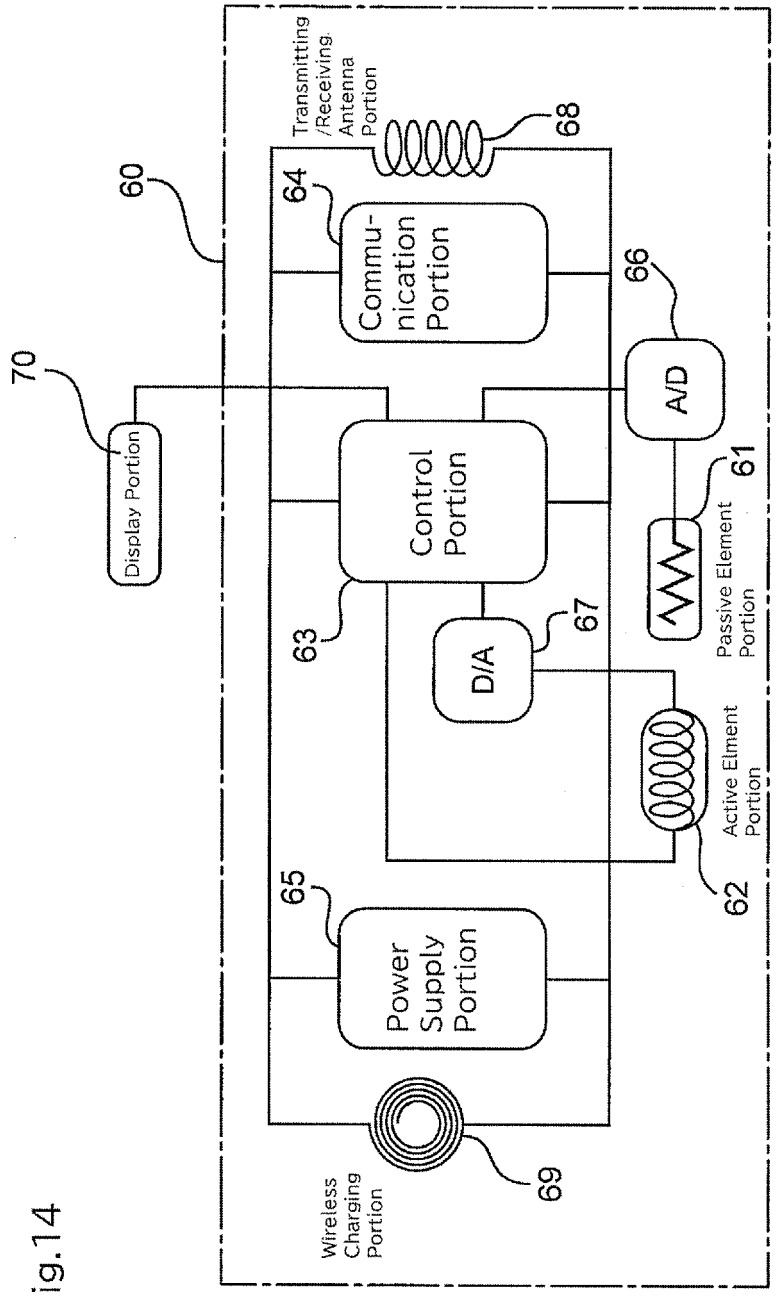

60
70
Display Portion
Transmitting /Receiving Antenna Portion
68
64
Commu-nication Portion
66
A/D
Control Portion
63
D/A
67
61
Passive Element Portion
Active Elment Portion
62
65
Power Supply Portion
Wireless Charging Portion
69

Fig.14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/045571

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. D04B1/14(2006.01)i, D03D1/00(2006.01)i, D03D15/00(2006.01)i, D03D15/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl. D04B1/14, D03D1/00, D03D15/00, D03D15/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	WO 2013/057830 A1 (KYOSEMI CORPORATION) 25 April 2013, claims, paragraphs [0016], [0023]-[0026], [0035], [0048]-[0049], [0062], [0072]-[0075], examples, drawings & TW 201318044 A	1-2, 6-8, 10-11 3-5, 9
Y A	JP 59-28054 Y2 (YAMAZAKI, Takeshi) 14 August 1984, claims, column 2, line 34 to column 3, line 16, column 4, lines 1-9, drawings (Family: none)	1-2, 6-8, 10-11 3-5, 9
P, A	JP 2017-120863 A (TEIJIN LTD.) 06 July 2017, entire text & WO 2017/115860 A1	1-11

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 March 2018 (22.03.2018)	03 April 2018 (03.04.2018)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

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- JP 2008003087 A **[0004]**
- JP S60193993 U **[0050]**
- JP S63282304 A **[0076]**