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3,409,007

BODY ELECTRODE SUPPORT GARMENT

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2 Sheets-Sheet 1

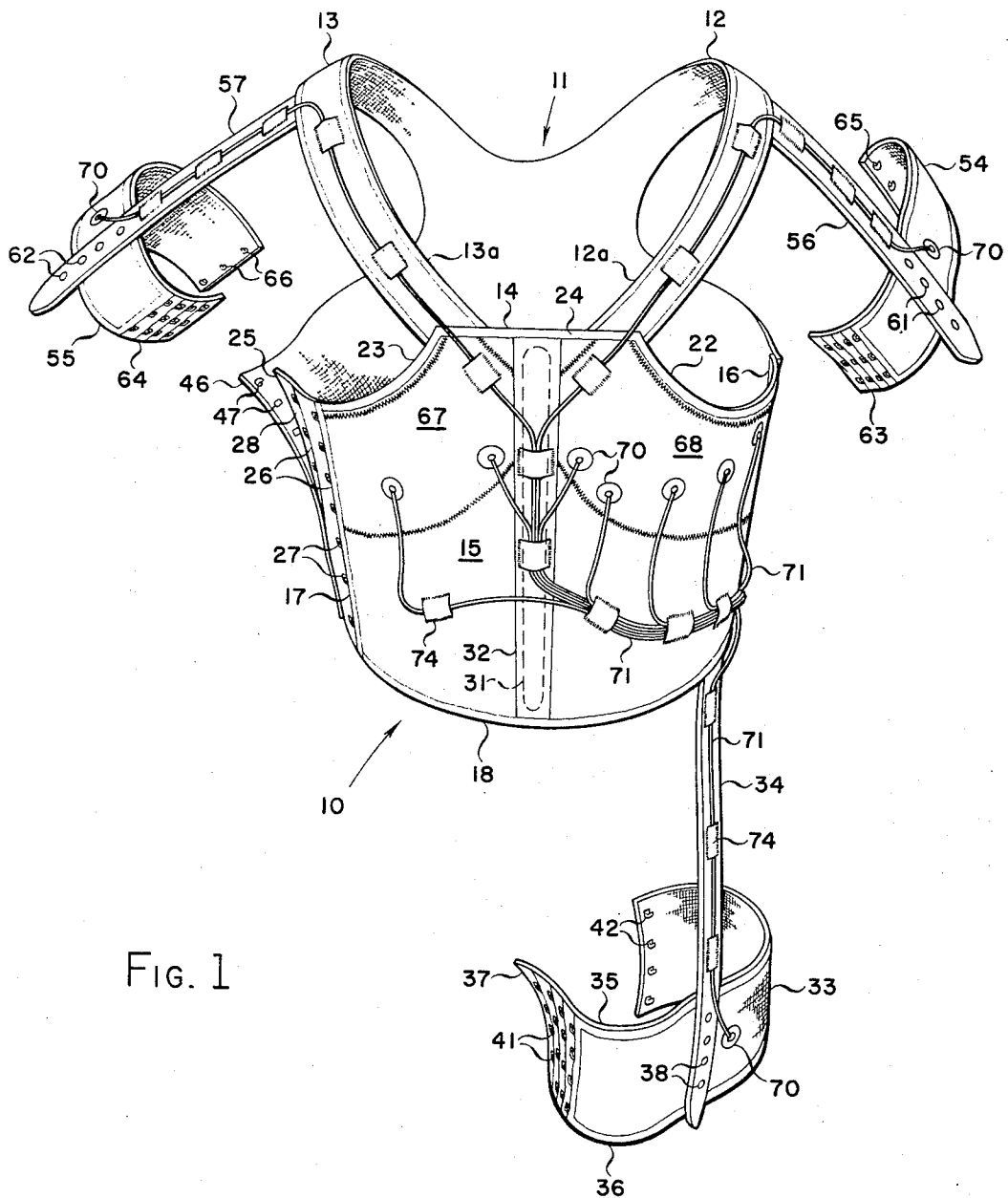


FIG. 1

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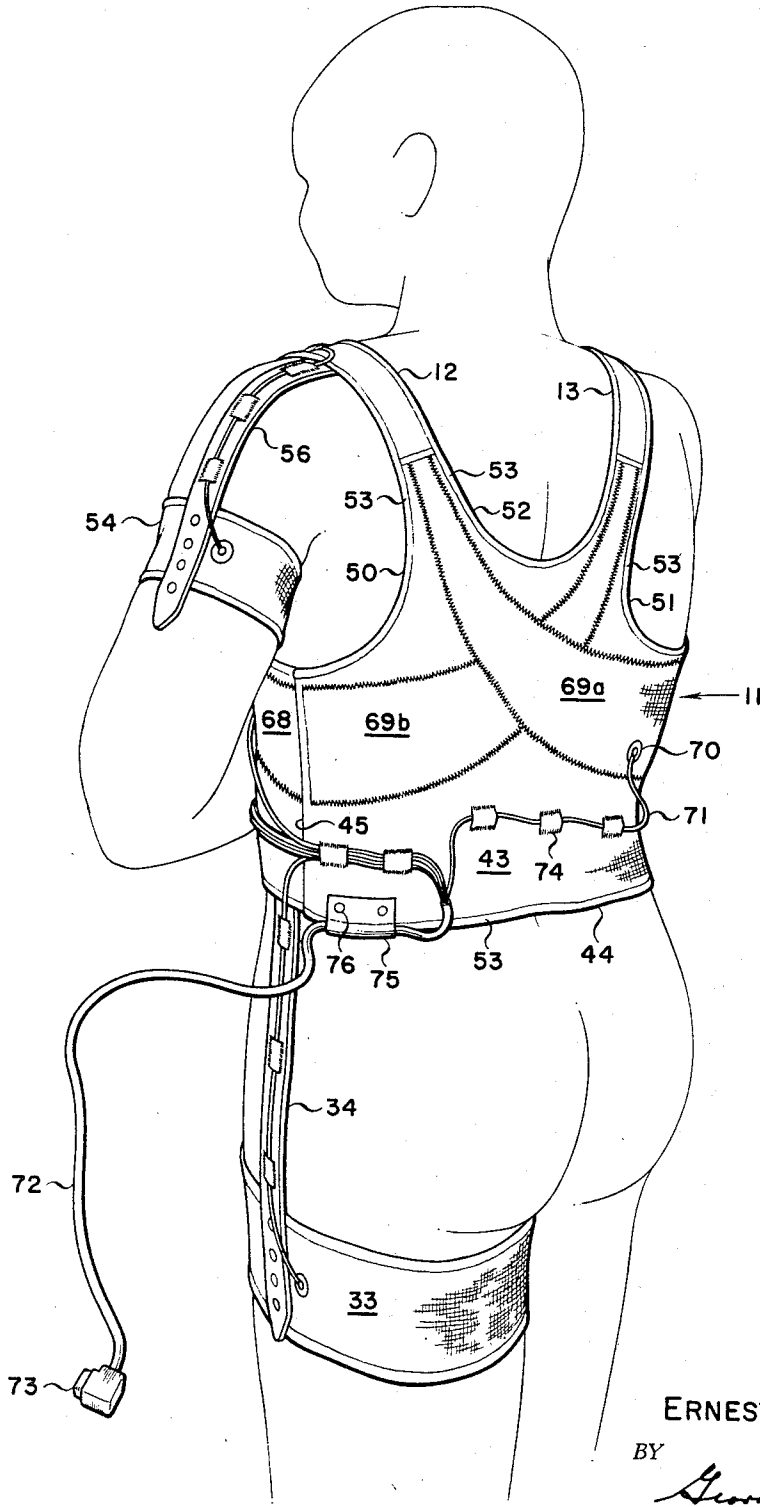
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2 Sheets-Sheet 2

FIG. 2



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3,409,007

BODY ELECTRODE SUPPORT GARMENT

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7 Claims. (Cl. 128—2.06)

ABSTRACT OF THE DISCLOSURE

A vestlike garment preferably fabricated from elastic cloth and configured to surround snugly at least the upper portion of the torso of a wearer. A number of electrodes of a type useful in cardiological examination can be attached to the garment in predetermined locations so that when the garment is worn, these electrodes are respectively properly positioned on the body of the wearer for cardiological examination purposes. A pair of arm bands and a leg band each containing an electrode are attached to the vestlike garment preferably by a substantially inelastic support so that a definite location of these limb electrodes is assured.

This invention relates in general to body garments, and in particular to a body garment capable of supporting a plurality of body contact electrodes in a predetermined relationship with respect to the body of a wearer.

In ascertaining the physical and/or mental condition of the human body, the electrical potentials produced by various organs of the body and present at various locations on the skin of the body frequently must be examined. An example of this may be found in the field of cardiology, wherein it may be necessary to take one or a series of electrocardiograms in an attempt to determine the state of the patient's heart. This normally is accomplished by applying suitable electrodes to preselected areas on the body of the patient and then connecting these electrodes to a cardiograph recorder, whereby a suitable electrocardiogram, or recording of the body potentials produced through the operation of the heart, is reproduced in a manner well known to those skilled in the art.

The technique of electrode placement generally used in the prior art of cardiology consists of affixing individually to the skin of the body a plurality of separate electrode units. These electrode units, which by way of example may consist of the suction-cup type of electrode known to those skilled in the art and including a cuplike member having a concave contact face and a resilient bulb in communication with the concave face, must be affixed to the body and the limbs in predetermined locations to ensure an accurate reading of the potentials produced through the operation of the heart and, additionally, to ensure that cardiograms taken at different times, between which the electrodes are removed from the body of the patient, have no appreciable inconsistency resulting from a difference in electrode location between the two times.

Accordingly, the required preciseness of location of the electrodes on the body means that these electrodes must be positioned either by or under the immediate supervision of a physician having expertise in the field of cardiology. Moreover, these same precautions as to electrode location should be taken every time the electrodes are

applied to the body of a particular patient, even though this patient may have had electrodes applied to his body for this purpose a number of times. Furthermore, because of the general differences between types of body physiques and because of the specific differences between the bodies of individuals having a particular type of physique, it is not practical to provide a universal template or similar position indicating device to enable electrodes to be accurately positioned on the body without the supervision of a physician.

Furthermore, circumstances may arise wherein a medical layman is required to fit electrodes to his body without the presence and guidance of a physician or of anyone else possessing cardiological skill. For example, apparatus is known which enables the electrical potentials produced by the operation of such body organs as the heart to be converted into audio signals suitable for application to a conventional telephone so that these audio signals, as reproduced at a receiving telephone, correspond to and can be converted to an input voltage suitable for application to a conventional cardiograph recorder to produce a cardiogram at the receiving location. Such apparatus, as exemplified by patent application Ser. No. 490,359, entitled "Apparatus for Remote Transmission of Data," filed Sept. 27, 1965, and assigned to the same assignee as the present invention, has been deliberately designed to facilitate its use by laymen not having particular expertise in either the medical or engineering fields; and so there arises the need for a technique or apparatus which permits such a person to position electrodes on his body accurately and with the repeatability as to location necessary to ensure that meaningful results can be obtained from a series of cardiograms taken at different times.

This problem is overcome according to the present invention wherein there is provided a vestlike garment to which the requisite electrodes are attached and which is designed to be worn by the patient at least during the time that the examination of the body electrical potentials is underway. The garment is designed so that it may be worn for extended periods of time without undue discomfort to the wearer, who may wear conventional outer garments such as a shirt or a dress over the vestlike garment to conceal its presence.

Accordingly, an object of this invention is to provide improved body electrode positioning apparatus.

A further object of this invention is to provide apparatus to enable body electrodes to be accurately and rapidly positioned on the body.

Still another object of this invention is to provide apparatus to enable accurate placement of body electrodes by one not having knowledge of the specific locations on the body where such electrodes should be positioned.

A further object of this invention is to provide an improved garment having body contact electrodes mounted thereon.

Yet another object of this invention is to provide a body electrode support garment including electrodes which are accurately positioned with respect to the body of the wearer when the garment is donned.

A still further object of this invention is to provide a body electrode support garment which may be practicably worn under conventional outer clothing.

The exact nature of this invention as well as other objects and advantages thereof will be more readily apparent from consideration of the following specification relating to the annexed drawing in which:

FIGURE 1 shows a front elevation view of a garment according to this invention; and

FIGURE 2 shows a three-quarter rear elevation view of the garment shown in FIGURE 1 as donned by a wearer.

Stated generally, this invention includes a vestlike garment which may be made of a resilient material such as elastic cloth or the like. This garment, which may be sewn or otherwise fabricated, has at least one parting region with a series of securing devices to permit ease of donning and doffing the garment by a wearer. Associated with the garment are a plurality of electrodes which may be of various design and which are placed with respect to the garment such that when the garment is snugly disposed in place on the body of a wearer, the electrodes are positioned in electrically conductive relation with the body of the wearer to enable body potentials present thereon to be sensed by the several electrodes. A number of band-like appendages which may either be fixedly or removably attached to the garment provide supports as needed for limb electrodes. The electrodes may be connected through a suitable wiring harness to a common output connector.

More specifically and with reference to FIGURES 1 and 2 hereof, the depicted embodiment of the invention includes a front member shown generally at 10 and a rear member shown generally at 11. Rear member 11 includes shoulder strap portions 12 and 13 extending upwardly therefrom and which join with the top portion 14 of front member 10.

Front member 10 is made up of a panel 15 made of a resilient material such as elastic cloth or the like and having approximately vertical sides 16 and 17 and an approximately horizontal lower side 18. Inwardly curved edges 22 and 23 run from top portion 14 downwardly to sides 16 and 17, respectively. The unattached edges of panel 15 may be hemmed as at 24. The resilient portion of which panel 15 is fabricated, as well as the other portions of this invention which may be of resilient material, may advantageously be of the type having a substantial measure of elasticity in at least two orthogonal dimensions on the surface plane of the material.

Attached to left vertical side 17 of panel 15 is a securement panel 25 consisting of a plurality of rows 26 of attaching devices such as wire loops 27. These attaching devices may be securely fastened to a relatively non-resilient cloth member 28; the provision of plural rows 26 provides a size adjustment feature which enables a garment of a given size to be used with persons whose girth varies within a certain range.

Disposed on panel 15 approximately midway between sides 16 and 17 is a stay member 31 disposed in a tunnel 32 made of a suitable material such as elastic or inelastic cloth or the like. The entire length of stay member 31 may be contained in a single element made of metal, plastic, or the like, as shown, or the length of this stay may be apportioned into a number of smaller stay segments contained within a single tunnel or within a corresponding number of shorter tunnels.

A leg band 33 of sufficient length to extend around the leg of the wearer of the garment depends downwardly by means of relatively inelastic strap member 34 from front member 10. The uppermost end of strap member 34 is secured to lower side 18 of panel 15 as by stitching or the like, while the lower end of strap member 34 has a plurality of fastening devices 38 such as snap fasteners. Corresponding snap fastener elements are positioned on leg band 33 to permit adjustment of the distance of the leg band from the remainder of the garment. Leg band 33 may be made of a resilient material such

as elastic cloth to provide a snug fit with the portion of the leg around which it is to be disposed; while strap member 34 may, if desired, be made of a relatively inelastic material such as cotton cloth or the like for economy of fabrication and for more accurate positioning of the leg band with respect to the remainder of the garment.

Leg band 33, which has an upper edge 35 and a lower edge 36, has at one end thereof a securement panel 37 similar to panel 25 of front member 10. Panel 37 includes a number of rows of suitable fastening devices such as wire loops 41, and these fastening devices correspond with and are engageable with fastening devices 42 at the opposite end of the leg band. With the use of wire loops as given in this example, fastening devices 42 conveniently might be hook-like members as is known to those skilled in the garment making art.

Turning now to FIGURE 2, the rear member 11 as shown in this embodiment is seen to include a panel 43 made of the same type of material as panel 15 and having a lower edge 44 and side edges 45 and 46 with side edge 45 matingly attached to corresponding edge 16 of front member 10. Contained adjacent right edge 46 is a plurality of attaching elements 47 chosen to be engageable with attaching devices 27 of front member 10.

Curving inwardly from sides 45 and 46 are edge portions 50 and 51 which combine with arcuate upper edge 52 of panel 43 to form and define shoulder strap portions 12 and 13, respectively. These shoulder strap portions, which fit over the shoulders of the wearer of the finished garment and which serve to maintain the garment in the proper vertical relationship with respect to the body of the wearer, may be of one-piece construction formed integrally with rear member 11 or may have separate strap segments 12a and 13a, as seen in FIGURE 1; the shoulder strap portions may be made of the same material, e.g., elastic cloth, as are the front and rear portions of the garment. The various edges of the rear panel member are hemmed as shown at 53.

Associated with rear member 11 are a left arm band 54 and a right arm band 55. Each of these arm bands, which may be made of elastic cloth, is intended to wrap around its corresponding arm to fit snugly therewith. Left arm band 54 is attached to shoulder strap portion 12 by way of strap member 56, while right arm band 55 is attached to shoulder strap portion 13 through strap member 57. Strap members 56 and 57 may be fabricated from material that is either elastic or inelastic, as described above with regard to strap member 34.

A number of connecting devices 61 are disposed on strap member 56 at the end thereof remote from shoulder strap portion 12, while a number of similar connecting devices 62 are positioned on the corresponding end of strap member 57. These connecting devices mate with corresponding connecting devices (not shown) contained on arm bands 54 and 55 to provide an adjustment of the distance between the arm bands and the corresponding shoulder strap portions. Securement panels 63 and 64 are connected to an end of each of arm bands 54 and 55, respectively, and each of these securement panels may, at the option of the constructor, be similar in design and function to securement panels 25 and 37. At the opposite ends of arm bands 54 and 55 are connected rows of attaching devices 65 and 66, respectively, for matingly engaging the corresponding attaching devices on securement panels 63 and 64.

Thus far there has been described a vestlike garment made substantially from a resilient material such as elastic cloth or the like and intended to be worn directly over the upper portion of the body of a person in snugly fitting engagement therewith. So that the desired electrical potentials present on the skin of the wearer may be sensed, the garment is provided with a number of electrode elements 70 attached to the garment at appropriate locations thereon such that when the garment is being worn the

electrodes are disposed at predetermined locations on the skin of the wearer. As best see in FIGURE 1 of the drawing and as will be apparent to those skilled in the art, the electrodes disposed on front portion 10 of the garment are positioned so that when the garment is being worn these electrodes are positioned on the body of the wearer to sense the body potentials used in electrocardiography. The potentials from these chest electrodes, along with potentials sensed by electrodes on leg band 33, arm bands 54 and 55, and the back electrode positioned on rear portion 11, combine to provide a full and complete set of electrical potentials from which all of the generally accepted modes of cardiography may be utilized.

In a particular application of this invention it may be either necessary or desirable to provide additional resilient stiffness to the vestlike garment, so that the electrodes attached thereto may be maintained in precise location with respect to each other and to the body of the wearer. This may conveniently be accomplished by providing areas of multiple thickness of the material (e.g., elastic cloth) of which the garment is made. For example, on front member 10 there are intersecting bands 67 and 68 forming a second layer of elastic cloth attached as by stitching or another suitable technique to the primary layer which comprises panel 15. Each of bands 67 and 68 extend from an upper portion of securement panel 25 or side 16, respectively, to a point adjacent the connection of shoulder strap portions 12 and 13 with top portion 14. Two additional bands of double-thickness material are provided on rear member 11 at 69a and 69b thereof, with these bands extending from the vicinity of the connection of the shoulder strap portions downwardly of panel 43 to the upper portions of side edges 46 and 45, respectively. It can be seen that the lower ends of bands 67 and 68 generally are contiguous with the lower ends of bands 69a and 69b.

Suitable electrical conductors 71 are connected to each of electrode elements 70 and are combined into an electrical cable 72 terminating in a suitable connector 73. Suitable wire tunnels 74, which may be made of cloth or the like and which may be sewn or otherwise affixed to the fabric of the garment, are provided for maintaining conductors 71 in an orderly array on the garment. To facilitate laundering of the garment, the conductors preferably are relatively easily disconnectable from the respective electrodes so that the wire harness made up of the individual conductors 71 may easily be removed from the garment. Cable 72 is removably retained in place by means of a flap 75 secured by connecting devices such as snap fasteners 76 or the like to permit easy detachment of the cable from the garment. A similar flap and snap arrangement may be used with wire tunnels 74.

Electrodes 70 may be any of the electrodes of the prior art which may be attached to or fabricated with the garment of this invention. Alternatively, electrodes 70 may comprise flat, platelike elements of the type described in United States patent application Ser. No. 526,425 entitled "Dry Body Electrode" filed Feb. 10, 1966 and assigned to the same assignee as the present invention. Electrodes as described in the aforementioned application offer the added advantage that no conductive paste or similar solution need be applied to the electrodes to provide adequate conductivity between the electrode and the skin of the person wearing the vest.

From the foregoing it can be seen that there has been described an embodiment of a vestlike garment having secured therewith a number of electrode elements whereby these electrode elements may be quickly and easily disposed on the body of a patient without resort to tedious and time-consuming individual electrode placement. In an exemplary application of this invention, an individual patient is fitted with a vest having electrodes placed in predetermined locations thereon as prescribed by a doctor. Once this has been done, the patient need only don the vestlike garment, attaching the several securement panels

of the garment, the leg band, and the arm bands to produce a snug fit of the garment to his body, and then attach electrical connector 73 to an electrocardiograph recorder or to the data transmitting apparatus referred to above. A garment made according to this invention, once fitted to an individual, may be kept in the possession of that person so that he may cause cardiological data to be transmitted from his home or from any other location whereat a physician or other person skilled in the placement of cardiological electrodes is not likely to be present.

If desired, a bib-like cover made of cloth or the like may be removably attached to front member 10 and rear member 11 to cover the wiring harness and the connections of the individual conductors 71 to their respective electrodes. This has the effects of rendering a more pleasing appearance to the garment and of protecting the wiring harness and electrical connections from damage.

It should be understood, of course, that the foregoing relates to only a preferred embodiment of the invention and that numerous modifications or alterations may be made therein without departing from the spirit and the scope of the invention as set forth in the appended claims.

What is claimed is:

1. A body garment suitable for supporting body contact electrodes in a predetermined relationship with respect to the body of the wearer comprising:

- a vestlike garment;
- said vestlike garment having a front portion, a back portion and a side portion;
- said front portion being coextensive with at least that part of the chest of a wearer against which one or more body contact electrodes are to be disposed;
- said back portion being coextensive with at least that part of the back of a wearer against which one or more body contact electrodes are to be disposed;
- said side portion interconnecting said front and back portion and extending around at least that portion of the left side of the body of a wearer against which body contact electrodes are to be disposed;
- vertical support members configured to extend over the shoulders of a wearer, said vertical support members being attached to said front portion and said back portion so that the garment when worn is retained in a predetermined location with respect to the body of the wearer;
- a parting region defined by a corresponding edge of each of said front and back portions, said parting region being located on the garment so as not to interfere with the placement of body contact electrodes thereon;
- securement means on said front and back portions to enable said parting region to be disconnectably secured together so that the garment may easily be donned and doffed by a wearer; and
- at least one limb electrode support member connected to said vestlike garment, said limb electrode support member being made of flexible material and dimensioned to snugly surroundingly engage a limb of a wearer.

2. A body garment suitable for supporting body contact electrodes in a predetermined relationship with respect to the body of the wearer comprising:

- a vestlike garment;
- said vestlike garment having a front portion, a back portion and a side portion;
- said front portion being coextensive with at least that part of the chest of a wearer against which one or more body contact electrodes are to be disposed;
- said back portion being coextensive with at least that part of the back of a wearer against which one or more body contact electrodes are to be disposed;
- said side portion interconnecting said front and back portion and extending around at least that portion of the left side of the body of a wearer against which body contact electrodes are to be disposed;

vertical support members configured to extend over the shoulders of a wearer, said vertical support members being attached to said front portion and said back portion so that the garment when worn is retained in a predetermined location with respect to the body of the wearer;

a parting region defined by a corresponding edge of each of said front and back portions, said parting region being located on the garment so as not to interfere with the placement of body contact electrodes thereon;

securement means on said front and back portions to enable said parting region to be disconnectably secured together so that the garment may easily be donned and doffed by a wearer;

a pair of arm band members attached to said vestlike garment, each of said arm band members being dimensioned to snugly surroundingly engage a predetermined portion of a respective arm of a wearer; and

a leg band member dependently attached to said vestlike garment, said leg band member being dimensioned to snugly surroundingly engage a predetermined portion of a leg of a wearer,

said front portion, said back portion, said side portion, said arm band members and said leg band member all being at least partially fabricated from an electrically nonconductive elastic material.

3. An electrode supporting body garment for maintaining body contact electrodes in a predetermined location with respect to the body of a wearer comprising:

a front panel member of elastic material;

a back panel member of elastic material;

said front panel member and said back panel member being secured together to form a body encompassing member of substantial width and extending substantially completely around the body of a wearer;

said body encompassing member having a parting region including securement means associated therewith to enable said parting region to be disconnectably secured together;

at least a substantial portion of said body encompassing member being firmly disposed against those portions of the body of a wearer whereat body electrical potentials to be examined are present;

a plurality of body contact electrode assemblies mounted in spaced apart relationship on said body encompassing member;

each of said electrode assemblies including an electrode member situated on the side of said body encompassing member adjacent the body and disposed adjacent said body portions whereat electrical body potentials to be sensed are present;

an individual electrical conductor in electrically conductive relationship with each of said electrode members, said electrical conductors being disposed on the opposite side of said body encompassing member from said electrode members;

at least one elastically extensible arm encircling member dimensioned to snugly engagingly encircle the arm of a wearer of the garment and having an electrode assembly supported thereon;

an elastically extensible leg encircling member dimensioned to snugly engagingly encircle a leg of a wearer of the garment and having an electrode assembly supported thereon;

each of said arm and leg encircling members being connected to said body encompassing member with a substantially inelastic member of predetermined length to define a certain location of said encircling members on their respective arm or leg with respect to said body encompassing member; and

each of said electrode assemblies having an electrode member disposed for electrically conductive engage-

ment with the respective arm and leg of a wearer when said encircling members are in snugly engaging relationship with the respective arm and leg of the wearer.

4. A body garment as in claim 3 wherein:

each of said arm and leg encircling members is in the form of a weblike band having coacting securement means at opposite ends thereof to enable said encircling members to be readily attached to and removed from the limbs of a wearer.

5. An electrode supporting body garment for maintaining body contact electrodes in a predetermined location with respect to the body of a wearer comprising:

a front panel member of elastic material;

a back panel member of elastic material;

said front panel member and said back panel member being secured together to form a body encompassing member of substantial width and extending substantially completely around the body of a wearer;

said body encompassing member having a parting region including securement means associated therewith to enable said parting region to be disconnectably secured together;

at least a substantial portion of said body encompassing member being firmly disposed against those portions of the body of a wearer whereat body electrical potentials to be examined are present;

a plurality of body contact electrode assemblies mounted in spaced apart relationship on said body encompassing member;

each of said electrode assemblies including an electrode member situated on the side of said body encompassing member adjacent the body and disposed adjacent said body portions whereat electrical body potentials to be sensed are present;

a pair of shoulder strap members configured to extend over the shoulders of a wearer, an end of each of said shoulder strap members being secured to said front panel member and the opposite ends of said shoulder strap members being secured to said back panel member,

said shoulder strap members being of such length that said body encompassing member is retained in a predetermined vertical relationship with respect to the body of a wearer so that said electrode members remain aligned with respect to said body portion whereat electrical body potentials to be sensed are present;

a first limb encircling member having an electrode assembly mounted thereon and dimensioned to snugly encircle a leg of a wearer of the garment, said first limb encircling member being connected to said body encompassing member at a point thereon by means of a relatively inelastic member of predetermined length;

second and third limb encircling members, each having an electrode assembly mounted thereon and each being dimensioned to snugly encircle a respective one of the upper arms of a wearer,

said second limb encircling member being connected to one of said shoulder strap members by means of a relatively inelastic member of predetermined length and said third limb encircling member being connected to the other of said shoulder strap members by means of another relatively inelastic member of predetermined length,

each of said electrode assemblies mounted in said limb encircling members including an electrode member situated to be in electrically conductive contact with the limb when said limb encircling member is in place on the limb of a wearer.

6. A garment as in claim 5 wherein:

each of said limb encircling members is in the form of a weblike band fabricated at least partially from a

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material having substantially elastic characteristics.
 each of said weblike bands having coacting ad-
 justable securement means at opposite ends
 thereof to enable said limb encircling members
 to be readily attached to and removed from 5
 the limbs of a wearer.

7. A garment as in claim 6 wherein:
 said securement means associated with said body en-
 compassing member includes adjustable means
 whereby the nominal girth of said body encompass-
 ing member may be varied. 10

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