June 6, 1967 W. R. BARRETT, JR 3,323,514

ELECTROCARDIOGRAPH CUSHION

Filed March 26, 1964

FIG. 1.

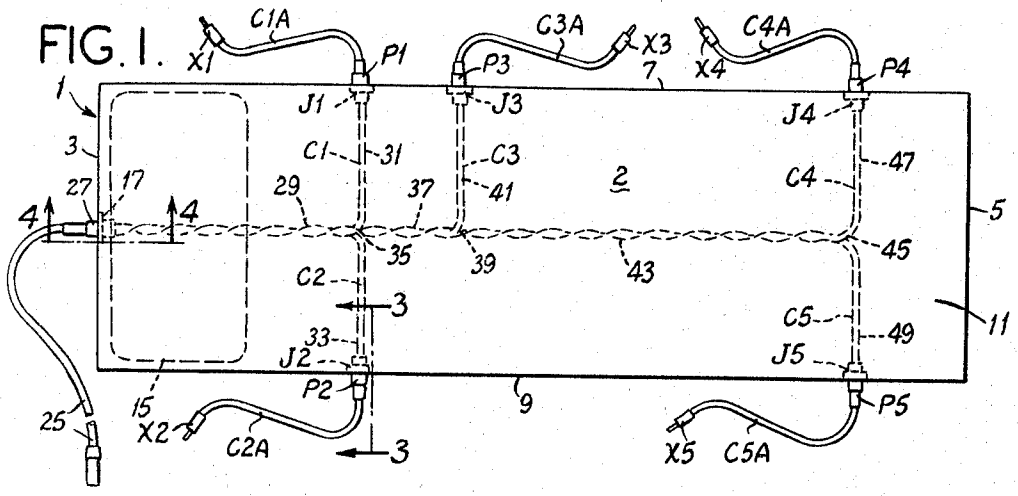
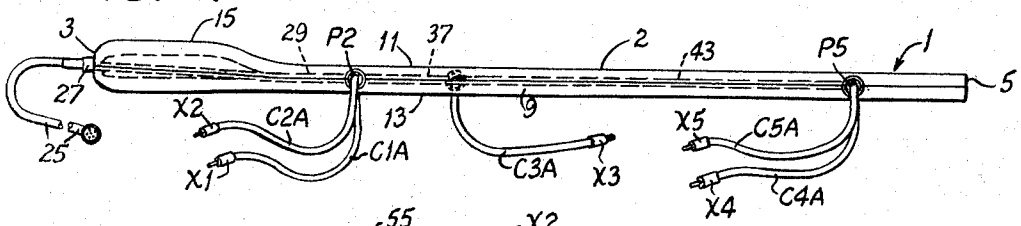


FIG. 2.



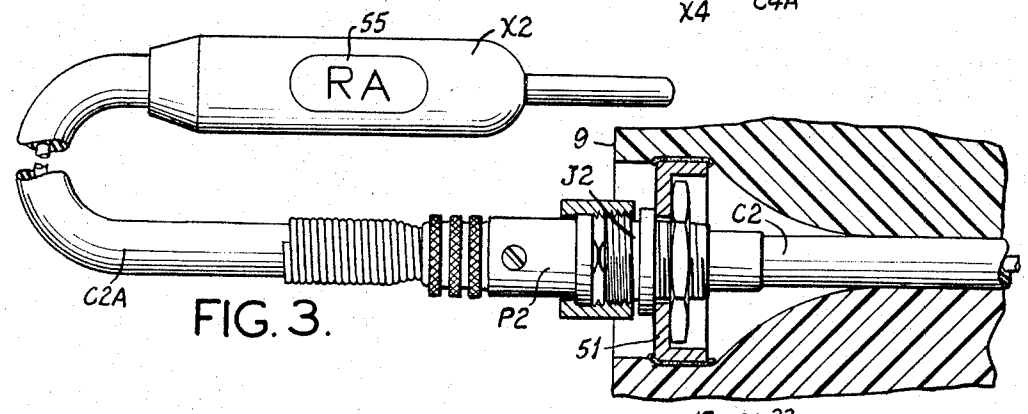


FIG. 3.

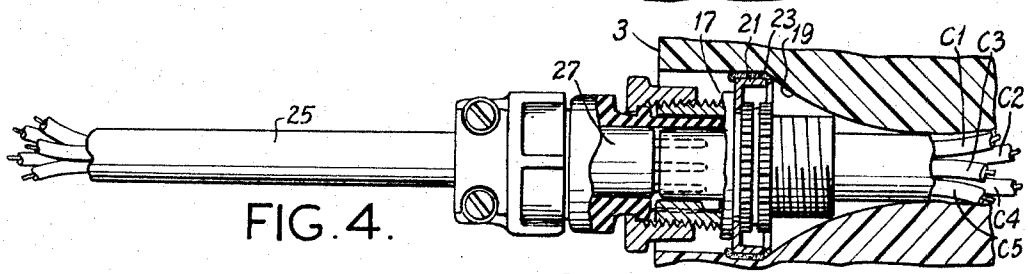


FIG. 4.

Walter Raymond Barrett, Jr.,
Inventor.
Koenig, Lenniger, Powers and Leavitt,
Attorneys.

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ELECTROCARDIOGRAPH CUSHION

Walter Raymond Barrett, Jr., 2700 Mockingbird, Florissant, Mo. 63031

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This invention relates to a cushion for use by a patient undergoing electrocardiography, and more particularly to such a cushion and a wiring harness for interconnecting an electrocardiograph to a plurality of electrodes.

Among the several objects of the invention may be noted the provision of a cushion and wiring harness for electrocardiography which reduces the effect of ambient electrical disturbances and interference frequently picked up by the electrical conductors used to interconnect the electrodes to the electrocardiograph; the provision of such a cushion and wiring harness which minimizes somatic tremor and drifting and provides improved electrocardiogram tracings thereby permitting the cardiologist to read and analyze the results with greater speed and precision; the provision of a cushion and wiring harness of the type described that improves the efficiency in setting up the patient for electrocardiography and virtually eliminates the possibility of incorrect connection of leads and electrodes; the provision of a cushion and wiring harness for electrocardiography which sharply reduces the possibility of broken electrical lead conductors and minimizes any lead replacement expense; and the provision of a cushion and wiring harness of the type described which enhances the physical comfort of patients undergoing electrocardiography and reduces possible patient anxiety. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinatfer described, the scope of the invention being indicated in the following claims.

To obtain a technically satisfactory electrocardiogram, it is essential that the minute electrical signals or action potentials associated with the contraction of the heart be sensed and accurately reproduced or traced without any significant interference or distortion. The placement of the lead wires or electrical conductors interconnecting the electrocardiograph to the five electrodes used, for example, in bipolar electrocardiography is quite critical. Not only must these conductors and their electrodes be physically positioned to provide the maximum heart voltage signals to the electrocardiograph, but they must also be placed so as to minimize the effect of ambient electrical fields which are present in varying degrees in the examining room. This problem of lead placement is not only time-consuming and therefore frequently neglected by the technician, but it is usually a poor compromise at best to find the most desirable placement for the best signal position commensurate with the least electrical interference. Furthermore, with the customary and conventional electrocardiograph systems now in use, the electrode leads will frequently have to be draped over portions of the patient's body, causing some discomfort and possible anxieties in certain pateints. Also, it is essential that the electrocardiograph electrical conductor leads be connected to the proper five electrodes and not reversad.

In accordance with the present invention, these difficulties and disadvantages of existing electrocardiograph equipment are obviated by my novel cushion and wiring harness. The cushion includes a pad of resilient material generally sized to fit the surface of the typical examining table or cot, and an electrical cable system having a

plurality of electrical conductors positioned under the upper surface of the pad and extending from one end of the pad toward the other end generally along a central axis thereof. A first two of said cable conductors are respectively carried generally laterally through opposite side edges of a first portion of the pad (preferably adjacent the first end of said pad) for connection respectively to first and second electrocardiograph electrodes. A third cable conductor is carried generally laterally through one of the side edges of the pad for connection to a third electrocardiograph electrode, while a second two of said cable conductors are respectively carried generally laterally through opposite side edges of another portion of the pad (preferably adjacent the second end of said pad) for connection respectively to fourth and fifth electrocardiograph electrodes. This cushion utilizes the body of a patient reclining on said pad to effect an electrical shielding effect on the electrocardiograph cable conductors within said pad, thereby minimizing the effect of ambient electrical interference. Preferably, the electrical conductors are bundled and twisted together for the various lengths between the points where the electrical conductors branch laterally. Further, it is advantageous to provide jacks in one end edge and the two side edges of the pad so that the pad and cable system are an integral unit adapted to have extension cables and conductors detachably interconnecting the jacks and the respective electrodes and the electrocardiograph.

In brief, the wiring harness of this invention, which interconnects the electrocardiograph to a plurality of electrocardiograph electrodes, includes a plurality of electrical connectors which are positioned so that the reclining body of a patient will cover the major portion of the harness. One end of each of said electrical conductors commonly terminates in a cable connector adapted to be interconnected to the electrocardiograph. All of the electrical conductors are bundled together to extend from the connector to a first branching point at which two of the electrical conductors are carried generally laterally in opposite directions generally normal to the axis of the bundled electrical conductors for respective interconnection to first and second electrocardiograph electrodes. The remaining three electrical conductors are bundled together to extend from the first branching point to a second branching point at which a third of said electrical conductors is carried generally laterally in a direction generally normal to the axis of the bundled conductors for interconnection to a third electrocardiograph electrode. The remaining two electrical conductors are bundled together to extend together from the second branching point to a third branching point at which these last two conductors are carried generally normal to the axis of the bundled conductors for respective interconnection to fourth and fifth electrocardiograph electrodes. Again, the reclining body of a patient effects an electrical shielding of the electrocardiograph cable conductors. Also, it is preferred that the bundled conductors of each of the cable portions be twisted together.

In the accompanying drawings in which one of various possible embodiments of the invention is illustrated:

FIG. 1 is a top plan view of a preferred embodiment of an electrocardiograph cushion and wiring harness of the present invention;

FIG. 2 is a side elevation of the cushion and harness of FIG. 1;

FIG. 3 is an enlarged view, taken along lines 3—3 of FIG. 1 and partly in section, of an electrical conductor and jack utilized in the present invention; and

FIG. 4 is a similar enlarged view, taken along lines 4—4 of FIG. 1, of an electrical connector component of the present invention.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now more particularly to the drawings, a cushion for use by a patient undergoing electrocardiography is indicated generally at numeral **1**. Cushion **1** is formed of a pad **2** of resilient material, such as foamed polyurethane or foam latex, and is generally rectangular in shape, having end edges **3** and **5**, opposite side edges **7** and **9** and upper and lower surfaces **11** and **13**. A portion of the upper surface of pad **2** at the head or upper end (left as viewed in FIGS. 1 and 2) is preferably raised as indicated at **15** to form an elevated portion for supporting the head and shoulders of the patient. The size of pad **2** generally corresponds to that of the surface of the conventional examining table or cot used for examining patients. An electrical connector **17** is affixed in a recess **19** in the end edge **3** of pad **2** by means of a fitting **21** bonded as indicated at **23** to the interior surfaces of recess **19**. Connector **17** is a conventional multiconductor jack-type connector which constitutes one component of an electrical cable system. One end of each of five insulated (and preferably electrically shielded by the customary metallic braid sheath) conductors **C1–C5** is connected to respective terminals of jack **17**, which thereby forms one end of a wiring harness adapted to be connected to any conventional electrocardiograph (not shown) by means of a multiconductor cable **25** having a plug end **27** which mates with jack **17**. Conductors **C1–C5** are bundled together and preferably twisted as indicated so that they extend as a cable portion **29** from pad end **3** toward the other end edge **5** generally along a longitudinal central axis of pad **2** intermediate the upper and lower surfaces **11** and **13**. A first two of the conductors, **C1** and **C2**, are then carried generally laterally in opposite directions as indicated at **31** and **33** toward opposite side edges **7** and **9** of a first portion of the pad, i.e., generally adjacent the top or end edge **3** of pad **2**. The point where conductors **C1** and **C2** branch away from the main cable portion is indicated at **35**. A second portion **37** of the cable comprising twisted conductors **C3–C5** extends from branching point **35** to a second branching point **39** at which conductor **C3** is carried generally laterally as indicated at **41** toward a side edge **7** of a second portion of the pad, i.e., generally intermediate the pad ends. A third portion of the cable **43** comprising twisted conductors **C4** and **C5** extends toward a third branching point **45** at which conductors **C4** and **C5** are carried laterally in opposite directions as indicated at **47** and **49** toward opposite side edges **7** and **9** of a third portion of pad **2**.

Although conductors **C1–C5** may be carried outside edges **7** and **9** for direct connection to the respective customary electrodes (not shown) of an electrocardiograph, it is preferred to make these connections indirectly by terminating conductors **C1–C5** at jacks **J1–J5** respectively (each mounted in recesses in the side edges of pad **2** by means of brackets **51** bonded to the pad material) and utilizing conductor extensions **C1A–C5A** each of which has a respective plug connector **P1–P5** which mates for detachable interconnection with recessed jacks **J1–J5**, respectively. Conductor extensions **C1A–C5A** are each insulated and shielded and have the outer ends terminating in pin connectors **X1–X5** respectively for connection to the customary electrocardiograph electrodes (not shown). Pin connectors are preferably coded as indicated at **55** by indicia such as "RA" or "LA" etc., indicating "right arm" and "left arm," respectively. It will be understood that these conductor extensions may be terminated by permanently connected electrodes, if desired.

The operation of the cushion and wiring harness of the present invention is as follows: Cushion **1** is preferably

left on the examining table and covered with a protective sheet or cover, which may be formed with apertures in the side and end edges to permit access to jacks **J1–J5** and connector **17**. The technician either before or after instructing the patient to recline with head and shoulders resting on the raised portion **15** of pad **2** will then interconnect the electrodes by means of cable extensions **C1A–C5A** to the proper points on the patient's body and interconnect the portable electrocardiograph machine by means of multiconductor cable **25** and its plug **27** to the electrical connector jack **17**. As the jacks **J1** and **J2** are respectively positioned on the left and right sides of cushion **1** closely adjacent the points of attachment of the arm electrodes to the patient's left and right biceps, it is virtually impossible to reverse these connections. Jack **J3** is similarly positioned near the chest area of the reclining patient so that conductor extension **C3A** may be conveniently connected by means of its electrode to the various desired locations on the patient's chest. Also, jacks **J4** and **J5** are positioned so that they are adjacent the points of application of the electrodes to the patient's left and right leg calves, again avoiding any likelihood of technician error in crossing leads **C4A** and **C5A** to these electrodes. It will also be noted that the cables and conductors constituting the wiring harness are not draped over the patient's body, which draping in some instances causes patient anxiety that may adversely affect the electrocardiogram. Moreover, the usual frequent tangling and untangling of conductors interconnecting the electrodes and the electrocardiograph are avoided by providing the wiring harness and cushion of this invention which remains under the patient's reclining body. The comfort provided by the resiliency of the cushion and the raised portion **15** assists in relaxing the patient and reduces the possibility of somatic tremor from muscle action frequently caused by patient discomfort.

As the examining area is generally located in a building with electrical wiring, X-ray apparatus, etc., substantial ambient A.C. electric fields are almost invariably present. Such A.C. fields, 60-cycle and otherwise, constitute a serious electrical interference problem in sensing the extremely minute action potentials or signals generated by heart muscle contraction and transferring them without distortion and electrical noise pick-up to the electrocardiograph. As the heart voltages are so minute and ambient electrical fields can produce voltages in the conductor leads to the machine which may be of substantial magnitudes relative to that of the heart voltage levels, it is essential that the lead conductors from the electrodes to the elecrocardiograph, even though covered by the usual metallic braid sheath, be carefully routed to minimize this interference pick-up. The mass of the patient's body and the generally symmetrical placement of the wiring harness beneath his body acts as a very effective electrical shield and sharply reduces or minimizes the effect of the ambient electrical interference fields. The twisting of the conductors **C1–C5** in the cable portions **29**, **37** and **45** is preferred, as interference picked up by **C1**, for example, will cancel interference picked up by its mate **C2**, and similarly with **C4** and **C5**.

It will be understood that the cable portion **29** may be constituted by all five conductors **C1–C5** being commonly twisted together, or by **C1** and **C2** being twisted together to form a first twisted pair and **C4** and **C5** being twisted together to form a second twisted pair, **C3** then being bundled with these two twisted pairs.

It will also be noted that the positioning of the wiring harness under the patient's body and preferably embedded in cushon **1** protects the conductors and avoids electrical shorts and opens. Moreover, if one of the conductor extensions **C1A–C5A** is broken or develops a fault, only the faulty extension need be replaced instead of replacing the entire conductor length or wiring harness. Moreover, drifting (which is a deviation in the baseline of the electrocardiogram from a horizontal trace) is minimized

by this invention, inasmuch as the possibility of unsatisfactory electrode contact is greatly reduced.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompnaying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. A cushion for use by a patient undergoing electrocardiography comprising:

a pad of resilient material having two end edges, two side edges, and upper and lower surfaces;

an electrical cable system including a plurality of electrical conductors positioned under said upper pad surface and extending from one end of said pad generally along a central axis thereof toward the second end;

means adapted for connecting said cable system to an electrocardiograph;

a first two of said cable conductors being respectively carried geenrally laterally through opposite side edges of a first portion of said pad;

means adapted for connecting said first two conductors respectively to first and second electrocardiograph electrodes;

a third cable conductor being carried generally laterally through one of said side edges of a second portion of said pad;

means adapted for connecting said third conductor to a third electrocardiograph electrode;

fourth and fifth cable conductors being respectively carried generally laterally through opposite side edges of a third portion of said pad; and

means adapted for connecting said fourth and fifth conductors respectively to fourth and fifth electrocardiograph electrodes whereby the body of a patient reclining along the central axis of said pad effects an electrical shielding effect on the electrocardiograph cable conductors within said pad.

2. An electrocardiograph cushion as set forth in claim 1 in which each of said electrical conductors is individually insulated and shielded and the individual conductors are twisted together to form a five-conductor cable length extending from the first said end of said cushion to the point at which said first two conductors branch laterally, said third through fifth conductors being twisted together to form a three-conductor cable length extending between the points where said first two conductors branch laterally and the point where said third conductor branches laterally, said fourth and fifth conductors being twisted together between said last said branching point and the point at which said fourth and fifth conductors branch laterally.

3. An electrocardiograph cushion as set forth in claim 1 in which said means adapted for connecting said cable system to an electrocardiograph includes a jack positioned in the first said end of the pad.

4. An electrocardiograph cushion as set forth in claim 1 in which each of said means adapted for connecting said conductors comprises a respective jack secured in the side edge of said pad, the other ends of said conductors commonly terminating in a multicontact jack secured in the first said end edge, said multicontact jack constituting said means adapted for connecting said cable system to an electrocardiograph, and separate shielded electrical conductors, each having one end respectively adapted to be connected to one of said side edge jacks and the other end respectively adapted to be electrically connected to one of said electrodes.

5. An electrocardiograph cushion as set forth in claim 1 in which said pad is formed of foamed resilient material and the electrical cable system is positioned intermediate the upper and lower pad surfaces.

6. A cushion for use by a patient undergoing electrocaridography comprising a pad of resilient material having two end edges, two side edges, and upper and lower surfaces; an electrical system including a first multicontact jack positioned in a first end edge of the pad adapted to be interconnected to an electrocardiograph and being interconnected commonly to one end of each of five shielded electrical conductors; said electrical conductors being bundled and twisted together to form a cable positioned intermediate said pad surfaces and extending from one end of said cushion generally along a central axis of said pad toward the second end to a first branching point at which the first and second cable conductors are respectively carried generally laterally to respective second and third jacks mounted in opposite side edges of said pad generally adjacent the first end of said pad and adapted for connection respectively to first and second electrocardiograph electrodes; the other three cable conductors being bundled and twisted together to form a cable portion extending from said first branching point toward the second pad end to a second branching point at which the third conductor is carried generally laterally to a fourth jack mounted in one of said side edges of said pad and adapted for connection to a third electrocardiograph electrode; the remaining two cable conductors being bundled and twisted together to form another cable portion extending from said second branching point toward said second pad end to a third branching point at which these two remaining conductors are carried respectively generally laterally to fifth and sixth jacks mounted in opposite side edges of said pad generally adjacent the second end of said pad and adapted for connection respectively to fourth and fifth electrocardiograph electrodes whereby the body of a patient reclining on said pad effects an electrical shielding effect on the electrocardiograph cable conductors within said pad.

7. A wiring harness for interconnecting an electrocardiograph to a plurality of electrodes, said harness comprising:

means adapted for disposing an electrical cable system under the reclining body of a patient undergoing electrocardiography, said cable system including a plurality of electrical conductors;

a cable connector, at which one end of each of said electrical conductors commonly terminates, adapted to be interconnected to said electrocardiograph;

all of the electrical conductors being bundled together to extend from said connector through a first portion of said means to a first branching point at which two of said electrical conductors are carried generally laterally in opposite directions generally normal to the axis of said bundled electrical conductors;

means adapted for respectvely interconnecting said two conductors to first and second electrocardiograph electrodes;

the remaining three electrical conductors being bundled together to extend through a second portion of said means from the first branching point to a second branching point at which a third of said electrical conductors is carried generally laterally in a direction generally normal to the axis of the bundled conductors;

means adapted for interconnecting said third conductor to a third electrocardiograph electrode;

the remaining two electrical conductors being bundled together to extend together through a third portion of said means from the second branching point to a third brannching point at which these last two conductors are carried generally normal to the axis of the bundled conductors; and

means adapted for respectively interconnecting said remaining two conductors to fourth and fifth electrocardiograph electrodes whereby the reclining body of a patient lying on said means effects an electrical

shielding effect on the electrocardiograph cable conductors.

8. A wiring harness as set forth in claim 7 in which each of said electrical conductors is individually insulated and shielded and the five individual conductors are twisted together from the cable connector to the first branching point, the remaining three cables being twisted together from the first to the second branching points, and the remaining two cables being twisted together from the second to the third branching points.

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RICHARD A. GAUDET, *Primary Examiner.*

W. E. KAMM, *Assistant Examiner.*