April 30, 1968 J. D. FRASIER 3,380,445

ELECTRICAL PICKUP STRUCTURE FOR ELECTROCARDIOGRAPHS AND THE LIKE

Filed Sept. 24, 1965

FIG. 1.

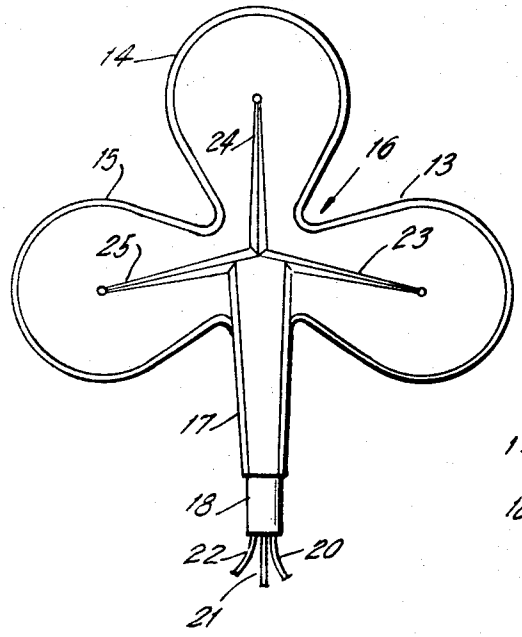


FIG. 2.

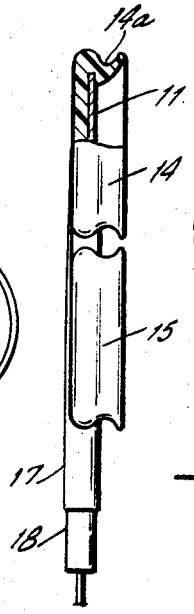


FIG. 4.

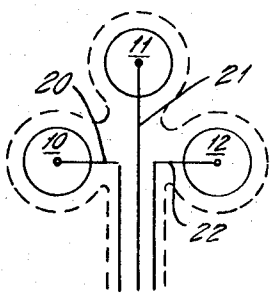


FIG. 5.

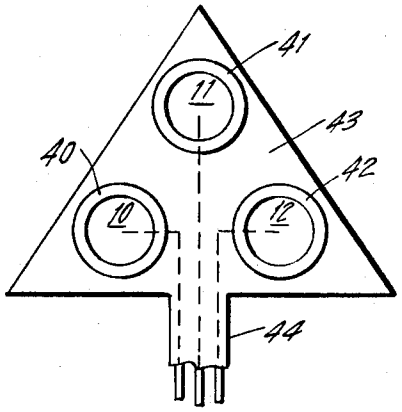


FIG. 3.

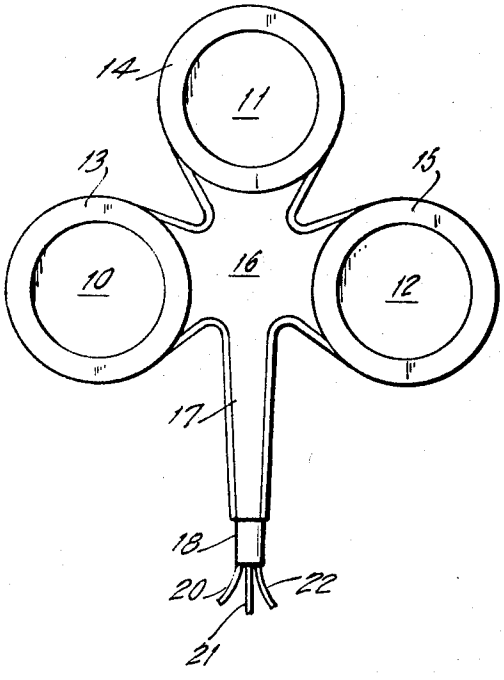
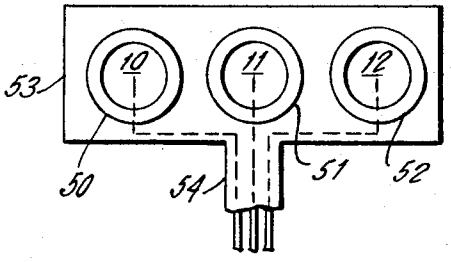


FIG. 6.



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ELECTRICAL PICKUP STRUCTURE FOR ELECTRO-CARDIOGRAPHS AND THE LIKE

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ABSTRACT OF THE DISCLOSURE

An electrical pickup structure for an electrocardiograph consisting of three electrodes mounted in the lobes of a cloverleaf shaped flexible support having a thin central web. The leads for each of the electrodes are taken out through a common stem.

This invention relates to an electrical pickup structure, and more particularly relates to a novel electrode construction for the electrodes of an electrocardiograph, or for a heart pulse pickup.

It is well known to connect electrodes to the human body with the use of a suitable jelly for decreasing contact resistance, whereby the output electrical signals developed between various electrodes will indicate various functions of the heart. In addition, such arrangements may be used for monitoring the heartbeat.

In the standard prior art arrangement of such electrodes, the electrodes are individually applied to the body resulting in a large number of awkwardly placed lead wires inhibiting the patient's movement. If these electrodes must remain in place over a long period of time, as when used for intensive care patients, the patient's movements are unduly hampered and, more serious, his movement can cause the generation of spurious signals into the monitoring electrical equipment because of physical movement of the electrode with respect to his body.

Furthermore, with the prior art arrangement and where the electrodes must remain attached to the body for an appreciable period of time, the jelly used for improving contact resistance is exposed to the air and will dry out rapidly unless covered with a suitable bandage.

A further problem with the prior art individual electrode arrangement, especially in an emergency situation, is the relatively long length of time required to individually coat the electrodes with jelly, individually place them on the body and hold them secure to the body.

The present invention provides a novel electrode structure adapted for connection to standard cardioscopes or other electrical signaling monitoring equipment in which a plurality of electrodes are contained within respective cups formed in a common resilient, rubber-like body.

In a preferred embodiment of the invention, the support body arrangement resembles a shamrock wherein the central web provides great flexibility to the extending lobes which have electrodes embedded therein. These electrodes, which are contained within cup-shaped lobes, then may be covered with a suitable jelly simply by dropping some suitable amount of jelly within each of the cups, whereupon the entire assemblage can be immediately placed upon the patient's body in any suitable location.

The leads extending from the individual electrodes are carried out through a common cable conductor which is terminated by a suitable cable multi-terminal connector. Thus, only a single wire extends from the multi-electrode structure as contrasted to the nest of wires commonly associated with electrocardiogram monitoring equipment. Moreover, since the jelly is contained within cups which are intimately secured to the body, the jelly does not

dry out as rapidly as when it is exposed. Furthermore, where the structure is to be secured against patient movement, a simple strip of tape will retain all of the electrodes rigidly in position with respect to the patient's body, thereby decreasing possibility of spurious signal generation due to the relative movement of the electrode and the body.

In the novel arrangement, with each of the electrodes contained in a common flexible body and with the electrodes embedded in cups which serve as jelly receptacles, the device can be immediately utilized in emergency situations, or at least provides an exceptionally convenient instrument for the use of a doctor or technician in non-emergency situations.

Moreover, by carrying the electrodes in a flexible body, each of the electrodes can deflect with respect to the remaining electrodes and follow the contours of the body portion on which the assemblage is placed.

Accordingly, a primary object of this invention is to provide a novel electrode structure for use with medical electrical equipment,

Yet another object of this invention is to provide a convenient means for connecting a plurality of electrodes to the human body.

A further object of this invention is to provide a multi-electrode structure for connection to the human body which can be rapidly used in an emergency situation.

Another object of this invention is to provide a novel multi-electrode structure wherein the individual electrodes are contained within a common flexible support which can follow the contours of the human body.

A still further object of this invention is to provide a novel multi-electrode structure for cardioscopes, or the like, which decreases the generation of spurious signals to the cardioscope.

These and other objects of this invention will become apparent from the following description when taken in connection with the drawings, in which:

FIGURE 1 is a rear plan view of a first embodiment of the invention wherein three electrodes are contained within a shamrock-shaped flexible container.

FIGURE 2 is a side view of FIGURE 1 partially in cross-section to illustrate the configuration of the cup walls which contain the electrodes.

FIGURE 3 is a front view of the device of FIGURES 1 and 2 and particularly illustrates the cups and the exposed electrode surfaces for the electrodes contained within the cups.

FIGURE 4 is a schematic circuit diagram illustrating the electrical conductors extending from the electrodes through the terminal cable.

FIGURE 5 is a front view of a second embodiment of the invention in which the support structure is triangular in shape.

FIGURE 6 is a front view of the third embodiment of the invention wherein the support is of a rectangular shape.

Referring now to FIGURES 1, 2 and 3, which illustrate the shamrock-shaped embodiment of the invention, a plurality of electrodes **10**, **11** and **12**, which are each suitable for connection to the human body, are contained within respective cups **13**, **14** and **15** which are formed integrally in a common flexible support body having the central connecting web **16**.

A sheath **17** which is integral with the web **16** extends downwardly between the lobes defining cups **13** and **15**, and an electrical cable **18** extends from the end of sheath **17**.

The individual electrodes **10**, **11** and **12** may be of the standard type used in electrocardiograph work. Good results have been obtained through the use of a nickel-

silver disk having a diameter of 1⅝ inches and a thickness of 0.03 inch. It has been found useful to sandblast the outer surfaces of electrodes **10**, **11** and **12**, mainly to prevent their discoloration by the commercially available jellies which are normally used.

Each of electrodes **10**, **11** and **12** then have respective conductors electrically connected thereto, as schematically illustrated in FIGURE 4, as the conductors **20**, **21** and **22**, respectively.

In forming the assemblage, as will be described more fully hereinafter, the conductors **20** through **22** extend below the integrally molded ribs **23**, **24** and **25**, respectively, at the generally flat rear surface of the assemblage, and extend downwardly to the common shielded cable **18**. Note that the cable **18** will be relatively long and could have a length, for example, of 12 feet, and is terminated by a standard multi-terminal connector that will be connectable to any standard cardioscope.

Each of the cups **13**, **14** and **15** have a wall shape best shown in FIGURE 2 at the upper portion thereof for the wall **14***a* of cup **14**. Note that the electrode **11** is captured within a shoulder formed at the interior beginning of wall **14***a*. Each of electrodes **10**, **11** and **12** are captured within their respective cups **13**, **14** and **15** in the same manner.

In forming the novel structure of the invention, the electrodes **10**, **11** and **12** are connected to their respective conductors **20**, **21** and **22** which terminate the preformed cable **18** and are stripped at the ends thereof to permit the desired electrical connection. Thereafter, the electrodes are placed within a plastic mold into which the flexible material is poured to form the shape shown in FIGURES 1, 2 and 3 after setting.

In particular, any typical well-known flexible material could be used in the molding operation.

As a typical example of the dimensions which could be used with the present invention, in the device of FIGURES 1, 2 and 3, the lobes are separated from one another by approximately 105°. The overall thickness or height of the cup was ½ inch, while the thickness of the central web **16** was ⅛ inch. The electrodes **11**, **12** and **13** extended approximately 5/32 of an inch into the walls of their cups, thereby obtaining good securement, and the cup walls extended approximately ⅛ of an inch beyond the ends of the electrodes. The length of sheath **17** from the center of web **16** was approximately 2¾ inches, and the distance from the center of the web to the outer periphery of cups **13**, **14** and **15** was also approximately 2¾ inches.

Thus, the entire molded arrangement could lie within a circle having a radius of 2¾ inches. The ribs **23**, **24** and **25** extended approximately ⅛ of an inch beyond the flat surface of the rear of the support at the center of web **16** and taper downwardly as they approach the outer periphery of their respective cups. Each of the cups then had a diameter of approximately 1⅞ inches at their outer periphery.

Clearly, any suitable method of manufacture or of embedding electrodes within a common flexible support could be used within the scope of the present invention.

While the shamrock-shape of FIGURES 1 through 4 has been found to give particularly good results, especially when using a thin, central web **16** to provide the required flexibility, it will be apparent that other shapes could also be used, and that other numbers of electrodes could be carried in the common support.

By way of example, FIGURE 5 illustrates that the electrodes **10**, **11** and **12** can be formed within cups **40**, **41** and **42** which are integral with a triangular base **43** having an integral output sheath **44**. In a similar manner, a rectangular support could be used, as shown in FIGURE 6, wherein the electrodes **10**, **11** and **12** are contained within jelly-receiving cups **50**, **51** and **52** carried on the rectangular web **53** having the output sheath **54**. Clearly, any other number of shapes such as oval shapes, diamond shapes, or the like, which would permit sufficient flexure of the individual cups to conform to the contours of the body would be suitable for use with the present invention.

Although this invention has been described with respect to its preferred embodiments, it should be understood that many variations and modifications will now be obvious to those skilled in the art, and it is preferred, therefore, that the scope of the invention be limited not by the specific disclosure herein, but only by the appended claims.

The embodiments of the invention in which an exclusive privilege or property is claimed are defined as follows:

1. A multiple electrode structure comprising a generally flat flexible base structure, a plurality of flat electrodes secured to the same surface of said flat flexible base structure, said plurality of flat electrodes spaced from one another and coplanar with said flexible base structure, a plurality of lead wires each respectively connected to a respective electrodes of said plurality of electrodes, and a common sheath containing extending portions of said plurality of lead wires, said base structure comprising a thin central connecting web having a plurality of lobes extending therefrom; each of said electrodes secured to a respective lob of said plurality of lobes.

2. The device substantially as set forth in claim **1** wherein each of said plurality of flat electrodes is surrounded by flexible cup-shaped walls extending from said surface of said base structure.

3. The device substantially as set forth in claim **2** wherein said plurality of electrodes extend into the bottom of their said surrounding walls.

4. The device substantially as set forth in claim **3** wherein said walls, base and common sheath are integral with one another.

5. The device substantially as set forth in claim **4** wherein said common sheath etxends from said central connecting web between two adjacent lobes.

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