United States Patent

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[54] **CABLE**
9 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** ..... **128/2.06 R,** 128/DIG. 4
[51] **Int. Cl.** **A61b 5/04**
[50] **Field of Search** ..... 128/2.06 A, 2.06 B, 2.06 E, 2.06 G, 2.06 R, 2.06 V, 2.1 E, 404, DIG. 4

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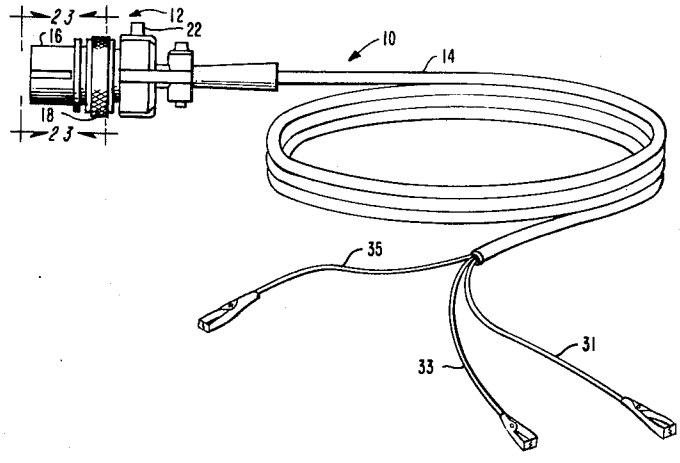
ABSTRACT: The three-lead exercise cable is characterized by a connector portion having five pins mounted therein for attachment to a standard socket in an electrocardiogram machine. A housing is connected to the connector portion, and the pins in the connector portion extend into the housing. Inside the housing, three of the pins are wired together. One wire for the three-wire cable extends from the three wired pins for connection to the body of the patient. Similarly, two other wires extend from the two remaining pins for connection to the body of the patient to form a three-lead exercise cable, which is compatible with a standard electrocardiogram machine. To eliminate muscle noise or electromagnetic interferences, filtering devices may be mounted in the housing.



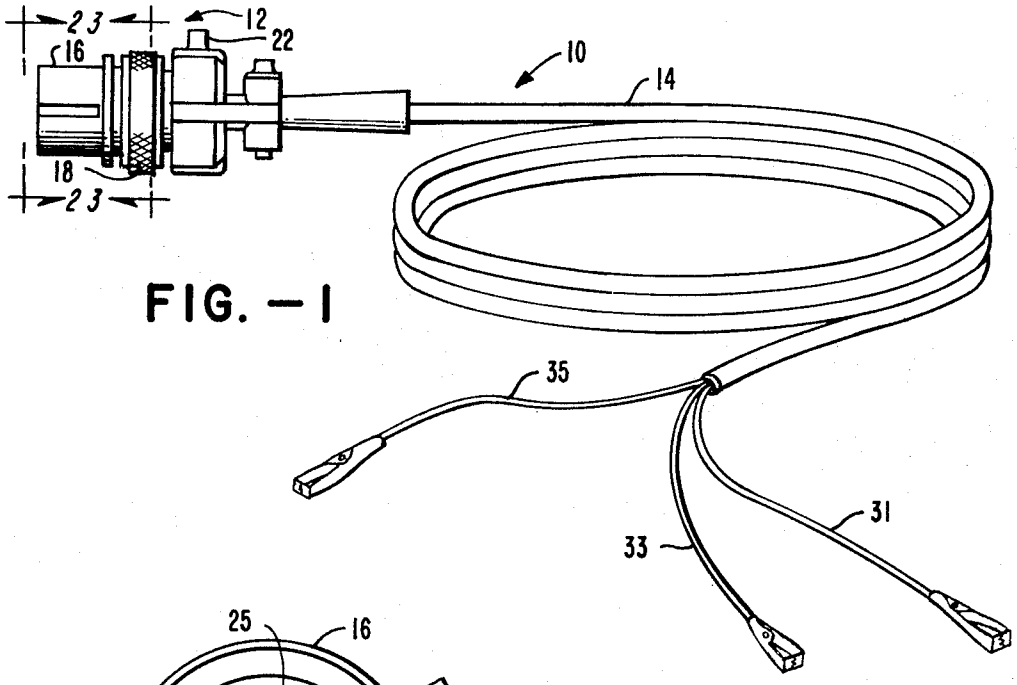


FIG. — 1

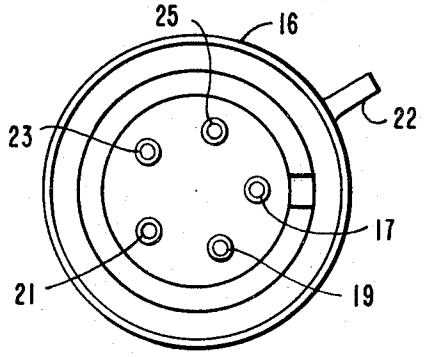


FIG. — 2

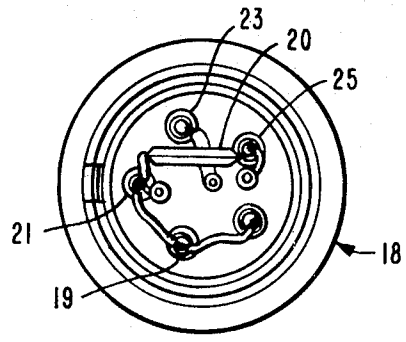


FIG. — 3

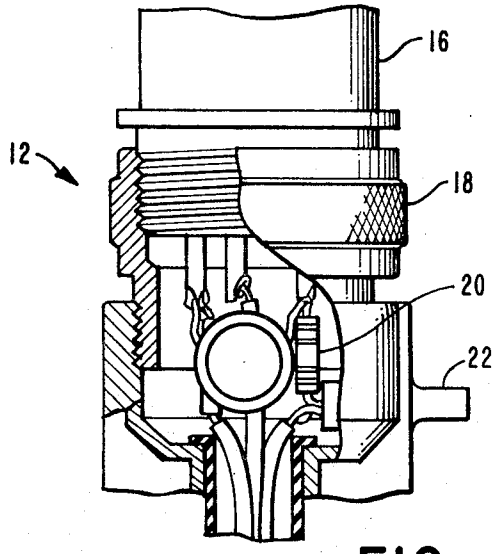


FIG. — 4

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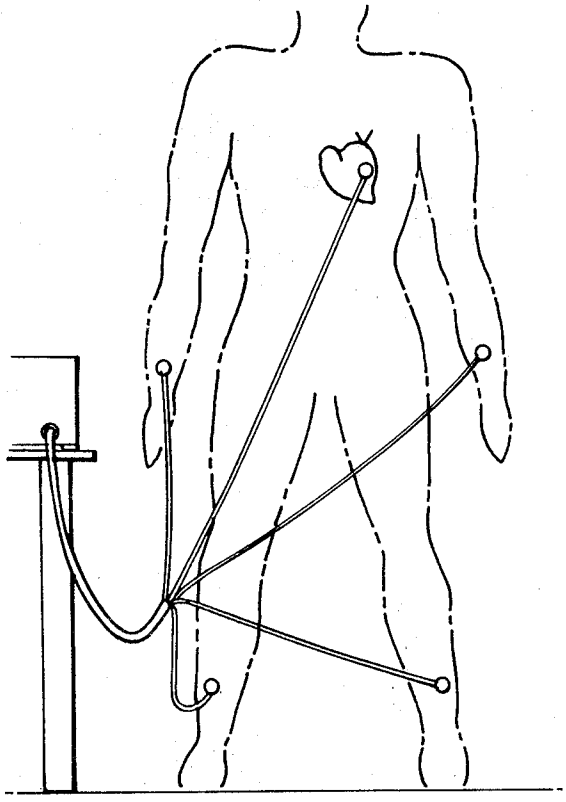

FIG.—5

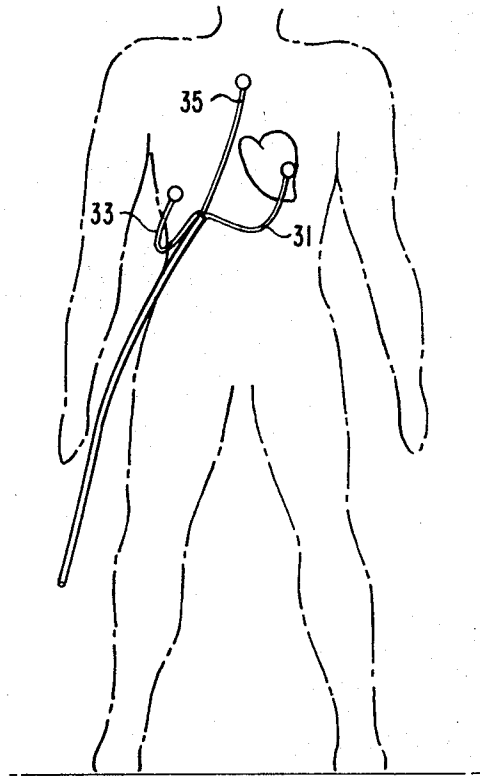

FIG.—6

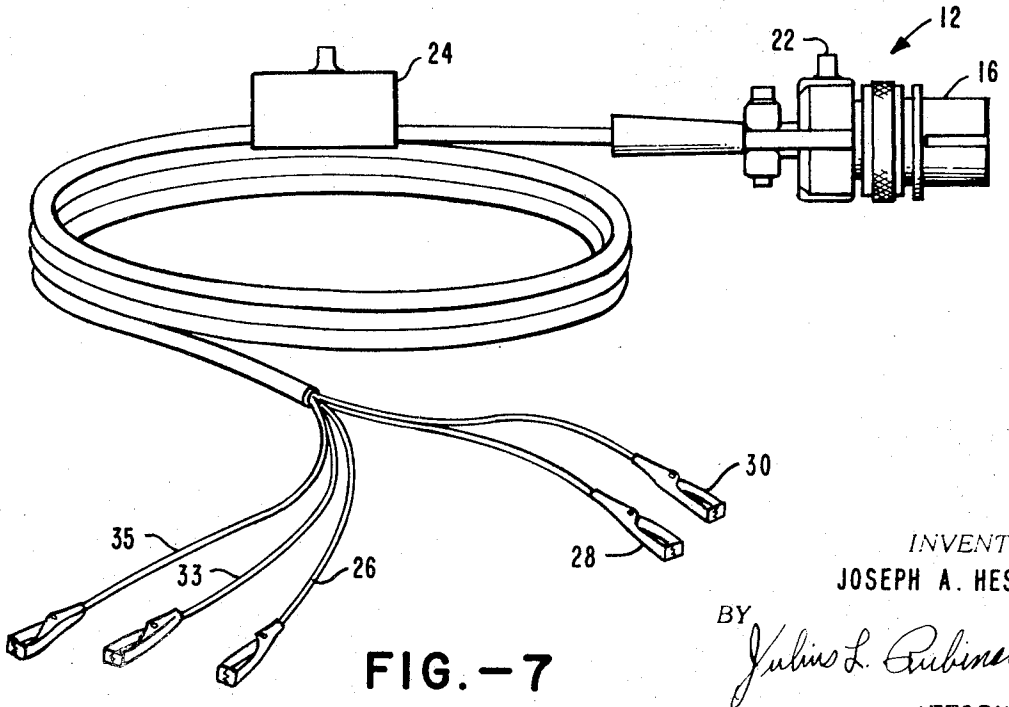

FIG.—7

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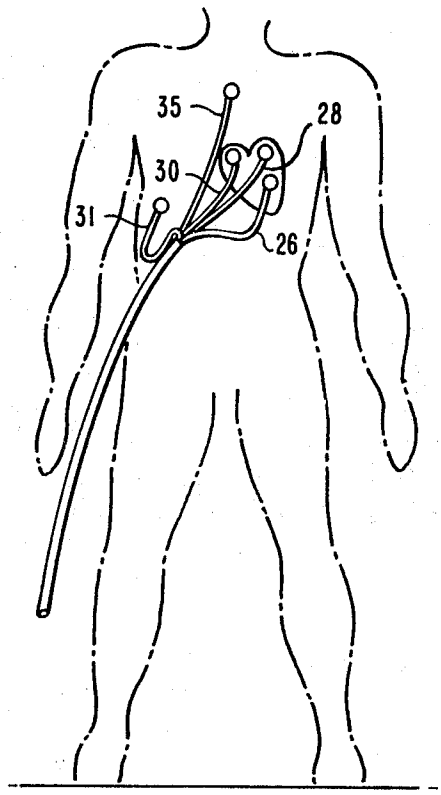

FIG.-8

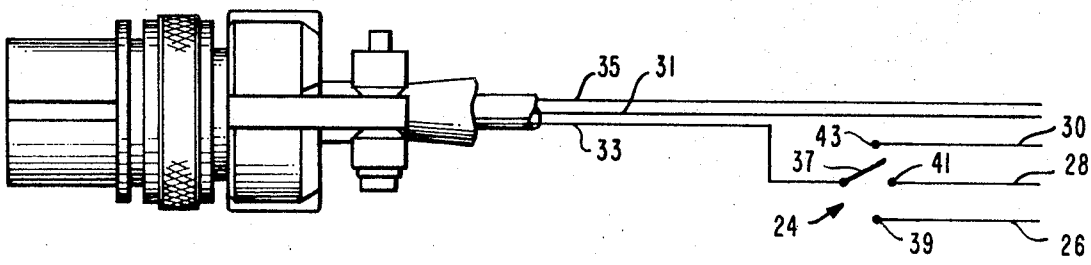

FIG.-9

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CABLE

This invention relates generally to a cable, and more particularly to an exercise cable for an electrocardiogram machine.

BRIEF SUMMARY

The use of electrocardiogram machines in the diagnosis of heart disease has developed slowly and empirically, as physicians have, over the years, observed and recorded a large number of abnormal records in connection with the clinical features of the patients who gave them. The electrocardiogram machine is based on the phenomenon that if two wires are electrically connected, to two areas of the skin, and these wires are connected to a galvanometer, the instrument will record a current if the skin areas are near the heart, or if the heart is located between the skin areas. Any pair of areas from which current is lead off to the instrument is called a lead or derivation. However, every different lead produces a different variable current from the heart. Consequently, in order for the records from the electrocardiogram machine, more commonly referred to as a ECG machine, to have some meaning, it is necessary that the lead used in measuring heart activity be standardized.

More recently, the importance of leads obtained from the precordium have been noted, because the potential variations from such leads are substantially greater than leads obtained at the extremities. As a result, ECG machines have been designed for use with a standard five-lead cable, and the leads of these cables have been applied to the patient at standardized locations. Usually one lead is placed on the precordium, while the remaining four leads are placed on the arms and legs.

The behavior of the heart under the stress of exercise, as recorded by the ECG machine provides a more useful clinical tool, because the exercise response of the ECG machine correlates roughly with the functional capacity of the heart. However, the use of the standard five-lead cable imposes limitations on the emperical interpretation of the record of the ECG response, because the leads attached to the arms and legs of the patient interfere with the exercise of the patient and they introduce noise into the machine.

To overcome this problem, the unipolar or precordial lead has been developed, which employs only three leads connected to the chest of the patient. However, the standard five-lead cable is not well adapted for use with the unipolar lead because a switching device must be built into the ECG machine to adapt the ECG machine for the unipolar lead. With this arrangement, the long length of cables extending from outside the ECG machine to its interior can pick up an electrical interference and carry them into the machine, so that these signals appear as noise and interfere with the interpretation of the record of the machine. Consequently, it would be desirable to provide a unipolar cable which can be used with a standard ECG machine, but which does not tend to introduce noise into the machine, and to provide such a cable, constitutes one object of this invention.

Another difficulty connected with the use of ECG machines is that of noise produced by muscle activity. Such noise can interfere with the interpretation of the record of the ECG machine. Since noise produced by muscle activity is different from the frequency of the heart signals, it is most practical to eliminate such noise by an appropriate filter system built into the cable, and to provide such a filtering system constitutes another object of this invention.

Additionally, the conductivity of regions over the pericordium may vary substantially on the same patient. This could introduce errors in the interpretation of the ECG record. Consequently, physicians may wish to record multiple v-lead tracings over the heart area without having to wait around until each recording is finished, or trust a nurse to connect the v-leads at the precise location desired. Consequently, a multiple v-lead cable is needed which permits all the electrodes to be attached to the body at the same time and to be distributed over the pericordium as required, but which can record each of the v-leads in sequence, and to provide such a multiple v-lead exercise cable constitutes a still further object of this invention.

These and other objects of this invention will become more apparent when better understood in the light of the accompanying drawings and specifications wherein,

FIG. 1 shows a plan view of a three-lead exercise cable for an electrocardiogram machine constructed according to the principles of this invention.

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1.

FIG. 3 is a sectional view taken on line 3—3 of FIG. 1.

FIG. 4 is an elevational view partly in section, showing the internal structure of the connector portion and housing of the cable.

FIG. 5 shows a standard five-lead cable connected to a patient.

FIG. 6 shows the three-lead exercise cable constructed according to the principles of this invention, connnected to the chest portion of the patient.

FIG. 7 shows a multiple v-lead exercise cable constructed according to the principles of this invention.

FIG. 8 shows the multiple v-lead cable connected to the body of a patient.

FIG. 9 shows the electrical circuit of the rotary switch in the multiple v-lead exercise cable.

Referring now to FIG. 1 of the drawings, the cable constructed according to the principles of this invention and indicated generally by the reference numeral **10**, includes a connector portion **12**, and a three-lead cable **14**. The connector portion **12** is provided with a standard five-pin connector portion **16** for connection with a socket in a standard ECG machine, see FIG. 2. The connector portion includes pins **17**, **19**, **21**, **23** and **25**. Pin **17** is identified as the left leg pin. Pin **19** is identified as the left arm pin. Pin **21** is identified as the right arm pin. Pin **25** is identified as the v-lead pin, and pin **23** is identified as the right leg pin. These pins extend into the housing portion **18**.

As shown in FIG. 3, pins **17**, **19** and **21** are wired together. Wire **31** of the cable extends from the three-connected pins **17**, **19** and **21** to the body of the patient. This wire is usually located farthest from the heart and is designated as the reference. Two additional wires **33** and **35** of the cable extend from the v-lead pin **25** and the right leg pin **23** to the body of the patient. The electrodes connected to these wires are designated as the recording and ground electrodes respectively. With this arrangement, the three wires in the cable extend from the housing **12** to the patient to provide a single unipolar v-lead exercise cable. These wires are connected to the body as shown in FIG. 6. Furthermore, the three-wire cable described is compatible with standard ECG machines without requiring any internal changes in the ECG machine.

The advantage of the three-lead cable over the conventional five-lead cable can be seen by reference to FIG. 5, wherein the standard five-lead cable for the ECG machine is shown connected as usual to the extremities of the patient and to the precordium during the exercise operation. However, it is apparent that the movement of the patient is impaired and the movement of the extremities introduces noise into the various wire connections.

Tremors or muscle activity by the patient or interferences from other electrical equipment in the area, if troublesome, may be filtered out through the use of a filtering network which may be mounted in the housing portion **18**. In the particular embodiment shown, it has been found that a simple resistor **20** may be connected across pins **25** and **21** in the housing **18** through an externally controlled switch **22** mounted on the housing. Of course, as described above, any other kind of filter could be inserted in place of resistor **20** to satisfy other special requirements.

In the event it is desired to make multiple v-lead recordings without stopping the operation of the ECG machine to change the location of precordium leads, the modified v-lead cable

shown in FIG. 7 can be used. This cable is provided with a rotary switch 24 consisting of a rotary slider 37 and fixed contacts 39, 41 and 43, see FIG. 9. Wires 26, 28 and 30 are connected to fixed contacts 39, 41 and 43, respectively, for connection to the precordium of the body of the patient. Wire 33 leading from the v-pin 25 is connected to the rotary slider 37. If space is available the rotary switch could be mounted on or in the housing portion 18, or in a separate box, as shown in FIG. 7.

With this arrangement, the physician can connect wires 26, 28 and 30 to various parts of the precordium in a v-lead configuration as shown in FIG. 8 and then turn on the ECG machine leaving it to a technician to simply rotate the slider 37 through the various fixed contacts as each v-lead recording is completed. In this way the records of the v-leads on the various parts of the precordium are recorded in sequences to provide in sequence an anterior and posterior view of the electrical activity of the heart.

In this connection, it is noted that the advantages of the multiple v-lead exercise cable could be incorporated in the standard cable show in FIG. 5 if it is desired to take multiple v-lead recordings without stopping the operation of the ECG machine to change the location of the precordium leads. In such an event, cable 33 shown in FIG. 5 would be connected to the slider of the rotary switch 24. With this arrangement, various wires attached to the fixed contacts of the switch would be connected to various portions of the precordium. In this way, the physician could make records of the leads on the various parts of the precordium in sequence to provide the various views of the electrical activity of the heart.

Having described the invention what I claim as new is:

1. An exercise cable for an electrocardiogram machine, comprising: at least three wires adapted to be connected to a patient; a connector portion having five pins attached therein for connection with the socket of a conventional electrocardiogram machine, said pins including a v-lead pin, a left arm pin, a right arm pin, a left leg pin, and a right leg pin; a housing portion connected to said connector portion, said pins in said connector portion extending into said housing portion; the left arm, left leg, and right arm pins in the connector portion being wired together, one wire of the cable being connected to said wired-together pins, another wire of said cable being connected to the v-lead pin, and the remaining wire of said cable being connected to the right leg pin, so as to provide a three-wire unipolar exercise cable compatible with a standard electrocardiogram machine.

2. An exercise cable for an electrocardiogram machine, comprising: at least three wires adapted to be connected to a patient; a connector portion having five pins attached therein for connection with the socket of a conventional electrocardiogram machine, said pins including a v-lead pin, a left arm pin, a right arm pin, a left leg pin, and a right leg pin; a housing portion connected to said connector portion, said pins in said connector portion extending into said housing portion; the left arm, left leg and right arm pins in the connector portion being wired together in the housing portion; means for filtering out muscle noise to provide a more accurate record of heart activity, said means being mounted in the housing portion of the exercise cable; one wire of said cable being connected to said wired-together pins, another wire of said cable being connected to the v-lead pin, and the remaining wire of said cable being connected to the right leg pin, so as to provide a three-wire unipolar exercise cable compatible with a standard electrocardiogram machine, said filtering means being connected between said v-lead pin and the wired-together pins within said housing portion.

3. The exercise cable described in claim 2, wherein said means for filtering out muscle noise is a resistor connected between said v-lead pin and the wired-together pins in the housing portion.

4. An exercise cable for an electrocardiogram machine comprising: at least three wires adapted to be connected to a patient; a connector portion having five pins attached therein for connection with the socket of a conventional electrocardiogram machine, said pins including a v-lead pin, a left arm pin, a right arm pin, a left leg pin, and a right leg pin; a housing portion connected to said connector portion, said pins in said connector portion extending into said housing portion; the left arm, left leg and right arm pins in the connector portion being wired together in the housing portion; an electric switch and an electrical resistor associated with said housing portion, said electric switch controlling the connection of said electrical resistor across said connected pins and said v-lead pin in the housing portion for selectively eliminating muscle noise; one wire of said cable being connected to said connected pins, another wire of said cable being connected to the v-lead pin, and the remaining wire of said cable being connected to the right leg pin, so as to provide a three-wire unipolar exercise cable compatible with a standard electrocardiogram machine.

5. A multiple v-lead exercise cable for an electrocardiogram machine comprising: at least three wires adapted to be connected to a patient; a connector portion having five pins attached therein for connection with the socket of a conventional electrocardiogram machine, said pins including a v-lead pin, a left arm pin, a right arm pin, a left leg pin, and a right leg pin; a housing portion connected to said connector portion; said pins in said connector portion extending into said housing portion; the left arm, left leg and right arm pins in the connector portion being wired together in the housing portion; one wire of the cable being connected to the right leg pin, and another wire of the cable being connected to said wired-together pins; a rotary switch having a slider and a plurality of fixed contacts; a wire connected between said v-lead pin and the slider of said rotary switch; a wire in the cable extending from each fixed contact in said rotary switch so that by rotating the rotary slider of said switch any of the wires connected to said contact may be connected to the v-lead pin in said housing portion, whereby a physician can initially make all the v-lead connections with said wires connected to said fixed contact of said rotary switch on the body of the patient, and then leave a technician to operate the electrocardiogram machine and rotate the slider of said switch to make sequential recordings of v-lead connections around the heart.

6. The multiple v-lead exercise cable described in claim 5 including means for filtering out muscle noise, said means being mounted in the housing portion of the v-lead cable, and being connected between said v-lead pin and the wired-together pins inside the housing portion of the cable.

7. The multiple v-lead exercise cable described in claim 6, wherein said means for filtering out muscle noise comprises a resistor connected between said v-lead pin and the wired-together pins inside the housing of the cable.

8. The multiple v-lead exercise cable described in claim 7 including a control switch mounted on the body of the housing portion, said control switch being connected between said resistor and said v-lead pin in the housing portion for selectively filtering out muscle noise during operation of the electrocardiogram machine.

9. A multiple lead exercise cable for an electrocardiogram machine comprising a connector portion having five pins attached therein for connection with the socket of a conventional electrocardiogram machine, said pins including a v-lead pin for attachment to a wire adapted to lead to the pericardium of a patient, a rotary switch having a slider and a plurality of fixed contacts, a wire connected between said v-lead pin and the slider of said rotary switch, a wire in the cable extending from each fixed contact of said rotary switch so that by rotating the rotary slider of said switch any of the wires connected to said contact may be connected to the v-lead pin in said housing; the free end of each wire connected to a fixed contact in the rotary switch being adapted to be connected to various parts of the pericardium of the patient; three other pins of said connector being connected together, and wires connected from the connected pins and from the remaining pin in the connector portion for attachment to the arms and legs of the patient, whereby a physician can initially make all

the v-lead connections with said wires connected to said fixed contacts of said rotary switch on the body of a patient, and then leave a technician to operate the electrocardiogram machine and rotate the slider of said switch to make sequential recordings of the v-lead connections around the heart.

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