United States Patent [19]

Adams

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[54] **HEART RATE MONITOR**

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[73] Assignee: **Medtronic, Inc.**, Minneapolis, Minn.

[21] Appl. No.: **80,597**

[22] Filed: **Oct. 1, 1979**

Related U.S. Application Data

[63] Continuation of Ser. No. 851,030, Nov. 14, 1977, abandoned, which is a continuation of Ser. No. 714,873, Aug. 16, 1976, abandoned.

[51] **Int. Cl.**[3] **A61N 5/04**

[52] **U.S. Cl.** **128/690;** 128/706

[58] **Field of Search** 128/690, 706, 710, 642, 128/734, 689

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,144,018	8/1964	Head	128/642
3,870,034	5/1975	James	128/734
4,009,708	3/1977	Fay, Jr.	128/690
4,091,610	5/1978	Sasaki et al.	128/690
4,120,294	10/1978	Wolfe	128/710

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Attorney, Agent, or Firm—Carl A. Forest; Lew Schwartz; Joseph F. Breimayer

[57] **ABSTRACT**

A wrist watch size heart rate monitor coupled with a flexible metal expansion band detects a electrocardiac signal on one arm and applies that detected signal to electronic circuitry within the monitor. Means are also included for receiving a second electrocardiac signal from the other arm to obtain an electrocardiac lead I signal. The receiving means may be a contact member adapted to being placed in physical contact with a second flexible metal expansion band around the wrist of the other arm and having a like contact member associated therewith or the receiving means may be metal members adapted to having the thumb and a finger of the hand of the other arm squeezed thereagainst.

4 Claims, 6 Drawing Figures

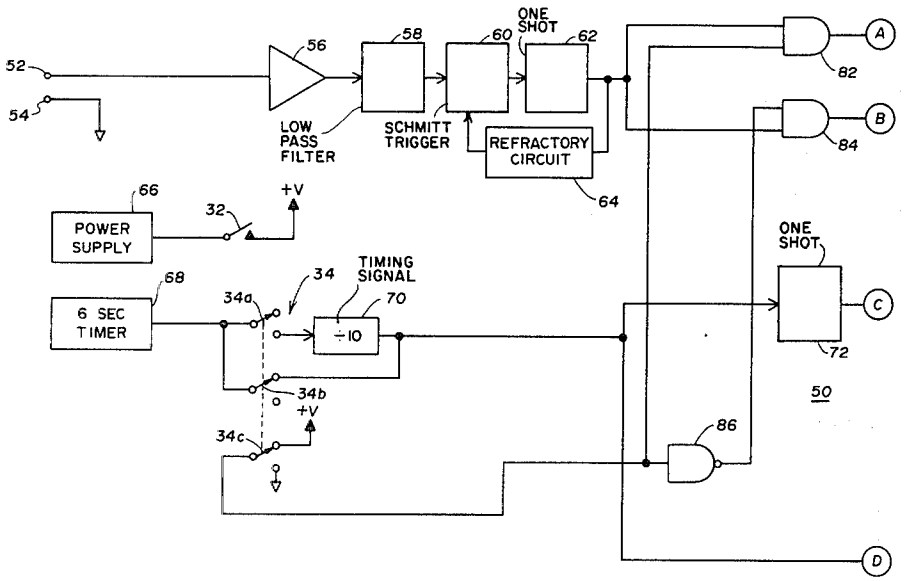
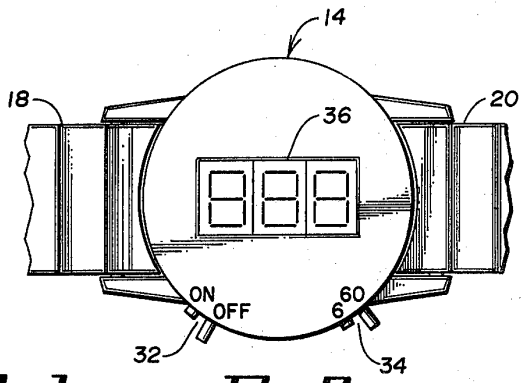


Fig. 2



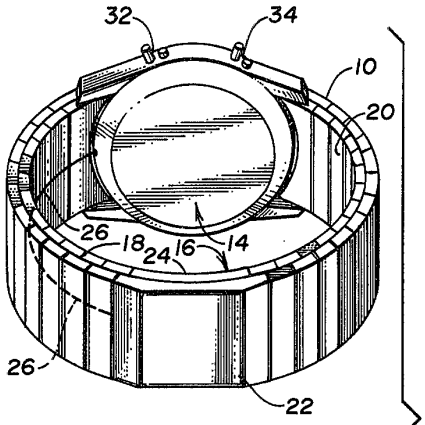


Fig. 1

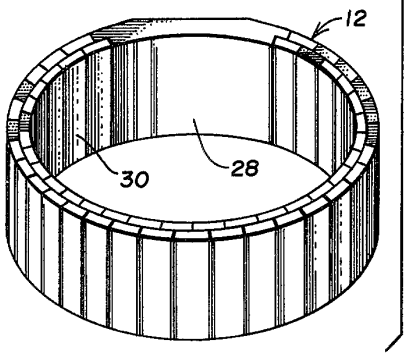


Fig. 3

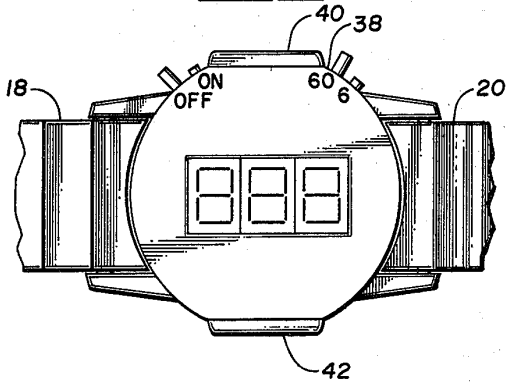


Fig. 4

Fig. 4a	Fig. 4b

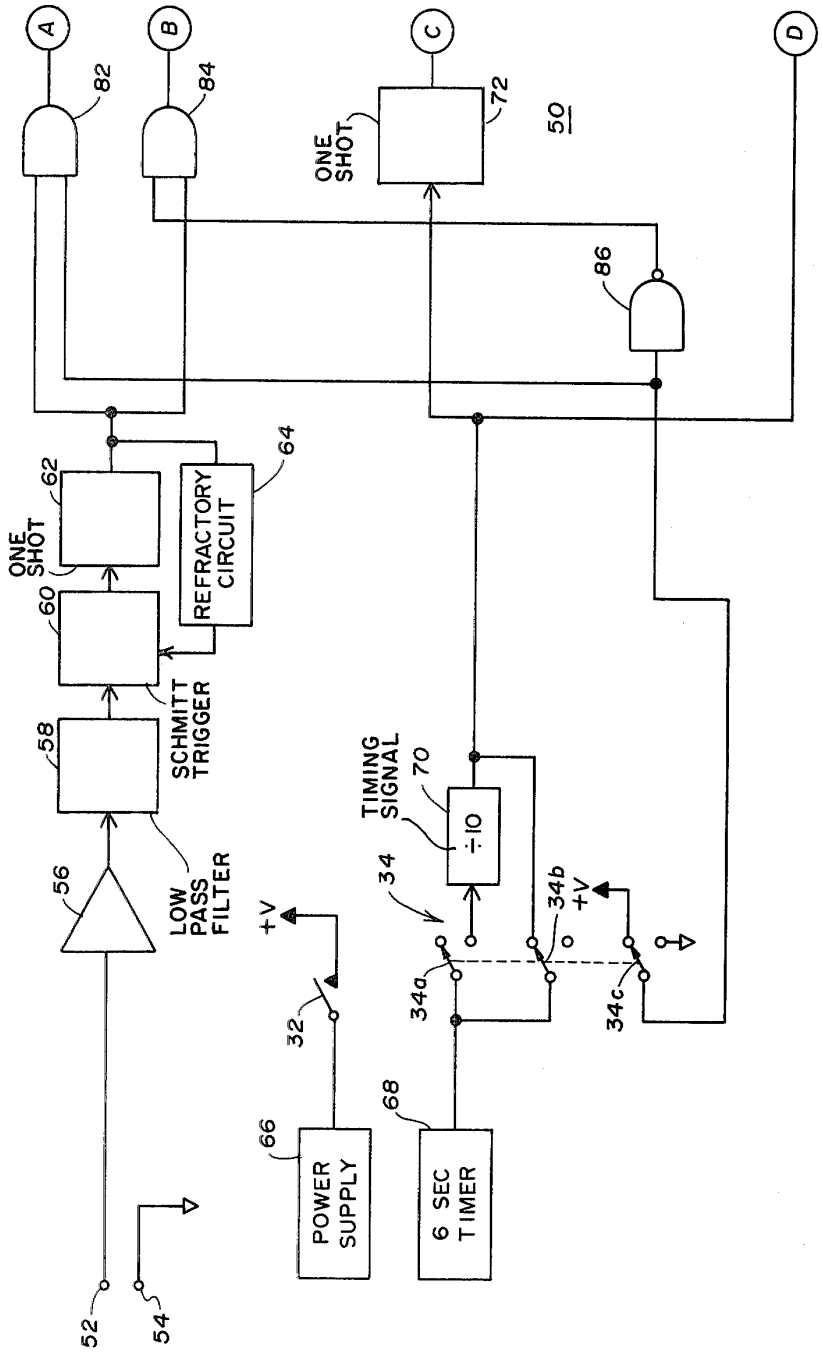


Fig. 4a

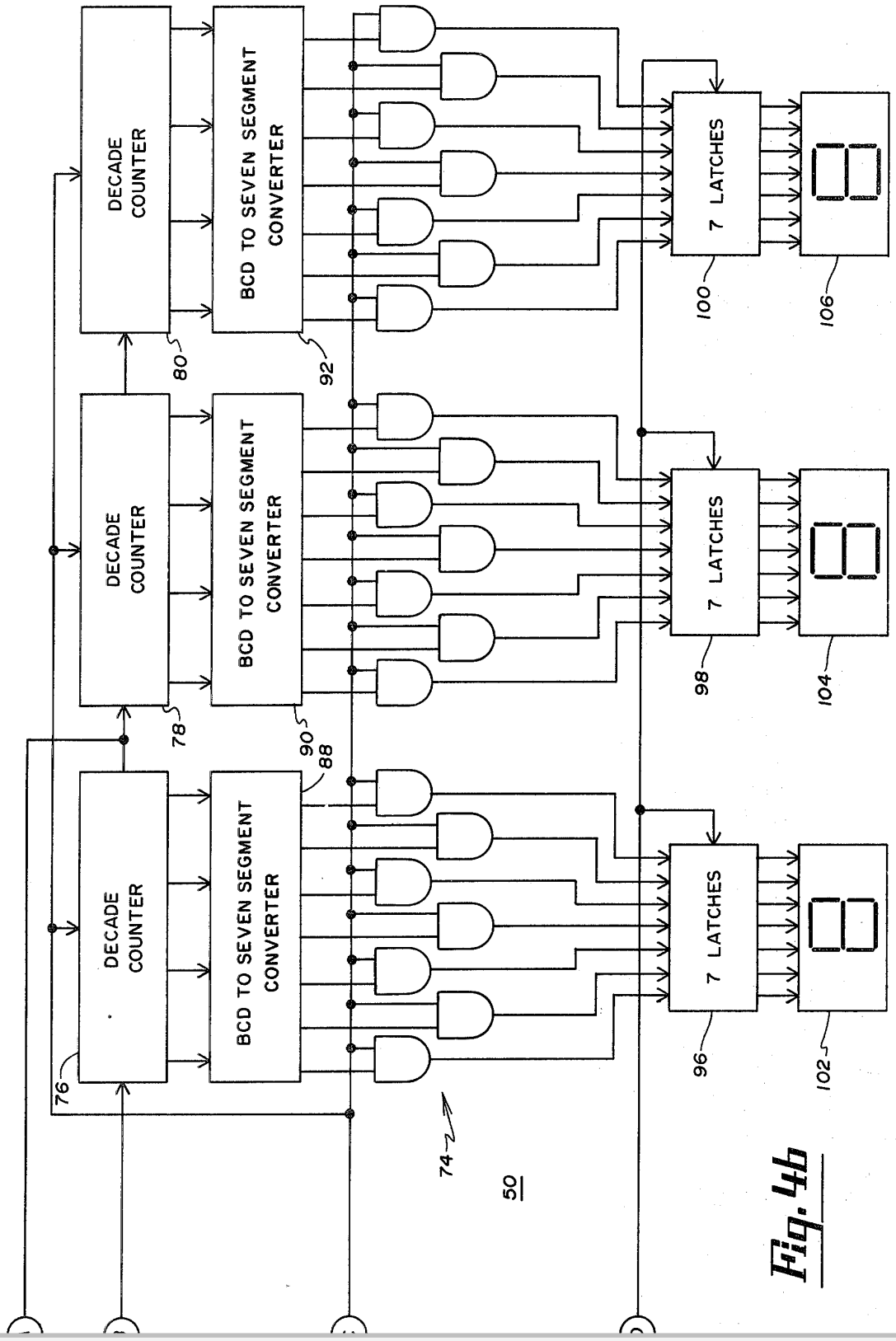


Fig. 4b

HEART RATE MONITOR

This is a continuation of application Ser. No. 851,030 filed Nov. 14, 1977, now abandoned which was itself a continuation of application Ser. No. 714,873 filed Aug. 16, 1976, abandoned.

This invention relates to cardiac monitoring and more particularly to apparatus for detecting and providing cardiac signals to processing circuitry.

In the prior art, many devices exist which are adapted to be used in measuring the heart rate of a subject. The devices vary from sophisticated, computer-controlled apparatus capable of monitoring a plurality of patients simultaneously to small, individual patient units designed to monitor only the heart rate. Of these latter type devices, the majority accomplish the task of measuring the heart rate by measuring the pulse rate and are implemented in the form of a wrist band with pressure sensitive or sound sensitive transducers affixed to the band and positioned on the wrist adjacent to the palm of the hand.

In addition to the pulse monitoring devices, some small individual devices measure the electrocardiac signal which may be detected from the skin of the subject. This has been done by wires running from the device to electrodes affixed by conventional means to the chest area of the subject. In this manner, a conventional electrocardiac signal is detected by the electrodes and applied through the wires to the device. The device may be adapted for use by the subject at several different places of the body. For instance, the device may include a small box-like configuration adapted to be worn on the belt of the subject or the device may be in the form of a wrist band adapted for being worn around the wrist. A problem, however, is that the wires leading from the chest area to the device, wherever it may be placed, are prone to disconnection and breakage as the subject moves, thereby terminating the ability of the device to monitor.

The reason that wires have been utilized in measuring the electrocardiac activity in the past is that it has been thought that it is necessary to continuously monitor the patient. However, in many instances, it is only necessary to take an instantaneous reading of the heart rate. For instance, if a subject has previously suffered a coronary attack and has recovered sufficiently to lead a normal, or near normal, life with the exception that his heart rate should be limited to a certain maximum, it would only be necessary to take a measurement of the heart rate during strenuous activity, such as exercising. In this case, a continual monitoring of the cardiac activity of that subject's heart would be wasteful utilization of the power source (battery) powering the device. Of course the prior art apparatus could be modified by placing a simple switch on the device to render it active only when desired by the subject. However, the problem of wires running from the patient's chest area to the area where the device is located, still remains.

In accordance with one preferred embodiment of this invention, there is provided a cardiac signal detecter including a housing containing circuitry for processing a pair of electric signals, each one of which manifests the electric signal at a different limb of a person, and further including a band member of an electrically conductive material selected to be capable of detecting electric signals on the skin of such person, said band being affixed to said housing and of a size to allow the

housing and band combination to firmly contact one of the limbs. The band is in electric communication with the circuitry to provide the signal at said one limb as one of the pair of signals. In addition, there is provided receiving means mechanically fixed to the housing and band combination and electrically isolated therefrom. The receiving means is in electrical communication with the circuitry and adapted to receive, by contact, an electric signal from the other limb and to provide such received signal to the circuitry as the other one of the pair of signals.

A preferred embodiment of this invention is hereafter described with specific reference being made to the following FIGS., in which:

FIG. **1** shows a pair of wrist band detectors adapted for use with circuitry associated with one of the wrist bands;

FIG. **2** shows the face of the housing containing the circuitry for processing the signals detected by the detectors of FIG. **1**;

FIG. **3** shows an alternate embodiment of the housing containing the circuitry shown in FIG. **1**; and

FIG. **4** shows the orientation of FIGS. **4***a* and **4***b* which in turn show, in block format, a circuit diagram for processing the signals detected by the apparatus shown in FIG. **1** or FIG. **3**.

Referring now to FIG. **1**, a pair of wrist bands **10** and **12** each adapted to be worn on a different wrist of a subject are shown. Wrist band **10** includes the housing **14**, a contact member **16** and a pair of flexible metal expansion members **18** and **20**, connecting housing **14** contact **16**.

Housing **14** contains the electronic circuitry used in processing the pair of signals representing a lead I electrocardiac lead signal. This circuitry will be described in detail hereafter with respect to FIGS. **4***a* and **4***b*, arranged as shown in FIG. **4**. As is wellknown in the art, a lead I electrocardiac signal is derived from the left and right hand wrists of the subject and measures the electrical activity of the heart along a plane running generally parallel to the ground as a patient is in an upright position.

Contact member **16** includes a conductive portion **22** and an insulator portion **24** arranged so that conductive portion **22** is not in electrical communication with expansion members **18** or **20**. A wire **26** or other electrical conducting member connects conductive portion **22** to the circuitry within housing **14**.

Expansion members **18** and **20** may be similar to conventional metal expansion watch bands. However, members **18** and **20** should be of a material capable of detecting electrical signals appearing on the skin when in firm contact with the skin. In addition, members **18** and **20** should be constructed to conduct the detected electric signal to the electric circuitry within housing **14**, with which circuitry members **18** and **20** are in electrical communication. Expansion members **18** and **20** should also be constructed to be adjustable by either deleting or adding links therein so that the entire wrist band **10** can be sized to fit firmly around the wrist of the subject thereby allowing a firm contact between bands **18** and **20** and the skin to achieve good electrical detection of the skin signals. Further, bands **18** and **20** should be of an adequate width to allow sufficient surface area for good contact.

Band **12** is similar to band **10** with the exception that no housing for electrical circuitry is included and no insulator portion, such as portion **24**, is included in

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