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(54) **HEART RATE MONITOR WITH A MULTIPLE EXERCISE PROFILE FEATURE AND METHOD OF USING SAME**

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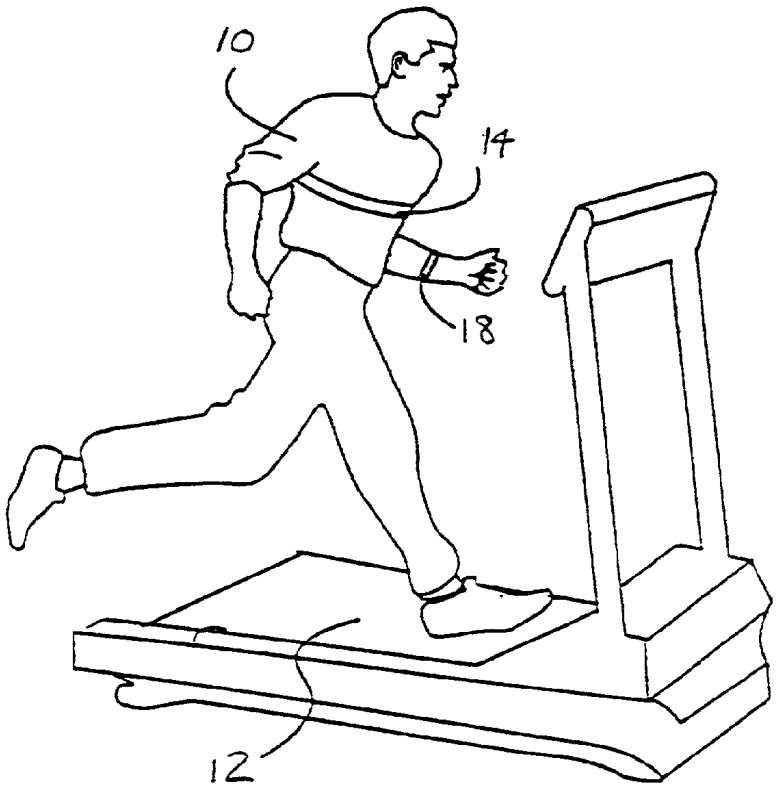
(57) **ABSTRACT**

A heart rate monitor and methods for monitoring a user's heart rate, which enable the monitor to be used under different sets of exercise and physiological parameters or profiles without reprogramming between different profiles. The exercise parameters include an exercise type, a day of the week, a time, a user's name, a level of difficulty, and physiological parameters of the user including height, weight, age, and level of fitness. A sensor detects the user's heartbeat, and an input device enables the user to enter information to be associated with each of a plurality of exercise profiles. A memory device stores the profiles, and an indicating device provides a sensory indication of when the user is outside a target heart rate zone. The profiles may be uploaded from a computer and information obtained during the profiles may be downloaded for additional review, analysis, and processing.



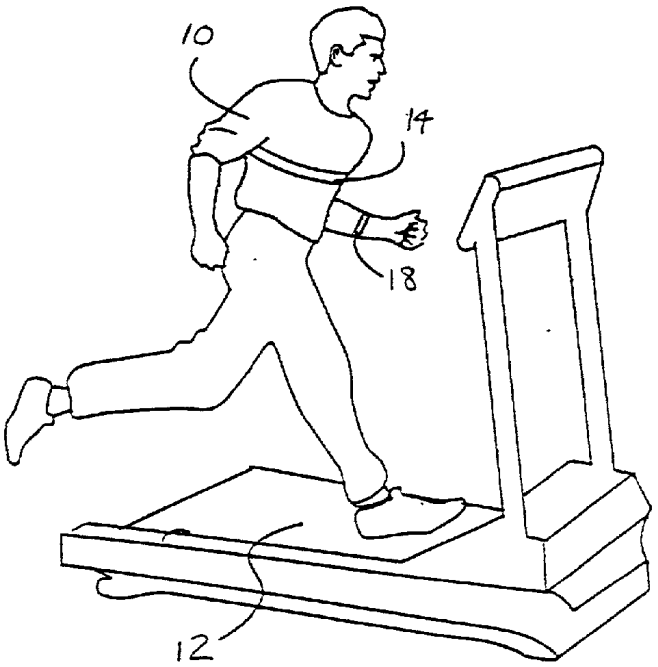


FIG. 1

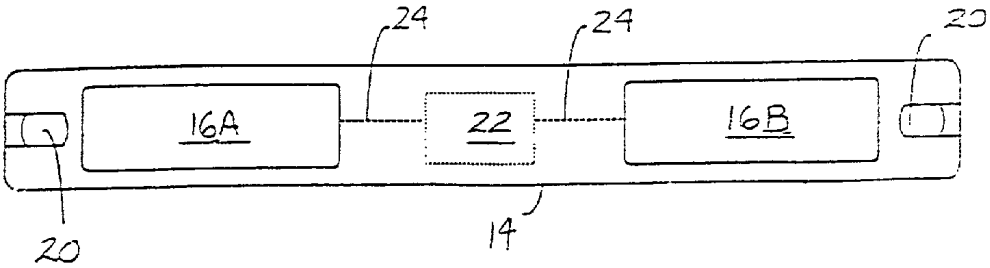


FIG 2

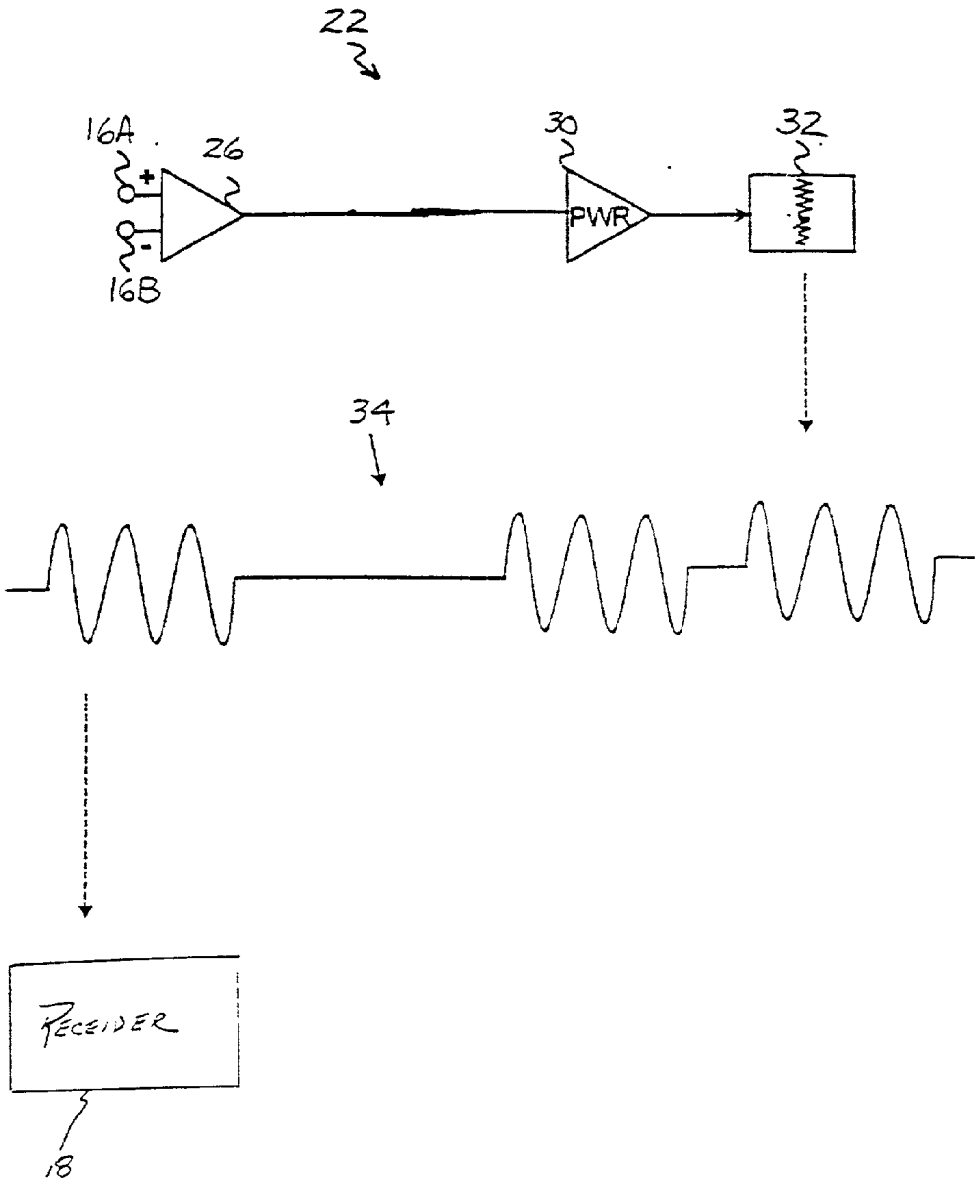


FIG. 3

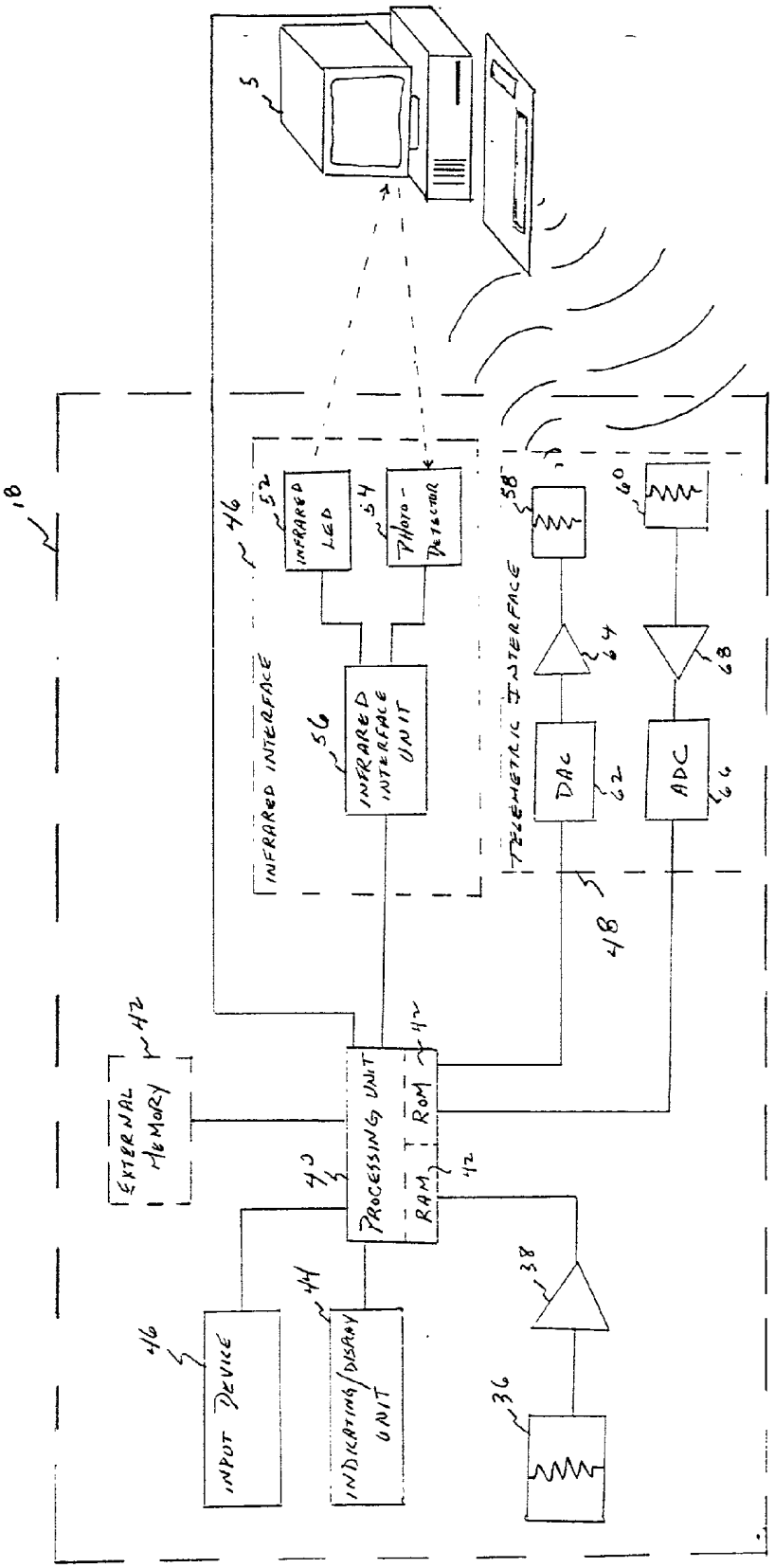

10
5
46
INFRARED INTERFACE
52
INFRARED LED
54
PHOTO-DETECTOR
56
INFRARED INTERFACE UNIT
TELEMETRIC INTERFACE
58
60
64
68
DAC
62
ADC
66
48
EXTERNAL MEMORY
42
PROCESSING UNIT
43
RAM
ROM
47
40
INPUT DEVICE
44
INDICATING/DISPLAY UNIT
38
36

FIG. 4

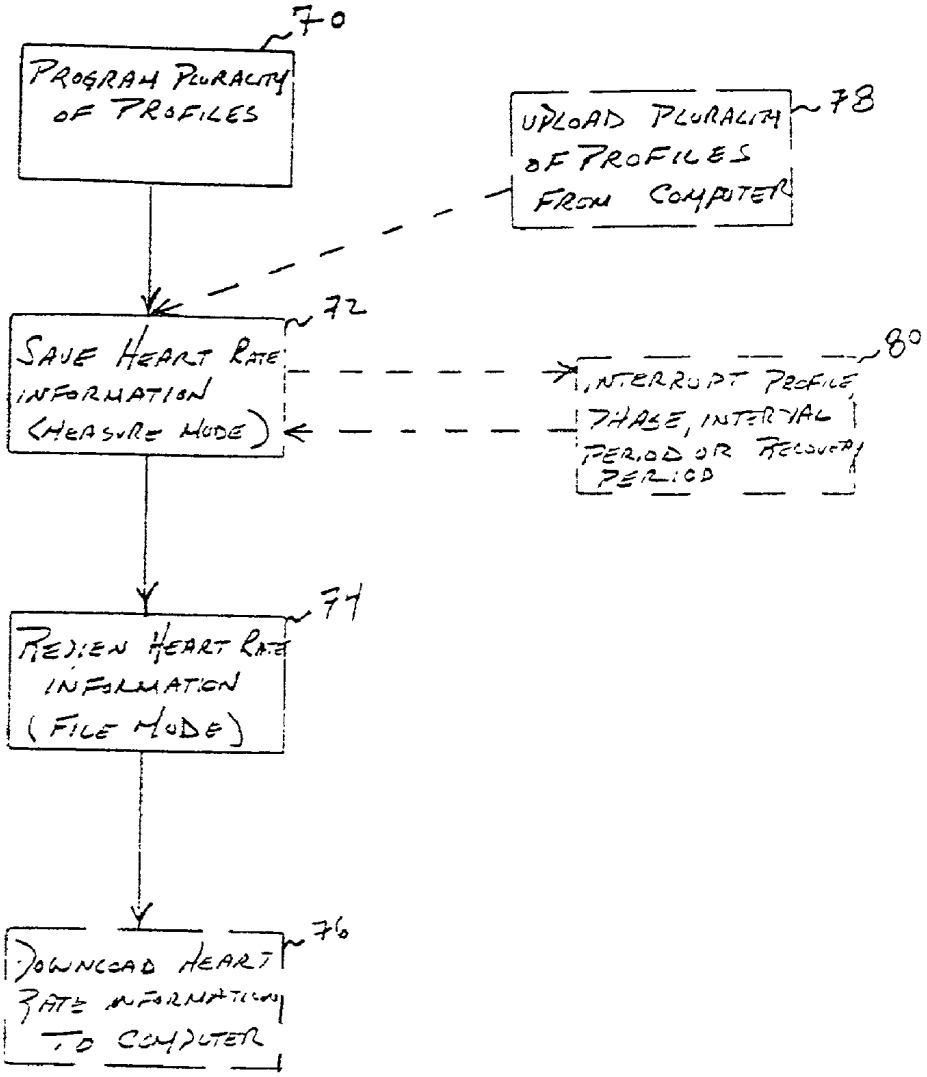

70
PROGRAM PLURALITY OF PROFILES
78
UPLOAD PLURALITY OF PROFILES FROM COMPUTER
72
SAVE HEART RATE INFORMATION (MEASURE MODE)
80
INTERRUPT PROFILE, PHASE, INTERVAL PERIOD OR RECOVERY PERIOD
74
READ HEART RATE INFORMATION (FILE MODE)
76
DOWNLOAD HEART RATE INFORMATION TO COMPUTER

FIG. 5

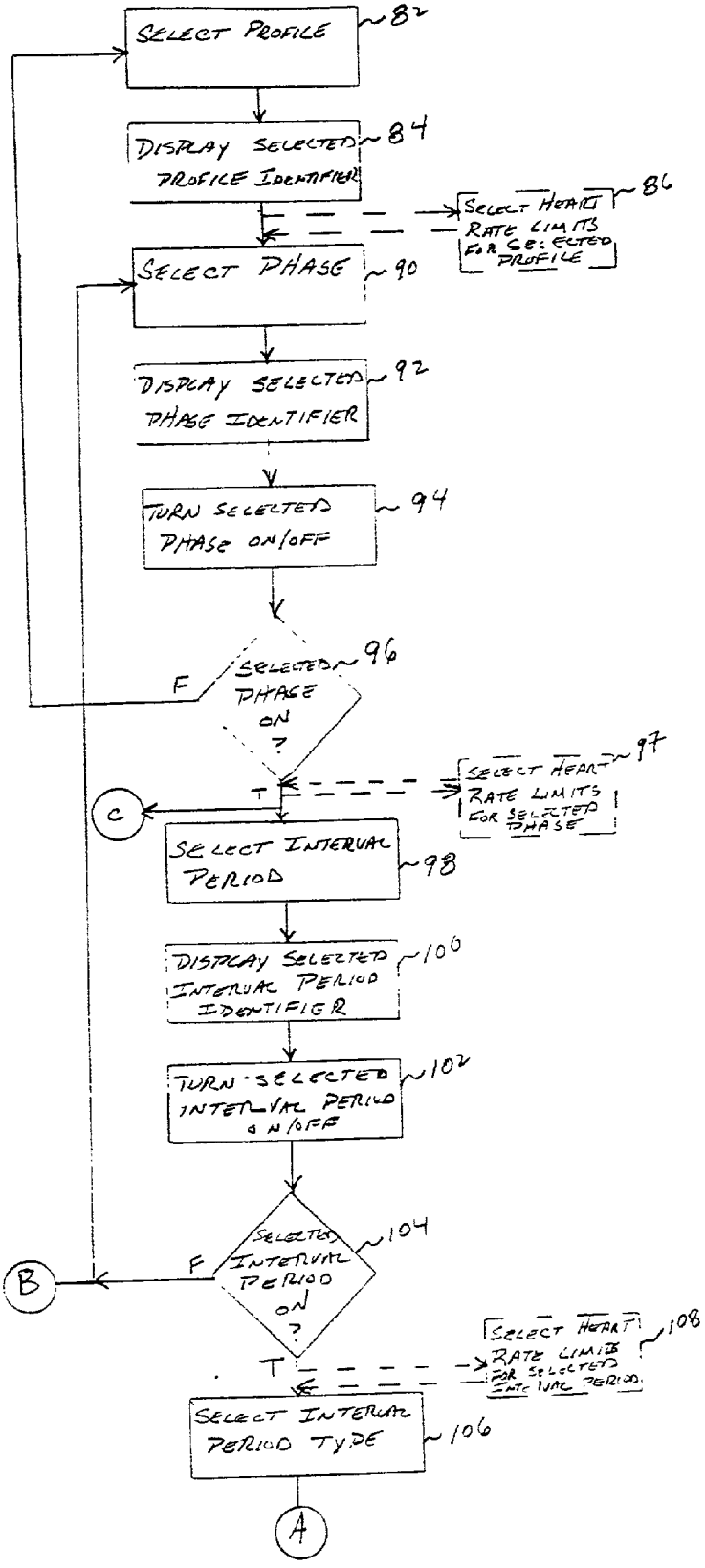

SELECT PROFILE
82
DISPLAY SELECTED PROFILE IDENTIFIER
84
SELECT HEART RATE LIMITS FOR SELECTED PROFILE
86
SELECT PHASE
90
DISPLAY SELECTED PHASE IDENTIFIER
92
TURN SELECTED PHASE ON/OFF
94
SELECTED PHASE ON ?
96
F
T
SELECT HEART RATE LIMITS FOR SELECTED PHASE
97
C
SELECT INTERVAL PERIOD
98
DISPLAY SELECTED INTERVAL PERIOD IDENTIFIER
100
TURN SELECTED INTERVAL PERIOD ON/OFF
102
SELECTED INTERVAL PERIOD ON ?
104
F
B
T
SELECT HEART RATE LIMITS FOR SELECTED INTERVAL PERIOD
108
SELECT INTERVAL PERIOD TYPE
106
A

FIG 6A

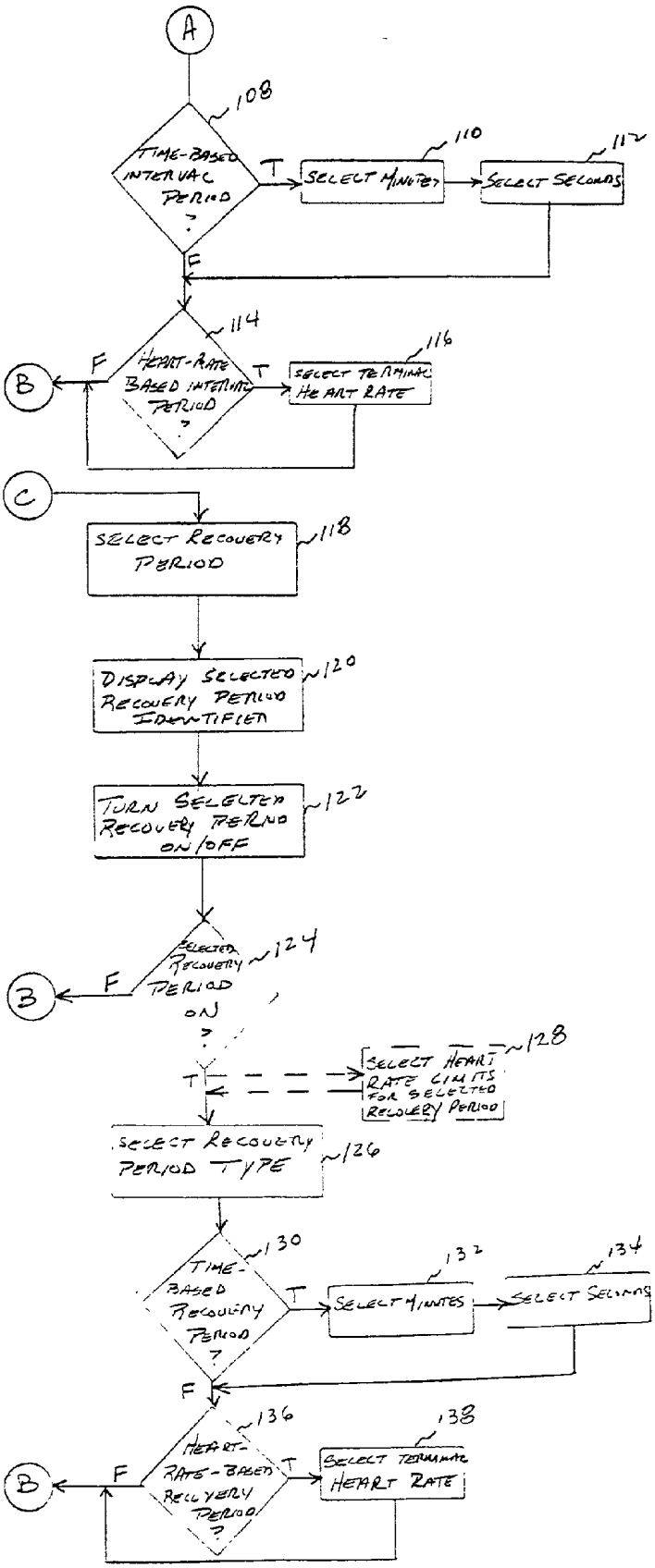

A
108
TIME-BASED INTERVAL PERIOD ?
T
110
SELECT MINUTES
112
SELECT SECONDS
F
114
HEART-RATE BASED INTERVAL PERIOD ?
F
B
T
116
SELECT TERMINATE HEART RATE
C
SELECT RECOVERY PERIOD
118
DISPLAY SELECTED RECOVERY PERIOD IDENTIFIER
120
TURN SELECTED RECOVERY PERIOD ON/OFF
122
SELECTED RECOVERY PERIOD ON ?
124
F
B
T
128
SELECT HEART RATE LIMITS FOR SELECTED RECOVERY PERIOD
SELECT RECOVERY PERIOD TYPE
126
TIME-BASED RECOVERY PERIOD ?
130
T
132
SELECT MINUTES
134
SELECT SECONDS
F
HEART-RATE-BASED RECOVERY PERIOD ?
136
F
B
T
138
SELECT TERMINATE HEART RATE

FIG 6B

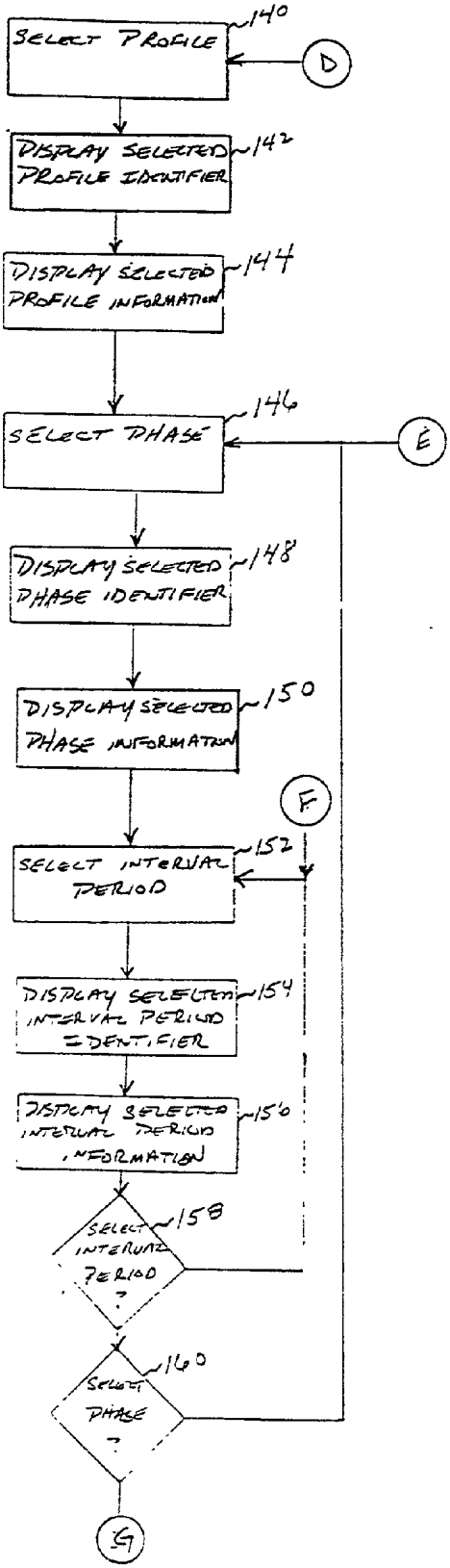

SELECT PROFILE
140
D
DISPLAY SELECTED PROFILE IDENTIFIER
142
DISPLAY SELECTED PROFILE INFORMATION
144
SELECT PHASE
146
E
DISPLAY SELECTED PHASE IDENTIFIER
148
DISPLAY SELECTED PHASE INFORMATION
150
F
SELECT INTERVAL PERIOD
152
DISPLAY SELECTED INTERVAL PERIOD IDENTIFIER
154
DISPLAY SELECTED INTERVAL PERIOD INFORMATION
156
SELECT INTERVAL PERIOD ?
158
SELECT PHASE ?
160
G

FIG. 7A

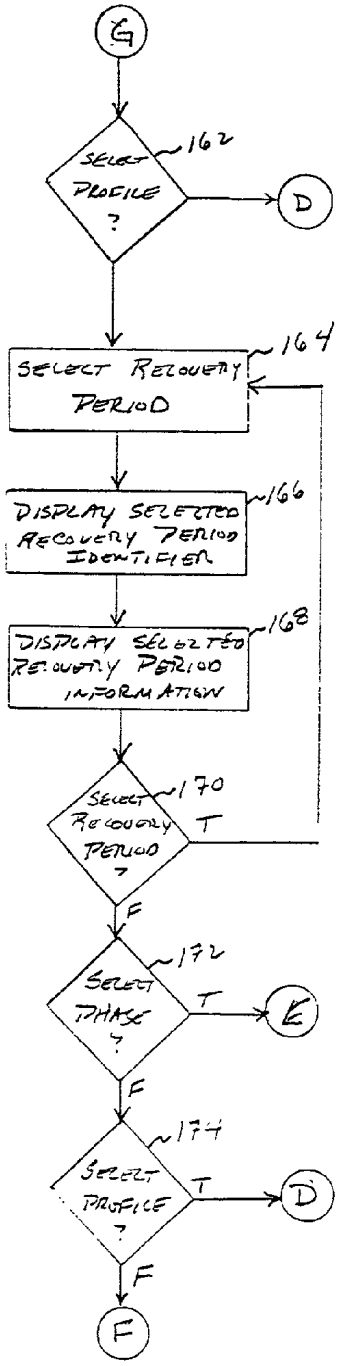

G
SELECT PROFILE ?
162
D
SELECT RECOVERY PERIOD
164
DISPLAY SELECTED RECOVERY PERIOD IDENTIFIER
166
DISPLAY SELECTED RECOVERY PERIOD INFORMATION
168
SELECT RECOVERY PERIOD ?
170
T
F
SELECT PHASE ?
172
T
E
F
SELECT PROFILE ?
174
T
D
F
F

FIG. 7B

HEART RATE MONITOR WITH A MULTIPLE EXERCISE PROFILE FEATURE AND METHOD OF USING SAME

FIELD OF THE INVENTION

[0001] The present invention relates generally to a heart rate monitor and more particularly to an ambulatory heart rate monitor having multiple exercise profiles that may be selected in response to different exercise and/or physiological parameters.

BACKGROUND OF THE INVENTION

[0002] A user's heart rate during exercise is measured with a heart rate monitor (HRM) in terms of the number of heartbeats that occur during a unit of time e.g., beats per minute. The HRM typically includes a chest unit that detects an electrical signal generated by the heart and displays the measured heart rate on a display unit. The display unit can additionally display indicators, such as predetermined heart rate limits or target zones.

[0003] Conventional ambulatory HRMs provide a single profile to guide a user during an exercise routine having a single set of parameters. For instance, if the user is running, the HRM can be programmed to indicate when the user's heart rate exceeds predetermined upper and lower limits during a jogging routine. These limits can also be programmed to be different at different times during the profile, such as lower during warm-up and cool-down portions and higher during an intermediate portion of the profile. These portions may be further subdivided into laps, sprints, and the like, which substantially complicates the process of programming the HRM.

[0004] Entry of information associated with the profile is further complicated if the user performs different types of exercise routines requiring substantially different profiles, such as weightlifting, cycling, rowing, spinning, and the like. Programming of the HRM is even more complex if the user wants use and retain profiles having different intensities for the same activity under different circumstances, such as the day of the week and various physiological parameters. In either of these instances, the user is forced to reprogram the HRM with a different profile.

[0005] Such a task is both time-consuming and impractical, particularly for users who alternate activities on a daily basis. The need to reprogram the HRM each day following an exercise routine for that particular day typically discourages the majority of users from performing each of their exercise routines with the HRM. This significantly limits the effectiveness of the HRM as a tool for maintaining the user's level of fitness.

OBJECTS AND SUMMARY OF THE INVENTION

[0006] It is an object of the present invention to provide an ambulatory heart rate monitor having multiple exercise profiles that may be used to monitor a user's heart rate or to guide a user in his/her training during different exercise routines and activities.

[0007] It is a further object of the present invention to provide a heart rate monitor, which avoids the necessity of reprogramming a heart rate monitor with different exercise profiles each time the user performs a different activity or exercise routine.

[0008] It is still a further object of the present invention to provide a heart rate monitor that is capable of inputting a plurality of pre-programmed exercise profiles.

[0009] It is another object of the present invention to provide a heart rate monitor, which is simpler to program and requires less time to initialize prior to its use.

[0010] It is still another object of the present invention to provide a heart rate monitor that is able to support multiple exercise profiles tailored to the physiological parameters and activities of a particular user.

[0011] It is an object of the present invention to provide a heart rate monitor that is able to record heart rate information of a user during multiple exercise routines for downloading, processing, and analysis by a computer.

[0012] It is another object of the present invention to provide a heart rate monitor that is able to upload preprogrammed exercise profiles from a computer and download heart rate information collected during a user's exercise routine to the computer for further review, processing, and analysis via a bidirectional wired or wireless link, such as an infrared and/or telemetric link.

[0013] These links make it possible to upload a preprogrammed plurality of exercise profiles from the computer **50** to the receiver **18** and upload It is an object of the present invention to provide an ambulatory method of monitoring a user's heart rate, which supports multiple exercise profiles that may be used during different exercise routines and activities.

[0014] It is a further object of the present invention to provide a method of monitoring a user's heart rate, which avoids the necessity of reprogramming a heart rate monitor with different exercise profiles each time the user performs a different activity or exercise routine.

[0015] It is still a further object of the present invention to provide a method for monitoring a user's heart rate that is capable of inputting a plurality of preprogrammed exercise profiles.

[0016] It is another object of the present invention to provide a method for monitoring a user's heart rate, which substantially simplifies the process of programming a heart rate monitor and reduces the amount of time required by the user to initialize the monitor prior to its use.

[0017] It is still another object of the present invention to provide a method for monitoring a user's heart rate that is able to support multiple exercise profiles tailored to the physiological parameters and activities of a particular user.

[0018] It is an object of the present invention to provide a method for monitoring a user's heart rate that is capable of recording heart rate information during multiple exercise routines for downloading, processing, and analysis by a computer.

[0019] The present invention provides an apparatus for monitoring a user's heart rate, which includes a sensor, an input device, memory, an indicating device, and a processing device. The sensor detects the user's heart rate, and an

exercise profile program is stored in memory. The program enables one of a plurality of exercise profiles, which are also stored in memory, to be selected and information to be associated therewith. The processing device is responsive to the sensor, input device, and a selected profile stored in memory. The indicating device is responsive to the processing device and the processing device stores and/or recalls information associated with each selected profile. The exercise parameter may include an exercise type, a day of the week, a time, a user's name, a level of difficulty, and a physiological parameter, such as height, weight, age, and level of fitness.

[0020] The present invention also provides a method of programming a heart rate monitor including the steps of selecting one of a plurality of profiles stored in memory, entering an upper heart rate limit and a lower heart rate limit to be associated with the selected profile stored in memory, and repeating these steps for at least one more of the profiles stored in memory.

[0021] The present invention further provides a method of monitoring a heart rate including the steps of selecting one of a plurality of profiles stored in memory, detecting the heart rate, comparing the detected heart rate to at least one of an upper heart rate limit and a lower heart rate limit associated with the selected profile, indicating whether the detected heart rate is at least one of greater than the upper heart rate limit and less than the lower heart rate limit associated with the selected profile, and repeating these steps for at least one more of the profiles stored in memory.

[0022] A preferred embodiment of a heart rate monitor and corresponding methods of use, as well as other features and advantages of this invention, will be apparent from the following detailed description, which is to be read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] **FIG. 1** shows a person using a heart rate monitor formed in accordance with the present invention.

[0024] **FIG. 2** is a top view of an electrode belt of the heart rate monitor shown in **FIG. 1**.

[0025] **FIG. 3** is a block diagram of the components of the heart rate monitor formed in accordance with the present invention.

[0026] **FIG. 4** is a block diagram of the receiver in the heart rate monitor shown in **FIG. 3**.

[0027] **FIG. 5** is a flowchart showing the top-level functions of the heart rate monitor formed in accordance with the present invention.

[0028] **FIGS. 6A and 6B** is a flowchart showing the top-level function of programming multiple profiles, as first shown in **FIG. 5**.

[0029] **FIGS. 7A and 7B** is a flowchart showing the top-level function of reviewing heart rate information, as first shown in **FIG. 5**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0030] The heart rate monitor formed in accordance with the present invention is a completely ambulatory device that enables an individual to exercise while being guided by a plurality of exercise profiles, at home, at a health club, or anywhere else. The heart rate monitor includes a sensor, which is preferably located on the user's chest, which detects the user's heartbeat from an electrical signal generated by the heart.

[0031] The monitor also displays a heart rate, which is calculated from the number of heartbeats that occur during a given interval of time. Such heart rate monitors are intended to include chest units that are wired to a display, chest units that wirelessly transmit heart rate data to a receiver and a display in a wrist unit, and heart rate monitors that operate solely on the wrist without a chest transmitter.

[0032] **FIG. 1** shows a user **10** running on a treadmill **12**. The heartbeat of the user **10** is detected by a transmitter electrode belt **14**, which is preferably arranged on the user's chest. The heartbeat is detected with two or more electrodes **16**A and **16**B provided on the transmitter electrode belt **14**. An electrical potential is generated between the electrodes in response to the beats. The transmitter electrode belt **14** is attached around the user's body with, for instance, a band made of an elastic material. A signal representing the detected heartbeat is transmitted preferably inductively to a receiver **18** on the wrist, which preferably also includes a display for indicating the heart rate, such as beats per minute.

[0033] As described above, the heart rate monitor may also be a wrist device, in which the transmitter and receiver are integrated in one device. The heartbeat may be detected by the wrist unit from either an electrocardiogram (ECG) signal, which is derived from two electrodes (e.g., a wrist electrode in contact with one of the user's arms and a finger electrode in contact with another of the user's arms), from an arterial pressure pulse, or by observing optically detectable changes in blood flow.

[0034] The electrode belt **14** is shown in greater detail in **FIG. 2**, which shows the electrode belt **14** from the side of the electrodes **16**A and **16**B, i.e. from the side facing the body of the user. **FIG. 2** also shows fasteners **20** that attach the electrode belt **14** to the elastic band, which is strapped around the body. A dotted line in **FIG. 2** represents an electronics unit **22** for processing the heart rate information received from the electrodes **16**A and **16**B. The electrodes **16**A and **16**B are electrically connected to the electronics unit **22** by conductive lines **24**.

[0035] **FIG. 3** is a block diagram of the preferred embodiments of the electronics unit **22** on the transmitter electrode belt **14** and a receiver **18**, which is preferably worn on the user's wrist. The electronics unit **22** is shown at the top of the figure, a sample of heartbeat information to be transmitted is shown in the middle of the figure, and a block representing the receiver unit **18** is shown at the bottom of the figure. The electronics unit **22** receives the heartbeat information from the electrodes **16**A and **16**B. Alternatively, heart rate information may be processed in the electronics unit **22** of the transmitter **14** and transmitted as a heart rate value to the receiver **18**.

[0036] From the electrodes, a heart rate signal is supplied to an amplifier **26** from which the signal is outputted to a power amplifier **30** and then to a transmitter **32**. The transmitter **32** is preferably implemented as a coil, which

inductively transmits heartbeat information **34** to the receiver, such as the receiver unit **18** to be arranged on the user's wrist or to, for instance, an external computer.

[**0037**] The heartbeat information **34** may be transmitted inductively, optically, through a wired conductor, or alternative means well known in the art. In one embodiment shown in **FIG. 4**, the receiver **18**, such as the receiver to be worn on the wrist, includes a receiver coil **36** from which the received signal is outputted to a processing unit **40**, such as a microcontroller or microprocessor, via a signal receiver or amplifier **38**. The processing unit **40** controls and coordinates the operation of the different elements of the receiver **18**.

[**0038**] The receiver **18** includes a memory device **42**, which may be internal or external to the processing unit **40**, for storing heartbeat information. The receiver **18** also includes an indicating device and display **44** for displaying the heart rate and other variables and visually and/or audibly indicating when the user is outside a target heart rate zone.

[**0039**] The receiver **18** includes an input device **46**, such as one or more selectable buttons, a keypad, an electronic notepad, or a speech control means. The input device **46** is used to activate the monitor and to initiate different functional modes of the monitor. The input device **46** of the present invention further enables the user to electronically enter or program information to be associated with a plurality of exercise profiles, such as heart rate limits and the duration of specified portions of the exercise profile, such as phases, interval periods, and recovery periods. The input device further preferably allows the user to electronically enter one or more exercise parameters (such as the day of the week, time, fitness level, exercise intensity, and the like) or physiological parameters unique to the user (such as weight, height, age, sex, self-reported exercise frequency, and the like).

[**0040**] A phase refers to a specific portion of the duration of an exercise profile selected from the plurality of exercise profiles. A plurality of interval periods and recovery periods preferably exist during each phase. The interval period refers to the duration of time during which the user is substantially exercising and the recovery period refers to the duration of time during which the user is substantially at rest.

[**0041**] The receiver **18** further includes the processing unit **40**, which performs a multiple exercise profile program. The method used by the program will be described in detail with reference to FIGS. **5-7** below. In the preferred embodiment, the program is implemented in software using a general-purpose microprocessor or microcontroller. However, the method may also be implemented in an application specific integrated circuit (ASIC), by discrete logic components, or by employing alternative means well known in the art.

[**0042**] An infrared interface **46** and a telemetric interface **48** preferably provide bi-directional communication links between the receiver **18** and a computer, such as a personal computer. The telemetric interface **48** may include an inductive interface and/or an audio interface. These links make it possible to upload a pre-programmed plurality of exercise profiles from the computer **50** to the receiver **18** and download heart rate information collected during the user's exercise routines to the computer **50** for further review, processing, and analysis.

[**0043**] The infrared interface **46** preferably includes an infrared light emitting diode (LED) **52**, which translates an electrical signal into pulses of infrared light and transmits these pulses from the receiver **18** to the computer **50**. The infrared interface **46** also preferably includes a photo-detector **54**, which receives infrared light pulses from the computer **50** and translates these pulses into an electrical signal. An infrared interface unit **56** is coupled to the infrared LED **52** and photo-detector **54** and performs the electrical translations necessary to interface these components **52**, **54** with the processing unit **40**.

[**0044**] The telemetric interface **48** preferably includes a coil **58**, which translates an electrical signal into a magnetic signal and transmits the magnetic signal from the receiver **18** to the computer **50**. The telemetric interface **48** may also include a coil **60**, which receives a magnetic signal from the computer **50** and translates the magnetic signal into an electrical signal. A digital-to-analog converter **62** and an amplifier **64** translate the digital signal from the processing unit **40** to an analog signal suitable for the coil **58**. An analog-to-digital converter **66** and an amplifier **68** translate the analog signal provided by the coil **60** to a digital signal suitable for the processing unit **40**. Such wireless and telemetric data transmission techniques have been described in U.S. Pat. Nos. 6,229,454; 5,690,119; and U.S. application Ser. No. 09/716,630, which are incorporated herein by reference.

[**0045**] **FIG. 5** is a flowchart showing the top-level functions of the heart rate monitor formed in accordance with the present invention. The plurality of exercise profiles are programmed manually in step **70**. While the user is exercising and the heart rate monitor is in a measure mode, heart rate information is stored in the heart rate monitor in step **72**.

[**0046**] It must be noted that the subject invention is able to guide the user in maintaining his heart rate within a target zone while performing a plurality of exercise routines. The heart rate monitor formed in accordance with the present invention accomplishes this by being able to store, revise, and manipulate a plurality of exercise profiles. Each of the exercise profiles may be tailored to a particular set of exercise or physiological parameters, thereby eliminating the need for the user to reprogram the heart rate monitor with a different exercise profile when switching between routines.

[**0047**] The user may optionally review the heart rate information while in file mode in step **74**, and may optionally download the heart rate information to a computer for further processing and analysis in step **76**. As discussed above, the user may upload a pre-programmed plurality of profiles from a computer in step **78** rather than manually programming the plurality of profiles in step **70**. The user may also interrupt a currently running profile, phase, interval period, or recovery period while in the measure mode in step **80**.

[**0048**] Step **70** in **FIG. 5** is shown in greater detail in **FIGS. 6A and 6B**, which detail the function of manually programming the plurality of profiles. Each of the plurality of exercise profiles is selected in step **82** and the selected profile identifier is preferably displayed in step **84**. The profile identifier may be modified by the user or retained as a numerical identifier. Heart rate limits or a target heart rate zone may be selected by the user for the selected profile in step **86**.

[0049] A phase in the selected profile is then selected in step **90**, and the selected phase identifier is displayed in step **92**. Like the profile identifier, the phase identifier may optionally be modified by the user or retained as a numerical identifier. The user may then choose to turn the selected phase on or off in step **94**. As described above with respect to the profile, the user may set heart rate limits or a target heart rate zone for the selected phase in step **97**. If the user chooses to turn the selected phase off, the user may then select the same or another profile by returning to step **82** via step **96**.

[0050] If the selected phase is determined to be turned on in step **96**, the user will then select an interval period within the selected phase in step **98**, and the selected interval period identifier will be displayed in step **100**. As described above, the user may modify the interval period identifier or choose to retain a numerical identification of the selected interval period. The user can then choose to turn the selected interval on or off in step **102**, and if it is determined that the selected interval period is on in step **104**, the type of interval period may be selected in step **106**. As with the selected profile and selected phase, the user may select heart rate limits or a target heart rate zone for the selected interval period in step **108**. If the user has chosen to turn the selected interval off in step **102**, the user may then select the same or another phase in step **90** via step **104**.

[0051] The interval period types include manual, time-rate-based, and heart-rate-based. The manual interval period terminates in response to the user selecting a button on the heart rate monitor. The time-rate-based interval period terminates after a specified duration of time, and the heart-rate-based interval period terminates when a specified terminal heart rate has been achieved.

[0052] If the user selects a time-based interval period in step **108** of **FIG. 6**B, the user will then select the minutes in step **110** and the seconds in step **112**, which determine the duration of the selected interval period. If the user selects a heart-rate-based interval period in step **114**, the user will select a terminal heart rate in step **116**, which will terminate the selected interval period. The method then proceeds to step **90** to select the same or another phase.

[0053] Following the determination that the selected phase is turned on in step **96** of **FIG. 6**A, the user may select a recovery period within the selected profile and phase in step **118** of **FIG. 6B**. The selected recovery period identifier is then displayed in step **120**, and the user may choose to turn the selected recovery period on or off in step **122**. As with the profile, phase, and interval period, the recovery period identifier may be modified by the user or retained as a numerical identifier. If the selected recovery period has been determined to be on in step **124**, the user will select the recovery period type in step **126**. The user may select heart rate limits or a target heart rate zone for the selected recovery period as a means of implementing a biofeedback approach to induce relaxation between interval periods in step **128**.

[0054] The recovery period may be time-based or heart-rate-based. The time-based recovery period terminates following a selected time period and the heart-rate-based recovery period terminates in response to a terminal heart rate being achieved. If the user selects a time-based recovery period in step **130**, the user will then select the minutes in step **132** and the seconds in step **134** after which the selected recovery period will terminate. If the user selects a heart-rate-based recovery period in step **136**, the user will then select a terminal heart rate in step **138**. The method will then return to select the same or another phase in step **90**.

[0055] **FIGS. 7A and 7B** are a flowchart showing details of the function of reviewing heart rate information stored during a plurality of exercise profiles as shown in step **74** in **FIG. 5**. The user selects each of the plurality of profiles in step **140**, and the selected profile identifier is displayed in step **142**. The selected profile information, such as the start time, duration, target heart rate zone, average heart rate, maximum heart rate, and minimum heart rate is displayed in step **144**. The user then selects the phase within the selected profile in step **146**, and the phase identifier is displayed in step **148**. Information concerning the selected phase, such as the start time, duration, target heart rate zone, average heart rate, maximum heart rate, and minimum heart rate is displayed in step **150**.

[0056] The interval period in the selected phase and selected profile is then selected in step **152**, and the selected interval period identifier is displayed in step **154**. Information concerning the selected interval period, such as the start time, duration, target heart rate zone, average heart rate, maximum heart rate, and minimum heart rate is displayed in step **156**. If the user would like to select the same or another interval period in step **158**, the method returns to step **152**, and if the user would like to select the same or another phase in step **160**, the method returns to step **146**. If the user would like to select the same or another profile in step **162** of **FIG. 7**B, the algorithm returns to step **140**.

[0057] If none of these conditions are true, the algorithm continues with selecting a recovery period within the selected phase and selected profile in step **164**. The recovery period identifier is displayed in step **166**. Information concerning the selected recovery period is displayed in step **168**, such as the start time, duration, target heart rate zone, average heart rate, maximum heart rate, minimum heart rate, drop in heart rate, and the time to attain the pre-set heart rate limit in heart-rate-based recovery periods.

[0058] If the user would like to select the same or another recovery period in step **170**, the method returns to step **164**, and if the user would like to select the same or another phase in step **172** the method returns to step **146**. Finally, if the user would like to select the same or another profile in step **174**, the method returns to step **140**, and if none of the above are true, the method returns to select another interval period in step **152**.

[0059] The invention thus provides an ambulatory heart monitor and method having multiple exercise profiles that may be used to monitor the user's heart rate during different exercise routines and activities without the necessity of reprogramming the monitor with different exercise profiles each time the user performs a different activity or exercise routine. The subject invention further provides a heart rate monitor and method that are capable of inputting a plurality of pre-programmed exercise profiles, which substantially simplify the process of programming the monitor and reduce the amount of time required by the user to initialize the monitor prior to its use.

[0060] In addition, the subject invention provides a heart monitor and method that are able to record the heart rate

information of a user during multiple exercise routines for subsequent, downloading, processing, and analysis by a computer and is able to perform bidirectional communication with a computer via wired and wireless means, such as infrared and telemetric links.

[0061] Although the illustrative embodiments of the present invention have been described herein with reference to the accompanying drawings, it is to be understood that the invention is not limited to those precise embodiments and that various other changes and modifications may be effected therein by one skilled in the art without departing from the scope or spirit of the invention.

What is claimed is:

1. A heart rate monitor for monitoring a user's heart rate comprising:

at least one sensor for detecting the user's heart rate;

at least one input device;

a memory device having an exercise profile program stored therein, the exercise profile program enabling the selection of one of a plurality of profiles stored in the memory device, the exercise profile program enabling the storage of information to be associated with each selected profile, each of the plurality of profiles being associated with at least one exercise parameter;

at least one indicating device; and

a processing device, the processing device being responsive to the at least one sensor, the at least one input device, and a selected profile stored in the memory device, the at least one indicating device being responsive to the processing device, the processing device performing at least one of storing and recalling the information associated with each selected profile.

2. The heart rate monitor as defined by claim 1, wherein the at least one exercise parameter includes at least one of an exercise type, a day of the week, a time, a user's name, a level of difficulty, and a physiological parameter.

3. The heart rate monitor as defined by claim 2, wherein the physiological parameter includes at least one of height, weight, age, and level of fitness.

4. The heart rate monitor as defined by claim 1, wherein at least one of the plurality of profiles includes a plurality of phases, the duration of each of the plurality of phases being at least a portion of the duration of at least one of the plurality of profiles.

5. A heart rate monitor as defined by claim 4, wherein at least one of the plurality of phases includes at least one of an upper heart rate limit and a lower heart rate limit associated therewith, the indicating device indicating whether the detected heart rate is at least one of greater than the upper heart rate limit and less than the lower heart rate limit associated with the at least one of the plurality of profiles.

6. The heart rate monitor as defined by claim 4, wherein at least one of the plurality of phases includes at least one of an interval period and a recovery period, the interval period and the recovery period being representative of at least a portion of at least one of the plurality of phases, the interval period being associated with a period of time during which the user is substantially exercising, the recovery period being associated with a period of time during which the user is substantially at rest.

7. A heart rate monitor as defined by claim 6, wherein at least one of the interval period and the recovery period includes at least one of an upper heart rate limit and a lower heart rate limit associated therewith, the indicating device indicating whether the detected heart rate is at least one of greater than the upper heart rate limit and less than the lower heart rate limit associated with the at least one of the interval period and the recovery period.

8. The heart rate monitor as defined by claim 6, wherein information input by the user associates the interval period with at least one of a maximum duration and a terminal heart rate, the interval period terminating in response to attaining at least one of the maximum duration and the terminal heart rate

9. The heart rate monitor as defined by claim 6, wherein information input by the user associates the recovery period with at least one of a maximum duration and a terminal heart rate, the recovery period terminating in response to attaining at least one of the maximum duration and the terminal heart rate.

10. The heart rate monitor as defined by claim 1, wherein the at least one indicating device indicates at least one of the user's heart rate, programmable limits for the user's heart rate, and a duration of at least a portion of the selected profile.

11. The heart rate monitor as defined by claim 1, further comprising an infrared interface, the infrared interface providing an infrared communication link between the heart rate monitor and a computer.

12. The heart rate monitor as defined by claim 11, wherein the infrared interface includes an amplifier and an infrared light emitting diode.

13. The heart rate monitor as defined by claim 1, further comprising a telemetric interface, the telemetric interface providing a telemetric communication link between the heart rate monitor and a computer, the telemetric communication link including at least one of an inductive link and an audio link.

14. The heart rate monitor as defined by claim 13, wherein the telemetric interface includes an analog-to-digital converter, an amplifier, and a coil.

15. The heart rate monitor as defined by claim 1, wherein the information to be associated with each selected profile is input as a preprogrammed plurality of profiles.

16. The heart rate monitor as defined by claim 15, wherein the preprogrammed plurality of profiles is uploaded from a computer.

17. The heart rate monitor as defined by claim 15, wherein the preprogrammed plurality of profiles is output from an exercise profile application program, the exercise profile application program inputting at least one of an exercise parameter and a physiological parameter.

18. A method of programming a heart rate monitor comprising the steps of:

selecting one of a plurality of profiles stored in memory, each of the plurality of profiles being associated with at least one exercise parameter;

entering at least one of an upper heart rate limit and a lower heart rate limit to be associated with the selected profile and stored in memory; and

repeating the above steps for at least one more of the profiles stored in memory.

19. A method of programming a heart rate monitor as defined by claim 18, further comprising the step of storing into memory a unique profile identifier to be associated with each selected profile, the profile identifier being representative of at least one of an exercise type, a day of the week, a time, a user's name, a level of difficulty, and a physiological parameter.

20. A method of programming a heart rate monitor as defined by claim 19, wherein the physiological parameter includes at least one of height, weight, age, and level of fitness.

21. A method of programming a heart rate monitor as defined by claim 19, further comprising the step of displaying the profile identifier.

22. A method of programming a heart rate monitor as defined by claim 18, further comprising the step of selecting one of a plurality of phases, the selected phase being representative of at least a portion of the duration of the selected profile.

23. A method of programming a heart rate monitor as defined by claim 22, wherein the selected phase includes a phase identifier associated therewith, the method including the step of displaying the phase identifier.

24. A method of programming a heart rate monitor as defined by claim 22, further comprising the step of entering at least one of an upper heart rate limit and a lower heart rate limit to be associated with the selected phase.

25. A method of programming a heart rate monitor as defined by claim 22, further comprising the step of selecting at least one of an interval period and a recovery period, the interval period and the recovery period being representative of at least a portion of the duration of the selected phase, the interval period being associated with a period of time during which a user is substantially exercising, the recovery period being associated with a period of time during which the user is substantially at rest.

26. A method of programming a heart rate monitor as defined by claim 25, wherein the interval period includes an interval period identifier associated therewith, the method including the step of displaying the interval period identifier.

27. A method of programming a heart rate monitor as defined by claim 25, wherein the recovery period includes an recovery period identifier associated therewith, the method including the step of displaying the recovery period identifier.

28. A method of programming a heart rate monitor as defined by claim 25, further comprising the step of entering at least one of an upper heart rate limit and a lower heart rate limit to be associated with the selected at least one of the interval period and the recovery period.

29. A method of programming a heart rate monitor as defined by claim 25, further comprising the step of entering at least one of a maximum duration and a terminal heart rate to be associated with the interval period, the interval period terminating in response to attaining at least one of the maximum duration and the terminal heart rate.

30. A method of programming a heart rate monitor as defined by claim 25, further comprising the step of entering at least one of a maximum duration and a terminal heart rate to be associated with the recovery period, the recovery period terminating in response to attaining at least one of the maximum duration and the terminal heart rate.

31. A method of programming a heart rate monitor as defined by claim 18, further comprising the step of displaying at least one of the user's heart rate, programmable limits for the user's heart rate, and a duration of at least a portion of the selected profile.

32. A method of programming a heart rate monitor as defined by claim 18, further comprising the step of entering information to be associated with each selected profile, the information including a preprogrammed plurality of profiles.

33. A method of programming a heart rate monitor as defined by claim 32, wherein the step of entering information includes the step of uploading the preprogrammed plurality of profiles from a computer.

34. A method of programming a heart rate monitor as defined by claim 32, wherein the step of entering information includes the step of inputting the preprogrammed plurality of profiles from an exercise profile application program, the exercise profile application program inputting at least one of an exercise parameter and a physiological parameter.

35. A method of monitoring a heart rate comprising the steps of:

selecting one of a plurality of profiles stored in memory, each of the plurality of profiles having at least one of an upper heart rate limit and a lower heart rate limit associated therewith;

detecting the heart rate;

comparing the detected heart rate to at least one of the upper heart rate limit and the lower heart rate limit associated with the selected profile;

indicating whether the detected heart rate is at least one of greater than the upper heart rate limit and less than the lower heart rate limit associated with the selected profile; and

repeating the above steps for at least one more of the profiles stored in memory.

36. A method of monitoring a heart rate as defined by claim 35, wherein entering a unique profile identifier associated with each selected profile, the profile identifier being at least one of an exercise type, a day of the week, a time of day, a user's name, a level of difficulty, and a physiological parameter.

37. A method of monitoring a heart rate monitor as defined by claim 36, wherein the physiological parameter includes at least one of height, weight, age, and level of fitness.

38. A method of monitoring a heart rate as defined by claim 36, further comprising the step of displaying the profile identifier.

39. A method of monitoring a heart rate as defined by claim 35, wherein at least one of the plurality of profiles includes a plurality of phases, at least one of the plurality of phases being representative of at least a portion of the duration of each of the selected profiles.

40. A method of monitoring a heart rate as defined by claim 39, wherein the at least one of the plurality of phases includes a phase identifier associated therewith, the method including the step of displaying the phase identifier.

41. A method of monitoring a heart rate as defined by claim 39, wherein the at least one of the plurality of phases includes at least one of an upper heart rate limit and a lower heart rate limit associated therewith, the method further

including the step of indicating whether the detected heart rate is at least one of greater than the upper heart rate limit and less than the lower heart rate limit associated with the at least one of the plurality of phases.

42. A method of monitoring a heart rate as defined by claim 39, wherein the at least one of the plurality of phases includes at least one of an interval period and a recovery period, the interval period and the recovery period being representative of at least portions of the duration of the at least one of the plurality of phases, the interval period being associated with a period of time during which a user is substantially exercising, the recovery period being associated with a period of time during which the user is substantially at rest.

43. A method of monitoring a heart rate as defined by claim 42, wherein the interval period includes an interval period identifier associated therewith, the method including the step of displaying the interval period identifier.

44. A method of monitoring a heart rate as defined by claim 42, wherein the recovery period includes a recovery period identifier associated therewith, the method including the step of displaying the recovery period identifier.

45. A method of monitoring a heart rate as defined by claim 42, wherein at least one of the interval period and the recovery period include at least one of an upper heart rate limit and a lower heart rate limit associated therewith, the method including the step of indicating whether the detected heart rate is at least one of greater than the upper heart rate limit and less than the lower heart rate limit associated within the at least one of the interval period and the recovery period.

46. A method of monitoring a heart rate as defined by claim 42, wherein the interval period includes at least one of a maximum duration and a terminal heart rate associated therewith, the method including the step of terminating the interval period in response to attaining at least one of the maximum duration and the terminal heart rate.

47. A method of monitoring a heart rate as defined by claim 42, wherein the recovery period includes at least one of a maximum duration and a terminal heart rate associated therewith, the method including the step of terminating the recovery period in response to attaining at least one of the maximum duration and the terminal heart rate.

48. The method of monitoring a heart rate as defined by claim 35, further comprising the step of displaying at least one of the user's heart rate, programmable limits for the user's heart rate, and a duration of at least a portion of the selected profile.

49. The method of monitoring a heart rate as defined by claim 35, further comprising the step of storing the detected heart rate occurring during each of the selected profiles in memory.

50. The method of monitoring a heart rate as defined by claim 35, further comprising the step of downloading the detected heart rate occurring during each of the selected profiles via at least one of an infrared link and a telemetric link to a computer.

51. The method of monitoring a heart rate as defined by claim **50**, further comprising the step of processing the downloaded heart rate occurring during each of the selected profiles.

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专利名称(译)	具有多运动轮廓特征的心率监视器及其使用方法		
公开(公告)号	US20030004424A1	公开(公告)日	2003-01-02
申请号	US09/894999	申请日	2001-06-28
[标]申请(专利权)人(译)	BIRNBAUM BURTON ^ h PUOLAKANAHO佩尔蒂 HYYPPA OUTI		
申请(专利权)人(译)	BIRNBAUM BURTON H. PUOLAKANAHO佩尔蒂 HYYPPA OUTI		
当前申请(专利权)人(译)	Polar Electro Oy公司		
[标]发明人	BIRNBAUM BURTON H PUOLAKANAHO PERTTI HYYPPA OUTI		
发明人	BIRNBAUM, BURTON H. PUOLAKANAHO, PERTTI HYYPPA, OUTI		
IPC分类号	A61B5/00 A61B5/024 A61B5/0245 A61B5/0408 A63B22/00 A61B5/04		
CPC分类号	A61B5/0006 A61B5/02028 A61B5/02416 A61B5/02438 A61B5/02455 A61B5/04085 A61B5/681 A61B5/6831 A63B22/00 A63B2230/06		
外部链接	Espacenet USPTO		

摘要(译)

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