United States Patent [19]

Cavanagh

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[54] **COMPUTER SHOE SYSTEM AND SHOE FOR USE THEREWITH**

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[51] **Int. Cl.**[4] **G01C 22/00;** A43B 5/00

[52] **U.S. Cl.** ..... **364/561;** 364/410; 36/132; 36/136; 235/105; 340/323 R

[58] **Field of Search** ..... 364/561, 565, 410, 413; 235/105; 36/136, 1, 44, 72 B, 132; 324/171, 168; 340/323 R; 272/69, 70

[56] **References Cited**

U.S. PATENT DOCUMENTS

3,780,272	12/1973	Rohner	364/561
4,466,204	8/1984	Wu	36/136
4,578,769	3/1986	Frederick	364/565
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4,703,445	10/1987	Dassler	364/410

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3308431	9/1984	Fed. Rep. of Germany	235/105

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"Gait Analysis Instrumentation", from B & L Engineering, Santa Fe–Springs, Colorado 90670 (date unknown).

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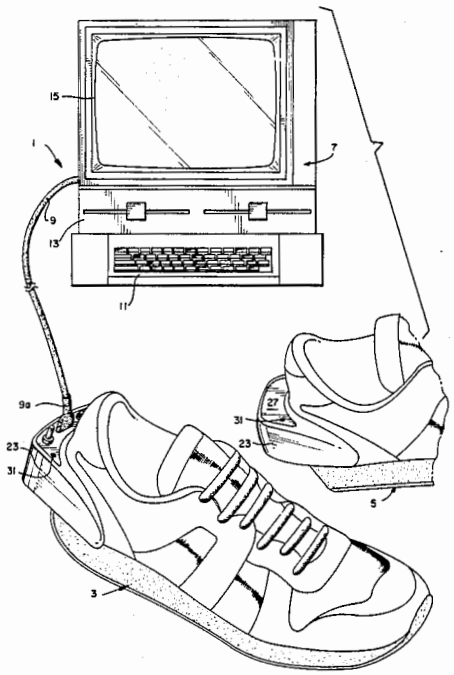
[57] **ABSTRACT**

A pair of running shoes provided with a housing at the heel thereof, into one of which an electronic device is removably mounted. The electronic device comprises a normally open inertia switch for producing a footstrike count, an oscillator crystal for providing a stopwatch function, a sound generating device, a battery power source and a gate array for counting time and footstrikes. The electronic device together with a computer and a cable for enabling communication between the computer and the electronic device in the shoe form a computer shoe system for enabling accurate information to be obtained with respect to a period of usage of the shoes of one or more users as well as enabling a running log to be maintained. The computer shoe system is capable of producing more accurate data related to distance and speed of travel than simple pedometer arrangements because, instead of utilizing a stride length constant, the system converts running time and footstrike data into distance and running speed information as a function of stride time. In a preferred form, the housing for each shoe wraps around the heel thereof so as to form an external heel counter.

6 Claims, 2 Drawing Sheets



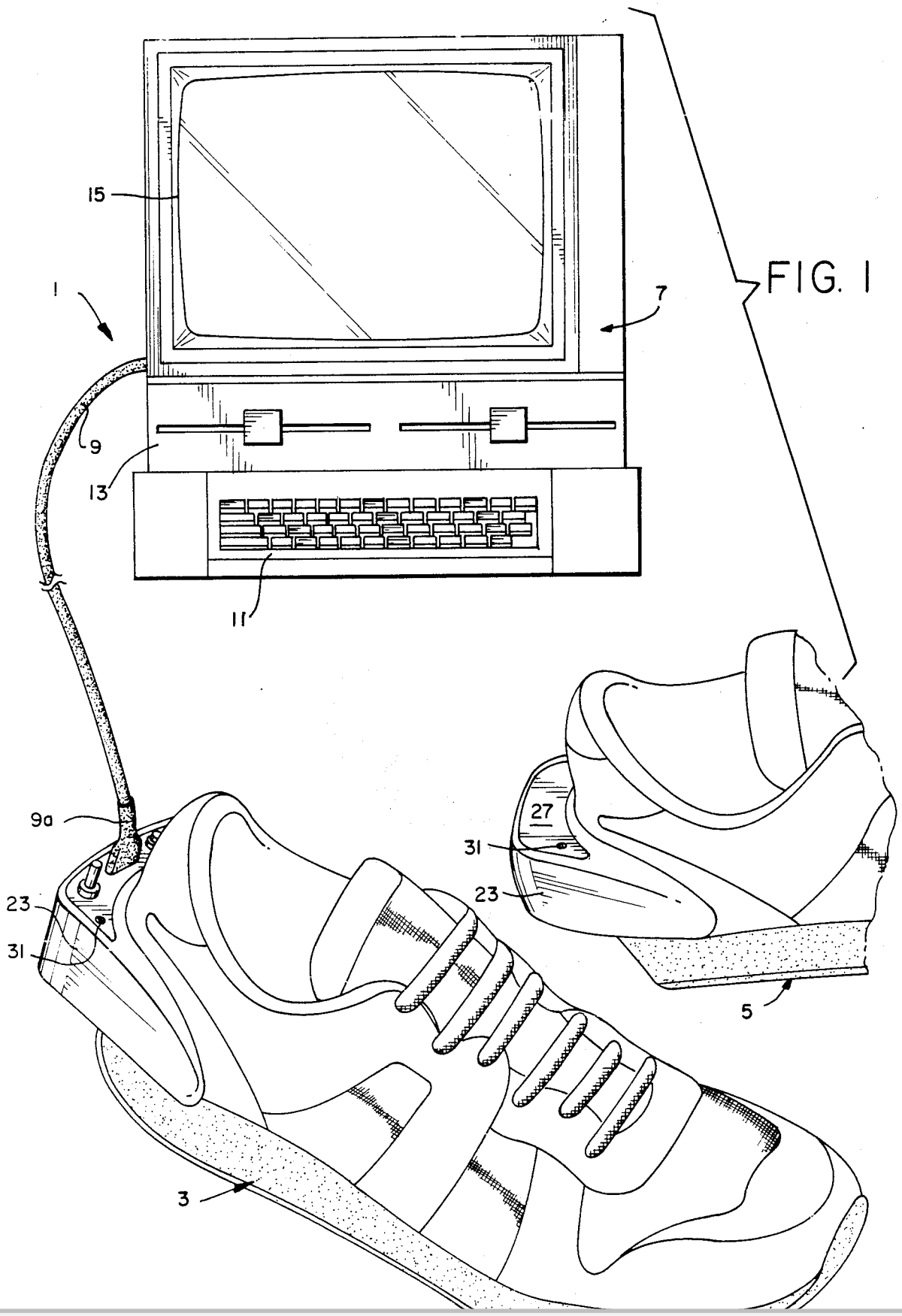


FIG. 1

FIG. 2

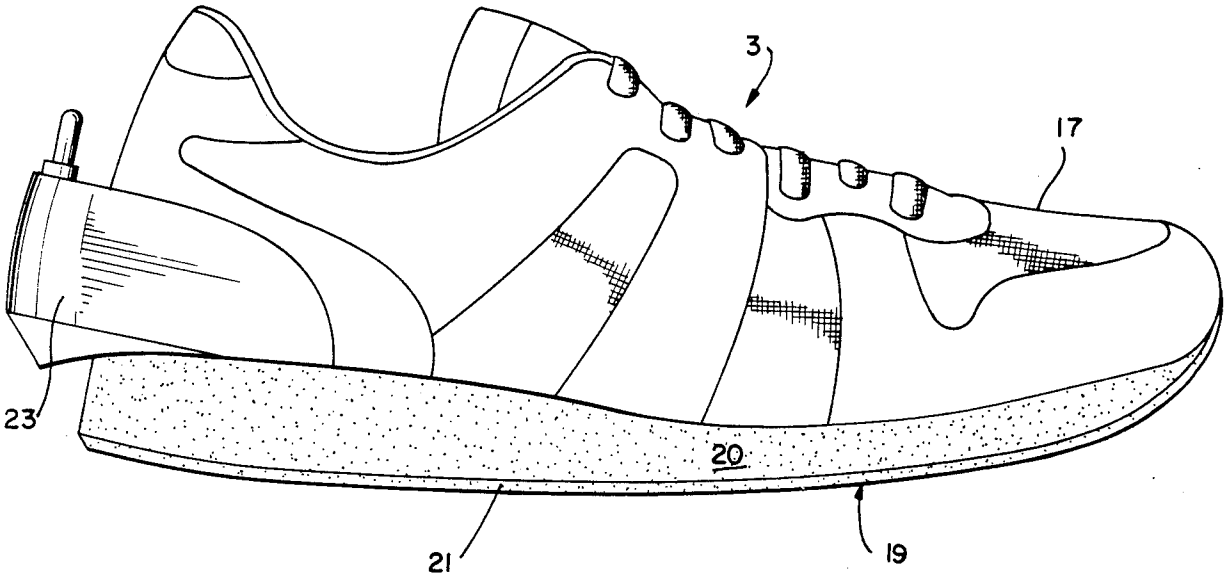
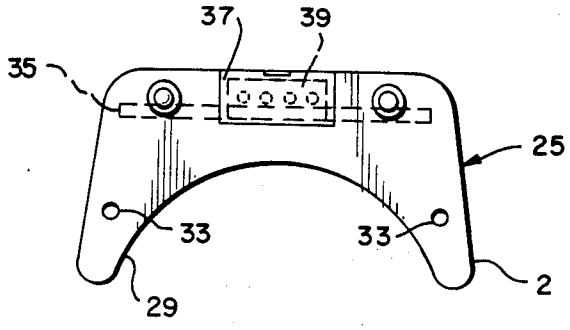


FIG. 3



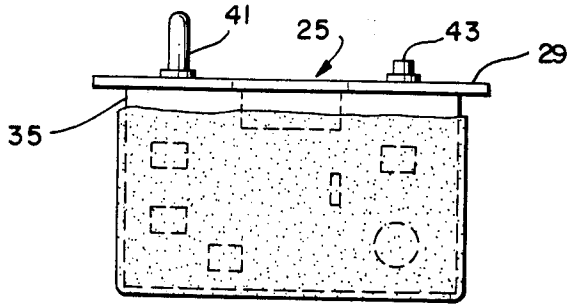


FIG. 4

COMPUTER SHOE SYSTEM AND SHOE FOR USE THEREWITH

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to shoes, particularly running shoes, of the type which provide at least a pedometer function, especially by electronic means.

2. Background Art

Pedometers of various forms have long been known and U.S. Pat. No. 4,402,147 to Wu, for example, discloses a running shoe having a switch embedded in the sole thereof whose output feeds a signal to an electronic step counter. A display element is associated with the electronic counter for providing a digital readout of the number of steps taken with the shoe. However, for a runner to determine useful information from a mere step count readout is complicated, time consuming and inaccurate, even under the best of circumstances.

Johnson U.S. Pat. No. 4,510,704 also discloses a shoe incorporating an electronic pedometer and further discloses that, by incorporating a microprocessor into the pedometer unit, the step count can be converted into values corresponding to such data as the total number of steps taken, distance covered, average speed, peak speed or the like for selective readout by the user on a display incorporated into the device. However, the unit of this patent is basically merely a combination pedometer and stop watch with means to calculate distance and time related data on the basis of a constant that corresponds to an average stride length that is set by the user in a memory storage location of the processing circuitry.

While such a device enables a user to obtain time and distance related data in a less complicated and cumbersome manner that can be achieved via a mere pedometer and stop watch, the resulting data is no more accurate due to the crude calibration of the processor unit that unrealistically relies upon a single average stride length that is the same for all speeds at which the shoe wearer travels. In this regard, Searcy, in his disclosure relative to a jogger's computational device in U.S. Pat. No. 4,220,996, points out that conventional mechanical or electronic pedometers are not useful for providing an indication of distance traveled since the normal length of stride varies depending upon whether the athlete is walking, jogging or running; although, despite this recognition, the calculations performed by Searcy's computational device still are determined on the basis of a single, average stride length approximation that the user inputs, prior to use, on the basis of whether his activity will be running, walking, or jogging.

In addition to the above, the Johnson patent also discloses that, by having his pedometer incorporate a micro-processor that senses footstrikes via a gravitationally or inertially-operated switch or other sensor, no sensor need be incorporated into the shoe itself, so that the unit could be formed as an attachment secured to the shoe, such as by being detachably secured or clipped to the heel thereof, or by being fastened on top of the shoe by a strap. However, no specific manners for implementation of this concept are illustrated or described. Thus, there is no recognition of the problem that could result if such an attachment were not secured firmly enough to the shoe to prevent relative accelerations between the shoe and attachment which could effect operation thereof, nor is there any indication as to how such an attachment could be optimally configured and constructed from both a manufacturing and use standpoint.

Furthermore, a sophisticated running shoe system is disclosed in commonly owned U.S. patent Ser. No. 701,194 filed Feb. 23, 1985, that enables distance-related data to be accurately produced. However, the system of this application achieves such accuracy by measurement of actual stride length and requires a transmitter-receiver arrangement capable of providing signal inputs from which actual stride length determinations can be made.

Thus, no simple pedometer-type shoe arrangement exists which is capable of producing accurate data related to the distance and speed of travel of a user thereof. Likewise, no attempt has been made, until now, to provide a shoe system which will not only provide accurate data, but which can form part of a comprehensive record keeping and training system which is adapted, not only to the use of a particular individual, but also to the needs of organizations such as running clubs, track teams, and the like. In particular, there has been no attempt to provide a shoe with an electric device capable of communicating with a computer in order to take advantage of the fact that personal computers are now in relatively widespread use as a convenient and accurate means of keeping records, so as to integrate the shoe system into a comprehensive record keeping and training analysis system.

SUMMARY OF THE INVENTION

In view of the foregoing, it is an object of the present invention to provide a simple and versatile running shoe system that will provide accurate data concerning the activities of one of more shoe wearers.

It is another object of the present invention to provide a running shoe having an electronic device capable of communicating with a computer.

It is still another object of the present invention to provide a running shoe with an electronic device, the electronics of which are housed in a manner that enables the entirety thereof to be transferred from one shoe to another having a compatible housing for use therein.

Yet a further object in accordance with the present invention is to provide an electronic device, in accordance with the preceding objects, wherein the housing thereof actually contributes to the performance of the shoe as a running shoe.

These and other objects are achieved in accordance with a preferred embodiment of the present invention wherein one, and preferably both of a pair of running shoes is provided with a housing at the heel thereof, into one of which an electronic device is removably mounted. The shoe mounted electronic device comprises a normally open inertia switch for producing a footstrike count, an oscillator crystal for providing a stopwatch function, a buzzer or other sound generating device for providing acoustic indications to the user, a battery as a power source and, most importantly, a gate array including a pair of dividers, one for time in seconds and one for footstrikes.

External aspects of the system include a personal computer and a cable for coupling the computer to the shoe electronics. The computer enables a running log to be maintained for an unlimited number of electronic shoe users, the information stored within the shoe as a result of a period of usage to be decoded, and informa-

tion to be down-loaded into the shoe when, instead of recording information concerning a run to be made, it is desired to set a goal for the run and have the shoe produce an appropriate acoustical indication when such is achieved.

Because the electronic device in the shoe provides the footstrike count and the run time, but a separate processor unit assimilates this information into meaningful data, the shoe electronics can be kept relatively simple, yet a single system can be utilized by a number of runners and can accurately provide a large range of distance and time related information as well as caloric expenditure, including graphic displays of goals verses actual distances. In this regard, despite the simple electronics carried by the shoe, a high degree of accuracy is achieved, in comparison to that achieved by existing pedometer type devices, due to the fact that the system does not rely on a single preset average stride length value for calculating the output values, such as distance covered, average speed, and the like. Instead, the system of the present invention determines a pair of stride length regression constants for use in the calculation of the desired information from data values obtained during a usage period so as to take advantage of the knowledge that stride length and stride time vary considerably as a function of running or walking speed and, thus, a more accurate determination can be made if it is known how fast the user was actually traveling.

In particular, the system in accordance with the present invention is not calibrated by the use of a predetermined average stride length, but rather is calibrated through the inputting of a plurality of times and numbers of footstrikes at which a predetermined distance was covered (for example, data from ten to twenty calibration runs must be input). From this information, the computer is able to produce a regression line to describe the individual footstrike time-speed relationship for each user. Thereafter, distance, time and caloric cost information can be calculated for any given run based upon the user's body weight and stride time regression relationship read from computer memory and run data read from the shoe.

Similarly, for preloading the shoe with values so that the shoe will emit tones which, for example, indicate when a given distance has been completed, since one cannot know, in advance, how fast the runner will actually run, the invention does not merely load a number of footstrikes into the shoe electronics that is equal to the desired distance divided by some predetermined average stride length. Instead, the present invention is able to examine the speed used over a preceding period of time (such as the last 30 days) for which data exists. Then the mean of these values can be taken and the stride time for this speed calculated from the regression coefficients, thereby enabling the number of strides at this speed that would be needed to travel the required distance to be determined and loaded into the shoe electronics.

In order to enable an electronic device capable of communicating with a computer to be incorporated into a running shoe, not only without detracting from the performance characteristics of the shoe, but in a manner complementing it, the housing for the shoe electronics, in the preferred embodiment, has been shaped to be secured about the heel of the shoe in the form of an external counter. Thus, the housing enables the known benefits of an external shoe counter support to be obtained in an effective manner, but without such having to be incorporated during manufacture of the shoe proper. In this respect, it is noted that both shoes of a pair have such housings, even though only one housing will actually receive the electronic device and the other will be merely a dummy housing. In a related vane, it is noted that the present invention, with the provision of dummy housings for the shoe electronics, makes it unnecessary for a person to buy the electronics more than once since, after the original pair of shoes has worn out, subsequent pairs having only dummy housings can be purchased and the electronic device from the worn-out pair simply transferred into one of the dummy housings of the new pair.

These and other features and advantages of the present invention will become apparent to those of ordinary skill in the art from the following description and accompanying drawings which describe, for purposes of illustration only, a preferred embodiment of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a partial perspective view of a preferred embodiment computer shoe system in accordance with the present invention;

FIG. **2** is a side elevational view of a shoe forming part of the computer shoe system of the preferred embodiment;

FIG. **3** is a top plan view of the electronic device of the shoe shown in FIG. **2**;

FIG. **4** is a side elevational view of the electronic device of FIG. **3**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. **1**, a complete running shoe system, in accordance with a preferred embodiment of the present invention, is designated generally by the reference numeral **1**. This system is comprised of a pair of running shoes **3, 5**, a computer (such as a personal computer, for example, an "Apple IIe" personal computer) and a detachable cable **9** by which an electronic device carried by one of the shoes **3, 5** may communicate with the computer **7** before and/or after a usage of the shoes. As typical of such personal computers, it includes a keyboard **11**, disk drive **13** and display monitor **15**.

The running shoes **3, 5**, as is conventional for running shoes, has of an upper **17** and a sole **19** that is comprised of a shock absorbing midsole **20** formed, for example, of a polyurethane foam and an outer sole **21** of a wear resistant material. Furthermore, no special modifications need be made to these components of the running shoes **3, 5** and thus any known running shoe construction may be utilized, including those provided with anti-pronation inserts and specialized outer sole configurations, and the like.

In addition to the noted conventional components, the running shoes **3, 5**, in accordance with the present invention, are provided with a housing **23** that is firmly secured to the heel of each running shoe **3, 5**. In this regard, it is known to provide an athletic shoe with an external heel counter to provide good heel stability and comfort while preventing blistering. In accordance with the present invention, the housing **23** has been configured so as to provide the characteristics of such an external heel counter by being attached to the exterior of the heel portion of the shoe upper in a manner completely wrapping around the heel from one side to the other and tapering at it front ends.

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