(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 293 140 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
19.03.2003 Bulletin 2003/12

(51) Int Cl.[7]: **A43B 7/02**

(21) Application number: **02020385.7**

(22) Date of filing: **12.09.2002**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SK TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **12.09.2001 IT MI20010499 U**

(71) Applicant: **Colombo, Roberto**
20020 Bienate-Magnago (Milano) (IT)

(72) Inventor: **Colombo, Roberto**
20020 Bienate-Magnago (Milano) (IT)

(74) Representative: **Cicogna, Franco**
Ufficio Internazionale Brevetti
Dott.Prof. Franco Cicogna
Via Visconti di Modrone, 14/A
20122 Milano (IT)

(54) Foot heating device in particular for cyclists, sportsmen and persons living in cold climates

(57) A heating device, specifically designed for use by cyclists, comprising an insole or ferrule to be applied inside a shoe and including heating means supplied by a power supply coupled to a fixing means which can be applied at the ankle region of the cyclist, sportsman or user.

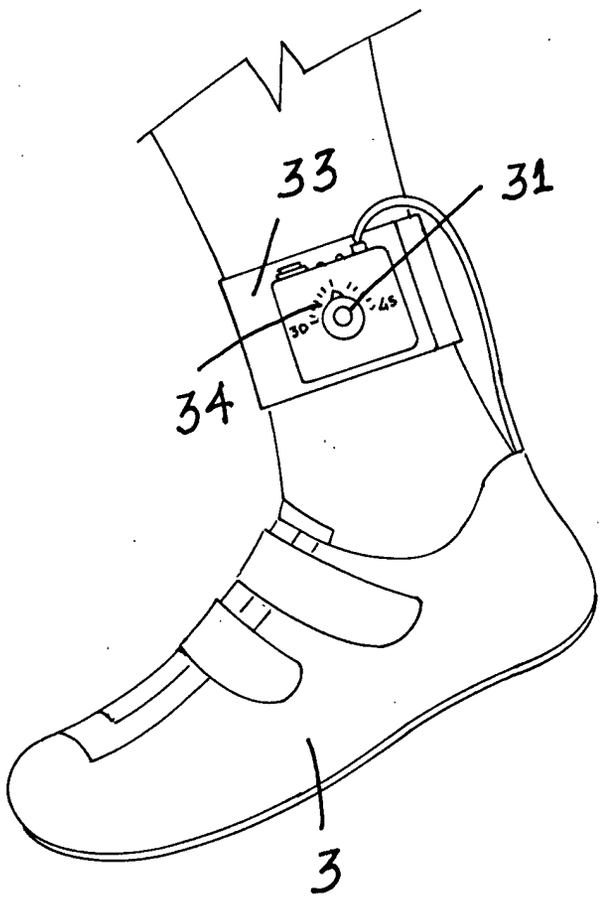

FIG. 7

EP 1 293 140 A2

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a device for heating feet, which has been specifically designed for cyclist use or for mountain sports.

[0002] As is known, cyclists, in particular professional ones, frequently trains also in wintertime.

[0003] In certain climates, environmental conditions may be prohibitive, with respect to temperature, thereby causing great problems for the athlete.

[0004] In fact, the comparatively high speeds achieved by professional cyclists, especially on discents, cause the well known wind-cooling effect.

[0005] Accordingly, it is absolutely necessary to protect the cyclist's body by an excessive heat loss.

[0006] On the other hand, since the cyclists must necessarily use suitably designed shoes, and since the cyclist's shoes have necessarily such a size as to prevent thermal wadding from being applied, the feet of the cyclist are inevitably exposed to cold conditions.

SUMMARY OF THE INVENTION

[0007] Accordingly, the aim of the present invention is to provide such a foot heating device, specifically designed for use by cyclists, but which other people can also use.

[0008] Within the scope of the above mentioned aim, a main object of the present invention is to provide such a foot heating device which can also be used with conventional cyclist light shoes or with mountain boots.

[0009] Another object of the present invention is to provide such a heating device which does not hinder the pedaling operations by the cyclist.

[0010] Yet another object of the present invention is to provide such a heating device which is very strong and reliable construction-wise.

[0011] Yet another object of the present invention is to provide such a foot heating device which can be simply used.

[0012] According to one aspect of the present invention, the above mentioned aim and objects, as well as yet other objects, which will become more apparent hereinafter, are achieved by a foot heating device, for heating feet of cyclists, skiers and persons living and/or working in rigid climates, characterized in that said foot heating device comprises an insole designed for application inside a shoe and including heating means power supplied by a power supply source coupled to a fixing means which can be applied at the ankle region of the cyclist or user.

[0013] According to an advantageous feature of the invention, the foot heating device of the invention which, as stated, has been specifically designed for cyclists, sportsmen and persons living in cold climates, provides to use a control system including a SCRT temperature feedback device, which does not require a broad adjusting range for adjusting the surface temperature of the heater, since, as it occurs for conventional home temperature adjusters, the temperature comfort range for a foot is limited to few degrees in a range of 30°C / 37°C.

[0014] The foot heating device according to the present invention comprises a temperature adjusting system which is designed for setting and holding a shoe inner average temperature within a comfort temperature range, which can be directly set by the user, depending on the outside temperature variations occurring under the specific conditions and with the desired comfort level.

[0015] In order to properly design and make a SCRT, also considering that the system must be of a portable type, and accordingly supplied by a battery, the inventor of the present invention has studied in depth details the energy and temperature ratio, that is the heat amount to be supplied to the system in order to hole a desired temperature, with respect to a system including a foot, a shoe and outside environment.

[0016] In this connection it should be apparent that as the outside temperature decreases, the heat amount to be supplied to the system to hold a desired temperature value will increase.

[0017] To provide an accurate and efficient temperature adjustment, without excessively draining the battery power, the present invention provides to use a battery set and a temperature adjusting and controlling system, arranged in an ergonomic configuration sealed container, to prevent moisture and dirt from penetrating the container.

[0018] The above container can be fixed to a supporting element allowing it to be connected to an edge or rim of a shoe, or on a resilient band, for example including Velcro coupling means, to be used in a case in which the shoe rim has not a sufficient size, as in a case of a cyclist light shoe.

[0019] The above mentioned container comprises, on its outside surface, an adjusting trimmer for adjusting the shoe temperature which can be manually set.

[0020] In particular, said trimmer comprises a graduated bush or ring-nut, allowing to easily set and display a desired temperature.

[0021] The electronic circuit for adjusting temperature is controlled by sensors arranged near electric resistances applied on the tip of the insole or shoe upper or, optionally, at other portions of the insole.

[0022] The temperature adjusting assembly comprises, in addition to the mentioned sensors and trimmers, temperature control electronic circuits and power supply circuits allowing to provide optimum results, with a comparatively low current drain.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Further characteristics and advantages of the present invention will become more apparent hereinaf-

ter from the following detailed disclosure of a preferred, though not exclusive, embodiment of the invention, which is illustrated, by way of an indicative, but not limitative, example, in the accompanying drawings, where:

Figure 1 is an exploded perspective view of the foot heating device according to the invention and a cyclist light shoe, or for sports use, to which the subject device can be applied;

Figure 2 is a phantom perspective view of the foot heating device applied to the shoe;

Figure 3 is a further phantom perspective view illustrating the device applied to the shoe, according to a further aspect of the invention;

Figure 4 is a side perspective view of the device shown in figures 1 and 2, during the use thereof;

Figure 5 is a further side perspective view of the device shown in figure 3, during the use thereof;

Figure 6 is a further exploded perspective view showing the upper of a shoe and an insole heated by the foot heating device according to the invention;

Figure 7 shows a cyclist light shoe and a band applied to a foot of a user, in which is held the battery pack, temperature control system and temperature setting or adjusting trimmer;

Figure 8 is a partially cross-sectioned view illustrating a container or housing in which are housed the power batteries and adjusting trimmer for adjusting temperature; and

Figures 9 and 10 respectively show two block diagrams related to the temperature controlling and adjusting circuits included in the foot heating device according to the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] With reference to the number references of the above mentioned figures, the foot heating device according to the present invention, which has been generally indicated by the reference number 1, comprises an insole 2, which can be applied inside a shoe 3 and comprises heating means power supplied by a power or energy source 4.

[0025] The power or energy source 4 is coupled to a fixing or clamping means, 5 or 105, which can be applied at the region of the ankle of a cyclist or sportsman.

[0026] The heating means advantageously comprise one or more electric resistances embedded in the insole 2, and not specifically shown, which are power supplied through an electric cable 6 including a connector 7.

[0027] The connector 7 can be coupled to a second connector 17 of the power cable 6 in turn coupled to the power source comprising, in this embodiment, a rechargeable battery 4 or a dry battery support element, either of a disposable or of a rechargeable type, which are of any standard types as commercially available.

[0028] The clamping or fixing means for clamping the energy source can comprise a spat element 5, open at the underlying region, which can be applied to the ankle of the cyclist or sportsman, so as to cover this region and shoe 3, as is clearly shown in figures 2 and 4.

[0029] The spat element 5 comprises, in particular, a pocket 8 for housing said battery 4 therein.

[0030] Advantageously, at least the pocket 8 is made of a resilient material, so as to allow the battery 4 to be easily engaged therein and disengaged therefrom, while assuring a proper anchoring of the battery 4 during use, also in the presence of comparatively high stresses generated by the foot movement, during the pedaling operations and, as it should be apparent, by the road unevennesses.

[0031] Advantageously, the overall spat element 5 is made of a sufficiently resilient material to provide a better fitting and comprises closure means including, in the shown embodiment, a rear hinge closure 9.

[0032] Moreover, the materials forming the mentioned spat element 5 must be suitably selected to provide a given thermal insulation and, possibly, even a sufficient perspiration.

[0033] The spat element 5, moreover, can be optionally made waterproof.

[0034] Figures 3 and 5 show a further type of clamping means comprising, instead of a spat element, a band 105 which can be applied to the bottom region of the leg, near the ankle of the cyclist.

[0035] The band 105 comprises, as shown, a pocket 108 for housing therein said battery 4.

[0036] Advantageously, at least the pocket 108 is made of a resilient material, so as to allow the battery 4 to be easily and quickly engaged therein and disengaged therefrom, while assuring a proper anchoring of the battery 4 during use, even in the presence of a comparatively high stress due to the movement of the pedaling foot and, obviously, because of the road surface unevennesses.

[0037] Advantageously, the overall band is made of a sufficient resilient material to provide a better fitting and comprises closure means formed, in the shown embodiment, by a closure 109, of the type known on the market as "Velcro" closure or the like.

[0038] The selection of the clamping or fixing means to be used will depend, of course, on the cyclist preference and environmental conditions.

[0039] While the mentioned spat element 5 provides a great protection from cold, the band 33, 105, has the advantage that it is of less size, with respect to the mentioned spat element.

[0040] The foot heating device according to the present invention can be used in a very simple and easy manner.

[0041] In fact, it is sufficient to engage the insole 2 inside the shoe 3, and wear the shoe so as to allow the electric cable 6 and connector 7 to exit the shoe itself.

[0042] Then, the clamping means, i.e. said spat 5 or

band 33, 105 are worn, and the connector 7 of the power cable 6 of the battery 4 is coupled to the connector 17, thereby providing the electric resistances 48 embedded in the insole with power.

[0043] As it should be apparent, the position of the battery 4, engaged in the outer pocket 8 or 108, does not affect in any manners the pedaling operation by the athlete.

[0044] With reference to figures 6, 7, 8, 9 and 10, it should be apparent that the foot heating device according to the invention is controlled by an electronic circuit 46 or 47 providing an optimum temperature adjusting of the insole 2 or ferrule 48 and, accordingly, or the cyclist or skier shoe 3, by operating on the trimmer 31 preferably housed in the container or casing 32 of the battery 4.

[0045] With reference to figures 8 and 9, it should be apparent that the battery supply 4 and temperature setting system 31 are arranged in an ergonomic configuration sealed container or casing 32, to prevent any moisture and dirt infiltrations.

[0046] The mentioned container or casing 32 also holds therein the cards 46 and 47 shown in figures 9 and 10.

[0047] The casing 32 comprises a metal supporting element 5, allowing said casing to be easily clamped on the edge or rim of the shoe 3 or on a Velcro type of resilient band 33, to be used in a case in which the rim of the shoe is of insufficient size, as in a case of a cyclist light shoe.

[0048] The casing 32 comprises, on its outside surface, a manual trimmer 31 for adjusting temperature, including a graduated ring-nut or bush 34 allowing to easily set and display the temperature values.

[0049] The power supply battery assembly 4 is electrically coupled to the temperature adjusting circuit inside the casing 32.

[0050] Said temperature adjusting circuit, in turn, is coupled with an ultra-flat cable or ribbon.

[0051] Thus, on the same cable, which would be obviously of a multipolar configuration, will be present signals coming from temperature sensors 44 arranged on the heating insole 2.

[0052] The flat cable 16, 45 passes under the foot bearing surface, in order to provide a good comfort lever.

[0053] A thermal compensation of the temperature sensors 44 can be performed on the temperature adjusting cards 46, 47.

[0054] Figure 6 is a schematic view illustrating the basic construction of the foot heating device according to the invention.

[0055] Said device comprises an insole 2, made of an ultralight and perspiring material, of high mechanical strength, a series of temperature sensors 44 evenly arranged on a surface of a flat heater 48, having an anatomic configuration, by using special metal alloys for forming highly efficient heating resistances.

[0056] The heater 48 is advantageously applied to a resilient supporting blade element.

[0057] The assembly is thermally and electrically insulated by a high strength special resin and comprising the foot bearing insole 2, allowing a very good comfort for an even transfer of heat to the foot bottom.

[0058] Figures 9 and 10 show two different embodiments of the block diagrams or cards 46 and 47 of the system CRT.

[0059] The heater 48 comprises an electric resistance which can be embedded in the insole 2 or can be successively applied to any desired type of plantar element.

[0060] In this case, it will be covered by suitable insulating materials.

[0061] The foot heating device according to the invention can be also applied to a ski boot or on a cyclist light shoe as disclosed.

[0062] In the first case, the battery 4 pack 32 will be clamped on the rim or edge of the boot 1, whereas, in the second case, it will be clamped or applied on a supporting resilient band 33, 105.

[0063] Figures 9 and 10 show two block diagrams defining the operating principle of the controlling and adjusting system.

[0064] In the embodiment shown in figure 10, the latter shows a block diagram of the circuit 47 defining the operating principle of the controlling and adjusting system with a PWM control of the load supply DUTY-CYCLE.

[0065] The PWM block supply the load by pulses, in order to reduce to a minimum the power dissipated or drained by the control circuit.

[0066] The DUTY-CYCLE variation is obtained depending on the values sensed by the sensors T°C SENSE, detecting the temperature at several regions, thereby allowing to efficiently providing an even temperature value.

[0067] Each temperature sensor controls a PWM section of the heater, thereby allowing to operate locally in order to modify a desired temperature.

[0068] The T°C-CTRL block uses the information coming from the temperature sensors, as suitably standardized and converted to voltage by the block β, to generate the feedback signal for adjusting the load current.

[0069] The T°C-SET value is set by a setting trimmer 31 for setting the comfort temperature.

[0070] Another embodiment is shown in figure 9, which illustrates a block diagram defining the operation principle of a controlling and adjusting system including a feedback control means PID.

[0071] The PID block provides adjustment of the load current.

[0072] The T°C-SENSE sensors detect temperature at several regions, thereby efficiently providing a temperature even value.

[0073] Each temperature sensor controls a PID section of the heater, thereby allowing to locally operate in order to suitably modify a desired temperature.

[0074] The T°C-CTRL block uses the information coming from the temperature sensors, as suitably standardized and converted to voltage by the block β, to generate the load current adjusting feedback signal.

[0075] The T°C-SET value is set by a setting trimmer 31 designed for setting the comfort temperature.

[0076] It has been found that the invention fully achieves the intended aim and objects.

[0077] In fact, the invention provides a foot heating device which can be used with conventional or regular light shoes for cyclists, as well as with winter sports shoes, and being adapted to provide a sufficient temperature without hindering the pedaling operation.

[0078] An important advantage of the invention is its very simple use.

[0079] In practicing the invention, the used materials, as well as the contingent size and shapes can be any, according to requirements and the status of the art.

[0080] As mentioned, the foot heating device according to the present invention has been specifically designed for heating feet of cyclists, skiers and sportsmen in general, practicing their sports in an outside environment and under a rigid climate.

[0081] However, it should be apparent that the foot heating device according to the invention can also be used by other persons living and/or working under rigid or cold climates.

Claims

1. A foot heating device, **characterized in that** said device comprises an insole or ferrule to be applied inside a shoe and including heating means power supplied by a power source coupled to a clamping means which can be applied at a region of the ankle of the cyclist, sportsman or user.

2. A device, according to Claim 1, **characterized in that** said heating means comprise one or more electric resistances embedded in said insole or applied to said insole, and power supplied through an electric cable having a connector for connection with said power source.

3. A device, according to Claim 1 or 2, **characterized in that** said power source comprises a rechargeable battery or a support for dry batteries, either of a disposable or of a rechargeable type.

4. A device, according to one or more of the preceding claims, **characterized in that** said connector of said electric cable of said insole is adapted to be coupled to a second connector of a power supply cable in turn coupled to said power source.

5. A device, according to one or more of the preceding claims, **characterized in that** said clamping means for clamping said power source comprise a spat element, open at a bottom region thereof and adapted to be applied to a region of the ankle of the cyclist or user, thereby covering said region and shoe.

6. A device, according to one or more of the preceding claims, **characterized in that** said spat element comprises a sufficiently resilient material to provide a good fitting and further comprising closure means including a rear hinge closure.

7. A device, according to one or more of the preceding claims, **characterized in that** said spat element materials are so selected as to provide a thermal insulation.

8. A device, according to one or more of the preceding claims, **characterized in that** said spat element forming materials are so selected as to provide a sufficient perspiration.

9. A device, according to one or more of the preceding claims, **characterized in that** said spat element forming materials are so selected as to assure waterproofing properties.

10. A device, according to one or more of the preceding claims, **characterized in that** said clamping means comprise a clamping band which can be applied at a bottom region of a user leg, near the ankle of the user or cyclists.

11. A device, according to one or more of the preceding claims, **characterized in that** said clamping band is made of a sufficiently resilient material to provide a good fitting and includes closure means comprising a "Velcro" closure or the like.

12. A device, according to one or more of the preceding claims, **characterized in that** said clamping means comprise a pocket for housing therein said power source.

13. A device, according to one or more of the preceding claims, **characterized in that** said pocket is made of a resilient material, to allow said power source to be easily engaged therein and disengaged therefrom, while providing a proper anchoring of said power source during use even in the presence of stresses due to the movement of the foot of the cyclist during the pedaling and due to the road surface unevennesses.

14. A device, according to one or more of the preceding claims, **characterized in that** said device is controlled by an electronic control circuit allowing to properly adjust the heating of said insole or ferrule to be applied to an insole suitably heated of a shoe

for cyclists or sports use, by operating a trimmer including a graduated bush housed in the same casing as that of said batteries.

15. A device, according to one or more of the preceding claims, **characterized in that** said battery casing is coupled to a rim of said shoe or to a Velcro resilient band.

16. A device, according to one or more of the preceding claims, **characterized in that** said device comprises one or more temperature sensors, arranged on said heating insole or ferrule of said shoe.

17. A device, according to one or more of the preceding claims, **characterized in that** said control and adjusting circuit comprises a PWM block, feeding the load by pulses, the DUTY-CYCLE variation being made depending on values detected by the sensors T°C-SENSE detecting the temperature at several regions; each temperature sensor controlling a PWM section, while the T°C-CTRL block uses the information of the temperature sensors, as suitably standardized and converted to a voltage by a block β, to generate the load current adjusting feedback signal, the T°C-SET value being set by an adjusting trimmer for adjusting a comfort temperature.

18. A device, according to one or more of the preceding claims, **characterized in that** said device comprises an electronic circuit including a temperature PID feedback control means, said PID block performing a load current adjusting, whereas the T°C-SENSE sensors detect the temperature at several regions; each temperature sensor controlling a PID section to modify locally said temperature; the T°C-CTRL block using the information of said temperature sensors, as suitably standardized and converted to a voltage by said block β, to provide the load current adjusting feedback signal; the T°C-SET value being set by a comfort temperature adjusting trimmer.

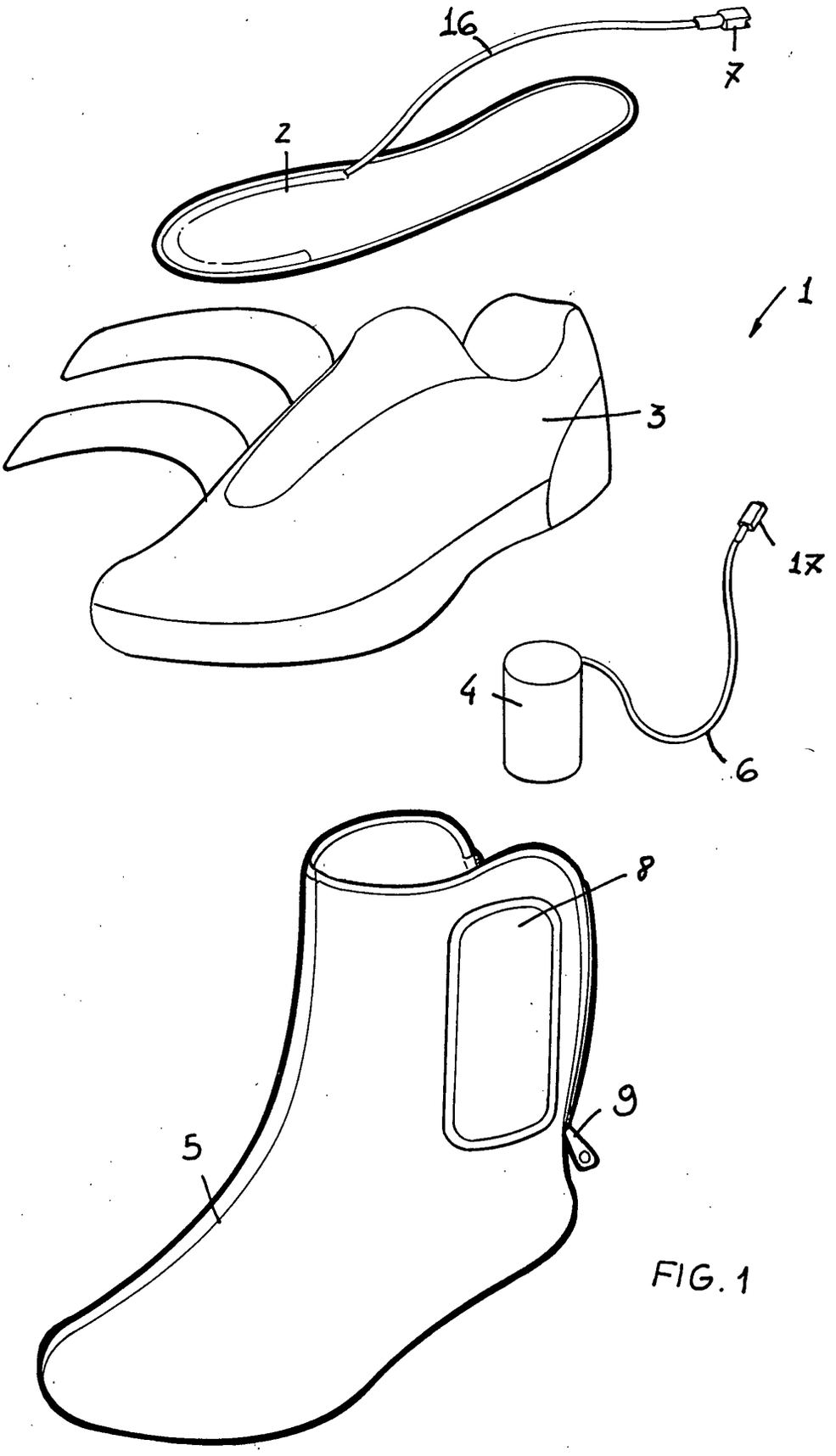

FIG. 1

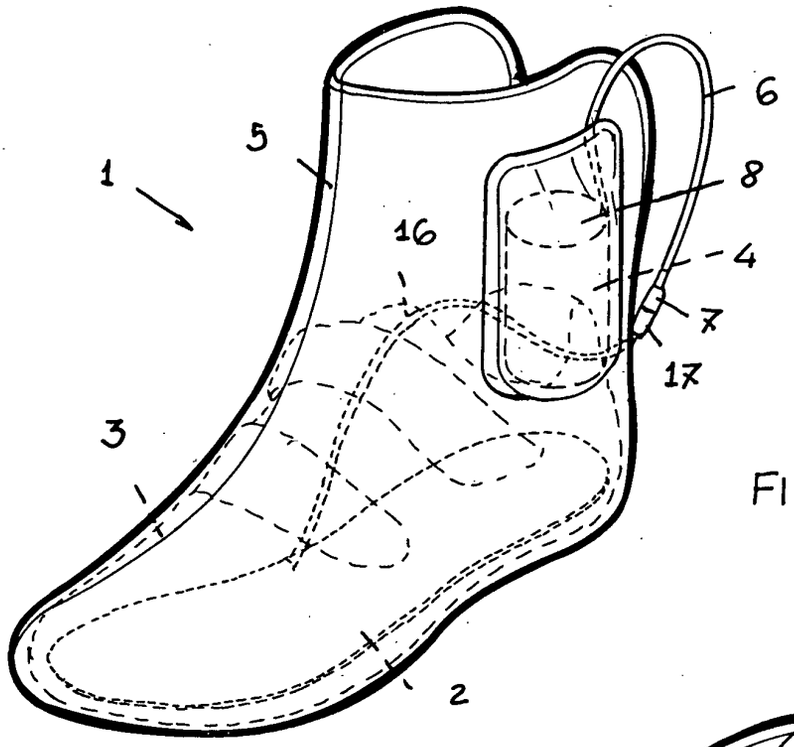

FIG. 2

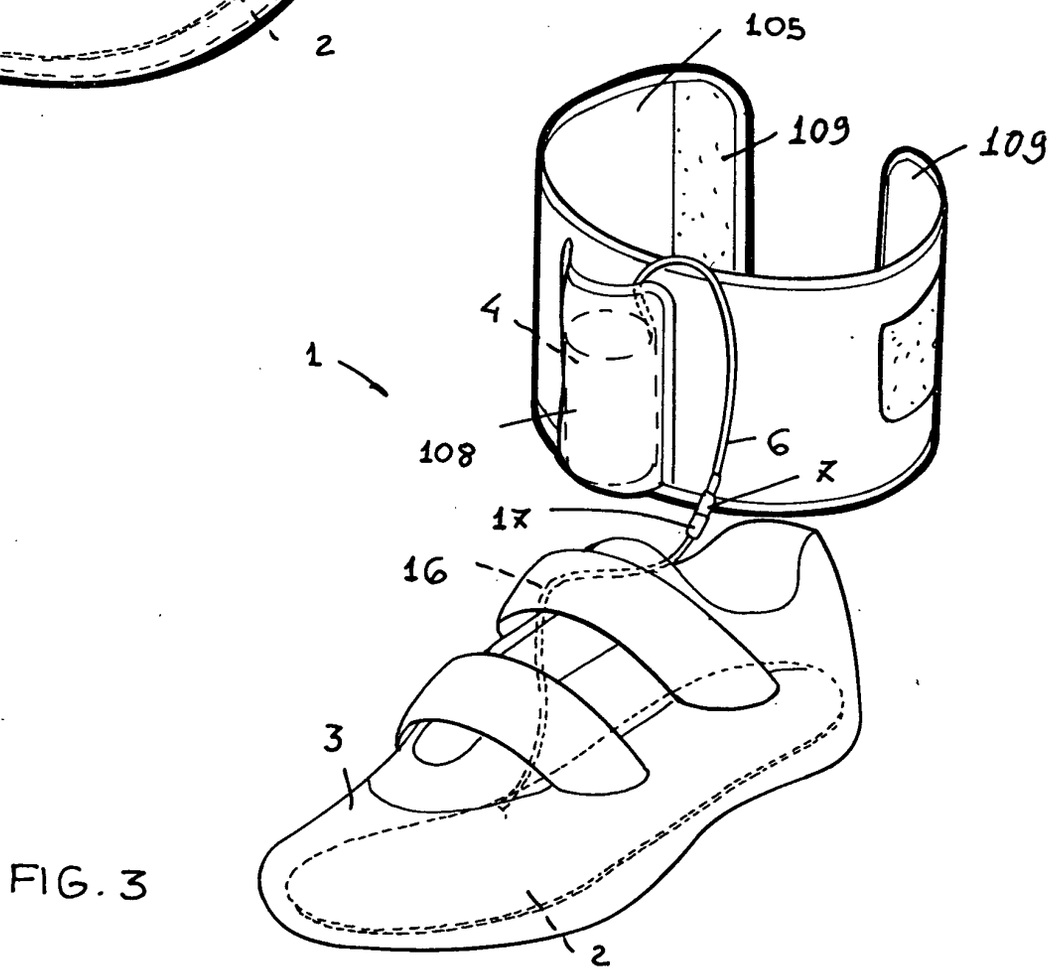

FIG. 3

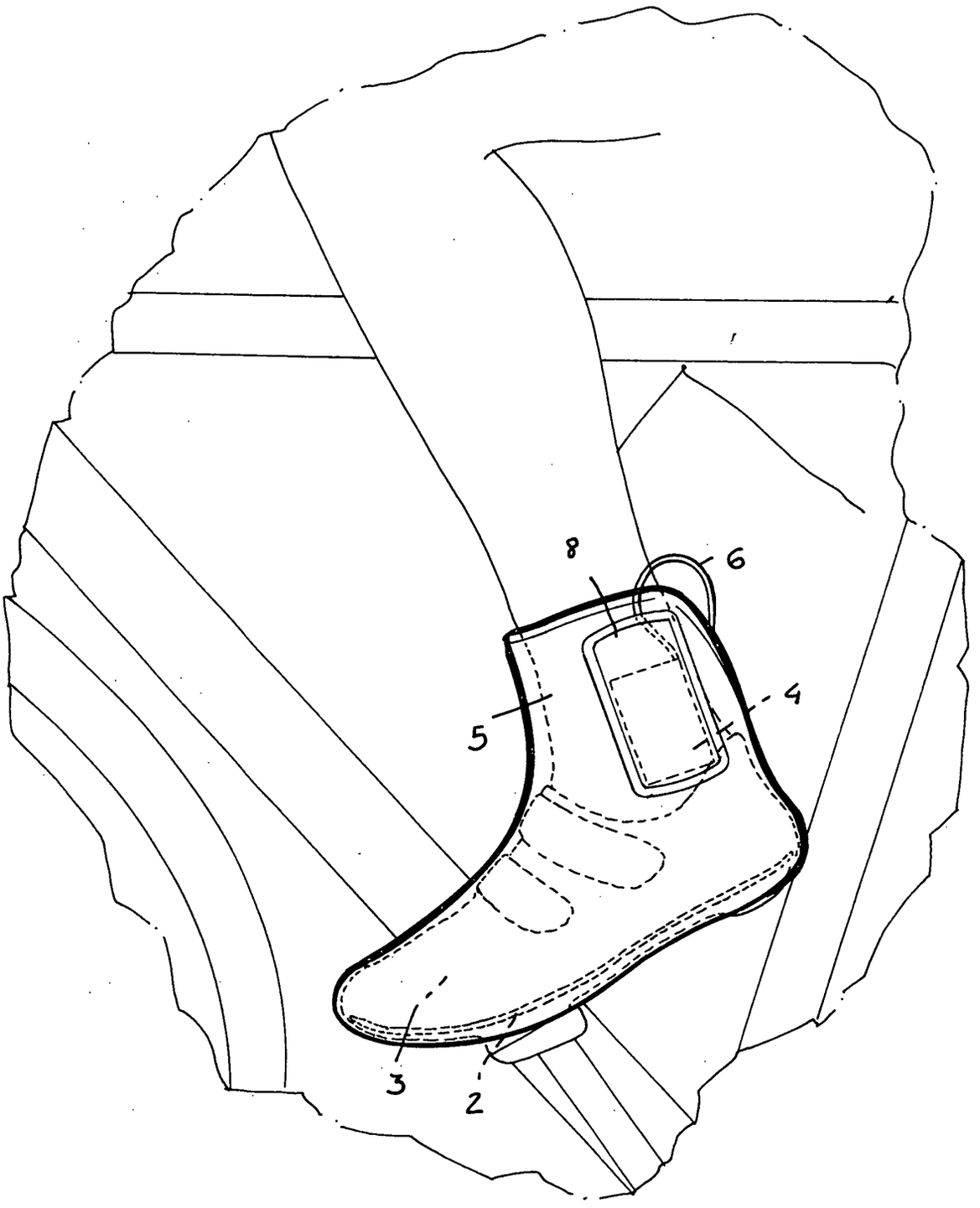

FIG. 4

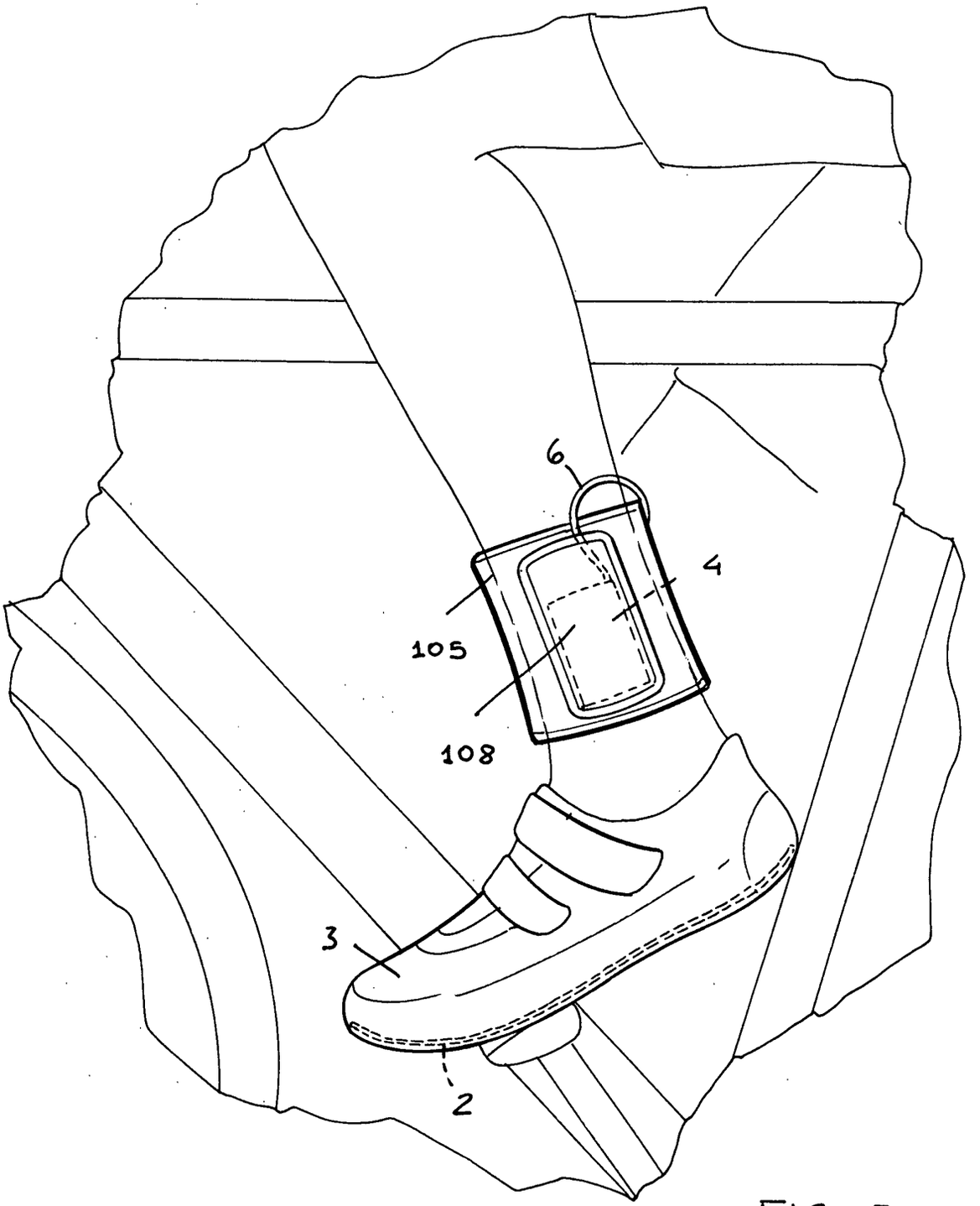

FIG. 5

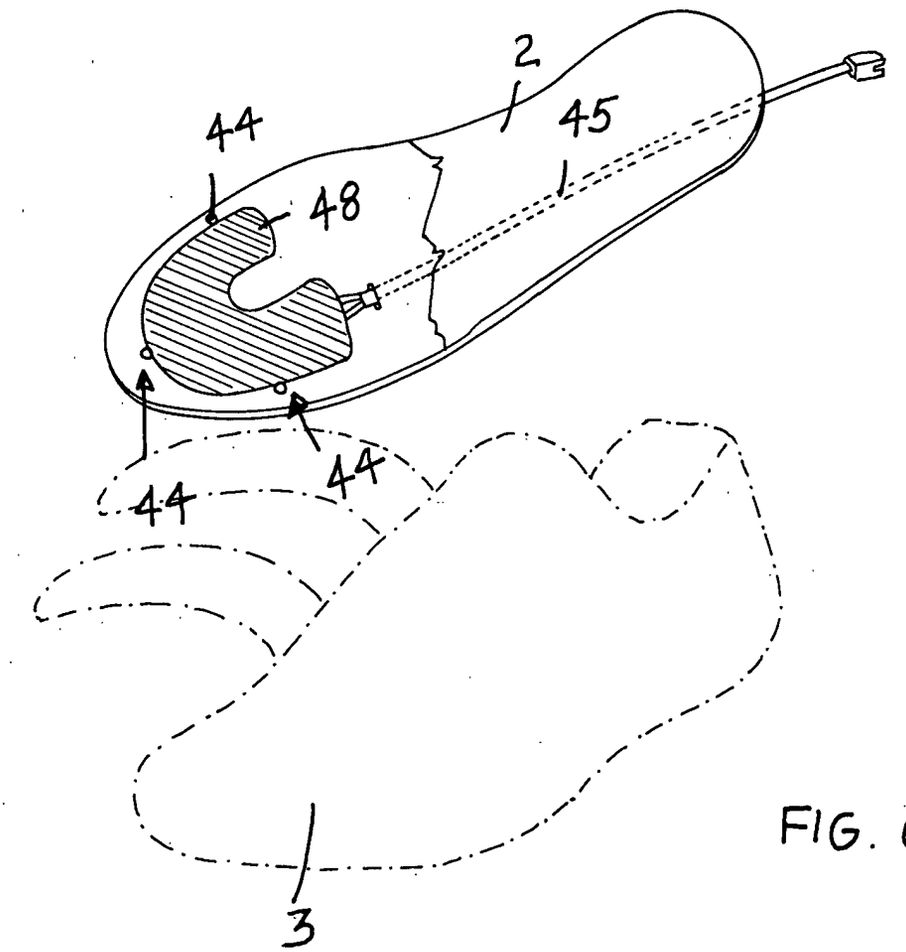

FIG. 6

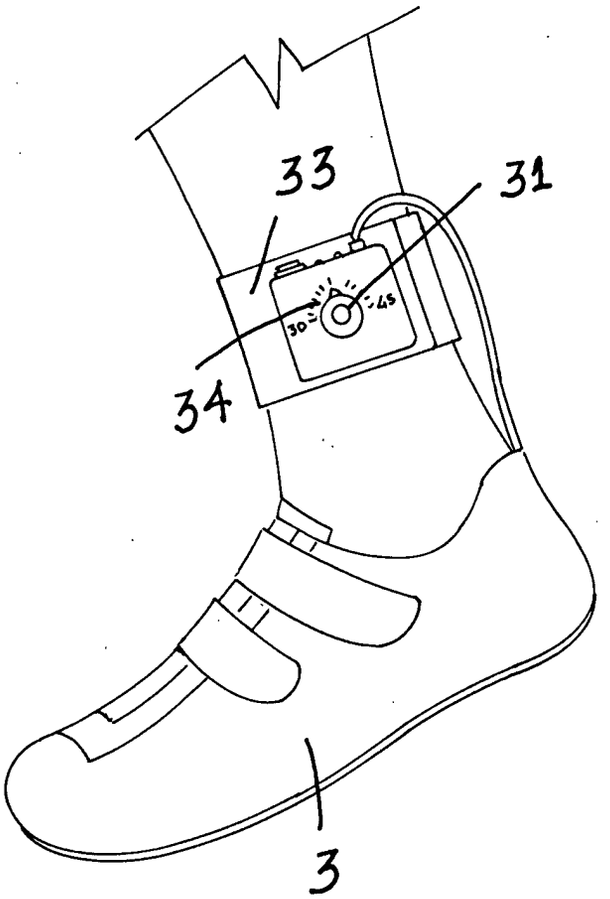

FIG. 7

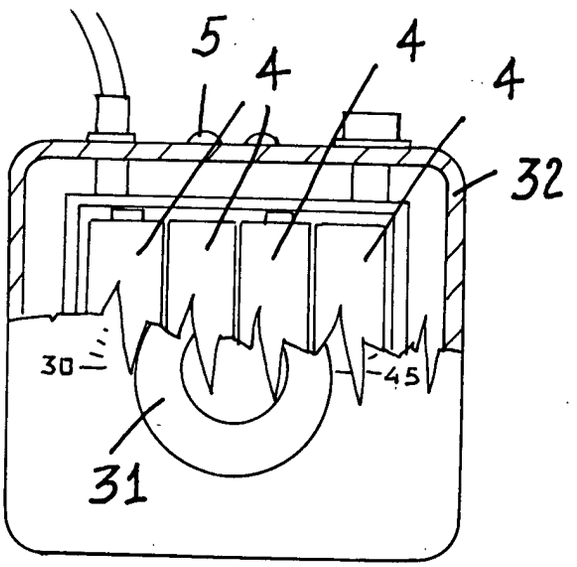

FIG. 8

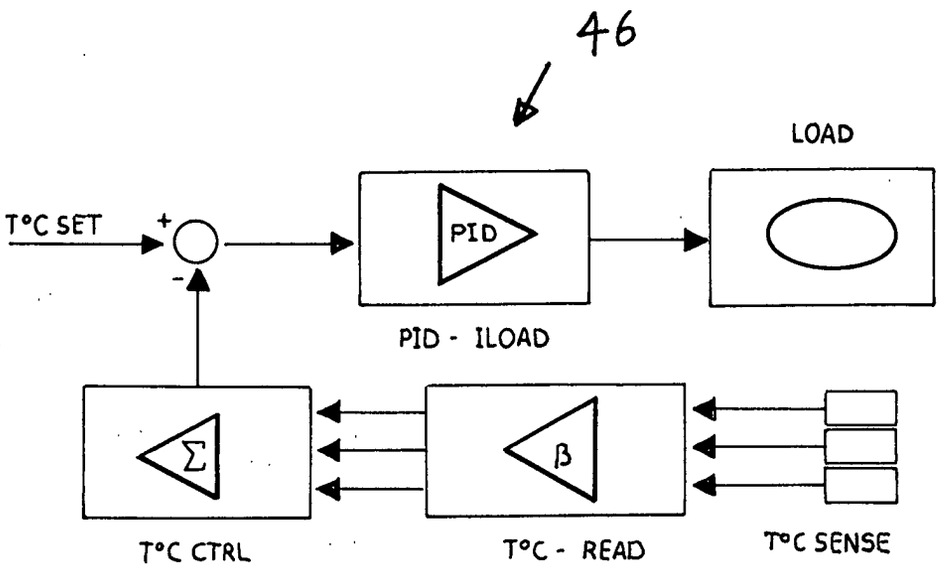
46
LOAD
T°C SET
+
-
PID
PID - ILOAD
Σ
β
T°C CTRL
T°C - READ
T°C SENSE

FIG. 9

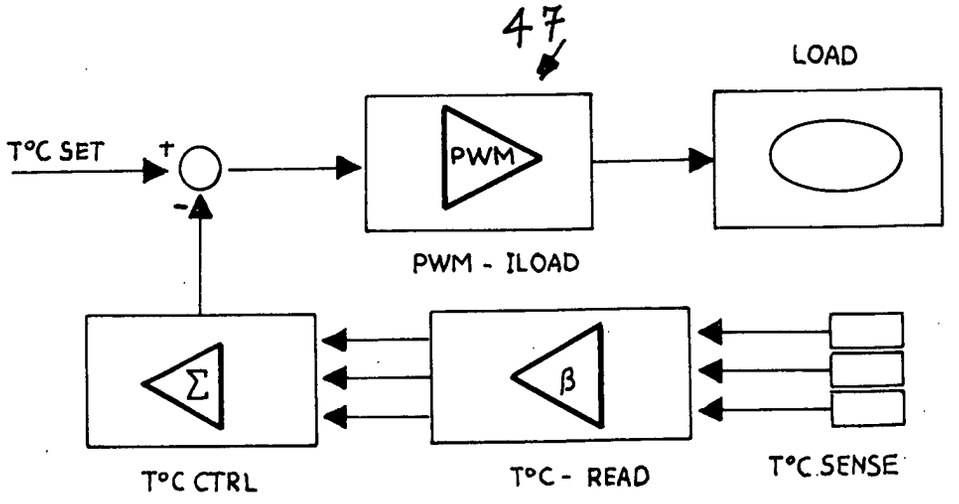
47
LOAD
T°C SET
+
-
PWM
PWM - ILOAD
Σ
β
T°C CTRL
T°C - READ
T°C SENSE

FIG. 10