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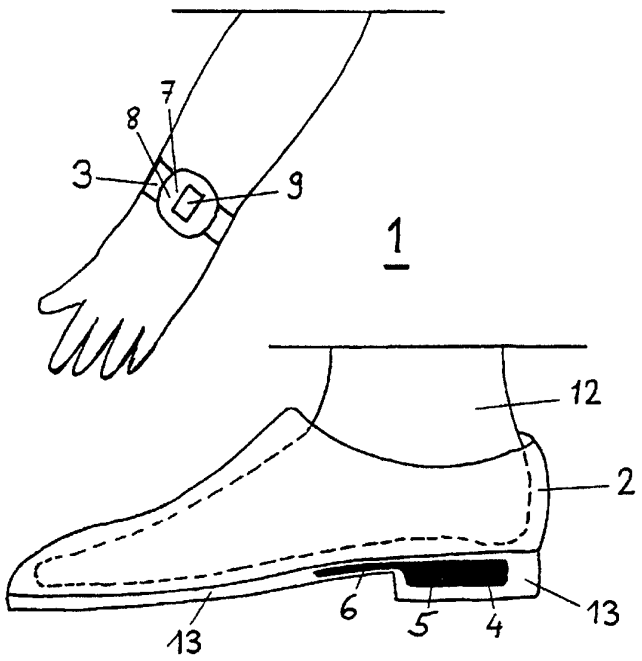

(57) Abstract

In this method for determination of the weight of human body force or pressure exerted by the foot (12) of the human body on supporting means (13) of the foot (12) is measured by sensing means (5) incorporated in a shoe (2) generating an electric signal proportional or analog to said force or pressure. The signals are transmitted to a remote area where they are indicated in the form of body weight data on the display (9) of a wrist watch (3).

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METHOD FOR DETERMINATION OF THE WEIGHT OF HUMAN BODY AND DEVICE FOR PERFORMING THE METHOD

FIELD OF THE INVENTION

This invention relates to a method for determination of the weight of human body and a device for performing it. It can be used also for the determination of loads carried by a person by differential measurement.

BACKGROUND ART

A large variety of body weight scales are available which, however, are stationary and not designed for permanent determination of the body weight during normal walking or sporting activities.

Especially for diet patients it is desirable to know at any time and at any location the exact body weight in order to take decisions regarding food up-take or sporting activities.

SUMMARY OF THE INVENTION

The invention as claimed solves the above described problems by providing a method for determination of the weight of human body which can be performed permanently according to the actual needs.

Suitable sensors can be chosen from a variety of compression and tension force sensors available on the market and discussed in detail in Günter W.Schanz, "Sensoren, Fühler der Messtechnik", Dr.Alred Hütig VErlag, Heidelberg, 1986, in particular on pages 270 - 325.

The preferred piezoresistive or piezoelectric pressure transducers convert pressure exerted by the foot of the human body into an electric signal. The pressure transducer is connected either by wire or wire-less to a pressure measuring and indicating apparatus. This apparatus may comprise a digital voltmeter which receives the force-proportional signal from the pressure transducer.

In a preferred embodiment of the invention the pressure transducer (one or several) are embedded in a shoe insert which can easily be inserted in and removed from the shoe. Arranging several pressure transducers over the whole area of the foot contact allows for compensation of non-uniform application of force to the supporting means of the foot. Preferably the pressure transducers are then distributed in a matrix array over

a suitable force measuring carpet which may have the form of a shoe insert. The electric signals derived from such a matrix array will then be supplied to an evaluation apparatus which calculates the exerted total force, transforms it into body weight of the person exerting such a force and indicates the body weight on a suitable display, e.g. a wrist watch.

The preferred piezoresistive or piezoelectric pressure transducers may be replaced by a strain gauge connected in a Wheatstone bridge or any other appropriate pressure sensor.
The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming part of this disclosure. For the better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings, examples and descriptive matter in which are illustrated and described preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

Fig. 1 is a schematic perspective view of a device for performing the method according to the invention; and

Fig. 2 shows a block diagram of a device for performing the method according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows a device 1 for performing the method according to the invention, incorporated partly in a shoe 2 and partly in a wrist watch 3 on the optical display 9 of which the body weight data are permanently displayed. The pressure exerted by a persons foot 12 on the sensing means 5 in the form of a pressure sensor incorporated in the supporting means 13 (i.e. the sole) of shoe 2 is used for continuously obtaining body weight data of the person of which the body weight shall be monitored.

The device 1 of Fig. 1 is explained more in detail with reference to Fig. 2; it consists of an electrical power supply battery 4 connected to a piezoresistive sensor 5 which in turn is connected to a transmitter 6 which generates infrared light for transmitting the data wireless to the wrist watch 3 which contains to this effect a receiver 7, a microprocessor 8 (with a RAM and a ROM) and an optical display 9.

The display 9 indicates the body weight data by means of a LCD or LED arrangement. In case that only one sensor 5 is used in the shoe 2 there is the need of statistical processing of the

data measured, in order to obtain an average of the body weight of the person wearing the shoe 2. This can be effect by the Gauss equation called $\exp(x^2)$.

Instead of using wireless transmission of the data it is possible to use a cable of course.

Preferably an active charge amplifier 10 which functions as a signal preamplifier may be used. The preamplifier may be arranged in or on the sensor 5.

The wireless transmitter 6 can take the form of a high-frequency transmitter, the carrier signal of which is modulated by the measurement signal (input). In a further embodiment the wireless transmitter 6 can take the form of an infrared or laser transmitter device. A digital signal transmission is particularly advantageous.
In low power supply situations, the digital sensor data can also be transmitted via optical waveguide cables.

For digital transmission of the sensor signals the analog measurements signals of the sensor 5 must be converted into digital signals by means of a converter 11. Various methods are sufficiently known from the state of the art. For this purpose it is of advantage to provide for serial output of the digital values of the converter 11, since a parallel output necessitates additional expense as regards transmission devices.

Preferably the signal preamplifier 10 and the analog/digital converter 11 are combined into a single functional unit; e.g. by using a charge/frequency converter in which the charge amount of the mechanoelectrical converter is directly converted into a frequency-proportional signal.

With the embodiment of the invention shown in Figs. 1 and 2 as a sensor 5 an absolute pressure sensor is used, for instance the absolute pressure sensor KPY 14 manufactured by Siemens AG, Munich (Germany).This absolute pressure sensor is embedded in an elastomeric material in such a manner that there is no essential contact of the absolute pressure sensor (when inserted in the shoe) to either the foot or the shoe sole. This results in a uniform pressure distribution and good protection of the absolute pressure sensor 5, any compensation resistors, cables and of the transmitter 6 against environmental influences in particular against penetration of gases, humidity and sweat.

In another embodiment the sensor 5 is configured as a transducer diaphragm. This leads to an extremely compact and light-weight sensor 5 being in no way an obstruction when inserted in the shoes 2 of a person. It is, therefore, possible with no problem whatsoever to carry out body weight measurements on the wearer under dynamic loading conditions.

While the foregoing description and drawings represent the preferred embodiments of the present invention, it will be obvious for those skilled in the art that various changes and modifications may be made therein without departing from the true spirit and scope of the present invention.

Claims

1. Method for determination of the weight of human body, characterized in that force or pressure exerted by the foot (12) of the human body on supporting means (13) of the foot (12) is measured by sensing means (5) generating an electric signal proportional or analog to said force or pressure, said signal being transmitted to a remote area where it is indicated in the form of body weight data.

2. Method according to claim 1, characterized in that said force or pressure measurement and said body weight indication is performed in a permanent way.

3. Method according to claim 1 or 2, characterized in that said body weight data are visually displayed.

4. Method according to one of the claims 1 to 3, characterized in that said supporting means (13) of the foot (12) are shoes (2), shoe inserts or socks.

5. Method according to one of the claims 1 to 4, characterized in that said body weight data are indicated on a wrist-watch (3), bracelet, magnetic card, credit-card or hand-held receiver.

6. Method according to one of the claims 1 to 5, characterized in

that said sensing means (5) is a sensor responsive to static and dynamic compression and tension, preferably a piezoresistive or piezoelectric sensor.

7. Method according to one of the claims 1 to 6, characterized in that said signal is transformed to body weight data in the foot area and subsequently transmitted to the remote area for indication.

8. Method according to one of the claims 1 to 6, characterized in that said signal is first transmitted to the remote area and subsequently transformed to body weight data in said remote area for indication.

9. Method according to one of the claims 1 to 8, characterized in that transmission of said signal is performed electrically, electromagnetically or optically.

10. Method according to one of the claims 1 to 9, characterized in that additionally to the foot force or pressure other body data, preferably body temperature, blood pressure or number of foot steps, are measured and indicated in said remote area.

11. Method according to one of the claims 1 to 10, characterized in that said body data are stored in a memory and used for comparative purposes and for elaborating statistic data.

12. Method according to one of the claims 1 to 11, characterized in that said force or pressure measurement and said body weight indication is calculated from a statistical function, for the average of the body weight, called Gauss equation by terms of $y = \exp(x^2)$.

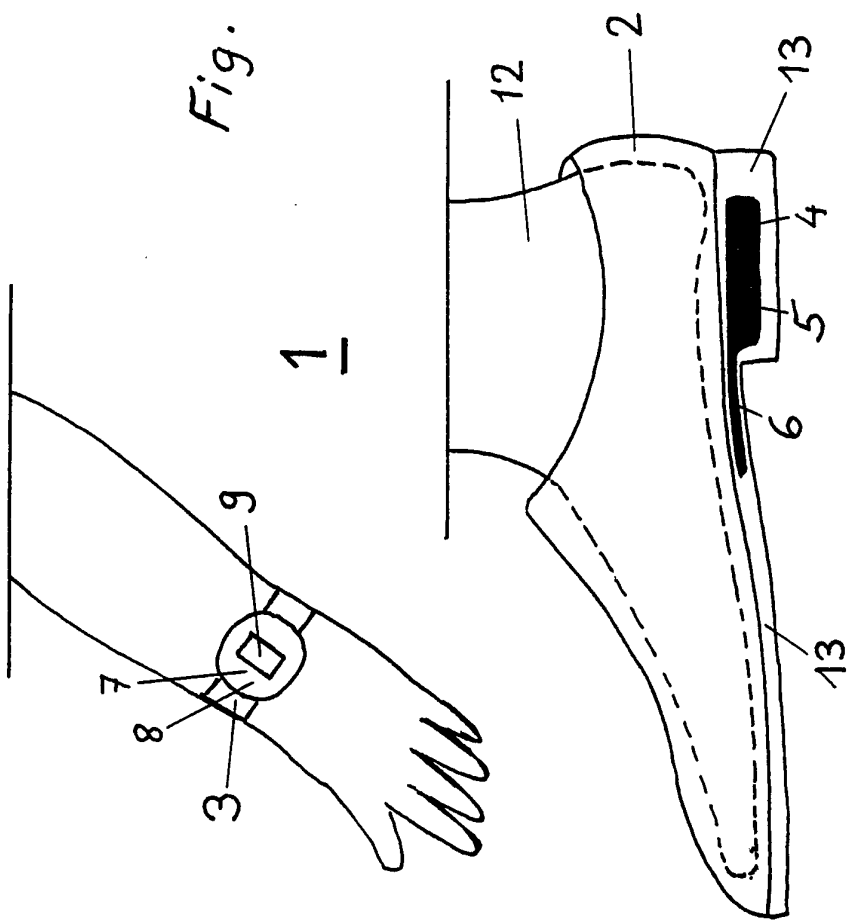
13. Device for performing the method according to one of the claims 1 - 12, characterized by force or pressure sensing means (5) located at supporting means (13) of the foot (12), pressure data transmitting means (6) and indicating means (9) at a remote area.

14. Device according to claim 13 characterized in that it comprises a microchip or microprocessor (8) for storing, transforming, handling, comparing and indicating the signals generated by said force or pressure sensing means (5).

15. Device according to claim 13 or 14, characterized in that the sensing means (5) comprise a plurality of sensors distributed at different locations of the supporting means (13) of the foot (12).

16. Device according to one of the claims 13 to 15, characterized in that the sensing means (5) are arranged or embedded in a shoe insert.

Fig. 1



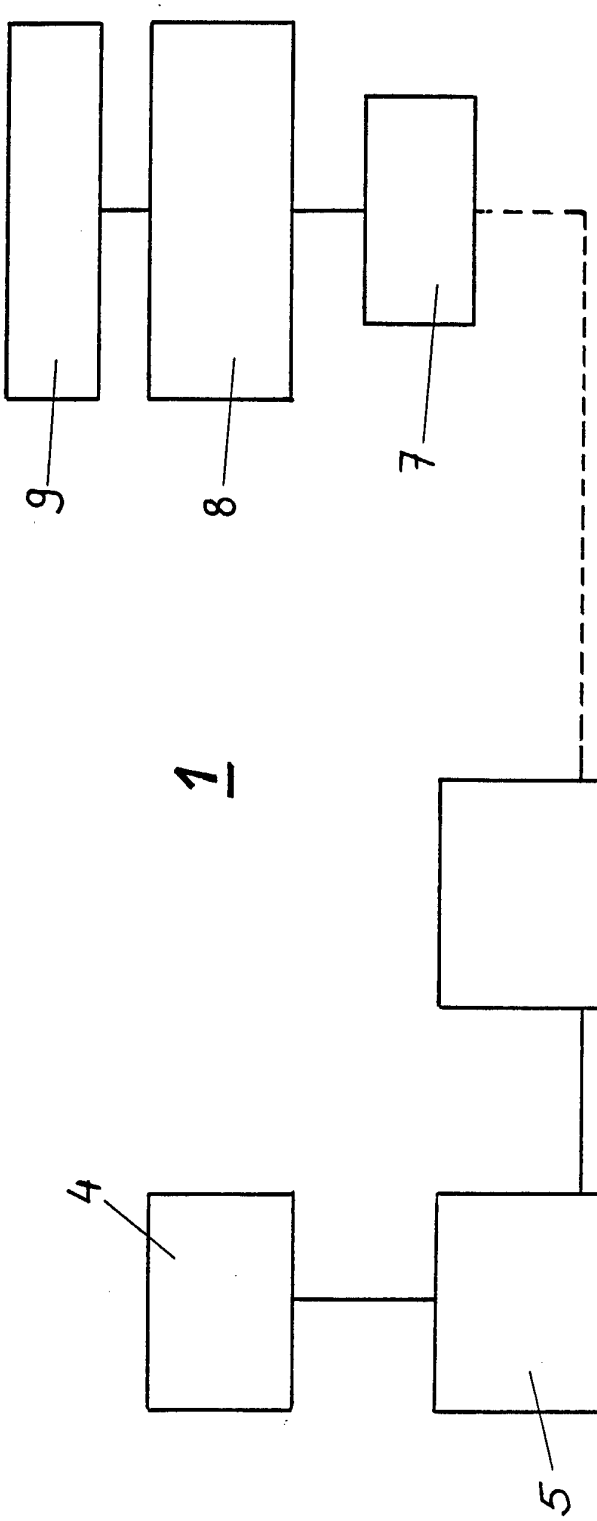


Fig. 2

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/EP 93/03265

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A61B5/103 G01G19/44

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 A61B G01G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO,A,90 00031 (EFFNER GMBH) 11 January 1990 see page 3, line 1 - page 5, line 18 see page 6, line 21 - page 7, line 7; figures 1,2	1-11, 13-16
X	DE,A,37 32 891 (TETRON DEVELOPMENTS GESELLSCHAFT FÜR INNOVATIVE TECHNIK MBH) 20 April 1989 see the whole document	1-6,9, 13,16
X	WO,A,89 01760 (NYBERG) 9 March 1989 see page 3, line 1 - line 33; claims; figure	1-3,7-9, 13

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
22 July 1994	31.08.94

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inte ›nal Application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9000031	11-01-90	DE-A- 3827999	11-01-90
		EP-A- 0377714	18-07-90
DE-A-3732891	20-04-89	NONE	
WO-A-8901760	09-03-89	AU-A- 2329688	31-03-89