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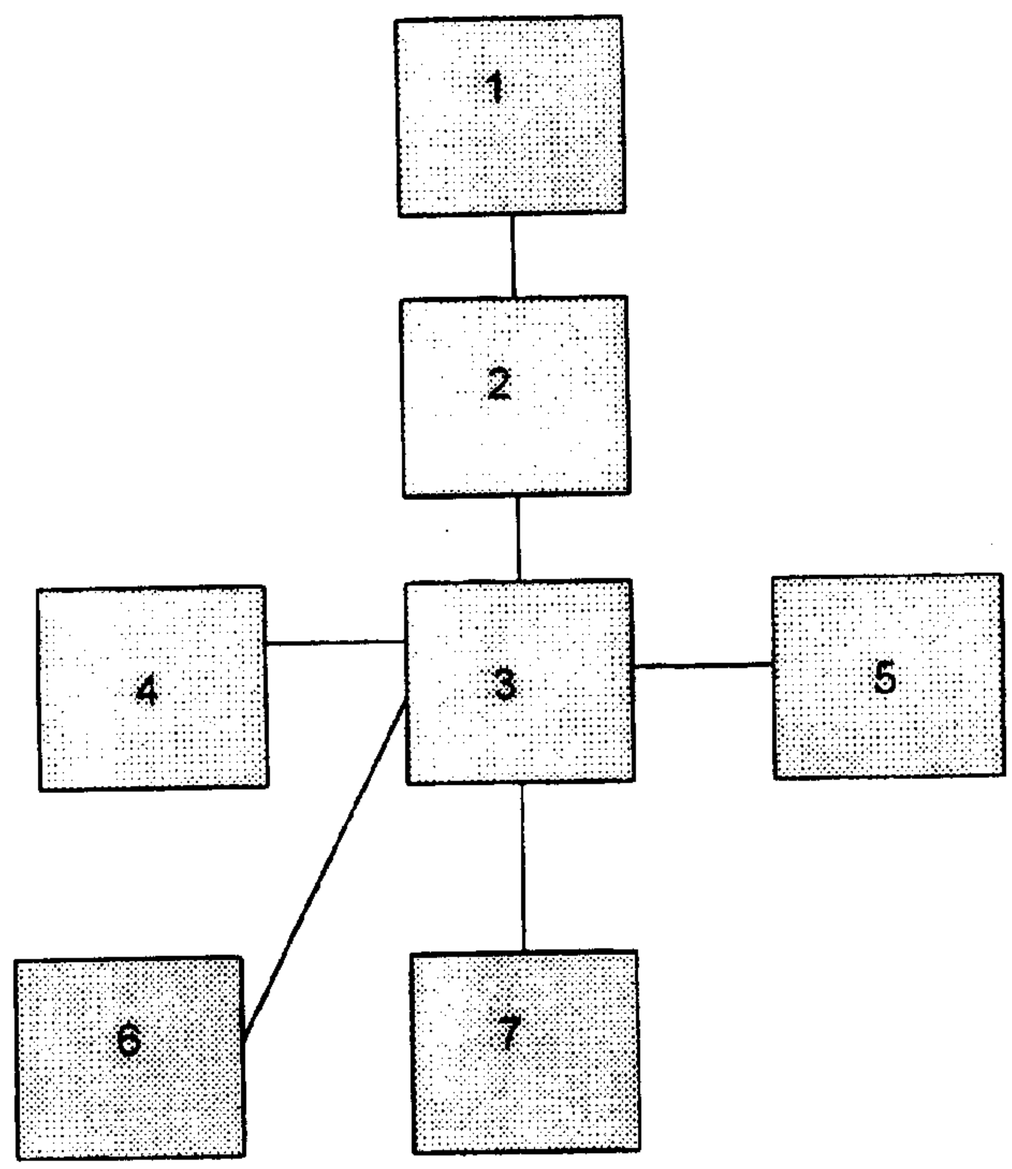


(57) Abrégé/Abstract:
The invention relates to a method and a device for determining the physical performance of persons at a given moment. According to the invention the person's heart rate is determined continuously and from the heart rate determined in this way and the speed of the person a quantity expressing the physical performance of said person is calculated. The speed is detected by a radar device (1) carried by the person by evaluation of a Doppler signal and together with the heart rate data is analyzed further in a computing unit (3). The measurements can be carried out anywhere so that the athlete concerned is completely independent of outside assistance or auxiliary devices.

ABSTRACT

The invention relates to a method and a device for determining the physical performance of persons at a given moment. According to the invention the person´s heart rate is determined countinously and from the heart rate determined in this way and the speed of the person a quantity expressing the physical performance of said person is calculated. The speed is detected by a radar device (1) carried by the person by evaluation of a Doppler signal and together with the heart rate data is analyzed further in a computing unit (3). The measurements can be carried out anywhere so that the athlete concerned is completely independent of outside assistance or auxiliary devices.

DETERMINING THE PHYSICAL PERFORMANCE OF A PERSON

The invention relates to a process and a device which directly establishes the current physical performance capability of people while training, in which the heart rate is constantly determined and from the determined heart rate and the speed of movement of the person a figure is calculated which expresses the performance capability of that person. The speed of movement of the person is recorded from the signals which come from the radar device the person has with him/her and calculated by means of a calculating device which the person also has with him/her.

A minature radar speedometer, which is worn directly on the body and which records the current speed of a moving person by recording and evaluating the Doppler effect, is well-known from the US-PS 4,757,714.

A mobile measuring device worn directly on the body to record the heart rate is well-known from the US-PS 4,566,461. In this case the heart beat is recorded by means of a breast strap and transmitted to a device worn on the wrist.

What is important in the evaluation of the stamina performance capability of a sportsperson is the heart rate-deflection point also called the anaerobic threshold. In order to determine this the point is established in the heart rate-speed diagram, from which with increasing strain. e.g. increasing running tempo, the heart rate can no longer increase in a linear fashion. If the body is strained to this point, the oxygen taken in through the lungs and the blood into the muscles is sufficient to break down the lactate produced in the conversion of energy to the same extent to which it is produced. This is also known as sufficient aerobic energy provision. As far as this intensity is not increased, there is a lactate-balance. The anaerobic threshold shows the maximum speed with which the strain can be endured over a longer period. If this speed is increased to over the anerobic threshold, then there will be an increase in lactate, which can no longer be completely broken down.

In order to establish the anaerobic threshold a so-called Conconi-Test or a Lactate-Threshold Test is carried out. The Conconi-Test is a very simple non-invasive method to establish the anerobic threshold, whereby a heart rate speed diagram is produced. The sportsperson moves on a closed off running track. He/she must start with 8 to 12 km/h increasing his/her speed by 0.5km/h every 200 meters. The heart rate is recorded for the duration of the test. The test Is over when the sportsperson can no longer keep to the given speed. In order to determine the speed a time card is used or in modern tests a loud speaker which, according to the speed, gives off a signal every 20 meters. On the track, bollards have been set up every 20

meters. The sportsperson only has to ensure that he/she runs past a bollard every time he/she hears the signal.

In the case of the Lactate-Test blood is taken from the body during the endurance period. In practice the test is carried out with the runner moving on a closed running track. The runner is given the running tempo by means of time cards. After a given running time the lactate content in the blood is measured. The speed is gradually increased. The heart rate is recorded for the duration of the test. The test is over when the sportsperson can no longer keep to the given speed. The heart rate and the lactate content are recorded in a diagram. When the anaerobic threshold is exceeded there is a great increase in the lactate content. This method however requires the presence of a doctor and is therefore rather inconvenient for the sportsperson.

A further disadvantage of these tests is that the sportsperson is tied to one place and additional personnel are also required in order to carry out the tests.

It is also very important especially for the competitive sportsperson to be able to establish that day´s performance capability and/or the recovery time in order to choose the endurance training correctly.

Apart from the length of time needed for the above-mentioned methods in recording the current performance capability, they are also tied to a particular place because of the additional stationary devices required for the establishing of the data.

It is therefore the task of this device to create a process and a device to establish the current performance capability, which is not tied to one place and which requires no additional stationary devices, as well as doing without the medical aid. The invented process and the device should enable the sportsperson to receive the required information concerning his/her performance capability during the training without additional aids.

This task is solved by means of a process, which shows the charcateristics of claim 1.

The invented device consists of a minature speedometer which establishes the distance covered and the current speed, from the current heart rate and by means of a calculating device which records the values from the signals given by the transmittor and from the heart rate monitor, thereby calculating the required values, whereby all the components are registered on a device worn directly on the body of the sportsperson.

This device itself registers the following data:

* the current speed, in km/h, m/sec or miles/h.
* the distance covered by means of a daily kilometer counter or total kilometer counter and
* the current heart rate via a normal ECG pulse monitor.

The current performance in particular (in watt) and the daily energy consumption (in kJ or kcal) as well as the average speed and the maximum speed can be determined from this data.

It is of course possible to transmit the stored data to any data processing unit in order to carry out a more detailed analysis as in the more conventional way, whereby the speed of a skiier over several relay stations on the piste can be transmitted and shown directly on tv.

The advantages of the invented process and device are that a determining of the current threshold can be carried out, whereby the sportsperson is permanently controlled in his/her speed via the display of the invented device. It is completely independent of the place where the threshold is established and it can be established without any additional aids or help. As soon as the anerobic threshold has been exceeded the device finishes the test and informs the sportsperson of his/her speed and his/her heart rate at this anaerobic threshold. The corresponding speed serves to evaluate the performance capability and the corresponding heart rate serves as a stopping point for future training plans.
Furthermore the device is capable of showing the gradient of the heart rate course at the speed as an index for the current recovery time or the resilience of the sportsperson. Depending on the form of training in the past days or weeks the gradient of the heart rate course changes. Should the sportsperson approach "over training" then the maximum heart rate sinks, the relaxed rate increases. As a result the line of regression becomes flatter. In the other case the line of regression becomes steeper following a period with a low extent of training.

This recovery or resilience index can also be calculated without exceeding the anareobic threshold. With the position of the line of regression (three to five heart rate points are transmitted at low speed) a possible change in the position of the anaerobic threshold can be calculated compared to the previous test, without running through it.

Should the maximum heart rate be recorded in the calculating device on the basis of the generally used rule of thumb (max. heart rate = 220 - age) or on other experience values, the anaerobic threshold can also be calculated with acceptable exactness based on the line of regression, without the person having to run over this anaerobic threshold and thereby preventing over-exertion. This is a great advantage especially in the case of older or sick people.

Furthermore if the line of regression is transmitted at the beginning of the training the drop in performance compared to the beginning of the training can be calculated and be presented in order to prevent over-exertion.

By establishing the maximal performance capability of the day without having to run the anaerobic threshold, it will be possible to acheive an increase in performance without overexerting the organism during a longer training programme. The invented device and process have a very wide field of application. They are suitable for competitive sportspeople for example who basically carry out their sport without aids. These are sports such as running, skiing, track and field athletics, tennis, football, ice hockey, ice skating. It can also be used advantageously in sports diagnostics in the evaluation of performance. It is of particular advantage in rehabilitation in the registering and displaying of the progress in performance or in the protection of a possible over-exertion of the organism.

The device is shown in the following diagram. In this a signal of a certain frequency is pointed diagonally at the floor via a microwave module 1. As in the Doppler effect the microwaves reflected on the floor undergo a linear change in frequency according to the running speed. The Doppler-frequency is separated in the microwave module 1 via a mixed or filter via the reflection signal. In the signal preparation module 2 the Doppler-frequency is increased and filtered. The diagonal frequency of the filter can be freely adjusted by the user. The Doppler-signal is adjusted to a preferred level of speed by limiting the frequency range. Should the sportsperson run for example along a street then he/she can prevent the radar device from recording the passing cars, thereby falsifying the distance covered and showing false readings. Should he/she choose for example 25 km/h as the maximum speed limit , then the sources of disruption on the street are eliminated. Following the filtering, the Doppler-signal is changed into a rectangular signal via a Schmitt-Trigger and transmitted to the micro-controller 3. Here the current speed is determined according to the following formula:

$f_d = ((2v_o \times f_o) / c) \times \cos a$

whereby: f_d = Doppler-frequency

v_o = Running speed c = Speed of light

f_o = Transmittor frequency a = Angle of reflection

The distance covered can be transmitted from the number of rectangular impulses. The heart rate impulses are received in Block 4 and transmitted to micro-controller 3 to calculate the heart rate. The results of the calculation in micro-controller 3 can be shown as desired on display 5. A signal 6 and input area 7 complete the invented device.

PATENT CLAIMS

1. Process to establish the current physical performance capability of people, by which the heart rate and the speed of movement is constantly determined, characterized by the fact that the performance capability of people in form of the anaerobic threshold is determined by a mobile device, worn by that person, with integrated heart rate measuring device and radar device to determine the speed of movement of the person, through slow leading up and controlled passing by the threshold.

2. Process according to claim 1, characterized by the fact that the physical performance capability is recorded over a longer period and the change in the performance capability is recorded as compared with an earlier point in time.

3. Process characterized according to claims 1 or 2 that the momentary performance is calculated from the calculated speed and the registered weight and sex of the person.

4. Process characterized by one of the claims 1 to 3 that from the registered values given from the measured heart rate and from the calculated speed of movement further relevant values such as the daily energy consumption, the present speed of movement, the average speed , the maximum speed and the distance covered are calculated and shown on a display.

5. Process characterized by one of the claims 1 to 4 that the extent which the performance capability expresses is immediately calculated during the training and shown on a display.

6. Process characterized by one of the claims 1 to 5 that during the training optical and /or acoustic signals are transmitted from the calculating device to the person, which regardless of the measured heart rate and speed of movement lead the person to increase or decrease the speed of movement and that the calculating device constantly compares these guidelines with the present measurement and calculation values.

7. Process characterized by one of the claims 1 to 6 that the resilience or recovery condition of a person can be calculated by means of the gradient of the line of regression by his/her own heart rate frequency at low speed without exceeding the anaerobic threshold.

8. Process characterized by one of the claims 1 to 6 that by means of the gradient of the line of regression a change in the anaerobic threshold as compared to the previous test can be transmitted.

9. Process characterized by one of the claims 1 to 6 that the drop in performance can be shown by means of the heart rate at a certain speed of movement in relation to the line of regression from the beginning of the training.

10. Process characterized by one of the claims 1 to 6 that the anaerobic threshold is calculated (without having to run through it) by means of the line of regression and the input of a maximum heart rate.

11. Device to determine the present physical performance capability of people with a sensor in order to record the heart rate and a calculating device to determine the anaerobic threshold, which the present physical performance capability of a person is expressed, characterized by the fact that the person must be wearing a radar device, which is connected to the calculating device.

12. Device according to claim 11 characterized by the fact that a filter is installed in the receiving part of the radar device, with which disruptive signals are eliminated.

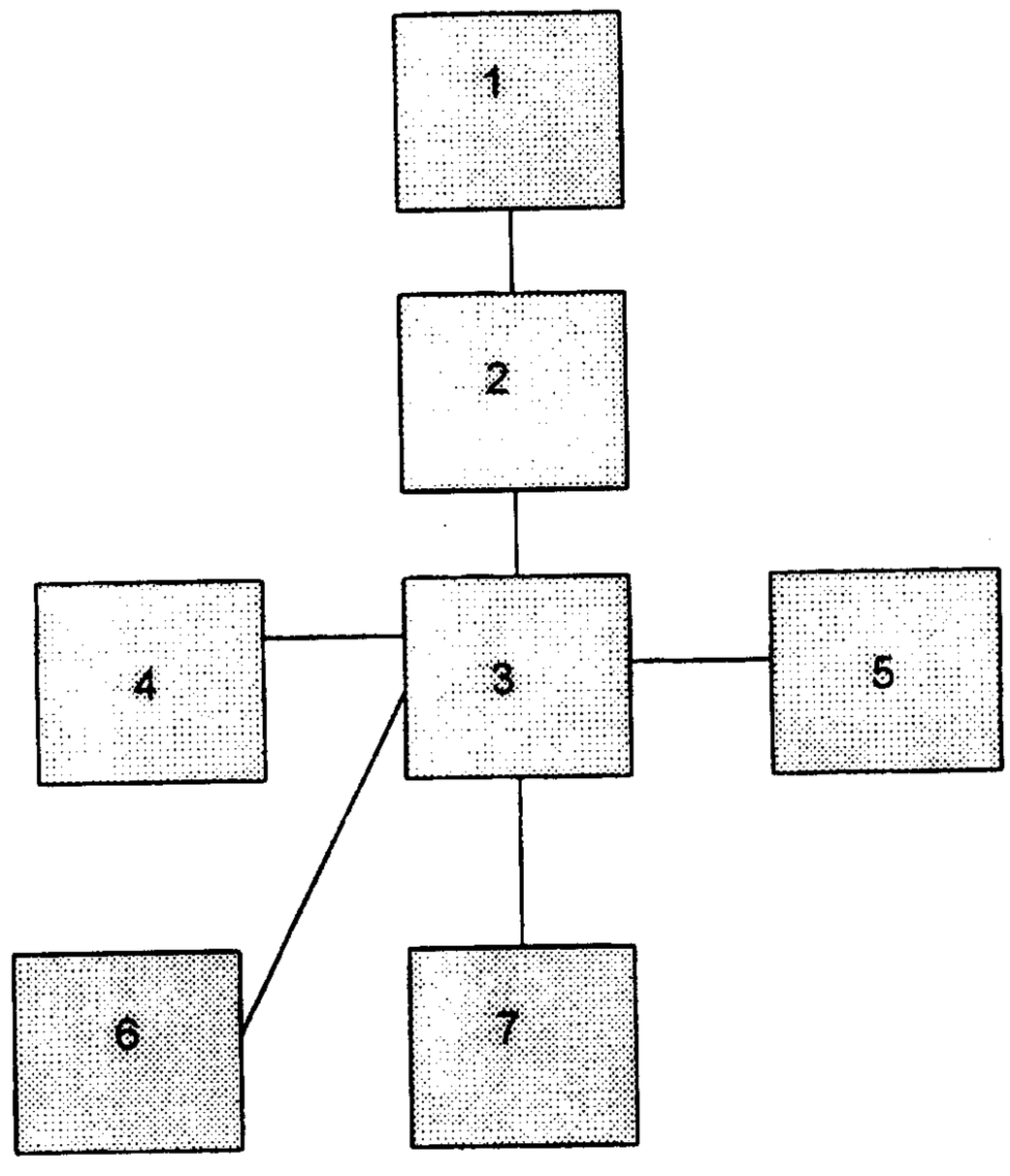
13. Device as characterized in one of the claims 11 or 12 that a memory is installed, which is required for the acceptance of measured values and calculated figures over a pre-determined period of time.

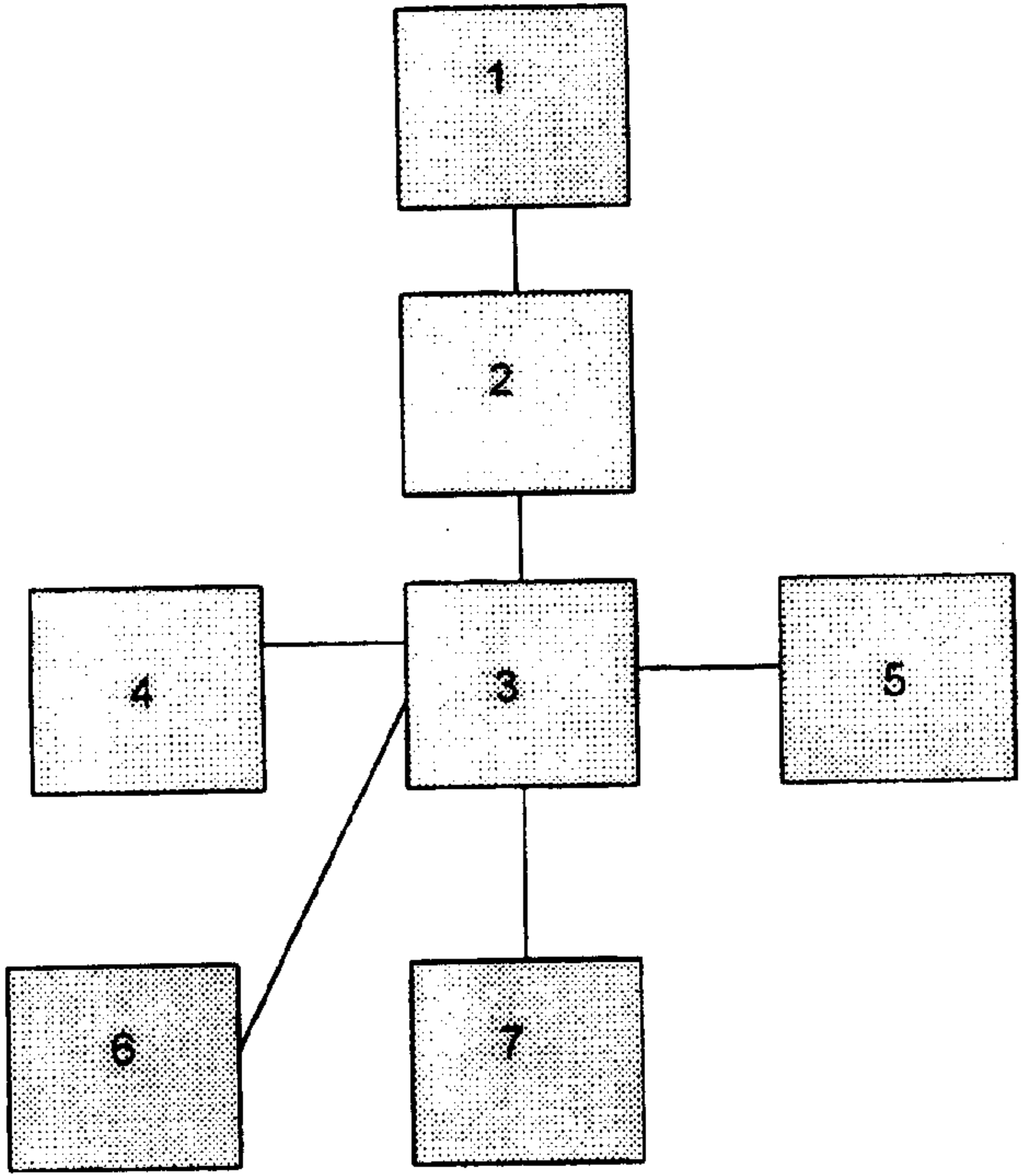
14. Device as characterized in one of the claims 11 to 13 that a display unit is installed, which shows the extent to which the physical performance capability of a person is expressed and if necessary also shows further measured and calculated values.

15. Device characterized in one of the claims 11 to 14 that an input unit is also installed in order to be able to put in data such as the sex, age and the weight of a person.

16. Device characterized by one of the claims 11 to 15 that a transmittor is installed in order to transmit the measured values or calculated values of a person to an external receiving device.

Zeichnung 1/1

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