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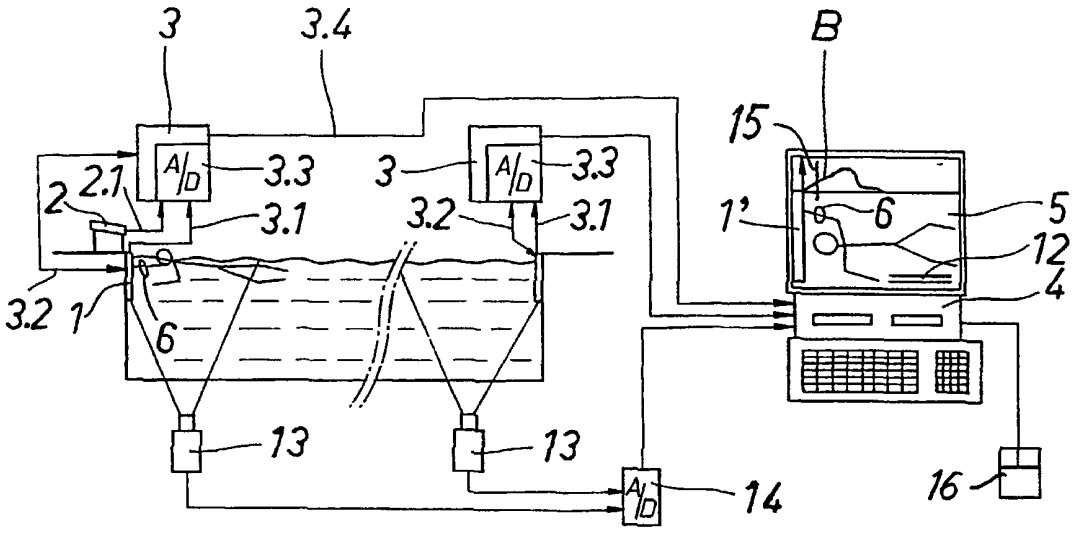
(54) Title: SWIMMING ANALYZER



(57) Abstract: The invention relates to a swimming analyser which comprises a touch sensor (1) located at the end of a swimming pool, the sensor being in data communication (3.1, 3.3, 3, 3.4) with a data collection device (4) equipped with a display (5), the device being provided with a program for displaying the data obtained from the touch sensor (1) on the display (5). The signal received from the touch sensor (1) is dependent on the contact force and/or the duration of the contact time and is arranged to be displayed on the display (5) as a time-function curve (B) and/or as numerical values (12). The touch sensor (1) may be an EMF film.

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Swimming analyser

The invention relates to a swimming analyser which comprises a touch sensor located at the end of a swimming pool, the sensor being in data communication with a data collection device equipped with a display, the device being provided with a program for displaying the data obtained from the touch sensor on the display.

From US patent publication 5,812,049 is known a monitoring system which measures swim time, the system also comprising an apparatus for identifying the swimmer and determining his location. By means of this known system, the swim times, including intermediate times, and swimming distances of different swimmers can be monitored in a diversified manner. This is based on the operation of a touch sensor which starts a clock in response to each touch and at the same time identifies the swimmer by means of a transmitter-receiver antenna associated with the touch sensor.

This known system does not, however, make it possible to analyse the swimmer's turning and start dive events from the training point of view, so that any deficiencies and errors relating to performance technique could be detected and eliminated. Today, assessments based on conventional video images and the subjective view of the trainer are used for this purpose.

The aim of the invention is to provide a swimming analyser which is suitable for analysing a swimmer's turning and/or start dive events, in addition to performing various time and distance measurements, by means of exact information, without having to rely on subjective assessment.

This aim is achieved by means of the invention, on the basis of the characteristics disclosed in the appended claim 1. The dependent claims describe preferred embodiments of the invention.

One embodiment of the invention is described in the following, with reference to the appended drawings, in which

Figure 1 shows a general diagram of the swimming analyser according to the invention;

Figure 2 shows diagrammatically, as a function of time (t), the curves (A, B, C) of the forces relating to the turning and start dive events, which can be displayed on the display of the analyser according to the invention;

Figure 3 shows the touch sensor of the analyser according to the invention as seen from one side when the outermost waterproof protective film is removed;

Figure 4 shows a section of Figure 3 along line IV-IV on a larger scale, the thicknesses of the layers being exaggerated for the sake of clarity; and

Figure 5 shows in greater detail one example of the analyser display.

In the embodiment shown, at both ends of the pool is positioned a touch sensor 1, the signal given by which is transmitted via a cable 3.1 and an A/D transformer 3.3 to an adapter unit 3 which converts the signal into a form readable by a PC 4. The adapter 3 is connected by means of a cable 3.4 to a PC 4, the hard disk of which acts as a data collection device. The connection may obviously also function wirelessly through a radio signal or IR signal.

As shown in greater detail in Figures 3 and 4, the touch sensor 1 consists of EMF film comprising a middle layer 8 of flexibly compressible dielectric substance, on both sides of which is a thin metal film 9. The metal films 9 may be, for example, aluminium films formed by vaporisation. The layered structure formed in this way

is laminated between two waterproof surface layers 10. The surface layers 10 may be rubber or plastic film. This type of a sensor structure is previously known in connection with other applications and it is called an EMF film (Electro-Magnetic Foil). It is characteristic of this type of film that when external pressure is exerted on the film, tension forms between the metal films 9, the magnitude of which is proportional to the contact pressure. Inside the film is located a signal amplifier 11, from the output of which is obtained a signal to cable 3.1, which is proportional to the contact force.

Around the contact area, at a distance from the edge of the metal film 9, is formed a transmitter-receiver antenna 7 comprising several conductor loops which consist of, for example, a conductor made of aluminium foil. The antenna 7 functions in the known manner as a transmitter and receiver antenna in such a way that its transmission signal energises an identification tag 6 attached to the swimmer's wrist and/or ankle, which tag - as a result of the energisation - transmits the swimmer's identification code, which the antenna 7 relays to the adapter unit 3. The operating range of the antenna 7 may be only 30 to 40 cm, whereby identification takes place in connection with the contact, for example, immediately before contact with the sensor 1.

When the output signal of the touch sensor 1 is dependent on contact force in the manner described above, the analyser can be used to measure the take-off force used for the turn and the time used for the turn. These can be displayed on the display 5 as a time-function curve B or C, as illustrated in Figure 2. The times t_1 and t_2 may represent the turning times at the opposite ends of the pool, or they may also represent the hand and foot contacts of one turn. In the latter case, total time T_2 refers to the time used for the whole turn. The shapes of curves A, B and C shown in Figure 2 are merely symbolic and may in reality vary in many ways.

The starting block can also be provided with a similar EMF film sensor 2, the signal A received from which and representing the take-off force is led via cable

2.1 and the AD transformer 3.3 to the adapter 3, from which the data is transmitted in digital form to the RS-232 series port of the PC 4.

In addition to analysing the turning and start dive events, the analyser may obviously be used in the manner known from the publication US 5,812,049 for measuring the intermediate times, total time and total distance of the swimming performance.

In the analyser can also be included a digital camera 13 at one or both ends of the pool, which camera films the turning of the competing swimmer. In the case described, video cameras 13 are connected via the AD transformer 14 to the PC 4, on the display 5 of which the image filmed with the camera 13 is arranged to be displayed temporally synchronised with the cursor line 15 pointing at the corresponding point in the curve B, C representing the contact force signal. Synchronisation may take place, for example, in such a way that the moment of contact with the sensor 1 is the sign for starting the displaying of the image and/or for positioning the cursor line 15 on the corresponding point of the force signal curve B or C (e.g. at the beginning of the point of change). The events taking place at the diving-off moment can be depicted in a corresponding manner in connection with curve A which represents the take-off force.

Reference numeral 12 on the display 5 denotes an area in the image field in which the events to be analysed can be shown also as numerical values. As swimming data can be displayed intermediate times, total time and total distance. As turning data can be displayed turning times and maximum forces and average forces in contact. To the PC 4 can obviously also be connected a printer by means of which the data on the swimmers can be obtained as a printout.

In Figure 5, the image field is divided into sectors, of which sector 5a shows the end of one or more swimming lanes, for example, over a distance of 2 to 3 metres. In sectors 5b can be displayed mosaics from different cameras or several successive freeze-frames of the same turning event. Curve B_F is proportional to

the contact force and curve B_T is calibrated to greater sensitivity with respect to the force, whereby the peaks of the curve are cut off and curve B_T illustrates contact time T more clearly. The vertical cursor line 15 slides in the horizontal direction and shows on curves B_F and B_T the corresponding point where the swimmer is in image sector 5a. The arrow cursor (not shown) of the mouse 16 can be used to drag the line cursor 15 and move it back and forth, thus moving the swimmer in image 5a correspondingly. The arrow cursor of the mouse 16 can also be used to drag the swimmer in image 5a and to move the swimmer temporally to different places, that is, to different stages of the performance, whereby the line cursor 15 moves correspondingly. In field 12F is shown numerically the sensor force corresponding to the line cursor 15, for example, in Newtons, and in field 12T is shown numerically the total contact time T and the period of time from the beginning of the contact to the line cursor's 15 respective position. In this way, the turning event can be analysed accurately and clearly in all swimming events, irrespective of whether hand contact, foot contact or double contact is in question.

The PC's operating system may be, for example, Windows NT, and the software can be implemented, for example, by means of the Visual C++ software environment.

The touch sensor 1 can be realised also by means of other types of sensor solutions than the EMF film described. For example, strain-gauge transducers or sensors realised with a piezoresistive substance, which also give out a signal proportional to the contact force and/or the length of the contact period, may also come into question.

Communication from the adapters 3 to the analysing computer 4 may also take place wirelessly by radio. This is easy to implement in an open indoor swimming pool space, and existing short-range radiocommunication modules are inexpensive.

At the end of each lane are several touch sensors side by side so that the area surrounding one antenna loop can be kept sufficiently small. This is necessary for maintaining the energy and data transfer between the tag fastened to the wrist or ankle and the antenna sufficiently sensitive. To prevent the antennae from consuming transmit power unnecessarily, they are arranged to be activated for a set period - the length of which may be adjustable - following contact with he EMF film sensor.

Claims

1. A swimming analyser which comprises a touch sensor (1) located at the end of a swimming pool, the sensor being in data communication (11, 3.1, 3.3, 3.4) with a data collection device (4) equipped with a display (5), the device being provided with a program for displaying the data obtained from the touch sensor (1) on the display (5), **characterised** in that the signal received from the touch sensor (1) is dependent on the contact force (F) and/or the duration of the contact time (t_1, t_2, T) and is arranged to be displayed on the display (5) as a time-function curve (B, C) and/or as numerical values (12).

2. A swimming analyser as claimed in claim 1, **characterised** in that the touch sensor (1) consists of EMF film comprising a layer (8) of flexibly compressible dielectric substance, and on either side of it a thin metal film (9), especially an aluminium film layered by means of vaporisation.

3. A swimming analyser as claimed in claim 2, **characterised** in that around the touch sensor area, at a distance from the metal film (9) of the touch sensor, is formed a transmitter-receiver antenna (7) of the loops formed by the metal film conductor.

4. A swimming analyser as claimed in any of the claims 1 to 3, **characterised** in that the image from the video camera (13) or digital camera filming the turning area is arranged to be displayed on the display (5) of the said data collection device (4).

5. A swimming analyser as claimed in any of the claims 1 to 4, **characterised** in that the video image or digital image is arranged to be displayed temporally synchronised with the cursor line (15) indicating the corresponding point in the curve (B, C) representing the contact force signal.

6. A swimming analyser as claimed in any of the claims 1 to 3, **characterised** in that data communication with the data collection device (4) is implemented wirelessly through radio.

7. A swimming analyser as claimed in claim 3, **characterised** in that the antenna (7) is arranged to be activated through contact with the touch sensor (1).

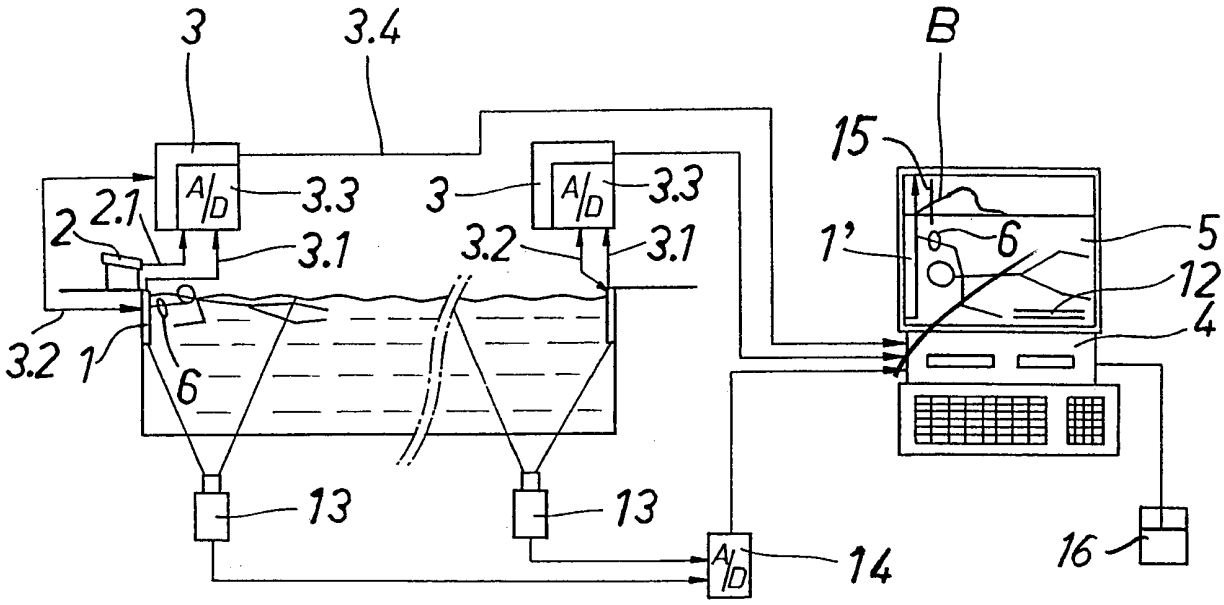

Fig. 1

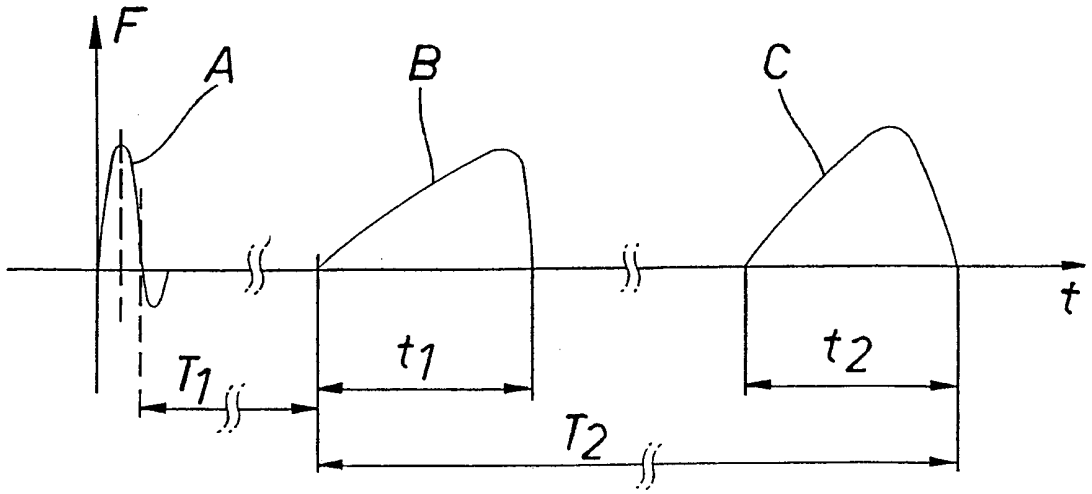

Fig. 2

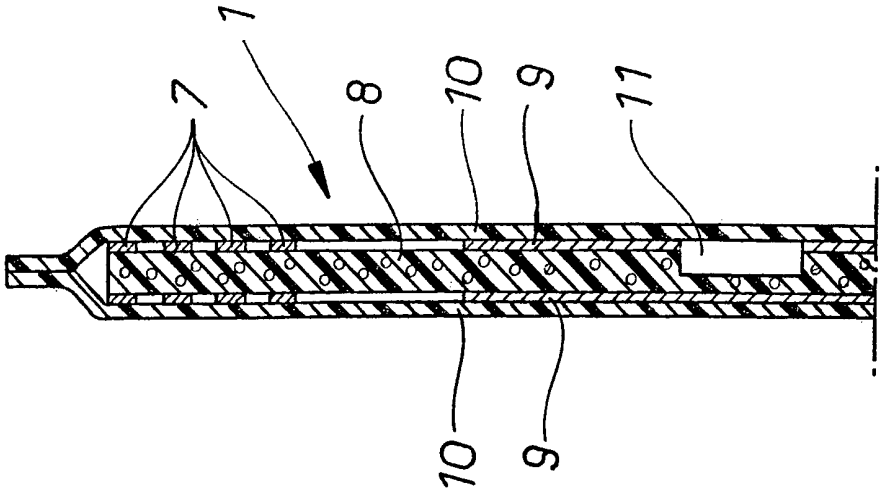

Fig. 4

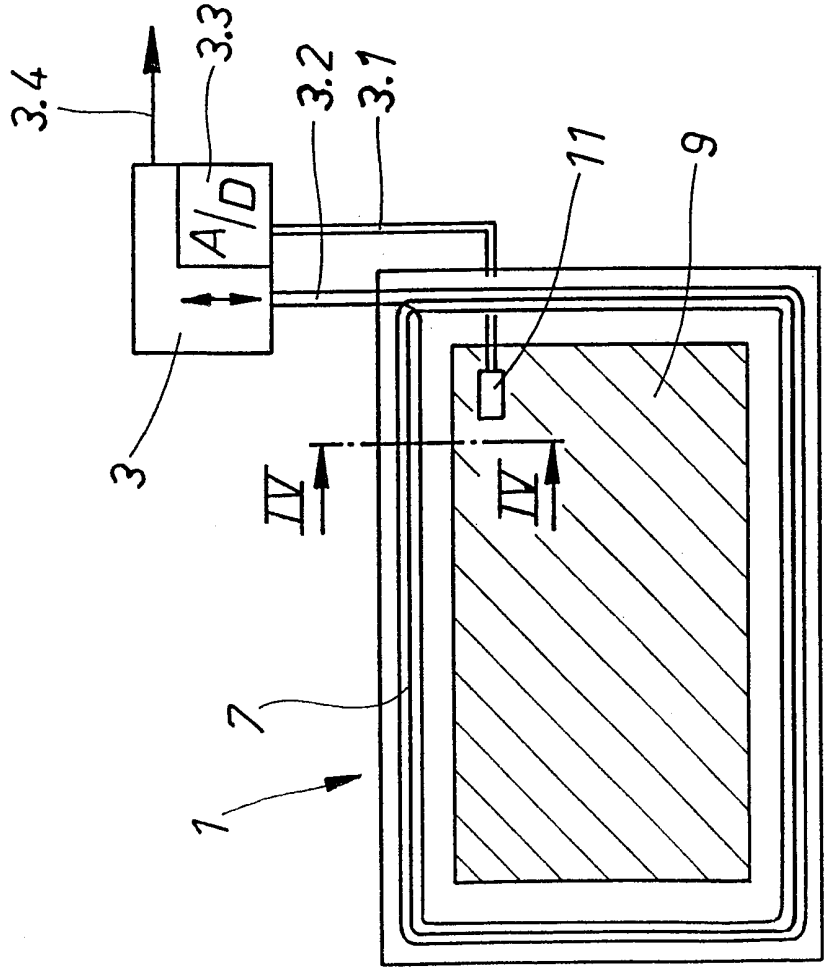

Fig. 3

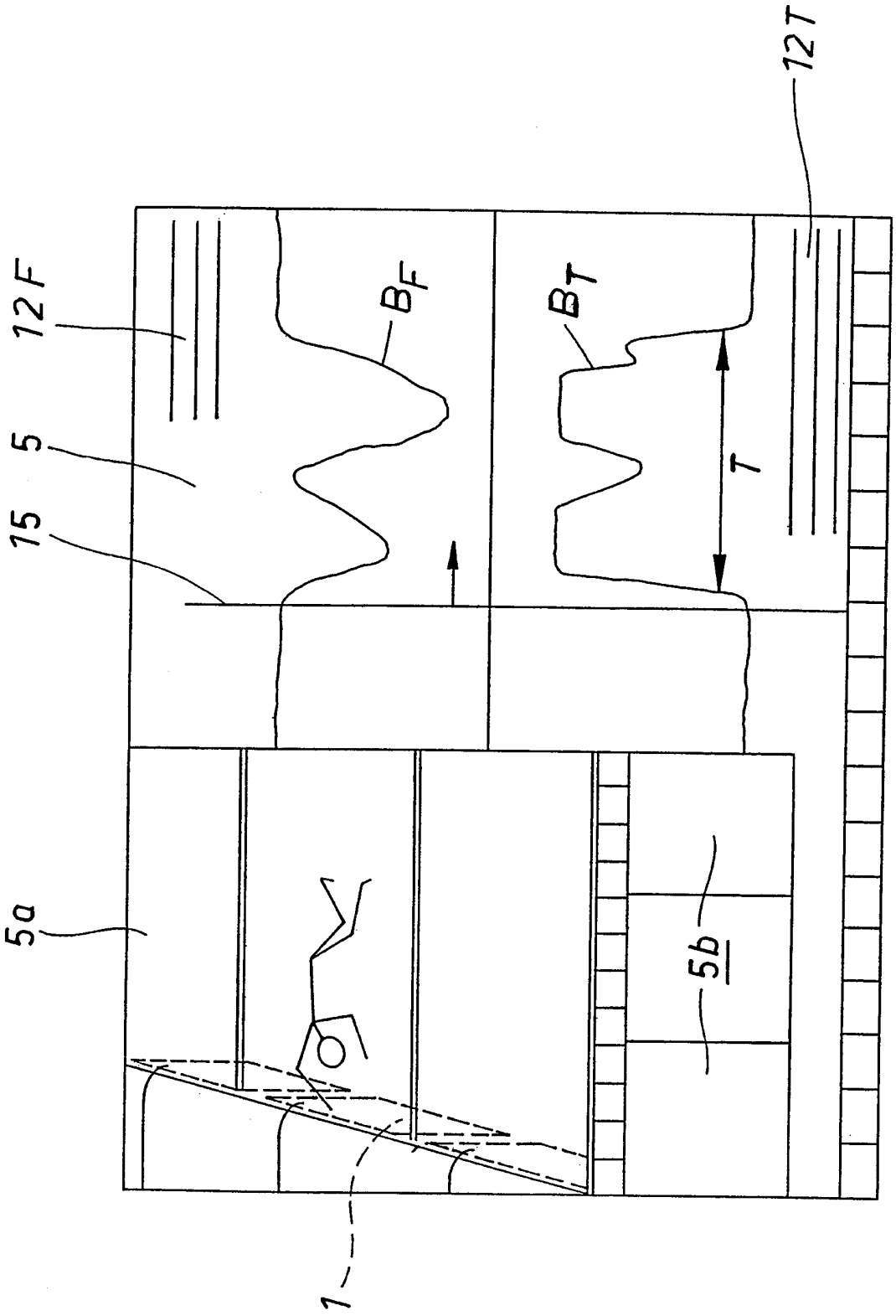

Fig. 5

INTERNATIONAL SEARCH REPORT

Intern..onal application No.
PCT/FI 00/00732

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: G07C 1/22, A63B 71/06
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)

IPC7: G07C, A63B

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

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, 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.
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Y	DD 294787 A5 (GREISER, SIEGBERT), 10 October 1991 (10.10.91), whole document	1
A	AU 1395592 B (GLEN CHARLES GANNON ET AL), 20 January 1994 (20.01.94), whole document	1-7
A	US 4780085 A (MALONE), 25 October 1988 (25.10.88), whole document	1-7

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
18 December 2000	20 -12- 2000
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Inger Löfving / JA A Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Intern. ɔnal application No.
PCT/FI 00/00732

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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A	SU 1556653 A (CHELY MED INST) 1990-04-15 (abstract) World Patents Index (online). U.K.:Derwent Publications, Ltd. (retrieved on 2000-12-18). Retrieved from EPO WPI Database. DW199044, Accession No. 1990-333582 ---	1-7
A	SU 814372 B (LENGD ELEC ENG INST) 1979-03-19 (abstract) World Patents Index (online). London, U.K.:Derwent Publications, Ltd. (retrieved on 2000-12-18). Retrieved from:EPO WPI Database. DW198201, Accession No. 1982-A1224E --- --------	1-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/FI 00/00732

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		GB 2254453 A,B	07/10/92
		GB 9207316 D	00/00/00
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US 5663897 A	02/09/97	NONE	