AT 397869B

(19) **Republic of Austria**
Patent Office

(12) **PATENT**

(21) Application Number: 2682/86(51) Int. Cl. **G01D 3//10**

(22) Filed: 9. 10. 1986

(42) Begin of Patent Protection: 15. 11. 1993

(45) Published: 25. 7. 1994

(73) Patent Holder:
BIERAMPERL ERICH

(56) A-4040 LINZ (AT)

(54) Measuring And Display Unit

Abstract

(56) The invention relates to a device for measuring and displaying the temporal course of successively following events along a moving object, whereby, with each timing pulse, random sources are received via sensor. The sensor data are captured as analog or digital measurement data, and stored together with the correlating time data. Both data streams are transferred to a data input/output-interface and/or or display unit.
The apparatus includes measures for presenting time lapse diagrams, measures to control the display unit in the interval of each data acquisition, measures for direct access to the stored data, as well as measures to evaluate, delete, overwrite or copy the data.

Description

The invention relates to a measuring and display unit, which is arranged on a moving object, and to a sensor-activated electronic timer that measures the time said object requires for movement. The apparatus includes measures for presenting sequences btw. time lapse diagrams on a monitor, especially a LCD-display, measures for access to stored data, as well as measures to evaluate, delete, overwrite or copy the data.

Some sorts of mobile devices for measuring and displaying physical or chemical values, received via sensors, are already known. These devices logs the detected measured data digital or analog on strips of paper, magnetic tapes, cartridges or diskettes. Of disadvantage, however, is the relatively long data access time, limited miniaturization and lack of reliability of mechanical drives. A flush mount or hermetic installation in tight spaces is hardly feasible.

To avoid such disadvantages, it is already known to use data collection devices, comprising semiconductor memories. These devices offer the advantage of compact design, fast data access and direct connectivity to a display or evaluating unit; but in order to represent the time course of the detected sources and to derive analysis, precise time reference to each stored measurement data is required. In some applications, many data acquisition operations with different time-expenditure occur, e.g. when they serve for the reconstruction of the own movement, based on measured events along non-track-bound objects, whereby a variety of environmental and local measurement data together with internal parameters is required, acquired via sensor. In such cases, it is not possible to obtain a usable reconstruction regarding said movement without the use of systems for measuring, monitoring or data transmission which are distant from the moving object

This purpose is being solved in the way that the memory element, in which the clock pulses are counted and stored, serves as an address register for that memory unit, which is used to record the time-related measurement values or data. Sensors are available together with circuits for analog or digital recording btw. data conversion. They serve for the reception of signal sources along the object. Furthermore, a programmable semiconductor memory for the sequential storage of acquired measurement data is available, as well as circuits for display and data input/output; wherein, with timing pulse of the electronic timer, the acquired measurement data are written in said semiconductor memory, and wherein the time memory element stores the counted pulse number and assigns it as the address of the correlating measurement data. Besides, the memory contents are transferable to the circuits for the display and/or the data input/output interface.

This inventive solution now enables the synchronously storage of the continuously acquired measurement data in a simple and advantageous way. These parameters are assigned to the position-related time data at each point-in-time of the measurement acquisition, together with the measured elapse time. On the display, esp. a LCD monitor, the parameters are presented in parallel with the time data, from which the sequence of events along the object can be identified as a time lapse diagram in a vivid manner. The user, e.g. an athlete in self-training with such a described unit, is thus capable to reconstruct his motion without external recording systems or video camera or communication devices; only on base of the acquired data, and may drew useful conclusions, which lead to improve his pace, his style or his condition. Due to direct access to the memory elements via said addresses, and since the content is transferable to the circuits for the data input/output - interface, the stored data and sequences are immediately analysable and reproducible. Different types of sensors may be used as required. For instance, ambient radiation sources, magnetic and acoustic sources can be simultaneously recorded and stored as digital measurement data, wherein filtering and classification of spectra by using specific sensors with corresponding perception zones is possible. To measure distances between moving object and periphery, suitable distance sensors, esp. ultrasound-, laser-or radar sensors, are provided. Optionally, a single sensor is already sufficient for determining and reconstructing of a motion sequence. It should also be noted that the described device can be predominantly consist of microelectronic circuits with semiconductor memory elements of high capacity, and can be adapted into a compact module in a variety of manners. It is therefore obvious, to apply them innovatively in many aspects of life in the manner shown as follows: E.g. in sports equipment,

fitness studios, in biomedical data acquisition, for mobile noise and emission measurements, as a device on vehicles for registration of driving times, layovers and events, in the track measurement, for braking and acceleration measurement, as tachographs and flight recorders, for traffic- and room surveillance, in meteorological and seismological stations, in pockets navigation devices, speech analysis, in the image and sound technology, for engine testing devices, in the spectral analysis, for event detection in machines, robots, industrial and consumer products, for radiation dosimeters, and for correlation measuring instruments of various types.

According to a further embodiment of the invention it is provided, that the control of the circuits for the monitor, the data input/output-interface and the sensors is performed through a microprocessor unit, that program memory and control elements for the input of operating programs and function commands are provided and connected to the microprocessor unit, and that time pulse sequences for data acquisition and data access are programmable, thus displaying, evaluating, deleting, overwriting, or copying of data can be accomplished in a comfortable manner.

According to a further embodiment of the invention it is provided, that the acquired and stored measured data, together with the correlating time data, are illustrated on the display device (esp. LCD) optionally as a graph or as a digital sequence of numbers, wherein the control of the circuitry for indicating the chronological course (time curve) of the sequential acquired measurement data takes place through a micro processor.

According to a further embodiment of the invention it is provided, that the programming of modes, measuring intervals, maximum or minimum levels, calibration values for adjustment, test operation and the addressing of memory contents via data input/output-interface takes place by means of connection to an external processor or controller.

According to a further embodiment of the invention it is provided, that measuring values, whose size exceed or deceed certain thresholds, are counted by appropriate programs; and that the chronological allocation and the number of such threshold crossings becomes detected and likewise displayed or made accessable.

According to a further embodiment of the invention it is provided, that repetitively performed measurement data acquisitions, which take place along the same course, get displayed on the monitor (e.g. LCD) as parallel graphs btw. time lapse diagrams, whereby the user has direct comparison and analysis capability.

According to a further embodiment of the invention it is provided, that the circuitry for the data input/output-interface is connectable to data receiving units and/or data transmission units for the remote transmission of measured and stored data, or to other units of the type described above.

According to a preferred embodiment of the invention it is provided, that the circuits and memory elements are formed as a monolithically integrated semiconductor unit, and thus discretionarily interchangeable, transferable and applicable.

Finally, it is provided within the scope of the invention, that - together with sensors - a further measurement and display device is made available, which is characterized to measure the time required between exceeding and deceeding a perception zone (esp. an adjustable threshold), thus the duration of a perception-pause can be acquired, displayed and made accessable.

For a more precise understanding of the present invention it is explained in more detail with reference to the embodiments shown in the drawings:

Fig. 1) shows a block diagram of a minimum configuration of the unit according to the invention, **Fig. 2)** shows an example for designing such a device, **Fig. 3a), 3b)** and **3c)** shows various operational and functional features, **Fig 4)** shows an attachment to the body of a skier, **Fig. 5)** shows optionally sensed parameters.

In **Fig. 1)** shows -1- the sensor-activated electronic timepiece, whose time data memory represents the address-registers -2-, -3- and -4- for addressing the correlative measurement data btw. memory contents. -5 -, -6 - and -7 -. Connectable to the memory elements are the display circuits -11-, -12- and -13-. They serve for the optical representation of the time curve of the measurement values, together with the measured time on a display -15-. Likewise connected to the memory elements are the sensors -8 -, -9- and -10-, that are coupled to circuits for analog or digital detection btw. data conversion. In addition, the memory contents are transferable to the data input/output-interface -14–.

Fig. 2) shows an example of a configuration of the described measuring and display unit according to the invention, which can be used by a skier for reconstructing the trajectory along a slalom course. A flat, ergonomically shaped housing -16 -, made of impact-resistant plastic, contains a LCD monitor -17 -. On both sides of the monitor there are flat flush membrane buttons to enter function commands, so that the unit can be operated in a manner similar to a cassette recorder of known types. 18 - and - 19 – are different sensors, especially distance measuring radar sensors for acquiring the distance to slalom poles, or optical sensors for the perception of light sources of arbitrary intensity and type; or magnetic sensors, serving to determine the chronological course of the deviation from a fictional, by the earth's magnetic field given reference line along the route. If necessary, additional sensors can be arranged in the housing, e.g. to determine the slope, the vectorial acceleration, or the velocity-curve chart of the unit. Besides, two sockets - 20 - and -21 - are available for the connection of blood pressure sensors or heart rate sensor at the body of the skier. Connectable to the parallel or serial interface -22 - is an additional processor- or control- unit for the programming of levels, threshold values, modes, measurement intervals, calibration values for test operation and adjustment, or for additional functions by attachment of additional sensors. In addition, certain acquired and stored time-correlating measurement values can be displayed by simple time-addressing via keyboard on the screen, and the data can be made accessable in this manner. Finally, another interface -23 - finally serves to output the digital data, for transferring data from or to an external data storage device, for connecting an evaluation unit, or a data transmitting- or data receiving device, or to run a synthetic speech synthesizer, if required.

Fig. 3a) shows an example of operation and function according to the invention described herein. With button -24 -, the measuring and display unit becomes turned on and off. The data remain stored. After switching to “on”, a message appears on the LCD-display, indicating the functions and programs, together with a cursor and the current time. By means of the keys -25 -, - 26 - and -35 -, mode or program is preselected. In the present configuration, mode A enables the measurement of the distance to slalom poles or lateral boundaries, mode B the course of deviation related to the earth`s magnetic field, and mode C the measurement of the course of the heart pulse rate of the skier along the travelled path. The display shows the coordinates for mode A as LCD-grafic, wherein the upper section of the display is for the left-sided distance measurement, the lower section for the right-sided distance measurement. With key -27-, the measurement size range can be incremented or decremented as needed. The adjustment of the measurement size range is generally done manually by a calibration with button -3 -; however, this can also happen in a self-adapting way during use of such measures. By using the button -28- the time range becomes expanded or narrowed. The optimal representation may derive as result of experiences, mainly from the required time pulse sequence for the sequential acquisition of the measurement data and from the frequency and fluctuation of measurement events. Using the button -29-, the preferred graphical representation of the measured value characteristic is selected on the display, e.g. tracking. The adjustment of the current time takes place by means of the button -30 -. Before starting, the user (e.g. skier) activates button -31-, together with the key -33 - for acquiring, storing and displaying the measured data along that slalom course. Standby to data acquisition is shown by means of -37- on the display, together with the selected display mode -36-. In the present example, after passing through the finish line, the LCD monitor displays the course of the measured events along the moving object, namely between the time -40 - and the measured elapsed time -41- below the cursor -43-. The user then activates the button -35 -. The last measured distances to both sides are shown as digital numbers -42 - on the display, wherein -37– goes out. If the user wants to have access to information on earlier measured events or sequences, he presses the button -34 - for fast rewind of the shown data. With the button -33 -, the acquired data may be digitally outputted within the selected time-ranges, step by step, and displayed; and thus they can be analyzed by using the time allocation. For a fast forward of the

presented measurement data, button -32 – is provided. By actuating the button -31 - along with -33 - or -32 -, either specific individual data, or parts of the memory, or all stored data, can be deleted or overwritten.

Fig. 3b) shows an example of another function mode of the unit according to the invention, which is called “mode B” -46 -. In this case, it is the measurement and display of the course of deviation from a fictitious geomagnetic reference-line, wherein the displaying -44 - takes place parallel to the manner shown in Fig. 3a). Before the start, a reference line, shown as an arrow -50- on the monitor, is programmed via a parallel or serial interface -51-. Likewise, the measurement size range -47- is calibrated and adjusted in the manner as shown in Fig. 3a), to display the positive and negative gradients. In the example shown, after passing through the finish line, the LCD monitor displays the course of the gradient between the point in time -48 - and the measured elapsed time -49-. Using the measured gradients, the user may reconstruct all his body movements along the mastered slalom course, by analyzing the presented data according to the playback mode -45-. With an appropriate computer program it is also possible, to determine after several trials, the optimum racing ideal line on base of the acquired and stored data. Then, the apparatus may be programmed via the interface -51- anew, to measure and display the course of the deviation from the optimum line.

Fig. 3c) shows an example of an additional operation-mode of the unit according to the invention, which is called modus C. This means the measuring and display of the time curve of a pulse frequency of the skier along the slalom course. Two time curves in any order -52 - and -53 – can be presented in parallel on the monitor, and are thus comparable and analyzable. Via the interface -51-, a threshold -54- is programmable for the ongoing determination of the heart rate -57- by means of plug -22-, which is connected to a pulse sensor. The course of the pulse of the user between point in time -55- and the measured elapsed time -56- becomes shown on the display. As a further option it is provided, to save the shortest time curve of a plurality of successively recorded events, and to show it in the upper display range of the monitor to make it available for direct comparison. The selected mode -58-, together with the mode -59-, is likewise shown on the display.

Fig. 4) shows an example of an attachment of the herein described measuring and display unit on the body of a skier. The unit -60- is fastened by means of belt -61- around the waist.

Fig. 5) finally shows the sensed parameters along that slalom course, wherein -62- is the right-side distance to slalom poles, -63- is the left-side distance to slalom poles, -64- is a north-south reference line constituted by the earth's magnetic field, and -65- is the resulting programmed reference line for the gradient measurement.

Claims

1. A measuring and display unit on a moving object, comprising a sensor-activated electronic timepiece (1) which determines the elapsed time for a distance covered, wherein the memory device (2, 3, 4) in which the clock pulses are counted and stored, is used to address the registers of the storage device (5, 6, 7) in which the time-based measurement parameters or data are stored.

See drawing, 1 sheets.

ÖSTERREICHISCHES PATENTAMT Patentschrift Nr. AT 397 869 B

Ausgegeben 25. 7.1994 Int. Cl.[5]: G01D 3/10
Blatt 1

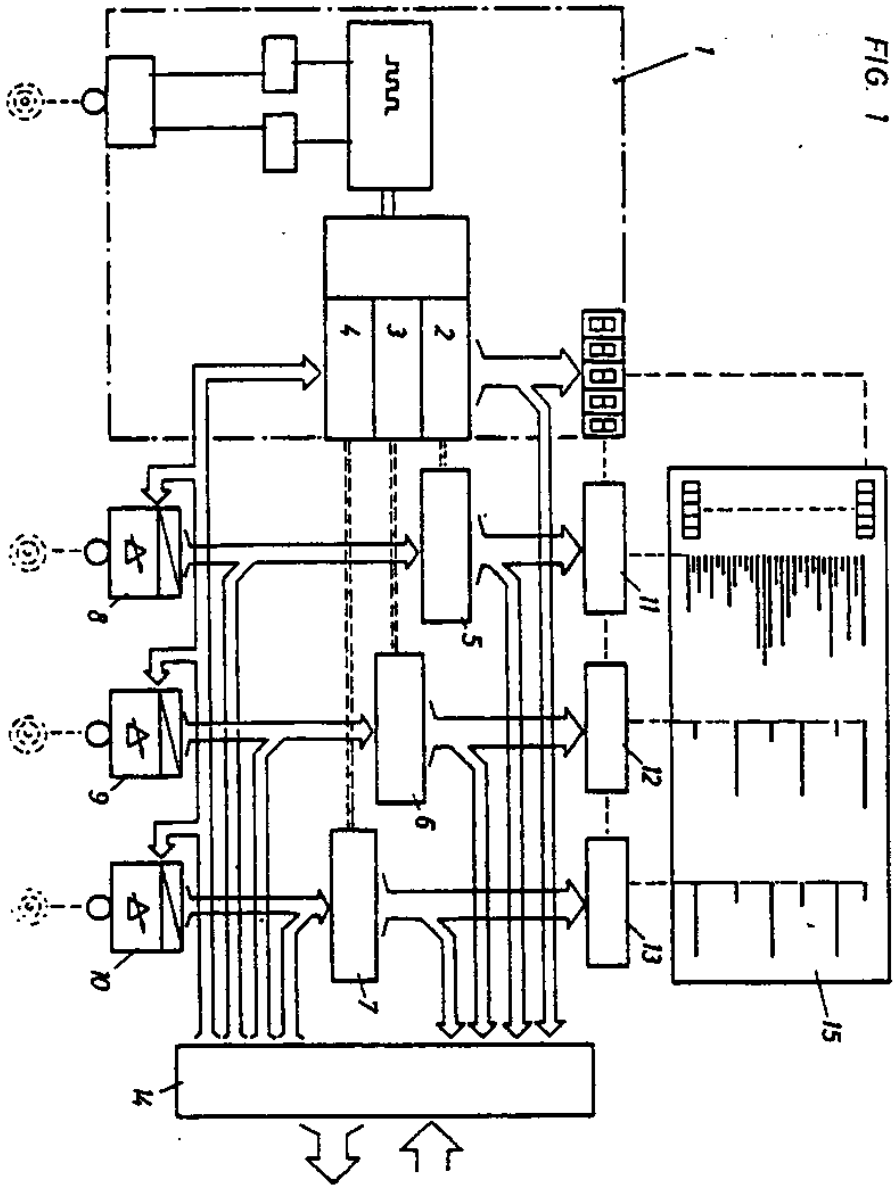


FIG. 1

ÖSTERREICHISCHES PATENTAMT Patentschrift Nr. AT 397 869 B

Ausgegeben 25. 7.1994 Int. Cl.[5]: G01D 3/10
Blatt 2

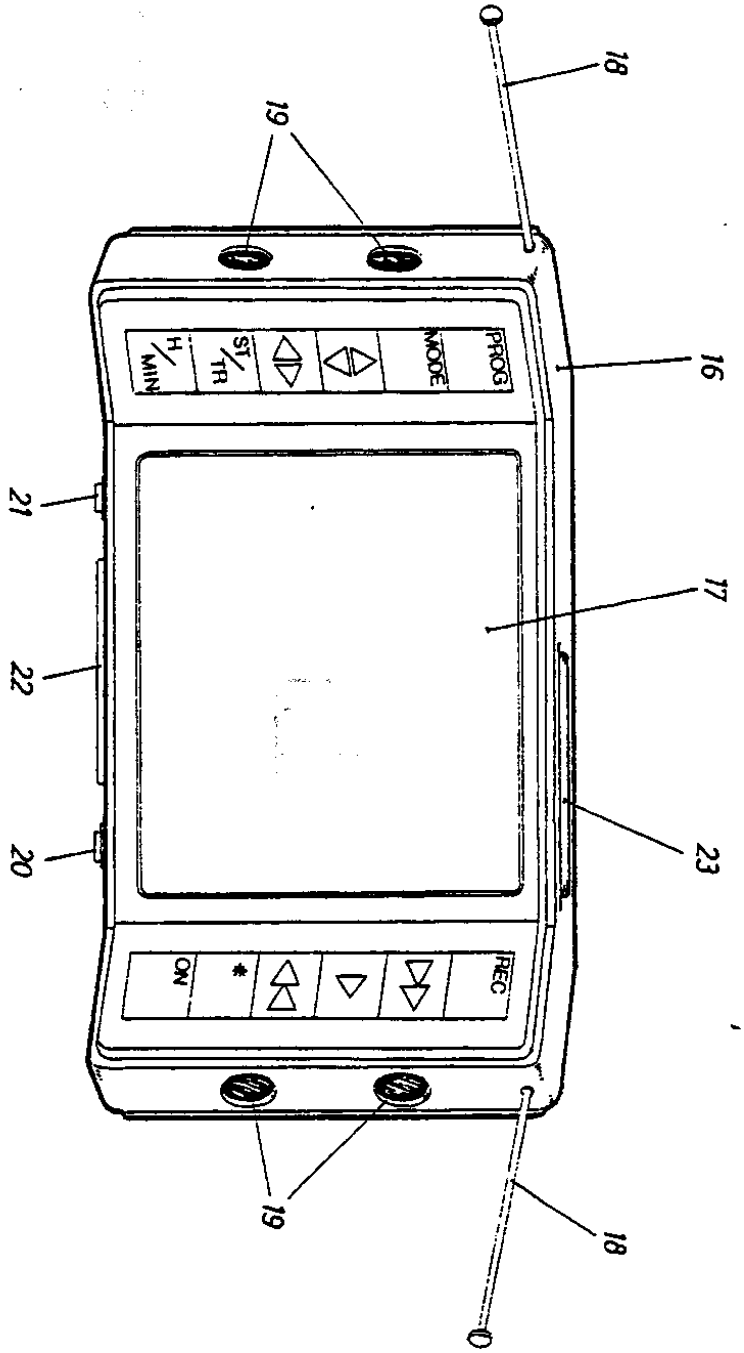


FIG. 2

ÖSTERREICHISCHES PATENTAMT Patentschrift Nr. AT 397 869 B

Ausgegeben 25. 7.1994 Int. Cl.[5]: G01D 3/10
Blatt 3

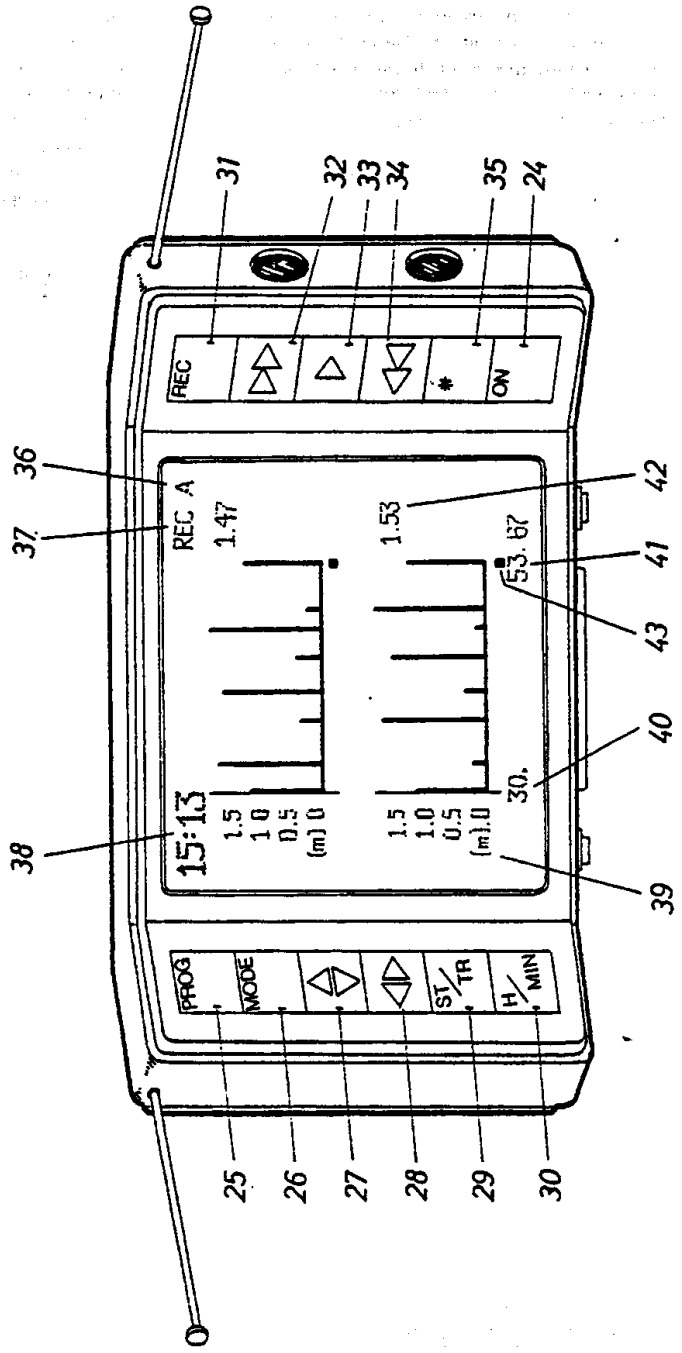


FIG. 3A

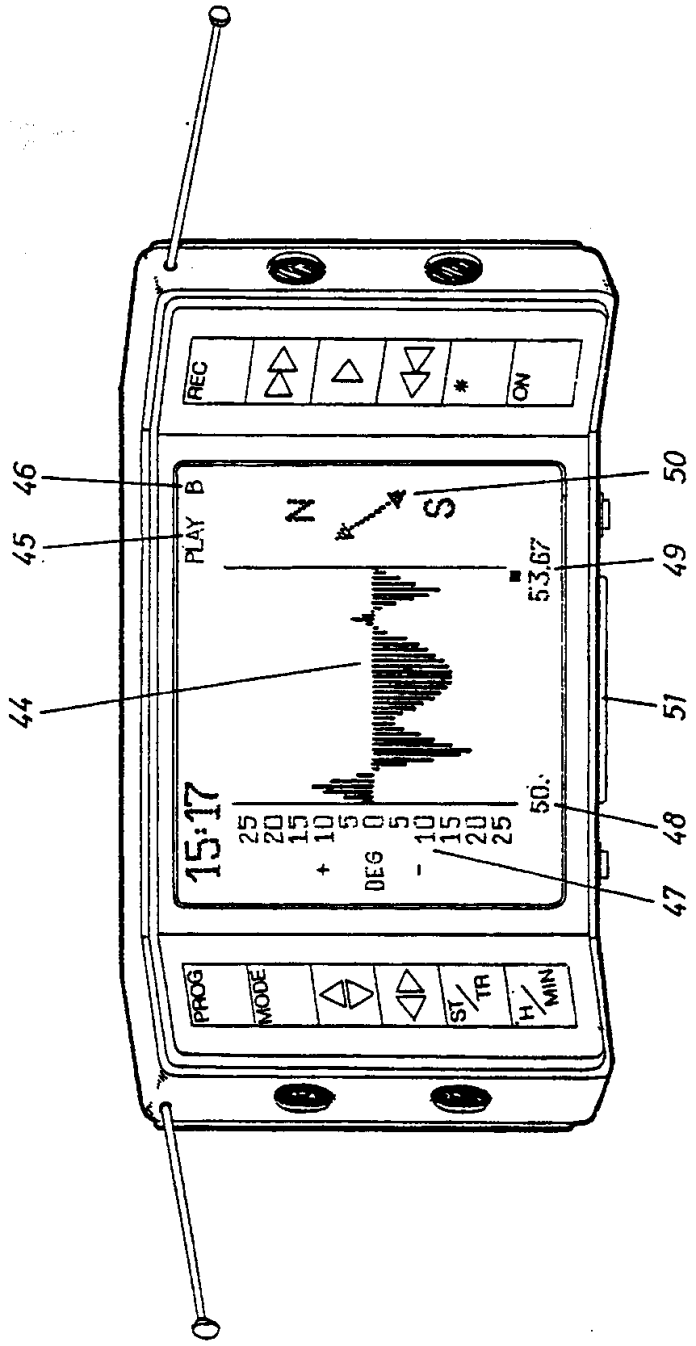

REC
ON
PLAY B
N
S
53.67
15:17
25 20 15 10 5 0 5 10 15 20 25
+
DEG
-
50.
PROG
MODE
ST/TR
H/MIN
46
45
44
50
49
51
48
47

FIG. 3B

ÖSTERREICHISCHES PATENTAMT Patentschrift Nr. AT 397 869 B

Ausgegeben 25. 7.1994 Int. Cl.[5]: G01D 3/10
Blatt 5

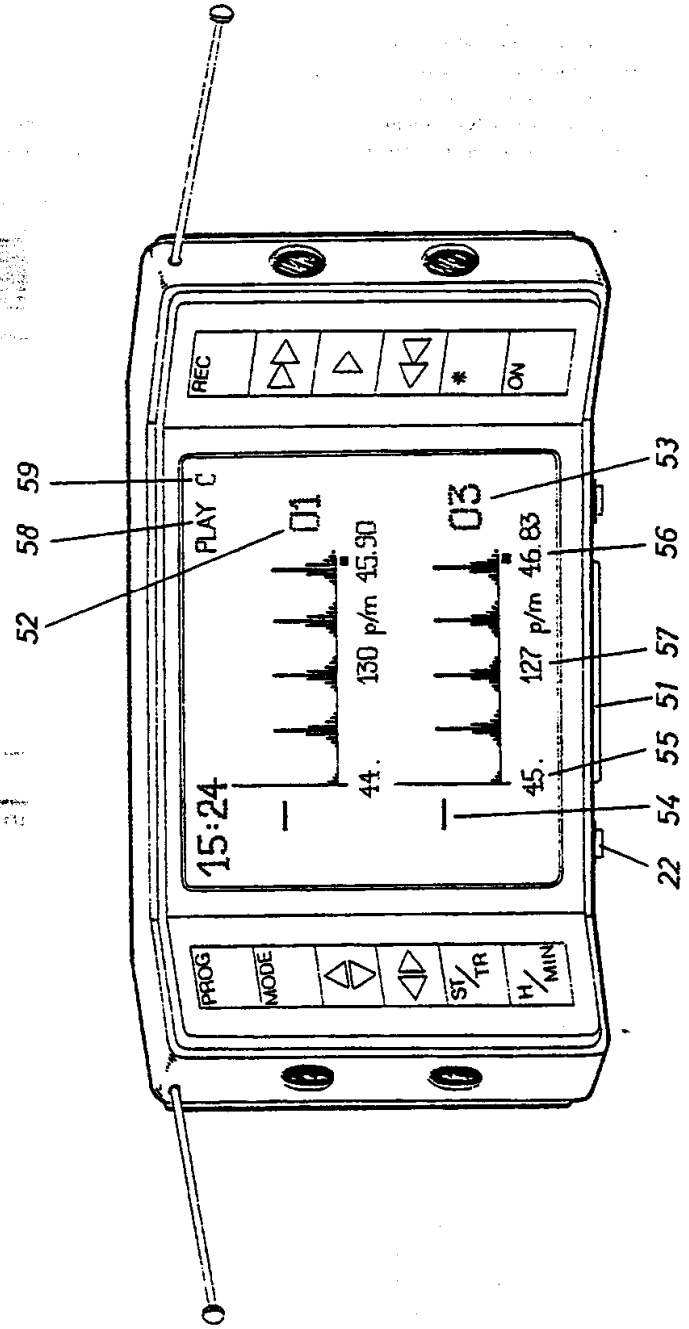
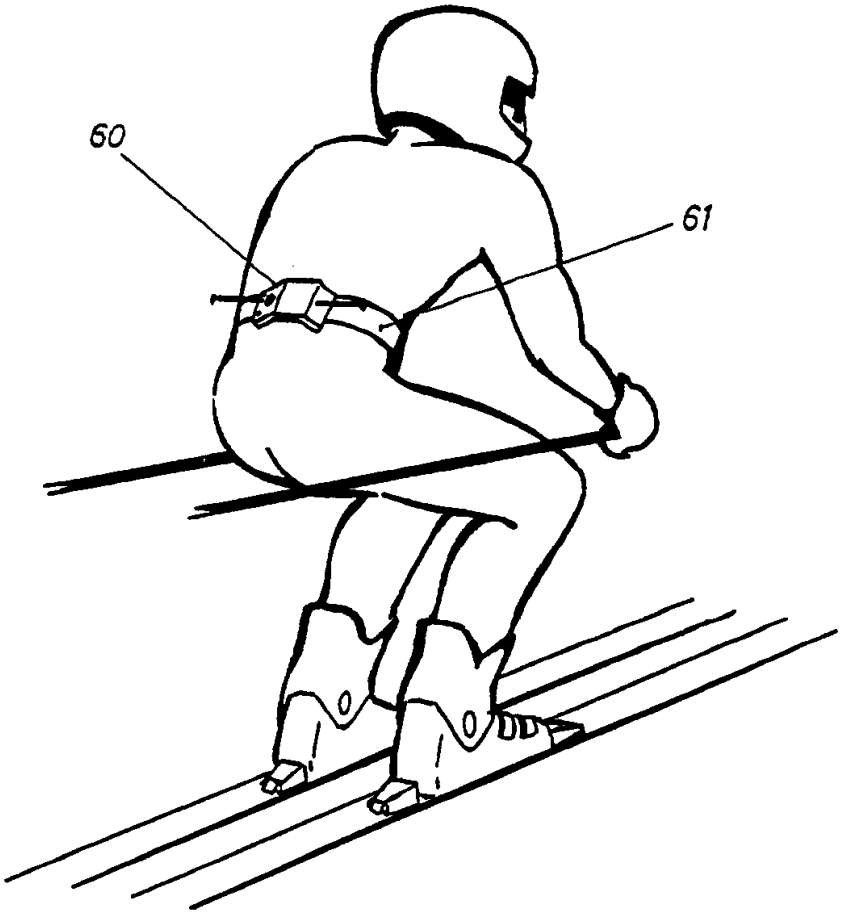


FIG. 3C

ÖSTERREICHISCHES PATENTAMT Patentschrift Nr. AT 397 869 B

Ausgegeben 25. 7.1994 Int. Cl.[5]: G01D 3/10
Blatt 6

FIG. 4



ÖSTERREICHISCHES PATENTAMT Patentschrift Nr. AT 397 869 B

Ausgegeben 25. 7.1994 Int. Cl.[5]: G01D 3/10
Blatt 7

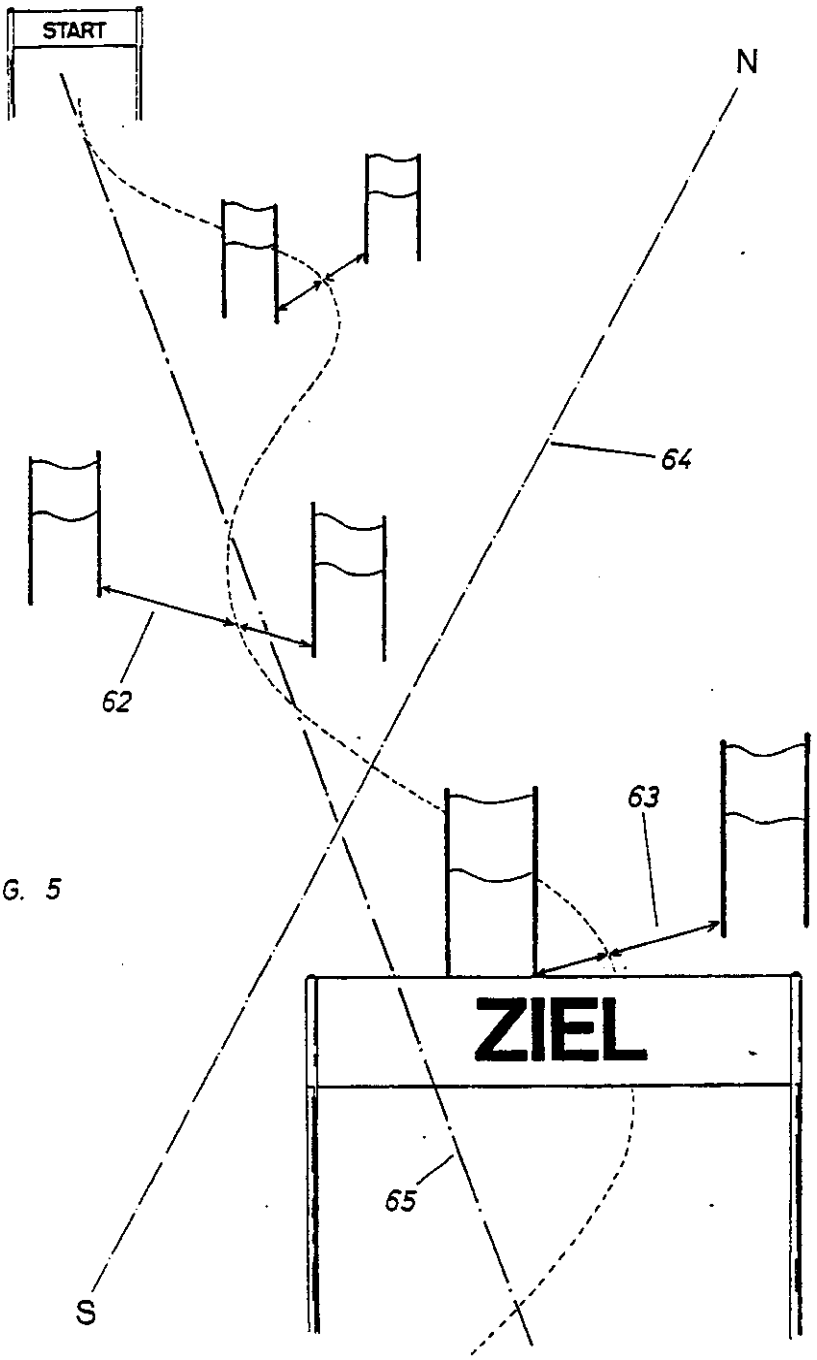


FIG. 5