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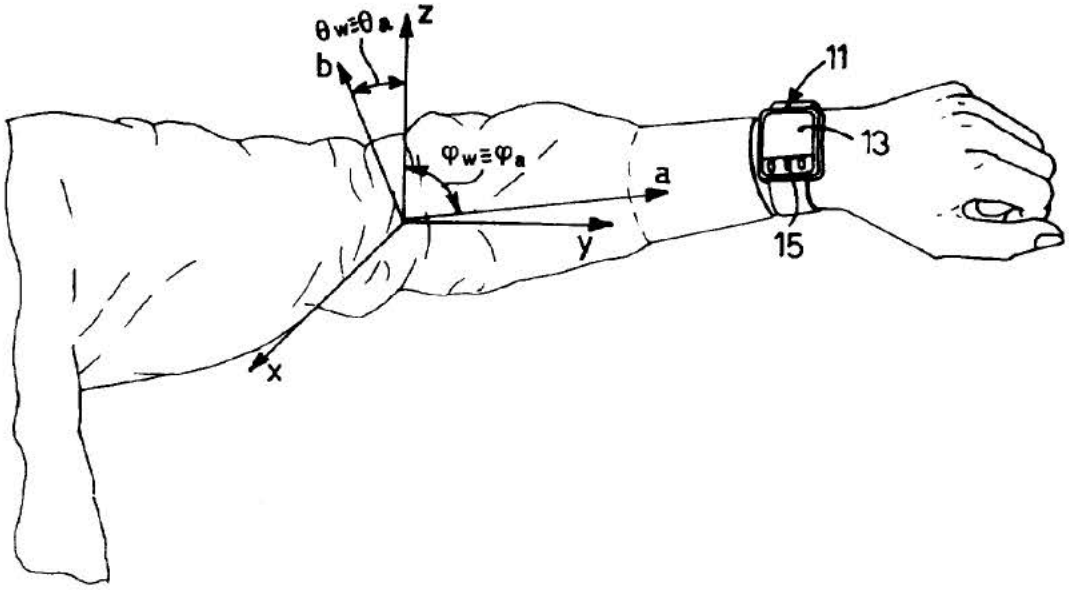

(57) Abstract: Energy saving device (10) associated with a portable electronic apparatus (11), and comprising activation/de-activation means (17, 18) associated with said apparatus (11) and able to memorize a determinate reference position and/or functional condition (ϕ_a; $\theta\phi_a$) of said apparatus (11), to detect an instantaneous position and/or functional condition (ϕ_w; θ_w) of said apparatus (11) relative to the operator (12), to command the automatic activation of said apparatus (11) when said instantaneous position and/or functional condition (ϕ_w; θ_w) substantially corresponds, with a desired margin of tolerance ($\Delta\phi$; $\Delta\theta$) to said ; reference position and/or functional condition (ϕ_a; θ_a), and to command the automatic de-activation, even complete, of said apparatus (11) when said instantaneous position and/or functional condition (ϕ_w; θ_w) is different, with a desired margin of tolerance ($\Delta\phi$; $\Delta\theta$), from said reference position ; and/or functional condition (ϕ_a; θ_a).

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"ENERGY SAVING DEVICE FOR A PORTABLE ELECTRONIC APPARATUS"

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FIELD OF THE INVENTION

The present invention concerns an energy saving device associated with a portable electronic apparatus, in particular of the so-called "wearable" type, so as to activate or de-activate the portable electronic apparatus, autonomously, even completely, so defining a condition of energy saving, according to the instantaneous position and/or operating condition and use of the latter.

BACKGROUND OF THE INVENTION

Portable electronic apparatuses are known, such as for example wearable processors, known in English as "wearables", Personal Assistants (PA), Personal Enhancements (PE), intelligent viewers for night vision, or others, which assist the user in performing a variety of operations, or provide the user with an increase in his own perceptive or active capacities.

This type of portable electronic apparatuses, for the normal functional requirements of transportability, must have characteristics of small size, limited weight and high feed autonomy. Moreover, there is a growing demand, on the part of users, to implement said portable electronic apparatuses with new, digital multi-media and telecommunication technologies such as for example: display interfaces with increasingly high quality and able to work in any condition of environmental visibility; increased calculating power that enables to actuate on mobile devices applications which once were only intended for personal computers; wireless communication and data exchange systems, and others.

However, such implementations have a high energy requirement, both for the wireless communication in itself

and also to exploit the multimedia services offered, for example video streaming and high speed data connection.

Moreover, evolved graphical interfaces not only entail greater energy consumption, but also an increase in weight and size of the apparatus.

The state of the art does not know of rechargeable energy sources with high capacity and limited weight, which allow to use said portable apparatuses for an overall time of several hours, for example to cover an entire working day of eight hours, without entailing an increase in weight and size of the portable apparatuses.

To be more exact, in the case of an electronic apparatus to be worn on the arm or wrist, in order to allow the user to operate efficiently with free hands, the apparatus must have a decidedly limited weight, so that it is not bulky and heavy, or able to reduce the user's freedom of movement and, with extended use, cause discomfort and tiredness of the limb.

It is also known to implement portable apparatuses, even those worn on the wrist, with the above communication and display technologies, using feed sources of a standard type, typically rechargeable batteries, with a limited weight and bulk, but also with a limited capacity and autonomy.

It is known to maximize the autonomy of the batteries by implementing the apparatus with hardware and software devices, such as for example LongRun™ by Transmeta™ and Intel™ SpeedStep®, and obtain a reduction in consumption of digital systems in general, thanks to the higher level of integration of the components and the reduced feed tensions required.

According to the portable apparatus and the intended use, it is possible to optimize the management of the

peripherals, such as screens, keyboards and others, obtaining reductions in consumption in many cases of more than 30%.

Known devices used to optimize energy consumption are based especially on man-machine interaction, to recognize the condition of use of the device by the user; to be more exact, when the apparatus does not receive external input for a defined interval of non-use, it progressively passes to states of low consumption which de-activate peripherals and user interfaces, until the apparatus is completely and automatically switched off.

Generally speaking, these known devices are valid, but they are not optimum for some specific uses of portable apparatuses, especially when the intervals of inactivity are short and frequent.

In these cases, the need to re-activate the apparatus with every use, for example by pressing a specific button, considerably reduces the reactivity of the apparatus and can considerably reduce the overall effect of reducing energy consumption.

Moreover, when an operator needs to keep his hands on the working equipment, but in any case needs to consult the apparatus frequently, such known devices do not allow him to interact quickly and easily with the apparatus, without having to intervene manually in order to re-activate it and wait for the energy-saving state to be de-activated.

A method is also known, from US-A1-2002/0021278, actuated by an internal apparatus of an electronic apparatus which, according to resources memorized in a CPU of the electronic apparatus, assesses the variables of context and spatial positioning of the electronic apparatus, and autonomously influences the functioning state, on full or low power.

In this solution, the CPU of the apparatus itself

constitutes an essential part of the energy-saving device and therefore must in any case always be kept active, so as to allow, precisely, the variables of context to be assessed; this makes it impossible to temporarily switch off the electronic apparatus completely, and therefore it is not possible to obtain a substantive energy saving.

One purpose of the present invention is therefore to achieve an energy saving device for a portable electronic apparatus which allows to optimize the energy saving by de-activating, completely or at least partly, the apparatus in its condition of non-use, and which is suitable to re-activate the apparatus in a substantially autonomous manner without any manual intervention from the operator, thus keeping maximum reactivity with the user.

Another purpose of the present invention is to achieve an energy saving device which on each occasion can be configured according to the specific operating requirements of the apparatus and/or of the user.

The Applicant has devised, tested and embodied the present invention to overcome the shortcomings of the state of the art and to obtain these and other purposes and advantages.

SUMMARY OF THE INVENTION

The present invention is set forth and characterized in the main claim, while the dependent claims describe other characteristics of the invention or variants to the main inventive idea.

In accordance with the above purpose an energy saving device according to the invention is associated with a portable electronic apparatus, such as for example a wrist-wearable system able to be worn on an operator's arm.

According to a characteristic feature of the present invention, the device comprises activation/de-activation

means associated with the apparatus, which are suitable to memorize a determinate position (φ_a; θ_a), and/or reference functional condition or activity condition of the apparatus, for example a desired position of the arm in which the use of the apparatus is natural, and/or the functioning state of at least some of the components of the apparatus, in order to detect an instantaneous position (φ_w; θ_w) and/or functional condition of said apparatus relative to the movement of the user's arm, and/or to the functioning state of the components of the apparatus, and to command the automatic activation of the apparatus associated therewith only when the instantaneous position (φ_w; θ_w) and/or functional condition of the apparatus substantially corresponds, with a desired margin of tolerance, to the reference position (φ_a; θ_a) and/or functional condition memorized, and to command the automatic de-activation, even complete, of the whole associated apparatus, if the instantaneous position (φ_w; θ_w) and/or functional condition of the apparatus is different, with a desired margin of tolerance, from the reference position (φ_a; θ_a) and/or functional condition memorized.

In this way, the activation, and even complete de-activation, of the apparatus is commanded according to the position and/or functional condition of the apparatus itself, that is, it is activated only when it is taken to a position that coincides with the position of use, which is or can be pre-determined, and/or according to the functional condition of the various components of the apparatus; the apparatus is completely de-activated, or at least partly switched off, when it is in other positions, different from the position of use and/or when different functional conditions of its components are detected.

In the case of an application of the device according to

the invention to a wrist-wearable apparatus worn on the user's arm, it is possible to activate the apparatus according to the posture and the conditions of use, discriminating when the user wants to interact with the apparatus rather than perform other functions. In this last case, the device according to the present invention switches off, even completely, the electronic apparatus associated with it, thus achieving a great saving of the feed energy, since the electronic apparatus is switched on only and exclusively when it has to operate in the correct condition of use.

The device according to the invention thus allows to optimize the management of energy saving for any portable electronic apparatus whatsoever, without the manual intervention of the operator and in an automatic manner, adapted to the specific configuration of use, maintaining the maximum reactivity of the system to the interaction with the user.

Moreover, the solution according to the present invention allows to selectively keep the apparatus in different functioning conditions, for example known as "run", "stand-by", "sleep" and "off", according to different functioning conditions, and also outside the pre-set operating position.

One of these conditions, for example, is when the device according to the invention detects an instantaneous position of the apparatus which is different from the reference position, but the apparatus is still in the processing and/or data transfer step. In this case, the device commands, for example, the display to be de-activated, but not the processing unit of the apparatus, at least until the end of the processing and/or data transfer steps.

In this case, the device according to the present invention communicates with a subsystem that manages the energy of the apparatus, so that, generally speaking, it is the subsystem that manages the energy that coordinates the energy saving states of the apparatus.

Advantageously, the subsystem that manages the energy receives different input from various members of the apparatus, based on which it is able to decide the method of energy saving to activate (stand-by, sleep, off, etc.). The instantaneous position of the apparatus must be considered, in this case, further input for the subsystem that manages the energy, based on which the specific energy-saving condition is decided.

To be more exact, if the apparatus is in the OFF state, the subsystem that manages the energy must allow the device to re-activate the apparatus autonomously, if a condition of activity is verified.

In a preferential form of embodiment, the activation/de-activation means comprise at least a timer element, which commands the automatic activation of the apparatus only after a determinate minimum period of time T_a in which the condition of substantial correspondence between the instantaneous position (φ_w; θ_w) and the reference position (φ_a; θ_a) memorized is maintained.

In this way, the device is able to discriminate between a situation of voluntary and involuntary posture of the arm, commanding the apparatus to switch on only when actually necessary and responding to the operator's desires. In fact, even if the apparatus is in an instantaneous position (φ_w; θ_w) that substantially corresponds to the reference position (φ_a; θ_a), if this position is not maintained for the minimum time T_a, for example about half a second, the device does not command the apparatus to switch on.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other characteristics of the present invention will become apparent from the following description of a preferential form of embodiment, given as a non-restrictive example with reference to the attached drawings wherein:

- fig. 1 shows an operator wearing a portable electronic apparatus in which the energy saving device according to the invention is installed;
- fig. 2 is an enlarged view of the apparatus in fig. 1, in the operating condition;
- fig. 3 is an enlarged view of the apparatus in fig. 1, in an energy-saving condition;
- fig. 4 is a schematic view of the energy saving device according to the present invention and part of the apparatus in fig. 1 with which the device is associated.

DETAILED DESCRIPTION OF A PREFERENTIAL FORM OF EMBODIMENT

With reference to the attached drawings, a portable electronic apparatus 11 is shown schematically, provided inside with an energy saving device 10 according to the present invention, substantially constituted as a separate unit having an independent functioning, although functionally correlated to the apparatus 11.

In this case, the electronic apparatus 11 is of the type that can be worn on the wrist and known as a wearable, that is, a Personal Assistant (PA) or a Personal Enhancement (PE), the function of which is to provide assistance for an operator 12 in performing a plurality of operations, such as for example detecting particular parameters of maintenance or functioning of a machine, or to provide the operator 12 with an increase in his perceptive or active capacities, for example to improve vision in the dark, or to protect his eyes from very intense lights, or other.

The apparatus 11 is fed by means of a group of rechargeable batteries, of a known type and not shown here, and substantially comprises a high-quality display interface 13, a calculation processor, not shown, with a calculation capacity such as to allow the apparatus 11 to actuate applications normally intended for personal computers, and a command panel 15 which allows the operator 12 to interact with the calculation processor in order to display the data and information on the display interface 13.

The apparatus 11 also comprises a device to manage the energy 16, both software and hardware, which normally maintains a part of the calculation processor, the display interface 13 and other possible peripherals in a de-activated state, in order to reduce energy consumption of the batteries, according to the different information acquired.

The device 10 according to the invention is, as already said, an autonomous component installed inside the apparatus 11 and comprises a configuration unit 18 and a unit to detect activity 17.

To be more exact, the configuration unit 18 substantially consists of a software driver and a relative interface, and allows the user to set, for example by means of the command panel 15, the parameters of functioning, sensitivity and activation of the activity detection unit 17.

The activity detection unit 17 is provided with a detection circuit 19 which feels the two-dimensional oscillations of the apparatus 11 in order to detect the instantaneous position (φ_w; θ_w), with a conditioning circuit 20 in which a reference position (φ_a; θ_a) or activity position of the apparatus 11 is memorized, and with a logic unit 23 associated at outlet with the energy management

device 16; the device to manage the energy 16 is suitable to evaluate at which level of energy saving the electronic apparatus 11 must be maintained, also according to the positioning information obtained, and/or to parameters pre-set and/or programmed by the operator.

To be more exact, since the device 10 is configured as an autonomous and distinct device with respect to the electronic apparatus on which it is applied, it is possible to command the electronic apparatus 11 to be completely switched off, thus determining a consumption of energy that is nearly zero during the non-use of the apparatus.

The operation to switch the apparatus on again is performed by the device 10, which always stays active, but with an extremely limited energy consumption if compared with that of the electronic apparatus 11, which will act in the event that a condition of inactivity is detected.

The detection circuit 19 comprises two sensors 30 and 31 which respectively detect the inclination of the arm with respect to a substantially vertical axis "z" and the rotation of the wrist of the user 12, substantially on two axes "a" and "b", which define respectively an angle φ_w of the inclination of the arm with respect to the vertical axis z, and an angle θ_w of rotation of the wrist with respect to the vertical axis z. In this way a determinate instantaneous position (φ_w; θ_w) of the apparatus 11 is defined.

The detection circuit 19 sends the data relating to the angles φ_w and θ_w detected to the logic unit 23, in a substantially continuous manner.

The conditioning circuit 20 comprises two memories 21 and 22, in which are memorized respectively the data relating to the inclination of the arm and the rotation of the wrist, that is, the angles φ_a and θ_a formed by the axes a

and b with respect to the axis z, thus identifying the reference position (φ_a; θ_a) or activity position of the apparatus 11, in which the operator 12 has chosen to interact with it and to read the data supplied on the display interface 13.

The logic unit 23 is substantially provided with two trigger devices 25 and 26 which compare respectively the values of the angles φ_a and φ_w in a field of tolerance $\Delta\varphi$ and the values of the angles θ_a and θ_w in a field of tolerance $\Delta\theta$, and with an "AND" logic operator 27 which receives a binary signal from the trigger devices 25 and 26, and sends a command signal.

In this way, it is provided that a plurality of instantaneous positions of the apparatus 11, near the reference position (φ_a; θ_a), in any case determine the activation of the display interface 13 and of other possible peripherals of the apparatus 11, normally de-activated.

Moreover, the activity detection group 17 comprises a timer device 29 connected at inlet to the logic operator 27 and at outlet to the energy management device 16, and is able to send an activation signal "A" to the latter only after the command signal arriving from the logic operator 27 is maintained for a determinate minimum activity time T_a, programmable by the configuration unit 18.

In this way, we prevent the situation where an instantaneous position that comes within the field of tolerance but is assumed involuntarily, for example because of the natural movement of the arm during the operator's work, is considered.

By doing this, the signal "A" that activates the peripherals of the apparatus 11 is therefore a function of the instantaneous position (φ_w; θ_w), the reference position

(φ_a; θ_a), and the minimum activity time T_a, that is: $A=f[(\varphi_w; \theta_w), (\varphi_a; \theta_a), T_a]$.

The activity detection unit 17 also comprises a control interface 24 connected at inlet to the configuration unit 18, and at outlet both to the two memories 21 and 22, to the two trigger devices 25 and 26, and also to the timer device 29, so that the operator 12 can set as desired, through the driver of the configuration unit 18, the values of the angles φ_a and θ_a, the fields of tolerance $\Delta\varphi$ and $\Delta\theta$, and the time the command signal arriving from the logic operator 27 is maintained, before sending the activation signal to the energy management device 16.

The device 10 as described heretofore functions as follows.

The operator 12 sets the reference position (φ_a; θ_a), or activity position, and the sensitivity of the automatic re-start system, through the driver of the configuration unit 18, which initially programs the specific functioning parameters of the device 10, that is, he sets the minimum activity time T_a, for example equal to about one second, he defines the fields of tolerance $\Delta\varphi$ and $\Delta\theta$, for example from about $-10°$ to about $+20°$, and memorizes the reference position (φ_a; θ_a) of the apparatus 11 in which he chooses to actively use the apparatus 11, for example the one shown in fig. 2.

During the working steps, the detection circuit 19, by means of its sensors 30 and 31, instantaneously detects according to the movement of the arm and the rotation of the user's wrist 12, the relative values of the angles φ_w and θ_w, and continuously transmits these values to the respective trigger devices 25 and 26.

When both the trigger devices 25 and 26 verify that the values of the angles φ_w and θ_w detected by the sensors 30

and 31 come within the respective fields of tolerance $\Delta\varphi$ and $\Delta\theta$ of the angles φ_a and θ_a memorized in the memories 21 and 22, that is, when the instantaneous position (φ_w; θ_w) assumed by the apparatus 11 substantially corresponds to the reference position (φ_a; θ_a), both the trigger devices 25 and 26 send a signal to the logic operator 27, which in turn sends a command signal to the timer device 29.

At this point, if the command signal remains present for a minimum time T_a or more, the timer device 29 sends the activation signal A to the energy management device 16 which re-activates the display interface 13 and/or the other peripherals of the apparatus 11, through a programmed or programmable subsystem to manage the energy saving, thus giving the possibility to the operator 12 to interact with the apparatus 11 without having to activate it manually, but simply by positioning his arm with a pre-determined inclination and rotation of the wrist.

In the same way, when both the trigger devices 25 and 26 verify that the values of the angles φ_w and θ_w detected by the sensors 30 and 31 no longer come within the respective ranges of tolerance $\Delta\varphi$ and $\Delta\theta$ of the angles φ_a and θ_a memorized in the memories 21 and 22, that is, when the instantaneous position (φ_w; θ_w) assumed by the apparatus 11 diverges from the reference position (φ_a; θ_a), both the trigger devices 25 and 26 send a signal to the logic operator 27, which in turn sends a switch-off signal to the timer device 29.

At this point, if the switch-off signal remains present for a minimum time T_a or more, the timer device 29 sends a de-activation signal to the energy management device 16, which switches off the display interface 13 and/or one or all the other peripherals of the apparatus 11, for example through the programmable subsystem to manage the energy

saving, actuating a desired energy saving.

In fact, in the switched-off step too, the subsystem to manage the energy saving receives specific signals concerning the state of activity of the various components of the apparatus 11, and decides which components to switch off and which to keep in an active or partly active state, so as to define the different energy-saving conditions to be activated.

It is clear, however, that modifications and/or additions of parts may be made to the device 10 as described heretofore, without departing from the scope of the present invention.

For example, it comes within the scope of the present invention to provide that the energy management device 16 can be directly integrated into the device 10, instead of being part of the apparatus 11.

It is also clear that, although the present invention has been described with reference to specific examples, a person of skill in the art shall certainly be able to achieve many other equivalent forms of energy saving device for a portable electronic apparatus, having the characteristics as set forth in the claims and hence all coming within the field of protection defined thereby.

CLAIMS

1. Energy saving device associated with a portable electronic apparatus (11), characterized in that it comprises activation/de-activation means (17, 18) associated with said apparatus (11) and able to memorize a determinate reference position (φ_a; θ_a) and/or functional condition of said apparatus (11), to detect an instantaneous position (φ_w; θ_w) and/or functional condition of said apparatus (11) relative to the operator (12), and to command the automatic activation of said apparatus (11) when said instantaneous position (φ_w; θ_w) and/or functional condition substantially corresponds, with a desired margin of tolerance ($\Delta\varphi$; $\Delta\theta$), to said reference position (φ_a; θ_a) and/or functional condition, and to command the automatic de-activation, even complete, of said apparatus (11) when said instantaneous position (φ_w; θ_w) and/or functional condition is different, with a desired margin of tolerance ($\Delta\varphi$; $\Delta\theta$), from said reference position (φ_a; θ_a) and/or functional condition.

2. Device as in claim 1, characterized in that said activation/de-activation means (17, 18) comprise at least a timer element (29) able to command the automatic activation, or de-activation, of said apparatus (11) only after a determinate period of minimum time (T_a) in which the condition of substantial correspondence, or divergence, between said instantaneous position (φ_w; θ_w) and/or functional condition and said reference position (φ_a; θ_a) and/or functional condition is maintained.

3. Device as in claim 1 or 2, characterized in that said activation/de-activation means comprise an activity detection unit (17) and a configuration unit (18) substantially consisting of a driver and able to allow to set functioning parameters of said activity detection unit

(17).

4. Device as in claim 3, characterized in that said activity detection unit (17) comprises a detection circuit (19) able to feel the two-dimensional oscillations of said apparatus (11) in order to detect said instantaneous position (φ_w; θ_w), and a conditioning circuit (20) in which said reference position (φ_a; θ_a) is memorized in order to selectively command the activation, or de-activation, of said apparatus (11).

5. Device as in claim 4, wherein said apparatus (11) can be worn by the operator (12) on an arm at the height of the wrist, characterized in that said detection circuit (19) comprises sensor elements (30, 31) able to detect an angle of inclination of the arm (φ_w) with respect to a vertical axis (z) and an angle of rotation of the wrist (θ_w) with respect to said vertical axis (z), in order to detect said instantaneous position (φ_w; θ_w) of said apparatus (11).

6. Device as in claim 4 or 5, characterized in that said conditioning circuit (20) comprises memory elements (21, 22) in which an angle of inclination of the arm (φ_a) with respect to a vertical axis (z) and an angle of rotation of the wrist (θ_a) with respect to said vertical axis (z) are memorized, in order to define said reference position (φ_a; θ_a) of said apparatus (11).

7. Device as in any claim from 4 to 6, characterized in that said activity detection unit (17) also comprises said timer element (29) and a logic element (23) disposed downstream of said detection circuit (19) and of said conditioning circuit (20) and upstream of said timer element (29), and able to verify the condition of substantial correspondence between said instantaneous position (φ_w; θ_w) and said reference position (φ_a; θ_a).

8. Device as in claim 7, characterized in that said logic

unit (23) comprises two trigger devices (25, 26) each one able to compare respectively the angles of inclination of the arm (φ_a, φ_w) in a relative field of tolerance ($\Delta\varphi$), and the angles of rotation of the wrist (θ_a, θ_w) in a relative field of tolerance ($\Delta\theta$),and a logic operator (27) able to receive a signal from both the trigger elements (25, 26) and to send a command signal to said timer element (29).

9. Device as in claim 8, characterized in that said activity detection unit (17) also comprises a control interface (24) connected at inlet to said configuration unit (18), and at outlet both to said memory elements (21, 22), to said two trigger elements (25, 26), and also to said timer device (29).

10. Device as in any claim hereinbefore, characterized in that said activation/de-activation means (17, 18) comprises at least a subsystem to manage the energy, able to detect the functioning state of the various components of said apparatus (11) and to command the functioning thereof in different energy-saving conditions chosen from “run”, “stand-by”, “sleep” and “off”.

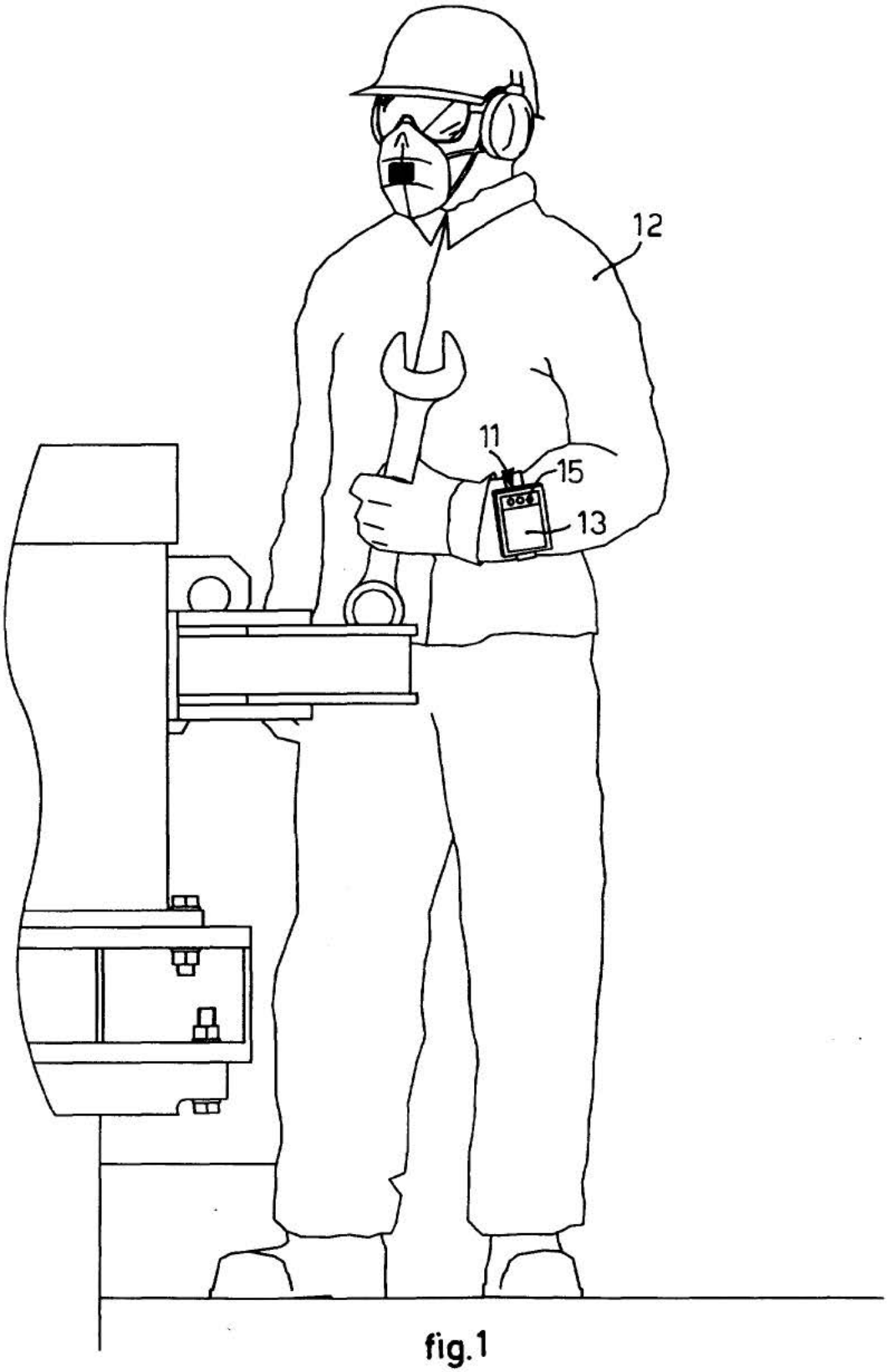


fig.1

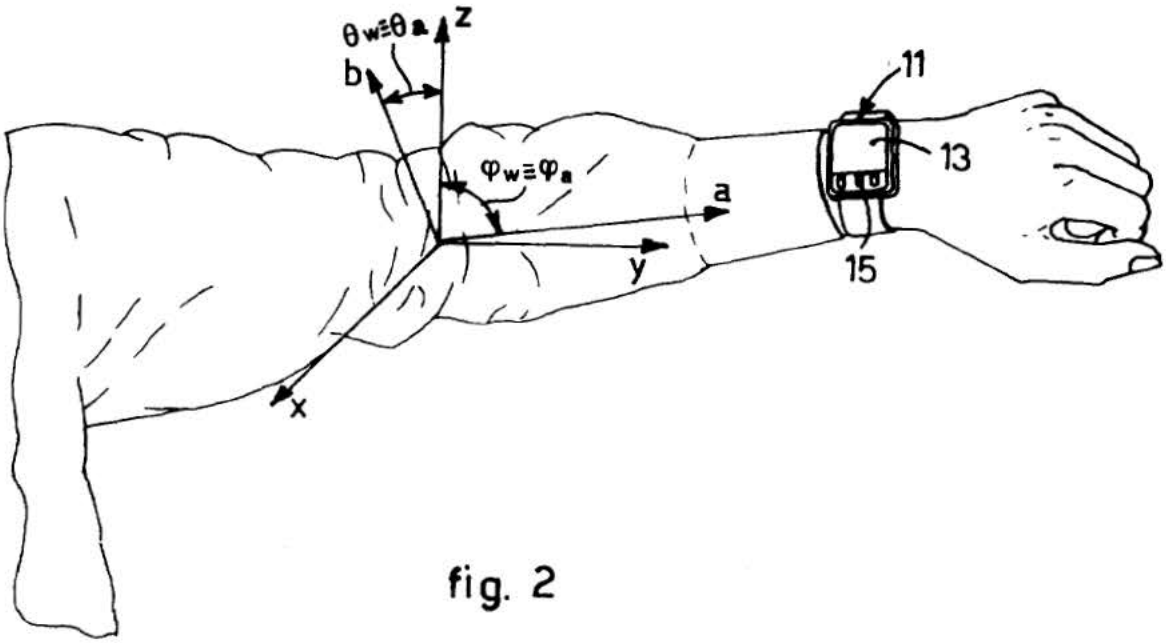


fig. 2

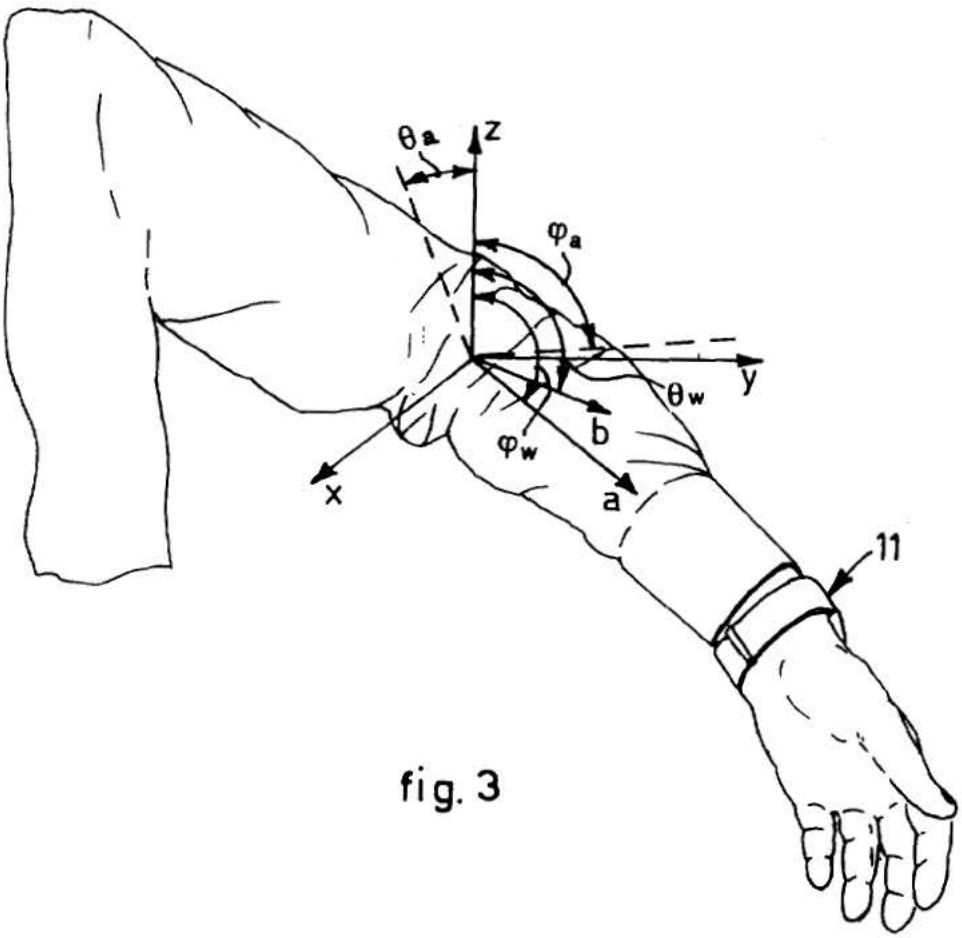
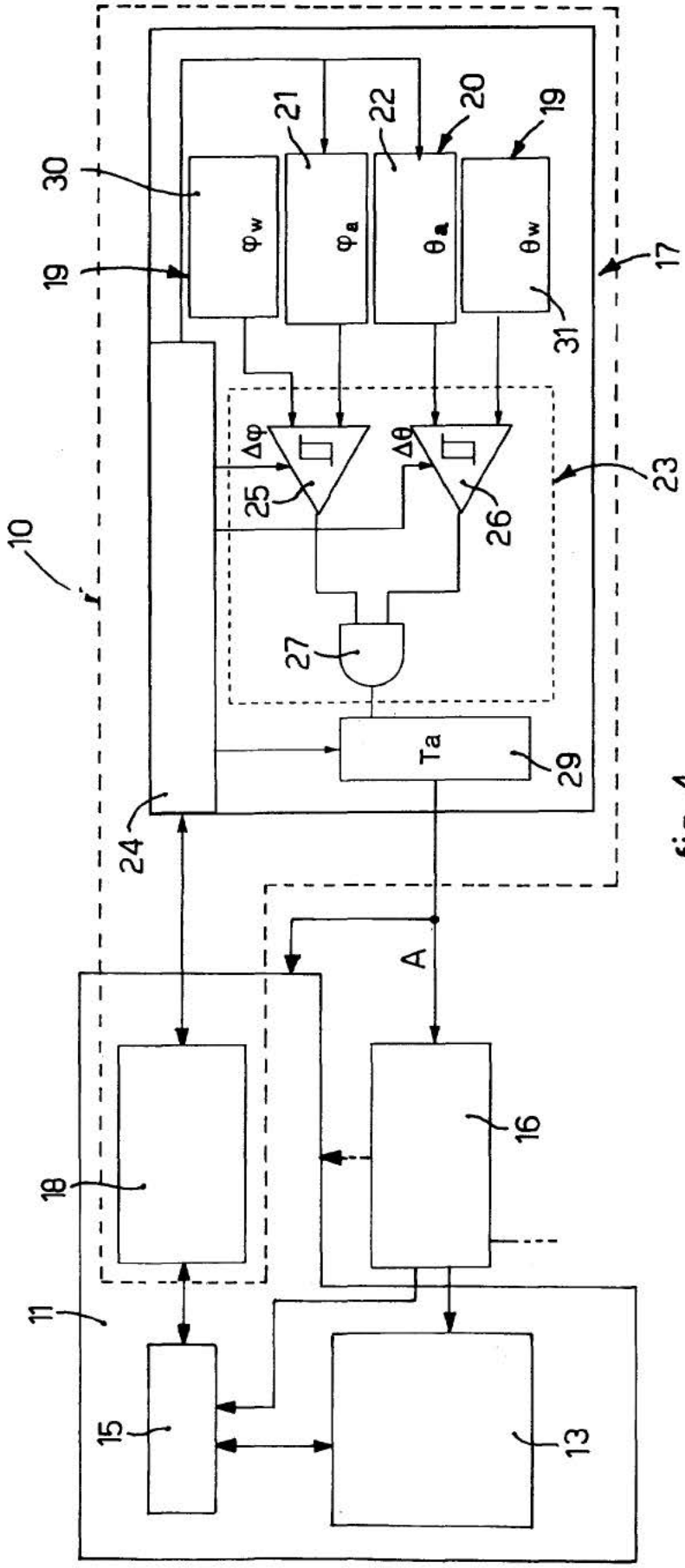


fig. 3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