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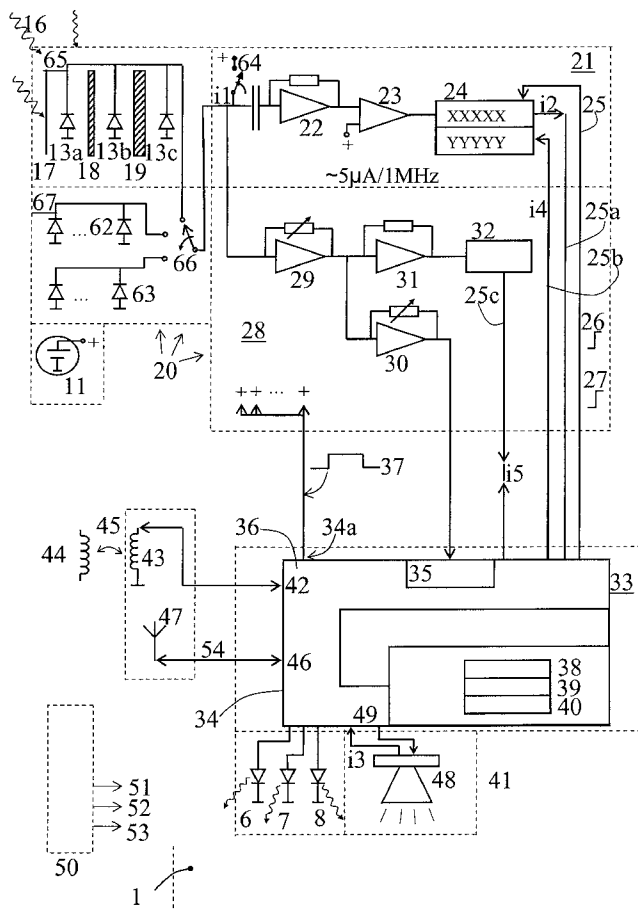
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(54) Title: DEVICE AND ARRANGEMENT FOR SENSING AND DISPLAYING RADIATION



(57) Abstract: An arrangement is adapted for detecting and initiating indication of doses of radiation. The arrangement includes radiation dose receiving means (65) and function handling means for storing and displaying received radiations/radiation doses. The arrangement is operable by means of one or several power sources. The arrangement includes one or several portable meters (1) exhibiting miniature external dimensions and being provided with internal power sources, preferably in the form of one or several batteries. The respective meter (1) is provided with radiation receiving means (65) and function handling means (20). Furthermore, each meter includes one or several preferably continuously connected first components (21), requiring low power, and temporarily connectable second components (28), requiring increased or increasing power in relation to said low power. Furthermore one or several third components (33), handling the temporary connection and disconnection of the second component or components, is/are included. The first components are activated at low radiation intensities and the second components are connected when high radiation intensities are occurring. The third components connect and disconnect the second components at the different intensities. The invention also relates to a meter (1) which can operate independently or be included in said arrangement.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Device and arrangement for sensing and displaying radiation.

The present invention relates to an arrangement for detecting and initiating
5 indication of doses of radiation, which can be constituted of ionizing radiation
(X-radiation, α - and β -radiation, etc. Advantageously, the arrangement and the
meter can also be utilised for measuring radon and solar radiation, and other
(dangerous) radiation to which the human body is exposed. The arrangement and
the meter, respectively, include radiation receiving means and function handling
10 means for storing and displaying received radiations/radiation doses. Thereby, the
means are operable by means of one or several power sources.

There is a need of individual meters which can directly warn the user at certain
radiation levels and record accumulated doses over time (days, months, years).
15 Today, a number of so called active (battery operated) meter alternatives are
available in the market, wherein some are known since about 15 years. The
known meters are designed with relatively large external dimensions which are
oriented towards science and consume far too much electrical power to be used
during a long succession of years without requiring battery change. It is also
20 previously known with so called passive individual dosimeters (non-battery
operated) which are used for recording accumulated dose.

There is a need of an integrated individual dosimeter which is small (having a so
called thumb-volume) and can be used for at least 5 years with the same non-
25 rechargeable battery. There is also a need of a smaller meter (having a thumb
nail-volume) which measures and warns of dangerous radiation and which is
intended for measuring substantially shorter time periods. Furthermore, the meter
should be resistant to environments which are mechanically difficult,
temperature-variable and humid. It should be easily readable with respect to
30 accumulated dose and time-stored values (even values up to about 100 dose
values). There is also a need to be able to stimulate and facilitate the desire of
ordinary people to utilise the relevant meters. The smallness is of critical

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importance for easy and natural use of the meter. The use of an internal battery with remarkably small external dimensions contributes to this smallness, and all without having to sacrifice a reliable and clear-cut function. The object of the present invention is to solve these problems entirely or partially.

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The main feature which can be regarded as characterizing of an arrangement according to the invention is, among other things, that it includes one or several portable meters exhibiting miniature external dimensions and having a power source or several power sources assigned thereto. The respective meter is provided with radiation dose receiving means and function handling means of its own, and further includes one or several, substantially continuously connected, first components, requiring low power and being activated at low radiation intensities, one or several, temporarily connectable, second components, requiring increased or increasing electrical power in relation to the low power and being activated at increasing, increased or higher radiation intensities, and also one or several third components, controlling the temporary connection and disconnection of the second component or components when the last-mentioned radiation intensities are starting and ending, respectively.

20 In further developments of the inventive idea, said function handling means can include first and second function handling means, wherein the respective meter includes the first function handling means and the second function handling means can be located outside the meter and constitute or be included in an actuatable control unit which can be common to a number of, or all, meters. The function handling means and first function handling means, respectively, of the
25 respective meter preferably include a microcomputer, being provided with and/or being connected to memory means, and indicating means, e.g. light indicating means and/or sound emitting means. The first function handling means of the respective meter can further include a circuit for the connectability of the
30 microcomputer to said second function handling unit via wireless or wirebound connection being actuatable e.g. by means of a mobile phone. The respective meter is preferably provided with an internal power source of its own, in the form

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of a small battery with a capacity of about 400 mAh. Said first component or components can operate with a current consumption in the order 5 μA , (3-7 μA). The respective meter can be provided with a power receiving circuit for inductive reception of power arriving from outside of the second function handling means.

5 The meter or meters is/are placeable onto an object, e.g. a human body, and is/are controllable by means of said control unit. The respective meter receives and records radiation which is dangerous to human beings. In one embodiment, one or several meters can include two or several sensors which are assigned to different types of ionizing radiations, wherein the respective sensor can constitute
10 a separate channel together with first, second and third components being assigned thereto.

The main feature which can be regarded as characterizing of a meter according to the invention is, among other things, that its exhibits miniature external
15 dimensions. The meter includes the function handling means, mentioned by way of introduction, which exhibits/exhibit the preferably continuously connected, one or several first components, requiring low power and being activated when receiving low radiation intensities, one or several temporarily connectable second components, requiring an increased or increasing power in relation to the low
20 power and being activated when receiving increasing or higher radiation intensities, and also one or several third components, controlling the temporary connection and disconnection of the second component or components when the increasing or higher radiation intensities are starting and ending, respectively.

25 In further developments of the inventive idea, specific external dimensions are indicated. The housing can include a base member and a shell shaped cover member, which are sealed against each other by means of sealing means, e.g. a rubber seal or an elastic member and/or glue, preventing moisture penetration. The shell shaped cover member can be replaceable, relative to the base member
30 or base members of the meter, by a new cover member. The function handling means can include sensor arrangements, sampling means and memory means, and also radiation indicating means being made up of components which are

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substantially insensitive to temperature variation, of a type which is known *per se*. In one embodiment, said means and components are cooperatable with a battery with long durability time, e.g. 5 years. In another embodiment, there are reduced requirements for durability, which thereby can be reduced substantially and e.g. comprise hours or one or several days. In one embodiment, the sensor arrangement can include one or several sensors, e.g. two sensors, being sensitive to the radiation in question, e.g. X-radiation. Thereby, the arrangement can be such that there is a reduced need of correction for different radiation energies. A lower radiation level can represent a remarkably low level of radiation, e.g. a few photons/min, which normally occurs 99 % of the total time which the user is carrying the meter. Thereby, the sensor arrangement can be connected or connectable to a pulse amplifier being part of the first components, said amplifier in its turn being connected or connectable to pulse counting means (a first pulse counter) for said remarkably low radiation level. The first components can be substantially continuously connected, and are of the type requiring remarkably low current consumption, e.g. 5 μ A. The second components are temporarily connectable and can include a current/voltage amplifier, a voltage/frequency converter and a second pulse counter being connectable in series, and a voltage/voltage converter being connected in parallel to said voltage/frequency converter and second pulse counter. A third component can include a microcomputer unit with an analogue/digital converter, unit for connecting digital pulse, memory means and connections for displaying means. Furthermore, one or several connections can be included for piezoelectric means and/or light emitting elements being included in the displaying means, e.g. light emitting diodes, which operate with different indicating functions, e.g. colour and/or flash functions, and connection to wireless communication (radio) with time storage memory, and connection to inductive circuit portion for power reception from a unit emitting inductive power being present outside the meter, and located e.g. in said control unit. Said second pulse counter can be connected to the digital connecting unit or the digital in/out unit. In one embodiment, the microcomputer unit is activatable in predetermined intervals from the first pulse counter in dependence of pulses emitted therefrom, representing numbers which the first

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pulse counter displays when receiving incoming radiation energy. In said interval, the microcomputer unit is handling the temporary connection of the second component or components, all in order to minimize the power consumption. Said handling takes place when the number or numbers totalled in the first pulse counter exceeds/exceed a predetermined number. At such an exceeding number the microcomputer rapidly connects the more power-requiring second components, e.g. within 0.001-10 seconds. Disconnection of the latter preferably occurs equally rapidly when the totalled number or numbers once again falls/fall below the predetermined number or numbers. Alternatively or additionally, the radiation intensity over time can be stored only for temporary reading at the moment in question in order to thereby put a smaller load on the battery. The indicating means preferably include a buzzer which sounds a warning at a radiation intensity or radiation intensities of predetermined magnitude or magnitudes over different times. In one embodiment, the buzzer is of a piezoelectric type which, inversely, can act as a push button which, when being subjected to a mechanical shock, generates an electric signal perceivable as a key stroke. The indicating means can include a green light emitting diode which flashes a number of times per period of time at a radiation intensity and/or accumulated dose which is acceptable or absent. Alternatively or additionally, the indicating means can also include an orange/yellow light emitting diode which gives a single flash or several flashes per period of time if the dose intensity exceeds the predetermined level or levels. Alternatively or additionally, the indicating means include a red light emitting diode which gives a flash/several flashes per period of time predetermined level/levels if accumulated dose exceeds the predetermined level/levels.

A readily portable miniature meter sensitive to radiation, e.g. X-radiation and radon radiation, and which warns of high radiation intensities and radiation doses and records accumulated doses of varying magnitudes, is made possible by means of the features proposed in the foregoing. The meter can be carried around and be utilised for a long period of time without replacement of current executing means for a long time, in spite of possible use in said difficult environments. The

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replaceable shell shaped cover enables the contents of the meter to be reused with another or a new design. The basic structure and the selection of battery and components in the meter enable the miniaturization and the low current or power need, and thereby forms an incentive for stimulating the desire to utilise the
5 meter/arrangement. Alternatively, the meter can be adapted for short-term use and then be arranged with further reduced external dimensions.

Presently preferred embodiments of an arrangement and a meter according to the invention will be described, while simultaneously referring to the attached
10 drawings, in which

Figure 1 shows the meter from the front;

Figure 2 shows the meter according to Figure 1 from the side;

15

Figure 3 shows function handling and displaying means being included in the meter in schematic form;

Figure 4 shows examples of radiation intensity over time in diagrammatic form, and wherein different initiations of the
20 displaying means are starting and ending; and

Figure 5 shows utilisation of the meter/arrangement on a patient during an X-ray investigation in principal diagram form.

25

In Figures 1 and 2, a meter is indicated with 1. The meter exhibits a top member 2 and a base member 3, being mountable together via sealing means 4 in order to be able to form a moisture-proof internal cavity 5. At one end, the meter is provided with light indicating means 6, 7 and 8, being visible from the outside
30 through a transparent portion or a window 9. The light indicating means can consist of light emitting diodes which are arranged for being able to light up with green (6), orange/yellow (7) and red (8) light. The top member 2 is shell shaped,

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whereas the base member exhibits a more straight extension in the view according to Figure 2. In the view according to Figure 1, the meter has a substantially oval or crescent shape, and carries said window or the like at a narrowed end member. On its underside, the base member 3 carries fastening means, which can be constituted of a clamp 10, needle, glue, chain, adhesive tape, etc. The meter can be attached to an object or a carrier, e.g. a human being, on which long-term measurement and/or shorter measurement of any occurring radiation is to be made. The material in the meter can consist of plastic (hard plastic), metal, alloy, etc. A battery, preferably with miniature dimensions, e.g. a battery having a diameter D of approx. 20-25 mm and a thickness of approx. 3-5 mm, and with a capacity of e.g. 400 mAh, is disposed inside the enclosed cavity of the meter. For short-term use, as is described in the following, further dimensional reductions, for example into half, can be utilised. The battery is disposed/attached at one side of a printed circuit card 12, which on its other side carries function handling means in the form of one or several sensors 13. ASIC-components 14 and the other electronics 15, the printed circuit card 12 with battery 11, components 15 and displaying means 6, 7, 8 are preferably anchored to the base member 3, and different top members (shells) with different colours, marking, shape, etc. can be applied onto the base member as desired.

20

In Figure 3, symbolically indicated radiation, e.g. X-radiation or other radiation dangerous to humans, incides towards the meter 1, which has been indicated only symbolically in figure 3 by means of its cover or shell. The radiation is detected by the sensors 13a, 13b and 13c, being cooperatable with filters 17, 18, 19 in a way known *per se*. The sensors convert the radiation into electrical signals 11, which are processed in function handling means 20 being included in the meter. The battery 11 is supplying power to the function handling means in a way known *per se*. The function handling means 20 include first components 21, being of the type requiring remarkably little power in order to operate. In the first components, a pulse amplifier 22 and a comparator being connected to the output of the same, wherein the output of said comparator 23, in its turn, is connected to a pulse counter 24. Said first components are operating with, among other things,

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a sampling function, and can also be regarded as or include sampling means. The pulse counter 24 is adjusted or adjustable to deliver a pulse or pulses on its output 25 having intervals which can vary in dependence of the radiation intensity and activate the microcomputer accordingly. The microcomputer reacts if the interval 5 is shorter than a normal interval which is specified in the computer. The pulse counter totals numbers in dependence of received pulses and the microcomputer reads the number (numbers) and compares it or them with its own number. At a predetermined similarity, connection of the second components takes place. Activating pulses are exemplified with 26 and 27 and occur at an indicated time 10 interval T. The function handling means also exhibit second components 28, including or consisting of a current/voltage amplifier 29 and a voltage/voltage amplifier 30 being connected in series with said current/voltage amplifier. A voltage/frequency amplifier 31 and a pulse counter, here denoted second pulse counter 32, are arranged in parallel to the unit 30.

15

The function handling means also include a microcomputer unit 33 with a microcomputer 34, which can be constituted of a microcomputer known *per se*. The microcomputer is provided with an analogue-digital converter 35 which is connected to the output of the amplifier 30. The microcomputer also includes an 20 incoming and an outgoing digital connecting unit 36, being connected to the output on the second counter 32. Via said unit 36, the microcomputer is also connected to the output on the second pulse counter 24, and thus receives the numerical signals 26, 27 occurring at certain intervals T. In dependence of the reception of said numerical signals 26, 27 and the numeric state in the counter 24, 25 the microcomputer activates an initiating pulse 37 at an output on the unit 36, by means of which the microcomputer activates the second components. The second components 28 are of the type requiring a higher power consumption than the first components 21. By means of a pulse or pulses 37, the microcomputer can thus activate the second component for a predetermined time, i.e. activate them 30 temporarily. Accordingly, by means of the arrangement having the first and second components and the microcomputer, the first components can continuously inform the microcomputer about the fact that they are activated, i.e.

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continuously activated, whereby the microcomputer can connect the other, more power requiring, second components 28 for short predetermined intervals at increased or higher radiation intensity.

5 In a known way, the microcomputer includes programming circuits 38, and memories 39, 40. The memories can be of different types and, accordingly, so-called volatile memories 39 and non-volatile memories 40 can be utilised. The last-mentioned memories are more power requiring than the volatile memories. The microcomputer is connected to a displaying unit 41 which includes the
10 above-mentioned light emitting diodes 6, 7 and 8. The microcomputer is of the type which, in way known *per se*, exhibits terminal pins or terminal legs for the different functions described in the foregoing. The microcomputer is in one embodiment, via connection 42 in unit 36, connected to an inductive circuit portion 43, being cooperatable with an inductive circuit portion 44 being arranged
15 outside the meter. Accordingly, during passage through the portion 44, inductive power 45 can be transferred to the coil 43 and be brought into the microcomputer. A connection 46 on the microcomputer can also be connected to or constitute an input and/or output for a wireless connection, which has been symbolized with an antenna 47. The microcomputer is also connected to a piezoelement 48, being
20 connected to the microcomputer via a connection 49. The element 48 is adapted to emit a sound signal in dependence of a signal i_2 from the counter 24 in the first components. The element 48 can operate with an inversed function and, when being subjected to knocking or mechanical actuation, initiate a signal i_3 in the opposite direction relative to the buzzer 48 for activation of a function, e.g.
25 memory detection, to or towards the first components. The first components are of the type requiring about $5\mu\text{A}$ in order to operate. The pulse amplifier operates within a band width region of 1 MHz. The meter according to Figure 3 can operate independently or in cooperation with other meters, being at least substantially similarly made up. Such an interaction can take place via controlling
30 or interacting means 50, being located outside the meter, and can e.g. include the inductive portion 44. Accordingly, the controlling portion 50 can interact with several meters and interactions with three meters have been symbolized with

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arrows 51, 52 and 53. The microcomputer can also acquire frequency power 54 via the wireless connection or radio connection 47.

The microcomputer 34 causes connection of electrical power supply via the
5 connection to the different blocks of the second components, which can take place in a way known *per se*. Biasing is connectable in accordance with the following. In Figure 3, a first number in the counter 24 is symbolized with xxxxx. At selected intervals, this number is transferred to the microcomputer 34, which in its turn emits information i4 about a number yyyyy set in the computer, which
10 is compared with the radiation intensity received within the respective interval by the counter. When the compared numbers exhibit a predetermined mutual relation, e.g. that they are the same, the counter 24 transmits the activating pulses 26, 27 on the connection 25, and thus activates the microcomputer so that it, in its turn, activates the second components via the connection 34a and, among other
15 things, connects the second components and their battery supply. The microcomputer exchanges signals i5 with the second counter 32 in connection with the activation of the second components. The connections between the microcomputer and the counter 24 are indicated with 25, 25a and 25 b, whereas the connection between the microcomputer and the counter 32 is indicated with
20 25c. The number yyyyy can correspond to a dose of about 1 μ Sv.

Figure 4 shows examples of reception of radiation over a certain time. The vertical axis indicates intensity in mSievert per unit of time (hour) and the horizontal axis time, e.g. in hours or days or weeks, months, years, etc. A
25 represents the reception of a low dose level A during a time portion T1. The low dose level is present during a very large portion of the time of use of the meter in long-term use, e.g. approx. 99 % of this time. The curve representing the received radiation is denoted 54. The level B of the intensity constitutes a warning level one, whereas C and D constitute warning levels two and three, respectively.
30 Level E indicates a storage level. At these levels, the meter primarily operates only with the first components, which require the less demanding energy consumption. At level F, the radiation or intensity has increased to a value where

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also the second components (28 in Figure 3) are connected more permanently. Such peaks in the received intensity are usually of a temporary nature for meters in long-term use.

5 T1 constitutes a time period where the pulse counter 24 is read each 3-5 seconds by the otherwise disconnected microprocessor (34 in Figure 3). At time S1, i.e. where the warning level B has been achieved, a single beep signal is emitted from the element (48) and/or the orange/yellow light emitting diode (7) is lighted with a single flash. At S2, which indicates that the intensity has increased to the level
10 C, a single beep is initiated on the element (48), at the same time as the orange/yellow light emitting diode is activated and emits a double flash. In a corresponding way, at S3, single beep is caused to be omitted and the orange/yellow light emitting diode gives a triple flash. At L1, which represents the level E, storage of individual samples into the memory (39 and/or 40) takes
15 place. This storage can take place every second/every tenth second/every minute/every tenth minute, etc. At A2, which indicates the level F, connection of the second components takes place. When the intensity falls below the level F, the power to the other components is disconnected, etc. T2 indicates examples of when the intensity exceeds the normally received low intensity, cf. T1.

20

Storage of accumulated dose takes place continuously. If the accumulated dose exceeds certain limit levels, a single beep signal and a single/double/triple flash on the red light emitting diode (8) are emitted. Furthermore, in one embodiment, storage of accumulated dose into a non-volatile memory (40), being more power-
25 requiring than storage into a volatile memory, can take place every hour, or every tenth, twenty-fourth hour, etc.

When controlling or reading, three alternative cases can occur, wherein a key stroke is executed in the first case by means of knocking the meter/element (48)
30 against a hard support. In a second alternative, a predetermined frequency can be received from another base unit via the radio communication connection (47). Alternative three concerns inductive functions or readings. Accordingly, reading

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of accumulated dose can take place from the outside and no energy consumption from the internal battery (11) needs to occur in this case. Programming of the meter can be done via the terminal strip unit (50) or the communicating connection (47). Programming of the programming circuit 38 of the

5 microcomputer can take place according to a known programming method. In those cases where the meter (meters) operates (operate) with function handling means being present inside the meter and being present outside the meter, these are denoted first and second function handling means, respectively. The

10 respective meter can be designed with several channels 62, 63, which each can be assigned function handling means of its own or entirely or partially share the same function handling means. The bias determining circuit for the counters is indicated with 64, and the detecting unit with filters and sensors has the designation 65. The channels 62, 63 are connectable one by one by means of switching means 66. The block with the channel functions has the designation 67.

15 Parts which are not described here are of a type known *per se*, having functions which are evident from the context. In one embodiment, the first components can be disconnected when the second components are connected, and *vice versa*.

Figure 5 shows examples of an arrangement where a number of meters are

20 interacting via a central unit 55. The short-term meters (thumbnail meters) are applied onto a patient 56 or an other object in question. Two of the meters have been indicated with 57a and 58 a. The respective meters can be in contact with the central unit 55 via one or several inductive circuits 59 and/or via wireless connection 60. Staff members working with the patient during the radiation

25 treatment or radiation are symbolized with 61a and 61b. The staff members carry the meters 57b and 58b and 57c and 58c, respectively, in question. The patient and the staff members are subjected to radiation, e.g. X-ray equipment (tubes) 68 producing direct radiation 69. Also secondary radiation 70 at the place of work can be measured. In the embodiment according to claim 5, much smaller batteries

30 can be used in the respective meters being used on the patient than in the case of long-term meters. Furthermore, the light emitting diodes (6,7,8) can be omitted, which all together makes it possible with meters of thumbnail size. The battery

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time can be selected to be remarkably short, e.g. 24-100 hours. In Figure 2, the buzzer has the reference numeral 71.

The invention is not limited to the exemplary embodiment shown above, but can
5 be subjected to modifications within the scope of the following claims and the inventive idea.

Claims

1. Arrangement for detecting and initiating indication of doses of radiation
5 (16), including radiation dose receiving means (13a, 17; 13b, 18; 13c, 19) and
function handling means for storing and displaying received
radiations/radiation doses, said means being operable by means of one or
several power sources (11), including one or several portable meters exhibiting
miniature external dimensions and having a power source assigned thereto,
10 and wherein the respective meter is provided with radiation dose receiving
means and function handling means of its own,
characterized in that said meter includes one or several first
components (22, 23, 24), requiring low power and being activated when
receiving low radiation intensities, one or several temporarily connectable
15 second components (29, 30, 31, 32), requiring increased or increasing
electrical power in relation to the low electrical power and including a
current/voltage amplifier (29) being activated when receiving increased or
higher radiation intensities, and one or several third components (33), handling
the temporary connection and disconnection of the second component or
20 components when the increasing or higher radiation intensities are starting and
ending, respectively.
2. Arrangement according to claim 1, **characterized in** that said
function handling means (20) include first and second function handling
25 means, wherein the respective meter includes the first function handling
means, and the second function handling means (50) is located outside the
meter (1) and constitute or are included in an actuatable control unit.
3. Arrangement according to claim 2, **characterized in** that the meters,
30 in the case with more than one meter, are assigned the same control unit (50).
4. Arrangement according to claim 2 or 3, **characterized in** that the

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function handling means (20) and the first function handling means of the meter, respectively, include a microcomputer (34), including and/or being connected to memory means (39, 40), and indicating means, e.g. light indicating means (6, 7, 8) and/or sound emitting means (40).

5

5. Arrangement according to claim 4, **characterized in** that the first handling means of the meter include a circuit for the connectability of the microcomputer (34) to said second function handling unit via wireless (47) and/or wirebound connection being actuatable e.g. by means of a mobile phone..

10

6. Arrangement according to any one of the preceding claims, **characterized in** that the respective meter is provided with a power source (11) of its own.

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7. Arrangement according to claim 6, **characterized in** that the power source includes a long-lasting battery, having a capacity of e.g. 400 mAh.

8. Arrangement according to any one of claims 1-7, **characterized in** that said first component or components (21) is/are operating with a current consumption of about 5 μA , e.g. 3-7 μA .

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9. Arrangement according to any one of the preceding claims, **characterized in** that the respective meter (1) is provided with a power receiving circuit (43) for inductive reception of power arriving from outside the second function handling means (44, 50).

25

10. Arrangement according to any one of claims 2-7, **characterized in** that the meter or meters is/are placeable onto one or several objects, e.g. onto human bodies, and is/are controllable by means of said control unit (55).

30

11. Arrangement according to any one of the preceding claims,

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characterized in that one or several meters includes/include two or several sensors (62, 63) compensating for different types of radiation energies.

12. Arrangement according to any one of claims 1-11, **characterized in**
5 that several meters are controllable by means of a common unit, wherein meters being disposed on several persons can be controlled by the same unit (55).
2. 13. Meter (1, 57, 58) for detecting and initiating indication of doses of
10 radiation (16), including radiation dose receiving means and function handling means (20) for storing and displaying received radiations/ radiation doses, said means being operable by means of one or several power sources (11), and exhibiting miniature external dimensions,
characterized in that said function handling means (20) include one or
15 several preferably continuously connected first components (21), requiring low power and being activated when receiving low radiation intensities, one or several temporarily connectable second components (28), requiring increased or increasing electrical power in relation to the low electrical power, including a current/voltage amplifier (29), and being activated when receiving increased
20 or higher radiation intensities, and one or several third components (33), controlling the temporary connection and disconnection of the second component or components when the increasing or higher radiation intensities are starting and ending, respectively.
- 25 14. Meter according to claim 13, **characterized in** that it exhibits a width (B) of 20-30 mm, a length (L) of 40-50 mm and a thickness (T) of 10-20 mm when in long-time use, or a width (B) of 5-10 mm, a length (L) of 10-15 mm and a thickness (T) of 4-7 mm when in short-term use.
- 30 15. Meter according to claim 13 or 14, **characterized in** that the housing includes a base member (3) and a shell shaped cover member (2), being adapted to each other by means of moisture penetration-preventing

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means (4), e.g. a rubber seal or an elastic member and/or glue.

16. Meter according to claim 15, **characterized in** that the shell shaped cover member (2) is replaceably arranged relative to the remaining member/members (3) of the meter.
17. Meter according to any one of claims 13-16, **characterized in** that the function handling means (20) includes/include sensor arrangements (13a, 17; 13b, 18; 13 c, 19), sampling means and memory means, and the radiation indicating means (6, 7, 8, 48) are of a type being substantially insensitive to temperature variation.
18. Meter according to any one of claims 14-17, **characterized in** that the function handling means (20) having the sensor arrangement, sampling means and memory means, and the radiation indicating means are measurable with current executing means/battery (11) having a long durability time, e.g. 5 years, for long-term usability of the meter, or a shorter durability time, counted e.g. in days, weeks, months, etc., when a shorter durability time is required from the meter.
19. Meter according to any one of claims 13-18, **characterized in** that the sensor arrangement includes one or several sensors (62, 63) compensating for different types of radiation energies.
20. Meter according to any one of claims 13-19, **characterized in** that a lower received radiation level (A) represents a remarkably low radiation level, e.g. a few photons/min, which normally occurs 99% of the total time of use of the meter.
21. Meter according to any one of claims 13-20, **characterized in** that the first components (21) include a first pulse amplifier (22), a comparator and a pulse counter (24) being connected in series.

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22. Meter according to any one of claims 13-21, **characterized in** that the second components (28) include a voltage/frequency converter (31) and a second pulse counter (32) being connectable in series, and a voltage/voltage
5 converter (30) being connected in parallel to said voltage/frequency converter and second pulse counter.
23. Meter according to any one of claims 13-22, **characterized in** that the third component or components (33) includes/include a microcomputer
10 unit (34) having an analogue-digital converter (35), digital in/out unit (36), memory means (39, 40) and connections for displaying means (6, 7, 8, 48).
24. Meter according to claim 23, **characterized in** that the microcomputer unit (34) includes one or several connections for piezoelectric
15 means (48) and or light emitting elements (6, 7, 8) being included in the displaying means, e.g. light emitting diodes, operating with different indicating functions, e.g. colour and/or flashing functions.
25. Meter according to claim 23 or 24, **characterized in** that the microcomputer unit (34) exhibits connection (46) to wireless communication
20 (radio) having a time-storage memory (e.g. 40).
26. Meter according to claim 23, 24 or 25, **characterized in** that the microcomputer unit (34) exhibits connection to an inductive circuit portion
25 (43) for power reception from an inductive power emitting unit (44) being present outside the meter and located e.g. in or at said control unit (50).
27. Meter according to any one of claims 23-26, **characterized in** that the pulse counter (24) is connected to the digital in/out unit (36), and that the
30 microcomputer unit (34) is activatable in predetermined intervals by said pulse counter (24) in dependence of pulses (26, 27), being emitted therefrom and representing numbers generated by the counter (24), and that the

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microcomputer unit (34) is handling said temporary connection of the second component or components (28) by means of a signal pulse (3 7).

28. Meter according to any one of claims 24, 25 or 26, **characterized in**
5 that, in the case with a piezoelectric means (48), said means includes a buzzer, which inversely functions as a push button by means of generating an electric signal, being perceivable as a key stroke, when it is subjected to a mechanical shock.
- 10 29. Meter according to any one of claims 24-28, **characterized in** that the light emitting elements include a green light emitting diode (6) flashing a number of times, e.g. once, per time period, e.g. one minute, when radiation intensity and/or accumulated dose is acceptable or absent.
- 15 30. Meter according to any one of claims 24-29, **characterized in** that the light emitting elements include an orange/yellow light emitting diode (7) giving single, double or triple flash during the time period in question, if the dose intensity exceeds the predetermined level (one, two, three).
- 20 31. Meter according to any one of claims 24-30, **characterized in** that the light emitting elements include a red light emitting diode (8) giving single, double or triple flash during the time period in question, if the accumulated dose exceeds the predetermined level (one, two, three).
- 25 32. Meter according to any one of claims 23-31, **characterized in** that the memory means (39, 40) include one or several non-volatile first memories and one or several volatile second memories, that the first memory or memories is/are storing data about accumulated dose only at longer time
30 intervals, e.g. once an hour or day, because relatively high power is required for the respective storage event and/or that the second memory or memories is/are storing data about accumulated dose at shorter time intervals, e.g. each 3-5 seconds, which are sub-stored in the second memory or memories, which

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thereby is/are supplied with electrical power by the battery.

33. Meter according to any one of claims 26-32, **characterized in** that reading of received dose is executable from the outside of the meter by means of transmitting radio frequency via the wireless communication (47) and the inductive circuit portion (43).
34. Meter according to any one of claims 18-33, **characterized in** that its battery (11) is of miniature size and of a size order with a diameter of approx. 20-30 mm and a thickness of approx. 5 mm, e.g. 3-7 mm for a long-term usable meter, or 2-4 mm and 1-2 mm, respectively, for a short-term usable meter.
35. Meter according to any one of claims 13-34, **characterized in** that the first component or components is/are continuously connected.
36. Meter according to any one of claims 13-35, **characterized in** that the third component or components is/are handling the temporary connection and disconnection by means of detecting the reception, by the first component or components, of the reception of radiation, by the radiation dose receiving means.
37. Meter according to claim 36, **characterized in** that the first component or components detects/detect pulses caused by the low received radiation intensity and, in dependence of the pulses, generates/generate numbers at a predetermined interval or predetermined intervals.
38. Meter according to claim 37, **characterized in** that the third component or components detects/detect said number/numbers and, when exceeding or falling below this or these, connects/connect or disconnects/disconnect the second component or components.

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39. Meter according to claim 37, **characterized in** that the third component or components connects/connect or disconnects/disconnect the increasing or higher electrical power immediately/rapidly, e.g. within 0.001-10 seconds.

5

40 Meter according to claim 38 or 39, **characterized in** that the third component or components is/are long-term or short-term storing the read numbers in one or several memories as an indication of accumulated received long-term and/or short-term radiation doses.

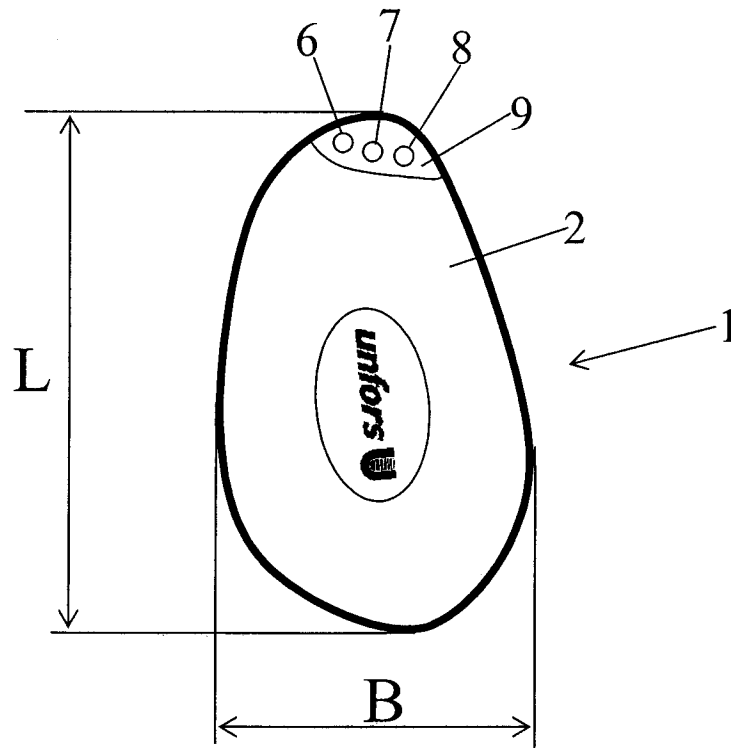


Figure 1

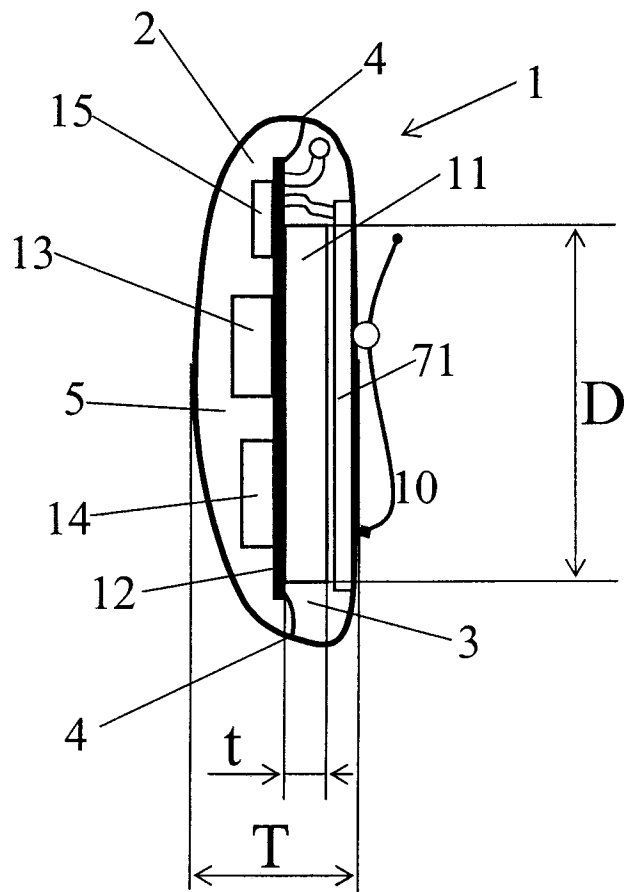


Figure 2

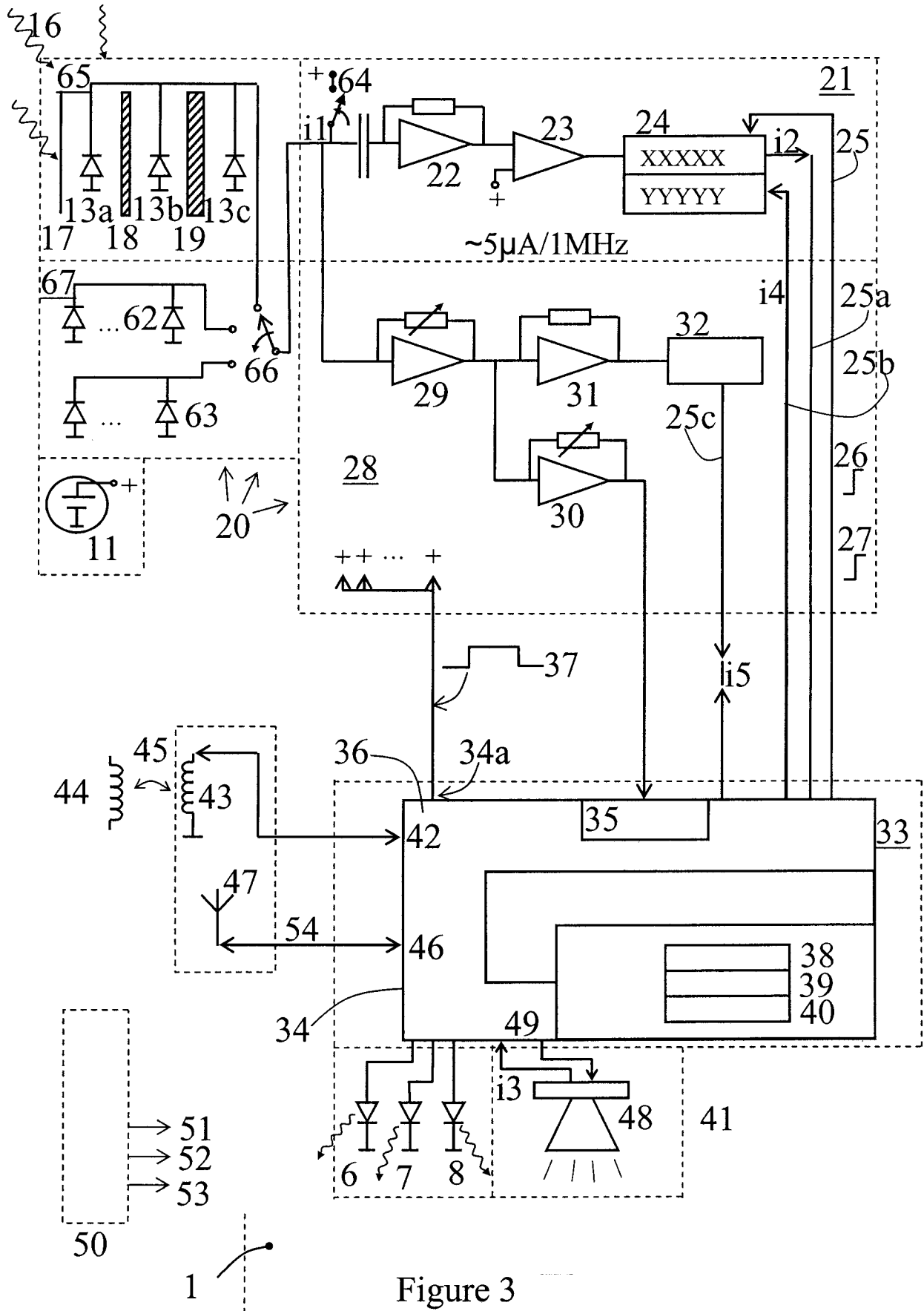


Figure 3

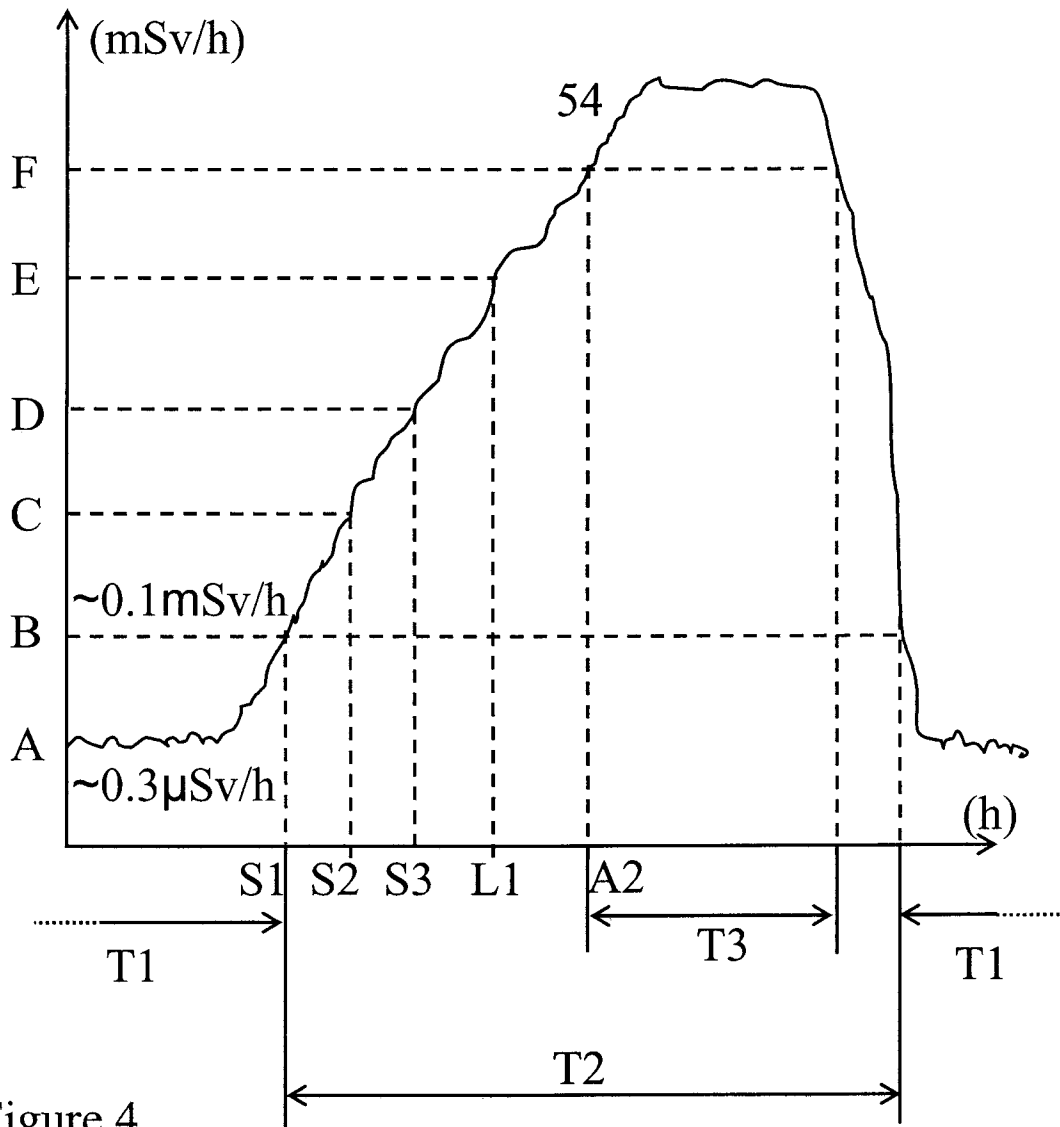


Figure 4

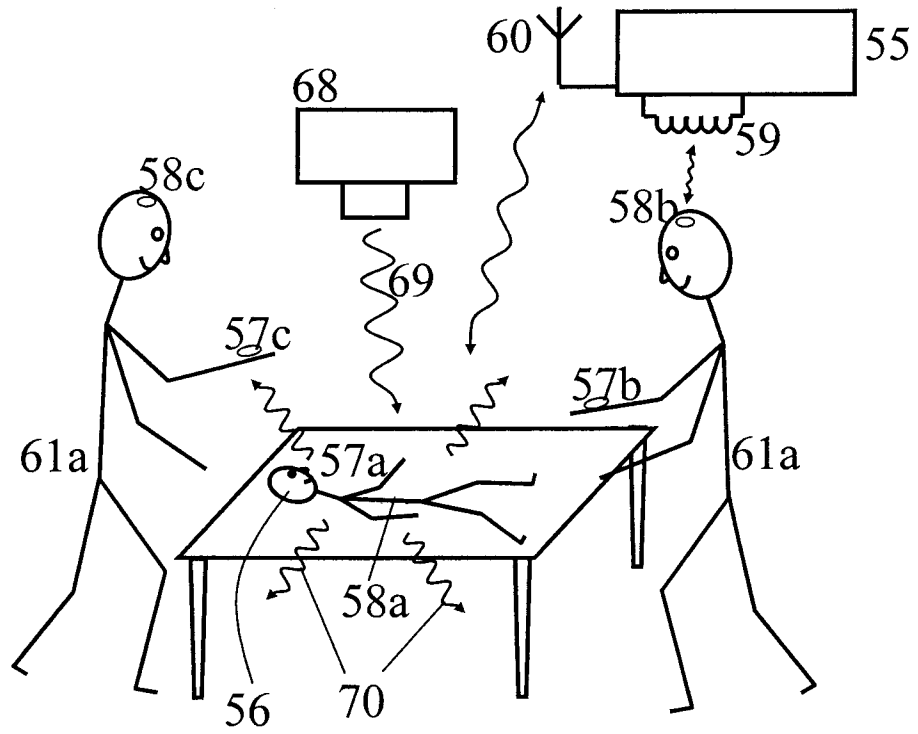


Figure 5

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2007/000008

A. CLASSIFICATION OF SUBJECT MATTER		
IPC: see extra sheet 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: G01T		
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)		
EPO-INTERNAL, WPI DATA, PAJ		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	FR 2669437 A1 (MERLIN GERIN (S.A.)), 22 May 1992 (22.05.1992), page 1, the last part; page 2, the first part; page 4 --	1-40
Y	US 6031454 A (LOVEJOY, M.L. ET AL), 29 February 2000 (29.02.2000), column 2, line 26 - line 30; column 5, line 22 - line 42; column 5, line 55 - line 60, figure 3 --	2-12,14-40
Y	US 3614444 A (NIRSCHL, J.C.), 19 October 1971 (19.10.1971), figure 1, abstract --	1-40
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> 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
10 May 2007		15 -05- 2007
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 Sture Elnäs /OGU Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2007/000008

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004279277 A, SEIKO EPSON CORP, 2004-10-12: (abstract) Retrieved from: PAJ database --	1-40
A	CS 8802473 A2, BURIAN ALES ING, 1990-02-12: (abstract) Retrieved from: EPODOC database --	1-40
A	US 4687622 A (LONGDEN, L.L.), 18 August 1987 (18.08.1987), abstract -- -----	1-40

International patent classification (IPC)
G01F 1/02 (2006.01)

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Use the application number as username.

The password is **CUIVREJASO**.

Paper copies can be ordered at a cost of 50 SEK per copy from PRV InterPat (telephone number 08-782 28 85).

Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

31/03/2007

International application No.

PCT/SE2007/000008

FR	2669437	A1	22/05/1992	NONE
US	6031454	A1	29/02/2000	NONE
US	3614444	A1	19/10/1971	NONE
US	4687622	A1	18/08/1987	NONE