A radiation dosimeter providing an indication of the dose of radiation to which the radiation sensor has been exposed. The dosimeter contains features enabling the monitoring and evaluating of radiological risks so that a user can concentrate on the task at hand. The dosimeter provides an audible alarm indication that a predetermined time period has elapsed, an audible alarm indication reminding the user to check the dosimeter indication periodically, an audible alarm indicating that a predetermined accumulated dose has been prematurely reached, and an audible alarm indication prior to reaching the ¾ scale point.
Fig. 6
Fig. 7
SMART RADIOLOGICAL DOSIMETER

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT

The invention described herein was made in the performance of work under a contract awarded by the U.S. Department of Energy. The government has certain rights in the invention.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates generally to detecting radiation dose, and more specifically to a device for monitoring and evaluating radiological risks.

2. Description of the Prior Art

As a consequence of both the short-term health effects (radiation syndrome) and long-term health effects (a possibility of cancer later in life) of exposure to radiation, certain personnel who may be exposed to such radiation are required to wear radiation measurement devices 1) to measure accumulated dose and 2) to provide indication of accumulated dose while in radiation areas. The first device, a thermoluminescent dosimeter (TLD) is worn on the body, typically between the neck and waist to measure accumulated dose of beta and gamma radiation and must be processed by a dosimetry lab to determine a worker’s accumulated dose. A second device, a pocket dosimeter (pocket dosimeter) is typically worn next to the TLD for periodic visual indication of a worker’s accumulated gamma dose while in the radiation area. Pocket dosimeters typically measure 0 to 200 mrem, however, some high radiation pocket dosimeters are designed for measuring between 0 and 5 rem.

The pocket dosimeter of the prior art provides a viewing window with a scale (0 to 200 mrem typically) and a slim needle which moves upscale as gamma rays impact the dosimeter sensor element, the charge slowly dissipates, due to a capacitive discharge effect, and the needle moves to the right indicating a larger and larger accumulated dose.

Personnel may be assigned an “allotted dose” (100 mrem, for example) before entering a radiation area along with a “stay time.” The allotted dose is determined by subtracting the worker’s accumulated dose to date for that calendar year from the yearly limit assigned to that worker at the beginning of the year and halving that to ensure the yearly limit is not exceeded. The stay time is determined by dividing a worker’s accumulated dose to date for that calendar year and halving that to ensure the yearly limit assigned to that worker at the beginning of the year and halving that to ensure the yearly limit is not exceeded. The stay time is determined by dividing a worker’s allotted dose by the expected exposure while in the work area. For example, if an area has a radiation source which emits 100 mrem per hour and the worker’s stay time/allotted dose are 1 hour/100 mrem, respectively, then it would be unexpected if after just 15 minutes the worker’s pocket dosimeter reads 90 mrem.

Pocket dosimeters of the prior art only provide an indication of accumulated dose and nothing else. Hence, personnel entering a radiation area must not only concentrate on and perform the task at hand, but they must continuously be mindful of the 10-minute interval check, conscious of their assigned stay time, watchful of their assigned allotted radiation dose, and watchful of the ¼ scale point. From experience gained from the use of dosimeters of the prior art, it was considered that an improved radiological dosimeter could be developed to raise the level of safety by reducing the risk of overexposure while enabling improved concentration on work tasks for all radiation workers. Therefore, there is a need for smart dosimeters, which are dosimeters incorporating dosage-triggered and time-triggered alarm features that allow the user to concentrate on the task at hand.

SUMMARY OF THE INVENTION

The radiation dose monitoring device, or smart radiological dosimeter of the present invention is designed to provide the same visual indication of accumulated gamma dose as pocket dosimeters in current use, with additional enhancements designed to give the radiological worker an extra level of assurance so that the worker can concentrate on the task at hand while the proposed invention takes on the burden of monitoring and evaluating the radiological risks encountered. The smart dosimeter provides and audible alarm indication to the user when their stay time (a predetermined time period) has elapsed, an audible reminder to check their dosimeter indication periodically for abnormal dose accumulation, an audible alarm indication indicating that their dosimeter has prematurely reached a predetermined accumulated dose (an “allotted dose” limit that shouldn’t be reached based on their calculated stay time), and a means to ensure an audible alarm indication occurs prior reaching the ¼ scale point (a limit imposed to preclude the dosimeter from going off-scale).

This invention is an enhanced radiological accumulated dose measuring and monitoring system. It is a highly modified conventional pocket dosimeter instrument which incorporates a mobile miniature photonic optical sensor to detect the instant when the dosimeter needle arrives at a specific dose setpoint, a mechanical stop to limit the mobile sensor position to the ¼ scale point, an amplifier and latch circuit to process the optical sensor output signal, a digital counter/timer circuit to indicate specific time setpoints, and a small 4-digit LCD display with “stay time” programming pushbuttons, a watch-type battery, a miniature alarm (buzz), and a reset switch.

In the present invention, these dosimeter features are consolidated into a compact package. The conventional dosimeter radiation sensing element internals are not affected. The optical sensors and miniature electronics of the dosimeter of the present invention are physically isolated from the sensing element components and are packaged in and around the view window end of the conventional dosimeter. In the present invention, these components are isolated from the sensing element because tapping off the charged sensing element signal can render the gamma measurement system inaccurate. Additionally, processing such low level charge signals into usable information requires additional complicated comparative and isolative electron-
ics. The smart dosimeter system components are packaged into a wider flanged bottom in order to aid in anchoring the dosimeter in the worker's pocket and to aid in preventing dosimeters from falling out of pockets.

With regard to package size, only the width of the dosimeter will increase. When workers are required to wear anti-contamination garments, this wider dosimeter can now be located in the flapped pocket adjacent to the conventional pocket dosimeter pocket which should not represent a significant inconvenience to the wearer. Finally, the proposed dosimeter can still be charged at the charging receptacle end of the dosimeter which is opposite the viewing window and which is consistent with conventional dosimeter designs.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a pocket dosimeter according to the prior art;
FIG. 2 is a view of the scale of a pocket dosimeter according to the prior art;
FIG. 3 is a top view of a dosimeter according to the present invention;
FIG. 4 is a side view of a dosimeter according to the present invention;
FIG. 5 is a front view of a dosimeter according to the present invention;
FIG. 6 is a view of the scale of a dosimeter according to the present invention;
FIG. 7 is a block diagram of a dosimeter according to the present invention;
FIG. 8 is a diagram of the mechanical components of the optical sensor assembly according to the present invention; and
FIG. 9 is an electrical schematic diagram of a dosimeter according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 is a perspective view of a radiation dosimeter according to the prior art. Dosimeter 2 typically has an exterior surface or casing 3 on which a clip 4 is provided. A scale 6 is also housed in dosimeter 2. An indicator needle 8 is housed in dosimeter 2 and indicates, by its motion in relation to scale 6, the quantity of the accumulated dose.

FIG. 2 is a view of the scale 6 of a typical radiation dosimeter 2 of the prior art. Exposure levels are indicated on scale 6 in mrem (millirem) by the indicator needle 8.

FIG. 3 is a top view of dosimeter 10 according to the present invention. Dosimeter 10 typically has an exterior surface or casing 12 on which a clip 4 is provided to permit the device to be attached to a shirt pocket. Protruding from the exterior surface or casing 12 is a flange 14 to aid in anchoring dosimeter 10 to a pocket of the user, and to aid in preventing it from falling through a small opening, such as a bilge grating, in the work environment. Dosimeter 10 is also provided with a cover 16, preferably composed of a clear plastic and preferably attached by means of a hinge 18 to the exterior surface or casing 12, to protect indicators and input devices housed on the exterior surface or casing 12, and to prevent inadvertent button action.

FIG. 4 is a side view of dosimeter 10 according to the present invention, showing clip 4, timer and timer display 20 and timer set buttons 22 housed in the exterior surface or casing 12. Typically, timer and timer display 20 includes a digital LED (light-emitting diode) display or LCD (liquid crystal display). Set buttons 22 permit timer and timer display 20 to be set for a desired period of time, referred to as the stay time, and to start the timing function of timer and timer display 20. Timer and timer display 20 is also capable of generating check time signals indicating the need to check dose accumulation.

FIG. 5 is a front view of dosimeter 10 according to the present invention, showing controls housed on the front. An audible alarm 30 indicates that the stay time has passed, that a check time period has elapsed, or that a dose limit has been reached. A reset button 32 resets the alarm 30. A view window 34 in the exterior surface or casing 12 allows the user to view scale 36. An indicator needle 38 is housed in dosimeter 10 and indicates, by its motion in relation to scale 36, the quantity of the accumulated dose. A dose limit setpoint switch 40 allows the setting of a dose limit setpoint.

FIG. 6 is a view of the display visible through view window 34, including scale 36 and indicator needle 38. A beam and sensor package 42 able to generate a beam, typically an optical beam, is mechanically linked to beam and sensor package 42 and is provided with a cover 30 and which is consistent with conventional dosimeter designs.
The radiation dosimeter of claim 1, wherein the dosimeter is an optical sensor accommodating, and reacting to, the passage of the dose indicator produces an indication of a predetermined dose.

The radiation dosimeter of claim 1, wherein the scale has a zero end and a full scale end, further comprising a mechanical stop located on the scale between the sensor and the full scale end, restricting the motion of the sensor to the portion of the scale between the zero end and the mechanical stop.
5. The radiation dosimeter of claim 4, wherein the mechanical stop is located about \( \frac{3}{4} \) of the distance on the scale from the zero end of the scale.

6. The radiation dosimeter of claim 1, wherein the timer provides a stay time signal after the passage of a stay time and provides check time signals after the passage of each of at least one consecutive check time period.

7. The radiation dosimeter of claim 6, wherein the stay time signal and check time signals produce an audible alarm.

8. The radiation dosimeter of claim 1, further comprising: a low voltage indicator producing an audible indication of low voltage.

9. The radiation dosimeter of claim 1, further comprising: an exterior casing comprising a top end and a bottom end, wherein the bottom end is flanged.

* * * * *