NUCLEONIC MEASURING APPARATUS WITH AUTOMATIC FIRE SAFETY RADIATION SOURCE SHUTTER CLOSING AND LOCKING MEANS RESPONSIVE TO HIGH TEMPERATURES FOR BLOCKING THE PATH OF THE SHUTTER MOVEMENT TO OPEN POSITION

ABSTRACT: A nuleonic measuring gauge for cigarette tubing in which a housing contains a radiation source and has an aperture controlled by a sliding shutter, in which a U-shaped spring steel shutter lock is positioned in the path of shutter movement and has leaves which are held in an open position by a quantity of malleable material permitting the spring leaves to move between the leaves, and in which the spring leaves are stressed to close together behind the shutter blocking the shutter in a closed position upon occurrence of an abnormally high ambient temperature with the melting of the material.
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RELATED INVENTIONS

The present invention relates to inventions disclosed in the copending application Ser. No. 634,364, Filed Apr. 27, 1967, now abandoned of Bernhard C. Holten and Richard E. Bach, Ser. No. 634,366, Filed Apr. 27, 1967 of Richard E. Bach and Ser. No. 634,363, filed Apr. 27, 1967 of George J. Trachekski, and Earnest A. Auborn, all assigned to the same assignee as this invention and filed on even date herewith.

BACKGROUND OF THE INVENTION

Compact nucieonic measuring gauges, such as those used for measuring the weight or density of cigarette tubing for example, have been provided with radiation source housings having shutters which are operated by a suitable motor, such as by an electric rotary solenoid, for retracting the shutter and permitting the release of radiation from the nucieonic source. Examples of such measuring instruments are shown in the U.S. Pats. of Radley et al. Re. No. 25,476 of 1963 and Dukes et al. No. 3,240,940 of 1966, both assigned to the same assignee as this invention.

Normally such shutters are positioned between the source and a radiation aperture, and also arranged to close automatically upon the deenergization of the controlling motor, such as by a retraction or closing spring in or associated with the solenoid. Accordingly, when the radiation measuring device is deenergized, the shutter automatically returns to its closed position. However, in the event of a fire or other disaster, it is important that the shutter remain in its closed position to confine all radiation to the source housing and to assure the integrity of the housing even during conditions of severe jarring or rapid accelerations or decelerations.

SUMMARY OF THE INVENTION

The present invention relates to nucleonic gauging apparatus of the compact type disclosed in the above-mentioned Radley et al. and Dukes et al. patents, and more particularly to compact, lightweight, and reliable apparatus for locking a shutter in its closed position in the event that certain predetermined safety or normally high temperature limits are exceeded.

The invention employs a spring member which has oppositely positioned leaves or legs which are normally spring biased together, but which are maintained in a separated or open condition by reason of a quantity of meltable material, such as solder or lead, formed between the leaves of the spring. In the open condition, the leaves form a clearance or gap through which the shutter may pass as it moves from its closed toward its open position.

The lock of this invention occupies a minimum of space and is therefore particularly adapted for use where there are space limitations. It is also of simple construction and is resistant to mechanical shock. When the material melts, the spring leaves move together to close the gap, thereby locking the shutter in the closed position. The subsequent releasing of the spring at even higher temperatures does not adversely affect the integrity of the lock. Shock loads tend to move both free ends of the spring in the same direction, and the spring is so configured and positioned so that some portion of the spring always blocks the path of the shutter after the barrier material has melted.

It is accordingly an important object of this invention to provide a nucleonic measuring instrument having a shutter lock in the form of a folded or a U-shaped spring which has oppositely positioned leaves held apart by a barrier of meltable metal, such as solder or lead, and which leaves move together upon the melting of this material to form a mechanical block preventing opening movement of the shutter.

These and other objects and advantages of the present invention will be apparent from the following description, the accompanying drawings, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical sectional view of a radiation source and detecting unit incorporating a shutter lock of this invention, taken generally along the line 1--1 of FIG. 2.

FIG. 2 is a bottom plan view, partially broken away, of the nucleonic source housing assembly taken generally along the line 2--2 of FIG. 1.

FIG. 3 is a vertical fragmentary section through the housing assembly taken generally along the line 3--3 of FIG. 2.

FIG. 4 is an enlarged fragmentary section through the housing assembly taken generally along the line 4--4 of FIG. 2.

FIG. 5 is a vertical fragmentary section showing the shutter lock in the open position.

FIG. 6 is a view similar to FIG. 5 showing the lock after it has been actuated by the melting of the barrier material; and

FIG. 7 is an end view looking into the end of the lock and showing the shutter in section taken generally along the line 7--7 of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a nucleonic measuring unit 10 includes a mounting base 11 on which is supported a block 12 of shielding material. An ionization chamber detector 15 is mounted in a superimposed relation on the block 12. A cylindrical pass tube 16 is formed through the block 12, through which cigarette rod 17, or the like, may pass for measurement. The tube 16 is positioned in intersecting relation to a vertically aligned slot 18 formed in the block 12. The slot 18 forms a passage through which radiation passes from the source to the detector 15.

A nucleonic radiation housing assembly is indicated generally at 20 in FIGS. 1 and 2, and is mounted on the bottom surface of the block 12. The assembly includes a source 22 mounted in a slot 22' in a hinged source holder 23 so that when the holder 23 is closed, as shown, the source 22 is positioned in alignment with the slot 18. A source holder retain plate 24 retains the source holder 23 in its closed position.

The source holder 23 and the retainer plate 24 are mounted on a retaining assembly and shutter guide plate 25 which is retained on the lower surface of the base plate 12 by four screws 27 (FIG. 2). The plate 25 defines an aperture or window 28 which is in substantial alignment with the slot 18, and is spaced from the bottom surface of the block 12 by a similarly apertured phenolic spacer 30.

A radiation shutter 35 is guided for sliding movement between the retainer plate 25 and the phenolic spacer 30. The plate 25 is notched at 36 as indicated in FIG. 4 to provide a guide channel for the shutter 35. The shutter 35 is thus guided for sliding movement between an open position where it exposes the window 28 and a closed position, as shown in FIGS. 2 and 4. In the closed position it effectively closes the aperture formed by the window and blocks the escape from the housing of any radiation from the source 22.

Means for opening and closing the shutter includes a rotary, spring-return solenoid 40 mounted on an L-shaped support bracket 40' above the detector 15. The rotary motion of the solenoid 40 is transferred to sliding movement at the shutter by means of a solenoid arm 41 which is forked at its end to engage a pin 42 mounted on an arm 43. The arm 43 is clamped to a shaft 44, and the shaft 44 is rotatably supported at its upper end on the support 40', and at its lower end in the block 12.

A depending portion of the shaft 44 extends downwardly through the block 12 and supports an arm 45 at its lower end. A depending crank pin 46 on the arm 45 is received within an elongated slot 47 (FIG. 2) formed in the shutter 35, so that turning movement of the arm 45 affects sliding movement of the shutter 35 in its guideways. For further details of the con-
struction and operation of the device reference may be had to the Radley et al. and Dukes et al. patents previously mentioned.

Means for locking the shutter 35 in the closed position upon the occurrence of an abnormally high temperature includes a generally U-shaped lock 50 formed of leaf spring material. The lock 50 is thus formed with an integral back 51 and a pair of generally oppositely positioned leaves or legs 52 and 53. The spring legs are slightly angled inwardly toward each other and terminate in outwardly turned, integral flanges 54 and 55. The spring material from which the lock is made is stressed so that the legs 52 and 53 are normally urged together, but are maintained in spaced relation to each other by a filling or barrier 60 of meltable material which is cast in place between the legs 52 and 53 and against the back 51 partially filling the space between the legs while defining a gap 62 at the leg terminal ends and at the flanges 54 and 55.

The material 60 may be made of any suitable composition which melts at a predetermined high temperature, such as solder or lead. For example, it may be formed of a solder composition of approximately 75 percent tin 3.5 percent silver and 1 percent antimony which has a eutectic melting temperature of approximately 430° F. However, other metal alloys may be used which have substantial resistance against cold flow, to retain the shape of the lock 50 and to prevent creeping of the leaves over extended periods of use at temperatures below the eutectic temperatures.

The opposite legs of the lock 50 are accordingly held in normally spaced apart relationship defining the space or gap 62 therebetween, as shown in FIG. 5. The lock 50 is positioned so that an edge portion of the shutter 35 must pass through the gap 62 in the initial movement from its closed to its open position. The lock 50 is held in position on the block 12 by a suitable cap screw 65 extending through openings formed in each of the legs 52 and 53 and threaded into a tapped hole formed at the bottom of the block 12. The lock 50 is symmetrical so that an edge portion with respect to the head of the screw 65 is not required.

In the operation of the invention, in the event that an abnormally high temperature occurs such as would be caused by a fire, the shutter will be closed by the removal of, or the failure of, power to the rotary solenoid 40. To assure that the solenoid is deenergized, power to the solenoid may be controlled by a temperature sensitive fuse 66, such as the WKR, Buss leaf spring type manufactured by Bussman Manufacturing Division of McGraw-Edison Company of St. Louis, Missouri, which will interrupt the flow of current to the solenoid 40 when the ambient temperature reaches approximately 200° F.

The shutter 35 will then be returned to its closed position. Thereafter, if the ambient temperature should continue to rise to the eutectic range of the blocking material 60, the material will melt permitting the spring legs or leaves 52 and 53 to close the gap 62 by moving together behind and in blocking relation to the shutter, substantially as shown in FIG. 6, thereby preventing shutter movement into its open position and effectively blocking it in the closed position. The outwardly extending end portions 54 and 55 assure the effectiveness of the block even when movement of the lock 50 may occur as a result of shock or vibration. Further, the shutter lock of this invention will remain effective even though the temperature may continue to rise to the point where the temper of the spring material is lost.

It will therefore be seen that this invention provides a compact, dependable, and shock-resistant barrier or shutter lock which operates to lock closed a movable shutter of a nucleonic measuring gauge upon the occurrence of abnormally high temperatures, such as would occur during a fire. It retains its effectiveness over extended periods of normal usage and is subject to very little, if any, creepage when operated in a temperature environment below the melting or eutectic temperature range of the material 60.

While the form of apparatus herein described constitutes a preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

1. A nucleonic radiation-measuring instrument comprising a housing enclosing a source of nuclear radiation and having an aperture for releasing radiation from said housing for measurement purposes, a shutter for said aperture, means guiding said shutter for movement between an open position to release radiation from said aperture and a closed position effectively confining the radiation within said housing, motor means for moving said shutter from said closed position to said open position, means for locking said shutter in its said closed position, and an indication of abnormally high ambient temperature for releasing said said spring member between said legs held said legs in said spaced apart position and being meltable in response to said high ambient temperature for releasing said legs for movement into their said closed position.

2. The instrument of claim 1 in which said rigid material is a eutectic metal alloy cast in said spring member and partially filling the space between said legs.

3. The instrument of claim 1 in which said legs terminate in outwardly turned ends for blocking said shutter in the event of movement of said spring member.

4. The instrument of claim 1 in which said spring member is formed from flat spring material.

5. A nucleonic radiation energy-measuring instrument having a source of nuclear energy and incorporating a temperature-responsive safety lock in which a shutter member is mounted for movement between a retracted position defining an opening for radiation measurement purposes and a closed position effectively confining radiation from said source, the improvement in shutter-locking mechanism comprising means defining a locking spring having portions positioned adjacent said shutter and movable between a first position defining a clearance gap permitting movement of the shutter therapeutically between its said positioned second position, and a barrier of a normally rigid meltalbe material supporting said spring portions in their said first position and being meltalbe upon the occurrence of an abnormally high ambient temperature to permit said spring portions to move to their said second position.

6. The locking mechanism of claim 5 in which said movable portions comprise two leaves of a generally U-shaped spring and said clearance gap is defined as the space between the ends of said leaves.

7. The locking mechanism of claim 6 in which said barrier comprises a eutectic metal alloy cast within and partially filling the space between the said leaves.