

- [54] **ELEVATOR MECHANISM AND METHOD FOR SCINTILLATION DETECTORS**
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 [22] Filed: **June 11, 1973**
 [21] Appl. No.: **368,693**

Related U.S. Application Data

- [63] Continuation-in-part of Ser. No. 241,987, April 7, 1972, abandoned.
 [52] U.S. Cl. **250/328; 187/17**
 [51] Int. Cl. **G01t 7/08**
 [58] Field of Search **250/328; 187/17, 27**

[56] References Cited

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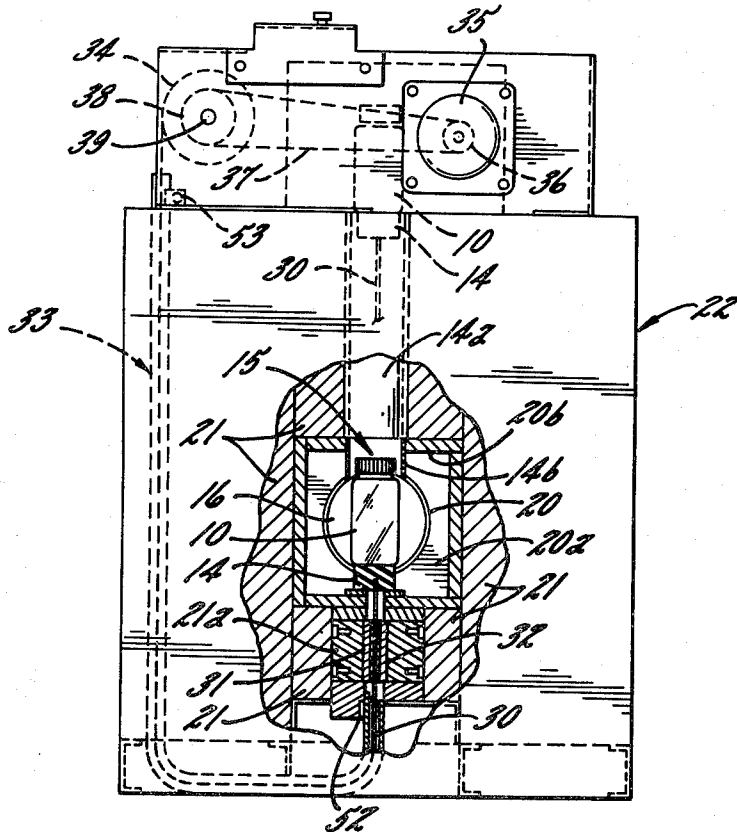
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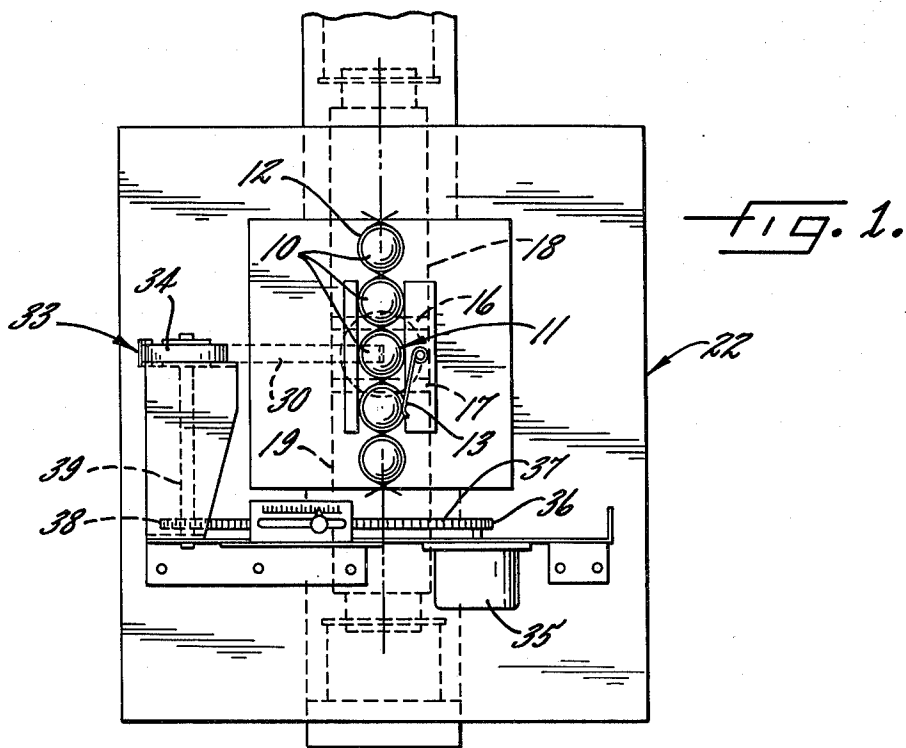
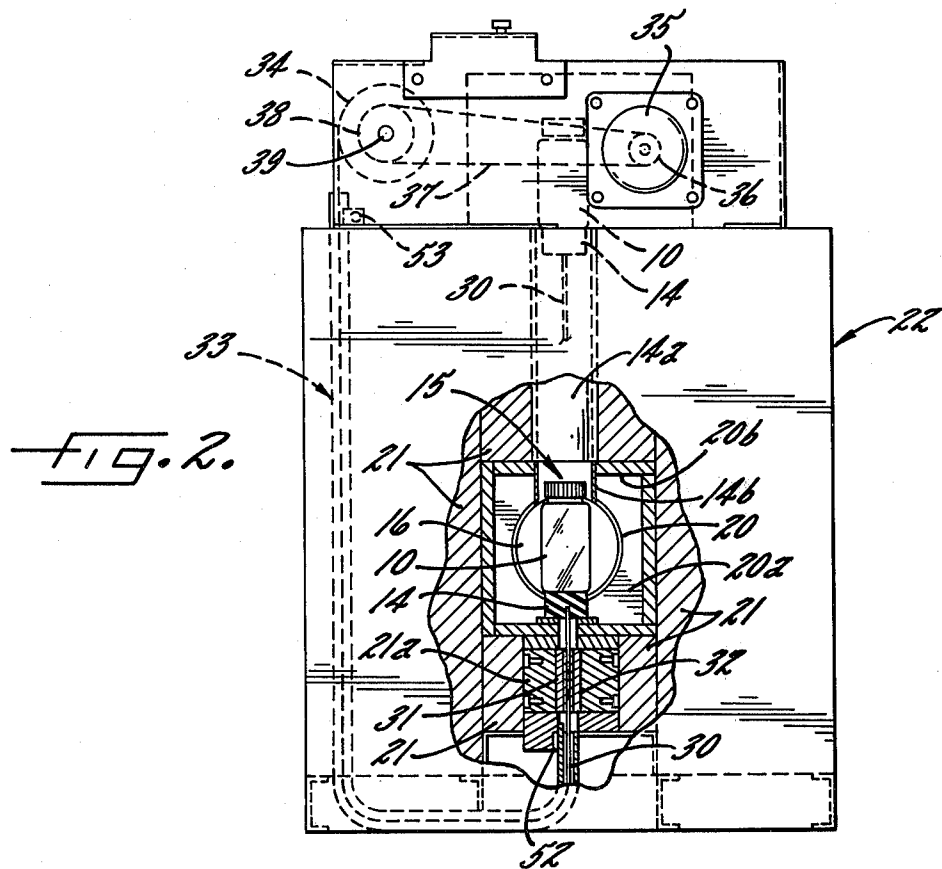
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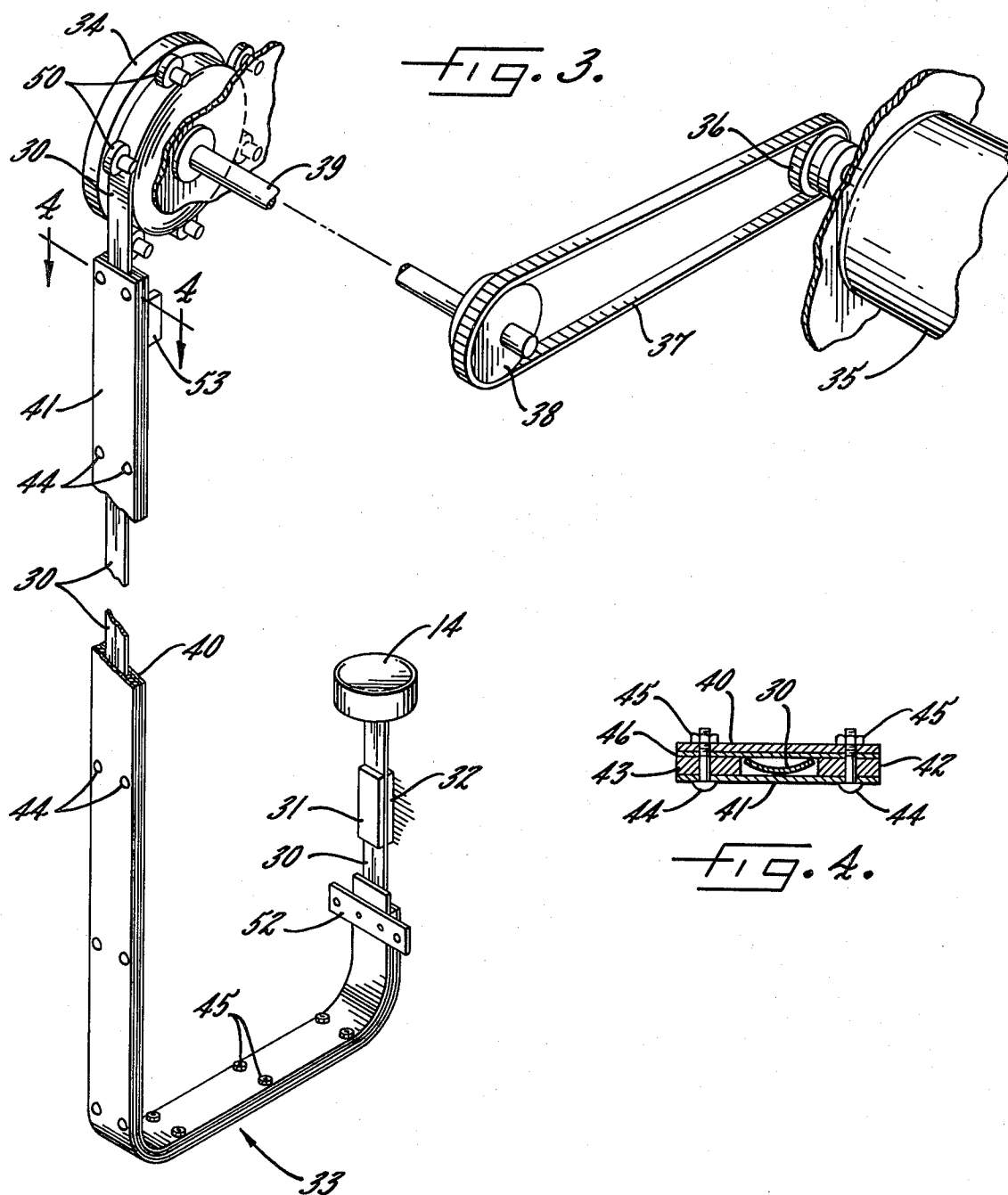
[57] ABSTRACT

An elevator mechanism and method for raising and lowering radioactive samples through a shielded vertical counting chamber in a benchtop scintillation detector which has a practical limit on its height. The elevator mechanism adds little or nothing to the height of the detector by using an elongated flexible member such as a metal tape secured to the bottom of the elevator platform and extending downwardly through the counting chamber and its bottom shielding, where the tape is bent laterally for connection to a drive means. In the particular embodiment illustrated, the tape is bent laterally below the bottom shielding for the counting chamber, and then upwardly along or through one side of the shielding to a reel at the top of the shielding. The tape is wound onto the reel, and the reel is driven by a reversible motor which winds and unwinds the tape on the reel to raise and lower the elevator platform.

10 Claims, 4 Drawing Figures







ELEVATOR MECHANISM AND METHOD FOR SCINTILLATION DETECTORS

RELATED APPLICATIONS

The present application is a continuation-in-part application based upon my copending parent application Ser. No. 241,987, filed Apr. 7, 1972 and entitled "Elevator Mechanism for Scintillation Detectors And The Like", now abandoned. This application is further related to my copending application Ser. No. 322,965, filed Jan. 12, 1973 and entitled "Elevator Mechanism And Method", a divisional application based upon and divided out of my aforesaid copending parent application Ser. No. 241,987.

DESCRIPTION OF THE INVENTION

The present invention relates generally to elevator mechanisms and methods and more particularly, to elevating systems that can be used to raise and lower radioactive samples through a shielded vertical counting chamber in a scintillation detector.

It is a primary object of the present invention to provide an improved elevator system that raises and lowers an elevator platform by forces applied to the bottom of the platform, and yet require little or no space beneath the well traversed by the elevator platform.

Another object of the invention is to provide an improved elevator mechanism of the foregoing type which is particularly suitable for raising and lowering samples in a benchtop instrument, where the height of the instrument must be kept as small as possible. In this connection, a more specific object of the invention is to provide such an improved elevator mechanism which can be used to raise and lower radioactive samples through a shielded vertical counting chamber in a scintillation detector, which has a certain minimum height even without the elevator mechanism due to the shielding required above and below the counting chamber.

It is a further object of the invention to provide an improved elevator mechanism of the type described above which requires only a small number of parts and can be efficiently manufactured at high production rates and a relatively low cost.

Yet another object of the invention is to provide such an improved elevator mechanism which provides reliable operation over a long operating life, with a minimum of maintenance.

A still further object of the invention is to provide such an improved elevator mechanism which permits the use of a simple, conventional prime mover in the drive mechanism.

Other objects and advantages of the invention will be apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIG. 1 is a top plan view of a scintillation detector embodying the invention;

FIG. 2 is a side elevation of the detector of FIG. 1, with a fragment of the central portion thereof broken away to show the internal structure;

FIG. 3 is an enlarged perspective view of the elevator mechanism for raising and lowering samples in the detector of FIG. 1; and,

FIG. 4 is an enlarged section taken substantially along the line 4-4 in FIG. 3.

While the invention will be described in connection with certain preferred embodiments, it is to be understood that the invention is not limited to these particular embodiments. On the contrary, it is intended to cover all alternatives, modifications and equivalent arrangements as may be included within the spirit and scope of the invention as expressed in the appended claims.

Turning now to the drawings and referring first to FIGS. 1 and 2, a plurality of radioactive samples contained in vials 10 are advanced in seriatim order past a fixed counting station 11. In the particular arrangement illustrated, the sample vials 10 are carried in vertical compartments formed by a flexible belt 12 forming vial compartments which are open at both the top and the bottom. Each time a sample vial is advanced into alignment with the counting station 11, as determined by a sensing switch 13, the aligned vial rests on an elevator platform 14 which automatically lowers the sample vial through a vertical tube 14a and liner 14b into a counting chamber 15 where the radioactivity of the sample is automatically measured.

In a detector of the type illustrated, the counting chamber 15 is typically designed to measure gamma radiation by means of a pair of thallium-activated sodium iodide crystals 16 and 17 forming opposite sides of the counting chamber and mounted on a corresponding pair of light-sensing photomultiplier tubes 18 and 19, respectively. As is well known, the gamma radiation produces light scintillations in the crystals 16 and 17, and these scintillations are converted to corresponding voltage pulses by means of the photomultipliers 18 and 19. The energy level of the gamma rays is determined by the intensity of the light scintillations and the amplitude of the corresponding voltage pulses, while the rate at which the gamma rays are emitted is determined by the frequency of the light scintillations and the corresponding voltage pulses.

In order to shield the counting chamber and particularly the crystals 16 and 17 from background radiation from extraneous sources, the crystals are housed in a non-magnetizable container 20 which is held in place by a pair of clamping frames 20a within an elongated core structure 20b that is shielded on all sides by means of a plurality of lead blocks 21 contained within the external housing 22. This lead shielding makes the detector relatively bulky, and thus it is desirable to minimize the size of the sample transfer mechanism in order to make the overall size of the detector as small as possible. This is particularly true of the elevator mechanism which must move the successive samples along a vertical path of substantial length in order to traverse the relatively thick lead shielding above the counting chamber. This problem of minimizing the overall size of the detector, including the elevator mechanism, is particularly acute in the case of scintillation detectors which are intended for benchtop use.

In accordance with the present invention, the improved elevator system includes an elongated flexible member such as a metal tape secured to the bottom of the elevator platform 14 and extending downwardly through the counting chamber and the lead shielding thereunder, the tape having sufficient flexibility to enable it to be bent through or around the shielding below the counting chamber and wound onto a reel which is selectively rotated in both directions for raising and lowering the elevator platform. The flexible member is

unsupported along the path traversed by the elevator platform, but has sufficient rigidity to support the platform throughout the entire length of the vertical path traversed by the platform. Thus, in the illustrative arrangement, an elongated metal tape 30 is secured to the bottom of the elevator platform 14 and extends downwardly through registered apertures formed in the shielding blocks 21 disposed below the counting chamber 15. One of the lead shielding blocks 21a holds a pair of bearing pads 31 and 32 for supporting and guiding the tape 30 as it passes back and forth through the bottom shielding. Directly beneath the bearing pads 31 and 32, the tape 30 enters a generally U-shaped tape guide 33 having a short vertical leg 33a aligned with the elevator axis and a long vertical leg 33b extending up through one side of the lead shielding 21.

In order to minimize the vertical dimension of the elevator mechanism, the tape guide 33 bends the tape 30 horizontally directly beneath the lead shielding so that the tape extends transversely away from the vertical axis of the elevator, and the guide 33 then bends the tape vertically up through a side portion of the lead shielding to a reel 34. The reel 34 is driven by a reversible electric motor 35 via sprocket 36 on the motor shaft and a chain 37 meshing with the sprocket 36 and a second sprocket 38 fixed to the reel shaft 39. As the reel is rotated in the counterclockwise direction as viewed in FIG. 3, the tape 30 is advanced upwardly through the counting chamber 15 to raise the elevator platform 14 to its raised position at the top of the housing 22, as illustrated in broken lines in FIG. 2. When the reel is driven in the clockwise direction as viewed in FIG. 3, the tape 30 is lowered through the counting chamber 15 to position a sample vial carried by the elevator within the counting chamber. A preferred control system for energizing and de-energizing the motor 35 in alternating directions to control the winding and unwinding of the tape 30 on the reel 34, thereby controlling the lowering and raising of the elevator platform, is described in detail in my copending application Ser. NO. 241,988, filed Apr. 7, 1972 and entitled "Method and Apparatus for Optimizing Measurement of Radioactivity of Samples in Scintillation Type Counter", now U.S. Pat. No. 3,786,259, assigned to the same assignee as the present invention.

In order to provide the exemplary elevator tape 30 with sufficient rigidity to support the elevator platform throughout the entire length of its vertical travel, the tape 30 is curved in the direction transverse to its direction of movement. Thus, as shown most clearly in FIG. 4, the tape 30 is curved transversely of its longitudinal axis to provide the tape with rigidity along its longitudinal axis. While this transverse curve makes the tape rigid enough to support the weight of the elevator platform 14 and a sample vial carried thereon, the tape is still sufficiently flexible to permit it to be bent around the corners formed by the tape guide 33 and to be wound onto the reel 34. Consequently, the vertical dimension of the entire elevator assembly can be made extremely compact, so that it adds very little to the total height of the complete spectrometer.

Referring to FIG. 3 for a more detailed description of the tape guide 33, the main body portion of the guide 33 is formed by a pair of relatively thin elongated strips 40 and 41 positioned on opposite sides of a pair of spacers 42 and 43 extending along the longitudinal edges of the strips 40 and 41 and connected thereto by

a plurality of bolts 44 and nuts 45. The transverse space between the two spacers 42 and 43 forms a central cavity for supporting and guiding the tape 30 along the generally U-shaped path defined by the complete guide assembly 33. A guide strip 46 is provided on the inside surface of the body strip 40 to provide a bearing surface for the longitudinal edges of the curve tape 30.

In accordance with one particular aspect of the invention, a plurality of roller bearings are mounted on the tape reel 34 and spaced around the circumference thereof for holding the tape in a compact coil on the reel 34. Thus, as shown in FIG. 3, six roller bearings 50 are mounted at equally spaced positions around the reel 34 with their axes parallel to the axis of the reel to hold that portion of the tape that is wound on the reel in the form of a circular coil. The spring action of the tape 30 continuously urges the tape toward a straight longitudinal configuration, and thus biases the tape that is wound onto the reel 34 outwardly against the roller bearings 50.

To mount the tape guide 33 on the lead shielding or its outside housing 22, a pair of mounting brackets 52 and 53 are secured to the body strip 41 at opposite ends thereof. Suitable screws or other conventional fastening elements are passed through holes in these mounting flanges 52 and 53 to fix both ends of the guide assembly to adjacent portions of the lead blocks 21 or the housing 22.

As can be seen from the foregoing detailed description, this invention provides an improved elevator mechanism and method that raises and lowers the elevator platform by applying forces to the bottom of the platform, and yet the entire elevator mechanism requires little or no space beneath the well traversed by the elevator platform. Thus, the elevator mechanism provided by this invention is particularly suitable for use in benchtop instruments, where the height of the instrument must be kept as small as possible. The elevator mechanism is also ideally suited for use in raising and lowering radioactive samples through a shielded vertical counting chamber in a scintillation detector, which has a minimum height even without the elevator mechanism due to the shielding required above and below the counting chamber. Furthermore, this improved elevator mechanism requires only a small number of parts and can be efficiently manufactured at high production rates and a relatively low cost, and yet its simplicity ensures reliable operation over a long operating life with a minimum of maintenance.

I claim as my invention:

1. An elevator mechanism for raising and lowering radioactive samples through a shielded vertical counting chamber in a scintillation detector, said elevator mechanism comprising the combination of platform means mounted for vertical movement through said counting chamber and its top shielding, an elongated flexible member secured at one end to the bottom of said platform means and extending downwardly through said counting chamber and its bottom shielding, laterally away from said chamber below the bottom thereof, and then upwardly with said flexible member terminating with its other end at an elevation above said chamber, a reel rotatably disposed above the shielding of said chamber, said other member end being secured to said reel, said member being unsupported along the length of travel of said platform means and sufficiently rigid to support said platform means

throughout said length of travel, said member also being sufficiently flexible to be bent around the shielding below said counting chamber, and reversible drive means coupled to said reel for winding and unwinding said member onto and off of said reel to shift said member through said counting chamber and thereby raising and lowering said platform means through said counting chamber and its top shielding.

2. An elevator mechanism as set forth in claim 1 which includes a plurality of bearings spaced around the circumference of said reel for holding said tape on said reel.

3. An elevator mechanism as set forth in claim 1 wherein guide means extends laterally under said bottom shielding and upwardly to said reel for guiding said tape between said reel and said bottom shielding.

4. An elevator mechanism as set forth in claim 1 wherein said member is curved in the direction transverse to its direction of movement to provide the member with rigidity along its longitudinal axis.

5. A method of raising and lowering radioactive samples through a shielded vertical counting chamber in a scintillation detector having platform means mounted for vertical movement through said counting chamber and its top shielding, said method comprising the steps of connecting one end of an elongated flexible member to the bottom of said platform means and extending said member downwardly through said counting chamber and its bottom shielding, said member being unsupported along the length of travel of said platform means and sufficiently rigid to support said platform means throughout said length of travel, bending said member around the shielding below said counting chamber and then upwardly so that the other end of said flexible member is at a point above said counting chamber, coupling said other flexible member end to a reversible drive mechanism, and alternately actuating said mechanism first in one direction and then in the other direction to shift said member longitudinally through said counting chamber to raise and lower said platform

means through said counting chamber and its top shielding.

6. A method as set forth in claim 5 wherein said reversible drive mechanism is a reel and said member is alternately wound onto and unwound from said reel.

7. A method as set forth in claim 6 wherein said member is a flexible metal tape.

8. A method as set forth in claim 7 wherein said reel is located above the shielding of said counting chamber, and a guide means extends laterally under said bottom shielding and upwardly to said reel for guiding said tape between said reel and said bottom shielding.

9. A method as set forth in claim 7 wherein said tape is curved in the direction transverse to its direction of movement to provide the tape with rigidity along its longitudinal axis.

10. An elevator mechanism for raising and lowering radioactive samples through a shielded vertical counting chamber in a scintillation detector, said elevator mechanism comprising the combination of platform means mounted for vertical movement through said counting chamber and its top shielding, an elongated flexible member secured at one end to the bottom of said platform means and extending downwardly through said counting chamber and its bottom shielding, laterally under said bottom shielding, and then upwardly so that the other end of said flexible member is at an elevation above said counting chamber, said member being unsupported along the length of travel of said platform means and sufficiently rigid to support said platform means throughout said length of travel, said member also being sufficiently flexible to be bent around the shielding below said counting chamber, and reversible drive means mounted at an elevation above said counting chamber and connected to said other flexible member end for shifting said member through said counting chamber and thereby raising and lowering said platform means through said counting chamber and its top shielding.

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