June 1, 1965 J. FRATANTUNO 3,187,182

RADIOACTIVE SAMPLE PROCESSING APPARATUS INCLUDING A CLOSED LOOP HORIZONTAL CONVEYOR SYSTEM AND AN ELEVATOR POSITIONED BENEATH THE LOOP FOR ELEVATING THE SAMPLES TO A DETECTOR

Filed Dec. 19, 1960 5 Sheets-Sheet 1

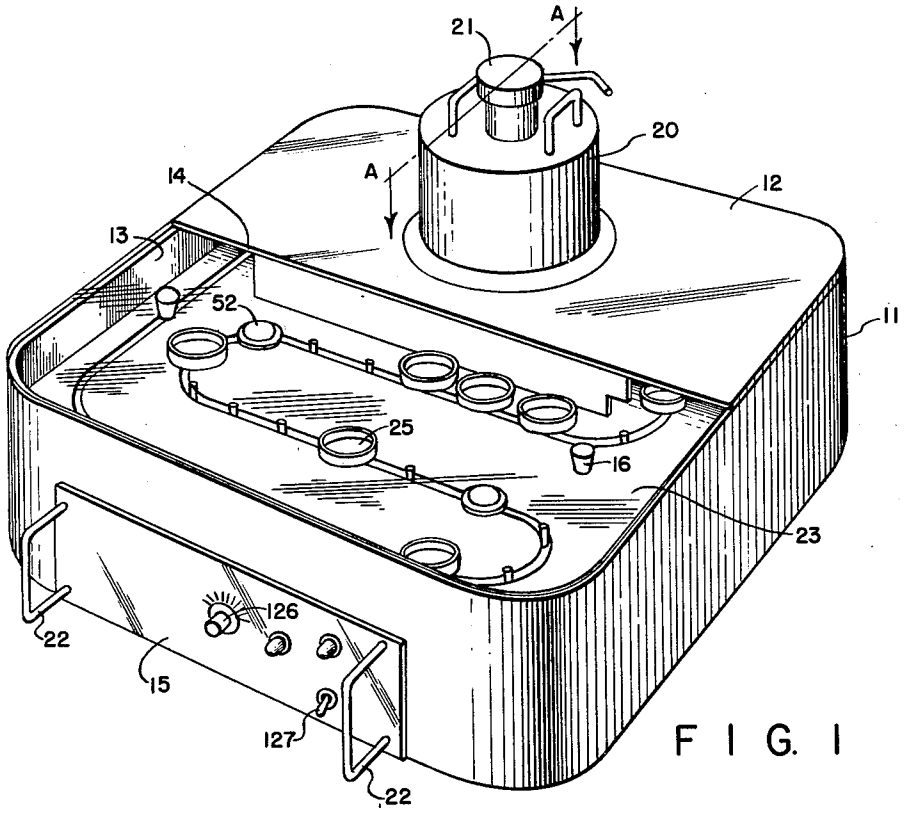


FIG. 1

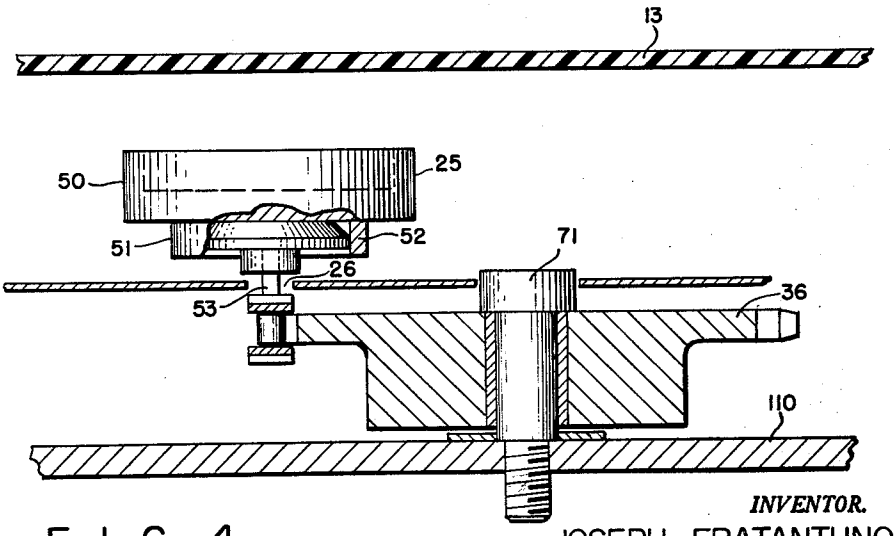


FIG. 4

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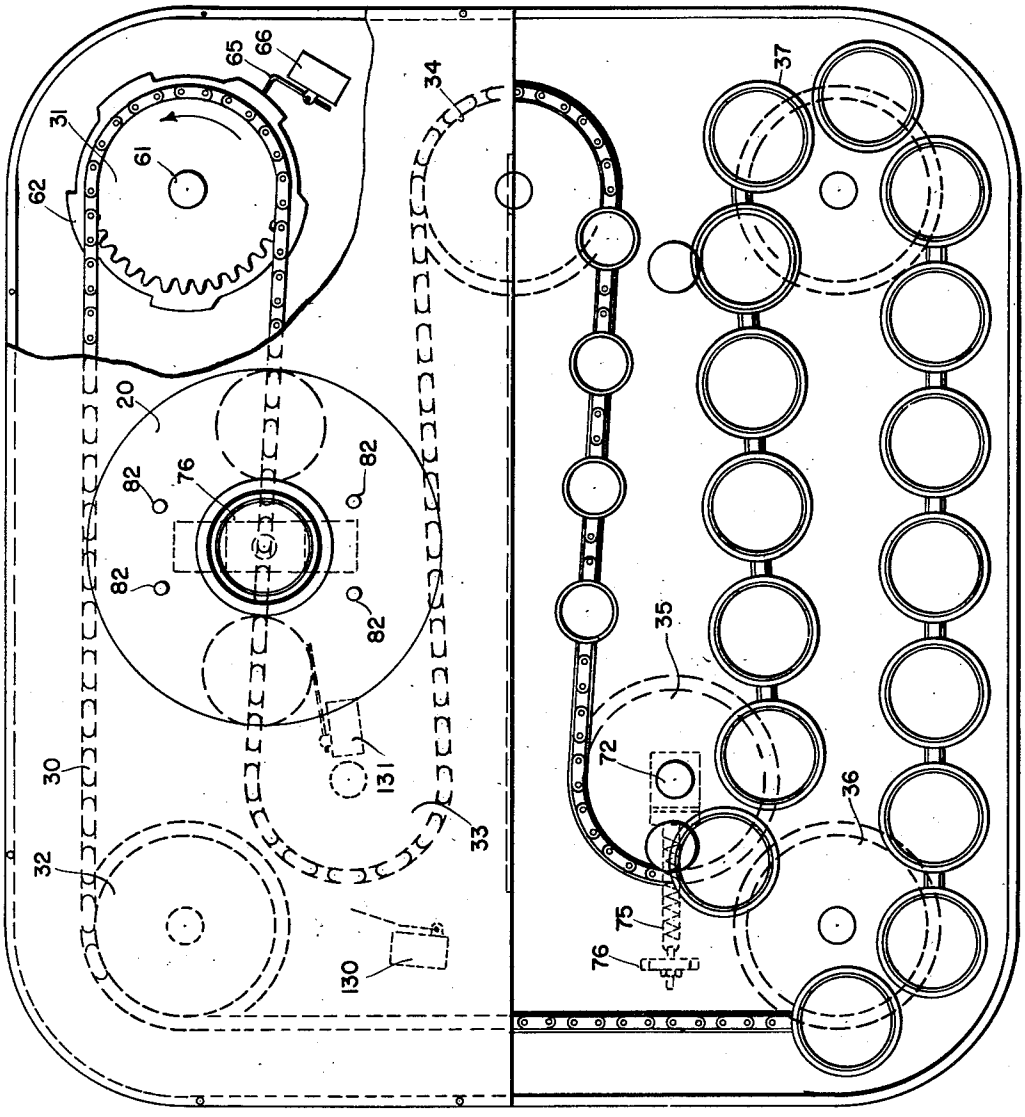


FIG. 2

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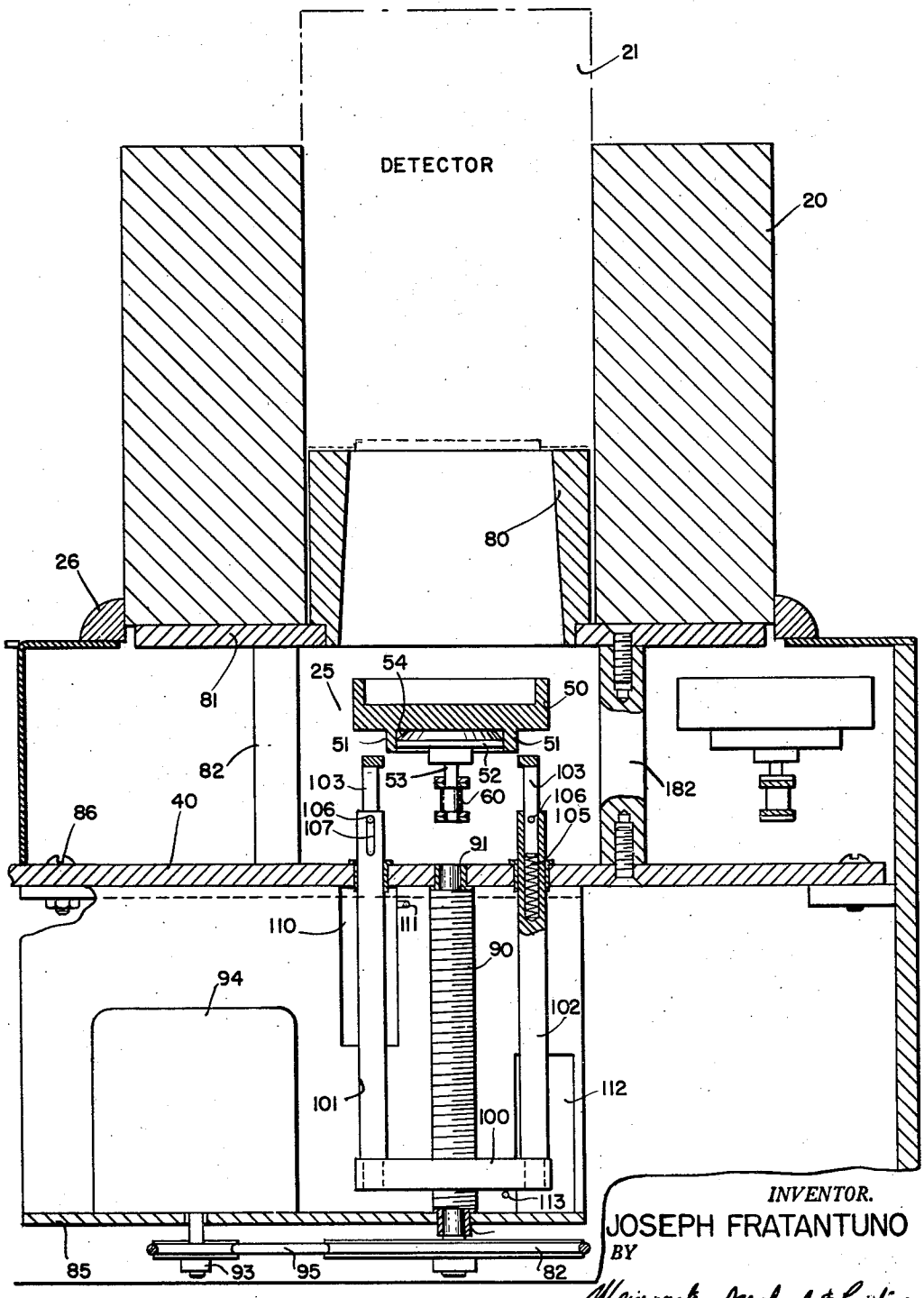


FIG. 3

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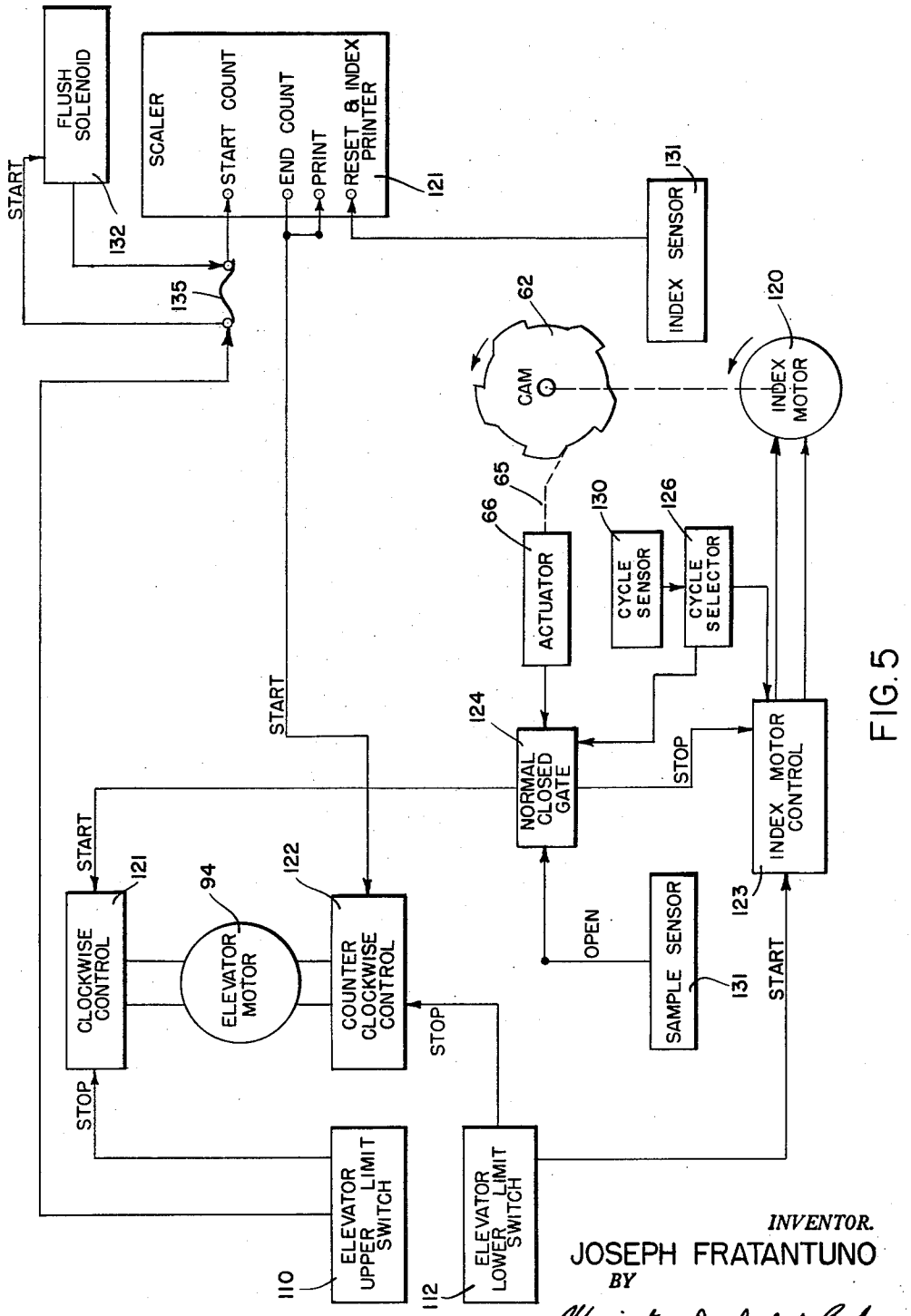


FIG. 5

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Filed Dec. 19, 1960 5 Sheets-Sheet 5

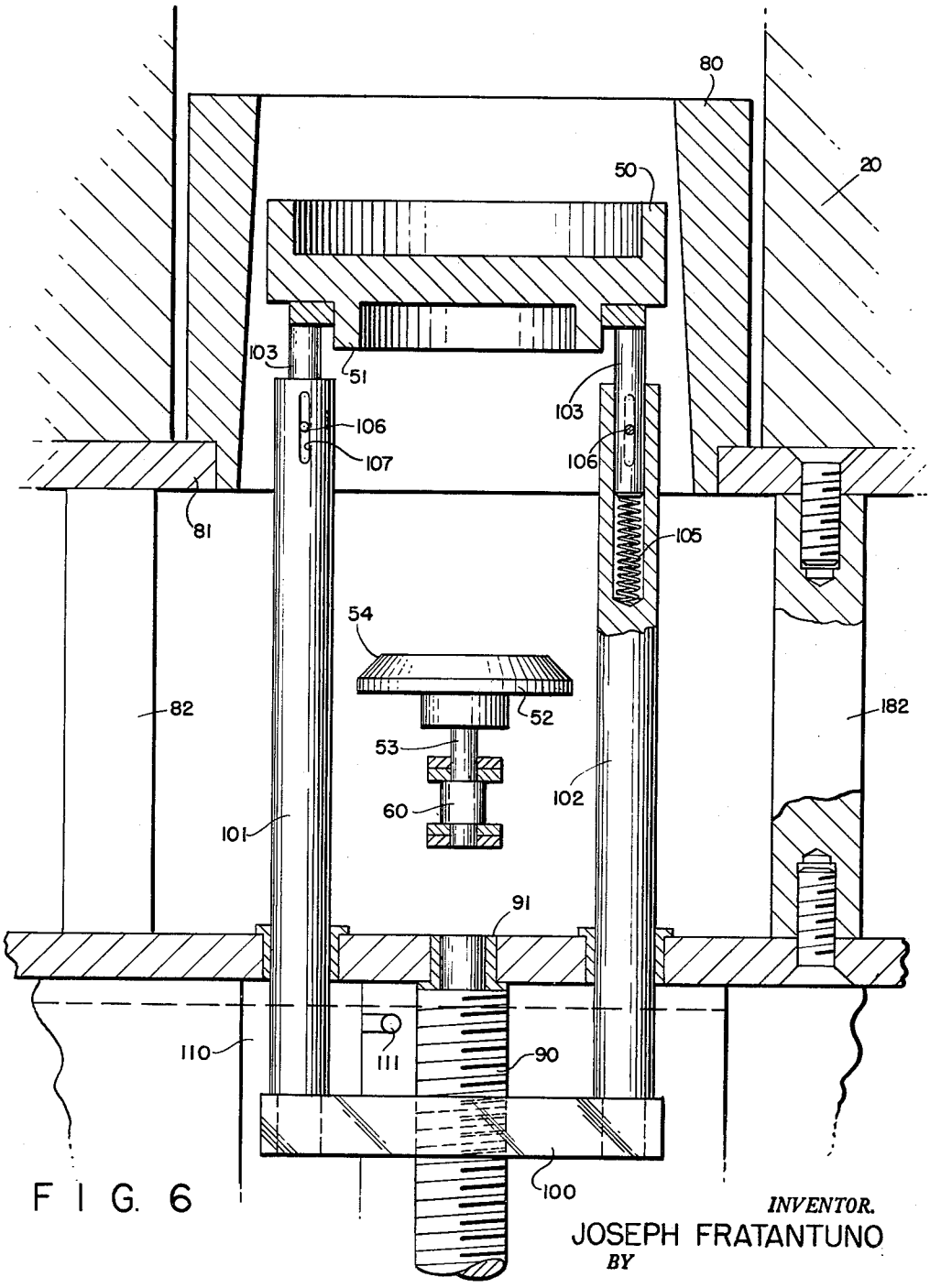


FIG. 6

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13 Claims. (Cl. 250—106)

This invention relates in general to radioactivity measurement and more particularly to an automatic sample changer for the storage and measurement of a relatively large number of radioactive samples.

Automatic measurement of radioactive samples is now a well developed art. A variety of designs for equipment capable of storing and measuring a relatively large number of radioactive samples have been developed. These instruments in general must provide three distinct functions: storage, transport, and counting. The operation, then, for such a system involves loading the apparatus with a number of radioactive samples to be measured, transporting the samples one at a time to a counting chamber where the sample is measured either for a predetermined total number of counts or a predetermined time and then removing the sample to storage while the next successive sample is introduced into the counting area for measurement. In many cases the time required to measure an individual sample may be relatively long, as, for example, in tracer experiments, and hence one complete cycle of the automatic counting equipment may take several hours. It is therefore customary to leave the equipment unattended for long periods of time while it is performing the measurement. This circumstance imposes a requirement of high reliability on the apparatus in that the jamming of the mechanism or other failure leading to stoppage may lose several hours of counting time before it is observed, particularly if the arrangement is used in "overnight" counting. In a radioactivity measurement laboratory there may be a wide number of radioactivity experiments being carried on and hence there may be a large number of diverse counting problems. Thus in one group of samples both very high specific activity and very low activity samples may be included and for a constant accuracy this would require an equally wide variation in measurement time. Again one group of samples may contain an isotope emitting purely beta radiation thus calling for a specific counter type such as a very thin window Geiger counter or a flow counter. Another group of samples may contain isotopes having a relatively high gamma activity and, in this instance, the preferred detector would be a scintillation counter and problems of shielding between the detector and the stored samples would be presented. In many instances the amount of sample preparation available will vary and hence the size of the sample itself may vary, for example, both 1-inch and 2-inch diameters samples are commonly used. The particular type of experiment being carried out may also influence the counting program. In some instances a relatively large number of samples may be measured once each, while in others a lesser number of samples may be measured either once or several times. Even in the case of a large number of samples it may be desired to count each sample a number of times in order to establish decay patterns or the like.

It becomes apparent then that the most useful type of automatic measurement equipment must provide a great deal of flexibility in terms of detector types, shielding, size and number of samples, and programming cycles. The automatic counting apparatus should then be one

which embodies complete programming and flexibility together with very high reliability and reasonable economy.

One type of automatic sample changing equipment known in the art employs a disc having the samples stored around its periphery which is rotated in discrete steps, thus placing each sample successively in a position near the detector. A separate mechanism is generally employed to transport the sample from this "load" position to a measurement position in direct juxtaposition to the detector. Such a device becomes very unwieldy if, for example, fifty 2-inch diameter samples are to be measured since the circumference of the disc would then have to be greater than 100 inches.

A second type of device somewhat obviates this storage problem by employing a spiral track system, however in this instance the transport is accomplished by forming a train of samples which push one another and this arrangement is susceptible to jamming as well as lacking the precision of step-wise transport movement.

Another type of automatic sample changer employed in the art employs vertical cartridges for storing the samples in vertical stacks with a rotating disc to remove each sample from the bottom of a pre-measurement stack, insert it into the detector area, and restack it at the bottom of a post-measurement storage cartridge. Such a device has the obvious disadvantage that the samples after measurement are stacked in the inverse of their original order and consequently an extra step must be employed to restack them in their original order for second, third, or fourth cycles of measurement. Further, since the feed from the cartridges is essentially a gravity feed, jamming is likely to occur unless extremely precise tolerances are observed in the transport mechanism.

It is, therefore, a primary object of the present invention to provide an automatic, flexible sample changer for the measurement of radioactive samples.

It is another object of the present invention to provide an automatic sample changer for radioactive samples which can be employed with a variety of detectors and a variety of sample sizes.

It is still another object of the present invention to provide an economic automatic sample changer for radioactive samples which can accommodate a large number of samples in a relatively small space and in which each sample in a sequence of samples is removed from storage, measured and returned to its sequential position before the next successive sample is measured.

Broadly speaking the sample changer of this invention employs a closed, folded loop conveyor system as both the storage and principal transport means. In addition an elevator mechanism operates in conjunction with the conveyor system to lift each individual sample from the conveyor, place it in direct proximity to the detector and return it to the conveyor after measurement. A discrete step-wise drive for the conveyor movement is employed to move each successive sample into the position at which the elevator mechanism operates. The conveyor itself is formed of either a flexible chain or belt and by guiding this belt or chain around suitably located idler wheels a substantial length of the conveyor may be confined within a relatively small area and hence a substantial number of samples may be stored and transported within a relatively small area. Since the conveyor is formed as a closed loop then, at the conclusion of a measurement cycle including all of the samples in sequence, the first sample is automatically in position to be counted in a second cycle of measurement. A control system employing switches to indicate the presence or absence, and the position of samples provides automatic programming and ensures measurement of all the samples within the system in sequence whether or not the apparatus is

loaded to full capacity. Because of the mechanical simplicity of a chain or belt drive and because of the precision of a step-wise movement the apparatus is extremely reliable and is not susceptible to jamming.

Other objects and advantages will become apparent in the following detailed description when taken in conjunction with the accompanying drawing in which:

FIG. 1 is an illustration in perspective view of the sample changer of this invention;

FIG. 2 is a top view of the sample changer of FIG. 1 with a section broken away in order to show the driving mechanism;

FIG. 3 is a cross-sectional view taken along the line A—A of FIG. 1;

FIG. 4 is a cross-sectional view taken along the line B—B of FIG. 2;

FIG. 5 is an illustration in block diagrammatic form of the control system for this sample changer; and

FIG. 6 is a cross-sectional view along the line A—A of FIG. 1, with the elevator raised.

With reference now particularly to FIG. 1, the sample changer is seen to include a generally rectangular base **11**, which is a few inches high and which has a top cover formed of two pieces; a fixed piece **12** and a movable piece **13**, which is hinged along the joint **14** between it and the fixed piece **12**. The movable cover **13** is preferably formed of transparent material such as clear plastic or the like and is provided with a pair of knobs **16** to facilitate manual raising of this cover. A radiation shield **20** and detector **21** are mounted on the fixed portion of the cover **12** near the back. A control panel **15** having gripping handles **22** for removing the control chassis from the base **11** is located on the front side of the base and provides the control switches and indicator lights. A shelf **23** which extends over the front interior area of base **11** in front of joint **14** is set about two inches below the upper edge of the casting. This shelf **23** serves to protect the operating mechanism of the changer and allows the radioactive samples, generally indicated as **25**, to traverse over its surface through means of a slot **26** layed out in a generally serpentine path. A facing panel **27** extends from the cover **12** to the shelf member **23** along the joint **14** between the movable and fixed portions of the cover. This facing panel **27** has openings at either end to allow the samples to move in and out of the compartment thus formed in the back portion of the sample changer beneath the top cover **12**. In operation, the hinged portion of the cover **13** is raised and the samples are loaded onto the transport system which carries them along the serpentine path **26** and into the measurement position located underneath the shield **20** and detector **21** and then out again into the front compartment. The exact mode of operation will be more clearly seen from discussion of detailed views of FIGS. 2, 3, and 4.

Turning now to FIG. 2 a view from above shows the layout of the conveyor system and some of the drive mechanism. In general, the sample changer mechanism may be considered in terms of that portion which appears above the shelf member **23** and that portion which is located below shelf member **23** within the base **11**. The conveyor is formed of the flexible chain **30** which is driven by a sprocket **31** and which is guided in the path as indicated in FIG. 2 around idler gears **32** through **37**. The chain is formed of a series of connected links which are connected in fashion to permit rotation on a horizontal plane but provide rigidity in the vertical plane. The chain itself, as well as the sprocket **31** and idler wheels, are located beneath shelf **23** and the samples are carried, as is best indicated in FIG. 4, on pins extending vertically, from selected ones of the pivot studs of the chain, through the slot **26** in shelf **23**. The detail of the sample carrier mounting arrangement will be discussed at a later point. The drive sprocket **31** and the idler gears are supported on a horizontal support member **40** which divides the space below shelf **23** in the base member into two vertical compartments. The base **11** then has three vertical levels within it. The upper level above shelf **23** serving as the level at which samples are stored and moved into position for entry into the detector volume, the next lower level between shelf **23** and support **40** serving as the operating level for the conveyor mechanism and containing the conveyor chain, the drive and idler sprockets. The lowest level below support **40** contains the motors which drive the conveyor sprocket and elevator mechanism and also the control circuitry. The elevator mechanism located directly beneath the detector position serves to raise samples vertically from the conveyor into close proximity with the detector element and return them after counting to the conveyor element. The exact operation of this elevator mechanism will be discussed in greater detail below.

Before discussing the over-all automatic sequential operation of this sample changer, the detailed construction of the elements will be discussed so that the cooperative nature of the entire mechanism may be more clearly understood.

Referring specifically to FIGS. 3 and 4 the construction of the radioactive sample holder designated generally as **25** is illustrated. The typical radioactive sample itself would be a disc of a diameter, as indicated previously, which varies from one to two inches and of a thickness which may well vary from a few hundredths of an inch to a quarter of an inch. The sample holder **50** into which the sample disc is placed is a disc having a recessed center portion on top to receive these radioactive sample discs. A lip extends from the underside to form a concentric ring **51** of smaller diameter. The ring **51** is of such a diameter to fit over the sample pedestal **52** which has sides tapered inwardly towards the top, forming a bevel **54**, thereby providing a certain amount of self positioning when placing the sample holder **50** on the pedestal **52**. The pedestal **52** is fitted over the pin **53** which itself fits through the pivot roller **50** in the chain link. These pins are fitted into pivot rollers selected such that there is approximately one-quarter inch spacing between the peripheries of adjoining sample holders, and in this embodiment the total length of the conveyor chain is such that **50** sample holders may be accommodated at once. The pedestal **52** is mounted on the pin **53** by making the pin with a split spring end so that a forced fit can be made between the pin and the pedestal.

Considering now the conveyor system in itself, this is best illustrated in FIGS. 2 and 4. The conveyor chain **30** is formed of a length of single roller chain which permits horizontal flexibility but is rigid in the vertical plane. The chain, as previously indicated, is a closed loop and is guided in a folded loop configuration around a series of idler gears **32** through **37** arranged to provide a sufficient length of chain within the confines of the base **11** to accommodate fifty 2-inch diameter samples.

The chain **30** is driven by driving sprocket **31** which is pinned to a shaft **51**, which extends through support **40** and which is in turn coupled to an electric motor (not shown) in the lowermost section of the base **11**. A cam **62** is pinned to the same shaft and rotates with it. The cam **62** is formed with five evenly-spaced depressions around its periphery and operates in conjunction with switch **66** to control precisely the step-wise movement of the conveyor chain **30** is transporting each same into and out of the loading position **70** directly above the elevator mechanism. Each of the idler gears **32** to **37** are identically formed. Typically, idler **36**, as illustrated in FIG. 4, is formed of a circular gear rotating freely about a stud **71** mounted on support **40**. The upper end of stud **71** extends slightly through an opening in shelf **23**. The remaining idler gears are similarly mounted with the single exception of idler **35** which has its pivotal stud **72**

mounted, not in a clearance hole, in support 40 but rather a slot which permits lateral adjustment of this stud. The stud 72 is maintained in a position within the slot by the force of a spring 75 attached between it and a bracket 76 fixed to the support member 40, thereby establishing a force acting against the force of the chain. The over-all effect is to provide tension for the entire chain.

The elevator mechanism and the detector mounting structure are shown in some detail in FIG. 3 and FIG. 6. The detector is located directly over one of the loops of the chain near the back edge of the base 11. The detector shield 20, which typically may be formed of two inches of iron or the like to shield the sensitive volume of the detector from external ambient radiation, is supported at approximately the level of the top cover 12 on supporting plate 81 which is in turn mounted on four supporting studs 82 secured to horizontal support 40. The studs 82 are arranged, as indicated in FIG. 2, to straddle the chain 30 in such a way that they provide full clearance for the passage of the radioactive source holder mounted on the chain underneath the detector. A ring 86 fits around the outside perimeter of shield 20 in order to shield the internal compartment underneath the detector from dust and the like. The detector shield 20 has, as indicated, an open central core to permit insertion of a suitable detector 21, which may be a Geiger counter, flow counter, scintillation detector, or the like. A source guide element 80 is mounted around the inner edge of the support ring 81 and extends upward into the hollowed core of the shield 20, supporting the detector 21. The source guide element 80 is again generally ring shaped, tapering however from a diameter of approximately two inches at the top to a diameter of 2½ inches at the bottom. This taper provides that when the sample holder 50 is raised by the elevator to come into contact with the bottom of the detector 21, as illustrated in FIG. 6, it is automatically centered on the detector and yet the clearance at the level of the support ring 81 is sufficiently wide to prevent any possibility of jamming.

Having discussed in detail the transport mechanism, the sample holder carried by the transport mechanism, and the detector position and housing, the elevator mechanism which carries the sample holder from the transport mechanism into contact with the detector will now be considered. With reference now to FIG. 3 and FIG. 6 the elevator mechanism is shown in cross-sectional detail. A U-shaped bracket 85 is mounted beneath horizontal support 40 by bolts, of which bolt 86 is typical, and this bracket 85 supports the elevator mechanism. A lead screw 90 is mounted directly beneath and in line with the center line of detector 21 between horizontal support 40 and the bottom of bracket 85. The lead screw 90 is supported in bushings 91 at either end which allow free rotation of the lead screw. A pulley 92 is fixed to the lower end of lead screw 90 below bracket 85 and is driven by a belt 95 from the drive pulley 93 of electric motor 94. The electric motor 94 is a reversible electric motor, the operation of which is controlled by the over-all control system in a manner which will be explained in detail below. The lead screw 90, then, is rotated in either direction, depending on the direction of the drive from motor 94. A rectangular bar 100 is mounted on lead screw 90 as the lead screw follower and is adapted to rise when the lead screw is rotated clockwise and to descend when the lead screw is rotated counterclockwise. A pair of uprights 101 and 102 mounted to either end of the lead screw follower bar 100 extend up through bushing in horizontal support 40 in a fork-like arrangement. Mounted in the top portion of each of the uprights 101 and 102 are a pair of T-shaped fingers 103 which are spaced apart the appropriate dimension to clear the diameter of the lower retaining ring 51 of the sample holder and butt against the bottom of the sample holder 50. Each of these fingers 103 is slidably mounted in the top of its respective upright and is maintained at its uppermost position by a compression spring 105. The upper limit of travel of these fingers is limited by a pin 106 riding in a vertical slot 107 near the top of each upright. A switch 110 is mounted beneath support 40 and has its arm 111 extending, just below support 40, into a position where it will be tripped by the follower bar 100 near the top of the lead screw. As will be described in the over-all discussion of the control system, this switch serves to limit the upward travel of the lead screw follower 100. A corresponding switch 112 is mounted just above the bottom of bracket 85 with its arm 113 in a position to be tripped by the follower bar 100 at the bottom of its travel, thus providing for a lower limit control on the elevator mechanism. The lower limit of travel of the elevator is such that the tops of fingers 103 are lower than the bottom edge of the sample holder 50 in its normal position on the pedestal 52, as illustrated in FIG. 3. By rotating the lead screw clockwise this elevator and hence the fingers 103 are raised until they come in contact with the bottom of the sample holder 50 and then raise it off pedestal 52 bringing it up finally into a position, as shown in FIG. 6, in contact with the bottom of the detector, which corresponds to the position where the follower bar 100 trips microswitch arm 111. The freedom of travel of fingers 103 against the springs provides a large tolerance factor in establishing this position, hence permitting relatively wide variation in the thickness of the sample holders and in the actuating point of the microswitch. In addition the spring loaded compression of the fingers against the source holder permits the source holder to form a relatively tight seal against the lip of a gasketed flow counter, thereby improving the operation of the flow counter. Since the motion of the source holder, in being disengaged from the pedestal, traveling to the detector and returning to the pedestal is only in the vertical direction, the possibility of jamming is considerably reduced. The positive nature of the source holder mounting on the pedestal coupled with the beveled pedestal top and tapered guide also reduces the jamming possibility.

Turning now to FIG. 5 the control system for the automatic sample changer is illustrated in block diagrammatic form. The function of the control system is, of course, to provide completely automatic operation for a preset program once the radioactive samples have been loaded into the sample changer. While some variation in program is available, there is a basic sequential operation and it is this sequence which will first be discussed. The radioactive samples are first loaded into the sample holders, and the sample holders then placed on pedestals in the desired succession by manually advancing the index motor control 123 through the manual index switch 96, which is located on the front panel of the sample changer. The sample changer unit illustrated is connected by a cable connection (not shown) to a conventional scaler and print-out unit 121. The scaler would normally be an electronic unit capable of being repetitively operated by electrical signals from the sample changer and which would measure each sample for a predetermined number of counts, providing an electrical output signal when that total number of counts had been reached. The scaler and print-out unit would then, in response to actuating signals, print-out the time required for each sample count as well as an index number representing the sequential position of the particular sample. This scaler unit 121 is initially reset and when the first sample to be measured is indexed into the elevator position by manual operation of cycle selector 126 the index number on the printing portion of scaler 121 is set at sample 1. The cycle selector 126 is then set on automatic operation and this provides an actuating pulse through normally closed gate 124 to start the clockwise control 121 on the elevator motor 94. The elevator motor, driving clockwise, raises the first sample holder until the elevator upper limit switch 110 is actuated. The actuation of this switch 110 provides a stop signal to

the clockwise control **121**; thus the sample is raised and stopped in the upper position. This elevator upper limit switch **110** also provides a signal to the scaler unit **121** onto the start count terminal, thereby initiating the counting measurement of the first sample. A portion of the line carrying the actuating signal from the limit switch **110** to the start count terminal is formed of a jumper **135**, which permits direct transmission of this signal to the start count terminal. In the case of operation of a gas flow counter in which it is the usual practice to flush the counting volume with gas for a short period immediately after the sample has been placed in position, the jumper **135** is removed and the actuating signal from the upper limit switch initiates a flush period through flush solenoid **132**. At the conclusion of the flush which typically might be a few seconds a signal is provided from the flush solenoid **132** to the start count terminal. The sample changer remains in this position until the count of the first sample has been completed, which may be indicated either by the elapsing of a predetermined time or by the totalizing of a predetermined number of counts. At the conclusion of the measuring period an actuating pulse is provided from the scaler **121** onto the end count terminal. This end count pulse is supplied directly to the print input of the scaler thereby printing out the accumulated count in conjunction with the sample number. The end count actuating pulse is also provided as a start pulse to counterclockwise control **122** on the elevator motor. The elevator motor then is driven counterclockwise lowering the elevator and sample holder until the elevator lower switch **112** is actuated. At this point the sample holder has been returned to the pedestal on which it was mounted and the finger elements **103** are retracted out of contact with the sample holder. The elevator lower limit switch then provides a stop signal to the counterclockwise control **122** thereby stopping the elevator motor and this same signal is provided as a start signal to the index motor control **123**. The index motor control operates the index motor **120** which rotates the drive sprocket **31** and also cam **62**. The drive sprocket **31** drives the conveyor chain **30** thereby moving the second sample in sequence into the position above the elevator mechanism and moving the first sample out. Cam **62** rotates until the feeler arm **65** on the actuator switch **66** is raised on the cam and then lowered into the next trough. The dropping of the feeler arm **65** into the next trough provides a signal from actuator **66** through normally closed gate **124** to the index motor control **123**, stopping the index motor. At the same time the signal from actuator **66** is fed through normally closed gate **124** as a start signal to clockwise control **121** on the elevator motor thereby initiating the raising and hence measurement of the second sample, the sequence continuing as in the case of the first sample. Microswitch **131** which octs both as an index sensor and a sample sensor is located near the conveyor line just prior to entry of the sample holder into the position above the elevator. This microswitch, operating as an index sensor, provides a signal, as the sample moves past it into the position above the elevator, to the scaler reset terminal. This signal resets the scaler readings to zero in preparation for the next count. If there is no sample holder mounted on the pedestal approaching the elevator position, then microswitch **131** acting as a sample sensor provides a separate actuating signal which opens normally closed gate **124** thereby preventing the signal from actuator **66** from stopping the motor control and starting the elevator motor control. This action then acts as a bypass since the cam and index motor continue to rotate until a sample is sensed by the sample sensor **131**.

Each of the sample pedestals **52** are provided with an index number and the sample pedestal corresponding to the index **50** has a pin extending beneath it. This pin is so positioned that, as it passes microswitch **130** which acts as a cycle sensor, it actuates this microswitch thereby providing information as to the completion of a cycle. The cycle selector **126** may be set to operate for one cycle, a predetermined number of cycles, or continuously. Thus, the signal from the cycle sensor **130** which is provided to the cycle selector **126** may either turn off the entire apparatus or merely initiate a new cycle.

It will be understood that, while the present apparatus has a total capacity of 50 samples, the sequential operation is independent of the number of samples actually loaded into the sample changer. In addition, the sequential operation is independent of whether a partial capacity load is entered into the sample changer in juxtaposition to one another or whether they are spaced over the entire length of the conveyor chain, since the sample sensor provides for automatic bypass when no sample is on a pedestal and this sample sensor also acts as the index register to provide the next index number. While the present apparatus has been described in terms of 50 samples the invention is not so limited, rather the principles may be applied to almost any number of samples with equal effectiveness. Again, as previously discussed, the sample changer for this invention may be operated in conjunction with almost any type of detector, even flow-gas detectors as previously discussed. In view of the fact therefore that numerous modifications and departures may now be made by those skilled in the art, the invention herein should be construed as limited only by the spirit and scope of the appended claims.

What is claimed is:

1. Radioactive sample processing apparatus comprising, a generally rectangular base member; a continuous flexible conveyor element disposed in a configuration of folded-over loops in the horizontal plane within said base member; a plurality of pedestal elements mounted in fixed spaced-apart relationship along the length of said conveyor element; a plurality of radioactive sample holders, each of said sample holders being disposed on a respective one of said pedestals in a manner to permit vertical removal only therefrom; a radiation detector mounted upon said base member in a horizontal plane above said conveyor elements; means adapted to impart lengthwise motion to said conyevor element in discrete steps for transporting each of said sample holders sequentially to a position directly beneath said radiation detector; elevator means adapted to raise each of said sample holders in said position beneath said radiation detector upward from its respective pedestal into operative juxtaposition with said detector and to return said sample holder to its respective pedestal before said conveyor element transports the next sequential one of said sample holders into said position beneath said radiation detector.

2. Apparatus in accordance with claim **1** having a semple sensor element adapted to sense the presence of one of said sample holders on each of said pedestals as it approachs said position beneath said radiation detector and to provide, in response to a pedestal having no sample holder, an actuating signal to said motion-imparting means acting in response to said actuating signal to transport said respective one of said pedestals through said position without stopping.

3. Radioactive sample processing apparatus for processing a plurality of radioactive samples comprising, a base member, a continuous closed-loop conveyor system disposed in a horizontal plane within said base member, said conveyor system being formed of a length of roller chain, said chain being formed of a plurality of links; said links being connected together by hinge pins; a radiation detector mounted upon said base member in a horizontal plane above said conveyor; a plurality of pedestal elements fixed to said chain at spaced-apart positions along the length thereof, each of said pedestals being formed as a disk having a bevel around the upper edge thereof and a pin connecting said disk to said chain; each of said pedestal connecting pins being in fixed coaxial relation with one

of said chain hinge pins; a plurality of sample holders each adapted to retain one of said radioactive samples on its upper side and each adapted to be mounted on one of said plurality of pedestal elements, said conveyor system being adapted to transport sequentially each of said sample holders mounted on one of said pedestals to a position directly beneath said radiation detector; an elevator mechanism disposed within said base member beneath said position and adapted to move each of said source holders in said position in the vertical direction only from said pedestal into operative juxtaposition to said radiation detector.

4. Apparatus in accordance with claim 3 wherein each of said sample holders is formed with a peripheral recess on the underside for receiving said beveled disk portion of one of said pedestal elements.

5. Apparatus in accordance with claim 3 wherein said elevator mechanism has a plurality of T-shaped fingers for holding the underside of one of said sample holders.

6. Apparatus in accordance with claim 5, wherein each of said fingers comprises a casing element and a sample holder contacting element extending upward from said casing, said contacting element being adapted to move vertically with respect to said casing; a compression spring within said casing adapted to exact an upward force on its respective contacting element, for maintaining said contacting element at its uppermost position within said casing.

7. Radioactive sample processing apparatus comprising, a flexible closed-loop conveyor system for storing and transporting a plurality of radioactive samples in a horizontal plane, a radiation detector disposed above said conveyor system, said conveyor being arranged to transport said samples sequentially in said horizontal plane to a position beneath said detector, and an elevator disposed beneath said conveyor system, said elevator comprising means for lifting each sample in said position off said conveyor system upward into operative juxtaposition with said radiation detector, and means for actuating said lifting means when a sample is disposed in said position.

8. Radioactive sample processing apparatus comprising a flexible closed-loop conveyor system disposed in the horizontal plane and adapted to store and transport sequentially a plurality of radioactive samples; a radiation detector disposed in fixed-spaced relationship above said conveyor system, said conveyor system being adapted to transport each of said samples sequentially to a position beneath and in vertical alignment with said radiation detector; elevator means for moving a sample in said position upward off of said conveyor system into operative juxtaposition with said detector and for returning said sample to said conveyor before said conveyor transports the next sequentially sample into said position, said elevator means comprising vertically reciprocal lifting means engageable with a sample disposed in said position.

9. Radioactive sample processing apparatus comprising, a generally rectangular base member; a continuous flexible closed-loop conveyor system disposed for movement in a horizontal plane within said base member, said conveyor system being adapted to store a plurality of radioactive samples disposed in spaced-apart fixed relationship upon said conveyor; a radiation detector mounted upon said base member in a horizontal plane above said conveyor, said conveyor being adapted to transport each of said samples sequentially to a position directly beneath said radiation detector; an elevator mechanism disposed within said base member beneath said position, said elevator mechanism comprising means for transferring a sample in said position from said conveyor upward into operative juxtaposition to said rediation detector; means for sensitizing said detector for a predetermined measurement period of time for each of said samples, means operative at the conclusion of said predetermined period for actuating said elevator mechanism to return said sample to said conveyor before said conveyor transports the next sequential sample into said position.

10. Radioactive sample processing apparatus comprising, a generally rectangular base member; a continuous flexible closed-loop conveyor system disposed in a horizontal plane within said base member, said conveyor system being adapted to store a plurality of radioactive samples disposed in spaced-apart fixed relationship upon said conveyor; a radiation detector mounted upon said base member in a horizontal plane above said conveyor, said conveyor being adapated to transport each of said samples sequentially to a position directly beneath said radiation detector; an elevator mechanism disposed within said base member beneath said position and adapted to move a sample in the upward direction only from said position into operative juxtaposition to said radiation detector; means for sensitizing said detector for a predetermined measurement period of time for each of said samples; means operative at the conclusion of said predetermined period for actuating said elevator mechanism to return said sample to said conveyor before said conveyor transports the next sequential sample into said position, wherein said conveyor system comprises a closed-end single roller chain; a motor-driven sprocket disposed in operative contact with said chain; a plurality of idler sprockets adapted to guide said chain in a generally folded loop path within said base member; a cam adapted to rotate in conjunction with said drive sprocket; means operative at the conclusion of each of said predetermined measurement periods for rotating said drive sprocket; means actuated by said cam member for stopping rotation of said drive sprocket after a time sufficient to transport the next sequential one of said samples into said position beneath said detector.

11. Apparatus in accordance with claim 10 wherein a plurality of pedestal elements are fixed to said chain at spaced-apart positions along the length thereof, each of said pedestals being adapted to hold one of said plurality of radioactive samples.

12. Apparatus in accordance with claim 10 wherein said elevator mechanism comprises a lead screw having its longitudinal axis in the vertical plane; a lead screw follower mounted on said lead screw and adapted to travel upward along said screw when said lead screw is rotated in one direction and downward when said lead screw is rotated in the opposite direction; first and second posts extending upward from said lead screw follower, said first and second posts being adapted, as said lead screw follower is driven upwards, to contact the bottom of each of said samples in said position beneath said radiation detector and to move said sample upward into operative juxtaposition with said detector.

13. Radioactive sample processing apparatus comprising, a generally rectanglar base member; a continuous flexible conveyor element disposed in a configuration of folded-over loops in a first horizontal plane within said base member; a plurality of pedestal elements mounted in fixed spaced-apart relationship along the length of said conveyor element; a plurality of radioactive sample holders, each of said sample holders being disposed on a respective one of said pedestals in a manner to permit removal therefrom only in an upward direction; a radiation detector mounted upon said base member in a horizontal plane above said conveyor elements; means adapted to impart lengthwise motion to said conveyor element for transporting each of said sample holders in said first horizontal plane sequentially to a position directly beneath said radiation detector; and elevator means adapted to raise each of said sample holders from its respective pedestal in said position beneath said radiation detector upward into operative juxtaposition with said detectors and for returning said sample holder to its respective pedestal before said conveyor element transports the next sequential one of said sample holders into said position beneath said radiation detector.

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