

March 14, 1950

F. C. HENRIQUES, JR

2,500,492

APPARATUS FOR HANDLING MATERIALS

Filed Jan. 18, 1949

5 Sheets-Sheet 1

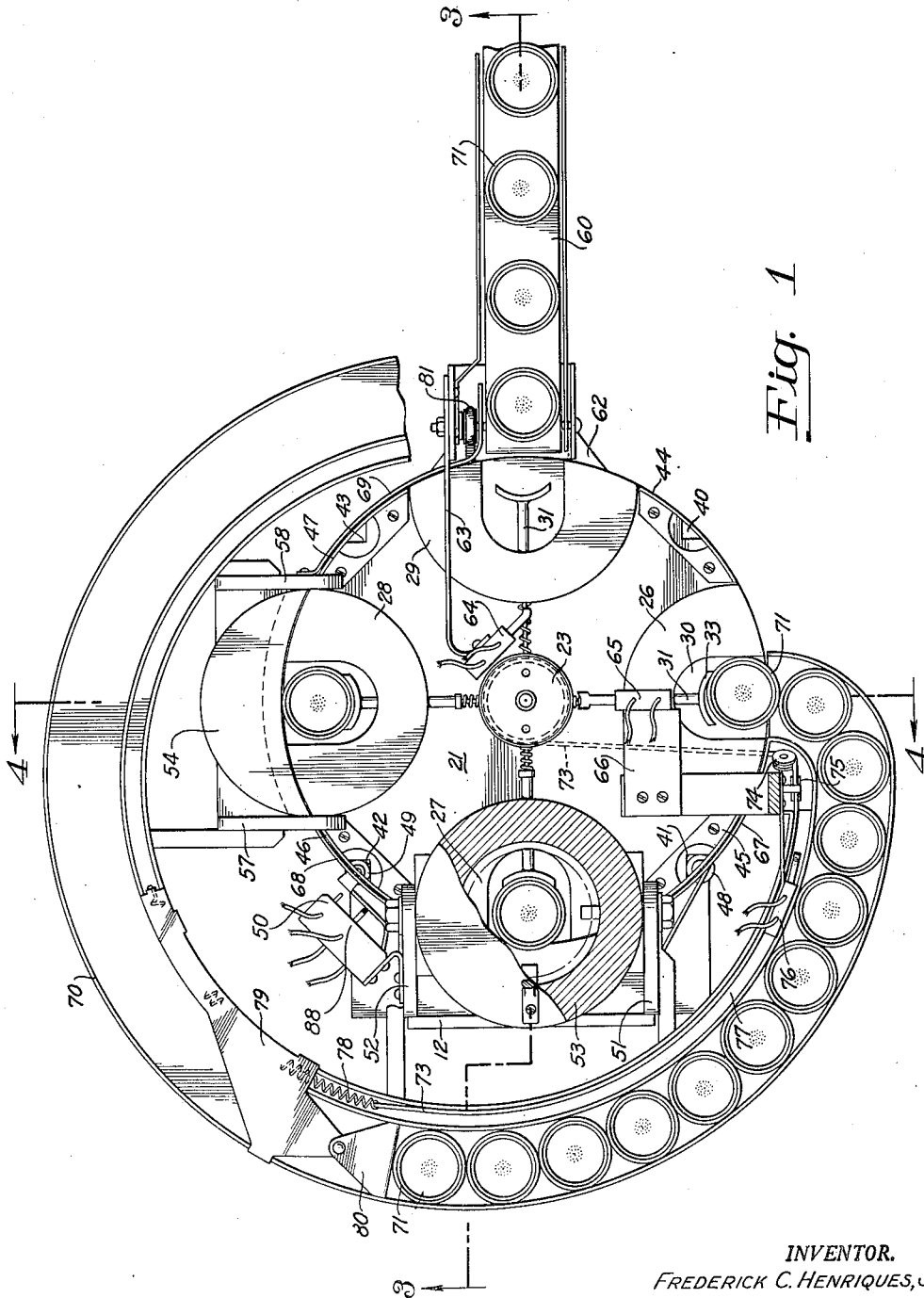


Fig. 1

INVENTOR.
FREDERICK C. HENRIQUES, JR.

BY
Roland P. Anderson

ATTORNEY.

March 14, 1950

F. C. HENRIQUES, JR

2,500,492

APPARATUS FOR HANDLING MATERIALS

Filed Jan. 18, 1949

5 Sheets-Sheet 2

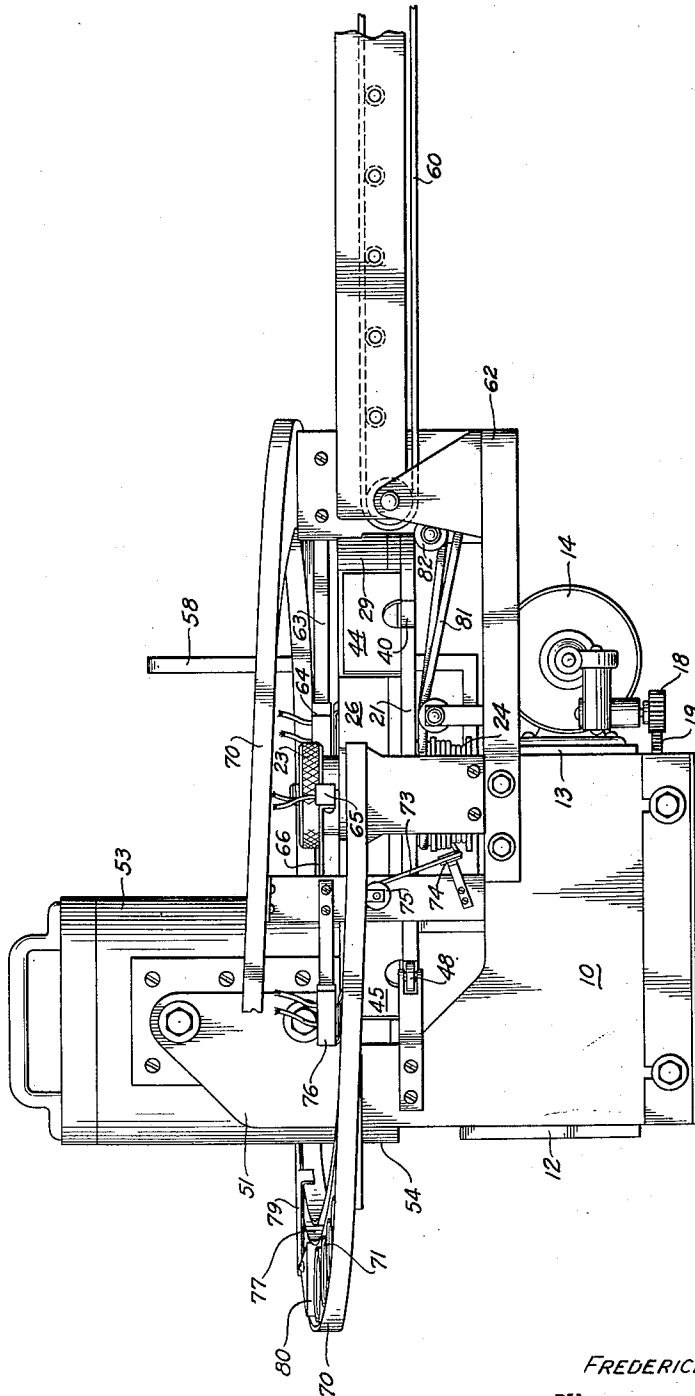


Fig. 2

INVENTOR.

FREDERICK C. HENRIQUES, JR.

BY

Roland A. Anderson

ATTORNEY.

March 14, 1950

F. C. HENRIQUES, JR
APPARATUS FOR HANDLING MATERIALS

2,500,492

Filed Jan. 18, 1949

5 Sheets-Sheet 3

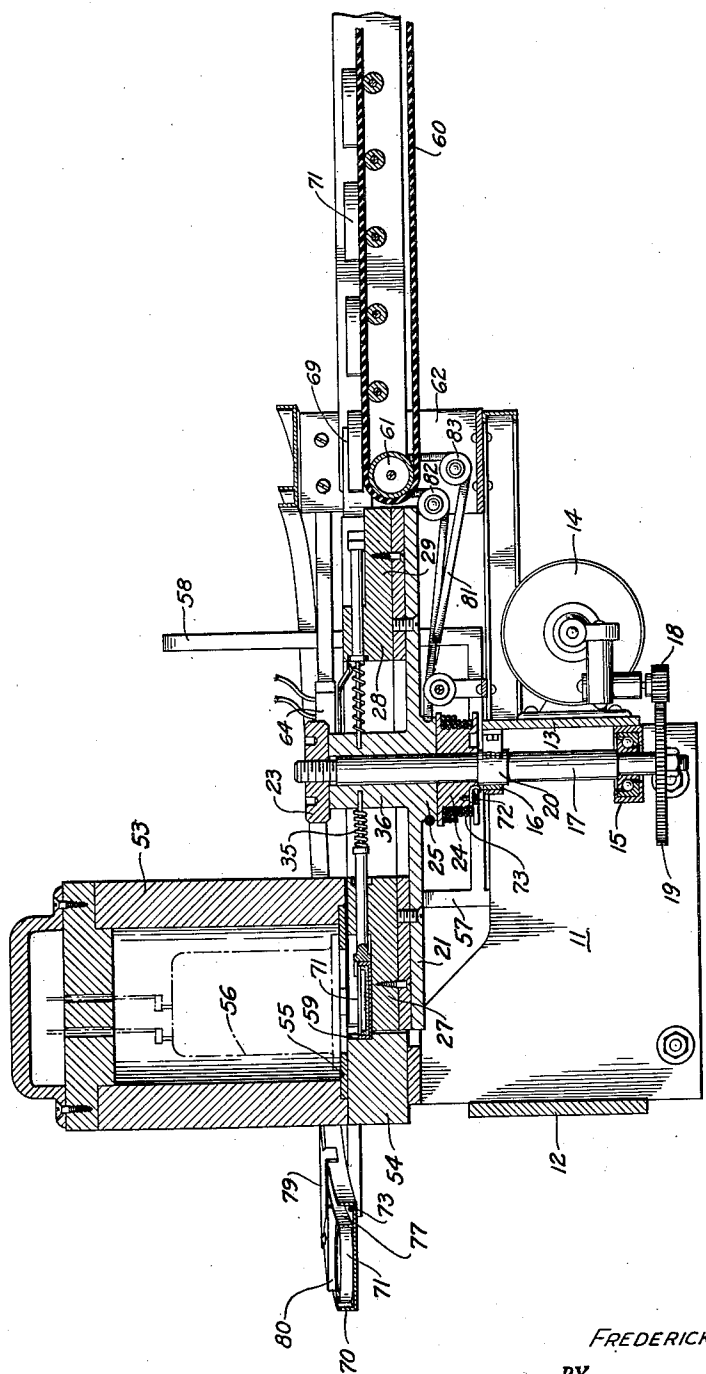


Fig. 3

INVENTOR.
FREDERICK C. HENRIQUES, JR.
BY
Alfred R. Anderson
ATTORNEY.

March 14, 1950

F. C. HENRIQUES, JR

2,500,492

APPARATUS FOR HANDLING MATERIALS

Filed Jan. 18, 1949

5 Sheets-Sheet 4

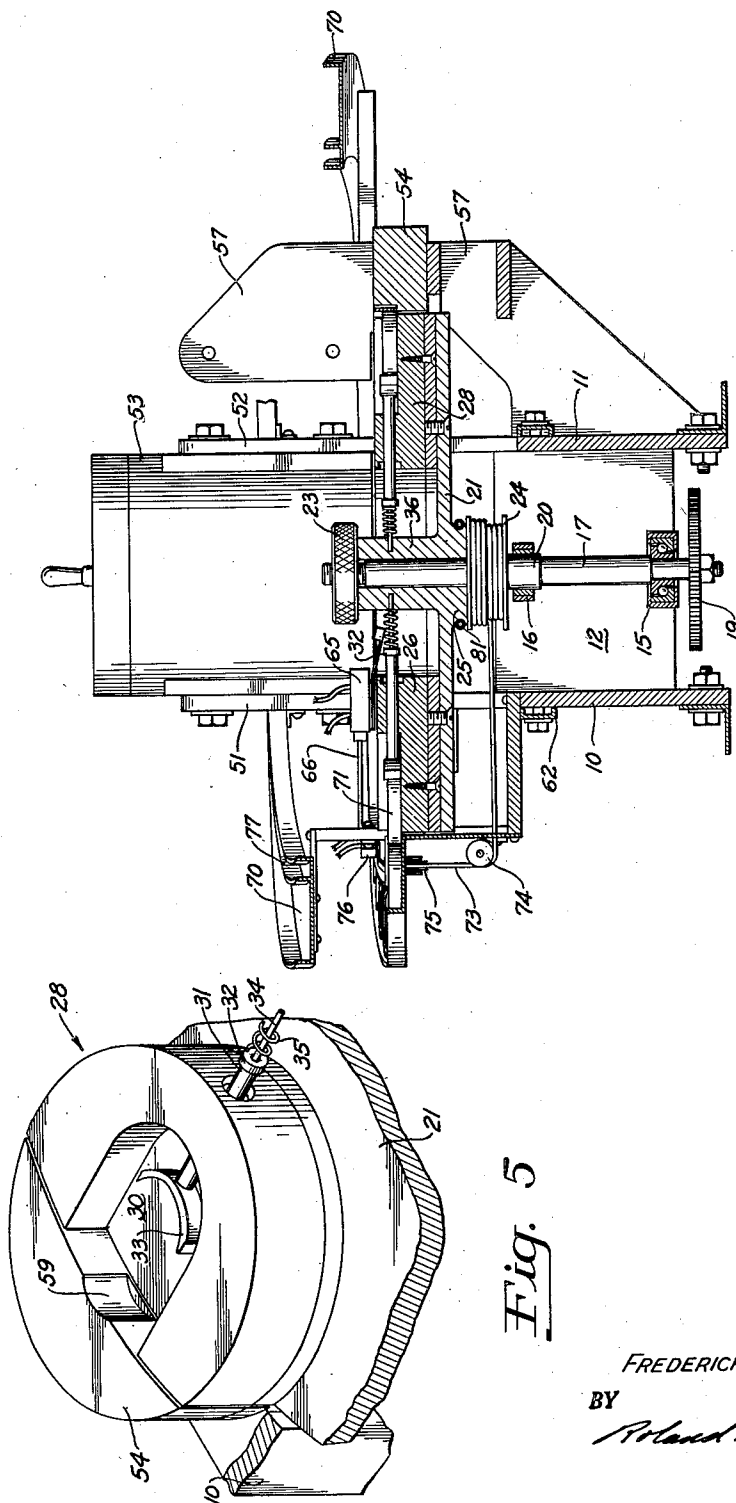


Fig. 4

Fig. 5

INVENTOR.
FREDERICK C. HENRIQUES, JR.
BY
Poland A. Anderson
ATTORNEY.

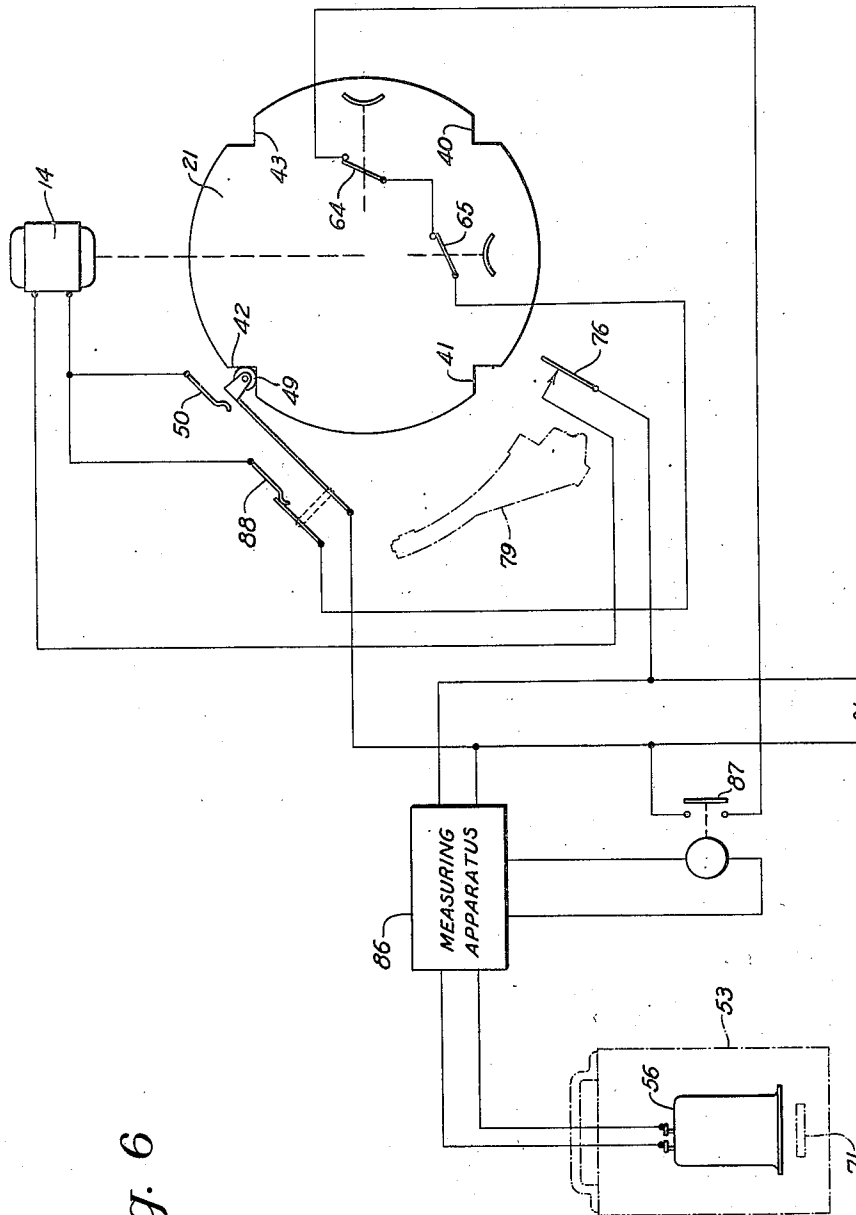
March 14, 1950

F. C. HENRIQUES, JR
APPARATUS FOR HANDLING MATERIALS

2,500,492

Filed Jan. 18, 1949

5 Sheets-Sheet 5



INVENTOR.
FREDERICK C. HENRIQUES, Jr.

BY

Poland A. Anderson

ATTORNEY.

UNITED STATES PATENT OFFICE

2,500,492

APPARATUS FOR HANDLING MATERIALS

Frederick C. Henriques, Jr., Winchester, Mass.,
 assignor to the United States of America as
 represented by the United States Atomic Energy
 Commission

Application January 18, 1949, Serial No. 71,511

13 Claims. (Cl. 250—83.6)

1

This invention relates to radioactivity measurement and more particularly to a new and improved apparatus for handling samples of radioactive material. The invention is especially well adapted to use in the measuring of comparatively small samples of relatively high specific activities due to the shielding of the sample, while under measurement, from external radioactive influences which might otherwise result in a distorted, inaccurate or slow measurement. Conventional delicate measuring means may be employed, if desired, in conjunction with the invention without the necessity for using samples large enough to introduce problems of safety to personnel. As is well known, the extent of danger in handling radioactive materials is dependent not only upon the degree of radioactive intensity and amount of a given material, but also upon the time of exposure thereto. In order to provide accurate measurements, some types of prior apparatus have been compelled to compromise with one or more of these considerations or else have necessitated recourse to complex, expensive or relatively inefficient means. The present invention, on the contrary, enables the user to handle samples with much greater safety and with marked efficiency.

One of the chief objects of this invention is to provide a means for accurately handling samples of radioactive materials in a rapid and safe manner.

A second object is to provide an automatic material handling apparatus in which no manual handling of the material is required.

Another object is to provide a handling apparatus for radioactive materials which operates rapidly and is capable of handling a plurality of samples in rapid sequence.

A further object is to provide in cooperation with a conventional measuring apparatus, a handling apparatus for radioactive materials with an interlocking means which bars entry of an unmeasured sample until a measured sample is ejected.

A still further object is to provide a handling apparatus for radioactive materials which is compact, easily shielded, and quickly refillable.

Another object is to provide a handling apparatus for radioactive materials which can be readily disassembled and in which uncontaminated parts can readily be substituted for parts contaminated with radioactivity.

Other objects and advantages will become more apparent when the invention is considered

2

in conjunction with the following description and drawings in which:

Figure 1 is a plan view showing the general arrangement of the apparatus, with a portion of the isolation compartment broken away;

Fig. 2 is a side elevation view of the apparatus;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1;

Fig. 4 is a sectional view taken on line 4—4 of Fig. 1;

Fig. 5 is a perspective view showing the details of the shield construction; and

Fig. 6 is a view showing diagrammatically one arrangement of wiring suitable for use in connection with the invention.

Passing first to Figs. 3 and 4, it will be noted that a suitable framework, preferably stationary, consisting of walls 10 and 11 spaced apart by plates 12 and 13 forms a rigid base structure upon which the handling apparatus rests. Mounted upon one side of plate 13 is a suitable driving means, for example an electric motor 14, preferably suitable for stepwise rotation and controlled by a suitable power circuit, the essentials of which are shown diagrammatically in Fig. 6. On the other side of said plate 13 is arranged a pair of suitably disposed bearings 15 and 16 adapted to support a vertically disposed drive shaft 17. Conventional gears 18 and 19 of any suitable ratio connect the motor to the drive shaft.

Shaft 17 may have an integral collar section 20 upon which a separate pulley member 24, the function of which will later become apparent, is adapted to rest. Mounted upon the upper portion of shaft 17 is a container supporting table 21, preferably circular in form and horizontally disposed with its lower central portion resting in close contact with the upper surface of pulley 24. As best shown in Fig. 3, the table 21 is provided with a lower hub portion 25 adapted to retain and drive a belt 31, later to be described, and is also provided with an upper hub portion 36 preferably terminating in a flat surface upon which a clamping nut 23 is adapted to bear.

Mounted upon the upper side of table 21 adjacent the periphery thereof is a series of shields 26, 27, 28, and 29, corresponding to the number of stations desired in the handling of the radioactive samples. In this case four such stations are shown. These shields may be made of any suitable material useful in protecting against radioactive radiations as, for example, lead, and may be mounted upon table 21 in any suitable manner as by means of backing plates which

can be easily attached or detached from said table. When contaminated as a result of prolonged use, these shields may readily be disconnected and new shields substituted therefor. Although the shields are shown as having in plan view, the general shape of a horseshoe, it will be obvious that other configurations may be used without departing from the invention. The shape as shown, however, has been found to be desirable when handling relatively flat cylindrical containers.

Referring now to Fig. 5, one shield 28 is shown in perspective and provides an illustration of the other shields which preferably are similar. As will be noted, the shield is generally of arcuate external form with a horizontal internal floor portion and contains a recess 30 of comparatively shallow dimensions adapted to receive the container for the radioactive material. The back wall of the shield is provided with a small hole through which extends a hollow sleeve 31 having at one end a collar 32 of larger diameter than the diameter of the hole. At the other end of said sleeve is a curved pusher plate 33 detachably secured to the sleeve in any suitable manner. A rigidly mounted rod 34 affixed in a suitable manner to the hub 36 extends into the hollow sleeve 31 and provides a guide upon which said sleeve may move with a reciprocatory motion. A spring 35, interposed on said rod 34 between the hub 36 and the collar 32 of sleeve 31, serves normally to move the pusher plate outwardly within the recess 30 for a purpose later to be described.

Referring now to Fig. 1, which indicates the operating position at the moment when a container for radioactive material is entering the table 21, it will be noted that four depressions 40, 41, 42, and 43 are located in the outer periphery of circular table 21. Adjacent each such depression and extending between successive shields are apertured upstanding guards 44, 45, 46, and 47, respectively, mounted adjacent the peripheral surface of said table and serving to prevent stoppage of the apparatus by action of unmeasured containers seeking to enter the apparatus. A first positioning detent 48 resiliently mounted upon the stationary framework serves to engage each depression in turn as the table 21 rotates and a second resiliently mounted detent 49 likewise engages each depression in turn as the table rotates. Detent 49 is adapted to contact a suitable switch 50 containing a suitable auxiliary switch 88 located in the control circuit to motor 14, at such times as the table 21 is rotating and the detent is being cammed outwardly by the periphery of the table.

Upstanding webs 51 and 52 of walls 10 and 11 provide a convenient support for an isolation chamber or compartment 53 formed of a suitable material capable of shielding the interior thereof from extraneous radioactive influence to an extent permitting accurate measuring of a sample introduced into said compartment. As best shown in Fig. 3, the bottom of compartment 53, when the compartment is arranged in place upon said webs, is in close contact with a stationary and complementary shielding member 54 supported in turn by the webs 51 and 52. For supporting and positioning the radioactivity responsive apparatus indicated generally at 56 and of any conventional form, a suitable ring structure 55 removably affixed to the lower portion of the box 53 may be employed. As will be noted, rotation of table 21 carries the several arcuate shields in turn into cooperative relation with stationary

shield 54 and the ring 55 with a small clearance only between the stationary and rotatable parts, thus providing a substantially closed space within compartment 53 at the time when apparatus 56 is functioning. Suitable leads from apparatus 56 may extend through the top of compartment 53 and connect with a conventional measuring means 86 and to any suitable motor control circuit in which the motor control switches, later to be described, are also connected, all as indicated generally in Fig. 6. As will be apparent to those skilled in the art, the electronic measuring apparatus may operate either on the basis of measuring the number of counts received from a sample of radioactive material in a given increment of time, or of measuring the amount of time required for a given number of counts. After such measuring is completed, however, the sample needs to be removed from the compartment 53 and the next sample introduced for measurement. For positioning a container resting on the floor of a movable shield in its proper relation to the counting means, a shallow centering space 59 in stationary shield 54 may be employed as shown in Fig. 5.

If desired, a second isolation chamber or compartment for supplemental or alternate measuring can be provided, without departing from the invention, by mounting the same between upstanding webs 57 and 58 attached to wall 11, but for purposes of simplicity the same is omitted from this disclosure. Assuming then that the four shields on table 21 are provided for four stations of operation, the final station may then be that at which the measured sample is removed from the apparatus. For example, a conveyor means 60 mounted at one end upon pulley 61 attached to a bracket 62 suitably supported upon walls 10 and 11 may serve as the station at which the measured sample is removed. Intermediate the loading station, the first and subsequent measuring stations and the removal station, suitable curved walls 67, 68, and 69, respectively, may be supported by the stationary framework adjacent the periphery of table 21 in order to hold containers within the loaded shields and against the ejecting pressure of the springs.

For controlling the movement of table 21, any suitable electrical circuit and controls may be employed in connection with drive motor 14. One form of controlling switches is shown in Fig. 1 wherein there is attached to bracket 62 an arm 63 extending inwardly of the table adjacent the removal station and carrying a suitable switch 64 mounted in a position to be actuated by movement of the collar 32 on a sleeve 31. Also, a switch 65 mounted upon bracket 66 attached to wall 10 adjacent the loading station is mounted in position to be actuated by collar 32 on a sleeve 31. As will be obvious, the purpose of these switches is to insure that no premature motion of table 21 will take place until the measured sample is ejected at the removal station and the new sample is placed on the table at the loading station.

In order to provide for rapid measuring of a series of samples in predetermined progression, the capacity of the apparatus may be made large while retaining the apparatus in compact form through the use of a helical track 70 having a pitch which permits movement of a series of shallow containers 71 of similar size containing samples of the radioactive material or materials. Containers 71 may be loaded on said track by any suitable remote control apparatus, not shown.

Attached to the under side of pulley 24 is an anchoring means 72 into which is fastened one end of a flexible cord 73 wound about said pulley. Cord 73 further extends from said pulley through suitably disposed sheaves 74 and 75 and under a switch mechanism 76 and thence into channel 77 of helical track 70. The extreme end of cord 73 is connected to a suitable resilient connection 78 attached to a follower 79, adapted to slide along the track 70 and having a depending pusher plate 80 serving to push containers 71 along said track.

As shown in Figs. 2 and 3, the lower hub portion 25 of table 21 provides a drive surface for belt 81 passing over separate pulleys 82 and 83 and serving to drive conveyer pulley 61.

Having thus described the component parts of one type of apparatus suitable for carrying out the invention, the numerous advantages thereof will become more apparent with reference to the operation of the same. Considering the operation shown in Fig. 1, one sample of radioactive material is being measured in isolation chamber 53, one sample of measured material is at the intermediate station, a measured sample has just been ejected onto conveyer 60, and a new unmeasured sample is entering shield 26. Tension of cord 73 due to rotation of shaft 17 meanwhile has moved the container 71 for the new unmeasured sample into shallow recess 30 of shield 26 and while pushing the container against plate 33 is in the process of forcing the collar 32 of sleeve 31 against the contact projection of switch 65, and compressing spring 35 on rod 34. At this moment the motor 14 has come to rest, table 21 is at rest and measuring of the sample in isolation chamber 53 is taking place. Upon completion of the sample measurement an impulse sent from measuring apparatus 86 closes relay 87 and allows current to flow to motor 14 through closed switches 64, 65 and switch 88 which is linked to the movable detent 49. Upon initiation of rotation of table 21 detent 49 is promptly cammed outwardly into contact with switch 50 and simultaneously opens switch 88 whereupon current then flows through switch 50 until the detent 49 falls into the next depression on table 21, in this case the depression 41. It will be noted that this cycle of operation cannot take place until switch 64 has been closed by the ejection of a previously measured sample and switch 65 has been closed by loading of a new unmeasured sample onto the table 21.

The above prescribed rotation of table 21 has meanwhile wound more of cord 73 upon pulley 24, moved another container into position at the loading station and moved conveyer 60 in order to carry away the measured sample previously moved thereupon. Upon reaching the limit of the prescribed distance of rotation the depression 40 has been engaged by positioning detent 48 and the depression 41 has been engaged by detent 49. Moreover in springing into the depression 41 detent 49 has broken contact with switch 50 and reset switch 88 while relay 87 which was de-energized after the measuring of the previous sample has again opened the circuit to motor 14. The above cycle of operations thereafter is continued stepwise until the measured sample reaches the unloading position as shown by shield 29 in Fig. 1. It will be noted that since leaving the loading station, the spring 35 upon a given rod 34 has remained compressed, since at all points in its travel the outer periphery of the container 71 is bearing upon a wall structure. As it arrives at the unloading position, however,

spring 35 moves outwardly causing collar 32 to actuate relief switch 64. In moving outwardly, sleeve 31 and plate 33 push the measured sample on to conveyer 60 whence it is moved to any suitable point for further use or disposal.

When the last container 71 on track 70 is moved into a shield on table 21 switch 76 is actuated by follower 79, thus breaking the electrical circuit to the apparatus, and operations are suspended. At this time two measured samples still remain upon the table. By any suitable method, preferably remotely controlled, nut 23 is then loosened on shaft 17, and follower 79 is moved backwardly up helical track 70. During this operation the shaft 17, the table 21, and the hub 25 with their connected parts remain stationary due to action of detent 48, whereas the pulley 24 rotates backwardly and permits the unwinding of the cord 73 therefrom.

After follower 79 is retracted a suitable distance, a series of additional containers 71 is then placed on track 70 and the 73 cord is tightened on pulley 24. Nut 23 is again tightened upon shaft 17, thus bringing the table 21, hub 25, pulley 24 and collar 20 into frictional engagement whereby they rotate as a unit. The electrical circuits are then again established, whereupon a new series of measurements is initiated.

Since the apparatus is capable of remote control, it will thus be noted that a minimum of exposure to radioactivity is received by operators of the apparatus. Furthermore, due to the shape and positioning of the shields, the accuracy of measuring taking place in isolation compartment 53 is substantially free of external radioactive influences. This latter feature is due in part to the configuration of the shields since as will be noted, a straight line drawn from any part of a container resting upon table 21, outside of compartment 53, to the arcuate opening at the bottom of that compartment will be intersected by a portion of the shield for that container. Also straight lines drawn from containers moving down the helical track 70 to the opening in the isolation compartment will be intersected by the shielding of that compartment.

The automatic operation of the apparatus together with the arrangement for conveying containers 71 to and from the apparatus therefore makes possible an efficient handling operation using production line techniques. As will be obvious, any suitable shielding walls may be built to surround the above described compact handling apparatus and to afford increased protection to workers. Since the nature of such a structure forms no essential part of my invention, it accordingly has not been shown herein.

While the salient features of the invention have been described in detail in one embodiment of the same, it will of course be apparent that numerous modifications may be made within the spirit and scope of this invention and it is not desired to limit the invention to the exact details shown except insofar as they may be defined in the following claims.

What is claimed is:

1. Apparatus for handling radioactive materials including, a series of containers for samples of the material, an isolation compartment substantially free of external radioactive influence in which radioactivity of a sample of material is measured, a rotatable table for conveying said containers and samples into the compartment in a predetermined progression, means for mov-

ing said containers on to the table, radioactivity shielding means on said table surrounding at least a portion of the periphery of the container and shielding the compartment therefrom prior to and after said sample is measured, and means for removing the container and measured sample from the apparatus.

2. Apparatus for handling radioactive materials including, a series of containers for samples of the material, an isolation compartment substantially free of external radioactive influence in which radioactivity of a sample of material is measured, a rotatable table for conveying said containers into the compartment in a predetermined progression, means for moving said containers on to the table, radioactivity shielding means on said table surrounding at least a portion of the periphery of the container and shielding the compartment therefrom prior to and after said sample is measured, an actuating rod in contact with the container and normally urging said container outwardly from said shielding means, and conveyor means for removing the container and measured sample from the apparatus.

3. A structure of the character described in claim 2, in which said containers are introduced on to the table by pushing means actuated by movement of said table.

4. A structure of the character described in claim 2, in which said measured sample is removed from the apparatus by conveying means actuated by movement of the table.

5. Apparatus for handling radioactive materials including, a series of containers for samples of the material, an isolation compartment substantially free of external radioactive influence in which radioactivity of a sample is measured, a rotatable table for conveying said containers into the compartment in a predetermined progression, a resilient, container-positioning means mounted radially of said table and adapted to position a container in measuring position within said compartment, driving means for rotating said table, means for controlling said driving means in order to stop said table at predetermined stations, means for moving said containers on to the table into contact with said positioning means, and means for removing the container and measured sample from the table and from contact with said positioning means.

6. Apparatus for handling radioactive materials including, a series of containers for samples of the material, an isolation compartment substantially free of external radioactive influence in which radioactivity of a sample is measured, a rotatable table for conveying said containers into the compartment in a predetermined progression, a resilient, container-positioning means mounted radially of said table and adapted to position a container in measuring position within said compartment, station-indicating means carried by the table, a detent mounted upon a stationary portion of the apparatus and adapted to contact said station-indicating means during rotation of the table, driving means for rotating said table, means for controlling said driving means in order to stop said table at predetermined stations, means for moving said containers on to the table into contact with said positioning means, and means for removing the container and measured sample from the table and from contact with said positioning means.

7. Apparatus for handling radioactive mate-

rials including, a series of containers for samples of the material, an isolation compartment substantially free of external radioactive influence in which radioactivity of a sample is measured, a rotatable table for conveying said containers into the compartment in a predetermined progression, means for moving said containers on to the table, shielding means on said table surrounding at least a portion of the periphery of the container and shielding the compartment therefrom prior to and after said container is measured, an actuating rod extending through said shielding means in contact with the container and normally urging said container outwardly from said shielding means, a spring surrounding said rod, barrier means against which said container is held by the spring action while within the apparatus, and means for releasing said spring whereby a container and measured sample may be removed from the apparatus.

8. Apparatus for handling radioactive materials including, a curved track, a plurality of containers for samples of the material positioned on said track in a predetermined progression, an isolation compartment in which radioactivity of a sample is measured, said compartment being positioned interiorly of said track, a rotatable table for carrying said containers progressively into said isolation chamber, a pulley, driving means for said table and pulley, a follower for moving said containers along the track, flexible cord means attached to said follower and adapted to be wound upon the pulley, and means for detaching said table from said driving means whereby the follower and cord may be retracted along the track.

9. Apparatus for handling radioactive materials and having in combination, a rotatable table supporting a container for said material, a stationary isolation compartment in which radioactivity of a material in said container is measured, said compartment being disposed adjacent the periphery of said table, a container-positioning means mounted upon said table and movable radially thereof and adapted to position a container in measuring position within said compartment, means for placing a container upon said table in contact with said positioning means, means for removing a container from said table and from contact with said positioning means, and means for intermittently rotating said table.

10. Apparatus for handling radioactive materials and having in combination, a rotatable table supporting a container for said material, a stationary isolation compartment in which radioactivity of a material in said container is measured, said compartment being disposed adjacent the periphery of said table and having an aperture into which said table moves in substantially sealing engagement therewith, a container-positioning means mounted upon said table and movable radially thereof and adapted to position a container in measuring position within said compartment, means for placing a container upon said table in contact with said positioning means, means for removing a container from said table and from contact with said positioning means, and means for intermittently rotating said table.

11. Apparatus for handling radioactive materials and having in combination, a rotatable table supporting a container for said material, a stationary isolation compartment in which radioactivity of a material in said container is measured, said compartment being disposed adjacent

the periphery of said table, a central hub portion of said table, a container-positioning means mounted upon said hub portion and extending radially of said table, said positioning means having a pusher member in contact with a container and adapted to position the container in measuring position within said compartment, means for placing a container upon said table in contact with said positioning means, means for removing a container from said table and from contact with said positioning means, and means for intermittently rotating said table.

12. Apparatus for handling radioactive materials and having in combination, a rotatable table supporting a container for said material, means for driving said table in one direction by intermittent movement, means for detaching said table from said driving means whereby the table may be moved in a reverse direction, a stationary isolation compartment in which radioactivity of a material in said container is measured, said compartment being disposed adjacent the periphery of said table, a container-positioning means mounted upon said table and movable radially thereof and adapted to position a container in measuring position within said compartment, means for placing a container upon said table in contact with said positioning means and means for removing a container from said table and from contact with said positioning means.

13. Apparatus for handling radioactive materials and having in combination, a rotatable table supporting a container for said material, switch controlled means for driving said table, a stationary isolation compartment in which radioactivity of a material in said container is measured, said compartment being disposed adjacent the periphery of said table, a container-positioning means mounted upon said table and movable radially thereof and adapted to position a container in measuring position within said compartment, a switch controlling said driving means and adapted to be actuated by movement of said positioning means, means for moving a container upon said table into contact with said positioning means and thereby forcing said loaded positioning means to actuate said switch, and means for removing a container from said table and from contact with said positioning means.

14. Apparatus for handling radioactive mate-

rials and having in combination, a rotatable table supporting a container for said material, switch controlled means for driving said table, a stationary isolation compartment in which radioactivity of a material in said container is measured, said compartment being disposed adjacent the periphery of said table, a container-positioning means mounted upon said table and movable radially thereof and adapted to position a container in measuring position within said compartment, a switch controlling said driving means and adapted to be actuated by movement of said positioning means, means for placing a container upon said table in contact with said positioning means, and means for removing a container from said table and from contact with said positioning means, thereby enabling the unloaded positioning means to actuate said switch.

15. Apparatus for handling radioactive materials and having in combination, a rotatable table supporting a container for said material, dual-switch controlled means for driving said table, a stationary isolation compartment in which radioactivity of a material in said container is measured, said compartment being disposed adjacent the periphery of said table, a container-positioning means mounted upon said table and movable radially thereof and adapted to position a container in measuring position within said compartment, a first switch, a second switch, means for moving a container upon said table into contact with said positioning means thereby forcing said loaded positioning means to actuate said first switch and means for removing a container from said table and from contact with said positioning means thereby enabling the unloaded positioning means to actuate said second switch.

FREDERICK C. HENRIQUES, Jr.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,300,406	Johnson et al.	Apr. 15, 1919

OTHER REFERENCES

Peacock and Good, Review of Scientific Instruments, vol. 17, No. 7, July 1946.