

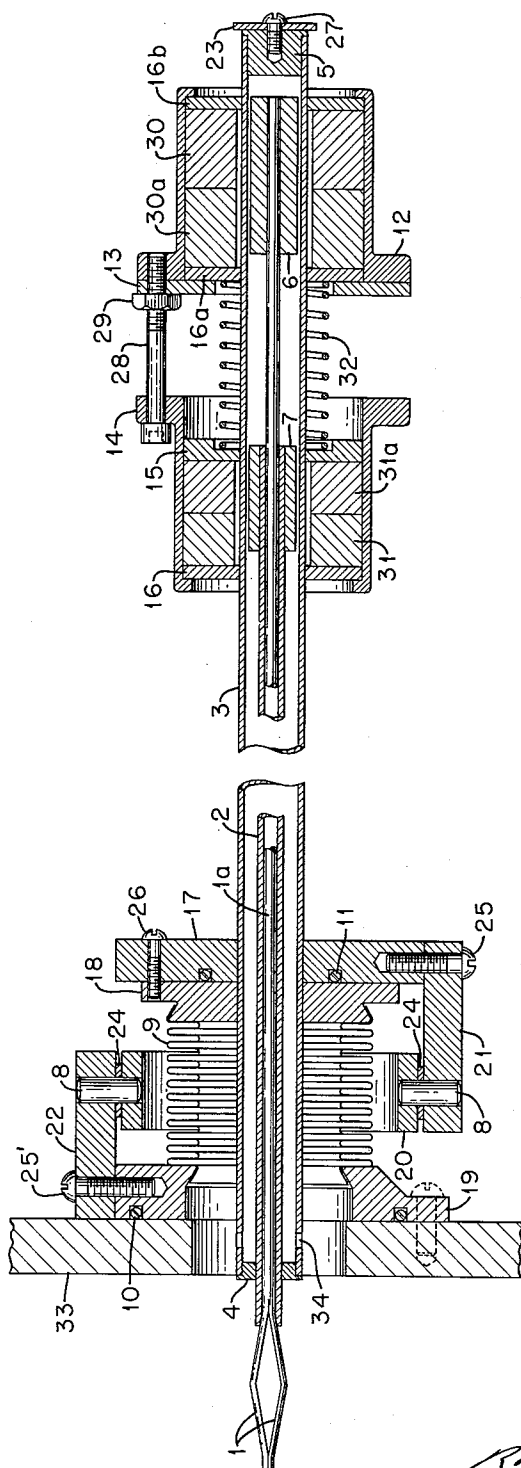
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REMOTELY OPERATED MANIPULATOR

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REMOTELY OPERATED MANIPULATOR

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This invention relates to a means for performing, within an entirely enclosed cell containing radioactive materials, various mechanical operations—specifically the transfer of radioactive samples from carrier to sampler and the opening of the same for analysis of the contents thereof.

Many manipulators, both simple and complex, have been developed in the prior art for accomplishing various operations with the isolated cells wherein radioactive materials are processed. Some of these manipulators have been mechanical, others pneumatic or hydraulic, still others electrical, and more often a mixture of these basic manipulating means have been used. Typical of these are the type which utilize a pantograph type of operation over the top of a wall of the cells to duplicate inside the cell the movements performed outside. This necessitates an opening in the cell. Another type uses a plurality of endless belts to transmit the motion. This also necessitates an opening into the cell.

A large proportion of the other prior art manipulators also require some opening into the cell through which some mechanical portion of the motion is accomplished. If these openings are placed so as to prevent radiations from penetrating the same, such manipulators are useful for most radioactive materials. However, when the radioactive materials are volatile or are easily scattered, as in the case of plutonium, the cell must be completely closed, thus obviating the use of many of the prior art manipulators.

Some prior art manipulators are electro-mechanical and require no openings through the cell wall, such as disclosed in U.S. Patent No. 2,476,249. However, they are too complex for small operations. It is desirable to provide a relatively inexpensive and simple manipulator for use in a completely enclosed cell.

With a knowledge of the complexity of the prior art manipulators for use with enclosed cells, it is a primary object of this invention to provide a simple and inexpensive manipulator wherein the "driver" is positioned outside a hot cell and the "slave" or driven portion is within the cell, and the cell is maintained airtight.

It is another object of this invention to provide a manipulator with a minimum of movable parts, which is simple to operate, and which is essentially leak free.

These and other objects and advantages of this invention will become apparent from a consideration of the following detailed specification and the accompanying drawing, wherein:

The single figure is a cross sectional view of the manipulator designed to accomplish the above stated objects.

The above objects have been accomplished in the present invention by providing a rod which is slidable within a tubular sleeve. The rod has a pair of fingers affixed thereto which may be separated by relative movement between the rod and sleeve. The rod and sleeve are enclosed in a tubular member, the rod being longer than the sleeve. A magnetic follower of magnetizable material is affixed to the end of the sleeve that extends out of the cell, and another magnetic follower is affixed to the end of the rod. A permanent magnet is enclosed in a sleeve member which slides on the tubular member and the magnet is disposed adjacent to the magnetic follower fixed to the sleeve. Another permanent magnet is en-

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closed in another sleeve member slidable on the tubular member and the other magnet is disposed adjacent to the magnetic follower fixed to the rod. The respective sleeve members are held in a fixed position with respect to each other by a compression spring so as to normally hold the fingers on the cell end of the rod closed. The sleeve members may be moved toward each other to impart relative motion between the rod and sleeve to thus open the fingers. When the sleeve members are moved as a unit, the rod and sleeve may be moved in an axial direction, or be rotated about their axis by the action of the magnets upon the magnetic followers. The tubular member enclosing said rod and sleeve is sealed to an opening in the cell by means of a flexible bellows in such a manner that additional motion may be imparted to the fingers in at least two planes.

Refer now to the drawing, which illustrates one embodiment in which the principles of this invention may be carried out. A central rod 1a extends centrally through the entire unit and terminates in formed tong fingers 1, which extend through a hole in one wall 33 of the cell. Encircling the rod 1a is a guide tube 2, and spaced coaxially therefrom is a closure tube 3. A bushing 4 closes one end of the annulus between the guide tube 2 and closure tube 3, and serves as a bearing for the guide tube 2. A plurality of openings 34 are provided in closure tube 3 adjacent to bushing 4 to provide for movement of air into and out of tube 3 to allow freedom of movement of rod 1a and guide tube 2 within tube 3. The outer end of the closure tube 3 is made airtight by a plug 5 inserted therein. The rod 1a is longer than the guide tube 2 and extends beyond the outer end thereof. A cylindrical soft iron magnet core 6 surrounds, and is attached to, the outer end of rod 1a. A similar core 7 surrounds, and is attached to, the outer end of guide tube 2.

An airtight and yet flexible connection between the closure tube 3 and cell wall 33 is provided by a multiconvolution bellows 9. One end of the bellows is sealed by brazing to an adaptor plate 19 which, in turn, is removably fastened to the cell wall 33. An O-ring 10 provides a seal between plate 19 and wall 33. The other end of the bellows 9 is sealed by brazing to an adaptor ring 18. This ring 18 is removably secured to a terminal plate 17 by screws 26, only one of which is shown. Plate 17 is sealed by brazing to the outer surface of the closure tube 3. A seal between ring 18 and plate 17 is provided by an O-ring 11.

In order to eliminate undue strain on the bellows 9, a gimbal-like structure is provided by a ring 20 surrounding the bellows 9. Ring 20 is supported on four pins 8, two of which, in turn, mate through washers 24 into a pair of blocks 21, only one of which is shown, attached to terminal plate 17 by screws 25. The other two pins 8 mate through washers 24 into a pair of blocks 22, only one of which is shown, attached to adaptor plate 19 by screws 25'. Thus the enclosure tube 3 may be non-rotatably pivoted about a point in the center of ring 20 to provide side-to-side and up-and-down motion, or a combination thereof, of the tong fingers 1.

Rotary and axial motion of the tong fingers 1, as well as opening and closing of the fingers 1, is accomplished by movement of at least a portion or all of four circular magnets 31, 31a and 30, 30a, which encircle the outer extremity of closure tube 3. The magnets 30, 30a are enclosed in a sleeve 12 and restrained therein with a pair of washers 16a, 16b. A plate 13 completes the housing. The magnets 31, 31a are enclosed in a similar sleeve 14 and are restrained therein with washers 15, 16. A repulsive force is applied between the magnet assemblies by a spring 32. The maximum separation of the assemblies is established by a plurality of adjustable in-

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dexing studs 28, only one of which is shown. Studs 28 pass through sleeve member 14 and threadably engage sleeve member 12. Lock nuts 29 are provided to prevent studs 28 from rotating once they have been adjusted to provide the desired spacing between the magnet assemblies.

The magnet assemblies are slidable along the enclosure tube 3 but are prevented from disengagement therewith by a washer 23 releasably secured to the plug 5 by a screw 27. It can be seen in the figure that the maximum spacing between the magnet assemblies is chosen so that they respectively encircle the magnetic core 6 attached to the rod 1a and the magnetic core 7 attached to the guide tube 2. The value of this maximum spacing is chosen to cause the tong rod 1a to be drawn into the guide tube 2 to a maximum distance so as to close fingers 1. The fingers 1 may then be opened by moving the magnet assemblies, and thus the magnetic cores 6, 7 toward each other so as to move the tong rod 1a axially within guide tube 2.

The tong fingers may be moved further into the cell by movement of the entire magnet assembly toward the cell wall 33, and withdrawn by movement of the entire magnet assembly in the reverse direction. The tong fingers may be rotated about the axis of the tong rod 1a by rotating the magnet assemblies about the axis of the closure tube 3. Also, as discussed above, limited up-and-down and side-to-side motion of the tong fingers 1 may be made by movement of the closure tube 3 in those planes. It may thus be seen that the above manipulator may be moved with little limitation without the use of sliding or rotating seals, since the rod 1a, sleeve 2, and the magnetic cores 6, 7 are sealed within closure tube 3 so that the problems of leaks are essentially eliminated.

This invention has been described by way of illustration rather than limitation and it should be apparent that other changes in the arrangement of the various parts of my invention as shown and described may be resorted to without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. An improved remotely operated manipulator for use in an enclosed cell provided with a manipulator opening and containing radioactive materials, comprising an elongated rod provided with fingers on one end, a sleeve shorter than and slidably fitted on said rod, a tubular member enclosing said rod and its sleeve and coaxially spaced therefrom, a bushing positioned in one end of said tubular member, said bushing having a central open-

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ing which acts as a sliding bearing for said sleeve, a plug disposed in the other end of said tubular member, means for supporting and for flexibly sealing said one end of said tubular member within said opening in said cell, said fingers and a portion of said rod and one end of said sleeve extending into said cell, a first magnetic follower affixed to the other end of said rod, a second magnetic follower affixed to the other end of said sleeve, a first sleeve member slidable upon said tubular member, a first permanent magnet disposed in said first sleeve member and positioned in a magnetic coupling relation to said first magnetic follower, a second sleeve member slidable upon said tubular member, a second permanent magnet disposed in said second sleeve member and positioned in a magnetic coupling relation to said second magnetic follower, means for coupling said sleeve members together, said coupling including resilient means disposed between said sleeve members, said resilient means acting in cooperation with said magnetic couplings for urging said sleeve against the base ends of said fingers to hold them closed, said resilient means adapted to be compressed by movement of said sleeve members toward each other to effect relative movement between said rod and sleeve by means of said magnetic couplings to thereby open said fingers, said rod and sleeve being manually movable in unison along the axis and rotatable about the axis of said rod relative to said tubular member by action of said magnets upon said followers to thereby effect movement of said manipulator to a plurality of selected longitudinal and axial positions.

2. The manipulator set forth in claim 1, wherein a third permanent magnet is disposed in said first sleeve member and in a magnetic coupling relation to said first magnetic follower, and a fourth permanent magnet is disposed in said second sleeve member and in a magnetic coupling relation to said second magnetic follower.

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