Aug. 28, 1956 H. E. FOSKUHL 2,760,655

REMOTE HANDLING APPARATUS

Filed April 28, 1955

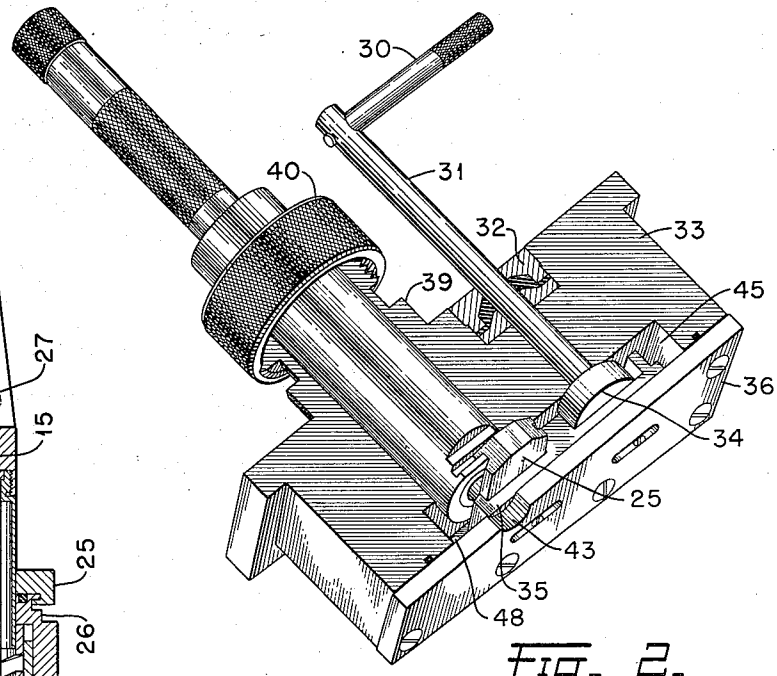


FIG. 2.

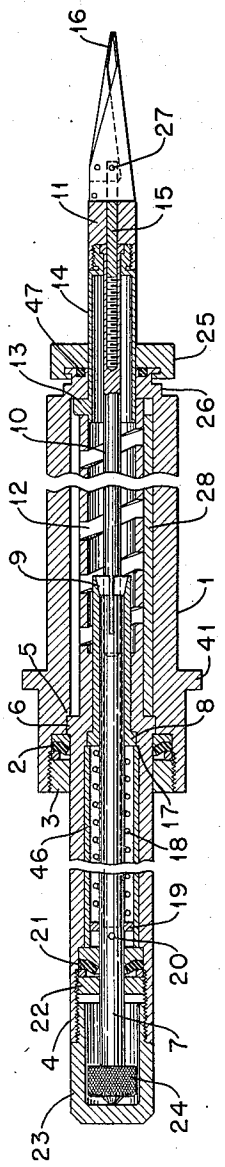


FIG. 1.

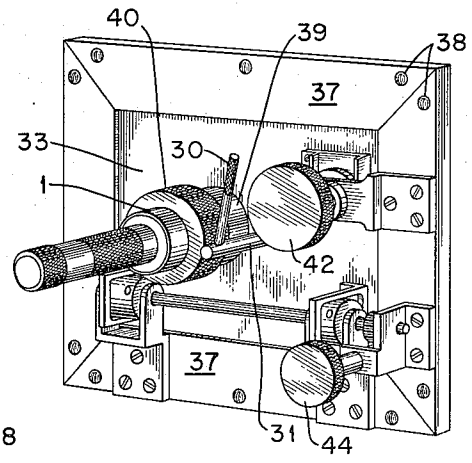


FIG. 3.

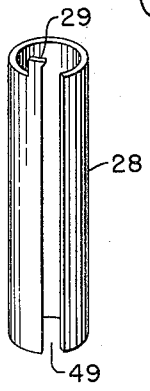


FIG. 4.

INVENTOR.

BY Henry E. Foskuhl

Roland A. Anderson

ATTORNEY

United States Patent Office 2,760,655 Patented Aug. 28, 1956

2,760,655

REMOTE HANDLING APPARATUS

Henry E. Foskuhl, Waynesville, Ohio, assignor to the United States of America as represented by the United States Atomic Energy Commission

Application April 28, 1955, Serial No. 504,695

5 Claims. (Cl. 214—17)

The present invention relates to remote control handling, and more especially to special equipment for performing operations of the type where the material to be handled must be closely confined, protected by an inert atmosphere, or where an object must be inserted into a vacuum system without breaking the vacuum. The invention is especially useful in transporting radioactive sample materials from one closed system to another closed system without the human operator touching the sample, without allowing the escape of dangerous particles from the sample, and without exposing the operator to dangerous radiations given off by the sample.

In the performance of certain assay operations, radioactive foils must be transferred from a plating bath where they receive the active material to a microbalance for weighing. The foils are so highly radioactive that the complete transfer must be accomplished within a gas and radiation-tight chamber to prevent the spread of contamination as the foils are transported from one place to another. Moreover, adequate radiation shielding must be provided so that a human operator can carry the foils from place to place. Since certain operations must be performed inside vacuum chambers, means must be provided for inserting a foil into a chamber and removing it without breaking the vacuum, and also without allowing the external surfaces of the vacuum chamber to become contaminated from contact with or exposure to radiation from the foils. In addition, certain operations require that the foil be moved from place to place within the enclosed chamber and be rotated through 180° to allow counting of both foil surfaces.

Other operations, not involving radioactivity, require that certain chemically active substances be shielded from air or from moisture during transport from one place to another, and that means be provided for inserting and withdrawing such substances from gas-tight vessels without dangerous exposure of the substance. Still other operations require replacement of small parts within a vacuum system, such as that of a mass spectrometer or a high pressure nuclear radiation counter, without loss of pressure or vacuum due to the insertion or removal of the part to be replaced.

Accordingly, it is a primary object of applicant's invention to provide improved means for withdrawing, transporting, and inserting objects from one closed system into another closed system. A further object of the invention is to provide a novel sample carrier for transporting a substance in a gas-tight sealed carrier between the two closed systems. Yet another object of the invention is to provide novel fittings for vacuum systems including a detachable portion which may be transported from a first system to a second system and inserted into a corresponding fitting member on the second system, together with means for insertion of the substance carried into the second system and manipulation of the substance therein. Other objects and advantages of the invention will become apparent in the following detailed description of a preferred embodiment thereof, when read in conjunction with the appended drawings, in which:

Figure 1 illustrates the detachable portion of my novel apparatus removed from its normal position for clarity.

Figure 2 illustrates, in partial section, the fitting including the detachable portion;

Figure 3 illustrates a front view of the mechanism of the invention as it is attached to a closed vacuum system, and

Figure 4 shows a sleeve forming an integral part of the sub-assembly of Figure 1.

According to the invention, extendable forceps are provided inside the body of a detachable carrier which forms a vacuum tight seal with a mounting block member. The block member in turn is mounted on a wall of the system to be served and communicates with the interior of the system through an aperture which registers with an axial aperture in the carrier. A cam is provided with a cam follower which grasps the end cap of the carrier and slides it to one side responsive to cam movement to expose the axial carrier aperture to the registering aperture in the block. Means are provided for extending the forceps from inside the carrier through the block aperture into the closed system and for rotating the forceps therein.

Referring first to Figure 3, a typical installation of one embodiment of the invention on the wall of a closed, vacuum type vessel is illustrated. Suitable knobs **42**, **44** and their respective associated gearing are shown for moving the block **33** up and down and right and left, respectively, within the limits of frame **37**. Block **33** is inserted into an aperture in the wall of the closed vessel so that the shoulders of the block abut against the external wall face. A suitable frame **37**, having thin inner edges and thicker outer edges surrounds the block and clamps it vacuum-tight against the vessel wall by means of screws **38**, which fasten to the wall. A raised boss portion **39** receives the carrier **1** and a knurled, threaded and gasketed cap **40** fits over a flange **41** on the carrier and the correspondingly threaded boss portion **39** to form a gas-tight seal. Arm **31** and handle **30** extend outward from the face of block **33** through Wilson seal **32** for easy operation of the cam **34**, as shown in Figure 2.

In the sectional view of Figure 2, the block **33** is secured to a plate **36** by countersunk, flat-head screws, a ring gasket being provided to insure a vacuum-tight seal. The plate is provided with an entrance aperture **43** registering with the axis of a bore through boss **39** and the block **33**. A channel **45** in the front face of the block receives the sliding gate **35** and also the cam **34**. The cam is mounted on arm **31**, which extends out through a bore in the block **33** and a Wilson seal **32** and terminates in a handle **30**. When the body of carrier **1** is inserted as shown, the end cap **25** fits in a first of two parallel slots formed in the inner surface of a rectangular, sliding gate **35**. Two leaf springs, not shown, are placed between the gate and the top of recess **45**, so that a vacuum-tight, sliding seal is obtained between the gate and plate **36**. Movement of the handle **30** will rotate arm **31** and cam **34**, sliding gate **35** to the right in the figure, pulling cap **25** across the face of the carrier and exposing the center aperture or mouth which registers with the corresponding opening **43** in the plate **36**. It is apparent that boss **39** could take the form of a counterbore in block **33** to receive the closure member **40**, but the boss supports the member **40** where it can be grasped readily. A port **48** is provided near the corner of recess **45**, and is connected through a flexible metal tubing to an auxiliary vacuum and gas supply system.

Referring now to Figure 1, the sample carrier may comprise a body member **1** of preferably tubular configuration, counterbored at one end to receive a Wilson seal **2**

which is compressed by threaded plug 3. A flanged, tubular forceps positioner 4 extends co-axially inside of the body member 1, with the flange 6 having one surface abutting against a shoulder 5 within the body and the opposite surface contacting the Wilson seal 2 to form a radiation-tight seal between the body and the external surface of the positioner.

Hollow clutch rod 7 is disposed axially within the positioner 4 and is provided at its forward end with a collet clutch 9. Flanged sleeve 8, which has its forward end tapered to receive the collet, fits snugly around the forward section of rod 7 and moves therewith. A forceps operating rod 10, of smaller diameter than rod 7, is disposed with its rear portion extending through the collet into the hollow center of the rod 7. Its forward section is flanged to seat in the counterbored neck portion of sleeve 14, the neck being externally threaded to engage a correspondingly threaded recess in plug 11. The forward end of positioner 4 is provided with helical grooves 12 which engage a lug 13 on the rear end of sleeve 14. A rod 15 has its rear section threaded to engage a correspondingly threaded section of the bore of operating rod 10, while the forward section extends through an axial bore in plug 11 and is pinned by pin 27 to a pair of forceps 16, which are mounted on the reduced outer end portion of plug 11.

Within the rear portion of positioner 4, a sleeve 46 is provided between the shoulder 17 of the positioner and the rear of a flange on the sleeve 8. Clutch spring 18 abuts at one end against the rear of that flange on sleeve 8 and at the other end against retainer 19, which is restrained from lateral movement by a pin 20 which passes through rod 7. A Wilson seal 21 is provided at the end of sleeve 46 and is compressed by externally threaded nut 22 which engages the inner threaded end portion of positioner 4. End cap 23 also engages the threaded portion of positioner 4 and may be removed to expose the knurled knob 24, which is fitted to the end of rod 7. The inner end of the body 1 is also provided with a notched neck portion 26 which receives the correspondingly notched end cap 25. An O-ring gasket 47 surrounds the mouth of the notched portion 26 to form a gas and radiation-tight seal with cap 25. Figure 4 shows slotted sleeve 28, the longitudinal slot 49 appearing above the helical grooves 12 in Figure 1. Lug 29 on sleeve 28 is hidden behind lug 13 in Figure 1. In operation, when forceps 16 are extended by rotating positioner 4, lug 13 travels along groove 12 and slot 49 until it contacts lug 29. Continued rotation allows the forceps to rotate in the fully extended position as lug 13 rides on the end of sleeve 28, rotating the sleeve also. If positioner 4 is rotated in the opposite direction, lug 13 rides on the end of sleeve 28 until it contacts lug 29. Then lug 29 guides lug 13 into groove 12 so that further rotation will withdraw the forceps.

For an example of operation of my invention, suppose mounting block 33 is suitably fastened to one wall of a closed, inert-gas filled system to be entered. A substance to be transported, such as a foil, is held tightly by the forceps 16 which are fully retracted inside the inert-gas filled carrier, and the end plate 25 is in place across the carrier mouth, thereby forming an effective gas-tight seal. The carrier 1 is inserted into the proper opening in the mounting block 33 and positioned so that the end cap is seated in a groove in the cam follower, or gate 35, which covers the sample aperture of the closed system. The gasketed coupling nut 40 is put on the threaded boss and carrier and tightened to obtain a vacuum-tight seal between the carrier and the mounting block at the only point of exit to the atmosphere. Air trapped in recess 45 may be removed through port 48, which is connected to an external vacuum system. Then the port is connected to a supply of inert gas to fill the recess before aperture 43 is unsealed. The handle 30 which rotates the cam 34 and moves the gate 35 is then rotated to the open position, sliding the end cap 25 sideways to uncover the sample port 43 and the mouth of the carrier to expose the inner chamber. The handle portion 4 of the carrier is then rotated, moving lug 13 along groove 12, moving forceps 16 and the foil carried thereby to the right, into the closed system. After the forceps are fully extended, additional rotation of the handle 4 will rotate the foil and forceps as desired, as is described in connection with Figure 4. When the foil is to be released, the end cap 23 is unscrewed and removed, exposing a knob 24 which, when rotated, will open the forceps which grip the foil. When the cap 23 is in place, the knob is disengaged from the forceps by the collet clutch arrangement which automatically engages when the cap is removed. Thus it may be seen that, when the cap is in place over the knob, there is no danger of opening the forceps inadvertently and dropping the substance carried thereby. Yet the forceps map be opened readily, merely by removing the protective cap and turning the suitable knob.

For another example, suppose that an object is to be picked up inside a closed evacuated system to which a mounting block 33 is fitted. The carrier is inserted into the block and the nut 40 put on boss 39. The cam 34 may be rotated sufficiently to unseal the mouth of the sample carrier, while not unsealing the aperture 43. The sample carrier and the recess 45 are evacuated through port 48, then cam 34 is rotated further to open aperture 43. The forceps may be extended into the closed vessel without increasing the pressure within the vessel since the entire system has been evacuated. The object may be grasped by rotating knob 24 in the opposite direction to close the forceps. Then cap 23 is returned to positioner 4, and screwed into place, urging knob 24 and rod 7 inward against the tension of spring 18, releasing the collet clutch 9 from sleeve 8 and disengaging the forceps operator 10 from the rod 7. Then there will be no further danger of opening the forceps accidentally. Positioner 4 is then rotated in the opposite direction, rotating the lug 13 through the helical grooves 12 to the left in the drawing, withdrawing the forceps through the mouth of neck 26 into the body of the carrier until the end of the object carried lies within the carrier body. Then end cap 25 is slid across the end face of the carrier body by means of the gate 35, cam 34, rod 31, and handle 30 to seal the aperture 43 through which the mechanism extended. The carrier body may be filled with inert gas, if desired, through port 48, and then the cam 34 is rotated further to seal the carrier with cap 25. The sliding gate forms an excellent, metal-to-metal gas and radiation-tight seal between the plate 36 and the end cap 25, while the cap 25 seals off the carrier mouth.

The sample may then be carried automatically or manually to a receiving apparatus, the carrier inserted in the proper block 33, the sealing cap 40 put in place, and the appropriate handle 30 turned to move the end cap away from the mouth of carrier 1. Positioner 4 may be rotated to extend the forceps holding the sample out of the seal chamber and into the receiving apparatus.

Thus it will be apparent to those skilled in the art that a most useful remote control system for handling and transporting radioactive materials, or materials which must be protected by an inert atmosphere, or the like, has been provided. It is apparent that the forceps 16 may take other configurations for grasping curved objects, if desired. Other uses of the disclosed apparatus will be readily apparent to those skilled in the art, and the foregoing description of the apparatus with relation to transporting a radioactive foil is intended in a descriptive sense, and not by way of limitation.

Having described my invention, what is claimed as novel is:

1. Means for entering one or more closed vessels without loss of vacuum comprising loading blocks mounted in vacuum-tight relation in each vessel to be entered, said blocks each being provided with a recessed portion near

its inner face, a normally closed aperture in said face communicating with said recess, and a passageway from the outer face to said recess and aligned with said aperture; a detachable member having a hollow body portion disposed within said passageway, a moveable cap at the inner end of said body, a handle, and axially extendable forceps mounted within said handle; a closure member engaging said body and said block for sealing said passageway; means for opening said aperture to said recess; means for removing said cap to expose said hollow body to said apertures; and means for extending and manipulating forceps through said aperture into said vessel.

2. Means for entering a closed vessel through one wall thereof comprising a loading block mounted in said wall and provided with an aperture in its inner face, a recess in the inner portion communicating with said aperture, a boss portion, and a passageway between said boss and said recess and aligned with said aperture; a rectangular gate provided with first and second parallel slots in its inner face slidably mounted in said recess and adapted to seal said aperture in its normal position; an eccentric cam disposed in said first slot of said gate and provided with a shaft extending externally of said block for cam rotation, said rotation sliding said gate to uncover said aperture; a detachable member having a hollow body portion disposed within said passageway, a removable cap, and a handle portion, said cap being disposed in said second slot and moveable thereby; a detachable closure member disposed about said boss and said body for sealing said body and passageway from the external atmosphere; said carrier member being provided with forceps and means for extending and retracting said forceps axially thereof through said aligned block aperture into said vessel.

3. A device according to claim 2 wherein said loading block inner face comprises an apertured plate secured to the recessed end of said block and wherein said rectangular slidable gate is provided with a central portion between said slots contacting the end wall of said recess and an outer surface portion forming a metal-to-metal seal with said plate to effectively seal said aperture.

4. A device of the character described comprising a hollow body portion; a hollow positioner rotatably mounted axially of said body and extending from the rear thereof, the front portion of said positioner being provided with a helical groove; a longitudinally moveable

operating rod disposed coaxially within said grooved portion and carrying a collet thereon; a front rod carried by the forward end of said operating rod; a hollow clutch rod adapted to receive said operating rod therein; a sleeve carrying a lug which engages said groove and adapted to extend axially from the forward end of said body; a plug carried by the forward end of said sleeve and provided with an axial passage for said front rod; forceps carried by the forward portion of said plug and provided with a hinge pin extending through said front rod; a flanged clutch sleeve disposed coaxially about said clutch rod and provided with a tapered forward end to receive said collet and lock said clutch and operating rods together; a spring disposed about said clutch rod and bearing against the rear flange on said clutch sleeve; an annular spring retainer disposed about said clutch rod; a pin through said clutch rod rearward of said retainer, whereby said clutch rod is urged rearward, an end cap detachably coupled to said positioner and contacting the rear end of said clutch rod to prevent rearward motion thereof; means for sealing said positioner within said body while permitting rotational motion; means for sealing said clutch rod within said positioner while permitting rotational motion; and a detachable closure member adapted to seal the forward end of said body member.

5. In a device of the character described, a hollow body member provided with a mouth at its forward end; a hollow positioner having a forward internally threaded portion disposed coaxially within said body and a rear handle portion; means for sealing said body and positioner while permitting relative rotational motion; a sleeve member carrying at one end two forceps members and at the opposite end a lug adopted to engage said threaded portion to move the sleeve axially within the positioner responsive to rotation of the positioner handle; a forceps operating rod disposed along the axis of said sleeve and fastened to said forceps to move with said sleeve; a collet clutch fixed to said rod; a clutch sleeve to receive and close said collet disposed coaxially within said positioner handle; means normally urging said collet rearward into said sleeve, and a cap over the rear end of said rod engaging said positioner and urging said rod forward to prevent engagement of said clutch.

No references cited.