Oct. 18, 1966 M. AUBERT ET AL 3,279,627

REFUELLING DEVICE FOR NUCLEAR REACTORS

Filed July 14, 1964 2 Sheets-Sheet 1

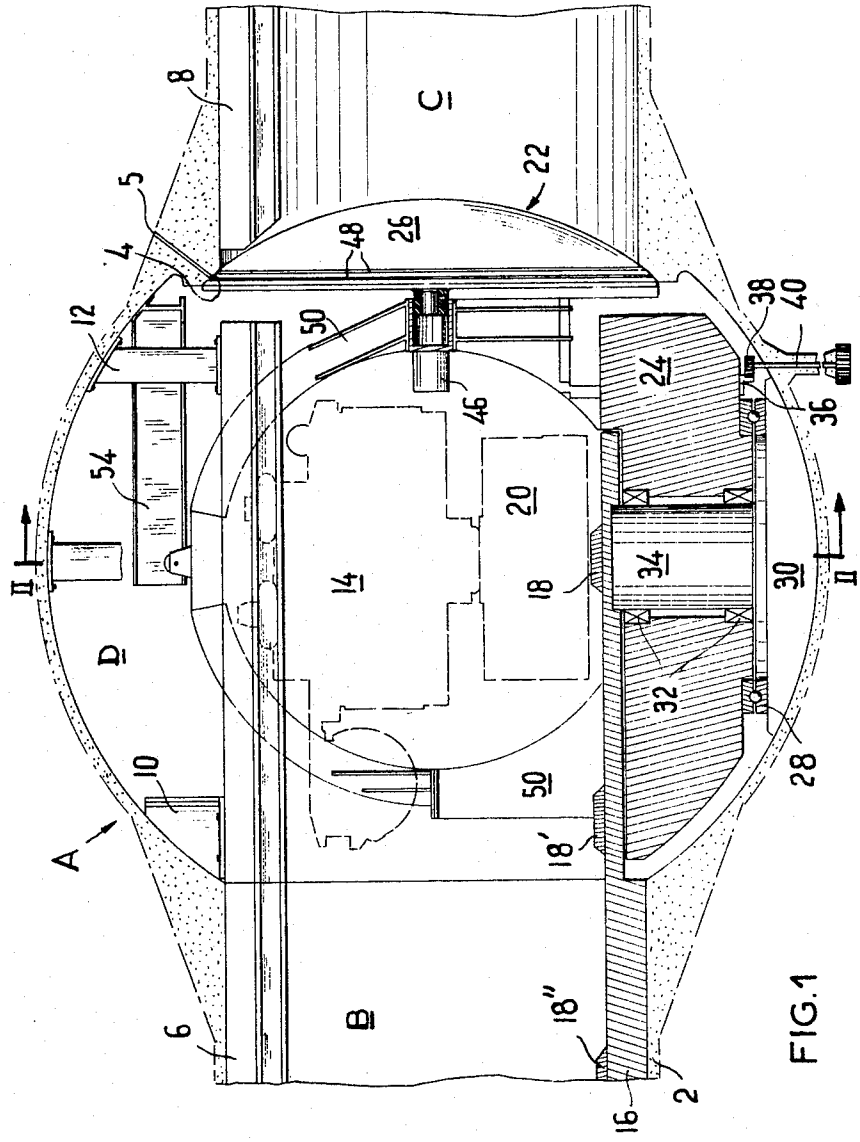


FIG.1

Oct. 18, 1966 M. AUBERT ETAL 3,279,627

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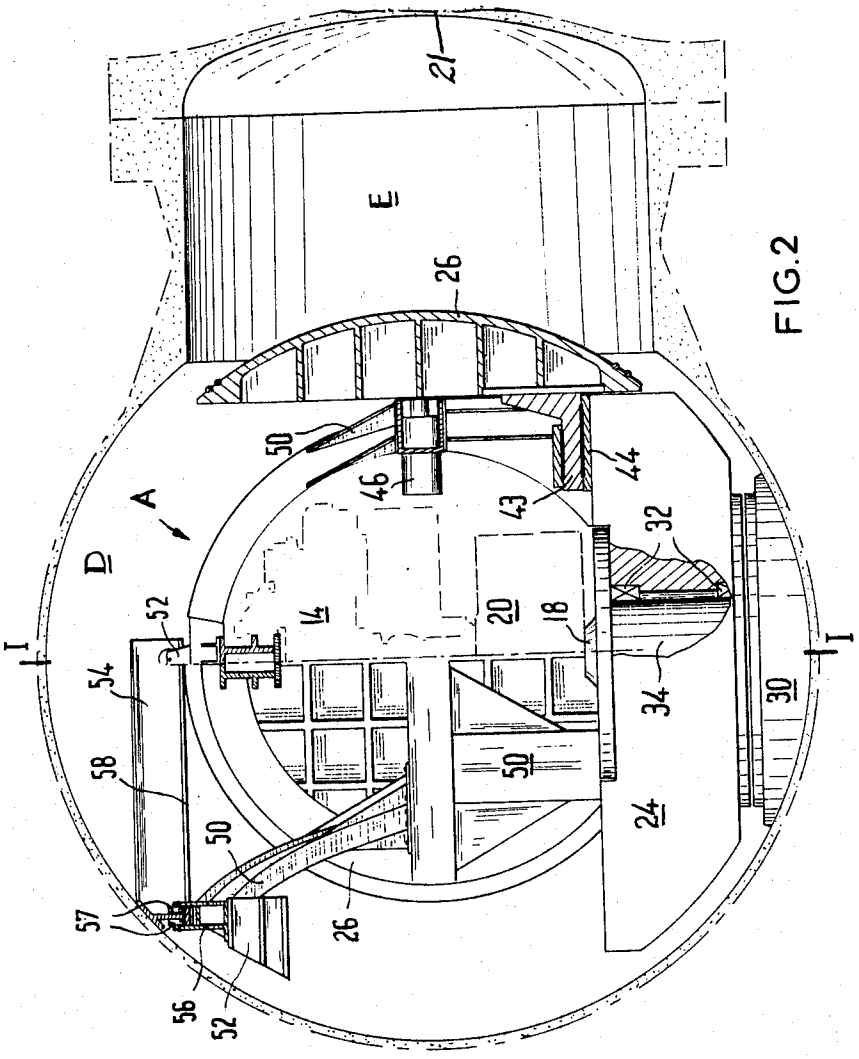


FIG.2

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REFUELLING DEVICE FOR NUCLEAR REACTORS

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5 Claims. (Cl. 214—18)

The present invention relates to a refuelling device for nuclear reactors which is applicable especially to gas-cooled solid moderator reactors, the chief aim of this invention being to provide improvements in certain arrangements described in U.S. Patent No. 3,196,802.

The main patent describes a fuelling device for gas-cooled nuclear reactors of the type comprising a moderator structure through which are formed channels for accommodating fuel elements, said device comprising a handling system which is placed within the reactor containment shielding inside a compartment which is separated from the core chamber by a wall pierced with obturable openings for providing access to the channels, a system for the insertion and withdrawal of fuel element magazines into and out of said compartment, said handling system being provided with means for effecting a transfer of fuel elements between a magazine and a channel, said device being characterized by a storage system disposed within the compartment and comprising a number of magazine storage stations which is greater than the number of magazines which are inserted or withdrawn simultaneously by the inserting system and by means which are fitted on the handling system and which serve to take and deposit said magazines at a station of the storage system.

The device which has just been described will be referred-to hereinafter as being "of the above-mentioned type."

The system for the insertion and withdrawal into and out of the servicing chamber of the device of the above-mentioned type comprises a lock-chamber disposed within a horizontal tunnel which provides access to the servicing chamber and which separates this latter from those portions of the system which are maintained at atmospheric pressure.

In the lock-chamber which was illustrated in FIGS. 2 and 5 of the main patent, provision was made for doors which each consisted of a flap having the shape of a segment of sphere and swingable on horizontal pivot-pins at right angles to the axis of the tunnel between a position in which the flap was brought against a stationary bearing surface formed within the tunnel, and a position in which it was withdrawn from said bearing surface, and for jacks which were designed to apply the flap against the bearing surface.

In order to permit the possibility of transferring a manipulator for emergency-servicing of the equipments contained within the servicing chamber, the tunnel was provided with a rail along which said manipulator could travel and which was interrupted at the level of the bearing surface and each flap was fitted with a rail segment which served to bridge the gap in the rail when the flap was in the open position; this solution did have the merit of simplicity but this was offset by the need to apply the manipulator on a portion of rail which formed a cantilevered extension with respect to the axis of the flap at the time of its transfer, the correlative appearance of high pivoting moments in the flap and the need for a substantial breach in the rail to allow the flap to pass.

The invention is directed to the design of a door which

does not have the disadvantages noted above. To this end, the invention proposes a device of the above-mentioned type which comprises, within a tunnel of the insertion system in which a seating having a horizontal axis is formed in the tunnel wall, a rail carried by said wall and having a break at the level of said seating, a rotary system consisting of a base-plate which is rotatably mounted on a vertical pivot supported by the bottom portion of the tunnel wall and a flap which is capable of being applied against the seating, means for causing the moving system to perform a movement of rotation about the pivot between a closed position in which the flap meets the seating and an open position in which said flap is moved away from said seating, a rail segment secured to the base-plate and adapted to span the gap in the rail which is secured to the tunnel wall when the flap is in the open position, and means for guiding the rail segment which are secured to the tunnel wall and so arranged as to support said rail segment at least when the moving system is in the open position.

In a preferred form of embodiment, the flap is provided together with the base-plate with a coupling which is adapted to slide in the direction at right angles to the axis of rotation and means such as jacks are provided for the purpose of displacing the flap with respect to the base-plate between a position in which, in the closed orientation, a clearance is left between said flap and its seating and a position in which said flap is applied against said seating.

The base-plate is advantageously fitted with a counterpoise which is designed to balance the weight of the flap so as to prevent the moving system from applying a bending moment on the pivot. As seen in FIG. 1, this counterpoise is formed by an excess of weight of the base plate opposite the flap by making the base plate unsymmetrical.

The invention also consists of a certain number of arrangements which can usefully be employed in conjunction with the preceding but can also be employed independently thereof. The invention will be more readily understood from a perusal of the following description, reference being made to the accompanying drawings in which one form of embodiment of the invention is given by way of example without implied limitation. In the drawings:

FIG. 1 shows a lock-chamber door in accordance with the invention in cross-section taken along the plane of symmetry of the lock-chamber, the components being shown in the position which they occupy when the lock-chamber door is closed;

FIG. 2 shows the lock-chamber door in cross-section taken along the line II—II of FIG. 1, the left-hand portion showing the door in the closed position and the right-hand portion showing the door in the open position.

The lock-chamber door A which is shown in FIGS. 1 and 2 is intended to be mounted in the access tunnel to the servicing chamber of a nuclear reactor refueling facility of the type described in the main patent. Said door is designed for the purpose of separating the section of tunnel which constitutes the lock-chamber B from the tunnel section C which is continuously maintained at atmospheric pressure.

The tunnel is formed within a concrete biologicad shield structure and is preferably delimited by a leak-tight lining membrane which has not been shown in the drawings. The tunnel section which has been represented consists of a substantially cylindrical portion which forms part of the lock-chamber B, a hemi-spherical portion D which is occupied by the door and the commencement of the tunnel section C. Between the compartment D and the tunnel section C, there is formed in the wall a seating

4 having the shape of a spherical cup in whics the flap is intended to fit. A suction duct 5 provided within the shield structure serves to recover leakage from the lock-chamber towards the tunnel section C.

There is secured to the top wall of the tunnel a rail (as shown in FIG. 1) which consists of two segments 6 and 8 separated by a gap having a length which is just sufficient for the purpose of permitting the passage of the door-sealing flap. The rail serves for the displacement of either an emergency-servicing machine or the handling machine 14, the outline of which is shown in broken lines in FIG. 1 and in the right-hand portion of FIG. 2. The rail segment 8 is directly secured to the wall of tunnel section C. The terminal portion of the rail segment 6 which projects from the compartment D is attached to the top wall of this latter by means of members such as a right-angle bracket 10 and a tie-beam 12 (as shown in FIG. 1), thereby preventing any overhang.

The floor of the lock-chamber B is formed by a slab 16 which is extended into the compartment D by a plate having a semi-circular extremity. The said slab is provided with a certain number of frusto-pyramidal centering bosses 18, 18', 18'' which constitute receiving stations for the fuel element magazines which are intended to be transferred between the lock-chamber B and the tunnel section C. One of the said fuel element magazines 20 is shown diagrammatically in FIGS. 1 and 2 in the position in which it is coupled to the handling machine 14.

A conduit E (as shown in FIG. 2), which is designed to provide access to the lock-chamber door so as to permit either disassembly or repair of this latter and which is normally closed by a sealing cover 21, has its opening in the compartment D at right angles to the lock-chamber B and the tunnel section C.

The door-rotating system which is generally designated by the reference 22 essentially consists of a base-plate 24 which is supported by a vertical thrustbearing and of a flap 26.

The bearing means on which the base-plate 24 is carried consists of a thrust-bearing 28 which transmits the weight of the moving system to a footing-block 30 which is secured to the wall of compartment D (as shown in FIG. 1) and of centering bearings 32 which couple the base-plate to a pivot 35 (as shown in FIGS. 1 and 2). The pivot 34 is fixed on the footing-block 30 and transmits to this latter the pressures which are exerted on the cantilevered terminal portion of the slab 16 which bears on said pivot.

The rotary motion of the base-plate 24 on the thrust-bearing is carried out by means of any suitable mechanism which is operated from the exterior of the tunnel. By way of example, FIG. 1 shows diagrammatically a toothed ring 36 which is supported by the base-plate and which engages with a pinion 38. Said pinion is driven by a rotary shaft 40 which passes in leak-tight manner through the outer casing of compartment D.

The flap 26 which is shown in elevation in FIG. 1 and in cross-section in the right-hand portion of FIG. 2 is slidably mounted on the base-plate 24. To this end, the flap is fitted with a frame provided with extensions 43 which are adapted to roll on balls provided for this purpose, within guides 44 of the base-plate (as shown in FIG. 2).

The flap 26 is operated by double-acting jacks 46 which are shown diagrammatically in FIG. 1 and in the right-hand portion of FIG. 2. Said jacks serve to displace the flap 26 relatively to the base-plate between a forward position in which it is shown in FIG. 1 and a rear position. When the moving system is in the closed orientation and the flap is in the forward position, O-ring seals 48, which are fitted on the front face of the flap which has the shape of a spherical cap are applied against the seating 4 on each side of the duct 5. In the rear position, the flap is released from the seating and the moving system can accordingly be driven in rotation.

A support brace 50 provides a rigid coupling between the base-plate 24 and a rail segment 52 (as shown in FIG. 2) which is intended to bridge the gap between the segments 6 and 8 when the moving system is in the open position. During the displacement of the moving system from the closed orientation (left-hand portion of FIG. 2) to the open orientation (right-hand portion of FIG. 2), the rail segment 52 is guided and supported by a roller track 54 having the shape of a circular arc which is developed through an angle of 90°. In the form of embodiment which has been shown in the drawings, the rail segment 52 is fitted with a yoke 56 in which are rotatably mounted two rollers 57 which are adapted to run on the flanges 58 of the roller track 54.

As a rule, the rail segment 52 does not necessarily have to be supported along its entire length by the roller track and it is merely necessary to ensure that the rail is supported in that orientation in which it spans the gap between the rail segments 6 and 8. It is in fact only in this latter orientation that the said rail segment 52 is subjected (at the time of passage of the manipulator) to stresses which must be transmitted directly to the wall of compartment D by the roller track 54 and not to the base-plate 24 on which they apply a pivoting moment.

The operation of the lock-chamber door during a transfer operation has been clearly brought out by the foregoing and will therefore be described only very briefly. It being assumed that the door is closed (which is the position shown in FIG. 1) and that the lock-chamber B is occupied by fuel element magazines, the sequence of discharge operations is as follows: the door which separates the lock-chamber from the servicing chamber and which is similar to the door shown in FIGS. 1 and 2 is closed. The lock-chamber is put under the same pressure as the servicing chamber by means of conduits which have not been shown in the drawings. The jacks 46 of the door which separates the lock-chamber from the servicing chamber are actuated so as to displace the corresponding flap 26 from its seating 4 and to bring said flap into the rear position.

The rotary drive to the moving system is set into operation so as to cause this latter to turn through an angle of 90° and bring it from the position in which it is shown in FIG. 1 to the position shown in the right-hand portion of FIG. 2.

The lock-chamber is then in communication with the servicing chamber and the gap between the corresponding rail segments 6 and 8 is closed by rail segment 52. It is then possible to carry out the transfer of the magazines 20 from their storage stations to the servicing chamber.

In the event of a breakdown occurring, it is also possible to move a manipulator 14 from the tunnel C into the lock-chamber by causing it to roll successively along the rail segment 8, the rail segment 52 and the segment 6, then from the lock-chamber into the servicing chamber.

The foregoing description shows that the door in accordance with the invention provides the advantages which have been defined at the beginning of this specification, inasmuch as the pivot is not subjected to any bending moment both during operation of the door and at the time of passage of the manipulator. The gap in the rail on which the manipulator is intended to travel has a length which is reduced to a minimum. Moreover, the moving system as a whole rests on a thrust-bearing pivot of large size, thereby ensuring a high degree of stability. Finally, the elimination of balancing problems avoids the need of a system for locking the door in the open position since the passing of the manipulator is not liable to produce a pivotal movement of the moving system.

Aside from the mechanical advantages which are provided, it should be noted that a magazine storage station (boss 18) can be provided actually in the axis of the compartment 22 which, for a given number of storage

stations, makes it possible to reduce the length of the lock-chamber.

It will be readily apparent that the invention is not limited to the form of embodiment which has been given solely by way of example and it will furthur be understood that the scope of this patent extends to any device or arrangment which is mechanically equivalent to that which has been described.

What we claim is:

1. Refueling device for nuclear reactors having a tunnel for the insertion system and a seating having a horizontal axis formed in the tunnel wall comprising a longitudinal rail carried by the tunnel wall, a break in said rail at the level of the seating, a rotary system including a base plate, a vertical pivot supported by the bottom portion of the tunnel wall rotatably mounting said base plate and a flap on said base plate applied against the seating, means for causing said rotary system to rotate about said pivot between a closed position in which said flap is applied on the seating and an open position in which said flap is spaced from the seating, a rail segment secured to said base plate spanning the break in said rail when said flap is in open position and means secured to the tunnel wall for guiding said rail segment and so arranged as to support said rail segment at least when said rotary system is in open position.

2. Device as described in claim 1 wherein said guiding means consists of a semi-circular roller track having an angular development on the order of 90° and secured to the top portion of the tunnel wall.

3. Device as described in claim 2 including rolling members on said rail segment adapted to roll on said roller track.

4. Device as described in claim 1 including means for coupling said flap and said base plate with a sliding motion in a direction at right angles to the axis of rotation of said rotary system and means for displacing said flap with respect to said base plate between a position having a clearance between said flap and the seating and a position in which said flap is applied against the seating.

5. Device as described in claim 1 including a counterpoise for said base plate balancing the weight of said flap.

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