United States Patent [19]

Jones

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[54] **ELEVATOR FOR A REACTOR WELL AND EQUIPMENT STORAGE AREA**

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[21] Appl. No.: **133,687**

[52] **U.S. Cl.** **187/17,** 182/37, 182/144

[51] **Int. Cl.** **B66b 11/04**

[58] **Field of Search** 187/17, 20–23, 187/27; 104/89, 122; 176/30–32, 27, 28; 182/142, 144, 37; 92/137; 212/18

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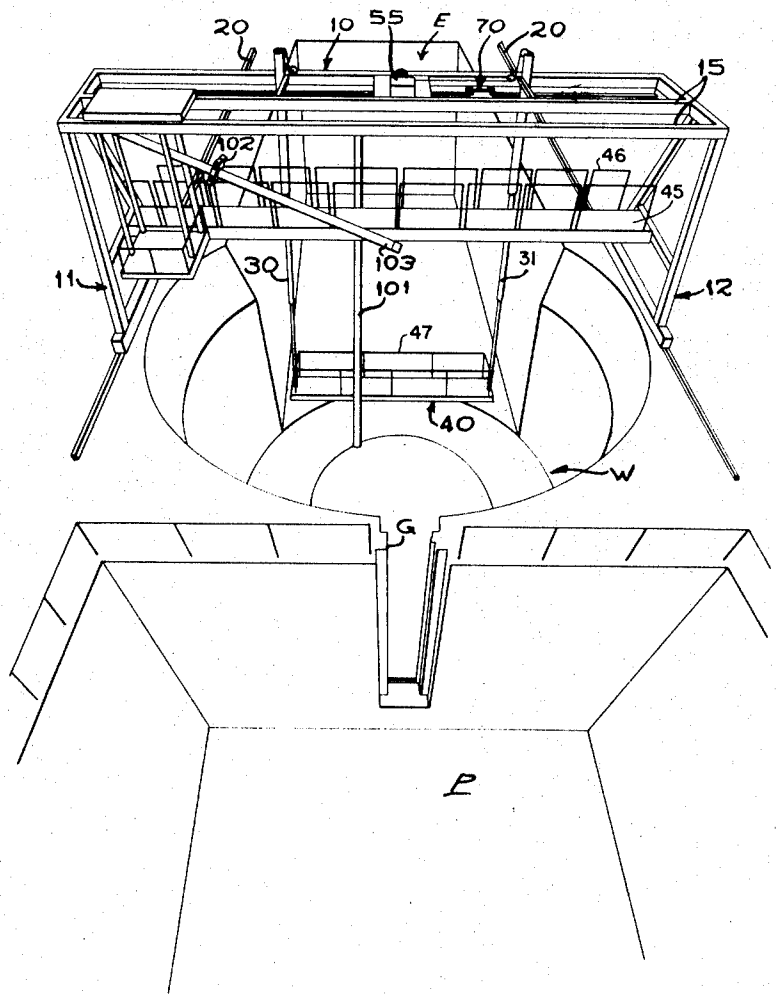
[57] **ABSTRACT**

An elevator for a reactor well and an equipment storage area wherein a service platform is raised and lowered within the reactor well and adjoining area for performing operations within the reactor well and the equipment storage area. Toward this end, stationary tubes are suspended in fixed relation from an overhead support. Telescopically received by the stationary tubes are movable, upright tubes. Fixed to the lower ends of the movable tubes for rectilinear movement therewith is the service platform. A lifting and lowering device, such as a cable and drum arrangement or a hydraulically actuated system, is mounted on the overhead support. The cables extend into the stationary tubes and are attached at their free ends to the movable tubes for raising and lowering the same, thereby raising and lowering the service platform. The movable tubes are spaced apart a distance slightly greater than the diameter of a reactor pressure vessel in the reactor well and a space is provided between the service platform and the adjacent superstructure of the refueling platform for the passage of equipment therebetween.

9 Claims, 7 Drawing Figures



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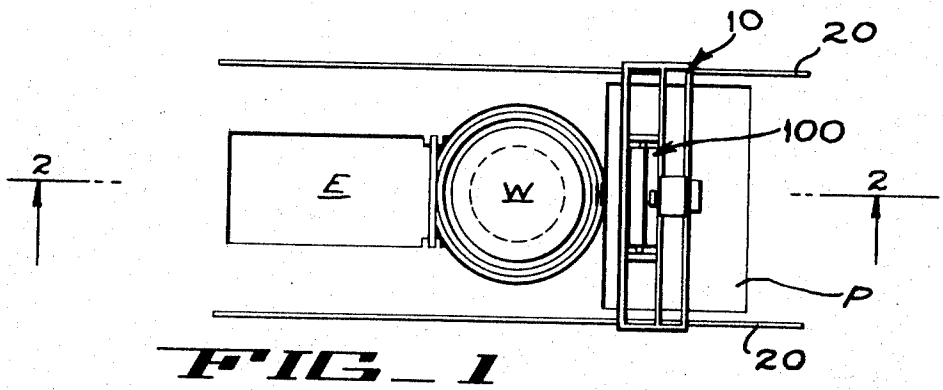

FIG_1

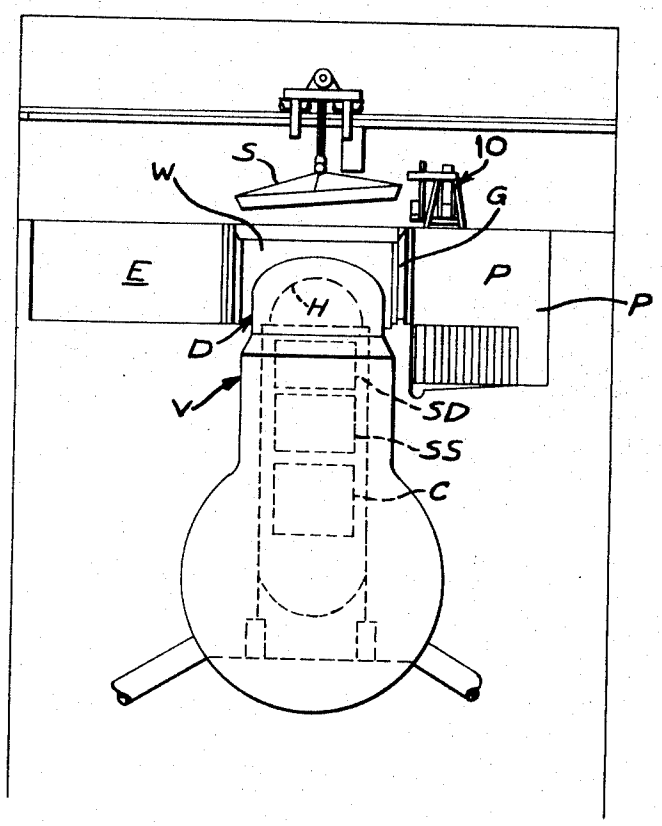

FIG_2

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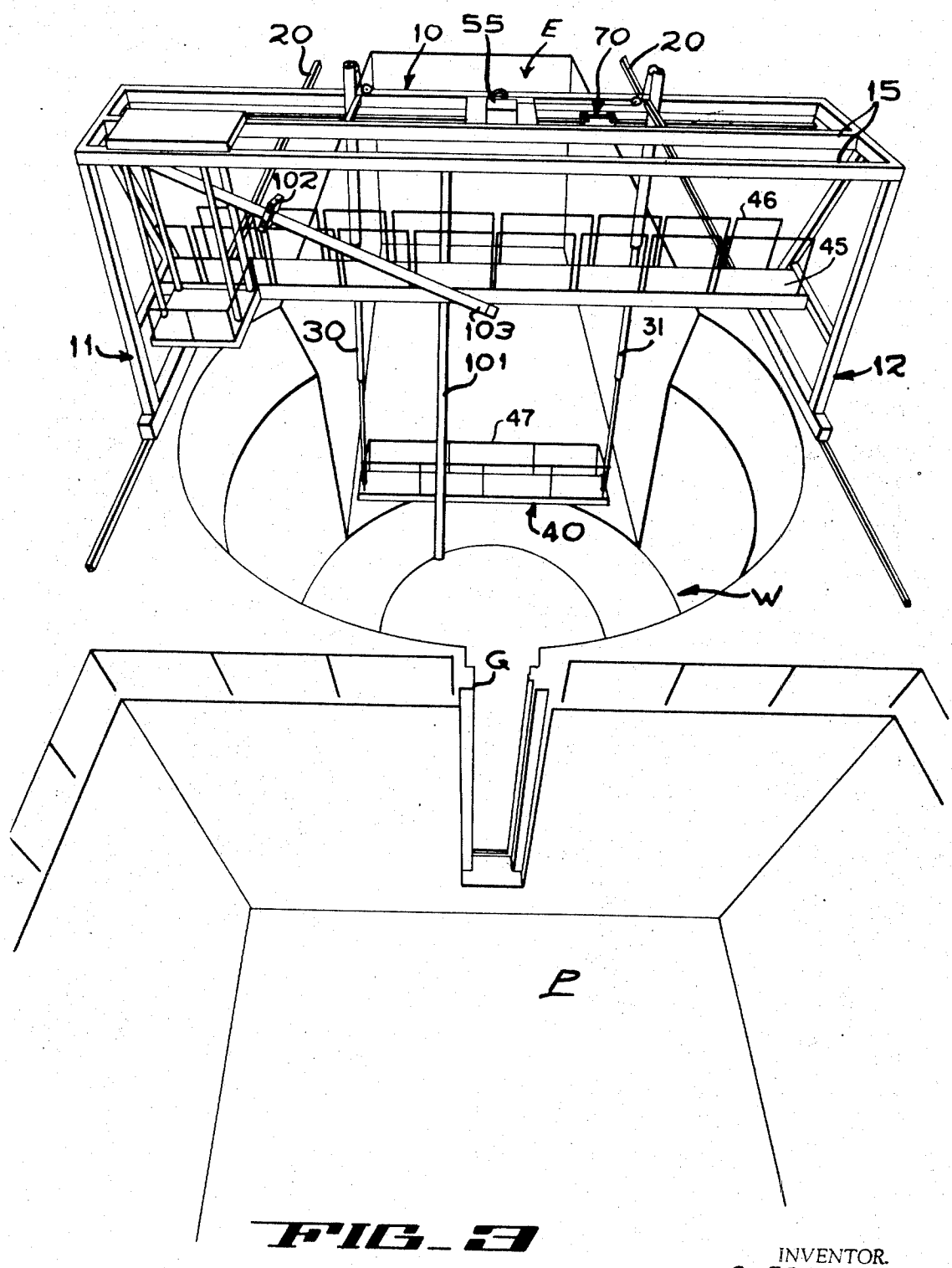

FIG_3

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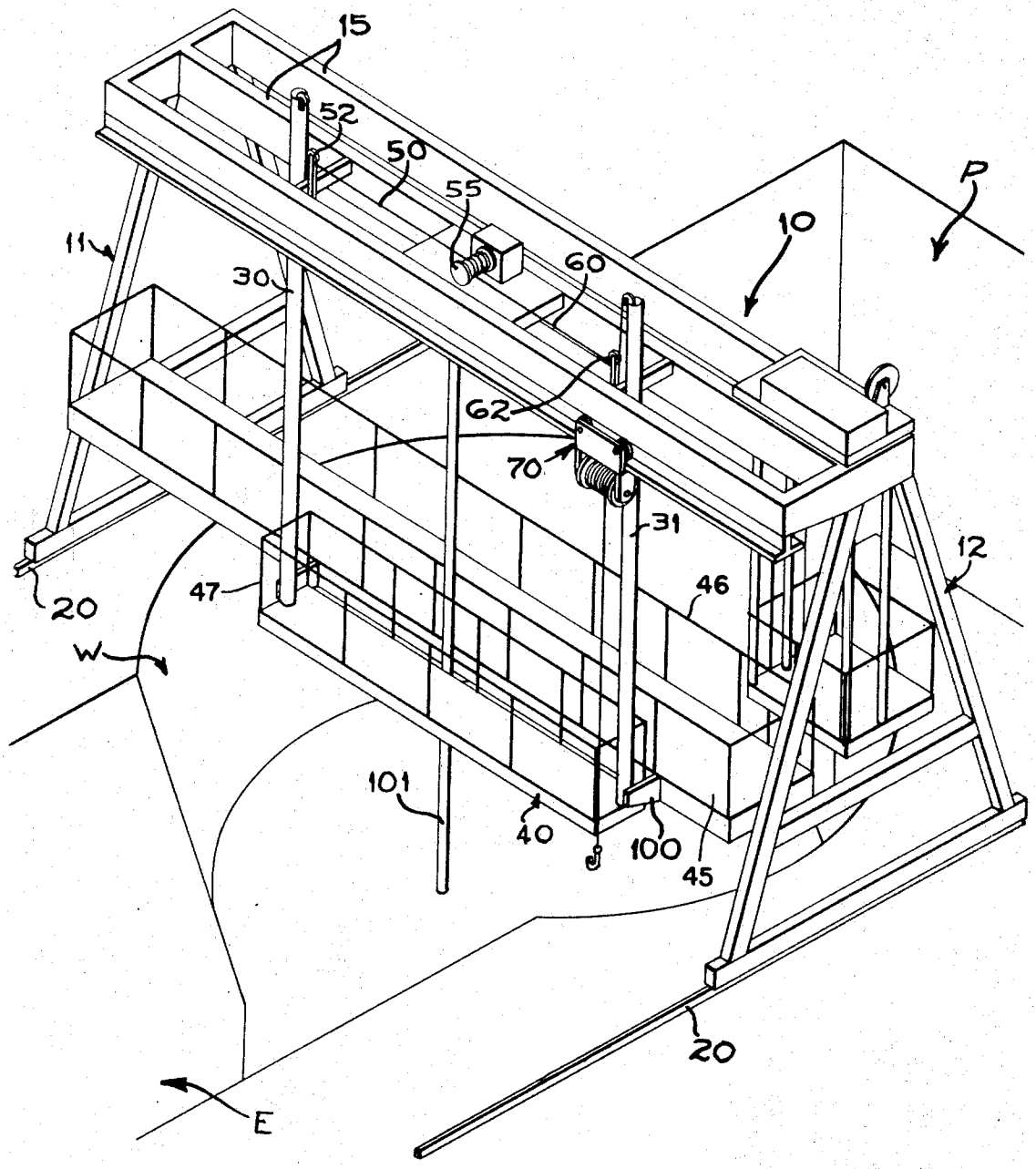

FIG 4

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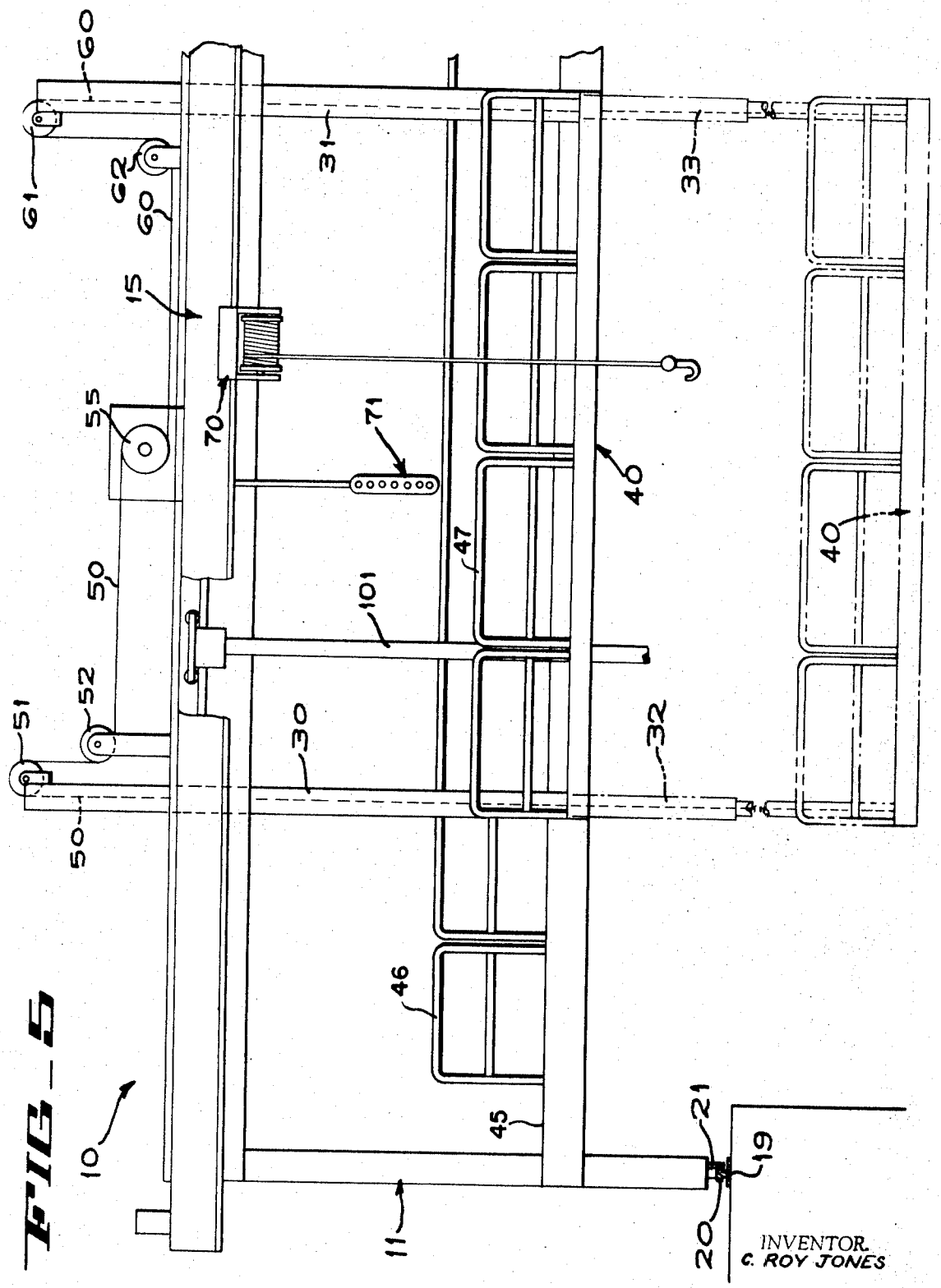

FIG. 5

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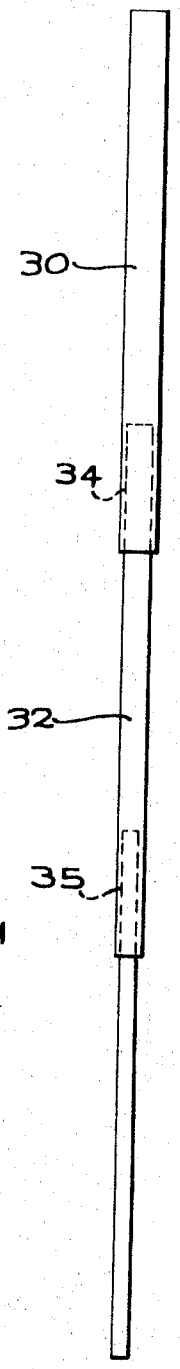
FIG_7



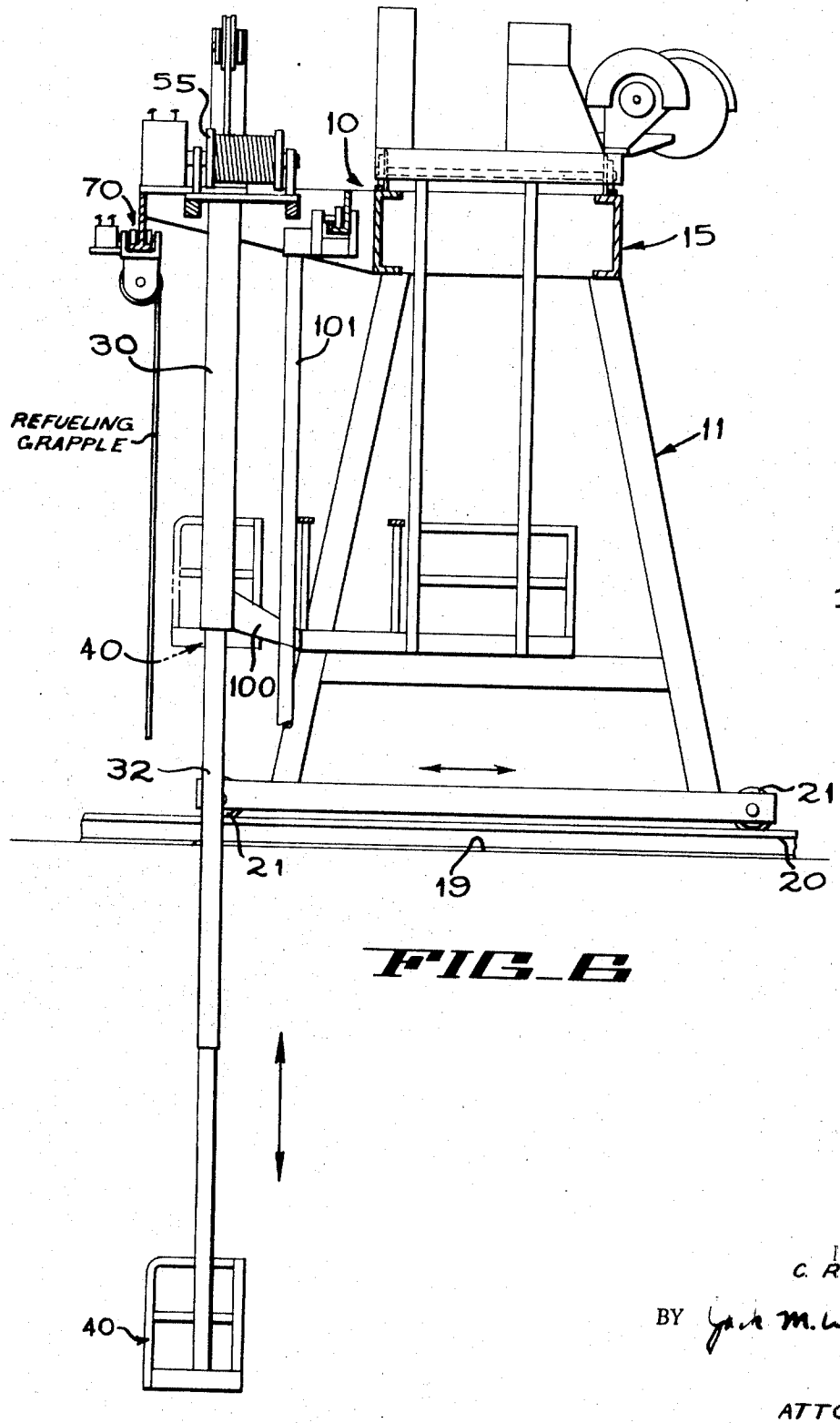


FIG_6

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ELEVATOR FOR A REACTOR WELL AND EQUIPMENT STORAGE AREA

BACKGROUND OF THE INVENTION

The present invention relates in general to a refueling platform and more particularly to an elevator for access to a reactor well.

In refueling a light water moderated reactor access is required to the reactor well. After the reactor is shutdown and cooled, a shield block is removed. Then the drywell head bolts are removed and the drywell head is stored on the refueling floor should the system be one that employs pressure suppression. Reactor vessel head bolts are removed and connections to the reactor pressure vessel head are operating Then, the reactor pressure head is stored on an oPerating floor. These steps take several days, and different tools to complete. Heretofore, a ladder was employed to gain access to the reactor well. This arrangement was both hazardous and time consuming.

Some installations have required the removal of a steam separator with the associated hold down bolts to gain access over the reactor core. In other systems, the equipment located above the core is removed. Water is pumped into the reactor well until the height thereof is above the reactor fuel and core, which provides adequate shielding for access. Equipment above the core, such as the steam dryer, is then removed by conventional sling equipment. A seal protector is installed in the reactor well and a portion of a rotating platform is lowered into the reactor well to remove the bolts from the steam separator. The portion of the rotating platform so lowered is accomplished by a sling which required considerable time to perform and requires a ladder to gain access to auxiliary equipment for the removal of additional internal parts. While in some systems, a portion of the access platform so lowered employed supporting telescoping tubes, the telescoping tubes were mounted internally of the refueling platform, and, hence, made it impractical to use auxiliary tools for performing the aforementioned operations. Thus, the arrangement was inefficient as far as performing the above-required operations and gaining access to additional internal parts in the reactor well. Some installations employed a circular track mounted on a flange of the reactor pressure vessel and a platform travelling in an annular path along the tracks. The installation and removal of the circular track arrangement was also time consuming and, therefore, inefficient.

After the portion of the access platform is removed from the reactor well or after the circular track arrangement is removed from the reactor pressure vessel, the reactor well and equipment storage area are flooded and the gate between the fuel storage pool and the reactor well is removed to fill the reactor well with water for the refueling operation. The refueling operation now starts, which is transferring spent fuel to the fuel storage area of the reactor fuel storage pool, and the replenishing of the reactor with a new supply of fuel. To place the reactor back into operation, the reverse process is carried out.

SUMMARY OF THE INVENTION

An elevator for a reactor well wherein a service platform is moved in a vertical direction within the reactor well and the vertically movable service platform is

greater than the diameter of a reactor pressure vessel in the reactor well.

A feature of the present invention is the employment of telescoping tubes for moving the service platform vertically and the distance between movable tubes of the telescoping tubes is greater than the diameter of the reactor pressure vessel.

Another feature of the present invention is the provision of space between the movable service platform and the adjacent superstructure of the refueling platform for the passage of tools and equipment therebetween.

Still another feature of the present invention is the ability to use both sides of the service platform so that all functions other than handling fuel can be performed more efficiently.

By virtue of the present invention, an arrangement is provided whereby workers and the equipment employed by the workers can gain access to any level of the reactor well, to the equipment storage area and to any position above the reactor with facility, ease of operation, rapidly and safely. Tools and equipment can be made available within the reactor well. In some instances, by the greater expanse of the movable service platform, access to auxiliary equipment is gained for moving a greater number of internal parts initially positioned within the reactor well.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a plan view of a reactor well and an equipment storage area employing the elevator of the present invention.

FIG. 2 is a diagrammatic view taken along line 2—2 of FIG. 1.

FIG. 3 is an enlarged perspective view of a reactor well and an equipment storage area employing the elevator of the present invention.

FIG. 4 is an enlarged fragmentary perspective view of the elevator of the present invention illustrated in conjunction with a reactor well and a fuel storage pool.

FIG. 5 is a fragmentary front elevation view of the elevator embodying the present invention illustrated in conjunction with a reactor well.

FIG. 6 is an enlarged end elevation view partially in section of the elevator embodying the present invention.

FIG. 7 is an enlarged elevation view of telescoping tubes employed in the elevator embodying the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Illustrated in FIGS. 1–3 is a conventional nuclear fuel storage pool P containing water and having at the bottom thereof suitable facilities for storing nuclear fuel. Adjacent the fuel storage pool P is a conventional reactor well W. A gate G separates the reactor well W and the storage pool P. When the water level in reactor well W is equal to that of storage pool P, gate G is opened and water communicates between the storage pool P and reactor well W.

Generally disposed within the reactor well W are a shielding block S, a drywell head D, a pressure vessel head H, a reactor pressure vessel V, a steam dryer SD, a steam separator SS, and a reactor core C (FIG. 2).

Refueling platforms for either a pressurized water reactor or a boiling water reactor comprise a superstruc-

ture 10 of steel with upright end frames 11 and 12 interconnected by plates 15. The plates 15 are slightly greater than the diameter of the reactor well W. Parallel tracks 19 and 20 extend along side of the fuel storage pool P and the reactor well W. The end frames 11 and 12 of the superstructure 10 are supported by wheels 21 that travel along the tracks 19 and 20 for moving the superstructure 10 between the fuel storage pool P and the reactor well W. In this manner, the reactor well W can be serviced for refueling and the like and also fuel can be transported between the reactor well W and the fuel storage pool P. The operation of the superstructure 10 along the tracks 19 and 20 is well-known in the art.

It is conventional to have an equipment storage area E at the opposite side of the reactor well W from which the fuel storage pool is located for storing the steam dryer and the steam separator as well as other internal equipment. Where there is an equipment storage area, then, of course, the tracks 19 and 20 will extend a sufficient distance from the superstructure 10 to service the equipment storage area.

Fixed to the horizontal beams of the superstructure 10 are stationary, upright, tubes 30 and 31 of steel. Of course, the stationary tubes 30 and 31 will move with the refueling platform, but is fixedly positioned relative to the superstructure 10. Telescopically received by the fixed tubes 30 and 31, respectively, are upright, movable tubes 32 and 33 of steel. Suitable bearings 34 and 35 (FIG. 7) are interposed respectively between telescoping tubes 30–32 and 31–33 for maintaining stability between the telescoping tubes. The telescoping tubes 30–32 and 31–33 are spaced apart a distance slightly greater than the diameter of the reactor pressure vessel V. More specifically, the distance between the confronting cylindrical walls of the movable tubes 32 and 33 is slightly greater than the diameter of the reactor pressure vessel V. It is apparent that the movable tubes 32 and 33 may be in the form of rods or shafts.

Fixed to the movable tubes and, preferably, to the distal ends of the movable tubes 32 and 33 for vertical movement therewith is a service platform 40. The service platform 40 extends the entire distance between the movable tubes 32 and 33. For raising and lowering the service platform 40, a steel cable 50 is received by the stationary tube 30 and is attached at its free end to the upper portion of the movable tube 32. The cable 50 is trained around pulleys 51 and 52. In addition, the cable 50 is wound around a conventional drum 55. Similarly, a steel cable 60 is received by the stationary tube 31 and is attached at its free end to the upper portion of the movable tube 33. The cable 60 is trained around pulleys 61 and 62. In addtion, the cable 60 is wound around the drum 55. The drum 55 is electrically operated by means of an electrical system with a control box in a manner well known in the art. It is apparent that a hydraulic system will operate equally as well.

Spacer 100 (FIG. 6) is provided between the sides of the service platform 40 and the framework of the superstructure 10 to permit the free passage of equipment grapple 101 therebetween. An auxiliary hoist 70 is mounted from the superstructure 10 and is disposed outboard from the service elevator platform 40. An auxiliary pendant control 71 for controlling movement of the refueling platform along the rails and up and down movement of the service platform 40 is provided for the latter so that all the areas above the reactor core may be reached by horizontal as well as vertical movement. At the beginning of a reactor shutdown, the normal control console 102 with its associated refueling grapple 103 is moved to the side and the refueling grapple is placed in its stored position which is out of the water. This enables the platform 40 to travel from the refueling pool area to the reactor well and the equipment storage area. At this time, control is passed from the refueling platform to the service platform 40. This enables the service platform 40 to travel in the horizontal direction and the vertical direction in the reactor well and in the equipment storage area.

As will be further observed, a fixed walkway 45 for personnel is connected between the superstructure uprights 11 and 12. The service platform 40, as shown, is spaced from the walkway 45 to enable equipment such as the grapple 101 to be extended down between the two. Both the walkway 45 and platform 40 have personnel-containing railings 46 and 47, respectively, and the platform 40 as shows shown is to but has a shorter length than that of the walkway 45.

I claim:

1. An elevator for a reactor well with a reactor pressure vessel in the reactor well comprising:

a. a superstructure extending across the reactor well and supported by surfaces adjacent to the reactor well;

b. upright tubes supported by said superstructure and spaced apart a distance greater than the diameter of the reactor pressure vessel;

c. a movable upright member received by each of said upright tubes for vertical movement therein;

d. a platform carried by said movable upright members for vertical movement therewith;

e. means supported by said superstructure and attached to said movable upright members for raising and lowering said movable upright members to impart vertical movement to said platform, said movable platform being laterally spaced from said superstructure; and

f. equipment mounted on the superstructure and extendible through the space between the superstructure and movable platform.

2. An elevator as claimed in claim 1 wherein support means comprises a cable for each of said movable tubes, each of said cables having the free end portion thereof disposed within its associated tube supported by said superstructure and attached to the upper portion of its associated movable tube, said cables being wound around drum means for raising and lowering the free ends thereof and being trained around pulleys for guiding the path of travel thereof.

3. An elevator as claimed in claim 1 wherein working access is provided on both sides of said movable platform.

4. Apparatus for providing access to equipment and parts in a nuclear reactor well sunk below a floor level and containing within the well a reactor pressure vessel of given diameter, comprising a bridge superstructure having uprights supported on the floor level at opposite sides of the reactor well and upright connecting means extending over and across the reactor well, means for moving the bridge superstructure in a horizontal direction relative to the reactor well, an elongated platform for personnel having a length of approximately that of the diameter of the pressure vessel, means connected to the platform for supporting same on the upright con-

necting means of the superstructure, means for moving the platform upward and downward relative to the superstructure and down into the reactor well to enable personnel on the platform to have access to the reactor well and to the pressure vessel and parts contained therein, a walkway extending across the bridge superstructure, and means for laterally spacing the platform from the walkway to enable equipment to be extended down between the platform and walkway.

5. Apparatus as set forth in claim **4** and including rails on the floor level on opposite sides of the reactor well, said bridge superstructure being mounted on the rails for movement therealong.

6. Apparatus as set forth in claim **4** wherein the platform supporting means comprises plural supporting members connected to the platform substantially at opposite ends thereof.

7. Apparatus as set forth in claim **6** wherein the platform supporting means comprises a pair of telescoping tubes each having an upper end secured to the bridge upight connecting means and a lower end secured to an end of the platform.

8. Apparatus for providing access to equipment and parts in a nuclear reactor well sunk below a floor level and containing within the well a reactor pressure vessel of given diameter, comprising a bridge superstructure having uprights supported on the floor level at opposite sides of the reactor well and upright connecting means extending over and across the reactor well, means for moving the bridge superstructure in a horizontal direction relative to the reactor well, an elongated platform for personnel having a length of approximately that of the diameter of the pressure vessel, means connected to the platform for supporting same on the upright connecting means of the superstructure, means for moving the platform upward and downward relative to the superstructure and down into the reactor well to enable personnel on the platform to have access to the reactor well and to the pressure vessel and parts contained therein, and a fixed walkway extending across the bridge superstructure, said walkway extending generally parallel to the platform and having a length longer than the platform.

9. Apparatus as set forth in claim **8** and including protective railings on the walkway and platform.

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