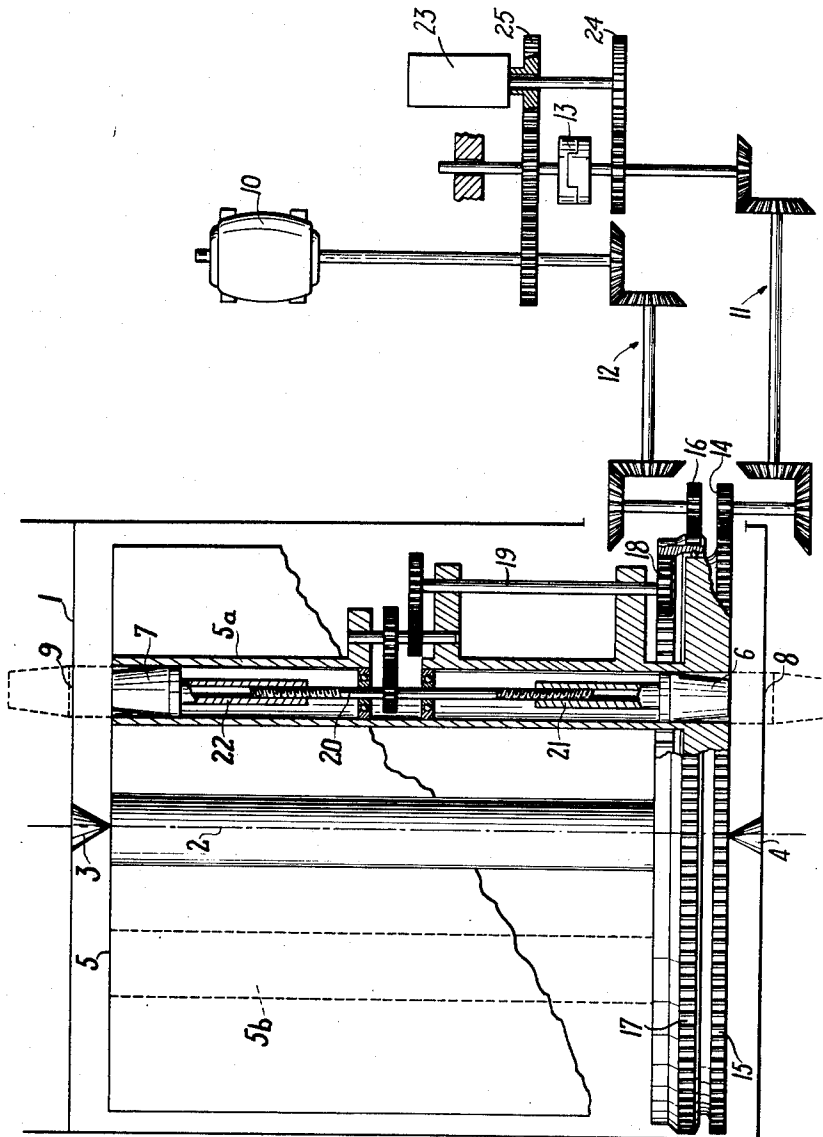


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REACTOR FUEL HANDLING HOOD

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REACTOR FUEL HANDLING HOOD

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The present invention relates to a mechanical device which is designed for the purpose of controlling the movement of a fuel drum in the handling hood of a nuclear reactor.

It is known that in this type of reactor, the fuel elements must be withdrawn at the end of a certain period of operation in order to be replaced by new elements. These loading and unloading operations are made very difficult on account of the intense radiations produced by the fuel elements thus conveyed. Such operations accordingly call for the use of "handling hoods," that is to say sealed enclosures which are put into communication with the reactor core for the purpose of withdrawing an irradiated element therefrom, and which are then sealed off in order to be moved, for example, to a storage well from which the reverse operation is effected. The same procedure is adopted when inserting a new element in the core of the pile from a storage well which contains such elements.

In order to achieve the purpose for which it is intended, the "hood" usually has a circular cylindrical chamber having walls which are at right angles to the axis of revolution and which are pierced with two oppositely facing orifices along an axis which is parallel to the said axis of revolution, the said orifices being normally sealed off by means of detachable plugs so as to provide perfect tightness with respect to radiations and gases in the said enclosure. In the interior of the chamber, there can rotate a drum or fuel magazine which is provided with one or a number of housings located off-centre and having axes parallel to the axis of revolution, the said housing or housings being designed to be brought into the axis of the two orifices of the chamber as a result of the appropriate rotation of the device.

The kinematic problem created by a device of this type consists on the one hand in imparting a movement of rotation to the drum and on the other hand, in a pre-determined position of the said drum, in carrying out the movement of translation of the two plugs along an axis parallel to the axis of rotation of the said drum and in two opposite directions, in such manner as to give free access for the transfer of the fuel towards the exterior of the chamber of the "hood." If the movement of translation of the plugs is carried out while supporting those latter, for example, by means of a worm-screw having threads of opposite pitch and fitted in the drum while the rotation of the said worm-screw produces the displacement of the said plugs, the problem consists in the final analysis in imparting a rotary motion to the said screw in a particular position of the drum. One manner of achieving this consists in making use of two pinions, one pinion being engaged with the screw which is mounted in the drum while the other pinion is coupled with a stationary motor, the said two pinions being engaged only when the drum is in the correct position with respect to the orifices to be sealed off. A device of this kind is subject to obvious drawbacks by reason of the fact that the gears are only in contact in one position of the drum; this gives rise to jerks and rapid damaging of the gears which strike each other each time the drum is brought into that position which corresponds to the closure of the orifices.

The present invention has for its object a device for

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operating the drum of a handling hood which overcomes the said drawbacks and accordingly results in an arrangement of great simplicity.

The said device is essentially characterized in that it comprises two ring gears disposed co-axially on the drum, the first ring gear being integral with the drum while the second ring gear is mounted to rotate freely on the said drum, two gear-trains designed to impart to the said two ring gears equal movements of rotation obtained from a same stationarily mounted motor, means being provided for the purpose of interrupting the gear-train between the first ring gear and the said motor and thus immobilizing the drum, a worm-screw on the ends of which are formed threads of opposite pitch and which is coupled by means of gears to the second ring gear, the rotary motion of the said worm-screw about an axis which is fixed with respect to the drum and parallel to the axis of rotation of this latter producing the translation of the plugs which are mounted at the ends of the said worm-screw, the rotation of the drum taking place as a result of the rotation of the motor when the kinematic coupling between the first ring gear and the said motor is established, the movement of translation of the plugs taking place as a result of the rotation of the motor when this same coupling is interrupted and the drum is maintained in the stationary position.

Further characteristic features and advantages of the invention will be brought out by the following description and by the accompanying drawings, the single figure of which is a diagrammatic illustration of the device which forms the subject of the invention.

The figure shows diagrammatically the cylindrical enclosure 1 of a handling hood. Inside the said enclosure, there is rotatably mounted on a spindle 2 by means of the two fixed pivots 3 and 4 a drum 5 constituting a fuel magazine and intended either for the distribution of new fuel elements to be introduced in the core of the reactor or for the storage of spent fuel elements which have been withdrawn from this latter. The said drum is also provided with a series of vertical tubular housings or passages such as the housing 5b which are uniformly spaced apart around the shaft 2 in such manner that, as the drum rotates about the said spindle, each of the above-mentioned housings are permitted to move into position in the axis of the orifices 8 and 9 which are formed in the line of extension of each other through the enclosure 1 of the handling hood. The said orifices are normally sealed off by means of axially aligned plugs which have been designated by the references 6 and 7, the bottom plug having the reference 6 and the top plug having the reference 7. By means of this arrangement, the axis of each passage 5b, the axis of orifices 8 and 9 and the axis of plugs 6 and 7 are all spaced the same predetermined distance from the fixed axis of spindle 2, about which the fuel magazine rotates.

For the purpose of handling fuel by this method, it can be seen that it is first necessary to remove the above-mentioned closure plugs by bringing them, for example, into the drum housing 5a which is reserved for this purpose, then to impart an appropriate movement of rotation to the said drum so as to place any one of the other housings 5b in the axis of the orifices. It is then possible for a suitable gripping device to be adapted to seize through the top hole the element contained in the above-mentioned housing and to lower the said element through the bottom orifice into the core of the reactor, or conversely to withdraw an element from the core and to store the said element in the housing chosen.

The drum-operating device comprises a single motor 10 which drives in rotation two gear-trains 11 and 12 which are constituted by a system of shafts and pinions. A device 13 of the electromagnetic clutch type, for example,

provides a means of interrupting the gear-train 11 and of immobilizing that section of the said gear-train which is coupled to the drum. The said gear-train 11 is additionally designed to drive in rotation through the intermediary of the pinion 14 a ring gear 15 which is integral with the drum while the second gear-train 12 drives in rotation through the intermediary of the pinion 16 a ring gear 17 which is mounted to rotate freely on the said drum. The said two gear-trains 11 and 12 can be arranged in various ways on condition that the movements of rotation which they are intended to impart to the two ring gears are identical. The ring gear 17 has internal teeth which are engaged with a toothed wheel 18 adapted to move about a shaft 19 which is fixed on the drum. The said toothed wheel in turn drives through the intermediary of gear systems a worm-screw 20 on the ends of which are formed threads of opposite pitch which work conjointly with two internally threaded rods 21 and 22 which are integral with the plugs 6 and 7.

The operation of the control device is as follows:

When the gear-trains 11 and 12 are set in rotation, that is to say when the gear-train 11 which drives the ring 15 forming one piece with the drum is coupled with the motor 10, the two ring gears 15 and 17 are endowed with identical movements of rotation; the toothed wheel 18, the rotation of which with respect to the drum results from the relative movement of the two ring gears, consequently remains stationary with respect to the drum, and the worm-screw 20 which controls the movement of translation of the plugs and which is dependent on the said toothed wheel similarly remains stationary. When the gear-train 11 which drives the ring gear 15 is kinematically disengaged from the motor 10 by means of the declutching device 13 and is accordingly immobilized, the ring gear 17 alone is driven in rotation and in turn causes the rotation of the worm-screw 20 which produces the movement of translation of the plugs 6 and 7; the said plugs then take up the positions shown in full lines in the drawing inside the drum housing 5a. It will obviously be merely necessary to subsequently reverse the direction of rotation of the motor in order to displace the plugs in the opposite direction and thus to close off the orifices 8 and 9 once again.

The movement of translation of the plugs must be carried out for one position only of the drum and that is when the plugs 6 and 7 are in axial alignment with orifices 8 and 9. A position indicator 23 which reproduces along a same axis the movements of rotation of the two gear-trains 11 and 12 through the gears 24 and 25 respectively provides a means of locating on the one hand the relative rotative position of the drum as reflected by the rotative position of the gears 24 and 25 and, on the other hand, the position of the plugs during the movement of translation of these latter as reflected by the relative rotative position of the gear 25 with respect to the gear 24.

It follows from the foregoing description that the control device which forms the subject of the present invention makes it possible to obtain great flexibility of operation of the handling hood and provides a simplification as compared with conventional devices. The said device requires only a single motor for the purpose of effecting the movement of rotation of the drum and the movement of translation of the plugs, the movement-changing operation being carried out by means of a single clutch unit which is located outside the chamber which contains the drum and to which access can readily be gained. It can further be noted that the gears inside the hood are continuously engaged and furthermore that it is not possible to operate at the same time both the plugs and the drum, inasmuch as the de-clutching device 13 is in fact so designed that, when disengaging the motor from the gear-train which is associated with the drum, the said gear-train is simultaneously immobilized.

It will be understood that the present invention is in no way limited to the form of embodiment as described

and illustrated and which has been given solely by way of example.

What we claim is:

1. In a nuclear reactor fuel element handling hood having axially aligned fuel element transfer orifices provided in opposed walls thereof; a fuel magazine supported in said hood for rotation about an axis spaced a predetermined distance from and parallel to the axis of said axially aligned orifices, said magazine having at least one passage extending therethrough from one end to the other end thereof for receiving fuel elements therein, said passage being disposed parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance; a plug mounted for axial movement on said magazine at either end thereof and spaced circumferentially from said passage, said plugs being disposed in axial alignment on an axis parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance; means for simultaneously moving said plugs axially in opposite directions between an extended position seated in said orifices and a retracted position withdrawn from said orifices into the interior of said hood; and means for rotating said magazine.

2. In a nuclear reactor fuel element handling hood having axially aligned fuel element transfer orifices provided in opposed walls thereof; a fuel magazine supported in said hood for rotation about an axis spaced a predetermined distance from and parallel to the axis of said axially aligned orifices, said magazine having at least one passage extending therethrough from one end to the other end thereof for receiving fuel elements therein, said passage being disposed parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance; a plug mounted for axial movement on said magazine at either end thereof and spaced circumferentially from said passage, said plugs being disposed in axial alignment on an axis parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance; means for simultaneously moving said plugs axially in opposite directions between an extended position seated in said orifices and a retracted position withdrawn from said orifices into the interior of said hood; means for rotating said magazine and position indicator means connected to said means for rotating said magazine, said position indicator means indicating the position of rotation of said magazine and the position of said plugs.

3. In a nuclear reactor fuel element handling hood having axially aligned fuel element transfer orifices provided in opposed walls thereof; a fuel magazine supported in said hood for rotation about an axis spaced a predetermined distance from and parallel to the axis of said axially aligned orifices, said magazine having a series of uniformly spaced apart fuel element receiving passages formed therein and extending therethrough from one end to the other end thereof for receiving fuel elements therein, said passages being disposed parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance, a plug mounted for axial movement on said magazine at either end thereof, and spaced circumferentially from said passages, said plugs being disposed in axial alignment on an axis parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance; means for simultaneously moving said plugs axially in opposite directions between an extended position seated in said orifices and a retracted position withdrawn from said orifices into the interior of said hood; and means for rotating said magazine.

4. In a nuclear reactor fuel element handling hood having axially aligned fuel element transfer orifices provided in opposed walls thereof; a fuel magazine supported in said hood for rotation about an axis spaced a pre-

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determined distance from and parallel to the axis of said axially aligned orifices, said magazine having at least one passage extending therethrough from one end to the other end thereof for receiving fuel elements therein, said passage being disposed parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance; a plug mounted for axial movement on said magazine at either end thereof and spaced circumferentially from said passage, said plugs being disposed in axial alignment on an axis parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance; gear means on said magazine for simultaneously moving said plugs axially in opposite directions between an extended position seated in said orifices and a retracted position withdrawn from said orifices into the interior of said hood; power means connected to said gear means for driving said gear means in either direction, said power means being drivingly connected to said magazine for rotating said magazine; and means for interrupting the driving connection between said power means and said magazine.

5. In a nuclear reactor fuel element handling hood having axially aligned fuel element transfer orifices provided in opposed walls thereof, a fuel magazine supported in said hood for rotation about an axis spaced a predetermined distance from and parallel to the axis of said axially aligned orifices, said magazine having at least one passage extending therethrough from one end to the other end thereof for receiving fuel elements therein, said passage being disposed parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance, a plug mounted for axial movement on said magazine at either end thereof and spaced circumferentially from said passages, said plugs being disposed in axial alignment on an axis parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance, means operably connected to said plugs and mounted on said magazine for simultaneously moving said plugs axially in opposite directions between an extended position seated in said orifices and a retracted position withdrawn from said orifices into the interior of said hood; a pair of ring gears mounted on said magazine coaxially with the axis thereof, one of said ring gears being rigid with said magazine for rotation therewith, the other of said ring gears being freely rotatable on said magazine for rotation independent thereof; means operably connecting said other ring gear and said means for moving said plugs; motor means for simultaneously driving said pair of ring gears in the same direction and at the same rate of rotation; a first gear train operably connecting said motor means and said one ring gear; a second gear train operably connecting said motor means and said other ring gear; and means for interrupting the driving connection between said motor means and said one ring gear.

6. In a nuclear reactor fuel element handling hood having axially aligned fuel element transfer orifices provided in opposed walls thereof, a fuel magazine supported in said hood for rotation about an axis spaced a predetermined distance from and parallel to the axis of said axially aligned orifices, said magazine having at least one passage extending therethrough from one end to the other end thereof for receiving fuel elements therein, said passage being disposed parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance, a plug mounted for axial movement on said magazine at either end thereof and spaced circumferentially from said passages, said plugs being disposed in axial align-

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ment on an axis parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance, screw means operably connected to said plugs and rotatably mounted on said magazine for simultaneously moving said plugs axially in opposite directions between an extended position seated in said orifices and a retracted position withdrawn from said orifices into the interior of said hood upon rotation thereof; a pair of ring gears mounted on said magazine coaxially with the axis thereof, one of said ring gears being rigid with said magazine for rotation therewith, the other of said ring gears being freely rotatable on said magazine for rotation independent thereof; gear means operably connecting said other ring gear and said screw means for rotating said screw means upon rotation of said other ring gear on said magazine; motor means for simultaneously driving said pair of rings gears in the same direction and at the same rate of rotation; a first gear train operably connecting said motor means and said one ring gear; a second gear train operably connecting said motor means and said other ring gear; and means for interrupting the driving connection between said motor means and said one ring gear.

7. In a nuclear reactor fuel element handling hood having axially aligned fuel element transfer orifices provided in opposed walls thereof, a fuel magazine supported in said hood for rotation about an axis spaced a predetermined distance from and parallel to the axis of said axially aligned orifices, said magazine having a series of uniformly spaced apart fuel element receiving passages formed therein extending therethrough from one end to the other end thereof for receiving fuel elements therein, said passages being disposed parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance, a plug mounted for axial movement on said magazine at either end thereof and spaced circumferentially from said passages, said plugs being disposed in axial alignment on an axis parallel to said axis of rotation and spaced radially outwardly from said axis of rotation a distance equal to said predetermined distance, screw means operably connected to said plugs and rotatably mounted on said magazine for simultaneously moving said plugs axially in opposite directions between an extended position seated in said orifices and a retracted position withdrawn from said orifices into the interior of said hood upon rotation thereof; a pair of ring gears mounted on said magazine coaxially with the axis thereof, one of said ring gears being rigid with said magazine for rotation therewith, the other of said ring gears being freely rotatable on said magazine for rotation independent thereof; gear means operably connecting said other ring gear and said screw means for rotating said screw means upon rotation of said other ring gear on said magazine; reversible motor means for simultaneously driving said pair of ring gears in the same direction and at the same rate of rotation; a first gear train operably connecting said motor means and said one ring gear; a second gear train operably connecting said motor means and said other ring gear; and means for interrupting the driving connection between said motor means and said one ring gear.

8. A device as defined in claim 7, including a position indicator connected to said motor means for indicating the position of rotation of said magazine and the position of said plugs.

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