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GRAB DEVICES

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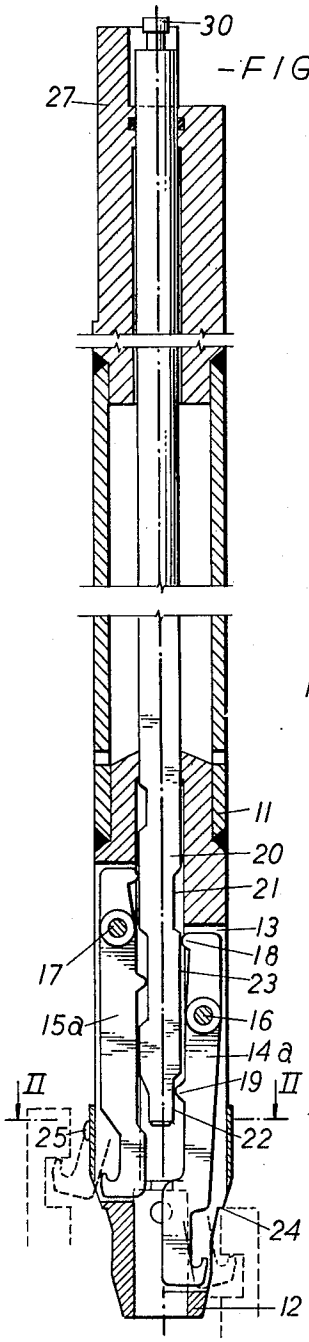
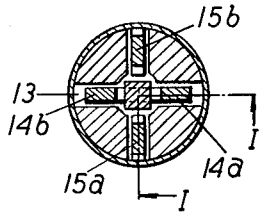
-FIG. 1.-



-FIG. 2.-



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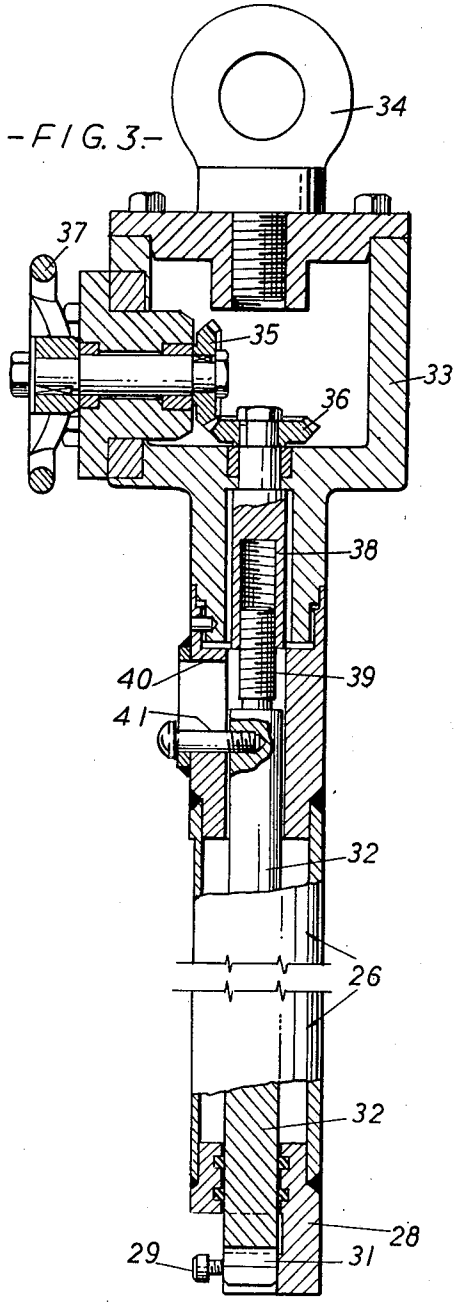
-FIG. 3-



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GRAB DEVICES

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5 Claims. (Cl. 294—95)

The present invention relates to remotely operable grab devices by which articles provided with fittings appropriate to grasping by the grab device can be handled. In the field of nuclear reactors, to which the invention is primarily applicable, the charging and discharging of fuel elements generally entails the use of a grab device capable of penetrating into the confined space of channels into which the fuel elements are charged. Such a grab is included as part of fuel element handling facilities afforded by a reactor charging machine.

The requirement may arise for a grab device which will grasp a variety of fittings. If there is a sufficient likeness between the various fittings involved, the grasping means of the device can be made flexible in operation to the point of being universal for the particular range of fittings. This flexibility may not always be attainable conveniently, and furthermore is not suitable where the occasion arises for articles presenting different fittings to be grasped at the same time.

According to the present invention, a grab device comprises separate grasping means appropriate in their respective engaging states to the grasping of fittings of different character, and coupling means through which the grasping means are respectively maintained positively positioned by a movable actuating member throughout an operative range of travel of the latter, the actuating member being adapted on movement through this range to effect in sequence the transition of each grasping means between a released state and the engaging state. The positive positioning ensures that the functioning of one grasping means is not interfered with by another, and since actuation to the engaged states occurs in successive steps of movement of the actuating member, the separate grasping means are selectively actuable by adjustment of the actuating member to different points in its operative range of travel.

More particularly, according to the present invention, a grab device of a nuclear reactor charging facility comprises sets of grasping fingers with the fingers of each set disposed symmetrically about the longitudinal axis of the device in planes through this axis, a movable actuating member having an operative range of travel, and coupling means maintaining positive coupled engagement of the respective sets of fingers with the actuating member throughout the range of travel of the latter, the actuating member being adapted on movement through this range to spread apart and close together the sets of fingers radially of the axis and to effect such finger movement over a different portion of its travel for each set of fingers.

In our co-pending application No. 146,206/61 the replacement of fuel elements in a nuclear reactor core entails removal of an element from the core into a carrier which has been previously positioned immediately adjacent the location of the element. Thereafter, the removed element, now totally immersed in liquid filling the carrier, is transported by means of the carrier to a disposal point. A grab as herein set forth is capable of handling the fuel element and the carrier separately, and can also be arranged for grasping both at the same time. In this way there is a safeguard against the fuel element being dropped during transport in the carrier because, should

the grasp of one of the two become accidentally released, the fuel element will at all events remain supported.

The accompanying drawings show, by way of example only, a particular form of grab device embodying the invention and for use with a carrier in the servicing of a nuclear reactor as previously referred to.

In the drawings:

FIG. 1 is a diagrammatic sectional view taken on the line I—I of FIG. 2,

FIG. 2 is a similar view taken on the line II—II of FIG. 1, and

FIG. 3 is a diagrammatic sectional view of an extension of FIG. 1.

As illustrated, a tubular elongated housing 11 terminating in a solid nose 12 is slotted through its walls in mutually perpendicular planes through the longitudinal axis to provide two pairs of diametrically opposed slots, such as 13. In these slots sets of fingers taking the form of claw plates 14*a*, 14*b* and 15*a*, 15*b* with ends hooked outwardly are rockably mounted on pivots, such as 16 and 17, intermediate their ends, one set of two claw plates being arranged in one of the pairs of slots and the other set of two claw plates being arranged in the other pair of slots. Each of the claw plates of the two sets is coupled through a pair of cam following projections, such as 18 and 19, which are spaced apart one to either side of the respective claw pivot, with an actuating member 20 movable co-axially within the hollow interior of the tubular housing. Towards each pair of claw plate following projections, this actuating member presents a cam track extending lengthwise of the member so that by remotely controlled axial movement of the latter the claw plates can be spread apart and closed together.

Each of the cam tracks is profiled to present three effective portions made up of alternating high and low portions, such as 21, 22 and 23, the middle portion 23 being of a length corresponding to the distance between the respective pair of cam following projections. These projections therefore both remain in following engagement with the cam track over the whole of the operative range of travel of the actuating member so that the claw plates are positively positioned and locked against movement at all times. When the upper projection of the pair is on a high portion and the lower projection on a low portion the claw plate is rocked inwardly, and when the actuating member is moved to bring the upper projection on a low portion, and hence the lower projection on a high portion, the claw plate is rocked outwardly.

The disposition of the cam following projections and the portions of the respective cam tracks is identical for the claw plates of each set so that the plates of a set are rocked, whether by way of spreading or closing together, both at the same time. However, by staggering the middle portions of the cam tracks lengthwise of the actuating member, the rocking of the sets is arranged to occur over different portions of the travel of the actuating member, and therefore in sequence as the actuating member is moved.

The end fittings to which the sets of claw plates are appropriate have tubular open ends with internal undercut recesses at different diameters for the respective sets. Thus, the engaging state of the claw plates of a set corresponds to their being spread apart; the outwardly directed hooks at their lower ends then enter into the recesses of the appropriate end fitting. More specifically, the set of claw plates 14*a*, 14*b* are for grasping a fuel element and therefore spread apart to a lesser diameter than the other set of claw plates 15*a*, 15*b* which are for grasping the carrier. To assist lengthwise location of the grab relative to the article to be grasped there are abutment surfaces 24 and 25 on the tubular housing 11 which sur-

faces are disposed to define by engagement respectively with the fuel element and carrier end fittings the correct positions at which the claws are insertable for grasping.

Considering, for example, the stage in the discharging of a fuel element at which it is suspended from the grab and being lowered into the carrier, the lowering of the grab is continued until the abutment surface 25 engages the end fitting of the carrier. The actuating member 20 has already been moved in the housing 11 from the position seen in FIG. 1 in order to grasp the fuel element being handled; more specifically, at this stage, the lower projections of the claw plates 14*a*, 14*b* have been brought on to high portions of the cam tracks whilst the lower projections of the other claw plates 15*a*, 15*b* remain on low portions. To grasp the carrier, movement of the actuating member in the tubular housing is continued to bring the latter-mentioned lower projections on to high portions of the respective cam tracks. Consequently the claw plates 15*a*, 15*b* spread apart and grasp the carrier so that now both the fuel element and carrier are grasped for transport together.

The housing 11, together with the mechanism described up to this point, is adapted to form an extension piece of a body section 26 seen in FIG. 3. This section is tubular to the same cross sectional dimensions as the housing 11 and the two are fitted together, end to end in axial alignment, by the provision of stepped scarf end pieces 27 and 28 which can be bolted together by bolts such as 29, passing transversely of the longitudinal axis. The end of the actuating member 20 adjacent the end piece 27 has a head 30 receivable in a T slot 31 formed in the neighbouring end of a rod 32 slidable co-axially within the hollow interior of the body section 26.

Surmounting the body section 26 is a gear box 33 with a lifting eye 34. Within the gear box there are bevel gears 35 and 36 by which drive applied to a handwheel 37 externally of the gear box is transmitted to a nut 38 rotatable in the body section but immovable in the lengthwise direction. Threaded in the nut is a screw-threaded terminal length 39 of the rod 32.

A window 40 is cut through the body section wall in the region of the terminal length 39 and projecting into this window is a pin 41 fixed to the rod 32. A pointer carried by this pin so as to register with a scale framing the window serves as an indication to the operative of the position to which the rod has been moved by drive applied from the handwheel through the screw and nut arrangement 39, 38. Such movement is in turn applied to the actuating member 20 for operation of the claw plates between their respective engaging and released states.

It is to be understood that the invention is not limited to the particular form of grab device described above with reference to the drawings and that many variations are within the scope of the invention as defined by the following claims. It is to be noted for instance that the planes in which the sets of claw plates lie in the illustrated example can be at an angle other than a right angle.

We claim:

1. A grab device comprising a housing means, separate grasping means supported in the housing means and effective in their respective load engaging positions for grasping fittings of different characters, an actuating member movable through an operative range of travel, and coupling means maintaining said grasping means positioned positively by said actuating member throughout said range of travel, said actuating member being formed in such a manner that on movement through said range it effects in sequence the transition of each of said separate grasping means between a released position and the load engaging position.

2. A grab device for a nuclear reactor charging facility comprising a housing means, sets of grasping fingers supported in the housing means, the fingers of each set being disposed symmetrically about a longitudinal axis of the housing means in planes through said axis, an actuating member movable relative to said sets of fingers through an operative range of travel, and coupling means maintaining positive coupled engagement of the respective sets of fingers with said actuating member throughout said range of travel, said actuating member being formed in such a manner that on movement through said range it spreads apart and closes together said sets of fingers radially of said axis and such that it effects such finger movement over a different portion of said range of travel for each of said sets of fingers.

3. A grab device according to claim 2 wherein said actuating member includes cam means and said fingers include cam following means, said cam means and following means co-operating to spread apart and close together said fingers in accordance with movement of said actuating member and to lock said fingers against movement for any given position of said actuating member.

4. A grab device comprising in combination an elongated tubular housing having adjacent one end thereof a plurality of sets of slots directed radially with respect to the longitudinal axis of said housing, the slots of each of said sets being disposed symmetrically about said axis, finger members extending in the direction of said axis and disposed in sets for projection of hooked ends thereof respectively through said slots, a pivot mounting each finger member rockably with respect to said housing, cam following means on each of said finger members, a common actuating member movable within said housing in the direction of said axis, and cam means on said actuating member for each of said fingers and co-operating with the respective cam following means to lock the respective finger against rocking in both directions about the pivot thereof, said cam means being profiled to adjust in sequence the radial spread of each set of said fingers.

5. A grab device according to claim 4, wherein said cam following means takes the form of two cam followers which are spaced apart one to either side of said pivot and which engage respectively high and low portions of a cam track on said actuating member.

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