United States Patent [19]

Ventre

[11] **3,726,557**

[45] **Apr. 10, 1973**

[54] HANDLING GRAB

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[22] Filed: **June 23, 1971**

[21] Appl. No.: **155,699**

[30] **Foreign Application Priority Data**

July 31, 1970 France.....7028420

[52] **U.S. Cl.**.....**294/86 A**, 294/1 R, 294/93, 294/99 R, 176/12

[51] **Int. Cl.**.....**B66c 1/30**

[58] **Field of Search**.....294/1 R, 86 R, 86 A, 294/86.24, 93, 97, 99 R; 176/12, 30, 31

[56] **References Cited**

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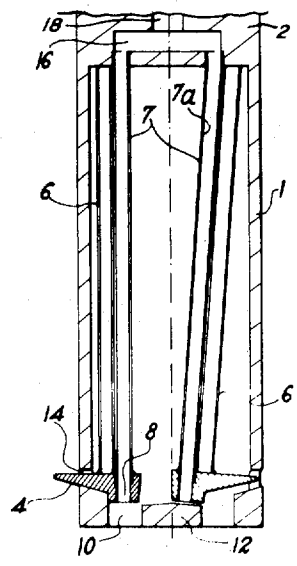
[57] **ABSTRACT**

The grab comprises a hollow cylindrical body which is connected to a suspension and control unit and in which grappling claws are displaced simultaneously between a position of engagement with a load to be handled and a position of disengagement therefrom. Each claw is supported by two parallel metallic rods which are fastened together along their entire length or only at one end. At least one rod which is of hollow construction, is connected at one end to the exterior and at the other end to a source of control fluid. Said fluid is brought to a temperature which is different from the ambient temperature, thereby causing differential expansion of the two rods and displacement of the claws.

8 Claims, 4 Drawing Figures



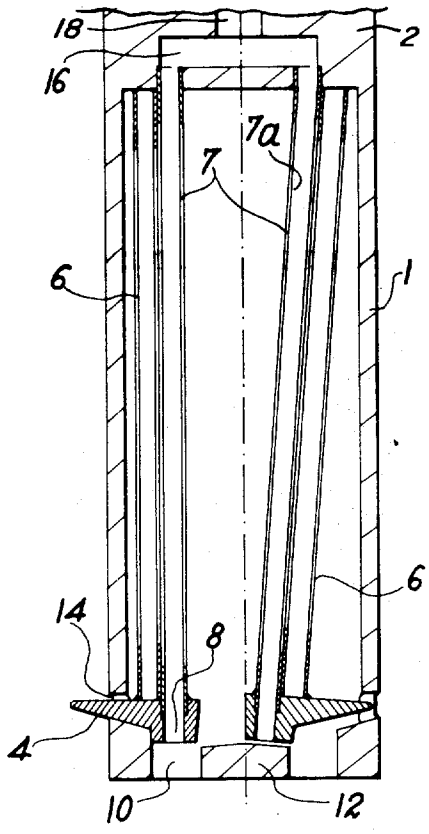


FIG. 1

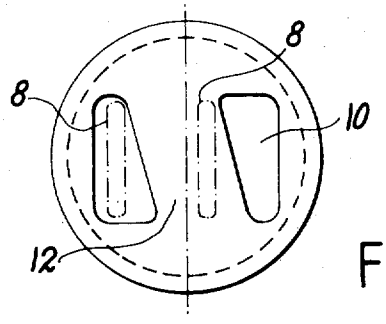


FIG. 2

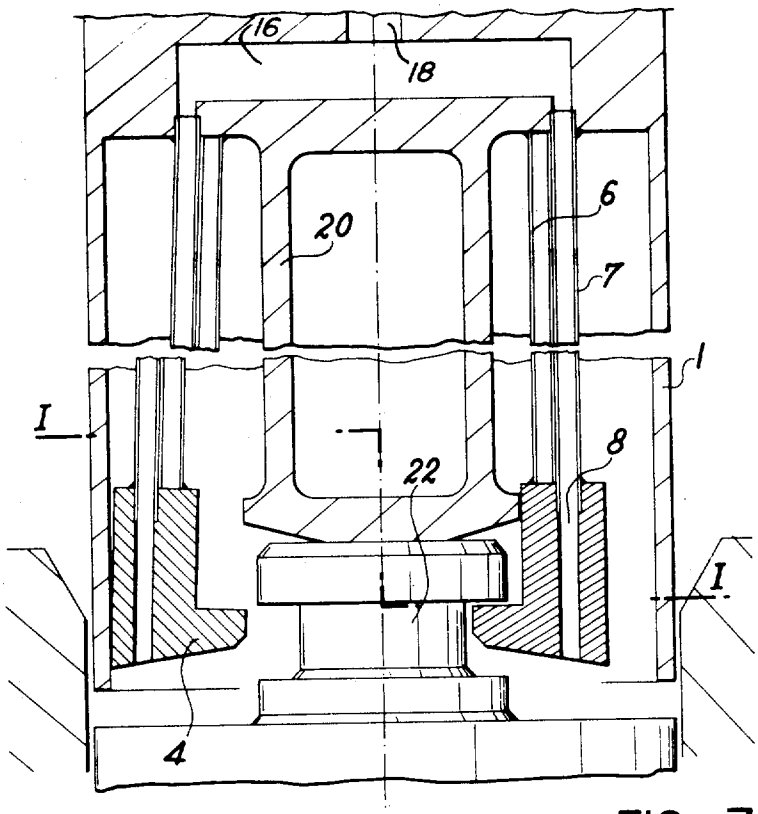
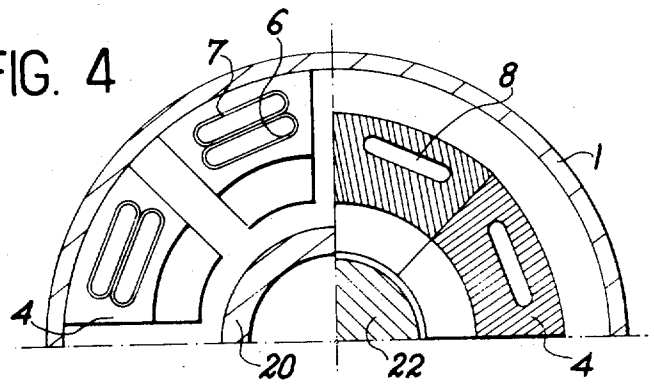


FIG. 3

FIG. 4



HANDLING GRAB

This invention relates to a handling grab which is applicable in particular to the handling of fuel elements in a nuclear reactor.

Many types of grab which are intended for the purpose of handling different objects are at present in existence. These grabs are usually provided with grappling claws carried by articulated lever-arms whose displacements between inward or outward positions of engagement or disengagement of the load are controlled by mechanical components, electrical components or the like. Said grabs are employed in particular in the case of replenishment of nuclear reactor fuel elements, that is to say in particularly hazardous environments and at high temperatures. In point of fact, whether the control devices are mechanical or electrical, they are easily damaged as a result of the action of nuclear radiations and do not readily withstand the temperatures involved. It is therefore necessary to watch them with very close attention and to replace their control devices at frequent intervals since fault conditions or stoppages of operation can have very serious consequences.

The object of the present invention is to overcome this disadvantage by means of a grab in which the control devices are no longer liable to sustain damage, the displacement of the grappling claws being caused by a variation in thermal effect on the devices which support said claws.

To this end, the handling grab under consideration which comprises a hollow cylindrical body connected to a suspension and control device and in which grappling claws are displaced simultaneously between a position of engagement with a load to be handled and a position of disengagement therefrom is characterized in that each claw is supported by two parallel metallic rods which are fastened together at least at one end thereof, at least one of said rods being of hollow construction and extended internally by means of a passageway which provides a communication with the exterior and being connected to a source of control fluid, said fluid being brought to a temperature which is different from the ambient temperature so as to cause the differential expansion of the two rods and displacement of the claws.

In accordance with a particular characteristic feature of the grab under consideration, the rods are formed of the same metal.

The displacements of the grab claws are thus initiated by creating a temperature difference between the metallic rods, that is to say in fact by means of a differential expansion of said two rods. No mechanical or electrical device is used within the interior of the grab, the only means employed being a liquid or gaseous fluid and this latter can be the same as the fluid which constitutes the surrounding atmosphere while being brought to a different temperature, said fluid being circulated through one of the rods while being in contact with the internal wall of this latter. The mechanical strength of a grab of this type is therefore very substantial, irrespective of the ambient temperature and the nature of the fluid which surrounds said grab. Moreover, safety of the handling operation is readily ensured by making use of the action of the control fluid solely in the direction of displacement of the claws towards the position of disengagement from the load, the return movement to the position of engagement being carried out naturally as a result of suppression of the action of the fluid.

The following description of embodiments which are given by way of non-limitative example with reference to the accompanying drawings brings out all the characteristic features and advantages of the invention in even greater detail.

FIG. 1 is a longitudinal sectional view of a handling grab in the position of engagement in the left-hand portion and in the position of disengagement in the right-hand portion of the figure.

FIG. 2 is a bottom view of the grab of FIG. 1.

FIG. 3 is a longitudinal sectional view of an alternative form of construction of the grab as also shown in the position of engagement and in the position of disengagement.

FIG. 4 is a partial sectional view taken along line I—I of FIG. 3.

The grab which is illustrated in FIG. 1 comprises a hollow cylindrical body 1 which is closed at the top portion thereof by means of an end-piece 2 and this latter is connected to a suspension and control unit (not shown).

Within the interior of said body 1, two grappling claws 4 are suspended from the end-piece 2 by means of two hollow rods 6 and 7 which are parallel to each other and securely fastened together along their entire length although they could be attached to each other only at one of their common extremities. These two rods are formed of the same metal. The rod 6 which is located nearest the grappling tip of the claw 4 is closed at both ends on the one hand by means of the claw itself and on the other hand by means of the end-piece 2 whilst the second rod 7 is extended through the claw 4 by means of a passageway 8 which puts said rod into communication with the exterior and especially with slots 10 which are pierced in the base 12 of the body 1.

In the position shown in the left-hand portion of FIG. 1, the two rods 6 and 7 are vertical, that is to say parallel to the lateral wall of the body 1. The claw 4 passes through a slot 14 which is pierced in said well in order to project towards the exterior when said claw is in position for holding a load (not shown). The two rods 6 and 7 are subjected in an identical manner to the temperature of the surrounding fluid irrespective of the nature of this latter and can expand only at the same time and in the same manner. No accidental displacement of the claw 4 need therefore be expected. This latter in any case rests on the edge of the slot 14 in order that the weight of the load should be carried by the wall of said slot, that is to say by the body 1 itself.

At the top portion of the grab, each of the internal ducts 7*a* of the rods 7 has an extension within the end-piece 2 in the form of an elbowed duct 16 and is connected by means of this latter to an axial passage 18 which provides a communication with a fluid source (not shown). When said fluid is introduced through said passage 18 and passes into the ducts 16 and the rods 7 at a temperature which is different from that which prevails around the grab, said fluid produces a temperature difference which results in differential expansion of the rods 6 and 7 which tends to displace the claw 4 in the direction of the coldest rod, that is to say in the direction of the rod 6.

In consequence, in order to displace the claw **4**, for example from the engagement position which is shown in the left-hand portion of FIG. **1** to the disengagement position which is shown in the right-hand portion, a cold fluid is introduced through the passage **18** into the internal duct **7***a* of the rod **7** up to the moment when said fluid initiates the displacement of the claw **4**. During this movement, the passageway **8** moves away progressively from the slots **10** in order to come into position above the central portion of the base **12**. The outlet of the rod **7** is then progressively closed by said base.

When the claw is fully withdrawn, the passageway **8** is almost completely closed and the fluid circulates only at a low rate of flow. Cooling no longer takes place but the rod **7** is maintained at a sufficiently low temperature to remain in its withdrawn position. However, stopping of the temperature drop within the rod **7** limits deformation and prevents this latter from becoming permanent. The rods thus retain their full elasticity and the temperature of the rod **7** returns progressively to its initial value as soon as the fluid supply is interrupted. The claw **4** returns little by little to the position of engagement.

The embodiment of FIGS. **1** and **2** presupposes that the load to be engaged is pierced by a central bore into which the grab penetrates and is provided with a groove or a shoulder for locking the outwardly-displaced claws. The passage **18** must therefore be supplied with control fluid in order to bring the claws together during introduction of the grab into the load. This supply is then interrupted in order to permit the claws **4** to penetrate into the groove or beneath the shoulder. Handling and displacement of the load can then be carried out in a simple manner without making use of the control fluid and without any danger of accidental disengagement.

No matter what load may be transported, engagement is in fact carried out in an extremely reliable manner since the rest position of the claw is the position of engagement whilst disengagement makes it necessary to control the circulation of fluid and to maintain said circulation. The shape of the slots **10** can readily be slightly trapezoidal (FIG. **2**) in order to ensure progressive closure of the passageway **8** and consequently a complete displacement of the claw.

This automatic regulation of the fluid which produces action on the rod can also be carried out in various other ways. For example, the passageways **8** can be elbowed and open in the direction of the axis of the grab. The discharge of fluid is then prevented progressively by the closing movement of the claws which place the passageways **8** in the line of extension of each other or apply them against a fixed central abutment.

Even when a grab of this type is employed in a nuclear reactor in which the ambient temperature is very high, this temperature is not liable to damage the grab and the same degree of safety is maintained after an extended period of use.

When the load is solid and surmounted by a grappling head, engagement must be carried out by inward displacement of the claws. FIGS. **3** and **4** show an embodiment of this type in which the grappling members are also maintained in the position of engagement when no control fluid is present but this position of engagement is the position of closure of the claws, the grappling members being directed towards the axis of the grab whilst the lower portion of the body **1** is open.

As in the previous case, a cooling fluid passes through the rod **7** which is located at the greatest distance from the grappling tip and the two rods have a rectilineal vertical position when no action is produced by the control fluid. The claws are then engaged with the head **22** of the load. Admission of the fluid is intended to initiate the opening movement of the claws, that is to say the displacement of said claws towards the lateral wall of the body **1**. Since said body **1** does not have a base, the passageways **8** which form an extension of rod **7** through the claw **1** remain open in the position of disengagement of the claw, deformation of the rods being nevertheless limited by the contact made between the claw and the wall of the body **1**.

The operation of a grab of this type is similar to that of the grab of FIG. **1**. In the same manner as this latter, it must be supplied with control fluid while it approaches the load in order to cause the outward displacement of the claws or when it withdraws from the deposited load. However, the grab is provided with a central projection **20** and when said grab is lowered onto the load to be engaged such as a nuclear reactor fuel element, for example, said projection is abuttingly applied against the head **22** of this assembly. The contact made between these two members then causes the downward movement of the grab to stop and closes off the supply of the duct **18**, thereby permitting the inward displacement of the claws as a result of reheating of the rod **7** and return of the rods **6** and **7** to the same temperature. When the claws **4** are engaged with the head **22**, the grab can be displaced with the load.

As is readily understood, in the case of handling of nuclear reactor fuel elements or handling of other objects which are also placed in an atmosphere at an extremely high temperature, the fluid which controls the grappling members is a relatively cold fluid but it is wholly apparent that, if the grab were to be employed for displacing objects placed in an atmosphere at a low temperature, the grab would be capable of operating in the same manner by making use of a relatively hot fluid. This fluid would in that case flow through the rod **6** which is placed in proximity to the grappling tip of the claw and would consequently produce a similar displacement of the claws. The same safety and the same ease of operation would be obtained in this case.

Said grab could also be pierced by two series of ducts such as **16** for connecting the rods **6** and **7** respectively to two passages such as **18** which are intended to be connected in one case to a source of hot fluid (supply of the rods **6**) and in the other case to a source of cold fluid (supply of the rods **7**). The choice of the source and of the control rod is accordingly determined by the intended use of the grab.

Similarly, the rod which is not intended to carry a circulation of fluid need not be closed at both ends but can be solid.

The difference in temperature between the two rods can also be increased by interposing a heat insulator such as, for example, a layer of metallic wires between said rods and along their entire length in order to ensure thermal decoupling.

The two rods can in any case be fastened together only at both ends, thereby permitting deformation of said rods along different curves while nevertheless permitting of sufficient displacement of the claw under the action of differential expansion.

The number of the claws can also vary according to the magnitude of the load. Provision is thus made for two claws in FIGS. 1 and 2 and for eight claws in FIGS. 3 and 4.

In all cases, since the control is limited to displacement of the claws towards the position of disengagement and since any components designed solely for the purpose of actuation are dispensed with, the handling operation is reliable.

A number of different modifications could clearly be made in the embodiment which has just been described without thereby departing from the scope of the invention.

What we claim is:

1. A handling grab comprising a hollow cylindrical body connected to a suspension and control unit and in which grappling claws are displaced simultaneously between a position of engagement with a load to be handled and a position of disengagement therefrom, wherein each claw is supported by two parallel metallic rods which are fastened together at least at one end thereof, at least one of said rods being of hollow construction and extended internally by means of a passageway which provides a communication with the exterior and being connected to a source of control fluid, said fluid being brought to a temperature which is different from the ambient temperature so as to cause differential expansion of the two rods and displacement of the claws.

2. A grab in accordance with claim 1, wherein the rods are formed of the same metal.

3. A grab in accordance with claim 2, wherein the rods have the same length and are parallel to the axis of the body when there is no circulation of control fluid, the claws of the grab being in the position of engagement.

4. A grab in accordance with claim 1, wherein the hollow body comprises a lateral opening through which the extremity of each claw passes in the position of engagement and a base pierced with slots so as to permit discharge of the control fluid during the greater part of the displacement of the claws towards the position of disengagement.

5. A grab in accordance with claim 4, wherein the rod which is located at the greatest distance from the extremity of each claw passes through said claw and the control fluid circulates within said rod.

6. A grab in accordance with claim 1, wherein both rods are hollow.

7. A grab in accordance with claim 1, wherein the rods are fastened together along their entire length.

8. A grab in accordance with claim 1, wherein a thermal decoupling means is interposed between the two rods.

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