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AUTOMATIC EXPLOSIVELY OPERATED ACTUATING MECHANISM

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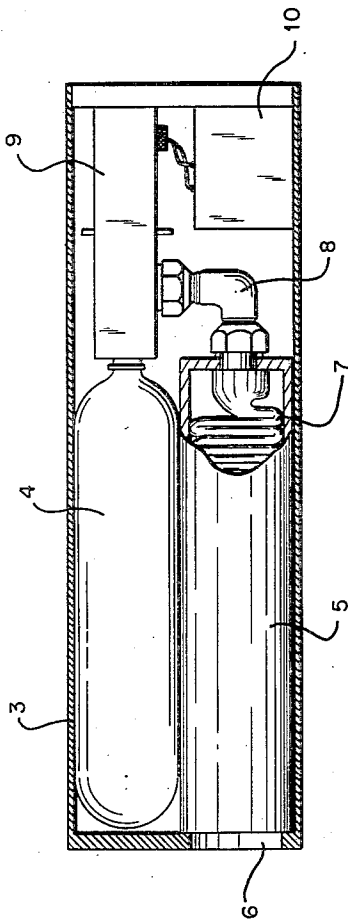


Fig. 1

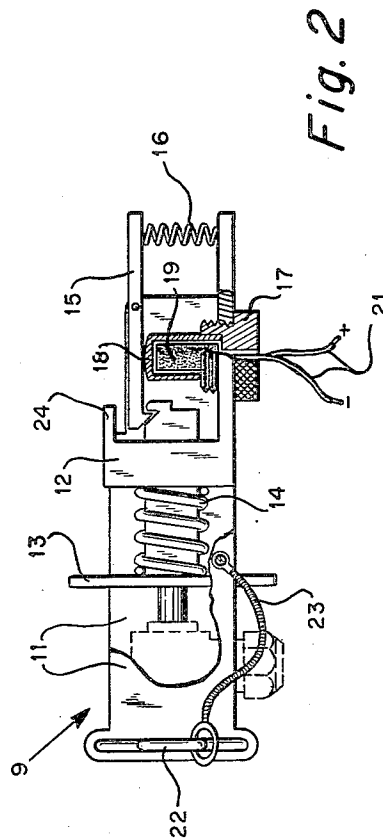


Fig. 2

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AUTOMATIC EXPLOSIVELY OPERATED ACTUATING MECHANISM

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6 Claims. (Cl. 222—3)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to an automatic explosively operated actuating mechanism and more particularly to an automatic actuator mechanism having a powerful biasing means arranged to produce rapid translational movement of an actuator and provided with a relatively small explosive charge arranged to release said biasing means when the charge is detonated in response to a signal from a suitable condition sensing means.

Existing types of automatic actuating mechanisms operative in response to a change in conditions such as immersion in water generally rely upon either a chemical reaction to the change in condition or upon a pressure sensitive device. However, with such triggering means as those noted, the delay between a significant change in condition and the actual operation of the actuator mechanism may be unduly long and at best is of uncertain duration. Consequently, such actuator mechanisms are not desirable for use in applications wherein a minimum time lag is essential.

This invention contemplates a quick releasable positive action automatic actuator mechanism including a relatively powerful biasing means normally retained in a forcibly displaced position to store a substantial amount of potential energy, retaining means for securing the biasing means in its displaced position, and release means movable in response to detonation of an explosive charge to release the biasing means from the restraining means. This actuator mechanism is particularly suited to use with condition sensing means for operation in response to a significant change in condition. For example, this automatic actuator mechanism in combination with a battery capable of generating a current upon submersion in salt water may be combined with the other necessary elements to provide reliable emergency flotation gear immediately operable whenever an object to which it is attached is immersed in salt water.

An object of the present invention is the provision of a reliable rapidly acting automatic actuator mechanism in which a relatively large actuating force is released by a relatively small impulse generated in response to a significant change in condition.

An object of the present invention is the provision of a reliable rapidly acting actuator mechanism capable of insuring substantial displacement of a highly loaded valve means such as the closure for a fluid container designed for storage of a fluid under considerable pressure.

Another object is to provide a compact actuator mechanism provided with a linear actuator means arranged to be rapidly displaced with considerable force.

The exact nature of this invention as well as other objects and advantages thereof will be readily apparent upon consideration of the following specification in relation to the annexed drawing in which:

Fig. 1 is a plan view longitudinally sectioned of a pre-

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ferred embodiment of a flotation assembly incorporating the present invention, and

Fig. 2 is a plan view of a preferred embodiment of the present invention with various elements partially broken away and shown partly in section to facilitate an understanding of the relationship between various elements.

Referring now to the drawing, wherein like reference characters designate like or corresponding parts throughout the several views, there is shown in Fig. 1 a preferred embodiment of an automatically operable flotation assembly including a generally rectangular housing 3 open at its right end as shown in Fig. 1 and arranged to snugly enclose the essential elements of a complete flotation assembly including a container 4 for storing a buoyant fluid such as carbon dioxide, a shell 5 open at its left end as shown in Fig. 1 and mounted in alignment with a port 6 in the closed end of housing 3, said shell being arranged to accommodate and protect a collapsed inflatable bladder 7 shown in Fig. 1 in its stowed position within the shell 5, conduit means 8 interconnecting the container 4 and the bladder 7, an automatic actuator mechanism 9 arranged to control the flow of fluid through the conduit 8 from the container 4 to the bladder 7, and a means 10 responsive to immersion in salt water to generate an electrical impulse to operate the automatic actuator mechanism 9 described in detail below in relation to the showing in Fig. 2.

Referring now to Fig. 2, the automatic actuator mechanism 9 includes a pair of elongated spaced parallel supporting plates 11 fixedly secured to opposite sides of a frame member 12. The frame member 12 is provided with a suitable opening therethrough arranged to slidably support a plunger assembly 13 biased to the left as shown in Fig. 2 by a compression spring 14. The actuator mechanism 9 is normally maintained in the cocked position by the seat plate 15 pivotally mounted upon the supporting plates 11 and biased into an engagement with a suitable notch in the plunger assembly by the compression spring 16. The plunger assembly 13 is released for rapid translational movement under the influence of compression spring 14 by operation of a release means including a threadably mounted hollow squib cylinder 17, a hollow piston 18 slidably mounted within the hollow squib cylinder, and an explosive squib 19 enclosed between the hollow piston 18 and the squib cylinder 17 and provided with electrically conducting leads 21 extending through the bottom of the squib cylinder 17 for connection to a suitable signal generating means. The automatic actuator mechanism 9 may conveniently be releasably secured to the existing valve fitting of a conventional pressurized fluid container by means of a suitable wire clip 22 inserted through openings in the supporting plates 11 and secured against loss by a suitable retaining means 23 such as a link of flexible cable attached to one of the supporting plates 11 as shown in Fig. 2. The phantom showing of a valve assembly in Fig. 2 is provided to illustrate the manner in which the automatic actuator mechanism 9 is conveniently mounted and arranged for cooperation with the fluid release valve of a conventional pressurized fluid container, such as a CO₂ bottle.

Operation of the automatic actuator mechanism 9 is initiated by applying an electrical impulse to the leads 21 to detonate the explosive squib 19. The force generated by detonation of the squib 19 displaces the hollow piston 18 in relation to the squib cylinder 17. Since the piston 18 is initially in engagement with the seat plate 15, its forcible displacement overpowers the compression spring 16 to lift the seat plate 15 out of engagement with the notch in the plunger assembly 13. When the plunger assembly 13 is released from engagement with the seat plate 15, the powerful compression spring 14 displaces it rapidly to the left as shown in Fig. 2 to open the fluid

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release valve of a cooperating pressurized fluid container. The stop 24 projecting from the frame member 12 is arranged to limit the travel of the sear plate 15 so that the hollow piston 18 cannot be driven completely out of engagement with the squib cylinder 17. After each operation of the automatic actuator mechanism 9 it can be readied for reuse by once again bringing the notch in the plunger assembly 13 into engagement with the sear plate 15 so that these parts assume the relative positions shown in Fig. 2. In addition, the release means must be recharged by removing the squib cylinder 17 from the frame member 12 and inserting a new squib within the hollow piston 18.

When the automatic actuator mechanism 9 is employed in a flotation assembly of the type shown in Fig. 1, immersion of the assembly in salt water causes immediate generation of an electric current within the salt water responsive battery 10. The current thus generated detonates the squib 19 to operate the actuator mechanism automatically in the manner described above. Operation of the actuator mechanism releases the pressurized fluid from the container 4 for transmission through the conduit 8 to the bladder 7 stowed within the shell 5. The flow of pressurized fluid into the bladder 7 causes it to inflate, forcing the bladder out of the shell 5 and through the port 6 as it is filled by the pressurized fluid. When the bladder is fully inflated it provides buoyant support for the flotation assembly shown in Fig. 1 and for the object to which it is attached.

Thus, the present invention provides an automatic actuator mechanism particularly useful as an essential component of automatically operable flotation equipment for attachment to objects which may be immersed in water. For example, a unit of the type shown in Fig. 1 incorporating the present invention may conveniently be attached to a target designed to be towed by an aircraft and to be dropped into salt water upon its release from the aircraft. The provision of such automatically operable flotation equipment insures against loss of the target due to sinking and greatly facilitates its recovery from the water. A much smaller variation of the same type of unit could be attached to a life-saving vest to insure automatic inflation of the vest whenever the person wearing the vest becomes immersed in salt water.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An automatic actuating mechanism comprising a supporting frame, an actuating means slidably mounted upon the supporting frame, a first relatively large and powerful spring biasing means arranged to bias the actuating means in one direction, a sear means pivotally mounted upon the supporting frame adjacent to said actuating means, a second relatively small spring biasing means arranged to act on one portion of said sear means to bias said sear means into engagement at a second portion of said sear means with said actuating means to restrain said actuating means against movement in response to said first biasing means, release means mounted upon the supporting frame acting on said sear means between said first and second portions thereof, and a relatively small explosive charge mounted within said release means and effective on its detonation to displace said release means to overpower the second spring biasing means sufficiently to disengage said sear means from said actuating means, whereby said actuating means is rapidly displaced in a predetermined direction in response to the force applied thereto by said first biasing means.

2. An automatically operable actuating mechanism comprising an elongated supporting frame, an elongated actuating member mounted for sliding movement longitudinally of said supporting frame and having a recess in one end thereof, a first spring biasing means mounted

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concentrically around said actuating member and arranged to bias the actuating member in one direction, an elongated sear plate pivotally mounted intermediate its ends upon said supporting frame, said sear plate having a projection on one end so disposed that it may be engaged in the recess in one end of said actuating member to restrain said member against the biasing effect of the first spring biasing means, a second spring biasing means mounted upon said supporting frame and bearing against the other end of said sear plate to continuously urge the projection on the sear plate into engagement with the recess in said actuating member, and a release means attached to the supporting frame adjacent the sear plate, said release means including a hollow squib cylinder opened at one end and having a small opening through the other end, a hollow piston mounted slidably in the open end of the squib cylinder and disposed with its closed end in contact with the sear plate, an explosive squib fitted inside the hollow piston, and electrically conductive leads attached to the explosive squib and extending through the small opening in the end of the squib cylinder for attachment to a suitable electrical impulse generating means, whereby detonation of the explosive squib in response to an electrical impulse will force the hollow piston against the sear plate to release the actuating member for rapid movement in response to the first spring biasing means.

3. In a flotation assembly operable in response to immersion in salt water including a storage container for a pressurized fluid, an inflatable bladder, a fluid conduit interconnecting the storage container and the bladder, a releasable valve means normally closing said conduit and a battery means arranged to generate an electrical impulse upon its immersion in salt water, an electrically controlled automatic actuating mechanism operable in response to an electrical impulse generated by the battery means to release the normally closed valve means in the conduit, said actuator mechanism comprising an elongated supporting frame, an elongated actuating member mounted for sliding movement longitudinally of said supporting frame and having a recess in one end thereof, a first spring biasing means mounted concentrically around said actuating member and arranged to bias the actuating member in one direction, an elongated sear plate pivotally mounted intermediate its ends upon said supporting frame, said sear plate having a projection on one end so disposed that it may be engaged in the recess in one end of said actuating member to restrain said member against the biasing effect of the first spring biasing means, a second spring biasing means mounted upon said supporting frame and bearing against the other end of said sear plate to continuously urge the projection on the sear plate into engagement with the recess in said actuating member, and a release means attached to the supporting frame adjacent the sear plate, said release means including a hollow squib cylinder opened at one end and having a small opening through the other end, a hollow piston mounted slidably in the open end of the squib cylinder and disposed with its closed end in contact with the sear plate, an explosive squib fitted inside the hollow piston, and electrically conductive leads attached to the explosive squib and extending through the small opening in the end of the squib cylinder for attachment to a suitable electrical impulse generating means, whereby detonation of the explosive squib in response to an electrical impulse will force the hollow piston against the sear plate to release the actuating member for rapid movement in response to the first spring biasing means, permitting the transfer of pressurized fluid from the storage container to the inflatable bladder.

4. An automatic actuating mechanism for a quick-acting flotation device comprising an inflatable bladder, an elongated, slidable member resiliently urged in the direction of initiating inflation of said bladder, said member provided with a recess adjacent one end thereof, pivotal

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means having a hooked end in engagement with said recess of said member restraining initiating movement of said member, resilient means at the other end of said pivotal means normally maintaining said engagement, expansive charge means acting upon release directly against said pivotal means adjacent said hooked end thereof to render said engagement ineffective substantially instantaneously, and means to release said expansive charge means, whereby said actuating member is released quickly for rapid movement in response to the aforesaid resilient urging for inflating said bladder.

5. An automatically operable actuating mechanism comprising an elongated supporting frame, an elongated actuating member mounted for sliding movement longitudinally of said supporting frame and having a recess in one end thereof, a first spring biasing means mounted concentrically around said actuating member and arranged to bias the actuating member in one direction, an elongated sear plate pivotally mounted intermediate its ends upon said supporting frame, said sear plate having a projection on one end so disposed that it may be engaged in the recess in one end of said actuating member to restrain said member against the biasing effect of the first spring biasing means, a second spring biasing means mounted upon said supporting frame and bearing against the other end of said sear plate to continuously urge the projection of the sear plate into engagement with the recess in said actuating member, and a release means attached to the supporting frame adjacent the sear plate, said release means including a piston mounted in contact with the sear plate, and electrically actuated means for forcing said piston against the sear plate to release the actuating member for rapid movement in response to the first spring biasing means.

6. In a flotation assembly operable in response to immersion in salt water including a storage container for a pressurized fluid, an inflatable bladder, a fluid conduit interconnecting the storage container and the bladder, a releasable valve means normally closing said conduit and

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a battery means arranged to generate an electrical impulse upon its immersion in salt water, an electrically controlled automatic actuating mechanism operable in response to an electrical impulse generated by the battery means to release the normally closed valve means in the conduit, said actuator mechanism comprising an elongated supporting frame, an elongated actuating member mounted for sliding movement longitudinally of said supporting frame and having a recess in one end thereof, a first spring biasing means mounted concentrically around said actuating member and arranged to bias the actuating member in one direction, an elongated sear plate pivotally mounted intermediate its ends upon said supporting frame, said sear plate having a projection on one end so disposed that it may be engaged in the recess in one end of said actuating member to restrain said member against the biasing effect of the first spring biasing means, a second spring biasing means mounted upon said supporting frame and bearing against the other end of said sear plate to continuously urge the projection on the sear plate into engagement with the recess in said actuating member, and a release means attached to the supporting frame adjacent the sear plate, said release means including a piston mounted in contact with the sear plate, and electrically actuated means for forcing said piston against the sear plate to release the actuating member for rapid movement in response to the first spring biasing means, permitting the transfer of pressurized fluid from the storage container to the inflatable bladder.

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