

[54] **MARINE MAMMAL UNDERWATER ATTACHMENT AND RECOVERY TOOL**

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[73] Assignee: **The United States of America as represented by the Secretary of the Navy**

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[51] Int. Cl. .... **B66c 1/18**

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[57] **ABSTRACT**

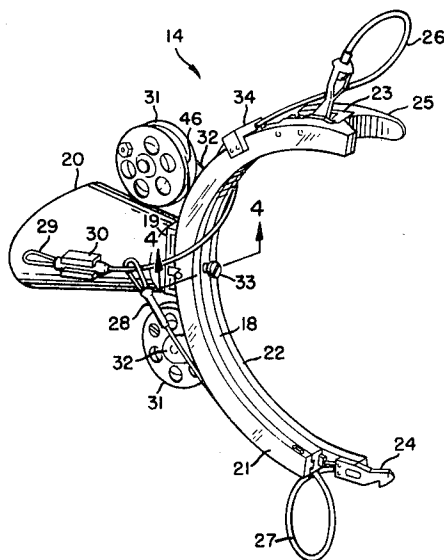
An attachment and recovery tool for recovery of underwater objects has two telescopically extending arms which together with a central portion encircles the object to be recovered. The telescopically extending arms are urged into object engaging position by spring motor means mounted on the central portion. Latch units mounted on each telescopic arm secure them in encircling engagement with the object to be recovered. Cable means carried by said latch means cooperate with a lifting line to raise the object to the surface.

[56] **References Cited**

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**10 Claims, 8 Drawing Figures**



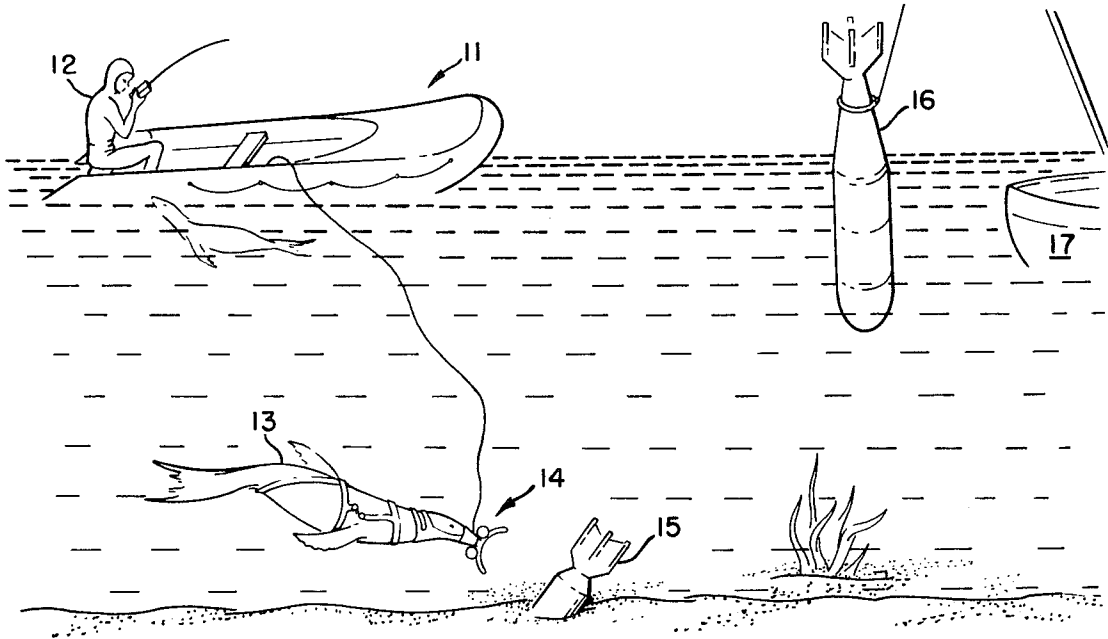


FIG. 1

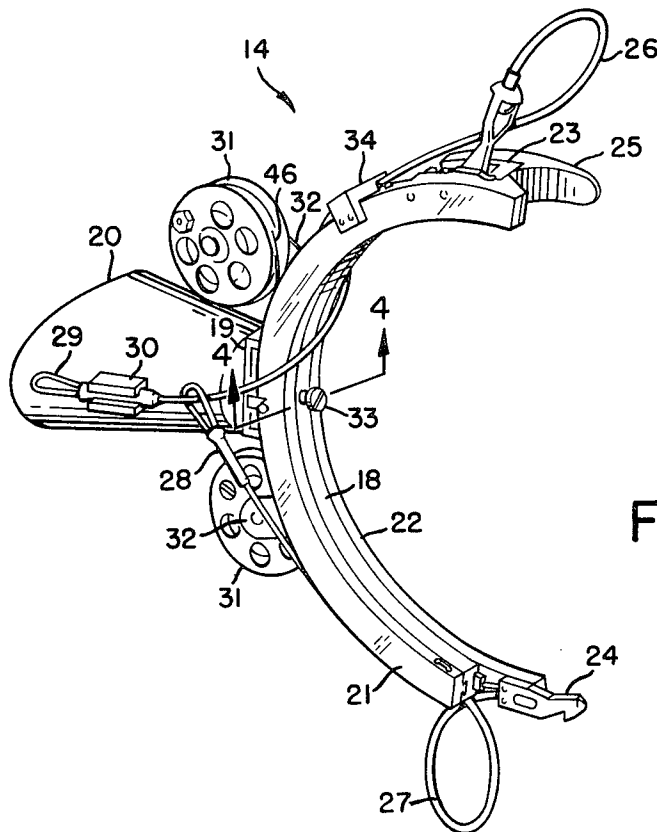


FIG. 2

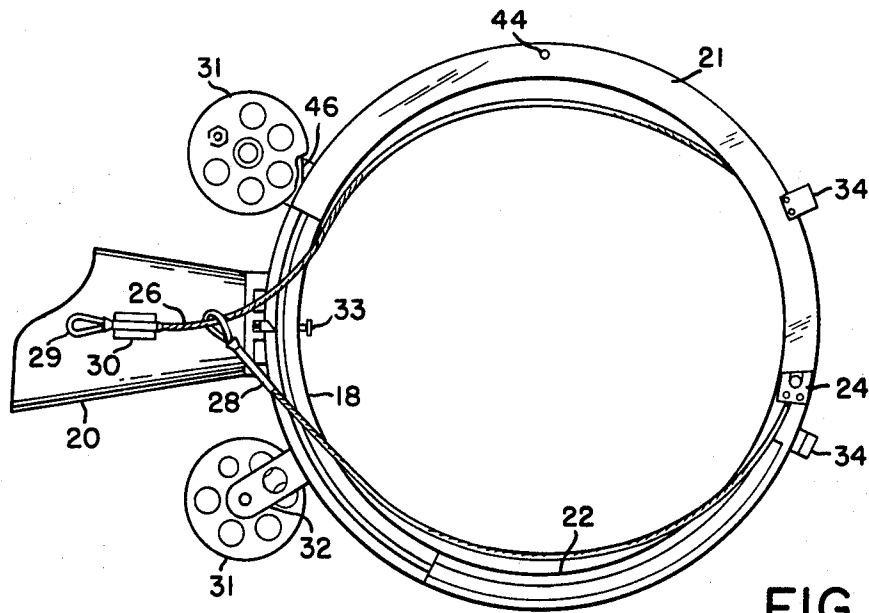


FIG. 3

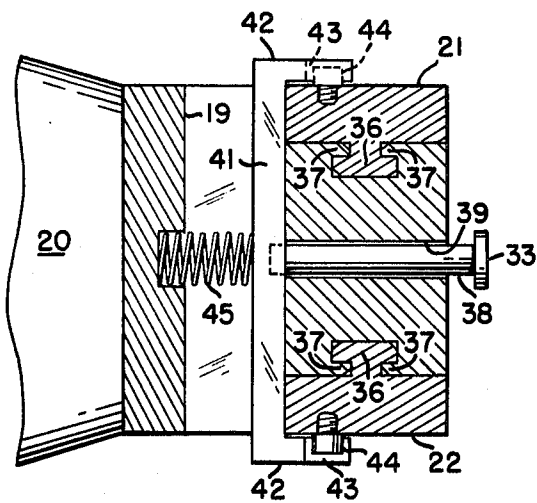


FIG. 4

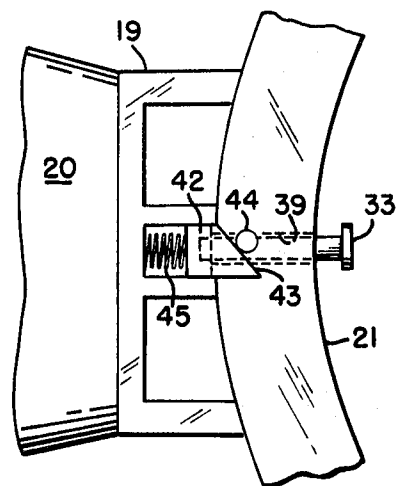


FIG. 5

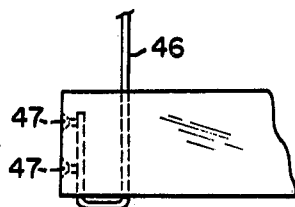


FIG. 6

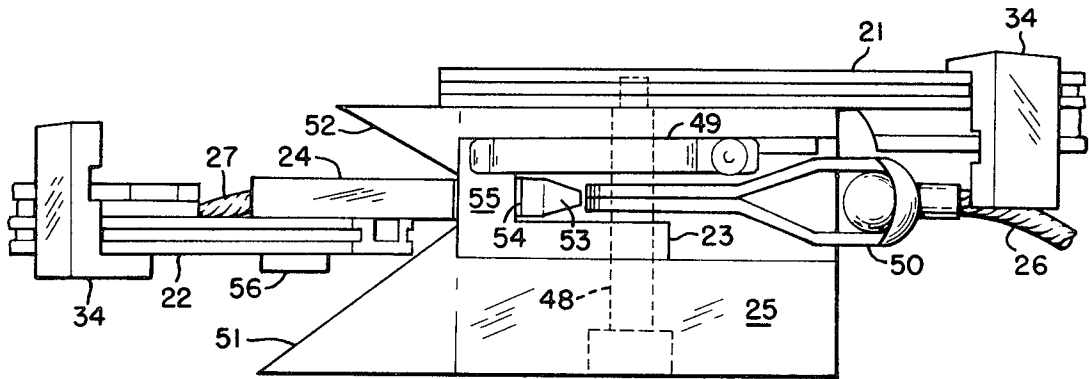


FIG. 7

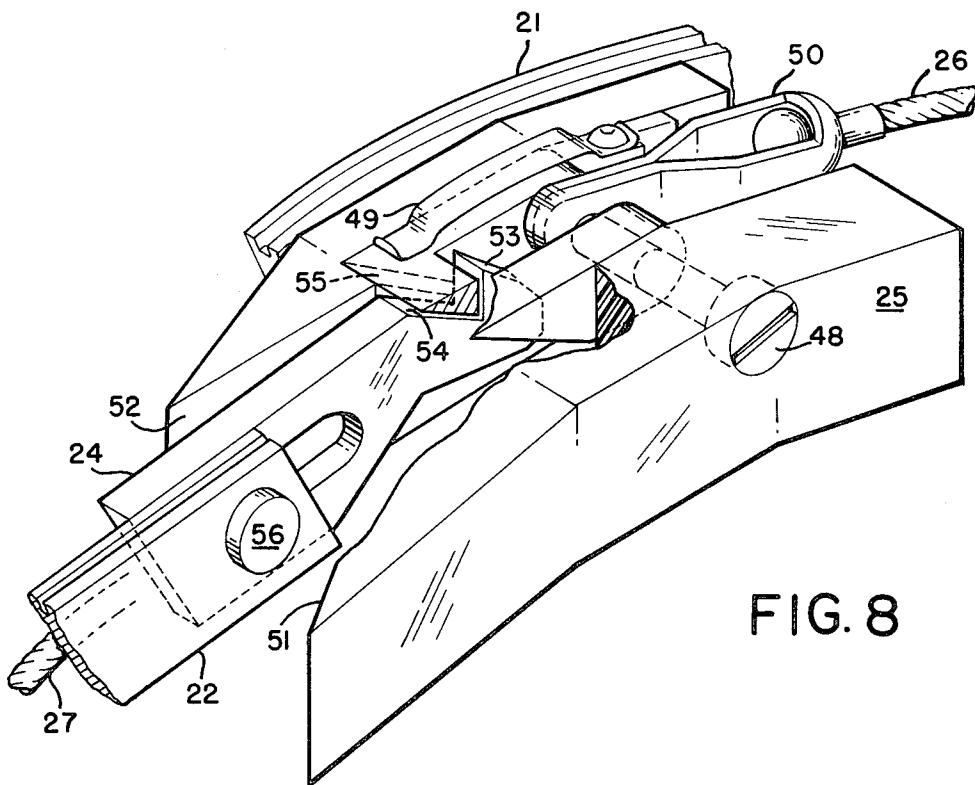


FIG. 8

## MARINE MAMMAL UNDERWATER ATTACHMENT AND RECOVERY TOOL

### STATE OF GOVERNMENT INTEREST

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.

### FIELD OF THE INVENTION

This invention relates to the field of object attachment means. More particularly, but not by way of limitation thereto, this invention relates to an object handler for marine loading and unloading. In still greater particularity, the invention relates to the attachment mechanism to be placed on undersea objects to permit them to be recovered. By way of further description, the invention relates to an object attachment means to be placed on a submarine object by a trained marine mammal.

### DESCRIPTION OF THE PRIOR ART

The number and types of different object grasping and handling devices known in the prior art are so vast as to preclude any general description of the state of the art. However, such tools for recovery of objects from the floor of the sea are more limited in number and generally comprise fitted members which engage with cooperatively shaped receiving pads on the object to be gripped thereby.

There are, of course, a class of grapple devices that cooperate with no particular mating surfaces on the object to be recovered. Such devices, however, are unrelated in concept and operation to the instant invention.

There are also known in the art object holders which grip the object by internal spring mechanisms. However, none of the known devices have proven entirely satisfactory in underwater operations. Their spring mechanisms are subject to becoming fouled by salt water and water borne debris. Further, devices of this type are actuated by volitional movements of the operator of the device independent of the positioning thereof.

Also, the prior art devices offer no positive latching means necessary in recovery of objects from the floor of the sea. Without such a latch means, the attachment to the object afforded by prior art devices is not sufficient to support the lifting forces required to lift the objects to the surface.

In general, there are no prior art devices which are capable of being placed about an object resting on the floor of the sea and attaching a lifting line thereto which may be lightly and easily moved beneath the surface of the water. Such lightness and high lifting strength is of particular value where the device is to be positioned on the object to be lifted by trained animals. There are no object holders in the prior art which have the combination of features to lend themselves to this important application.

### SUMMARY OF THE INVENTION

The present invention provides a lightweight device which may be easily maneuvered beneath the water by a trained animal and when placed on an object to be lifted to the surface, fastens itself thereto. An arcuate

center section supports two motor driven extensible arms which, when released, encircle the object to be lifted. Latch means on the distal ends of said extensible arms are self-connecting to secure the encircling engagement of the object. A lifting cable carried by the arms is also effectively attached about the object to be lifted by the same mechanical elements.

### STATEMENT OF THE OBJECTS OF THE INVENTION

With the foregoing discussion in mind, it is an object of this invention to provide an improved attachment tool.

A further object of this invention is to provide an attachment tool adapted for lifting objects from the bottom of the sea to the surface thereof.

A further object of this invention is to provide a recovery tool which is self-attaching to the object.

A further object of this invention is to provide a recovery tool which may be carried and operated by a trained marine mammal.

A still further object of this invention is to provide a marine mammal operated attachment and recovery tool.

Yet another object of this invention is to provide an object engaging tool which encircles the object to be engaged thereby by means of arcuately extensible arms.

These and other objects of the invention will become more readily apparent from the ensuing specification when taken with the drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view showing the device of the invention as employed in its operational environment;

FIG. 2 is a perspective view of the object of the invention with the extensible arms thereof in the retracted position;

FIG. 3 is a plan view of the device of the invention showing the extensible arms in their extended positions;

FIG. 4 is a sectional view showing the latch release mechanism taken along lines 4—4 of FIG. 3;

FIG. 5 is an enlarged detail of the latch mechanism shown in FIG. 3;

FIG. 6 is an enlarged plan view of the end of one of the attachment arms shown in FIGS. 2 and 3;

FIG. 7 is an end elevation showing the details of the latch means according to the invention; and

FIG. 8 is a perspective view with partial cut away of the latch mechanism.

### DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, the operational environment of applicant's invention is shown. An inflatable vessel 11 with an animal trainer 12 stationed therein deploys trained marine mammals 13. Marine mammal 13 may be of any type commonly used in these operations, however, California sea lions have proved especially adaptable for training and work of this nature. Marine mammal 13 is shown placing the device of the invention 14 on a second object 15. For purposes of illustration, second object 15 is shown as a piece of marine

ordnance. However, it should be obvious that the device of the invention will work equally well on other submerged objects particularly those having a relatively cylindrical shape.

When marine mammal 13 places the recovery tool 14 on the object 15, it returns to inflatable vessel 11. A line attached to the recovery tool is then passed to a suitable support vessel 17, which, by means of suitable tackle mounted thereon, raises the recovered second object. A recovered object 16 is shown being raised from the surface of the water for purposes of illustration.

Referring now to FIG. 2, the engaging tool of the invention will be shown in greater detail. As shown, an arcuate center member 18 is mounted upon a suitable shaped mounting 19 which, in turn, is supported on nose cup 20. Nose cup 20 represents an illustrative type of tool support, however, any suitable body engagement member may be substituted therefor in dependence on the operator of engaging tool 14. For purposes of illustration and completeness, nose cup 20 may be considered to be that shown in copending U.S. Pat. application filed by Ronald L. Seiple on Dec. 30, 1971 Ser. No. 214,227 for "Resilient Marine Mammal Nose Cup." Slidably supported on arcuate center member 18 is a suitably shaped front extensible arm 21 and a rear extensible arm 22. It should be noted that the designators "front" and "rear" have no particular structural significance but refer merely to the position shown in FIG. 2, however, for purposes of uniformity these designators will be used herein. Front and rear extensible arms 21 and 22 are arcuately slidable on arcuate center member 18 by means of tongue and groove engagement therewith. The details of this arrangement will be more clearly described presently.

On the outer end of front extensible arm 21, a suitably configured latch lock 23 is attached. Likewise, on the outer end of rear extensible arm 22 a cooperating latch key 24 is mounted. Latch lock 23 is surrounded by a suitably shaped latch guide 25.

Any suitable material may be used in the construction of the device, however, the choice of materials will depend on the object to be lifted as well as the environmental considerations. In the developmental models, arcuate center member 18 and front and rear extensible arms 21 and 22 have been made of aluminum alloy. Latch lock 23 and latch key 24, however, are made of stainless steel. Latch guide 25 is constructed of polyethylene having a low density.

A front lift cable 26 is attached to latch lock 23 to be carried by the front extensible arm and a similar rear lift cable 27 is attached to latch key 24 to be carried by rear extensible arm 22. Lift cables 25 and 26 may be made of any suitable material including certain non-metallic lines as well as stainless steel wire rope. As in the other components, the choice of materials depends somewhat on the applications to which the device is being placed, as will be readily understood by those skilled in the art.

It will be seen that front lift cable 26 is threaded through a suitable configured rear eye 28 which is attached to rear lift cable 27. Front lift cable 26 terminates in a front eye 29 which, in the illustrated arrangement, is held against nose cup 20 by a suitable retainer 30. Retainer 30 may be made of a resilient

material having a slot cut therein to receive front eye 29 such that eye 29 may be pulled therefrom by exertion of a suitable force. Of course, other arrangements for the temporary securement of front eye 29 may be provided for, for example, a magnetic support might be used where front eye 29 is made of a magnetic material. Again, the choice of constructions of eye holder 30 depend in some degree upon the application to which the engaging tool 14 is to be placed.

Two suitable spring motors 31 are mounted by means of suitably shaped brackets 32 on arcuate center member 18. Spring motors 31 are connected by means of flexible cable or line wound thereon to extensible arms 21 and 22. Spring motors 31 are wound such that they urge extensible arms 22 into the extended position from the open position as shown in FIG. 2. The connection of spring motors 31 to extensible arms 21 and 22 will be described in greater detail herein.

It will also be noted in FIG. 2 that a releasing trigger button 33 is mounted in the center of arcuate center member 18. The function of trigger button 33 together with the mechanism triggered thereby will be described in greater detail presently.

FIG. 3 is a plan view showing the engaging tool of the invention in the released position. It will be observed that extensible arms 21 and 22 have moved from their retracted, or cocked, position to an extended position such that the latch means comprising latch lock 23 and latch key 24 has been engaged to secure the arms into a structurally rigid, circular object holding arrangement.

It will also be observed more clearly in FIG. 3 that extensible arms 21 and 22 each have a cable clip 34 mounted thereon. Cable clip 34 is made of suitable resilient material and engages lifting cables 26 and 27 so as to hold a loop in the end thereof when in the cocked position as shown in FIG. 1. Upon release of the extensible arms by trigger mechanism 33, the arms are driven to the extended position as shown in FIG. 3 and cables 26 and 27 are pulled from beneath cable clips 34.

Referring now to FIG. 4, a cross sectional view of arcuate center member 18 with extensible arms 21 and 22 taken along lines 4—4 of FIG. 2 is shown. It will be observed that arcuate center member 18 has two grooves 35 cut in either side thereof. T-shaped tongues 36 are slidably retained within the grooves 35 by lips 37 thereof. T-shaped tongues 36 depend from extensible arms 21 and 22 and may, if desired, be formed integrally therewith. It will be observed that the corners of T-shaped tongues 36 and lips 37 have been beveled to provide greater clearances, water lubrication, and to generally lessen the chances of extensible arms 21 binding in the arcuate center member 18.

Extensible arms 21 and 22 as well as arcuate center member 18 are shown as being solid unitary metal structures. In this configuration, they may be machined from a solid billet stock. However, as will be obvious to those skilled in the machine tool art, other fabrication techniques might be employed for the construction of these elements. For example, arcuate center member 18 may be made up of arcuate strip stock of varying thicknesses fastened together with threaded fasteners with a solid piece for the center section and four strips providing the wide portion of groove 35 and four wider strips providing the lips 37. In fact, the first developmental models were made in this fashion.

Also shown in FIG. 4 in greater detail is the trigger and cocking mechanism which holds extensible arms 21 and 22 in their retracted position which is shown in FIG. 2. As shown, trigger button 33 is attached to a trigger plunger 38. Trigger plunger 38 extends through a suitably dimensioned bore 39 in arcuate center member 18 to be received in a latch bar 41 which is slidably retained within mounting 19. Latch bar 41 has end portions 42 with opposite facing bevel portions 42 on the ends thereof. Beveled portions 43 engage suitable stops 44 protruding from the surfaces of extensible arms 21 and 22. In the embodiment illustrated, extensible arm stops 44 are comprised by stainless steel, allen-head machine screws threadedly received in extensible arms 21 and 22. As will be obvious to those skilled in the machine tool art, a variety of other latch arrangements might be used in place of that shown. The alternative arrangements may include integral stops made on extensible arms 21 and 22 to be engaged by beveled portions 43 or, the latch bar ends 42 extending over the top of extensible arms 21 and 22 could engage suitable stops in the edges thereof.

Suitable resilient means, such as spring 45, urge latch bar 41 and trigger plunger 38 in the illustrated position thereby latching extensible arms 21 and 22 in the retracted positions. On depression of trigger button 33, trigger plunger 38 carries latch bar 41 rearwardly against the resilient force provided by spring 45 such that the beveled end portions 43 of the latch bar ends 42 clear stops 44 to permit spring motors 31 to drive arms 21 and 22 forward.

This operation may be more readily understood with reference to FIG. 5 which is an enlarged view of the trigger mechanism as shown in FIG. 2 with certain non-relevant portions of the mechanism omitted for purposes of clarity.

Referring to FIG. 6, the arrangement for attaching extensible arms 21 and 22 to spring motors 31 is shown. For purposes of illustration, the attachment will be shown to arm 21, however, it should be recognized that the attachment to extensible arm 22 is identical. It will be observed that flexible cable 46 passes through the side of extensible arm 21 to immerge on the other side thereof and reenter a parallel bore drilled therethrough. Set screws 47 are threadedly engaged to the end of arm 21 to clamp flexible cable 46 and retain it within the arm 21. Flexible cable 46 is wound about spring motor 31. When extensible arms 21 and 22 are in the cocked position, cable 46 is unwound from the spring motor 31 to its full extension and the spring in motor 31 is tensioned or "wound."

Cable 46 is wound upon spring motors 31 in such a fashion that when extensible arms 21 and 22 are withdrawn to be held by latch bar 41, cable 46 is fully extended on spring motor 31. Upon release of extensible arms 21 and 22 by latch bar 41, spring motors 31 rewind cables 36 thereby sliding extensible arms 21 and 22 along their arcuate path determined by the groove 35 in cooperating T-shaped tongue 36 until the latch members on the ends of extensible arms 21 and 22 engage.

Referring now to FIGS. 7 and 8, the operation of the latch portion carried by the ends of extensible arms 21 and 22 will be described. FIG. 7 shows the latch portion in elevation view while FIG. 8 shows the same assembly in a perspective view with portions thereof cut away for

purposes of explanation. It will be seen that latch lock 23 and latch guide 25 are secured to front extensible arm 21 by means of a shouldered threaded fastener 48. Latch guide 25 is configured to receive latch lock 23 in a depression formed therein. Latch lock 23 is resiliently held in this position by suitable means, such as flat spring 49. It will also be observed that lifting cable 26 terminates in a suitable shackle means 50. An aperture in the distal end of shackle means 50 is pierced by shoulder fastener 48 to permit pivotal movement thereabout.

It will be observed that latch guide 25 has two tapered surfaces 51 and 52 on the forward edge thereof. The purposes of tapered surfaces 51 and 52 will become more apparent in the discussion of the mode of operation of the device.

Latch key 24 has a tapered nose portion 53 at the forward end thereof and a suitably shaped notch hook 54 in the upper surface thereof. Notch hook 54 cooperates with the triangular section nose portion 55 of latch lock 23 in a manner to be described presently. Latch key 24 is secured to extensible arm 22 by means of suitable fasteners such as pin 56. Rear lift cable 27 is secured directly to latch key 24 as may be best seen in FIG. 2.

In the illustrated arrangement, latch key 24 is rigidly secured to extensible arm 22 and latch lock 23 is flexibly retained on extensible arm 21. It should be obvious to those versed in the art that latch key 24 could be mounted resiliently on arm 22 and latch lock 23 rigidly secured to arm 21. Of course, if desired, both latch lock 23 and latch key 24 could have limited degrees of flexible mounting. However, the illustrated arrangement has proven satisfactory in developmental models.

#### MODE OF OPERATION

Although the foregoing description and explanation are sufficient to enable one to build the device of the invention, its operation will be better understood with reference to the following description of the mode of operation.

The operation of the device of the invention commences with cocking the recovery tool 14. This is accomplished by sliding extensible arms 21 and 22 to their retracted position as shown in FIG. 2. This retraction winds spring motors 31 by means of flexible cables 46 as previously explained in connection with FIG. 6. Cables 26 and 27 are then placed in the cable clips 34 such as to ensure freedom of movement of the slides which mount extensible arms 21 and 22. That is, the excess cable is maintained in a loop near the distal ends of extensible arms 21 and 22. Front eye 29 is then inserted in eye holder 30 on nose cup 20. Suitable recovery line is attached to eye 29 and nose cup 20 is positioned on the operator of the device, in this case, a trained California sea lion.

As shown in FIG. 1, sea lion 13 swims to a sunken object 15 and, following a trained pattern presses the engaging tool 14 against sunken object 15. When trigger button 33 contacts object 15, latch bar 41 is pressed rearwardly against the action of spring 45 as previously described in connection with FIGS. 4 and 5.

When latch bar ends 42 are clear of extensible arm stops 44, spring motors 31 rewind flexible cable 46 to extend extensible arms 21 and 22 in an arcuate trajec-

tory defined by groove 35 in arcuate center member 18. As the ends of extensible arms 21 and 22 approach one another, latch key 24 is guided by tapered surfaces 51 and 52 into a cooperative engagement with latch lock 23. The tapered nose portion 53 of latch key 24 abuts the nose portion 55 of latch lock 23 forcing it upwards against the resilient biasing action of spring 49. The notch hook 54 has cleared nose portion 55, spring 49 depresses latch lock 23 into engagement such that triangular sectioned nose portion 55 fits within the notch hook 54.

As will be readily appreciated, during the extension of extensible arms 21 and 22, lifting cable 26 and 27 is withdrawn from cable clips 34.

When engaging tool 14 is in place on second object 15, the sea lion 13 frees itself from the friction nose cup 20 and returns to the inflatable vessel 11 where it is rewarded by trainer 12. Trainer 12 is in communication with surface vessel 17 and passes the bitter end of the lifting line previously connected to front eye 29 to personnel aboard surface vessel 17. After appropriate connections are made to the lifting tackle aboard surface vessel 17, sunken object 15 is raised to the surface.

Ordinarily, recovery tool 14 is configured to closely conform to the outer dimensions of sunken device object 15 and is capable of carrying the lifting load as it is raised to the surface. However, in instances where this fit is not exact, the noose like arrangement provided by rear eye 28 extending around front lift cable 26 provides the necessary gripping action.

Although the object of the present invention is shown as being operated by trained animals for lifting ordnance devices, it is manifestly obvious that it may be used for a variety of other purposes and with other, including human, operators. For example, the device may be used to recover oceanographic instrument packages. By replacing nose cup 20 with suitable other gripping means, other operators than marine mammals may use the device of the invention.

The foregoing description taken together with the appended claims constitutes a disclosure such as to enable persons skilled in the oceanographic and mechanical engineering arts and having the benefit of the teachings contained therein to make and use the invention. Further, the structure herein described meets the objects of the invention and, generally, constitutes a meritorious advance in the art unobvious to such a skilled worker not having the benefit of the teachings contained herein.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings, and, it is therefore understood that within the scope of the disclosed inventive concept, the invention may be practiced otherwise than specifically described.

What is claimed is:

1. An object engaging system for attachment to an object resting on the floor of the sea comprising, in combination:

an arcuate center member;

object gripping arm means slidably supported on said center member for arcuate extensive movement between a retracted and an extended position with respect thereto;

motor means attached to said arcuate center member and effectively connected to said object arm means for powering extension thereof with respect to said center member;

latch means mounted on the extensible end of said object gripping arm means for latching said object gripping arm means to encircle said object;

lifting cable means attached to each latch means for encircling said object and providing a lifting noose thereabout.

2. An object engaging system according to claim 1 in which said object gripping arm means includes two object engaging arms mounted on opposite sides of said arcuate center member.

3. An object engaging means according to claim 2 further including:

slot means in opposite sides of said arcuate center member for forming a guiding track therein;

cooperating tongue means extending from one side of each of said object gripping arm means and engaged by said slot means for slidable support of said object gripping arm means upon said arcuate center member.

4. An object engaging system according to claim 2 in which said motor means comprises a pair of spring wound motors.

5. An object engaging system according to claim 4 in which each said spring wound motor is attached to one of said object gripping arm means by a flexible metal cable.

6. An object engaging system according to claim 5 in which said flexible metal cable is wound about its associated spring motor in such a fashion that moving the object engaging arm to its retracted position winds the motor for timely driving said arm to its extended position.

7. An object engaging system according to claim 6 further including:

retaining means effectively mounted on said arcuate center member for engageably holding said object engaging arms in their retracted position; and

trigger means effectively connected to said retaining means and extending through an aperture in said arcuate center member for release of said retaining means when said arcuate center member is pressed against the object to be engaged.

8. An object engaging system according to claim 2 in which said latch means includes; a

latch lock means resiliently carried by one object gripping arm for pivotal movement thereon; and

latch key means rigidly carried on the other gripping arm and positioned to align with said latch lock means and shaped to cooperate with said latch lock means for engaging said latch lock means to form a secure couple therewith.

9. An object engaging system according to claim 8 further including guide means carried by said arm supporting said latch lock means, said guide means being shaped so as to extend about said latch lock means and direct said latch key into cooperative engagement therewith.

10. An object engaging system according to claim 1 in which said motor means comprises a spring wound motor.