Oct. 24, 1961 R. B. COLT ET AL 3,005,215

BUOY AND LIKE FLOATING OBJECT INCORPORATING MEANS FOR RESILIENTLY CONNECTING SAME TO ITS ANCHOR

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FIG. 1.

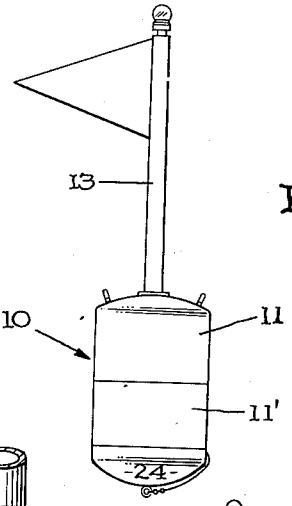


FIG. 2.

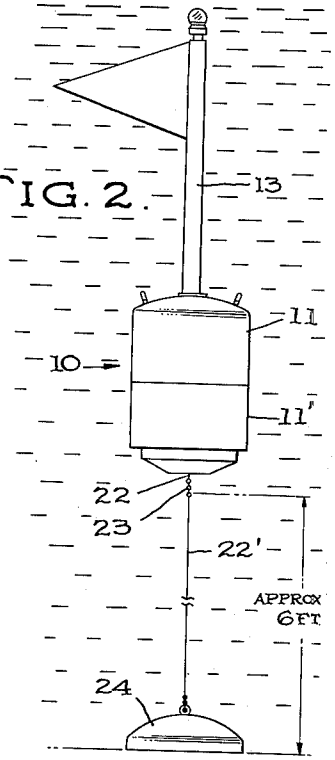
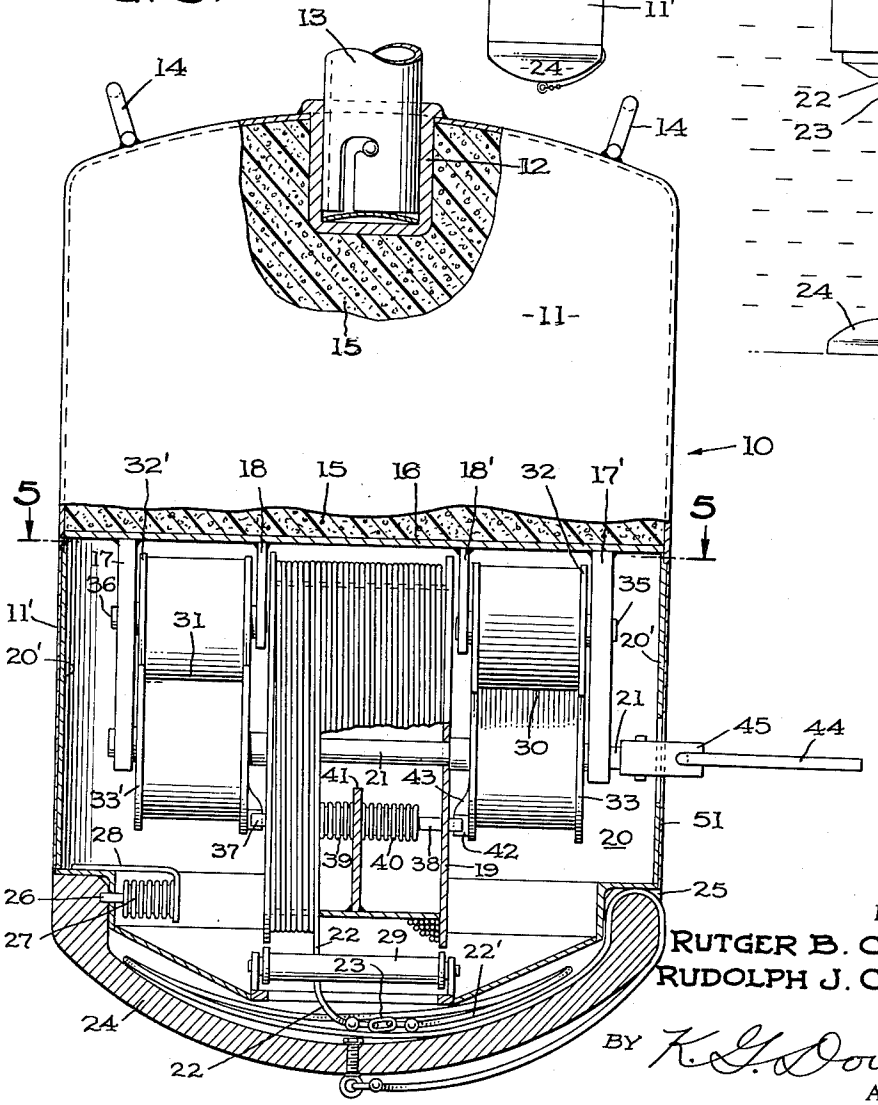


FIG. 3.



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FIG. 5.

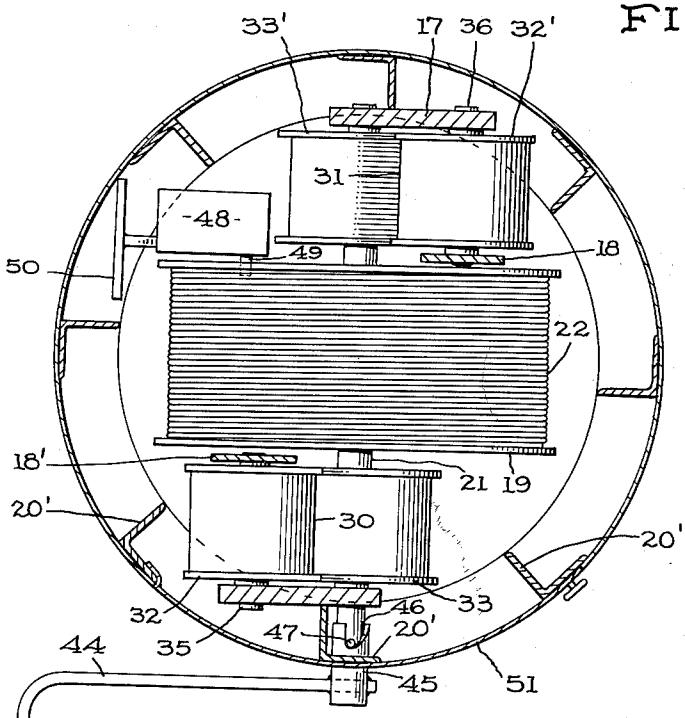
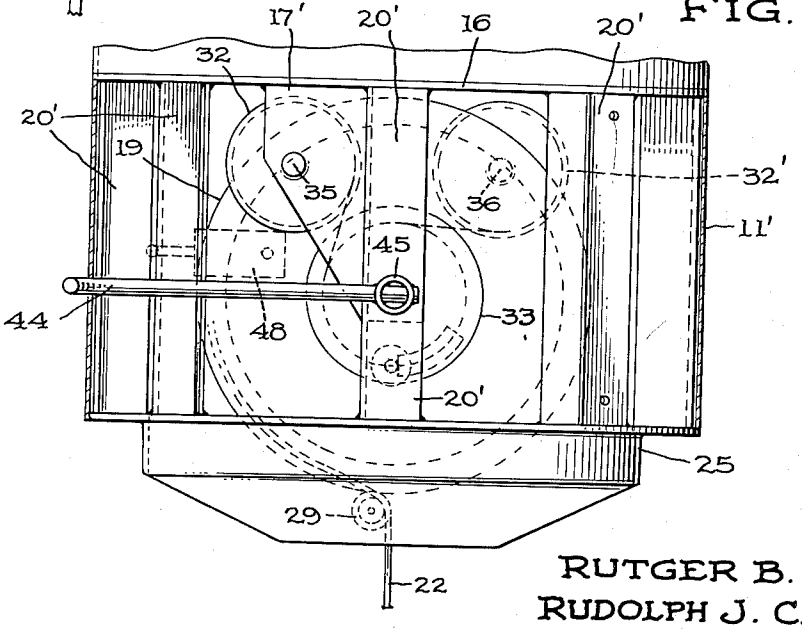


FIG. 4.



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BUOY AND LIKE FLOATING OBJECT INCORPORATING MEANS FOR RESILIENTLY CONNECTING SAME TO ITS ANCHOR

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7 Claims. (Cl. 9—8)

The primary object of the present invention is to provide a marking buoy or the like incorporating improved means for resiliently connecting same to its anchor in a manner such as to prevent flotation forces resulting from "rough" water, rise and fall of the tide, and strong currents from displacing the anchor and hence the buoy itself from its original "planted" position.

A more specific object is to provide a practical and conveniently transportable buoy and anchor combination embodying means whereby when the buoy is "planted," it will remain at or close to its initially anchored position despite rapidly moving currents, rough water conditions and/or rise and fall of the tide. To attain this object, we provide a combined buoy and anchor package incorporating a compact constant-force spring mechanism acting on the anchor cable in a manner such as to minimize the effects of buoy flotation forces on the anchor which might otherwise cause the latter to drift or "walk" and permit the marking buoy to drift from its initial marking position.

Specifications for making buoys, particularly those of the so-called time-delay type which are planted by being dropped into the water from air or water craft and remain submerged until the buoy is automatically released from its anchor, impose limitations on the size and/or weight of the package; and another object of the present invention is to provide a buoy incorporating a constant-force metallic ribbon spring and reel assembly for the anchor cable which may be coordinated with a rotatable cable drum or like cable storage member in a manner such as to permit the use of a spring and reel assembly of limited bulk and weight irrespective of the length of cable required to anchor the buoy when the latter is planted.

A further object is to provide a combination buoy and anchor combination package of the time-delay type incorporating constant-force spring means for the anchor cable which may be "armed" to become effective automatically only after the buoy, following submersion, has been released from its anchor and has risen to within a predetermined depth with respect to the water surface.

Briefly stated, the improved buoy and anchor combination comprises a marking float or buoy proper carrying a housing detachably supporting a contoured anchor member; and this housing defines a floodable chamber within which is located a cable drum or like cable storage member and an operatively related constant-force spring and reel assembly utilizing a spring of the so-called negator type, i.e. a pre-stressed metallic ribbon spring wound on a reel; it has a constant spring-force characteristic such that when the spring is unwound by drawing it from its reel, the torque opposing unwinding remains substantially constant throughout the effective length of the spring. If such a spring is rewound from a first reel onto a second reel arranged to flex the spring in a direction opposite the direction of flexure of the first reel, a constant torque will be exerted on the shaft of the second reel whenever it is driven in a spring-winding or unwinding direction. The "second reel" herein is rotatably mounted on the cable drum shaft, and means are provided for connecting the said second reel to the cable drum for rotation therewith after the cable has been payed out to within a given distance of the length

required for anchoring, thereby permitting the use of a compact spring and reel assembly of limited effective length and size common to all buoys regardless of anchorage depth. The connecting means may be controlled as a function of water pressure and hence depth, so that if the buoy is of the time-delay type adapted to be submerged until released from its anchor after a predetermined lapse of time, or is planted by dropping from a height such as to cause submersion of the "package" before the buoy is released from its anchor, the constant-force spring reel will be automatically clutched to the cable drum when the buoy rises to within a predetermined depth below the water surface.

In the drawings:

FIG. 1 is a view in elevation of a buoy and anchor combination in accordance with the invention;

FIG. 2 is a view similar to FIG. 1 but showing the anchor released from the marking buoy;

FIG. 3 is a view similar to FIG. 1 but showing the marking buoy and its associated mechanism housing broken away with parts in section;

FIG. 4 is a view in side elevation of FIG. 3 with a section of the housing removed; and

FIG. 5 is a view in section taken on the line 5—5, FIG. 3.

Referring to the drawings in detail, a buoy housing **10** has a float chamber section **11** and a cable drum section **11'**; the latter being connected as by welding to the section **11**, or both housings may be made as an integral unit. The top wall of the float section or chamber is provided with a socket **12**, which is adapted to receive a mast **13**, the buoy in this instance being of the spar type. Handles **14** are provided to facilitate handling of the buoy. The float chamber is packed with a buoyant material **15** although it could simply be filled with air.

The bottom wall **16** of the float section **11** has depending therefrom a series of hanger brackets **17**, **17'** and **18**, **18'** for supporting the cable drum and constant-force spring assembly. The cable drum is indicated at **19**; it is located in the chamber **20** defined by the housing section **11'** and is secured on and rotates with a shaft **21**, which at its outer extremities is mounted in bearings carried by the hanger brackets **17** and **17'**. (In certain installations, the cable drum remains fixed and the anchor cable is trained over pulleys mounted on the outer and inner ends of a rotating arm having its inner end secured on a rotatable shaft projecting from the center of the drum.) A series of reinforcing angles **20'** line the wall of the chamber **20**. A cable **22** is wound on the drum **19**; it has an extension **22'** to which it (cable **22**) is connected by means of a swivel assembly **23**, the said extension **22'** in turn being connected to an anchor **24**, which is preferably of generally concavo-convex shape and has its peripheral flange or rim contoured to engage seat **25**, formed at the bottom of the housing section **11'**. The anchor is preferably releasably connected to the housing section **11'** by means of a plurality of slidable locking pins **26** (one only of which is visible in FIG. 3) which project from the free or movable ends of pressure-sensing devices such as the spring-loaded bellows **27**, which are anchored to the bottom wall of the housing section **11'** by brackets **28**. As will be obvious, when the bellows **27** are subjected to a predetermined pressure, they will collapse and release the locking pins **26**, freeing the anchor **24** from its support. A guide roller **29** is provided for the cable **22**.

A pair of so-called "negator" springs are indicated at **30** and **31**. Each spring is originally wound on a take-up reel **32**, **32'** and unwinds on an output reel **33**, **33'**. The take-up reels **32**, **32'** are mounted on shafts **35**, **36** journaled in the brackets **17**, **18** and **17'**, **18'**, while the output reels **33** and **33'** are rotatably or loosely mounted

on the drum shaft 21 for the cable reel or drum 19. The springs on the take-up reels 32, 32' resist unwinding and hence the anchor cable is placed under spring tension; but regardless of whether the spring is being pulled out or taken up as a result of flotation forces increasing above or dropping below the torque exerted by the negator spring, the tension on the cable will remain substantially constant. As heretofore indicated, the springs 30, 31 are made of pre-stressed ribbon steel and are wound on their coacting reels in a manner such as to cause the spring to flex in opposite directions whenever a spring is wound on one reel and unwound from its coacting reel. Springs of this type are known as "negator" springs and may be purchased in the open market. The windup torque exerted by the take-up reels is of a value such as to permit the buoy to "give" and absorb the shocks of changes in flotation forces without transmitting forces of displacement magnitude to the buoy anchor.

The cable drum 19 is releasably connected to the adjacent output reels 33 and 33' by means of locking pins 37 and 38, which project from the free or movable ends of spring-loaded bellows 39 and 40, each anchored at its opposite end to a radially inwardly projecting member 41, carried by the peripheral wall of the drum. The outer free ends of the pins 37, 38 are adapted to engage in recesses 42, formed in cam members 43, which may be secured to or form part of the adjacent side wall of the reels 33 and 33'. When the bellows 39 and 40 are subjected to collapsing pressure, the pins 37 and 38 will be retracted, freeing the cable drum 19 from its connection with the output reels 33 and 33'. When the pressure drops below a predetermined value, however, the bellows will have expanded to a point where the locking pins engage in the recesses 42, whereupon the cable drum will be connected to the output reels 33, 33' and be under the influence of the negator spring. The pin-contacting surfaces of cams 43 are sloped in a direction to facilitate engagement of the pins 37, 38 in the recesses 42 during rotation of the drum.

A removable handle or crank 44 may be connected to the outer end of the cable drum shaft 21 by means of a socket member 45, having a locking slot 46, adapted to receive a pin 47, fixed in shaft 21, to enable the cable to be rewound manually whenever desired. The box indicated at 48 (note FIG. 5) contains timing mechanism which may be of any conventional type and forms no part of the present invention; it controls a locking pin 49 which is adapted to engage in a recess in the adjacent wall of the cable drum 19. A time-setting handle is indicated at 50. At will be obvious, the timing mechanism is for use in the so-called time-delay type of buoy; it may be set to release the pin 49 from the cable drum at a predetermined time after the buoy has been "planted" and allow the buoy to rise to the surface of the water. Obviously, if the pressure-responsive locks 26, 27 are used in addition to the time lock, the anchor will not be released unless the buoy has sunk to a depth such as will cause the bellows 27 to collapse. Normally, the release depth would be relatively shallow in a time-delay buoy, since the primary function of the pressure anchor lock when the time lock is used is to hold the anchor stable until the buoy is planted. If a time lock is not used, the pressure locks serve to release the anchor immediately when the buoy has sunk to a predetermined depth.

Operation

While the buoy as herein disclosed may be considered of the all-service type, it has been particularly devised for service as a time-delay buoy, i.e. one which when dropped from an aircraft, for example, in the form of a package made up of an anchor and buoy combined sinks to the bottom of a body of water and the buoy is subsequently freed from its anchor by time-controlled mechanism and rises to the surface. The following description of operation applies to a buoy of the time-delay type.

The buoy and anchor combination or package as shown in FIGS. 1 and 3 is ready for planting, the anchor 24 having been connected to the inset bottom wall of the housing 11' by the locking pins 26, the anchor cable 22 is fully wound upon its drum 19, the negator springs 30, 31, or the major portions thereof, are wound upon the take-up reels 32 and 32', and the drum and reel locking pins 37, 38 are projected outwardly into locking position; and it also may be assumed that the timer mechanism has been set to retract the locking pin 49 at some predetermined time. If the entire package is dropped into a body of water, it will sink to the bottom (assuming a reasonable depth); and during this brief period the pressure will overcome the bellows 27 and the locking pins 26 will retract, freeing the buoy housing from its anchor. The buoy or buoy housing now rises to a point where it takes up the slack on the extension 22', note FIG. 2; and it will remain in this position until the timing mechanism 48 retracts the locking pin 49. The collapsing pressure for the bellows 39, 40 may be of a value such as will cause the locking pins 37 and 38 to be projected into drum-and-reel locking position whenever the buoy is at or above a depth of say 20 feet. Hence the said locking pins 37, 38 will retract whenever the buoy sinks below that depth and will remain retracted until after the timing mechanism operates and the buoy rises back up to within approximately 20 feet of the surface of the water. Thus as the buoy approaches the surface, following submersion and release of the drum by the timer mechanism, and the water pressure in the chamber 20 drops below the spring setting of the bellows 39, 40, the locking pins 37, 38 move outwardly and engage in the cam recesses 42, whereupon the cable drum is connected to the negator spring output reels 33, 33' and the said drum comes under the influence of the constant-force spring action provided by the springs 30, 31. The fully wound negator springs 30, 31 now partly unwind from the take-up reels 32, 32' as the buoy continues to rise to the surface of the water, and the unwound lengths wind on the output reels 33, 33'.

When the buoy is riding at or near the surface of the water, any flotation forces resulting from fast currents, rise and fall of the tide, or wave conditions will tend to displace the buoy temporarily from its marking position, but it will always return to its marking area due to the wind-up torque exerted on the cable drum shaft by the negator springs 30 and 31. However, irrespective of the distance of displacement (within reasonable limits), the force exerted on the anchor cable will remain substantially constant and will be well within the limits of the force necessary to displace the anchor 24 and cause the latter to "walk" from its planted position. Since the negator spring system acts on the cable drum for only a predetermined part of the overall cable length, the system automatically adapts itself to varying depths of water. Furthermore, the spring system or assembly need not be unduly large or bulky.

If the buoy is to be used as a permanent marking buoy, the constant-force spring mechanism still contributes the important advantage of preventing drift, and this means that the anchor need not be unduly heavy or large, thereby reducing labor and transportation costs involved in planting heavier buoys.

Obviously, the buoyant device to be anchored need not necessarily be a buoy; it could be any type of water craft or floating object utilizing a cable and cable drum or wrench for connecting the device to its anchor.

While the invention has been shown applied to only one type of buoy, it will be obvious that it could be applied to other types without the exercise of the inventive faculties once the basic concept has become known to those having a layman's knowledge of the art. For ex-

ample, certain types of buoys utilize a relatively stationary or non-rotatable type of cable drum or analogous cable-storage member and the cable is wound on and unwound from the drum by means of a rotating arm secured on the cable drum shaft and carrying guide pulleys over which the cable is trained. In such an arrangement, the output reel for the negator spring (corresponding to reel 33) would act on the shaft for the rotating arm, which shaft usually projects through the center of the non-rotating cable drum. Thus the constant force spring and reel assembly may be readily adapted to any type of buoy having a rotatable member which controls the winding and unwinding of the anchor cable.

What we claim is:

1. A combination marking buoy and anchor therefor comprising a housing defining a buoyant chamber, means for releasably connecting an anchor to the housing, an anchor cable for connecting the buoy to its anchor, means for storing said cable in coiled condition in said housing exterior of said chamber, means for uncoiling and guiding said cable when the anchor is released and drops to anchoring position including a member which rotates in relation to the effective length of the cable required to anchor the buoy, a spring take-up reel having a metallic prestressed constant force ribbon spring wound thereon, a spring output reel adapted to rotate with said rotatable member and to have said spring wound thereon and unwound therefrom in response to variations in flotation forces acting on the buoy when the anchor is in anchored position, and means for connecting said rotatable member to said output reel for rotation in unison therewith after the cable has been payed out to within a predermined distance of anchoring depth.

2. In a combination, a buoyant device and an anchor therefor, an anchor cable for connecting said device to its anchor, a rotatable cable drum, a spring take-up reel having a prestressed constant-force ribbon spring wound thereon, a spring output reel adapted to rotate with said cable drum and to have said spring wound thereon and unwound therefrom in response to variations in flotation forces acting on the buoyant device when said anchor is in anchoring position and said device is riding on the surface of the water, and means for automatically disconnecting said drum from said output reel when said buoyant device is submerged beyond a given depth and to reconnect the drum to the output reel when said device is freed from its anchor and rises to approximately said given depth.

3. A combination buoy and anchor package comprising: a buoyant housing, an anchor releasably connected to said housing, a rotatable cable drum and a shaft therefor mounted in said housing, an anchor cable wound on said drum and connected at its free end to said anchor, a constant-force spring assembly comprising an output reel loosely mounted on said shaft and a take-up reel having a pre-stressed constant-force ribbon spring wound thereon and adapted to be wound on and unwound from said output reel in response to variations in flotation forces acting on the buoy, and means for automatically connecting said drum to said output reel after said package has been "planted" in a body of water and the housing has been freed from its anchor and has risen to a predetermined depth.

4. A combination buoy and anchor package comprising: a buoyant housing, a contoured anchor adapted to engage the bottom of said housing, pressure-responsive means for releasably connecting said anchor to said housing, a rotatable cable drum and a shaft therefor mounted in said housing, an anchor cable wound on said drum and connected at its free end to said anchor, a constant-force spring assembly comprising an output reel mounted for free rotation on said shaft and a take-up reel having a pre-stressed constant-force ribbon spring wound thereon and adapted to be wound on and unwound from said output reel in response to variations in flotation forces acting on the buoy, and pressure-responsive locking means carried by said drum and adapted to connect the drum to the output reel for rotation therewith or free the drum from the output reel, depending upon the depth at which said housing may be riding.

5. A combination marking buoy and anchor therefor comprising a housing defining a buoyant chamber, means for releasably connecting an anchor to the housing, an anchor cable for connecting the buoy to its anchor, means for storing said cable in coiled condition in said housing exterior of said chamber, means for uncoiling and guiding said cable when the anchor is released and drops to anchoring position including a member which rotates in relation to the effective length of the cable required to anchor the buoy, a spring take-up reel having a metallic prestressed constant-force ribbon spring wound thereon, a spring output reel adapted to rotate with said rotatable member and to have said spring wound thereon and unwound therefrom in response to variations in flotation forces acting on the buoy when the anchor is in anchored position, and pressure-responsive means for connecting said rotatable member to said output reel for rotation in unison therewith after the cable has been payed out to within a predetermined distance of anchoring depth.

6. A combination buoy and anchor therefor comprising: a buoyant housing, an anchor, pressure-responsive means releasably connecting said anchor to said housing, a cable drum rotatably mounted in said housing, an anchor cable wound on said drum and connected at its free end to said anchor, a constant-force spring assembly comprising an output reel adapted to be connected to and rotate with said drum and a take-up reel having a prestressed constant-force ribbon spring wound thereon and adapted to be wound on and unwound from said output reel in response to variations in flotation forces acting on the buoy and tending to rotate the drum.

7. A combination buoy and anchor package comprising: a buoyant housing, an anchor releasably connected to said housing, a rotatable cable drum and a shaft therefor mounted in said housing, an anchor cable wound on said drum and connected at its free end to said anchor, a constant-force spring assembly comprising an output reel loosely mounted on said shaft and a take-up reel having a prestressed constant-force ribbon spring wound thereon and adapted to be wound on and unwound from said output reel in response to variations in flotation forces acting on the buoy, and latch means controlled by a device responsive to changes in water pressure for automatically connecting said drum to said output reel after said package has been "planted" in a body of water and the housing has been freed from its anchor and has risen to a predetermined depth.

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