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(54) **Underwater tow system and method.**

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Description

This invention relates to an underwater tow system and method according to the precharacterising part of patent claims 1 and 21, respectively.

A tow system of the aforementioned kind is known from DE—B—1 045 860. In this reference, an underwater sonic system is disclosed in which a submerged tow vehicle is connected to a vessel travelling on the surface of the sea by a tow cable, the free end of which is connected to a weight body contacting the seabed. An arm extending from the front side of the tow vehicle and being rigidly secured thereto is pivotally connected to a clamping means which, in turn, is connected to the tow cable at a predetermined distance from the weight body. The tow vehicle has a neutral buoyancy in water so that it is kept in a horizontal position under the influence of the movement of the vessel towing the cable.

From FR—A—2 270 141, FR—A—2 274 501 and DE—C—334 689, systems for maintaining a self-propelled, underwater travelling vessel at a predetermined distance to the seabed are known. These systems comprise a tow rope being connected to the submarine vessel and having a flexible end which contacts the seabed. By changing the length of the cable being wound on a drum, the distance between the vessel and the seabed may be influenced. The same principle for maintaining the distance to the ground is, for instance, also used with airborne balloons in the landing stage.

In the first-mentioned underwater tow system, the tow vehicle may be influenced by erratic movements of the vessel or cable due to the rather rigid connection of the tow vehicle to the cable. It is, therefore, the object of the present invention to provide an underwater tow system in which the tow vehicle follows the ground closely and is effectively immunised from erratic movements by the vessel or cable.

This object is solved by the characterising features of patent claim 1. Preferred embodiments of the invention and a method for towing a vehicle underwater are the subject matter of further claims.

The invention and its advantages and embodiments will become apparent from a consideration of the following detailed description, presented in connection with the accompanying drawings in which:

FIG. 1 is a side view of an underwater tow system made in accordance with the present invention, showing the system as it could be utilised underwater;

FIG. 2 is a side elevation view of the tow vehicle of FIG. 1, showing the positioning of some of the components in the vehicle;

FIG. 3 is a fragmented, perspective view of the fairlead assembly of the underwater tow system of FIG. 1.

FIG. 4 is a cross-sectional view of the clamp of FIG. 3 taken along lines 4—4;

FIG. 5 is a front view of the coupling apparatus for coupling the chain of FIG. 3 to the fairlead assembly; and

FIG. 6 is a side view of the coupling apparatus for coupling the tow cable to the tow vehicle.

Detailed Description

Referring to FIG. 1 there is shown an underwater tow system 4 made in accordance with the present invention and being towed by a surface vessel 8. The tow system 4 is coupled by way of a tow cable 12 to a winch 16 on the vessel. The tow cable 12 includes, in a conventional manner, electrical conductors for connecting electrical apparatus on board the ship 8 with underwater apparatus housed in a tow vehicle 20 of the underwater tow system.

The underwater tow system 4 includes the tow vehicle 20 (see FIGS. 1 and 2) formed generally in the shape of a torpedo and having an elongate cylindrical body 24 rounded on a front end 28 thereof. The rear of the body 24 tapers inwardly to accommodate three fins 32 circumferentially spaced about the body. The streamlined shape of the tow body 24, together with the fins 32, serve to stabilize movement of the tow vehicle through the water.

Eyelets 36 are attached to the top of the body 24 at spaced apart locations to provide coupling or lifting elements by which the tow vehicle 20 may be lifted from the water.

Illustrative parameters of the tow vehicle 20 are a body length of about 17 feet, a body diameter of 3 feet, and a weight of 1500 pounds in air (when component electrical apparatus is included). The tow body 20 is constructed to be buoyant in water, with a net buoyant force of about 250 pounds. Buoyancy is achieved by including within the tow body 24 a plurality of syntactic foam cylinders, balls or blocks 42 positioned against the inner wall of the body as shown in FIG. 2, and held in place, for example, by epoxy. Of course, other buoyant material might also be utilized provided such material did not interfere with operation of electrical equipment contained in the tow vehicle. Syntactic foam has been found to be suitable since it does not resonate to thereby create interference with acoustical equipment which might be utilized on the tow vehicle.

Also included in the tow vehicle is a conventional pinger 44 which is arranged to automatically commence transmitting an acoustical signal when power to the pinger is interrupted. This would occur if, for example, the tow vehicle were detached from the tow cable. A light beacon 46 is positioned on top of the tow vehicle to emit light if the tow vehicle floats to the surface. That is, the light beacon is attached to emit light when the water pressure falls below some level indicating that the vehicle is nearing the surface.

A fairlead assembly 40 interconnects the tow cable 12 with the tow vehicle 20 and with a chain weight 48. The chain weight 48 includes a plurality of links, an end one of which is coupled to the fairlead assembly 40. The chain weight is

provided to pull the tow vehicle 20 and tow cable 12 downwardly in the water until the chain contacts the sea floor. As the ship 8 moves in the water, the chain weight 48 will drag over the sea floor and, since the tow vehicle 20 is buoyant, the tow vehicle will "fly" or move through the water at a substantially constant predetermined distance above the sea floor. This distance depends upon the towing speed and the length of the cable or coupling between the fairlead assembly 40 and the tow vehicle 20. For a tow vehicle having a buoyant force of about 250 pounds, a weight for the chain 48 advantageously is about 2000 pounds. This weight, it has been found, is sufficient to dampen small erratic movements by the tow cable 12 caused either by sea currents or by small speed surges of the vessel 8. Because of this dampening effect, the tow vehicle 20 remains more stable as it is pulled through the water. That is, the yaw, heave and roll which might otherwise occur in the tow vehicle 20 by reason of erratic movements of the tow cable 12 are reduced. Also, in the event that the ship 8 comes to a halt, the tow vehicle 20, being buoyant, will continue to float above the sea floor and not "crash" into the floor or other sea floor obstacle.

Although other types of weighting devices could be used, it has been found that the use of a chain 48 is advantageous since the total weight can be readily modified by simply removing or adding links. Also, slight variations in the speed of the ship will generally result simply in a few more (or less) chain links contacting the sea floor to still maintain the elevation of the tow vehicle 20 at a substantially constant height above the sea floor. Thus there is not a single speed threshold level at which the weight is lifted from the sea floor as might be the case with a unitary weight.

FIG. 3 shows a more detailed perspective view of the fairlead assembly 40 of FIG. 1. This assembly is swivelably coupled by an electro-mechanical coupler 54 to the cable 12. The coupler 54 is of conventional design. The assembly 40 includes a saddle 52 composed of a curved channel 56 into which the cable 12 is inserted, and a pair of skirts 60 which extend downwardly on either side of the cable 12 as shown. An elongate upper extension of the channel 56 and skirts 60 is placed in a clamp 64 for clamping the fairlead assembly onto the cable 12. The cable 12 thus runs through the channel 56, between the skirts 60, and generally curves with the curvature of the channel.

The clamp is shown in greater detail in FIG. 4, which is a cross-sectional view thereof taken along lines 4—4 of FIG. 3. As shown in FIG. 4, the clamp includes a top plate 68 and a bottom plate 70 held in a clamping relationship by bolts 72. The channel 56 of the fairlead assembly 52 which is held between the clamp includes a friction pad 74. A channel element 78 is welded to the plate 70 and includes therein a similar friction pad 76. These pads are shaped to fit snugly about the tow cable 12 to hold the tow cable in place when the clamp is tightened. Advantageously, the fric-

tion pads 74 and 76 are made of lead to deform against the cable as the clamp is tightened. The pads are held in place in the channel 56 and the channel element 78 by pressure. The side walls of the two channels 56 and 78 will mate to prevent damage to the cable 12 in the event the bolts 72 are tightened too tight.

Referring again to FIG. 3 and also to FIG. 5, it will be seen that the fairlead assembly 52 also includes a coupling mechanism 80 interconnecting the skirts 60 to the chain weight 48. The coupling mechanism 80 includes a first clevis 82, the free ends of which extends about the skirts 60 to align openings in the ends of the clevis with openings in the skirt 60 through which a clevis pin 84 is inserted. A cotter pin 86 then secures the clevis pin 84 in place to thereby secure the clevis 82 on the skirts 60.

The base of the clevis 82 is swivelably attached by way of a bit 88 to the base of a second clevis 90, as best seen in FIG. 5. A shear pin 92 extends through aligned openings in the free ends of the clevis 90 and through a sleeve 94. A shackle 96 is fitted in place about the sleeve 94 and this shackle is then linked with the end link of the chain weight 48 to secure the chain weight onto the fairlead assembly. The shear pin 92 is selected so as to break and release the shackle 96 from the clevis 90 when the shackle is subjected to some predetermined pulling force. Thus, if the chain gets caught on the sea bottom, the shear pin 92 will release the chain to thus avoid possible damage to the fairlead assembly which might otherwise occur if the chain weight 48 were allowed to continue pulling on the assembly. The breaking strength of the shear pin 92 must, of course, be greater than the weight of the chain 48 so that while being launched in the water, the chain doesn't cause the shear pin to break. For a chain weight of about 2000 pounds, the breaking strength of the shear pin 92 might illustratively be 4000 pounds.

FIG. 6 shows a side view of a connector mechanism by which the tow cable 12 is coupled to the underneath side of the body 24 of the tow vehicle 20. This connecting apparatus includes a gripping element 100 suitable for connection to the end of the tow cable 12. An exemplary gripping element might be the element known as Dyna-Grip produced by Preformed Line Products Inc. of Cleveland, Ohio. The end of the gripping element 100, opposite the end at which the element is connected to the tow cable 12, is formed into a clevis and includes a clevis pin 102 which is inserted in aligned openings in the ends of the clevis to extend through the opening in a tongue 104 inserted in the clevis. The tongue 104 is attached to a yoke 106 which includes aligned openings through which a shear pin 108 extends. The shear pin 108 also extends through another coupling element 110 which extends within a yoke 112 which is coupled to the underneath side of the body 24 of the tow vehicle. The shear pin 108 has an illustratively breaking strength of about 10,000 so that if the tow vehicle gets caught

on some type of underwater obstruction, the pin will break and release the tow vehicle to allow it to float to the surface and be recovered. Upon release by the shear pin 108, electrical connectors 116 and 120 (such as the ER type waterproof connectors produced by Boston Insulated Wire Co.) are pulled apart interrupting electrical power to the pinger 44 and this causes the pinger (FIG. 2) to emit acoustical signals which may be detected on the towing ship to indicate the location of the tow vehicle. In addition, the beacon light 46 begins emitting light signals as the vehicle reaches the water surface. The positioning of the buoyant material 42 maintains the tow vehicle 20 upright on the surface so that the beacon light 46 remains out of water. The connection between the tow vehicle and the cable 12 allows pivoting in two degrees.

In use, it may be advantageous simply to pay out a sufficient amount of tow cable 12 so that while towing the tow vehicle, a portion of the cable itself drags over the sea floor. Allowing a portion of the tow cable 12 to drag on the sea floor, as well as the chain weight 48, serves to further isolate the effects of erratic movement of the ship 8 from the tow vehicle 20 and to alleviate the ship winch operator from trying to maintain only the chain weight 48 in contact with the sea floor.

Claims

1. Underwater tow system (4) adapted for being towed by a tow cable (12) behind a vessel (8), the system including a tow vehicle (20) for housing apparatus to be used under water, a weight means (48) connected to the tow cable (12) and having a weight sufficient to pull the tow vehicle (20) downwardly in the water until the weight means (48) contacts the water floor, characterized in that the end of the tow cable (12) is connected to the tow vehicle (20), that means (40) are provided for coupling the weight means (48) to the tow cable (12) at a predetermined distance from the tow vehicle (20) and that the tow vehicle (20) has a positive buoyancy in water.

2. Underwater tow system according to claim 1, characterized in that the buoyancy force of the tow vehicle (20) is about one-fourth the weight of the weight means (48) in water.

3. Underwater tow system according to claim 1 or 2, characterized in that the tow vehicle (20) has a generally elongate cylindrical body rounded on a front end thereof and that the coupling means (112) is located forwardly on the underneath side of the body (24).

4. Underwater tow system according to any one of the claims 1 to 3, characterized in that the tow vehicle (20) is provided with a pair of lifting elements (36) spaced apart along the length of the body (24) on the upper surface thereof by which the tow vehicle (20) may be lifted.

5. Underwater tow system according to any one of the preceding claims, characterized in that the interior of the tow vehicle (20) is provided with a

plurality of buoyant elements (42).

6. Underwater tow system according to claim 5, characterized in that the buoyant elements (42) are comprised of syntactic foam.

7. Underwater tow system according to claim 5 or 6, characterized in that the buoyant elements (42) are positioned against the upper wall of the body (24) of the tow vehicle (20).

8. Underwater tow system according to any one of the preceding claims, characterized in that the weight means comprises a chain (48) having a plurality of links, and one end of which is coupled to the coupling means (112) or the tow cable (12).

9. Underwater tow system according to claim 8, characterized in that the buoyancy force of the tow vehicle (20) is about 113 kg and the weight of the chain (48) is about 906 kg.

10. Underwater tow system according to claim 8 or 9, characterized in that the chain is about 6 m in length.

11. Underwater tow system according to any one of the preceding claims, characterized by a shear element (40) connecting the weight means (48) to the coupling means (112) or the tow cable (12) and releasing when subjected to a certain force.

12. Underwater tow system according to claim 11, characterized in that the shear element (40) comprises a clevis (90) connected at its base to the coupling means (52) or to the tow cable (12) and including in-line openings in the free ends of the clevis, a shear pin (94) inserted through the openings in the clevis (90) and adapted to shear or break when subjected to the certain force, and a connector (96) for connecting the shear pin (94) to the weight means (48).

13. Underwater tow system according to claim 12, characterized in that said shear element (40) further comprises a second clevis (82) swivelably connected at its base to the base of the first clevis (90), the free ends of the second clevis (82) being connected to the coupling means (52) or tow cable (12).

14. Underwater tow system according to any one of the preceding claims, characterized by a second shear element (100) for connecting the tow vehicle (20) to the coupling means (112) or the tow cable (12) and for releasing when subjected to a certain force.

15. Underwater tow system according to claim 14, characterized in that the tow vehicle (20) includes a signal producing means (44) for producing a signal to enable a user to locate the tow vehicle (20) in the event that the second shear element releases to allow the tow vehicle (20) to float to the water surface.

16. Underwater tow system according to any one of the preceding claims, characterized by swivel means (82, 88, 90) for swivelably interconnecting the cable to the coupling means (60, 112).

17. Underwater tow system according to any one of the preceding claims, characterized by a fairlead assembly (40) for connecting the weight means (48) to the tow cable (12), the fairlead

assembly comprising saddle means (52) for fitting over the tow cable (12), the saddle means including a pair of skirts (60) extending downwardly on each side of the tow cable (12), a clamp (64) for clamping the saddle means (52) to the tow cable (12), and means for attaching the weight means to the skirts (60) of the saddle means (52).

18. Underwater tow system according to claim 17, characterized in that the attaching means (80) includes means (82, 88, 90) for swivelably attaching the weight means (48) to the skirts (60) of the saddle means (52).

19. Underwater tow system according to claim 17 or 18, characterized in that the attaching means (80) includes a shear element (94) for releasing the weight means (48) from attachment to the skirts (60) of the saddle means (52) when subjected to a certain pulling force on the weight means (48).

20. Underwater tow system according to any one of claims 17 to 19, characterized in that the clamp (64) includes a friction pad (74) made of lead for contacting the tow cable (12).

21. Method of towing a tow vehicle underwater comprising coupling the tow vehicle to a towing vessel by way of a tow cable, providing a weight means coupled to the tow vehicle or the cable for causing the tow vehicle to sink in the water until the weight means contacts the water floor, and moving the towing vehicle in the water at a speed which allows the weight means to drag on the floor, characterized in that the tow vehicle is made buoyant and is coupled to the tow cable so as to float thereabove.

22. Method according to claim 21, characterized by paying out the tow cable from the towing vessel until a portion of the tow cable contacts and drags on the water floor.

Patentansprüche

1. Unterwasserschleppvorrichtung (4), die dazu eingerichtet ist, von einem Schleppkabel (12) hinter einem Schiff (8) geschleppt zu werden, wobei die Vorrichtung einen Schleppkörper (20) zur Aufnahme eines unter Wasser zu benutzenden Gerätes, eine Gewichtseinrichtung (48), die mit dem Schleppkabel (12) verbunden ist und ein Gewicht hat, das ausreichend ist, um den Schleppkörper (20) im Wasser nach unten zu ziehen, bis die Gewichtseinrichtung (48) Grund berührt, dadurch gekennzeichnet, daß das Ende des Schleppkabels (12) mit dem Schleppkörper (20) verbunden ist, daß Einrichtungen (40) vorgesehen sind, um die Gewichtseinrichtung (48) mit dem Schleppkabel (12) in einer vorbestimmten Distanz vom Schleppkörper (20) zu verbinden, und daß der Schleppkörper einen positiven Auftrieb in Wasser hat.

2. Unterwasserschleppvorrichtung nach Anspruch 1, dadurch gekennzeichnet, daß die Auftriebskraft des Schleppkörpers (20) ungefähr ein Viertel des Gewichts der Gewichtsvorrichtung (48) in Wasser beträgt.

3. Unterwasserschleppvorrichtung nach An-

spruch 1 oder 2, dadurch gekennzeichnet, daß der Schleppkörper (20) einen im wesentlichen langgestreckten zylindrischen Körper hat, der an seinem vorderen Ende abgerundet ist, und daß die Verbindungseinrichtung (112) vorne an der Unterseite des Körpers (24) angeordnet ist.

4. Unterwasserschleppvorrichtung nach einem der Ansprüche 1 bis 3, dadurch gekennzeichnet, daß der Schleppkörper (20) mit einem Paar Hebeelementen (36) versehen ist, die im Abstand längs der Länge des Körpers (24) an der Oberseite desselben angeordnet sind, mit denen der Schleppkörper (20) gehoben werden kann.

5. Unterwasserschleppvorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das Innere des Schleppkörpers (20) mit einer Mehrzahl von Auftriebsselementen (42) versehen ist.

6. Unterwasserschleppvorrichtung nach Anspruch 5, dadurch gekennzeichnet, daß die Auftriebsselemente (42) aus synthetischem Schaum bestehen.

7. Unterwasserschleppvorrichtung nach Anspruch 5 oder 6, dadurch gekennzeichnet, daß die Auftriebsselemente (42) an der oberen Wand des Körpers (24) des Schleppkörpers (20) angeordnet sind.

8. Unterwasserschleppvorrichtung nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Gewichtsvorrichtung eine Kette (48) aufweist, die eine Merzahl von Gliedern enthält und von der ein Ende mit der Verbindungseinrichtung (112) oder dem Schleppkabel (12) verbunden ist.

9. Unterwasserschleppvorrichtung nach Anspruch 8, dadurch gekennzeichnet, daß die Auftriebskraft des Schleppkörpers (20) ungefähr 113 kg und das Gewicht der Kette (48) ungefähr 906 kg beträgt.

10. Unterwasserschleppvorrichtung nach Anspruch 8 oder 9, dadurch gekennzeichnet, daß die Kette ungefähr 6 m lang ist.

11. Unterwasserschleppvorrichtung nach einem der vorhergehenden Ansprüche, gekennzeichnet durch ein Abscherelement (40), das die Gewichtsvorrichtung (48) mit der Verbindungseinrichtung (112) oder dem Schleppkabel (12) verbindet und auslöst, wenn es einer gewissen Kraft unterworfen wird.

12. Unterwasserschleppvorrichtung nach Anspruch 11, dadurch gekennzeichnet, daß das Abscherelement (40) einen Bügel (90) enthält, der an seiner Basis mit der Verbindungseinrichtung (52) oder mit dem Schleppkabel (12) verbunden ist und an den freien Enden des Bügels fluchtende Öffnungen aufweist, ein Scherstift (94) durch die Öffnungen in den Bügel (90) eingesetzt ist und dazu eingerichtet ist, zu scheren oder zu brechen, wenn er der gewissen Kraft ausgesetzt ist, und durch einen Verbinder (96) zum Verbinden des Scherstiftes (94) mit der Gewichtsvorrichtung (48).

13. Unterwasserschleppvorrichtung nach Anspruch 12, dadurch gekennzeichnet, daß das Scherelement (40) weiterhin einen zweiten Bügel

(82) enthält, der verschwenkbar an seiner Basis mit der Basis des ersten Bügels (90) verbunden ist, und daß die freien Enden des zweiten Bügels (82) mit der Verbindungseinrichtung (52) oder dem Schleppkabel (12) verbunden sind.

14. Unterwasserschleppvorrichtung nach einem der vorhergehenden Ansprüche, gekennzeichnet durch ein zweites Scherelement (100) zum Verbinden des Schleppkörpers (20) mit der Verbindungseinrichtung (112) oder dem Schleppkabel (12) und zum Auslösen, wenn es einer gewissen Kraft unterworfen wird.

15. Unterwasserschleppvorrichtung nach Anspruch 14, dadurch gekennzeichnet, daß der Schleppkörper (20) eine Signalerzeugungseinrichtung (44) zum Erzeugen eines Signals aufweist, um es einem Benutzer zu ermöglichen, den Schleppkörper (20) zu lokalisieren im Falle, daß das zweite Scherelement auslöst, damit der Schleppkörper (20) an die Wasseroberfläche auftreiben kann.

16. Unterwasserschleppvorrichtung nach einem der vorhergehenden Ansprüche, gekennzeichnet durch Gelenkeinrichtungen (82, 88, 90) zur drehbaren Verbindung des Kabels mit der Verbindungseinrichtung (60, 112).

17. Unterwasserschleppvorrichtung nach einem der vorhergehenden Ansprüche, gekennzeichnet durch eine Durchführungsanordnung (40) zum Verbinden der Gewichtsvorrichtung (48) mit dem Schleppkabel (12), wobei die Durchführungsanordnung einen Sattel (52) zur Befestigung über dem Schleppkabel (12) enthält, der Sattel ein Paar Taschen (60) aufweist, die sich nach unten zu beiden Seiten des Schleppkabels (12) erstrecken, und eine Klemmvorrichtung (64) aufweist, um den Sattel (52) an dem Schleppkabel (12) festzuklemmen, und eine Einrichtung enthält, um die Gewichtsvorrichtung an den Taschen (60) des Sattels (52) zu befestigen.

18. Unterwasserschleppvorrichtung nach Anspruch 17, dadurch gekennzeichnet, daß die Befestigungseinrichtung (80) eine Einrichtung (82, 88, 90) zum drehbaren Befestigen der Gewichtsvorrichtung (48) an den Taschen (60) des Sattels (52) aufweist.

19. Unterwasserschleppvorrichtung nach Anspruch 17 oder 18, dadurch gekennzeichnet, daß die Befestigungsvorrichtung (80) ein Scherelement (94) aufweist, um die Gewichtsvorrichtung (48) von der Befestigung an den Taschen (60) des Sattels (52) freizugeben, wenn es einer gewissen Zugkraft an der Gewichtsvorrichtung (48) ausgesetzt ist.

20. Unterwasserschleppvorrichtung nach einem der Ansprüche 17 bis 19, dadurch gekennzeichnet, daß die Klemmvorrichtung (64) eine Reibplatte (74) aus Blei zur Berührung des Schleppkabels (12) aufweist.

21. Verfahren zum Schleppen eines Schleppkörpers unter Wasser durch Ankuppeln des Schleppkörpers an ein schleppendes Schiff mit Hilfe eines Schleppkabels, Vorsehen einer Gewichtsvorrichtung, die mit dem Schleppkörper oder dem Kabel verbunden ist, um bewirken, daß

der Schleppkörper im Wasser sinkt, bis die Gewichtsvorrichtung Grund berührt, und Bewegen des Schleppkörpers im Wasser mit einer Geschwindigkeit, die es ermöglicht, daß die Gewichtsvorrichtung über den Grund schleift, dadurch gekennzeichnet, daß der Schleppkörper auftreibend gemacht ist und mit dem Schleppkabel so verbunden ist, daß er über ihm schwebt.

22. Verfahren nach Anspruch 21, gekennzeichnet durch Ausgeben des Schleppkabels vom schleppenden Schiff, bis ein Teil des Schleppkabels Grund berührt und darüberschleift.

Revendications

1. Système de remorquage sous-marin (4) conçu pour être remorqué par un câble de remorquage (12) derrière un bateau (8), comprenant un véhicule remorqué (20) pour loger un appareillage à utiliser sous l'eau et un moyen pesant (48) connecté au câble de remorquage (12) et ayant un poids suffisant pour tirer le véhicule remorqué (20) vers le bas dans l'eau jusqu'à ce que ledit moyen pesant entre en contact avec le fond de l'eau, caractérisé en ce que l'extrémité du câble de remorquage (12) est connectée au véhicule remorqué (20), que des moyens (40) sont prévus pour coupler le moyen pesant (48) au câble de remorquage (12) à une distance prédéterminée du véhicule remorqué (20) et que ledit véhicule est doté d'une flottabilité positive dans l'eau.

2. Système de remorquage sous-marin selon la revendication 1, caractérisé en ce que la force portante du véhicule remorqué (20) est égale à environ un quart du poids du moyen pesant (48) dans l'eau.

3. Système de remorquage sous-marin selon la revendication 1 ou 2, caractérisé en ce que le véhicule remorqué (20) a un corps (24) essentiellement cylindrique et allongé, arrondi à l'extrémité et que le moyen de couplage (112) est disposé vers l'avant sur le côté inférieur du corps (24).

4. Système de remorquage sous-marin selon l'une des revendications précédentes, caractérisé en ce que le véhicule remorqué (20) est muni de deux organes de levage (36) disposés à une certaine distance l'un de l'autre dans la direction longitudinale du corps (24) sur la surface supérieure de celui-ci et par lesquels le véhicule remorqué (20) peut être soulevé.

5. Système de remorquage sous-marin selon l'une des revendications précédentes, caractérisé en ce que l'intérieur du véhicule remorqué (20) est garni d'un certain nombre d'éléments de flottaison (42).

6. Système de remorquage sous-marin selon la revendication 5, caractérisé en ce que les éléments de flottaison (42) sont composés de mousse synthétique.

7. Système de remorquage sous-marin selon la revendication 5 ou 6, caractérisé en ce que les éléments de flottaison (42) sont disposés contre la paroi supérieure du corps (24) du véhicule remorqué (20).

8. Système de remorquage sous-marin selon l'une des revendications précédentes, caractérisé en ce que le moyen pesant comporte une chaîne (48) formée d'un certain nombre de maillons et dont une extrémité est couplée au moyen de couplage (112) ou au câble de remorquage (12).

9. Système de remorquage sous-marin selon la revendication 8, caractérisé en ce que la force portante du véhicule remorqué (20) est d'environ 113 kg et que le poids de la chaîne (48) est d'environ 906 kg.

10. Système de remorquage sous-marin selon la revendication 8 ou 9, caractérisé en ce que la chaîne (48) a environ 6 mètres de longueur.

11. Système de remorquage sous-marin selon l'une des revendications précédentes, caractérisé en ce qu'il est prévu un organe à cisaillement (40) connectant le moyen pesant (48) au moyen de couplage (112) ou au câble de remorquage (12) et libérant ledit moyen respectif lorsqu'il est soumis à une certaine force.

12. Système de remorquage sous-marin selon la revendication 11, caractérisé en ce que l'organe à cisaillement (40) comprend une chape (90) connectée par sa base au moyen de couplage (52) ou au câble de remorquage (12) et comportant des ouvertures alignées dans ses extrémités libres, un axe à cisaillement (94) passé dans lesdites ouvertures et dimensionné pour se cisailier ou se rompre lorsqu'il est soumis à une certaine force, et un organe de connexion (96) pour connecter ledit axe à cisaillement au moyen pesant (48).

13. Système de remorquage sous-marin selon la revendication 12, caractérisé en ce que l'organe à cisaillement (40) comprend en outre une seconde chape (82) connectée de façon tournante par sa base à la base de la première chape (90), les extrémités libres de la seconde chape (82) étant connectées au moyen de couplage (52) ou au câble de remorquage (12).

14. Système de remorquage sous-marin selon l'une des revendications précédentes, caractérisé en ce qu'un second organe à cisaillement (100) est prévu pour connecter le véhicule remorqué (20) au moyen de couplage (112) ou au câble de remorquage (12) et pour libérer ledit moyen respectif lorsqu'il est soumis à une certaine force.

15. Système de remorquage sous-marin selon la revendication 14, caractérisé en ce que le véhicule remorqué (20) comporte un moyen de production de signaux (44) pour produire un signal destiné à permettre à un utilisateur de localiser ledit véhicule si le second organe à cisaillement le libère pour lui permettre de remonter et flotter à la surface de l'eau.

16. Système de remorquage sous-marin selon

l'une des revendications précédentes, caractérisé en ce que des moyens tournants (82), (88), (90) sont utilisés pour connecter de façon tournante le câble de remorquage (12) aux moyens de couplage (60), (112).

17. Système de remorquage sous-marin selon l'une des revendications précédentes, caractérisé en ce que l'on utilise un ensemble à chaumard (40) pour connecter le moyen pesant (48) au câble de remorquage (12), ledit ensemble à chaumard comportant un moyen en forme de selle (52) pour épouser la forme dudit câble, ledit moyen en forme de selle comportant deux joues (60) s'étendant vers le bas de chaque côté du câble de remorquage (12), un serre-câble (64) pour serrer le moyen en forme de selle (52) sur ledit câble, et un moyen pour attacher le moyen pesant (48) aux joues (60) dudit moyen en forme de selle (52).

18. Système de remorquage sous-marin selon la revendication 17, caractérisé en ce que le moyen de couplage (80) comprend des moyens (82), (88), (90) pour attacher de façon tournante le moyen pesant (48) aux joues (60) du moyen en forme de selle (52).

19. Système de remorquage sous-marin selon la revendication 17 ou 18, caractérisé en ce que le moyen de couplage (80) comporte un organe à cisaillement (94) pour libérer le moyen pesant (48) des joues (60) du moyen en forme de selle (52) lorsqu'une certaine force de traction est exercée sur le moyen pesant (48).

20. Système de remorquage sous-marin selon l'une des revendications 17 à 19, caractérisé en ce que le serre-câble (64) comporte une garniture de friction (74) en plomb qui est en contact avec le câble de remorquage (12).

21. Procédé de remorquage d'un véhicule sous-marin comprenant les opérations consistant à coupler le véhicule remorqué (20) à un bateau remorqueur (8) à l'aide d'un câble de remorquage (12), à prévoir un moyen pesant (48) couplé audit véhicule ou audit câble pour obliger le véhicule à s'enfoncer dans l'eau jusqu'à ce que ledit moyen pesant vienne en contact avec le fond de l'eau, et à faire avancer le véhicule remorqué (20) dans l'eau à une vitesse qui permet au moyen pesant (48) de traîner sur le fond de l'eau, caractérisé en ce que le véhicule remorqué est doté de flottabilité et est couplé au câble de remorquage (12) de façon à flotter entre deux eaux au-dessus de l'extrémité immergée dudit câble.

22. Procédé de remorquage selon la revendication 21, caractérisé en ce que le câble de remorquage (12) est déroulé du bateau remorqueur (8) jusqu'à ce qu'une partie dudit câble vienne en contact avec le fond de l'eau et traîne sur celui-ci.

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FIG. 1

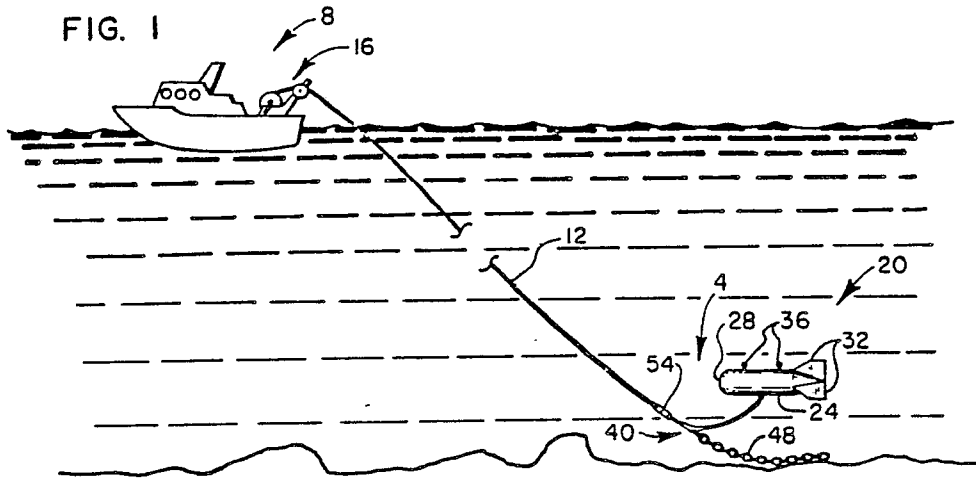


FIG. 2

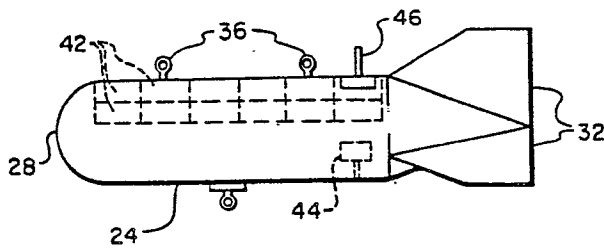


FIG. 3

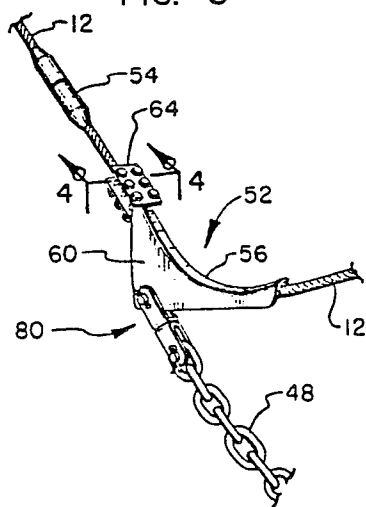


FIG. 4

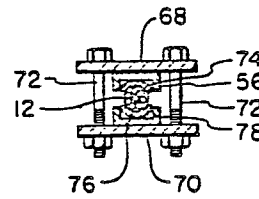


FIG. 5

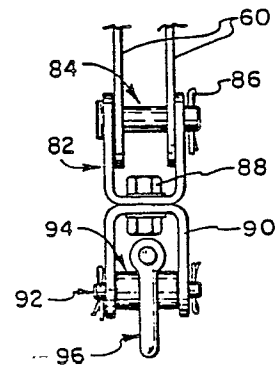


FIG. 6

