United States Patent [19]

Higgins

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[54] **INSULATED CONDUCTOR DETECTOR**

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[52] **U.S. Cl.** ..... **340/4 R**; 114/221 A; 114/235 B; 340/3 T

[51] **Int. Cl.²** **B63C 11/48**

[58] **Field of Search** ..... 340/3 T, 4, 4 R; 114/221, 114/221.1, 235.2, 221 A, 235 B

[56] **References Cited**

UNITED STATES PATENTS

3,071,098	1/1963	Hinckley et al.	114/221
3,108,246	10/1963	Jones	340/4 R

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[57] **ABSTRACT**

An insulated conductor detector having a weighted body containing a rotatable cutter blade which rotates only after a predetermined force is applied to the cutting edge thereof. Disposed on each side of said cutter blade are a pair of inductance coils, one of which forwardly radiates radio frequency electromagnetic energy toward an acquired electrical conductor to be cut and the other of which receives a rebroadcast thereof from said conductor until such time it is cut. Cutting of the conductor is indicated by a rapid decrease of current flow in the receiving inductance circuit.

10 Claims, 5 Drawing Figures

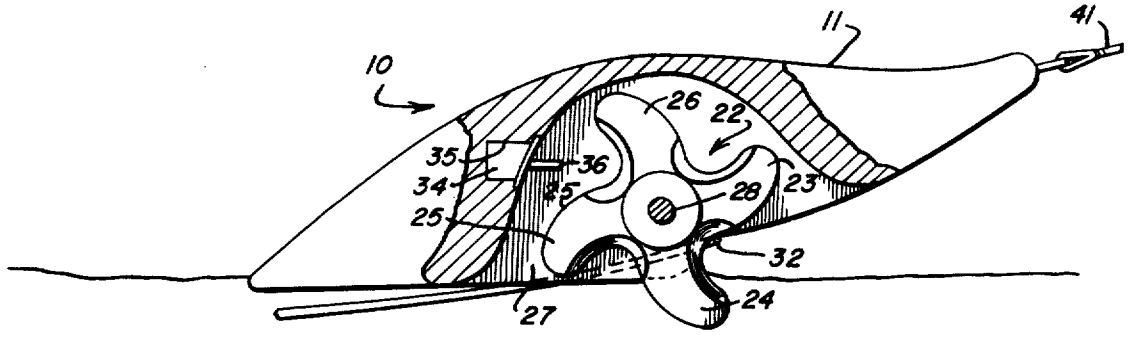


Fig. 1

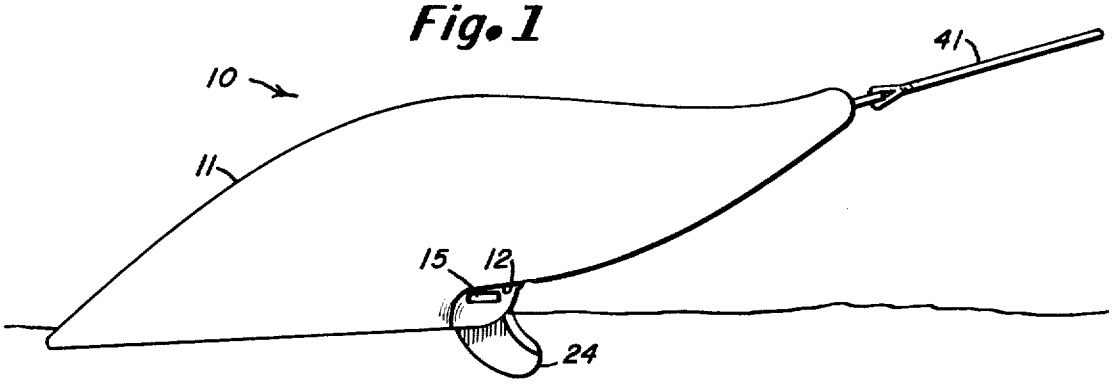


Fig. 2

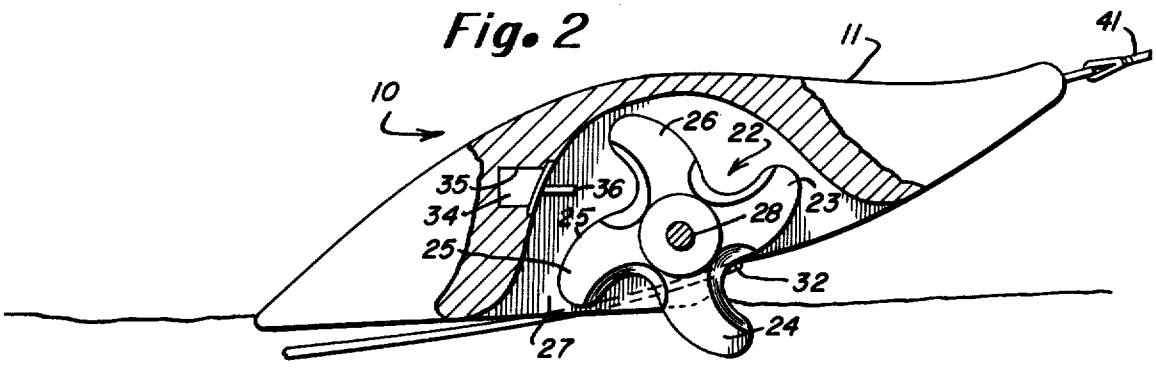
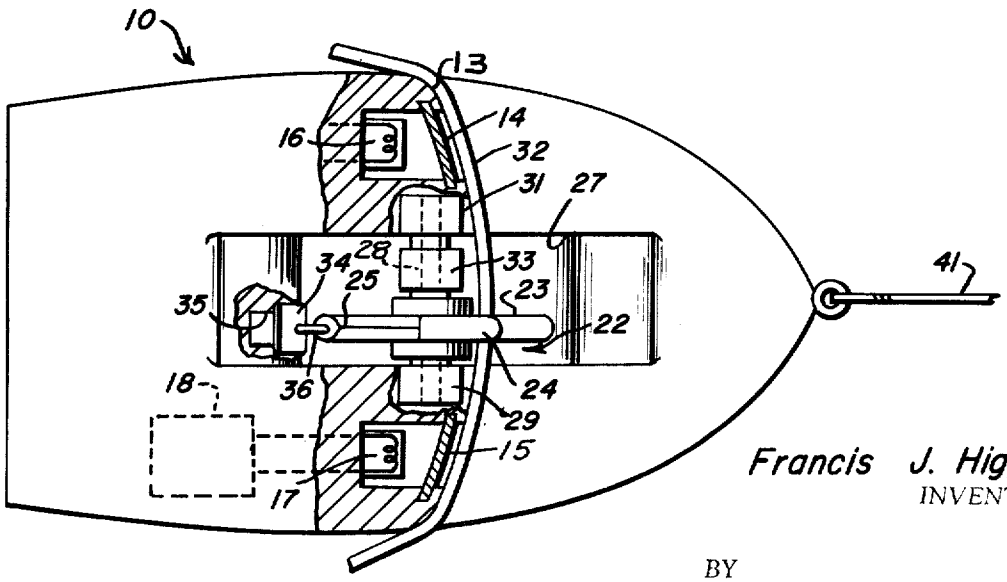


Fig. 3



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Fig. 4

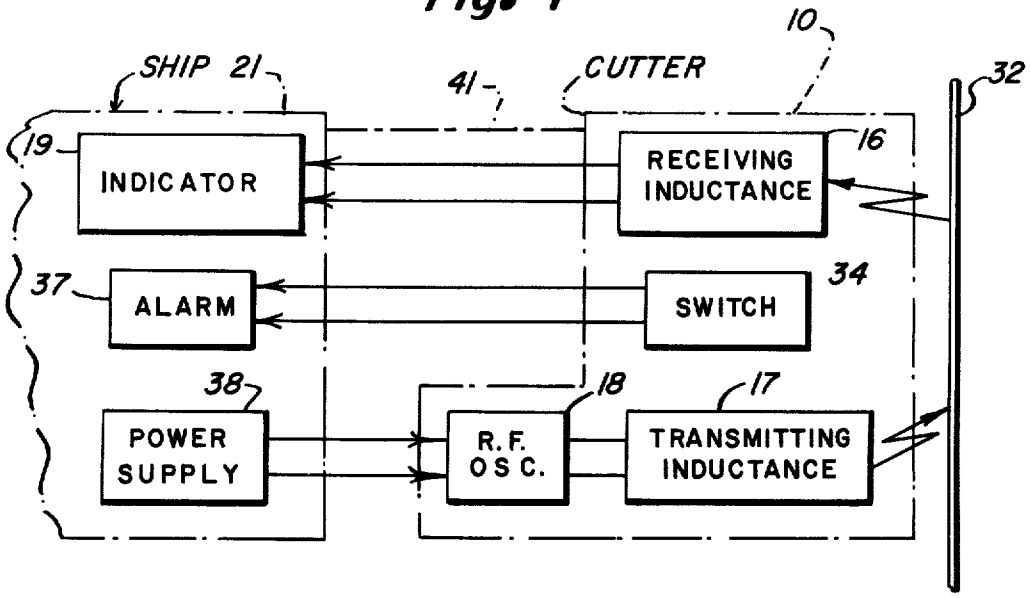
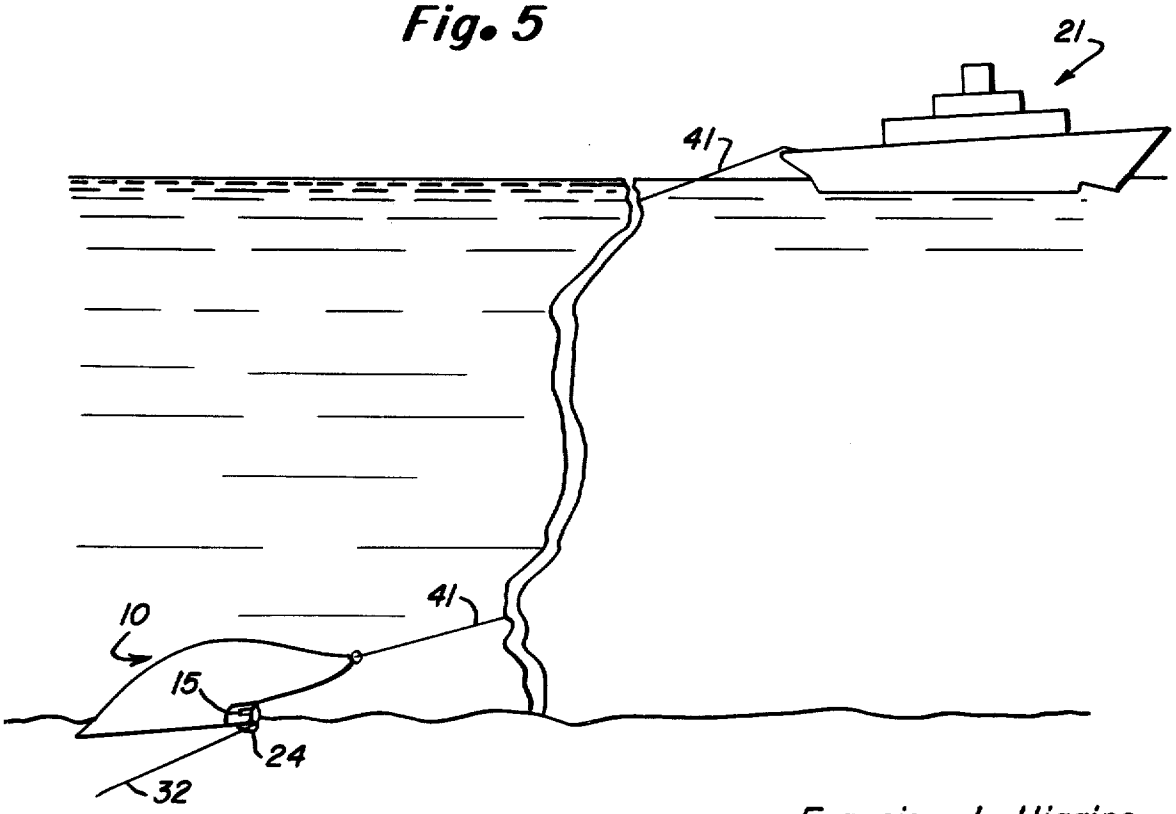


Fig. 5



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INSULATED CONDUCTOR DETECTOR

The present invention relates generally to wire and cable cutters and, in particular, is an improved method and means for acquiring and cutting an insulated electrical conductor laying on or submerged in the floors of bodies of water, such as rivers, lakes, bays, and oceans. In even greater particularity, it is an insulated wire detector and cutter that both indicates that an insulated electrical wire to be cut has been acquired or hooked and that it either has or has not been cut.

In the past, insulated electrical conductors laying on a river bottom or a sea floor have been cut by dragging a specially constructed heavy chain along said river bottom or sea floor. While for some purposes such device has proven to be quite satisfactory, in many instances, it leaves a great deal to be desired. This is primarily due to the fact that such prior art has no wire detection capabilities concomitantly incorporated therein and, therefore, it cannot be determined for sure that a wire has been encountered or severed, during the use thereof.

The subject invention overcomes most of the difficulties of the aforementioned prior art, in that it provides both wire detection and wire severance operations.

It is, therefore, an object of this invention to provide an improved method and means for acquiring and cutting an insulated conductor laying on or submerged within a river bed.

Another object of this invention is to provide a method and means of indicating that an insulated electrical wire conductor laying on or submerged within a river bed has been detected and cut.

Other objects and many of the attendant advantages will be readily appreciated as the subject invention becomes better understood by reference to the following detailed description, when considered in conjunction with the accompanying drawings wherein;

FIG. **1** is a side elevational view of the subject invention;

FIG. **2** is a schematic side elevational view of the device of FIG. **1**, with parts broken away;

FIG. **3** is a schematic bottom plan view of the subject invention, with parts broken away;

FIG. **4** is a block diagram of the overall system constituting this invention; and

FIG. **5** is a quasi-pictorial view, illustrating a typical mode of operation of the subject invention within its normal environment.

Referring now to FIGS. **1** through **4** of the drawing, a preferred embodiment **10** of the detector-cutter constituting this invention is shown as having a relatively heavy, partially hollow, metallic housing **11** with a curved groove **12** extending around the lowest front extremity thereof. As seen in FIG. **1**, groove **12** is preferably shaped in such a concave manner that any wire, cable, or insulated electrical conductor that comes into contact with it, either by direct or indirect acquisition, will tend to wrap around it and be held in place during the actual cutting operation.

The aforesaid groove **12** is actually disposed in what amounts to a forward wall **13** (see FIG. **3**) of said lowest front extremity. Also disposed in said wall is a pair of windows **14** and **15**, which will act as the mediums for the transmission of electromagnetic energy. Although any suitable material may be used in the making thereof, plastic appears to be suitable in this particular instance.

Behind windows **14** and **15** are a receiving inductance **16** and a transmitting inductance **17**, respectively, the latter of which is timely energized as a result of being connected to the output of a variable frequency radio frequency oscillator **18**. Receiving inductance **16** is connected to the input of any suitable indicator **19**. For example, a readout of the recorder type, or a meter of the ammeter type, or the like, may be used for this purpose. Obviously, selection of the indicator best suited for any predetermined operational circumstances would be well within the purview of one skilled in the art having the benefit of the teachings herewith presented. In this particular embodiment, indicator **19** is disclosed as being located on a ship **21**, so that it may be advantageously observed by human operators; however, the disposition thereof should not be considered to be limited to such location.

A rotatable cutting wheel **22**, having a plurality of knife blades **23** through **26**, is mounted in a hollow space **27** of housing **11** by means of a rotatable shaft **28** supported by bearings **29** and **31**, which are also securely mounted in any appropriate conventional manner in said housing. Each of said blades is shaped in such manner as to have its cutting edge in the forward position, when it is rotated in its lowest wire-acquiring position. Furthermore, all of said blades are preferably shaped to have a hook-like configuration which will facilitate acquiring a wire upon substantially normal contact therewith and cause it to slide up adjacent to and wrap around the aforementioned groove **12**, thereby becoming disposed in a contiguous electromagnetic relationship with the aforesaid windows **14** and **15**. Hence, for example, if wire **32** were acquired or hooked by blade **24**, it would probably assume a position similar to that depicted in FIG. **3**.

Mounted between shaft **28** and housing **11** is a brake **33**, which, for reasons that will be discussed subsequently, should be designed in such manner as to prevent the rotation of cutting wheel **22** until such time that a predetermined rearwardly directed force is applied to the cutting blade thereof disposed at the lowest position at that instant. For this purpose, any suitable brake may be employed; however, types that seem to work quite well are the conventional ratchet or powered ratchet types, either of which may be so designed as to always hold one of said knife blades in the position of readiness for hooking an electrical conductor. Of course, said brake should also be so designed to be released whenever the aforesaid knife blade has a predetermined rearwardly directed force applied to the front edge thereof by some immovable object such as, for instance, a rock or the like, which has been inadvertently acquired or contacted thereby.

A switch **34** is mounted in a recess **35** located in housing **11** in such manner that its toggle arm **36** will be actuated by timely contact with one of the cutter blades of cutter wheel **22** whenever it is rotated by any of the aforesaid immovable objects. Switch **34** is electrically connected to an alarm **37** located aboard ship **21**.

A power supply **38** is also located on board ship **21** and is electrically connected to the aforementioned radio frequency oscillator **18** for the powering thereof.

A cable **41** which acts as a combination tow cable and electrical cable is connected to the front end of housing **11** in any conventional manner that will enable it to both pull the invention along a desired course and conduct electrical signals or energy, as the case may be, to and from the various components contained therein.

For towing purposes, in order to allow the subject cutter to maintain a proper or at least optimum attitude as it is being pulled along, bridles, hinges, swivels, sliding electrical contacts, etc., as necessary to effect such result, may be optionally incorporated in said tow cable or connected thereto in such manner as to effect coupling thereof to housing **11**.

The subject invention will now be discussed from the standpoint of its operation in conjunction with all figures of the drawing.

Referring first to FIG. **5**, there is shown a typical operation wherein the preferred embodiment of the invention illustrated in FIGS. **1** through **3**, is being towed along the floor of a body of water by a ship. At this time, it may be noteworthy that although ship **21** is herewith disclosed as the tractor vehicle, any other suitable tractor vehicle may be substituted therefor which will facilitate positioning the subject indicator cutter in an optimum effective position. For example, ship **21** may be a small boat or a slow moving aircraft, such as a helicopter or the like. Furthermore, although not shown, any device which would control the action of tow cable **41** so as to optimize the locating of cutter **10** may, likewise, be incorporated in the overall system if so desired without violating the scope or spirit of the invention.

It is of some importance that the subject cutter be towed at such attitude that one of the cutting blades thereof plows through the upper surface of the sea floor or river bottom over which it is being towed. So doing obviously improves the probability of the subject cutter acquiring an insulated electrical conductor that has become somewhat submerged within said sea floor or river bottom as a result of the shifting of the various and sundry sand or mud compositions thereof. Of course, the fact that cutter blade **24** actually plows below the surface of said sea floor or river bottom does not in any way detract from its ability to acquire a wire or other insulated conductor that may be laying thereon or even suspended in the water thereabove, inasmuch as any conductor would automatically be directed down toward the cutter by the towing cable connected thereto.

Due to the forward profile of each of the cutting blades of wheel **22** being shaped in a substantially scoop-like configuration, it, too, acts as a guide for any acquired conductor and will thus move said acquired conductor up to a position substantially adjacent to the groove located in the lowest frontal extremity of the invention. So doing thus places the acquired conductor in a position where transformer action may occur between it and inductances **16** and **17**.

At the time such positioning occurs, the electromagnetic energy from inductance **17** is broadcast through window **15** to electromagnetically contact wire **32** which, in turn, rebroadcasts the electromagnetic energy received thereby through window **14** to receiving inductance **16**. The electrical energization of inductance **16** resulting therefrom creates a current which is appropriately indicated by indicator **19**. Hence, any human operator observing said indicator **19** would become aware of the fact that an electrical conductor has been acquired by the cutter.

The actual cutting of said conductor occurs as a result of the continuous force being applied to it at the point of cutter blade **24** as the subject device is being pulled or towed by ship **21**. Once wire **32** has been cut, its severance breaks the electromagnetic connection between inductances **17** and **16**, and this breakage, of course, is indicated at indicator **19** as a drop in current circulating in the indicator-receiving inductance circuit. On the other hand, in the event that indicator **19** shows no such interruption of current, the human operator would know that the acquired conductor has not been cut but is still being dragged along.

During the normal operation of the subject invention, it is entirely probable that it will snag various and sundry objects laying on the sea floor or river bottom, which would cause it to hang thereupon, were it not for the fact that cutting wheel **22** is designed to be rotatable whenever a predetermined force is applied in a rearwardly direction to the front edge thereof. Obviously, such objects are detrimental to the operation of the invention, therefore, they must be handled in such manner as will not adversely effect the overall operation of the invention to any inordinate degree. To clarify the type of undesirable objects which may be encountered, it would appear to be advantageous to list a few of them at this time. They are rocks of all sizes; submerged vegetation; debris which ordinarily accumulates on the floor of a river, the sea floor, or the mouth of a river or a bay; cables laid on the river bottom or sea floor for either strength or electrical signal conduction purposes; and even sea floors and river beds themselves, if they should be composed of hard unyielding materials.

It may readily be seen that cutting wheel **22** must be held stationary whenever a force is applied thereto by the wire intended to be cut; however, inasmuch as said wire is ordinarily small and relatively weak compared to the aforementioned snagged objects, the rotation of cutter wheel **22** may be prevented by the use of a simple brake **23**. Although the type of brake employed in this particular instance would be contingent upon the operational circumstances, it may be any of the many conventional types which would not release until a predetermined torque exists in the shaft which it is holding. In the event that a further degree of sophistication is required with respect to said brake, it may be equipped with a positive positioning ratchet release or even with a powered positioning ratchet release type, if so desired. Thus, when one of the cutting blades happens to snag an immovable object, brake **33** will release it and allow both it and the shaft to which it is connected to rotate within bearings **29** and **31** shown in FIG. **3**.

Upon rotation of cutter wheel **22**, one of the cutting blades thereof contacts toggle **36** of switch **34**, thereby closing it and setting off alarm **37**. Of course, alarm **37** may be any appropriate type such as a bell, a light, or a combination thereof, or the like.

The geometrical configuration of the housing of the subject invention preferably should be such as to streamline it whenever it is being towed within a subaqueous medium. As previously suggested, moreover, it should include sufficient weight to cause it to drop to the river bottom or sea floor, even though it is being towed in such manner by a tractor vehicle that there is a vertical life component applied thereto. To further facilitate disposing the subject device upon said river bottom or sea floor, the length of tow cable **41** should be taken into consideration and optimized in such manner as to reduce the aforesaid vertical force vector component.

Obviously, other modifications and embodiments of the subject invention will readily come to the mind of

one skilled in the art having the benefit of the teachings presented in the foregoing description and the drawings. It is, therefore, to be understood that this invention is not to be limited thereto and that said modifications and embodiments are intended to be included within the scope of the appended claims.

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 hereon or therefor.

What is claimed is:

1. An insulated conductor detector and cutter comprising in combination:

a weighted housing;

a wheel, having a predetermined plurality of radially extending cutting blades, mounted for rotation in said housing in such manner that one of the cutting blades thereof protrudes from the lowest frontal extremity of said housing;

means effectively interconnecting said housing and said wheel for preventing the rotation thereof until a predetermined force is applied to the cutting edge of one of the cutting blades thereof;

a groove of predetermined diameter extending around the lowest frontal extremity of said housing on each side of said protruding cutting blade;

a pair of electromagnetic energy windows disposed immediately behind predetermined portions of said groove, with one thereof located on one side of said protruding cutting blade and the other thereof located on the other side of said protruding cutting blade;

means mounted in said housing and contiguously disposed with one of said windows for broad-casting electromagnetic energy therethrough;

means mounted in said housing and contiguously disposed with the other of said windows for receiving electromagnetic energy passing therethrough;

means connected to the output of said electromagnetic energy receiving means for indicating the electromagnetic energy received thereby; and

means connected to the input of the aforesaid electromagnetic energy broadcasting means for supplying electrical power thereto.

2. The device of claim **1** wherein said means effectively interconnecting said housing and said wheel for preventing the rotation thereof until a predetermined force is applied to the cutting edge of one of the cutting blades thereof comprises a brake.

3. The device of claim **1** wherein each of said pair of electromagnetic windows disposed immediately behind predetermined portions of said groove is of plastic.

4. The device of claim **1** wherein said means mounted in said housing and contiguously disposed with one of said windows for broadcasting electromagnetic energy therethrough comprises:

an inductance; and

a radio frequency oscillator connected to the inputs of said inductance.

5. The device of claim **1** wherein said means mounted in said housing and contiguously disposed with the other of said windows for receiving electromagnetic energy passing therethrough includes an inductance.

6. The invention according to claim **1** further characterized by means disposed contiguously with said wheel for indicating the rotation thereof.

7. The device of claim **6** wherein said means disposed contiguously with said wheel for indicating the rotation thereof comprises:

a switch having a toggle arm capable of being actuated by the abutment of the cutting blades of said wheel as it rotates; and

an alarm connected to the output of said switch in such manner as to be timely actuated thereby.

8. The invention according to claim **1** further characterized by means connected to the aforesaid weighted housing for the pulling thereof in such manner along a predetermined course on a river bottom that the cutting blade protruding from the lowest frontal extremity of said housing plows through a predetermined depth thereof.

9. The device of claim **8** wherein said pulling means comprises:

a tractor vehicle; and

a combination electrical-tow cable interconnecting said tractor vehicle and the front end of the aforesaid weighted housing.

10. The device of claim **9** wherein said tractor vehicle is a ship.

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