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MARINE SEISMOGRAPHIC PROSPECTING

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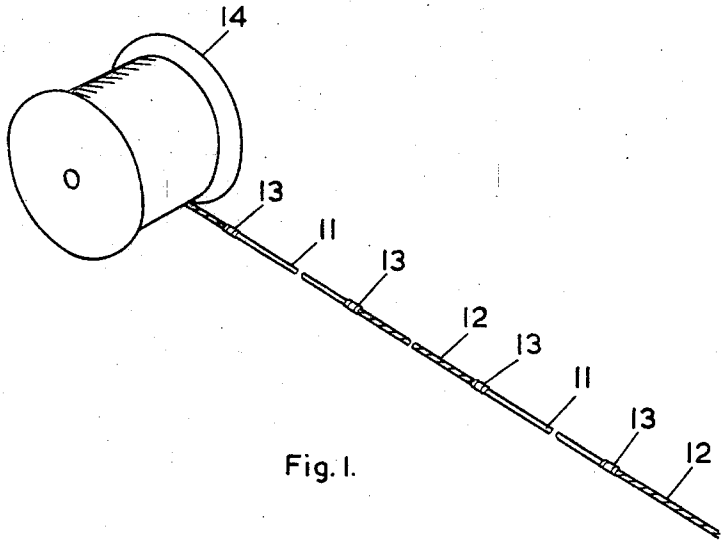

Fig. 1.

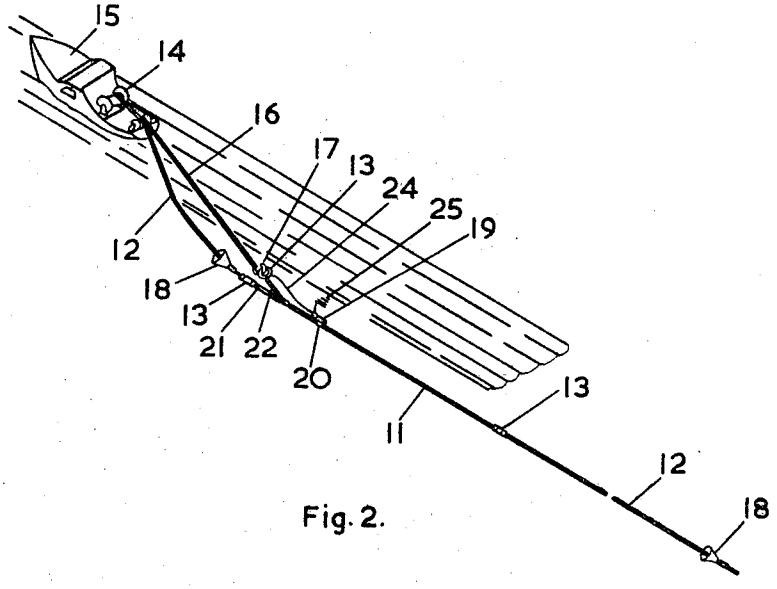

Fig. 2.

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MARINE SEISMOGRAPHIC PROSPECTING

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ABSTRACT OF THE DISCLOSURE

An assembly for marine seismographic prospecting comprises a plurality of lengths of fuse cord and a plurality of lengths of non-explosive cord, each of the latter being connected between two of the lengths of fuse cord. In use drag elements are attached to the non-explosive cords so that sequential lengths of fuse cord will be dragged into the water after the initial drag element is thrown into the water from a moving boat.

This invention relates to a method of laying elongated explosive charges underwater in marine seismographic prospecting operations and to an assembly of explosive charges for use therein.

It has recently been proposed to use elongated explosive charges for marine seismographic prospecting in order to diminish the effect on the seismographic record of the expanding and contracting gas bubble produced by the explosion. One form of elongated explosive charge which is favoured for this purpose is detonating fuse-cord in lengths of at least 15 metres comprising a core of a granular high explosive such as pentaerythritoltetranitrate (PETN) or cyclotrimethylenetrinitramine, surrounded by textile wrappings and encased in a flexible waterproof envelope of synthetic plastic material. In the marine seismographic prospecting operations the elongated explosive is stored as a bulk supply on reels on a boat and each individual charge in withdrawn as required from the reel, cut from the supply, fitted with detonation initiating means and fed into the water behind the moving boat. At least the initial portion of the elongated charge must be positively fed from the boat into the water until sufficient length is immersed for the drag of the water to pull the remainder from the boat.

It is an object of this invention to provide a method of laying elongated charges underwater for seismographic prospecting wherein all the charge is pulled from the boat by the drag of the water and to provide an assembly of charges whereby this may be achieved.

In accordance with this invention a method of laying elongated explosive charges consecutively in position for firing in marine seismographic prospecting comprises immersing in the water at a prospect area a first drag element attached to one end of an elongated explosive charge on a moving boat, permitting said explosive charge to be drawn into the water by the pull of the drag element, attaching to the other end of said explosive charge detonation initiating means and a second drag element, and permitting the second drag element to be drawn into the water by the pull of the first drag element, said second drag element being also joined to one end of the next consecutive explosive charge and being of sufficient length to separate the ends of the consecutive explosive charges sufficiently to prevent communication of detonation from one charge to the next.

The assembly of elongated explosive charges for use in the invention comprises two or more elongated explosive charges joined one end of one to one end of another by means of one or more intermediate drag elements of

sufficient length to prevent communication of detonation from one charge to the next.

Each drag element may be in the form of a non-explosive cord which may be joined at its ends to consecutive explosive charges. In a preferred form having improved drag, a vane, which may be in the form of a disc or funnel, is attached to the cord to present a resistance area perpendicular to the cord.

The elongated explosive charges may conveniently be lengths of detonating fuse-cord, and in this case the charges are conveniently joined together by intermediate lengths of non-explosive cord or string which are preferably joined to the fuse-cord by crimped metal sleeve joints.

The arrangement of charges may advantageously be stored on reels which may be mounted for rotation on an axle to permit the charges to be withdrawn as required.

The charges are conveniently fired by means of detonating initiating means comprising an electric detonator and for this purpose a long firing cable terminating in an uninsulated hook may be trailed behind the boat so as to sink the charge to the required firing depth. A metal slip-ring on the cable is attached to one terminal wire of the electric detonator and is also attached by a tie member to an explosive charge, the tie member being arranged to prevent strain on the terminal wire. The other terminal wire of the detonator is left free. When the explosive charge is pulled from the boat the metal slip-ring slides down the cable to contact and to engage and be held by the hook. The free terminal wire trails in the sea to provide an "earth" return for the firing circuit. The charge is thus held in position for firing and the firing circuit through the detonator is ready for firing and may be fired by applying an appropriate voltage to the cable.

When the first explosive charge is fired the drag element is left trailing in the water and the drag may be used to pull the next charge into the water.

The invention also includes a method of producing a seismic record of underwater rock formations which comprises laying an elongated explosive charge at a prospect area by the aforedescribed method, detonating the explosive charge and receiving and recording the resulting seismic waves reflected or refracted from the underwater rock layer interfaces.

Further features of the invention are included in the preferred embodiment which is hereinafter described, by way of example only, with reference to the accompanying drawings wherein

FIG. 1 shows—diagrammatically an arrangement of cord-like explosive charges,

FIG. 2 shows diagrammatically an explosive charge being towed behind a boat in position for firing.

The charge assembly shown in FIG. 1 comprises lengths of detonating fuse-cord **11** and lengths of cotton string **12** arranged alternately with their ends joined by a crimped aluminium sleeve **13**. The assembly is stored on a reel **14**.

In using the assembled charge for seismographic prospecting the reel **14** is mounted for free rotation around its axis on a boat **15** (shown in FIG. 2) from which an insulated firing cable **16** terminating in a bare metal hook **17** is towed as the boat is moved over the prospect sea area. A funnel-shaped metal drag member **18** is crimped on the end length of string **12** to augment the drag on the string **12**, and this end length of string **12** is thrown into the sea. The first length of detonating fuse-cord is thereby pulled into the sea, but before it leaves the boat it is temporarily stopped and an electric detonator **19** is crimped to it by means of a deformable metal clip **20**. A metal slip-ring **21** which is around the firing cable **16** is joined to the length of detonating fuse-cord **11** by means of a cotton string **22** and a crimped metal sleeve **13** and is also joined to a bared end portion of one of the

terminal wires **24** of the detonator **19**. A further drag member **18** is crimped on the next length of string **12** and the assembly is released. The slip-ring **21** slides along the cable **16** until it reaches the hook **17** where it is arrested. On further movement of the boat **15** the string **22** becomes taut and the immersed charge is dragged at a fixed distance behind the boat as shown in FIG. 2 so that the terminal wire **24** is not tensioned The second terminal wire **25** has a bared end portion which lies in the water to provide an "earth" return for the firing circuit. The charge in this position is fired by applying a high voltage between the cable and the boat. On firing the length of detonating fuse-cord **11** is destroyed and the next length of string **12** is free to be pulled away from the boat thereby to draw a further length of detonating fuse-cord **11** into the water. Slip-rings **21** from fired charges are pushed off the end of the hook **17** into the water by subsequent rings **21** being moved into the firing position.

The lengths of detonating fuse-cord may be varied over a wide range as desired but lengths of 15 to 150 metres of a detonating fuse commercially available as "Cordtex" (registered trademark) containing 10–20 g. of PETN per metre have been found convenient. The lengths of string **12** may also vary widely but lengths of 15 to 50 metres are usually sufficient to separate the detonating fuse-cord charges sufficiently to enable one charge to be fired without any portion of the next charge being in the water.

What I claim is:

1. A method of laying elongated explosive charges consecutively in position for firing in marine seismographic prospecting which comprises immersing in the water at a prospect area a first drag element attached to one end of an elongated explosive charge on a moving boat, permitting said explosive charge to be drawn into the water by the pull of the drag element, attaching detonation initiating means and a second drag element to the other end of said explosive charge, and permitting the second drag element to be drawn into the water by the pull of the first drag element, said second drag element being also joined to one end of a next consecutive explosive charge and being of sufficient length to separate the ends of consecutive explosive charges sufficiently to prevent communication of detonation from one charge to the next.

2. A method as claimed in claim **1** wherein each drag element comprises a non-explosive cord.

3. A method as claimed in claim **2** wherein a vane is attached to the cord to present a resistance area perpendicular to the cord.

4. A method as claimed in claim **1** wherein the explosive charge comprises detonating fuse-cord.

5. An assembly of elongated explosive charges for use in marine seismographic prospecting comprising at least two elongated explosive charges, each including a length of detonating fuse cord, joined one end of one to one end of another by means of intermediate drag elements of sufficient length to prevent communication of detonation from one charge to the next, each of said drag elements including a length of non-explosive cord joined to the fuse cord by crimped metal sleeve joints.

6. A method of producing a record of underwater rock formations which comprises laying an elongated explosive charge at a prospect area by a method as claimed in claim **1**, detonating said explosive charge and receiving and recording the resulting seismic waves reflected or refracted from the underwater rock layer interfaces.

7. An assembly of elongated explosive charges for use in marine seismographic prospecting comprising a plurality of distinct elongated explosive charges and a plurality of elongated distinct intermediate drag elements of sufficient length to prevent communication of detonation from one explosive charge to the next, the opposite ends of each drag element being connected to one end of a different explosive charge.

8. An assembly as in claim **7** wherein each drag element comprises a non-explosive cord.

9. An assembly as in claim **8** including a vane attached to the non-explosive cord to present a resistance area perpendicular to the non-explosive cord.

10. An assembly as in claim **9** wherein said vane is in the form of a disc or funnel.

11. An assembly as in claim **8** wherein each of the explosive charges comprises a detonating fuse cord.

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