(No Model.) 3 Sheets—Sheet 1.

A. J. COOPER & E. E. WIGZELL.

ELECTRIC DEEP SEA SOUNDER.

No. 418,889. Patented Jan. 7, 1890.

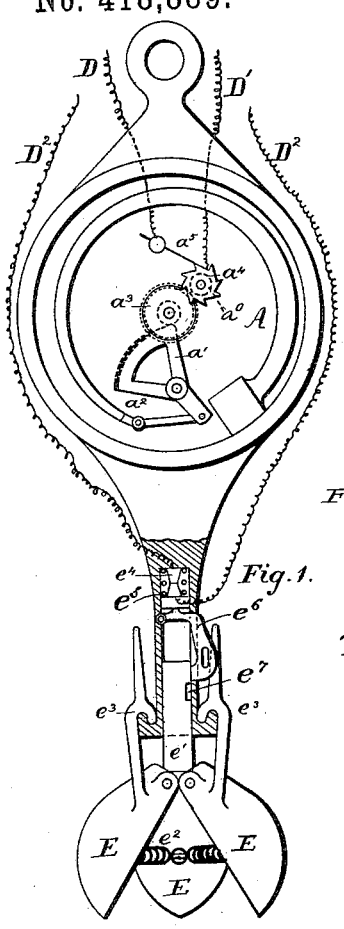


Fig. 1.

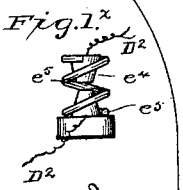


Fig. 1ˣ.

Fig. 2.

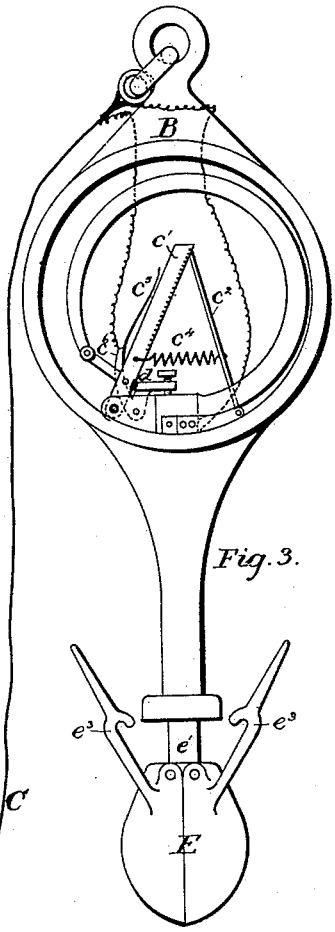


Fig. 3.

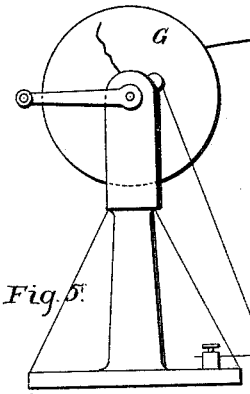


Fig. 5.

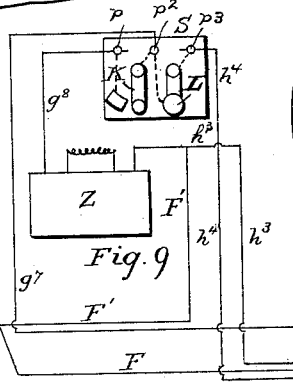


Fig. 9.

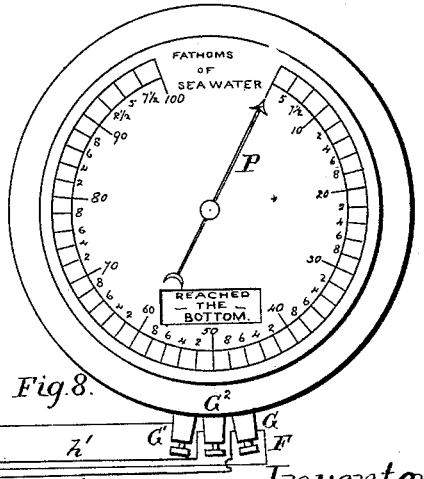


Fig. 8.

Witnesses:
Allan McLane Abbot
A. C. Rawlings

Inventors
ALFRED JOPLING COOPER,
EUSTACE ERNEST WIGZELL,
By their Attorney
E. L. Ewin.

(No Model.) 3 Sheets—Sheet 2.

A. J. COOPER & E. E. WIGZELL.

ELECTRIC DEEP SEA SOUNDER.

No. 418,889. Patented Jan. 7, 1890.

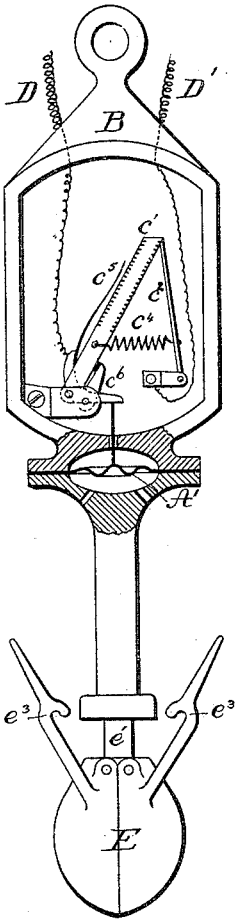


Fig. 4.

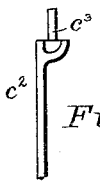


Fig. 12.

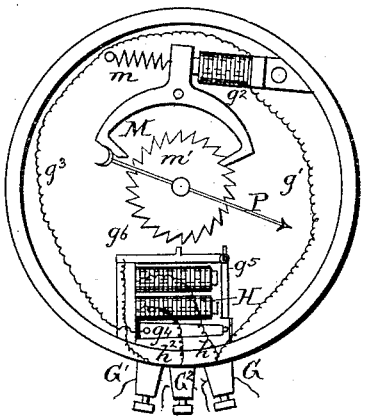


Fig. 6.

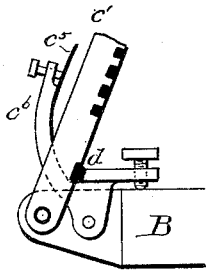


Fig. 13.

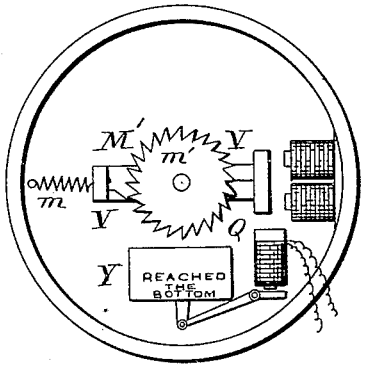


Fig. 7.

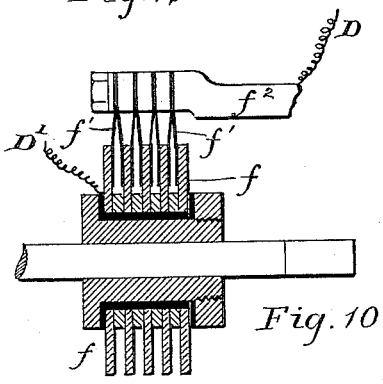


Fig. 10.

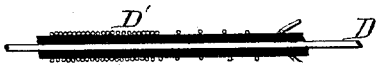


Fig. 11.

Witnesses:
Allan McLane Abert
A. E. Rawlings

Inventors
ALFRED JOPLING COOPER,
EUSTACE ERNEST WIGZELL
By their Attorney
Edwin L. Edwin.

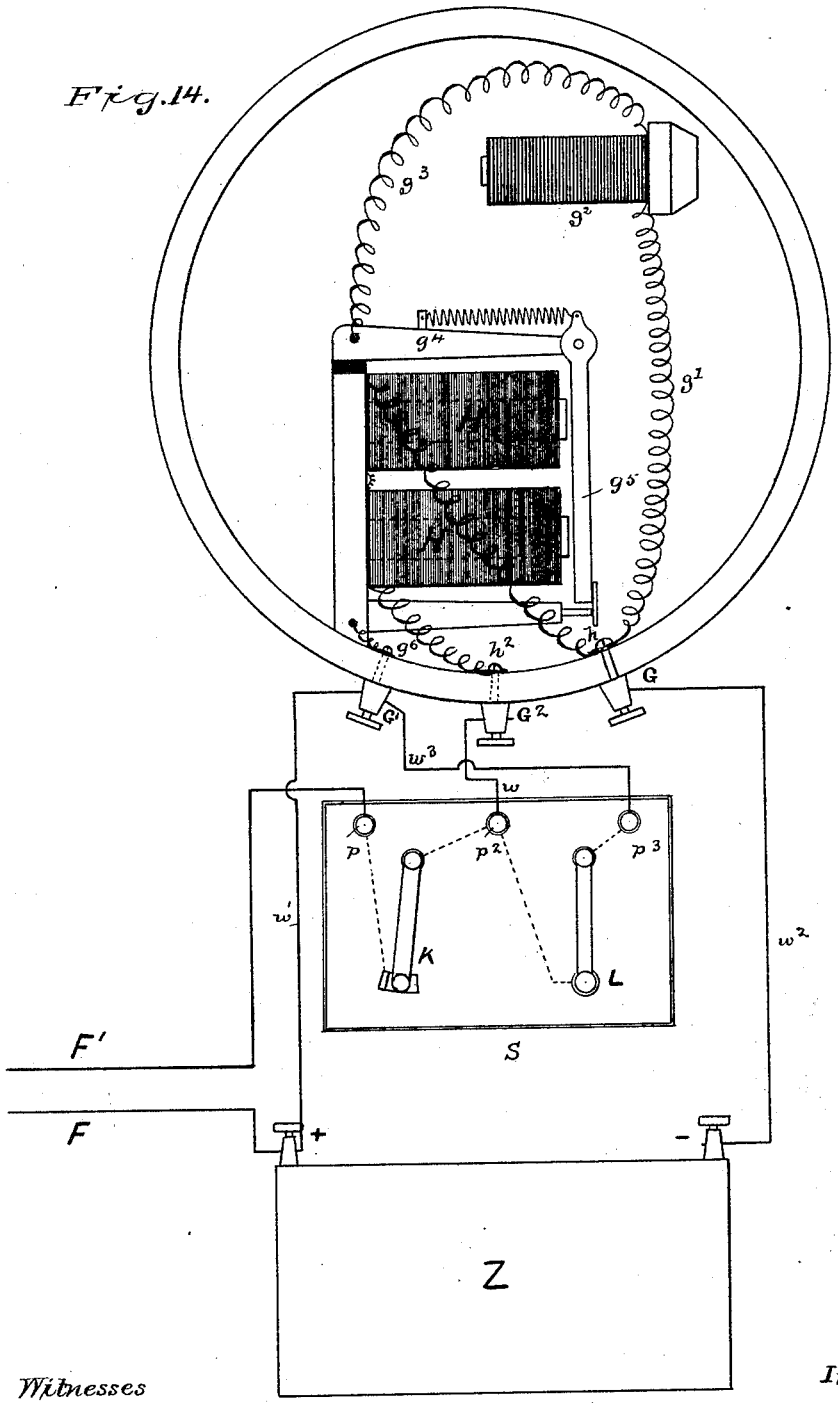
(No Model.) 3 Sheets—Sheet 3.

A. J. COOPER & E. E. WIGZELL.

ELECTRIC DEEP SEA SOUNDER.

No. 418,889. Patented Jan. 7, 1890.

Fig. 14.



Witnesses

Wm H. Bates

Vandeleur Phillips.

Inventors

ALFRED JOPLING COOPER.

EUSTACE ERNEST WIGZELL.

By their Attorney

E. L. Ewin.

UNITED STATES PATENT OFFICE.

ALFRED J. COOPER AND EUSTACE E. WIGZELL, OF LONDON, ENGLAND.

ELECTRIC DEEP-SEA SOUNDER.

SPECIFICATION forming part of Letters Patent No. 418,889, dated January 7, 1890.

Application filed November 16, 1887. Serial No. 255,350. (No model.)

To all whom it may concern:

Be it known that we, ALFRED JOPLING COOPER and EUSTACE ERNEST WIGZELL, both of London, England, subjects of Her Majesty the Queen of Great Britain and Ireland, have invented an Improved Electric Deep-Sea Sounder, of which the following is a specification.

This invention relates to apparatus for ascertaining the depth of submersion of one portion of the instrument containing a hydrostatic-pressure gage, the results being indicated above water by a recording or registering mechanism operated by an intermittent electrical current established between the two portions of the said sounding-instrument, so long as the submerged portion continues to descend, and proportionally to the depth of such descent.

In order that our invention may be the better understood, we now proceed to describe the same in relation to the drawings hereunto annexed, reference being had to the letters marked thereon.

Like letters refer to similar parts throughout the figures.

Figure 1 is a sectional elevation of the submerged portion of our sounding-instrument, showing a Bourdon pressure-tube and connected mechanism to produce an intermittent electrical current. Fig. $1^{\times}$ is a magnified detail view supplemental to Fig. 1. Fig. 2 is a sectional elevation of the submerged portion of our sounding-instrument, showing a Bourdon pressure-tube with modified but equivalent connected mechanism to produce an intermittent electrical current. Fig. 3 is a sectional elevation of the submerged portion of our sounding-instrument with a Bourdon pressure-tube, and modified but equivalent connected mechanism to produce an intermittent electrical current. Fig. 4 is a vertical elevation of the submerged portion of our sounding-instrument, with elastic pressure-diaphragm and similar connected mechanism to produce an intermittent electrical current, as that in Fig. 3. Fig. 5 shows the winch in general elevation, by which the submerged portion of our sounding-instrument is lowered out and electrically connected to the registering devices, Figs. 6, 7, and 8. Fig. 6 is a view of the interior of the registering portion of our sounding-instrument. Fig. 7 is an interior view of a modified but equivalent arrangement of mechanism in the registering portion of our sounding-instrument. Fig. 8 is an external view of dial of our registering-instruments. Fig. 9 is a diagrammatic view of convenient electrical connections. Fig. 10 is a detail of electrical contacts of winch. Fig. 11 is a sectional detail of the conducting wires to immersed portion of our sounder. Figs. 12 and 13 are details of the ends of the contact-bars employed in the immersed portion of our sounder. Fig. 14 is a diagram, enlarged from Figs. 6 and 9, showing the registering-circuits more clearly, with certain preferred but immaterial modifications.

To utilize the hydrostatic pressure due to submersion, we employ a Bourdon pressure-tube A, Figs. 1, 2, and 3, or an equivalent elastic diaphragm A′, Fig. 4, to which the water has free access. This tube or diaphragm and connected mechanism are inclosed in a water-tight vessel B, which is thrown into the sea, being attached by a cable or wires C to a winch, Fig. 5, through which electrical communication is maintained with the registering device, Figs. 6, 7, and 8, above water, as hereinafter described.

The movement of the Bourdon pressure-tube A or equivalent diaphragm A′ under the water-pressure is utilized to operate a mechanism which shall intermittently make and break an electrical circuit in one direction only of the movement—that is to say, in the descending movement of the said submerged portion of the sounder. We effect this intermittent breaking of an electrical circuit by the following equivalent devices:

In Figs. 1 and 2 a pivoted sector a' is connected by a link a^2 to the end of the Bourdon pressure-tube, and in Fig. 1 the said sector a' is toothed and gears into wheels a^3, the last wheel a^4 of the train being driven by a clutch-pinion a^0, so that it rotates only in one direction. It is provided with step-teeth, upon which electrical contact is made by a spring-tongue a^5, and is intermittently broken by the rotation of the said wheel. The circuit through the mechanism is made from the wire

D′ to the insulated spindle of the wheel a^4 and from the insulated axis of the spring-tongue a^5 to the return-wire D.

In Fig. 2 the face of the sector a' is provided with peripheral teeth (shown in dotted lines) and with cheeks b', of ivory or other non-conducting material, and a spring a^5 rests thereon so that it makes metallic contact with the metallic teeth of the sector, but rests upon the non-conducting cheeks in the spaces between. The circuit is here made from D through the spring a^5 and the sector a', thence through spring b^4 to an insulated disk b^2, which is in metallic contact with the spring b^3, and thence to the return-circuit D′. Metallic contact only is made between the sector and the insulated disk b^2 through the spring b^4, which takes place on the movement of the sector from left to right, but is broken on the return travel from right to left. In this return travel of the sector a' it first moves away from the contact-spring b^4, which remains stationary, owing to inertia, and is caused to follow the sector (out of contact therewith) by the coaction of the latter with a stud b^5 on the disk b^2, which carries said spring and turns on the axis of the sector.

In Figs. 3 and 4 the pressure-tube or diaphragm operates a bar or lever c', which is pivoted at its lower end and is provided on one or both faces with teeth, the spaces between being filled up with non-conducting material. Against this prepared face a second pivoted bar c^2 rests, which is conveniently formed, as shown in Fig. 12, with a forked end united with a strip of platinum wire c^3. The bar c^2 is thus provided with a sensitive and durable contact-point, which coacts with said prepared face of the bar c'. The two bars are connected by an insulated spiral spring c^4, which causes the extremities of the bars always to remain in contact and balances the parts. As the electrical circuit is completed through the extremity of the said bars c' c^2, the circuit is intermittently made or broken by the formation of the faces of the bar c' with alternate metallic and non-conducting faces. The circuit is completed through the spring c^5. When the pressure decreases in the tube or on the diaphragm, thus causing a return travel, the bar c', which is insulated at its pivot, thus leaves the spring c^5 and breaks contact. A projection d, which is insulated, is attached to the bar or lever c', and brings over the piece c^6, which is pivoted to the case or piece B, and thus keeps the spring c^5, which is attached to the piece c^6, at a regulated distance from the bar c'. When the bar c' has made a short travel by the hydrostatic pressure in the tube or on the diaphragm A, contact is made between the bar c' and the spring c^5, and an intermittent electrical current is formed. Two or more grippers E E are pivoted on the bottom of this submerged portion of the sounder, upon a sliding spindle e', the grippers being connected together by spiral springs e^2. They are secured to remain open in position, as shown in Fig. 1, by lugs and a claw-spindle e^3. Upon striking the ground these grippers, which are in themselves a known mechanism, are released from their catch and close, the spindle e' being forced up into the socket of the submerged portion of our sounding-instrument. The motion thus ensuing from striking the ground, in addition to acting as a pneumatic buffer obviating shock, is utilized to make and break an electrical contact e^4, through independent insulated wires D^2, and thus to operate a signal-disk on the registering portion of the instrument, as hereinafter more fully described. The parts of said contact e^4 are separated to break the current by an interposed spiral spring e^5, Figs. 1 and $1^\times$, as soon as the grippers E close. While the grippers are open the contact is kept closed, so as to complete the circuit, by a peculiarly-shaped lever e^6, as clearly shown in Fig. 1, the lower end of the lever resting against one side of the sliding spindle. When the grippers close, a recess e^7 in said side admits said lower end of the lever e^6 and permits the spring e^5 to open the contact e^4, and thus break the circuit.

To connect said submerged portion of our instrument electrically with the registering portion above the water, we lower out the sounding-case B by a wire attachment C from a winch, Fig. 5. The wire attachment C conveniently consists of one or more internal insulated wires D, Fig. 11, protected and covered in any convenient manner, and with an external return-wire D′, from which metallic contact can be made with the exterior of the metallic drum G of the winch. The internal insulated wire (or wires) D is carried through the body of the drum of the winch to a series of metallic disks f, which are metallically connected with one another, but insulated from the spindle and bearing on the winch. Making contact upon these disks is a series of double-spring brushes f', from an insulated holder f^2, bolted to the frame of the winch, but insulated therefrom, from which the circuit D is continued. The other portion of the circuit D′, made through the drum, axle, and framing of the winch, is continued to the registering portion of the instrument by a wire F′, attached in any convenient way to the frame of the said winch.

The registering portion of our instrument is operated in either of the two following and equivalent ways:

By the construction and operation of the submerged portion of our sounder the current transmitted through it by the battery Z to the registering portion of our instrument is rendered intermittent. The respective ways of operating the registering devices are illustrated by Figs. 6, 8, and 9, and by Fig. 14. In both arrangements the casing of the registering portion of the instrument is provided with three binding-screws G G′ G^2, permanently connected in substantially one

and the same way with electro-magnetic devices within the register-casing, as best shown in Fig. 14, (which see,) and we employ in connection therewith and with the battery Z a switch-board S, Figs. 9 and 14, provided with an ordinary switch K and a spring-key L and with three posts p p^2 p^3, which are connected with the switch.

In the arrangement represented in Figs. 6, 8, and 9 the intermittent current from the submerged or sounder portion enters the registering portion of the instrument at its binding-screw, (marked G,) and passes through the wire g', Fig. 8, to the registering electro-magnet g^2, and thence by a wire g^3, an insulated frame part g^4, the armature g^5 of auxiliary electro-magnets H, and a wire g^6 to the binding-screw G′, Figs. 6 and 8, and thence through the wire g^7, Fig. 9, post p^2, switch K, post p, and wire g^8 to the battery Z, the circuit being closed, as shown in Fig. 14, and said armature g^5 having a contact-piece at the end opposite its pivot, which contacts with said frame part g^4 in this arrangement. During each descent of the sounding portion of the instrument, the switch K being closed, as shown in Fig. 14, the above-described circuit beyond the binding-screw G is automatically closed during each registering-impulse by said magnets H, a shunt-circuit extending from the said binding-screw G through a wire h, Fig. 6, to the coils of said magnets H, and thence through the wire h^2, Fig. 6, binding-screw G², and wires h' h^3, Figs. 8 and 9, to the line-wire F′ and battery Z.

The object of placing the auxiliary electro-magnets H in the shunt-circuit is to emphasize and prolong the intermittent action of the main current from the submerged portion of the sounding device. The faint intermittent electrical current passing through the shunt-magnets produces the alternate making and breaking of the main circuit beyond them, and through the mechanical operating device by the movement of the armature g^5 making and breaking the circuit g' to g^6 in obedience to the faint impulse of the intermittent current through the submerged portion of the sounder. By means of said key L the registering portion of the instrument may be short-circuited, so as to be worked independently of the sounder portion for setting the pointer P at zero or for testing its operation. This is effected in said arrangement represented in Figs. 6, 8, and 9 as follows: Each time the key L is put down or closed a circuit is completed from the battery Z through the wire g^8, Fig. 9, post p, switch K, (closed,) post p^2, switch L, post p^3, wire h^4, binding-screw G, Figs. 8 and 6, wire h, the coils of the magnets H, the wire h^2, the binding-screw G², and wires h' h^3 to the line-wire F′ and battery Z.

In the arrangement represented by Fig. 14 the delicate intermittent current from the descending sounder portion of the instrument enters the registering portion by the line-wire F′, through the switch-board post p, switch K, (closed,) post p^2, and wire w at the binding-screw G², and passes thence, through the wire h^2, the coils of the magnets H, the wire h, the binding-screw G, and the wire w^2, to the battery z, the line-wire F being directly connected with the other pole of the battery. The magnets H close a shunt-circuit from the battery Z, through the wire w', binding-screw G′, the wire g^6, the frame of the magnets H, their armature g^5, and insulated frame part g^4, and the wire g^3, to the registering-magnet g^2, and thence by the wire g', binding-screw G, and wire w^2, back to the battery. Through this alternative circuit of low resistance a powerful current is established through the magnet g^2 for the registration of each unit, and a reliable registration is thus insured. When the key L is operated in this arrangement represented by Fig. 14, the current extends from the battery Z, through the wire w', binding-screw G′, wire w^3, post p^3, key L, (closed,) post p^2, wire w, binding-screw G², wire h^2, the coils of the magnets H, the wire h, binding-screw G, and wire w^2, back to the battery, and in the shunt-circuit, as before, from the battery through the wire w', binding-screw G′, wire g^6, the frame of the magnets H, their armature g^5, insulated frame part g^4, wire g^3, the coils of the registering-magnet g^2, the wire g', the binding-screw G, and the wire w^2, back to the battery, the switch K being open in this operation.

The operation of the pointer P of the registering portion of the instrument by the intermittent electric current is as follows: A pivoted anchor M is provided, to which is affixed a recoil-spring m, and its tappets are of such form that when engaging alternately in the teeth of the wheel m' by reason of the intermittent attraction of the electro-magnet g^2 and the recoil of the spring m it thereby rotates the wheel m' tooth by tooth. Equivalently the intermittent action of the electro-magnets and the recoil-spring m may be made to operate a reciprocating bar M′, Fig. 7, provided with V-pieces V, which engaging in the teeth of the wheel m' will cause its rotation, tooth by tooth, as in the case of the anchor M.

A signal-card y is provided to indicate that the submerged portion of the device has reached the bottom. This is a card mounted on a pivoted armature provided with balance-weight or recoil-spring and controlled by an electro-magnet Q, through which an independent circuit is made or broken; as the sounder reaches the bottom, by the action of the grippers, as hereinabove described.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is—

1. In a registering deep-sea sounder, the combination of a submerged portion having an elastic part moved by hydrostatic pressure, an electrical make-and-break device and mechanical connections between the two, an

upper portion provided with electrical registering mechanism, and electrical conductors connecting said make-and-break device with said registering mechanism, substantially as hereinbefore specified.

2. In the submerged portion of a registering deep-sea sounder, the combination of an elastic part moved by hydrostatic pressure, an electrical make-and-break device comprising a movable part having a series of contact-points, mechanism transmitting motion to said movable part from said elastic part, and a contact-spring coacting with said points in succession, substantially as hereinbefore specified.

3. In the submerged portion of a registering deep-sea sounder, the combination of a Bourdon tube A, an oscillating sector a', mechanically connected therewith and having peripheral contact-points between insulating-cheeks, a contact-spring a^5, resting upon said points and cheeks, a contact-spring b^4 at one edge of said sector, and an insulating-disk b^2, carrying said contact-spring b^4 and provided with a stud b^5, whereby a lost-motion connection is made between said sector and said contact-spring b^4 during the return travel of said sector, substantially as hereinbefore specified.

4. In the submerged portion of a registering deep-sea sounder, the combination of sand-grippers E E, an electrical contact, a spring for opening said contact, a lever for closing the same, and a recessed sliding stem connected with said grippers and coacting with said lever, substantially as hereinbefore specified.

5. In a registering deep-sea sounder, the combination of a submerged portion having an elastic part moved by hydrostatic pressure, an electrical make-and-break device and suitable connections, an upper portion provided with electrical registering mechanism, a winch provided with insulated disks and contact-brushes, electrical conducting-wires connecting said submerged portion and said winch, electrical registering mechanism, and electrical conductors connecting said brushes and said mechanism, substantially as hereinbefore specified.

6. In the upper portion of a registering deep-sea sounder, an electrical registering mechanism comprising an oscillating anchor, a toothed wheel rotated by said anchor, an electro-magnet and recoil-spring for oscillating said anchor, suitable electrical conductors, and auxiliary or shunt magnets for manipulating or working more strongly the current between the magnet first named and the submerged portion of the instrument, substantially as hereinbefore specified.

7. In a registering deep-sea sounder, the combination of a submerged portion having an electrical make-and-break device operated by hydrostatic pressure and a separate electrical contact connected with sand-grippers at its lower extremity, suitable electrical conductors, and an upper portion comprising electrical registering mechanism in circuit with said hydrostatic-pressure device, and an indicator, to show whether or not the bottom has been reached, in circuit with said contact, operated by the sand-grippers, substantially as hereinbefore specified.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

ALFRED J. COOPER.
EUSTACE E. WIGZELL.

Witnesses:
SAM. P. WILDING,
HENRY J. FULLER.