(No Model.) 4 Sheets—Sheet 1.

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

ELECTRIC REGISTERING DEEP SEA SOUNDER.

No. 410,786. Patented Sept. 10, 1889.

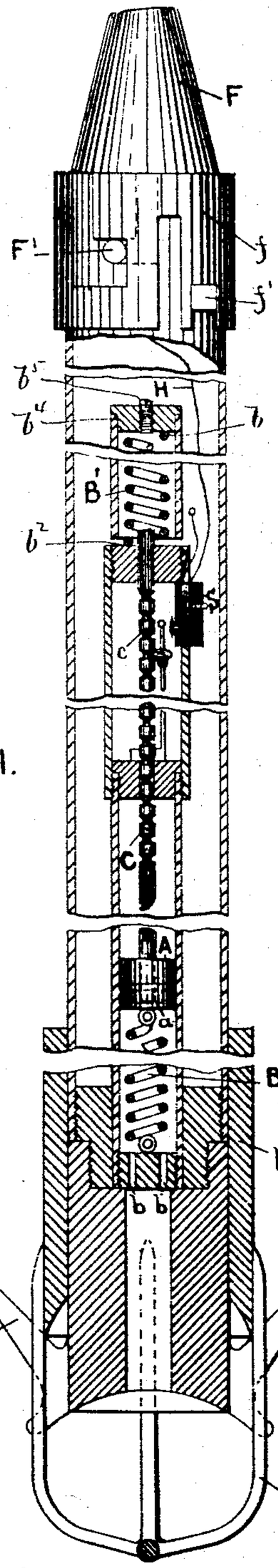

FIG. 1.

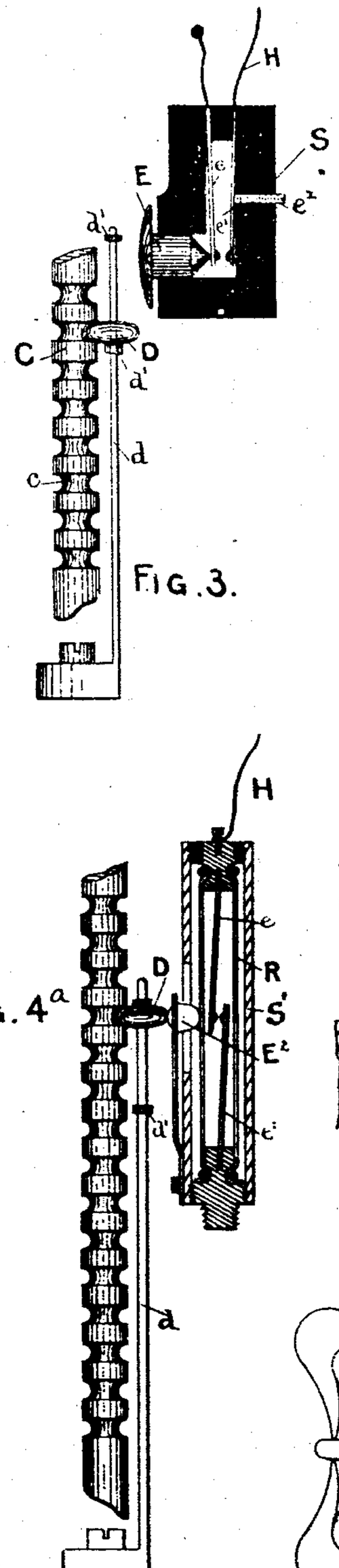

FIG. 3.

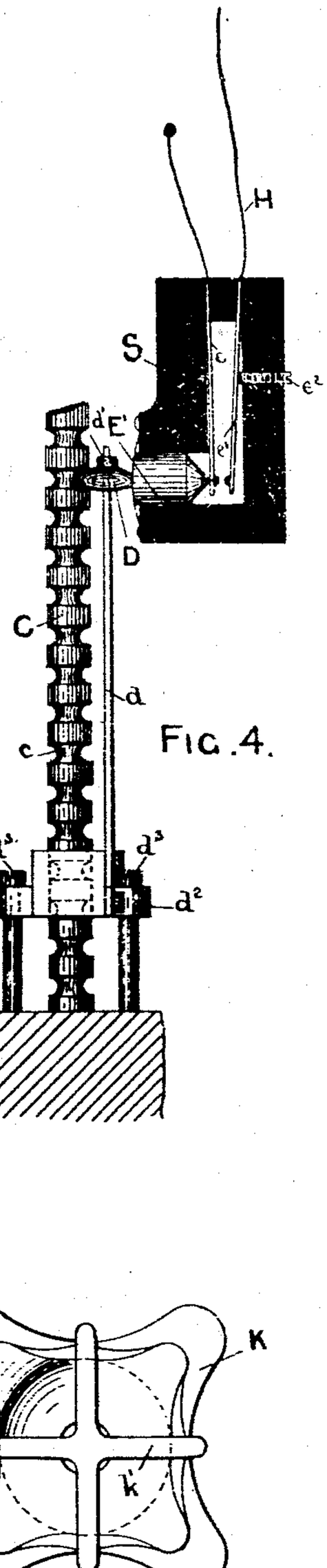

FIG. 4.

FIG. 4ª

FIG. 2.

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(No Model.) 4 Sheets—Sheet 2.

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

ELECTRIC REGISTERING DEEP SEA SOUNDER.

No. 410,786. Patented Sept. 10, 1889.

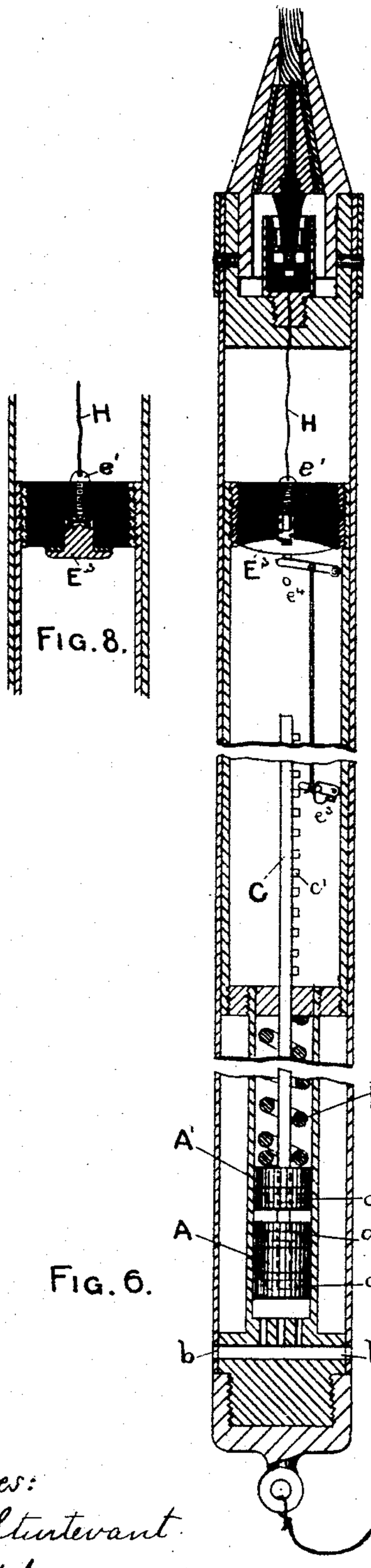

FIG. 6.

FIG. 8.

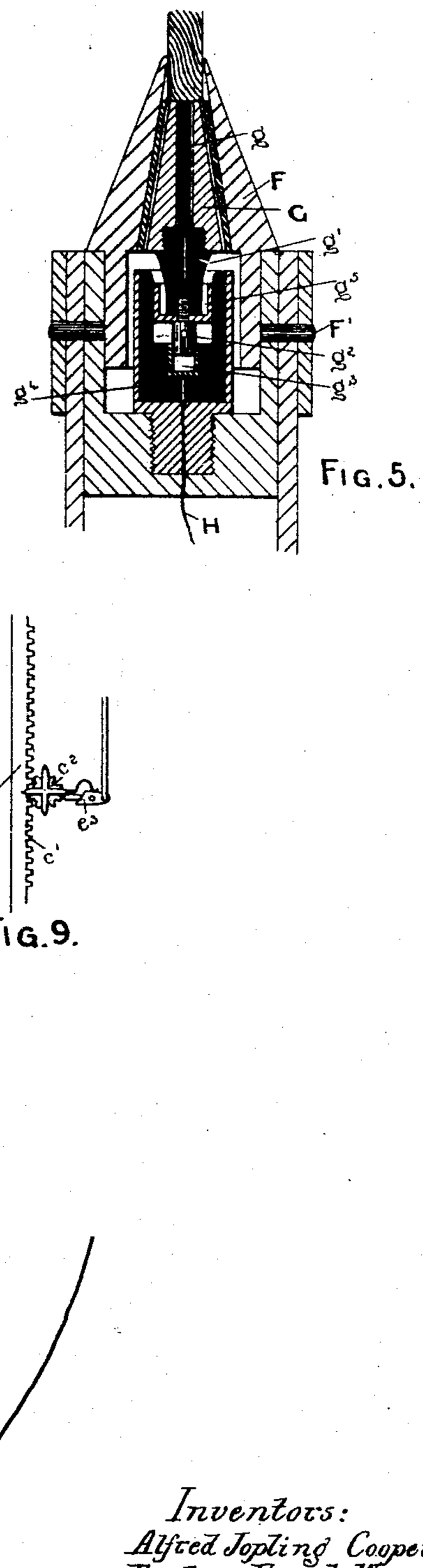

FIG. 5.

FIG. 9.

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(No Model.) 4 Sheets—Sheet 3.

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ELECTRIC REGISTERING DEEP SEA SOUNDER.

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Fig. 10.

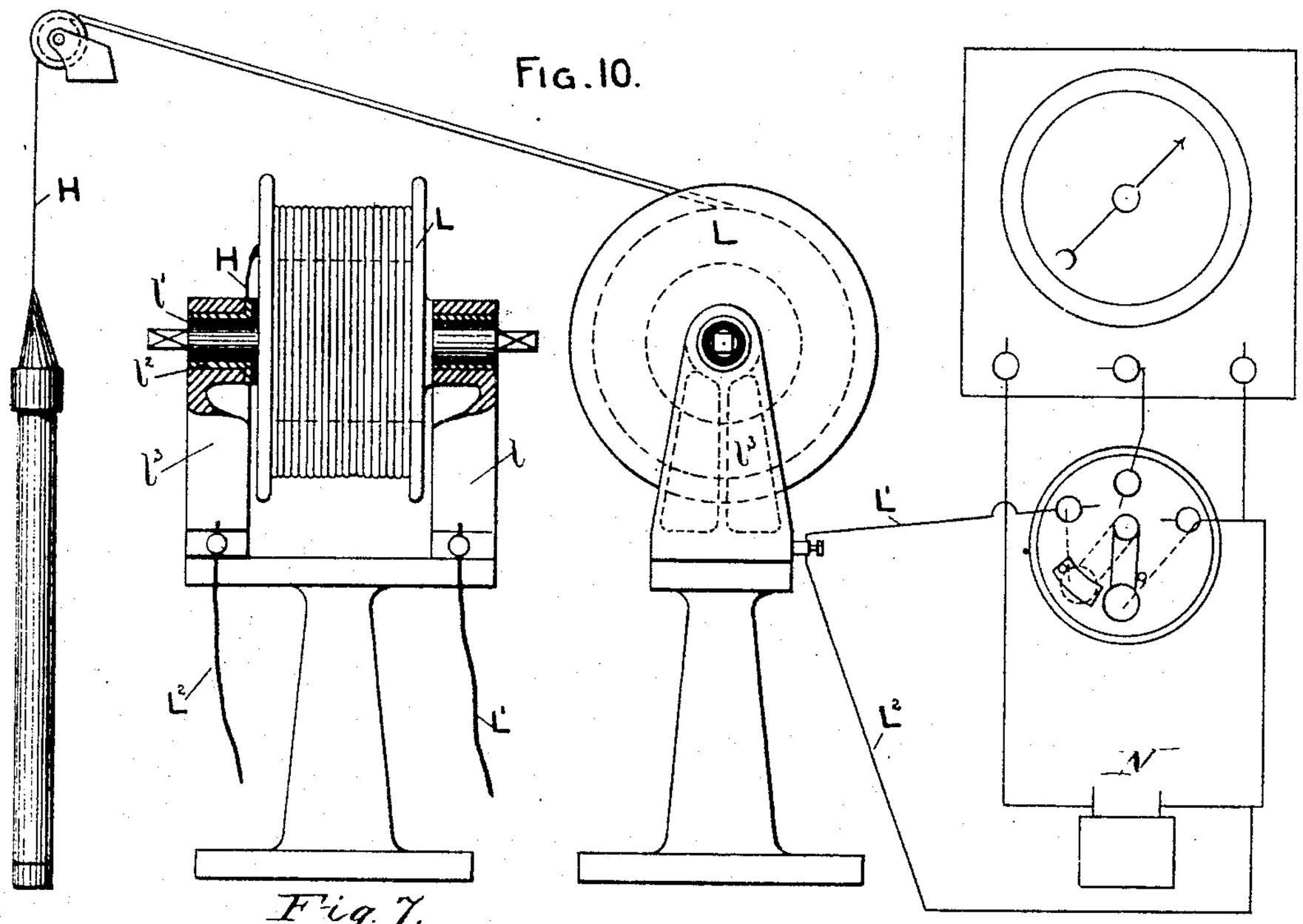

Fig. 7.

Fig. 14. Fig. 14a

Fig. 12.

Fig. 12a.

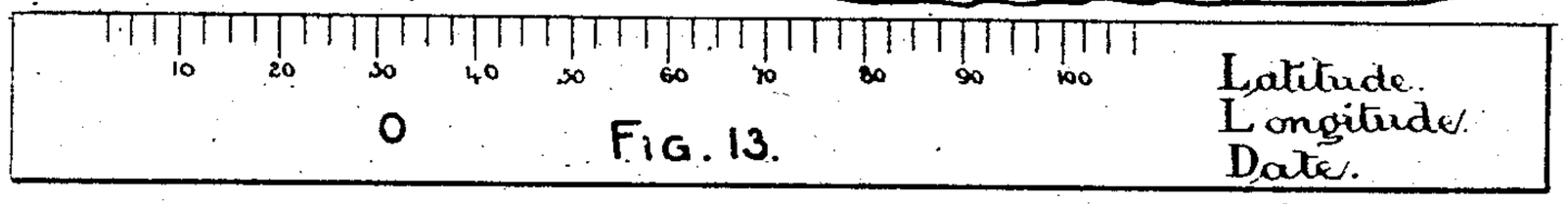

Fig. 13.

Fig. 11.

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(No Model.) 4 Sheets—Sheet 4.

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ELECTRIC REGISTERING DEEP SEA SOUNDER.

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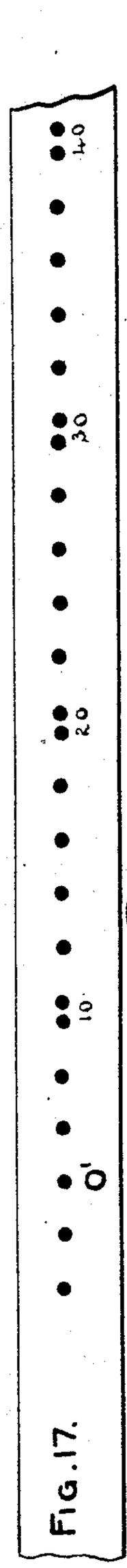

FIG. 17.

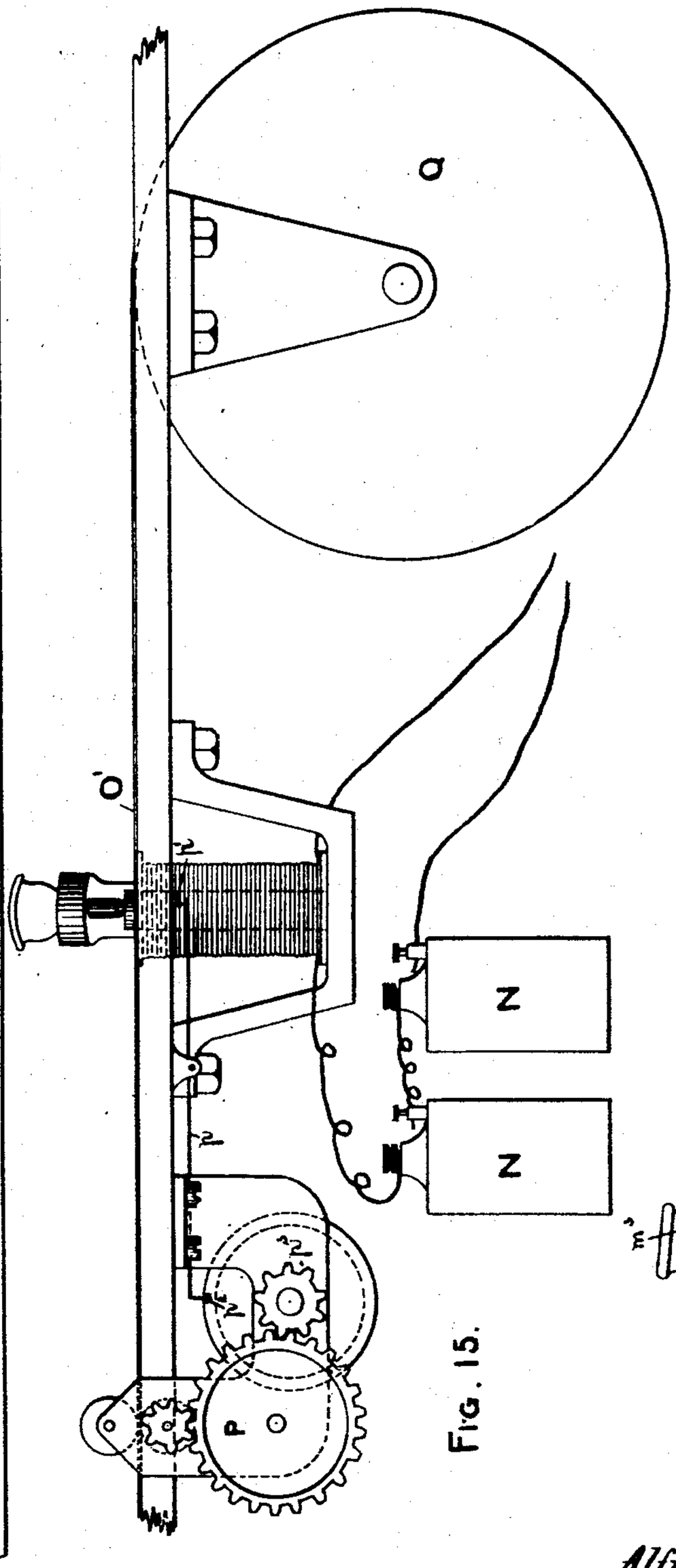

FIG. 15.

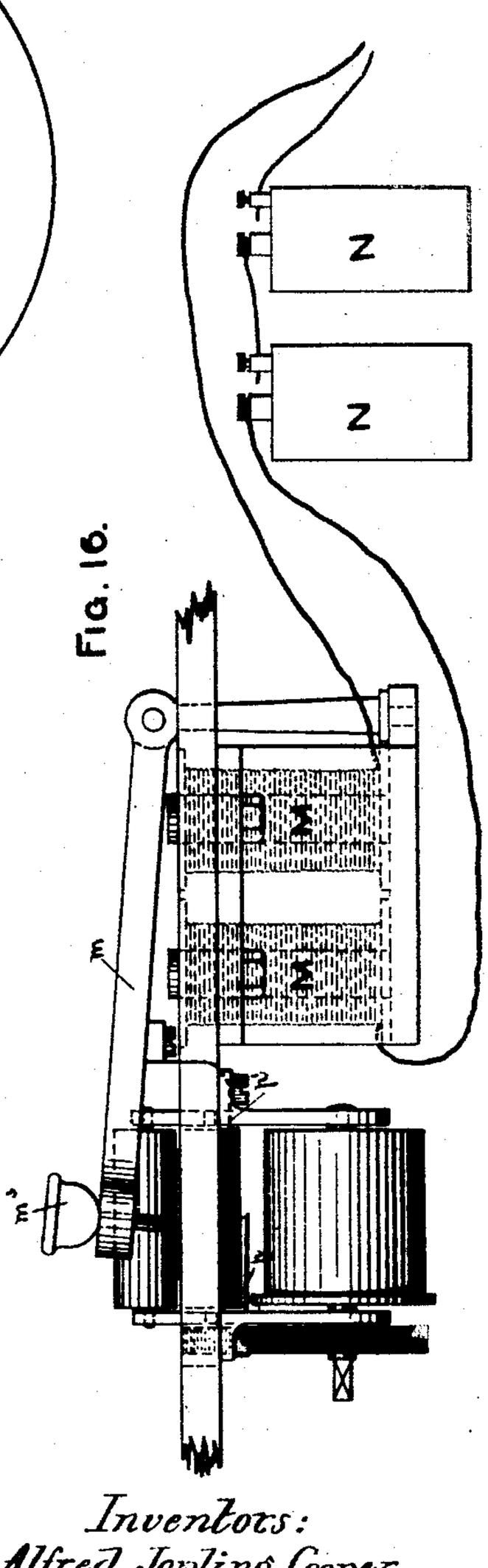

FIG. 16.

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UNITED STATES PATENT OFFICE.

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

ELECTRIC REGISTERING DEEP-SEA SOUNDER.

SPECIFICATION forming part of Letters Patent No. 410,786, dated September 10, 1889.

Application filed October 24, 1888. Serial No. 289,043. (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 Improvements in Electric Registering Deep-Sea Sounders, of which the following is a specification.

This invention relates to apparatus for ascertaining or sounding the depth of submersion of one portion of the apparatus containing a spring-pressed piston in communication with the hydrostatic pressure of the sea, the results being registered above water by a registering mechanism operated by an intermittent electrical current established between the aforesaid two portions of the said sounding apparatus; and this invention consists in improvements in construction upon a registering deep-sea sounder applied for by us in a prior application, filed November 16, 1887, Serial No. 255,350. The improvements are essentially these: The submerged portion of the sounder is contained in a case of such an outline as to offer least hold upon or resistance to the water. The electric intermittent contact therein is inclosed in an independent sealed or water-tight chamber, so as to be protected from the effect of moisture or water that may possibly penetrate the outer case, such portion of mechanism as may remain so exposed being of a character unaffected by moisture. Further, the cap of the submerged portion of the sounder is attached in such a manner as to be secure, and yet readily removed, and so as to make an electrical contact with the interior of the instrument protected from the action of moisture. The intermediate winch for lowering the sounder is constructed in an improved and simplified manner, and a simpler and more convenient registering-instrument is connected thereto.

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 and figures marked thereon.

Like letters refer to similar parts throughout the drawings.

Figure 1, Sheet 1, is a part vertical section through the submerged part of our improved sounder with sand-gripper attached. Fig. 2 is an under plan of the same. Figs. 3, 4, and 4^a are enlarged details of equivalent intermittent contact mechanism with sealed or water-tight contact-chamber used therein. Fig. 5, Sheet 2, is a vertical enlarged section through the cap of the said submerged portion of the sounder. Fig. 6 is a vertical section through a slightly-modified but equivalent form of the submerged portion of our sounder. Fig. 7, Sheet 3, is an elevation, partly in section, of the improved winch by which the sounder is lowered. Fig. 8 is a detail, slightly modified, of the sealed or water-tight electrical contact-chamber therein. Fig. 9 is an equivalent but slightly-modified form of the piston-rod rack and pinion producing the intermittent electrical contact. Fig. 10, Sheet 3, is an end elevation of the improved winch from which the sounder is lowered. Fig. 11 is a detail of the cable used for the submerged part of the sounder to prevent twisting. Fig. 12 is a perspective view of improved registering apparatus contained in a box, together with batteries. Fig. 12^a is a detail of a hand-punch fitted therein. Fig. 13 is a large-scale detail of the registering-card used therein. Fig. 14 is a front and Fig. 14^a a side elevation of the operating electro-magnet of the registering-instrument. Fig. 15, Sheet 4, is a large-scale side elevation of a modified but equivalent registering-instrument. Fig. 16 is an end elevation of the same. Fig. 17 is a plan of the registered card produced therein.

To utilize the hydrostatic pressure of submersion, we fit a sliding piston A, provided with a cup-leather *a*, Fig. 1, Sheet 1, or a series of pistons A A′, provided with cup-leathers *a a′* a^2, Fig. 6, Sheet 2, the two latter facing toward each other and filled at pressure with glycerine or other suitable fluid. Apertures *b* are provided for access of the external water thereto, and the piston in its ascending motion reacts against a spring B or springs B B′, in which case the second spring B′ is utilized to re-enforce the action of the other spring after a certain distance has been traversed by the rod C, so as to provide high resistance for great depths. The lower end of the spring B′ is soldered at b^2 to the head of the piston-cylinder, or to some other part

stationary relative to rod C, and the upper end is soldered at b^3 to a cap or case b^4, provided with an adjusting-screw b^5 in line with rod C. When the rod has by hydrostatic pressure been forced upward a certain distance, determined by the adjustment of screw b^5 in its cap, said rod will encounter the lower end of the screw and any further movement will extend spring B′ as well as B. Upon the rod C of this piston are provided grooves *c*, Figs. 1, 3, 4, and 4ª, Sheet 1, or projections *c′*, Figs. 6 and 9, Sheet 2. In the first case, where the grooves are employed, an oval bead D, Figs. 1, 3, 4, and 4ª, Sheet 1, is mounted upon a stem *d*. In Fig. 3, Sheet 1, this stem is shown as a fixture at its base, the upper portion being capable of elastic movement. The bead D lies between two stops *d′*. Thus when the stem first begins to move it carries the bead D opposite to a sliding cup-headed water-tight spring-pressed piston E, Fig. 3, Sheet 1, or a sliding spring-pressed piston E′, covered with a water-tight diaphragm, Fig. 4, Sheet 1, until it is checked by the top stop *d′*. The bead being there arrested intermittently moves away from the piston-rod C each time that the ridges between the grooves on the said rod force their way past the said bead. Equivalently, instead of the bead sliding on the stem *d* between two collars, the bead may be fixed on the stem *d*, of which the lower part may be mounted on a sliding cross-head d^2, so that the first lift of the piston causes the said bead, rod, and cross-head to rise with it until checked by the bolt-heads d^3, Fig. 4, Sheet 1. In consequence of this arrangement of the said bead D and stem *d*, on the return of the piston the bead D slides down with the rod C, clear of the spring-pressed piston E E′. During, however, the ascending stroke of the piston-rod C the intermittent oscillation of the bead D, when in front of the spring-pressed piston E or E′ or spring-knob E^2, Fig. 4ª, Sheet 1, causes a similar reciprocating movement to be thereby communicated to the said piston or knob, the spring *e* in Figs. 3 and 4, Sheet 1, which forms one pole of the internal current through the case, producing the required recoil, and (Fig. 4ª, Sheet 1) the knob E^2 is mounted on a spring-tongue. The reciprocating movement produced is sufficient to cause the spring *e* to touch the extremity of the other opposite spring *e′*, which can be adjusted by the set-screw e^2 in Figs. 3 and 4, Sheet 1, the said spring being the other insulated pole of the internal current, the body of the chamber S being composed of insulating material. In Fig. 4ª, Sheet 1, the water-tight chamber protecting the said contacts is formed by an elastic tube R, closely bound at either end to metal plugs, one of which is insulated from the case S′ for attachment to the insulated internal wire H. The elastic tube R is protected by an external metal case S′. In Figs. 6, 8, and 9, Sheet 2, a mechanically-equivalent device is shown. The projections *c′*, provided on the rod C, strike an oscillating lever e^3, which by a rod communicates an upward movement to another lever e^4, pressing against a sliding piston or diaphragm E^3, which said piston or diaphragm, being in electrical contact with the case, forms one pole of the internal current. The opposite insulated pole of the internal current *e′* is brought into contact with the inner end of the sliding piston, or the inner face of the diaphragm E^3, when pressed home by the lever-movement e^4. The outer end of the lower lever e^3 is jointed and spring-pressed, so that on the downward travel of the notched piston-rod the end of the lever may give freely without producing further movement; but the joint of the said lever will not bend upward. Fig. 9, Sheet 2, shows an equivalent mechanical movement with the projections reduced to a rack *c′* with an intermediate pinion c^2. To close the upper end of the submerged portion of the sounder while maintaining electrical contact, we use a conical cap F, Fig. 5, Sheet 2, with pins F′ fitted in the cap, making an ordinary bayonet-joint in the outer case. Over this we apply a loose sleeve *f*, which serves to lock the bayonet-joint F′ in place, as shown. To release this bayonet-joint, the cap *f* is lifted until it is clear of the locking-pin *f′*. The cap is then turned toward the right until the bayonet-pin F′ comes under the vertical slot above it and the locking-pin *f′* comes under the slot alongside it. The sliding sleeve *f* is then pressed down, the locking-pin *f′* sliding up the groove above it, and the bayonet-pin F′ also sliding up the groove above it until the sleeve is pressed so far down as to free the bayonet-pin F′. The external cap F can then also be turned to the right and lifted clear, as in an ordinary bayonet-joint. Within the cap F is a central cone G, through which one wire from the cable is carried in an insulated manner, while the other wire or wires from the cable are laid along the outside of the said cone and make contact with the case through the cap F. The aforesaid insulated wire *g* is continued through a projecting piston *g′* of insulating material, and finally to a split metallic piston g^2, by which electrical contact can be made through the metal lining g^3 in a cylinder of insulating material g^4 to the internal wire H, and thence to the contact-box S. To prevent access of moisture to this internal contact-plunger g^2, a cup-leather g^5 is fitted to the plunger above it, by which the moisture is prevented from entering the lower part of the cylinder in which it is working.

The sand-gripper is constructed as follows: The gripping-arms K are in the form of a cup and petals with the concave side toward the sounder and the petals projecting outward beyond the sounder. A sliding weight *k* is fitted above the grippers, so as to slide down by its natural weight and close the concave mouth of the gripper. This weight is continued by a cage *k′*, Fig. 1, Sheet 1, or a further weight and spindle *k′*, Fig. 7, Sheet 2, so that

this projection first strikes the ground as the sounder reaches the bottom. The upper sliding weight *k* is thereby lifted from the concave mouth of the sand-gripper, and as it is found in practice that the sounder falls upon its side and is so dragged for a short while the projecting petals thus scrape up a portion of the bottom of the sea, and upon lifting the sounder from the bottom the weight falls only to close the mouth of the gripper, and thus to securely retain its contents. The above described submerged portion of the sounder is attached by a light wire rope to a reel L, Fig. 10, Sheet 3, for convenient lowering out and winding up on board ship.

The cable is constructed as follows: In the center of the cable is the insulated wire or wires H, Fig. 11, Sheet 3, which are led through the cap of the submerged portion of the sounder to the aforesaid insulated pole within the submerged portion of the sounder. Surrounding this wire is an insulating-covering of gutta-percha and tape *h h'*, and these are again covered with two coatings of wire h^2 h^3, wound in opposite directions to prevent as far as possible any twisting of the cable. The cable is wound upon the metallic drum L, the return-current from the submerged portion of the instrument being from the case through the exterior metallic winding h^3, and thus to the insulated metal of the drum L; thence through the frame *l* to the wire L', one journal of the said drum being fitted in the usual gun-metal bearing. The other journal of the drum is provided with an insulated sheath *l'*, and that again is covered with a metal bush l^2, these being secured to the shaft and revolving with the shaft in the metal frame l^3. The insulated current to the interior of the submerged portion of the sounder passes from a battery or other generator N through L^2, thence through the insulated standard l^3 to the metal revolving bush l^2, thence by insulated-wire attachment H, passing through the body or cheek of the drum L to the center of the cable, and thence to the interior of the submerged portion of the sounder. The current, when the circuit is closed in the submerged portion of the instrument, may then pass through the wires L' L^2 and through a registering-dial and battery, as fully described in connection with our prior application, or through the registering device and battery, as illustrated in Figs. 12, 12^a, 13, and 14, Sheet 3, and 15, 16, and 17, Sheet 4. This device consists of an electro-magnet M, (shown in detail, Fig. 14, Sheet 3, and 16, Sheet 4,) the batteries N N being necessarily included in the circuit. As the current is intermittently made and broken in the submerged portion of the sounder as it descends, each closing of the circuit will operate the electro-magnets M. These, attracting a spring-held armature *m*, register the successive degrees of descent of the submerged portion of the sounder, and thus indicate the depth of descent. This may be effected in either of two equivalent ways. In Figs. 12 and 14, Sheet 3, the reciprocating armature *m* is provided with an arm *m'*, terminating in a pin or broad point, which will feed the registering-card O, on which a scale has been prepared, through successive distances proportionate to the scale for depth. A fixed reverse point m^2 under or over the card prevents the registering-card from traveling backward on the return-throw of the armature. In order to permanently mark the depth at any required moment or position, the hand-punch, Fig. 12^a, Sheet 3, is used to punch the registering-card. Equivalently, in Figs. 15 and 16, Sheet 4, the armature *m* is made to operate an ink-punch m^3, which, descending on the registering card or tape O', makes a series of ink-dots at scaled intervals, with a double dot at every ten, as shown in plan, Fig. 17, Sheet 4, the registering-card being fed forward either by clock-work P or by an electro-magnet device and feed-pin, as already described in relation to Figs. 12 and 14, Sheet 3. If clock-work P be used, it is checked by a lever *p*, which is disengaged by the finger *p'*, attached to the reciprocating armature *m*, so that the commencement of the travel of the registering-card O' is caused by the lifting of the check-lever *p* by the first downward movement of the armature *m*. In this case the paper may be conveniently fed from a drum Q, and the check-recess p^2 in the escapement-wheel of the clock-work is so placed with regard to the circumference of the escapement-wheel p^3 that before the recess p^2 comes round again and the clock-work is checked sufficient paper is run off in order to take any ordinary soundings. Should, however, the feed of the paper be excessive before the soundings are finished, the continued movement of the armature F will immediately again release the clock-work and allow the travel of the paper to continue.

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 submerged portion having a spring-pressed piston in communication with the sea and moved by hydrostatic pressure and an electrical make-and-break device contained in a special sealed or water-tight chamber operated by the upward movement of the serrated rod of said piston against an elastically-supported sliding bead opposite to said electrical contacts, the said bead falling out of position on return-stroke, in combination with an upper portion provided with electrical registering mechanism fitted with an electro-magnet making a registering-pulsation for every make and break in the current from the submerged portion of the sounder, and with electrical conductors connecting said make-and-break device with the said registering mechanism, substantially as hereinbefore specified.

2. In a submerged portion of a registering

deep-sea sounder, the combination of a spring-pressed piston moved by hydrostatic pressure and an electrical make-and-break device consisting of an indented or serrated stem of the said piston, producing on the upward stroke intermittent pressure through an elastically-supported sliding bead upon spring electrical contact-points incased in a sealed or water-tight chamber, the bead falling out of operation on the return-stroke, substantially as hereinbefore specified.

3. In a submerged portion of a registering deep-sea sounder, the combination of a hydrostatically-moved piston, spring-pressed or pulled by two springs, one re-enforcing the other during the travel, having a piston-rod grooved at suitable intervals, with a bead supported and sliding on an elastic rod and pressing upon the said piston-rod, the upward movement of the piston raising the said bead to the highest position on the rod, and thus producing intermittent pressure upon the electrical contacts within an adjoining sealed or water-tight chamber, the said bead falling out of operation on the return-stroke, substantially as and for the purposes described.

4. In the submerged portion of a registering deep-sea sounder, the combination of a cap to which the connecting-wires are attached, the cap being secured to the case by a locking bayonet-joint, and an internal projecting plunger making electrical contact with the continued internal insulated wire, the said plunger being surrounded by a cup-leather working in a chamber of insulating material to prevent contact of the sea-water with the said insulated internal current, substantially as hereinbefore specified.

5. In a registering deep-sea sounder, the combination of a submerged portion having a spring-pressed piston moved by hydrostatic pressure operating an electrical make-and-break device, a winch provided with one specially-insulated bearing conducting an insulated current, and wires connecting said submerged portion and said winch with electrical registering mechanism, so as to maintain complete circuit between the said sounder and battery and registering mechanism while the connecting-wire is being unrolled from the said winch, substantially as hereinbefore specified.

6. In the upper portion of a registering deep-sea sounder, an electrical registering mechanism comprising a sliding card provided with a suitable scale whereon the register of depth is maintained by it being fed uniformly forward by an electro-magnet and driving-pin operated by the said intermittent current from the submerged portion of the sounder, and a punch which regulates the distance traveled by the said sliding card.

7. In a registering deep-sea sounder, the combination of the spring-pressed piston in communication with the sea and moved by hydrostatic pressure, serrations carried by said piston, and an electrical make-and-break device contained in a closed chamber and having one of its contacts operated by said serrations as the piston moves under the pressure of the sea, substantially as set forth.

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

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E. E. WIGZELL.

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