No. 840,018. PATENTED JAN. 1, 1907.

M. VON SCHOULTZ.

APPARATUS FOR SEARCHING OF SUNKEN BODIES.

APPLICATION FILED MAY 18, 1899.

3 SHEETS—SHEET 1.

Fig. 1.

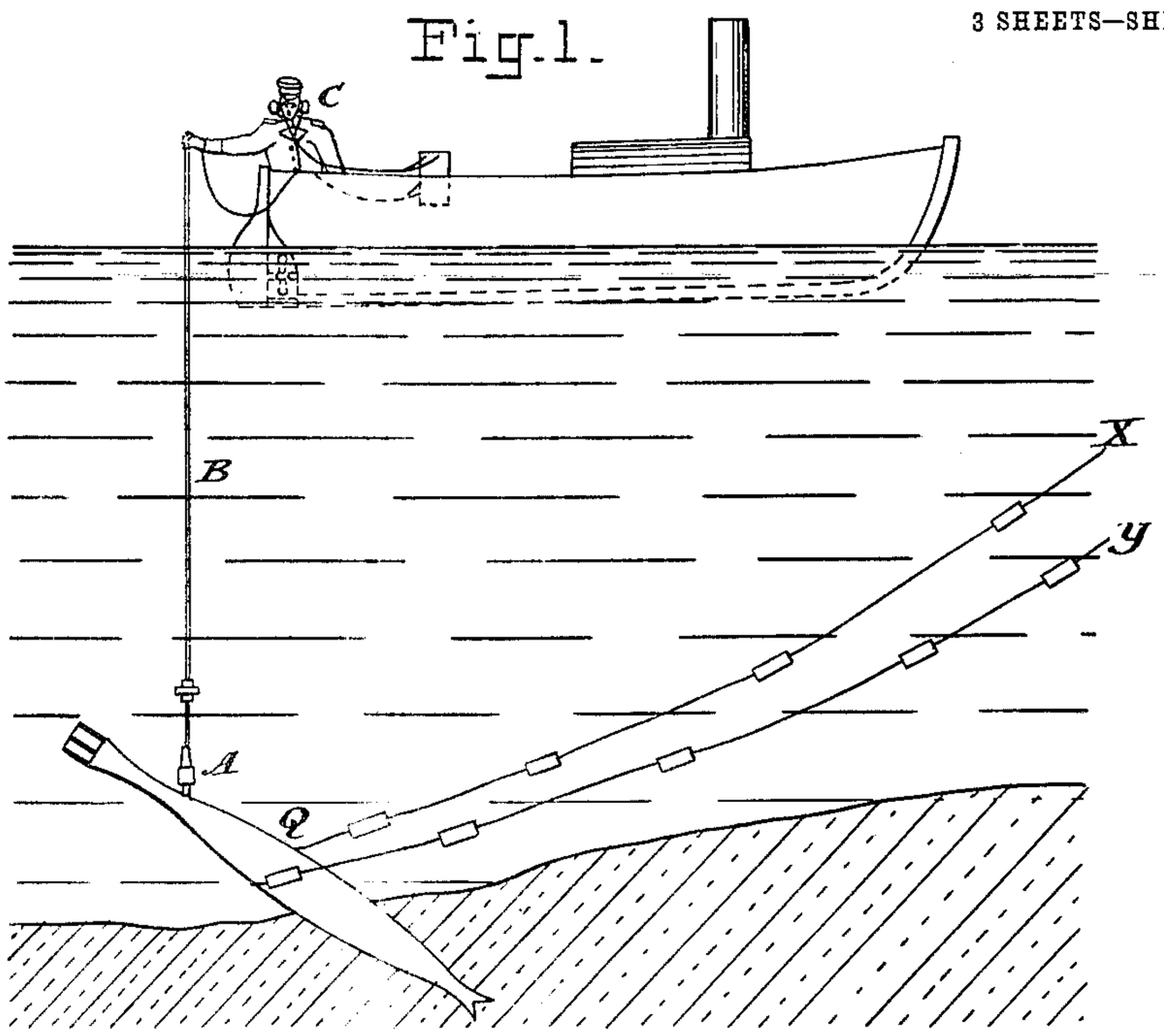


Fig. 2.

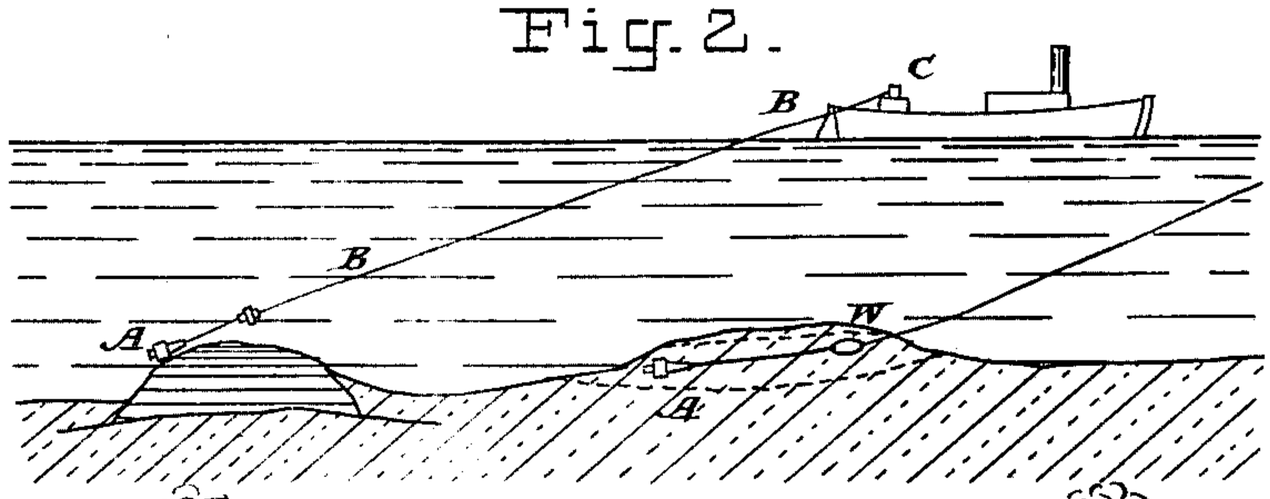
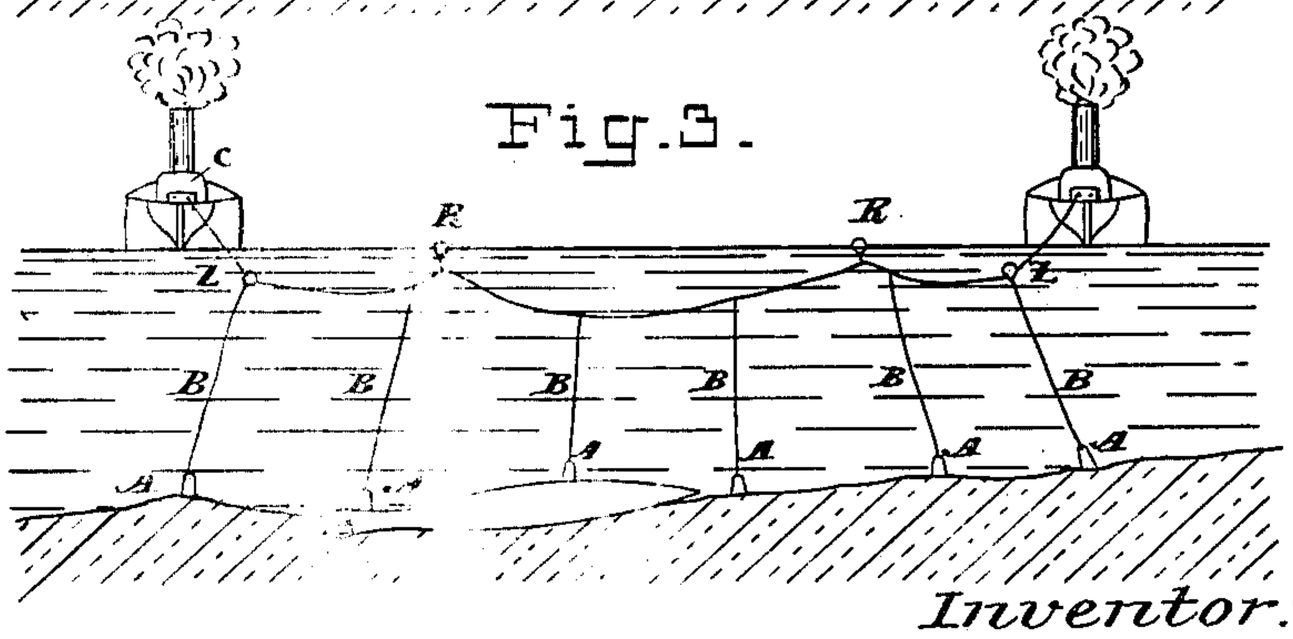


Fig. 3.



Witnesses:
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Thos. Kirkpatrick

Inventor:
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3 SHEETS—SHEET 2.

Fig. 4.

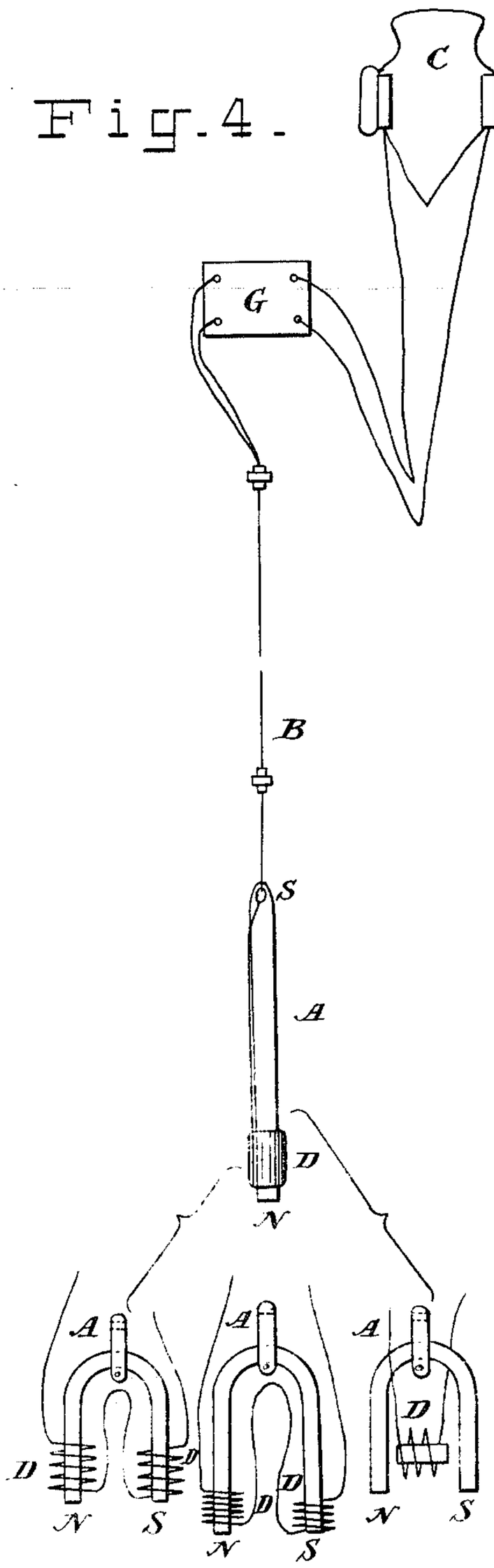
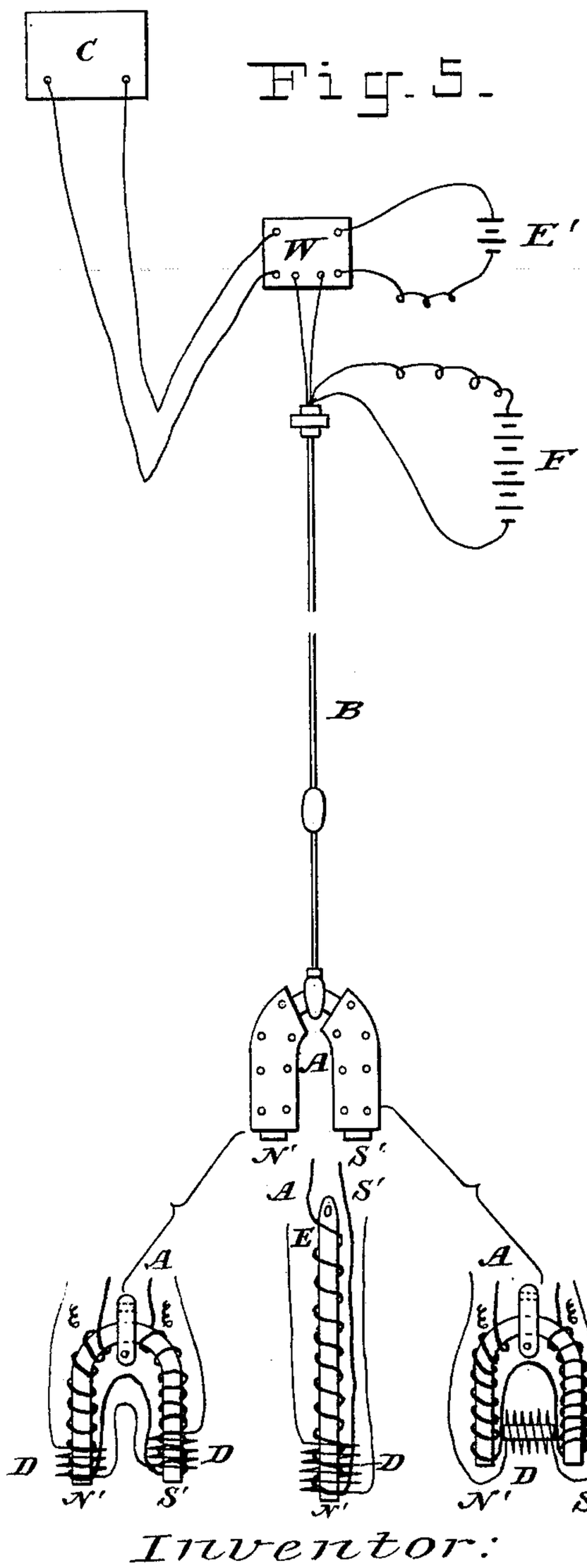


Fig. 5.



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APPLICATION FILED MAY 16, 1899.

3 SHEETS—SHEET 3.

Fig. 6.

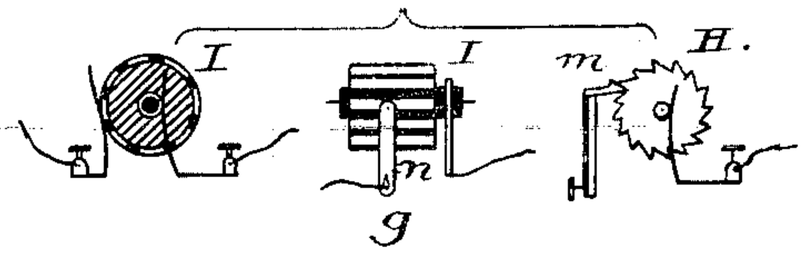


Fig. 7.

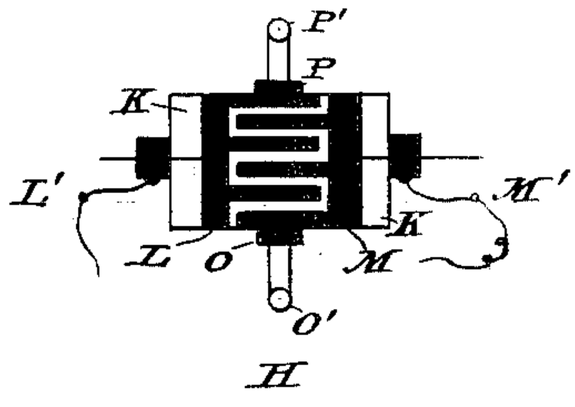


Fig. 9.

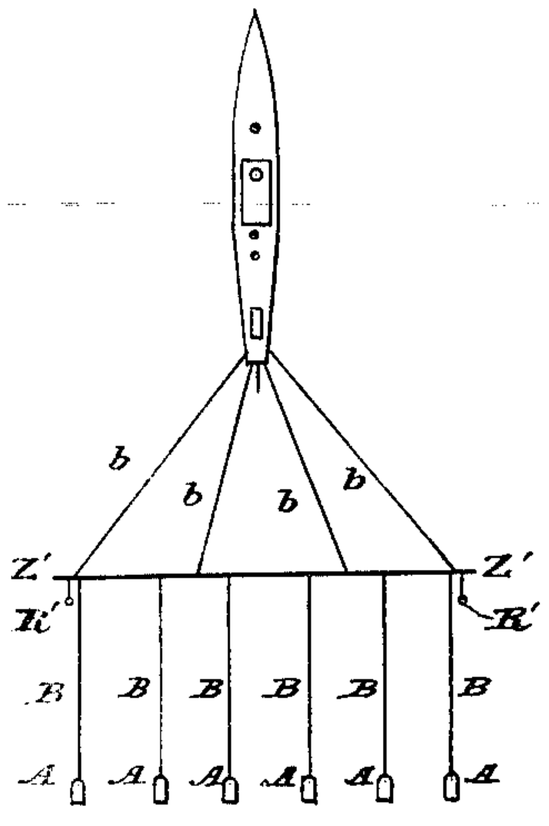


Fig. 8.

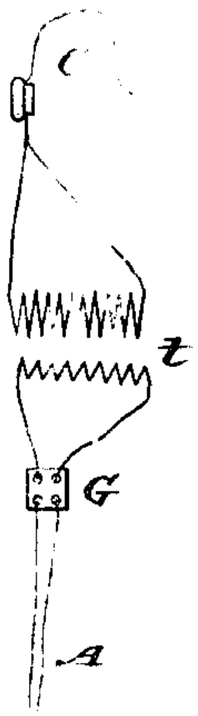
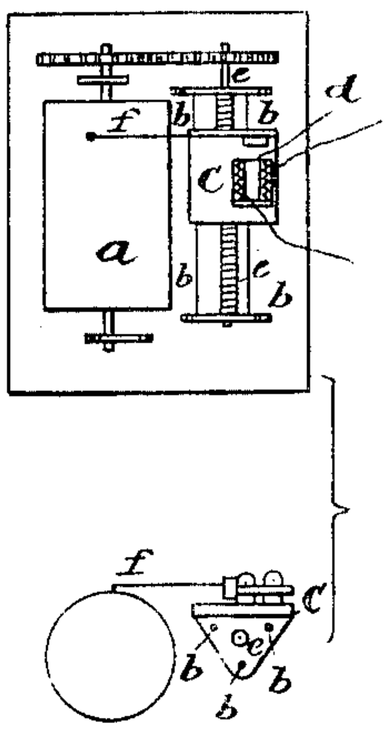


Fig. 10.



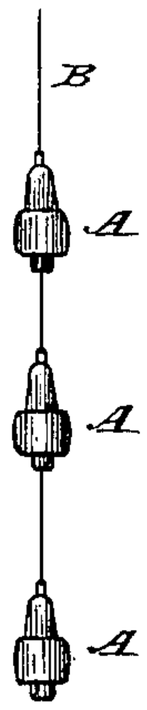


Fig. 11.

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UNITED STATES PATENT OFFICE.

MAX VON SCHOULTZ, OF ST. PETERSBURG, RUSSIA.

APPARATUS FOR SEARCHING OF SUNKEN BODIES.

No. 840,018. Specification of Letters Patent. Patented Jan. 1, 1907.

Application filed May 18, 1899. Serial No. 717,371.

To all whom it may concern:

Be it known that I, MAX VON SCHOULTZ, a subject of the Emperor of Russia, and a resident of St. Petersburg, Russia, have invented certain new and useful Improvements in Apparatus for Searching for Sunken Bodies, of which the following is a specification.

This invention relates to an apparatus for searching sunken or submerged articles; and its object is to serve as an auxiliary when searches of that kind are made by means of a drag-net.

The invention enables with the utmost positiveness and ease to ascertain without the help of divers what objects have been touched by said drag-net. Moreover, it can be applied independently in the form of an electromagnet drag-net with one, Figure 2, or more lines, Fig. 3.

The construction of the apparatus is based upon the phenomena of the magneto-electric induction, and its sole object is to search and determine those objects whose magnetic permeability differs considerably from that of the surrounding element—that is to say, from that of the water—as, for instance, iron, steel, &c., these being the objects for which in the practice most searches are made, I need only to mention ships, anchors, chains, torpedoes, &c.

The apparatus itself consists of two main parts, the finder A and the signaling device C, Figs. 1, 2, 3, 4, and 5. The latter is located upon a ship or vessel and connected with the former by a cable B.

The electromagnetic finder A consists as a rule of one or more permanent magnets N S, Fig. 4, or of one or more electromagnets N′ S′, Fig. 5, which may be either straight or horseshoe-shaped. Their poles may be provided with an armature of soft iron. In the magnetic field produced by the magnets N S or the electromagnets N′ S′ are arranged, preferably on the pole ends or in shunt between them, one or more coils of insulated wire, either in series or parallel.

The windings of the finder and the cable, as well as the parts connecting the same, are carefully insulated. In order to protect them from outside injury, all these parts may be surrounded by a mantle or jacket of suitable material arranged in such a manner that it can be easily removed for the purpose of inspection or repair.

It is obvious that every change in the magnetic field caused by some body of paramagnetic material—or, for instance, iron, steel, nickel, cobalt, manganese, &c.—produces an electric current in the windings D. The intensity of this current is proportionate to the magnetic permeability of the mass as well as to rapidity and intensity of the change in the magnetic field.

The towing or connecting cable B, which is insulated to suit the requirements, may consist of one, two, Fig. 4, three, or four conducting-wires, Fig. 5. When the magnetic field is produced by a permanent magnet N S, Fig. 4, two conducting-wires are sufficient, and even one would suffice, while the other would be replaced by the water. In the latter case, however, one of the poles of the circuit is connected with the finder—that is to say, the magnet, its winding, and the outer covering of the cable—while the other pole is in contact with the surrounding water—for instance, through the intermediary of the metallic hull of the ship, of the lightning-plate, the propeller, or of a separate metallic plate suspended from the vessel or from the cable.

In the case that electromagnets are used the cable has two complementary conductors the object whereof is to feed the windings E of the magnet or of the magnets from a source located on board the vessel. This source may be an accumulator-battery, a dynamo, or the like.

The construction of the signaling apparatus depends upon the purpose for which it is intended to use the apparatus and upon the amount that one wishes to spend thereon.

When the apparatus is used for searching the bottom of the sea, Fig. 1, and the material, the approximate size and shape of the object caught in the drag-net X Y, one or more telephones cut in the circuit may be used which are preferably attached to the ears of the searching party or parties. The reason therefor is that when the object in question is of paramagnetic material a current will be generated in the circuit, and in that case the generated current will be heard in the telephone; but when approaching suddenly a paramagnetic mass or getting away from it suddenly, thus, only when and at the moment that the current is generated, only one single intimation of its presence will be audible, because the bending of the telephone membrane keeps on as long as the magnetic conditions alter uniformly and ceases when after passing the mass, the entire period of

time that the finder is coming nearer to the paramagnetic object or is getting away from it may be realized through the telephone an interrupter is cut in the circuit at the same time as the telephone, which breaks the circuit at very short intervals or a commutator which continuously changes the direction of the current. Thereby the electromotive force which is generated by the finder coming near to or getting away from the mass as a consequence of the weaker or more powerful magnetization of the horseshoe-magnet is constantly interrupted or changed as to its direction, whereby the telephone-membrane will vibrate. The most various construction may be used either for the interrupter or for the commutator and movable contacts having an electric resistance variable and alternating with great frequency. For instance, the interrupter may be composed of a metallic toothed wheel H, Fig. 6, connected with one of the poles of the apparatus, while the other pole is connected with a spring which engages with the teeth of the rotating wheel, thus interrupting the current at very short intervals. Instead of the toothed wheel a metallic cylinder J, Fig. 6, also connected with one of the poles, may be used, the periphery of which is covered with lamellæ inlaid with some insulating substance, as ivory, rubber, crystal, or the like. The contact-spring connected with the other pole presses against this cylinder. This toothed wheel or cylinder is operated by hand or by a small electromotor, a wheel worked, or the like. Any device applicable for this purpose may be used.

The commutator, Fig. 7, can also be constructed in various manners. It can, for instance, consist of a cylinder K of some insulating material and provided at its periphery with two independent conductors, the end of one of which is connected with the conductor of the circuit which of course does not touch the cylinder at any point. Two brushes O and P press against this cylinder and are arranged in contact with a different conductor. The brushes O P at their ends O′ P′ are connected with telephones and by the sputtering which is heard indicate when a current is generated in the circuit when the finder approaches a paramagnetic mass. The telephone C can also be inserted in the secondary circuit of a transformer *t*, Fig. 8, the primary winding of which is inserted in the circuit of the finder and the commutator or the interrupter. In order to prevent the influence of self-induction from being felt, condensers may be interpolated in the well-known manner.

When sufficiently protected from outside injury, the apparatus may also be used as a magneto-electric drag, as is shown diagrammatically in Fig. 2. When the vessel passes over a metallic body, the sputtering in the telephone will indicate it.

In order to have the search for sunken bodies shorter and more certain a number of magneto-electric drags may be used simultaneously. These are suspended at equal distances, which will depend upon the size of the object it is desired to find, from a cable Z Z, as shown diagrammatically in Fig. 3, which is towed by two ships as an ordinary drag-net. In order to prevent a too great slack of the cable, it may be suspended from two or more buoys R R, which prevent sinking.

This kind of apparatus is very suitable for searching for an object the position of which is hard to ascertain, which makes it necessary to search over an extended portion of the bottom at the same time.

Such a magneto-electric drag with several conductors, but of smaller size, may be used also when only towing vessel can be used, as shown diagrammatically in Fig. 9. In this case the cable is lashed to a cross-bar Z′ Z′ and maintained in a perpendicular position to the wake of the vessel by one or more sprits. It is, moreover, kept in a horizontal position relative to the level of the water by buoys R′ R′.

When the magneto-electric drag is used on a soft bottom and towing-cable is provided with a harrow U, Fig. 2, consisting of a piece of metal of suitable shape and size, an independent finder may be adapted to this harrower. Generally in order to exclude every chance of missing the object looked for each towing-cable may be provided with two or more finders in a row. Thus each preceding finder will serve as a harrow for the next coming, which facilitates the loosening of the ground and the sinking of the finder into the ooze.

In some cases, especially where the search must be made over a very extended territory, it may be advisable to replace the telephone by a more effective signaling apparatus. In such case in order to increase the sensitiveness of the magneto-electric drag an intermediate device W, Fig. 5, can be used—as, for instance, a relay or the like—which is actuated by the current induced in the windings of the finder when coming near a paramagnetic body. Its only purpose is to close the circuit of a separate battery of the signaling apparatus. It is preferable for that purpose to use conductors of heavy currents of great sensitiveness, responding to currents of both directions, yet arranged in such a manner that the deviation of the movable part takes place always in the same direction and is not influenced by the iron on the vessel.

The relay, as in electrodynamometers, consists of two coils of insulated wire arranged in series, of which one is stationary, while the other is movable around a common axis in which their planes cross. The coils are arranged in an almost rectangular posi-

tion relative to each other, which position is maintained by means of a spring with regulable tension. When a current is sent through these coils by the finder, the angle formed by their planes changes, and the local circuit of the battery of the signaling apparatus is closed.

In order to increase the sensitiveness of the relay, it is surrounded by a casing of soft iron, which passes across the inner movable coil, yet without touching the same.

When an ordinary relay is used the deviation of which depends upon the direction of the current or the like, a rectifier is inserted in the circuit in front thereof or a device composed of plates of aluminium or of some other metal—for instance, lead—immersed in a solution which allows only the currents of the same direction to pass through it.

For signaling apparatus any device may be used provided it be capable when in operation to attract the attention of the operators or to register automatically the location of the vessel at the moment that a current passes through it.

Signaling apparatus of the most various kinds may be used in connection with the apparatus—for instance, an electric alarm-clock, an indicator with numbered annunciator-valves, an electric primer operating an alarm-rocket or a loaded gun, &c. The most practical device, however, is an autographic registering apparatus, as shown in Fig. 10. It consists, mainly, of a paper-covered cylinder *a*, rotating with a speed proportionate to that of the vessel or at a uniform speed which must be calculated and determined beforehand. At the side of this cylinder rotates, at a corresponding rate of speed, either on guide-ropes *b b* or in grooves, a plate C, which carries an electromagnet, *d* inserted in the circuit of the finder. In order that the plate C may be brought in motion, it is provided with a nut, through which a screw-spindle *l* passes, which runs parallel to the axle of the cylinder, which communicates the rotary motion thereto by means of a toothed wheel or the like. By this arrangement each turn of the cylinder causes a certain shifting of the plate C, which for a screw of a predetermined size will depend upon the proportion of transmission of the transmitting-organs from the cylinder-axle upon the spindle. Upon the periphery of the cylinder a pencil, pen, or slate-pencil *f* presses, which is fixed to the armature of the electromagnet *d*, arranged upon the plate, and which consequently will, when the parts are in motion, draw a spiral line upon the paper of the cylinder; but when the finder approaches a paramagnetic body and a circuit is generated thereby in its circuit the armature of the electromagnet will be attraced and the pen or the like connected therewith will draw a line upon the paper perpendicular to the spiral line. It will be easy from the position of this perpendicular line to determine the moment when the same was made or the exact point where the vessel was at that moment, which point can be marked upon the chart.

With this apparatus the dragging can be effected without interruption, and later on the points marked on the chart can be searched more carefully. The investigations may be marked on lines crossing each other perpendicularly—for instance, one set from north to south and the other from east to west. When the spaces between these lines are not larger than the size of the object looked for multiplied by sin. forty-five degrees, it will be certain that one of the finders will pass thereover and signal its presence.

It is evident that the described arrangement can be used for making systematic searches over a considerable space and in a comparatively short time.

I claim—

1. An apparatus for searching for submerged bodies, the magnetic permeability of which is different from that of the surrounding element, consisting of a magneto-electric finder comprising a magnet attached to a cable, and signaling connections including a coil in the field of said magnet, in combination with a harrow also secured upon said cable in advance of the magneto-electric finder.

2. An apparatus for searching for submerged bodies, the magnetic permeability of which is different from that of the surrounding element, consisting of a plurality of magneto-electric finders secured to a cable common to all, and floats secured to said cable.

In witness whereof I have hereunto set my hand in presence of two witnesses.

MAX VON SCHOULTZ.

Witnesses:

N. TSCHEKALOFF,

J. BLAU.