J. L. V. DA CRUZ.

ELECTRICAL FIRING OF EXPLOSIVE MINES.

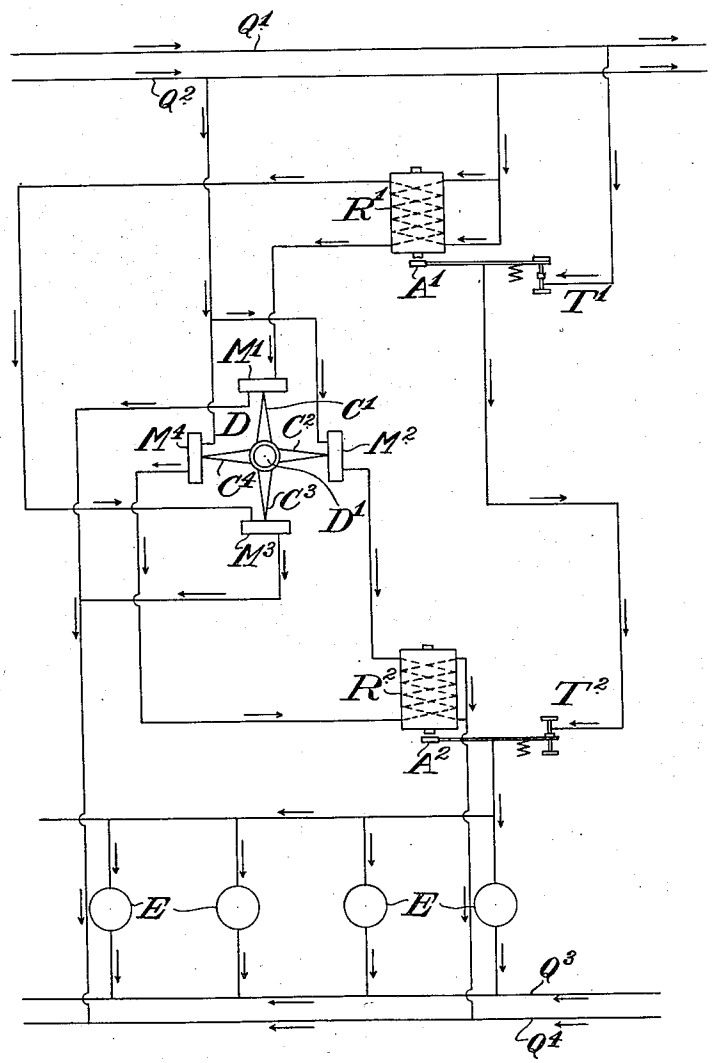
APPLICATION FILED DEC. 29, 1919.

1,364,615.

Patented Jan. 4, 1921.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig: 2.

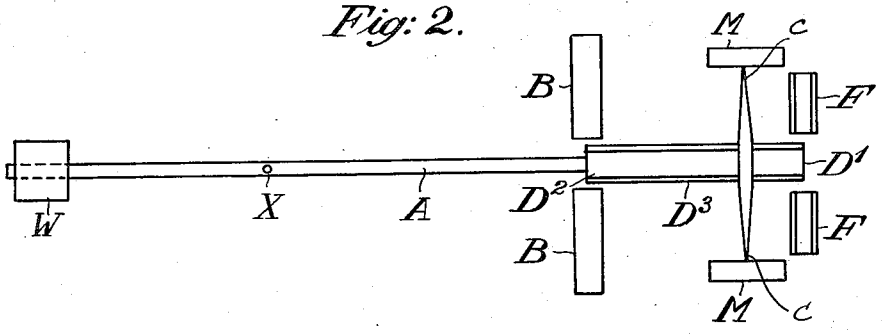
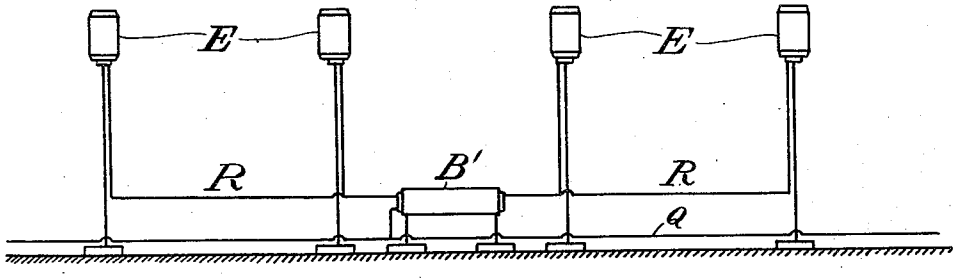


Fig: 3.



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UNITED STATES PATENT OFFICE.

JULIO LOPES VALENTE DA CRUZ, OF LISBON, PORTUGAL.

ELECTRICAL FIRING OF EXPLOSIVE MINES.

1,364,615. Specification of Letters Patent. Patented Jan. 4, 1921.

Application filed December 29, 1919. Serial No. 348,201.

To all whom it may concern:

Be it known that I, JULIO LOPES VALENTE DA CRUZ, of Lisbon, Portugal, commander in the Portuguese Navy, a citizen of the Portuguese Republic, have invented certain new and useful Improvements Relating to the Electrical Firing of Explosive Mines, of which the following is a specification.

This invention consists in an electric device for the automatic firing of ground or buoyant explosive mines through the magnetic action of any iron or steel vessel or the like passing above them.

This device is used in connection with detectors of magnetic forces from distant sources such as described in the Patent Specification No. 117825, filed December 12, 1918, or with any other instruments of a similar character which resolve the magnetic action of a vessel on the instruments into its horizontal and vertical components.

The mines are disposed as usual for ground or buoyant observation mines in parallel lines receiving the electric current from a control station ashore. The mines of each line are divided into groups, each group being controlled by a junction box placed in line with the mines in the center of its respective group and containing the automatic device for the firing of the whole group.

The invention is illustrated diagrammatically in the accompanying drawings in which:

Figure 1 is a diagram of the device for firing each group of mines.

Fig. 2 is a diagrammatic plan of a magnetic detecting device of the kind described in the specification above referred to, and

Fig. 3 shows a group of four buoyant mines with a junction box and connections.

Referring first to Fig. 2, the magnetic detecting device consists essentially of a pivoted non-magnetic bar A carrying on one side of the pivot x a magnet or electromagnet D^3 and on the other side a counterweight W. This pivoted system is kept in position by means of contacting points C bearing against fixed microphone boxes M. The action of the earth on the pole D^1 farthest from the pivot x is partly compensated by the opposite action of the earth on the pole D^2 and partly by the magnetic action of a number of soft iron bars B placed close to the pole D^2 in a plane transverse to the instrument which tends to increase the said opposite action of the earth on that pole, the instrument being thus rendered astatic to earth. The stability of the system is insured by means of magnets or electromagnets F placed on either side of the pole D^1 and acting on the latter by repulsion.

The electric cable Q connecting the junction boxes along the line with the control station ashore comprises a wire Q^1 to supply the current for the detonators of all groups of mines of the line which are connected to it in parallel, and another wire Q^2 to supply the current for the magnetic detectors, which are also connected to it in parallel. The wires Q^3 Q^4 are also contained in the cable Q. The current for the detonators of each group of mines flows through two armatures in series A^1 A^2 of two relays R^1 R^2, one relay R^1 acting as circuit-closer, the contacts at T^1 being normally open, and the other one R^2 as contact-breaker, the contacts at T^2 being normally closed. Both these relays R^1 R^2 shown in the diagram are of the type having two windings on the coil in which the current flows in opposite directions, the relay consequently only acting when the intensity of the current in both wires is unequal.

D designates in Fig. 1 the magnetic detecting device the free end D^1 of which is shown held in position by means of four contacting points C^1, C^2, C^3, C^4 bearing against four mixed microphone boxes M^1, M^2, M^3, M^4, two of which latter are arranged for contact in the vertical plane and two in horizontal plane. In this case an additional set of soft iron bars B and magnets F would be provided in a plane at right angles to those shown in Fig. 2 and the bar A would be pivotally mounted for both vertical and horizontal movement. The two microphone boxes M^1 M^3 on the vertical plane are in parallel and each is connected in series with respective wire of the relay R^1. In the same way both microphone boxes M^2 M^4 on the horizontal plane are also in parallel, and each one is in series with its respective wire of the relay R^2. E, E designate the group of mines.

In Fig. 3 is shown a group of four buoyant mines E electrically connected by means of an armored cable R to the buoyant junction box B′ arranged in line with the mines and in the center of the group. The armored cable Q connects the junction boxes B′ along the line of mines with the control station ashore.

The magnetic detectors used in connection with this device are placed in the junction boxes with their longitudinal axes parallel to the line of mines, and they are arranged to have a greater horizontal range of action than their depth of submersion in order to insure that the horizontal component of the magnetic action of a submarine or surface vessel should act before the vertical component when the vessel approaches the line of mines.

These precautions being taken, the automatic device works in the following way: When no magnetic action is exerted on the magnetic detector, the intensity of the current is equal in both wires of the relays R^1 R^2: the relays consequently do not act, and the current for the detonators of the mines E, E of each group is cut off by the armature A^1 of the relay R^1 adapted to act as a circuit-closer. As soon as a submarine, for instance enters the range of action of the magnetic detector, the horizontal component of its magnetic action on the detector causes the pressure exerted by one of the points C^2 C^4 on the respective microphone box M^2 or M^4 to be increased, while releasing the pressure in the opposite one, and the difference of intensity of current thus produced brings the relay R^2 into action, thereby breaking the contact of the armature A^2 with the contact T^2. At this moment, therefore, the current for the detonators is cut off in both relays R^1 R^2. The submarine getting nearer to the line of mines, the vertical component of its magnetic action on the detector causes it to increase the pressure on the one or other of the microphone boxes M^1 M^3 and reduce the pressure on the opposite one, thus producing a difference of intensity of the current flowing through them, which brings the relay R^1 into action. The armature A^1 is consequently pressed against the contact T^1 and the circuit to the detonators is closed at this point, but remains open at the armature A^2 of the relay R^2 corresponding to the horizontal component. This position remains unaltered until the submarine is just above the line of mines. At this moment the horizontal component of its magnetic action on the detector suddenly ceases, the pressure on both microphone boxes M^2 M^4 becomes the same, and consequently the relay R^2 releases the armature A^2 thereby closing the circuit for the detonators. As at this moment both armatures A^1 A^2 are closing the circuit, the whole group of mines E E is fired.

The wires from the magnetic detector and the detonators may be earthed or connected to the return wires Q^3 Q^4 as shown in the diagram.

The direction of flow of the current in the circuits is shown by arrows.

What I claim as my invention and desire to secure by Letters Patent of the United States is:—

The combination with a detector of magnetic forces from distant sources for resolving the magnetic action of a vessel or the like on them, into horizontal and vertical components, of explosive mines provided with detonators, and an electrical device for automatically firing said mines, the electrical device including an electric circuit, a pair of contact breakers arranged in series with the detonators in the said circuit, one contact breaker being arranged to normally make contact to close the circuit, and the other contact breaker to normally break contact, and both the said contact breakers being constructed and arranged to be actuated separately by variations of current intensity produced by successive differential operations of the detecting device under the influence of the horizontal and vertical components, respectively, the normally closed circuit-breaker being caused to open by the horizontal component prior to the closing of the normally open circuit-breaker by the vertical component, and the firing of the mines being effected by closure of the open contact by cessation of the horizontal component due to the position of the vessel directly above the mines.

In witness whereof I have signed this specification in the presence of two witnesses.

JULIO LOPES VALENTE da CRUZ.

Witnesses:
ALBUMO MINO SAICIEVER,
LEON ADEVEY.