G. W. PICKARD.

AMPLIFIER.

APPLICATION FILED AUG. 7, 1907.

1,027,755. Patented May 28, 1912.

Fig. 1.

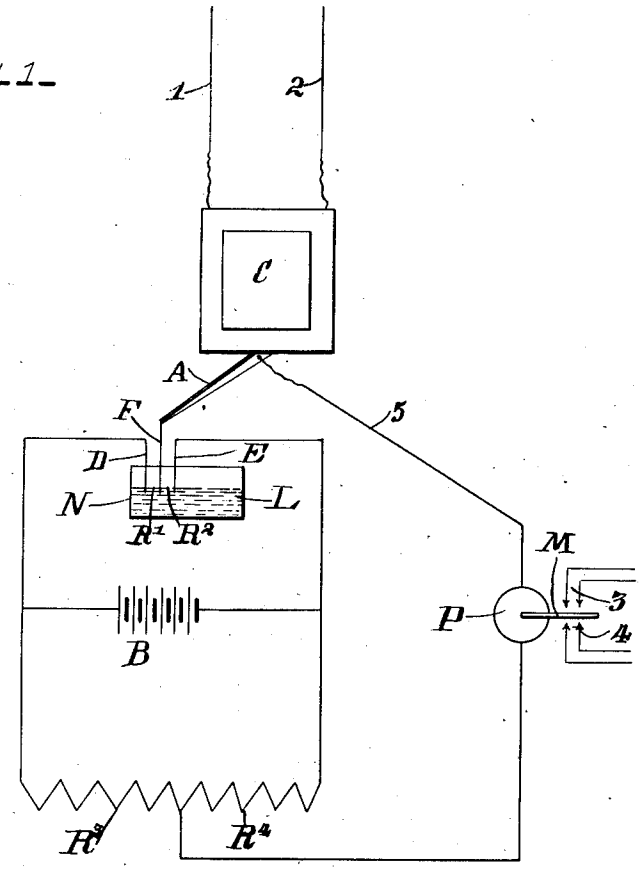
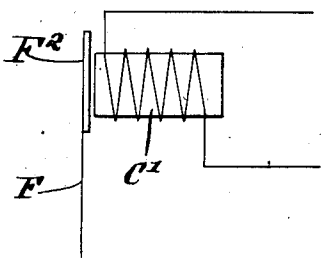


Fig. 2.



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AMPLIFIER.

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To all whom it may concern:

Be it known that I, GREENLEAF WHITTIER PICKARD, a citizen of the United States of America, and a resident of the town of Amesbury, State of Massachusetts, have invented a certain new and useful Amplifier, the principles of which are set forth in the following specification and accompanying drawing, which disclose the form of the invention which I now consider to be the best of the various forms in which those principles may be embodied.

This invention relates to a liquid amplifier for use as a relay or as a repeater in any electrical circuits employing minute amounts of energy, and particularly in receiving circuits of installations for the communication of intelligence by electromagnetic waves. The invention may also be used directly as a detector of wireless telegraphy oscillations.

An object of the invention is to obtain a reliable device which will make practicable the control by feeble received impulses of large amounts of auxiliary energy to permit the positive operation thereby of suitable indicating apparatus, and particularly, independently of the operation and electrical closure of metallic contacts by the feeble energy of received communications.

Heretofore such devices have been hampered or limited, either by instability of operation, or by narrow limits of control of the auxiliary source of energy, as the mechanical forces resulting from very feeble currents are insufficient for the positive opening and closing of conducting contacts.

This invention consists of means which is stable in its operation and which permits wide limits of control of auxiliary energy. In accordance herewith a circuit containing an auxiliary source of electromotive force is controlled by the variation of the resistance of a conducting liquid path or paths in the circuit, this variation being effected by the short movement through the liquid of a low-inertia member of the circuit, the movement of which is caused by the feeble received energy.

The devices which have been capable of control of large amounts of auxiliary energy, and which have been otherwise stable, have been subject to the troubles accompanying the making and breaking of contact between solid conductors by the mechanical forces resulting from feeble currents. By this invention such troubles are obviated, by the expedient of dispensing with any such contact-making arrangement.

Of the drawings, Figure 1 is a diagrammatic illustration of an embodiment of the invention, and Fig. 2 is a similar illustration of a modification.

In Fig. 1 the part A and its dependent conducting part F constitute the movable low-inertia member which is operated by the feeble received energy. This member is connected to the battery B by the wire 5 on one side, and on the other side by either of the portions R^1 or R^2 of the conducting liquid L in the receptacle N. The terminals D and E are fixed in the liquid L, and may be a few hundredths of an inch apart, the part F lying normally midway between them, so that R^1 and R^2 each possesses the same resistance.

The circuit includes a Wheatstone bridge, of which the fixed resistances R^3, R^4 constitute one arm, and the variable resistances R^1, R^2 the other. The circuit includes also the polarized relay or electromagnet P, having a contact-controlling-arm or tongue M.

The movement of the conducting part F to left or right from its midway position, will vary resistances R^1 or R^2, increasing one and decreasing the other, thus throwing the bridge out of balance and operating the relay P, throwing its contact arm or tongue in one or the other direction to close a circuit 3 or 4 of a local auxiliary source of electromotive force and operate any desired indicating mechanism.

The bridge circuit may be adjusted so that a resistance change of one per cent. in the circuit (as at R^1 or R^2) will operate the relay P. The part F may conveniently be placed within a hundredth of an inch of terminals D and E. In such case, a movement of F of one ten-thousandth of an inch will vary R^1 or R^2 sufficiently to operate the bridge relay P, and so give the desired signal.

The only opposition to the motion of the part F is the damping of the liquid, which is too slight to hinder effectual working, but may be made sufficient to insure uniformity of operation by acting as a governor.

The arm F may, among its various possible modes of use, be mounted on and moved by the suitably suspended oscillatable coil C, which may be such as is commonly used with the siphon recorder. The terminals 1

2 of coil C may be connected to the terminals of any telegraph or cable system, or to the circuit of a detector of oscillations produced by electromagnetic waves used to communicate intelligence; or the part C may be the movable coil of an electro-dynamometer of suitable construction and windings for direct insertion in a wireless telegraph receiving circuit, without the use of any other detector.

When used in telegraphy for recording purposes, the movement of the coil C and arm A, and of tongue M, in two directions, to alternately close circuits 3 and 4, may be for dot and dash records; or when used with electromagnetic waves, only one movement of arm A may be used, of short and long durations for dots and dashes, the tongue M of relay P being used to close a local indicating circuit, either 3 or 4, through a telephone or recording-indicating mechanism, and a source of electromotive force therefor.

When the parts C, A and F return to their normal position midway between D and E, upon the cessation of a received impulse, the relay P will stop acting, its tongue M being returned to its inoperative position with respect to the circuits 3 and 4. The tongue M may have considerable inertia by weight and by return-spring, and any suitable means of eliminating contact-sticking, because it is operated by the energy of a battery B, and not by the feeble energy received in coil C.

Instead of being moved by the coil C, the arm F may be made telephonically movable, as shown in Fig. 2, a portion F^2 of the arm F serving as the telephone armature, in cooperation with a suitable coil and core C'; the coil being supplied with current the effects of which it is desired to amplify, such as those used in connection with a wireless telegraph detector. In this case the device P M, 3, 4 of Fig. 1 may be a telephone receiver, as that shown in Fig. 2, the coil C^1 thereof being in the circuit in place of the coil of P, and the parts F, F^2 of Fig. 2, representing the complete telephone diaphragm.

Obviously, since there are no metallic contacts at the parts moved by the coils C or C', there can be no sticking of contacts which will interfere with perfect independence of the coil of all action except that due to received impulses.

In the claims the specification of the conductors as projecting into the liquid, means simply an operative conducting connection therewith.

I claim:

1. Means for amplifying feeble electrical impulses, which comprises two variable resistance liquid conducting paths constituting one side of a Wheatstone bridge, and means operated by the feeble electrical impulses to vary said liquid resistances and thereby unbalance the bridge.

2. In an amplifier of feeble electrical impulses, the combination with a conducting liquid; of two conductors supported in position to include the liquid in circuit between them; a third conductor which is movable through the liquid between said conductors; a Wheatstone bridge including all said conductors and the included liquid; and means operated by the feeble impulses to move said third conductor through the liquid.

3. An amplifier of feeble electrical impulses, which comprises a Wheatstone bridge having a conducting liquid in one arm, and including an electromagnetic circuit closer; and means operated by the feeble impulses to vary the resistance-distribution of said liquid in the bridge arm.

4. In an amplifier of feeble electrical impulses, the combination with a Wheatstone bridge having fixed resistance in one side, and a normally-balanced variable liquid resistance in the other side; of means operated by the feeble impulses to unbalance said liquid resistance.

5. In an amplifier, the combination with an arm of a Wheatstone bridge including a conducting liquid; of a movable electrode in circuit with the bridge and said liquid; and means for moving said electrode in the liquid to unbalance the resistance thereof.

6. An electric current amplifier, which comprises a suitable electrical indicating device and a divided circuit containing an auxiliary source of E. M. F., the two sides of said circuit being normally balanced with respect to said indicating device; and two conducting liquid paths respectively in the two sides of said divided circuit; and means operated by the currents to be amplified, for oppositely varying the resistances of said two liquid paths, and thereby unbalancing the divided circuit to cause the operation of the indicating device.

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