D. J. McCARTHY.

FREQUENCY RELAY.

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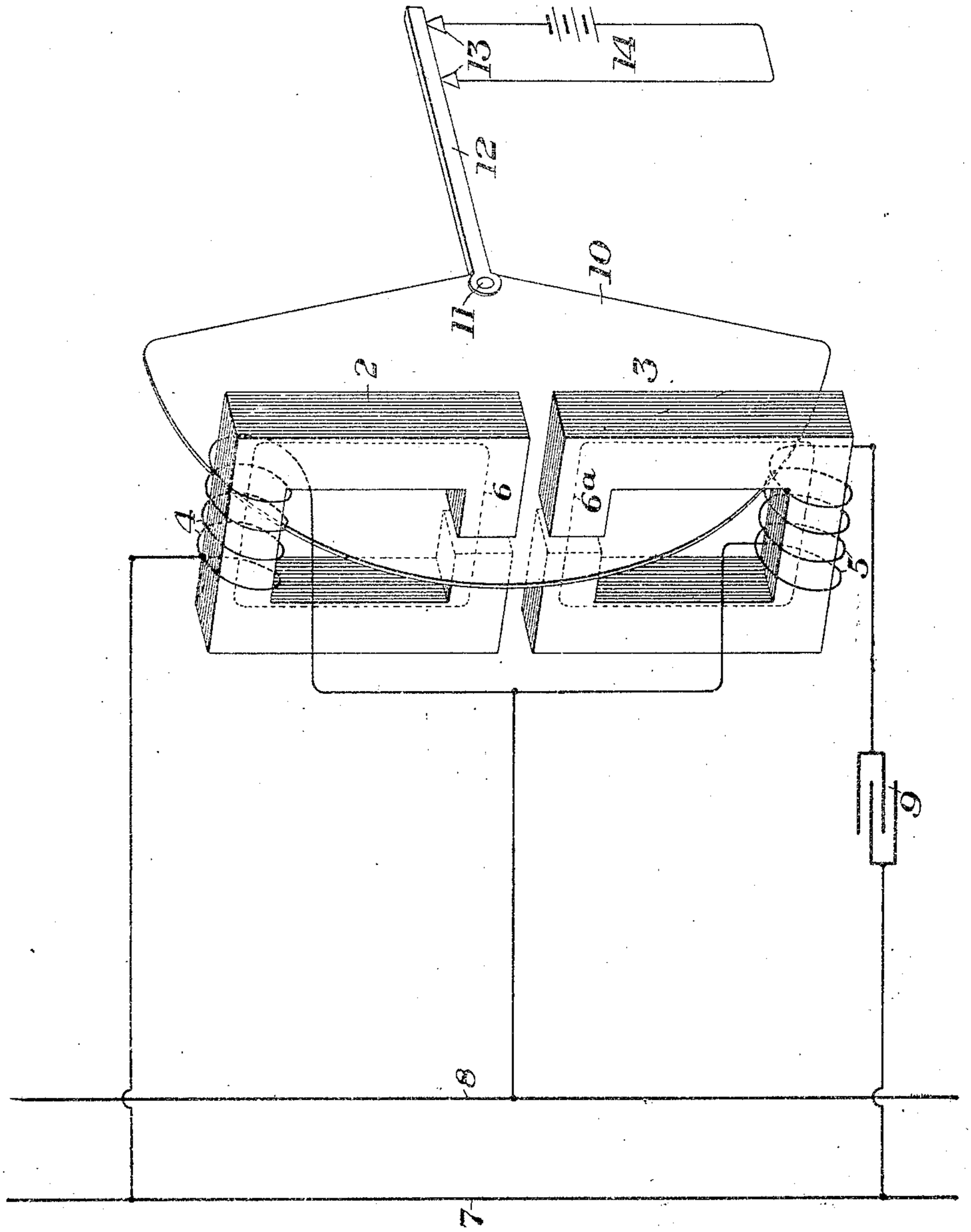
928,531. Patented July 20, 1909.



WITNESSES

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FREQUENCY-RELAY.

No. 928,531. Specification of Letters Patent. Patented July 20, 1909.

Application filed April 24, 1907. Serial No. 370,019.

To all whom it may concern:

Be it known that I, DANIEL J. McCARTHY, of Wilkinsburg, Allegheny county, Pennsylvania, have invented a new and useful Frequency-Relay, of which the following is a full, clear, and exact description, reference being had to the accompanying drawing, forming part of this specification, in which the figure is a perspective view showing one form of my invention.

My invention relates to the class of relays designed for use in circuits wherein two or more alternating electric currents of different frequencies are employed. It is designed to provide a selective apparatus as between the currents of different frequencies, so that it will operate on a current of predetermined frequency, and be inoperative on currents of another frequency.

The invention is based on the principle of resonance; that is, on the balance that may be established between a capacity and a coil having self-induction when placed in an alternating current circuit. If a condenser and a coil having self-induction are put in series in an alternating current circuit, the reactance of the condenser will be opposite to that of the inductance coil, and the relative magnitude of these two reactances may be made such that they will balance and cancel one another so that the current will flow in the circuit just as it would if it contained only resistance. The condition necessary to obtain this balance is indicated by the equation $\frac{1}{C\,p} = L\,p$, where C is the capacity of the condenser, L the coefficient of the induction of the coil, and p the coefficient depending upon the frequency. It can readily be seen from this that a change in the value of p will very greatly disturb the balance. If this balance is established for any given frequency, then any frequency greater or less than this predetermined frequency will cause the current to be very considerably reduced. To give a concrete example: Suppose the capacity to be 530 microfarads, the coefficient of self-induction 13.3 millihenrys, the resistance 1 ohm, the electromotive force 5 volts, and the frequency 60 cycles per second; then 5 amperes will flow through the circuit. If now, leaving the circuit and the electromotive force the same, the frequency be changed to 25 cycles, the current will be only 0.5 of an ampere; or if the frequency be changed to 100 cycles, the current will be only 0.9 of an ampere. It can be seen from this that either increasing or decreasing the frequency causes the current to rapidly decrease. It is on this principle that I depend for making the relay operative at a given frequency, and not operative at a frequency greater or less than this given frequency.

In the drawing, I show a relay having cores 2 and 3 of magnetic material, and which are preferably laminated.

4 and 5 are coils arranged to cause a magnetic flux in the cores 2 and 3, whose path is indicated by dotted lines 6 and 6ª. The coils are arranged in two electric circuits connected to conductors 7 and 8 through both of which currents of different frequencies are passing. In the circuit of the coil 5 is placed a condenser 9; and the capacity of this condenser is preferably so adjusted in relation to the reactance of the coil 5, that at a given frequency the electro-motive force and current are in phase or nearly so, the current in coil 5 producing a magnetic flux in the core 3. The current flowing in circuit through the coil 4 will lag behind the electro-motive force, and consequently be out of phase with the current flowing through the coil 5. The flux induced in the core 2 will therefore lag behind that induced in the core 3; and if a vane or movable element of conducting material be subjected to the influence of these currents, the lag will cause a movement of such vane. I have shown such a vane at 10 which is pivoted at 11, and moves within registering slots in the adjacent legs of the cores. The vane may be provided with an arm 12 which closes contacts at 13, thus completing a local circuit 14 which may contain a source of current and a signal or other device to be operated.

In order for the relay to operate there must flow through each of the two windings a current of sufficient value to produce the desired magnetic flux in the cores and a decrease of the current value in either winding will render the relay inoperative. The condenser or capacity which is in series with one of the windings acts to reduce the value of the current flowing in this winding except that current has the predetermined frequency which will produce a state of resonance in the circuit of this winding.

The relay is so designed that it will not be operated except by a current in the track circuit of predetermined frequency, being inoperative on a current having a frequency of a different value, such as the propulsion current of an alternating current electric railroad. While there may be a tendency of the relay to operate on a current of a different frequency than that of the predetermined one, the coils of the relay will not receive sufficient current to operate the movable member or vane except at the predetermined frequency. Both the coils 4 and 5 are arranged to have the same inductance, the capacity 9 being adjusted to suit the coil 5.

The advantages of my invention result from the simplicity and effectiveness of the selective relay, and its not being liable to be operated by unbalancing of the propulsion current or by stray currents.

The device is of special value for block signal systems and may be used on electric railroads having either alternating current or direct current, or on steam roads or those having other means for propulsion of the cars.

Many changes may be made in the form and arrangement of the coils, the means for obtaining the lag in one circuit, the movable element, etc., without departing from my invention.

I claim:—

1. In a frequency relay, two windings having separate magnetic cores in which fluxes are produced by current flowing in said windings, a movable element subjected to the combined influence of the said fluxes and arranged to make a partial revolution under the combined action of both fluxes, only, and means to render the circuit of one of the windings resonant under the influence of a current of a predetermined frequency and to prevent the flow of sufficient current of any other frequency to cause the movable element to operate, said movable element being arranged to move in the opposite direction when either one of the windings is deënergized below a predetermined value, substantially as described.

2. In a frequency relay, two windings having separate magnetic cores in which fluxes are produced by the current flowing in said windings, a movable element subjected to the combined influence of the fluxes and arranged to make a partial revolution under such combined influences, and a condenser included in the circuit of one of the windings to render the same resonant under the influence of a current of a predetermined frequency and to prevent the flow of sufficient current of any other frequency to cause the movable element to operate, said movable element being arranged to move in the opposite direction when either one of the windings is deënergized below a predetermined value, substantially as described.

3. A frequency relay having two windings of substantially equal inductance arranged to produce fluxes, a movable element subjected to the combined influences of the fluxes, and means to render the circuit of one of the windings resonant under the influence of a current of a predetermined frequency, substantially as described.

4. A frequency relay having two windings of substantially equal inductance arranged to produce fluxes, a movable element subjected to the combined influence of the fluxes and a condenser in the circuit of one of the windings to render the same resonant under the influence of a current of a predetermined frequency, substantially as described.

In testimony whereof, I have hereunto set my hand.

DANIEL J. McCARTHY.

Witnesses:
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