No. 869,490. PATENTED OCT. 29, 1907.

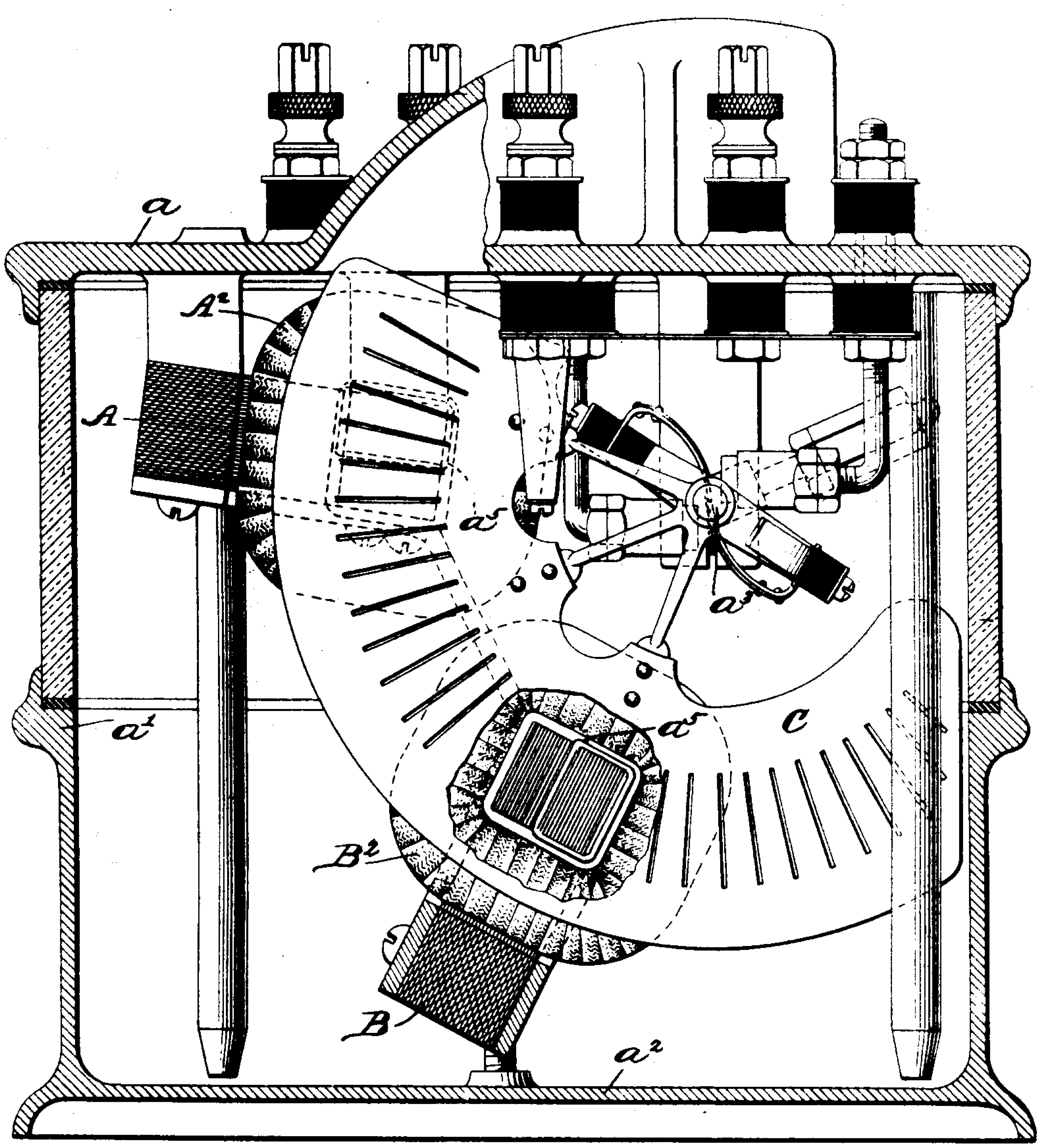
L. F. HOWARD.

RELAY.

APPLICATION FILED DEC. 24, 1906. RENEWED SEPT. 10, 1907.

3 SHEETS—SHEET 1.

Fig: 1



Witnesses:
A. Herman Wegner,
Joseph E. Walsh.

Inventor:
Lemuel Frederic Howard
By Geo. E. Cruse
his Attorney.

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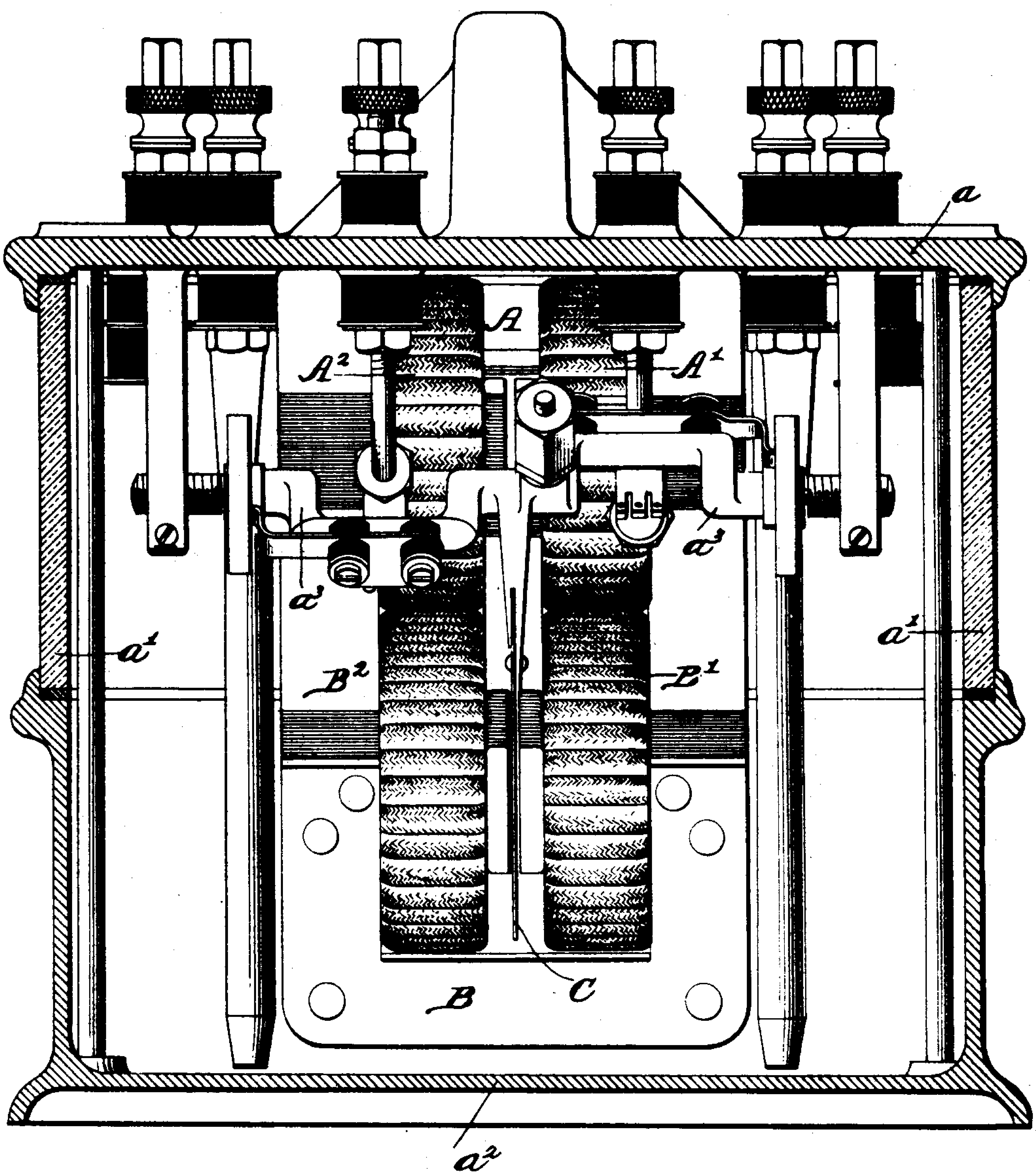
3 SHEETS—SHEET 2.

Fig: 2.



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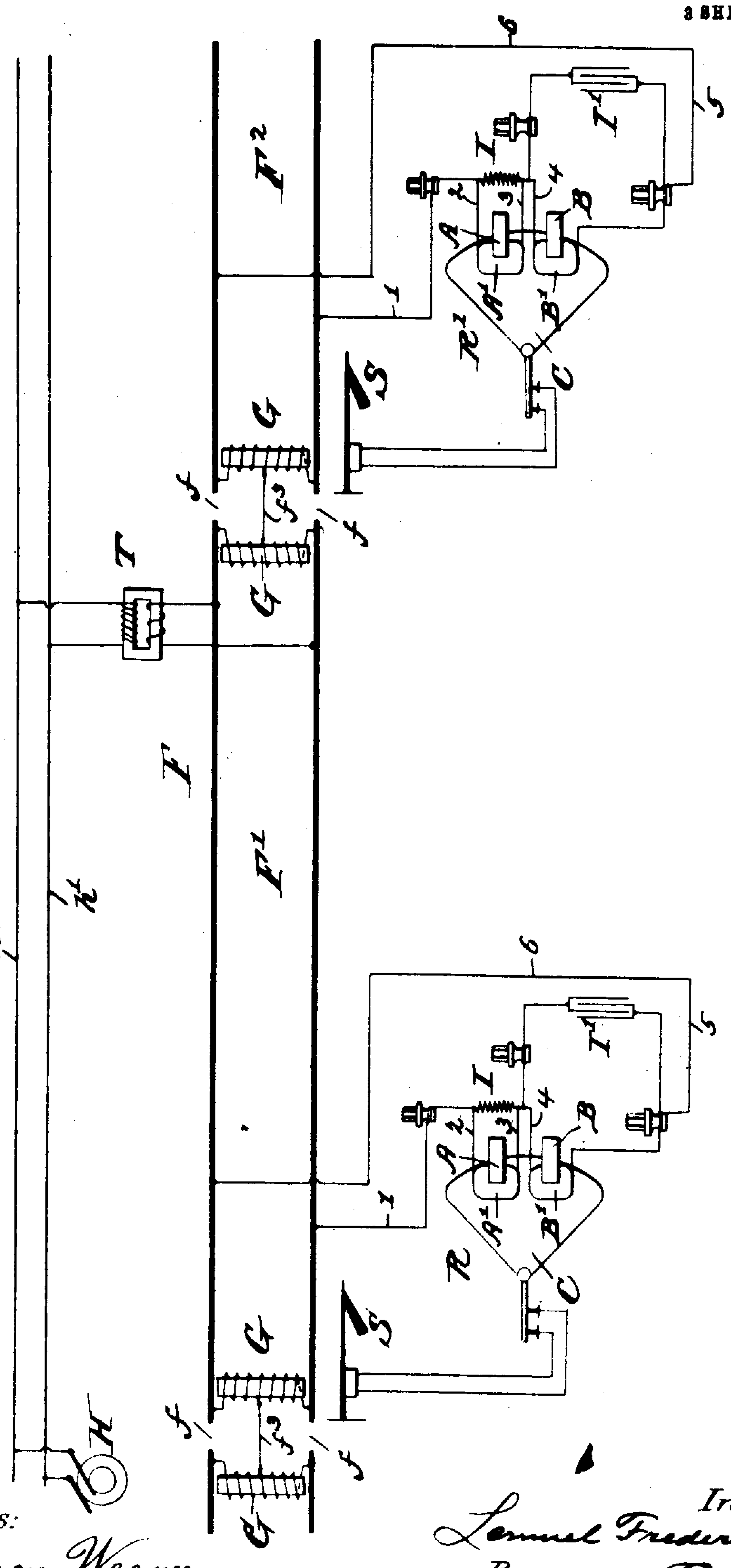
3 SHEETS—SHEET 3.

Fig: 3.



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UNITED STATES PATENT OFFICE.

LEMUEL FREDERIC HOWARD, OF EDGEWOOD PARK, PENNSYLVANIA, ASSIGNOR TO THE UNION SWITCH AND SIGNAL COMPANY, OF SWISSVALE, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

RELAY.

No. 869,490. Specification of Letters Patent. Patented Oct. 29, 1907.

Application filed December 24, 1906. Serial No. 349,267. Renewed September 10, 1907. Serial No. 392,216.

To all whom it may concern:

Be it known that I, LEMUEL FREDERIC HOWARD, a citizen of the United States, residing at Edgewood Park, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Relays, of which the following is a specification.

My invention relates to relays for use in railway signaling systems and particularly to relays used in alternating current signaling systems when such systems are applied to electric railroads using an alternating current for propulsion purposes and a track rail or the tracks rails in the return circuit for the propulsion current. The alternating propulsion current is generally of a low frequency, say 25 cycles, while the alternating signaling current is of a higher frequency, say 60 cycles. As the two currents are impressed upon the track rails simultaneously during the operation of cars on the railway and the signaling system in the control of the cars traveling along the railway, and as the relays are connected with the track rails at intervals, it is obvious that provision must be made to prevent a wrong operation of the relays by the propulsion current to have a railway signal give a clear indication when a danger indication should be given. Ordinarily, the car propulsion current will flow along the track rails in its return to the power generator rather than flow through by-paths, for example, the relay coils and transformer coils, owing to the fact that the track rail or rails offer a path of least resistance. It sometimes happens, however, that track conditions, such as a broken rail or unequal resistances in the two rails will produce a difference in potential of the propulsion current between the track rails at the relay terminals, (that is, at the points where the relay coils are connected with the track rails) thereby causing the power current to flow through the relay coils. Should this happen, the propulsion current will cause the relay to operate to open a circuit for the railway signal, irrespective of the position of a car relatively to the relay, and thus have the railway signal give a dangerous indication.

I will describe a relay embodying my invention and then point out the novel features thereof in claims.

In the accompanying drawings Figure 1 is a vertical sectional view of a relay embodying my invention. Fig. 2 is also a vertical sectional view but in a different plane than Fig. 1. Fig. 3 is a diagrammatical view of a portion of an electric railway, the track rails of which are divided to form block sections and are included in a return path to the generator for the car propulsion current and having applied thereto a signaling system including a relay embodying my invention.

Similar letters of reference designate corresponding parts in all of the figures.

Referring now to Figs. 1 and 2. The mechanism or parts of the relay are inclosed in a suitable casing comprising a removable top a, a circular wall a^1, partly of metal and partly of glass, and a bottom a^2. The top is suitably secured by bolts and carries the necessary contacts which are suitably and electrically connected with binding posts. Some of the contacts carried by the top a are electrically connected with contacts carried upon a shaft a^3 suitably mounted within the casing and movable in its mountings through a vane C which is acted upon by a plurality of magnetic circuits as will be hereinafter more fully explained. The arrangement of contacts, casing and frame may conveniently be substantially like that illustrated in U. S. Patent No. 823,086, granted June 12, 1906, to L. H. Thullen for an alternating current translating device.

A designates a laminated core, substantially C-shaped in design, which is suitably secured to the top a. The ends of the core are on opposite sides of the vane C and the ends of the core are split or bifurcated, and around one of such split or bifurcated portions is placed a metallic (copper) band a^5.

A^1, A^2, designate energizing coils, placed on the core A and in series with one another. If desired, there may be only one such coil. These coils when traversed by an alternating current, generate lines of force in the core A and these lines of force induce currents in the closed conductor band a^5, which current, however, is of a different phase or is out of step with the alternating current flowing in the coils A^1, A^2. The lines of force produced by these alternating currents induce eddy currents on the vane C and cause it with the shaft a^3 and contacts carried thereby, to move in one direction, that is, to close the contacts. When the alternating current in the coils A^1, A^2, ceases flowing for any reason, a reverse movement of the vane takes place and thus the contacts are opened. This operation of the vane is fully set forth in the patent hereinbefore referred to.

B, designates a second laminated and C-shaped core, constructed in all respects like the core A except that the closed conductor band a^5 is placed on the opposite split or bifurcated portion. The reason of this is that when the lines of force induce the eddy currents on the vane C they will be of the opposite polarity from those generated by the core and will, therefore, produce a movement of the vane C in a direction opposite to that produced by the core A. In other words, the direction of movement of the vane C produced by the core B is in a direction to open the contacts, whereas the direction of movement of the vane C produced by the core A is to close the contacts. The core B, is provided with energizing coils B¹, B² in series with each other and in series with the coils A¹, A². If desired, there may be only one energizing coil on the core B.

In practice alternating current of whatever frequency is designed to flow in all four coils, which as stated are in series. Means, however, are provided in shunt across one pair of coils, for example, the coils A¹, A², to divert a certain amount of the total current in relay circuit from coils A¹, A²; the amount of current thus diverted varying inversely as the frequency. These means will be in the form of an impedance which may, if desired, be included within the relay casing and suitably secured in place. Means are also provided in shunt across the other pair of coils (B¹, B²) to divert a certain amount of the total current in the relay circuit from the coils B¹, B²; the amount of current diverted being in this case varying directly as the frequency. These means will be in the form of a capacity. Thus it will be seen that in consequence of a proper adjustment of the relations of the impedance and capacity, when an alternating current of high frequency is flowing through the coils, it can be made strongest in the coils A¹, A², and thus the vane will be caused to move to close the contacts and when an alternating current of lower frequency is flowing through the coils, it will be stronger in the coils B¹, B², and the vane C will thus be caused to move in a direction to open the contacts.

Referring now to Fig. 3. This figure illustrates a relay involving my invention in a signaling system applied to an electric railway on which the cars or trains are propelled by an alternating current of low frequency. I have not illustrated the power generator, the feeder conductor extending therefrom, nor the connection of one pole of the generator with the track rails as this is well understood to those skilled in the art. Such parts and connections, however, are to be understood as existing. F designates a portion of an electric railway, both track rails of which are divided at points by insulation f to form block sections. I have illustrated one complete block section F¹, and a portion of another F². Each block section is provided with an automatic railway signal S at one end, the operation of which is controlled by a relay in the usual and well known manner. At the ends of each block section I provide a reactance bond G and electrically connect the winding or windings on two adjacent bonds. f^3 designates a conductor between bonds. These reactance bonds are of the balanced type, that is, the winding or windings thereof are so arranged as to conduct the propulsion current from the two rails of a block section in reverse directions so as not to produce any magnetism in the core thereof, thereby leaving the bonds free to act as paths of high impedances to the alternating signaling current. A type of such bond is illustrated in a U. S. Patent granted to L. H. Thullen. Thus it will be seen that the track rails and bonds will conduct the alternating power current back to the generator. The alternating signaling current, however, will be confined to the individual blocks by the insulations f, and as the bonds G across the rails, are of such high impedance they will not act as a short circuit for the alternating signaling current.

H designates an alternating current generator, and h, h^1, line conductors extending therefrom. The alternating current from the generator is of a higher frequency than the alternating propulsion current.

At each block section I provide a transformer T which supplies alternating signaling current to the track circuit of the block section from the line conductors h, h^1, at a reduced voltage. Each track circuit as is well understood, comprises a source of current (transformer T), the track rails of the block section, and a relay.

R, R¹, designate the relays and as hereinbefore stated they are of a type illustrated in Figs. 1 and 2. I have only diagrammatically illustrated the relays and only a coil A¹ and a coil B¹.

I designates an impedance across the coils A¹, or as hereinbefore stated in shunt across the coil, and I¹ designates a capacity across the coil B¹.

The usual operation of the signaling system is well understood. With no car or train in a block section the alternating signaling current will flow from one terminal of the secondary of transformer T, along one rail, wires 1, 2, coil A¹, wires 3, 4, coil B¹ and wires 5, 6, to the other track rail and other terminal of the secondary of transformer T. It will be noted that the alternating signaling current at the juncture of wires 1, 2, has a path through the impedance I, but as stated the impedance chokes back the alternating signaling current and causes most of it to flow through the coil A¹. It will also be noted that the alternating signaling current from the coil A¹ at the juncture of wires 3, 4, has a path through the capacity I¹, and as stated, the capacity is adjusted in relation to impedance I, so that a greater part of the signaling current from the rails will flow through coil A¹, rather than the coil B¹. Thus the coil A¹ will be the stronger and the vane will be moved to close the circuit of the railway signal. When a car or train enters a block section, the wheels and axles thereof short circuit the alternating signaling current from the coils A¹, B¹, and they being deënergized permit a reverse movement of the vane to open the circuit of the railway signal.

Should for any reason, and irrespective of the location of a car relatively to a relay, there be such a difference of potential of the alternating propulsion current at the terminal of the relay as would cause the propulsion current to flow through the coils A¹, B¹, such current would be stronger in the coil B¹, for the reason before stated and thus the vane C would be moved to open the circuit of the railway signal, and thus have the railway signal give a dangerous indication.

Of course, the number of turns in the two coils or two pairs of coils may be different and the impedance and capacity may be so proportioned as to give the best results.

What I claim as my invention is:

1. In a relay the combination with a vane, contacts opened and closed by movements of the vane in reverse directions, a coil and magnetic circuit for causing a movement of the vane in one direction when the coil is traversed by a high frequency alternating current, a coil and magnetic circuit for causing a movement of the vane in a reverse direction when said second coil is traversed by an alternating current of a lower frequency, means for shunt-

ing an alternating current of high frequency from one coil, and means for shunting an alternating current of a lower frequency from the other coil.

2. In a relay the combination with a vane, contacts opened and closed by movements of the vane in reverse directions, a coil and magnetic circuit for causing a movement of the vane in one direction when the coil is traversed by a high frequency alternating current, a coil and magnetic circuit for causing a movement of the vane in a reverse direction when said second coil is traversed by an alternating current of a lower frequency, said coils being in series circuit, an impedance in shunt across the terminals of one coil and a capacity in shunt across the terminals of the other coil.

In testimony whereof I have signed my name to this specification in the presence of two subscribed witnesses.

LEMUEL FREDERIC HOWARD.

Witnesses:

J. G. SCHREUDER,

W. L. MCDANIEL.