

No. 743,417.

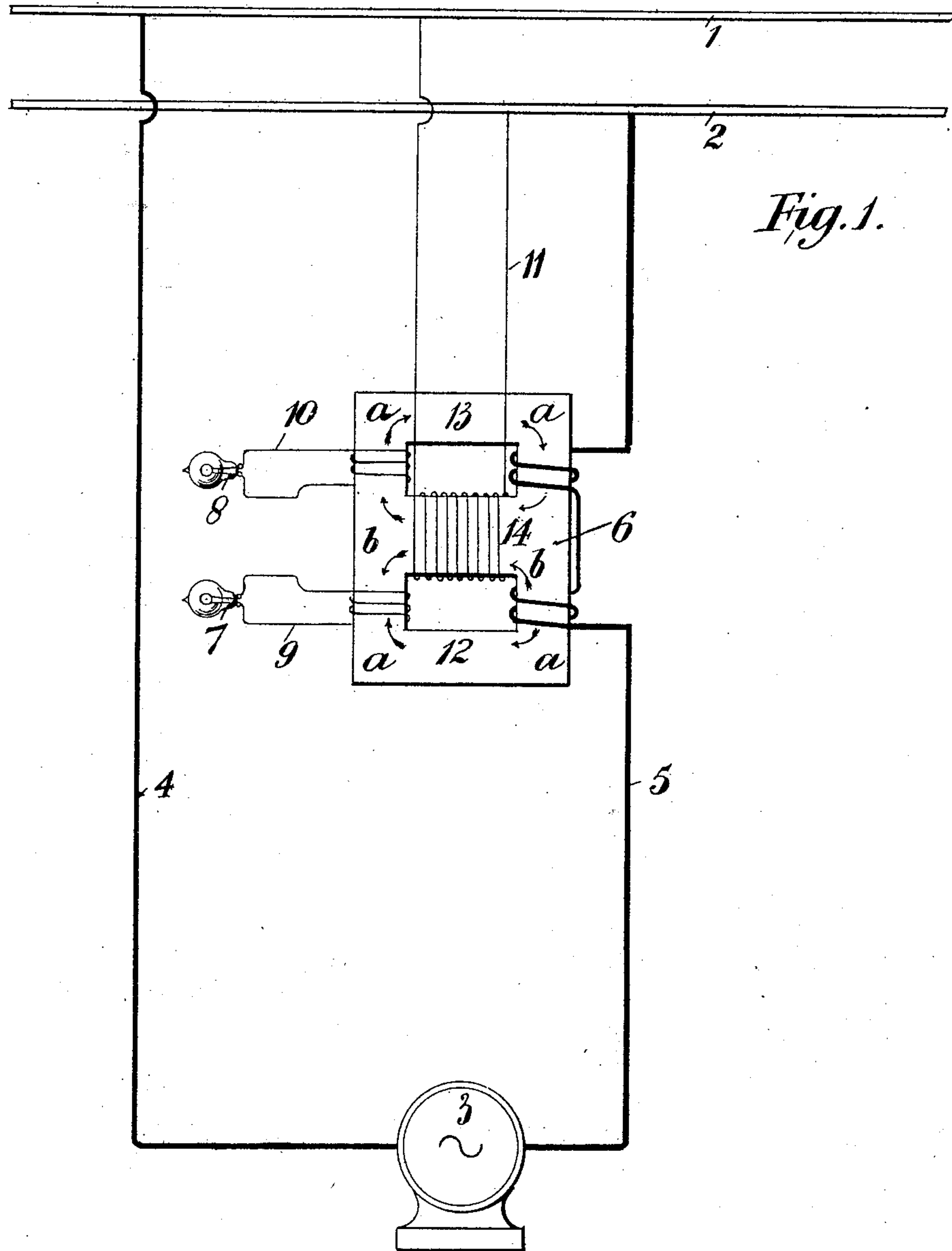
PATENTED NOV. 10, 1903.

L. ANDREWS.  
REVERSE CURRENT INDICATOR.

APPLICATION FILED MAR. 30, 1903.

NO MODEL.

2 SHEETS—SHEET 1.



*Witnesses.*  
*J. H. Andrews*  
*J. R. Field*

*Inventor.*  
*Leonard Andrews*

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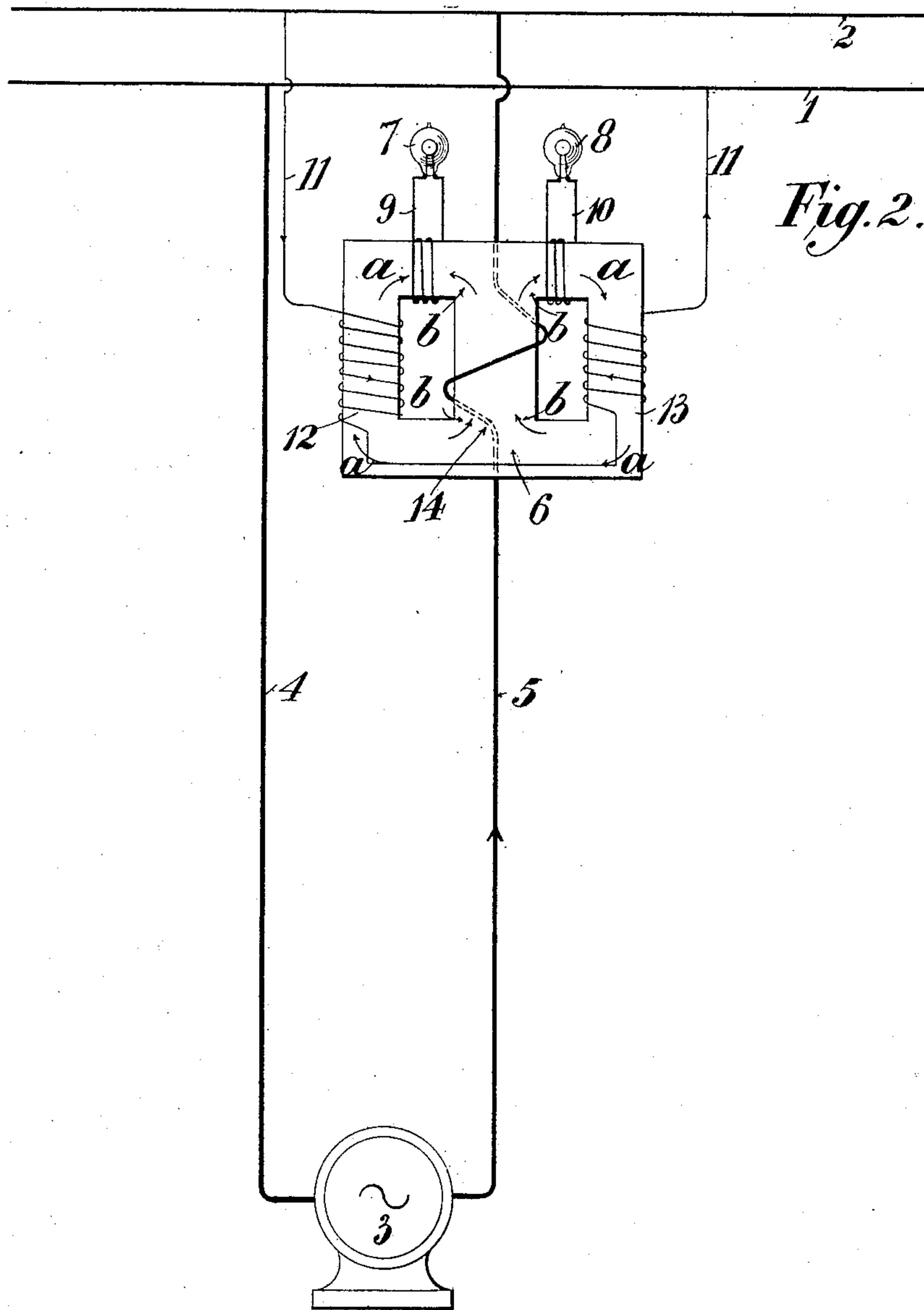
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J. W. Law.  
J. H. Field

Inventor.  
Leonard Andrews



# UNITED STATES PATENT OFFICE.

LEONARD ANDREWS, OF HASTINGS, ENGLAND, ASSIGNOR TO STANLEY ELECTRIC MANUFACTURING COMPANY, OF PITTSFIELD, MASSACHUSETTS, A CORPORATION OF NEW JERSEY.

## REVERSE-CURRENT INDICATOR.

SPECIFICATION forming part of Letters Patent No. 743,417, dated November 10, 1903.

Application filed March 30, 1903. Serial No. 150,317. (No model.)

*To all whom it may concern:*

Be it known that I, LEONARD ANDREWS, a subject of the King of Great Britain and Ireland, residing at Hastings, in the county of Sussex, England, have invented Improvements in Reverse-Current Indicators, of which the following is a specification.

This invention relates to apparatus adapted for indicating or for opening or closing a circuit on change of the direction of the flow of electrical energy in the form of alternating current. An apparatus according thereto comprises a transformer-core forming two magnetic circuits magnetically connected together, two secondaries arranged to be energized by said two circuits, respectively, a primary arranged to produce fluxes in both of said circuits simultaneously, and a primary arranged to influence said fluxes, so as to oppose one and assist the other. The circuits of the two secondaries may be either provided with means for producing separate indications or be adapted to produce a single indication resulting from their mutual coöperation. The transformer has or may have a core with a central member which carries one primary winding and which has at its ends two cross members which each extend in opposite directions from the central member and are magnetically connected together at their ends and of which one carries equally on its parts projecting on opposite sides of the central member a winding for the other primary, while the other cross member carries the two secondaries disposed one on each side of the central member. Such a transformer comprises two magnetic circuits united for a portion of their length and adapted to be mutually energized by the primary winding surrounding their united portions and other windings, of which one (a primary) is divided between and adapted to influence the two magnetic circuits on their ununited portions, while the remaining windings are respectively located upon the ununited portions of the two magnetic circuits and adapted to supply indicating-currents. It will be clear from this that the conductors on the ununited portions of the magnetic circuits may be severally located in any desired positions and are not re-

stricted to the positions previously indicated. The directions and situations of the windings are such that one of the primaries will tend to induce in the two magnetic circuits fluxes to produce equal indicating-currents in the conductors therefor, while the other primary will tend to increase the flux in one magnetic circuit and decrease it in the other, the magnetic circuit having the greater flux and producing the controlling or the greater indicating current being liable to change with change in the relative directions of the currents in the primaries.

The indication may be furnished in various ways. According to one arrangement separate windings adapted to furnish indicating-current are connected to lamps. It may be colored red and green, respectively. the arrangement being such that unless currents flow in both of the primaries neither of the lamps will be lighted, but that if currents flow in both in the proper relative directions the green lamp will light, while if one of them flows in the wrong direction in relation to the other then the red lamp will become luminous. It is obvious that the only function of the lamps is to indicate the presence of current in the secondaries and that consequently any well-known electroresponsive device, such as a voltmeter, may be substituted for the lamps.

The accompanying Figures 1 and 2 are diagrams representing in each case the application of apparatus according to this invention to one of a number of alternating-current generators connected in parallel to a pair of bus-bars. In each example 1 and 2 are the bus-bars. 3 is the generator. 4 and 5 are the conductors leading from the generator 3 to the bars 1 and 2, respectively. 6 is the core of the transformer. 7 and 8 are two indicating-lamps arranged, respectively, in secondary conductors 9 and 10, and 11 is a conductor connecting together the two bars 1 and 2. It will be seen that the transformer-core, as hereinbefore described, forms two magnetic circuits 12 and 13, which are united for a portion 14 of the length of each. In the example shown in Fig. 1 the conductor 5 is wound round an ununited portion of each of



the circuits 12 and 13, while the conductor 11 is wound upon the united portions 14; but in the example shown in Fig. 2 the reverse is the case. In each example the secondary conductors 9 and 10 are wound upon un-  
 5 united portions of the two circuits 12 and 13. The arrows attached to the primaries 5 and 11 indicate the directions of the currents flowing therein when the generator is supply-  
 10 ing energy to the bus-bars 1 and 2. When the currents are flowing in the conductors 5 and 11 in the directions indicated, they tend, respectively, to induce magnetic fluxes in the core of the transformer in the directions  
 15 indicated by the arrows marked *a* and *b*, respectively. It will be seen that the fluxes due to the primaries oppose each other in the circuit 12, and consequently the lamp 7 of the secondary 9 wound thereon is not lighted,  
 20 whereas the flux due to the two primaries assist each other in the circuit 13, and consequently induce sufficient current in the secondary 10 wound thereon to light the lamp 8. It will be obvious that the simultaneous  
 25 reversal of the currents in the conductors 5 and 11 due to the mere alternation of current in the system will have no effect on the lamps 7 and 8. Should the generator-cur-  
 30 rent fail, current will flow to the failing generator from the bus-bars, which are excited by the other generators, and the direction of the flux produced by the conductor 5 would be reversed in relation to that produced by the conductor 11, so that the lamp 8 would  
 35 be extinguished and the lamp 7 would be lighted.

Instead of connecting the two bus-bars together directly the conductor 11 might obviously be arranged to have current induced  
 40 in it by the current in the bus-bars. Again, instead of connecting the primary of the conductor 11 to the bars 1 and 2 it might be connected to the conductors 4 and 5 at points between the generator 3 and the transformer  
 45 and between the generator and the bar 1, respectively.

It will be seen that the primary of the conductor 5 and the primary of the conductor 11 are respectively in series with and a shunt  
 50 to the circuit of the generator 3; but the reverse might be the case

What I claim is—

1. The combination of a transformer-core forming two magnetic circuits magnetically  
 55 connected together, two secondaries arranged to be energized by said two circuits respectively, a primary arranged to produce fluxes in both of said circuits simultaneously and a primary arranged to influence said fluxes so  
 60 as to oppose one and assist the other.

2. The combination with an electrical circuit, of a transformer-core forming two mag-  
 65 netic circuits magnetically connected together, two secondaries arranged to be energized by said two circuits respectively, a primary arranged to produce fluxes in both of said circuits simultaneously, and a primary

arranged to influence said fluxes so as to oppose one and assist the other, one of said pri-  
 70 maries being connected in series with said electrical circuit and the other of said pri-  
 maries being a shunt thereto.

3. The combination of a transformer-core forming two magnetic circuits united for a  
 75 portion of the length of each of them, and four windings, namely a winding round the united portions of said circuits, a winding round the ununited portion of each of said  
 80 circuits, and a winding partly round the ununited portion of one of said circuits and partly round the ununited portion of the other of said circuits.

4. The combination of a transformer-core forming two magnetic circuits united for a  
 85 portion of the length of each of them, a winding round the united portions of said cir-  
 cuits, a winding partly round the ununited portion of one of said circuits and partly round the ununited portion of the other of  
 90 said circuits, conductors also wound upon said core so as to be under the influence of the magnetic fluxes produced by currents  
 95 flowing in said windings and electroresponsive devices connected to the terminals of said conductors.

5. The combination of a transformer-core forming two magnetic circuits united for a  
 100 portion of the length of each of them, a winding round the united portions of said cir-  
 cuits, a winding partly round the ununited portion of one of said circuits and partly round the ununited portion of the other of  
 105 said circuits, conductors also wound upon said core so as to be under the influence of the magnetic fluxes produced by currents  
 flowing in said windings, and a lamp or other signaling device connected in the circuit of each of said conductors.

6. The combination of a transformer-core forming two magnetic circuits united for a  
 110 portion of the length of each of them, four windings, namely a winding round the united portions of said circuits, a winding round the ununited portion of each of said circuits, and  
 115 a winding partly round the ununited portion of one of said circuits and partly round the ununited portion of the other of said circuits, and a lamp or other signaling device con-  
 120 nected in the circuit of each of said windings wound round the ununited portion of only one of said circuits.

7. In combination, two magnetic circuits, two secondaries arranged to be energized by  
 125 said two circuits respectively, a primary arranged to produce fluxes in both of said cir-  
 cuits simultaneously, a primary arranged to influence said fluxes so as to oppose one and assist the other, and electroresponsive de-  
 130 vices connected to said secondaries.

8. In combination, two magnetic circuits, two secondaries arranged to be energized by  
 130 said two circuits respectively, a primary arranged to produce fluxes in both of said cir-  
 cuits simultaneously, and a primary arranged



to influence said fluxes so as to oppose one and assist the other.

9. In combination, an electrical circuit, two magnetic circuits, two secondaries arranged  
5 to be energized by said two circuits respectively, a primary arranged to produce fluxes in both of said magnetic circuits simultaneously, a primary arranged to influence said  
10 fluxes so as to oppose one and assist the other, one of said primaries being connected in series with said electrical circuit and the other of said primaries being in shunt thereto.

10. In combination, an electrical circuit, two magnetic circuits, two secondaries ar-  
15 ranged to be energized by said two magnetic

circuits respectively, indicating devices connected to said secondaries, a primary arranged to produce fluxes in both of said magnetic circuits simultaneously and a primary arranged to influence said fluxes so as to op- 20  
pose one and assist the other, one of said primaries being connected in series with said electrical circuit and the other of said primaries being in shunt thereto.

Signed at 75-77 Cornhill, London, England, 25  
this 18th day of March, 1903.

LEONARD ANDREWS.

Witnesses:

PERCY E. MATTOCKS,

WM. O. BROWN.