No. 710,990. Patented Oct. 14, 1902.

M. J. MYERS.

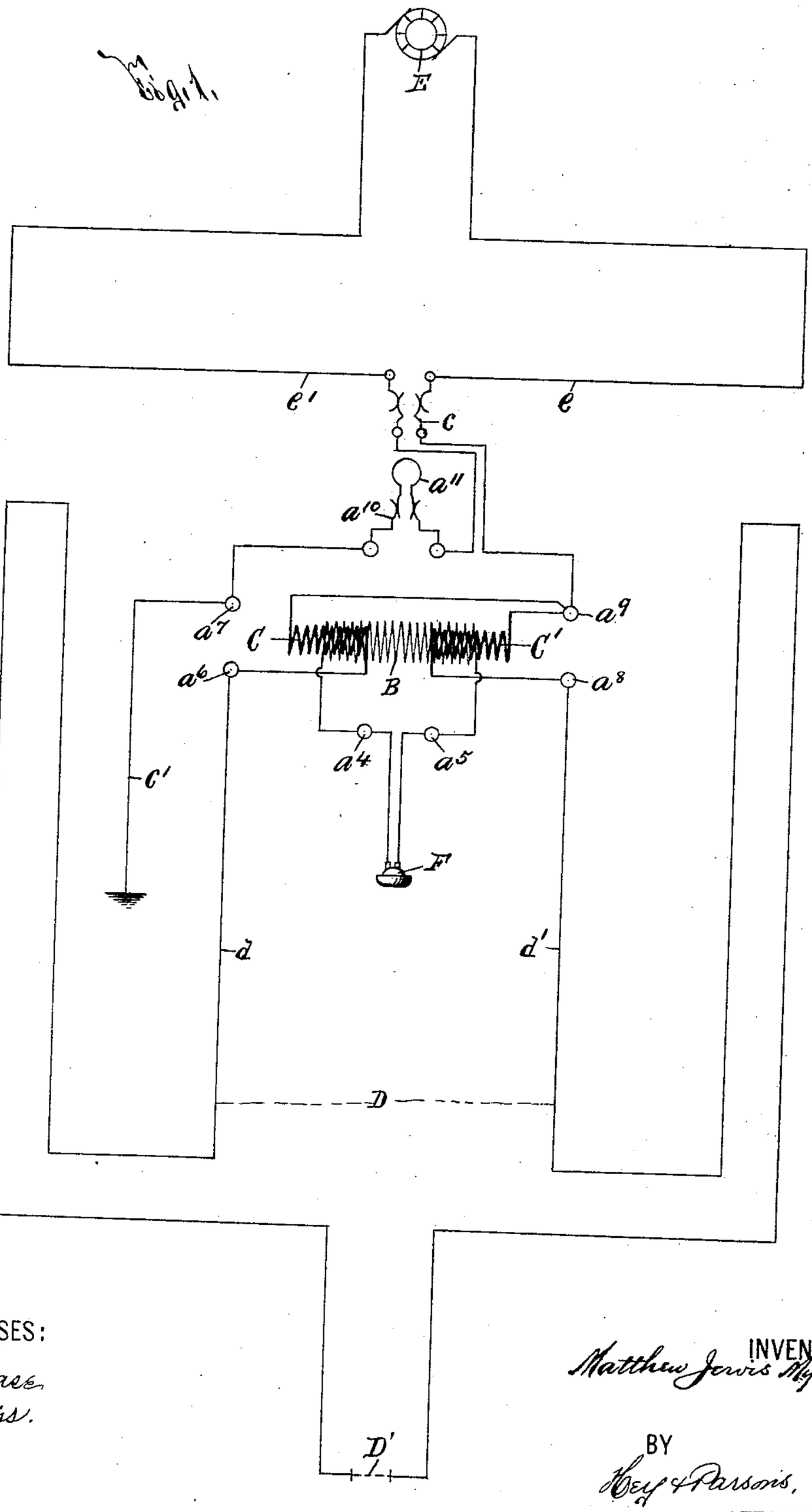
DEVICE FOR LOCATING BREAKS AND GROUNDS ON ELECTRIC CIRCUITS.

(Application filed June 9, 1900.)

(No Model.)

3 Sheets—Sheet 1.

Fig. 1.



WITNESSES:
H. C. Chase.
M. D. Lewis.

INVENTOR
Matthew Jervis Myers.

BY
Key & Parsons,
ATTORNEYS

No. 710,990. Patented Oct. 14, 1902.

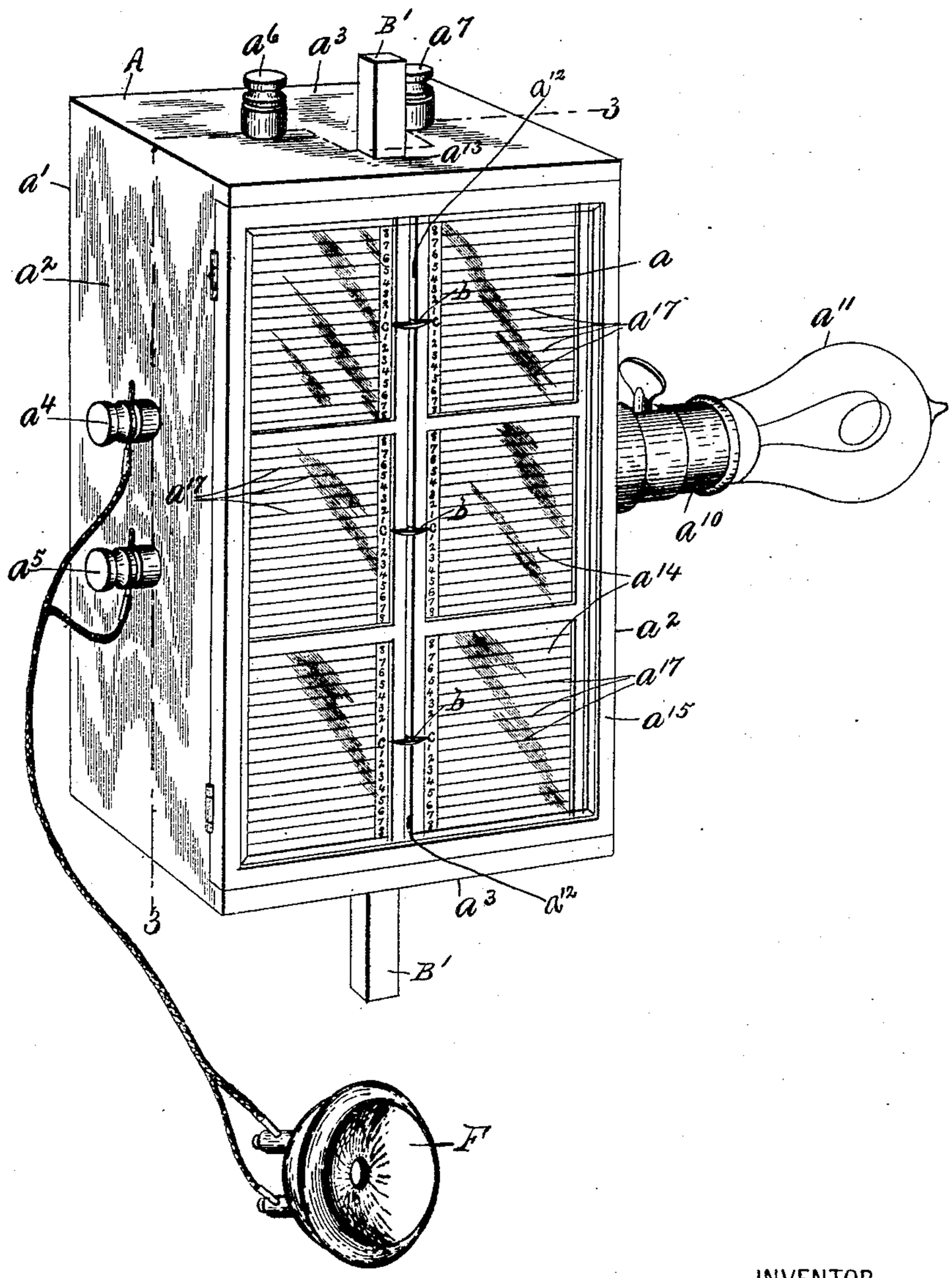
M. J. MYERS.

DEVICE FOR LOCATING BREAKS AND GROUNDS ON ELECTRIC CIRCUITS.

(Application filed June 9, 1900.)

(No Model.) 3 Sheets—Sheet 2.

Fig. 2.



WITNESSES:
H. E. Chase
M. D. Lewis.

INVENTOR
Matthews Jowis Myers

BY
Bey & Parsons
ATTORNEYS

No. 710,990. Patented Oct. 14, 1902.

M. J. MYERS.

DEVICE FOR LOCATING BREAKS AND GROUNDS ON ELECTRIC CIRCUITS.

(Application filed June 9, 1900.)

(No Model.) 3 Sheets—Sheet 3.

Fig. 3.

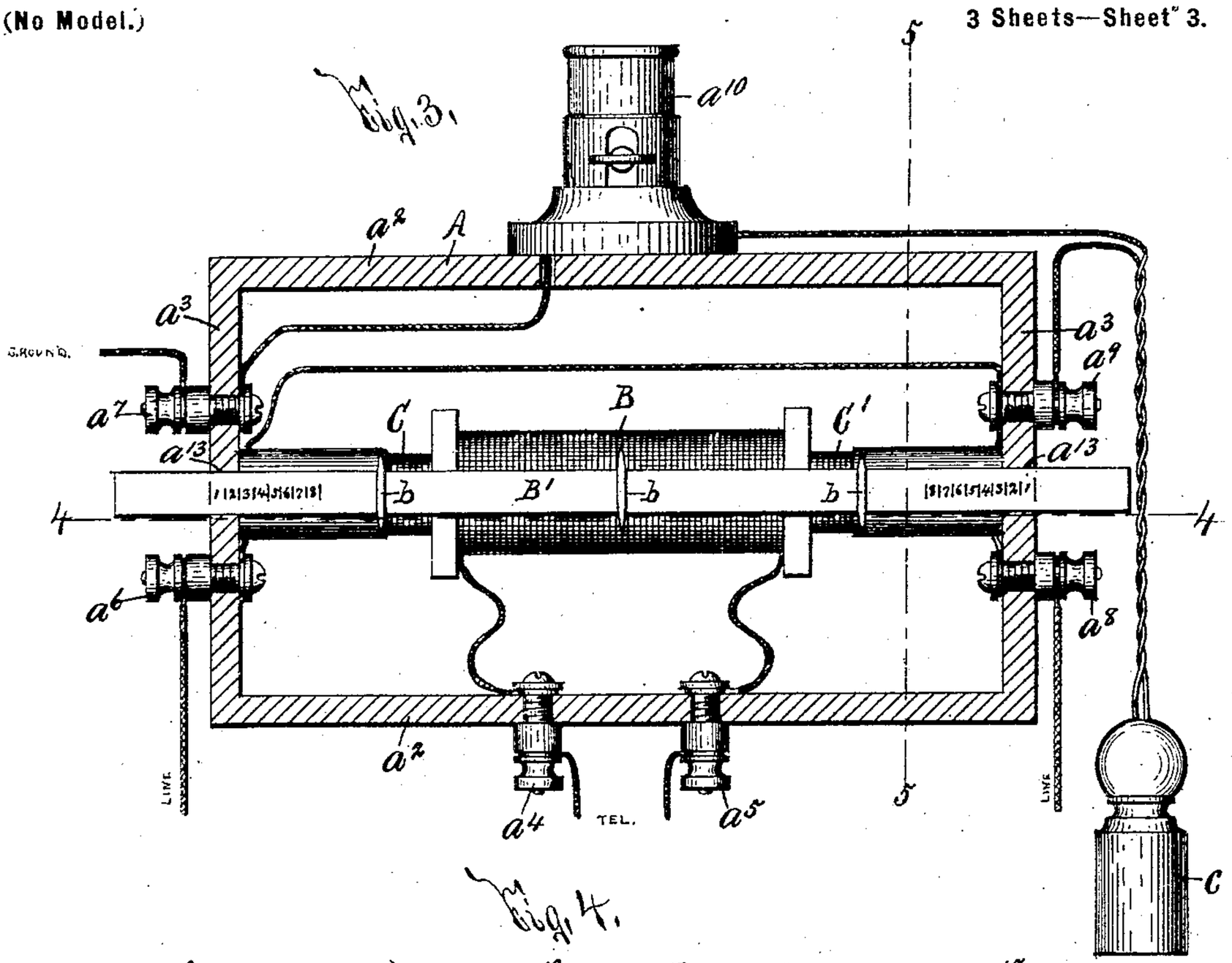
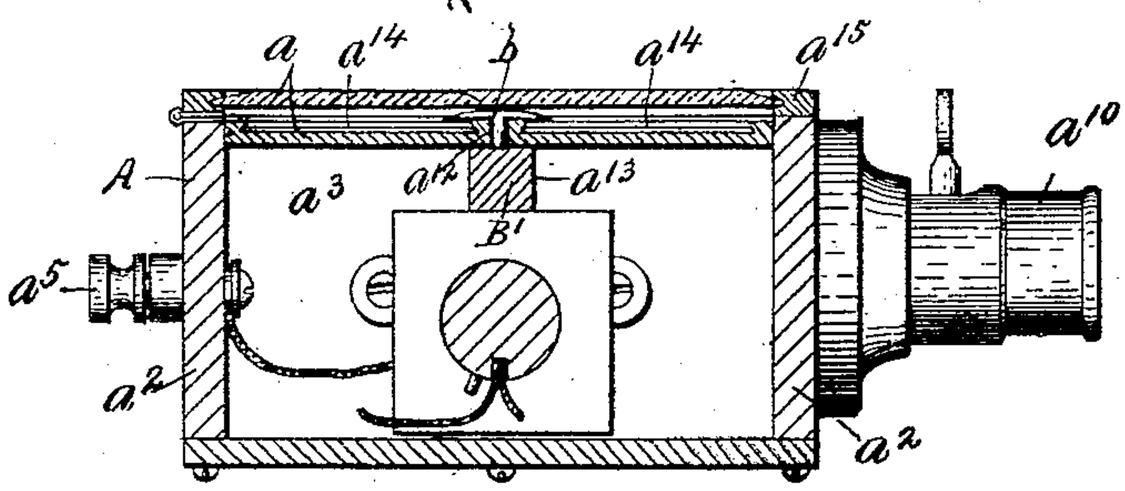


Fig. 4.

Fig. 5.



WITNESSES:
H. E. Chase
M. D. Lewis.

INVENTOR
Matthew Jervis Myers

BY
Key & Parsons.
ATTORNEYS

UNITED STATES PATENT OFFICE.

MATTHEW JERVIS MYERS, OF SYRACUSE, NEW YORK.

DEVICE FOR LOCATING BREAKS AND GROUNDS ON ELECTRIC CIRCUITS.

SPECIFICATION forming part of Letters Patent No. 710,990, dated October 14, 1902.

Application filed June 9, 1900. Serial No. 19,655. (No model.)

To all whom it may concern:

Be it known that I, MATTHEW JERVIS MYERS, of Syracuse, in the county of Onondaga, in the State of New York, have invented certain new and useful Improvements in Devices for Locating Breaks and Grounds on Electric Circuits, of which the following is a specification.

My invention has for its object the production of a simple and efficient means for locating breaks and grounds on electric circuits and for comparing the electrical resistance of one circuit with another; and to this end it consists in the devices and combinations hereinafter described, and pointed out in the claims.

Referring to the drawings, Figure 1 is a diagrammatic view showing a circuit broken at an unknown point, a source of electrical energy, and my invention operatively connected to said circuit and source of electric energy and to a grounded conductor. Fig. 2 is an isometric view of my invention. Figs. 3, 4, and 5 are sectional views taken, respectively, on lines 3 3, 4 4, and 5 5, Figs. 2 and 3.

My device for locating breaks and grounds on electric circuits and comparing the electrical resistance of one circuit with another preferably comprises a frame A, a magnetizable member B, magnetizing members C C′, means for moving the part B relatively to the parts C C′, and means for indicating the action of said members C C′ upon the member B.

The frame A is of any desirable form, size, and construction, being usually provided with top, bottom, sides, and ends a, a', a^2 a^2, a^3 a^3, terminals a^4 a^5 a^6 a^7 a^8 a^9, a socket a^{10}, a removable resistance device a^{11}, guides a^{12} a^{13}, and one or more indicating-surfaces a^{14}. In the illustrated construction of my invention the top a is provided with the guide a^{12}, a plurality of the indicating-surfaces a^{14}, and a removable cover a^{15}, arranged above said guide and indicating-surfaces. The sides and ends a^2 a^2 a^3 a^3 support the terminals a^4 a^5 a^6 a^7 a^8 a^9, the socket a^{10}, and the resistance device a^{11}, and the ends a^3 a^3 are provided with the guides a^{13}. Said terminals a^4 a^5 a^6 a^7 a^8 a^9 are of any desirable form, size, and construction. The socket a^{10} is provided with a suitable switch, (not illustrated,) and the removable resistance device a^{11}, which may be dispensed with, if desired, generally consists of an incandescent lamp detachably supported by the socket. The guides a^{12} a^{13} extend substantially parallel with the sides a^2 a^2, and the indicating-surfaces a^{14} are generally arranged one in advance of the other on opposite sides of the guide a^{12} and are formed with transverse graduations a^{17}, a central character, as c, and additional characters, as 1, 2, 3, 4, &c., reading in opposite directions from the central character c. These indicating-surfaces are preferably arranged upon removable charts supported beneath the cover a^{15} of the top a at opposite sides of the guide a^{12}. The subdivisions of said indicating-surfaces represent corresponding subdivisions of the circuit, which is broken or grounded at an unknown point.

The magnetizable member B is subjected to the influence of the members C C′, presently described, and is here illustrated as consisting of a secondary coil or conductor normally encircling the adjacent ends of the members C C′ and having its opposite extremities connected to the terminals a^4 a^5, which are usually connected in circuit with the means, also presently described, for indicating the action of the members C C′ upon the member B. Said members B C C′ form, essentially, the secondary and primary coils of a transforming device. It will be apparent, however, to those skilled in the art that the member B does not necessarily encircle the members C C′, as said member B may be movable along the parts C C′ at one side thereof or may be movable between the adjacent ends of said parts C C′, which may be separated a greater distance than as shown in the accompanying drawings.

The magnetizing members C C′ are here illustrated as consisting of fixed primary coils or conductors arranged end to end within the frame A between its end walls a^3 a^3 and having their adjacent ends separated and connected, respectively, to the terminals a^6 a^8 and their opposite ends connected to the terminal a^9. Said terminals a^6 a^8 are connected, respectively, to the opposite branches or limbs d d' of the circuit D to be tested, which is illustrated as broken at D′, and said terminal a^9 is suitably connected to one pole of a source of electric energy E for irregular

current having its opposite pole grounded, said opposite pole being here shown as connected in circuit with a detachable plug *c*, the socket a^{10}, the resistance device a^{11}, and the terminal a^7. When the terminal a^9 is connected as illustrated, the plug *c* is provided with separated terminals, (shown diametrically in Fig. 1,) which are connected, respectively, to the line conductors *e e'*, leading from opposite poles of the source of electric energy E, and the terminal a^7 is connected to a grounded conductor *c'*. One pole of the source of electric energy E is then connected to both magnetizable members C C' by the conductor *e*, one terminal of the plug *c*, and the terminal a^9, and the opposite pole of said source of electric energy is then grounded through the conductor *e'*, the other terminal of the plug *c*, the resistance device a^{11}, and the conductor *c'*. Said members C C' when subjected to the influence of currents passing therethrough generate induced currents in the member B, the action of the parts C C' upon the part B being governed by the strength of the currents passing through the members C C', the size and construction of said members, and the susceptibility of the member B to magnetism. In the preferable construction of my invention a comparatively weak current is passed through the members C C' and the members B C C' are so relatively proportioned that the action of the members C C' is insufficient to move the member B. It will be apparent, however, to those skilled in the art that the strength of the currents passed through the members C C' and the relative proportion of the members B C C' may be such that the member B may be moved in opposite directions by the action of the members C C'.

The means for moving the part B usually consists of an actuating member B', reciprocally movable in the guides a^{13} and having its opposite extremities extended beyond the outer faces of the ends a^3 a^3 of the frame A. Said actuating member is generally provided with one or more indicators *b*, movable in the guide a^{12}, and with indicating characters 1, 2, &c., arranged on its opposite ends and movable into alinement with the outer faces of said ends a^3.

The means for indicating the action of the members C C' upon the member B usually consists of a telephone-receiver or other indicator F, which is connected in circuit with the terminals a^4 a^5 and produces more or less noise or other indicating action upon the passage of greater or less currents through the member B. Said indicator by informing the user of my invention of the action of the members C C' upon the member B as the same is moved lengthwise of said parts C C' facilitates the ready adjustment of said part B to a position where the action of one magnetizing member neutralizes that of the other magnetizing member.

In the use of my invention for finding breaks, as D', in a circuit D, containing magnets or other resistance devices in circuit, the opposite branches *d d'* of said circuit are connected, respectively, to the terminals a^6 a^8, the plug *c* is connected in circuit with the source of electric energy E, and the grounded conductor *c'* is connected to the terminal a^7, as illustrated in Fig. 1. Said branches or limbs *d d'*, connected to the terminals a^6 a^8, form parts of two circuits, and currents of sufficient power to actuate my invention pass through the magnetizing members C C' from one pole of the grounded source of electric energy E through said respective branches or limbs *d d'*. The passage of the currents through the members C C' produces induced currents in the member B, and said member is moved lengthwise by the actuating member B' until the current induced by one of the members C C' substantially neutralizes the current induced by the other of said members, this result being indicated by the lack of sound in the indicator or receiver F. When the member B is in said position, the indicator *b*, movable along the proper indicating-surface a^{14}, will be alined with the graduation of said indicating-surface corresponding to the subdivision of the circuit D, containing the break.

In case the indicating characters on the actuating member B' are used to determine the position of the break the circuit must be divided into subdivisions corresponding to said characters, and the break will be found in the subdivision corresponding to the graduation of said indicating-surfaces alined with the outer face of one of the ends a^3 of the frame A.

When my invention is used for finding unknown grounds on a circuit, it is connected and operated in the same manner as when used for finding unknown breaks. If said invention is so used on a circuit containing no magnets or other resistance devices, the graduation alined with the indicator *b* will not correspond to the grounded portion of the circuit, but to the opposite portion of said circuit. Consequently if the proper indicator stops at graduation 4 at one side of the central character *c* of the corresponding indicating-surface, the operator determines upon graduation 4 on the opposite side of said character as being the graduation corresponding to the grounded portion of the circuit.

In some instances, as will be readily understood by those skilled in the art without additional illustration, I prefer to avoid any movement of the magnetizable and magnetizing members B C C' in the operation of my invention. This result is effected by the use of a local circuit of variable length having both limbs substantially parallel or entwined one around the other, one limb of the local circuit being connected to the ground and the other limb having one extremity connected to one of the terminals a^6 a^8 and its opposite extremity connected to said grounded

limb or disconnected therefrom at will by a suitable switch. The other of said terminals a^6 a^8 is connected to one side of the circuit to be tested.

When my invention connected as just described is used for finding a break, the two limbs of the local circuit, one limb being grounded and the other being connected to one of the terminals a^6 a^8, are disconnected from each other, whereupon a current passes through the primary conductor in circuit with the limb of said local circuit connected to said one of the terminals a^6 a^8. The length of said limb of the local circuit is then increased or diminished until the action of the members C C′ are neutralized, as determined by the indicating means F, whereupon the length of said limb of the local circuit required to effect the neutralization of the action of the members C C′ enables the operator to determine the position of the break.

If said invention connected as just described is used for finding an unknown ground, the two limbs of the local circuit are connected together, whereupon a current passes through the magnetizing member in circuit therewith.

To those skilled in the art it will be obvious that in the use of my invention, as just described a condenser may be substituted for the local circuit when determining the position of an unknown break and that a high-resistance device, as a graphite rod, may be substituted for said local circuit when determining the position of an unknown ground.

My invention may also be utilized for measuring coils or conductors by connecting the terminals a^6 a^8 to said coils or conductors in the same manner as to the branches or limbs e e' of the circuit E.

The construction and operation of my invention will now be readily understood upon reference to the foregoing description and the accompanying drawings, and it will be particularly noted that more or less change may be made in the construction and arrangement of its component parts without departing from the spirit of my invention.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a plurality of oppositely-acting primary conductors connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary conductors, a secondary conductor subjected to the differential influence of the currents in the primary conductors, and means for indicating the current in the secondary conductor, substantially as and for the purpose described.

2. The combination of a plurality of primary conductors having corresponding ends connected, respectively, to electric circuits, a source of electric energy having one pole connected to the ground and its other pole connected to the opposite ends of the primary conductors, a secondary conductor subjected to the differential influence of the currents in the primary conductors, and means for indicating the current in the secondary conductor, substantially as and for the purpose specified.

3. The combination of a plurality of primary conductors connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary conductors, a secondary conductor subjected to the differential influence of the currents in the primary conductors, and a telephone-receiver connected in circuit with the secondary conductor, substantially as and for the purpose set forth.

4. The combination of a plurality of primary conductors having corresponding ends connected, respectively, to electric circuits, a source of electric energy having one pole connected to the ground and its other pole connected to the opposite ends of the primary conductors, a secondary conductor subjected to the differential influence of the currents in the primary conductors, and a telephone-receiver connected in circuit with the secondary conductor, substantially as and for the purpose described.

5. The combination of a plurality of primary conductors connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary conductors, a secondary conductor subjected to the differential influence of the currents in the primary conductors, means for moving one of the conductors relatively to another of the conductors, and means for indicating the current in the secondary conductor, substantially as and for the purpose specified.

6. The combination of a plurality of primary conductors having corresponding ends connected, respectively, to electric circuits, a source of electric energy having one pole connected to the ground and its other pole connected to the opposite ends of the primary conductors, a secondary conductor subjected to the differential influence of the currents in the primary conductors, means for moving the secondary conductor relatively to the primary conductors, and means for indicating the current in the secondary conductor, substantially as and for the purpose set forth.

7. The combination of a plurality of primary conductors arranged one in advance of the other and connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary conductors, a secondary conductor subjected to the influence of the currents in the primary conductors and movable lengthwise relatively to said primary conductors, and means for indicating the current in the secondary conductor, sustantially as and for the purpose described.

8. The combination of a plurality of primary conductors arranged one in advance of the other and connected, respectively, to elec-

tric circuits, a grounded source of electric energy connected in circuit with the primary conductors, a secondary conductor for encircling the primary conductors, and means for indicating the current in the secondary conductor, substantially as and for the purpose specified.

9. The combination of a plurality of primary conductors connected, respectively, to electric circuits, a source of electric energy having one pole connected in circuit with a removable resistance device and to the ground, and its other pole connected in circuit with the primary conductors, a secondary conductor subjected to the differential influence of the currents in the primary conductors, and means for indicating the current in the secondary conductor, substantially as and for the purpose set forth.

10. The combination of a plurality of primary coils arranged one in advance of the other and connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary coils, a secondary coil movable relatively to the primary coils and subjected to the differential influence of the currents in the primary coils, and means for indicating the current in the secondary coil, substantially as and for the purpose described.

11. The combination of a plurality of primary coils arranged one in advance of the other and connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary coils, a secondary coil subjected to the influence of the currents in the primary coils, means for moving one of the coils relatively to another of the coils, and means for indicating the current in the secondary coil, substantially as and for the purpose specified.

12. The combination of a plurality of fixed primary coils arranged end to end and connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary coils, a secondary coil subjected to the influence of the currents in the primary coils and movable in a plane extending lengthwise of said primary coils, and means for indicating the current in the secondary coil, substantially as and for the purpose set forth.

13. The combination of a frame having a guide, a plurality of primary conductors supported by the frame and connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary conductors, a secondary conductor subjected to the influence of the currents in the primary conductors and movable relatively thereto, an actuating member movable in the guide and connected to the secondary conductor for moving the same, and means for indicating the current in the secondary coil, substantially as and for the purpose described.

14. The combination of a frame having a guide, a plurality of primary conductors supported by the frame one in advance of the other and connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary conductors, a secondary conductor for encircling the primary conductors, an actuating member movable in the guide and connected to the secondary conductor for moving the same lengthwise of the primary conductors, and means for indicating the current in the secondary conductor, substantially as and for the purpose specified.

15. The combination of a plurality of primary conductors connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary conductors, a secondary conductor subjected to the differential influence of the currents in the primary conductors, means for moving one of the conductors relatively to another of the conductors, means for indicating the position of the relatively movable conductor, and means for indicating the current in the secondary conductor, substantially as and for the purpose set forth.

16. The combination of a plurality of primary conductors connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary conductors, a secondary conductor subjected to the influence of the currents in the primary conductors, an actuating member for moving one of the conductors relatively to another of the conductors, said actuating member being provided with means for indicating the position of the relatively movable conductor, and means for indicating the current in the secondary conductor, substantially as and for the purpose described.

17. The combination of a plurality of primary conductors connected, respectively, to electric circuits, a grounded source of electric energy connected in circuit with the primary conductors, a secondary conductor subjected to the influence of the currents in the primary conductors, means for moving one of the conductors relatively to another of the conductors, an indicating-surface, an indicator movable along said indicating-surface for indicating the position of the relatively movable conductor, and means for indicating the current in the secondary conductor, substantially as and for the purpose specified.

18. The combination of a frame provided with an indicating-surface, primary conductors supported by the frame and connected, respectively, to electric circuits, a source of electric energy connected in circuit with the primary conductors, a secondary conductor supported by the frame and subjected to the influence of the currents in the primary conductors, means for moving one of the conductors relatively to another of the conductors, means moving along the indicating-surface during the movement of the relatively movable conductor for indicating the position of

said relatively movable conductor, and means for indicating the current in the secondary conductor, substantially as and for the purpose set forth.

19. The combination of a frame provided with a guide and indicating-surfaces on opposite sides of the guide, a plurality of primary conductors supported by the frame and connected, respectively, to electric circuits, a source of electric energy connected in circuit with the primary conductors, a secondary conductor supported by the frame and subjected to the influence of the currents in the primary conductors, means for moving one of the conductors relatively to another of the conductors, an indicator movable in the guide during the movement of the relatively movable conductor, and means for indicating the current in the secondary conductor, substantially as and for the purpose described.

20. The combination of a plurality of primary conductors connected, respectively, to electric circuits, a source of electric energy connected in circuit with the primary conductors, a secondary conductor subjected to the influence of the currents in the primary conductors, means for moving one of the conductors relatively to another of the conductors, an indicating-surface provided with a plurality of graduations, a substantially central character, and additional characters reading in opposite directions from the former character, an indicator movable along the indicating-surface during the movement of the relatively movable conductor, and means for indicating the current in the secondary conductor, substantially as and for the purpose specified.

In testimony whereof I have hereunto signed my name, in the presence of two attesting witnesses, at Syracuse, in the county of Onondaga, in the State of New York, this 17th day of March, 1900.

MATTHEW JERVIS MYERS.

Witnesses:
S. DAVIS,
M. D. LEWIS.