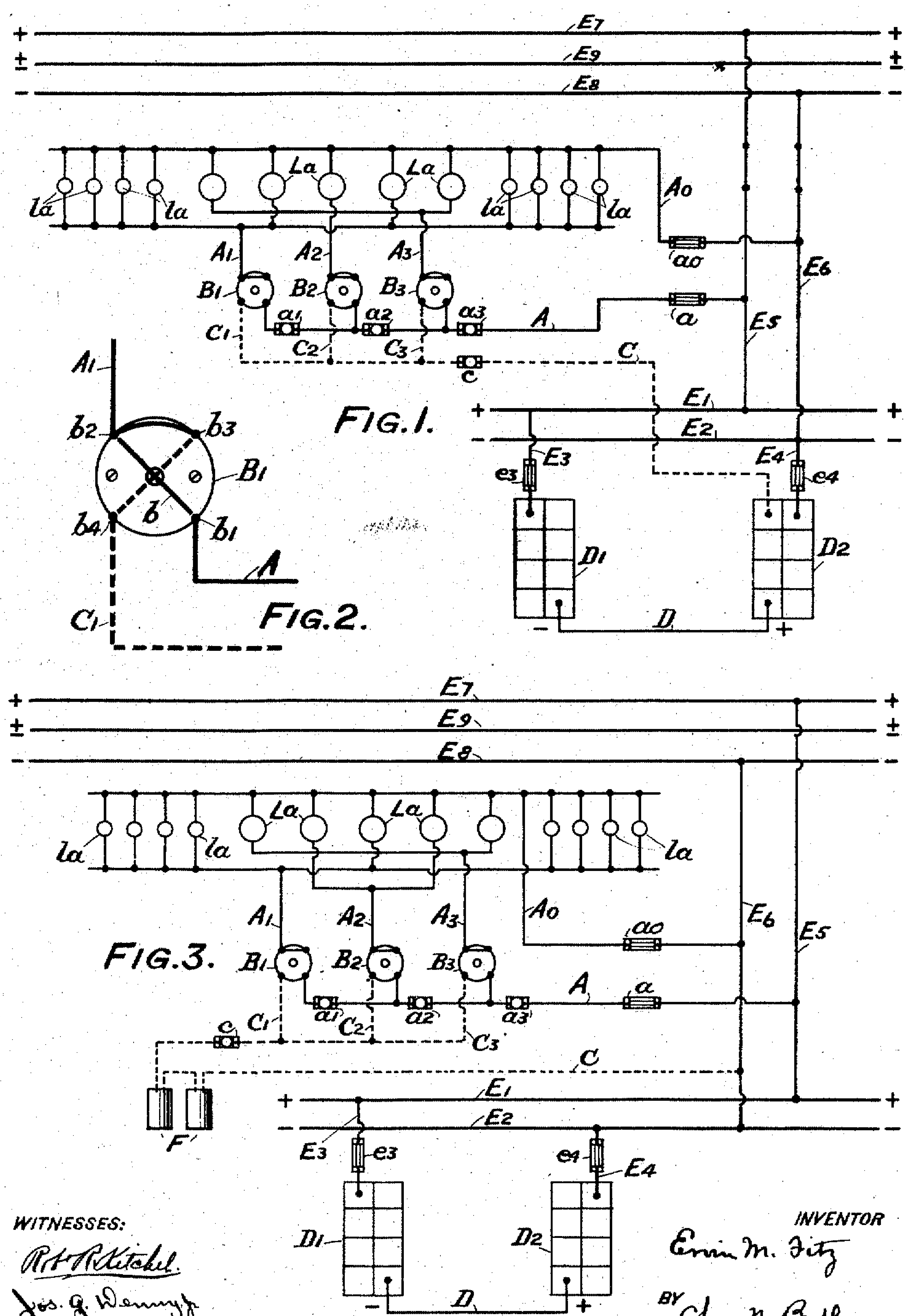
E. M. FITZ.

ELECTRIC LIGHTING SYSTEM.

APPLICATION FILED FEB. 13, 1909.

984,128. Patented Feb. 14, 1911.

5 SHEETS—SHEET 1.



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5 SHEETS—SHEET 2.

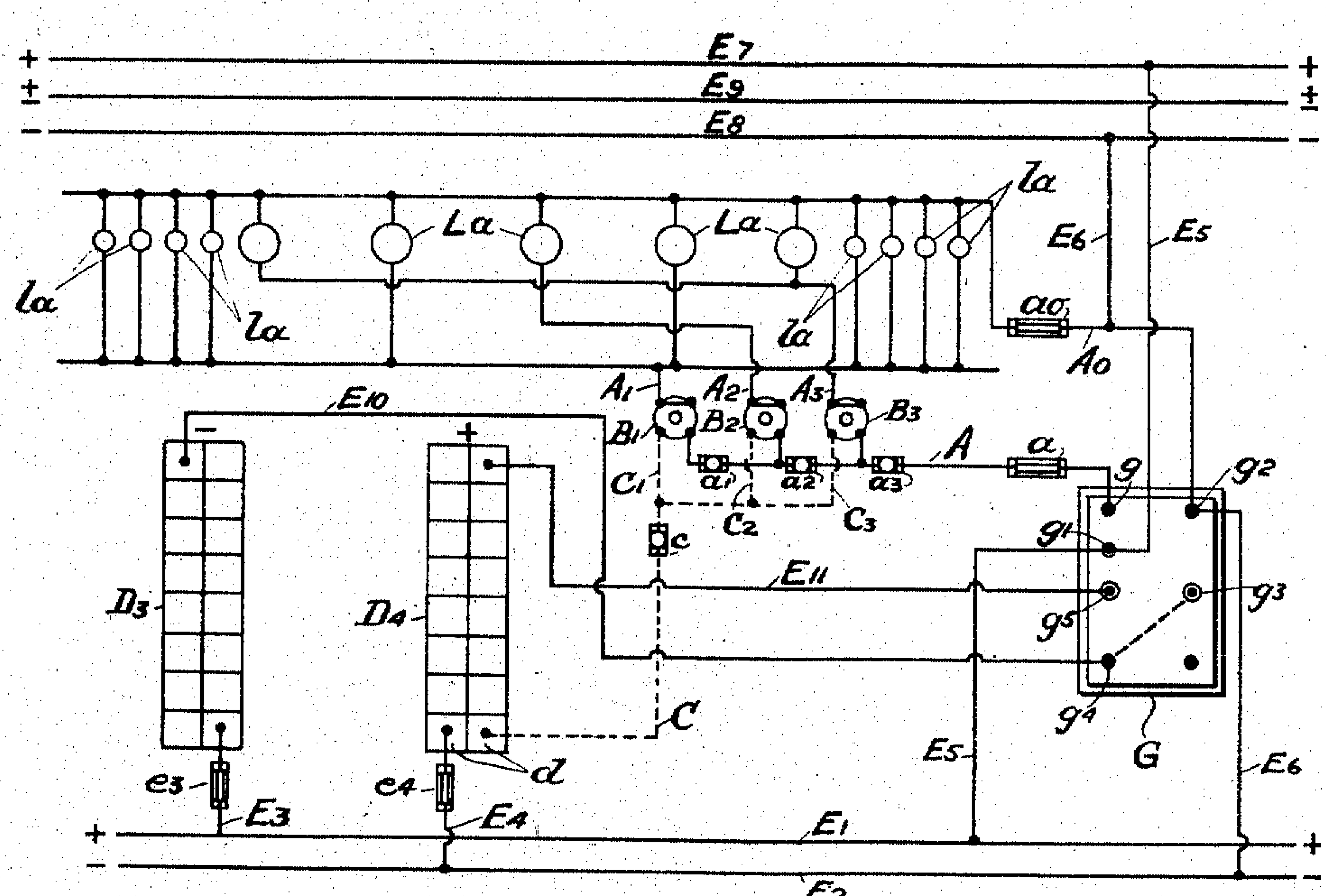

FIG. 4.

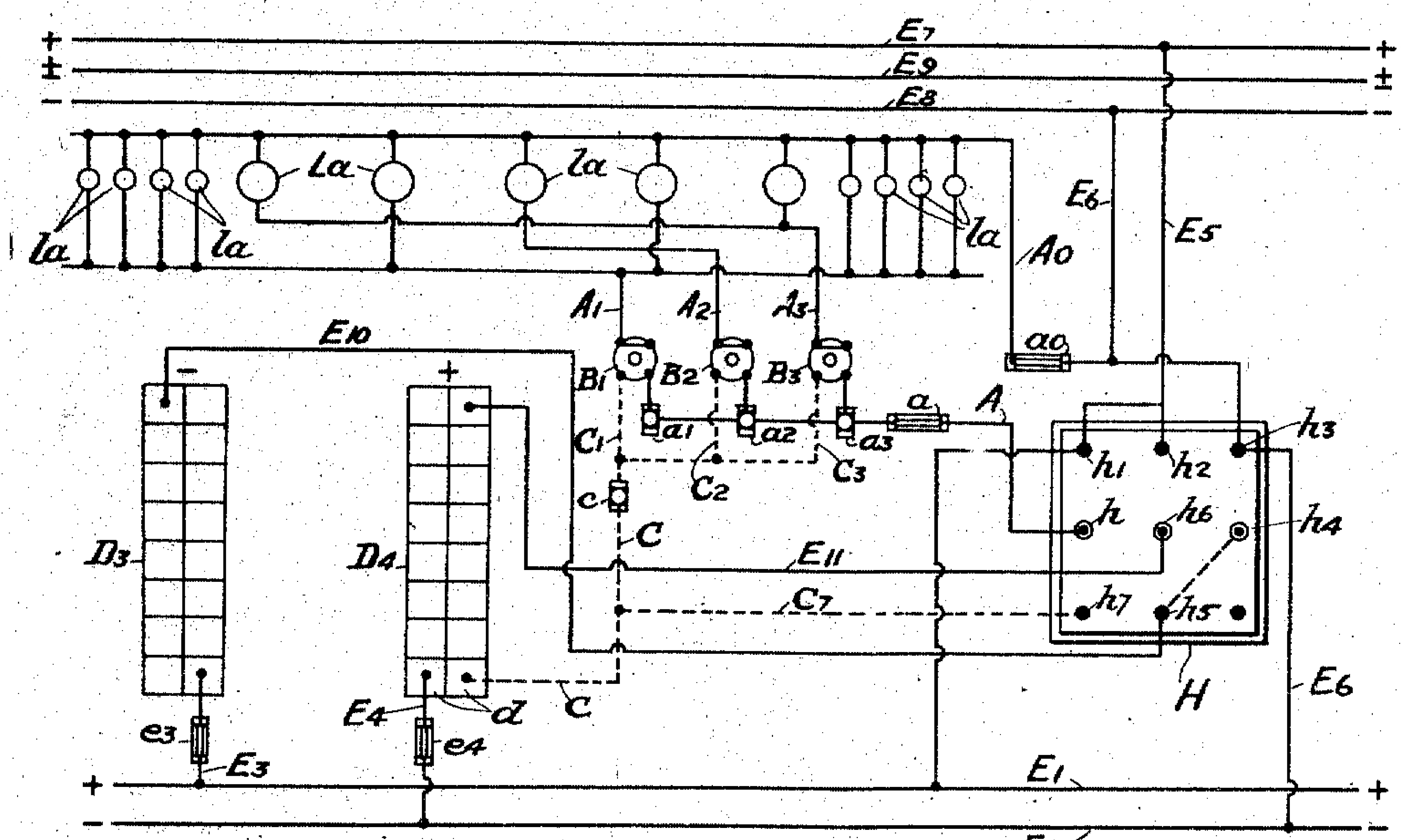

FIG. 5.

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5 SHEETS—SHEET 3.

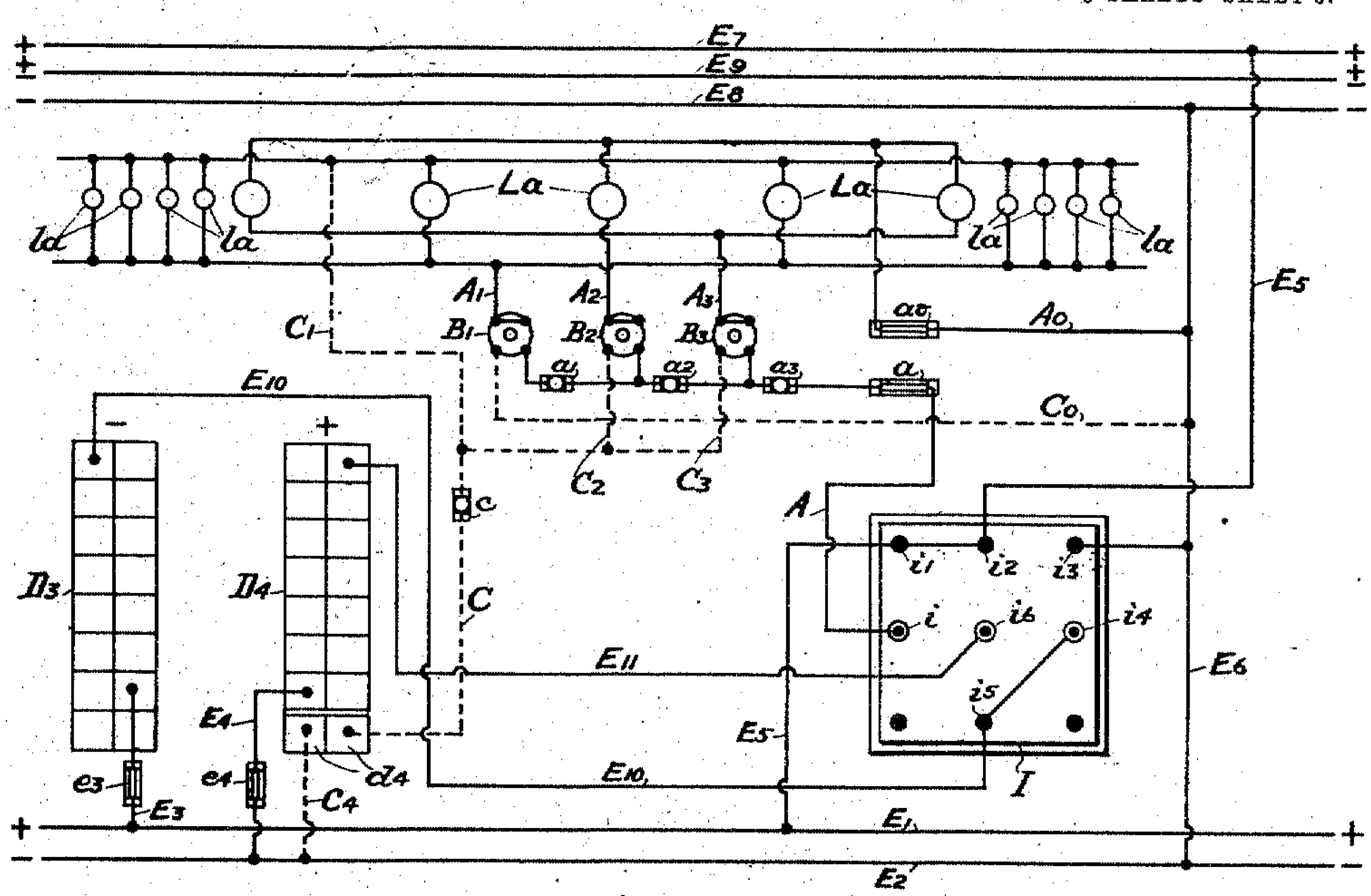

FIG. 6.

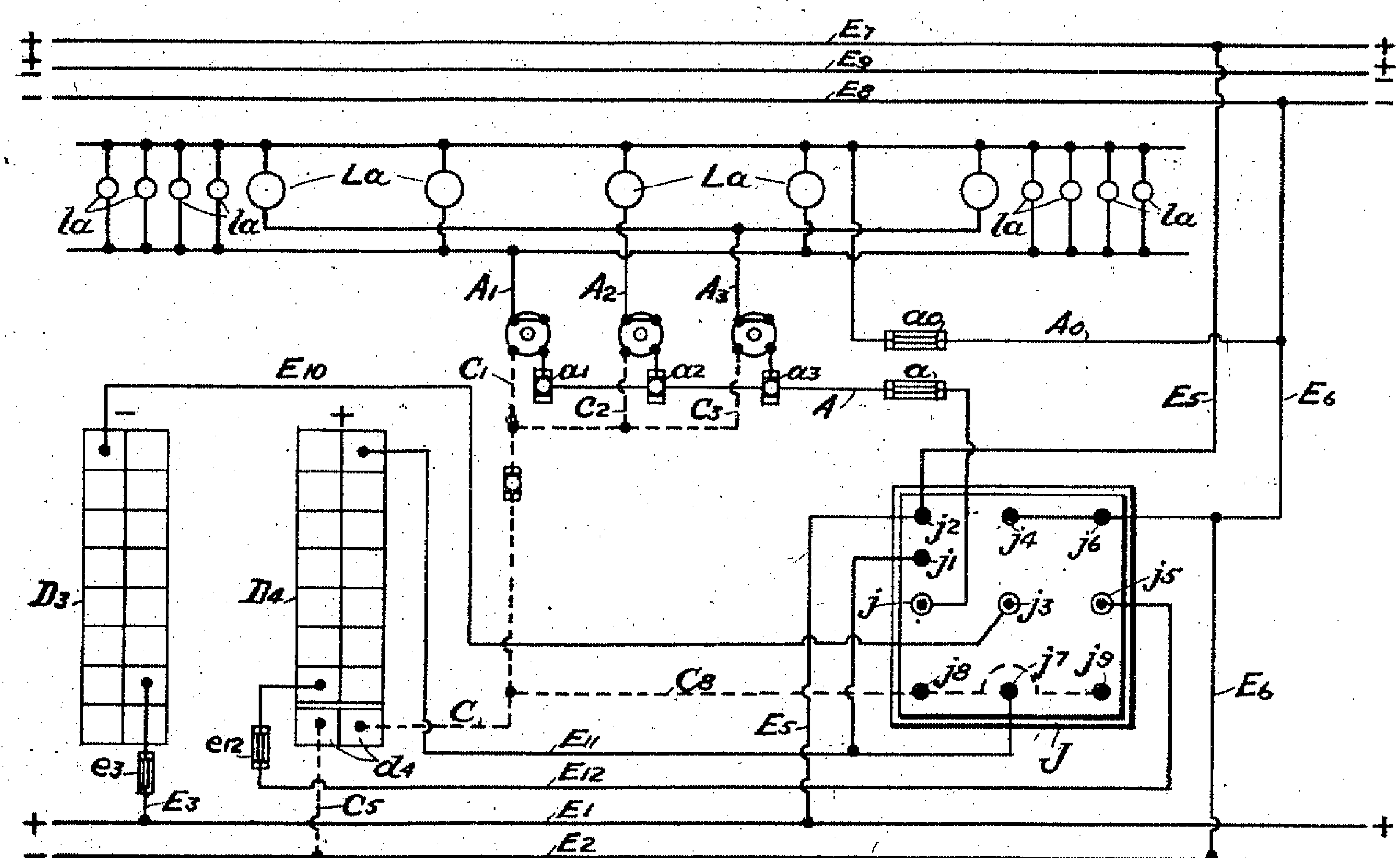

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FIG. 7.

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5 SHEETS—SHEET 4.

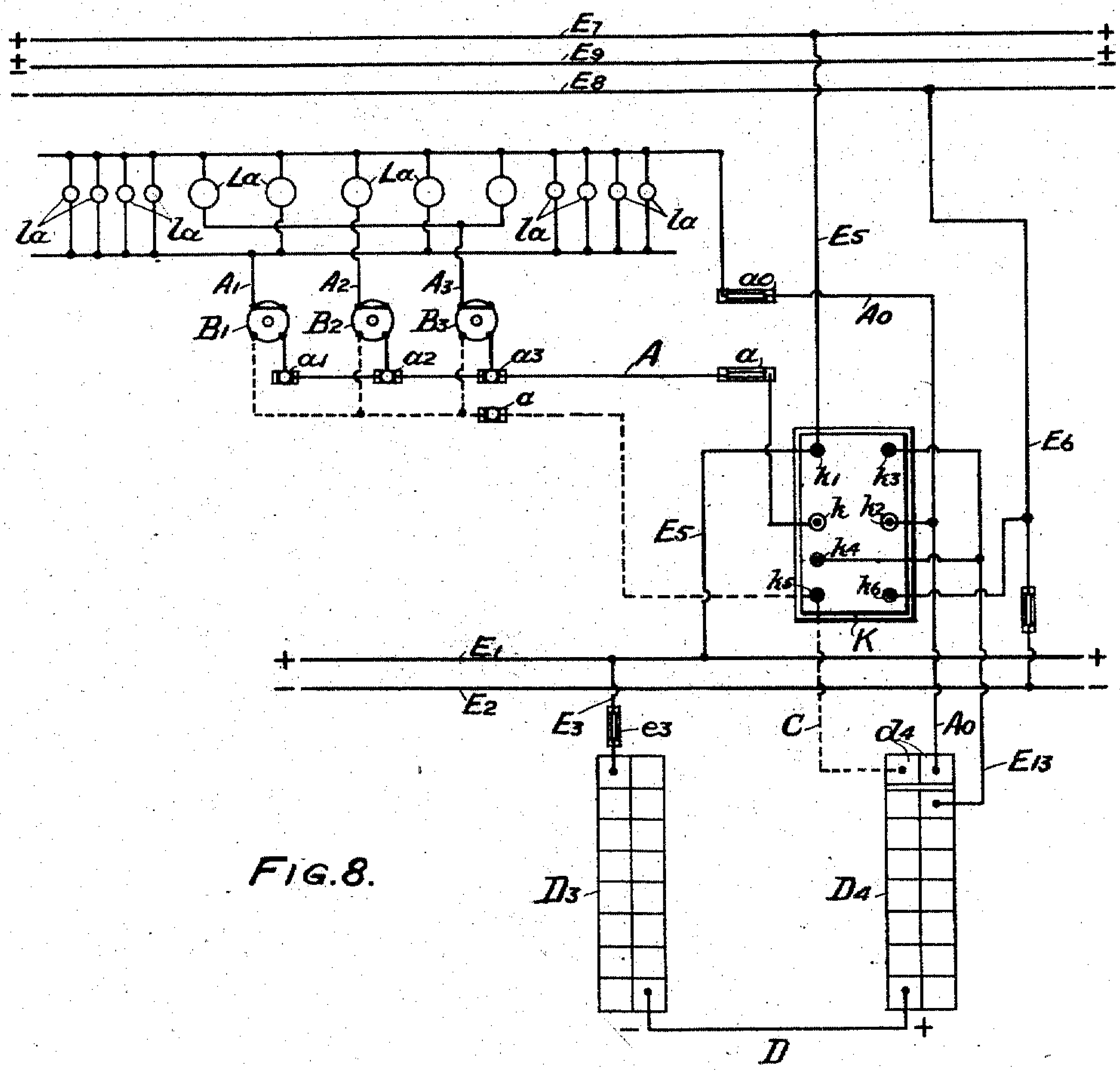

FIG. 8.

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5 SHEETS—SHEET 5.

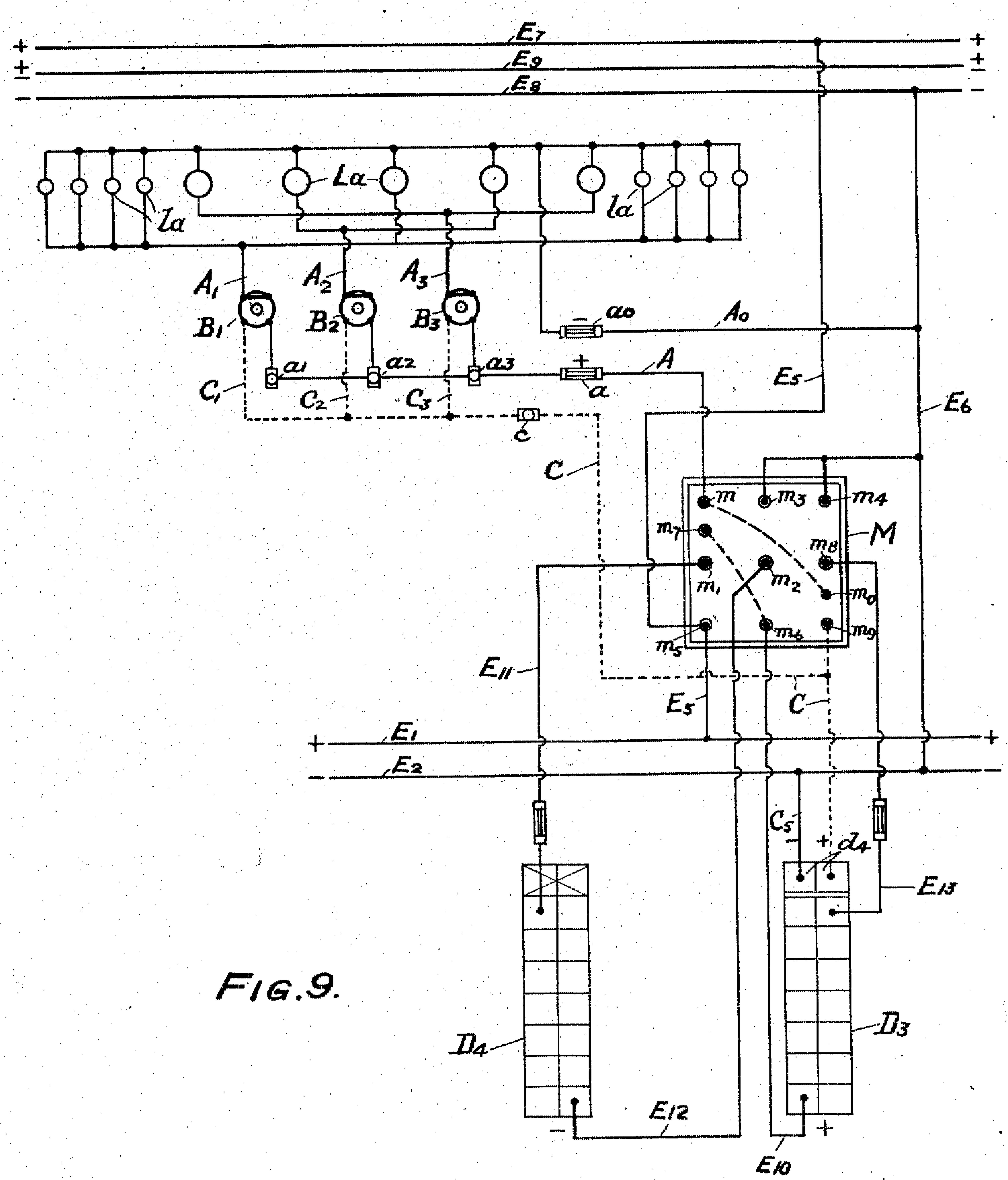

FIG. 9.

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ELECTRIC-LIGHTING SYSTEM.

984,128. Specification of Letters Patent. Patented Feb. 14, 1911.

Application filed February 13, 1909. Serial No. 477,531.

To all whom it may concern:

Be it known that I, ERVIN M. FITZ, a citizen of the United States, residing in the city of Columbus, county of Franklin, and State of Ohio, have invented an Improved Electric-Lighting System.

My invention is an electric lighting system comprising incandescent lamps connected with a source or sources of electric energy by a distribution system or systems which supply high voltage current for the purpose of illumination when the lamps are in service and low voltage current for the purpose of protecting the filaments when the lamps are out of service.

It is a well known fact that the filaments of incandescent lamps, especially the high efficiency types, such as those having tantalum or tungsten filaments, are very fragile and brittle when cold or not in use, and it is well established that such high efficiency lamps, as now used, are readily destroyed by vibration or shock when unlighted, which renders their use unsatisfactory in mills, warehouses, freight houses, railway stations, cars, locomotives and places generally subject to vibrations and jars. Their fragile character and destructibility when cold have prevented the use of electric incandescent lamps, that are economical of current, particularly on locomotives, cars and trains, constantly subject to jars.

A leading object of my invention is to provide for the protection, by simple and inexpensive electrical means, of the fragile high efficiency lamp filaments and render practicable their use for train lighting, with resulting improved quality of light and reduction of cost of operation and maintenance. The use of high efficiency lamps, thus made practicable, requires an expenditure of less electrical energy, thus reducing the initial cost for car lighting purposes under given conditions or increasing the range of operation of a battery of a certain capacity. It also increases the number of cars or batteries that can be changed and cared for at charging stations with a power plant of a certain capacity. A further practical result accomplished is making it possible to electric-light cars in long distance trains which heretofore have been beyond the range of straight-storage lighting systems on account of the incapacity of the batteries for the work.

The electrical maintenance of the lamp filaments at a temperature sufficient to render them tough or ductile and keep them from breaking can be effected by circuits controlled by three-way switches which, respectively, in one position give the corresponding lamps normal current of say 110 volts and $\frac{1}{2}$ ampere or 30 volts and $\frac{1}{4}$ ampere, and in another position give the reduced current required for keeping the filaments hot of say 10 volts and $\frac{1}{5}$ ampere or 2 volts and $\frac{1}{10}$ ampere, it being necessary of course to determine the requisite low voltage and corresponding low amperage necessary to effect the "hot" condition or secure the temperature requisite to maintain the filaments in the desired pliable and tough state. The low voltage for maintaining the filaments "hot" while the lamps are out of service can be secured from either the main or an independent source of supply, as from one or two battery cells either independent or a part of the storage batteries employed for supplying the current when the lamps are in service, or otherwise as by using the low voltage connection on a transformer, or by introducing fixed resistance.

This system has been shown by practical tests under the conditions of actual service to prolong the burning life of the lamps from four to five times the eight hundred hour life usually stipulated by lamp manufacturers. This prolonged life is understood to be due to the elimination of the extreme contraction of the filament which results in a tungsten lamp when the full voltage current is cut off. The coefficient of expansion and contraction of the tungsten filament is comparatively large and hence when, as in the usual operation, the lamp is turned out and the filament becomes cold it is subjected to the extreme conditions which result in its destruction and which conditions are avoided by the present system of maintaining the filament hot, with resulting great saving in renewals and operating expense.

The means employed in providing and distributing current in the practice of my improvements are specified in the accompanying drawings and the following description thereof.

In the drawings, Figure 1 is a diagrammatic representation of an application of my invention comprising three lamp circuits in combination with a storage battery of sixteen cells connected in series for supplying both the high and low voltage; Fig. 2 is a diagrammatic representation of a three point switch suitable for controlling the respective circuits; Fig. 3 is a diagrammatic representation of three lamp circuits in combination with a storage battery for supplying the high voltage and a primary battery for supplying the low voltage; Fig. 4 is a diagrammatic representation of circuits combined with a storage battery having cells charged in series and discharged in parallel, with a constant connection to the low voltage circuit; Fig. 5 is a diagrammatic representation of circuits and storage battery cells connected so that they can be charged in series and discharged in parallel with the low voltage circuit constantly protecting the lamps; Fig. 6 represents a layout in which provision is made for effecting the parallel discharging and series charging the cells, including the source of low voltage current which is in series in one of several circuits during discharging to lamps; Fig. 7 represents a layout in which the storage cells for supplying the high voltage current are independent of the storage cells for supplying the low voltage current when the latter is discharging through the lamps, while the two sets of cells are adapted to be connected in series for charging them; Fig. 8 represents a layout for discharging the cells in series to provide the high voltage current and rendering it impossible to charge while the lamps are burning, with means for supplying the low voltage current to the lamps at all times when the lamp switches are set therefor; and Fig. 9 is a further layout arranged for series charging and parallel discharging with current constantly on the lamps.

The system, in the several forms represented in the drawings, comprises lamp circuits A^1, A^2 and A^3 respectively containing the switches B^1, B^2 and B^3 and the auxiliary circuits C^1, C^2 and C^3 respectively controlled by these switches. The circuits A^1, A^2 and A^3 have the common conductors A and A^0 containing the respective protecting fuses a and a^0 on opposite sides of the lamps L^a and l^a and between the fuse a and the respective switches, for further protection are the fuses a^1, a^2 and a^3, these circuits being designed to carry the current desired for lighting the lamps. The circuits C^1, C^2 and C^3 have the common conductors C containing the fuse c and are designed to carry current sufficient only to heat the lamp filaments sufficiently to keep them tough, as to a cherry color.

The switches B^1, B^2 and B^3 serve to make and break the main circuits and the auxiliary circuits alternately, the conductor b being thrown into contact with the points b^1 and b^2 to make the main circuit and break the auxiliary circuit and into contact with the points b^3 and b^4 to make the auxiliary circuit and break the main circuit.

In the arrangements represented in Figs. 1 and 2, the storage battery sections D^1 and D^2, connected by the conductor D, consist of sixteen cells in series, representing thirty-two volts. The cells are charged by means of the positive conductor E^1 and negative conductor E^2 through the respective conductors E^3 and E^4 containing the protecting fuses e^3 and e^4. The charging lines E^1 and E^2 are connected by the respective conductors E^5 and E^6 with the positive train line conductor E^7 and the negative train line conductor E^8, the train lines having the return wire E^9. The conductors E^5 and E^6 are connected respectively with the conductors A and A^0 through which the entire voltage of the batteries is carried to light the lamps, when the switches close the main circuits and open the auxiliary circuits.

In Fig. 1, the auxiliary circuits have the conductor C connected with the battery so that two cells will supply current to the lamps so that four bolts pass therethrough and return by the conductors E^6 and E^4 when the switches are in position to close the auxiliary circuits and open the main circuits.

In Fig. 3, the conductor C is tapped onto the conductor E^6 and contains the two primary cells F which provide the current for the auxiliary circuit in lieu of the two cells of the storage battery as in Fig. 1.

In Fig. 4, a switch G has the point g connected with the conductor A, the point g^1 connected with the conductor E^5 joining the lines E^1 and E^7, the point g^2 connected with the conductor E^6 joining the lines E^2 and E^8 and connected with the conductor A^0, the points g^3 and g^4 connected with the conductor E^{10} which is connected with the sixteen cell battery section D^3, and the point g^5 connected with the conductor E^{11} which is connected with the sixteen cell battery section D^4; the battery section D^3 being connected through the conductor E^3 containing the fuse e^3 with the conductor E^1 and the battery section D^4 being connected through the conductor E^4 containing the fuse e^4 with the conductor E^2. The switch G has its points g^4 and g^5 connected when it is desired to charge the battery sections, upon which the latter are connected and charged in series through their connections with the wires E^1 and E^2. During charging, with their switch connections closed, the auxiliary circuits receive current by the conductor C from two cells d of the battery section D^4, the return being effected through the conductors A^0, E^6, E^2 and E^4. When the switch G has connected the point g^5 with the points g^1 and g and the point g^3 with the point g^2, the battery sections discharge in parallel to the conductor A through their respective connections E^3, E^1 and E^5 from the section D^3, and E^{11} from the section D^4; the return from the conductor A^0 being effected through the conductor E^6 which is connected by the conductor E^{10} with the battery section D^3 and by the conductors E^2 and E^4 with the battery section D^4. It will be observed that the operations of the switch G do not affect the auxiliary circuits which are supplied independently when the lamp switches are in the off position.

In Fig. 5, a switch H has the point h connected with the main conductor A, the points h^1 and h^2 connected with the conductor E^5 which joins the conductor E^1 with the conductor E^7, the point h^3 connected with the conductor E^6 which is connected with the main conductor A^0 and connects the conductors E^2 and E^8, the points h^4 and h^5 connected with the conductor E^{10} which is connected with the sixteen cell battery section D^3, the point h^6 connected with the conductor E^{11} which is connected with the sixteen cell battery section D^4, and the point h^7 which is connected by the conductor C^7 with the auxiliary circuit conductor C which is tapped onto two cells of the battery section D^4. It will be seen that in this layout the low voltage or auxiliary circuits will always protect the lamps. When the switch H is in such position that the point h is connected with the point h^7 and the point h^6 is connected with the point h^5, for charging the battery, the sections thereof are charged in series through the conductor E^1, conductor E^3 containing the fuse e^3, section D^3, conductor E^{10}, connected points h^5 and h^6, conductor E^{11}, section D^4, conductor E^4 containing the fuse e^4, and conductor E^2. Simultaneously current is supplied from two cells d to the conductors C and C^7 whereby low voltage is supplied to the lamps regardless of the positions of their switches. When the switch H is in such position that the point h is connected with the point h^1, the point h^6 connected with the point h^2 and the point h^4 connected with the point h^3, the battery sections will discharge in parallel to the main lamp circuit conductor A, with which the section D^3 is connected by the conductors E^3, E^1, E^5 and connected points h^1 and h and the section D^4 by the conductor E^{11}, connected points h^6 and h^2, connected points h^2 and h^1, and connected points h^1 and h; the return from the conductor A^0 being by way of the conductor E^6, connected points h^3 and h^4, and conductor E^{10} to the section D^3 and by way of the conductors E^6, E^2 and E^4 to the section D^4.

In Fig. 6, the switch I has the point i connected with the lamp circuit conductor A, the points i^1 and i^2 connected with the conductor E^5 which connects the conductor E^1 with the conductor E^7, the point i^3 connected with the conductor E^6 which connects the conductor E^2 with the conductor E^8 and is connected with the conductor A^0, the points i^4 and i^5 connected by the conductor E^{10} with the sixteen cell battery section D^3. Two cells d^4 are connected in the auxiliary circuits comprising the conductors C, C^1, C^2, C^3, C^0 and A^0, the two latter being tapped onto the return conductor E^6 which is connected through the conductors E^2 and C^4 with the two cells forming the low voltage battery section. When the switch I is in position to connect the points i^5 and i^6, the battery sections will be connected in series and in charging current flows from the conductor E^1 through conductor E^3 containing the fuse e^3, section D^3, conductor E^{10}, points i^5 and i^6, conductor E^{11}, section D^4, and conductor E^4 containing the fuse e^4 to the conductor E^2. When the switch I is in such position that the points i and i^1, i^6 and i^2, i^4 and i^3 are respectively connected, the battery sections are connected in parallel with the conductor A of the lamp circuits, upon which the section D^3 discharges through the conductors E^3, E^1, E^5 and the connected points i^1 and i and the section D^4 discharges through the conductor E^{11}, connected points i^6 and i^2, conductor E^5 and connected points i^1 and i; the return from the conductor A^0 taking place through the conductors E^6, connected points i^3 and i^4 and conductor E^{10} to the section D^3 and through the conductors E^6, E^2 and E^4 to the section D^4. While the lamps l^a are burning, return current from the conductor E^2 is carried by the conductor C^4 to and charges the cells d^4. When the lamp switches are turned off the cells d^4 discharge current through the conductor C and the circuits C^1, C^2 and C^3, the return being from the conductors A^0 and C^0 as described.

In Fig. 7, the switch J has the point j connected with the conductor A, the point j^1 connected with the conductor E^{11} which is connected with the battery section D^4, the point j^2 connected with the conductor E^5 which connects the battery section D^3 through the conductors E^1 and E^3 with the conductor E^7, the point j^3 connected by the conductor E^{10} with the battery section D^3, the point j^4 connected with the conductor E^6 which connects the conductors E^2 and E^8, the point j^5 which is connected by the conductor E^{12} through the fuse e^{12} with the battery section D^4, the point j^6 which is connected with the conductor E^6, the point j^7 which is connected with the conductor E^{11}, and the points j^8 and j^9 connected with the conductor C^8 which is tapped onto the auxiliary conductor C, the latter being connected with two cells d^4 which are connected by a conductor C^5 with the conductor E^2. When discharging low voltage to the auxiliary circuits these cells d^4 are independent of the main cells of the section D^4 when the switch is in position to pass high voltage current to the lamps. When the switch J is in position to break the high voltage current to the lamps, the cells d^4 are thrown into series and charged with the main cells of the section D^4. When the lamp switches are on and the lamps are burning, these cells d^4 will not discharge. Hence the source of energy for the auxiliary circuits will have an extended capacity. That is to say, when the switch J is in such position as to connect the respective points j and j^8, j^3 and j^7, j^5 and j^9, current from the conductor E^1 will flow through the conductor E^3, battery section D^3, conductor E^{10}, connected points j^3 and j^7, conductor E^{11}, main battery section D^4, conductor E^{12}, connected points j^5 and j^9, conductors C^8 and C, cells d^4, and conductor C^5 to the conductor E^2; and when the switch J is in such position as to connect the respective points j and j^1 and j^2, j^3 and j^4, j^5 and j^6, the main conductor A will receive current from the battery section D^3 through the conductors E^3, E^1, E^5 and the connected points j^2 and j and from the main cells of the battery section D^4 through the conductor E^{11} and connected points j^1 and j; the return from the conductors A^0 and E^6 being by way of the connected points j^4 and j^3 through the conductor E^{10} to the section D^3 and by way of the connected points j^6 and j^5 through the conductor E^{12} to the main cells of the battery section D^4.

In Fig. 8, the switch K has the point k connected with the main conductor A, the point k^1 connected with the conductor E^5 connected through the conductors E^1 and E^3 with the battery section D^3, the point k^2 connected with the conductor A^0 which is connected with the low voltage cells d^4, the point k^3 connected with the conductor E^{13} which is connected with the main cells of the section D^4, the point k^4 connected with the conductor E^{13}, the point k^5 connected with the conductor C which is connected with the cells d^4 and the point k^6 connected with the conductor E^6 joining the conductors E^2 and E^8. The battery sections D^3 and D^4, connected by the conductor D, are charged and discharged in series. When the main sections of the battery are discharging through the lamps, the cells d^4 are cut out of series therewith and at the same time the cells d^4 are connected up with the auxiliary circuits so that by operating the lamp switches B^1, B^2 and B^3 either the normal or low voltage current can be passed through the lamps. When the battery is charging, being cut off from the high or normal voltage lamp circuits, the low voltage circuits receive discharge from the low voltage cells d^4. Hence the lamps are protected under all conditions. That is to say, when the switch K is in such position that the respective points k and k^4 and k^5, k^2 and k^6 are connected, current from the conductor E^1 flows through the conductor E^3, section D^3, conductor D, section D^4, conductor E^{13}, connected points k^4 and k^5, conductor C, cells d^4, conductor A^0, connected points k^2 and k^6, and conductor E^6 connected with the point k^6 and with the conductor E^2. At the same time, low voltage current flows through the conductors A or C to the lamps, depending upon the position of the lamp switches. When the switch K is in such position that the point k is connected with the point k^1 and the point k^2 is connected with the point k^3, the battery sections D^3 and D^4 discharge through the conductors E^3, E^1, E^5, points k^1 and k to the conductor A, while the return from the conductor A^0 is through the points k^2 and k' and the conductor E^{13}. At the same time, the cells d^4 are connected so that when the lamp switches throw the normal current off, the low voltage current is carried by way of the conductor C to the lamps, the return being by way of the conductor A^0.

In the arrangement shown in Fig. 9, for charging the switch M has connected its points m^1 and m^5, m^2 and m^6, m^8 and m^0 and m^9, whereupon current flows from the conductor E^1 through the conductor E^5, connected points m^5 and m^1, conductor E^{11}, battery section D^4, conductor E^{12}, connected points m^2 and m^6, conductor E^{10}, battery section D^3, conductor E^{13}, connected points m^8 and m^0 and m^9, conductor C, cells d^4 and conductor C^5 to conductor E^2. Simultaneously part of the current flows from the point m^0 by way of the point m through the conductor A or from the point m^9 by way of the conductor C through the switches B^1, B^2 and B^3 and the lamps L^a and l^a, returning through the conductors A^0 and E^6 to the conductor E^2. For discharging, the switch M has connected its points m^1 and m^7 and m, m^2 and m^3, m^8 and m^4. With the lights on current now flows from the battery section D^4 through the conductor E^{11}, connected points m^1 and m^7 and m to the conductor A and from the battery section D^3 through the conductor E^{10} and the connected points m^6 and m^7 and m to the conductor A, thence through the switches B^1, B^2 and B^3 and the lamps L^a and l^a, returning by the conductors A^0 and E^6, connected points m^4 and m^8 and conductor E^{13} to battery section D^3 and connected points m^3 and m^2 and conductor E^{12} to battery section D^4. With the lights off, the low voltage current flows from the cells d^4 through the conductor C, switches B^1, B^2 and B^3, and lamps L^a and l^a, returning by the conductors A^0 and E^6, to cells d^4.

Having described my invention, I claim:

1. In an electric lighting system, a source of electric energy, a circuit connected therewith and containing an incandescent lamp having a filament brittle when cold and tough when heated, and means whereby a lighting current and alternately therewith

a heating current insufficient for producing incandescence are passed through said lamp, for the purpose specified.

2. In an electric lighting system, battery cells, connected therewith a circuit containing a high efficiency incandescent lamp having a filament brittle when cold and tough when heated, and means whereby normal voltage current for lighting and lower voltage current, insufficient for lighting, are maintained alternately on said lamp, said means comprising a main circuit, an auxiliary circuit, and a switch closing and opening said circuits alternately.

3. In an electric lighting system, a circuit containing an incandescent lamp, and means whereby a normal voltage lighting current and a lower voltage heating current are passed alternately through said lamp, said means comprising battery cells and connections for placing different numbers of said cells in circuit with said lamp to supply said different voltages therefor.

4. In an electric lighting system, storage battery cells, a lamp, a main circuit containing switching mechanism for connecting said cells with said lamp and supplying a lighting current therefor, and an auxiliary circuit controlled by said switching mechanism for connecting a part of said cells with said lamp and supplying thereto a heating current, insufficient for lighting.

5. In an electric lighting system, a main circuit containing an incandescent lamp having a filament brittle when cold and tough when hot, an auxiliary circuit, switching mechanism for connecting said lamp in said main and auxiliary circuits alternately, battery cells for supplying a lighting current to said main circuit, and battery cells for supplying a lower voltage heating current to said auxiliary circuit.

6. In an electric lighting system, storage battery cells, a lamp, a main circuit containing switching mechanism for connecting said cells with said lamp and supplying a lighting current therefor, an auxiliary circuit controlled by said switching mechanism, a circuit for charging said cells, and switching mechanism whereby said charging circuit is connected with said main circuit.

7. In an electric lighting system, a main circuit, an auxiliary circuit, a switch adapted for interrupting said circuits alternately, a lamp or lamps, and means for supplying a lighting current and a lower heating current to said lamp or lamps by said main and auxiliary circuits respectively in different positions of said switch.

8. In an electric lighting system, storage battery cells, charging and discharging circuits for said cells, switch mechanism whereby said cells are charged in series and discharged in parallel, a lamp or lamps adapted to be lighted by said discharging circuit, an auxiliary circuit, battery cells adapted for discharging a heating current through said auxiliary circuit, and switch mechanism for alternately making and breaking said first named discharging circuit and said auxiliary circuit, whereby said lamp or lamps are supplied with either said lighting or said heating current.

In witness whereof I have hereunto set my name this 8″ day of February, 1909, in the presence of the subscribing witnesses.

ERVIN M. FITZ.

Witnesses:

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BERTHA M. CARROLL.