D. R. LOVEJOY.

CONSTANT POTENTIAL ELECTRICAL SYSTEM.

APPLICATION FILED MAY 7, 1910.

1,008,482.

Patented Nov. 14, 1911.

FIG.1.

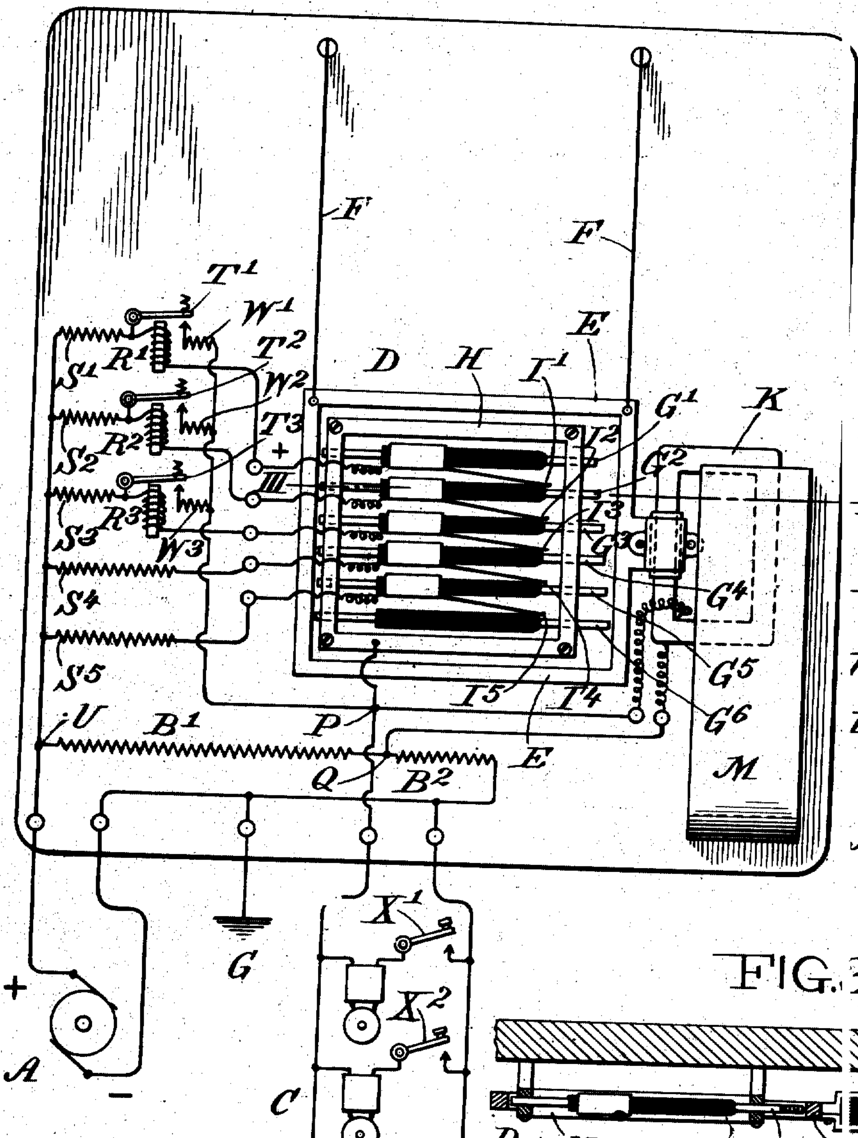


FIG.2.

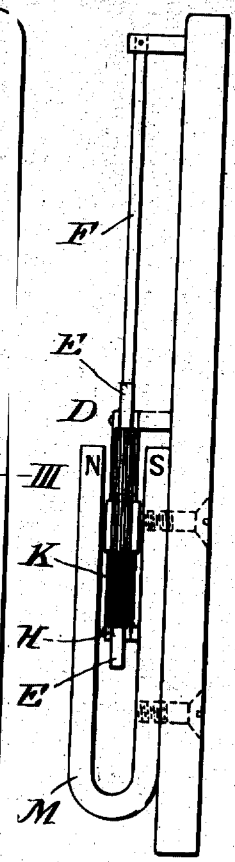


FIG.3.

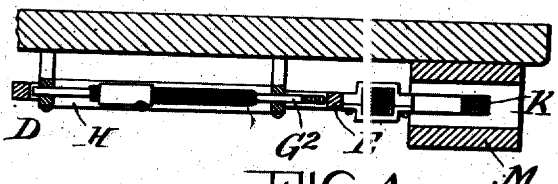


FIG.4.

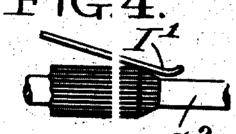
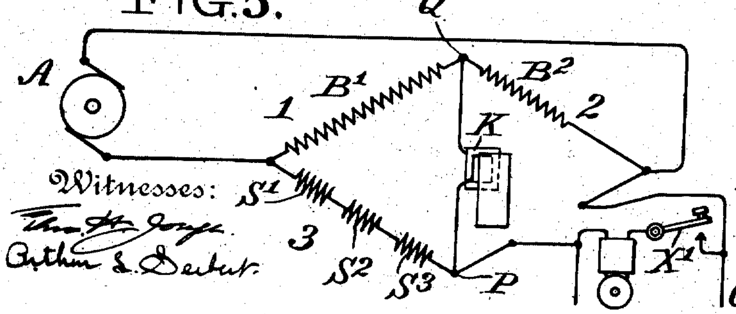


FIG.5.



Witnesses:

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CONSTANT-POTENTIAL ELECTRICAL SYSTEM.

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To all whom it may concern:

Be it known that I, DIMMITT ROSS LOVEJOY, a citizen of the United States, residing at Freneau, in the county of Monmouth and State of New Jersey, have invented certain new and useful Improvements in Constant-Potential Electrical Systems, of which the following is a specification.

My invention relates to constant potential systems for low voltage, and its object is to secure a substantially constant voltage supply of low potential current for use in operating telephones, bells, signaling systems, etc., utilizing as a primary source of energy a relatively high voltage circuit such as the incandescent lighting supply of the house, and at the same time to provide that the higher voltage of the source can never be impressed upon the low voltage apparatus and wiring, either on open or closed circuit condition of the latter.

I am aware that attempts have been made heretofore to utilize electric lighting current for the above purposes, using resistances in series to cut down the voltage, but this is dangerous because the voltage is cut down only at the time current is flowing and, when the circuit is broken, as at the contacts of a vibrating bell, the full voltage acts to cause severe arcing at these points, burning them out rapidly and furthermore, when no current is flowing, the full voltage of the lighting system is impressed upon the bell wiring, causing a dangerous fire hazard and much trouble from leaks, grounds, crosses, etc., on account of the usual poor quality of such wiring.

My invention provides means whereby the electric lighting service may be utilized as a source of current, while providing also that the high voltage can in no case be impressed upon the low potential wiring and apparatus, thereby obviating the above mentioned difficulties.

In the drawings, Figure 1, shows the practical arrangement of circuits set forth diagrammatically in Fig. 5, and also the details of the means whereby the pilot coil K is adapted to vary the resistance of arm 3 of the network so as to produce a balance. Fig. 2, is an end elevation of Fig. 1. Fig. 3, is a sectional view taken along the line III, III of Fig. 1. Fig. 4, is a detail of a contact on an enlarged scale. Fig. 5 is a diagrammatic view of the circuits which are shown in practical arrangement in Fig. 1.

I accomplish the objects of my invention as hereinafter set forth, and on the principle of the network of conductors, or Wheatstone bridge, as shown diagrammatically in Fig. 5, the ratio arms B^1 and B^2 of the bridge being high resistances proportioned to each other as the ratio of the high voltage minus the low voltage to the low voltage. The third arm of the bridge comprises variable resistances S^1, S^2, S^3, etc., and the fourth arm being the system of low voltage wiring and apparatus. The balance arm, between the points P and Q, includes a pilot coil K, this coil being adapted by means of suitable switching mechanism such as shown in Fig. 1, automatically to vary the resistance of the third arm proportionally to the variations that may occur in the fourth arm C, incidental to its use in signaling, etc., so as always to produce a balance and a drop of potential in this fourth arm equal to that in the second arm, this drop in the second arm being permanently fixed by the ratio of arm 2 to arm 1, thereby securing that a constant potential shall be impressed upon the low voltage system C, either on open or closed circuit condition of the same and regardless of the resistance variations thereof and at all current strengths therein within the limits of the capacity of the device.

In all the figures, A represents the source of high voltage current supply, as the 110 volt lighting service

B^1 and B^2 are respectively arms 1 and 2 of the bridge or network, the ratio of these fixing what voltage shall be impressed upon the working circuits C comprising arm 4 of the bridge. If this voltage is to be say 10 volts, then B^1 may be 2000 ohms and B^2 will then be 200 ohms, these being in the ratio of 100 volts to 10.

D, represents the switching mechanism to be further described in detail and by which the pilot coil K is enabled to vary the resistance of arm 3.

R^1, R^2, and R^3, are relays.

M, is a permanent magnet, and S^1, to S^5 are resistances of progressively increasing value and forming arm 3 of the network. These may be in series as shown in Fig. 5, or in parallel as shown in Fig. 1, the connections being suitably arranged for either grouping in the manner well known in the art.

W^1 to W^5 are small resistances connected in series with the contacts T^1 to T^5 of the relays to prevent complete short circuiting of the coils of their respective relays by the closing of their own contacts.

The switching mechanism D, comprises a framework E, suspended by strips F, F, or otherwise mounted so as to be freely movable from left to right and vice versa. Attached thereto and insulated therefrom is a flat coil K, adapted to play in the field of the magnet M.

G^1 to G^6, are metallic rods mounted so as to be freely slidable in holes in opposite sides of a metallic supporting frame H, and to make electrical connection therewith, frame H, being fixed to a proper supporting base as shown and itself not movable. The rods are of progressively increasing length as shown in Fig. 1, G^1 being the shortest and G^6 the longest. These rods are covered with insulating material, such as enamel, at their middle portions as shown in Figs. 1 and 4, and all except the lower rod carries a sleeve permanently fastened to the insulating portion thereof and carrying a contact spring adapted to make electrical connection with the next lower rod when the latter is pushed to the left by the frame E striking against its right hand end. These contact springs are lettered I^1 to I^5. Resistances S^1 to S^5 are connected preferably in parallel as shown in Fig. 1, these resistances being of progressively increasing value as before stated, each being of a value one half of the next in order.

S^5 is the highest resistance and S^1 the lowest. When the source A is of 110 volts and it is desired to operate the circuits C at 10 volts, these resistances will be of such value as to cause a drop of voltage of 100 in each, and their values may be for instance $S^5=1000$ ohms, $S^4=500$ ohms, $S^3=250$ ohms, $S^2=125$ ohms, $S^1=62.5$ ohms, and so on when more current is desired. With the above values, when all the resistances are cut in by the switching mechanism D, the total current flowing from source A will be equal to the sum of the currents through each resistance, *i. e.*, $1.6\times.8+.4+.2+.1$ amp. or a total of 3.1 amperes. In the case of the higher resistances 1000 and 500 ohms, the connection is made directly to the contact springs I^5 and I^4 respectively, as the currents are small enough to be safely made and broken at these points but, in the case of the lower resistances, relays are preferably used, R^1 to R^3 as shown, to handle the larger currents. These relays are provided with fine wire windings and are connected as shown to their respective contact springs I^1 to I^3, these contacts being therefore required to handle only the exciting currents of their respective relays. The other connections are as shown in the drawing. A ground is preferably connected at G, it being assumed that the negative side of the electric light system is grounded. The direction of the current in the bridge arm and pilot coil K with respect to the magnetic field M, is such as to produce motion to the left when the resistance of arm 3 is too high, and consequently motion to the right when said resistance is too low to produce a balance of the then condition of arm 4.

The operation of the device is as follows: The frame E is normally in the position shown in Fig. 1, and the springs I^1 to I^5 have their ends bearing on the insulated portions of rods G^2 to G^6 and out of electrical contact therewith. Arm 3 of the bridge is then open circuited and no current flows through it or arm 4. When there is a lowering of resistance of arm 4, as when a push button is pressed, the balance will be disturbed and current will flow from point Q to point P of the network through the balance arm and pilot coil K and thence through system C and back to source A. This current will cause K to move to the left, and the frame E will strike first the right hand end of rod G^6, pushing it also to the left and allowing spring I^5 to make contact therewith. A current of .1 amp. will then flow from A, through resistance S^5 and contact spring I^5 to rod G^6, thence to frame H, thence to point P and to system C and back to the negative side of source A. The effect of this current is to raise the potential of the point P and to tend to diminish the current flowing through the balance arm and coil K. Further motion of K and E to the left next moves rod G^5 to the left and spring I^4 makes contact therewith, allowing .2 ampere to flow through resistance S^4 and be added to the .1 ampere already flowing through S^5, and further raising the potential of the point P and further diminishing the current through coil K. If the system C is now of such resistance as to draw more than .3 ampere, current will still flow from point Q to point P through coil K which, on its further movement to the left, pushes rod G^4 and allows spring I^3 to make contact therewith, thus energizing relay R^3 and closing contacts T^3. This allows .4 ampere to flow through resistance S^3 to contact T^3, resistance W^3, point P, to system C, and further raises the potential of point P and further diminishes the current through coil K. If the demand of system C is for precisely .7 ampere, the current is now all supplied from A through resistances S^5, S^4, and S^3 in parallel, and the point P will be raised to the same potential as the point Q and the current through coil K will be completely stopped and the switching mechanism will come to rest. If system C wanted still more current, balance would not yet be reached and current would still flow from point Q through K and, on its further movement to the left, rods G^3 and G^2 would be pushed to the left, adding .8 ampere and then 1.6 amperes to the current already flowing through C from A. The potential of point P would continue to rise and the current through K to diminish until a point of balance was reached, at which point source A would supply all the current to system C through arm 3 and none would flow from point Q. The coil K therefore, carrying no current, would come to rest, and this condition would obtain so long as the demand for current by system C was constant. As soon as this demand diminishes or ceases, the potential of point P would rise above that of point Q and current would flow in a reverse direction through K, causing it to move now to the right and E would strike against the left hand ends of rods G^6 to G^2, commencing with the longest G^6 and then the others in succession, this continuing until all of the springs I^5 to I^1 were slid out of contact with their respective rods and the reversed current through K reduced to zero, this being the normal position shown in Fig. 1.

Let us suppose that the demand for current by C is not such as to be precisely made up by the progressive sums of .1+.2+.3+.8 amperes, etc. For instance, suppose C to be of such a resistance as to require say .6 ampere at the fixed potential of 10 volts. The action will then be as follows: On closing the circuit at C, current will flow from point Q through coil K as before, causing K to move to the left, successively cutting in .1 ampere, then .2 ampere, then .4 etc. This last step being .1 ampere in excess of the required amount, the potential of P rises above that of Q and the current through K will be reversed. K now moves to the right and cuts out the contact I^5, reducing the current from A by .1 ampere, and the remaining .6 ampere being just the required amount, a balance is reached and the coil stops. If the demand had been for .5 ampere, a balance would not yet be reached and coil K would continue to move to the right, cutting out next contact I^4 and reducing the current by .2 ampere more and leaving .4 ampere flowing through resistance S^3. This being too little to supply the demand, the current would again reverse through K, which would again move to the left, cut in contact I^5, and adding .1 ampere, would produce a balance and come to rest. The same effect of left and right motions of K would take place, and rods G^6 to G^2 would be pushed back and forth, always beginning with G^6 and progressing in the same order whether cutting in or out, and a balance would be reached within .1 ampere to meet any demand from .1 ampere to 3.1 amperes, the maximum capacity of the apparatus here shown.

I do not mean to confine myself to the exact construction or details set forth in this specification and drawing. The principles herein set forth may be carried out in other ways.

I claim—

1. In a low potential system, a relatively high potential source of electrical energy, and resistances to control the current flowing therefrom, said resistances forming branches of a network of conductors arranged as a Wheatstone bridge, two of said resistances bearing a fixed ratio to each other and fixing the ratio of the high potential to the said low potential and forming the ratio arms of the said network, one of the said resistances being variable and forming a third arm of the said network, and current using devices of relatively low potential and forming a fourth arm of said network, in combination with a pilot coil included in the bridge arm of said network, said pilot coil being adapted, by means of suitable switching mechanism controlled thereby automatically to control the said variable resistance of the said third arm so as to produce a balance and to impress upon the said current using devices a substantially constant potential.

2. In a low potential system, a relatively high potential source of electrical energy, current using devices of lower potential, and resistances interposed between said source and said devices and adapted to control the voltage impressed on said devices by ohmic drop, said resistances being arranged to form three arms of a network of which the said devices form a fourth arm, two of said resistance arms having a fixed ratio to each other and the third of said resistance arms being adapted to be varied proportionally to the variations of resistance of said devices and so as to maintain a balance, and automatic means for controlling said proportional variations in said third arm and for maintaining said balance.

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Witnesses:
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