P. C. HEWITT.

ELECTRIC CIRCUIT.

APPLICATION FILED JUNE 25, 1913. RENEWED JUNE 10, 1919.

1,328,326. Patented Jan. 20, 1920.

2 SHEETS—SHEET 1.

Fig. 1

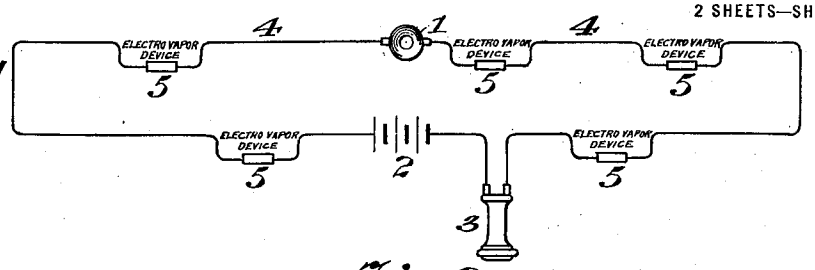


Fig. 2

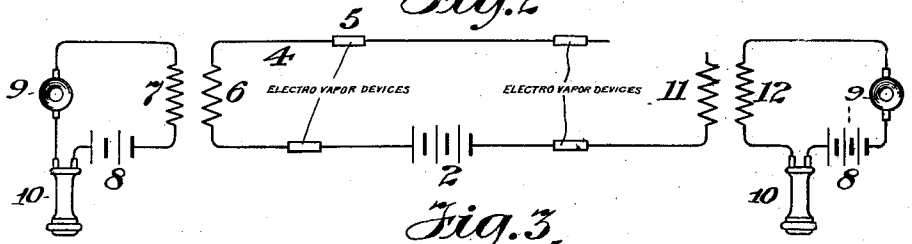


Fig. 3

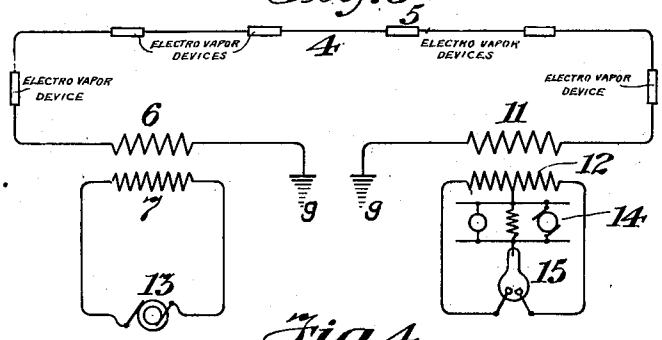


Fig. 4

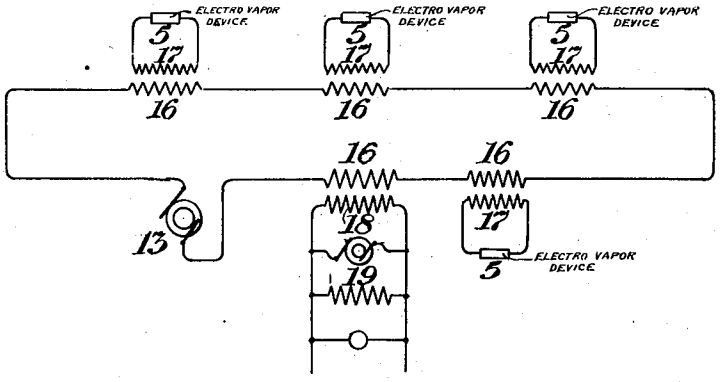
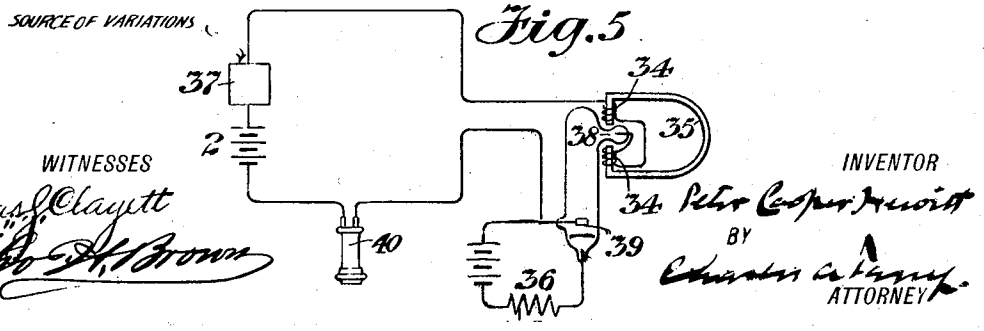


Fig. 5



WITNESSES

Chas. J. Claytt

Thos. H. Brown

INVENTOR

Peter Cooper Hewitt

BY

Charles Colgrove

ATTORNEY.

P. C. HEWITT.

ELECTRIC CIRCUIT.

APPLICATION FILED JUNE 25, 1913. RENEWED JUNE 10, 1919.

1,328,326.

Patented Jan. 20, 1920.

2 SHEETS—SHEET 2.

Fig. 6.

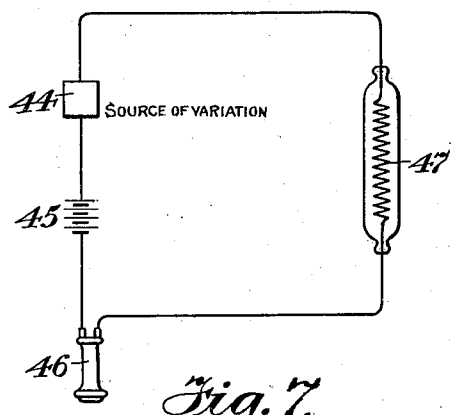
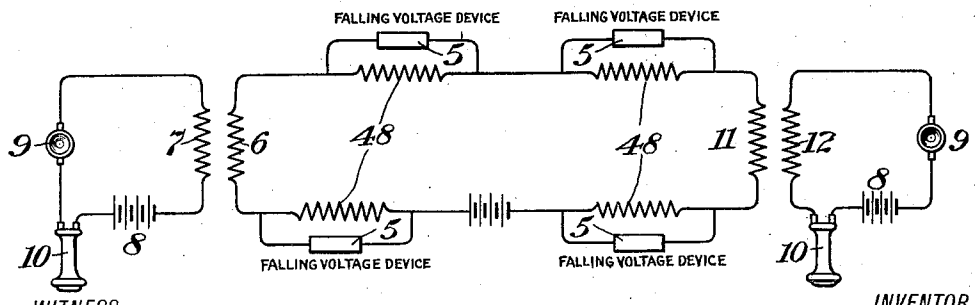


Fig. 7.



WITNESS

Chas. L. Clagett

H. D. Brown

INVENTOR

Peter Cooper Hewitt.

BY

Chandler & Fairy.

ATTORNEY

UNITED STATES PATENT OFFICE.

PETER COOPER HEWITT, OF RINGWOOD MANOR, NEW JERSEY.

ELECTRIC CIRCUIT.

1,328,326. Specification of Letters Patent. Patented Jan. 20, 1920.

Application filed June 25, 1913, Serial No. 775,632. Renewed June 10, 1919. Serial No. 303,251.

To all whom it may concern:

Be it known that I, PETER COOPER HEWITT, a citizen of the United States, and resident of Ringwood Manor, county of Passaic, State of New Jersey, have invented certain new and useful Improvements in Electric Circuits, of which the following is a specification.

An electric current traversing an ordinary electric circuit tends to vary proportionately with variations of the impressed electro-motive-force. Variations in energy produce variations in impedance, and the greater and more rapid the variations, the greater becomes the impedance effect.

In many classes of circuits it is desirable to modify, minimize or avoid such impedance or its effect, as, for instance, in telephone circuits and long lines.

Various means have been devised in an attempt to neutralize, overcome or do away with impedance. The methods and apparatus heretofore devised for such purpose have dealt, with a condition where the current flow varies directly with the electro-motive-force or applied difference of potential.

My invention is based upon the discovery that a composite circuit may be constructed in which the current flow is not in proportion to the applied electro-motive-force, (as it is in an all-metallic conductor) and in which the resistance of a portion of the composite circuit varies in inverse order to the energy absorbed by impedance. As a result it is possible to produce a circuit wherein the current flow is not directly proportional to the voltage, and the voltage drop varies less or more than would be the case for the same current variations over the ordinary metallic circuit, and the ratio of energy dissipated is not the same as in such metallic circuit.

The invention contemplates a composite electrical circuit consisting of members in certain of which the resistance tends to remain constant and is so under normal conditions, the current flow tending to vary directly with the impressed electro-motive-force, and another member or members electrically connected therewith wherein the resistance tends to be variable under the influence of difference of energy transmitted and the current passed is not proportional to the voltage. In one member the resistance tends to be constant and the voltage variable with varying current; in the other the resistance is variable.

The energy dissipating ability of one member is that of a true conductor, while the energy dissipating ability of another member follows a different law.

In an electrical system variation of energy dissipation is a function of varying resistance, varying voltage or varying current or any of them.

It follows from this that given a circuit in which the resistance can be varied in some ratio with respect to varying energy, it becomes possible to produce a circuit in which impedance effects such as the inductance and the capacity effects may be given other relative values for carrying energy than those of an ordinary circuit consisting simply of a true conductor.

My invention provides for such modification of the characteristics of a circuit by inserting at intervals resistance paths which have the quality of varying in resistance when transmitting variations of energy. I am able to do this by utilizing the electrical characteristics of certain bodies such, for instance, as a conducting gas or vapor as a part of the electrical circuit. When the means consists of a conducting vapor, it may be held in an air-tight container constructed to secure the essential requirements of gas purity and proper gas or vapor density, and it may be rarefied as required to be adapted to particular uses to which it is to be placed and be modified as to size and shape, and the gas contained as well as have its normal action modified by magnetic and by electrostatic action by the electric energy of the circuit, or be influenced by another circuit.

In certain cases this special conductor may be contained in an independent circuit inductively, electrically or electro-magnetically associated with the principal circuit as, for instance, by means of a transformer, the main circuit being the primary and the special conductor being included in the secondary circuit. In other cases, it may be used directly in the main circuit and connected around an impedance device in the line, or it may be located directly in the main line and form a part thereof.

In the accompanying drawings, Figure 1 shows a telephone circuit having capacity, inductance, resistance, a source of energy, and vapor devices; Fig. 2 is the same as Fig. 1 except that the telephone variations are

impressed upon the line inductively; Fig. 3 is a power transmission line; Fig. 4 is a modification of Fig. 3; Fig. 5 illustrates a simple embodiment of the invention herein described and claimed; Fig. 6 shows a hot wire in place of the gas or vapor device, or rather a device having a falling voltage characteristic appearing in the other figures of the drawing; and Fig. 7 illustrates a modification.

Referring to Fig. 1, 1 represents a telephone transmitter or other suitable means for varying the currents derived from a battery 2, or other suitable source of currents. 3 represents a receiving device such as a telephone receiver, or other apparatus, operated by the transmitted currents. The circuit connections between the device 1, and the device 3, comprise sections, 4, and sections, 5. The sections 4, are ordinary metallic conductors or what may be conveniently termed true conductors. The sections 5, include the vapor devices in which the resistance tends to be variable under the influence of different amounts of energy transmitted, and wherein the current passed is not proportional to the voltage, as hereinbefore described.

In Fig. 2, a source of current is represented at, 2, connected in the circuit, 4, 5. 6 represents the secondary of an induction coil, the primary of which is connected through a source of current, 8, with a telephone transmitter or other current varying device, 9, and a receiving device, 10. At some other portion of the circuit a similar transforming device having its primary, 11, connected in the circuit, 4, 5, and its secondary, 12, connected in a circuit containing another current-varying device, 9, and source, 8, and receiving device, 10, are shown.

In Fig. 3, the circuit, 4, 5, is shown as being grounded at *g*, *g*, the earth forming a portion of the return conductor. In this circuit, transformers 6, 7, and 11, 12, are shown. In connection with the primary, 7, there is shown a source, 13, of alternating or varying currents. The transformer, 11, 12, has its secondary connected at an intermediate point with one side of a consumption circuit, 14, containing any desired devices, the other side of the consumption circuit being connected with one terminal of one electrode of a vapor device, 15, two terminals thereof being connected, respectively, with conductors leading to the respective terminals of the coil, 12.

In Fig. 4, the source, 13, is shown as being connected through primary coils, 16, the secondary coils, 17, of which are connected through circuits containing vapor devices, 5, whose resistance varies in the manner above described. An additional primary, 16, is shown, having a secondary, 18, the terminals of which are connected through devices, 19, of any desired character, as shown.

In Fig. 5, there is shown a source, 2, of electric currents and a device, 37, for producing variations therein. A conductor from the device, 37, leads through two coils, 34, upon the poles or projections of the poles of a magnet, 35, which varies the voltage drop over the device, which poles are presented to an extension, 38, of the vapor device containing an electrode with which the coil, 34, is connected. An electrode, 39, is connected with the return conductor of the first circuit through a receiving device, 40, affected by variations of current. A keep-alive circuit, 36, of any convenient arrangement is also shown.

In Fig. 6 a typical circuit is shown in which is included a source of variation 44, a source of current 45, a receiver 46, and a device comprising in this instance an inclosed material, 47, the resistance of which has a falling electromotive characteristic. Fig. 7 shows several of the falling voltage devices 5 connected in series in a closed circuit, but each shunted by a resistance or reactance device 48. A transmitter 9, receiver 10 and battery 8 are connected through a coil 7 in inductive relation to a coil 6 in the first named closed circuit. At a distant point a coil 11 is included in this circuit, and this is in inductive relation to a coil 12 connected in series with a receiver 10, a source of current 8 and a transmitter 9.

From the various figures of the drawings it will be apparent from the description of the specification, that the possibilities of the application of the invention are extremely varied, but such variations all rest upon the fundamental device herein described.

On consideration of Ohm's equation in connection with the present system, it must be borne in mind that the resistance of the special conductor differs from that of the ordinary metallic conductor in that it may not remain constant with variations of energy so that any or all of the three members in the equation $C=\frac{V}{R}$ may become a variable, and as a result any selected one may be made to vary or be a constant within limits while any two may vary in different degrees with respect to each other. Owing to these possibilities the energy radiated or dissipated from a portion of the circuit may be given many values within wide limits.

It will be understood that in the equation $C=\frac{V}{R}$, the character C represents current strength, V, voltage or electromotive force, and R, resistance.

Thus the characteristices of a circuit consisting essentially of a normal or "true conductor," such as copper, may be modified

by including therein sections having characteristics other than those of such true conductor.

The variable resistance characteristics of certain forms of matter, when passing different amounts of electrical energy, may be modified by means external to it. This is particularly manifest in an attenuated gas or vapor wherein many of the electrical resistance phenomena may be modified by electromagnetic and electrostatic influence, including certain phenomena at the positive end of a conducting vapor or gas. These modifications are more pronounced at low densities. As an illustration, if a magnet be approached near a vapor device passing current, the voltage required to pass unit current will be increased and the voltage required to pass current may diminish as the current increases, and the device may have a falling voltage characteristic. Under these conditions, the voltage required to pass unit current—and, therefore, the apparent resistance—will be increased in some direct proportion as the magnetic effect is increased, and will be decreased in some direct proportion as the current is increased.

If a terminal of a permanent magnet adjacent to the device be surrounded by a coil of wire and be connected in series with the device or be connected in another circuit, in such manner that current passing through the coil will tend to demagnetize the magnet, and lessen its action on the device, the total resistance or opposition to the passage of the current presented by the device will be modified by the passing current by modification of the voltage required to pass current through the device, by modification of the magnetic force by the current, and also by the resistance varying inversely with the current passed. Such variable resistance of the added member is itself essentially most unstable and may require in circuit with it, certain features of impedance presented by a true conductor, and the ratio of the voltage drop over these may be made of such relative value as to produce the required results, and in circuits may be had by suitably positioning the variable resistance devices in the line so that the line presents such impedance.

The effect of the reverse connection of the coil on the magnet is obvious, and the illustration, is sufficent to show how to render useful, in like manner, many of the characteristic local phenomena manifest in different parts of a conducting vapor.

These results are also very serviceable for causing one circuit to act on another for transferring corresponding variations from one circuit to another and giving the variations a different value.

By means of my discovery it is possible to modify or to compensate for the effects of capacity or inductance in a circuit, or both, resulting from energy variations and so modify the impeding effects of these factors in circuits of considerable length; in other words, by adding to the energy consuming ability of a true conducting circuit, resistance of a different value and characteristics and thereby modifying the characteristics tending to produce impedance or impair wave forms.

A characteristic of a vapor device of variable resistance, is that the capacity and inductance effects are of very different order from those which are inherent in a true conductor. I propose using this phenomenon in connection with a true metallic circuit, and this is one feature of the present invention.

I claim as my invention:

1. The combination of a device having a variable resistance, magnetic means external thereto for increasing its resistance and means for utilizing this increased resistance by diminishing the effect of the external means in inverse ratio to the current flow through the resistance.

2. The combination of a device normally having a resistance characteristic other than that of a true conductor, magnetic means for increasing its initial resistance and means for utilizing this additional range of resistance for occasioning a fall of electromotive force in response to an increased flow of current through the resistance.

3. The method of producing and utilizing the falling electromotive characteristic of a conductor which consists in magnetically raising the resistance of the conductor and utilizing the excess of resistance as a field of falling electromotive-force responsive to increased current therethrough.

4. The method of utilizing the falling electromotive-force characteristics of a conductor, which consists in applying thereto a magnetic force serving to increase its initial resistance, varying the resistance by increased current flow through said resistance and coincidently varying the applied force, thereby augmenting the effective falling electromotive force.

5. The combination of an electric circuit, a source of current therein, a conductor having an inherent falling electromotive-force characteristic in said circuit, magnetic means for imparting an additional resistance thereto, and means for varying the effect thereof coincidently and inversely with the variations of the resistance of the conductor.

6. A composite electric circuit comprising a section in which the current flow is approximately proportional to the applied electromotive force, and a section in which the current flow is inversely proportional in some degree to the applied electromotive force, magnetic means for increasing its initial resistance, and means for utilizing

this additional range of resistance for occasioning a fall of electromotive-force in response to an increased flow of current therethrough.

7. In a telephone system, the combination of a transmitting device, a receiving device and a connecting circuit consisting in part of a metallic conductor and in part of a device having a falling voltage characteristic, magnetic means for increasing its initial resistance, and means for utilizing this additional range of resistance for occasioning a fall of electromotive force in response to an increased flow of current therethrough.

8. In an electrical system, a gas or vapor electric device, means for passing current through the same, and means for affecting the device by magnetic force and for causing the said force to be diminished by increased current flow through said device.

9. In an electrical system including a device having a falling voltage characteristic, the method of increasing the falling voltage characteristic, which consists in applying a magnetic force to the device and decreasing the said force by increased current flow through said device.

10. In an electrical system, including a translating device, the method of operation, which consists in increasing by magnetic action the electromotive force required to pass current through the said device and decreasing the required electromotive force in response to an increase of current flow therethrough.

11. In an electrical system, the combination with a translating device, of magnetic means for increasing the electromotive force required to pass current through the device and for decreasing the required electromotive force in response to an increased current flow therethrough.

12. In an electrical system including a device having a falling voltage characteristic, the method of controlling the current flow therein, which consists in affecting the said device by magnetic force and causing the action of the magnetic force to be diminished by increased current flow in said device.

13. In an electrical system including a device having a falling voltage characteristic, the method of increasing the falling voltage characteristic which consists in affecting the device by magnetic force and decreasing the said force by increased current flow through said device.

14. In an electric system including a source of variation, a magnet coil, a permanent magnet around the poles of which the said coil is wound, and a gas or vapor electric device in series with a source of variation and the magnet coil and means for keeping the said device alive, the poles of the permanent magnet being placed in operative proximity to the gas or vapor device.

15. In an electrical system, the method of operation which consists in varying current in the said system, creating magnetic force in the system, causing the said magnetic force to act upon a local path of falling electromotive force, thereby producing a drop of resistance in said local path.

Signed at New York in the county of New York and State of New York this 20th day of June A. D. 1913.

PETER COOPER HEWITT.

Witnesses:

ALEXANDER BEGG,

CHARLES A. TERRY.