

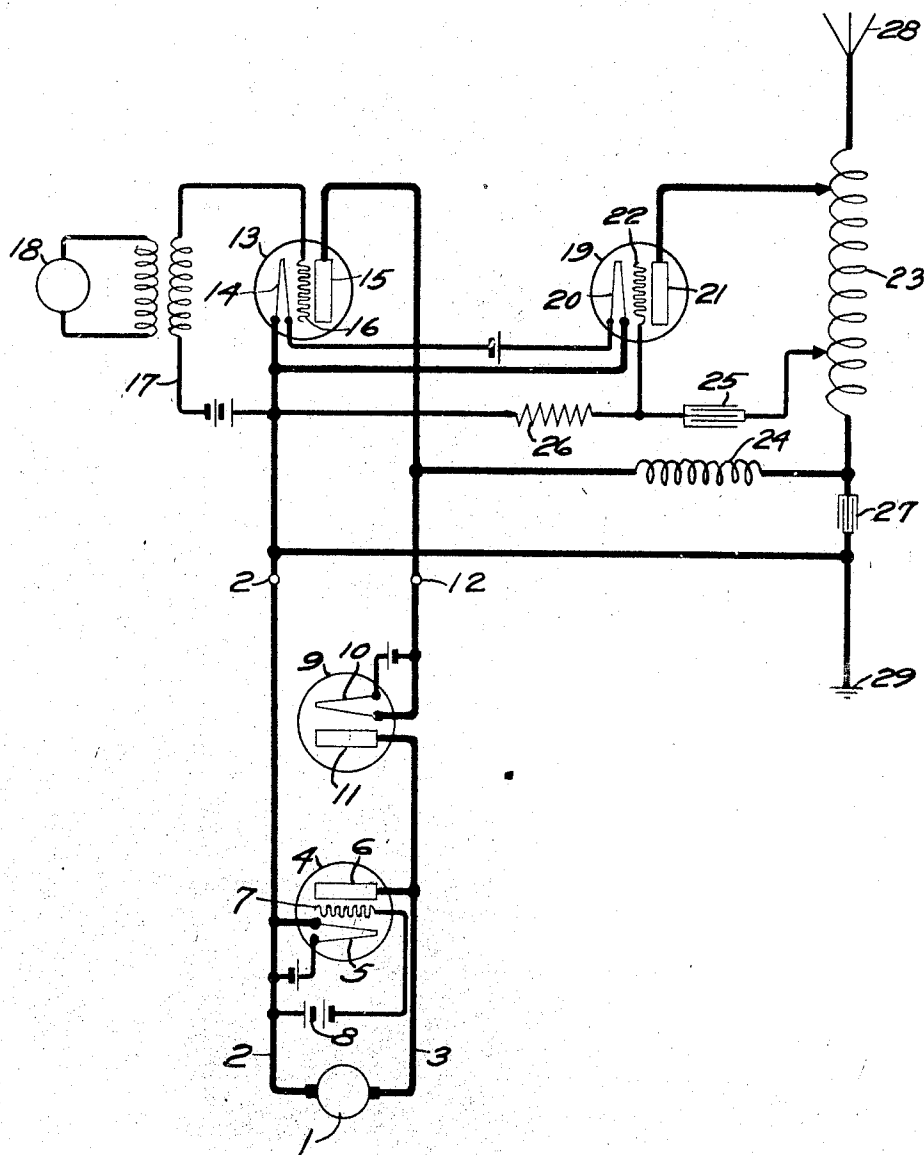
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ELECTRIC CONTROL CIRCUITS

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ELECTRIC CONTROL CIRCUITS.

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To all whom it may concern:

Be it known that I, JOHN MILLS, a citizen of the United States, residing at Wyoming, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Electric Control Circuits, of which the following is a full, clear, concise, and exact description.

This invention relates to regulators of electric current and potential, and more particularly to means for regulating the current and potential derived from a varying source of direct current.

One object of the invention is to suppress variations in a source of direct current.

Another object of the invention is to provide a substitute for the low frequency choke coil in the well-known Heising constant current modulating system.

In accordance with the present invention, variations in the potential derived from a direct current source are diverted from the load by means of a grid control vacuum tube shunted across the source and designed to short-circuit any potential in excess of a fixed constant value. Another vacuum tube connected in series between the source and the load, acts similarly to a choke coil by virtue of the well-known phenomena of saturation which occurs when all of the electrons, ions, or the like, in such a device, are so utilized that increases of potential across the device can produce no further increase in space current. The invention as applied to a constant current modulator presents variations in the source of space current from affecting the signaling circuits, the saturated discharge device taking the place of the low frequency choke coil ordinarily provided to supply constant space current to the modulator.

These and other objects and details of the invention are outlined in the accompanying description taken in connection with the appended drawing and claims.

In the drawing the source of direct current 1 supplies a potential difference to the terminal conductors 2, 3, this potential difference consisting of a component of steady or unvarying potential upon which is superposed a more or less complex component of variable potential, such as a commutator disturbance, a variation in the E. M. F. generated, or a similar variation. The vacuum tube 4 connected to conductors 2,

3, includes a cathode 5 connected to the negative terminal of the source 1, an anode 6 connected to the positive terminal of the source 1, and a control electrode or grid 7. The circuit between the bridge 7 and the cathode 5, includes the battery or other source of potential 8 to provide a negative potential on the grid. In order to dissipate the energy of variations in potential of the source 1, the potential of battery 8 is so adjusted as to render the tube 4 non-conducting between the anode 6 and the cathode 5 to any potential below the steady or unvarying component of potential from the source 1, while conducting to any potential in excess of this steady value. Tube 4 thus absorbs, or short-circuits, variations in excess of said steady potential while serving as an open circuit to potentials below said steady value. Battery 8 may be a source of relatively small energy, inasmuch as no appreciable current is drawn therefrom, and may be of relatively small potential compared with the potential to be controlled in view of the amplifying properties of the vacuum tube.

In series with the conductor 3 is connected the vacuum tube device 9, including a cathode 10 and an anode 11, the temperature of the cathode 10 being so adjusted relatively to the potential between the anode and cathode of the tube that saturation takes place, thus giving rise to a choking effect to current variations similar to that produced by a choke coil. On account of the saturated condition, the tube 9 functions as a non-inductive impedance element, the impedance or resistance of which varies proportionately to the potential applied between the anode and cathode. The tube 9 therefore cooperates with the tube 4 to reduce to a minimum, variations derived from the source 1, while at the same time preventing variations in the load, connected to the source 1 through tube 4, from reaching the source 1.

The amplifier, modulator, or repeating device 13 including the cathode 14, the anode 15, and the grid 16, is supplied with space current from the source 1 over conductors 2 and 12. Coupled to the grid circuit 17 is the source 18 of modulating waves for producing variations in the space current flowing through the repeating tube 13. In parallel with the space current circuit of

repeater tube 13 is connected the space current circuit of the oscillation generator 19 including the cathode 20, the anode 21, and the grid 22. The space current supply circuit of the oscillator 19 may be traced from the conductor 2 through cathode 20, anode 21, inductance 23, high frequency choke coil 24 to conductor 12. The grid 22 may be associated with the space current circuit of the oscillator in any well known manner to produce continuous oscillations. In the form shown, the grid 22 is connected by a circuit through condenser 25 to some point in the inductance 23, while the leak resistance 26 is connected between the grid 22 and the cathode 20. The output circuit of the modulator includes the oscillatory circuit comprising the inductance 23, capacity 27 and the capacity between the antenna 28 and the ground 29.

The vacuum tube 9 takes the place of the low frequency choke coil usually provided in the common space current circuit of the repeater and oscillator tubes.

When modulating waves, such as voice waves, are impressed upon the grid circuit 17, by the modulating source 18, waves are produced in the space current circuit of repeating tube 13 and are reflected from the conductors 2, 12 into the space current circuit of the oscillator 19 by reason of the current limiting action of the tube 9, so that variations in the output energy of the oscillator 19 are produced in accordance with the waves derived from the repeater tube 13 and the source 18. The high frequency choke coil 24 prevents the flow of high frequency energy into the space current circuit of the repeater tube 13. Tube 9 performs the double function of maintaining constant the current supply for the repeater and oscillator tubes 13 and 19 regardless of the frequency of the waves being transmitted, and of reflecting waves from the repeater circuit into the oscillator circuit, while tube 4 absorbs variations from the source 1, and thus prevents these variations from disturbing the current in the repeater 13, or the oscillator 19.

The low frequency choke coil in a constant current modulator is ordinarily considered to be a means for maintaining the current constant, but it is obvious that such a means is unable to suppress low frequency variations in current inasmuch as the choking effect decreases to zero as the frequency of the variations decreases. In other words, if the E. M. F. of the source 1 should for some reason decrease for a brief period in a circuit utilizing a choke coil in place of the tube 9, the output of the generator 19 would appreciably decrease, and thereby produce an undesired disturbance in the transmitted wave. According to this invention, it will be seen that the regulation of current, by the tube

9, is independent of the frequency of variations in the source of E. M. F. 1 or the frequency of the modulating waves from the source 18. For these reasons the tube 9 is as effective at very low frequencies, of the order of a few cycles per second or at any lower frequency, as at very high frequencies, and the use of tube 9 may be of particular advantage at these low frequencies inasmuch as it is impracticable to construct effective choke coils for these frequencies. Where a large or bulky choke coil might be necessary to produce the desired impedance, it will be seen that the tube 9 may be advantageously substituted to reduce the weight and cost of this impedance element.

The tubes 4 and 9 may be used in many other types of circuits than that shown, either in combination as disclosed in the drawing, or separately, the tube 4 being generally adapted to regulate the potential derived from a varying source of current, while the tube 9 is adapted to act as a current regulator and as a means for reflecting waves impressed thereon regardless of their frequency.

The invention has been disclosed in combination with a particular type of circuit merely for convenience, and it is not considered that the invention is limited to the specific form or means shown.

The features of the invention considered novel are particularly pointed out in the appended claims.

What is claimed is:

1. A source of direct current providing a varying and a steady component of potential, and a circuit in shunt thereto including a vacuum tube to conduct current of said varying component while serving as an open circuit to said steady component.

2. A source of current providing a varying and a steady component of potential, and a circuit in shunt thereto, including a vacuum tube to conduct current of said varying component while serving as an open circuit to said steady component, said tube having a control member to control the conductivity of said tube.

3. A source of current providing a varying and a steady component of potential and a circuit in shunt thereto, including a vacuum tube to conduct current of said varying component while serving as an open circuit to said steady component, said tube having a control circuit including a source of potential to control the conductivity of said tube.

4. A source of direct current providing a varying and a steady component of potential, a circuit in shunt thereto including a vacuum tube conductive to current in excess of a predetermined potential, but non-conducting to current below said potential.

5. A source of current providing a vary-

ing and a steady component of potential, and a circuit in shunt thereto including a vacuum tube having an anode, a cathode, and a grid, and means connected between
 5 said cathode and grid to apply a potential to said grid to render said tube non-conducting to current below said steady potential.

6. A source of direct current, a vacuum tube in shunt thereto, to absorb variations
 10 in the potential derived from said source, said tube having means for controlling the degree of said absorption and a vacuum tube in series therewith to impede variations in said potential.

15 7. A source of direct current, a grid controlled tube in shunt thereto, to absorb variations in the potential derived from said source, and a saturated tube in series therewith to impede variations in said potential.

20 8. A source of current, a vacuum tube in shunt thereto, for absorbing variations in the potential derived from said source, said tube having an anode, a cathode, and a grid the potential between said grid and cathode
 25 being less than the potential necessary to produce space current through said tube between said anode and cathode, and a vacuum tube in series with said source to impede said variations in potential.

30 9. A source of current, means in shunt thereto, for absorbing variations in the potential derived from said source, and a device in series with said source having a resistance substantially proportional to the po-
 35 tential applied across said device.

10. A source of current providing a varying and a steady component of potential, a circuit in shunt thereto, including a vacuum tube having an anode, a cathode, and a grid,

and means connected between said cathode 40 and grid to apply a potential to said grid to render said tube non-conducting to current below said steady potential, and a vacuum tube in series with said source of current so adjusted that the resistance of said
 45 tube is substantially proportional to the potential applied across said device.

11. In a constant current modulator, a repeating device and an oscillation generator having a common supply conductor, and
 50 means in said conductor having a resistance substantially proportional to the potential applied across said means.

12. In a constant current modulator, a repeating tube and an oscillating tube having
 55 a common space current circuit, and means in said circuit having a resistance substantially proportional to the potential applied across said means.

13. In a constant current modulator, a repeating tube and an oscillating tube hav-
 60 ing a common space current circuit, and a saturated tube in said common circuit to maintain the current flowing through said circuit substantially constant.

14. A wave suppressing network supplied with waves of varying potential and com-
 65 prising a pair of conductors, a member in shunt, and a member in series therewith, each of said members including a vacuum tube and means associated with one of said
 70 tubes for causing the substantial suppression of said potential waves.

In witness whereof, I hereunto subscribe
 75 my name this 2nd day of November A. D., 1921.

JOHN MILLS.