

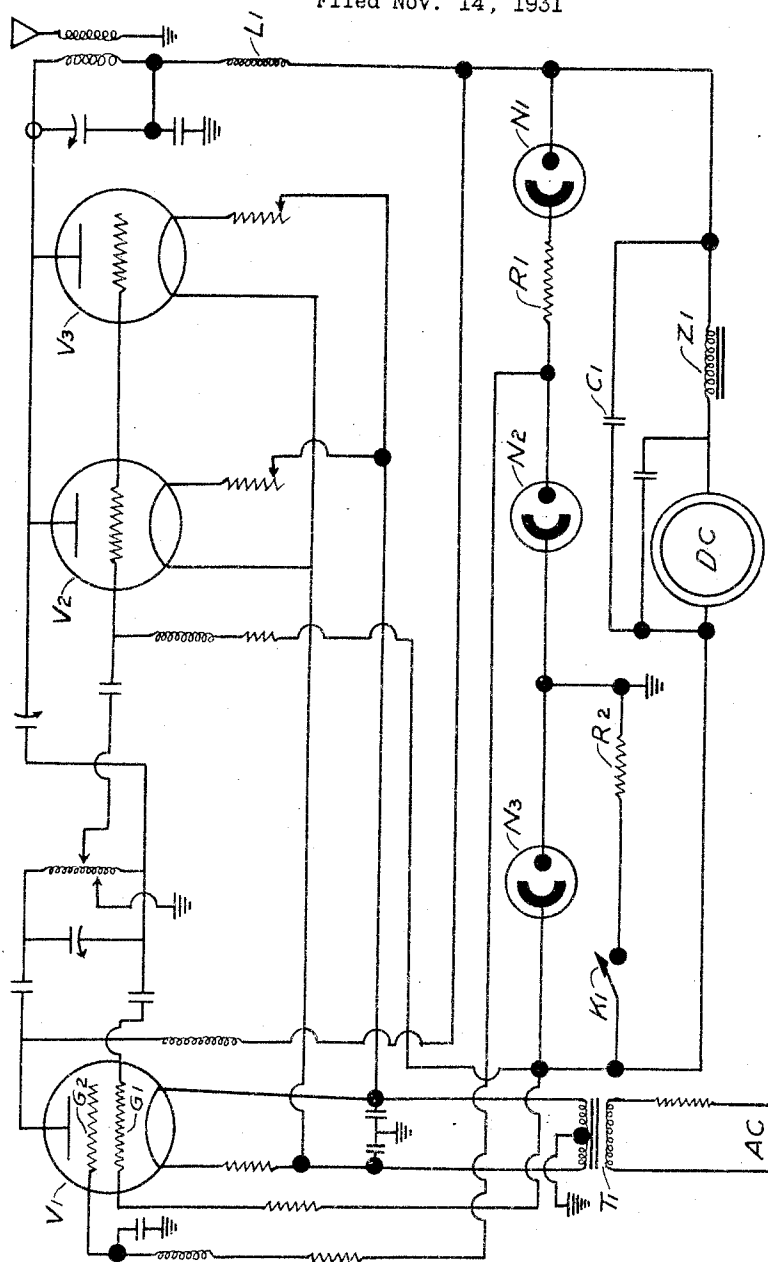
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O. T. FRANCIS

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TRANSMISSION SYSTEM

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INVENTOR

Olin Thomas Francis

UNITED STATES PATENT OFFICE

OLIVER THOMAS FRANCIS, OF MORRISTOWN, MINNESOTA

TRANSMISSION SYSTEM

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This invention relates to vacuum tube generators of high frequency currents and more particularly to means for keying said generators and to means for reducing energy dissipated in potentiometers used in connection therewith.

Vacuum tube transmitters in common use require voltages of various magnitudes for the plate and grid circuits of the various vacuum tubes therein. These voltages are at present supplied either by a plurality of direct current generators, or by a single generator with wire wound voltage divider. A plurality of direct current generators comprises an expensive installation and undue complication of circuit arrangement. Wire wound voltage dividers capable of dissipating the required amount of energy are also expensive, and are subject to overheating unless proper ventilation is provided. As these wire wound voltage dividers become heated their resistance varies due to temperature coefficient, which in turn results in variation in voltage applied to transmitter circuits with consequent variation in frequency of radio wave emitted. These wire wound voltage dividers also draw considerable current whether the key of the transmitter is up or down which constitutes a considerable drain on the direct current generator and is a waste of electrical energy.

A portion of this wire wound voltage divider is normally used in the grid circuit of one or more of the vacuum tubes for the purpose of maintaining desired negative voltage on the grids of said transmitter, the keying device of the transmitter being in parallel with the said portion or a portion of said portion to maintain the transmitter operative only when the key is closed. A condenser and additional resistance is usually required in parallel with said keying device to reduce arcing of the key contacts, with consequent modulation of radio frequency wave emitted by transmitter which produces "key clicks" in nearby receivers.

Some of the objects of this invention are: to reduce arcing of key contacts with resultant generation of damped wave, to make unnecessary the resistance and condenser nor-

mally used in parallel with the key, to reduce the energy dissipated in voltage dividers to a minimum, to effect this dissipation principally in the form of light rather than heat, to maintain voltages impressed on the elements of the vacuum tubes connected thereto at an optimum value.

These and other objects of the invention will appear more fully from the following detailed description and appended claims taken in connection with the accompanying drawing in which:

The figure represents a master oscillator power amplifier vacuum tube transmitter embodying the invention.

Referring to the figure, master oscillator vacuum tube V1 with a control grid G1 and screen grid G2 supplies the excitation voltage for power amplifier tubes V2 and V3. The filaments of these tubes are heated by current furnished by step down transformer T1. Generator DC supplies current for the plate and grid circuits of the transmitter thru filter system Z1. The circuit thus far described is that of the ordinary radio transmitter in common use.

In this circuit the voltage divider N1, R1, N2, N3 has been incorporated in such a manner as to produce the effects noted under the objects of this invention. N1, N2, and N3 are elements which conduct electricity by ionization of gases and may be the ordinary neon lamps, or a group of lamps. The resistance R1, is of such a value as to permit the proper amount of current to be supplied grid G2 when key K1 is closed. Its value is not critical since the voltage impressed on G2 is dependent upon the voltage drop across N2, which in accordance with the well known principles of conductivity of electricity in gases is substantially independent of current flow. As a result of this characteristic of N2 resistance R1 may itself be a variable resistance such as an ordinary carbon resistor, which decreases its resistance as the current passing therethru increases, a group of tungsten lamps, which increase their resistance as the current passing therethru increases, a thermionic vacuum tube which increases its

resistance as saturation is approached, or a vacuum tube having a grid.

The normal anode to cathode voltage drop across the element N3 is of such a value that
 5 when the direct current from generator DC is applied thereto it will render vacuum tubes V1, V2, V3 substantially non-conductive by reason of excessive negative grid bias. The
 10 break down voltage of N3 is much less than its normal anode to cathode direct current voltage drop, by reason of the fact that it is subjected to high frequency alternating currents generated by vacuum tubes V1, V2, and V3. In Fig. 1, at the instant the contacts of
 15 key K1 are separated, part of the high frequency current existing between the plate and filament of V3 passes thru choke coil L1, bypass condenser C1, gas discharge device N3 to ground and filament of V3. At the instant
 20 N3 breaks down, sufficient direct current rushes therethru to establish a d. c. voltage thereacross sufficient to render V1, V2, V3 non-conductive. The direct current conductive
 25 voltage of an element which conducts electricity by ionization of gases which is subjected to high frequency alternating currents is but a small percentage of its normal anode to cathode voltage drop, and consequently but very little d. c. voltage is applied
 30 to either neon tube N3, or key contact K1 until the negative grid bias applied to the tubes of the transmitter is such as to render them non-productive of high frequency currents. Biasing resistance R2 furnishes a considerable
 35 impedance to these high frequency currents while neon lamp N2 offers substantially no impedance in accordance with the principles of conductivity of high frequency currents in gases.

40 The principles involved are further illustrated by assuming a specific example. Assume V1 to be a seventy-five watt screen grid tube, V2 and V3 two hundred and fifty watt tubes, source of potential DC 1500 volts, R1
 45 to have a resistance of 75,000 ohms when cold and 50,000 ohms when hot, R2 to be three ohms, and gas discharge devices N1, N2, N3, to be composed of ordinary 200 volt five watt neon lights capacitated to maintain constant
 50 voltage drop thereacross for currents up to 25 milliamperes. Assume N2 and N3 to be composed of one of these lights each, and N1 to be composed of three of these lights in series.

55 The voltage drop across the units of the potentiometer when the key is up will then be N1 six hundred volts, R1 five hundred volts, N2 two hundred volts, N3 two hundred volts. Since the filaments of V1, V2, V3 are all connected to the anode of N3, and the
 60 control grids of V1, V2, V3 are all connected to the cathode of N3 two hundred volts of negative potential is impressed on the control grids of all three tubes illustrated which makes their space currents substantially zero.
 65 Since 500 volts is impressed on R1 with its

cold resistance of 75,000 ohms, 6.7 milliamperes will flow thru potentiometer N1 R1 N2 N3.

If now the key K1 is closed the voltage drop across the units of the potentiometer
 70 will then be N1 six hundred volts, R1 seven hundred volts, N2 two hundred volts, biasing resistance R2 less than three volts depending on the sum of the space currents of V1, V2, V3. Since 700 volts is impressed on R1 cold
 75 resistance 75,000 ohms 9.3 milliamperes will flow thru the potentiometer N1 R1 N2.

If after an hour of operation R1 becomes heated so that its resistance decreases to
 80 50,000 ohms the distribution of voltages with key up and down will be the same as when R1 was 75,000 ohms altho the current thru N1 R1 N2 N3 with key up will have increased to 10 milliamperes, and with key closed to 14
 85 milliamperes.

In each case illustrated above part of the current will be required for screen grid G2 but this will be taken from that which would
 otherwise flow thru N2, and a 200 volt drop will be maintained across N2 by reason of the
 90 fact that the voltage drop thereacross is independent of current flow. This characteristic of N2 makes possible the use of small potentiometer currents listed above with consequent
 95 saving in energy dissipated. Similar characteristics of N3 cooperate by tending to decrease the voltage impressed on N1 and N2 when the key contacts are open. While in the example assumed these savings are not
 100 large, it is apparent that with larger transmitters the savings might be a very important factor.

In the case illustrated gas discharge device N3 has been subjected to high frequency currents
 105 generated by the vacuum tube transmitter by metallic conductors. Such an effect could be accomplished by locating N3 in the vicinity of the plates of the tubes V2, V3 and in such a case the gases of N3 would
 110 remain ionized by electro-static conduction during the period of time that V2, V3 are generating high frequency currents, thereby rendering N3 conductive when extremely
 115 small direct current voltages exist between contacts K1.

It has been found that "key click" normally occurring when the key of the transmitter is raised is substantially eliminated by this
 120 arrangement, and that the "key click" occurring when the key is closed is greatly reduced. The arcing of the key contacts is substantially eliminated.

The current flowing thru the voltage divider is dependent upon the voltage impressed on R1 since the voltage drop across
 125 N1, N2, N3 is substantially independent of current flow. When the key is up the voltage impressed on R1 is small due to the fact that most of the voltage is required to maintain
 130 N1, N2, N3 conductive. When the key is

down N3 is short-circuited and a considerable current is allowed to flow to supply the grid G2 with proper current. This arrangement is extremely economical on current consumption since very little current flows thru voltage divider when the key is up.

While keying device, K1 has been illustrated as a telegraphic key, it will be understood that it could be any contact breaking device in vacuum or otherwise, or in fact any device for modulation of a vacuum tube generator.

High frequency currents have in the past been used to render gases between fixed terminals conductive to direct current, and also elements which conduct electricity by ionization of gases have been used across a source of voltage to maintain said source constant. The circuit herein described employs a gas conducting device in parallel with a contact breaking device, said parallel device being subjected to high frequency currents to render same conductive, and a voltage divider allowing for extremely small dissipation of energy.

While one embodiment of the invention has been shown and described, obviously the invention is applicable to other arrangements and it is to be understood that it is not limited except as by the following claims.

What is claimed is:

1. In an electric system, a vacuum tube generator of alternating current, a source of direct current voltage, a voltage divider for supplying proper voltages to the plate and grid circuits of said generator, means for controlling the amount of alternating current generated by said generator, said means comprising a gas discharge device, and a keying device in parallel in the grid circuit of one of the vacuum tubes of said generator, means for applying alternating current to said discharge device to reduce the direct current break down voltage thereof.

2. In an electric system, a generator of alternating current comprising a vacuum tube, means for controlling the amount of said alternating current generated by said generator, said means comprising a keying device and a gas discharge device in parallel in the grid circuit of said vacuum tube, means for applying a portion of said alternating current to said gas discharge device to reduce the direct current conductive voltage thereof.

3. In an electric system, a generator of alternating current comprising a plurality of vacuum tubes, means for controlling the amount of said alternating current generated by said generator, said means comprising a gas discharge device in the grid circuit of one of said vacuum tubes, means for applying a portion of said alternating current to said discharge device to control the resistance of said discharge device.

4. In an electric circuit, a vacuum tube,

means for controlling the space current of said tube, said means comprising a keying device, a gas discharge device connected across said keying device, a vacuum tube generator of alternating current, means for applying a portion of said alternating current to said discharge device at the instant said contacts are broken.

5. In an electric circuit, a vacuum tube, having an input and an output circuit, an anode, a cathode, and a control electrode, means for controlling the space current of said tube, said means comprising a circuit breaking device in parallel with a gas discharge device, connected in said input and said output circuit, a resistance connected from said anode to said cathode, and adapted to apply a voltage to said gas discharge device to maintain said gas discharge device conductive when said circuit breaking device is open.

6. In an electric circuit, a vacuum tube having plate and grid circuits, a source of voltage, means for obtaining substantially constant voltages of different magnitude from said source for said plate and grid circuits, said means comprising a resistance and gas discharge device bridged across said source, a keying device connected in series with said source, and said first mentioned means, means for reducing the energy from said source dissipated in said resistance, when said keying device is opened, said last mentioned means comprising a second gas discharge device connected in parallel relation to said keying device.

In testimony thereof I have affixed my signature.

OLIVER THOMAS FRANCIS.