

E. G. DANIELSON
RADIO RECEIVING SYSTEM
Filed June 23, 1925

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FIG-1-

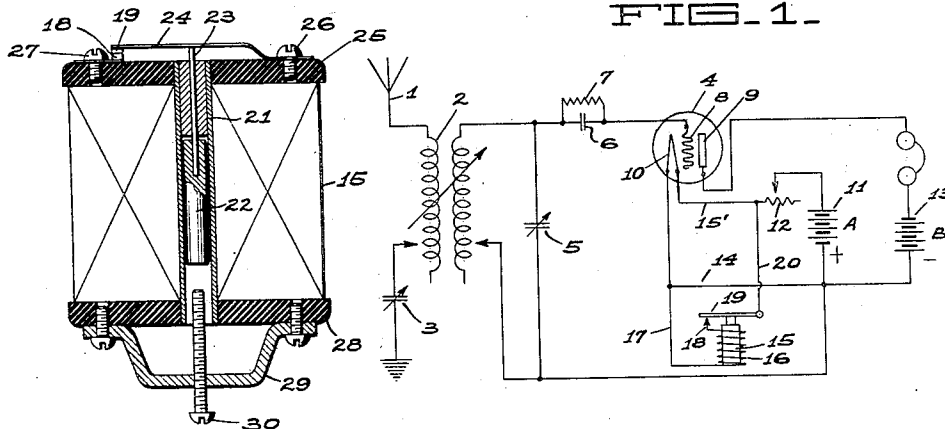


FIG. 2.

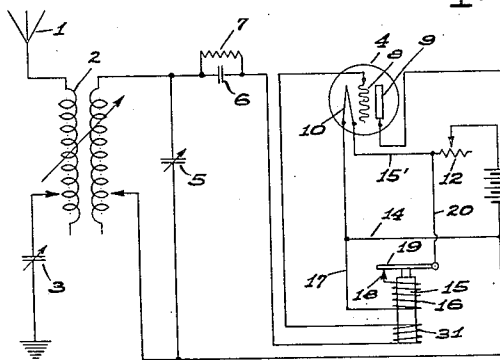
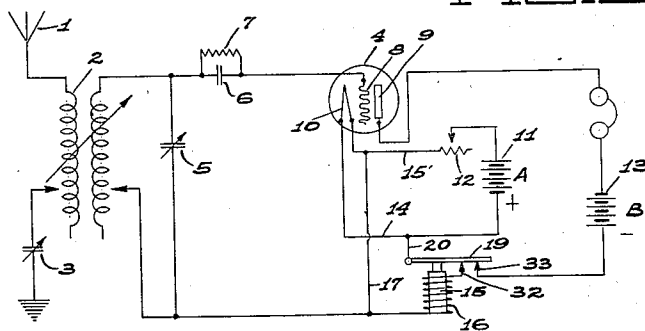


FIG. 3.



INVENTOR
ERNEST G. DANIELSON
BY *White Bird Evans*
his ATTORNEYS

UNITED STATES PATENT OFFICE

ERNEST G. DANIELSON, OF SAN FRANCISCO, CALIFORNIA

RADIO RECEIVING SYSTEM

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This invention relates generally to electrical systems which employ one or more vacuum tubes or electron relays. It has particular reference to systems of this kind in which the electron relays employ metallic filaments which are energized from a source of current.

It is an object of this invention to devise novel means for automatically informing an operator when an unsafe potential is being applied to the filament of an electron relay.

It is a further object of this invention to devise means for modulating the plate circuit of an electron relay with a current of audible frequency when a potential of excessive value is being applied to the filament of the relay.

Further objects of this invention will appear from the following description in which I have set forth the preferred embodiment of my invention. It is to be understood that the appended claims are to be accorded a range of equivalents consistent with the state of the prior art.

Referring to the drawings:

Fig. 1 is a circuit diagram illustrating a radio receiving circuit embodying my invention.

Figs. 2 and 3 are circuit diagrams illustrating a modification of the invention shown in Fig. 1.

Fig. 4 is a vertical sectional view of one form of electromagnetic vibrator used in connection with said circuits.

It is commonly known that electron relays may be seriously injured by applying too great a current to the filament. This is particularly true of relays having filaments which contain rare metals such as thorium, which are vaporized or boiled out if the operating temperature is too great. In radio receiving sets, it is common for an inexperienced operator to seriously impair the efficiency of the vacuum tubes by carelessly applying an excessive filament potential. Attempts have previously been made to protect the filaments by providing means for disconnecting the supply of current when the potential increases above a given maximum value. An arrangement of this sort is described in the *Wireless Age* of August, 1921, page 25. The difficulty with an arrangement of the sort

described in this publication, is that an inexperienced operator will not understand whether the de-energization of the relay is caused by too great a voltage or by an open circuit in the supply of "A" battery current. In this invention I have provided means for modulating the plate circuit of an electron relay with a current of audible frequency when the potential across the filament rises above a dangerous value. This audio frequency current causes a certain noise in the loud speaker or telephones which unmistakably indicates to an operator that the potential is too great and that it must be decreased.

One form of my invention as applied to a standard receiving circuit is shown in Fig. 1 in which the antennæ circuit comprises the antennæ 1, coupling transformer 2 and variable capacitance 3 by means of which the antennæ circuit may be tuned to any desired frequency. The grid circuit of a three electrode vacuum tube 4 is connected to the secondary of the transformer 2 which is shunted by a variable capacitance device 5 for tuning the grid circuit to the desired frequency. In the grid circuit is located a grid condenser 6 shunted by a grid leak resistor 7 for performing the function of keeping the grid at a negative value. The tube 4 has a grid element 8, a plate element 9 and a filament 10 which is heated by an A battery 11 and regulated by a resistance 12. A B battery 13 supplies current for the plate circuit. The filament circuit comprises the A battery 11, conductor 14, filament 10, conductor 15, resistance 12 back to the battery 11. The circuit described is a standard type which I have selected for purposes of illustrating my invention, and it is to be understood that I do not limit myself to any particular type of circuit as my invention may be embodied in any circuit using vacuum tubes.

In carrying out my invention, I connect an electromagnetic vibrator or circuit interrupter 15 in parallel with the filament 10. In Fig. 1, the winding 16 of the electromagnet 15 is connected at one end to the conductor 14 by a conductor 17 and its opposite end to a stationary contact 18. A movable contact 19, actuated by the electromagnet 15 is ar-

ranged to contact with contact 18 and connects with conductor 15' by a conductor 20. As shown in Fig. 4, the electromagnet 15 is provided with a central metallic tube 21 in which is loosely fitted a steel armature 22 having a stem 23 extending out of the tube 21 and engaging a spring 24, preferably of bronze. The spring 24 is secured at one end in an insulated base 25 by a screw 26 and at its opposite end carries the contact 19 arranged to cooperate with the contact 18 which is secured to the base 25 by a screw 27. The opposite end of magnet 15 is also provided with an insulated base 28 to which is secured a guide 29 for a screw 30, which extends into the lower end of tube 21. By means of the screw 30, the limit of travel of the armature 22 within the tube 21 may be adjusted. From this it will be seen that when the electromagnet 15 is energized sufficiently to operate, the armature 22 is raised to separate contacts 18 and 19, thus opening the circuit of the electromagnet, which thereupon becomes deenergized and the armature drops, permitting the circuit to be closed, due to the action of spring 24. The cycle is repeated in a well understood manner.

As has been explained above, the electromagnet 15 is connected across the filament 10 or in parallel therewith and is designed to function when the potential drop across the filament exceeds a predetermined maximum value. For example where the filament is designed to take a voltage of say 3 volts, the electromagnet will function when the voltage exceeds that value. Thus if the potential drop across the filament exceeds 3 volts, the electromagnet will rapidly interrupt the circuit between contacts 18 and 19 and will effect modulation of the plate or output circuit of the vacuum tube. The magnet produces a rapid vibration of the armature at audible frequency thereby giving a signal that the filament voltage is excessive. When the voltage is decreased by the operator to the correct value, the signal is arrested.

In Fig. 2 I have shown the use of means for impressing audible frequency currents produced by the interrupter upon the grid circuit or input circuit of the electron relay. This is effected by the use of an auxiliary winding 31 which is connected in series with the grid 8. The rapidly changing flux in the core 15 induces a repeatedly varying current in winding 31 which is repeated through the electron relay 4 and translated by the telephones or other translating means.

A further modification of the invention is shown in Fig. 3 in which the audible frequency current is impressed upon the translator by interrupting the output circuit of the relay. Thus the armature 19 is provided with an auxiliary contact 33 and is connected to the negative terminal of the "B" battery 13. Thus when the armature 19 is vibrated the output

or plate circuit of relay 4 is repeatedly opened and closed, and the resulting interruptions which are of audio frequency are translated by the telephones as a loud buzzing noise which is readily distinguishable from the radio signals being received.

I claim:

1. A radio receiving set including a three electrode vacuum tube and a telephonic device for normally reproducing audible frequencies, means responsive to abnormally high voltage on the filament of said tube for interrupting the filament circuit at audible frequency to protect the filament and produce a signal of said frequency in the telephonic device.

2. In a system of the class described, an electron relay having input and output circuits and an electron emission filament, a source of current for energizing said filament, and means responsive to a potential drop across the filament above a predetermined value for effecting modulation of the input circuit with a current of audio frequency generated by said means.

3. In a radio system of the class described, an electron relay having input and output circuits and an electron emission filament, a source of current for energizing said filament, means responsive to a potential drop across the filament above a predetermined value for effecting modulation of the input circuit with a current of audio frequency generated by said means, and means in the output circuit for translating into sound both signals repeated by the relay and said audio frequency currents.

4. In a system of the class described, an electron relay having the usual grid, plate and filament, a circuit for heating said filament, an input circuit connected with said grid, an output circuit connected with said plate, translating means associated with said output circuit, and means effective upon an increase in the potential drop across the filament above a safe value for repeatedly varying the potential upon the grid at a tone frequency whereby an amplified current is produced in the output circuit of a tone frequency to actuate said translating means.

5. In a radio receiving system, an electron relay having input and output circuits and a filament adapted to be heated by a current, a source of current connected to said filament, a source of signal energy coupled to the input circuit, means for effecting modulation of the output circuit with a locally generated source of audio frequency current when the current flowing thru the filament is above a predetermined maximum value, and means associated with the output circuit for translating both signal energy repeated by the relay and said audio frequency currents.

6. In a system of the class described, an

electron relay having input and output circuits and an electron emission filament, a source of current for energizing said filament, means associated with said filament and actuated by the potential drop across the filament above a predetermined value to produce a continuous audio frequency response in the output circuit.

7. In a system of the class described, an electron relay having input and output circuits and an electron emission filament, a source of current for energizing said filament, means including an electro-magnetic vibrator associated with said filament and actuated by the potential drop across the filament above a predetermined value to produce a continuous audio frequency response in the output circuit.

8. In a system of the class described, an electron tube relay having input and output circuits, an electron emitting filament, a source of current for energizing said filament, an electro-magnetic vibrator with an actuating coil connected in parallel with said filament for generating a pulsating current of audio frequency and actuated by an increase in the potential drop across the filament above a safe value to generate said current, and an inductance coil in series with the input circuit inductively coupled to said actuating coil for effecting modulation of the input circuit with said generated current.

9. In a system of the class described, an electron tube relay having a grid, plate and filament, a circuit for heating said filament, an input circuit connecting said grid and filament, an output circuit connecting said plate and filament, translating means in said output circuit, and means including an electro-magnetic vibrator for generating a pulsating current of audio frequency connected in parallel with the filament and coupled to the input circuit, said means being responsive to an increase in the potential drop across the filament above a safe value to modulate the input circuit with said generated current whereby an amplified current of audio frequency is produced in the output circuit to actuate said translating means.

In testimony whereof, I have hereunto set my hand.

ERNEST G. DANIELSON.

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