

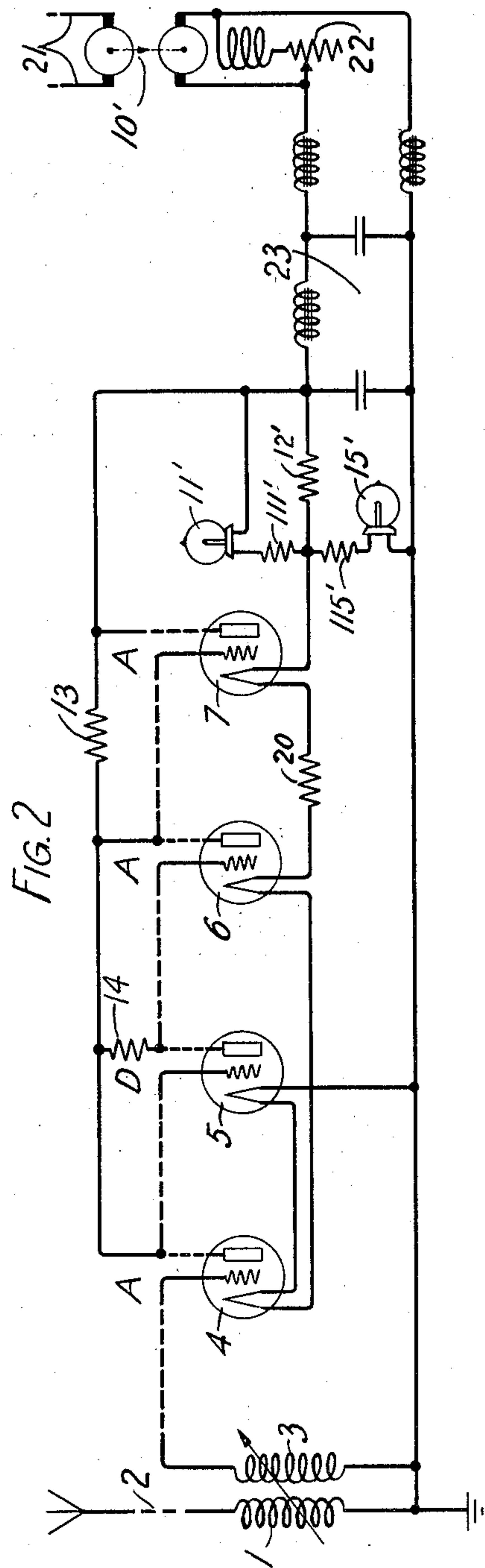
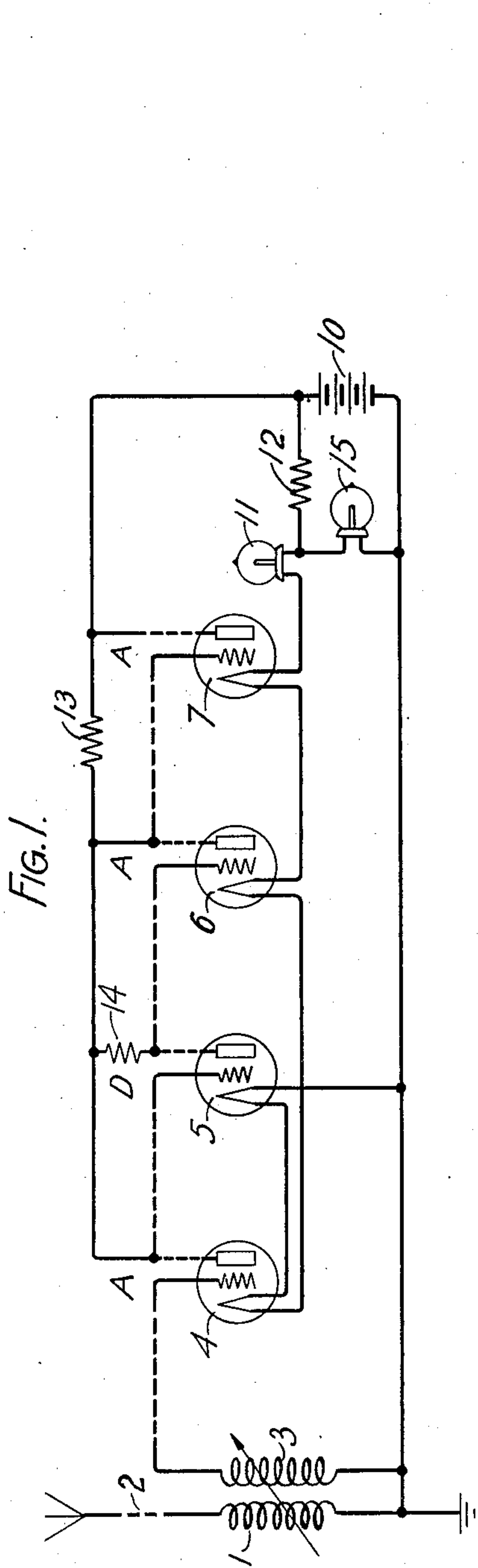
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INDICATING SYSTEM

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INDICATING SYSTEM

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This invention relates to indicating systems, and especially to systems for indicating the condition of electric space discharge tubes in a radio receiver or other apparatus including such tubes.

The invention is preferably embodied in an arrangement, specifically stated, in which two signal lamps, one green and one red, jointly indicate the condition of the filaments and filament heating source, operativeness of the filaments being indicated by the green lamp being lighted and the other dark; an inoperative condition of the filaments by the red lamp being lighted and the green dark; and a failure of the source, by the absence of light from both lamps. The space current is sometimes derived from the same source as the filament heating current, in which case the absence of light from both lamps likewise indicates the failure of the space current voltage supply.

Fig. 1 is a schematic showing of a radio receiver circuit embodying a form of the invention; and Fig. 2 is a schematic showing of a circuit embodying another form of the invention.

In Fig. 1 an inductance coil 1 in an open antenna 2 is variably coupled to an inductance coil 3 in the input circuit of an electric space discharge tube 4, the A. C. output circuit of which feeds the input circuit of a similar tube 5, which in turn has its output electrode connected to the input electrodes of a similar tube 6, which feeds a similar tube 7. By way of example, tube 4 may be a radio frequency amplifier, tube 5 a detector, tube 6 an audio frequency amplifying stage, and tube 7 a second audio frequency amplifying stage, the plate circuit of which may include in the dotted portion a loud speaking telephone receiver or other receiving device (not shown).

A source of unidirectional electromotive force 10 supplies plate current and filament current for all of the tubes. The filaments are connected in series with each other and with a green signal lamp 11 and with a resistance 12, across source 10. The plates of the tubes are connected to the positive pole of the source 10, the plate voltages applied

to tubes 4, 5 and 6 being adjusted by a resistance 13 included in the plate circuit of those tubes, and an additional resistance 14 being included, in serial relation to resistance 13, in the plate circuit of detector tube 5, to assist in adjusting the plate voltage applied to that tube. A red signal lamp 15 is connected across the path comprising lamp 11 and the tube filaments.

The lamp 11 may be a low voltage lamp, and the lamp 15 a high voltage lamp, the impedance of the path comprising lamp 11 and the tube filaments, in parallel with lamp 15, being sufficiently low, in comparison to resistance 12, to normally cause lamp 15 to be dark, or prevent lamp 15 from glowing brightly. Preferably the filament of lamp 15 is of some material, as for example tungsten, which has a temperature coefficient of resistance such that the filament has a pronounced tendency to darken when the voltage applied to the filament is decreased considerably below the normal filament voltage.

Normally the lamp 11 is maintained bright by the current flowing from battery 10 and resistance 12 through its filament to the tube filaments. In this condition the lamp indicates positively that the tube filaments are intact and that the plate voltage is applied to the plate current circuit for the tubes. If the source of plate and filament voltage fails, lamp 11 will cease to glow.

If, with the source of filament and plate voltage operative, a tube filament burns out or breaks, the load on the source 10, due to the plate currents of the tubes and the filament current of the tubes, is removed, and the impedance of the circuit consisting of the tube filaments and lamp 11 at the lamp 15 becomes infinite. The voltage of source 10 then divides between resistance 12 and lamp 15 in proportion to their impedances, and lamp 15 receives sufficient current to cause it to become bright to thereby indicate positively that the plate current circuit and the filament heating circuit are receiving voltage, but that the filament circuit is broken.

Fig. 2 shows a radio receiving system employing a green lamp 11' and a red lamp 15'

to give the same indications as to the condition of a plate current circuit and a tube filament heating circuit as are given by the lamp 11 and the lamp 15 in Fig. 1. The lamp 11', as well as the lamp 15', is a high voltage lamp, as for example a 10 watt, 110 volt tungsten filament lamp. It is in series with resistance 111'. The path consisting of lamp 11' and resistance 111' in series is connected in shunt to a resistance 12' which is in serial relation to the tube filaments as in the case of resistance 12 of Fig. 1. The path which includes lamp 15' is connected in parallel relation to the tube filaments and includes a resistance 115' in series with the lamp.

Tube 4 may be a radio frequency amplifier, tube 5 a detector, tube 6 an audio frequency amplifying stage, and tube 7 a second audio frequency amplifying stage, the tube 7 operating a loud speaking telephone receiver, not shown. A resistance 20 is included in the path through the tube filaments, and the voltage drop due to the flow of the tube filament heating current through the resistance is utilized in fixing the steady potential of the grid of tube 7 in a manner well known in the art but not shown in the drawing.

In Fig. 2 the source of voltage for supplying the filament heating current and the plate circuit current for the tubes is a motor generator 10', instead of the battery 10 shown in Fig. 1. The motor generator receives power from a line 21. A field rheostat 22 is provided for adjusting the voltage delivered by the motor generator, and a filter 23 prevents rapid fluctuations in this voltage from causing corresponding fluctuations in the tube filament heating current and the unidirectional space current in the tubes.

Current for heating the filaments passes from filter 23 through two parallel paths, one consisting of resistance 12' and the other consisting of lamp 11' and resistance 111' in series, then through the filament of tube 7, resistance 20, and the filaments of tubes 6, 4 and 5, back to filter 23.

By way of example, the following conditions may obtain in the system of Fig. 2. The normal voltage delivered at the output terminals of filter 23 when the tube filaments are lighted may be 165 volts. The normal filament current may be 250 milliamperes, the tubes 4, 5 and 6 being Western Electric type 215A tubes each having a filament voltage drop of about 1 volt, and the tube 7 being a Western Electric type 221D tube having a filament voltage drop of about 5 volts. Each of the lamps 11' and 15' may be a 110 volt, 10 watt tungsten filament lamp. The resistances 12', 111', 115', and 20 may have values of 850 ohms, 400 ohms, 700 ohms, and 22 ohms, respectively.

What is claimed is:

1. An electric space discharge tube having a filamentary cathode and an anode, a circuit including said cathode, a source of electromotive force for said circuit, connections from said source for supplying space current to said tube, an impedance connected in serial relation to said circuit with respect to said source, a circuit connected in shunt to said first circuit at the terminal of said impedance remote from said source, a lamp included in said second circuit, normally dark but lighting in response to voltage from said source applied to said second circuit when said first circuit is interrupted, a circuit connected in shunt to said impedance, and a signal lamp included in the latter circuit, normally lighted in response to voltage applied to the latter circuit from said impedance, due to current flowing from said source through said impedance and said first circuit.

2. A radio receiver comprising a plurality of electric space discharge tubes having anodes and filamentary cathodes, a source of electromotive force, a filament heating circuit including said cathodes in serial relation to each other, an impedance connected in serial relation to said circuit with respect to said source, connections from the terminal of said impedance adjacent said source to the anodes of said tubes for supplying space current thereto, a circuit connected in shunt to said first circuit at the terminal of said impedance remote from said source, a lamp included in said second circuit, normally dark but lighting in response to voltage from said source applied to said second circuit when said first circuit is interrupted, a circuit connected in shunt to said impedance, and a signal lamp included in the latter circuit, normally lighted in response to voltage applied to the latter circuit from said impedance due to current flowing from said source through said impedance and said first circuit.

3. In combination, an electric discharge device having a thermionic cathode and an anode, a circuit including said cathode, an electrical source for supplying heating current to said cathode, an impedance element connected to said source in series with said circuit, a second circuit including signal means connected in shunt to the first circuit at the terminal of said impedance element remote from said source to give a positive indication of an inoperative condition of said first circuit, and a third circuit including other signaling means connected effectively in series with said first circuit to give a positive indication of an operative condition of said circuit.

4. In combination, an electric space discharge device having a thermionic cathode, a circuit including said cathode, an electrical

source for supplying current to said circuit
for heating said cathode, an impedance ele-
ment connected in series relation with said
circuit with respect to said source, a circuit
5 including indicating means connected in
shunt to said first circuit at the terminal of
said impedance remote from said source to
give a positive indication in response to cur-
rent from said source when the first circuit
10 is interrupted, and a circuit including a sec-
ond indicating means connected in shunt to
said impedance to give a positive indication
in response to a voltage applied thereto due
to current flowing from said source through
15 said impedance and the first circuit.

In witness whereof, I hereunto subscribe
my name this 28th day of January A. D.,
1927.

PHILANDER H. BETTS.