June 28, 1955 R. E. SPRAGUE 2,712,130

ELECTRON TUBE ALARM DEVICE

Filed July 11, 1949

Fig. 1

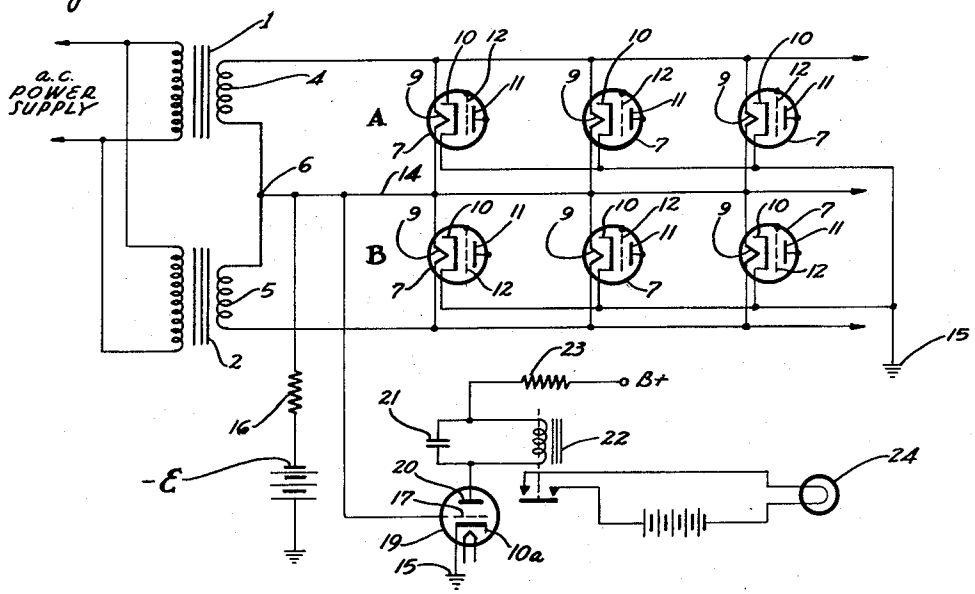
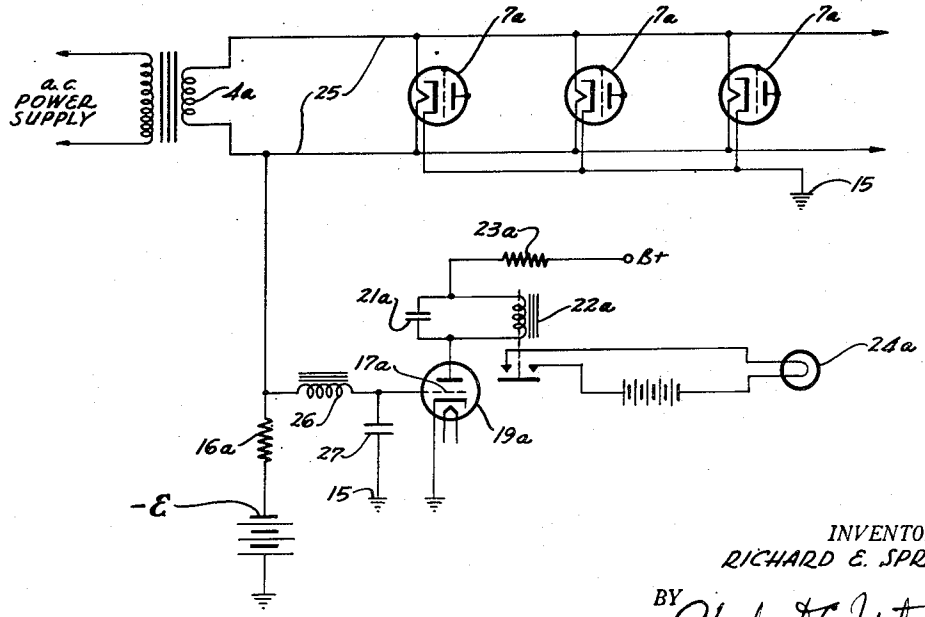


Fig. 2



INVENTOR.
RICHARD E. SPRAGUE
BY Herbert E. Metcalf
ATTORNEY

United States Patent Office 2,712,130
Patented June 28, 1955

2,712,130

ELECTRON TUBE ALARM DEVICE

Richard E. Sprague, Redondo Beach, Calif., assignor to Northrop Aircraft, Inc., Hawthorne, Calif., a corporation of California

Application July 11, 1949, Serial No. 103,985

5 Claims. (Cl. 340—248)

This invention relates to electronic alarm devices, and more particularly, to such a device for detecting and indicating a low impedance between the heater and cathode of an electron tube or a bank of electron tubes.

In electronic devices using a considerable number of electron tubes, the chances of a tube failure occuring are, of course, multiplied over uses involving only a few tubes. Miniature tubes are commonly used in such devices, to substantially reduce the overall size. It has been found that, in certain of these miniature tubes, the spacing between heater and cathode is so small that the shunt impedance between these two elements is more liable to decrease or cause an actual short circuit, sometimes intermittently, and consequently, such failures are expected to occur at intervals.

It is an object of the present invention to provide a means whereby a heater-to-cathode impedance of abnormally low value, of one tube in a bank of electron tubes, can be detected and either a visual or aural signal given.

Briefly, this invention comprises a voltage divider circuit connected to alter the grid voltage of an indicator tube so as to cause an alarm device to be actuated.

In the accompanying drawings, shown by way of illustration and not limitation:

Figure 1 is a complete wiring diagram of the present invention, showing two banks of electron tubes each connected in parallel with a separate heater voltage source.

Figure 2 is a wiring diagram showing the invention as applied to a bank of tubes operating from a single heater voltage source.

Referring directly to Figure 1 for a detailed description of my invention, two filament transformers **1** and **2** are arranged with the lower end of one secondary winding **4** connected to the upper end of the other secondary winding **5** at a tap **6**. An A. C. supply voltage is impressed across the respective primary windings, and a bank A of electron tubes **7** is connected with heaters **9** in parallel with one secondary winding **4**, while a second bank B of similar tubes **7** is similarly connected to the other secondary winding **5**. The heater supply voltage might also be obtained from a single transformer having a secondary winding center-tapped to provide the proper voltage on each side of the center. The tubes **7** may be any indirectly heated cathode type tube, having a cathode **10**, and may include an anode **11** and one or more additional elements **12**.

A neutral wire **14** connected to the secondary tap **6** forms a common lead for one side of each heater circuit. The cathodes **10** of the tubes **7** are connected directly, or through a relatively low impedance, to the negative side of the anode circuit, shown in Figure 1 by a ground symbol **15**.

A negative D. C. voltage, —E, from a battery, for example, is applied to the neutral wire **14** through a relatively high value resistor **16**. Also connected to the neutral wire **14** is a grid **17** of a triode tube **19**. A cathode **10***a*, or filament, as the case may be, in triode **19** is preferably connected to the negative side of the same

anode circuit as mentioned before. A plate element **20** of triode **19** is connected to a parallel combination of a condenser **21** and a relay **22** and then to a load resistance **23** to which is connected the positive end of the anode circuit voltage supply.

In normal operation, the resistor **16** will have no current flowing in it, since the heaters **9** are not connected to the cathodes **10** of the electron tubes **7**, and the heater circuit is floating with respect to ground potential and every part of the anode circuit. Hence, the constant voltage —E is impressed on the neutral wire **14** and also on the grid **17** of the triode **19**. The voltage —E is sufficient to cause triode **19** to be in a non-conducting condition, but not so large as to exceed the maximum heater-to-cathode voltage rating of the electron tubes **7** in banks A and B. Since the neutral wire **14** is connected to the secondary tap **6** as well as to one end of each heater **9**, substantially no A. C. voltage appears on the neutral wire or at the grid **17**.

When the heater-to-cathode impedance of one or more of the tubes **7** in bank A or B becomes less than a predetermined amount, a current of electrons will pass from —E, through resistor **16**, through the heater to cathode, to ground, which is the opposite end of the voltage source —E. This current flowing through resistor **16** now causes the voltage on the neutral wire **14** to be more positive than —E and thereby allows triode **19** to conduct when a certain value of grid voltage is reached. When triode **19** passes a sufficient plate current, the relay **22** is actuated to cause a warning light **24**, for example, to be illuminated, thus giving the alarm signal.

Condenser **21** is preferably provided for the purpose of stabilizing relay action and passing any A. C. current which might be present.

By adjusting the voltage —E, the amount of heater-to-cathode impedance drop necessary to actuate the relay **22** can be varied considerably. An aural indicator such as a buzzer, for example, or other warning device may be employed instead of the warning light **24**, if desired.

Thus it is apparent that the actuation of the warning device indicates a heater-to-cathode leakage or short circuit in one of the banks of tubes **7**.

A slight modification of the signal circuit, as shown in Figure 2, eliminates the requirement of two banks of tubes and a tapped or double-section heater voltage supply. Here, the tubes **7***a* are each connected across a single secondary winding **4***a* by a power wire **25**. A similar triode **19***a* and resistor **16***a* are used in conjunction with the voltage —E, and the resistor **16***a* is connected to one side of the power wire **25**. Therefore, an A. C. voltage is present at resistor **16***a* during operation, which would be undesirable to apply directly to the grid **17***a* of the triode **19***a*.

Also connected to power wire **25** is a filter choke **26** in turn connected to a filter capacitor **27**, the junction between the choke and capacitor leading to the grid **17***a*, and the opposite end of the capacitor **27** connected to the negative side of the anode circuit of the tubes.

This choke-capacitor combination filters out the A. C. voltage appearing at the upper side of resistor **16***a* and causes a practically pure D. C. voltage to be impressed on the grid **17***a*, this voltage amounting to the value of —E, during normal operation. Condenser **21***a* also assists in the filtering operation, when the triode **19***a* starts conducting, to prevent relay chattering, or intermittent operation. Otherwise, the operation is similar to that of the device shown in Figure 1.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail con-

struction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute, the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise the preferred form of several modes of putting the invention into effect, and the invention is, therefore, claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

What is claimed is:

1. An alarm device for indicating a heater-to-cathode short circuit in any of a plurality of electron tubes having a substantially common cathode circuit and a common heater circuit, comprising voltage supply means having its positive side connected to said cathode circuit, a supply resistor connected between the negative side of said voltage supply means and said heater circuit, said heater circuit having no other electrical path to said cathode circuit, a triode warning tube having a control grid connected to said heater circuit, and indicating means connected in the anode-cathode circuit of said triode, the value of said negative side being sufficient to cause blocking of said triode during normal operation of said electron tubes, but not sufficient to exceed the maximum safe heater-to-cathode voltage rating of said electron tubes, whereby an abnormally low impedance between the heater and cathode of any of said electron tubes will cause current to flow through said supply resistor to unblock said triode to actuate said indicating means.

2. Apparatus in accordance with claim 1 wherein said electron tubes are connected in two banks, each bank having its heaters connected in parallel across one of two separate heater supply sources connected in series, one common heater supply wire leading from a junction between said heater supply sources, and wherein said supply resistor and said control grid are connected directly to said common wire, whereby substantially no A. C. voltage is impressed on said control grid.

3. Apparatus in accordance with claim 1 wherein said indicating means comprises an electro-magnetic relay adapted to actuate a warning means.

4. Apparatus in accordance with claim 1 wherein said electron tubes are connected with said heaters in parallel across a single heater supply source, a filter choke is connected between said control grid and said heater circuit, and a filter capacitor is connected from said control grid to said cathode circuit, whereby substantially pure D. C., from said voltage supply means, is impressed on said control grid.

5. Apparatus in accordance with claim 1 wherein said electron tubes are connected with said heaters in parallel across a single heater supply source, and wherein filter means is connected between said control grid and said heater circuit, whereby substantially pure D. C., from said voltage supply means, is impressed on said control grid.

References Cited in the file of this patent

UNITED STATES PATENTS

2,292,159	Richardson	Aug. 4, 1942
2,329,518	Dimond	Sept. 14, 1943
2,390,788	Harder	Dec. 11, 1945
2,448,026	Grant, Jr. et al.	Aug. 31, 1948