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King

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[54] **FAIL-SAFE LAMP FILAMENT MONITORING CIRCUIT**

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Related U.S. Application Data

[62] Division of Ser. No. 69,765, Sept. 4, 1970, Pat. No. 3,725,728.

[30] **Foreign Application Priority Data**

Sept. 23, 1969 Great Britain 46903/69

[52] **U.S. Cl.** **315/136,** 315/276, 315/362, 340/251

[51] **Int. Cl.** ... **H01j 7/42,** H05b 37/03, G08b 21/00

[58] **Field of Search** 315/276, 129, 120, 136, 315/362, 127, 119; 324/51, 20, 22; 340/85, 251; 317/157

[56] **References Cited**

UNITED STATES PATENTS

2,257,797 10/1941 Higgins ..... 315/276 X

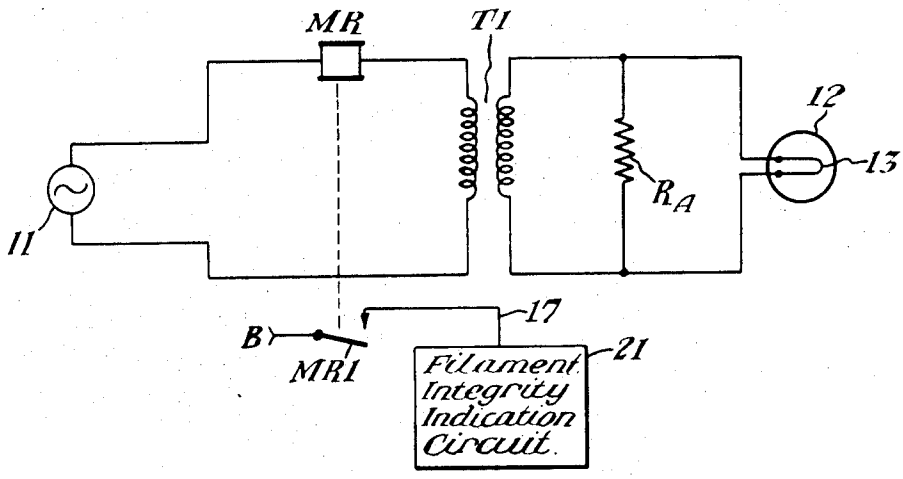
1,788,597 1/1931 Schultz ..... 315/362 X

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[57] **ABSTRACT**

This invention relates to a fail-safe lamp filament monitoring circuit including an a.c. signal source to provide an a.c. signal to the primary of a transformer which, in turn, supplies alternating electrical energy to a lamp filament connected in its secondary, a monitoring device responsive to the current in the primary winding and an auxiliary loading device connected in the secondary. The auxiliary loading device is effective to increase power flow through the transformer to energize the filament to a level where the monitoring device is operated and held operated until the lamp filament is no longer energized at which time the monitoring device is released at the transformer magnetizing current.

5 Claims, 2 Drawing Figures



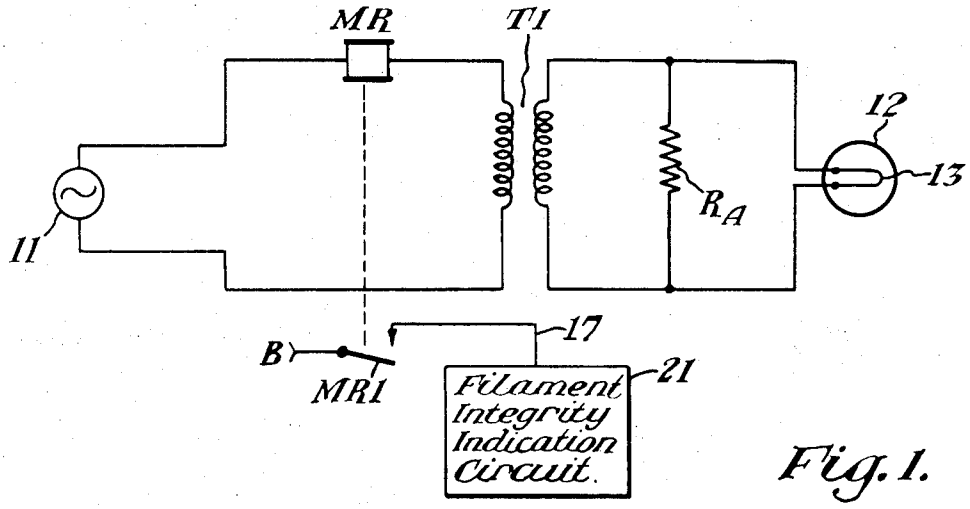

MR
T1
12
13
11
R_A
17
B
MR1
21
Filament Integrity Indication Circuit.

Fig. 1.

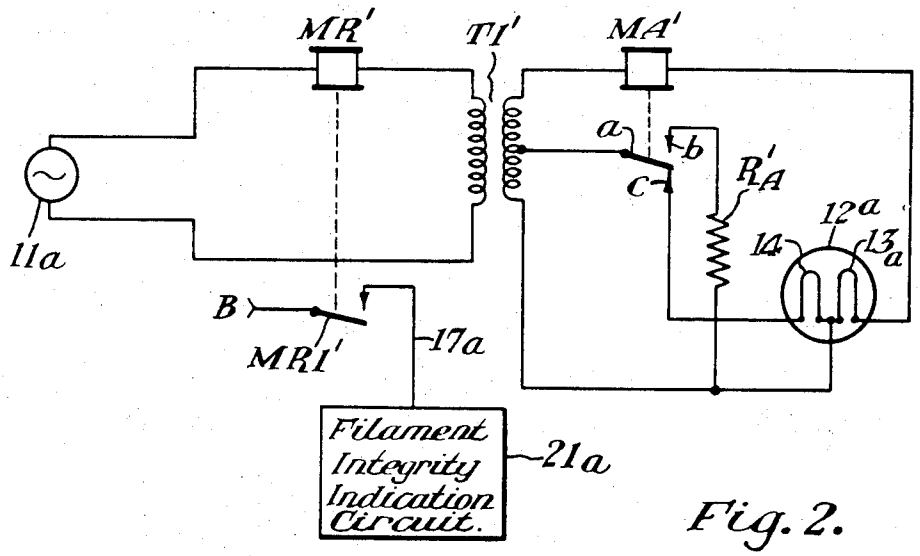

MR'
T1'
MA'
a
b
c
R'_A
12a
13a
14
11a
B
MR1'
17a
21a
Filament Integrity Indication Circuit.

Fig. 2.

FAIL-SAFE LAMP FILAMENT MONITORING CIRCUIT

This application is a division of my copending application for letters Patent of the United States, Ser. No. 69,765, filed Sept. 4, 1970, for Fail-Safe Lamp Filament Monitoring Circuit now U.S. Pat. No. 3,725,728, issued Apr. 3, 1973.

My invention relates to a fail-safe lamp filament monitoring circuit.

More particularly, my invention relates to a fail-safe lamp filament monitoring circuit comprising a transformer device, a lamp filament, a monitoring device, and an auxiliary loading circuit. The transformer device has a primary and a secondary winding, an a.c. signal source providing an a.c. signal to the primary winding. The lamp filament is connected to the secondary winding so that the transformer device supplies electrical energy to the lamp filament. The monitoring device has a first and a second state, and is responsive to the current in the primary winding of the transformer. It is initially in its second state. The auxiliary loading circuit is also connected to the secondary winding of the transformer and is effective to increase the power flow through the transformer device to energize the lamp filament to a preselected energizing power flow level which causes the monitoring device to assume and to be held operated in its first state. The monitoring device reassumes its second state at a preselected lower current flow level of the primary winding of the transformer when the filament is no longer energized due to full or partial open-circuiting.

In prior arrangements for testing the integrity of lamp filament circuits employed in railway signal applications, the filaments were connected in the secondary circuit of a transformer and fed with alternating current through the transformer. A current sensing relay was placed in the primary circuit of the transformer. It was desirable that the current sensing relay have a sensitivity capability such that it was held by the filament energizing power level and released upon the ceasing of the filament power flow. However, it has been found that in such arrangements the current sensing relay could remain held by the magnetizing current in the transformer primary circuit even in the absence of filament power flow. This is most unsatisfactory since it contravenes the fail-safe feature considered essential in railway environment wayside traffic signaling applications.

It is therefore an object of this invention to provide a unique fail-safe lamp filament monitoring circuit for detecting and indicating filament integrity through incorporation of a distinct filament energization power level whenever the filament is energized.

Another object of this invention is to provide a new fail-safe lamp filament monitoring circuit which utilizes transformer action to provide a preselected reference current power level, which power level is present when filament power flow ceases.

Yet another object of this invention is to provide an improved fail-safe lamp filament monitoring circuit having auxiliary loading means responsive to the current through the filament to present a distinct filament energization power level for detection when the filament is energized.

Still another object of this invention is to provide a novel fail-safe lamp filament monitoring circuit having

a first and a second filament, the second filament chosen to present the same power level for detection as the first filament whenever power flow in the first filament ceases.

In the attainment of the foregoing objects a fail-safe lamp filament monitoring circuit has been invented which includes an a.c. signal source to provide an a.c. signal to the primary winding of a transformer for supplying alternating electrical energy to a lamp filament connected in the secondary winding of the transformer, a monitoring relay responsive to the current in the primary winding of the transformer and an auxiliary resistive load device connected in the secondary winding of the transformer. The auxiliary resistance load device is effective to increase the power flow through the transformer to energize the filament to a level where the monitoring relay is operated and held operated until the filament is no longer energized at which time the relay is released at the transformer magnetizing current level, or some other preselected current level.

The circuit may also include a supplemental filament also connected in the secondary winding of the transformer and a further relay to selectively energize the first filament at a power level provided by the combination of the first filament and the auxiliary resistive load device until failure of the first filament whereupon the supplemental filament is energized, the auxiliary resistive load device drawing power which is substantially equivalent to the difference in power drawn by the filaments.

Further, the monitoring relay may be responsive to a partial failure of the first filament which would reduce the power flow through the transformer to a level distinguishable from that provided by the transformer magnetizing current by the flow to the auxiliary resistive device.

Other objects and advantages of the present invention will become apparent from the ensuing description of illustrative embodiments thereof, in the course of which reference is had to the accompanying drawings in which:

FIG. 1 depicts one preferred embodiment in schematic form of the instant fail-safe filament monitoring circuit in which one lamp filament and an auxiliary resistive load are connected across the transformer secondary.

FIG. 2 depicts still another embodiment of the instant fail-safe lamp filament monitoring circuit in schematic form in which a supplemental filament and a further relay are also connected in the transformer secondary.

A description of the above embodiments will follow and then the novel features of the invention will be presented in the appended claims.

Referring now to the drawings and particularly to FIG. 1 which depicts one preferred embodiment of the present invention, it will be seen in FIG. 1 that a transformer T1 has an a.c. signal provided to its primary via a.c. signal source **11**. A monitoring means in the form of a relay MR is also connected to the primary winding of transformer T1 and arranged to indicate, by means of its front contact MR1 and associated conventional circuitry depicted as a filament integrity indication circuit **21**, whether or not the current flowing in the primary winding of transformer T1 is sufficient to pick up contact MR1 of relay MR. As shown in FIG. **1**, connected in the secondary of transformer T1 is a lamp **12**

having a filament **13**, and an auxiliary loading resistor R_A connected across the secondary winding. The amount of current necessary to flow through the primary winding to pick up front contact MR1 of relay MR is determined by the amount of power consumed by resistor R_A and filament **13** of lamp **12**. The value of the resistance R_A is chosen with due regard to the power consumed in the lamp **12** and the magnetizing current of the transformer T1, which current initially flows in the primary of transformer T1, to ensure that while front contact MR1 of monitoring relay MR is picked up and held up by the current flowing to illuminate lamp **12**, should such current fall to a level at which illumination ceases through total or partial open-circuiting of the filament **13**, then front contact MR1 of monitoring relay MR is reliably released and the possibility of contact MR1 of relay MR being held up by the primary magnetizing current is eliminated. Accordingly, as long as filament **13** of lamp **12** is conducting, the power level due to power consumed by filament **13** of lamp **12** and resistor R_A will cause the picking up of front contact MR1 of monitoring relay MR establishing a first electrical state and thereby completing a circuit from a B (positive) battery terminal over front contact MR1 of monitoring relay MR, lead **17** to filament integrity indication circuit **21**, thereby providing an indication of filament energization and, a fortiori, lamp illumination. Should an open circuit be caused in filament **13** of lamp **12**, then the power drawn by the secondary of transformer T1 will be solely due to resistor R_A, the value of which is much greater than the parallel combination of resistance R_A and filament resistance. Hence, the current in the secondary of transformer T1 will be considerably diminished. It is at this current that contact MR1 of relay MR, being chosen such that it will only be picked up at the predetermined power level required by resistor R_A and filament **13** of lamp **12**, will release and no circuit will be completed to filament integrity indication circuit **21**. Similarly, should resistor R_A become open-circuited (noting that in fail-safe theory it is assumed that resistors never short circuit), monitoring relay MR would assume a second electrical state, namely, release its front contact MR1 since the power level at which contact MR1 of relay MR is picked up is no longer present due to the opening of resistor R_A. Further, should either the primary or secondary winding short between turns, there would be no transformer action present and, therefore, there would not be present the power level due to resistor R_A and filament **13** of lamp **12**.

Reference is now made to FIG. **2** which shows still another embodiment of the present invention employing a double-filament lamp, the two filaments of which are positioned and chosen to consume different powers. The main filament **13***a* is the one normally used and is positioned at the optimum optical position in the lamp **12***a*. A supplemental filament **14** is, of necessity, positioned elsewhere within lamp **12***a* and, therefore, must dissipate a higher power than filament **13***a* in order to compensate for the reduced optical efficiency resulting from the filament displacement from the optimum optical position in the optical system.

As shown in FIG. **2**, the filament **13***a* is energized by the upper portion of the secondary of a transformer T1' through an auxiliary load control relay coil MA'. A changeover contact *a* having front and back portions *b* and *c*, respectively, is arranged to connect an auxiliary load resistor R_A' across a portion of the secondary of transformer T1' when in position *b*, so long as relay MA' is energized. On relay MA' becoming deenergized the contact *a* changes over to position *c* to connect the supplemental filament **14** across the lower portion of the secondary of transformer T1', in place of auxiliary load resistor R_A'. Once again, a monitoring relay MR' is connected to the primary winding of transformer T1' and arranged to indicate by means of its front contact MR1' and associated circuitry depicted as a filament integrity indication circuit **21***a*, whether or not the current flowing through the primary winding of transformer T1' is sufficient to pick up contact MR1' of relay MR'. In the instant preferred embodiment, the auxiliary load resistor R_A' is chosen with regard to the burden upon relay coil MA' and relative power consumption of the two filaments **13***a* and **14** of lamp **12***a* so that the power flow through the transformer T1' is approximately the same under energization of filament **13***a* as it is under energization of supplemental filament **14**.

Also to be considered upon selection of resistor R_A' is differentiation between power flows from that due to the magnetizing current of the primary of transformer T1' such that there is no possibility of the front contact MR1' of relay MR' being held up by magnetizing current flow when due to complete or partial failure of both filament **13***a* and supplemental filament **14**, and there is a reduced or no power flow through the transformer T1'. Once again, should resistor R_A' become open-circuited, the filament **13***a* is energized and monitoring relay MR' would not release its front contact MR1' since the power level at which contact MR1' of relay MR' is maintained picked up by the lighting of supplemental filament **14** over back contact *c* of relay MA'. Thus, a circuit path through contact *b* of relay MA' is no longer present due to the opening of resistor R_A'.

It will be appreciated that while the invention has been illustrated as employing a resistive loading device, the invention is suitably adapted for any power consuming device.

While the invention has been described with reference to particular embodiments, it is understood that other modifications, changes and variations may be made by those skilled in the art without departing from the spirit of the invention or scope of the claims.

Having thus described my invention, what I claim is:

1. A fail-safe lamp filament monitoring circuit comprising,

a. transformer means having a primary and a secondary winding,

b. an a.c. signal source connected to said primary winding,

c. a lamp filament connected in parallel with said secondary winding, said transformer means supplying electrical energy to said lamp filament,

d. monitoring means having a first and a second state connected in said primary winding of said transformer and responsive to the current in said primary winding of said transformer, said monitoring means initially in said second state,

e. auxiliary loading means connected in parallel with the secondary winding of said transformer means and effective to increase power flow through said

transformer means to energize said filament to a preselected energizing power flow level where said monitoring means assumes and is held operated in said first state at said energizing power flow level, said monitoring means resuming said second state at a preselected lower current flow level of said primary winding of said transformer means when said filament is no longer energized.

2. The fail-safe filament monitoring circuit as described in claim 1, wherein said preselected lower current flow level is due to the magnetizing current of said

primary winding of said transformer means.

3. The fail-safe filament monitoring circuit as described in claim 1, wherein said monitoring means is a current responsive electromagnetic means.

4. The fail-safe filament monitoring circuit as described in claim 3, wherein said electromagnetic means is a current responsive relay.

5. The fail-safe filament monitoring circuit as described in claim 1, wherein said auxiliary loading means is a resistive device.

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