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ARRANGEMENT FOR PERIODICALLY CHANGING THE INTENSITY OF AN ELECTRIC CURRENT

Filed June 12, 1962

FIG. 1

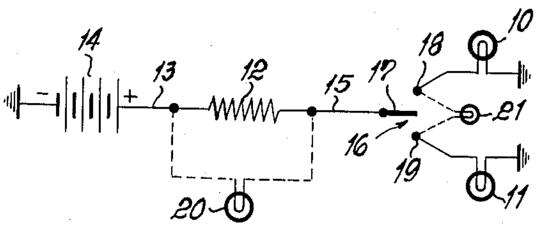


FIG. 2

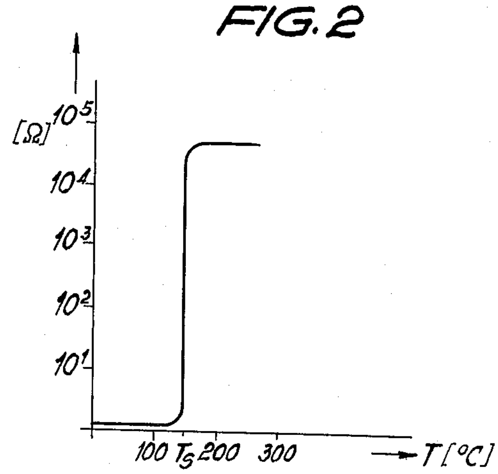
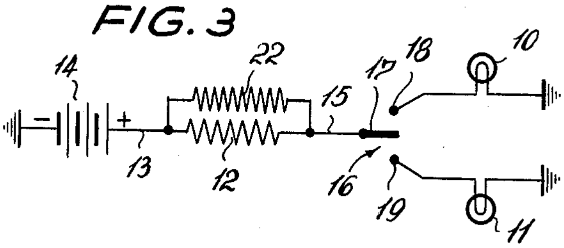


FIG. 3



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ARRANGEMENT FOR PERIODICALLY CHANGING THE INTENSITY OF AN ELECTRIC CURRENT

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The present invention concerns an arrangement for periodically or intermittently energizing an electric circuit and is particularly useful for operating blinker lights on automotive vehicles e.g. the direction signalling lights.

Known devices of this kind have the common feature that periodically contacts are alternatingly brought into engagement with each other and separated from each other. The movement of at least one of the contacts is conventionally produced by the alternating expansion and contraction of a wire or similar element which is heated electrically and cooled off when the circuit is interrupted. Such a known arrangement has the disadvantage that the initial tension of the heatable wire or member must be carefully adjusted in a time consuming manner for each individual arrangement. Also the contact pressure is comparatively weak so that easily the proper operation may be affected by contamination or wear of the contacts. Such devices are sensitive to shock or vibration and have a comparatively short life. Similar conditions are characteristic of devices utilizing bimetal members for controlling the movement of at least one of the contacts. Also devices are known for the above stated purpose which operate without contacts but which are based on the use of transistors as impulse generators but devices of this type are comparatively very expensive and difficult to maintain.

It is therefore one object of this invention to avoid the above-mentioned disadvantages and to provide for a device suitable for the quoted purposes and operating without contacts for interrupting and closing alternatingly a circuit.

It is another object of this invention to provide for an arrangement as set forth which can be produced at comparatively low cost and has a long life.

It is still another object of this invention to provide for an arrangement for said purposes which operates on the principle of periodically changing the intensity of an electric current in a circuit.

With above objects in view the invention provides for an arrangement for periodically changing the intensity of an electric current, comprising, in combination, a source of electric current, and circuit means connected with the source for permitting a current to flow therethrough and including resistor means heatable by such current flowing through the circuit means and having a temperature dependent resistance characteristic so chosen that the resistance of the resistor means changes abruptly at a predetermined temperature and that whenever during heating or cooling the latter assumes the predetermined temperature the current changes between values of lower and higher intensity, whereby every time when the resistor means is heated to a temperature at least equal to the predetermined temperature the intensity of the current is changed from one of the values to another value so that the resistor means is permitted to cool, and when then the temperature of the resistor means decreases beyond the predetermined temperature the intensity of the current is changed from the other value to the one value thereof, so that the intensity of a current flowing through the circuit means is periodically changed between said values.

The novel features which are considered as charac-

teristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing, in which:

FIG. 1 is a schematic circuit diagram of one embodiment of the invention;

FIG. 2 is a resistance vs. temperature characteristic of a resistance member forming part of the embodiment according to FIG. 1; and

FIG. 3 illustrates in the form of a schematic circuit diagram a second embodiment of the invention.

The embodiment according to FIG. 1 illustrates by way of example the application of the invention for operating the blinker lights or direction signalling lights **10** and **11** of an automotive vehicle. The circuit contains a source of energy e.g. a storage battery **14** and a circuit connecting this source with the blinker lights **10** and **11**. The circuit contains a resistor **12** which has a temperature dependent resistance characteristic and is heatable by a current passing therethrough. One end of the resistor **12** is connected by the line **13** with the positive terminal of the battery **14** while its other end is connected by a line **15** with a change-over switch **16** having a manually operable switch arm **17** which may be moved from the illustrated idle position into engagement with either the stationary contact **18** or with a stationary contact **19**. Contact **18** is connected with one terminal of the light **10** the other terminal of which is connected through ground with the negative terminal of the battery **14**. In a similar manner, contact **19** is connected with the other light **11**. For indicating whether the circuit is rendered operative by the movement of the switch arm **17** into engagement with either one of the stationary contacts **18** or **19** a tell-tale lamp **20** may be provided and connected in parallel with the resistor **12**. Instead of this arrangement of the tell-tale lamp **20** a tell-tale lamp **21** may be provided which is connected between the stationary contacts **18** and **19** so that it flashes in the same rhythm as that one of the blinker lights **10** and **11** which is energized upon the movement of the switch arm **17** into engagement with the correspondingly associated stationary contact **18** or **19**. For this purpose the resistance of the tell-tale lamp **21** is so chosen that when, for instance, the switch arm **17** is in engagement with contact **18** for causing blinking of the light **10**, then the tell-tale lamp **21** will light and cause a voltage drop so that not sufficient voltage is available between the contact **19** and across the other blinker lamp **11** to light the latter.

The resistor **12** may have a positive temperature characteristic as illustrated by FIG. 2, and may consist mainly of barium titanate. As can be seen from FIG. 2, in which the ordinate represents resistance and the abscissa represents temperature in degrees centigrade, the resistance of the resistor **12** is very small at temperatures below 140° C. but changes abruptly at a temperature of about 140° C. to more than 10^4 ohms. The critical temperature marked T_s may be changed by adding to the barium titanate other ingredients or elements.

The arrangement according to FIGS. 1 and 2 operates as follows: Whenever the switch member **17** of the switch **16** is moved from its illustrated idle position to one of its operative positions, e.g. into engagement with the stationary contact **18**, current will flow from the positive terminal of the source **14** via line **13**, through resistor **12**, line **15**, switch arm **17**, contact **18** and through the blinker light **10** to ground and thereby back to the negative terminal of the source **14**. Since the resistance of the still cold resistor **12** is very low the blinker light **10** is immediately lit. At the same time the heating of the resistor 12 is started by the current passing therethrough until upon reaching the critical temperature T_s the resistance of the resistor 12 abruptly increases. As soon as the comparatively high value of resistance is reached the current flowing through the resistor and through the blinker light 10 is decreased to an insignificant value. Consequently, the blinker light 10 discontinues the emission of light and the resistor 12 starts cooling off in view of the reduction of the current. As soon as the temperature of the resistor 12 decreases below the critical value T_s its resistance decreases abruptly to the initial value whereby the flow of current from the positive terminal of the source 14 is again increased so that the blinker light 10 is again lit and the resistor 12 is again heated. In this manner, the alternating or intermittent operation of the light 10 is continued as long as the switch member 17 remains in engagement with the contact 18.

It will be understood that the resistor 12 may also be chosen to have a negative temperature characteristic in which case it may consist for instance of silver sulfide. In this case the operation is as follows: When the circuit is closed by actuation of the switch 16 the resistance of the resistor 12 is initially very high so that only a very small current can flow through the resistor 12 and through the connected blinker lamp. Consequently, this lamp is not lit at first. However, the current flowing through the resistor 12 still is strong enough to heat the latter until at a critical temperature its resistance abruptly decreases so that enough current flows therethrough for lighting the respective blinker light. In this case the resistor 12 and the blinker lights are so dimensioned that the energy consumed by the resistor is smaller when its resistance is small than when its resistance is comparatively high. Consequently, the resistor 12 cools off while the energized blinker light emits light. In this manner the temperature of the resistor 12 returns to a value at which its resistance abruptly increases again. At this moment, the emission of light from the connected blinker light discontinues and a condition develops at which the resistor 12 is again heated.

In certain cases it is desirable to produce the heating of the resistor member of the circuit not directly by the current flowing therethrough but by application of heat generated in a separate heater element. An embodiment of this nature is illustrated by FIG. 3. The arrangement is generally the same as that illustrated by FIG. 1 except that a heater element 22 is connected in parallel with the resistor 12 which may be either one of the above described types having either a positive or a negative temperature characteristic. Evidently the operation of the embodiment of FIG. 3 is entirely analogous to that described above for the arrangement according to FIG. 1.

The following are some examples of practical embodiments of the invention.

Examples

Hereinafter:

$R_{20°}$=Resistance of resistor 12 in ohms (Ω) at 20° C.
U=Voltage of source 14 in volts.
$J_{20°}$=Current flowing through resistor 12 at 20° C. in ampere (a.).
$N_{20°}$=Energy consumption in resistor 12 at 20° C. in watts (w.).
R_{FL}=Resistance of e.g. light 10 amounting to 8Ω at an energy consumption of 18 watts.
N_{FL}=Energy consumption of light 10 in watts (w.).

(a) Example according to FIG. 1 Resistor 12 has positive temperature characteristic (barium titanate) and a critical temperature T_s of 140° C.

$R_{20°}=2\Omega$, $R_{140°}=10^4\Omega$
$R_{FL}=8\Omega$ with energy consumption of 18 watts.

Consequently:

$$J_{20°}=\frac{U}{R}=\frac{12}{2+8}=1.2\text{ a.}$$
$$N_{20°}=J^2.R=1.2^2.2=2.88\text{ w.}$$
$$N_{FL}=1.2^2.8=11.52\text{ w.}$$
$$J_{140°}=\frac{12}{10^{4+8}}=1.2.10^{-3}\text{ a.}$$
$$N_{140°}=(1.2.10^{-3})^2.10^4=1.44.10^{-2}\text{ w.}$$
$$N_{FL}=(1.2.10^{-3})^2.8=1.15.10^{-5}\text{ w.}$$

From the above it can be seen that the energy consumption of the resistor 12 at room temperature is greater than after reaching the critical temperature i.e. the resistor is heated until its reaches the critical temperature and cools off after it has reached that temperature.

(b) Example according to FIG. 1. Resistor 12 has a negative temperature characteristic (e.g. silver sulfide) and a critical temperature of 200° C.

$R_{20°}=32\Omega$, $R_{200°}=0.1\Omega$
$R_{FL}=8\Omega$ at an energy consumption of 18 watts.

Consequently:

$$J_{20°}=\frac{U}{R}=\frac{12}{32+8}=0.3\text{ a.}$$
$$N_{20°}=J^2.8=0.3^2.32=2.9\text{ w.}$$
$$N_{FL}=0.3^2.8=0.72\text{ w.}$$
$$J_{200°}=\frac{12}{0.1+8.0}=1.48\text{ a.}$$
$$N_{200°}=1.48^2.0.1=0.22\text{ w.}$$
$$N_{FL}=1.48^2.8=17.6\text{ w.}$$

It can be seen from the above that the energy consumption of the resistor 12 at room temperature is also in this case larger than after reaching the critical temperature so that again the resistor is heated before reaching the critical temperature and cooled off thereafter.

Consequently the connected blinker light 10 will intermittently emit light both in the case of using a resistor 12 with a positive temperature characteristic and in the case of using a resistor 12 having a negative temperature characteristic. The only difference is that in the first case the light 10 immediately light upon moving the switch 16 into operative position, while in the second case the emission of light by the blinker light 10 starts only after the resistor has reached its critical temperaure.

(c) Example according to FIG. 3 Resistor 12 has a negative temperature characteristic, and a critical temperature of 200° C.

$R_{20°}=1000\Omega$, $R_{200°}=0.1\Omega$
$R_{FL}=8\Omega$ at an energy consumtion of 18 watts.
R_{HW}=Resistance of the heater coil 22=20Ω

Consequently the total resistance R' is

$$R'_{20°}=\frac{R_{HW}.R_{20°}}{R_{HW}+R_{20°}}=\frac{20.100}{20+100}\approx 20\Omega$$
$$R'_{200°}\frac{20\cdot 0.1}{20\cdot 0.1}\approx 0.1\Omega$$

and therefore:

$$J_{20°}=\frac{U}{R'+R_{FL}}=\frac{12}{20+8}=0.43\text{ a.}$$
$$N_{20°}=J^2\cdot R=0.43^2\cdot 20=3.7\text{ w.}$$
$$J_{200°}=\frac{12}{0.1+8}=1.48\text{ a.}$$
$$N_{200°}=1.48^2\cdot 0.1=0.22\text{ w.}$$

Again it can be seen from the above that the arrangement according to FIG. 3 would also operate in a manner analogous to that described above with reference to FIGS. 1 and 2.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of an arrangement for periodically changing the intensity of an electric current differing from the types described above.

While the invention has been illustrated and described as embodied in an arrangement for periodically changing the intensity of an electric current by using a resistor having a temperature dependent resistance characteristic, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be secured by Letters Patent is:

1. An arrangement for periodically changing the energization of blinker lights in an electric circuit of an automotive vehicle, comprising, in combination, a source of electric current; at least two blinker lights each requiring a minimum amount of current for energization; and circuit means connecting said source and said blinker lights and including resistor means heatable by current flowing through said circuit means and having a temperature dependent resistance characteristic so chosen that the resistance of said resistor means changes abruptly at a predetermined temperature and that whenever during heating or cooling of said resistor means the latter assumes said predetermined temperature the current supplied therethrough to any one of said blinker lights changes abruptly between a value considerably below said minimum amount of current and a value at least equal thereto, respectively, said circuit means further including switch means for alternatively connecting either one of said blinker lights in series with said resistor means, whereby every time when the resistor means is heated to a temperature substantially equal to said predetermined temperature the current is changed abruptly from one of said values to the other value so that the resistor means is permitted to cool, and when then the temperature of said resistor means decreases to a value below said predetermined temperature the current is changed from said other value to said one value thereof, so that the energization of that one of the blinker lights which is connected by said switch means with the resistor means is periodically changed between an amount sufficient to light it and an amount insufficient to light it.

2. An arrangement for periodically changing the energization of blinker lights in an electric circuit of an automotive vehicle, comprising, in combination, a source of electric current; a blinker light requiring a minimum amount of current for energization; and circuit means connecting said source and said blinker light and including resistor means heatable by current flowing through said resistor means and having a temperature dependent resistance characteristic so chosen that the resistance of said resistor means changes abruptly at a predetermined temperature and that whenever during heating or cooling of said resistor means the latter assumes said predetermined temperature the current supplied therethrough to said blinker light changes abruptly between a value considerably below said minimum amount of current and a value at least equal thereto, respectively, said circuit means further including swift means for connecting said blinker light in series with said resistor means, whereby, every time said resistor means is heated to a temperature substantially equal to said predetermined temperature the current is changed abruptly from one of said values to the other value so that the resistor means is permitted to cool, and when then the temperature of said resistor means decreases a value below said predetermined temperature the current is changed from said other value to said one value thereof, so that the energization of said blinker light which is connected by said switch means with the resistor means is periodically changed between an amount sufficient to light it and an amount insufficient to light it.

3. An arrangement for periodically changing the energization of blinker lights in an electric circuit of an automotive vehicle as claimed in claim 1, wherein said resistor means has a positive temperature dependent resistance characteristic so chosen that the resistance of said resistor means changes abruptly at a predetermined temperature from a comparatively low value to a comparatively high value.

4. An arrangement for periodically changing the energization of a blinker light in an electric circuit of an automotive vehicle as claimed in claim 2, wherein said resistor means has a positive temperature dependent resistance characteristic so chosen that the resistance of said resistor means changes abruptly at a predetermined temperature from a comparatively low value to a comparatively high value.

5. An arrangement for periodically changing the energization of blinker lights in an electric circuit of an automotive vehicle as claimed in claim 1, wherein said resistor means has a negative temperature dependent resistance characteristic so chosen that the resistance of said resistor means changes abruptly at a predetermined temperature from a comparatively high value to a comparatively low value.

6. An arrangement for periodically changing the energization of a blinker light in an electric circuit of an automotive vehicle as claimed in claim 2, wherein said resistor means has a negative temperature dependent resistance characteristic so chosen that the resistance of said resistor means changes abruptly at a predetermined temperature from a comparatively high value to a comparatively low value.

7. An arrangement as claimed in claim 3, wherein said resistor means comprises material principally of barium titanate.

8. An arrangement as claimed in claim 4, wherein said resistor means comprises material principally of barium titanate.

9. An arrangement as claimed in claim 5, wherein said resistor means comprises silver sulfide.

10. An arrangement as claimed in claim 6, wherein said resistor means comprises silver sulfide.

11. An arrangement as claimed in claim 1, further comprising heating means for heating said resistor means and means connecting said heating means across said resistor means.

12. An arrangement as claimed in claim 2, further comprising heating means for heating said resistor means and means connecting said heating means across said resistor means.

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