United States Patent

[11] 3,611,010

[72] Inventor **Rudolf F. Strobel**
Union, N.J.

[21] Appl. No. **857,945**
[22] Filed **Sept. 15, 1969**
[45] Patented **Oct. 5, 1971**

[73] Assignee **Westinghouse Electric Corporation**
Pittsburgh, Pa.

[54] SERIES-TYPE ELECTRIC INCANDESCENT LAMP WITH INTEGRAL AUTOMATIC CUTOUT MEANS

5 Claims, 2 Drawing Figs.

[52] U.S. Cl. **315/75,** 313/315, 315/122
[51] **Int. Cl.** **H01k 1/70**
[50] **Field of Search** 313/315, 331, 332; 315/74, 122, 123, 75

[56] **References Cited**

UNITED STATES PATENTS

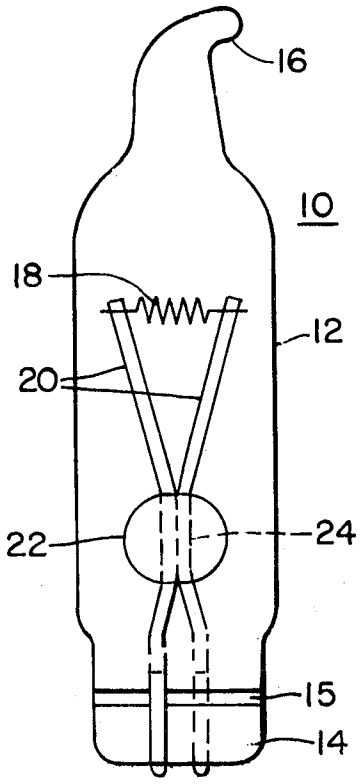
444,929	1/1891	Thomson	315/123 X
1,809,673	6/1931	Butler	315/123 X

FOREIGN PATENTS

894,287	10/1953	Germany	313/315

Primary Examiner—Raymond F. Hossfeld
Attorneys—A. T. Stratton, D. S. Buleza and W. D. Palmer

ABSTRACT: Selected portions of the lead wires located within the envelope are provided with a coating of electrically nonconductive material, such as copper oxide, and are held in contact with one another by a glass bridging member. The intervening layers of nonconductive material insulate the leads under the low voltage conditions which prevail during series-operation of the lamp but break down when the filament burns out and full line voltage is applied to the lead wires. The leads are thus automatically short-circuited and the remaining lamps in the circuit continue to operate. In the case of miniature lamps of the type used to decorate Christmas trees and the like, the leads are made of oxidized dumet wire and are thus inherently provided with a copper oxide coating which serves as the insulating means.



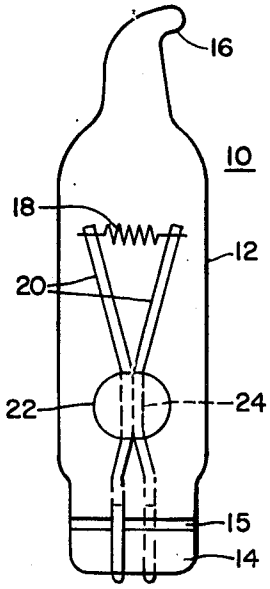


FIG. 1

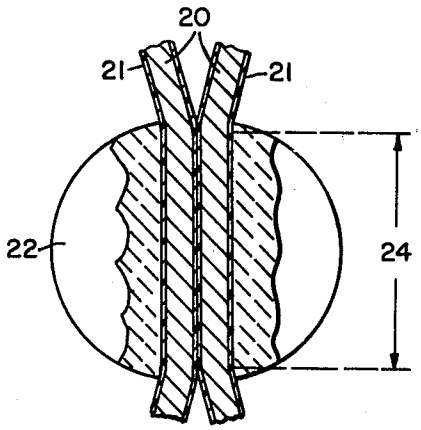


FIG. 2

WITNESSES
Helen M. Farkas
Wm. B. Sellers

INVENTOR
Rudolf F. Strobel

BY
D. S. Bulega
AGENT

SERIES-TYPE ELECTRIC INCANDESCENT LAMP WITH INTEGRAL AUTOMATIC CUTOUT MEANS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to electric lamps and has particular reference to an electric incandescent lamp that is adapted to be operated in a series circuit with other lamps and has an improved integral means for automatically short-circuiting the lamp when it fails and thus preventing it from rendering the circuit inoperative.

2. Description of the Prior Art

In certain applications it is desirable to operate a number of incandescent lamps from a single power source. This is especially true in the decorative lighting field, as for example, in lighting Christmas trees and other festive displays. To enhance the decorative effect, miniature lamps of low voltage and low light output are used. Due to the low voltage for which such lamps are designed, a stepdown transformer is required if the lamps are to be operated in parallel relationship from a 120-volt line. A more convenient and less expensive arrangement is to operate the lamps in series with one another utilizing suitable lamp holders or sockets that are wired together to form a string for a predetermined number of lamps. However, since all of the lamps in the string go out when one of the lamps fails and interrupts the circuit, this arrangement presents the historical problem of finding the burned-out lamp while the entire string is deenergized.

Various proposals have been disclosed in the prior art to overcome this problem. One arrangement which has been used consists of wrapping a length of anodized aluminum wire (known as "magnalium" wire) around the lead wires within the envelope. The conductive properties of the anodized aluminum wire are such that the leads remain insulated from each other while the lamps operate normally at low voltage. However, when one of the filaments burn out and the full line voltage of 120 volts is applied to leads of the lamp the anodized aluminum wire produces an arcing effect which welds it to the respective leads. The resulting short circuit electrically removes the failed lamp from the circuit, thereby allowing the rest of the lamps in the string to remain lighted.

While this arrangement achieves the desired objective of automatically short-circuiting the burned out lamps, it presents a serious manufacturing problem in that it is difficult to wrap the anodized aluminum wire around the lead wires with automatic equipment. Since the anodized aluminum wire has a diameter in the order of only tenths of a mil, it is very fine and fragile and thus breaks easily. In addition, the wrapped wire will not achieve its short-circuiting function unless it is taut and wound very tightly around the lead wires. This is most difficult to achieve under mass production conditions.

SUMMARY OF THE INVENTION

It is accordingly the general object of the present invention to provide an improved incandescent lamp which overcomes the aforementioned problems encountered in series circuit lighting applications.

A more specific object is the provision of a miniature incandescent lamp that is adapted for use in series type circuits such as Christmas tree lighting strings or the like, and has an integral short-circuiting component that is reliable, inexpensive and permits the lamps to be assembled efficiently on a mass-production basis.

The foregoing objects and other advantages are achieved in accordance with the present invention by coating portions of the lead wires with electrically nonconductive material, such as copper oxide, and then placing them in contacting relationship with one another inside the lamp so that the intervening layers of nonconductive material serve as the automatic short-circuiting means. According to a preferred embodiment, the lead wires of a miniature incandescent lamp adapted for use in series-type Christmas tree lighting strings are fabricated from oxidized dumet wire that are so shaped that selected portions of the lead wires inside the lamp touch one another and are held in this position by a bead of fused glass.

BRIEF DESCRIPTION OF THE DRAWING

A better understanding of the invention will be obtained by referring to the accompanying drawing wherein:

FIG. 1 is a front elevational view of a miniature incandescent lamp which embodies the invention; and,

FIG. 2 is an enlarged sectional view through the beaded short-circuiting component of the lamp.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. 1 there is shown a miniature "wedge-base" type Christmas tree lamp **10** which embodies the present invention and consists of a vitreous light-transmitting envelope **12** of elongated configuration that is closed at one end by a press seal **14** and is tipped off at its opposite end in the well-known manner to form a nodular seal tip **16** of fused glass. The envelope **12** is evacuated and contains a filament **18** of tungsten wire or the like that is fastened, as by spot welding, to the ends of a pair of suitable lead-in conductors such as sections of oxidized dumet wire **20**. The outer ends of the dumet lead wires **20** extend through the press seal **14** and are bent upwardly along opposite faces of the seal. The exposed ends of the leads **20** thus extend across transverse grooves **15** formed in the flat faces of the press **14** and serve as the lamp terminals.

In accordance with a preferred from of the invention, short-circuiting of the lamp **10** is automatically achieved when the filament **18** burns out by shaping the inner portions of the oxidized lead wires **20** in such a manner that they contact one another at a location between the press **14** and the filament **18**, as shown in FIG. **2**. The wires **20** are held in this position by a suitable bridging member of electrically nonconductive rigid material, such as a bead **22** of fused glass. As is well known in the art, dumet wire consists of a nickel-iron core wire that is clad with copper which is heat treated to controllably oxidize the copper surface. The nickel-iron core of the dumet wire generally comprises an alloy of 42 percent nickel and 58 percent iron. The copper cladding comprises about 24 percent of the finished wire by weight. The core and the copper cladding are bonded metallurgically so that the composite wire has a continuous metal structure. The nickel-iron core gives strength to the dumet wire and its expansion is close to that of the soft glasses used for lamp envelopes.

The degree to which the copper cladding of dumet wire has been oxidized is indicated by the color of the finished wire. It can vary from the natural color of unoxidized copper to the dark red or purple colors that are characteristics of heavily oxidized copper. For lamp applications, the dumet is oxidized to a degree such the wire segment that is embedded in the glass seal is light salmon pink in color.

In order to enhance the wetting action between the molten glass and the oxidized copper cladding during the sealing-in operation, the dumet is subjected to a "borating" treatment after it is oxidized. This consists of coating the wire with a concentrated solution of a suitable borate compound, such as sodium tetraborate, and then heating the wire to form a fused film of borate. This borate film is readily absorbed by the molten glass and protects the dumet from further oxidization during the sealing-in operation. The borate film melts and is removed from the unsealed portions of the dumet wire by the sealing fires. The borating process is described in detail in U.S. Pat. No. 1,268,647 issued June 4, 1918 to W. L. Van Keuren.

As will be noted in FIG. **2**, the contacting portions of the dumet leads **20** that are embedded in the glass bead **22** are insulated from each other by the intervening layers **21** of copper oxide and constitute an elongated short-circuiting component **24**. Thus, the lamp **10** will operate in the normal fashion when placed in a series circuit for which it is designed. However, when the filament **18** fails and the full line voltage (120 volts in the case of a Christmas tree lamp string operated in the

home) is applied to the leads **20**, the copper oxide coating **21** breaks down and short circuits the leads—thus automatically cutting the lamp out of the circuit and allowing the other lamps in the string to remain operating.

Satisfactory results have been obtained in the case of 6 volt miniature Christmas tree lamps designed for a 20 lamp string by using oxidized dumet wire approximately 0.010 inch in diameter that had a copper oxide coating which comprised about 0.5 percent by weight of the finished wire. This particular group of lamps shorted out at about 60 volts (average). The thickness of the copper oxide coating was approximately 1×10^{1} to 1×10^{14} of an inch.

Tests on similar lamps have shown that the weight of the copper oxide coating can vary from about 0.4 percent to 1 percent based on the wire weight. The corresponding breakdown voltage range was from about 55 to 80 volts (average). The copper oxide coating may include very small amounts of compounds, such as B_2O_3, produced by the borate film when the latter decomposes during the sealing in operation. However, such compounds do not interfere with the function of the Cu_2O coating as an insulator.

While the leads **20** of the lamp **10** are composed entirely of oxidized dumet wire, the copper oxide coating on the exposed portions of the leads which serve as the lamp terminals do not interfere with the normal operation of the lamp since the coating is very thin and is scraped off the exposed parts of the leads when the lamp is inserted into its socket and the socket contacts "bite" into and crimp the leads. A positive electrical connection between the lamp terminals and socket contacts is thus achieved. Of course, when a threaded or other suitable base member is used and is soldered to the outer ends of the leads, a permanent electrical connection is effected by the soldered joints.

As an alternative embodiment, multisection lead wires can be used in which only selected intermediate portions of the leads are made of oxidized dumet wire and held in contacting relationship by a glass bead or the like. The invention is also not limited to oxidized dumet wire or the use of copper oxide as the insulating material. Lead-in conductors composed of other metals whose oxides are nonconductive can thus be used. For example, nickel, nickel-plated copper, or aluminum lead wires can be employed—in which case the insulating material would be the oxide of the respective metals. Leads of solid copper could also be employed. In each case, however, the portions of the leads that are sealed within the glass press or stem of the lamp would be made of dumet or other suitable material that will provide the required hermetic seal.

Hence, the invention can be used with various kinds of lead wires and in lamps of various types, ratings and sizes.

It will be apparent from the foregoing that the objects of the invention have been achieved in that a very reliable and inexpensive self-actuating short-circuiting means has been provided which can be readily built into the lamp during the regular sequence of operations required to mass produce them.

While a preferred embodiment has been illustrated and described, it will be understood that various modifications can be made by those skilled in the art without departing from the spirit and scope of the invention.

I claim as my invention:

1. An electric lamp adapted for operation in a series-lamp circuit, said lamp comprising;
   - a sealed light-transmitting envelope that contains a filament,
   - a pair of lead-in conductors extending into said envelope and electrically connected to said filament, and
   - means for automatically short-circuiting the lamp when the filament fails during operation comprising (a) interior portions of said lead-in conductors that are disposed in side-by-side abutting relationship with one another and have a coating of insulating material thereon, and (b) a rigid bridge member of fused electrically nonconductive material that is bonded to and holds the said coated interior portions of the lead-in conductors in abutting and contacting relationship.
   - the combined thickness of the intervening layers of insulating material separating the abutting coated portions of said conductors being such that said insulating material breaks down when subjected to the full circuit voltage.

2. The electric incandescent lamp of claim 1 wherein said coating of insulating material comprises copper oxide and the underlying parts of said lead-in conductors are composed of copper.

3. The electric incandescent lamp of claim 1 wherein;
   - the abutting interior portions of said lead-in conductors comprise substantially straight wires that are composed of a metal selected from the group consisting of nickel, nickel-plated copper, aluminum, copper and dumet, and
   - said coating of insulating material comprises the oxide of the metal which constitutes the underlying surface of said wires.

4. The electric incandescent lamp of claim 1 wherein;
   - the abutting interior portions of said lead-in conductors comprise substantially straight segments of oxidized dumet wire,
   - said rigid bridge member comprises a vitreous body, and
   - said segments of oxidized dumet wire are embedded in said vitreous body.

5. The electric incandescent lamp of claim 1 wherein:
   - said lamp is of the miniature type and has an elongated envelope that is terminated at one end by a press seal,
   - said lead-in conductors comprise sections of oxidized dumet wire that extend through said press seal,
   - said insulating coating thus comprises copper oxide,
   - said rigid bridge member comprises a bead of fused glass that encloses the abutting portions of said dumet wires, and
   - said glass bead is bonded to intermediate portions of the dumet wires that are located between said filament and press seal.