Dec. 16, 1969 J. J. FRADETTE 3,484,600

METHOD AND APPARATUS FOR INCANDESCENT FILAMENT MOUNTING

Filed May 17, 1967 2 Sheets-Sheet 1

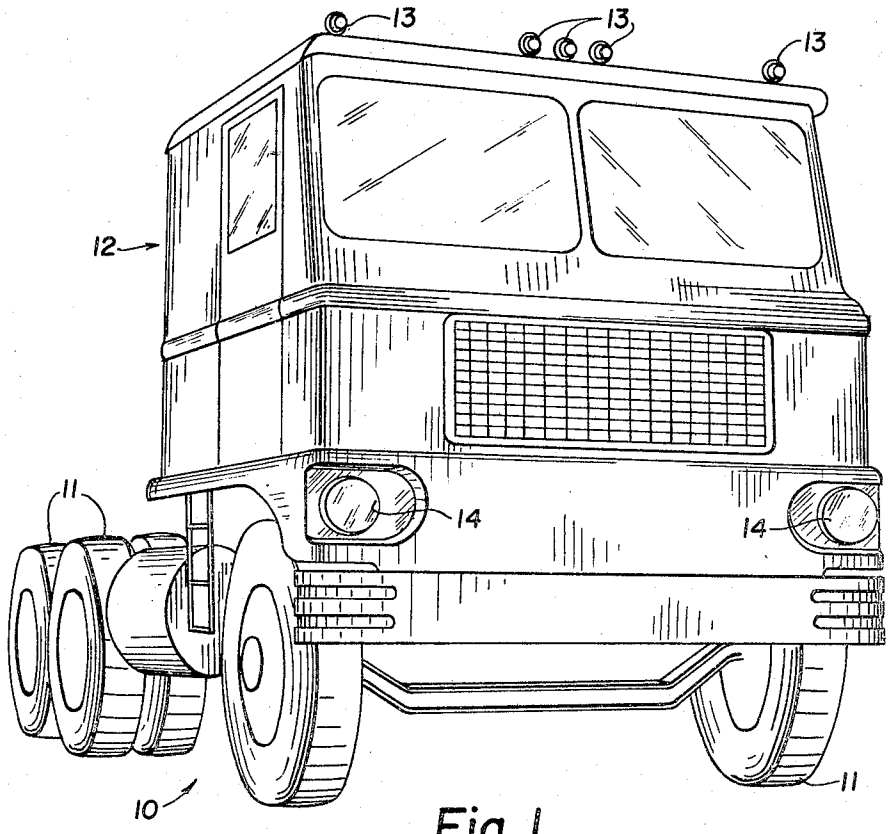


Fig. 1

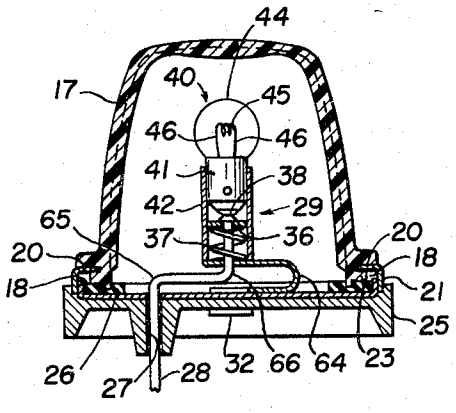


Fig. 2

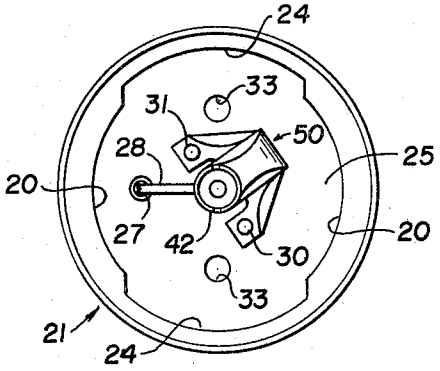


Fig. 3

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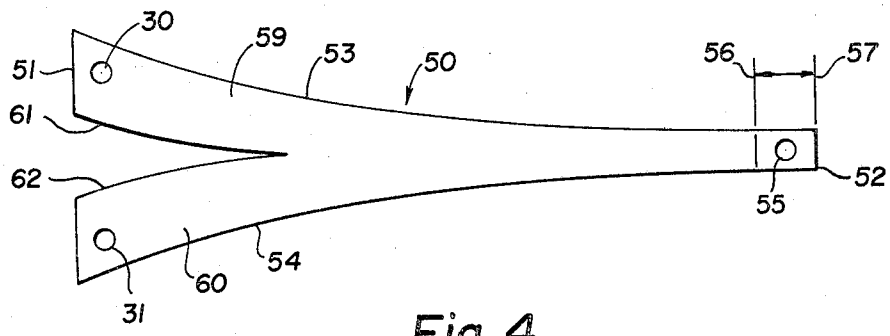


Fig. 4

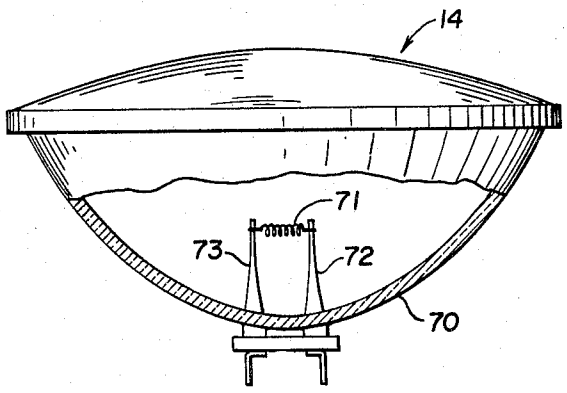


Fig. 6

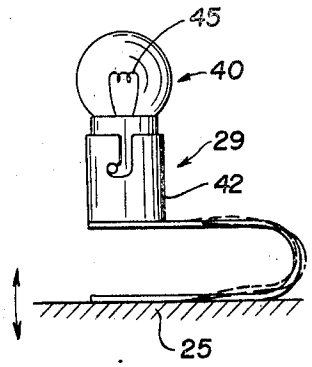


Fig. 5

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METHOD AND APPARATUS FOR INCANDESCENT FILAMENT MOUNTING

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U.S. Cl. 240—90 17 Claims

ABSTRACT OF THE DISCLOSURE

Automotive vehicle equipped with incandescent lamp filament mounting which isolates the filament from vibrations at the resonant frequency of the filament, thereby extending the life of the filament. The frequency isolation is accomplished with an exponential spring. The spring is secured to a lamp body and a socket is mounted at the node of frequencies which are the resonant frequency of the filament.

BACKGROUND OF THE INVENTION

Field of the invention

This invention is directed to a filament mounting for incandescent lamps and primarily directed to a mounting for the socket of small automotive lamps. The mounting is in the form of a spring which isolates the filament from vibrations at the resonant frequency of the filament.

In the automotive industry, the advent of 12-volt systems aggravated a problem that, prior to this discovery, had never been satisfactorily solved. The problem is that of excessive filament failure. The increased failure, as compared with 6-volt systems, is due to the smaller filament sizes in 12-volt bulbs of corresponding candle power. The filament breakage in fact is such a problem that, in heavy-duty diesel trucks and the like, it has deterred the truck manufacturing industry from changing to 24-volt systems. A 24-volt system is desirable and, in the view of some, essential in order to obtain adequate cranking power in the starting systems for heavy-duty diesel engines.

In attempting to determine the cause of filament failures, I conducted a survey of small bulbs such as those used in truck marker and stop lamps. In analyzing a relatively large number of such bulbs after their filaments had failed, I determined that over ninety percent of the failures are what can be termed "cold" failures. That is, over ninety percent of the bulbs failed at a time when they were not illuminated and hot. The explaination for this is that the vast majority of lamp failures in the past have been caused by vibrations and the filaments are more brittle when cold than when hot.

A typical highway tractor will be equipped with five so-called marker lamps. It is fair to say that the average life of those lamps has been approximately five thousand miles. Most such bulbs, so far as my survey could determine, failed due to breakage of the filament caused by vibration and very few burned out. Most such lamps which burned out were lamps from instrument panels within the cab where vibrations are minimized.

By contrast, in tests conducted with lamp assemblies made in accordance with this invention, all bulb failures have been due to burn out of the filament. The earliest bulb failure that has yet been experienced was at one hundred fifty-five thousand miles and the second earliest was at one hundred eighty-one thousand miles. In one truck, of five marker lamps, two were still operating at four hundred twenty-three thousand miles and the other three hand burned out at various times after the truck had traveled in excess of four hundred thousand miles.

Thus, the fact that one bulb failed at one hundred fifty-five thousand miles by burning out simply suggests that that bulb was not as well constructed as those which have lasted in excess of four hundred thousand miles. What has previously been substanitially, if not universally the cause of failure—breakage due to vibration—has been substantially completely, if not completely, obviated.

PRIOR ART

Previously, it has not been recognized that excessive filament failure has been caused by virbations at the resonant frequency of the filament and that the filament can be isolated from such vibrations. While there have been proposals for lamp constructions in the past where a socket is spring mounted to isolate the lamp from shock, none have been expressly designed to dampen vibrations equal to or in beat with the natural frequency of a filament. The result has been excessive filament failure.

SUMMARY OF THE INVENTION

Tests were conducted with a selected bulb type in an attempt to determine the cause of bulb failure. A fatigue curve was generated for the selected bulb type which showed the critical frequency to be 1125 cycles per second. At such a frequency on vibration tests, filaments would break in a very short period of time.

It was then discovered that if the socket was mounted at a particular location on the spring, the filament would be completely free of vibration when the resonant frequency of the bulb, 1125 cycles per second in this example, was applied to the base of the spring. Thus, the socket is mounted at the node for the resonant frequency of the filament of the bulb to be used, totally isolating the filament from its natural frequency. The isolation of the resonant frequency in this test example was so successful it was possible to use smaller bulbs requiring less than fifty percent the amperage because the mechanical strength of the larger filament was no longer required to inhibit filament breakage.

It is believed that in any vehicle operating along a road, it can be assumed that there are random vibrations imposed on each lamp typically and therefore periodically. By appropriate positioning of the filament on a selected spring, this periodic vibration at the resonant frequency of the filament cannot introduce any work energy into the system. This effectively filters out the resonant frequency so that the filament is never excited or forced to vibrate at its resonant frequency.

It has also been discovered that certain spring shapes are advantageous in designing a filament support which will isolate resonant frequencies. It has been discovered for example that if a spring which is tapered in its transverse dimension is used, the positioning of the socket and therefore of the filament along the spring is far less critical than it is with a spring which is rectangular or trapezoidal in shape. It has further been discovered that the best results are obtained if the configuration of the sides of the spring is exponential. For reasons that are not fully understood, this results in a range of points along the narrower end of the spring where the filament is isolated from its resonant frequency.

In the situation where, as in a tail lamp, there are two filaments, normally one is a minor and the other a major filament. That is, in the tail lamp example, the tail light filament will be relatively small and the stop light, being of considerably more candle power, is relatively large and heavy. In that circumstance, the lamp assembly is constructed to isolate the minor filament from vibrations since it is the minor filament which most frequently fails first due to vibrations.

It will be appreciated that while in the summary the description has been directed to a construction where the socket is mounted on a spring, it is within the scope of the invention to, in larger bulbs such as sealed-beam headlights for example, mount the filament itself on a pair of springs which serve as the conductors for supplying electric energy to the filament and also serve to isolate the filament from vibrations of its own resonant frequency.

The construction of this assembly then has the advantages of very marked improvement in the life of the filaments. This permits 24-volt, or even higher volt systems where desired, and even isolates the lamp from shock. It also permits the use of smaller lamps with lower current drains in many applications where, prior to this invention, bulbs of larger size than required for the lighting function were used simply to provide filaments having sufficient mechanical strength to last something resembling a reasonable length of time.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a perspective view of a highway tractor equipped with lamp assemblies of this invention;

FIGURE 2 is a cross-sectional view of an improved marker lamp assembly;

FIGURE 3 is a top plan view of the base and socket and supporting structure of the marker lamp assembly of FIGURE 2;

FIGURE 4 is a plan view of the filament resonant frequency isolating spring of the assembly of FIGURES 2 and 3 prior to bending into its finished configuration;

FIGURE 5 is a somewhat diagrammatic view illustrating the flexure of a frequency isolating spring of a lamp assembly made in accordance with this invention; and,

FIGURE 6 is a somewhat diagrammatic sectional view of a sealed-beam lamp with frequency isolating springs within a glass envelope and directly supporting a filament.

Referring to the drawings and FIGURE 1 in particular, a highway tractor is shown generally at **10**. The tractor **10** has the usual road wheels **11** and is of the well-known cab-over-engine type. The tractor has a cab **12** mounted above an engine (not shown) and the road wheels. The illustrated tractor has five marker lamps **13** and sealed-beam headlamps **14**.

Referring now to FIGURES 2 and 3, the marker lamp assembly includes a somewhat dome-shaped lens **16**. The lens is of conventional molded plastic construction with flutes, not shown, along sidewall portions **17**. The lens **16** has a pair of mounting tongues **18** which, when the lamp is assembled are below mounting flanges **20** of a mounting ring **21**. The flanges **20** project into a groove **23** in the lens and above the tongues **18**.

The tongue and mounting ring construction is more clearly understood by reference to FIGURE 3 and is conventional. The mounting ring **21** is secured to a base **25**. The mounting ring **21** has a pair of diametrically opposed cut-out portions **24**. When the lens **16** is connected to the base **25**, the tongues **18** are passed through the cut-out portions **24**. The lens is then pressed inwardly against a deformable sealing gasket **26** and rotated until the tongues **18** are disposed beneath the mounting flanges **21**.

The base **25** is molded of a suitable material such as hard rubber. The base **25** includes a wire passage **27** for a supply conductor **28**. A socket assembly shown generally at **29** is riveted or otherwise suitably secured to the base as by rivets **30**, **31** connected to a ground strap **32**. The ground strap **32** is suitably ground to the frame when the base **25** is secured to the frame as by fasteners inserted through the mounting apertures **33**, FIGURE 3.

The socket assembly **29** includes the usual contact **26** connected to the supply conductor **28**. The contact is biased by a contact spring **37** into engagement with base **38** of a bulb shown generally at **40**. The bulb **40** has a shank **41** which is conventionally secured to a socket **42**. The socket **42** serves both to mechanically mount the bulb and to provide a connection to grounding on the

frame. The bulb **40** has the usual generally-spherical glass envelope **44** which houses a filament **45**. The filament **45** is connected by conductors **46** to the base **38** and to the shank **41** in the usual manner.

The socket **42** is connected to the base **25** by a frequency isolation spring **50**. The spring **50** is preferably of a construction in which the transverse dimension diminishes from a base end **51** to a smaller socket mounting end **52**, FIGURE 4. As indicated in the introduction to this application, the construction is preferably exponential so that sides **53**, **54** are in the shape of logarithmic curves. It has been found that with this exponential construction, location of a conductor aperture **55** near the socket end **52** of the frequency isolation spring **50** is far less critical than with rectangular or trapezoidal configurations and in fact considerably less critical than with a linearly tapered construction.

The range of suitable locations for the conductor aperture **55** and therefore the axis of the socket **42** is indicated in FIGURE 4 by the lines **56**, **57**. With rectangular or trapezoidal configuration, the locus of points which will be along a node of the resonant frequency of a filament will be essentially a line transverse to the spring while, as indicated schematically by the lines **56–57** it has been found that the socket may be positioned with its axis anywhere within the generally rectangular configuration between those two lines.

It has been further found that in order to provide a satisfactory and stable mounting, space for the wire, and the like, without detracting from the characteristics of the mounting on an exponential type spring, the frequency isolation spring **50** may have leg portions **59**, **60**. These leg portions have transverse dimensions which are exponential. In other words, inner surfaces **61**, **62** of the leg portions **59**, **60** respectively, are exponential with respect to sides **53**, **54** respectively.

It will be recognized from an examination of FIGURES 2 and 3 in comparison with FIGURE 4 that the spring shown in a flat condition in FIGURE 4 is bent at **64** to provide the mounting configuration shown in FIGURES 2 and 3. It will be further recognizedd that the portion of the spring adjacent the socket end **52** is somewhat enlarged to provide adequate body to the spring for secure mounting of the socket **42**. Nonetheless, the spring is exponential in shape and the axis of the socket is secured to the isolation spring **50** at a location where frequencies of a resonant level of the filament are isolated. The isolation is demonstrated by reference to FIGURE 5. There, the vibrations of the isolation spring **50** are indicated schematically by the dotted lines. As shown, the lamp assemly **29** remains essentially stationary with respect to the base **25** even though the spring is vibrating appreciably at the frequency which is the resonant frequency of the filament **45**.

It has also been found that the conductor **28** may conduct vibrations at the resonant frequency of the filament **45**. Accordingly, the conductor aperture **27** in the base **25** is radially offset from the conductor aperture **55** in the isolation spring **50** to provide bends at **65**, **66**, in the conductor, which bends permit the wire to flex and therefore fail to transmit vibrations to the filament.

Referring now to FIGURE 6, the sealed-beam headlamp **14** is shown in a somewhat schematic form there. The headlamp **14** has an envelope **70** which houses a filament **71**. Conductors **72**, **73** which support the filament **71** are secured at their bases to the remainder of the headlamp. The conductors **72**, **73** are formed to be exponential vibration isolation springs so that resonant frequencies of the filament **71** are not transmitted to it. It is preferred that the isolation conductors **72**, **73** differ somewhat from one another in configuration so that they do not resonate with one another.

The proper location of the socket **42** on the spring **50** is deterimned by trial and error. So far as I am aware, there is no mathematical formula for determining the ap-

propriate and critical distance from the rivets **30, 31** to the axis of the socket. One process that has been developed is to:

(1) First determine the resonant frequency of the filament;

(2) Apply vibrations to the base of the frequency isolation spring at the resonant frequency; and

(3) Trim the length of the spring by trial and error until the filament doesn't vibrate at that resonant frequency. A stroboscope may be used for this purpose.

After the appropriate length has ben determined, a die can be constructed to accurately and inexpensively produce springs of the appropriate length.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. In combination with a frame structure which is subjected to vibration during use, a lamp assembly mounted on the frame, said lamp assembly including the improvement comprising:

(a) a filament having a resonant frequency; and

(b) resonant frequency vibration isolation means interposed between and connected to the filament and the frame, the space between such connections being such that one connection is substantially at a node of vibrations when vibrations at said resonant level are transmitted to said isolation means by said frame.

2. The combination of claim **1** wherein said isolation means is a spring.

3. The combination of claim **2** wherein the spring is of diminishing transverse dimension from one end to the other.

4. The combination of claim **3** wherein the larger end of the spring is near the base end and the connection of the filament to the spring is near the smaller end, and wherein the filament-to-spring connection includes a socket and a bulb which includes the filament.

5. The combination of claim **3** wherein the spring is an exponential spring.

6. The combination of claim **5** wherein the exponential spring includes a pair of mounting legs at the base end thereof.

7. The combination of claim **2** wherein said isolation means includes a pair of legs at a base end thereof.

8. A marker lamp assembly for an automotive vehicle or the like comprising:

(a) a base;

(b) a lens secured to the base;

(c) a socket assembly mounted on the base and within the lens, the socket assembly including a contact and a bulb with a filament therein;

(d) the assembly also including a socket mounting a bulb and for completing a circuit with the bulb;

(e) said assembly including a frequency isolating spring connecting the socket to the base with the socket positioned on the spring at a node of vibrations at a frequency resonant to the filament; and

(f) a conductor connected to the contact for supplying current to the contact and thence to the bulb.

9. The device of claim **8** wherein the conductor passes through an aperture in the base which aperture is offset from the socket and the conductor is bent to extend from the socket to the aperture in the base.

10. The device of claim **8** wherein said spring is an exponential spring.

11. The device of claim **10** wherein said spring has a pair of leg portions near the end secured to the base and wherein the other end is of smaller transverse dimension than the total transverse dimension of the base leg portions.

12. The process of mounting a lamp comprising the steps:

(a) providing a filament having a resonant frequency;

(b) forming a spring having non-linear frequency-transmitting characteristics;

(c) securing one end of the spring to a base; and

(d) securing the filament to the spring at a node of vibrations imposed on the base of the spring at said resonant frequency.

13. The method of claim **12** wherein the node is located by trial and error connection of the filament to the spring at various locations until the filament is connected at the node.

14. The method of claim **13** wherein the trial and error includes trimming portions of the spring from the filament end thereof.

15. The combination of claim **1** wherein the lamp assembly includes a lamp having a sealed envelope and wherein said filament and said resonant frequency vibration isolation means are both mounted within said envelope.

16. A lamp assembly comprising:

(a) a base;

(b) a socket;

(c) a spring mounting the socket on the base; and

(d) said spring having:

(i) non-parallel side walls of exponential configuration such that the transverse dimension of the spring near the base is greater than the transverse dimension of the spring near the socket; and

(ii) spaced legs at the base including non-parallel side walls of exponential configuration.

17. The assembly of claim **16** wherein the spring is of generally U shape in a plane transverse to said exponential configurations.

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