Dec. 27, 1966 W. D. YOUNG 3,295,007

DIFFERENTIAL OUTPUT TUBULAR INCANDESCENT LAMP

Filed June 25, 1964

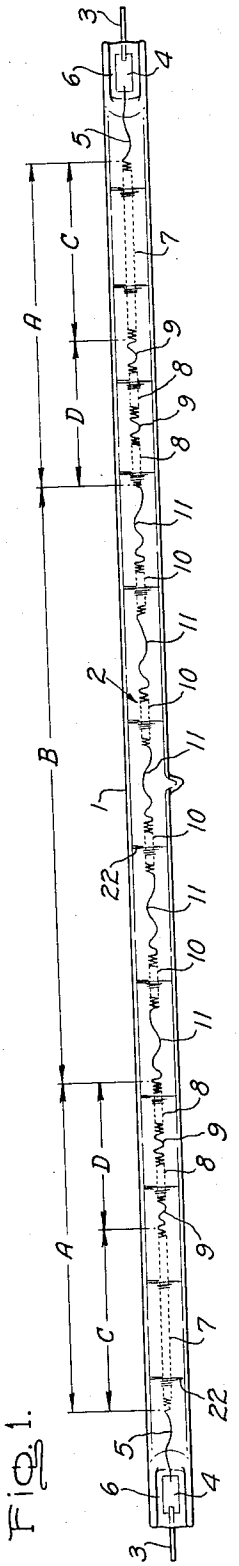


Fig. 1.

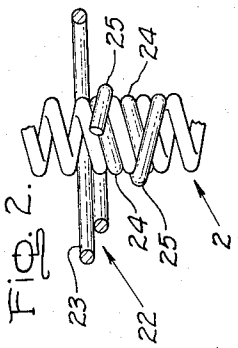


Fig. 2.

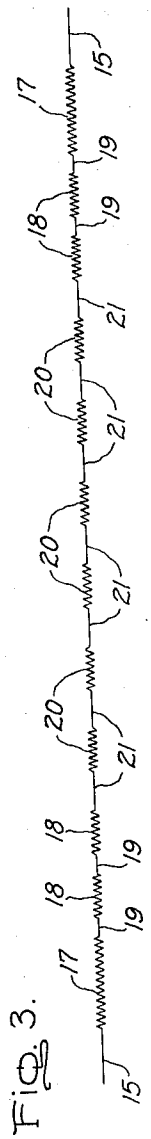


Fig. 3.

Inventor:
Warren D. Young
by Otto Tichy
His Attorney

United States Patent Office 3,295,007 Patented Dec. 27, 1966

3,295,007

DIFFERENTIAL OUTPUT TUBULAR INCANDESCENT LAMP

Warren D. Young, Cleveland Heights, Ohio, assignor to General Electric Company, a corporation of New York

Filed June 25, 1964, Ser. No. 377,973
6 Claims. (Cl. 313—273)

This invention relates generally to electric incandescent lamps, and more particularly to tubular lamps comprising an elongated sealed tubular envelope containing an incandescent filament extending longitudinally thereof.

Still more particularly, the invention relates to a tubular lamp having a differential output of radiant energy (visible or infrared or both) such that more energy is emitted from the ends of the lamp than from the center portion.

In certain photoreproduction processes, as the paper to be reproduced moves past a long linear source of radiant energy or is momentarily irradiated by such a source, each point in the paper receives energy from the entire lamp. If the lamp energy output is uniform along its length, then the edges of the paper will not receive as much energy as the center and the result is uneven exposure. By raising the radiant energy output in the ends of the lamp, or reducing the output from the center, it becomes possible to compensate for this "end fall-off". Heretofore, lamp combinations have been used to achieve this effect. For example, a shorter lamp has been placed in overlapping relation to each end of a long lamp, or two lamps of equal length have been arranged in axial alignment with a space between the proximate ends thereof. Such arrangements result in problems of increased maintenance and expense.

It is therefore among the objects of this invention to provide differential output from a single lamp, and to provide a construction which is relatively simple and inexpensive, and which is capable of manufacture on standard available machinery.

It is a further object to provide the desired effects by a filament structure preferably made of a single length of wire.

It is a still further object to provide a filament structure which makes it possible to retain the use of standard supporting elements for retaining the filament in the envelope axis.

Further features and objects of the invention will appear from the following description of species thereof and from the drawing wherein:

FIG. 1 is a side elevation of a lamp comprising the invention;

FIG. 2 is a fragmentary elevation, partly in section, of a portion of the filament and a form of supporting element attached thereto; and

FIG. 3 is a diagrammatic illustration of a modified proportioning of the filament.

Briefly stated, in accordance with the invention, the above stated objects are achieved by forming the filament of a multiplicity of helically coiled segments of closely spaced wire turns of substantially uniform pitch, the segments being spaced apart longitudinally by generally straight or uncoiled sections of the filament wire, and by so varying the relative lengths of the coiled segments and the spaces that the total length of the coiled segments per unit length of envelope is substantially greater at the ends of the envelope than at the central portion thereof whereby more radiant energy is produced in the said ends than in the said central portion of the envelope. In other words, more segments, or longer segments, are wound in the ends of the filament coil than in the center. The spaces between segments may amount, for example, to about one-third to one-half the total coil length.

Referring to FIG. 1 of the drawing, the lamp shown therein comprises an elongated tubular envelope **1** of radiation transmissive material, for example fused silica or quartz, containing an axially extending filament **2**, preferably of tungsten wire. At each end the filament is connected to an external lead-in conductor **3** through a thin molybdenum foil section **4** to which is connected a generally straight end leg portion **5** of the filament. The foil section **4** of the lead-in conductor is hermetically sealed and embedded in a flattened pinch seal portion **6** at each end of the envelope **1**.

The invention is particularly applicable to lamps of the so-called iodine cycle type such as disclosed and claimed in Patent 2,883,571 to E. G. Fridrich et al. wherein the envelope **1** contains a small quantity of iodine as a regenerative getter which serves to return to the filament **2** tungsten vapor which is evolved therefrom during operation of the lamp. The envelope also contains a filling of inert gas, such as argon, at a substantial pressure of six hundred to several thousand millimeters of mercury. Such lamps are capable of operation at high efficiencies for a long life with virtual freedom from blackening. Another form of lamp in which the invention may be employed is the so-called quartz heat lamp of the type described and claimed in Patent 2,864,025 to A. G. Foote et al. wherein the envelope is also filled with an inert gas such as argon and the filament **2** is operated at somewhat lower temperatures for efficient emission of infrared radiation.

In accordance with the invention, the lamp is made to produce more light at the ends than at the center by providing more coiled segments, or longer segments, at its ends than at the center. In the particular lamp illustrated in FIG. 1, there is a relatively long helically coiled segment **7** at each end, followed by a pair of substantially shorter segments **8** which are spaced apart by relatively short spacer sections **9** which are relatively straight or uncoiled. The central portion of the filament coil is composed of relatively short coiled segments **10** (here shown as four in number) which are separated by relatively long uncoiled spacer sections **11**. The several shorter coiled segments **8** and **10** may all be of substantially the same length, but the spacer sections **10** are substantially longer (for example, about twice as long) as the spacer sections **9**. The several segments **7**, **8** and **10** are preferably coiled to the same uniform pitch.

By way of example, good results may be obtained by so correlating the segments and spaces that the total length of the segments **7** and **8**, **8** at each end of the filament constitute about one-fourth of the overall filament length (as indicated at A) and have a length preferably in the approximate range of two-thirds to equal the total length of the four segments **10** constituting about one-half of the overall filament length (as indicated at B). The total filament length is considered as constituted by the sections A, B, A; that is, the end legs **5** are not included in the effective filament length. In some cases it may be desirable to increase the segment length (and light output) in the end quarter A to as much as three times the segment length in the central half B.

Stated somewhat differently, when the effective filament length is divided into two end sections A, each constituting one-quarter of the filament length, and a central section B constituting one-half on the filament length, then each end A may contain preferably from about two-sevenths to one-third, and up to three-sevenths of the total coiled segment lengths, with corresponding relative light output. In other words, generally speaking, preferably about one-third, or slightly less, of the light may be emitted from each one-quarter end length A of the filament, and one-third, or slightly more, from the central half length section B. As actually illustrated in FIG. 1,

about 37% of the segment length is located in each quarter end section A, and 26% in the central half section B.

Still more particularly, in the illustrated example shown in FIG. 1, each quarter section A is further broken down into sections C and D constituting, respectively, the long segment **7** and the two adjacent shorter segments **8, 8**. As thus subdivided, about 23⅓% of the total coiled segment length is at each extreme end C constituting 15% of the total filament length, about 26⅔% of the total coiled segment length is in the central half section B of the overall filament length, and about 13⅓% of the coiled segment length **8, 8** is in each section D constituting about 10% of the overall filament length.

FIG. 3 shows a modified filament form as coiled before mounting in the lamp envelope; it may be remembered that in the course of mounting the filament in the envelope, it is stretched taut and actually elongated slightly. In this case, exclusive of the end legs **15**, the total effective filament length is composed of relatively long coiled end segments **17**, followed by two short coiled sections **18** separated by short relatively straight spacer sections **19**, and the central portion of the filament is composed of six short coiled segments **20** separated by relatively large spacer sections **21** which are slightly more than twice the length of spacer sections **19**. All eight short segments **18** and **20** may be of the same length. In this case, each of the long end segments **17** together with the two adjacent shorter segments **18, 18** lie within the end one-quarter of the overall filament length and constitute about 28% of the total filament length, and the six short segments **20** lie within the central half of the total filament length and constitute about 44% of the filament length.

In order to maintain the filament substantially in the axis of the envelope **1**, it is provided with support members **22** (FIGS. 1 and 2) preferably by attachment of a single support to each of the short segments and a pair of supports to each of the longer end segments. In accordance with the invention, the formation of the filament into spaced segments each containing coil turns of substantially uniform pitch, makes it possible to use conventional forms of support members such, for example, as the wire spiral members shown in the aforesaid Patents 2,883,571 and 2,864,025, or disc members such as shown in Patent 2,813,993 to Fridrich. Such supports would not be feasible if it were attempted to obtain differential light output by using differential coil pitches.

The particular support member **22** shown in FIG. 2 is of the type disclosed and claimed in application Serial No. 97,803 to V. A. Levand, Jr., filed March 23, 1961 now Patent No. 3,168,670. It consists of a single length of wire comprising an outer circular coil portion **23** for engagement with the inner wall of the envelope **1** and which is joined to several helical turns **24** which are coaxial with and lie between adjacent turns of one of the segments of the filament coil **2** and are tightly secured in place by reversely wound and overlapping outer turns **25**.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. A differential output tubular incandescent lamp comprising an elongated tubular envelope of radiation-transmissive material, lead-in conductors sealed in and extending from respective ends of said envelope, an incandescible coiled wire filament extending longitudinally of said envelope and electrically connected solely at its ends to respective said lead-in conductors, said filament being formed of a multiplicity of helically coiled segments of closely spaced wire turns of substantially uniform pitch spaced apart longitudinally by generally straight sections of the filament wire, the relative lengths of coiled segments and spaces being varied such that the total length of coiled segments per unit length of envelope is substantially greater at the ends of the envelope than at the central portion of the envelope to the extent that about one-fourth of the overall filament length at each end thereof contains total lengths of coiled segments amounting to at least about two-thirds of the total coiled segment lengths in the central half of the filament length whereby more radiant energy is produced in the said ends than in the said central portion of the evelope.

2. A lamp as set forth in claim **1** wherein about one-fourth of the overall filament length at each end thereof contains total lengths of coiled segments in the approximate range of two-thirds to three times the total coiled segment lengths in the central half of the filament length.

3. A lamp as set forth in claim **1** wherein about one-fourth of the overall filament length at each end thereof contains about two-sevenths to three-sevenths of the total coiled segment lengths, and the central half of the overall filament length contains the remainder of the coiled segment lengths.

4. A lamp as set forth in claim **1** wherein about one-fourth of the overall filament length at each end thereof contains about two-sevenths to one-third of the total coiled segment lengths, and the central half of the overall filament length contains the remainder of the coiled segment lengths.

5. A differential output tubular incandescent lamp comprising an elongated tubular envelope of radiation-transmissive material, lead-in conductors sealed in and extending from respective ends of said envelope, an incandescible coiled wire filament extending longitudinally of said envelope, said filament being formed of a multiplicity of helically coiled segments of closely spaced wire turns of substantially uniform pitch spaced apart longitudinally by generally straight sections of the filament wire, the relative lengths of coiled segments and spaces being varied such that the total lengh of coiled segments per unit length of envelope is substantially greater at the ends of the envelope than at the central portion of the envelope whereby more radiant energy is produced in the said ends than in the said central portion of the envelope, and support members attached to only coiled segment portions of the filament to the exclusion of said generally straight sections and engageable with the inner wall of said envelope to support the filament axially therein.

6. A lamp as set forth in claim **5** wherein at least one said support is attached to each of said coiled segments.

References Cited by the Examiner

UNITED STATES PATENTS

2,306,559	12/1942	Pearson	315—66
3,073,986	1/1963	Hodge	313—315 X

JOHN W. HUCKERT, *Primary Examiner.*

A. J. JAMES, *Assistant Examiner.*