Oct. 11, 1966 T. C. RETZER 3,278,778

HIGH-CURRENT SEAL FOR ELECTRIC DISCHARGE LAMP

Filed April 26, 1963

FIG. 1.

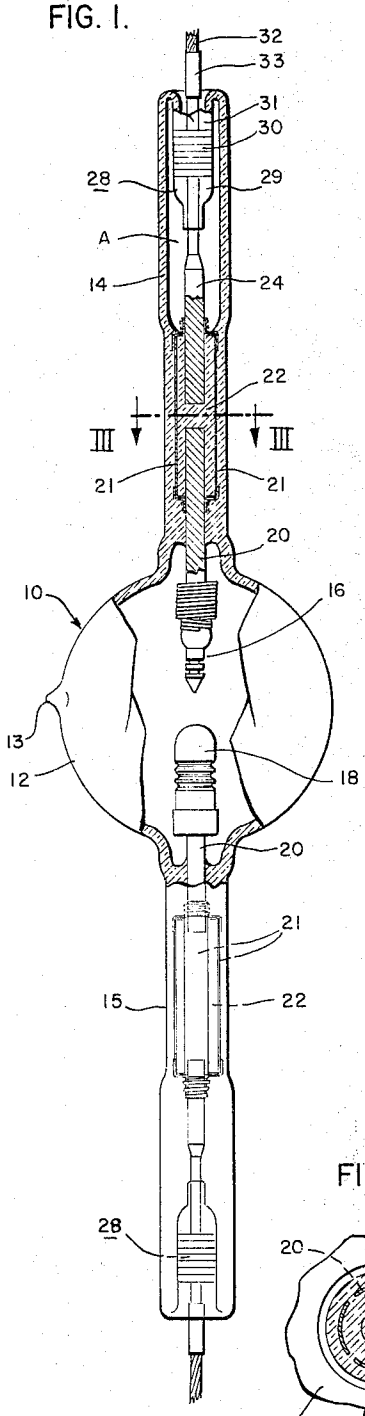


FIG. 2.

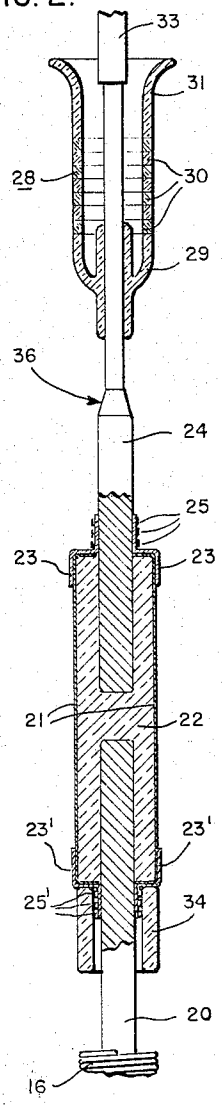


FIG. 4.

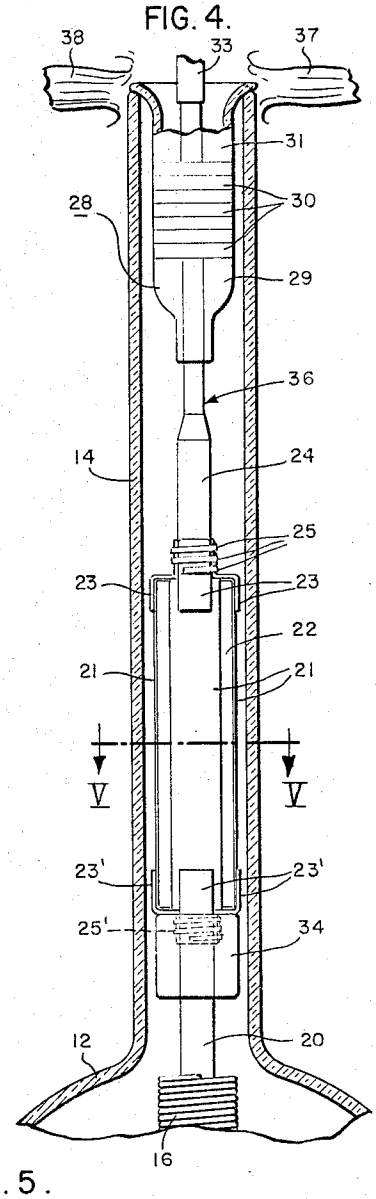


FIG. 3.

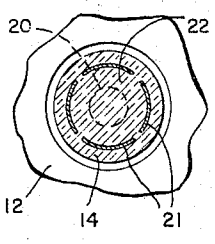
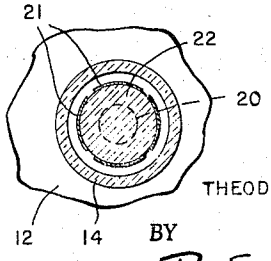


FIG. 5.



INVENTOR.
THEODORE C. RETZER.

BY D. S. Buleza
AGENT.

United States Patent Office 3,278,778 Patented Oct. 11, 1966

3,278,778

HIGH-CURRENT SEAL FOR ELECTRIC DISCHARGE LAMP

Theodore C. Retzer, Cedar Grove, N.J., assignor to Westinghouse Electric Corporation, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Apr. 26, 1963, Ser. No. 275,939
5 Claims. (Cl. 313—43)

This invention relates to seals and has particular reference to ribbon seals for short-arc mercury or xenon electric discharge lamps of high wattage rating.

One of the most expensive and critical items in a short-arc electric discharge lamp are the seals. This is primarily due to the fact that they must not only meet the stringent current-carrying requirements of such lamps but must do so without rupturing or otherwise exposing the lead-in conductors to excessive oxidation despite the extremely high operating temperatures that prevail during use. In one type of seal designed for short-arc lamps having a rating of about 500 watts or so, several metal ribbons are mounted on a vitreous core to form a lead-in conductor assembly which is subsequently sealed into a tubular arm that is attached to the envelope. The outer ends of the ribbons are connected to a conductor rod and the envelope arm is provided with a graded seal at its outer end so that it can be sealed directly to the rod. A seal of this character and the method of making it are described in U.S. Patent No. 2,682,009 issued June 22, 1954, to H. D. Fraser.

While the aforementioned seal construction is satisfactory for lamps of relatively low wattage (below 1 k.w.), it is much too expensive for use in lamps having ratings of 5 k.w. and above because of the large diameter electrodes required. Since the electrodes are inserted into the envelope through the arms during assembly, the diameter and cost of the graded seals increase markedly as the size of the electrodes increase.

It is accordingly the general object of the present invention to provide an improved seal for short-arc lamps of high-wattage rating.

Another object is the provision of a high-current seal for multi-kilowatt short-arc lamps that is inexpensive, rugged and easy to make.

Still another object is the provision of a seal assembly that will permit short-arc lamps having large diameter electrodes to be fabricated using graded seals of conventional size.

The aforesaid objects, and other advantages which will become apparent as the description proceeds, are achieved in accordance with the present invention by joining the outer end of the envelope arm to the lead-in conductor rod by means of a re-entrant stem which includes the graded seal component. This construction avoids the expense and complications encountered when the graded seal is made part of the envelope arm and then sealed directly to the conductor rod as in the prior art practice. As a result, graded seals of standard size may be used even though the diameter of the electrode and, hence of the envelope arms, are quite large.

In addition, since the end of the envelope arm need only be sealed to the flared end of the stem assembly instead of directly to the much smaller lead-in conductor rod, the sealing-in operation and fabrication of the lamp are greatly facilitated.

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

FIGURE 1 is an elevational view, partly in section, of a 5 kw. short-arc lamp incorporating the improved seal of the present invention;

FIG. 2 is an enlarged fragmentary view, mainly in section, of the electrode and lead-in conductor assembly before it is inserted into the envelope arm and sealed therein;

FIG. 3 is a cross-sectional view through the seal of the completed lamp along the line III—III of FIG. 1;

FIG. 4 is an elevational view, partly in section, illustrating the first step in fabricating the seal in accordance with the invention; and,

FIG. 5 is a cross-sectional view through the partly-fabricated seal along the line V—V of FIG. 4 and illustrates the spacing that is initially present between the seal assembly and the envelope arm.

While the improved seal of the present invention can be advantageously used in various types of electrical devices, it is especially adapted for use in conjunction with short-arc lamps that require massive electrodes and it has accordingly been so illustrated and will be so described.

Construction

In FIG. 1 there is shown a 5 kw. mercury short-arc lamp **10** comprising an envelope **12** of quartz or similar high-temperature vitreous material having a pair of oppositely disposed arms **14** and **15** through which the lead-in conductor assemblies are sealed. This particular lamp is designed for D.C. operation and accordingly contains a cathode **16** and a relatively massive anode **18** which project into the bulbous portion of the envelope from the aforesaid arms. The envelope contains a charge of mercury and an inert starting gas such as argon. If desired, a filling of xenon gas at a pressure of about 1 to 5 atmospheres can be used, with or without the mercury. Evacuation of the envelope **12** before the introduction of the ionizable medium is accomplished through an exhaust tubulation which is subsequently sealed off in the usual manner to leave a short tip **13**.

The cathode **16** and anode **18** are each held in opposing relationship within the envelope **12** by a support rod **20** that is anchored in the sealed portion of the respective arms. Since each of the seals are identical, only the one formed with the upwardly extending arm of the lamp as viewed in FIG. 1 will be described. As shown, one end of the support rod **20** is anchored in a vitreous core **22** that is preferably fabricated from quartz and is fused with the encircling end portion of the arm **14**. A lead-in conductor rod **24** is anchored in the opposite end of the core **22** and extends through the arm **14** to the end thereof where it is joined to a flexible lead **32** by means of a nickel sleeve **33**. The support rod **20** and conductor rod **24** are electrically connected by a series of thin metal ribbons **21** that are hermetically embedded in the sealed-off portion of the arm **14** and joined to the ends of the foregoing rods.

The simplification and reduction in the cost of the seal is achieved in accordance with the present invention by anchoring the outer end of the lead-in conductor rod **24** within the arm **14** by means of a re-entrant stem **28** that is sealed to the end of the arm and hermetically fused around an intermediate portion of the conductor rod. As shown in FIG. 1, this stem consists of a glass bushing **29** that is joined to a tubular graded seal **30** which, in turn, is joined to a quartz flare **31**.

As shown in FIG. 2, the cathode **16**, its support rod **20**, the quartz core **22**, conductor rod **24**, stem **28**, and the ribbon conductors **21** are joined together in the above-described manner to form a seal assembly **36** that is insertable into the tubular arm **14** of the envelope **12**. In this particular embodiment, four ribbon conductors **21** of molybdenum or the like are employed and uniformly spaced around the periphery of and extend along the core **22**, which is of cylindrical configuration see FIGS. 1 and

5). The core thus serves as a supporting mandrel for the delicate ribbons. The ends of the main ribbons **21** are spot welded to heavier jumper ribbons **23** the ends of which are fastened to the conductor rod by several turns of platinized molybdenum ribbon **25**. The opposite ends of the ribbon conductors **21** are similarly fastened to the support rod **20** by jumper ribbons **23'** and several turns of ribbons **25'**. As will be noted, the glass bushing **29** which comprises the inner end of the stem **28** is sealed to an intermediate portion of the conductor rod **24** and the latter extends through the stem **28** to the end of the flared portion **31** thereof.

The tubular graded seal **30** constitutes the intermediate portion of the stem **28** and consists of a series of glass rings that are joined together and have slightly different and progressively higher expansion coefficients. The glass at the end of the graded seal **30** joined to the quartz flare **31** has a low coefficient of expansion whereas the one at the opposite end that is joined to the glass bushing **29** has a much higher coefficient. The stem **28**, accordingly, compensates for the marked difference in the coefficients of expansion of the metal conductor rod **24** and the quartz arm of the envelope **12** and permits one end of the stem to be sealed directly around the rod and the other end of the stem to be sealed directly to the envelope arm without the danger of thermally induced strains and cracks. Since the stem **28** is located within the outer end portion of the arm **14**, graded seals **30** of conventional size can be used even though the size of the lamp is such that it requires massive electrodes and large diameter arms.

The bushing **29** is made from a glass such as uranium glass (Corning 3320) that has a high coefficient of expansion and can be sealed directly to tungsten.

In order to protect the ends of the jumper ribbons **23'** and the ribbon wrapping **25'** located adjacent the cathode **16** a collar **34** of quartz is preferably placed over this portion of the seal assembly **36**, as shown in FIG. 2, and is so dimensioned that it is held in this position by means of a force fit with the wrapping **25'**.

As a specific example of the dimensions of the various parts, in the case of the 5 kw. short-arc lamp here shown having tubular arms about 1⅛" in diameter, the diameter of the stem **28** was about ⅝" and increased to a dimension of about 1⅛" at its flared end. The diameter of the quartz core **22** and protective collar **34** were approximately the same as that of the stem. The lead-in conductor rod **24** was fabricated from tungsten and its outer end about 0.150" in diameter and its enlarged inner end was about ¼" in diameter. The support rod **20** was also fabricated from tungsten and was of substantially the same size as the enlarged end of the conductor rod. The conductor ribbons **21** were made of molybdenum and were 0.0012" thick and ⅜" wide. The jumper ribbons **23** were 0.004" thick and 0.125" wide. The jumper ribbons were also fabricated from molybdenum. The wrappings **25** and **25'** consisted of platinized molybdenum ribbon 1 mm. wide x 0.003" thick.

Fabrication

In fabricating the improved seal, the seal assembly **36** attached to the cathode **16** is first inserted into the arm **14** of the quartz envelope **12** until the flared end of the stem **28** abuts against the end of the arm. The assembly attached to the anode **18** is then similarly inserted into the other arm **15**. The partially assembled lamp is then placed in a chuck which grips the respective arms at points overlying the stems and the entire assembly is rotated through a pair of sealing fires **37** and **38** (see FIG. 4) that seals the flared ends of the stems to the ends of the respective arms. This anchors the electrodes in aligned predetermined position with respect to each other and seals off the arms from the atmosphere. The envelope **12** is then evacuated through the exhaust tube which is then tipped-off at a point remote from the envelope.

The partially assembled lamp is again rotated and the sealing fires are positioned to impinge on the portion of the arm **14** that encircles the outer end of the core **22**. The resultant softening of the arm causes it to sink down onto the core and interposed ribbon conductors **21** thus fusing the quartz members together and hermetically embedding the ribbons in the resulting solid body of quartz. The fires are then slowly advanced until the remaining portion of the arm that encircles the core and the protective collar **34** is heated and collapsed, the rotation of the lamp being maintained to effect uniform heating. Thus, the portion of the arm **14** extending from approximately its midpoint to a point just short of the bulbous body portion of the envelope **12** is sealed off and hermetically united with the core **22**. The outermost end portion of the arm, however, retains its original form and defines, in conjunction with the sealed-in stem **28**, an evacuated chamber A, as shown in FIG. 1. The chamber A is thus substantially devoid of oxygen and serves as a protective enclosure for an intermediate portion of the conductor rod **24**.

The other arm **15** of the envelope is processed in the same manner thus completing the assembly of the lamp.

The ribbon conductors **21** are, accordingly, hermetically embedded within the sealed portions of the arms, as shown in FIG. 3, and provide a seal capable of carrying the high current required to operate the lamp. By properly selecting the size of the various parts seals capable of handling currents of 100 or 200 amperes and higher can be readily made in accordance with this method of manufacture using graded seals of standard size.

It will be appreciated from the foregoing that the objects of the invention have been achieved insofar as an improved seal for high-wattage short-arc lamps has been provided which can be conveniently fabricated and tailored to accommodates electrodes of various sizes without increasing the cost of the lamp.

While a preferred embodiment has been described in detail, it will be appreciated that various changes in both the configuration and arrangement of parts and manner of assembly can be made without departing from the spirit and scope of this invention.

I claim as my invention:

1. A seal for a short-arc electric discharge lamp or the like having a vitreous envelope comprising, in combination;

a vitreous arm attached to and extending from said envelope,

a vitreous core fused with and hermetically closing the end of said arm that is joined to said envelope,

an elongated electrode having one end anchored in said core and its opposite end disposed in said envelope,

a rigid lead-in conductor anchored in the other end of said core and extending outwardly toward the end of said arm,

a ribbon conductor hermetically embedded in the sealed portion of said arm and electrically connecting said lead-in conductor to said electrode, and

a re-entrant vitreous stem that includes a graded seal component,

said stem being located within the outer end portion of said arm and having its outwardly-disposed end hermetically sealed to the proximate end of said arm and its other end hermetically sealed around an intermediate portion of said rigid lead-in conductor so that said stem, in conjunction with the sealed-in vitreous core, provides a chamber within said arm that (a) is sealed-off from the discharge space defined by the envelope and (b) protectively encloses an intermediate portion of said lead-in conductor.

2. A seal as set forth in claim **1** wherein said chamber is substantially free of oxygen.

3. A seal as set forth in claim 1 wherein the outwardly-disposed end of said stem that is sealed to said arm is flared and protrudes laterally beyond the body of the stem, and said chamber is evacuated.

4. An assembly adapted for use in an hermetic seal structure for a short-arc electric discharge lamp having a vitreous envelope with an outwardly extending arm, said assembly comprising;

an elongated core of vitreous material,

a metal rod anchored in and extending longitudinally from one end of said core,

an electrode attached to the free end of said rod,

a rigid lead-in conductor anchored in and extending longitudinally from the other end of said vitreous core,

a plurality of spaced metal ribbon conductors on and extending along said vitreous core,

means electrically connecting the ends of said ribbon conductors with the proximate ends of said metal rod and rigid lead-in conductor, and

a tubular stem comprising (a) a vitreous bushing, (b) a graded steel component and (c) a vitreous flare joined end-to-end in the aforesaid order with the protruding portion of said flare disposed at one end of said stem,

said vitreous bushing being hermetically sealed around an intermediate portion of said rigid lead-in conductor and the body portion of said stem being disposed in encircling spaced relationship with the outwardly-disposed end portion of said lead-in conductor so that the flared end of said stem constitutes one end of said assembly.

5. The assembly set forth in claim 4 wherein:

the flared segment of said stem has a lower coefficient of expansion than the vitreous bushing, and

the flared end of said stem and the end of the envelope arm have substantially the same cross-sectional configuration and dimensions.

References Cited by the Examiner

UNITED STATES PATENTS

2,982,877	5/1961	Heine-Geldern	313—184
3,140,417	7/1964	Tietze	313—266 X
3,154,713	10/1964	Beese	313—267

JOHN W. HUCKERT, *Primary Examiner.*

R. F. POLISSACK, *Assistant Examiner.*