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SODIUM VAPOUR ELECTRIC DISCHARGE LAMPS

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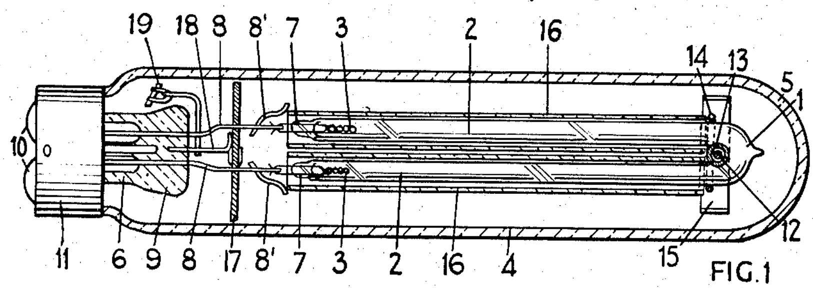

FIG. 1

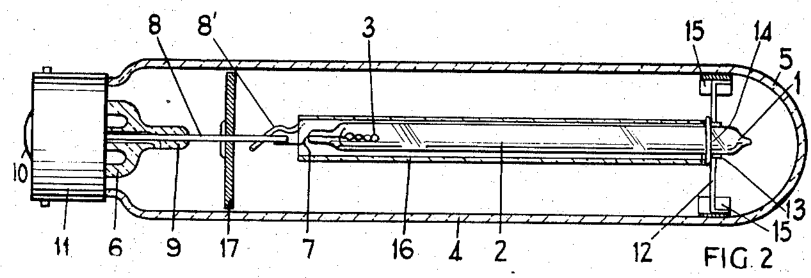

FIG. 2

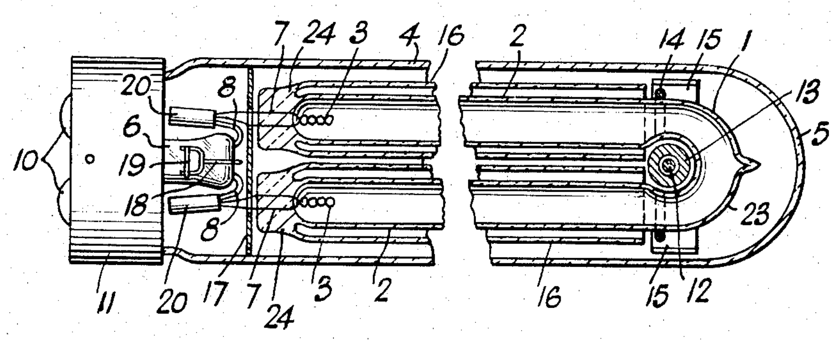

FIG. 3

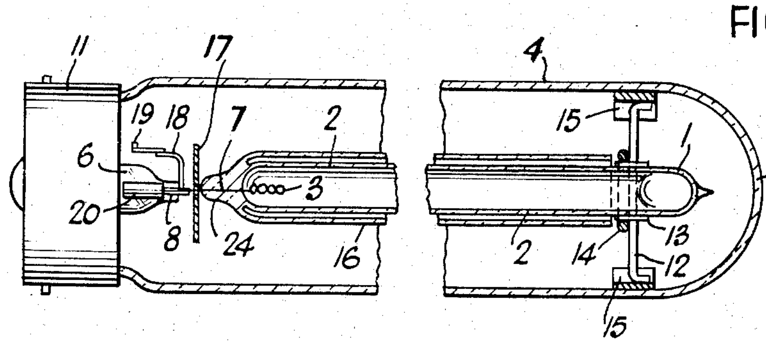

FIG. 4

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SODIUM VAPOUR ELECTRIC DISCHARGE LAMPS

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10 Claims. (Cl. 313—25)

This invention relates to sodium vapour electric discharge lamps of the positive column type having an elongated tubular discharge envelope containing electrodes for the passage of an electric discharge and a filling of sodium for providing a sodium vapour discharge in normal operation of the lamp, together with a filling of rare gas for enabling the lamp to start and the sodium vapour discharge to be developed.

In order that such a lamp should operate at high efficiency, it is desirable firstly that the current density of the discharge should be low and secondly that the sodium vapour pressure in normal operation should be at or near an optimum value. In present practice this optimum value is usually arranged to be somewhat below the pressure giving maximum efficiency in order to obtain a suitably long useful life for the lamp by reducing the effect of the sodium vapour attaching and blackening the internal surface of the discharge envelope and to avoid unduly rapid loss of efficiency resulting from an uneven distribution of sodium metal caused by thermal migration, which effect is accelerated by the use of high vapour pressures.

The first of the above requirements calls for the use of a discharge envelope of relatively large diameter, but as the diameter of the envelope is increased, its wall temperature for a given wattage dissipation in the discharge, and with it the operating vapour pressure of the sodium, is reduced, and too wide an envelope results in too low a sodium vapour pressure for high efficiency; a compromise has, therefore, to be made between these requirements, and in order to obtain the best compromise it is desirable to provide means for conserving the heat of the discharge envelope to enable as wide a diameter envelope as possible to be used consistent with its wall temperature not falling to an undesirably low value. The heat conserving means usually empolyed consists of a highly evacuated outer jacket into which the discharge envelope is fitted.

Two main forms of such evacuated outer jacket have been used or proposed. The form at present most commonly used consists of a double-walled hollow cylinder closed at one end and the space between the walls of which is sealed and highly evacuated. The discharge tube, usually in the shape of a letter U, is inserted into the jacket from the open end, and the lamp is operated with air present in the space between the discharge envelope and the inner wall of the outer jacket, the evacuated space between the inner and outer walls of the jacket, which is usually known as a Dewar jacket, providing the necessary heat conservation. The inner wall of the Dewar jacket serves as a screen for the absorption of infra-red radiation from the discharge envelope, which screen is protected by the evacuated space from the loss of heat to the outer atmosphere and thus helps to keep up the temperature of the discharge envelope; the screen also reflects back to the discharge envelope some of the infra-red radiation emitted by the latter.

The other form of outer jacket referred to consists of

a single-walled envelope into which the discharge envelope is sealed, the space between the discharge envelope and the jacket being highly evacuated. For further reducing the heat loss from the discharge envelope in such a lamp, it has been proposed effectively to duplicate the conditions obtained with a Dewar jacket by surrounding the discharge envelope with a heat-conserving cylindrical glass sleeve, containing both limbs of the U where the envelope is of U shape, and intervening between the discharge envelope and the outer jacket; this sleeve is insulated from the outer atmosphere by an evacuated space, as is the inner wall of a Dewar jacket, and serves to absorb and reflect infra-red radiation from the discharge.

However this form of lamp has not come into widespread use since it is little, if at all, more efficient than the Dewar jacketed lamp and the latter has particular advantages which have rendered it preferable. Thus it is less expensive in the long run, since the Dewar jacket can be made separately from the discharge envelope and the jacket and envelope simply assembled together without sealing; the Dewar jacket has a longer life than the discharge envelope and the same jacket can be re-used, usually more than once, with a different discharge envelope at the end of a normal lamp life. Also with the Dewar-jacketed lamp the fact that air is present in the space immediately surrounding the discharge envelope helps to equalise the temperature distribution of the latter in operation of the lamp. A disadvantage introduced by this last feature is that the presence of moisture in this air under conditions of high humidity, such as may be experienced by a lamp used for street-lighting, tends to render starting of the lamp difficult or unreliable; in addition it is difficult to tell when a Dewar jacket has failed, and repeated use of such jackets can readily lead to use of a lamp with a poor Dewar jacket, but despite these disadvantages the Dewar-jacketed lamp has been accepted for many years as the best form of sodium lamp.

A combination of the two forms of outer jacket above referred to, which combination may be described as a Dewar jacket having the discharge envelope sealed therein and the interior evacuated, has also been proposed, but such a combination is very expensive to make and is not much more efficient than either the single-wall jacketed lamp or Dewar jacketed lamp alone.

We have now found that by the use of a particular form of discharge envelope and heat-conserving sleeve arrangement in a single wall type of evacuated jacket, increases of efficiency can be obtained which are so surprisingly great as to render such lamps preferable to the Dewar-jacketed lamps for at least some uses.

According to the present invention, a sodium vapour electric discharge lamp of the positive column type has an elongated tubular discharge envelope of U-shape containing electrodes for the passage of an electric discharge and a quantity of sodium for providing a sodium vapour discharge in normal operation of the lamp together with a filling of rare gas for enabling the lamp to start and the sodium vapour discharge to be developed, the discharge envelope is sealed into a single-walled outer jacket with a highly evacuated space between the inner surface of the jacket and the outer surface of the discharge envelope, and each limb of the discharge envelope is individually provided with a sleeve of transparent heat-insulating material which fits closely round the limb along the whole or the greater part of the length of the limb.

The term "fits closely" implies, for the purposes of this specification, that the internal diameter of the sleeve is not more than 50% greater than the external diameter of the limb of the discharge envelope on which it is fitted, the diameters being taken in a cross-section at right angles to the axes of the sleeve or limb. Usually the sleeves and limbs will all be of circular cross-section, but where this is not the case each said diameter is to be taken as the maximum diameter in the corresponding cross-section, that is to say, as the longest straight line which can be drawn joining two points on the inner or outer periphery, as the case may be, of the cross-section. With the dimensions at present usual for sodium lamps of the kind used for street light purposes, this means that each sleeve will usually be everywhere nearer to the outer surface of the limb of the discharge envelope on which it is fitted than it is to the inner surface of the outer jacket. Preferably the internal diameter of each sleeve is only slightly greater, for example not more than two millimetres greater, than the external diameter of the limb on which it is fitted; the sleeve may be a sliding fit on the limb but must not be in such intimate contact with it that the sleeve constitutes in effect (as regards the loss of heat) merely a thickening of the wall of the limb.

For obtaining the best results with a lamp in accordance with the invention, the degree of vacuum within the outer jacket should be as high as possible and should not in any case be less than that customarily used in the evacuated outer jackets of known lamps of the kind to which this invention relates, that is to say, the residual gas pressure must not be substantially higher than 10^{-3} millimetres of mercury. A suitably high degree of vacuum can be ensured during manufacture of the lamp by exhausting the outer jacket to a high degree, preferably at least 10^{-4} millimetres mercury, and then dispersing a getter within the jacket to clean up residual gas; the getter should not, of course, be so dispersed as to obscure any appreciable part of the outer jacket or discharge envelope through which light is required to emerge in use of the lamp. The use of a getter is also desirable for ensuring the maintenance of a high degree of vacuum within the outer jacket, in use of the lamp, by absorbing occluded gas which may be liberated from the walls of the jacket and discharge envelope, or from other parts within the jacket, and a sufficient excess of getter for absorbing such occluded gas throughout the normal life of the lamp is preferably used.

The statement that the said sleeves in a lamp in accordance with the invention are of transparent heat-insulating material means that the material must be a good absorber or reflector of infra-red radiation so as, in operation of the lamp, to reduce the rate of loss of heat from the limbs of the discharge envelope on which the sleeves are fitted; the term "transparent" (which term in this specification includes translucent) means that the sleeves must absorb little or none of the visible radiation from the discharge. The wall thickness of the sleeves should, of course, be such as to give a high infra-red radiation absorption.

In general glass will be the most suitable and convenient material for the sleeves, but other materials, for example quartz, which have similar properties and are otherwise suitable for use in lamps in accordance with the invention, and in particular are capable of withstanding the heat developed in operation of the lamp without deterioration or without becoming discoloured so as to absorb appreciably the visible light from the discharge, could be used.

Spacing means may be employed, if desired, for holding the sleeves coaxially on the limbs of the discharge envelope, but in general we have found that such spacing means are not necessary for securing the required high lamp efficiencies, and the sleeves may merely be slid onto the limbs and retained in position without the use of spacing means and without being coaxial with the limbs. However the use of spacing means may in some cases be desirable for preventing rattling of the sleeves on the discharge envelope.

If it is desired positively to attach the sleeves to the discharge envelope, each sleeve may be attached to the limb on which it is fitted at one or more regions whose total axial length is small compared with the axial length of the said limb. Where a sleeve is attached to the limb of the discharge envelope on which it is fitted in this way, it should be attached to it for only a relatively short axial distance, so that the area of contact between the limb and the sleeve will be small compared with the surface area of the discharge envelope and the heat conserving effect of the sleeve will not be appreciably reduced.

If such attachment of the sleeves is used, preferably each sleeve is attached to the limb at a single region only, and in such an arrangement the attachment of each sleeve to its respective limb is preferably effected at the free end of the corresponding limb of the discharge envelope. In a lamp in which the electrode leads are sealed into the ends of the envelope by means of pinches, as is usual in known types of sodium vapour lamp, and the sleeves are of glass, each sleeve may be sealed to the pinch formed at the end of the limb over which the sleeve is fitted, provided that the thermal expansion coefficient of the glass of the sleeve is simlar to that of the glass of the discharge envelope.

In the manufacture of a lamp in accordance with the invention where this latter construction is employed the sealing in of the electrode lead or leads and the sealing of a sleeve to the respective limb of the discharge envelope may conveniently be carried out in a single operation, the lead or leads, the discharge envelope and the sleeve being held in predetermined relative positions in which they are to be sealed together, for example by means of suitably constructed jigs, the end of the limb surrounding the electrode lead or leads and the adjacent end of the sleeve being heated to soften the glass, and the heat-softened ends of the sleeve and the limb are squeezed together, for example by a pair of metal jaws, so as to form a pinch in which the electrode lead(s) is/are sealed, and so that the sleeve and the limb are sealed together in a fixed predetermined position after the cooling of the glass below its softening temperature.

The sealing of the two sleeves to their respective limbs by this method may be effected simultaneously if desired.

It will be appreciated that where each sleeve is attached to a limb at more than one region, the regions of attachment should not hermetically close the space between the limb and the sleeve bounded by these regions, in order to allow said space to be exhausted when the outer jacket is evacuated.

With some lamps in accordance with the invention a further increase in efficiency may sometimes be obtained by providing one or more further sleeves of transparent heat-insulating material of the kind aforesaid on each limb of the discharge envelope, each such further sleeve extending along the whole or greater part of the length of the corresponding limb of the discharge envelope.

The presence of such further sleeves further reduces the rate of loss of heat from the discharge envelope, which enhances the lamp efficiency, but also reduces slightly the emission of useful light by absorption which detracts from the lamp efficiency, and in practice there will in general be little advantage in using more than two, or at the most three, sleeves on each limb of the discharge envelope.

Preferably each such further sleeve fits closely round the sleeve which it immediately surrounds, that is to say, the internal diameter of each said further sleeve is preferably not more than 50% greater than the external diameter of the sleeve which it immediately surrounds, the diameters being taken in a cross-section at right angles to the axes of the sleeves, said diameters to be taken as the maximum diameters (as hereinbeforesaid) in the cross-section if the sleeves are not of circular cross-section. Preferably said diameters differ by only a few millimetres, for example not more than two millimetres.

The plurality of sleeves on each limb may be loosely fitted, or they may be supported from each other and the discharge envelope by suitable spacers, or they may be attached together at one or more regions of small axial length, for example with glass sleeves of suitable thermal expansion coefficient they may all be sealed together and to the pinched end of the limb of the discharge envelope at the time of forming said pinch.

The effect of the sleeves in reducing the rate of loss of heat from the discharge envelope in a lamp in accordance with the invention may be utilised to increase the lamp efficiency in two different ways; thus either the lamp may be arranged to operate at a higher sodium vapour pressure than possible for the same current density with a lamp of similar construction not provided with the sleeve or sleeves, or the diameter of the discharge envelope in the lamp in accordance with the invention may be increased over that used in the unsleeved lamp to enable the former to attain the same vapour pressure at a lower current density than is possible with the latter.

In general it will be preferable to utilize the effect in the second of these two ways, since in most cases an increase in the sodium vapour pressure is liable to shorten the useful life of the lamp by increasing the rate of attack of the sodium vapour on the inner glass surface of the discharge envelope and/or by accelerating the rate of sodium migration within the discharge envelope. In some cases, however, a combination of the two ways may be used.

Two sodium vapour lamps in accordance with the invention will now be described by way of example with reference to Figures 1 to 4 of the accompanying drawings, in which Figures 1 and 2 represent two side views of one of the lamps taken substantially at right angles to each other, and Figures 3 and 4 represent similar views of the second lamp, the lamps being shown in part section along the lamp axis in each of the four figures; the same reference numerals are employed to denote similar parts of the two lamps in each figure of the drawings.

Thus referring to Figures 1 and 2 the lamp shown therein comprises a substantially U-shaped discharge envelope **1** of glass, each limb **2** of which is approximately 32 centimetres long and has an internal diameter of 15 millimetres, with a wall thickness of about 1.0 millimetre, the inner surface of the envelope being of sodium resistant glass. The discharge envelope is filled with neon containing 0.5% by volume of argon at a total pressure of 10 millimetres of mercury, together with about 1 gramme of sodium. The lamp electrodes **3**, which are of the kind employed in known kinds of sodium lamp, are mounted near the ends of the discharge envelope so as to provide an arc length of 600 millimetres.

The discharge envelope **1** is mounted within a cylindrical glass outer jacket **4**, of approximately 50 millimetres outside diameter and wall thickness of about 1.5 millimetres, closed at one end by a dome-shaped end portion **5** and at the opposite end by a pinched foot-tube **6**, the outer ends of the leads **7** to the lamp electrodes **3** being connected to two stout mounting wires **8** which are sealed into the pinch **9** of the foot-tube for supporting the envelope in position within the jacket, the mounting wires connecting the leads **7** to two contact terminals **10** of a bayonet type lamp cap **11** which is sealed by means of a suitable cement to the end of the outer jacket. The mounting wires **8** themselves pass through holes in a circular mica disc **17** which is held in position coaxially within the outer jacket **4** by means of an additional support wire **18** sealed into the pinch between the mounting wires, the mica disc serving to prevent lateral movement of the mounting wires **8** and so holding the ends of the discharge envelope **1** in position within the outer jacket.

The curved end of the U-shaped discharge envelope **1** is supported centrally within the outer jacket **4** near to the domed end thereof by means of a length of wire **12** which passes through a tubular glass bush **13** carried between the limbs of the discharge envelope, a wire loop **14** which fits closely around the two limbs, and which is spot welded to the wire on opposite sides of the discharge envelope, holding the envelope in position on the wire, and the two ends of the wire being spot welded to curved metal plates **15** arranged to bear against the inner surface of the outer jacket, thus supporting the envelope within the jacket.

Over each limb **2** of the discharge envelope **1** is placed a cylindrical glass sleeve **16** having an internal diameter of 18.0 millimetres, which is approximately 1.0 millimetre larger than the external diameters of the limbs, the sleeves, which have a wall thickness of about 0.5 to 0.75 millimetre, extending the whole length of the limb of the discharge envelope.

Axial movement of the sleeves **16** on the limbs of the discharge envelope is prevented by means of wire stops **8'** spot welded to the mounting wires **8**, and bent so as to hold the sleeves against the wire loop **14** which surrounds the discharge envelope **1**.

The space between the discharge envelope **1** and the outer jacket **4** is highly evacuated, and contains a getter element **19** attached to the support wire **18** for providing a coating of getter material on part of the wall of the outer jacket near to the pinched foot-tube **6**, the getter material serving to absorb occuluded gas which may be liberated from the glass walls surrounding the evacuated space during the life of the lamp and so maintain the vacuum. The mica disc **17** besides acting as a support for the lamp serves to prevent the evaporated getter material from spreading into the space between the discharge envelope and outer jacket and may also serve to reduce heat losses to a certain extent by reflecting back part of the heat radiated from the discharge envelope **1** in the direction of the glass pinch **9**. As an aid to starting the lamp a thin nickel wire (not shown) is connected to each of the electrode leads **7**, each wire winding helically round one of the glass sleeves **16** and being insulatingly attached to the support for the curved end of the discharge envelope **1**.

For processing the lamp parts for the evacuation of the outer jacket, the following method was used. The jacket, with the discharge envelope mounted therein, was placed in a baking oven so as to be shielded from direct radiation from the heating elements and heated conductively by hot air, and was connected to an exhaust pump provided with a liquid air trap. The outer jacket was then evacuated to a pressure of about 10^{-4} millimetres of mercury whilst the lamp as a whole was raised to a temperature of between 100° C. and 125° C. With the lamp at this temperature the outer jacket was disconnected from the pump, filled with dry oxygen-free nitrogen at a pressure of 10–20 millimetres of mercury, and the temperature of the lamp then raised to 365° C.

The jacket was then re-connected to the pump, exhausted to a pressure of about 10^{-4} millimetres of mercury, and then refilled with a second quantity of dry oxygen-free nitrogen at the same pressure as before, the temperature of the lamp being maintained at 365° C. throughout this operation and for a further 5 minutes. The jacket was then again connected to the pump and evacuated to a pressure of about 10^{-4} millimetres of mercury, the lamp being baked at a temperature of 365° C. during this operation and for a further 5 minutes. The lamp was then allowed to cool and the outer jacket sealed off when the lamp temperature was about 100° C. When the lamp had finally cooled to room temperature, the getter element was heated to cause getter material to evaporate and condense on the adjacent parts of the wall of the outer jacket.

This lamp is intended to be operated with a nominal wattage dissipation of 85 watts and a current density of 0.35 amp. per square centimetre, and with such a lamp so operated we have succeeded in obtaining an initial luminous efficiency of about 90 lumens per watt.

Here it may be remarked that where in this specification specific luminous efficiencies are referred to, these were measured by a spherical integrating photometer of 5-foot diameter fitted with a photoelectric unit approximately corrected to the C. I. E. average eye response; the individual measurements are subject to the usual limits of accuracy of commercial photometry of about ±5% relative to true values, but the differences between any two efficiency measurements have a higher degree of accuracy and indicate the differences in efficiency with an error of not more than 2 or 3 lumens per watt, and probably less than this.

For a lamp similar to that just described, having the same arc length of 600 millimetres and arranged to operate with the same wattage dissipation as the lamp described with reference to Figures 1 and 2, but not provided with the glass sleeves 16 surrounding the limbs of the discharge envelope 1, we found it necessary to employ a discharge envelope of smaller diameter, that is to say of about 12 millimetres bore, in order to maintain the same vapour pressure in operation of the lamp. With such an envelope the lamp operated at a current density of 0.52 amp. per square centimetre for an 85 watt dissipation, and we found that the initial luminous efficiency was only about 77 lumens per watt.

With a lamp constructed as shown in Figures 1 and 2, but having a discharge envelope with an internal diameter of 19 millimetres and an arc length of 400 millimetres, and designed for operation at a nominal wattage dissipation of 140 watts, a current density of 0.33 amp. per quare centimetre was used to give the same vapour pressure as before and the initial luminous efficiency was found to be about 95 lumens per watt.

It will be appreciated that each limb of the discharge envelope in a lamp substantially as described with reference to Figures 1 and 2 could be provided, if desired, with a further glass sleeve fitting closely over the sleeve 16. In one such lamp, having a discharge envelope with an arc length of 400 millimetres and a tube bore of 15 millimetres, and arranged to operate at a current density of approximately 0.34 amp. per square centimetre, but otherwise constructed substantially as described by way of example with reference to Figures 1 and 2 of the drawings with the addition, on each limb of the discharge envelope, of a further sleeve having an internal diameter approximately 1 millimetre greater than the external diameter of the sleeves 16 and a wall thickness of between 0.5 to 0.75 millimetre, the luminous efficiency under the operating conditions referred to was found to be about 100 lumens per watt.

Referring now to Figures 3 and 4, the lamp shown therein also comprises a U-shaped discharge envelope 1 mounted within a cylindrical glass outer jacket 4, the internal diameter of the discharge envelope being about 15 millimetres and the length of the limbs 2 of the envelope being such as to provide an arc length of 600 millimetres between the lamp electrodes 3; the envelope, which has a wall thickness of about one millimetre, has the same gas and sodium metal filling as the lamp described with reference to Figures 1 and 2.

The curved end 23 of the discharge envelope 1 is supported within the jacket 4 by means of a length of wire 12 which passes through a tubular glass bush 13 carried between the limbs 2 of the envelope, as in the lamp shown in Figures 1 and 2, and two curved metal plates 15 which are attached to the ends of the wire and bear against the inner surface of the outer jacket; a wire loop 14 which fits closely round the two limbs and is spot welded to the wire 12 on opposite sides of the envelope prevents transverse movement of the envelope on the wire.

At the other end of the lamp the outer jacket is closed by a pinched foot tube 6 having two mounting wires 8 sealed into the pinch and connected at their outer ends to the terminals 10 of a bayonet type lamp cap 11 secured to the jacket as in the lamp previously described. In this lamp however the ends of the mounting wires 8 within the jacket are bent back away from the discharge envelope 1 so as to lie along the foot tube, and are connected to the respective electrode leads 7 by means of two nickel sleeves 20, one pair of leads 7 and the bent back end of the corresponding mounting wire 8 being inserted into the same end of one of the sleeves and being secured in place by spot welding. By this method of mounting, the discharge envelope can be located close to the foot tube 6, thereby reducing the length of outer jacket necessary for housing the envelope.

A sheet of mica 17 extends across the outer jacket with its ends in contact with the inner surface thereof as an additional support for the discharge envelope as in the lamp shown in Figures 1 and 2, although in this lamp the electrode leads 7 themselves extend through holes provided in the sheet, the connection to the mounting wires 8 taking place on the opposite side of the sheet to the discharge envelope.

The space between the discharge envelope 1 and the outer jacket 4 is exhausted and contains a getter element 19 welded to the end of a support wire 18 which is sealed at its opposite end into the pinch of the foot tube 6 between the two mounting wires 8, the end of the support wire 18 to which the getter element is attached being bent back in a similar manner to the mounting wires 8 so as to lie along the foot tube 6.

In accordance with the invention there is fitted over each limb 2 of the discharge envelope 1 a cylindrical transparent glass sleeve 16 having an internal diameter of approximately 18 millimetres, which is of the order of 1.0 millimetre larger than the external diameter of the limbs, the sleeves, which have a wall thickness of about 0.5 to 0.75 millimetre, extending substantially the whole length of the limbs and being sealed to the limbs on which they are fitted, by the sealing of one end of each sleeve to the pinch 24 at the end of the limb into which the electrode leads 7 are sealed. The sleeves 16 are thus supported coaxially on their respective limbs, and rattling of the sleeves is thereby prevented. Moreover the sealing of the sleeves to the limbs prevents relative axial movement between the sleeves and the limbs from taking place, thereby dispensing with the need for additional stops at the ends of the sleeves.

The sealing in of the electrode leads 7 at the ends of the discharge envelope 1 and the sealing of the sleeves 16 to the limbs 2 is conveniently effected in a single operation, the electrodes 3, the discharge envelope 1 and the sleeves 16 being held in predetermined relative positions by suitably constructed jigs, the glass of the limbs 2 and sleeves 16 at the ends surrounding the electrode leads 7 being heated until soft, and two jaws being arranged to pinch the softened glass so as to squeeze the end of each sleeve and limb into sealing contact with each other and simultaneously seal the electrode leads into the glass pinch which is formed.

The lamp is provided with starting wires surrounding the glass sleeves 16 in a similar manner to the lamp shown in Figures 1 and 2, and is intended to be operated at a nominal wattage dissipation of 85 watts and a current density of about 0.35 amp. per square centimetre. With such a lamp operating under these conditions we have succeeded in obtaining an initial luminous efficiency of about 90 lumens per watt.

It will be appreciated that the discharge envelope of the lamp substantially as described by way of example with reference to Figures 3 and 4 of the drawings may be provided with one or more additional transparent heat-insulating sleeves if desired, and these additional sleeves can be fitted loosely over the sleeves 16, although in some cases they may be attached to the sleeves 16 and to the discharge envelope 1.

I claim:

1. A sodium vapour electric discharge lamp of the positive column type having an elongated tubular discharge envelope of U-shape containing electrodes for the passage of an electric discharge and a quantity of sodium for providing a sodium vapour discharge in normal operation of the lamp together with a filling of rare gas for enabling the lamp to start and the sodium vapour discharge to be developed, wherein the discharge envelope is sealed into a single-walled outer jacket with a highly evacuated space between the inner surface of the jacket and the outer surface of the discharge envelope, and wherein each limb of the discharge envelope is individually provided with a sleeve of transparent heat-insulating material which fits closely round the limb along at least the greater part of the length of the limb.

2. A sodium vapour electric discharge lamp according to claim 1, wherein the internal diameter of each sleeve is not more than two millimetres greater than the external diameter of the limb on which the sleeve is fitted.

3. A sodium vapour lamp according to claim 1, including a getter material within the outer jacket for absorbing residual gas within said highly evacuated space and maintaining a high degree of vacuum within said space during the life of the lamp.

4. A sodium vapour lamp according to claim 1, wherein the said sleeves are held on the limbs of the discharge envelope by means which restrain the sleeves against relative longitudinal displacement, but without the sleeves being attached to the limbs and without the intervention of spacing means between the sleeves and the limbs.

5. A sodium vapour electric discharge lamp according to claim 1, wherein each said sleeve is of glass.

6. A sodium vapour lamp according to claim 1, wherein each sleeve is attached to the limb on which it is fitted at at least one region whose axial length is small compared with the axial length of said limb.

7. A sodium vapour lamp according to claim 6, wherein each sleeve is attached to the limb on which it is fitted at a single region only.

8. A sodium vapour lamp according to claim 7, in which the electrode leads are sealed into the ends of the discharge envelope by means of pinches and wherein each sleeve is of a glass whose thermal expansion coefficient is similar to that of the glass of the discharge envelope and is sealed to the pinch formed at the end of the limb over which the sleeve is fitted.

9. A sodium vapour lamp according to claim 1, wherein each limb of the discharge envelope is provided with at least one further transparent heat-insulating sleeve each of which fits closely over the sleeve which it immediately surrounds and extends along the whole or the greater part of the corresponding limb of the discharge envelope.

10. A sodium vapour lamp according to claim 9, wherein the internal diameter of each further sleeve is not more than two millimetres greater than the external diameter of the sleeve it immediately surrounds.

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