June 6, 1961 R. J. PAOLINO 2,987,640

ELECTRIC LAMP ENVELOPE

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Fig. 1.

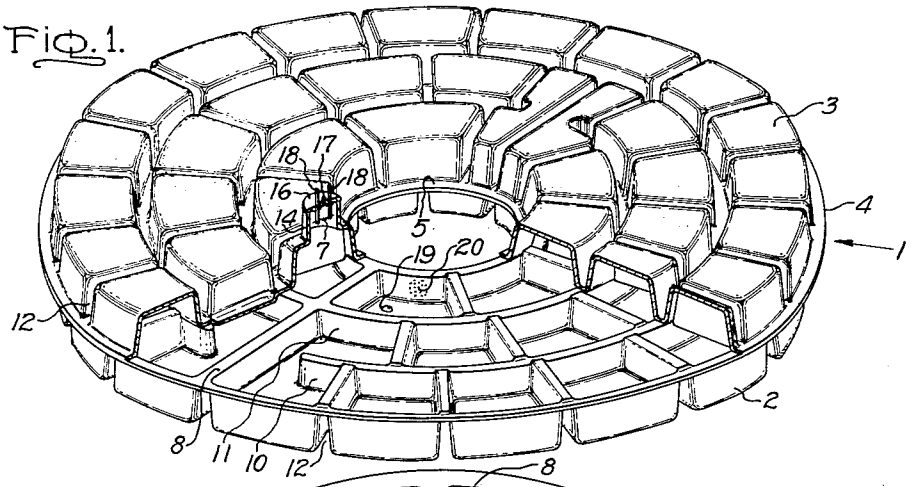

Fig. 2.

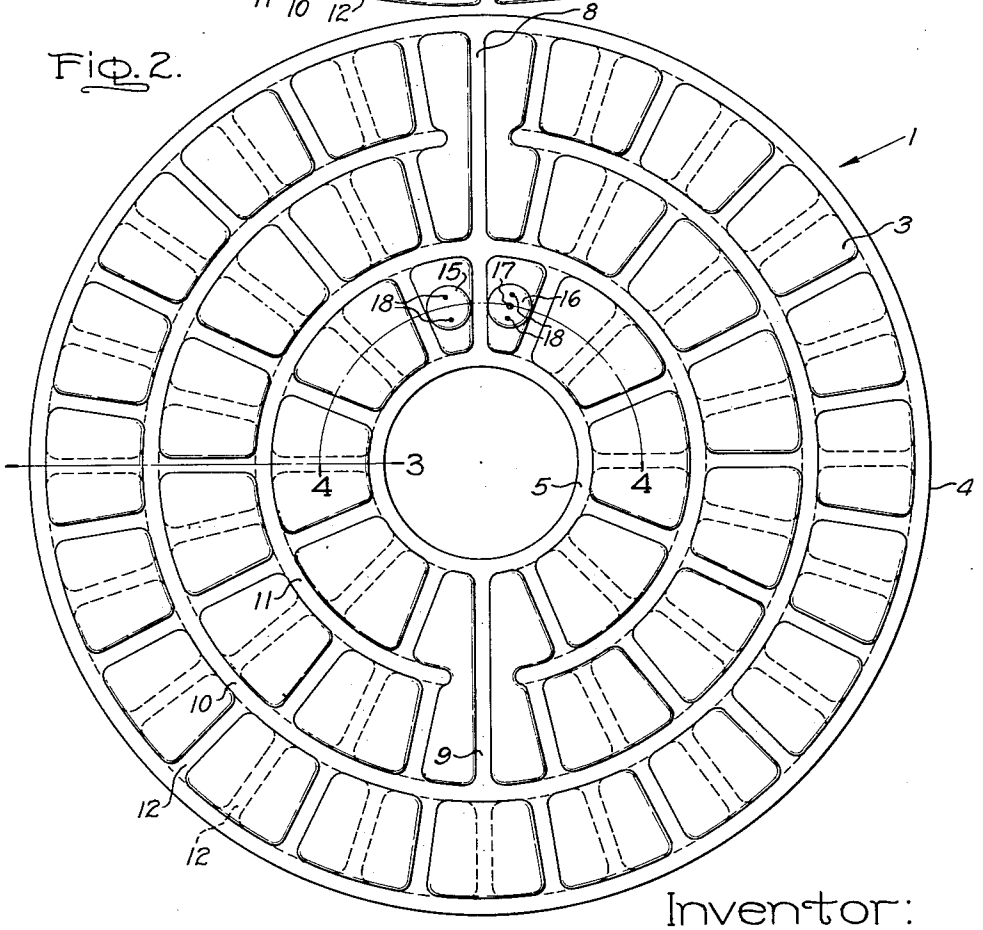

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Fig. 3.

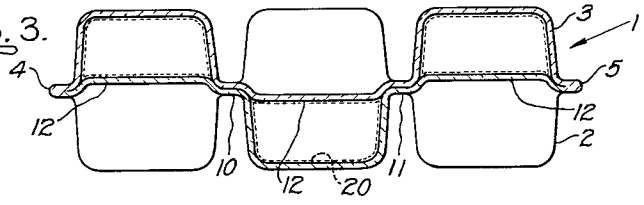


Fig. 4.

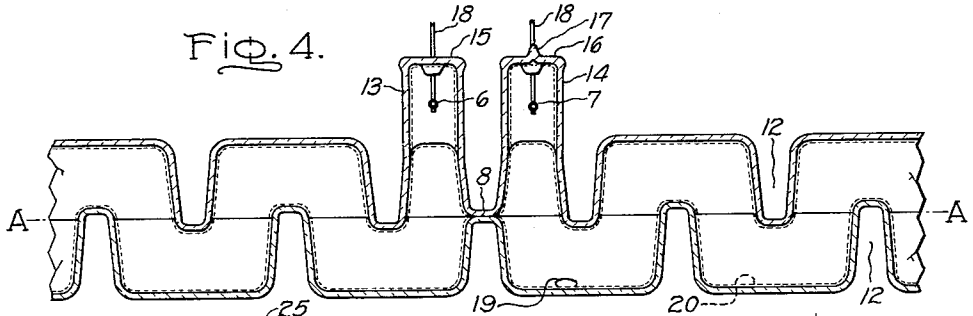
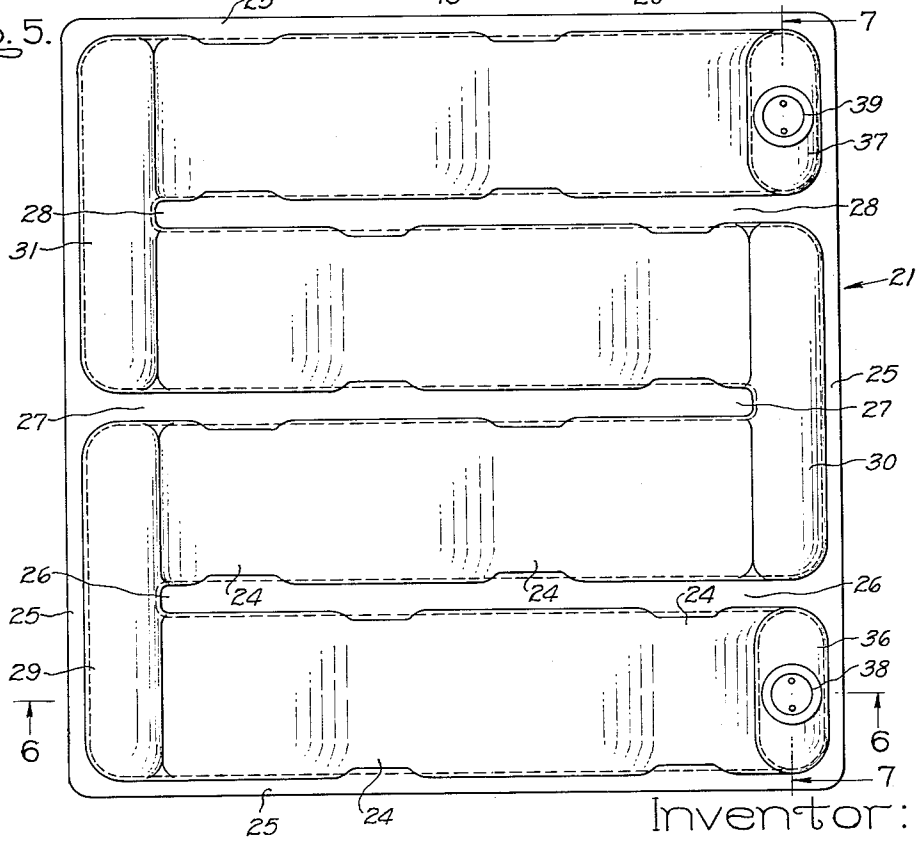


Fig. 5.



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ELECTRIC LAMP ENVELOPE

Filed Nov. 24, 1959 3 Sheets-Sheet 3

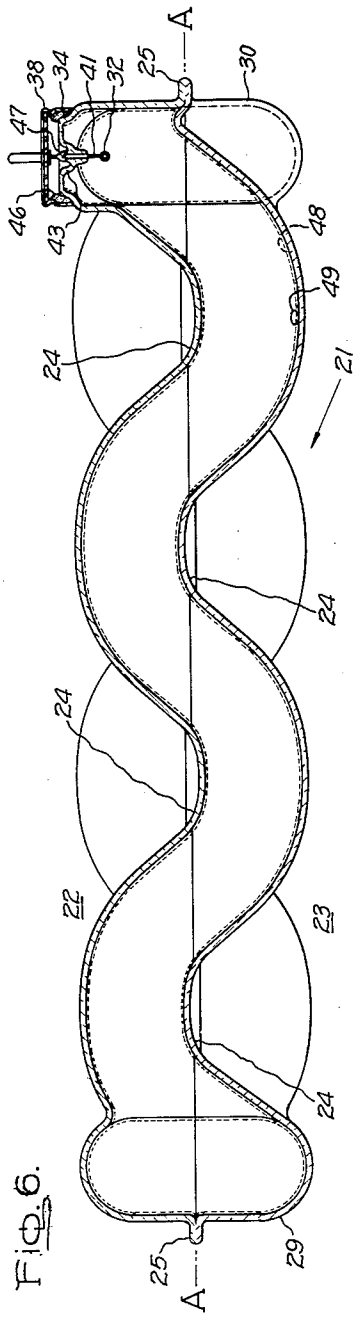

Fig. 6.

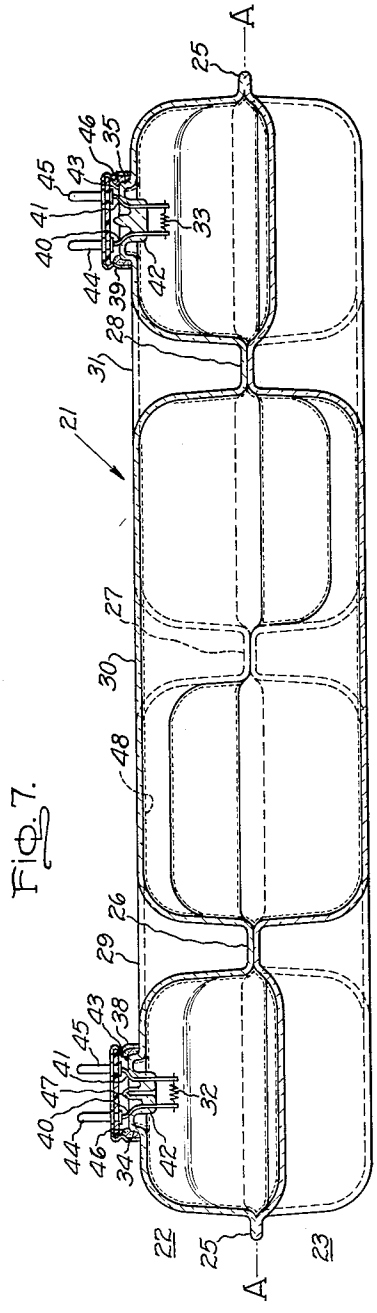

Fig. 7.

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United States Patent Office 2,987,640 Patented June 6, 1961

2,987,640

ELECTRIC LAMP ENVELOPE

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Filed Nov. 24, 1959, Ser. No. 855,088
10 Claims. (Cl. 313—204)

The present invention relates to electric lamps of the low pressure diffuse positive column discharge type in which the discharge is emissive of resonance radiation, such as fluorescent lamps in which phosphors are excited by the resonance radiation of mercury, germicidal mercury lamps and sodium lamps. More particularly, the invention relates to electric lamps of this type having an envelope in which the discharge passage between a pair of co-operating electrodes is a tortuous channel defined by two molded vitreous components sealed together to form a square or round panel which is generally flat but which may be of other shapes, such as bowl shape.

Lamps of this type have been proposed heretofore and offer the advantage of an elongated discharge passage in a compact lamp which may be made in a variety of shapes. The length of the discharge defined by the discharge passage is one of the principal factors in determining the light output and the luminous efficiency of the lamp. In general and within certain well-known limits, the longer the discharge in the discharge passage the higher the efficiency and the light-emitting capacity of the lamp.

The principal object of the present invention is to provide light-transmitting envelopes for highly efficient high light output, compact lamps of the above type.

Further objects and advantages of the invention will appear from the following detailed description of species thereof, from the accompanying drawings and the appended claims.

The invention attains its objects by forming the envelope of a panel-shaped lamp of the above type with an elongated undulating discharge passage noncircular in cross section with lengths or sections of said passage extending in side-by-side relation in a series. The adjacent lengths of the discharge passage in the series undulate in a direction generally transverse to the direction in which the sides of the respctive adjacent lengths are opposed to each other. In certain instances the undulations in adjacent lengths are out of phase to reduce self-absorption by the lamp of the light emitted by the discharge.

In the drawing accompanying and forming part of this specification,

FIG. 1 is a perspective view of a circular panel-shaped fluorescent discharge lamp embodying the invention with part of one of the molded components of the lamp envelope cut away to show the interior of the envelope,

FIG. 2 is a top plane view on a slightly enlarged scale of the lamp shown in FIG. 1 rotated an angular distance of slightly less than 180° from its position shown in FIG. 1.

FIG. 3 is a sectional view on an enlarged scale of the lamp shown in FIGS. 1 and 2 taken along the line 3—3 of FIG. 2,

FIG. 4 is a similar view of the lamp shown in FIGS. 1 to 3 taken along the line 4—4 of FIG. 2,

FIG. 5 is a top plan view of square panel-shaped fluorescent discharge lamps embodying the invention,

FIG. 6 is a side sectional view on an enlarged scale of the lamp shown in FIG. 5, taken along the line 6—6 of FIG. 5 in the direction of the arrows, and

FIG. 7 is an end view partly in section on the enlarged scale of FIG. 6 of the lamp shown in FIGS. 5 and 6 taken along the line 7—7 of FIG. 5 in the direction of the arrows.

Referring to FIGS. 1 to 4 of the drawings the envelope 1 of the lamp shown is in the form of a generally flat annulus made up of two dished, light-transmitting, complementary molded glass components 2 and 3 which have matching flanges or rims at their outer and inner peripheries fusion sealed together as shown at 4 and 5, respectively, either directly or by a glass solder. The sealed together flanges may be utilized to support the lamp. A pair of closely spaced co-operating discharge supporting electrodes 6 and 7 is sealed into the upper component 3 adjacent the inner periphery 5 of the envelope 1. An electric discharge between the electrodes is guided in a circuitous or tortuous path within the envelope by straight partitions 8 and 9 and curved partitions 10 and 11 (FIGS. 1 and 2) which subdivide the annular space defined by the envelope 1 into a continuous passage or channel opening at the electrodes 6 and 7 at its opposite ends.

The curved partitions 10 and 11 are concentric open rings. The circular partition 10 of the larger diameter terminates short of the straight partition 8 at both ends thereof whereas the circular partition 11 of shorter diameter terminates short of the straight partition 9 at both ends (FIG. 2). The straight partitions 8 and 9 are located on a diameter of the envelope and divide the interior annular space of the envelope into two equal sectors each extending an angular distance of approximately 180° around the envelope. An opening between the two sectors is provided in the partition 9 as described below and is located between the partition 10 and the outer wall of the envelope adjacent rim 4 thereof.

The partitions 8, 9, 10 and 11 are constituted by ridges (FIG. 1) formed in each of the envelope components 2 and 3 during molding of these components. The ridges are in the form of re-entrant grooves and are upstanding a sufficient height in each of the components so that their crests are abutting in the plane of the rims 4 and 5 when the flanges of the components are sealed together to form the envelope 1. The crests are made to fit together so closely that the partitions formed by the ridges prevent short circuiting leakage of the discharge between adjacent parts of the latter. The ridge in the envelope component 3 forming with the corresponding ridge in the envelope component 2 the straight partition 9 terminates at its outermost end at the curved partition 10 (FIG. 2) to leave an opening between the sectors which opening is part of the discharge passage defined by the envelope 1.

The discharge passage thus follows a convoluted path in each sector of the envelope in that it is in the form of a plurality of curved folds or sections extending in side-by-side relation. The folds or sections of the discharge passage in each sector of the envelope are connected together by the openings between the ends of the curved partition 10 and the straight partition 8, on the one hand, and the openings between the ends of the curved partition 11 and the straight partition 9, on the other hand.

In accordance with the present invention the continuous passage for the discharge in the envelope 1 undulates along its length to increase the length of the discharge between the electrodes and to increase also the area of the inner surface of the envelope exposed to the discharge in the passage. The passage undulates in a direction normal to the median plane A—A of the envelope including the rims 4 and 5 of the envelope and the abutting surfaces of the ridges forming the partitions 8 to 11. The undulations in the discharge passage are defined in part by the re-entrant grooves 12 formed in the walls of the components 2 and 3 during molding of these components.

The grooves 12 molded in each of the components 2 and 3 are upstanding therein and extend radially of the components and across the spaces between the curved

ridges constituting partitions 10 and 11 and the side walls of the components adjacent the sealing flanges constituting the rims 4 and 5 of the envelope 1. The grooves are upstanding in the components a distance such that they extend slightly beyond the plane A—A (FIG. 4) including the crests of the upstanding ridges and the sealing surfaces of the flanges. The grooves are so arranged in each of the components 2 and 3 that the grooves in one component alternate with the grooves in the other component along the discharge passage when the components are sealed together to form the envelope 1. In the envelope, the portions of the grooves extending beyond the plane A—A including the flanges 4 and 5 and the abutting crests of the ridges, that is, the median plane of the envelope are overlapping. As shown in FIG. 4, the discharge passage thus undulates in a plane generally normal to the median plane A—A of the panel-shaped envelope 1.

Further, the grooves 12 are so arranged in the respective components 2 and 3 that when the components are sealed together the overlapping portions of grooves are spaced apart equal distances along the folds or curved sections of the discharge passage. The spacing between the parts of the respective grooves overlapping each other in the envelope is equal to the distance between the bottom of the respective grooves and the wall of the envelope opposite the bottom of the respective grooves in the interior of the envelope. The area of the discharge passage in cross section between adjacent grooves, on the one hand, and between the bottom of the grooves and the opposed walls of the envelope, on the other hand, is the same. The voltage drop or gradient per unit length of the discharge along the folds of the undulating passage for the discharge thus is generally uniform.

The ends of the curved partitions 10 and 11 are spaced from the straight partitions 9 and 10 at such distances that the area in cross section of this part of the discharge passage is approximately the same as that between the bottom of the grooves and the wall of the envelope opposite the bottom of the grooves in the portions of the passage extending along the partitions 10 and 11.

The opening between the sectors of the envelope 1 on either side of the partitions 8 and 9, which opening is part of the discharge passage, is of such size that this part of the discharge passage has the same cross sectional area as the part of the passage extending between adjacent re-entrant grooves and between the bottom of the grooves and the interior of the envelope wall opposite the bottom of the grooves. The crest of the outermost end part of the ridge in the envelope component 2 which forms with the corresponding ridge in the component 3 the partition 9 in the envelope 1, is raised to the level of the grooves 12 in the component 2 in order to define with the opposite wall of the envelope component 3 an opening of the appropriate size within the envelope.

The discharge passage throughout its length is non-circular in cross section (FIG. 3) and is about twice as wide as it is deep. As pointed out in the U.S. Patent No. 2,482,421, Lemmers, this is advantageous because, in lamps generating resonance radiation, it is possible to obtain either greatly improved efficiency of operation or much greater current capacity and discharge wattage when the discharge passage is flat rather than round in cross section. Also the light emitted by fluorescent, low pressure mercury vapor discharge lamps of this type has a directional characteristic in that more light is emitted normal to the plane of the panel lamp than is emitted in that plane.

The upper component 3 of the lamp envelope 1 has a pair of upstanding tubulations 13 and 14, one on either side of the partition 8 (FIG. 3) into which tubulations are fusion sealed the glass discs 15 and 16 which close the outer ends of the tubulations. One of the discs 16 is provided with an exhaust tube 17 (FIGS. 1 and 4) which is sealed or tipped off after the envelope 1 has first been evacuated and then filled with a discharge conducting gaseous atmosphere at a suitable pressure. A pair of current inlead wires 18 extend through each of the glass discs 15 and 16 and the electrodes 6 and 7 are mounted between the inleads 18 on the discs 15 and 16, respectively.

The electrodes 6 and 7 may be of the low resistance and low thermal capacity rapid-start type disclosed and claimed in U.S. Patent 2,774,918, Lemmers, Electric Discharge Device, assigned to the same assignee as the present invention.

The lamp contains an ionizable atmosphere including a starting gas or mixture of one or more of the inert rare gases of group O of the periodic table at a low pressure, for instance argon at a pressure of 0.5 to 5 millimeters of mercury and mercury vapor. The droplets of mercury indicated at 19 (FIG. 1) exceed in amount the quantity vaporized during the operation of the lamp wherein the mercury vapor exerts a partial pressure in the range of 1 to 20 microns for optimum generation of mercury resonance radiation at 2537 A. The exact value of partial pressure of mercury vapor for optimum generation of 2537 A., that is for maximum lumens, may vary with the kind of starting gas, that is, whether argon, krypton or xenon, with the pressure of the starting gas, and with the current density. Where the starting gas is argon at approximately 3 millimeters pressure, the optimum pressure of mercury vapor is usually from 5 to 8 microns.

The phosphor coating indicated at 20 (FIG. 1) covering the inside of the envelope 1 converts the 2537 A. resonance radiation into visible light and may be applied either before or after the components 2 and 3 are united. It may be a halophosphate phosphor activated with antimony and manganese as per U.S. Patent 2,488,733, McKeag et al. of the same assignee as the present invention, and producing a cool white light. The envelope may be coated externally with a water-repellent or hydrophobic transparent coating to facilitate starting under high humidity or adverse atmospheric conditions. A suitable coating is a hydrolized organo-silicon halide as described in U.S. Patent 2,408,822, Tanis, of the same assignee as the present invention. It may be produced by exposing the lamp for a few minutes to the vapor of methylchlorosilane for instance, in a suitable enclosure maintained at 50% relative humidity.

A suitable lamp of the above type is one wherein the internal depth of the envelope is one and one-half inches and the other diameter of the annular envelope is approximately fourteen inches and the inner diameter thereof approximately three inches. The undulating discharge passage is of generally flattened shape in cross section as described above and has an average width of one and one-fourth inch and an average depth of five-eighths inch throughout its length. The grooves 12 extend approximately one-eighth of an inch beyond the plane A—A of the sealing flanges 4 and 5. These dimensions are internal dimensions. The grooves 12 are about three-sixteenths of an inch wide at the bottom and three-eighths of an inch wide at the top, these dimensions of the grooves 12 being taken externally of the envelope. The average thickness of the glass wall of the envelope is approximately one-sixteenth of an inch.

The length of the diffuse discharge is increased by the undulations in the discharge passage caused by the grooves 12 which interrupt the straight-line distance between the electrodes and, of course, the re-entrant grooves increase substantially the area of the phosphor coated inner surface of the envelope exposed to the diffuse discharge to increase the total light output and the luminous efficiency of the lamp. Further, as pointed out in the copending Lemmer's application Serial No. 577,017, filed April 9, 1956, now Patent No. 2,915,664, patented December 1, 1959, and assigned to the assignee of the present application, in lamps of this type light is emitted from the region of the grooves 12 at a higher efficiency and the grooves have a much higher brightness than other parts

of the lamp envelope due to the tendency of the diffuse discharge to hug the grooves.

The length of the diffuse discharge in the lamp is measured along a sinuous curve extending along the length of the discharge passage and spaced from the bottom of the grooves **12** approximately one-third the internal distance between the bottom of the grooves and the wall of the envelope opposite the bottom of the grooves. This curve is selected for measuring the length of the discharge because, due to the tendency of the diffuse positive column discharge to hug the grooves and also its tendency to constrict toward the center of the undulations of the discharge passage though retaining its diffuse character to fill the passage, the sinuous curve represents the effective average length of the diffuse discharge in the undulating discharge passage in the lamp envelope.

The diffuse discharge in a lamp of the above-described structure has an effective average length along the discharge passage of approximately 109 inches and is operable at a voltage of about 230 volts at a current consumption of about 100 watts. The diffuse discharge in a lamp of identical structure but without the undulations in the discharge passage defined in part by the grooves **12** has an effective length of approximately 83 inches and is operable at a voltage of about 170 volts at a current consumption of about 73 watts. Thus, the grooves **12** increase the effective length of the diffuse positive column discharge in the lamp by more than 30% without increase in the radial dimensions of the lamp. Of course, due to the substantial increase in the effective length of the discharge the luminous efficiency and the light output of the lamp are also substantially increased.

The molded components **2** and **3** of the lamp are capable of being inexpensively manufactured on a mass-production basis by conventional techniques, such as the sag and press methods and apparatus known in the art.

The embodiment of the invention shown in FIGS. 5 to 7 of the drawing is similar to that shown in FIGS. 1 to 4 in that the envelope **21** is made up of two complementary light-transmitting glass components **22** and **23** sealed together and is in the form of a generally flat panel. Also, the envelope defines an elongated undulating discharge path non-circular in cross section with lengths or sections of the discharge passage extending in side-by-side relation in a series.

In this embodiment, however, the envelope **21** is of flat square shape (FIG. 5) rather than of flat annular shape and the lengths of the undulating discharge passage extending in side-by-side relation are straight rather than curved. In addition, as best shown in FIG. 6 the grooves **24** corresponding to the grooves **12** of the embodiment of FIGS. 1 to 4 and defining with the other walls of the envelope the undulations in each of the respective lengths of the discharge passage are wider or more open than the grooves **12** of the embodiment of FIG. 1 to 4. Also, the grooves **24** are so arranged in each of the components **22** and **23** that when the flanges on these components constituting the rim **25** of the envelope are sealed together as described above in connection with the embodiment of FIGS. 1 to 4, the grooves **24** alternate on opposite sides of the discharge passage in such manner that the undulations in each of the lengths of the discharge passage are out of phase with the undulations in the length or lengths of the discharge passage immediately adjacent thereto in the series of lengths of the discharge passage extending in side-by-side relation. This minimizes the self-absorption of light by the lamp.

In this embodiment the straight partitions **26**, **27** and **28** of the envelope **21** separate the straight lengths of the discharge passage and the ridges constituting these partitions are so formed in the envelope components that the partitions terminate in one direction short of a wall of the envelope defining the discharge passage to connect together at one end only the passages extending along opposite sides of each partition so that the passage follows

a tortuous path within the envelope. Thus, as shown in FIG. 5, the partition **26** terminates short of the outer wall of that part **29** of the envelope defining the section of the passage connecting the lengths of the passage extending along opposite sides of the partition **26**. Similarly, the partition **27** terminates short of the outer wall of that part **30** of the envelope defining the section of the passage connecting the lengths of the passage extending along the partition **27** and the partition **28** terminates short of the outer wall of that part **31** of the envelope defining the section of the passage connecting the lengths of the passage extending along the partition **28**. The distance between the ends of the partitions **26**, **27** and **28** and the outer walls of the envelope portions **29**, **30** and **31**, respectively, is such that the area in cross section of these parts of the passage is approximately the same as that between the bottom of the grooves **24** and the wall of the envelope opposite the bottom of the grooves so that the voltage drop or gradient per unit length of the diffuse discharge in the lamp is substantially uniform.

Co-operating filamentary electrodes, shown at **32**, and **33** (FIGS. 6 and 7) similar to the electrodes **6** and **7** described above, are sealed into the envelope **21** at opposite ends of the discharge passage whereat tubular extensions **34** and **35** are provided at the envelope parts **36** and **37** and in the component **22** for receiving the electrodes, the supporting stems therefor and for attachment of bases **38** and **39** for the lamp.

Each of the electrodes **32** and **33** is affixed to the inner ends of a pair of current leading-in wires **40** and **41** which extend through and are sealed to the press **42** of a re-entrant flared glass stem **43** the flare of which is sealed to and closes the outer end of the tubular extensions **34** and **35** on envelope parts **36** and **37**. The outer ends of the leading-in wires **40** and **41** are secured, as by welding, to mutually insulated contact pins **44** and **45**, of the bases **38** and **39**. The bases are secured to the outer shouldered ends of the tubular extensions **34** and **37** by basing cement **46**. An exhaust tube **47** is provided on one of the stems **43** through which the discharge conducting gaseous atmosphere of the lamp is introduced into the envelope after the latter has been exhausted of air and before the exhaust tube is sealed or tipped off.

The phosphor coating indicated at **48** and the discharge conducting gaseous atmosphere of this embodiment of the invention are of the kind disclosed above in connection with the embodiment of FIGS. 1 to 4, the droplet of mercury being indicated at **49**. The envelope **1** is coated externally with the water repellent material mentioned above.

Lamps of the structure shown in FIGS. 5 to 7 like the lamp of FIGS. 1 to 4 may be made in various sizes for desired current consumption. For example, a panel-shaped lamp twelve inches square is desirable for many lighting installations. In a lamp of this size according to the present invention the average width of the flattened, undulating discharge passage is about two and one-quarter inches and the average depth about one inch. The projected length of each of the four side-by-side undulating sections of the discharge passage is about nine and one-half inches, the bottoms of the alternating grooves **24** are spaced apart about two and one-quarter inches along each section, the parts of the envelope connecting the ends of the undulating sections, that is parts **29**, **30** and **31** are one inch wide, five and one-half inches long and two and one-quarter inches deep, and the envelope parts **36** and **37** are one inch wide and two and one-quarter inches long, all measurements being taken internally of the lamp envelope.

The total projected length of the discharge passage in such a lamp is about 48 inches. The effective length of the diffuse discharge therein measured as described above and due to the undulations in the discharge passage, is about 53 inches. Thus, in accordance with the present invention the effective length of the discharge in the

square panel-shaped lamp described above in connection with FIGS. 5 to 7 is increased by about 10% without increase in the length of the sides of the lamp. Of course, the efficiency and the light output of the lamp are also increased due to the increase in the effective length of the discharge. A lamp of the structure described above but without the undulations defined in part by the grooves 24 and having a discharge passage and therewith an effective discharge length of about 48 inches is operable at a voltage of about 107 volts and consumes about 46 watts. A lamp of the above structure with an effective discharge length in the undulating discharge passage of about 53 inches is operable at a voltage of about 120 volts and consumes about 52 watts.

While flat, circular and flat, square-shape panel lamps embodying the invention have been shown and described, it will be understood that lamps of other shapes such as generally rectangular flat shapes, hollow bowl-like shapes, and the like, may be made without departing from the spirit and scope of the invention as defined in the appended claims. Also the generally flat shape of the discharge passage in cross section may be other than the generally rectangular shape in cross section of the discharge passages of the lamps shown and described, for example, the discharge passage in cross section may be of generally ovoidal shape particularly at the curved portions thereof with the narrower part of the ovoidal passage toward the center of curvature of such portions to obtain a substantially uniform voltage drop and light output across such curved portions of the discharge passage.

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

1. A generally panel-shaped vitreous envelope for an electric discharge lamp defining an elongated undulating discharge passage noncircular in cross section, lengths of the passage extending in side-by-side relation and undulating in a direction generally normal to the median plane of the envelope.

2. A generally panel-shaped vitreous envelope for an electric discharge lamp defining an elongated undulating discharge passage noncircular in cross section, lengths of the passage extending in side-by-side relation and undulating in a direction generally normal to the median plane of the envelope, the opposed sides of the side-by-side lengths of the passage extending along the widest part of the passage and being opposed in a direction generally parallel with the median plane of the envelope.

3. A panel-shaped vitreous envelope for an electric discharge lamp defining an elongated undulating discharge passage noncircular in cross section, lengths of the passage extending in side-by-side relation and undulating in a direction generally normal to the median plane of the envelope, the opposed sides of the side-by-side lengths of the passage extending along the widest part of the passage and being opposed in a direction generally parallel with the median plane of the envelope, the undulations in each of said lengths being out of phase with the undulations in the lengths of the passage immediately adjacent thereto.

4. A generally flat annular vitreous envelope for an electric discharge lamp defining an elongated undulating discharge passage noncircular in cross section, lengths of the passage extending in side-by-side relation and undulating in a direction generally normal to the median plane of the envelope.

5. A generally flat rectangular vitreous envelope for an electric discharge lamp defining an elongated undulating discharge passage noncircular in cross section, lengths of the passage extending in side-by-side relation and undulating in a direction generally normal to the median plane of the envelope.

6. A generally panel-shaped envelope for an electric discharge lamp comprising a pair of vitreous complementary dished components sealed together at their margins, each of said components having upstanding ridges constituting with corresponding ridges of the other component partitions subdividing the space within the envelope into a continuous elongated discharge passage noncircular in cross section, each of said components having also re-entrant grooves extending across the discharge passage in the envelope with the grooves in one of said components alternating with the grooves in the other of said components along the discharge passage, the grooves in each of the components extending inwardly of the envelope beyond the median plane of the envelope and terminating short of the opposite wall of the envelope whereby the discharge passage undulates along its length.

7. A generally panel-shaped annular envelope for an electric discharge lamp comprising a pair of vitreous complementary annular dished components sealed together at their inner and outer peripheries, each of said components having upstanding ridges constituting with corresponding ridges of the other component partitions subdividing the space within the envelope into a continuous elongated convoluted discharge passage having curved sections concentric with the annular envelope, said passage being noncircular in cross section and having its major dimension in the median plane of the envelope, each of the components having also re-entrant grooves extending radially of the envelope and across the curved sections of the discharge passage with the grooves in one of said components alternating with the grooves in the other of said components along the curved sections of the discharge passage, the grooves in each of the components extending inwardly of the envelope beyond the median plane of the envelope and terminating short of the opposite wall of the envelope whereby the curved sections of the discharge passage undulate along the length of the sections in a direction generally normal to the median plane of the envelope.

8. A generally panel-shaped annular envelope for an electric discharge lamp comprising a pair of vitreous complementary annular dished components sealed together at their inner and outer peripheries, each of said components having upstanding ridges constituting with corresponding ridges of the other component partitions subdividing the space within the envelope into two sectors of an annulus with an opening between the sectors and subdividing the space in the annular sectors into a continuous elongated discharge passage including the opening between the sectors and having curved sections concentric with the annular envelope, said passage being noncircular in cross section and having its major dimension in the median plane of the envelope, each of the components having also re-entrant grooves extending radially of the envelope and across the curved sections of the discharge passage with the grooves in one of said components alternating with the grooves in the other of said components along the curved sections of the discharge passage, the grooves in each of the components extending inwardly of the envelope beyond the median plane of the envelope and terminating short of the opposite wall of the envelope whereby the curved sections of the discharge passage undulate along the length of the sections in a direction generally normal to the median plane of the envelope.

9. A generally panel-shaped rectangular envelope for an electric discharge lamp comprising a pair of vitreous complementary rectangular dished components sealed together along their sides, each of said components having straight parallel upstanding ridges constituting with corresponding ridges in the other component partitions subdividing the space within the envelope into a continuous elongated discharge passage having straight parallel lengths, said passage being noncircular in cross section and having its major dimension along the straight lengths in the median plane of the envelope, each of the components having also re-entrant grooves extending across

the straight lengths of the discharge passage with the grooves in one of said components alternating with the grooves in the other of said components along the said lengths of the discharge passage, the grooves in each of the components extending inwardly of the envelope beyond the median plane of the envelope and terminating short of the opposite wall of the envelope whereby the discharge passage undulates along the straight parallel lengths thereof.

10. A generally panel-shaped rectangular envelope for an electric discharge lamp comprising a pair of vitreous complementary rectangular dished components sealed together along their sides, each of said components having straight parallel upstanding ridges constituting with corresponding ridges in the other component partitions subdividing the space within the envelope into a continuous elongated discharge passage having straight parallel lengths, said passage being noncircular in cross section and having its major dimension along the straight lengths in the median plane of the envelope, each of the components having also re-entrant grooves extending across the straight lengths of the discharge passage with the grooves in one of said components alternating with the

grooves in the other of said components along the said lengths of the discharge passage, the grooves in each of the components extending inwardly of the envelope beyond the median plane of the envelope and terminating short of the opposite wall of the envelope, the re-entrant grooves alternating along adjacent straight lengths of said passage being disposed at different distances from the ends of the respective straight passage lengths whereby the discharge passage undulates along the straight parallel lengths thereof and the undulations in adjacent discharge passage lengths are out of phase.

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