May 13, 1952 | H. E. KREFFT | 2,596,697

ELECTRICAL DISCHARGE LAMP

Filed Dec. 4, 1948 | 2 SHEETS—SHEET 1

Fig. 3.

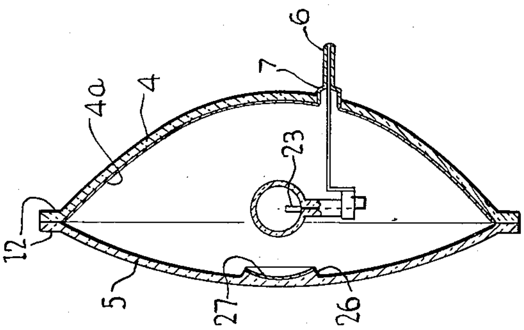


Fig. 2.

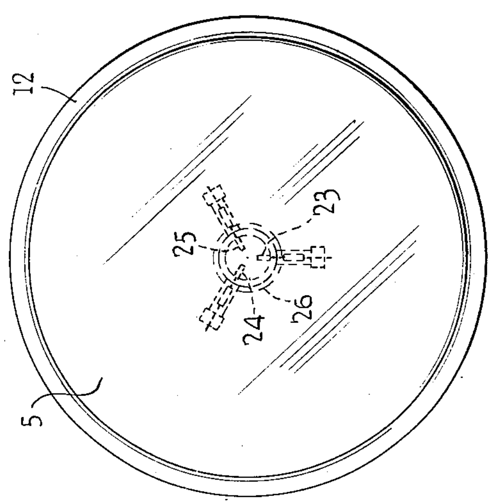
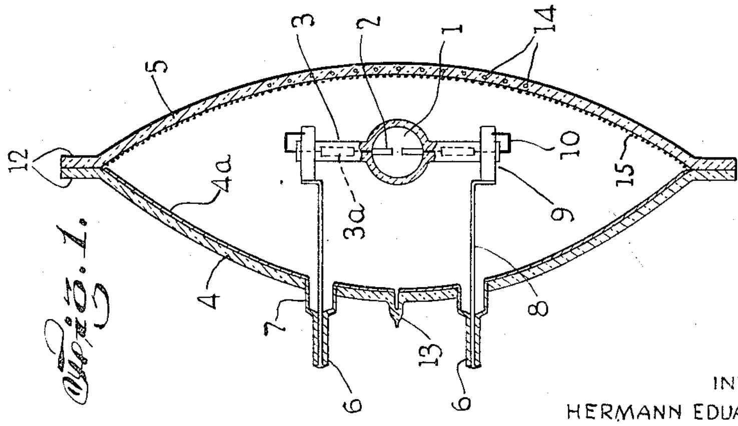


Fig. 1.



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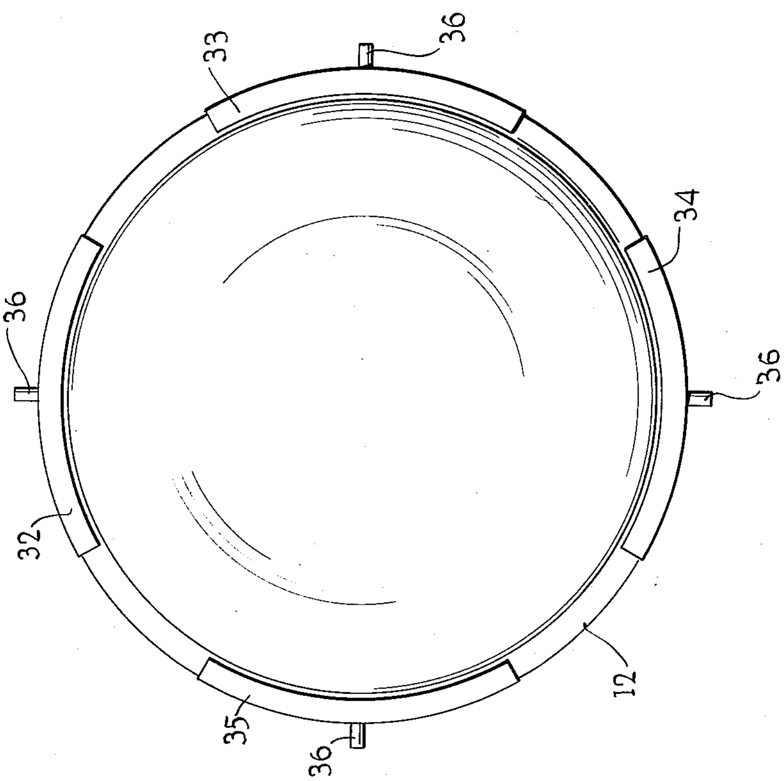

Fig. 5.

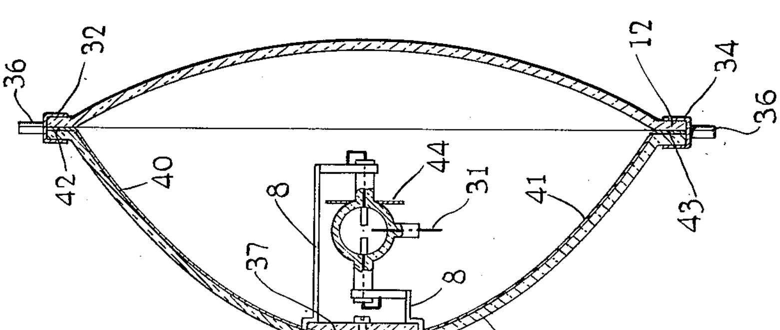

Fig. 4.

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ELECTRICAL DISCHARGE LAMP

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9 Claims. (Cl. 313—26)

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The present invention relates to electrical discharge lamps and more particularly to high pressure electrical discharge lamps.

The modern development of mercury high pressure lamps has resulted in the production of lamps having increased vapor pressures up to very high values of the order of a hundred atmospheres.

Under these very high pressures, the gradient of the arc obtains values of 100 to 500 volts per centimeter, and the electric power dissipated per unit arc-volume is very considerable. Owing to this fact, the brightness of the arc, depending on the degree of the electrical power applied, amounts from 10,000 to 100,000 candles per square centimeter. In the ultra-violet and infra-red, a radiation corresponding to this high brightness also exists. The radiant efficiency in these spectral ranges is very considerable and, for example, a luminous efficiency of 50 to 70 lumens per watt is obtained. Because of these properties, the super high pressure lamps find an extremely wide field of applications in all branches of lighting and uses of radiation.

On account of the great strain produced by pressure and temperature, the discharge tube of these lamps usually consists of a thick-walled quartz glass of spherical shape and of such surface dimensions that in operation it acquires temperatures of about 800° C. to 1000° C. The electrodes of such lamps are arranged close to each other, so that the length of the arc, depending on the type of the lamp and the power consumed, amounts from a few tenths of a millimeter to several millimeters. The discharge tube generally contains a limited quantity of mercury to which cadmium, zinc or thallium may be added, and which under full operation of the lamps, is completely evaporated. Super high pressure lamps of the same construction are filled, instead of with mercury, with krypton or xenon under high pressure of about 20 atmospheres, thereby becoming lamps of high brightness and efficiency and which are particularly adapted to operation with condenser discharges. Lamps of the kind above described have been made up to now for an input of about 50 watts to 2000 watts.

These super high pressure lamps have not been used hitherto to an extent corresponding to their efficiency and the great variety of uses they may find, for the reason that their use has been limited by various disadvantages. It is difficult to connect a base to these lamps because the quartz bulb and the seals acquire high

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temperatures. In order to utilize optically their high brightness, bases which are accurately made must be used and carefully adjusted to the lamps. Furthermore, quartz-glass is very susceptible to contamination which causes devitrification and thus lowers optical efficiency and lamp life. In order to avoid these drawbacks the lamps have been often supplied, in a manner already known, with an outer glass jacket. However, the difficulty of accurate basing is not eliminated in this way. Furthermore, such jacket is not desirable for optical reasons and causes overheating of the quartz tube when given small dimensions. Above all, the use of these lamps are handicapped by occasional explosions of the quartz bulb which endanger nearby persons or equipment.

It is one object of this invention to provide an electrical discharge lamp for safe operation under very high pressures. It is another object of this invention to provide an electrical discharge lamp which has a great flexibility of use in that novel modifications enable its application for therapeutic uses, illumination, light projection, fluorescence analysis, etc. It is a further object of this invention to provide an electrical discharge lamp for super high pressure discharges. Other objects and advantages of this invention will become apparent from the description hereinafter following and the drawings forming part hereof in which:

Figure 1 is a schematic representation of an electrical discharge lamp and envelope therefor according to the present invention,

Figure 2 is a schematic representation of a super high pressure electrical discharge lamp and envelope therefor,

Figure 3 illustrates a modification of the present invention,

Figure 4 is a schematic representation of an electrical discharge lamp of the present invention including an auxiliary electrode therefor and a modification of the reflector surface, and

Figure 5 illustrates another modification of the present invention.

According to the present invention, the disadvantages of mercury high pressure lamps hereinbefore set forth are avoided if the high pressure lamps, subsequently referred to as "tubes," are arranged within a comparatively wide and thick-walled container, formed by two shells, made of pressed glass, which serves as a reflector, which modifies the composition of radiations, which protects surrounding objects against damages caused by explosion, and which facilitates the operation and use of high pressure lamps. To this end, one of these pressed glass-shells is given a preferably paraboloid shape, depending on the use of the lamp, and its surface adjacent to the arc is coated with a reflecting material. The other pressed glass shell, which is made to fit exactly on to the reflector-shell, and which, in order to produce a closely fitting seal, is supplied, as well as the other, with a rim, and enables light and radiation to emerge from the lamp. The light transmitting shell is given a suitable curvature adequate to the pressure of the surrounding atmosphere. The rims of both shells are fused or soldered to each other as far as this is possible in glass technology. In other cases, they are firmly connected to each other by mechanical means.

Reflector-lamps of the kind described are already known in combination with incandescent filaments as source of radiation, and they are widely used because of the optical advantages connected with this construction. Considering the brightness of super high pressure lamps, which is 10 to 100 times larger, an accurate optical adjustment of the arc is of still greater importance for the utilization of its high brightness and for the production of a definite path of the beam emitted. Consequently, the lamp, according to the present invention, is particularly adapted to the construction of searchlights of high optical efficiency which can be used also as ultra-violet and infra-red searchlights. In automobiles, the new lamp improves the performance of headlights, up to now operated with incandescent filaments, many times, as the arc has at least ten times the brightness, three times the efficiency, and a spectral composition of radiation more favorable for the use of polarization filters. Various other constructions and uses will be indicated in the following description.

As super high pressure discharges also are excellent sources of ultra-violet radiation, they find a wide field of application in therapeutic lamps, in lamps for fluorescence analysis and other technical uses of ultra-violet radiation, and, also, as germicidal lamps. In these applications, a well defined spherical distribution of radiation, i. e. the quantitative reproducibility in different lamps of one type, plays an important role as their use, for example, the dosage in therapeutical applications, is greatly simplified in this way. For these uses, the shell through which radiation emerges must possess a special and well defined transmission which the ordinary technical glasses generally do not have. The reflector shell can be made of ordinary glasses in all cases, while the special glasses, which in most cases are hard to produce and to work, need only be used for the other shell. For ultra-violet therapeutical lamps, this special glass should have as high an ultra-violet transmission as possible and it should cut off the spectrum in a definite and reproducible manner. In lamps for fluorescent analysis, it is desirable to exclude visible radiation entirely and to utilize ultra-violet radiation or narrow ranges of wave-length of this radiation only. These special glasses must be made from pure materials and they are frequently produced under special conditions. Their composition mostly differs from that of ordinary glass and they are hard to work. Therefore, it is a great advantage of the lamps of the present invention that only the shell in the path of the emerging radiation has to be made with these special glasses, and that this shell is produced

by pressing in a mold. This method of production has the additional advantage that the thickness of the glass through which radiation passes can be always given exactly the value required and, consequently, the lamps always have the same spectral distribution of radiation, which for instance for medical uses, is of great importance for accurate dosage. The wall-thickness of the molded shell, which is comparatively large, is of no disadvantage for lamps of this kind as the ultra-violet spectrum can be given an accurate short wave limit, or visible radiation can be entirely eliminated, when a wall-thickness of a few millimeters is used. Owing to the particular composition of these special glasses, it is frequently not possible to fuse the two shells to each other even when the material of the reflector shell is adapted to the composition of the special glass. In these cases, it is sufficient to connect firmly the rims of the shells by mechanical means and, consequently, the space between the shells cannot be evacuated, which is not absolutely necessary as the tube is not susceptible to oxygen. In some cases, the transmitting shell may consist of pressed quartz-glass or of a glass similar to quartz with high ultra-violet transmission.

Reflector lamps containing a high pressure or super high pressure tube within an outer envelope, which serves as reflector, are already known, but in this type of lamps the envelope is blown in the mold like a bulb, and the tube is mounted on a lamp stem in the usual way. It is not possible, however, to accurately reproduce the wall-thickness of the envelope made in this way and to give it a thickness of a few millimeters. Furthermore, only such glasses can be used which can be blown in the mold and sealed to the stem. Frosting and application of the reflecting material to the bulb is very difficult. Particularly, it is almost impossible to mount the tube exactly in the required position with respect to the reflector. In comparison with the lamps which are already known, the lamps made according to the present invention, therefore, are a great improvement.

The arrangement of a super high pressure tube in a container consisting of two molded shells is of particular value for a safe operation of these tubes, which are operated under very high pressures. The molded shells may easily be made to have a wall-thickness sufficient to endure the impact of fragments which are projected with great violence in case of an explosion of the tube. In the case of tubes of high wattage, where a demolition of the container through heavy fragments may occur, all damage to nearby objects can be avoided when the reflector is protected by means of a metallic shield, while the transmitting shell is protected through a wire screen arranged between this shell and the tube, or by a screen imbedded in the light transmitting glass and thus preventing total destruction.

During manufacture of the new lamps, two reflector shells provided with conductors and an exhausting tube, the rims of which are suitably ground, make a close fit and are put together tightly. The space enclosed by the reflector shells is highly evacuated. A piece of metal, e. g. aluminum, which is contained in a tungsten coil fastened to the conductors, is evaporated by heating the coil. Having been supplied with a reflecting layer in this way, the shells are separated and the tube is mounted on the supports by means of a gauge which provides for the exact position of the tube with respect to the reflector. If a non-specular reflecting layer is to be made, the surface of the shell is frosted chemically, or by sandblast, before the metallic layer is applied. In this case, the inner surface of the other shell is also frosted. This frosting of the surfaces is of importance for lamps with broad spherical distribution of the radiation; the degree of frosting, however, must be accurately reproduced if the lamps are to have identical optical properties. After the mounting of the tube corresponding pairs of shells are fused to each other at the rims. The shells are carefully annealed and the rims are fused to each other by means of a pointed flame. The container is finally evacuated and filled with nitrogen or a rare gas. The pressure of the gas is preferably kept low enough to prevent an inner pressure exceeding atmospheric pressure during operating of the lamp, which may cause an explosion in case the tube happens to break. When the shells are made of two different glasses, it is advantageous to connect them to each other by means of a soft glass enamel. When this method cannot be used on account of too large differences in glass properties, the rims may be fastened to each other, in a way already known, by means of a soldering metal, or a vacuum proof connection is altogether given up and the shells are pressed against each other by a metal ring enclosing the rims and tightly pressing them together.

Some lamp constructions, made according to the invention, are contained in the attached drawings, which show different types of lamps according to the different uses of these lamps.

Figure 1 shows a construction suitable for illumination, or for medical uses. The tube 1, which is made of quartz-glass, in this case has a power dissipation of 300 watts. Its discharge vessel, which is nearly spherical, has an outer diameter of about 20 millimeters and the thickness of the wall amounts to about 2.5 millimeters. It is supplied with electrodes 2 consisting of tungsten wire or small bodies of sintered tungsten which are suitably activated with thorium oxide, or thorium, and which are about three millimeters apart. Instead of tungsten, I may use any other suitable refractory metal or in place of thorium or thorium oxide, I may use any other activation material, whether in the form of metal or in the form of oxide, to produce the activated electrode. The electrodes are mounted on seals 3 containing leading-in conductors, which are fused to the envelope. A tight connection between the quartz-glass of the seals and the metallic conductors is made by means of a molybdenum foil 3*a* of about 0.02 millimeter thickness forming the central part of the conductor. The envelope of the tube contains a rare gas of about 20 millimeters pressure or other pressure, lower or higher, suitable for starting a discharge, and an accurately determined quantity of mercury which, under operation of the tube and when completely evaporated, produces a pressure of about 40 atmospheres. Under these conditions, when the electrodes are connected to a line of 110 to 220 volts in series with a choke or resistance of suitable size, an arc is produced between the electrodes which has a brightness of about 30,000 candles per square centimeter and an intensity of about 2,000 candles. The voltage drop of the arc is about 80 volts. The tube is mounted within a container formed by the molded shells 4 and 5. The shell 4, which serves as reflector, has a paraboloid shape while the shell 5 through which the radiation emerges is given a curved shape adequate to the pressure of the surrounding atmosphere. To the shell 4, pins 6 are tightly fused by means of metallic rings 7. The pins support the lamp in the lamp-holder and also serve as leading-in conductors. Furthermore, they carry supporting wires 8 by means of which the tube 1 is held in the required position with respect to the shell 4. The seals 3 of the tube are provided with cuffs 9 to which the wires 8 are spotwelded. The electrical communication between these wires and the leading-in wires of the tube is made by linking wires 10. The reflector shell 4 carries a reflecting layer 4*a* on the surface adjacent to the tube, and this layer is suitably produced through evaporation of aluminum. The shells 4 and 5 are firmly sealed to each other by means of the rims 12. The space between the shells is carefully evacuated through the exhaust tube 13 and filled with an inert gas the pressure of which does not exceed a half atmosphere under operating conditions of the lamp.

In the present construction of the lamp, when the radiation is to emerge under a wide angle, the arc of the tube is arranged in a vertical position with respect to the axis of the reflector and, consequently, about half the radiation is emitted directly, while the other half is thrown back by the reflector. In order to give this part of the radiation a wide angle of divergence also, the arc is arranged between the reflector and its focus. The surface of the reflector shell is preferably frosted before the reflecting layer is deposited. In this case, the layer may also consist of other non-metallic materials having a high coefficient of reflection, for instance, magnesium oxide, which is deposited on the surface of the shell through combustion of magnesium.

The reflector shell, which has a thickness of about 3 millimeters, consists of an ordinary glass, which can be used also for the other shell when the lamp is to be used for illumination only. However, if the lamp is to be used for medical purposes, the shell 5 is made of a special ultra-violet transmitting glass the composition of which depends on the degree of transmission required.

If the lamp is to be used for medical purposes, it is particularly necessary to provide additional measures against a possible explosion of the tube, by which persons exposed to the radiation might be endangered. As indicated in Figure 1, a wire screen 14 is, therefore, imbedded within the wall of the shell 5 which prevents a total destruction of this shell and stops the fragments of the exploding tube projected with great violence.

If the shell 5 consists of a so-called black glass, which in the usual way contains 3 to 6% of nickel oxide, the present lamp is excellently suited as source for fluorescence analysis. In this case, a smaller tube with a wattage of 100 watts only is preferably used and, therefore, the lamp has a considerably smaller size. The nickel oxide glass mentioned is perfectly opaque for light at a wall-thickness of 3 millimeters, while the ultra-violet radiation of the mercury arc in the spectral range of 300 to 400 mu is well transmitted.

The same construction of the lamp can be used when the light of the mercury arc is to be improved by luminescent materials. As it is known, the light of the mercury arc contains too little radiation in the red and for this reason, it has been attempted to correct this defect by transforming the ultra-violet radiation, which is very considerable, into light containing a high percentage of red radiation by means of a luminescent powder. Theoretically, a percentage of red light corresponding to daylight and an increase in luminous efficiency of about 20% should result. The efficiency of transformation of radiation through the luminescent material, however, is greatly diminished by temperature and, therefore, with lamps already known, where the arc is completely surrounded by the luminescent layer, not more than one-third of the possible effect is obtained. The harmful effect of temperature is avoided in the lamp shown in Figure 1 by applying the luminescent material as a thin layer **15** only onto the shell **5** which is given a larger size in order to increase the surface. As the lamp is operated with the pins up and the luminescent layer on the lower side only, the material is only to a small extent exposed to heating through convection or conduction of the gas contained in the lamp. The heating effect through absorption of radiation and energy losses connected with the process of transformation is relatively small. The temperature of the luminescent material produced during operation of the lamp is additionally lowered by increasing the outer surface of the shell **5** by means of grooves or ribs. This structure can be produced without difficulty when the shell is pressed in the mold. As luminescent materials, sulfides and silicates are suitable. As binding material potassium silicate or phosphoric acid are preferably used. Both shells comprising the same glass are tightly fused to each other by means of the rims after previously coating one shell with the reflecting material and coating the other with the luminescent layer. The interior space is then carefully evacuated and the luminescent layer freed from any moisture. Preferably, this space is filled with a small quantity of oxygen, which may be also added to the usual gas-filling.

A new and efficient headlight for automobiles is obtained if, according to Figures 2 and 3, a super high pressure lamp with three electrodes having a wattage of 60 to 100 watts is used. As shown in Figure 2, the tube is provided with three electrodes **23**, **24** and **25** arranged symmetrically at an angle of 120° to each other and between which three mercury arcs of high brightness are formed when the electrodes are connected to three phase voltage. The distance between the electrodes amounts to about 2 millimeters and the discharge tube has such dimensions that the pressure of the mercury vapor has a value of about 60 atmospheres during operation of the lamp with the wattage indicated. The brightness of each mercury arc under these conditions amounts from 10,000 to 20,000 candles per square centimeter. Super high pressure lamps with three or more electrodes are known. However, in this case, the plane formed by the mercury arcs is vertically arranged with respect to the axis of the reflector and coincides with the focus. The tube is given such a position with respect to the reflector that the arcs formed between the electrodes **23** and **24** and between **23** and **25** produce a parallel beam of wide range, while the arc formed between the electrodes **24** and **25** produces a diverging beam directed to the road. As in such multiple-electrode tubes, the arcs can be operated singly or in pairs. It is possible in a simple way to use the present lamp as a headlight with concentrated or diverging beams by either operating the arcs **23—24** and **23—25** or **24—25** alone. This shifting from one arc to another does not require a special starting equipment because in such tubes, having three or more electrodes, each arc is produced immediately, regardless of high pressure, when the corresponding circuit is closed, provided that always at least one arc is maintained. Therefore, when this headlight lamp is to be shifted from parallel light, e. g. when the arcs **23—24** and **23—25** are operating, to diverging light, then the arc **24—25** must be first started before the other two are interrupted. In the reverse case, the arcs for parallel light must be first switched on before that for diverging light is put out. Of course, the arc **24—25** can be operated permanently also, and only the other two are started or interrupted according to need. As each starting of an arc requires fractions of a second only, this lamp can be used exactly in the same way as the usual automobile lamps having two incandescent filaments. Compared with these, however, the new headlight lamp offers extraordinary advantages as its arcs possess ten times the brightness and three times the luminous efficiency. The light of the new lamp is reflected by illuminated objects to a higher degree as it is composed mainly of the green and yellow mercury lines. For the same reason, when polarizing filters are used, losses through absorption are relatively small. Finally, the tube may be overloaded two or three times during short periods which results in a correspondingly higher candle power of the headlight.

According to Figure 3, the undesirable direct emission of the tube is screened off through an auxiliary reflector **26** which produces an image of the arcs and which throws also this part of the radiation on the reflector. This auxiliary reflector is also produced by pressing in the mold as a part of the shell **5**, and the metallic layer **27** is deposited, in a similar manner as with the reflector **4**, by evaporation of aluminum or other metals of high coefficient of reflection. The shell **4** is provided with three base pins. The shells **4** and **5** which are made of boro-silicate glass are fused to each other and the space enclosed by them is filled with an inert gas such as nitrogen. The blue and violet light of the mercury tube which is considerably scattered by atmospheric particles is preferably absorbed by using yellow glass in the making of the shell **5**.

The small reflector lamp, according to Figures 2 and 3, is also excellently suited for microscopic work. In this case, a magnified optical image of the arcs is needed, which is projected on the illuminating mirror of the miscroscope. The tube is arranged slightly outside the focus of the reflector **4**, so that the desired image is obtained at a distance of about 30 centimeters from the wall of the lamp. Owing to the high brightness, the lamp is suited for direct and indirect illumination of the microscopical field and particularly for fluorescence microscopy. This method which up to now has been little used, as it depended hitherto on the use of a large equipment becomes accessible to the widest extent with the new lamp. The light of the mercury arc to this end is modified with an ultra-violet transmitting blue glass filter which transmits radiation below 450 mu only. If the lamp is to be used for fluorescence microscopy only, the glass of the shell **5** is preferably colored with the oxides of cobalt and copper. In this case, the operation of the lamp with three phasic current is particularly advantageous as the three arcs fill out rather uniformly the space between the electrodes and in this way a source of light of nearly circular symmetry is produced which is required for the illumination of the microscopical object and for a uniform illumination of the field of the microscope. Also, when a tube with two electrodes only is used, the new small reflector lamp offers extraordinary advantages due to its high brightness.

A reflector lamp of the kind described is also excellently suited as a source of light for projectors if, as in the case of the microscopical lamp, an optical image of the arc is desired at a suitable distance from the lamp. As a high luminous flux is frequently required, tubes of higher wattage are used in these applications. In this case, the tube may also have three or even four electrodes in order to produce the circular symmetry required.

If a lamp according to Figures 2 and 3 is provided with a glass of high transmission in the ultra-violet or if quartz glass is used for the shell **5** which does not absorb ultra-violet radiation of short wave-length below 320 mu, a source of radiation is obtained which is excellently suited to germicidal uses. Compared with usual germicidal lamps, it has the advantage that small objects can be exposed to radiation from a large distance without incommodation of persons standing nearby. The new lamp, therefore, will have important uses in surgery.

A searchlight lamp, utilizing the high brightness of a super high pressure tube for the production of a parallel beam of light of very high luminous intensity, is indicated in Figures 4 and 5. In this case, the reflector forms a deep paraboloid and the arc is arranged in its focus and in a direction parallel to the axis of the reflector. The reflector shell is provided with a specular layer and, therefore, is not frosted the same way as the other shell. In the example shown, the tube is supplied with an auxiliary electrode **31** which greatly facilitates the starting of the lamp. With its help, the arc can be started in such cases when the tube is hot and possesses high vapor pressure. To this end, however, a Tesla voltage of several thousand volts must be applied to the starting electrode which is supplied by a transformer of sufficient capacity. The insulation of the customary base, however, and of the corresponding lamp-holder is not sufficient for this high voltage. The contacts of the lamp are, therefore, preferably arranged on the rims with which the shells are fused to each other. As shown in Figures 4 and 5, four contact elements **32**, **33**, **34** and **35** which are insulated from each other, and which consist of metal sheets with a U-shaped profile, are fastened to the rims **12**. The metal sheets are firmly connected to the lamp by pressing of each sheet into grooves specially provided in the rims, or by cementing. Each contact carries a pin **36** which, as in the usual swan-base, fits into a corresponding slot of the lamp-holder not shown in the drawing. The reflector shell **4** is not provided with base-pins as the conductors emerging from the interior of the container are preferably sealed between the rims of the shells. Through this new construction of the lamp, a method of supporting the tube results which is different from the method already described. As shown in Figure 4, the support wires **8** carrying the tube are fastened to a plate **37**, which consists of an insulating material and which is firmly connected to the reflector shell by means of a screw **38**. A cap **39** is fused to the shell which is provided with a screw thread for holding the screw. To the supporting wires **8** are connected the conductors **40** and **41** which lead, along the surface of the shell, to the seals **42** and **43** and to the contacts **32** and **34**. These conductors have the form of a wire or of a ribbon and they must be insulated against the metallic layer of the reflector. The reflector shell is preferably provided with grooves into which the conductors are inserted. The rims are also provided with such grooves, which are arranged in the planes of contact and contain the seals **42** and **43**. The shells are fused to each other with the rims, in a way already described, and in this manner the leading-in wires **42** and **43** are embedded tightly, or, if the rims cannot be fused together, they are firmly connected to each other by means of the contact elements. The starting electrode **31**, for reasons of insulation, is not connected to the contacts **33** or **35** in the same manner but its conducting wire is preferably passed across the space enclosed by the container to the rims. In order to avoid any contact with the reflecting layer, the conductors **40** and **41** may be arranged in the same way.

As the maximum of luminous intensity of the arc is in the direction vertical to the axis and to the axis of the reflector, while it becomes a minimum in the direction of the arc, the supporting plate **37** absorbs only little light and a small fraction only of the radiation can leave the lamp directly. If not wanted, this radiation may be eliminated through a shield **44**.

This lamp can be used as searchlight both with light or ultra-violet or infra-red radiation and the shell **5** depending on the application intended, consists of glasses with corresponding spectral transmissions. For these spectral ranges, the super high pressure arcs in krypton or xenon, already mentioned above, are particularly efficient sources of radiation. Therefore, in certain cases, one of these super high pressure tubes is used in the place of the mercury tube. These arcs, moreover, emit under high currents a nearly continuous spectrum extending from the ultra-violet to the infra-red, which is emitted with high radiant efficiency. As the time required for the building up and decay is very small, these arcs are particularly adapted to the operation with single or periodically repeated condenser discharges of very short duration and very high instantaneous currents. These lamps, therefore, are excellently suited for stroboscopes and as flashlights for photography with visible, ultra-violet or infra-red radiations. Due to their new design, they possess high optical efficiency and a particularly convenient construction.

What I claim is:

1. A gaseous discharge lamp with auxiliary envelope, comprising in combination a super high pressure discharge lamp having a substantially spherical quartz glass discharge vessel containing a plurality of closely spaced electrodes for operating under a pressure of more than 20 atmospheres, said discharge vessel being supported within an auxiliary envelope formed of a paraboloid reflector section and a light transmissive section, said sections being formed of molded glass and being firmly connected to each other at the rims thereof, said reflector section having at least one aperture formed therethrough, a substantially tubular and cylindrical metallic member seated in and fused to the walls of said aperture, a supporting structure for said lamp, said supporting structure being secured to said reflector section by means of said tubular metallic member, said lamp supporting structure com-

prising a pair of electrically conductive rods electrically connected across said lamp.

2. A gaseous discharge lamp according to claim 1, wherein the light transmissive section is reinforced by a wire screen and the reflector section is covered with a metallic reflecting surface deposited by evaporation of a metal of high reflectance.

3. A gaseous discharge lamp according to claim 1, wherein the auxiliary envelope has a reflector section with an inner surface of frosted glass and a metallic reflecting surface deposited thereon by evaporation of a metal of high reflectance.

4. A gaseous discharge lamp according to claim 1, wherein the auxiliary envelope has a reflector section with an inner surface covered with a reflecting surface consisting of magnesium oxide deposited on said inner surface by the combustion of magnesium.

5. A gaseous discharge lamp with auxiliary envelope, comprising in combination a super high pressure discharge lamp having a substantially spherical quartz glass discharge vessel containing a plurality of closely spaced electrodes for operating under a pressure of more than 20 atmospheres, said discharge vessel being supported within an auxiliary envelope formed of a paraboloid reflector section and a light transmissive section, said sections being formed of molded glass and being firmly connected to each other at the rims thereof, said reflector section having at least one aperture formed therethrough, a substantially tubular and cylindrical metallic member seated in and fused to the walls of said aperture, a supporting structure for said lamp, said supporting structure being secured to said reflector section by means of said tubular metallic member, said lamp supporting structure comprising a pair of electrically conductive rods electrically connected across said lamp, electrical contacts positioned on the perimeter of said auxiliary envelope, electrical conductors for said contacts sealed between the said sections and leading along the inner surface of said reflector section to said rods.

6. A metal vapor arc discharge lamp according to claim 5, wherein said contacts are U-shaped metal sheets laid around and pressed onto the rims of said auxiliary envelope.

7. A gaseous discharge lamp according to claim 5, wherein said discharge vessel contains three electrodes of which two are arranged to sustain an arc across the focus to produce a parallel beam of light and the third electrode is arranged to sustain an arc outside the focus to produce a diverging beam of light.

8. A gaseous discharge lamp according to claim 5, wherein said light transmissive section contains an auxiliary reflector on the central inner portion thereof.

9. A gaseous discharge lamp according to claim 5, wherein said arc vessel contains at least two electrodes arranged outside of the focus of the reflector section to magnify an arc image at a short distance from the light transmissive section.

HERMANN EDUARD KREFFT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,778,305	Blau	Oct. 14, 1930
2,212,879	Kalsing	Aug. 27, 1940
2,263,171	Hays	Nov. 18, 1941
2,275,768	Kern	Mar. 10, 1942
2,277,876	Macksoud	Mar. 31, 1942
2,341,990	Inman	Feb. 15, 1944
2,353,668	Hinman	July 18, 1944
2,367,871	Kalsing	Jan. 23, 1945
2,392,828	Noel	Jan. 15, 1946
2,398,970	Singer	Apr. 23, 1946
2,466,430	Hutchison	Apr. 5, 1949

FOREIGN PATENTS

Number	Country	Date
527,796	Great Britain	Oct. 16, 1940