

[54] **HIGH POWER ELECTRIC DISCHARGE LAMP WITH COOLED BASE ASSEMBLY**

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[22] Filed: **May 3, 1973**

[21] Appl. No.: **356,912**

[30] **Foreign Application Priority Data**

May 8, 1972 Germany..... 2222454

[52] U.S. Cl..... **313/32, 313/22, 313/39, 313/42**

[51] Int. Cl. **H01j 61/52**

[58] Field of Search **313/22, 25, 30, 32, 39, 313/42**

[56] **References Cited**

UNITED STATES PATENTS

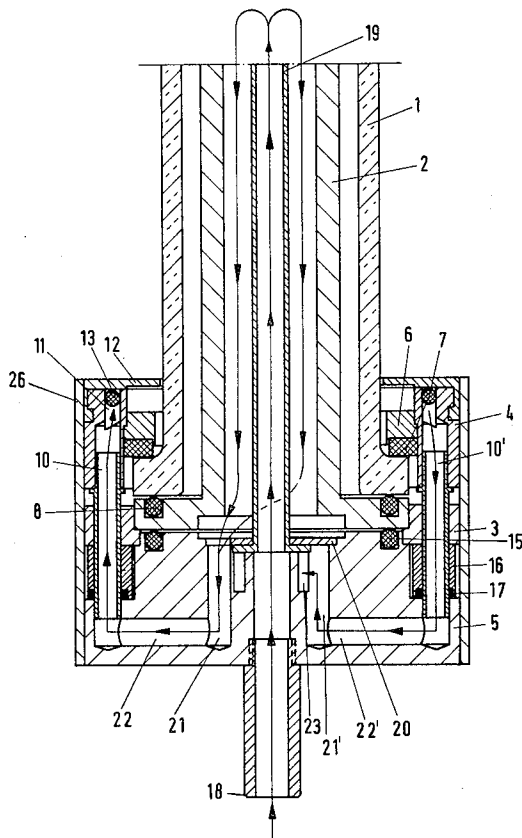
3,366,814 1/1968 Silco 313/32

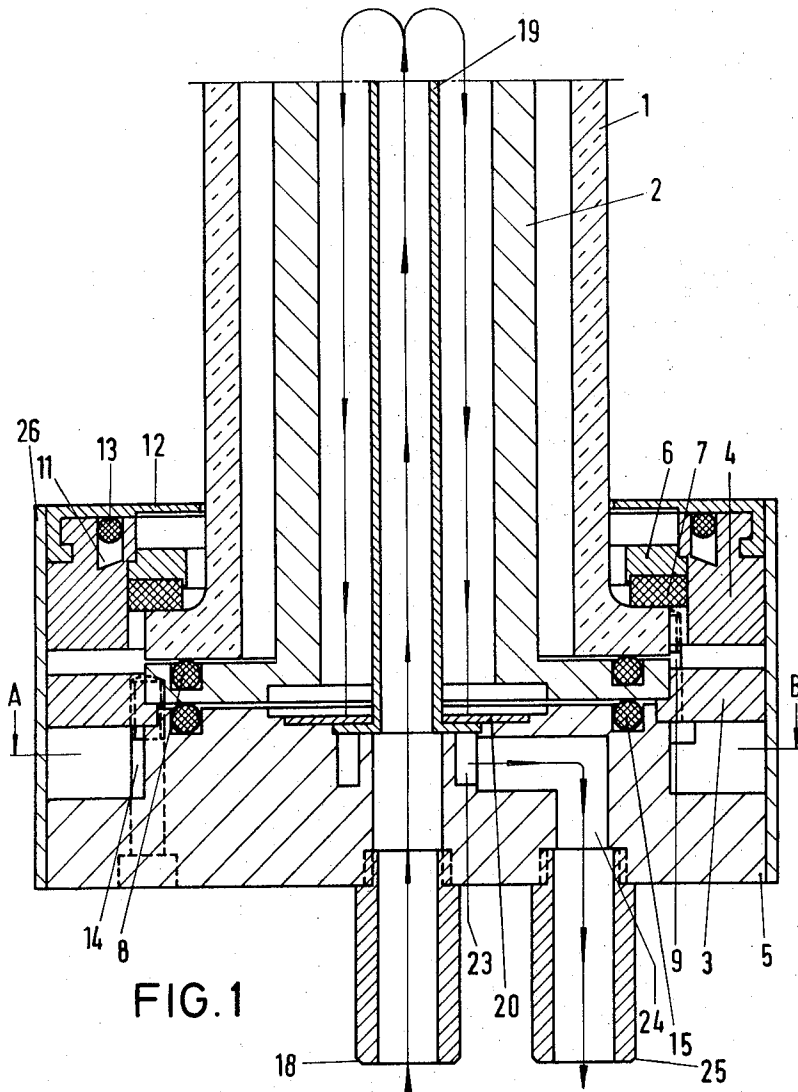
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[57] **ABSTRACT**

Fluid cooled high power discharge lamp, more particularly a high pressure xenon discharge lamp with a power input of more than 10 kW capable of being disassembled. A cooling system is included in the base assembly. A clamping ring clamps a coupling flange in which a plurality of ducts and tubes for coolant are embedded; the coolant cools both the electrode and the lamp base assembly. Resilient packings are interposed between the component parts, in the vicinity of the ducts, to be cooled by the coolant.

14 Claims, 4 Drawing Figures





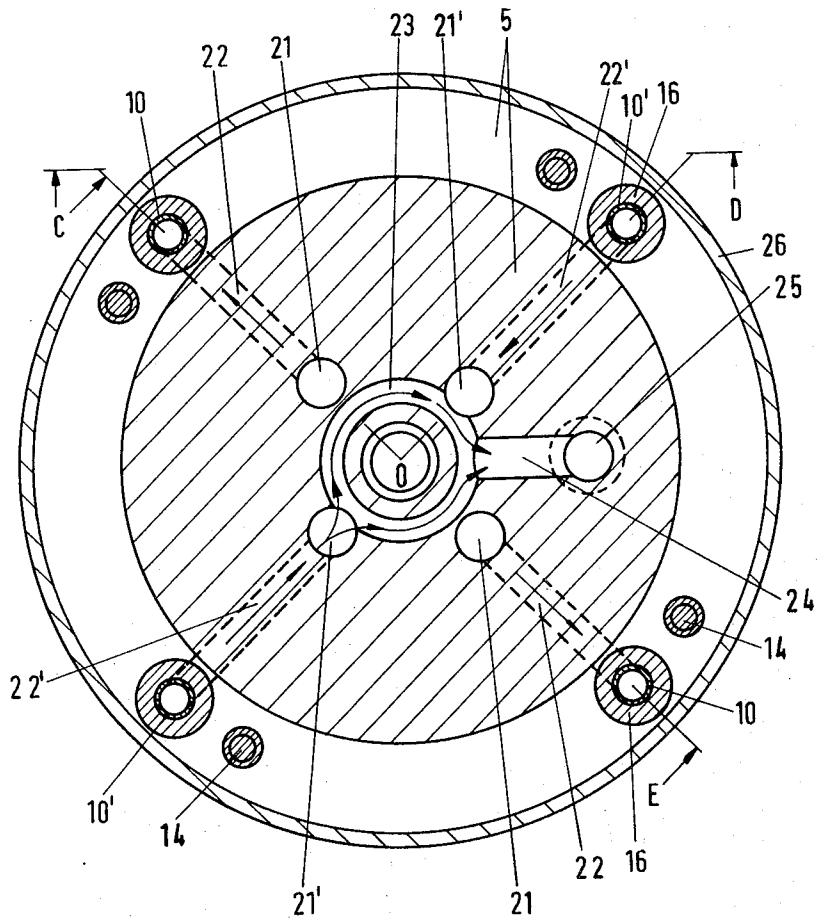
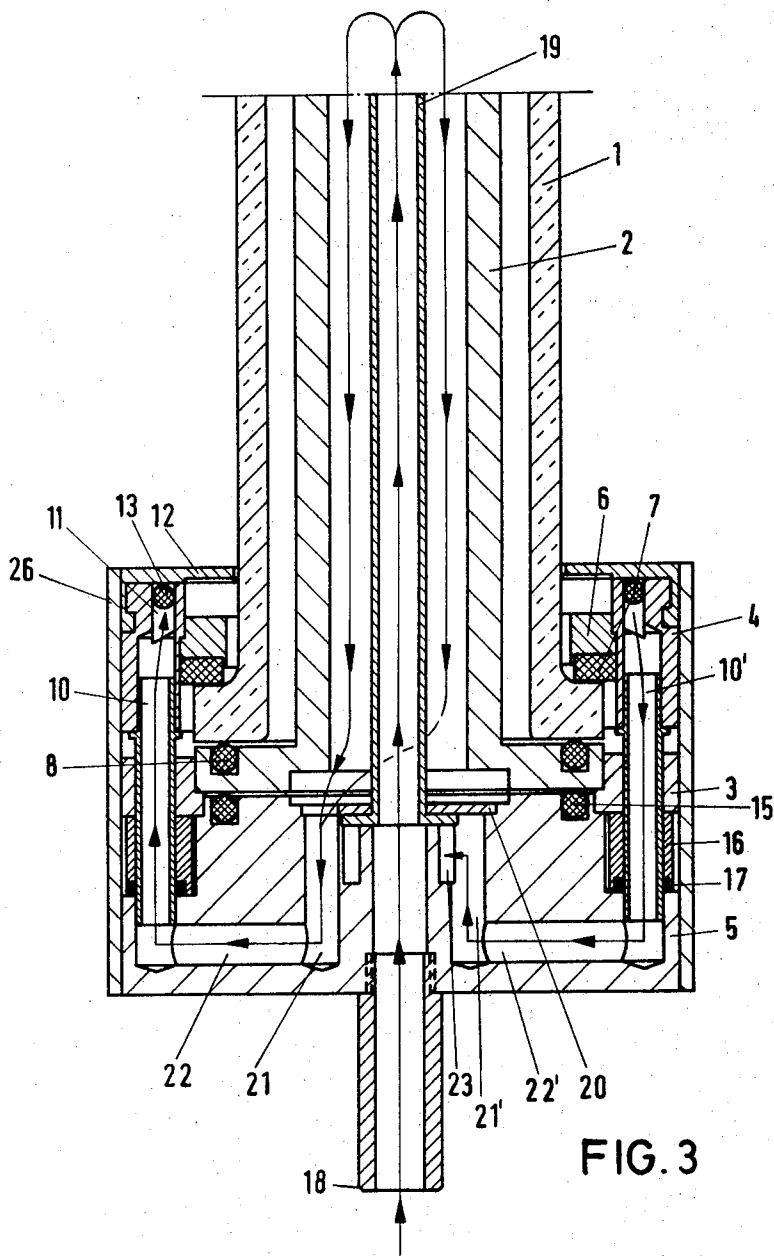
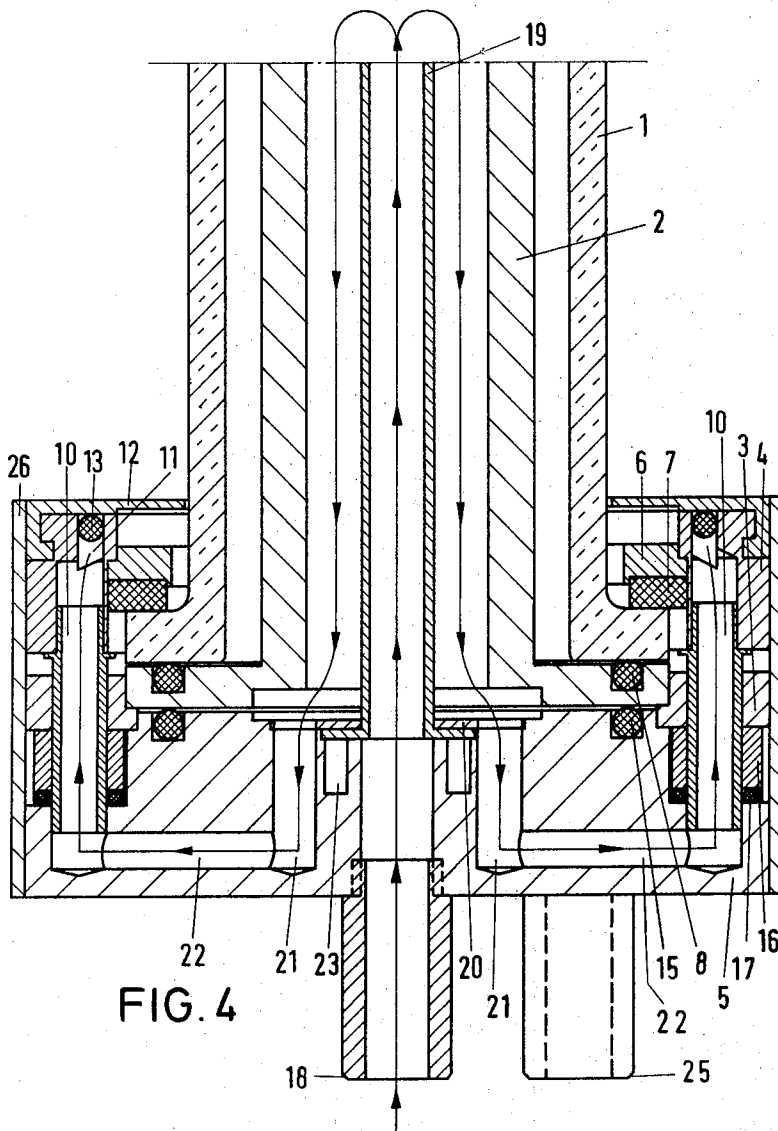


FIG. 2





HIGH POWER ELECTRIC DISCHARGE LAMP WITH COOLED BASE ASSEMBLY

The invention relates to a high power electric discharge lamp with separable, liquid-cooled base assembly and with a liquid-cooled electrode such as, e.g., high pressure xenon discharge lamps with a power input of more than 10 kW.

It is known to cool the electrodes and the base assemblies of high power electric discharge lamps by means of a liquid. Some lamps of this type can also be disassembled.

The high pressure xenon discharge lamp disclosed in U.S. Pat. No. 3,256,383 can be disassembled. No special cooling in the region of the highly stressed joints is provided so that lead joints have been used. It is common practice to use such lead joints when the base assemblies are insufficiently cooled. The sealing effectiveness of such joints, due to inelasticity of the lead components, is insufficient in most cases; moreover, the lead joints cannot be re-used after disassembly of the lamp; they fuse already at a temperature of 327°C so that they are hardly applicable to discharge lamps with a power input of more than 10 kW.

Another lamp is disclosed in U.S. Pat. No. 3,405,314. The high pressure, high power electric discharge lamp of this U.S. Pat. No. 3,405,314 cannot be readily disassembled because of the extensive length of the packing collar which is made of a "suitable material" interposed between arc tube and electrode assembly.

U.S. Pat. No. 3,543,070 discloses a high pressure electric discharge lamp wherein that portion of the base assembly is cooled which faces the discharge. The circumferential joint on the arc tube is exposed to substantial radiation from the discharge space. This lamp cannot be readily disassembled since joining of the base assembly to the arc tube is effected by means of a sealant which must be softened when effecting disassembly and assembly.

According to U.S. Pat. No. 3,366,814, the joining between arc tube and base assembly is protected from radiation from the discharge space by a ring of tantalum disposed within the discharge space. With high power electric discharge lamps having a power input of more than about 10 kW, however, this type of protection is insufficient for resilient packing rings for use in separable lamps.

It is an object of the present invention to provide a high pressure electric discharge lamp with separable base assembly in which all components are sufficiently cooled, and to permit use of commercially available and inexpensive packings or seals having the required properties, such as temperature resistance, resiliency, separability, sealing efficiency, re-usability and long life.

SUBJECT MATTER OF THE PRESENT INVENTION

Both the arc tube and the electrode tube are provided with flanges which are pressed together and supported by portions of the base assembly; the main portion of the base assembly facing the electrode is a clamping ring, and the main portion of the base assembly facing outwardly is a coupling flange. Both members have ducts and are interconnected by tubes associated with the clamping ring (hereinafter called clamping ring tubes), and the base assembly portion

facing the electrode carries a cover. The coolant supply tube projecting into the electrode is secured in the base assembly, the packing and intermediate rings located between the base assembly portions are of resilient material, and the base assembly portions are so designed as to allow cooling liquid to flow through the coolant supply tube secured in the base assembly to the tip of the electrode, passing then from the electrode tip through ducts in the coupling flange radially outwardly, then flowing through some clamping ring tubes to the clamping ring, passing through the latter, returning through other clamping ring tubes to the coupling flange, and reaching through ducts in said flange the outlet tube.

In one embodiment of the base assembly, the coupling flange is provided with first ducts which establish connections to the clamping ring tubes and to the clamping ring and open into the space between electrode tube and coolant supply tube, and with second ducts which establish likewise connections to the clamping ring tubes and to the clamping ring but open into an annular outlet passage within the coupling flange. The second ducts are therefore located more closely to the axis than the first ducts. The outlet duct establishing connection to the outlet tube opens likewise into the annular outlet passage. A washer or gasket is affixed to the coupling flange to prevent the coolant from returning from the annular outlet passage into the space between electrode tube and coolant supply tube during backflow from the clamping ring via the clamping ring tubes and the coupling flange. This washer or gasket seals the annular outlet passage as well as the ducts opening into this passage from the space between electrode tube and coolant supply tube. The washer is provided with bores through which the coolant liquid, coming from the electrode, can reach the ducts of the coupling flange, the clamping ring tubes, and the clamping ring.

The gas-tight connection between the arc tube provided with flanges at both ends, and the electrode tube likewise provided with flanges, is effected by pressing together the clamping ring and a central fixture ring with interposition of a packing ring, sealing ring or gasket. Interposed between the clamping ring and the flange of the arc tube are two half-rings of metal and two half-rings of resilient material. The clamping ring has a central bore which must be larger than the diameter of the arc tube flange to permit the ring to be slipped over the flange.

In an embodiment of the base assembly, the clamping ring tubes guiding the coolant from the coupling flange to the clamping ring and vice versa, are pressed into the clamping ring in fluid-tight manner. Joining of the clamping ring tubes provided in the coupling flange is effected by a packing ring or seal, each, and by a metal sleeve. The metal sleeve bears against the central fixture ring.

Intense cooling of the clamping ring is effected by flow of coolant through a circumferential groove thereof. Joining of said circumferential groove is effected by a ring of resilient material which in turn is supported by the cover of the clamping ring. The cover of the clamping ring protects the base assembly from radiation from the discharge space.

In an embodiment, the cover of the clamping ring embraces the clamping ring. To permit its removal and

re-insertion, it is composed of two parts which are held together by a tubular jacket.

Due to the highly effective cooling of the base assembly, resilient plastic may be used as the material for the resilient structural components. The plastic must be resistant to temperatures of up to about 200° C for extended periods of time because of degassing of the lamp prior to filling.

The base assembly is suited for high power discharge lamps having a power input of about 10 – 30 kW, e.g., for high pressure xenon electric discharge lamps.

FIGS. 1–4 are general views of the base assembly according to the invention;

FIG. 1 is a fragmentary longitudinal view of the base assembly;

FIG. 2 is a transverse section through the base assembly along line A-B of FIG. 1;

FIG. 3 is a fragmentary, longitudinal, angled section along line C-O-D of FIG. 2; and

FIG. 4 is a fragmentary, longitudinal section along line C-O-E of FIG. 2.

Both arc tube 1 of quartz glass and electrode tube 2 (FIG. 1) are provided at their respective ends with flanges which are pressed together and supported by portions of the base assembly. The main portion of the base assembly facing the electrode is clamping ring 4. The main portion facing outwardly is coupling flange 5. Coupling flange 5 is provided with ducts or bores 21, 22 (shown in FIGS. 2, 3, 4) which serve to supply coolant to the clamp ring tubes 10 (FIGS. 2 and 4) and to clamp ring 4, while ducts or bores 21', 22' (FIGS. 2 and 3) serve for passage of the coolant from the clamp ring tubes 10' (FIGS. 2 and 3) through coupling flange 5 and outlet duct 24 to outlet tube 25. Clamp ring 4 and coupling flange 5 are interconnected by clamp ring tubes 10, 10'. The gas-tight connection of the flanges of arc tube 1 and of electrode tube 2 is effected by insertion and pressing together of a resilient O-ring 8 within said flanges. Pressing together of O-ring 8 is effected by tightening of screws 9 (FIG. 1) which bear with their heads against central fixture ring 3. Embedded in central fixture ring 3 is the flange of electrode tube 2. Screws 9 draw the cooled clamping ring 4 towards the quartz glass flange of arc tube 1 by the interposition of half-rings 6 and 7. The half-rings 6 are inserted in clamping ring 4 and convey the tightening pressure to the half-rings 7 of resilient material, to the quartz glass flange and the O-ring 8. Coupling flange 5 is connected with central fixture ring 3 by screws 14. When tightening the screws 14, coupling flange 5 is pressed together with central fixture ring 3 against the flange of electrode tube 2, in the course of which sealing of the coolant in the electrode tube is effected by the interposition of an O-ring 15.

Clamping ring 4 has a central bore which must be larger than the diameter of the quartz glass flange of arc tube 1 to permit slipping it over the quartz glass flange. As is to be seen from FIGS. 3 and 4, clamping ring 4 has in addition a duct formed as a circumferential groove 11 on the side facing the discharge for passage of coolant, and on the opposite side four concentrically arranged bores into which the four clamp ring tubes 10, 10' are pressed in fluid-tight manner. Two bores and clamp ring tubes 10 at a time are used for supply of coolant to the clamp ring, and the other two bores and clamp ring tubes 10' are used for return flow

of the coolant from clamp ring 4 to coupling flange 5.

Metal sleeves 16 and O-rings 17 are slipped over clamp ring tubes 10, 10' between central fixture ring 3 and coupling flange 5 to effect seal of the path of the coolant.

A two-part cover 12 of the clamp ring on the side of clamp ring 4 facing the discharge, shields the radiation-sensitive portions 7, 8, 13 of the base assembly from radiation from the discharge space. Its central bore is therefore held as small as possible, i.e., only slightly larger than the outer diameter of arc tube 1. The cover 12 of the clamp ring prevents moreover that the O-ring 13 is pushed out of circumferential groove 11 of clamp ring 4. Tubular jacket 26 keeps the two parts of the cover 12 of the clamp ring together.

The packing and intermediate rings 7, 8, 13, 15, 17 which are interposed between the base-assembly components are made from a material commercially available under the trade name "Viton." The metal parts of the base assembly are made from an aluminum alloy.

Threaded holes (not shown), cut in coupling flange 5, are used to mount the lamp and to connect the electric leads.

Details and operation of coupling flange 5 and of further structural components, and path of the coolant:

The coolant is passed through an inlet tube 18 axially secured to coupling flange 5 and through a coolant supply tube 19 to the electrode tip (not shown) and from there back to the base assembly between coolant supply tube 19 and electrode tube 2. Here, the coolant passes through two bores of washer 20 to the two concentric ducts 21 in coupling flange 5. Washer 20, of metal, and provided with two bores is secured to flange 5 and guides the coolant coming from the electrode to enter only ducts 21 but not ducts 21' of coupling flange 5 (FIG. 2). The coolant continues its flow through ducts 22 of coupling flange 5 radially outwardly. It reaches clamping ring 4 coaxially through the two ring tubes 10, flows in circumferential groove 11 of the ring and cools ring 4 and the adjacent packing rings 7, 13. The coolant then flows back coaxially to coupling flange 5 from ring 4 through the two clamp ring tubes 10' (FIG. 2) offset by 90° relative to the two clamp ring tubes 10. In coupling flange 5 the coolant flows through the two ducts 22' radially inwardly and through the two ducts 21' coaxially into annular outlet passage 23. Ducts 21', 22' are offset by 90° relative to ducts 21, 22 (FIG. 2). In addition, ducts 21' of coupling flange 5 are located somewhat nearer the center than ducts 21 so as to establish connection (FIGS. 2, 3) to annular outlet passage 23. The liquid leaves the base assembly through an outlet passage 24 in coupling flange 5 and through the outlet tube 25 eccentrically secured in coupling flange 5.

Exhaustion and filling of the lamp with the discharge gas may be accomplished e.g., through a valve provided at the flange of electrode 2 (not shown).

Cooling of the clamping ring and shielding of the cover of the clamping ring prevents the temperature of the resilient sealing elements from rising to impermissibly high values so that commercially available materials and stock may be used. This permits quick and easy disassembly of the lamp. The base assembly remains gas-tight when subjected to sub-atmospheric pressure (during cleaning) as well as when subjected to excess pres-

sure (during operation) and can readily be degassed at about 200° C for an extended period of time prior to filling. Due to the intense cooling of the entire base assembly and of the electrode tube, the extension of the arc tube may be of reduced length. Thermal expansion of the tightening screws which clamp the lamp components is prevented.

No noticeable impairment of lamp characteristics could be detected even after many hundred hours of operation and repeated disassembly, cleaning and reassembly of 20 kW high pressure xenon discharge lamps having the base assemblies and intensely cooled electrodes according to the invention.

Various changes and modifications may be made within the scope of the inventive concept.

I claim:

1. Separable electric discharge lamp having a fluid-cooled base assembly and a fluid-cooled electrode assembly, separable from the base assembly, and being essentially a body of rotation having an axis, comprising

a flange (5) formed on the base assembly;

a separable arc tube (1) and electrode tube (2), forming said electrode assembly, each tube being formed with a flange;

a clamp ring (4) clamping said flanges together in overlapping relation;

duct means (11, 21, 22; 21', 22', 24) formed in said base assembly flange (5) and in the clamp ring (4);

axially extending connecting tubes (10, 10') connecting said duct means;

a cooling fluid supply and return tube means (19) secured to the base assembly and extending into the lamp to supply cooling fluid to the electrode to cool the electrode, and return the fluid to the base assembly, the tube means communicating with, and forming part of a flow path including

first selected ones of the duct means (22) in the base assembly flange (5) extending laterally from an axial region towards a circumferential region thereof, said first selected ones of the duct means (22) communicating with first axially extending connecting tubes (10) and with the duct means (11) formed in the clamping ring (4);

said duct means (11) in the clamping ring (4) communicating with second axially extending connecting tubes (10') and laterally extending ones of the duct means (22', 21') in the base assembly (5), and fluid outlet means (23, 24, 25) formed in the base assembly communicating with the laterally extending outlet duct means;

and resilient sealing means (7, 8, 13, 15, 17) sealing the flanges of the lamp together.

2. Lamp according to claim 1, further comprising a fluid directing plate (20) secured to the base assembly flange, the fluid directing plate being formed with openings establishing fluid communication between the return flow from the electrode and the first selected ones of the duct means.

3. Lamp according to claim 1, comprising a connecting ring (3) connecting the base assembly flange (5) and the clamping ring (4);

and wherein the resilient sealing means comprises a

first packing ring (8) located between the arc tube (1) and the electrode tube (2) and held in sealing relation by said clamping ring (4) and a sealing ring (15) located between the connecting ring (3) and the base assembly flange (5).

4. Lamp according to claim 3, wherein the axially extending connecting tubes (10, 10') are sealed into the clamping ring (4);

a metal sleeve (16) is provided for each connecting tube surrounding the respective tube and joining the respective connecting tube to the base assembly flange (5), one end of the sleeve bearing against the connecting ring (3) and the other end thereof bearing against the base assembly flange (5);

and sealing means to seal said tubes to the ducts in the base assembly flange (5).

5. Lamp according to claim 1, further comprising two superposed sectional rings (6, 7) located between the flange of the arc tube (1) and the clamping ring (4), one of said sectional rings (6) being of metal and the other of said sectional rings (7) being of resilient material.

6. Lamp according to claim 1, further comprising cover means (12) secured to the base assembly, the resilient sealing means (13) sealing the cover means to the duct means (11) in the clamp ring (4).

7. Lamp according to claim 6, wherein the clamp ring (4) is formed with a circumferential groove to provide said duct means therein, the resilient sealing means (13) comprising a sealing ring located beneath the cover means (12) and sealing said groove (11) against the cover means.

8. Lamp according to claim 6, wherein the cover means is a two-part cover.

9. Lamp according to claim 8, further comprising a tubular jacket (26) securing the parts of the cover means together.

10. Lamp according to claim 1, wherein at least some of the resilient means comprises a resilient plastic material having a continuous temperature tolerance of up to about 200° C.

11. Lamp according to claim 1, wherein the lamp is a discharge lamp of power input of between 10 kW to 30 kW.

12. Lamp according to claim 1, wherein the lamp is a high pressure xenon discharge lamp.

13. Lamp according to claim 1, wherein the cooling fluid is a liquid and the ducts are dimensioned for liquid flow.

14. Lamp according to claim 1, wherein the axially extending connecting tubes (10, 10') are sealed into the clamping ring (4);

the clamping ring being formed with a circumferential groove (11) to provide said duct means therein, said groove communicating with said axially extending connecting tubes to provide fluid flow from a tube (10) through at least a portion of the circumferential groove (11) and out another axially extending tube (10');

and separable sealing means (16, 17) are provided sealing said tubes to the base assembly flange (5) in position to communicate with said laterally extending duct means (2, 22').

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,816,784

Dated June 11, 1974

Inventor(s) Gerhard WENINGER

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

The assignee should read as follows:

-- Patent-Treuhand-Gesellschaft
fur elektrische Gluhlampen mbH --

Signed and sealed this 24th day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents