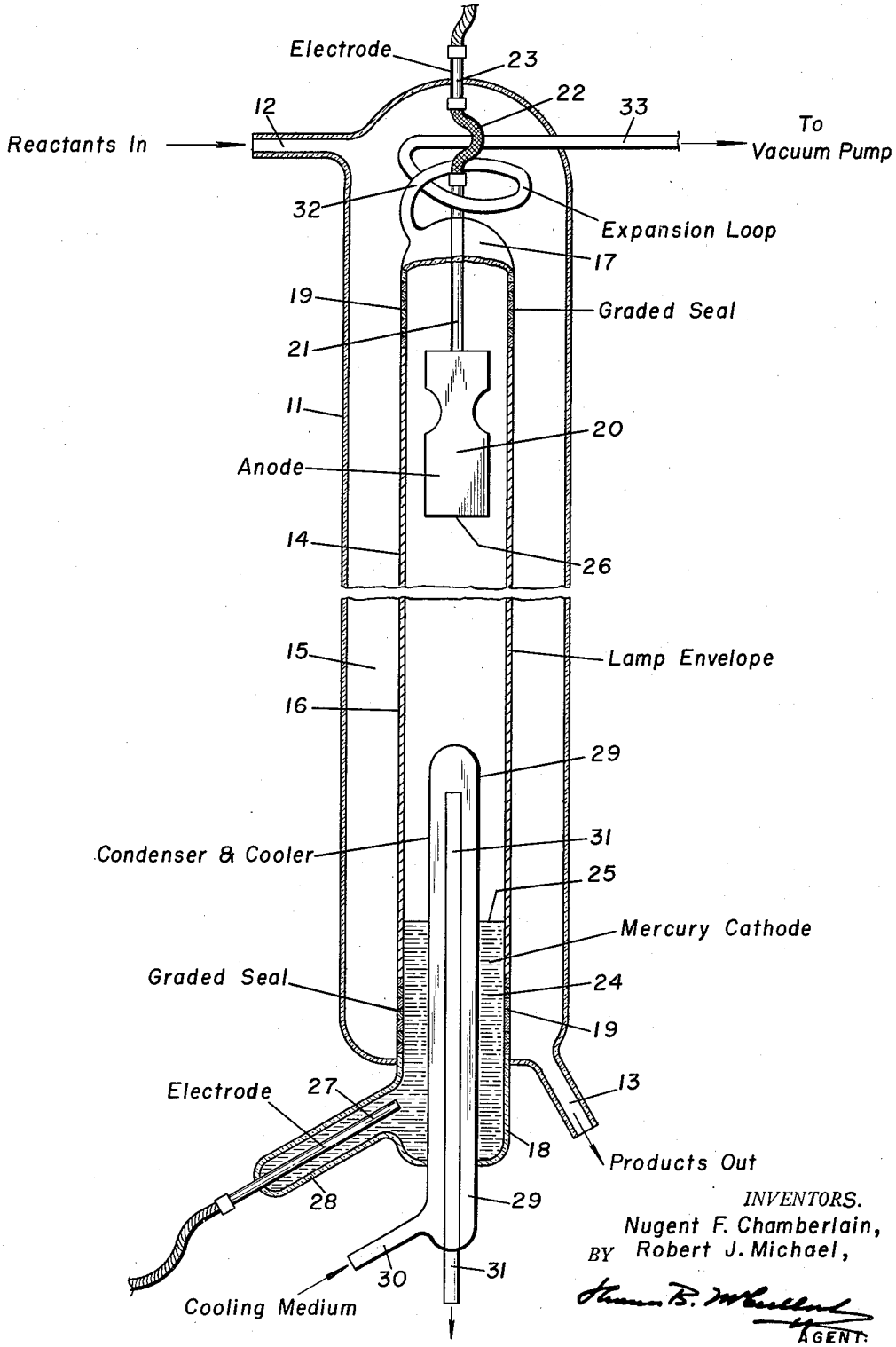
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VAPOR DISCHARGE LAMP

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VAPOR DISCHARGE LAMP

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The present invention is directed to a low pressure vapor discharge lamp. More particularly, the invention is directed to apparatus adapted for use in conducting photochemical reactions.

The present invention may be described briefly as embodying apparatus for conducting photochemical reactions which comprises, in combination, a glass envelope such as one of Pyrex glass which defines an inlet and outlet thereto. Arranged concentrically in the glass envelope is a low pressure vapor discharge lamp which defines with the glass envelope a passageway through which reactants undergoing a photochemical reaction may pass from the inlet to the outlet. The lamp is provided with an anode mounted in an upper part thereof having the discharge end pointing downwardly and a metallic cathode mounted in a lower portion of said lamp spaced away from said anode with the discharge end pointing upwardly. A space is defined between the anode and the cathode and projecting thereinto is a cooling means which passes through the cathode which suitably may be a column or a pool of liquid mercury in an end portion of the lamp. The lamp is suitably constructed so that it has a central portion comprising a tubular member of fused silica with first and second glass end members sealed thereto through graded seals arranged in the lamp at points remote from the discharge end of said anode and cathode.

The present invention will be more completely illustrated by reference to the drawing in which the single figure is a sectional view of a preferred embodiment.

Referring now to the drawing, numeral **11** designates a glass envelope which suitably may be a Pyrex glass jacket provided with an inlet **12** through which reactants may be introduced and outlet **13** which allows the discharge of products therefrom. Enclosed within envelope **11** is a low pressure vapor discharge lamp **14** defining with envelope **11** an annular passageway **15**. Lamp **14** comprises a fused silica central tubular member **16** with first and second glass end members **17** and **18**, respectively. First and second end members **17** and **18** are sealed to tubular member **16** by graded seals **19** such as are well known to the art. The lamp **14** is provided with a metal or carbon anode **20** which is suspended in lamp **14** by a suitable tungsten support **21** connected through a flexible lead or expansion loop **22** to tungsten electrode **23**. Suitable metals for use in anode **20** are iron, tantalum, tungsten, aluminum, titanium and molybdenum. The tungsten support **21** extends through lamp **14** and is sealed

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thereto while the electrode **23** passes through and projects outside the envelope **11** and is sealed thereto. Arranged in the lower portion of the lamp **14** is a column or pool of mercury **24** which defines a cathode having a discharge surface **25** facing upwardly. Anode **20** has a discharge face or end **26** facing downwardly. The cathode **24** is provided with a tungsten electrode **27** arranged in a leg **28** which communicates with end member **18** and similarly is filled with mercury. Electrode **27** is sealed to leg **28** and projects outwardly therefrom.

The end member **18** has a cooling means or finger **29** projecting into lamp **14** and through cathode **24**. The cooling means or finger **29** is provided with an inlet **30** through which cooling water may be introduced and an outlet **31** for discharge of cooling water. The outlet **31** extends upwardly into the cooling finger **29** to allow the circulation of water therethrough.

The lamp **14** is provided with a line **32** suitably constructed of Pyrex glass as an expansion coil which connects to line **33** outside of the glass envelope and may suitably be connected to a vacuum pump or other source of reduced pressure.

The lamp of the present invention is suitable for conducting photochemical reactions such as sulfonation reactions or reactions involving hydrocarbons. Reactants may be introduced by inlet **12** and flow by passageway **15** through the envelope and the products flow outwardly therefrom by line **13**. All air and other gases, exclusive of mercury vapor, are removed from the lamp **14** by reducing the pressure inside it to less than 1 micron of mercury absolute, by means of suitable mechanical and diffusion pumps. The last traces of gas are removed by distilling a small portion of the mercury from cathode **24** out through line **33** while the lamp is still connected to the vacuum pump. The lamp is then sealed off from the pump so that the pressure therein during operation will be due only to the vapor pressure of the mercury being condensed on cooling finger **29**. To operate the device, anode **20** and cathode **24** are suitably energized with a source of direct current, and an electric discharge is initiated through the mercury vapor between these elements by means of the momentary superimposition of a high frequency high voltage discharge such as from a Tesla coil. Thereafter the discharge is maintained by the direct current source. A small quantity of a noble gas such as argon or krypton may be admitted to the lamp to facilitate starting. The reactants passing through passageway **15** are irradiated with the

ultraviolet light generated in the electric discharge, said light passing first through quartz tubular member 16. This radiation supplies sufficient energy to the reactants to cause reaction thereof.

The apparatus of the present invention has numerous advantages over the conventional apparatus of similar type. By virtue of the arrangement of the central tubular section of fused silica all of the irradiation emitted by the lamp passes through the fused silica into the passageway 15 through which the reactants are flowing and is thus available as a source of energy for photochemical reactions. Moreover, the arrangement of the graded seals out of the direct arc stream allows these seals to last much longer than was possible heretofore, by virtue of the fact that these seals are in a relatively cool portion of the lamp. Provision of internal cooling allows condensation of the mercury vapor on the cooling means, when mercury is the cathode, instead of on the walls of the lamp itself, thereby allowing reproducible transmission of the emitted radiant energy. Furthermore, enclosing the entire arc stream in fused silica allows operation of the lamp at a lower overall temperature due to the transmission of the emitted ultra violet and infrared energy rather than their absorption in Pyrex or other types of glass with the resulting conversion into heat. By arranging the lamp in a vertical position and by eliminating the mercury anode employed heretofore in some apparatus distillation difficulties are eliminated.

While the apparatus of the present invention may suitably be used for sulfonation reaction and the like it may also be employed in reducing carbon monoxide and in other reduction operations involving hydrogen and olefins as well as reactions involving paraffinic hydrocarbons, and the like.

The nature and objects of the present invention having been completely described and illustrated, what we wish to claim as new and useful and to secure by Letters Patent is:

1. Apparatus adapted for conducting photochemical reactions which comprises, in combination, a glass envelope defining an inlet and an outlet, a vapor discharge lamp mounted concentrically within said envelope and defining therewith an annular passageway through which reactants may pass from said inlet to said outlet, said lamp including an anode mounted in an upper part of said lamp having a discharge end pointing downwardly, a metallic cathode mounted in a lower portion of said lamp spaced away from said anode with a discharge end pointing upwardly, an internal cooling means arranged in the lower portion of said lamp projecting into the space between the anode and cathode a distance sufficient to cool said space, said lamp having a central tubular member of fused silica with first and second end members sealed thereto through graded seals arranged at points remote from the discharge ends of said anode and cathode.

2. Apparatus in accordance with claim 1 in which the cathode is a column of mercury.

3. Apparatus adapted for conducting photochemical reactions which comprises, in combination, a vertical glass envelope defining an inlet and an outlet, a vapor discharge lamp mounted concentrically within said envelope and defining therewith an annular passageway through which reactants may pass from said inlet to said outlet, said lamp including an anode mounted in an upper part of said lamp having a discharge end pointing downwardly, a mercury cathode defining a column in a lower portion of said lamp spaced away from said anode defining a discharge end with a surface thereof, an internal cooling means arranged in said column and projecting thereabove a sufficient distance to cool the space between said anode and cathode, said lamp having a central tubular member of fused silica with first and second glass end members sealed thereto through graded seals arranged in said lamp at points remote from the discharge ends of said anode and cathode.

4. Apparatus in accordance with claim 3 in which the second glass end member and said cooling means project outside the glass envelope.

5. Apparatus in accordance with claim 3 in which the anode is suspended in said tubular member below the first end member and the mercury cathode is arranged in said tubular member so that its discharge end is above the second end member.

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