INDUCTIVE LIGHT SOURCE

Description
Main problem concerned with utilization of high-intensity light sources is the short service life of high-power lamps due to the fact that all industrial gas-discharge radiating elements include electrodes that fail at high current densities. An efficient solution to this problem is a new electrodeless technology of gas discharge generation. Experimental samples of inductive electrodeless gas-discharge lamps with mercury-argon filling and power varying from 100 W to 100 kW were developed at the Institute of Thermophysics SB RAS on the basis of research results on low-frequency (∼10 kHz) inductive discharges of a transformer type.

The operation principle of these lamps is similar to that of a transformer. Gas discharge is a closed toroidal plasma coil encompassing the magnetic circuit. A system of primary windings is placed on the magnetic circuit. Alternating voltage is fed to the system of primary windings. The gas discharge serves as a secondary winding of the transformer. Lack of wearing electrodes removes restrictions on the power of the lamp and increases its service life significantly. Thus, the power of a test sample reaches up to 100 kW, and the service life of the lamps (defined only by aging of the bulb material) exceeds 30,000 hours. For reference, the most powerful xenon lamp DKsTV50000 produced by Russian industry has the power of 50 kW and the service life of 600 hours. It is noteworthy that luminous efficiency of inductive lamps is ∼60 lm/W, while that of common arc mercury lamps is ∼50 lm/W. The power of another test sample is 100-1,000 W, the service life is over 50,000 hours, which exceeds by a factor of 8-10 the service life of the arc mercury lamps of comparable power. Now, the inductive lamps with sodium filling (luminous efficiency 100-120 lm/W) are being developed.

Scheme of generation of a transformer-type inductive discharge.

Technical characteristics

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Value</th>
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<tbody>
<tr>
<td>Luminous efficiency, lm/W</td>
<td>∼30</td>
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<tr>
<td>Power, W</td>
<td>100-500</td>
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<tr>
<td>Total luminous flux, lm</td>
<td>3000 – 15000</td>
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<tr>
<td>Service life, thousand hours</td>
<td>∼50-60</td>
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Technical appraisal and economic benefits
Main advantage of the developed light sources is long service life that is much longer than that of conventional gas-discharge light sources. Furthermore, these light sources are of high efficiency; they decrease power consumption for illumination, which is proved by the calculations presented below.

The service life of the DRL-400 lamp for street lighting is 5,000-6,000 hours, its luminous efficiency is ∼20,000 lm; the lamp costs about 150 rubles. The inductive lamp of the same luminous efficiency will
consume 300 W (100 W less) and serve no less than 50,000 hours. Thus, one inductive lamp for street lighting can substitute at least ten DRL-400 lamps and save 5,000 kWh of electric energy. If the costs of substitution and utilization of DRL lamps are considered, the economic effect of the inductive lamps will be even higher.

Other advantages of inductive light sources over conventional gas-discharge lamps are as follows:
- wide possibilities to control the lamp power, which provides savings in electricity consumption;
- lack of luminous flux pulsations due to high frequencies of discharge generation (25-80 kHz), which eliminates stroboscopic effect provoking eye fatigue.

**Application areas**
The developed inductive gas-discharge light source can be widely applied in municipal economy and different industries for:
- lighting of city streets and squares, railroad stations, oil derricks, and pits;
- photochemical industry;
- water and food disinfecting;
- other purposes, where gas-discharge light sources are used.

**Development stage**
By now, several test samples of inductive lamps with mercury filling are developed and successfully tested at the Institute of Thermophysics. Test samples of inductive lamps with xenon and sodium filling are being developed.

**Patent situation**
This invention is protected by two RF patents (1997 and 2000).

**Commercial offers**
An investment contract for bringing the test samples to the level of pilot samples and for joint commercialization. Production of the light sources can be set at plants producing gas-discharge lamps. All required components (quartz tubes, magnetic circuits, components of power sources) are produced in Russia.

**Estimated cost**
Investments of about US$ 100,000 are necessary to bring the developed inductive lamps to the stage of pilot samples.

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