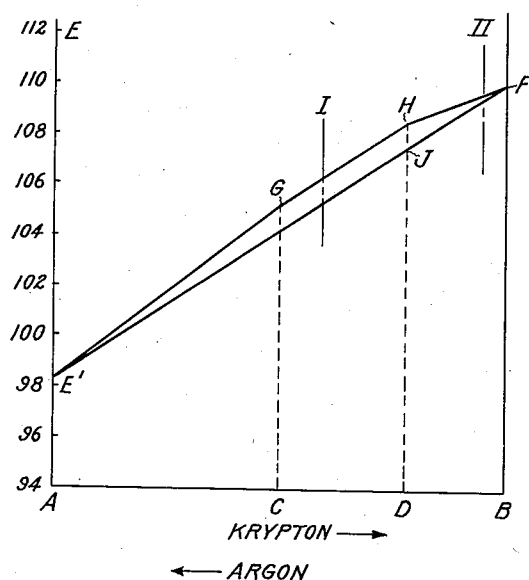


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ELECTRIC INCANDESCENT LAMP  
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## UNITED STATES PATENT OFFICE

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## ELECTRIC INCANDESCENT LAMP

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My invention relates to electric incandescent lamps comprising a sealed envelope containing a filament, such as a tungsten filament, and having a gas filling therein, and more particularly to lamps having a gas filling comprising krypton.

The gas filling in use at the present time consists of a mixture of argon and nitrogen. It has been proposed to provide as a gas filling a mixture of krypton and nitrogen to increase the efficiency of the lamps. However, because of the high cost of krypton such a mixture makes the lamps rather expensive.

According to the present invention, it has been discovered that a surprisingly high efficiency is retained when a portion of the krypton is replaced by argon. This is especially the case when the lamp contains a mixture of krypton, argon and nitrogen in which not more than twenty-five per cent by volume of the total gas volume is nitrogen, and the remaining part, consisting of krypton and argon, contains at least sixty per cent and not more than ninety-five per cent by volume of krypton. When krypton is referred to it will be understood that a mixture of krypton and xenon or pure xenon may be substituted therefor. A gas filling in which the gases krypton and argon are present in a ratio by volume of about 7:2 is considered as most advantageous. The incandescent lamp may contain, for example, seventy per cent of krypton, twenty per cent of argon and ten per cent of nitrogen, by volume.

I have discovered that in a lamp filled with krypton and nitrogen, introducing a gradually increasing amount of argon with an equally gradual decrease in the amount of krypton, does not result in a linear decrease in the efficiency of the lamp, but rather that the decrease in efficiency is less than such an increase of the argon content would lead one to expect.

The invention will be explained more fully with the aid of the graph shown in the drawing which illustrates the effect on the efficiency of a lamp of replacing a portion of the krypton with increasing amounts of argon.

Referring to the graph shown in the drawing, as indicated thereon the abscissa represents increasing amounts of krypton from left to right (A to B) and increasing amounts of argon from right to left (B to A), the nitrogen content being in all cases ten per cent by volume of the total gas volume. Therefore the point A represents a lamp with an argon content of ninety per cent and a nitrogen content of ten per cent, by volume, there being no krypton in this lamp.

The point B then represents a lamp in which the filling consists of ninety per cent of krypton and ten per cent of nitrogen, by volume, with no argon. The points between A and B represent lamps which, in addition to the ten per cent of nitrogen, contain both argon and krypton. Thus the point C represents a lamp which contains a filling of forty-five per cent argon, forty-five per cent krypton and ten per cent nitrogen, while the point D represents a lamp containing seventy per cent krypton, twenty per cent argon and ten per cent nitrogen.

The points on the ordinate of the graph represent the values of efficiency E of the lamps where these values are expressed by the relation between the radiated lumens and the watts consumed for a life of 1000 burning hours, recalculated to a definite comparable value. The line drawn in this graph represents the mean value of a great number of experimentally determined values derived from lamps of different voltage and wattage.

As a result of several experiments, a lamp with a gas filling consisting of ninety per cent argon and ten per cent nitrogen was found to have an efficiency of 98.3, as indicated at E' on the graph. The mean efficiency value for several lamps with a filling consisting of ninety per cent krypton and ten per cent nitrogen was found to be 110.1, as indicated at F. It would be expected that lamps with a filling consisting, besides nitrogen, of mixtures of krypton and argon, would increase in efficiency proportionately with the increase in krypton so that the values of efficiency would therefore lie on or close to the line E'F. However, I have found that this is not the case. The point G on the graph indicates an actual value of efficiency for a number of lamps of different voltage and wattage which, however, contained the same filling of forty-five per cent argon, forty-five per cent krypton and ten per cent nitrogen. The point H likewise indicates the mean value of efficiency for a number of lamps containing seventy per cent krypton, twenty per cent argon and ten per cent nitrogen. The surprising phenomenon indicated by the graph is that the efficiency is higher than would be expected. It was also found that a gas filling with a krypton content which varies between sixty per cent and ninety-five per cent of that part of the filling consisting of krypton and argon (between lines I and II) shows the effect to a high degree, while a gas filling of seventy per cent of krypton, twenty per cent of argon and ten per cent of nitrogen, 55

by volume, (point H), offers the most advantages.

From the above, the following important conclusions can be drawn. In a krypton lamp which contains a certain percentage of nitrogen (in order to prevent arcing) it is possible to replace part of the krypton with argon with a resultant decrease in efficiency appreciably less than would be expected. In this way the amount of the costly krypton is decreased and its favorable action is retained to a much greater extent than would be expected. For example, for a lamp containing seventy per cent krypton, twenty per cent argon and ten per cent nitrogen, the actual efficiency indicated at H and the expected efficiency indicated at J show a drop in efficiency of only one half of the drop to be expected.

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

1. An electric incandescent lamp having a gas filling consisting of krypton, argon and nitrogen, the amount of nitrogen being not more than twenty-five per cent by volume of the mixture, and the amount of krypton in the remaining krypton-argon mixture being between sixty per cent and ninety-five per cent by volume.

2. An electric incandescent lamp having a gas filling consisting of krypton, argon and nitrogen, the amount of nitrogen being not more than twenty-five per cent by volume of the mixture, and the krypton and argon being present in the ratio of about seven parts of krypton to two parts of argon by volume.

3. An electric incandescent lamp having a gas filling consisting by volume of approximately seventy per cent of krypton, twenty per cent of argon and ten per cent of nitrogen.

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