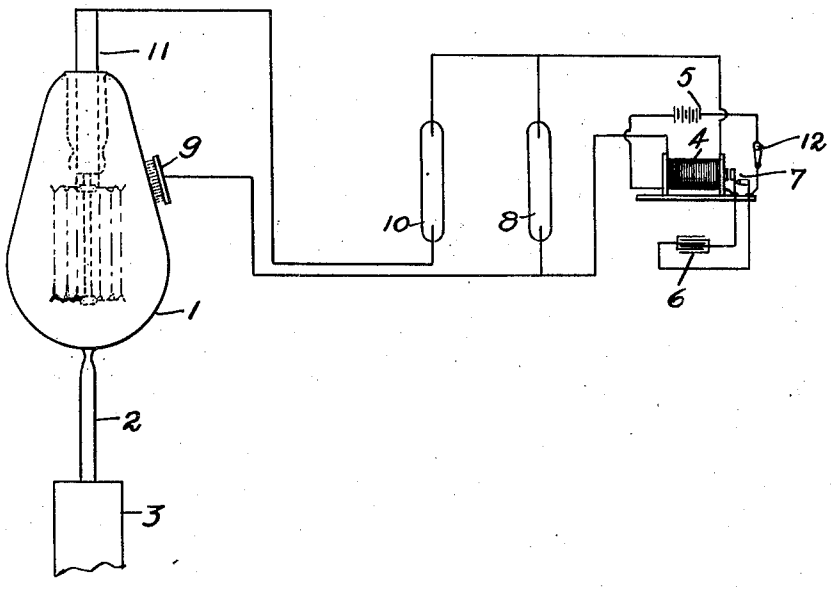
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TESTING INCANDESCENT LAMPS AND OTHER EVACUATED VESSELS

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TESTING INCANDESCENT LAMPS AND OTHER EVACUATED VESSELS.

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This invention relates to the manufacture of incandescent lamps and other evacuated vessels and more particularly to a method for testing the degree of vacuum therein.

An object of my invention is to reduce the formation of gases in a lamp while coiling the same.

Another object is the determination of the degree of exhaust in an incandescent lamp or other evacuated vessel without subjecting the same to a discharge of too high power.

A further object is the use of Geissler tubes or the like as indicators to show the degree of vacuum in an incandescent lamp during the process of coiling.

The usual method of coiling comprises the subjection of the lamp to a high-power discharge from an induction coil. This has proved to be disadvantageous on account of the liberation of undesirable gases during such test, as indicated by a higher residual pressure than that of one not so treated. In addition, the discharge is apt to, and frequently does, actuate the getter, thereby partially destroying its value. The gas is not only liberated from the walls of the bulb and the filament and other lamp parts but appears to be liberated from the exhaust connections for the lamp, such as the oiled rubber tubing. The amount of gas evolved during this coiling operation appears to depend on the strength of the current used and the length of time to which a lamp is subjected thereto.

By my invention, the degree of exhaust of the lamp is determined, not from the appearance of the discharge within the lamp itself, but from the appearance of one or more glass tubes provided with electrodes and filled with a suitable gas, such as Geissler tubes employed in connection therewith. A preferred method consists substantially in the use of two Geissler tubes, one in series with the lamp during the coiling operation and the other in parallel across the terminals of the secondary winding of the induction coil for the purpose of indicating the desired potential. With this arrangement, the degree of exhaust in the lamp can be determined by noting the appearance, both relative and absolute, of the Geissler tubes.

These Geissler tubes, filled with argon, neon or other suitable inert gas or a mixture thereof, require a smaller impressed voltage than a vacuum lamp for the formation of a visible discharge therethrough; therefore, the coil may be so adjusted as to cause a visible discharge through one or both of the Geissler tubes without the lamp showing an appreciable discharge. By this means, the vacuum of the lamp will not be impaired to any extent, as was previously the case when a high-power discharge occurred therethrough.

Other objects and advantages of the invention will be apparent as the description proceeds.

A preferred embodiment of the invention is illustrated in the accompanying drawing which is a diagram showing a lamp connected for test according to my invention.

The invention, as illustrated, is applied to a vacuum lamp, however, the same method may be employed for testing other evacuated containers.

Referring to the drawing, the lamp 1 is shown connected by its exhaust tube 2 to a suitable exhaust system 3. An induction coil 4 has a primary winding which is connected to a battery 5 or other suitable source of electricity and is preferably provided with the usual condenser 6 in shunt with the interrupter 7. As shown, a Geissler tube 8 is connected across the terminals of the secondary winding. One terminal of the secondary winding is connected to brush contact 9 in proximity to the bulb of the lamp to be tested. The other terminal is connected through a second Geissler tube 10 to the leading-in wires 11 of the lamp. Geissler tube 10 has preferably a lower filling gas pressure than Geissler tube 8 so that the combined resistance of tube 10 and the lamp 1 will approximate that of Geissler tube 8.

In testing 40 watt, 110 volt lamps, satisfactory results have been obtained by using Geissler tubes approximately 3″ long and ⅝″ in diameter. Dumet leading-in wires,

of the usual construction, with a nickel-iron core and copper sheath and such as might be made according to the disclosure in the patent to B. E. Eldred, No. 1,140,134, granted May 18, 1915, with nickel extensions were used as electrodes therein. Using argon as the filling gas, the pressure thereof in tube 8 should be about 10″ of mercury and that in tube 10 about 5″. These same tubes and pressures could probably be used with satisfaction on 25 and 60 watt, 110 volt lamps also. For testing 100 watt, 110 volt lamps, the pressure of the argon in tube 8 should be increased to approximately 15″ of mercury. That is, the larger the bulb of the lamp the higher the pressure or resistance of the tube 8 should be, compared with that of tube 10. The voltage from the secondary of the induction coil 4 should then be correspondingly increased to give a visible discharge through the tube 8 when either an air lamp or one with a very good vacuum is tested. Upon closing the switch 12 the coil is actuated to cause a visible discharge through one or both of the Geissler tubes, depending upon the degree of exhaustion of the lamp being tested.

The operation of this system depends on the resistance offered by the lamp. A very good vacuum offers a fairly high resistance, a reasonably good vacuum a smaller resistance, diminishing with increase of pressure until a fairly high critical pressure is reached when the resistance begins to again increase very rapidly. This permits an easy determination of the degree of vacuum in the lamp. The system may be adjusted initially by testing either an air lamp or one with a vacuum known to be very good so that the tube 8 shows a heavy discharge and the tube 10 is practically unaffected in appearance.

The experimental results of testing by this method are as follows. If the lamp 1 has a very good vacuum, the tube 8 will show a heavy discharge whereas the tube 10 will only flicker occasionally. If the vacuum in the lamp is fairly good, the tube 8 will remain black and the tube 10 will have a forked discharge. If the vacuum is poor, the tube 8 will be black while the tube 10 will show a very heavy discharge. If an air lamp is tested by this method, the tube 8 will show a very heavy discharge whereas the tube 10 will remain black.

The effect of using a Geissler tube in series with the lamp is shown by the following table which is taken from an actual test. The lamp was exhausted to 2.2 microns, the pump pinched off and the lamp coiled between the leads and the bulb. The pressure was read at the start and every two minutes on a McLoed gauge. The first column after the time column shows the normal increase due to leakage of the system. The next two columns show the increase when coiling with two different Geissler tubes in series. The last column shows the increase in pressure when coiling by the old method without using a Geissler tube. The results were:

Time min.	Microns no coil.	Microns coiled G. No. 1.	Microns coiled G. No. 2.	Microns coiled no tube.
0	2.2	2.2	2.2	2.2
2	4	4	5.5	35.0
4	5.5	7.5	14.0	62.5
6	8.6	14.0	36.0	

By the use of this method, little or no gas is liberated from the walls of the exhaust system while a lamp is being tested. The method is more accurate than that heretofore used because changes of the vacuum degree are followed by very definite changes in the discharge through the Geissler tubes. More careful voltage regulation is possible because of the lower arcing potential of argon or other inert gas as compared with that of air. Another advantage is that the Geissler tube indicators do not need to be near the lamp on test and may therefore, be placed in the most desirable position for observation.

With this system of testing, no ground connections are used and, therefore, undesirable stray currents are cut down. Fluids, such as water vapor or hydrogen, show up just as definitely as air by the use of this method, whereas they do not show up properly under the old method.

By means of the present invention, an evacuated vessel may be tested in a more accurate and more easily observed way than heretofore. Geissler tubes of different sizes or with different gas pressures therein may be used for lamps of different sizes, thereby giving great flexibility to this method. Lamps may be rapidly tested without the former harmful effects thereto, because the testing current is much reduced by this method.

While I have illustrated what I now consider to be the preferred embodiment of my invention, it is to be understood that many changes may be effected therein and that the same is to be limited only by the scope of the appended claims.

What is claimed is:

1. The method of determining the degree of exhaust in an evacuated vessel without passing an extensively high current therethrough which comprises passing an electrical current through an inert gas in series with the atmosphere within the lamp to give visible indication by reason of the inert gas of the degree of vacuum in said lamp.

2. An apparatus for coiling an incandescent lamp comprising an induction coil, a Geissler tube connected in parallel across

the secondary winding of the coil and a second Geissler tube connected in series with the evacuated portion of the lamp under test.

3. An apparatus for determining the degree of vacuum in an evacuated container without subjecting it to too high a power discharge comprising an induction coil, a Geissler tube connected across the secondary winding of the same for indicating the potential thereof, and another Geissler tube connected to said winding and in series with the evacuated container for reducing the power impressed on the same.

4. An apparatus for determining the degree of vacuum in an evacuated vessel including an induction coil, comprising primary and secondary windings, a Geissler tube having a relatively high gas filling pressure across the terminals of the secondary winding, a second Geissler tube having a relatively low filling gas pressure connected in series with the vessel to be tested and connected across the secondary terminals of the coil.

5. An apparatus for testing the degree of vacuum in an evacuated container comprising an induction coil including a primary winding connected to a suitable source of electricity and a secondary winding connected to a Geissler tube, containing an inert gas at a pressure less than atmospheric, in series with the container.

6. An apparatus for testing the degree of vacuum in an evacuated container comprising an induction coil including a primary winding connected to a suitable source of electricity, a secondary winding connected to a Geissler tube, containing an inert gas at a pressure less than atmospheric, in series with the container and a second similar tube containing an inert gas at a higher pressure than that of the first tube in parallel with the container and the other tube.

7. Means for testing the condition of exhaust in a container being evacuated comprising an induction coil including a secondary winding and a primary winding suitably connected to a source of electricity, a Geissler tube connected thereto to indicate the potential developed in the secondary winding and a second Geissler tube also connected to the coil and in series with the container.

8. Means for indicating the degree of vacuum in a vessel being exhausted comprising an adjustable source of high potential, a tube connected thereto as an indicator for adjusting the potential and containing a suitable gas at a relatively high pressure and a second tube, of similar construction but whose gas pressure is relatively low, connected in series with the vessel and this series arranged in parallel with the first tube.

In testimony whereof, I have hereunto subscribed my name this 28th day of March, 1922.

DANIEL SNYDER GUSTIN.