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METHOD OF MANUFACTURE OF ELECTRIC INCANDESCENT LAMPS AND LIKE DEVICES

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This invention relates to the manufacture of incandescent electric lamps and analogous electric devices such as electron discharge devices, gas discharge devices, vapor electric devices and the like, and more particularly relates to a method of effecting a surface cleansing and deoxidation of the metal parts of said devices.

In the manufacture of incandescent lamps and analogous electric devices, it is customary to assemble the device and to effect an entire removal of the enclosed atmosphere by evacuation means. Subsequently it is customary to effect degasification of the glass envelope and the metal parts thereof by heating these parts to elevated temperatures removing the evolved gases as liberated. As a result of the oxidizing conditions existing during the general assembling and manufacturing process and during this degasification procedure it is found that the enclosed metal parts become superficially oxidized.

In electron discharge devices the surface oxides of the enclosed metal parts may be substantially eliminated by subjecting the same to electronic bombardment and dissociation. In incandescent electric lamps this method may not be used. It is found however that lead and support members in these devices may not be completely deprived of these oxide layers by thermal or electron dissociation.

The presence of these surface oxides is highly detrimental to the life, maintenance and efficiency of these devices and it is highly desirable that the same be substantially eliminated therefrom.

It is one of the objects of this invention to eliminate the surface oxides of the metal parts of an evacuated device.

It is another object of this invention to provide a suitable "flushing" gas which is reducing with respect to metal oxides at relatively low temperatures.

It is another object of this invention to facilitate the manufacture of incandescent electric lamps and analogous electric devices.

Other objects and advantages will be apparent as the invention is more fully disclosed.

In accordance with the objects of my invention I eliminate the oxide compounds from the surface of the metal parts of the incandescent electric lamp by introducing therein at the conclusion of the usual exhaust procedure and while the glass envelope of the device is being subjected to the so-called baking step in the manufacturing process or immediately thereafter a proportion of a suitable reducing gas which is reactive or reducing with respect to the said surface metal oxides at temperatures not in excess of 450° C. Subsequently this reducing gas is evacuated in the usual manner, the device "flushed" with additional amounts of the same gas if desired, and the device sealed from the pumps or filled with an inert gas mixture in the usual manner and then sealed off, as desired.

It has been proposed heretofore in U. S. Patent No. 1,651,387 issued December 6, 1927 to utilize hydrogen, a reducing gas, as a flushing gas in the manufacture of incandescent lamps particularly of the gas filled type, wherein the relatively low viscosity of the hydrogen facilitates the subsequent removal of the gas, and the residual amounts remaining are beneficial in effecting a reducing action upon the carbon compounds of the incandescent filament. The hydrogen flush however is performed at room temperatures and replaces the relatively expensive pure nitrogen flush heretofore employed, and thereby essentially differs from the present invention.

I have found that pure dry hydrogen or the non-explosive admixtures of hydrogen with an inert gas such as nitrogen may not be employed in the practice of my invention for the reason that the temperatures at which the reducing effect of the gas upon metal oxide compounds is produced, are substantially above the softening point of the glass mixtures usually employed in the glass envelopes of incandescent electric lamps and like devices.

It is apparent that whereas the filamentary body of such a device may be glowed or incandesced to a sufficiently high temperature in such gases to effect a reduction of the surface metal oxides thereon, the co-operating support and lead members of the device

which are imbedded in the glass stem of the device and which it is also highly desirable to deoxidize, may not be so incandesced.

I have found however that a gas mixture comprised substantially of an inert gas, such as nitrogen, and a proportion of a reducing gas such as hydrogen, and containing a proportion of a second reducing gas such as carbon monoxide is a gas mixture which is suitable for the purpose of my invention. Such a gas mixture has heretofore been known to the trade as "water gas." The reducing action of this gas on the metal oxides of the enclosed metal parts takes place at a relatively low temperature approximating 250° to 450° C. depending in part upon the particular metal oxide to be reduced and at the latter temperature is quick and efficient in action. The resultant gaseous products may be subsequently speedily and entirely evacuated from the device, and residual amounts remaining therein are substantially beneficial to the operating life and efficiency of the device in a manner analogous to that described and claimed in U. S. Patent No. 1,651,387 above identified. Moreover such a reducing gas is substantially "dry" in character in that the reduction reaction appears to be due to the carbon monoxide content of the said "water gas" rather than to the hydrogen content and the reaction products are substantially carbon dioxide rather than water vapor.

Water gas may be readily, cheaply and efficiently prepared by passing air saturated with respect to water vapor at room temperatures over charcoal or carbon heated to bright redness. As commonly prepared in this manner "water gas" is substantially a mixture of nitrogen, hydrogen, carbon oxides and water vapor. Before use as a "flushing" gas the moisture and the carbon dioxide content should be removed by passing the same over a suitable drying agent such as soda lime. The dried gas remaining comprised substantially of nitrogen and from 30 to 40 percent carbon monoxide and not in excess of 20 percent hydrogen is employed for the flushing operation. The exact proportion of the nitrogen, hydrogen and carbon monoxide in the gas will depend upon the conditions of temperature, concentration of water vapor, rate of flow, etc., during the process of manufacture of the water gas. I prefer to reglate these factors so that I obtain a gas mixture having approximately 50 percent nitrogen, approximately 35 percent carbon monoxide and approximately 15 percent hydrogen. This mixture I find to be most servicable for the purpose of this invention.

This dry gas mixture is then introduced into the evacuated device in any suitable manner such as has been heretofore employed in the introduction of other "flushing" gases or gas fillings such as nitrogen, argon or the like in like devices. To effect the desired cleaning or reducing action upon the surface oxides it is only necessary to introduce the "flushing" gas within the device at the conclusion of the evacuation procedure while maintaining the device substantially at a temperature equivalent to the normal baking temperature of the glass envelope of the device which ranges from 375° C. to 450° C. When modern high speed exhaust machines are employed wherein the device is exhausted immediately subsequent to the sealing in, and no additional "baking" operation is auplied I have found that the metal parts are sufficiently heated so that an immediate "flush" with this reducing gas mixture subsequent to the exhaust will effect the desired cleansing action on the metal parts.

The specific process I employ is to introduce the "flushing" gas following thorough evacuation of the device, but during the baking procedure wherein the glass envelope may be freed of adsorbed gases I may flow the gas through the device or permit a pressure thereof to accumulate therein as desired.

At temperatures below 450° C. and above approximately 250° C. oxidized or discolored metal parts are quickly and efficiently cleansed and made bright and shiny. It is not usual or necessary except in extreme or severe cases of surface oxidation of the metal parts or when the amount of such metal surfaces are excessive, such as in the large or high wattage lamps as compared to the 10, 25 and 50 watt type, to repeat the "flushing" operation but it may be done if so desired. At the conclusion of a few minutes, the "flushing" gas may be evacuated and the device sealed off, or the desired nitrogen or argon-nitrogen gas mixture may be introduced into the device by any customary procedure prior to sealing off from the pumps. The residual reducing gas remaining will be found beneficial to the continued operating efficiency of the device in a manner analogous to that process disclosed by U. S. Patent 1,651,387 above mentioned.

The specific invention herein involved is comprised substanitally of the use in the manufacture of incandescent electric lamps and analogous devices of a "flushing" gas which is reducing with respect to metal oxides at temperatures lower than 450° C., which is the usual highest baking temperature to which the glass envelope of these devices are usually heated to effect degasification thereof during the evacuation procedure in the manufacturing process, and inasmuch as the application or use of the specific invention may be widely varied without essentially departing from the nature or scope thereof it is believed unnecessary to specifically describe the process of manufacture of any single device.

Furthermore in view of the fact that the

usual steps involved in the manufacture of the electric devices within the scope of this invention are so well known in the art it is believed unnecessary to specifically describe the process of manufacture of any single device as an illustration of the use in combination of the present invention therein. The breadth and scope of the present invention are outlined in the following claims.

What is claimed is:

1. The step in the manufacture of incandescent electric lamps and analogous electric devices which comprises "flushing" said device during baking with an atmosphere of "water gas."

2. The step in the manufacture of incandescent electric lamps and analogous electric devices which comprises "flushing" the interior of said lamp during the baking procedure with a gas mixture comprised of nitrogen, hydrogen and a proportion of carbon monoxide.

3. In the manufacture of incandescent electric lamps, and analogous electric devices the method of removing surface oxides from the metal parts thereof which comprises heating said metal parts to temperatures not in excess of 450° C., in a reducing atmosphere comprised substantially of nitrogen, hydrogen and a proportion of carbon monoxide.

4. In the manufacture of incandescent electric lamps and analogous electric devices the method of removing surface oxides from the metal parts thereof which comprises heating said metal parts to temperatures not in excess of 450° C. in an atmosphere of "water gas."

5. In the manufacture of evacuated electric devices the method of eliminating deleterious metal oxides therein which comprises flushing said device during baking, with "water gas."

6. In the manufacture of evacuated electric devices the method of eliminating deleterious metal oxides therein which comprises flushing said device during baking with a reducing gas mixture comprised substantially of nitrogen, hydrogen and a proportion of carbon monoxide.

7. In the manufacture of evacuated electric devices the method of eliminating deleterious metal oxides therein which comprises flushing said device during baking with a reducing gas mixture comprised substantially of nitrogen approximately 50 per cent, hydrogen not over 20 per cent, and a proportion of carbon monoxide between 30 to 40 per cent.

8. In the manufacture of incandescent electric lamps the method of removing surface oxides from the metal parts thereof which comprises heating said metal parts to temperatures between 250° C. and 450° C. in an atmosphere of "water gas."

9. In the manufacture of incandescent electric lamps the method of removing surface oxides from the metal parts thereof which comprises heating said metal parts to a temperature below the softening temperature of the glass envelope of the device in an atmosphere comprised of nitrogen, hydrogen and carbon monoxide.

10. The method of manufacturing incandescent electric lamps and analogous electric devices which comprises assembling said device, exhausting, baking, flushing said device while baking with an atmosphere comprised substantially of nitrogen, hydrogen and a proportion of carbon monoxide, removing said flushing gas, and sealing off.

11. The method of manufacturing incandescent electric lamps and analogous electric devices which comprises assembling said device, exhausting, baking, flushing said device while baking with an atmosphere comprised substantially of nitrogen, hydrogen and a proportion of carbon monoxide, removing said flushing gas and introducing a desired gas filling.

12. The method of manufacturing incandescent electric lamps and analogous electric devices which comprises assembling said device, evacuating, baking, flushing said device during baking with "water gas," removing the flushing gas and sealing off.

13. The method of manufacturing incandescent electric lamps and analogous electric devices which comprises assembling said device, evacuating, baking, flushing said device during baking with "water gas," removing the flushing gas, introducing a desired gas filling, and sealing off.

In testimony whereof, I have hereunto subscribed my name this 31st day of January, 1929.

LLOYD D. LOCKWOOD.