

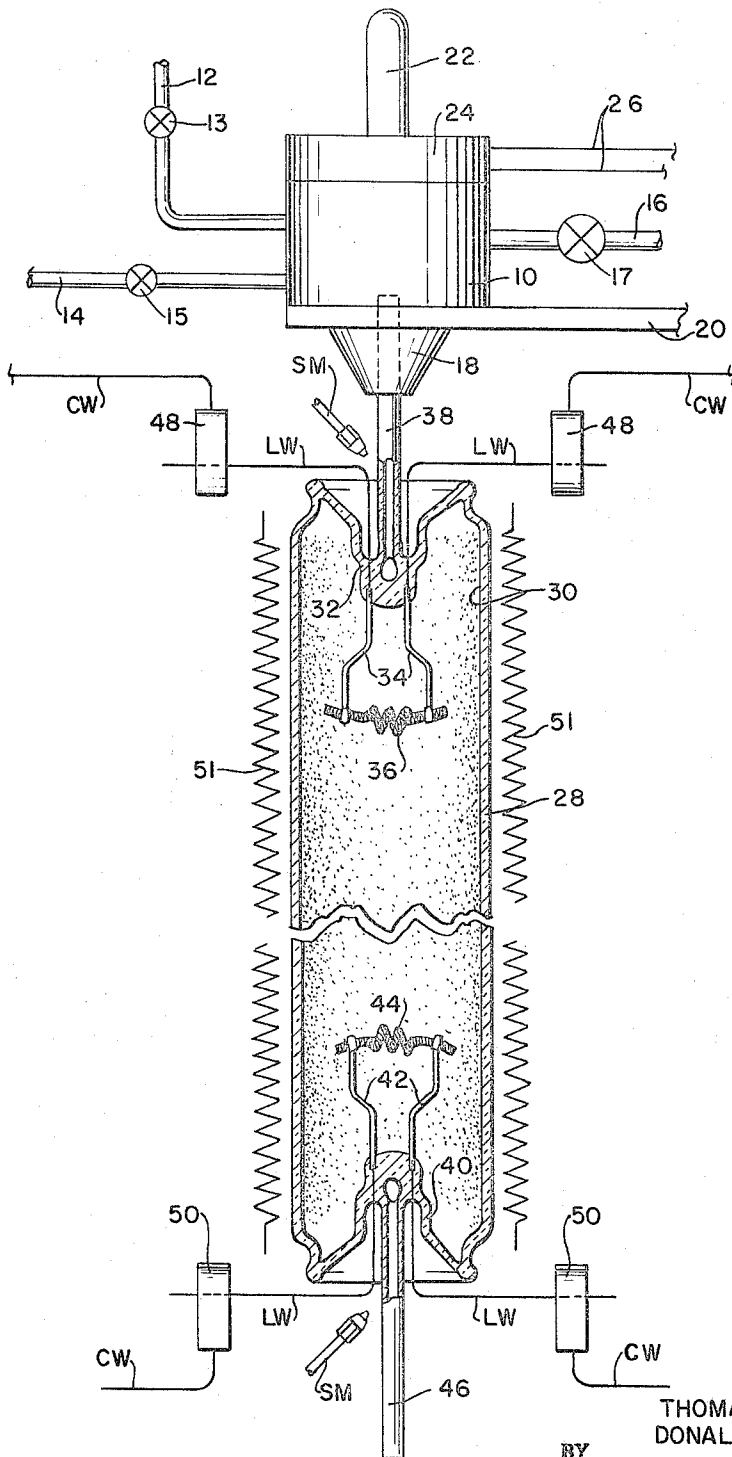
Dec. 27, 1966

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3,294,468

METHOD AND APPARATUS FOR MANUFACTURING FLUORESCENT LAMPS

Filed Feb. 5, 1965



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METHOD AND APPARATUS FOR MANUFACTURING FLUORESCENT LAMPS

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Filed Feb. 5, 1965, Ser. No. 430,533
12 Claims. (Cl. 316-24)

This invention is concerned with a novel apparatus and novel methods for finishing sealed electron discharge devices, such as fluorescent lamps.

The general object of this invention is to provide novel means and methods, by which electron discharge devices, and specifically fluorescent bulbs, are cleansed of their oxygen content, flashed, baked and sealed without subjecting the sealed bulbs to hard vacuum conditions.

In a broader sense, an object of this invention is to remove the oxygen from the bulb of the lamp and the occluded gases from the bulb wall, its fluorescent coating and its electrodes by a flushing process without requiring the withdrawal of the oxygen and other harmful gases by the use of vacuum equipment.

Maintaining high speed production of fluorescent lamps, in accordance with present methods, involves the use of complex vacuum exhaust systems prior to hermetically sealing the lamp bulbs. As is well understood in this art, in accordance with present methods, it is necessary to provide and maintain high vacuum type apparatus, leak detection systems and complicated auxiliary equipment in order to effect the extremely high vacuum required in the normal operation of the finished lamp.

Another object is to avoid many of the problems, of which those skilled in the art are aware, resulting from the strains which are placed on the lamp bulb during the heating cycle, at which time the bulb and its glass components are under high vacuum at high glass temperatures. Further reference will be made in a general way to these difficulties and the manner in which they are avoided in accordance with the practices of this invention.

Other and more detailed objects of the invention will be apparent from the following detailed description of one form of apparatus used in accordance therewith, and by means of which the methods of this invention are practiced.

In the accompanying drawings, the single diagrammatic illustration includes a simple form of apparatus in connection with which the methods herein disclosed may be practiced.

As will appear later, both the apparatus and the methods comprising the invention are particularly adapted to continuous operation, as distinguished from the multi-stage type of apparatus and method now commonly used in mass production of devices of this type. For simplicity purposes, the description will be in connection with a single head for processing a single fluorescent bulb.

As shown, the head comprises a casing 10 having gas supply connections 12 and 14 and a vent 16. The pipe 12 includes a control valve 13. The pipe 14 includes a control valve 15 and the pipe 16 a control valve 17. The casing is provided with a depending chuck 18 having an operating handle 20. In accordance with present practice in this art, this head assembly includes a valve container 22 from which a predetermined quantity of mercury can be released under the control of a magnetic coil 24 energizable through the circuit connections 26.

As suggested above, the methods of this invention are applicable to various types of electron discharge devices, but are particularly provided for the processing of fluorescent bulbs. Thus, as illustrated in the drawing, a fluorescent bulb 28 is provided with the usual desired

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fluorescent coating 30. Sealed into the collars of the tube 28 are the flared portions of the stem assemblies 32 and 40. Mounted on these stem assemblies are the inner lead wires 34 and 42 for the cathodes 36 and 44 respectively. Sealed into the stem assemblies 32 and 40 are the tubulation tubes 38 and 46, which provide communication with the interior of the bulb 28 through apertures in the stem assemblies in the usual way. Also part of the stem assemblies 32 and 40 for the inner lead wires 34 and 42 are the outer lead wires LW.

As illustrated in the drawing, the bulb 28 is supported in fluid tight relation in the chuck 18 by inserting the tubulation tube 38, for example, into the chuck and locking it in place by the operating handle 20. The tubulation tube 46 at the other end is open to the atmosphere.

The tubulation tube 38 communicates with the interior of the head 10, so that a flushing gas can first be supplied from any suitable source through the pipe 12 upon opening of the valve 13, valves 15 and 17 being closed at this time. A suitable flushing gas is nitrogen. This gas is supplied to the interior of the bulb 28 through the tubulation tube 38 at a pressure approximating or slightly above atmospheric pressure, so that a steady flow of the gas will be effected through the bulb 28, the gas being discharged to the atmosphere through the tube 46. This flow of flushing gas is continued until the air in the tube is completely replaced by the flushing gas. The transition from air to an atmosphere of inert gas through flushing can be accomplished quite rapidly, in the order of a few seconds.

As soon as the air has been flushed from the bulb the cathodes 36 and 44 which, as is well understood, are usually the oxide coated type are activated by supplying the proper current thereto through the circuit wires CW, which are connected to the conducting clips 48, in which the lead wires LW for these electrodes have been previously fastened. Activation of the electrodes continues in accordance with well known practice for a sufficient period of time to drive off any occluded gases and to decompose the carbonates comprising the coating.

When this step, which sometimes is called the flashing or cathode activation step, is completed, the supply of flushing gas is cut off by closing valve 13 and the gas which is to remain in the completed bulb, such, for example, as argon, is introduced into the bulb 28 by opening valve 15. This flow of argon is continued until all the original flushing gas has been displaced from the bulb 28. During the period of changeover from one gas to the other the whole lamp is enclosed within a suitable heating oven, the temperature of which is brought to between 400-500° C. for the purpose of degassing all of the lamp components. For illustrative purposes, the oven is indicated diagrammatically in the drawing by an electric resistance heater 50 which, in practice, will, of course, be enclosed within heat insulating walls, all as will be well understood in this art. The oven is then removed and immediately thereupon current is again passed through the electrodes 36 and 44 to heat them for the purpose of further cleaning the surface thereof of any vaporizable foreign material, so that it too can be carried out of the bulb in the gas stream. Upon completion of this degassing step the tubulation tube 46 is sealed off in the usual way, by applying heat to it, by means of a gas flame torch SM, so that it becomes sealed.

In order to prevent blowing out of the molten glass at the sealing off point, by reason of the building up of back pressure in the bulb 28, the valve 17 is opened as sealing off occurs, so as to equalize the pressure in the bulb.

Valves 15 and 17 are then closed. Thereupon a suitable vacuum source is connected to the line 12 or to the head 10 through a separate line, so as to reduce the pres-

sure of the fill gas, that is the argon in the bulb 28, from atmospheric pressure to the desired finished lamp pressure, which, as is well known in the art, is of the order of $2\frac{1}{2}$ to 3 mm. While the pressure in the bulb 28 is thus being reduced a measured quantity of mercury is introduced into the bulb in accordance with the usual practice. Diagrammatically this is illustrated as being accomplished by releasing, through a suitable and well known valving arrangement, a measured quantity of mercury from the container 22. In accordance with present practice this is accomplished by means of a magnetizable winding 24, which, when supplied with energy through the current leads 26, operates the valve to discharge a measured quantity of mercury into the bulb 28 through the tube 38.

When the desired final finished pressure is reached, the final sealing off of the bulb is accomplished by tipping off, that is by sealing the tubulation tube 38. This is accomplished in the usual way by means of a gas flame torch SM.

Upon review it will be seen then that by this method a finished fluorescent lamp can be produced without requiring the use of the complex and expensive mechanism now commonly employed to first produce a hard vacuum in the lamp bulb. It is obvious that very simple vacuum equipment can be used to reduce the gas pressure in the bulb 28 from about atmospheric pressure to the required final pressure, as explained above.

There are available other flushing gases but the use of nitrogen has been described because of its inertness and relatively low cost.

However, it is within the scope of this invention to eliminate, if desired and economically feasible, the use of nitrogen or its equivalent as a flushing gas and to carry out the entire operation with a final filling gas. In other words, at the beginning of the operation, instead of flowing nitrogen through the bulb 28 argon can be flowed through so that no transition is required from one gas to another.

It will also be understood that many other filling gases, depending upon the final desired characteristics of the lamp, can be used, such as krypton, neon, helium and xenon, as well as various mixtures thereof. As is well understood in the art, argon is admixture with neon, helium, krypton, xenon or in some cases even nitrogen could be used both as the flushing and filling gas or as the filling gas preceded by the use of nitrogen or its equivalent alone as the flushing gas.

Thus, it will be apparent to those skilled in the art that the subject matter of the invention herein disclosed are capable of variation in detail without departure from the basic novel subject matter herein disclosed. By way of example, it is apparent that many other forms of apparatus could be used to practice the methods disclosed.

It is preferable, therefore, not to be limited by the illustrative features of this disclosure, but rather by the scope of the appended claims,

What is claimed:

1. In the manufacture of an electron discharge device comprising a bulb having inlet and outlet connections at opposite ends and at least one electron emissive electrode therein, the steps of passing a flushing gas through said bulb from said inlet connection to said outlet connection to flush the air from said bulb to the atmosphere, heating said device to activate its cathode and drive off the occluded gases while continuing said flushing step, sealing off said outlet connection, withdrawing the flushing gas from said bulb to a final predetermined pressure, introducing a predetermined quantity of mercury into said bulb and sealing off said inlet connection.

2. In the method of claim 1, said heating including energizing said electrode.

3. In the method of claim 1, said flushing gas being supplied at a pressure at least equal to atmospheric pressure.

4. In the method of claim 1, said flushing gas being any one of the gases which are normally left in the atmosphere of such a device.

5. In the method of claim 1, said flushing gas comprising first nitrogen, subsequently followed by argon or its equivalent.

6. In the method of claim 1, said heating including applying heat to said bulb from an external source and energization of said electrode.

7. In the method of claim 1, the additional step of venting said bulb at the time said outlet connection is sealed off.

8. In the method of claim 1, said flushing gas comprising any one of the group consisting of argon, neon, krypton, helium and xenon.

9. In the method of claim 1, said flushing gas comprising argon in admixture with any one of the group of gases comprising neon, nitrogen, helium, krypton and xenon.

10. In the method of claim 1, said flushing gas consisting first of an inert gas followed by a finishing gas which can remain in said bulb when finally sealed.

11. An apparatus of the type described, comprising means for establishing a connection to the inlet passage of the bulb of an electron discharge device having an outlet passage to the atmosphere and having also at least one electron emissive electrode, means for supplying a flushing gas to said bulb through said means to said inlet passage, means for heating said bulb to release its occluded gases, means for sealing off said outlet passage, means for reducing the pressure of the flushing gas to a predetermined value after it is sealed off and means for sealing off said inlet passage.

12. In the combination of claim 11, means for energizing said electrode during the flow of flushing gas.

No references cited.

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