Aug. 12, 1969 HAJIME SHIRAGAKI 3,460,219

METHOD OF MAKING ELECTRIC BULBS

Filed Oct. 18, 1966

Fig. 1

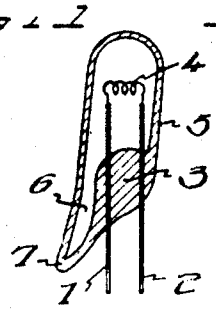


Fig. 2

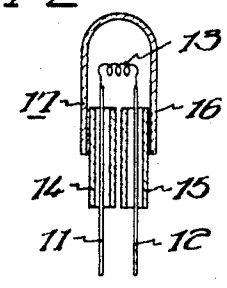


Fig. 3

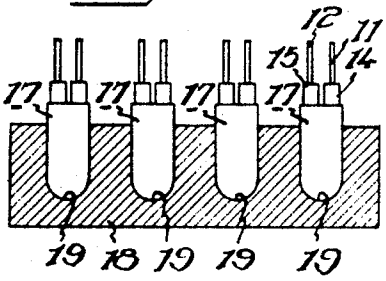


Fig. 4

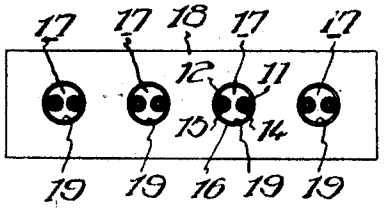


Fig. 5

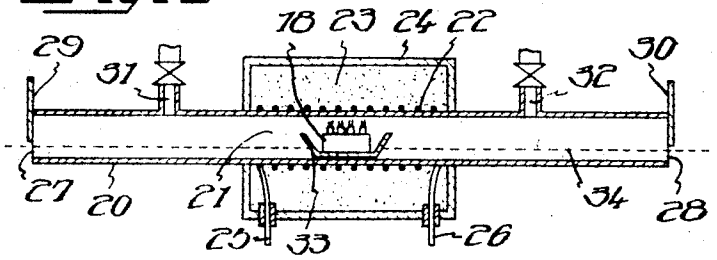


Fig. 6

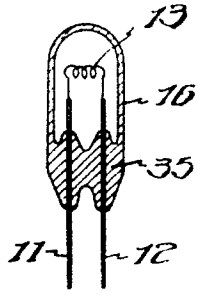


Fig. 7

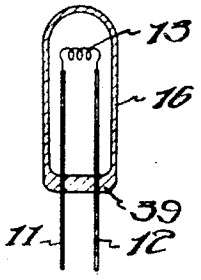
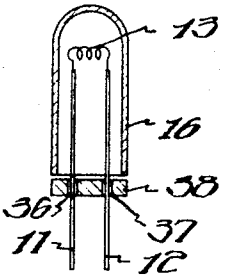


Fig. 8



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METHOD OF MAKING ELECTRIC BULBS

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ABSTRACT OF THE DISCLOSURE

A method for making an electric bulb in which a semiproduct is placed in a jig with the components to be sealed being exposed. The jig and semiproduct are positioned in a heating zone in which a vacuum is developed and an inert gas introduced and the sealing effected.

This invention relates to methods for making electric bulbs and more particularly to methods for making small or very small electric bulbs.

FIG. 1 is a vertical sectional view of a conventional small electric bulb,

FIG. 2 is a vertically sectional view of electric bulb component parts assembled according to the present invention,

FIGS. 3 and 4 are a vertically sectional view and plan view of a jig to be used in the present invention, respectively,

FIG. 5 is a vertically sectional view of a heating furnace to be used in the present invention,

FIG. 6 is a vertically sectional view of an electric bulb completed with the component parts shown in FIG. 2,

FIG. 7 is a vertically sectional view showing another example of electric bulb component parts assembled according to the present invention, and

FIG. 8 is a vertically sectional view of an electric bulb completed with the component parts shown in FIG. 7.

In a conventional small or very small electric bulb, as illustrated FIG. 1, two sealed lead wires **1** and **2** are first surrounded with glass to form a stem **3**, and a tungsten filament **4** is fixed to the tips of the sealed lead wires. Thereafter an encloser **5** is applied to cover the above components and is sealed with the stem **3**. In sealing, the components, an exhaust part **6** is made in a part of the encloser **5**. Then, such semiproduct of an electric bulb is connected to an exhausting stand, the interior of the encloser is exhausted, an inert gas is enclosed as required and the exhaust part **6** is sealed and cut at **7** so that a completed product may be obtained.

In the conventional manufacturing method, as described above, not only many steps are required but also specifically the steps of forming the stem and sealing the encloser are so difficult to automatically execute because the dimensions of the respective parts are small so that it is usual for those steps to be still carried out by hand by skilled glass workers. Therefore, the efficiency and output are low, with the greater part of the production cost being occupied by labor and therefore the price of the product is very high.

The present invention is to effect in one step the various steps of forming the stem, sealing the encloser, exhausting the encloser, enclosing the gas and sealing the exhaust part without requiring any skilled worker by using simple parts which can be mass-produced so that the number of steps may be materially reduced, labor may be greatly saved and uniform products may be cheaply mass-produced.

The present invention will be explained with reference to an embodiment shown in FIGS. 2 to 6.

11 and **12** are lead wires and a tungsten filament **13** is fixed to their tips in advance. Then, fine glass tubes **14** and **15** are fitted to the lead wires **11** and **12**, respectively, and are inserted into a glass encloser **16** so as to be positioned near the opening. Thus, a semiproduct **17** is assembled as shown in FIG. 2. This condition is kept by the friction between the respective parts.

Then, such semiproducts **17** are contained in inverted condition in respective holes or recesses **19** provided in the upper surface of a jig **18** as shown in FIG. 4. The jig **18** is formed of a heatproof material which will not be fused with glass as carbon or graphite or is formed by coating the surface of a heatproof metal with a material which will not be fused with glass. The hole **19** has a diameter substantially equal to that of the encloser **16** and a depth lesser than the height of the encloser **16**. Therefore, when the semiproduct **17** is inserted into the hole **19**, a part of the encloser **16** and fine glass tubes **14** and **15** will be exposed from the hole as shown in FIG. 3.

The jig **18** supporting the semiproducts **17** in such condition is inserted into a furnace as is shown in FIG. 5. The furnace has a furnace tube **20** made of a heatproof material as quartz or metal. A heating resistance wire **22** is wound around a heating part **21** in the middle of the furnace tube **20**. The heating part **21** is enclosed with heat insulating material **23** such as magnesia. Further, an enclosing wall **24** is provided outside the heat insulating material **23**. **25** and **26** are pull-out terminals of the heating resistance wire **22** provided on the enclosing wall **24**. Doors **29** and **30** for intercepting outside air are provided in an inlet **27** and outlet **28** of the furnace tube **20**, respectively. An exhaust part **31** for evacuating the furnace tube **20** and an inlet part **32** for feeding an inert gas are respectively provided between the doors and the above mentioned heating part. A carriage **33** for mounting the jig **18** is contained in the furnace tube **20**. A metal wire **34** for moving the carriage **33** from the inlet **27** to the outlet **28** is fixed to the carriage.

The jig **18** is mounted on the carriage **33** and is placed in the heating part **21** within the furnace tube **20** by the operation of the metal wire **34**. The inlet **27** and outlet **28** are closed. The furnace tube **20** is exhausted to a vacuum through the exhaust part **31**. Then, due to the radiant heat from the inside wall of the furnace tube, the temperature of the exposed glass part of the semiproduct **17** will quickly rise. However, the heat capacity of the jig **18** is so large that the rise of the temperature of the jig will be slow. Therefore, the part of the semiproduct **17** in the hole **19** is hard to heat. If the exhaust part **31** is closed and an inert gas is fed into the furnace tube through the inlet part **32** at a proper time, the inert gas will also enter the encloser **16** of the semiproduct. The temperature of the exposed part of the semiproduct **17** will continue to rise even thereafter. Finally, the glass part will melt, and a stem **35** as is shown in FIG. 6 will be formed while at the same time a sealing will be effected. Thereafter, the carriage **33** is moved out of the heating part **21** by the operation of the metal wire **34** and is gradually cooled. After it is properly cooled, the door **30** is opened and the carriage is moved out of the furnace tube **20**. Then the completed gas-filled electric bulbs as illustrated in FIG. 6 will be obtained.

In case it is not necessary to enclose an inert gas in the electric bulb, the above described feeding of the inert gas will not be required and only the exhausting operation will suffice. Further, the exhausting operation may be omitted and the inert gas may be constantly introduced into the furnace tube **20**. In such case, no doors will be required for the inlet **27** and outlet **28** and therefore it will be possible to continuously carry out the production by constantly inserting the semiproducts supported by the jig into the furnace tube. Further, in the case of producing electric bulbs for such low class uses as for models,

it will not be necessary to keep the interior of the furnace tube **20** at a vacuum or in an inert gas atmosphere. Even if air is present in the completed electric bulb as a result, the amount of air will be so small that the bulb can light.

Further, the semiproduced electric bulb to be inserted into the above described furnace may have a structure such as in FIG. 8 instead of the structure in FIG. 2. That is to say, a glass disk **38** having small holes **36** and **37** through which the lead wires **11** and **12** are to be inserted, respectively, can be used instead of the fine glass tubes **14** and **15** in FIG. 2. Even though such glass disk **38** is used, the above described manufacturing method can be carried out. FIG. 7 shows a thus completed electric bulb. **39** is a stem formed by melting the disk **38**.

As evident from the above explanation, according to the present invention, as the component parts to be used have simple shapes, they can be easily mass-produced, with such various steps as forming the stem, sealing the encloser, exhausting the encloser, enclosing the gas and sealing the exhaust part being effected in one step simultaneously for many electric bulbs and the operation requires no skilled labor. Therefore, uniform products of the same contour dimensions can be mass-produced at a low cost. Thus the present invention is effective as applied specifically to the manufacture of small or very small electric bulbs which have been difficult to manufacture.

What is claimed is:

1. A method for making electric bulbs comprising the steps of forming a semiproduct having lead wires, a filament, and a glass enclosure for the wires and filament provided with an open end, positioning the semiproduct in a recess in a member having a comparatively large heat capacity yet not capable of being fused with glass with the open end and portions to be sealed being exposed, positioning the member and semiproduct within a heating zone, developing a vacuum in the heating zone, introducing an inert gas into the heating zone which enters the enclosure through the open end and after which the exposed portion melts to form a seal about the wires, removing the member and semiproduct from the heating zone, and cooling the member and semiproduct to provide a gas-filled electric bulb.

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U.S. Cl. X.R.

29—25; 65—36, 59, 155