Sept. 21, 1948. A. W. SEITZ 2,449,676

METHOD OF MANUFACTURING ELECTRIC INCANDESCENT LAMPS

Filed Oct. 1, 1947

Fig. 1

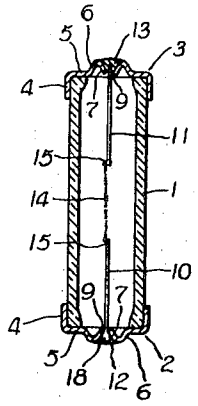


Fig. 2

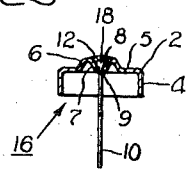


Fig. 3

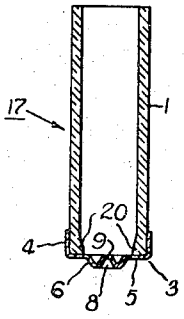


Fig. 4

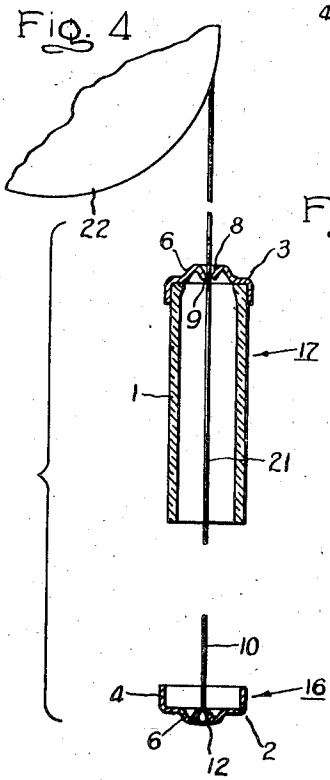


Fig. 5

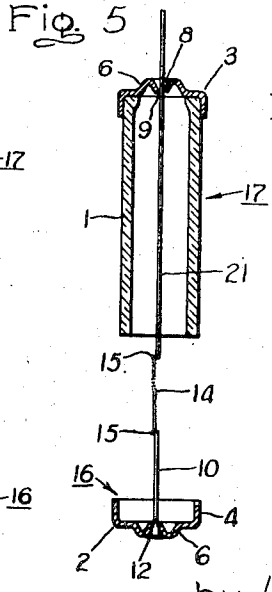


Fig. 7

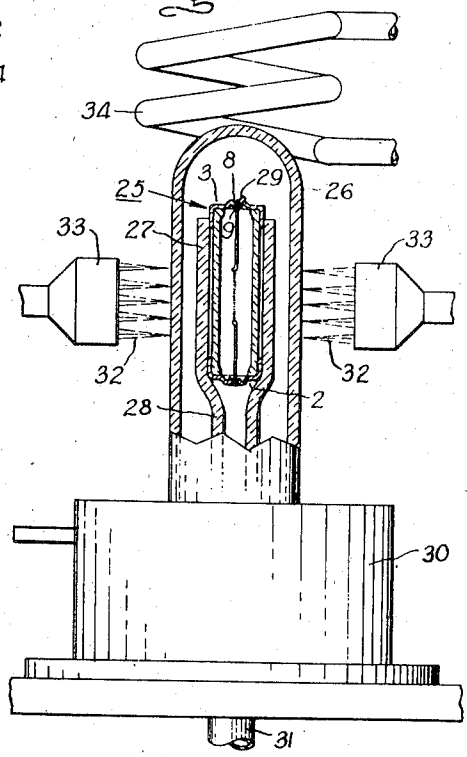
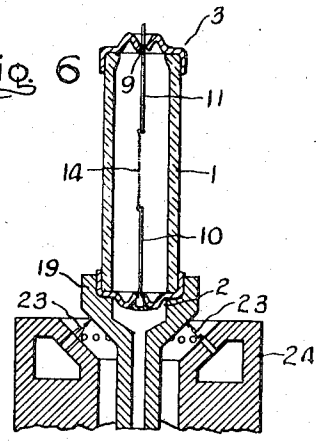


Fig. 6



Inventor:
August W. Seitz,
by Vernet C. Hauffman
His Attorney.

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UNITED STATES PATENT OFFICE

2,449,676

METHOD OF MANUFACTURING ELECTRIC INCANDESCENT LAMPS

August W. Seitz, Euclid, Ohio, assignor to General Electric Company, a corporation of New York

Application October 1, 1947, Serial No. 777,337

5 Claims. (Cl. 316—19)

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My invention relates in general to electric incandescent lamps, and more particularly to a method of manufacture thereof.

In co-pending application No. 777,239, A. Greiner, filed October 1, 1947, and assigned to the assignee of the present invention, there is disclosed and claimed an electric incandescent lamp of the double-ended miniature type having terminal contact members at the opposite ends thereof and a filament supported in place in the lamp envelope by conductor wires which are fastened to the terminal contact members and are connected to the opposite ends of the filament. The procedures heretofore employed in the manufacture of such type lamps have generally involved certain operations which were unsuitable to the production manufacture of the lamps by machine methods and which accordingly rendered manufacture of such lamps costly.

It is an object therefore of the present invention to provide an improved method of manufacturing an electric incandescent lamp of the above-described character which method is readily adaptable to machine production methods.

Further objects and advantages of my invention will appear from the following description of a species thereof and from the accompanying drawing in which:

Fig. 1 is a longitudinal section, on an enlarged scale, of an electric incandescent lamp manufactured by the method according to the invention; Fig. 2 is a detail view, in section, of the terminal cap and lead-in wire assembly for one end of the lamp; Fig. 3 is a detail view, in section, of the envelope and terminal cap assembly which is employed in the manufacture of the lamp according to the invention; Fig. 4 is a view illustrating the assembly of the envelope and terminal cap assemblies with the lead-in wires preparatory to the filament mounting operation; Fig. 5 is a view illustrating the filament mounting step in accordance with the method of the invention; Fig. 6 is a view illustrating the sealing of the terminal cap assembly to the envelope assembly to form the enclosure of the lamp; and Fig. 7 is a view illustrating the evacuation, and the sealing of the exhaust aperture, of the lamp.

Referring to Fig. 1, the electric incandescent lamp there shown comprises an evacuated tubular glass envelope 1 closed at its ends by identical metal end caps 2, 3 which are fusion-sealed to the envelope ends. The end caps 2, 3 are preferably made of silver-plated iron containing a small percentage of carbon, e. g., .05 per cent, and they are provided with peripheral lip or side wall portions 4 which fit over the ends of the glass envelope 1 and are fusion-sealed to the outer wall surface thereof. As shown, the glass envelope 1 is also sealed at its rim ends to the base wall portions 5 of the cap which base wall portions constitute, in effect, the end walls of the envelope itself. The glass envelope 1 is made of a suitable low-melting point glass which matches the expansion characteristics of the metal end caps 2, 3 and which readily wets and seals thereto. For sealing to silver-plated iron end caps such as are preferably employed, a soft lead glass of the following approximate composition has been found to be particularly suitable:

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	Per cent
SiO_2	45
PbO	35
Al_2O_3	2
Na_2O	3
K_2O	14
Li_2O	1

If desired, the lithium oxide in the above composition may be omitted.

The base or end walls 5 of the end caps 2,3 are formed on their outer sides with circular bosses 6 provided with re-entrant inner wall portions or indentations 7 which extend inwardly of the envelope to form cone-shaped recesses 8 in the outer side of the cap end walls 5. At the bottoms of the recesses 8, the end cap walls 5 are provided with apertures 9 through which lead-in wires 10, 11 extend into the envelope 1. The said lead-in wires 10, 11 are preferably made of the same silver-plated iron such as is used for the caps 2, 3, and they are electrically connected to and supported by the respective end caps by metallic fusible material or solder 12 and 13 disposed within the recesses 8 of the respective end caps 2 and 3. The lead-in wires 10, 11 project into the envelope 1 longitudinally and approximately axially thereof with their inner ends spaced apart and bridged by a filament 14 of suitable refractory metal such as tungsten. The filament 14 may be either in the form of a fine linearly-extending coil or a straight length of tungsten wire, and it is preferably fastened to the lead-in wires by pressing or embedding its opposite ends into the metal of the lead-in wires. As shown, the lead-in wires 10, 11 are preferably formed with short laterally-bent inner end portions 15 to which the filament ends are fastened.

Referring now to Figs. 2 to 7 illustrating the steps involved in manufacturing the lamp in the manner according to the invention, a terminal

assembly 16 as shown in Fig. 2 and an envelope assembly 17 as shown in Fig. 3 are first formed separately. The terminal assembly 16 comprises end cap 2 and lead-in wire 10 united by the solder mass 12, and it may be formed by flattening one end of the lead-in wire 10 (as indicated at 18), inserting the wire through the aperture 9 in the end cap until the flattened end 18 rests against the rim of the said aperture so as to be located within the cap recess 8, and then filling the recess 8 and the aperture 9 with molten solder while the parts are held in the above-described relation with each other. Instead of soldering the wire 10 to the end cap 2, it may be secured thereto in any other suitable manner as by welding, for instance, in which case the aperture 9 in the end cap 2 would be omitted.

The envelope assembly 17 comprises the glass envelopes 1 and the end cap 3 fusion-sealed together, and it may be formed by holding the end cap 3 inward side up, inserting one end of a glass tube into the cavity of the end cap formed by the peripheral lip 4 thereon with the glass tube resting of its own weight on the end cap, and then suitably heating the end cap (as by conduction of heat thereto from a cap-supporting holder 19, Fig. 6) to cause the lower end of the glass tube to soften and flow down partly onto the end wall 5 of the cap 3 to thereby form the thickened glass seal portion 20. For a fuller disclosure of the manner in which the terminal and envelope assemblies 16 and 17 may be formed, reference may be had to the above-mentioned co-pending Greiner application No. 777,239.

In accordance with the invention, the completed terminal and envelope assemblies 16 and 17 are next positioned and held in spaced, aligned relationship with each other, as shown in Fig. 4, with the open end of the envelope 1 facing the inward side of the end cap 2. The two assemblies 16, 17 may be held in such position in a suitable holder (not shown) which may comprise one of the heads of a turret-type machine, for instance. An extended lead-in wire 21 (which may constitute the free end portion of a supply of such wire coiled on a supply spool 22) is then inserted first through the aperture 9 in the end cap 3 and then passed through the envelope 1 until it projects a short distance beyond the open end of the envelope, with its end aligned with and spaced a predetermined distance from the facing inner end of the lead-in wire 10 on terminal assembly 16. The wires 10, 21 may be firmly held, adjacent their inner facing ends, in such aligned and spaced relation by suitable gripping jaws (not shown) provided therefor on the above-mentioned machine head. The inner end portions of the wires 10, 21 are then bent laterally in the same direction to extend more or less parallel to each other and provide the laterally bent inner end portions 15 (Fig. 5) spaced a predetermined distance apart. The filament 14 is then suitably fastened at its ends to the bent inner ends 15 of the wires 10, 21, as by pressing the filament wire into the metal of the said wires 10, 21.

After the mounting of the filament 14 in place on the wires 10, 21, a quantity of red phosphorus or other getter material may be applied to the filament 14, after which the terminal and envelope assemblies 16, 17 are brought together as shown in Fig. 6 and the wire 21 cut off at a point outwardly adjacent the end caps 3 to form the lead-in wire 11. The assemblies 16, 17 are then ready for sealing together. The lead-in wire 11 is kept from dropping through the aperture 9 in the end caps 3 and into the envelope 1 by the resistance of the filament 14 which possesses sufficient strength for such purpose. The sealing of the terminal assembly 16 to the envelope assembly 17 may be performed in the same manner and with the same sealing apparatus (Fig. 6) as is used in the fabrication of the envelope assembly 17, the end cap 2 being supportd in, and heated by conduction of heat thereto from, a stainless steel holder 19 which is heated by gas fires 23 from a ring burner 24 surrounding the holder.

The unitary lamp assembly 25 (Fig. 7) thus formed is then ready for the exhaustion (also gas filling, if desired) and the final sealing-off thereof, which operations may be conveniently carried out in a quartz exhaust chamber 26 as indicated in Fig. 7. As there shown, the lamp assembly 25 is placed and supported in an upright position, with its unsealed end cap 3 uppermost, within the enlarged upper end 27 of a vertically extending quartz tube 28 supported within the exhaust chamber 26, with one or more pellets 29 of a suitable silver solder disposed within the recess 8 of the end cap 3. At its lower end, the quartz exhaust chamber 26 is connected through a compression rubber chuck 30 to a vacuum line 31 which, when opened, evacuates the chamber 26 and also the lamp assembly 25 through the aperture 9 in the end cap 3. During the evacuation of the chamber 26, it is simultaneously heated in the region opposite the lamp assembly 25 therein, as by gas fires 32 from burners 33, to thereby heat the lamp assembly during the exhaustion thereof, in conformance with usual lamp exhausting procedure. A fuller disclosure of the construction of the exhaust chamber 26 and the chuck 30 is given in the aforementioned co-pending Greiner application No. 777,239.

When the required degree of vacuum is produced in the lamp assembly 25, the gas fires 32 are removed and an induction coil 34 moved down over the upper end of the quartz exhaust chamber 26 so as to surround the same at a point approximately opposite the end cap 3 of the lamp assembly 25 therein. The coil 34 is then connected to a source of high frequency current. The resulting magnetic field set up by the coil 34 serves to heat the metal end cap 3 to red heat which in turn melts the solder pellet 29 by conduction of heat thereto, causing the solder to flow down into and fill the recess 8 and aperture 9 in the end cap and connect the lead-in wire 11 to the said cap, thus completing the manufacture of the lamp. Any excess portion of the lead-in wire 11 projecting outwardly beyond the solder 13 (Fig. 1) of the finished lamp is then cut off flush with the outer surface thereof.

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

1. The method of manufacturing an electric incandescent lamp which comprises sealing an apertured metal end cap to one end of a double-ended glass envelope, fastening a lead-in conductor to another metal end cap to project from the inner side thereof, introducing an extended lead-in conductor through the apertured end cap and the associated envelope to project beyond the open end thereof, connecting the projecting ends of the lead-in conductors to the opposite ends of a filament, sealing the open end of the envelope to the said other end cap, and then exhausting the envelope through the aperture in the said apertured end cap and sealing the said aperture with metallic fusible material while the envelope is in exhausted condition.

2. The method of manufacturing an electric incandescent lamp which comprises sealing an apertured metal end cap to one end of a double-ended glass envelope to form an envelope assembly, fastening a lead-in conductor to another metal end cap to project from the inner side thereof and form a terminal assembly, positioning the said assemblies in spaced aligned relation with each other with the open end of the glass envelope opposed to the inner face of the terminal assembly, introducing an extended lead-in conductor through the apertured end cap and the associated envelope to project beyond the open end thereof with the projecting end of said extended conductor spaced a predetermined distance from the projecting end of the conductor on the terminal assembly, connecting a filament across the projecting opposed ends of the lead-in conductors, sealing the open end of the glass envelope to the end cap of the terminal assembly, and then exhausting the envelope through the aperture in the said apertured end cap and sealing the said aperture with metallic fusible material while the envelope is in exhausted condition.

3. The method of manufacturing an electric incandescent lamp which comprises sealing an apertured metal end cap to one end of a double-ended glass envelope to form an envelope assembly, fastening a lead-in conductor to another metal end cap to project from the inner side thereof and form a terminal assembly, positioning the said assemblies in spaced aligned relation with each other with the open end of the glass envelope opposed to the inner face of the terminal assembly, introducing an extended lead-in conductor through the apertured end cap and the associated envelope to project beyond the open end thereof with the projecting end of said extended conductor spaced a predetermined distance from the projecting end of the conductor on the terminal assembly, bending the opposed ends of the said conductors to form laterally extending bent end portions spaced a predetermined

distance apart, connecting a filament across the said bent end portions of the conductors, sealing the open end of the glass envelope to the end cap of the terminal assembly, and then exhausting the envelope through the aperture in the said apertured end cap and sealing the said aperture with metallic fusible material while the envelope is in exhausted condition.

4. The method of manufacturing an electric incandescent lamp which comprises sealing an apertured metal end cap to one end of a double-ended glass envelope, fastening a lead-in conductor to another metal end cap to project from the inner side thereof, introducing an extended lead-in conductor first through the apertured end cap and thence through the associated envelope to project beyond the open end thereof, connecting the projecting ends of the lead-in conductors to the opposite ends of a filament, sealing the open end of the envelope to the said other end cap, and then exhausting the envelope through the aperture in the said apertured end cap and sealing the said aperture with metallic fusible material while the envelope is in exhausted condition.

5. The method of manufacturing an electric incandescent lamp which comprises sealing an apertured metal end cap to one end of a double-ended glass envelope, fastening a lead-in conductor to another metal end cap to project from the inner side thereof, introducing the free end of a spooled lead-in conductor wire first through the apertured end cap and thence through the associated envelope to project beyond the open end thereof, connecting the projecting ends of the lead-in conductors to the opposite ends of a filament, sealing the open end of the envelope to the said other end cap, and then exhausting the envelope through the aperture in the said apertured end cap and sealing the said aperture with metallic fusible material while the envelope is in exhausted condition.

AUGUST W. SEITZ.