Nov. 1, 1927. 1,647,620

R. D. HALL

METHOD OF BORATING DUMET WIRE

Filed Feb. 20, 1926

FIG. 1

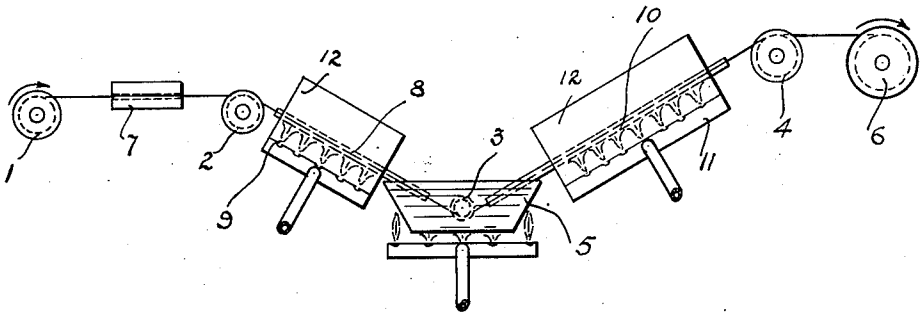


FIG. 2

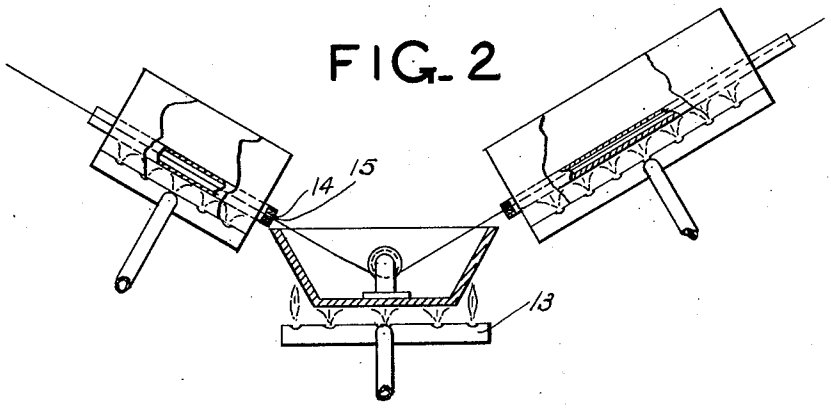
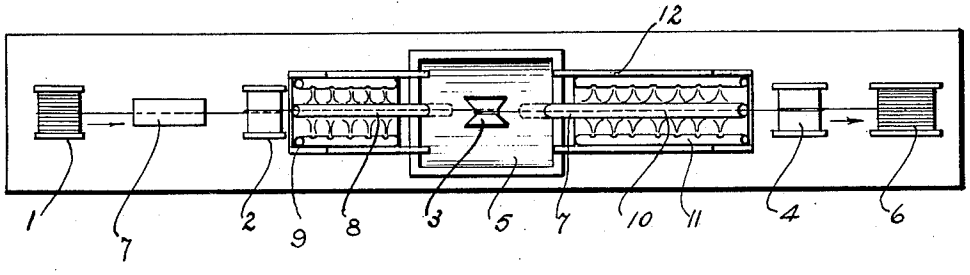


FIG. 3



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UNITED STATES PATENT OFFICE.

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METHOD OF BORATING DUMET WIRE.

Application filed February 20, 1926. Serial No. 89,759.

This invention relates to the application of fused coatings to wires, and more particularly to the coating of leading-in conductors for incandescent lamps, gaseous discharge devices, vacuum tubes, etc., employing a vitreous envelope, through which it is necessary to conduct electrical energy, with a material which protects the conductor from oxidation and facilitates the formation of a close union between the leading-in conductor and the material of the envelope.

The use of platinum as a leading-in conductor has been almost entirely superseded by composite wires composed of a nickel-steel core and a copper sheath. This product, known as Dumet wire, is described in the patent to Eldred, 1,140,136, granted May 18, 1915 and entitled Low expansion wire. In order to protect the wire from oxidation during stocking periods and in handling and to cause the Dumet wire to seal more readily with the material of the envelope, it is the usual practice to coat the wire with a borate such as, for instance, sodium tetraborate, $Na_2B_4O_7$. Such a borated wire forms the subject matter of Van Keuren Patent 1,268,647 granted June 4, 1918.

The method which has been used heretofore for borating such conductors consists briefly in heating the wire in gas flames, passing it while heated through a hot solution or borax and baking on the borax coating in gas flames, all of the above operations being conducted in the open air. A machine for carrying out this process is described and claimed in application Serial No. 574,615, of Steel and Kelly filed July 13, 1922, entitled Machine for treating wire, and assigned to the Westinghouse Lamp Company.

Simultaneously with the borating of the wire it is the usual practice to soft anneal the same. The annealing is essential in order to permit the Dumet wire to be manipulated in the hook forming machines and to enable it to be clamped to the filaments in the manner well known in the art and for this purpose, the wire should have an elongation of approximately 20 to 30%. In order to properly anneal the wire it should be heated to approximately 600 to 700° C. At this temperature, however, the copper sheath oxidizes very readily and at the conclusion of the borating and annealing operation, the wire is of a dark red color which indicates the presence of a large amount of copper oxide underneath or mingled with the borax coating.

This heavy oxide layer is detrimental to the obtaining of a proper seal between the wire and the material of the envelope. This is particularly true in lamps of the butt or lap seal type in which the leading-in conductor is sealed transversely through the envelope and has only a small portion thereof in contact with the glass and is aggravated by the fact that additional oxidation of the wire is caused by the heat of the operation of sealing the wires through the envelope. In order to make a tight seal with the glass it is necessary that the oxidation of the copper sheath be restricted to a small amount. A small quantity of oxide in the borated wire can be absorbed into the glass leaving a clean copper surface in contact with the glass. However, if any appreciable amount of oxide is present, it will not be taken up readily by the glass but a portion thereof may remain on the surface of the wire and after the seal is completed cause leaks, due possibly to the porous nature of the oxide.

The amount of oxide which will be absorbed into the glass from the leading-in conductor depends to some extent upon the time and temperature of the heat treatment employed in forming the seal and annealing the same. In sealing-in conductors which are oxidized to an appreciable extent, it is necessary to carefully control the heating conditions and to regulate the same depending on the degree of oxidation of the leading-in conductor. This requires close supervision of the sealing-in operation and is a disadvantage of considerable importance, particularly in connection with automatic sealing-in machines in which the tendency is to limit the number of operators to a minimum. It is very desirable, therefore, from this view-point, that the leading-in wire be substantially free from oxidation.

One of the objects of this invention is to provide a suitable method and apparatus for borating leading-in conductors and protecting them from oxidation during the borating process.

Another object is to provide a leading-in conductor which is substantially free from oxide and which has a coating of protective material for preventing oxidation of the

conductor during stocking periods and which facilitates sealing of the conductor with glass.

Other objects and advantages will hereinafter appear.

The amount of oxidation of the wire at the completion of the annealing and borating step may be controlled by regulating the conditions under which these operations are performed. I have found that the amount of oxidation is dependent upon the temperature at which the annealing is carried out, the uniformity with which the wire is heated and the environment in which the heating is accomplished.

In accordance with the present invention I subject the wire to uniform heating conditions by interposing between the wire and the gas flames, a baffle member which absorbs heat from the flames and radiates it uniformly to the wire. Preferably, the baffle member is in the form of a tube through which the wire passes to and from the borax solution.

I protect the wire during the heat treatment from oxidizing influences by maintaining a non-oxidizing atmosphere in contact therewith. This non-oxidizing atmosphere may consist of a stream of an inert gas such as nitrogen passed through the heating tube or in the preferred embodiment, one end of the tube may be restricted so as to obstruct the circulation of air through the tube. If desired, both ends of the tubes might be obstructed in this manner but I have found that when the tube is made of relatively small size, that the amount of diffusion of air into the tube through one end thereof is insufficient to cause substantial oxidation of the wire.

In order that this invention may be more fully understood, reference may be had to the accompanying drawing, in which;

Fig. 1 is a diagrammatic representation of the apparatus which I utilize in applying the coating to the wire;

Fig. 2 is a diagrammatic view of a modification of the apparatus shown in Fig. 1; and,

Fig. 3 is a plan view of the apparatus shown in Fig. 1.

The apparatus shown in Fig. 1 comprises a reel 1 from which the wire is drawn over suitable pulleys 2, 3, and 4 through a vessel 5 containing a solution of the coating material. The wire is rewound upon a spool 6. On its passage from the reel 1 to the vessel 5, the wire is drawn through any suitable apparatus for cleansing the wire as, for instance, a pair of wipers 7, after which the wire is passed through a tube 8 heated by burners 9 to a temperature sufficient to bake the coating to the wire. The tube 8 is of small diameter and is disposed at an angle to the horizontal with its lower end extending beneath the surface of the solution. The wire, as it leaves the solution, passes through a similar tube 10 also heated by means of gas flames by the burner 11. The tubes 8 and 10 may be of any suitable material and serve as a baffle to prevent direct contact of the gas flames with the wire. The heat from the burners is distributed uniformly throughout the length of the tube and local over-heating of the wire is prevented. On the initial passage of the heated wire through the tubes, the oxygen content is quickly reduced and since it is only replenished by diffusion downward along the tube, which is very slow, the wire is heated in an atmosphere practically devoid of oxygen or having a very low oxygen content.

The burners 9 and 11 are arranged in troughs 12 to protect the flames from draft and for directing the heat therefrom onto the tubes 8 and 10.

In borating Dumet wire the burners 9 and 11 should be adjusted so as to heat the Dumet wire from 600 to 700° C or at a sufficient temperature to properly anneal the wire, depending on the time of passage of the wire through the heater. At this temperature the borax is readily baked on the wire and when the wire emerges from the end of the tube 10 it is of a color resembling brass, indicating the absence of appreciable oxidation.

If the coating material used is a solution of sodium tetra-borate suitable burners 13 are provided to maintain the solution in a heated condition. The temperature should be maintained at approximately 90° C. and the specific gravity of the solution should be approximately 1.06 at 20° C.

In Fig. 2 a modified manner of obstructing the ends of the tubes is shown. In this view the obstruction takes the form of a closure member 14 for the lower end of the tube in the form of a plug having a small aperture 15 only slightly larger than the wire. Obviously, various other methods of obstructing the flow of oxygen through the tube may be devised. In place of restricting the oxygen content by means of obstructions in the tube, an inert gas such as nitrogen might be passed through the tube, although I have found that the oxidation of the wire may be sufficiently prevented to enable the wire to seal properly with glass by simply restricting one end only of the tubes.

While this invention has been described particularly with reference to the borating of Dumet leading-in wires, it is to be understood that it is not so limited but applies broadly to the production of wires of any nature having a fused coating thereon in which it is desired to protect the wire from oxidation during the coating process.

What is claimed is:

1. The method of controlling the oxygen

content of a borated conductor which consists in passing the conductor through a solution of borax and baking the borax thereon, said baking being conducted under uniform temperature conditions and in the substantial absence of oxygen.

2. The method of producing borated leading-in conductors which comprises heating said conductors under non-oxidizing conditions, passing the heated conductor through a borax solution and baking said borax on the conductor at a temperature sufficiently high to anneal the conductor in an atmosphere of rarefied oxygen content.

In testimony whereof, I have hereunto subscribed my name this 19th day of February, 1926.

ROY D. HALL.