UNITED STATES PATENT OFFICE.

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MAKING ELECTRICALLY-CONDUCTING JOINTS IN METALLIC-FILAMENT INCANDESCENT ELECTRIC LAMPS.

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To all whom it may concern:

Be it known that I, AUGUSTUS CHARLES HYDE, a subject of the King of Great Britain, residing at 3 Queen's Gardens, Ealing, London, England, have invented certain new and useful Improvements in Making Electrically-Conducting Joints in Metallic-Filament Incandescent Electric Lamps, of which the following is a specification.

My invention relates to a composition of matter and the application of a high tension current thereto, to form the conducting joints between the metallic filaments of incandescent electric lamps and the leading-in conductors thereof. The filaments usually consist of tungsten, molybdenum, niobium and the like, and the leading-in conductors usually consist of copper, platinum, iron, nickel or alloys of these metals. On account of the extremely fine size of the filaments and their great brittleness it is desirable to reduce the actual handling of them in the process of joining them to the leading-in conductors as much as possible. It is also necessary to make the joint so perfect that no resistance to the passage of the current from the leading-in wires to the filaments exists. Again it is desirable that during the process of making the joints, the leading-in wires should not be shortened, or the filament in any way displaced as is generally the case if the leading-in wires have their extremities melted around the filaments by means of an electric arc. It is also desirable that all joints should be made by thoroughly incasing the filaments and leading-in wires at their point of contact by metal which has been melted, and for this reason the joint should consist of metal or metals of comparatively low melting points, provided that the melting point of the metals is sufficiently high to resist any tendency to soften by contact with the incandescent filaments.

Joints are sometimes made with graphite formed into a paste with some carbonaceous agglutinant, but they are unsatisfactory because the filaments are only held loosely in the graphite causing bad electrical contact and rapid blackening of the lamps.

By the provision and use of a composition of matter such as hereinafter described and the action thereon of a high tension current I obtain the advantages of the pasting method without its disadvantages and with the merits of the fused metallic joint, I prepare the composition in the following manner:—

Finely divided metallic powder preferably iron or nickel containing a predetermined amount of the oxid of the particular metal used in the form of fine powder is made into a paste with some suitable carbonaceous agglutinant such as collodion cotton (cellulose di-nitrate) dissolved in one of the usual solvents, such as amyl acetate, acetic acid, acetone etc. The solvent should be a volatile one so that the little bulbs of paste can dry and become hard in the air. A suitable solution can be made by dissolving one gram of collodion cotton in 20 c.c. of amyl acetate. It is essential that the carbonaceous agglutinant used should possess the necessary adhesiveness and that it should not give off when heated to a red heat vapors capable of depositing carbon in a fine form upon neighboring bodies. Collodion is in this respect the best, but other substances such as caramel dissolved in water can be used. The amount of metallic oxid in the paste is so proportioned that it exists to the extent of about 10% over and above the amount chemically equivalent to the carbon residue left in the paste after the carbonaceous agglutinant has been raised to a red heat in a protecting atmosphere (such as hydrogen).

To make the joint between the filament and the leading-in wire I take a small quantity of the metallic paste prepared in the manner already specified and place it on the outer ends of the leading-in wires, I then place the ends of the metallic filaments in contact with the small bulbs of paste on the ends of the leading-in wires, and as the paste is of a very sticky and adhesive nature the filament becomes fixed in the position in which it is placed. The paste joints are then allowed to dry either in the air at the normal temperature, or if it is desirable to quicken the drying they may be dried in air at 100° C. The paste joints having been made in this temporary manner the lamp stem with the leading-in wires mounted thereon is placed inside a glass jar or tube containing hydrogen or carbonic oxid

gas. Electrical contact is then made between one or both of the free ends of the leading-in wires and one of the poles of a transformer generating a current of 1000 volts or thereabout. The other pole of the transformer suitably insulated, but with an exposed metallic terminal is then inserted into the jar or tube containing the hydrogen or carbonic oxid gas and brought into close proximity (2 or 3 m.m.) to each joint in turn of the leading-in wires and metallic-filament, and the high tension current is allowed to pass between such joints and the exposed metallic tip of the conductor from the transformer. I lay stress upon the necessity of employing a current of high tension because until the joints have been heated they are of an insulating nature, and a high tension current is needed to break down the insulation. A perfect electric conducting connection is thus established and the manipulation for making the connection in this manner can be carried out without touching the leading-in wires by the electrode or otherwise, which constitutes an advantage over those methods of connecting the said parts, which necessitate a contact at the point where the conducting connection is to be established and sometimes cause an undesired displacement. The passage of the high tension current over the gap can be so arranged as to develop sufficient heat to reduce and fuse the paste, so forming a thorough metallic joint between the leading-in wires and filaments.

The following successive actions take place with great rapidity during the heating by the electrical current:—

First, the carbonaceous agglutinating body is thoroughly carbonized and all volatile vapors expelled.

Second, the carbon residue remaining in the paste acts upon the oxid of iron or oxid of nickel which is in the paste becoming consumed and reducing such oxids to metal.

Third, any oxid left after the combustion of the carbon residue is reduced to metal by the hydrogen or carbonic oxid gas.

Fourth, the metal powder is fused into solid metal which surrounds the leading-in wire and the filament, and makes a perfect good conducting joint.

I claim:

A composition of matter for joining the metallic filaments to the leading-in conductors of incandescent electric lamps, consisting of finely divided iron powder, an agglutinant consisting of collodion dissolved in amyl acetate, and oxid of iron so proportioned that it exists in the composition to an extent approximately ten percentum greater than the amount chemically equivalent to the carbon residue left after the collodion has been raised to a red heat in a protecting and reducing atmosphere.

In testimony whereof I affix my signature in presence of two witnesses.

AUGUSTUS CHARLES HYDE.

Witnesses:
H. D. JAMESON,
RIPLEY WILSON.