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A. C. HYDE.

PROCESS OF MANUFACTURING LEADING IN TERMINALS.

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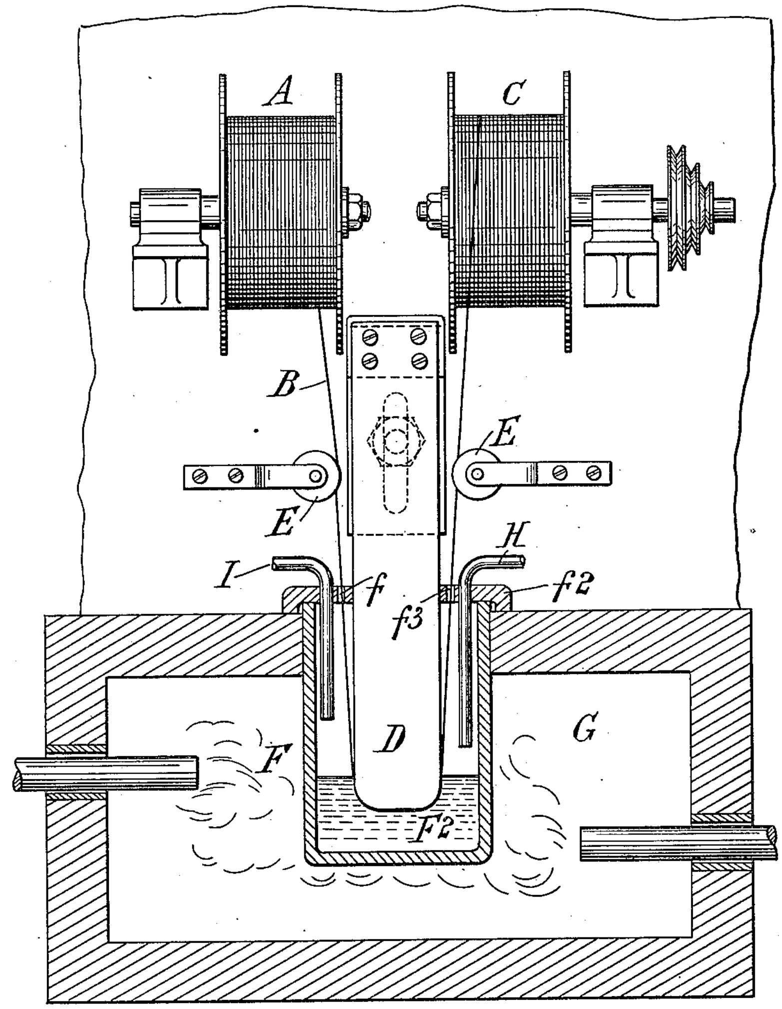

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UNITED STATES PATENT OFFICE.

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PROCESS OF MANUFACTURING LEADING-IN TERMINALS.

No. 825,219. Specification of Letters Patent. Patented July 3, 1906.

Application filed April 10, 1905. Serial No. 254,881.

To all whom it may concern:

Be it known that I, AUGUSTUS CHARLES HYDE, electrical engineer, a subject of the King of Great Britain and Ireland, residing at 3 Queen's Gardens, Ealing, in the county of Middlesex, England, have invented certain new and useful Improvements in Processes of Manufacturing Leading-In Terminals, of which the following is a specification.

In the manufacture of incandescent electric lamps and analogous vessels requiring conductors to be led thereinto and a high vacuum to be retained therein platinum has hitherto been the only conductor that could be satisfactorily sealed into the glass so as to make an air-tight joint.

Various attempts have been made to provide an economical substitute for platinum for this purpose. It is essential that such substitute shall have a coefficient of expansion so nearly that of the glass into which it is to be sealed that when sealed into the glass of incandescent electric-lamp bulbs or analogous vessels an air-tight joint will be formed sufficient to maintain the required vacuum, and cracking of the glass will not take place. It is known, for example, that alloys of nickel with iron, (sometimes called "nickel-steels,") and especially those consisting of either twenty-five per cent. of nickel and seventy-five per cent. of iron or of forty-three per cent. of nickel and fifty-seven per cent. of iron, have a coefficient of expansion such that conductors made of the said alloys can be sealed into glass without the glass cracking or the conductors contracting; but the use of these alloys in place of platinum is open to serious objections. One objection is that unless special precautions, which are expensive and troublesome, be taken a film of oxid is formed on the surface of the nickel-iron alloy while it is being sealed into the glass, and this film prevents the close adhesion of the glass to the metallic surface of the conductor and allows air to permeate between the said metallic surface and the glass, so that the necessary vacuum is not retained. Another objection to the use of such alloys is that frothing of the glass, due to the evolution of gases occluded in the conductor, is liable further to impair the air-tight character of the joints. For these reasons the use of conductors formed of such alloys has not been successful in practice in making joints which are required to be sufficiently tight to prevent leakage and retain a vacuum, the liability to leakage being too great to make conductors formed from these alloys commercially efficient substitutes for conductors of platinum.

Various means have been proposed with a view to overcome the objection due to oxidation. For example, it has been proposed to cover such conductors with a preliminary coating of glass applied *in vacuo*, (see Carolan's specification of British Letters Patent No. 18,255, A. D. 1903,) and it has been proposed to cover such conductors with a tube or sheath of non-oxidizable metal or alloy, (see Thom's specification of British Letters Patent No. 908, A. D. 1890;) but as far as I am aware neither of such means has resulted in the production commercially of a satisfactory substitute for platinum as a conductor.

My invention has for its object to overcome these difficulties and to produce an entirely satisfactory and commercially available substitute for platinum as a conductor for the purposes aforesaid, and I effect this by the following means: I have discovered that hydrogen affects in a remarkable manner the behavior of certain metals and alloys (notably alloys of the platinum group) when molten. I have found that hydrogen promotes the liquidity and mobility of the molten metal or alloy and that in the case of a molten alloy hydrogen enables a larger proportion of the more refractory metal to be used in the alloy than can be used at the same temperature without the mediation of hydrogen, and I have found that in coating a solid metal or alloy with a molten metal or alloy the hydrogen plays the part of a gaseous flux, its action being such that the metal or alloy to be coated is, as it were, wetted by the molten metal or alloy, producing an effect somewhat analogous to that brought about by ordinary fluxes in what is technically known as "tinning." I have also found that hydrogen has the property of cleansing or freeing from occluded gases certain metals or alloys—such, for example, as the aforesaid nickel-iron alloys—and that the difficulty hereinbefore mentioned, due to the evolution of occluded gases while "sealing in" the conductors, can be overcome by heating the said nickel-iron alloys in an atmosphere of hydrogen. Applying these observations to the coating of nickel-iron alloy with a non-oxidizable metal or alloy I have found that if I dip a wire or the like of nickel-iron alloy into a suitable molten non-oxidizable metal or alloy in an atmosphere of hydrogen the conductor produced possesses not only a coefficient of expansion the same as or approximating to that of the glass into which it is to be sealed, but that the said conductor possesses all the essential qualities of platinum for hermetically sealing into glass. I would here observe that in this specification and also in the claims when I refer to a "non-oxidizable" metal or alloy I mean a metal or alloy which will not be oxidized under the conditions pertaining to the sealing of the conductors into glass.

The non-oxidizable coating I prefer is one consisting of an alloy of silver and platinum such that its melting-point is sufficiently lower than that of the nickel-iron alloy to allow of wires or the like of such nickel-iron alloy being immersed in a molten bath of the non-oxidizable alloy without the nickel-iron alloy being melted, the composition which I find most suitable being an alloy containing from thirty per cent. to fifty per cent. of platinum. I may coat the conductors of nickel-iron alloy by introducing them in suitable lengths into a molten bath of the non-oxidizable coating metal or alloy contained in a crucible or equivalent vessel heated in any suitable manner which will keep the bath in the requisite molten condition or I may pass continuous lengths of the conductor through the said molten bath, an atmosphere of hydrogen being maintained in any case in the said crucible or equivalent vessel containing the molten bath during the coating operation. I may, for example, in coating a continuous length of conductor cause the wire or the like to pass from a reel through a suitable opening or passage and under the curved lower end of a guide of any suitable hard and highly-refractory material, such as porcelain or the like, the said guide being mounted so that it can be conveniently raised and lowered in the molten bath. The wire or the like after pasing through the molten bath is led through a suitable opening or passage out of the crucible or vessel containing the bath and may be wound on a receiving-reel. The hydrogen can be admitted as required by a passage and opening or openings in the upper part of the crucible or vessel containing the molten bath or through passages made in the aforesaid refractory guide under sufficient pressure to maintain an atmosphere of hydrogen in the space above the molten bath and also, if desired, in the passages through which the wire or the like is led into and from the said crucible or equivalent vessel, and the hydrogen can be withdrawn as desired by any suitable outlet, opening, and passage, or it may be burned thereat, provided that an atmosphere of hydrogen be maintained in the crucible or analogous vessel.

The thickness of coating applied to the conductors may be regulated by the rate of withdrawal from the bath or by variation in the temperature of the bath, the higher the temperature the thinner the coating.

By the use of hydrogen, as aforesaid, during the coating process I obtain conductors in which there is satisfactory adhesion of the non-oxidizable coating to the nickel-iron alloy and freedom from oxidation and also from frothing and cracking of the glass in the sealing-in operation and an intimate adhesion between the coated conductor and the glass such as to render the said coated conductor a commercially and practically satisfactory substitute for platinum for the aforesaid purposes.

The coating operation in an atmosphere of hydrogen, as aforesaid, may be depended upon to cleanse the wire or the like from occluded gases or the wire or the like can be previously treated to remove the said occluded gas (for example, by previously heating the said wire or the like in an atmosphere of hydrogen) and afterward be passed through the molten coating-bath in an atmosphere of hydrogen, as aforesaid.

The accompanying drawing represents in elevation, partly in section, an apparatus suitable for use in carrying out my invention; but is is only given as an example, and the invention is not limited to the use of such apparatus.

A is a reel carrying the wire B to be coated, and C is a reel to receive the wire when coated.

D is a guide of refractory material, round a groove in the lower curved end of which the wire B passes. The said wire can be guided by rolls E and passed through an opening f in the cover f^2 of the vessel F, containing the molten bath F^2, and out through the opening f^3 at the other side. The vessel F is supported in a furnace G, which may be heated by any suitable means, such as electricity, or a gas-and-air blowpipe arrangement, as illustrated.

H is a pipe by which hydrogen is admitted to the vessel F above the molten bath therein.

I is an outlet-pipe at which escaping hydrogen can be burned.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is—

1. The process of manufacturing leading-in terminals for electric-lamp bulbs and other glass vessels, which consists in coating an oxidizable metallic conductor, having substantially the same coefficient of expansion as glass, by applying thereto a molten non-oxidizable metal, or alloy, beneath an atmosphere of hydrogen through which the con-

ductor passes before entering the said molten metal, or alloy.

2. The process of manufacturing leading-in terminals for electric-lamp bulbs and other glass vessels, which consists in coating a conductor of a nickel-iron alloy, having substantially the same coefficient of expansion as glass, by applying thereto a molten non-oxidizable metal, or alloy, beneath an atmosphere of hydrogen through which the conductor passes before entering the said molten metal, or alloy.

3. The process of manufacturing leading-in terminals for electric-lamp bulbs and other glass vessels, which consists in coating a conductor of a nickel-iron alloy, having substantially the same coefficient of expansion as glass, by applying thereto a molten alloy of silver and platinum, beneath an atmosphere of hydrogen through which the conductor passes before entering the said molten alloy.

4. The process of manufacturing leading-in terminals for electric-lamp bulbs and other glass vessels, which consists in coating an oxidizable metallic conductor having substantially the same coefficient of expansion as glass, by applying thereto a molten non-oxidizable metal, or alloy, beneath an atmosphere of hydrogen through which gas the conductor passes before and after the application thereto of the non-oxidizable metal or alloy.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

AUGUSTUS CHARLES HYDE.

Witnesses:

KENNETH RAYDON SWAN,

FREDK. L. RAND.