

UNITED STATES PATENT OFFICE.

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LEADING-IN CONDUCTOR.

1,273,758.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that we, COLIN G. FINK and WALTER E. KOERNER, citizens of the United States, both residing at East Orange, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Leading-In Conductors, of which the following is a specification.

Our invention relates to leading-in conductors for evacuated vessels, such as incandescent lamps, and its object is to provide a leading-in conductor which is cheap and has greater electrical conductivity than leading-in conductors heretofore generally used. To this end we make the leading-in conductor either wholly or in part of some metal, such as copper, which is a very good conductor of electricity. Since a solid wire of any of the highly conducting metals will shrink away from the glass or similar vitreous material of which evacuated vessels are generally made, we make the leading-in conductor in the form of a unitary composite wire having a shell or sleeve which will make a permanent hermetical seal with the wall of the vessel, a highly conducting interior member usually in the form of a core, and some means, such as one or more layers of some suitable material, such as carbon, for positively preventing adhesion of the shell and the interior member. We prefer to make the wire by rolling and drawing an ingot made up of a shell, a core, and the intervening material, all in the proper relative proportions to produce a finished wire of the desired properties. The ingot is worked and drawn like a solid block of metal and the resulting wire is practically a solid unitary wire. The shell and core may be made of the same or of different metals. In some cases we prefer to make the sleeve of copper and the core of some metal such as brass, which will solder or weld to copper, and thereby facilitate the hermetical sealing of the end of the copper sleeve.

The novel features of our invention are pointed out with particularity in the appended claims but the invention itself will be better understood in connection with the accompanying drawing, in which merely for purposes of illustration, we have shown some of the various forms in which our invention may be embodied, and in which Figure 1 is a transverse section through a seal made

with a unitary composite leading-in wire embodying our invention; Fig. 2 is a transverse section through a seal made with a modified form of leading-in wire embodying our invention; Fig. 3 is a longitudinal section through the base and a portion of the bulb of an incandescent lamp having leading-in wires made in accordance with our invention and hermetically sealed at the outer ends by being soldered to the base; Fig. 4 is a longitudinal section through the stem of an incandescent lamp showing a leading in conductor made in accordance with our invention and comprising two sections, one made of unitary composite wire and the other of solid wire, the two sections being welded together end to end; Fig. 5 is a longitudinal section through the stem of an incandescent lamp having a leading-in wire made of two sections of unitary composite wire knotted together, the knot being embedded in the glass of the seal, and Fig. 6 is a view of the ingot from which the wire is rolled and drawn.

In the particular form of embodiment of our invention shown in Fig. 1, a vitreous body 1, such as the wall or stem of a lamp or similar vessel made of glass or other vitreous material, is hermetically sealed to a wire constructed in accordance with our invention and comprising a shell or sleeve 2, a core 3 and a filler or intervening layer 4, preferably of fibrous or powdered material. The core and the sleeve are preferably made of metals or alloys which will solder or weld easily to solid wires of the same or of other metals. For example, we may use a copper sleeve and brass core, or a brass sleeve and copper core. Where the core is made of brass and the intervening layer 4 is of carbon, chemical reaction may occur, and the carbon should be protected against chemical reaction with the brass by a coating of copper applied to the brass core in any suitable way, as by electroplating or by using a thin sleeve 5 of copper, as shown in Fig. 2. The end of the leading-in conductor may be hermetically sealed in various ways, as by soldering, by fusing the end, or by welding the end to a solid wire of some suitable metal. For example, as shown in Fig. 3, the ends of the leading-in conductors may be sealed by the solder 6 which fastens the leading-in conductors to the base or by solder 7 which fastens the

ends of the leading in conductors to the filaments. In many cases we make the leading-in conductor in three sections, as shown in Fig. 4, the middle one composed of a unitary composite wire constructed in accordance with our invention, and the other two of solid wires 8, of brass, copper or other suitable metal welded to the ends of the composite wire to hermetically seal the sleeve and make good electrical contact with the core. In this form of seal we prefer to embed both the welds 9 in the glass in which the leading-in conductor is sealed. In the immediate vicinity of the welds, the core and shell of the composite wire are firmly attached to each other, but at other points the shell and core are separated by the intervening layer 4 and expand and contract independently of each other. In some cases the leading-in conductor may be made of only two sections, one a solid wire 8 and the other a section of composite wire welded to the solid wire by a weld 9 embedded in the glass of the seal.

In some cases the composite wire may be formed into a loop embedded in the glass of the seal in such a way that the composite wire does not extend all the way through the seal. We may also, as shown in Fig. 5 join a section of composite wire to another section of composite wire or of solid wire by joining the two ends by a square knot 10, which is composed of two loops with their bights in contact, and is preferably drawn tight to hold the two sections so firmly that they can be handled as though they were one piece of wire. In this case the knot is preferably embedded in the glass of the seal.

The ingot from which the wire is drawn may be made in any suitable manner, but preferably as shown in Fig. 6. The ingot comprises a square outer tube 11, preferably of copper and proportioned to give a sleeve of the proper thickness when the wire is drawn down to the desired size, a square core 12 considerably smaller than the bore of the tube, and a suitable filling 13 in the space between the tube and the core. For the filling 13, we prefer to use wood in some form such as very thin veneering wrapped around the core, like paper, or strips of veneering or match wood which have been rolled and thereby rendered very compact.

The ingot is assembled by inserting one end of the core in the sleeve, placing the wood strips in position and sliding the core and wood filling into the sleeve. The ingot is first rolled to anchor the component parts and then heated to char the wood and to drive off any gases produced during charring and is then rolled and drawn. The wire is annealed at suitable intervals, preferably but not necessarily in an atmosphere of hydrogen. The ingot is worked and

drawn like a solid wire, the core and the tube sharing the strains incident to the drawing.

The shell or sleeve 2 may be made of various metals by which we mean alloys and mixtures of metals, as well as the elementary metals, provided the metal adheres to or makes a clinging union with glass when sealed into it. A metal, such as copper, which is highly conductive and has a coefficient of expansion much higher than that of glass can be used for the sleeve, provided the sleeve is properly proportioned. We have found that if the sleeve 2 is made of copper and has, for example, an external diameter of ten one thousandths of an inch and an internal diameter of nine one thousandths of an inch, it is practically non-rigid and so flexible and easily distorted that it cannot be used satisfactorily in a factory as a leading-in conductor, but it will make a permanent, hermetical seal with the glass commonly used for incandescent lamps, particularly if it is coated with some suitable material such as sodium borate or zinc borate before it is sealed into the glass. The copper appears to make such a close adherent joint with the glass that the contractile force exerted by the copper as the joint cools is insufficient to pull it away from the glass when in the form of a thin walled sleeve, though it will pull away if the walls of the sleeve are too thick.

It is not only very difficult to handle or use a seamless tube of the size of the sleeve 2, but also very difficult to draw it in the usual way, as the walls cannot be made of uniform thickness and are not strong enough to stand the strain of drawing, but in accordance with our invention we overcome these difficulties by using a substantially rigid ductile core. Unless there is an intervening layer of carbon or the like between the shell and core, the rolling and drawing of such a wire will cause the shell 2 and core 3 to become so tightly fitted and adhere to such an extent that the sleeve pulls away from the glass even though the sleeve and core are loose enough to permit slight leakage of air between them and are made of dissimilar metals which will not weld to each other. We therefore, provide the filling or layer 4 which is so firmly gripped or held that the composite wire is practically an integral solid wire; yet the core and sleeve do not adhere sufficiently to impair the seal. The filling 4 may be composed of any material which at the temperatures attained during the annealing and drawing is infusible, and does not exert any cementing action between the core and shell. As an example of suitable materials, we may use a refractory metal oxid which is not reduced to metal by the annealing and working of the wire, as for example,

silica, manganese dioxid, calcium oxid or chromium oxid; we may use a powder made of metal which will not cement the sleeve and core, as for example, powdered cast iron or steel, for a copper sleeve and a copper core; we may use material such as plaster of Paris or china clay; but in most cases we prefer to use carbon in some form such as graphite, or preferably the form of carbon produced by heating and carbonizing a paper or wood filling between the core and shell of the ingot.

The form of wire which we at present prefer is composed of a copper sleeve and a solid copper core separated from each other by a filler or layer of carbon or graphite.

The sleeve and the core may be made of many metals, alloys and mixtures of metals and alloys and the filling 4 may be of any material that will prevent adhesion of the adjacent members to the wire.

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

1. A unitary composite wire suitable for a leading-in conductor for hermetically sealed glass vessels and comprising a thin walled, substantially non-rigid sleeve of a base metal having the property of making a permanent, clinging, hermetical seal to glass, a substantially rigid core of metal having a thermal coefficient of expansion higher than that of the glass, and an intervening layer of non-adherent, heat refractory material normally gripped between said sleeve and said core to prevent relative longitudinal displacement of said core and said sleeve and to impart to said sleeve substantially the rigidity of said core.

2. A leading-in conductor for glass vessels comprising a metallic core of good electrical conductivity and of substantial rigidity embedded in heat refractory non-adherent, granular material and a sheath of base metal having the property of making a permanent, clinging, hermetical seal with glass and inclosing and firmly gripping said granular material to make said core, filler and sheath into a substantially unitary, composite wire having the rigidity of said core, said sheath having walls so thin that the sleeve is substantially non-rigid and the contractile force exerted by said sleeve is insufficient to break the joint between the sleeve and the glass.

3. A leading-in conductor for evacuated vessels of vitreous material comprising a substantially non-rigid, copper sleeve with walls thin enough to make a permanent, hermetical seal with the material of the vessel, a highly conductive, substantially rigid, metallic core inside said sleeve and an infusible granular filler between said core and sleeve for preventing adhesion or relative longitudinal

movement of said core and sleeve and mechanically supporting said sleeve to impart to it substantially the rigidity of said core.

4. A body of glass having therein a unitary composite wire having a surface sheath of base metal capable of making a clinging, hermetical seal with glass and thin enough to prevent rupture of the joint between said sheath and the glass, a substantially rigid metallic core, and a layer of heat refractory material surrounding said core and supporting said sleeve to impart to it the rigidity of the core.

5. A leading-in conductor for evacuated vessels comprising a unitary composite wire having a substantially non-rigid, thin-walled, tubular sleeve of a base metal having a coefficient of expansion greater than that of glass and the property of making a permanent, clinging, hermetical seal to glass, a substantially rigid metal core, an intervening layer of infusible, non-adherent material between said sleeve and said core and normally gripped to prevent relative longitudinal displacement of said sleeve and core and to impart the rigidity of said core to said sleeve, and a solid wire welded to the end of said composite wire to hermetically seal the end of said sleeve.

6. A leading-in conductor for electric lamps comprising a tubular sleeve of base metal thin enough to be adapted to make a permanent hermetical seal with the glass of the lamp, and a core of metal having a coefficient of thermal expansion greater than that of the glass and firmly gripped by said sleeve to make a substantially unitary structure, said core being non-adherent to the sleeve and composed of a metallic material having a melting point different from that of said sleeve and capable of soldering hermetically to said sleeve, said sleeve and core being discrete where the sleeve is sealed to the glass but soldered together at another point to hermetically seal said sleeve.

7. A unitary composite wire suitable for leading-in conductors for evacuated vessels and comprising a sleeve of copper having walls so thin that the sleeve is substantially non-rigid and will make a permanent, clinging, hermetical joint to glass, a substantially rigid brass core with a surface layer of copper, and a non-adherent carbonaceous layer between said core and sleeve for imparting to said sleeve substantially the rigidity of said core.

8. A unitary wire comprising a sleeve of copper proportioned to maintain a permanent hermetical junction with glass, a concentric layer of carbon adjoining the inner wall of said sleeve, a brass core, and a heat refractory protective shell between said core and said layer of carbon.

9. An incandescent lamp comprising a bulb and a leading-in conductor having a tubular sleeve of base metal with a coefficient of expansion greater than that of the
5 bulb and proportioned to make a permanent hermetical junction with said bulb and a non-adherent conductive core firmly gripped in said sleeve to form a unitary composite

wire extending through the wall of said bulb and hermetically and electrically joined to a 10 current carrying member of the lamp.

In witness whereof, we have hereunto set our hands this 17th day of September, 1915.

COLIN G. FINK.
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