

1,271,320.

Fig. 1.

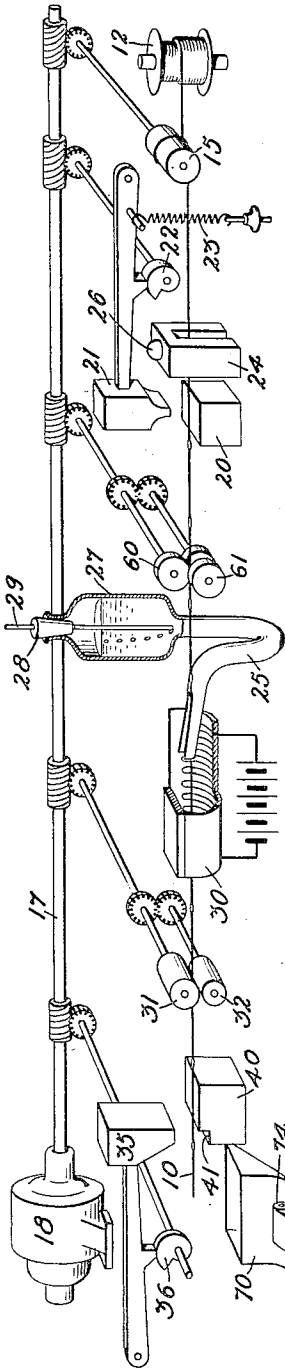


Fig. 3.

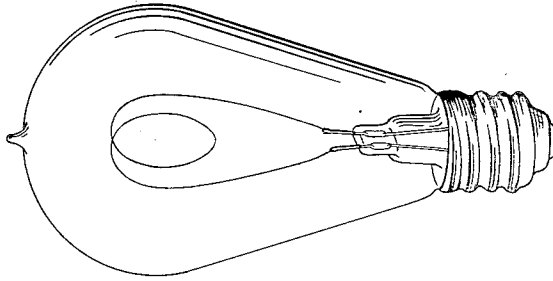


Fig. 4

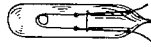
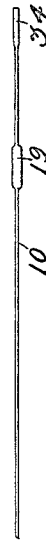


Fig. 2.



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UNITED STATES PATENT OFFICE.

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ELECTRIC CONDUCTOR.

1,271,320.

Specification of Letters Patent.

Patented July 2, 1918.

Application filed September 11, 1916. Serial No. 119,470.

To all whom it may concern:

Be it known that I, WILLIAM G. HOUSKEEPER, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Electric Conductors, of which the following is a full, clear, concise, and exact description.

10 This invention relates to improvements in the formation of seals between the walls of vitreous vessels such as commonly used for incandescent lamps, mercury arc rectifiers and similar apparatus, and leading-in conductors, and particularly to an improved method for producing conductors efficacious in making such seals.

In providing a suitable conductor for this purpose, there are several essential features to be considered, namely: the melting point of the conductor must be higher than that of the glass or vitreous material into which it is to be sealed; the conductor should contain the least possible amount of gas; the conductor should be high in conductivity; the coefficient of expansion of the conductor should be as near as possible that of glass or the material into which it is to be sealed, or more particularly the actual difference in expansion and contraction of the conductor and material into which it is sealed at the sealing-in point must be as small as possible; and the conductor material should be cheap.

35 Platinum wire probably comes nearer meeting all of these requirements, except as to cheapness, than any other metal or alloy. Its fitness for this purpose is evidenced by its wide and general usage.

40 The principal object of this invention is the production of a metallic leading-in conductor such that when it is sealed into glass or other vitreous material, an air-tight seal will be effected between the conductor and the surrounding material which will not be affected by changes of temperature. This feature, while applicable to all kinds of leading-in conductors, including platinum, is of greatest importance in its application to leading-in conductors composed of baser metals, such as copper, nickel, iron, brass, etc., since it admits of the use of conductors of much less cost than the platinum conductors used heretofore.

This treatment, briefly, may consist of flattening that portion of the conductor leading through the glass of vitreous wall, and preferably covering the conductor with a coating of a borate and then fusing the borate onto the conductor. Any of the above mentioned metals may, however, be sealed into the glass used in the manufacture of incandescent lamps, mercury arc rectifiers, vacuum arresters, etc., after being flattened and coated with a flux, such as sodium borax ($\text{Na}_2\text{B}_4\text{O}_7$), forming a thin coating on the conductor. Potassium and lithium borates could also be used or any of a variety of other fluxes, and the invention is not restricted to the use of sodium or other borate. While lead glass is generally used in the manufacture of incandescent lamps, the present invention is not restricted to use therewith, but is capable of use with any glass or other vitreous material. For example, leading-in conductors of one metal would cooperate better with glass having certain characteristics, while conductors of another metal might cooperate better with glass of somewhat different characteristics; the object being in all cases to obtain as effectual a seal as possible.

This invention will be clearly understood from the following description and accompanying drawings, in which like reference characters are used throughout for indicating similar parts, and in which Figure 1 is a diagrammatic view of apparatus for treating and preparing the leading-in conductors; Fig. 2 is an enlarged view of a leading-in conductor as prepared ready for sealing in; Fig. 3 is a view in perspective of an incandescent lamp illustrating the manner of sealing the flattened portion of the leading-in conductor into the glass chamber; and Fig. 4 is a view of a miniature lamp with flattened leading-in conductors sealed therein.

In Fig. 1, the several cooperating movable parts of the apparatus or mechanism are shown direct-connected by means of shafts and gears, so that exact synchronism is maintained at all times between these parts. Such an arrangement, however, is not essential to the successful use of this process and many modifications within the spirit of the invention, will be readily apparent to those skilled in the art.

The conductor 10, which may be of copper, nickel, iron, brass, silver, platinum, etc., as it is withdrawn from spool 12, supported in any suitable manner, passes once around a gear-driven mandrel 15, thence across the face of a highly polished anvil 20, thence through an opening in the end of a siphon-shaped tube 25, and thence through an electric furnace 30, and thence across a cutting block 40 where the conductor is cut to the required length unless it is desired to retain the conductor temporarily in continuous form.

The mandrel 15 is gear-connected to a main driving shaft 17 which is driven at a uniform and constant speed by a suitable motor 18. The purpose of mandrel 15 is to relieve the tension on the conductor as it is withdrawn from the spool and to insure a steady and uniform forward travel of the conductor. The conductor 10 is drawn from mandrel 15 across the anvil 20 and through the furnace 30 by means of gear-driven rollers 31 and 32, which are gear-connected to the main driving shaft 17 and are adapted to make frictional engagement with the conductor 10. One or both of the rollers are preferably faced with rubber. As the conductor leaves the mandrel 15, it passes over anvil 20, where it is acted upon at regular predetermined intervals by a cam-actuated hammer 21, which is hinged at one end and adapted to be actuated by cam 22 which is also gear-connected to the main driving shaft 17. The force of the hammer 21 may be increased by a spring member 23, one end of which is secured to the frame of the machine while the other end is connected to a pin projecting from the hammer arm. On a suitable support 24 and beneath the hammer arm is a buffer 26, preferably of rubber, for preventing the hammer 21 from resting on the anvil 20 or the conductor passing between the hammer and anvil, but adjusted so as not to prevent the hammer from striking the conductor when the cam 22 allows the hammer to fall. It will readily be seen that as the motor 18 rotates and draws the conductor across the face of the anvil, the dimensions of the flattened portion, as shown at 19 (Fig. 2), can be governed by the shape and size of the striking face of the hammer and the force with which the hammer strikes the conductor. It is desirable to flatten the conductors at the sealing-in point so that the width thereof is relatively great as compared with the thickness.

After the conductor is flattened, it is drawn through a suitable flux, preferably borax ($\text{Na}_2\text{B}_4\text{O}_7$) in solution. The flux is contained in a vessel 27 having a siphon-shaped outlet tube 25, the orifice of which is slotted so as to permit of the conductor passing therethrough. In the top of ves-

sel 27 is a stopper 28 having an air inlet tube 29 extending therethrough and into the borax solution for maintaining the solution at the proper level in the slotted portion of the siphon shaped tube 25. The end of tube 25 extends into the furnace 30 a sufficient distance, and the furnace is kept sufficiently hot to keep the borax solution, which comes in contact with the conductor 10, boiling. The boiling solution aids in cleaning the conductor by dissolving any grease and foreign matter which may adhere to it. In the arrangement shown, the borax is applied continuously, but this is not always essential, nor is it always necessary that the flux be in the form of a solution; more uniform results are, however, obtained when the flux is applied as a solution and fused.

The conductor, upon leaving the orifice of the tube 25, passes through the furnace 30, which may be of any suitable length and may be kept at any desired temperature. The heat from the furnace eliminates the moisture from the flux and fuses it onto the conductor, thereby forming a thin non-oxidizable coating. The flux also dissolves the metallic oxides on the conductors when brought to red-heat in the furnace 30.

From the furnace the conductor 10 is drawn through between the gear-driven rollers 31 and 32, as hereinbefore described, and then if it is to be at once cut into lengths passes across the face of a cutting block 40, where the conductor is cut to required length by means of drop hammer 35, which is adapted to be actuated by a cam 36 gear-connected to the main driving shaft 17. The position of drop hammer 35 is so adjusted that when the cam 36 rotates and allows the hammer to fall, the conductor 10 is severed across the upper left-hand edge of block 40, and the end of the conductor may be flattened, if desired, by the force of the hammer against an offset portion 41 of block 40. The flattened end portion is best shown in Fig. 2 at 34. The block 40 may be omitted if it is desired to furnish the conductor in continuous lengths instead of having it cut in short pieces. One end of each conductor is generally flattened only when used in connection with tungsten or tantalum filaments, in which case the flattened end portion of the conductor is bent over and the filament connected to the turned-over part of the conductor.

So much of the apparatus as hereinbefore described is especially useful for preparing leading-in conductors of low current-carrying capacity, such as used in miniature or switchboard lamps, where small gage conductors may be used though it may also be used for larger gage conductors, if desired. However, for preparing leading-in conductors of relatively high-current carrying capacity and of larger gage, such as used

in high voltage lamps and mercury arc rectifiers, the following additional steps in the process may be advantageously employed.

In preparing the larger sizes of wire, it is also desirable to flatten the conductors at the sealing-in point so that the width thereof is relatively great as compared with the thickness, and in so doing the width of the flattened portion becomes, in some cases, greater than is desirable, also the edges of the flattened portion are sometimes slightly irregular. These irregular or ragged edges may be cut away by employing a set of shears 60 and 61 having cutting edges properly adjusted and adapted to receive and shear off any portions of metal in excess of the desired width. The shears 60 and 61 are also gear-driven from the main driving shaft.

There is another feature to be considered in the preparation of the larger sizes of conductors, when such conductors are coated with a flux, and that is means for cleaning the ends of the conductors in order that a satisfactory union may be effected between the conductor and the lamp filament or other inside connections, and also to permit of a satisfactory union between the conductor and the outside connecting wires. This is accomplished by providing means for directing a miniature sand-blast against the conductors near each end and for rotating the conductors in front of the sand-blast orifice. The means for performing this operation will now be described. As the conductors are cut to the required length, they fall into a V-shaped receiver 70 having a slotted opening in the bottom thereof through which the conductors pass. Beneath the receiver 70 is a smooth stationary cylindrical member 71 whose axis is parallel with the slot in the receiver. A traveling belt 72 passes around rotatable pulleys 73 and 74, and is driven by a suitable pulley 75, which may be driven in any desired manner. The belt, in passing around pulleys 73 and 74, travels in very close proximity to a portion of the curved surface of cylinder 71. The conductors as they leave the receiver 70 are engaged by belt 72 and rotated between the belt and cylinder with the ends of the conductors projecting outwardly and past the outlets of two miniature sand-blasting devices 76 and 77. As the conductors are rotated past the sand-blasting orifices, the ends of the conductors are cleaned so as to permit of being readily soldered or joined to other wires.

Of the several base metals copper has

been found the most satisfactory for leading-in conductors. Iron is not as satisfactory as copper or nickel, because it has a tendency to burn during the coating and sealing-in operations although satisfactory seals have been obtained with iron conductors treated with borax. Nickel is somewhat objectionable on account of the commercial grades varying considerably in composition and containing large quantities of gas. However, most of the occluded gas may be liberated by heating the conductors before sealing them in, and unless the gas is liberated before the conductors are sealed in, some of the gas will be driven off during the sealing-in process and bubbles will be formed in the vitreous material around the conductor to such an extent as to cause imperfect seals. Even though the coefficient of expansion of copper is considerably higher than that of platinum and of ordinary glass, copper when properly treated is fully as satisfactory for leading-in conductors as platinum. When borax is fused onto copper conductors, there results a coating of sodium copper borate, which, upon melting during the sealing-in process, either dissolves in the surrounding vitreous material or makes good contact therewith. Observations which have been made of conductors treated in this manner and sealed into glass, indicate that the conductors and glass are brought together in far greater intimacy than has heretofore been possible.

What is claimed is:

1. A process for forming leading-in conductors which consists in flattening selected spaced portions of a conductive wire, passing the wire through a boiling flux solution, heating the wire to a sufficient temperature to remove the water from the flux solution adhering thereto and to fuse the remaining flux onto the wire, and separating said wire into lengths each of which includes one of said flattened portions.

2. A process for forming leading-in conductors which consists in flattening spaced portions of a conductive wire, trimming the edges of said flattened portions, coating said wire with a fluxing agent, fusing said fluxing agent onto the wire, separating said wire into lengths each of which includes one of said flattened portions, and removing the fused fluxing agent from the ends of each length.

In witness whereof, I hereunto subscribe my name this 8th day of September, A. D. 1916.

WILLIAM G. HOUSKEEPER.