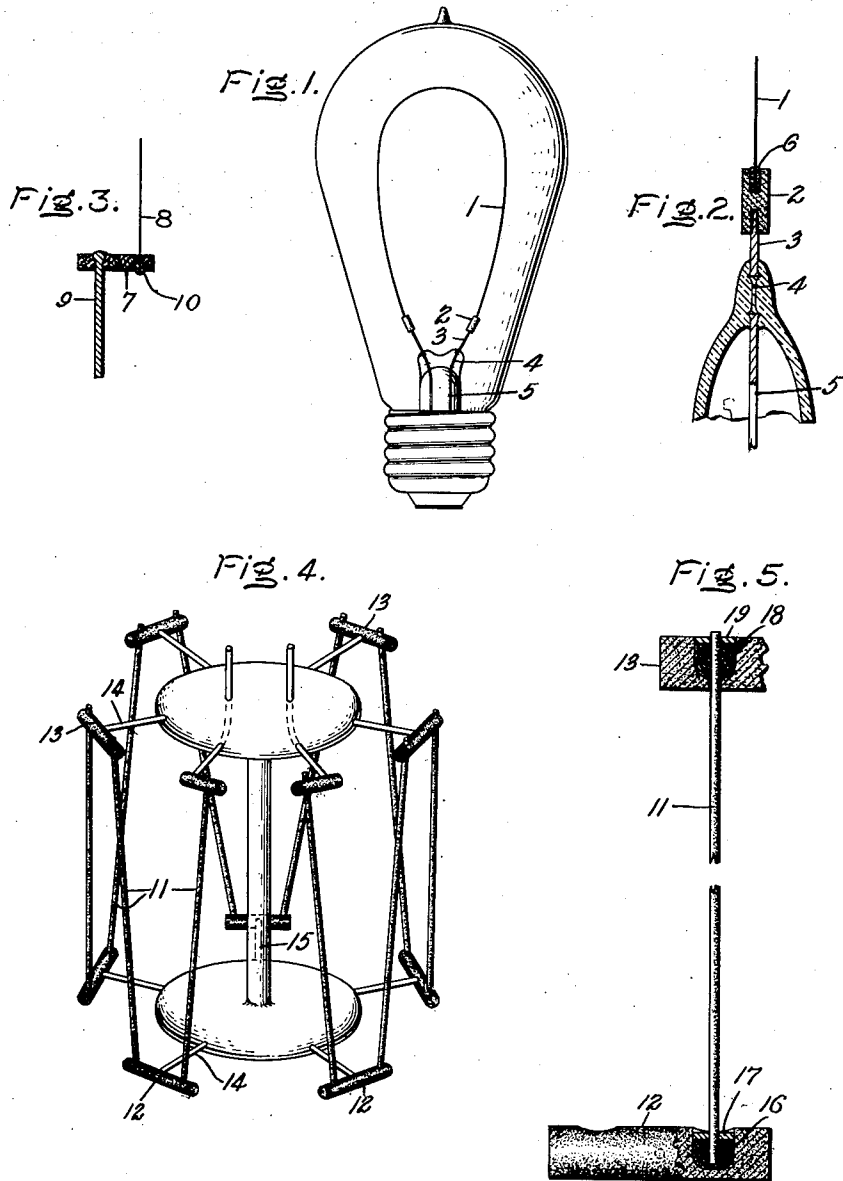


A. O. APPELBERG.  
 TERMINAL FOR INCANDESCING CONDUCTORS.  
 APPLICATION FILED JULY 2, 1906.

998,067.

Patented July 18, 1911.



WITNESSES:

*Samuel Oxford*  
*Margaret C. Hooley*

INVENTOR:

*Axel O. Appelberg,*  
 By *Albert G. Davis*  
 Att'y.

# UNITED STATES PATENT OFFICE.

AXEL O. APPELBERG, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

TERMINAL FOR INCANDESCING CONDUCTORS.

998,067.

Specification of Letters Patent. Patented July 18, 1911.

Application filed July 2, 1906. Serial No. 324,390.

To all whom it may concern:

Be it known that I, AXEL O. APPELBERG, a subject of the King of Sweden, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Terminals for Incandescing Conductors, of which the following is a specification.

This invention relates to terminals or supports for refractory metal conductors and comprises a novel arrangement of such conductors and supports.

It also comprises (as applicable to such an arrangement and for other purposes) pure metal terminals pressed or molded from powdered material and used to hold a filament of a lamp or a heater of a furnace, or used in any type of electrical apparatus where an incandescing conductor must be maintained in a predetermined position while hot.

The terminal may consist of the same metal as the incandescing conductor or of some metal which does not chemically react therewith and which is suitably refractory at the temperature at which the conductor operates.

My invention is applicable to pressed or molded terminals of various metals as applied to incandescing conductors of the same or other metals, but in order that my invention may be readily understood I have hereinafter described constructions in which the terminals or supports, and also the incandescing conductors, are of tungsten.

Figure 1 shows an incandescent lamp provided with a tungsten filament and pressed tungsten terminals. Fig. 2 is a sectional elevation of one form of terminal. Fig. 3 is a section of a modified form of terminal. Fig. 4 is a diagrammatic representation of a plurality of incandescent conductors connected in series by a plurality of pressed terminals. Fig. 5 is a detail of the joints used in the construction shown in Fig. 4.

Referring to Figs. 1 and 2, a tungsten filament 1 is connected to a pressed or molded terminal or block 2 of tungsten. The latter is secured in any suitable way to the metal conductor 3, which may be of copper, and a platinum sealing wire 4 and a copper lead wire 5 complete the means for introducing current into the tungsten fila-

ment as connected with the tungsten block 2 by being introduced into a cup-shaped depression in the block and surrounded with tungsten powder 6 packed tightly around the filament. I find that such a joint will hold the filament in place and that the joint becomes stronger with use because of hardening or sintering of the metal powder. I have illustrated the tungsten block 2 as screw-threaded to the copper conductor 3 but various other methods of attachment may be used. If desired, I may fuse the copper into the tungsten block and thereby make a welded joint, or I may use a binding material which does not disintegrate at the relatively low temperature of the tungsten block.

Fig. 3 shows an alternative means for connecting the filament to the lead wire, which possesses some advantageous features. In this case, the tungsten block 7 is arranged transversely of the filament 8 and is pierced with two conical holes. In one of these, a platinum lead-wire 9 is introduced and then fused down at the end to completely fill the conical hole in the block and rigidly secure the lead-wire to the block. The filament 8 passes through the other hole of the block and may be rigidly secured therein by fusing down a globule of platinum 10 around the filament. In this construction, the block is of sufficient size and radiating power to prevent the development of an excessive temperature therein, and is, therefore, cool enough to prevent the vaporization of the platinum, even though the filament is operated at a temperature much higher than that at which platinum vaporizes.

In Fig. 4, I have illustrated a plurality of filaments or rods 11 disposed in a zig-zag form about a suitable supporting means. I desire this figure to be considered merely as a diagrammatic representation of an arrangement of incandescing conductors which might be used in a lamp or in other types of electrical apparatus. I have illustrated each of the conductors 11 as electrically connected and supported at the bottom by metal blocks 12, and similarly connected and supported at the top by blocks 13. These blocks are supported by platinum or other rods carried by a standard 15 of glass or other insulating material. It will be apparent that these blocks may be supported in a great

variety of ways and that the whole apparatus may be variously modified and still come within the scope of my invention as defined by the claims appended hereto.

5 Fig. 5 shows one good way of connecting the rods or filaments 11 to the upper and lower supporting blocks. In the lower block 12, I provide a depression filled with refractory powder 16, in which the incandescing  
10 rod is embedded. If desired, a bushing 17 may be pressed down tightly on the top of the powder to insure a good initial contact between the rod and the block 12. I find that after the apparatus has been run for  
15 some time the powder bakes or sinters together into a compact, somewhat dense body and grips the rod very tightly. A somewhat similar joint is made in the upper block 13 by excavating a cup-shaped hole 18  
20 through which the rod 11 passes and in which the rod is in contact with metal powder held firmly in place by a bushing 19.

If I use a tungsten incandescing conductor, I may use tungsten blocks or terminals  
25 and a packing of tungsten powder. If I use tantalum incandescing conductors, I may make the other parts of tantalum. It will be understood, however, that my invention embraces the use, with a refractory metal conductor, of pressed or molded terminals of  
30 the same metal or of another refractory metal which does not chemically react on the incandescing conductors and is otherwise stable at the temperature of operation.

35 The pure metal blocks or terminals above described may be made by compressing pure metal powder into the desired shape, but for convenience in manufacture I sometimes add a small quantity of binding material  
40 such as glucose dissolved in water, thereby obtaining a mixture which is easy to mold and compress into the desired form. The addition of glucose introduces a very small amount of carbon into the mixture; and  
45 although the proportion of carbon to the metal is small, nevertheless I prefer to add to the mixture some reducible compound which will subsequently combine with the carbon and yield a volatile product. An  
50 oxid of the refractory metal is suitable for use as the reducible compound and should be added in the proportion of about 5 parts by weight when the proportion of glucose is approximately 2 parts by weight.

55 The reduction of the oxid may be effected by heating the pressed-up blocks to the temperature at which reduction occurs, or the material may be mounted in the lamp, furnace or other apparatus and there given a  
60 preliminary heat run before being put into regular operation.

It should be noted that when the apparatus is finished, no carbonaceous material remains at the junction between the intensely  
65 hot incandescing conductor and the other

parts of the electrical circuit, that the terminals are of substantially the same refractive power as the hottest part of the apparatus and consequently will resist disintegration at any temperature attainable in the 70 device.

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

1. The combination with an incandescing conductor of refractory metal, of a heat  
75 radiating terminal therefor consisting of a body of compressed refractory metal powder.

2. The combination with a refractory conductor of pure metal, of supporting means therefor consisting of a block of compressed  
80 refractory powder.

3. A terminal for a refractory conductor, consisting of metal powder consolidated into a coherent body by pressure.

4. In an electrical apparatus, the combination with a refractory conductor, of a less  
85 refractory conductor, and a block of compressed metal powder electrically connecting said conductors.

5. A heat radiating support for a tungsten  
90 conductor consisting of a coherent body of compressed tungsten powder.

6. The combination with an incandescing conductor of refractory metal, of a heat radiating support therefor consisting of a  
95 body of compressed refractory metal powder, and a current conductor by which current is furnished to said incandescing conductor through said heat-radiating support.

7. The combination with a refractory  
100 metal conductor, of a refractory metal terminal therefor, and a packing of metal powder between said conductor and said terminal.

8. In an electrical apparatus, a tungsten  
105 resistance member and a block of compressed tungsten powder supporting said conductor and establishing an electrical connection therewith.

9. The combination with a refractory  
110 metal conductor, of means for establishing an electrical connection therewith, said means consisting entirely of compressed refractory metal.

10. In an electrical apparatus, the combination of a tungsten resistance member, a  
115 block of compressed tungsten powder serving as a support for said member, a packing of tungsten powder between said resistance member and said block, and a conductor establishing electrical connection with said  
120 block.

11. In an electrical apparatus, the combination of a refractory metal resistance member and a rigid support for either end of  
125 said member, said supports each comprising a block of compressed metal powder with a socket containing the end of said resistance member packed about with dry metal  
130 powder.

12. A tungsten resistance stick held in a tungsten block by a sintered residue of dry powdered tungsten.

13. The combination of a resistance stick of compressed tungsten powder, rigidly mounted blocks of compressed tungsten powder engaging said stick at either end, and a packing between said stick and blocks consisting of a sintered residue of dry metal powder.

14. The combination of a suitable standard, a plurality of sets of supporting devices radiating from said standard, and a plurality of filaments arranged adjacent to said

standard and carried therefrom by said devices, devices of at least one of said sets comprising a suitable current connection between adjacent filaments and a part extending transversely with reference to said connection and to the longitudinal direction of the filaments by which the connection is secured to the standard.

In witness whereof, I have hereunto set my hand this 30th day of June, 1906.

AXEL O. APPELBERG.

Witnesses:

EDWARD WILLIAMS, JR.,  
ARBA B. MARVIN, JR.