(No Model.) 2 Sheets—Sheet 1.

C. SEEL.

ELECTRIC LAMP FILAMENT.

No. 382,560. Patented May 8, 1888.

Fig. 2.

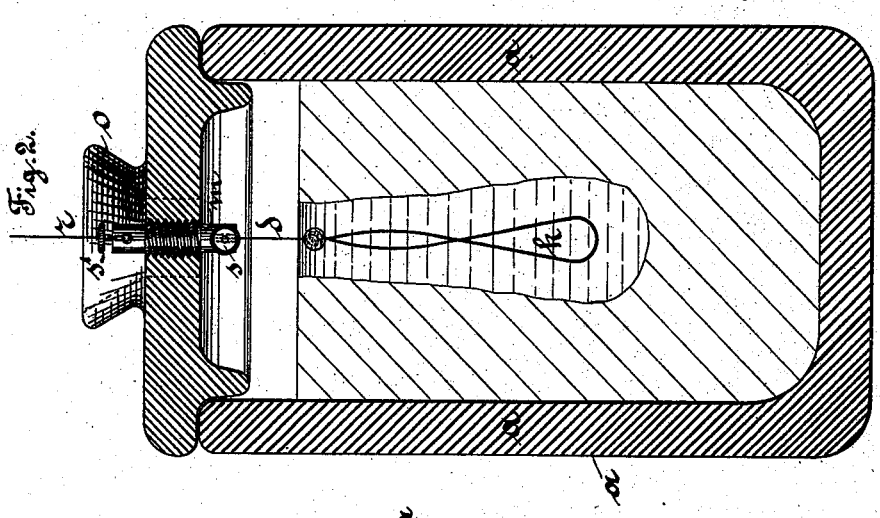
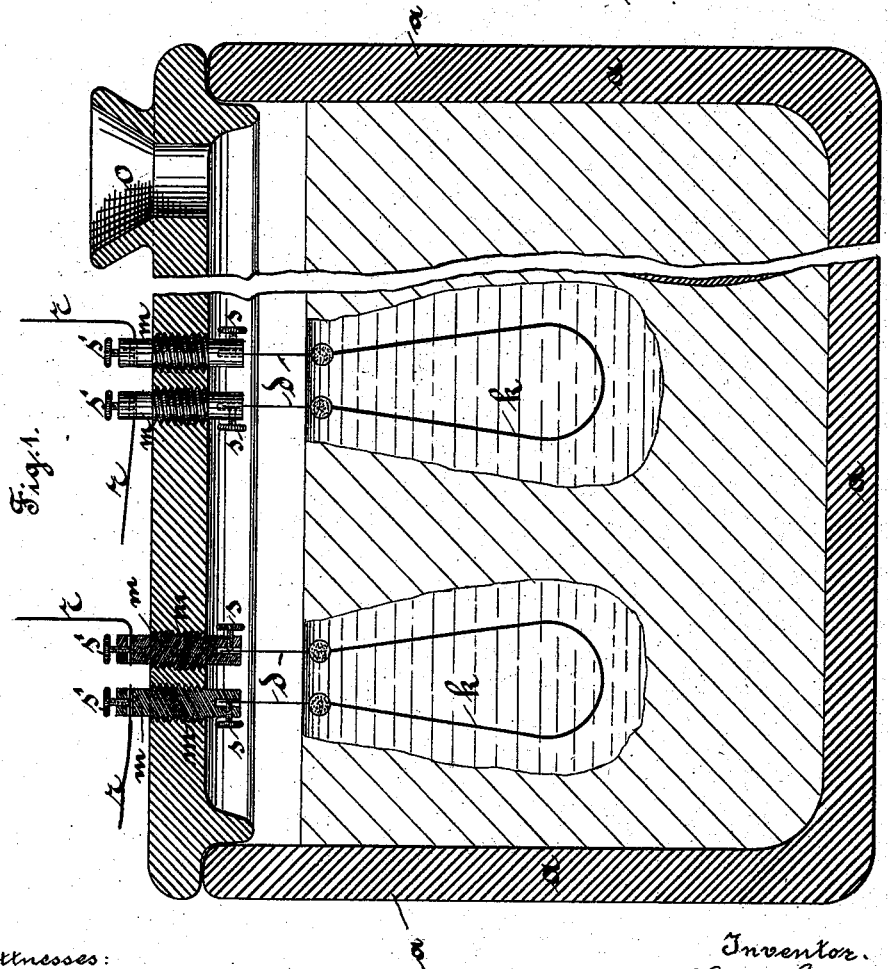


Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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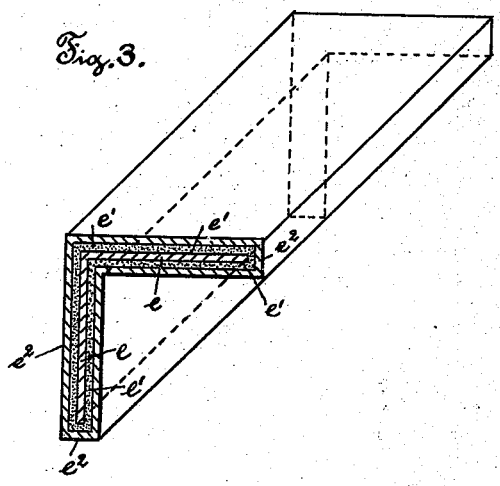
Fig. 3.



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UNITED STATES PATENT OFFICE.

CARL SEEL, OF BERLIN, GERMANY.

ELECTRIC-LAMP FILAMENT.

SPECIFICATION forming part of Letters Patent No. 382,560, dated May 8, 1888.

Application filed June 16, 1886. Serial No. 205,340. (No model.)

To all whom it may concern:

Be it known that I, CARL SEEL, a subject of the Emperor of Germany, residing at Berlin, in the Kingdom of Prussia, in the German Empire, have invented some new and useful Improvements in Electric Incandescent-Lamp Filaments, of which the following is a specification.

My invention relates to improvements in electric incandescent lamps, and the characteristic peculiarity of it is that the incandescent threads are formed of three annular layers, of which the innermost is the real carbon thread, which is saturated with mineral salts and a gum, and is thus provided with a non-conducting silicate or coating of a salt that melts during the carbonization. This coating not only protects the carbon thread from burning during the carbonization and excludes the air from it, but it also gives the carbon thread a smooth surface, on which the third layer, which is necessary for the adjusting of the resistance of the filament, is deposited in a finely-divided and uniform manner. This third layer is composed of carbon, which is precipitated in a certain manner, a paraffine bath being used for the purpose, as will be seen hereinafter.

It has been customary hitherto not to adjust the resistance of the filaments before inserting them in the lamps; but in the present invention the carbon threads are ready prepared before being connected and inserted in the lamps. They are, besides, tested as to their resistance, and the current resistances are equalized when they differ. To equalize these resistances is the purpose of the present improvements. It is already known that the equalization of these differences in resistance is effected by baths of carbonaceous gases or fluids; but in these baths there is one great drawback—namely, that when, in consequence of a rise of temperature, the particles of carbon are deposited on the charcoal threads a constant current sets in in the baths, and as there are always particles of oxygen in these baths all the oxygen contained in them gradually operates on the charcoal threads and deteriorates their quality. The bath of solid material, which is used in this case and considered new, removes this difficulty entirely, for when the threads are steeped in such a solid bath for the purpose of preparing them only those parts that are nearest to the threads become liquid or vaporous, and from these parts of the bath alone, which are limited as much as possible, does a depositing of carbonaceous particles on the threads take place. All currents in the bath itself are thus prevented, for only those parts of the bath that are nearest to the threads become fluid or vaporous, whereas the more distant and unliquefied parts of the bath form in a certain measure a closely-encircling vessel or basin. Paraffine or naphthaline is used for such baths, and as they are carburets of hydrogen, hardening at the usual temperature and free of oxygen, the bath is divided during the operation into two zones—into a solid and into a liquid or a vaporous envelope that closely encircles the charcoal threads, the resistance of which has to be equalized.

In the accompanying drawings is shown in Figure 1 a vertical longitudinal section of a flashing-vessel. Fig. 2 is a vertical cross-section of the same.

The method of preparing the threads is as follows: Wood, silk, cotton, or any other vegetable fiber is steeped in a solution of mineral salts and a gum, consisting of a mixture of a silicate or salt, gum-senegal, and caustic soda, and then rolled firmly between warmed grooved rollers. It is rolled, besides, in the shape of angle-iron, and thus combines the advantage of great resistance with that of being a many-edged material of small diameter. The sharp edges of a charcoal thread can shed, as experience teaches, a much brighter, whiter light than smooth surfaces do, and therefore always the angle-iron shape is the most advantageous for illumination. When this operation is finished, the thread is carbonized in the usual way after any of the well-known methods. After carbonizing, the charcoal thread is placed in vessel *a*, a cross-section of which is represented in Figs. 1 and 2. The cover of this vessel is made of an insulatory material, and is provided, as may be seen in the design, with metal insertion-pieces *m*, each two of which have two binding-screws, *s s'*, for securing both the charcoal threads *k* and the conducting-wires from an electric source. After having inserted the charcoal thread *k*, which has to be tested as regards resistance, in the insertion-pieces, (as design shows, several threads

can be stretched in at the same time, according as the size of the vessel permits,) the vessel is filled through the hole *o*, either with paraffine or naphthaline, so full that the charcoal threads are completely immersed. The paraffine is then allowed to cool and stiffen, and the wires *r r* are connected with the electric circuit, and a resistance-meter is included in the circuit, so that the resistance can be read off at any time. The electric current that passes through the charcoal thread in this way heats it, and the parts of the paraffine close to it become liquid and those closest to it even vaporized, and then, in consequence of the heating of the particles of carbon, are deposited on the thread, and owing to this the resistance of the latter decreases gradually. The parts of the paraffine farthest removed from the charcoal threads remain solid and form, as already mentioned, an envelope for those parts of the paraffine that are liquid and limit the liquefying of the material as much as possible. The current of the liquid caused by the rise of the temperature is thus restricted to a minimum. When the carbon thread has been lowered to the right degree of resistance, the electric current is cut off and the thread is ready for use. When the paraffine has been made perfectly liquid by heating it, the carbon thread can be drawn out. It is then cleaned by some suitable means of the paraffine particles attached to it—for instance by benzine—and is then ready to be inserted in the lamp. It must therefore be observed that the actual regulating of the resistance of the carbon thread takes place in the bath, only the very smallest part of which melts. This operation admits of only the least amount of air contact, and in addition to this paraffine and naphthaline, as well as all other carburets of hydrogen that stiffen easily, offer the advantage of discharging carbon most easily.

Fig. 3 shows a perspective view of the angular carbon thread with its layers and the form of the cross-section of the carbon thread. *e* is the inner layer of carbon. *e'* is the second layer, consisting of the silicate; and e^2 is the regulating-layer of carbon gained by the effect of the electric current.

The advantage which arises from the method of preparing the thread with mineral salts and a gum is still to be explained. The composition of this mineral salt and a gum has already been mentioned. Owing to the gum-senegal being used, it completely fills up the pores of the thread and makes the latter exceedingly tough and gives it great powers of resistance. The silicate and the caustic soda, on the other hand, encompass the thread entirely, and when the latter is subjected to the rolling process they encircle it closely and uniformly on all sides. After being carbonized and prepared the thread will therefore consist of three layers—namely, the inner carbon layer, the annular silicate layer, and the uppermost precipitated so called "regulating-layer" formed by the deposition of carbon.

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

In an incandescent lamp, a carbon thread characterized by an inner layer of carbon, *e*, in the shape of angle-iron, a second layer of silicate, *e'*, and a regulating-layer of carbon, e^2, at the outside for the purpose of equalizing the resistances, all substantially as described.

In witness whereof I have hereunto set my hand in presence of two witnesses.

CARL SEEL.

Witnesses:
TH. HESSE,
B. ROI.