(No Model.)

G. BOWRON & W. HIBBERT.

MANUFACTURE OF CARBON FILAMENTS FOR INCANDESCENT LAMPS.

No. 304,901. Patented Sept. 9, 1884.

FIG. 2a

FIG. 3a

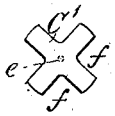


FIG. 1.

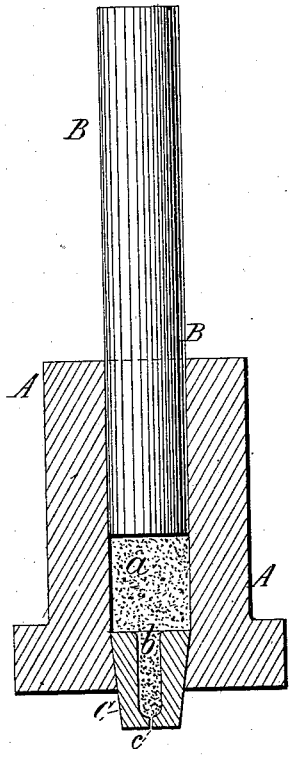


FIG. 2.

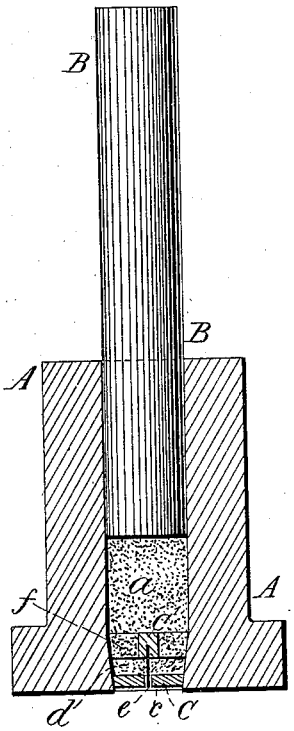


FIG. 3.

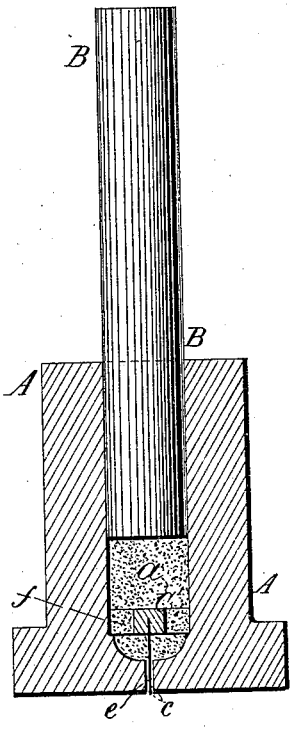


FIG. 4.

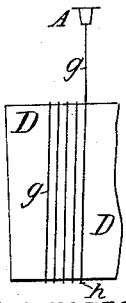


FIG. 5.

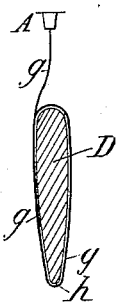


FIG. 6.

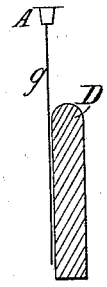


FIG. 7.

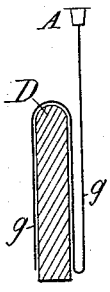


FIG. 8.

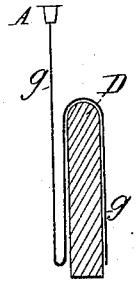
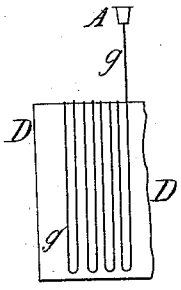


FIG. 9.



WITNESSES.

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UNITED STATES PATENT OFFICE.

GEORGE BOWRON AND WALTER HIBBERT, OF LONDON, COUNTY OF MIDDLESEX, ENGLAND.

MANUFACTURE OF CARBON FILAMENTS FOR INCANDESCENT LAMPS.

SPECIFICATION forming part of Letters Patent No. 304,901, dated September 9, 1884.

Application filed October 17, 1883. (No specimens.) Patented in England February 12, 1883, No. 764, and in France August 9, 1883, No. 156,962.

To all whom it may concern:

Be it known that we, GEORGE BOWRON and WALTER HIBBERT, subjects of the Queen of Great Britain and Ireland, and residing at London, in the county of Middlesex, England, have invented certain new and useful Improvements in the Manufacture of Carbon Filaments for Incandescing Electric Lamps, (for which we have received Letters Patent in Great Britain, No. 764, dated February 12, 1883, and have applied for Letters Patent in France, August 9, 1883;) and we do hereby declare that the following is a full, clear, and exact description of the invention, which will enable others skilled in the art to which it appertains to make and use the same.

Our invention has for its object the production of carbon filaments for incandescing electric lamps of a more homogeneous structure than has been heretofore attainable, whereby increased durability and greater illuminating power per unit of surface will be obtained; and it consists in making such filaments of a mixture of carbon in a very fine state of division and a solution of sugar or other viscous liquid of an organic nature, or holding organic substances in solution, in the manner and by the means substantially as hereinafter described.

In carrying out our said invention we take graphite or lamp-black, or vegetable black, and mix therewith the viscous liquid, by preference a strong solution of sugar, the two ingredients (the carbon and the solution of sugar or other viscous liquid) being employed in such relative proportions that their commixture shall form a pasty consistence. As this condition is the result which is to be sought, the exact proportions of the two ingredients may be readily arrived at by testing in small quantities, it being obvious that as the proportions must necessarily be varied according to the nature and state of division of the carbon it is not possible to give definite proportions which will be applicable in all cases. It should be observed, however, that no more of the viscous liquid should be used than is necessary to make a homogeneous paste presenting a dry appearance. We have found the following approximate proportions to give good results in practice, viz: With the use of graphite in a very fine powder a quantity of solution of sugar may be employed equal to, say, about sixty per cent. of the weight of graphite used, the solution containing, say, about sixty to seventy per cent. of sugar. With lamp-black or vegetable black, also in a very fine powder, a larger proportion of solution of sugar may be employed—viz., about two hundred per cent. of the weight of lamp-black or vegetable black used—the solution of sugar being of the same strength as before.

In lieu of employing graphite or lamp-black or vegetable black, charcoal derived from sugar or any equivalent carbon-yielding substance may be used; but as the results so far obtained with it have been inferior to those obtained with graphite or lamp-black or vegetable black, we do not recommend its use, but prefer to employ the forms of carbon first mentioned.

In lieu of using a solution of sugar we may employ other viscous liquids of an organic nature, or holding organic substances in solution. For example, when vegetable black is employed, a solution of resin in turpentine may be used; but in this case we have always found it advantageous to add to the carbon used a proportionate quantity of sugar. This is most conveniently done by mixing a suitable quantity of solution of sugar with the carbon and then evaporating to dryness, the carbon and granular sugar resulting being afterward mixed with the solution of resin in turpentine. Good results have been obtained by mixing with the vegetable black a quantity of pure sugar equal to about thirty per cent. of the weight of vegetable black used, the sugar being added in the form of a weak solution, containing, say, about five per cent. of sugar, and after evaporation mixing the vegetable black and sugar with a quantity of solution of resin in turpentine equal to, say, about ninety per cent. of the weight of the mixture of vegetable black and sugar used,

the solution containing, say, from about forty to fifty parts of resin in one hundred parts of the solution.

We desire to note here that in the foregoing stated proportions of ingredients we have given such figures as will enable the compound to be worked at ordinary temperatures—that is to say, without heating—which is a point of considerable practical advantage. The carbon and solution of sugar or other viscous liquid having been mixed together in suitable proportions, as before mentioned, so as to form a pasty consistence, the same is introduced into a vessel or receptacle having a very minute orifice, through which the material is forced by means of a plunger, and issues in the form of a continuous and flexible filament.

The accompanying drawings illustrate some convenient forms of apparatus to be used in the manufacture of the filaments.

Figure 1 represents a vertical section of one form of apparatus. A is a hollow cylinder, the interior *a* of which is bored true, smooth, and cylindrical for the greater part of its depth, for the reception of a plunger, B, but slightly conical at its lower end, for the insertion of a conical plug, C, the chamber *b* of the latter terminating in a very minute orifice, *c*. In operating with the apparatus, the plug C being in its place and the plunger B withdrawn, a suitable quantity of the mixture of carbon and solution of sugar or other viscous liquid in the condition of a pasty consistence is introduced into the interior *a* of the cylinder A; the plunger B is then inserted and pressure applied at its upper end by means of a screw-press or otherwise, whereby the material is forced out through the orifice *c*, and issues in the form of a continuous and flexible filament. This arrangement is adapted for the production of solid filaments. When tubular filaments are required, they may be produced by the addition of a filamentous core to the die or plunger, the core occupying the center of the orifice.

Fig. 2 is a vertical section of an apparatus intended for the production of tubular filaments. A is the cylinder, with its bore *a* terminating at its lower end in a conical portion, in which are fitted two plugs, C C′, a short distance apart, so as to leave a space, *d*, between them. The plug C is formed with an orifice, *c*, while the plug C′ carries a filamentous core, *e*, which occupies the center of the orifice *c*, grooves or passages *f* being provided on the periphery of the plug C′ (see detail Fig. 2ª) for the passage of the material. The operation is performed by the application of pressure to a plunger, B, as before.

Fig. 3 shows a similar apparatus in which the plug C is dispensed with, the orifice *c* being formed in the cylinder A. The plug C′, (shown in detail in Fig. 3ª,) with its pendent filamentous core *e*, is used as before. The continuous flexible filament, whether solid or tubular, issuing from the apparatus, is lightly wound or allowed to fall around or over a suitable "former" in such a manner as to approximate to the shape of the filaments and be then cut up or otherwise severed.

Figs. 4 and 5 represent, respectively, an elevation and section (drawn to a reduced scale) of a "former," D, by turning which and moving it slightly longitudinally as the filament *g* descends from its point of egress A the filament will become lightly wound round it, the several filaments being subsequently severed at *h;* or the device shown on a reduced scale in Figs. 6, 7, 8, and 9 may be conveniently adopted, of which Figs. 6, 7, and 8 are diagrammatic sectional views, illustrating three different positions, and Fig. 9 is an elevation. A represents the point of egress of the filament from its cylinder, and D the former. The continuous filament first descends down one side of the former D, as shown in Fig. 6. The former is then moved to the left, so that the filament will descend in a loop form down the opposite side, as shown in Fig. 7, after which the former is moved to the right and the loop descends down the other side, as shown in Fig. 8, and so on in succession until as the former is gradually moved longitudinally the whole length of the former is covered with loops, which only require severing to produce filaments of a form suitable for use in incandescing lamps.

It is obvious that the shape of the formers is to be varied to suit the form of filaments required. The filaments, having been cut or severed, may be at once subjected to the action of the carbonizing apparatus; or, as we prefer, they are first allowed to dry by exposure to the air and then carbonized. The filaments are then ready for connection to the leading-in wires of the lamp, to which they may be attached by adhesion and carbonization of a small quantity of the paste of which the filaments are made, or in any other suitable manner.

If preferred, the filaments may be attached to the leading-in wires before carbonization; or the continuous filament may be first dried and carbonized, and afterward cut up or severed into lengths for the finished filaments.

If desired, the filaments may be placed in an atmosphere of hydrocarbon vapor and raised to incandescence in the well-known manner.

The carbon filaments may be employed in exhausted bulbs in the usual manner.

Having fully described our invention, what we desire to claim and secure by Letters Patent is—

The hereinbefore-described improvement in the art of manufacturing carbon filaments for incandescing lamps from a mixture of carbon in a fine state of division with a solution of sugar or other viscous liquid of an organic nature or holding organic substances in solution, which consists in squeezing said mixture, in pasty condition, through a die, whence it issues in the form of a flexible continuous

filament, depositing said filament as it issues upon or around a former in the shape of a series of connected loops approximately of the shape required for the finished incandescing filaments, and subsequently separating said loops from one another and carbonizing the same, substantially as and for the purposes set forth.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

GEORGE BOWRON.
WALTER HIBBERT.

Witnesses:
THOMAS JOHN HANDFORD,
ALFRED MAXWELL,
Both of 42 Southampton Buildings, London.