UNITED STATES PATENT OFFICE.

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FILAMENT FOR INCANDESCENT LAMPS AND PROCESS OF MANUFACTURING SAME.

SPECIFICATION forming part of Letters Patent No. 626,460, dated June 6, 1899.

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To all whom it may concern:

Be it known that I, THOMAS A. EDISON, a citizen of the United States, residing at Llewellyn Park, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Filaments for Incandescent Lamps and Processes of Manufacturing the Same, (Case No. 995,) of which the following is a specification.

My invention relates to an improved filament for incandescent lamps which will be of a high resistance, and hence suitable for use on high-tension currents, and to an improved process for the production of such filaments.

In carrying out my invention I form a filament of highly-refractory non-conducting material which is preferably porous, and incorporate therein isolated particles of carbon, so as to produce spark-gaps between the particles, whereby high-tension currents, either alternating, continuous, or intermittent, will be conducted from particle to particle of the carbon to raise the filament to incandescence. By constructing the filament of a highly-refractory non-conducting porous material the interior thereof will be subjected to the effect of the vacuum to thereby assist in the conduction of the current through the carbon particles. The highly-refractory material which I prefer to use in the formation of my improved carbons is an oxid or oxids of the rare earths—such as the oxid of zirconium, thorium, and others—and I prefer to incorporate therein the isolated particles of carbon by a process of carbonization.

In order to provide an exterior surface for the filament which will radiate light, I preferably momentarily dip the filaments in a salt of the oxid, such as the acetate thereof, which will leave no carbon upon carbonization.

In making my improved filaments I prefer to admix with a highly-refractory non-conducting material, such as the oxid of zirconium or thorium, a carbonizable organic compound—such as a solution of sugar, asphalt, or a tartrate of the oxid itself—which will leave a residue of carbon upon carbonization. The proportion of carbonizable material admixed with the refractory substance depends upon the amount of carbon residuum desired to accommodate the filaments to the tension of current employed. The carbonizable material having been incorporated with the oxid or other refractory non-conducting substance, the plastic compound is preferably forced by heavy pressure through a fine opening or die to form a filament of the desired cross-sectional area. The filament is then bent into the proper shape and is carefully dried, after which it is carbonized in any suitable way.

The body of the filament will be dark in color, and hence will not give the desired high economy of radiation. It is therefore preferable to immerse the filament after drying, but before carbonization, in some substance of a sufficiently-refractory non-conducting nature which will leave no carbon upon carbonization, but which will result in the production of a white coating of high radiating capacity. This coating of high radiation is by preference obtained by dipping the filaments after drying, but before carbonization, in a salt of the oxid of the rare earths, such as zirconia or thoria, and preferably in an acetate of such oxid. A filament produced in this way will be composed largely of the refractory non-conducting material, with isolated particles of carbon therein. Owing to its resistance it cannot, therefore, be satisfactorily used on ordinary currents; but when alternating, continuous, or intermittent currents of several hundred volts are directed to the platinum terminals to which the filament is secured and the bulb exhausted in the ordinary manner the tension will be sufficient to produce a semiconduction, which results in the generation of enough heat in the internal portion of the filament to bring it up to incandescence.

Instead of carrying out the improved process above outlined the filaments may be formed by forcing through a die or otherwise producing the filament of plastic masses of a salt or salts of the oxids and by then subjecting the filaments to heat sufficient to decompose the salt and deposit the oxid, after which the filament will be soaked in a solution of a carbonizable material, such as asphalt dissolved in benzole, sugar in water, or a tartrate of the oxid itself. Such filaments after being dried are then dipped, as before, in a solution of the salt of the oxid to result in the production of

the desired white surface and are then carbonized.

Instead of producing the improved filaments by manipulating masses of the desired refractory non-conducting material, as explained, decomposable salts of the oxids of the rare earths can be formed into filaments of the desired shape and size by a series of heating operations, which will result in the gradual accumulation of the oxid or oxids. For example, threads of cotton may be soaked in a salt of the oxid, such as the acetate, and carbonized to form a deposit of the oxid therein, being resoaked and reheated successively until the desired quantity of oxid has been deposited, after which the filament will be soaked in the desired carbonizable substance, and after being dried will be dipped in a solution of a salt of the oxid to form the white radiating-coating desired, and finally carbonized.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is as follows:

1. An improved filament for incandescent lamps, consisting of a highly-refractory, non-conducting material, having isolated particles of conducting material therein, substantially as set forth.

2. An improved filament for incandescent lamps, consisting of a highly-refractory, non-conducting material, having isolated particles of carbon therein, substantially as set forth.

3. An improved filament for incandescent lamps, consisting of a highly-refractory, non-conducting material with isolated particles of carbon therein, and a white radiating coating of refractory, non-conducting material, substantially as set forth.

4. An improved filament for incandescent lamps, comprising a highly-refractory, non-conducting oxid or oxids of the rare earths, and isolated particles of carbon therein, substantially as set forth.

5. An improved filament for incandescent lamps, comprising a highly-refractory, non-conducting oxid or oxids of the rare earths, isolated particles of carbon therein, and a white refractory, non-conducting radiating coating for said filament, substantially as set forth.

6. An improved filament for incandescent lamps, comprising a highly-refractory, non-conducting oxid or oxids of the rare earths, isolated particles of carbon therein, and a white radiating coating of such oxid, substantially as set forth.

7. An improved process for making high-resistance carbon filaments, which consists in forming the filament of highly-refractory, non-conducting material mixed with a carbonizable substance, which when carbonized will deposit isolated particles of carbon, and in carbonizing the filaments, substantially as set forth.

8. An improved process for making high-resistance carbon filaments, which consists in forming the filaments of a highly-refractory, non-conducting substance with which is mixed a carbonizable material, which when carbonized will deposit isolated particles of carbon, in drying the filaments, and in finally carbonizing the same, substantially as set forth.

9. An improved process for making high-resistance carbon filaments, which consists in forming the filaments of a highly-refractory non-conducting substance with which is mixed a carbonizable material, in drying the filaments, in dipping the same in a salt of a highly-refractory, non-conducting oxid, and in finally carbonizing the same, substantially as set forth.

This specification signed and witnessed this 29th day of March, 1898.

THOMAS A. EDISON.

Witnesses:
J. F. RANDOLPH,
JNO. R. TAYLOR.