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# MANUFACTURE OF ELECTRIC INCANDESCENT LAMPS.

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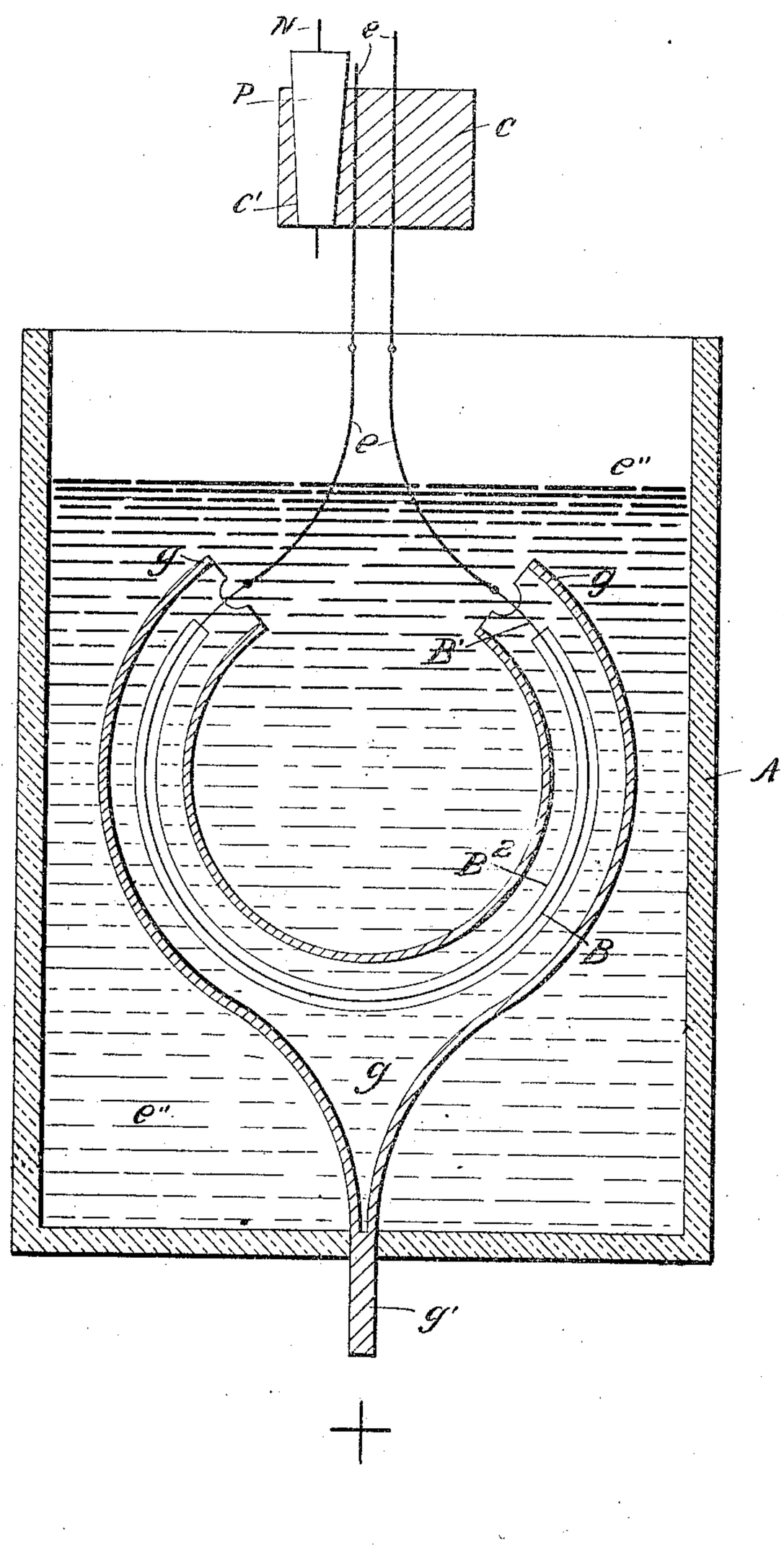


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# UNITED STATES PATENT OFFICE.

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## MANUFACTURE OF ELECTRIC INCANDESCENT LAMPS.

No. 877,408. Specification of Letters Patent. Patented Jan. 21, 1908.

Application filed March 17, 1904. Serial No. 198,564.

*To all whom it may concern:*

Be it known that I, FRANCIS M. F. CAZIN, a citizen of the United States, residing at 1108 Bloomfield street, in the city of Hoboken, Hudson county, State of New Jersey, have invented new and useful Improvements in the Manufacture of Electric Incandescent Lamps, Method and Product, of which the following is a specification

The invention relates to the class of electric incandescent lamps disclosed in my prior applications, to wit: December 7, 1892: Ser. No. 454,412: Patent No. 523,460—July 24, 1893: Ser. No. 481,332: Patent No. 523,461—July 24, 1893: Ser. No. 481,321: Patent No. 566,285—September 11, 1895: Ser. No. 562,189: Patent No. 620,640—October 29, 1895: Ser. No. 567,332: Patent No. 621,291—October 15, 1897: Ser. No. 655,312: Patent No. 621,292—February 2, 1899: Ser. No. 704,218: March 21, 1899: Ser. No. 709,902: Patent No. 640,366—July 27, 1899: Ser. No. 725,288: October 31, 1899: Ser. No. 735,439: January 27, 1900: Ser. No. 3,061: January 7, 1903: Ser. No. 138,084: February 2, 1903: Ser. No. 141,501: Patent No. 786,727—March 3, 1903: Ser. No. 145,871: August 27, 1903: Ser. No. 170,940: September 1, 1903: Ser. No. 171,515: Patent No. 760,849—November 30, 1903: Ser. No. 183,270.

The invention has, the same as those disclosed in the above-cited applications, the object, to provide for an improved lamp of the designated kind and of a simple, efficient and effective construction, which will readily serve its intended purpose,—and the aforesaid applications are referred to for the purpose of avoiding a repetition of the qualifications of parts and a specification of their functional requirements, so far as not now newly disclosed.

The invention which I desire to secure patent for by this present application, is in further development of details in the light-producing part, viz., in the illuminant of the electric incandescent lamps described by me in my previous applications for patents on such improved lamps, on which so far seven patents have been issued to me, and I refer to the contents of the records in these said cases, and to the said patents, for all information that may be required for rendering this present application more intelligent and clear.

In special do I desire to protect this invention in its broader character as an integral luminant structure of a metallic conductive element and a body of rare metal oxids.

My present improvement has mainly the object of substituting in electric incandescent lamps, in place of the present illuminants, improved light producing parts, such as herebelow disclosed, the general purpose of the improvement herein disclosed being precisely the same as that of my preceding applications, and especially as that of my prior application No. 735,439, namely the production, at a stated electric current expenditure, of a comparatively and proportionately greater amount of light as against the lamps of present tradé, and of such light in color and power as is best adapted to common use, and in lamps fit for being operated for a longer life time, and to effect such production mainly by the utilization of new materials and hereinafter described in the luminant part or structure of my improved lamps, which materials were not before so utilized in the art of electric light making. And as materials utilized by me to the said effect, I mention a certain class of rare metal oxids and a certain class of metals of the osmium-ruthenium kind, or class.

Such improvements, relating mainly to the luminant part or parts or structure of the lamps, I intend as well for electric lamps with one or more protecting glass bulbs, as for such without such protection, as well as for such with such glass bulbs that are filled with air, gas or vapor, as for such that have one or more bulbs air-exhausted, or have some so filled and another or others exhausted. (Compare my Patents No. 566,258 and No. 621,292).

The improvement or improvements which I desire to obtain patent for by this application were alluded to by me in my applications No. 555,312, of Oct. 15th, 1897, and No. 735,439, of Oct. 31st, 1899.

I desire it to be understood that I do not select carbon or any other material as the material exclusively to be used in the electrically heated part of my lamp, but on the contrary I propose to use any one single or mixed or compound material for such part as will adapt itself to the functional performance required in an electric incandescent lamp, such as I have specified and described heretofore, as aforesaid, and as I shall describe and specify herebelow.

The selection of material will in each con-

crete case be the result of the requirements of such case. For instance, whenever I desire to eliminate core or fillet from the luminant or heated part, be it before or be it during the operation of the lamp, then and in that case I select a material which can be eliminated by any of the known processes of such elimination, for instance, running out by melting (tin, zinc, bees-wax,) or by the solution or wet extraction process, (metals, etc., easily forming soluble salts with diluted acid).

When on the other hand I do not desire to eliminate the core or any other structural part of the heated part in my lamp, but do on the contrary desire to preserve the core or other part of such heated part of my lamp, as the means for supporting the luminant part or structure, in that case I preferably select and use material which, almost to the exclusion of all others for the main functional performances of conducting and producing light, I have been using in the heated part or parts or structure of my lamps, namely, metals and metal oxids, and of the latters preferably certain one or more specified oxids of rare metals. (Compare my Patents No. 621,291, page 1, 88th line, and No. 620,640, page 2, lines 70, etc., and other parts of these patents.)

In the specification to my Patent No. 621,291, issued on my application of October 29, 1895, the following definition of these oxids is given on page 3, lines 95, etc., namely: "In using the designation 'rare metal oxids' I intend to designate all those earths or oxids which combine with a high point of fusion, the peculiar qualities of more readily becoming incandescent or luminous under the influence of heat than other matter, and without confining myself to the use of single earths or of definite mixtures thereof." Since then the fact has been experimentally established that lime, magnesia and zirconia, though fusing at high temperature only, do not possess the peculiar qualities which would place them in the class of "rare metal oxids," a fact which, though ignored at an earlier period, is at present accepted and corroborated by all competent experimenters in regard thereto. This has resulted in the acceptance of a class-distinction between "earthy oxids," (such as lime, alumina, magnesia and zirconia), and "rare metal oxids," (such as the oxygen-compounds in the solid state of beryllium, cæsium, cerium, chromium, didymium, erbium, germanium, gallium, indium, iridium, lanthanum, lithium, molybdenum, niobium, palladium, rhodium, ruthenium, rubidium, selenium, scandium, samarium, tantalum, thalium, tellurium, thorium, titanium, tungsten, uranium, vanadium, wolfram, and ytterbium, and others of same functional qualification. Moreover, I repeat, that disclosing a heated part of the conductive element of the lamp by the function of conducting and of resisting to electric current, to the effect of producing heat primarily and not by any specifically preferred or selected material, I do use in or for such part any material functionally fit, singly or in conjunction with other material to be used in or for such part, be the material carbon or metal or metal oxid, or any mixture thereof, as long as they or their mixture perform the stated function, and in regard to using any class of metal in conjunction with rare metal oxids I refer to my application of Feb. 2, 1899, patented on November 13, 1906 to which specific reference is hereby made, and which is made a part hereof.

Whenever an attempt was made of utilizing a body of earthy oxids in the luminant of an electric lamp, neither an increased light efficiency nor a prolongation of life was the effect of such utilization on the lamp, but when I, as disclosed in my application of October 29, 1895, utilized "erbia and yttria and other oxids of the specified character and suitable for the specific purpose," in other words when I utilize a body of rare metal oxids in the luminant part or structure of an electric lamp, both light efficiency and the life of the lamp were materially increased. The one thing would not serve the purpose, but the other would. For further information as to that which I designate when I mention "rare metal oxids," or "certain rare metal oxids," I refer to my application No. 725,283. I preferably give to such oxid bodies the forms indicated, among others, in my amendment of February 10th, 1896, to my application of October 29, 1895, namely of cylinders or tubes, and, jointly therewith, of either an electrolytic deposit or of a pseudo fiber or fabric. (Compare my Patent No. 621,291, page 96, etc., and other previous disclosures.) And I may use or not use admixtures with the oxids such as fluor spar, (compare my application No. 704,218, and preceding ones,) and may mix in solution or suspension, (compare my Patent No. 621,291, page 1, lines 89 and 90,) the metallic oxids and their salts. And I do not exclude from the said oxids even those of the metals, such as herein further specified and preferably intended for the main conductive element in the form of an electrolytic deposit, which metals, when present in their metallic form within the body of oxids, assume in part or in an accessory manner, or even mainly, a conductive function in connection with such oxid-body or core, as hereinbelow further explained.

Instead of covering the core, fillet or filament with an oxid, I now propose to cover the same by some of the metals which will, under the influence of the electric current,

enter into a compound or into a mutual impregnation with the material of the core or fillet in some similar way; for instance, as a compound or mutual impregnation between iron and carbon which will produce steel, (carbureting). Among the metals I prefer for the stated purpose, on account of their functional properties, the metals of the ruthenium osmium class, because their temperature of fusion is so high, that at incandescing white heat they do not melt, as for instance platinum does, and of other metals I do only use those which will not melt at the temperature of white incandescence, but I may use any other metal or alloy of approximately as high a temperature of fusion,—whenever I can, as in the case often alluded to, of iron and carbon, increase their practical infusibility by impregnating them, or mixing with them carbon or some other material, that will have that effect. But even though and in case I do cover, as often described and as hereabove mentioned again, the core, fillet filament or materially heated part of the conductive element, primarily though not ultimately consisting of carbon, with oxid of any one or of several of the rare metals, as specified in the 11th paragraph of this specification, then the re-action occurs such as by me described in my Patent No. 620,640, on page 2, in lines 99 to 112, as follows:

"When the carbon filament is coated very thinly with oxids of the stated nature and is subjected in vacuo to an electric current, a very slight re-action takes place, the simultaneous result of which is the formation of carbon oxid and the deposition on the filament, reduced both in volume, and in conductivity, (increased resistance,) of a fine metallic skin or stratum, by means of which a compensating increase of conductivity (loss of resistance,) is provided. If the operation is continued until the metallic skin is, minutely thin as it may be, homogeneous, the re-action will cease."

And in so far as most of these rare metals also partake in the characteristics of high temperature of fusion and great affinity to oxygen, by which they class physically and chemically with those of the ruthenium osmium class, they are also subject to the hereabove specified entering into a compound or into a mutual impregnation with the material of the core, or a remainder thereof, forming a compound or mutual impregnation, analogous to steel, with the metal reduced as aforesaid from its oxids as present originally, to its metallic form as hereabove also specified, be it in part or entirely. On account of the metals of the ruthenium osmium class singly being non-ductile and on account of an electrolytic deposit of any single such metal being crystalline, while my invention also contemplates the use of such single metal, though it be brittle and not preferable for the stated purpose, I prefer to mix more than one of these metals in solution in the electrolyte, by doing which I produce electrolytically an amorphous, tenacious, ductile coating, preferably mixing osmiate of potash and chlorid of iridium.

As indicated I preferably employ electrolytic deposition of such metals as I intend to apply to a primary core.

From all that which in the preceding paragraph has been stated in the qualification of the metals, entering into the by me invented alloy-filament, which as disclosed in my application No. 725,283—of July 27, 1899 it is evident beyond a possible doubt, that the metal platinum does not thereto belong, such having been long known to the art as absolutely unfit for the function as filament in any incandescent lamp, an unfitness which it imparts in a more or less high degree to all of its alloys, even with the by me selected metals of the ruthenium osmium class, to which platinum does not belong, although chemically it ranges in their proximity. Its physical qualities, which alone determine its fitness or unfitness, are much inferior to those of the metals of the ruthenium osmium class, when the requirements in a filament are considered. As well and generally known, platinum melts before it is made to fully incandesce under electric current. On the other hand its affinity to oxygen is much less active or practically inactive, while in its pure state it is highly ductile and not brittle, or powderable, as the metals of the ruthenium osmium class in their native state exclusively are. (Compare my Patent No. 523,460, page 3, line 121.) Notwithstanding these good qualities, the fact that it melts before attaining the temperature of white incandescence, renders platinum, as stated, unfit for the function assigned to the coatings or cores in the luminant, as herein disclosed by this applicant.

Before immersing the filament-core in the electrolyte I may prepare its surface for the deposit of osmium-iridium, etc., by a primary deposit of zinc and by bringing the zinc cover into contact with mercury, respectively amalgamate the same, or I may primarily electrolytically deposit any other metal, and I may amalgamate such other metal such as copper, or I may expose it directly to further electrolytic deposition. It is by this process of intermediate coating that I succeed in producing a uniform cover of osmium-iridium, or of other metals of the same or equivalent class.

It goes without saying that zinc, mercury or any other metal, intermediately used, disappears in the further manipulation of the filament, be it by dissolution or by evaporation.

When I have set the osmium iridium fila-

ment into an exhausted bulb, or into a functional equivalent thereof, and have the current turned on, at the proper moment, even while completing the exhaustion, or when a virtual vacuum has been effected, and when there is carbon present, aside from eventual evaporation of such carbon, a carburization of metal takes place, and it depends on the proportionate thickness of metal and of carbon, whether the carburization takes in the entire carbon part, or all of the metal-cover, or leaves some carbon, or some metal, yet intact. In both cases I have produced a filament for electric vacuum lamps of highly improved character, as hereabove specified.

Increase of tension in the current to a certain voltage destroys the purely carbon filament. The same tension produces in the metal (osmium-iridium, etc.,) covered filament eventual carburization only, the filament continuing under all normal tension to maintain its shape and to emanate light. But even the thus obtained and improved filament is by me further improved in the method already disclosed as heretofore stated in my application No. 655,312.

If I desire to so further improve the filament in my lamp, I cause a further electrolytic deposit on the osmium-iridium cover, and for such deposit I select a metal or metals of the rare-metal class, the oxids of which have hereabove been mainly cited, and mixtures of these oxids; and as heretofore stated in my application No. 655,312, I enter the compound filament, as described, into the partially air-exhausted bulb, or its equivalent, such as the bell jar of an air exhausting apparatus. Unless the filament was previously oxidized on its surface, I then and there subject the same to electric current and permit partial or entire oxidation of the metal coat, before, in case a bulb has been used, sealing the same.

The electrolytic deposition of rare metals, such as specified, is conditioned on the absence of water in the electrolyte because with water present some of the stated rare metals, in the nascent state oxidize in decomposing water, I therefore in the first instance may select a primary deposition in a non-aqueous electrolyte and subsequent addition of water thereto, instead of oxidizing in air or oxygen a primary metal-deposit. By such oxidation the surface of the filament, then covered with adhesive rare-metal oxid, possesses the quality of reducing the dark-heat-rays in proportion to increasing the emanated light, the entire filament performing the functions of conducting the current and of producing heat and light.

When producing by my new process the stated metal- and oxid-filament, such as described hereabove in particular, I found that I obtained a filament of less brittleness, of greater co-hesiveness and of increased torsional strength, because, 1st. I avoid using the metals in either gaseous or molten form. 2nd. I prepared an electrolyte in liquid form at normal temperature. 3d. I introduced and used more than one of these metals in the liquid electrotype. 4th, I so adapted to the purpose the mixture of solutions and the dimensions of the electric current applied to the electrolytic action, and the direction of current, that a metal deposit was formed, containing more than one of the stated metals and each in proper proportion.

It is absolutely immaterial, as far as the solution is concerned, whether the deposit be used later as conductor at normal temperature or at suitably increased temperature, and whether incandescence be the direct consequence of heat, or whether heat produce intermediately conductivity and then incandescence, the observable and useful effect being entirely and absolutely the same,—whichever the scientific explanation be, given for the phenomenon of incandescence produced in normally non-conductive matter under current. But applicant states, that he, in harmony with all scientific authorities on such matter, rejects the explanation, that oxids, when they have been made to incandesce under electric current,—assume the function, such as in science is understood to be that of an electrolyte, and that the oxids then constitute: "a solid electrolyte, or an electrolytic conductor, though in absolute absence of electrodes."

By all scientific and technical terminology, as now in general, international and uncorrupted use, the "solid electrolyte" has no existence in fact, but only as the result of an attempt to circumvent a prior inventor's privilege,—and to attribute that,—which is known to be, and by all scientists of repute accepted to be: "chemical reaction under electric current and by the heat thereby set free," (a reaction, which is successfully prevented under these conditions by chemical insulation)—to an electrolytic wandering of material ions,—an effect never proven or corroborated by any scientist, except the pseudo-scientist, who originated the false teaching. (Compare in *The XXth Century Electric Light*, pages 45, 46 and 56 and applicant's Patent 620,640.)

It is equally immaterial, whether the electrode used in the deposition of metal receive the deposit on its faces exclusively or in its pores also.

I consider the product obtained (preferably carbureted osmium with a minor admixture of iridium) as analogous to steel when compared with iron, where a very small presence of carbon changes the physical qualities of the iron, or as analogous to the various rare-metal-oxids, where the presence of one such as ceria, as a small fraction of the whole, such as thoria, changes en-

tirely the light-producing quality of the whole, the effect not being dependent on the presence of carbon. Morever I am fully aware of the general faculty, as stated, of carbon, of increasing the resistance to fusion of the so carbureted metals, such as the cited steel and carbureted osmium-iridium, and therefore I include these carbon-metal-compounds as the material used in building up singly or in combination with other material the luminant of my improved electric incandescent lamps.

The electrical current-expenditure in the lamp with the newly discovered improved filament, is reduced to 1:5 to 2 Watts per candle power, the former being the main result, when such a filament is further embedded in a thin coat of rare-metal-oxid, and the current applied may be of higher tension, than applicable with an exclusively carbon- or exclusively metal-filament. And I found the functional qualities of a filament having a surface of metal of the ruthenium osmium class, materially enhanced by coating the same with another metal of less affinity to oxygen but of a similar resistance to fusion and evaporation, while in the metallic state, it becoming possible by such coating to use the coated filament either in an air-filled bulb or housing or even under free access of the atmosphere.

The by me improved electrolytic process of manufacturing the luminant in my improved lamps, such as preferably applied by me, is in its general character the same, as indicated by the adjoined drawing (Fig. 1) which originally formed part of my application No. 655312, but was withdrawn therefrom previous to issue of patent No. 621292. It shows that the two ends of the filament-core, as one electrode, are attached to the same pole. The other electrode may be dispensed with in its complicated form, as long as this second pole is immersed into the electrolyte. I preferably prepare the liquid electrolyte by dissolving osmiate of potash mainly with a small admixture of chlorid of iridium. And I assume that the deposition of the two metals is brought about in a secondary reaction, hydrogen being set free and reabsorbed in a double reaction. This process not only but the product also thereof may be further described as follows:—

In the first instance, I do not necessarily use the core in the electrolyte in its final form (horse shoe or other) but my product being ductile, I have the facility for bending the filament as by me produced, when it is set up on the glass-base.

In the second instance, when using a metallic core, I do not select platinum as such but I do select a metal as core which (such as tin or zinc) I can and do discard by melting or by evaporation or solution, leaving the two or more composite metals of the ruthenium osmium class in tubular form mainly, thereby imparting to the filament made thereof a greater tensile strength.

In the third instance, I do not use any of the stated class of metals in molten or vapor form, but do use them exclusively in liquid solution thereby avoiding the poisonous effect of these metals in such form, and from such solution I preferably deposit, not one metal at a time, but I deposit more than one of these metals simultaneously.

In the fourth instance, I preferably coat the filament made of these stated metals with a coat of fine metal viz. metal, which, when heated in air, will not oxidize and which protects them against oxygenation and other deterioration, such a fine metal being selected in consideration also of its temperature of fusion and evaporation.

In the fifth instance, when one metal exclusively is deposited it appears in crystalline structure of very small cohesiveness and extremely brittle and non-ductile, and without the homogeneity, which is absolutely indispensable for the performance of its intended function, while on the other hand the two metals deposited in mixture or as alloy by the electrolytic process now by me disclosed, have an amorphous, homogeneous inner structure of great cohesiveness which befits them for the intended function as a stable protection and support of a conductive fillet or as a stable conductive element in themselves.

In the sixth instance, whenever the fillet or core is of carbon, then a reaction takes place as already stated hereabove, which in order to produce a practicable filament, must both be known and be met in the making of a filament. Unless specially provided for or met by the proper remedy, this reaction leaves no luminant, such consisting of carbon and a stated metal, but it leaves a luminant of one sole material only, namely, of a carbon compound of the stated metal. And the dual nature or material in the product can be preserved only, by proportioning the carbon and metal to the effect of such reaction leaving unabsorbed a remainder of either or of both, because they are protected mutually by the intermediate compound of both resulting from the reaction. Then the luminant becomes a three-part luminant, consisting of a conductive core, of a chemical insulation thereof and of a metallic alloy, which may serve as such as a luminant or may further be improved by a cover of rare-metal-oxids. In the latter case the carbon-compound and the metal jointly constitute the chemical insulation between carbon and oxids.

The cause, why at no time the one-metal carbon filament has made its appearance in trade, must be found in the nature of the one-metal-deposit, as hereabove correctly

described, which renders the luminant thus made essentially non-feasible, non-usable or unfit for its purpose; on account mainly of brittleness and excessive conductivity. On the other hand the by me disclosed process produces a practicable and improved luminant, fit for its intended function and in fact a new and improved luminant of superior fitness and light-effect, and according to the highest authorities the discovery of an alloy, which, as a substitute for a single metal; possesses greater fitness for a technical purpose and produces an improved result and product, constitutes an invention.

In describing the apparatus, represented in Fig. 1, which Fig. 1 is a copy of a figure 3, filed with my original application No. 655,-312 on October 15, 1897,—I repeat verbally my statement, as contained on the last page of said application, preceding the formulated claims, of which 11 and 12 read as follows: 11. An electrolytic apparatus, in which the carbon-filament of an incandescent lamp is attached with its two ends to the negative pole and is surrounded in the bath by a metal-anode the form of which is adapted to the loop-form of the filament. 12. The method of electrolytically precipitating a solid coat on a carbon filament, by attaching both ends of the filament to the negative pole of the electrolytic apparatus, immersing the filament-loop into the electrolyte, namely:

I consider as my invention the arrangement of a carbon filament to form the negative pole in an electrolytic bath in a loop-shape, similar to the shape, in which it is to be used in the lamp, without direct connection with the positive pole, such as used in the common flashing process. I attach importance to the form of the metal, used as the positive pole in the bath, by which form the carbon-loop B is in close opposition or proximity and at mainly uniform distance to and from the plate of metal *g*, that acts as the positive electrode or anode, and which plate *g* is continuous in itself and to the positive pole *g'*. And *e'* marks the connecting wires between the negative pole N and the carbon-core B, B' while $B^2$ marks the part of the electrolytic deposit, which faces the plate B directly, the extreme parts of lighter deposits not being marked specially, but being limited only by the line of immersion *e''*.

C' is the connecting plug and P is the metallic receiver for the wires *e'* and the plug C'

It is obvious, that the entire process does not depend on the precise form of the positive pole as indicated, and that any other form or shape of the positive electrode, as a whole or spread or divided into branches may be used for obtaining essentially the same effect, it being evidently and obviously sufficient that the positive pole or electrode be submerged as the negative electrode is, as shown in Fig. 1,—the negative-one to the full extent and including the terminals, that it is intended to plate the conductive element or filament,—and that the positive electrode have on or in or about it a sufficient quantity of the material to be taken up by the electrolyte and to be deposited on the negative electrode. And in whichever cup or vessel or trough, dish or indenture the positive electrode ends, I fill it with the osmiate of potash and chlorid of iridium, or with such other compounds as will contain two or more metals of the stated class, which I desire to simultaneously deposit on the filament, be it carbon or metal. And with the required modifications I make use of the same arrangement that it was originally intended for, namely, for a deposition of a metal of the rare metal class, intended thereafter to be oxidized in part or entirely, etc.

The exact proportion of the different metals to be deposited jointly and in the same electrolytic manipulation is a matter of adaptation to such requirements or to functional conditions. Moreover it should be understood, that my fundamental idea of utilizing dark heat-rays for the increase of light, and producing the necessity of preserving as much heat as practicable in the lamp, and carried out by the introduction of an extra bulb, with or without provision for differential cooling of the inner bulb for purposes clearly set forth in my patent No. 621292, is also applicable to the luminant part of the specific constitution, as herein set forth. And I should further say as to the form of such illuminant part, though such form in its main total will preferably be cylindrical, and concentrical I may make use of bends and windings of the entire luminant part, and I may make use of bends and windings of a core part within a coating part, for the purpose of regulating their proportionate conductivity while their relations as core and cover be maintained. Such variations of form are incidental only, and a mere matter of proper adaptation to required functions.

Speaking generally it is immaterial what proportions of osmium and iridium be used, as the beneficial results of their combination are obtained when the two metals are used in widely different ratios, and therefore for the purpose of economy and convenience, and in order to avoid the necessity of the isolation of those metals, which is expensive, I may use a solution obtained by dissolving the nuggets known to metallurgists as "iridosmine" or "osmirid." (Compare bulletin of U. S. Geological Survey, No. 193).

Having thus described my invention what I claimand desire to secure by Letters Patent, is:—

1. A luminant for electric incandescent lamps, consisting of a carbon filet, a sur-

rounding layer of a mixture of carbon and metals, and a layer of the ruthenium-osmium metals surrounding the same.

2. A filament or luminant for electric incandescent lamps, composed primarily of a core of carbon, surrounded by an electrolytic coating of metal, the several materials of which the filament is composed, being so proportioned, that after the filament has been subjected to heat it will consist partly of carbon partly of the product of the reaction between carbon and metal and partly of metal.

3. A filament or luminant for electric incandescent lamps, composed primarily of a carbon-core, a thereon electrolytically plated coat of metals, of which the surface concentrical layer is oxidized on its surface—the several materials being so proportioned that after the luminant has been subjected to heat, it will consist of a central fillet of carbon, a concentrical layer of a mixture of carbon and metal, an adjoining layer of metal of the ruthenium-osmium-group—a layer of rare-metal oxidized on its surface.

4. The method of manufacturing luminants or filaments for electric incandescent lamps, which consists in plating electrolytically a carbon-fillet-electrode, including its terminals or joints to the current-leading wires, with metal.

5. The method of manufacturing luminants or filaments for electric incandescent lamps, which consists in electrolytically plating a carbon-fillet-electrode, including its terminals or joints to the current-leading wires, with metal of the ruthenium-osmium group of metals and oxidizing the same on their exposed surface.

6. The method of manufacturing luminants or filaments for electric incandescent lamps, which consists in electrolytically plating a carbon-fillet-electrode with metal of the ruthenium-osmium group of metals, and by subjecting such plated luminant to a slowly increasing electric current, whereby is produced such moderate reaction between carbon and metal, as will not disintegrate the luminant but will prevent subsequent further reaction between component materials.

7. The method of manufacturing filaments for electric incandescent lamps, which method consists in electrolytically plating a carbon-filament in its intended final bending and serving as anode, with sundry metals and in finishing off such filament by subjecting the same to an electric current of slowly increasing tension.

FRANCIS M. F. CAZIN.

Witnesses:
R. B. HOOVER,
C. F. HESSER.