UNITED STATES PATENT OFFICE.

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ARC-LIGHT ELECTRODE.

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To all whom it may concern:

Be it known that I, WILLIAM R. MOTT, a citizen of the United States, residing at Lakewood, in the county of Cuyahoga and State of Ohio, have invented a certain new and useful Improvement in Arc-Light Electrodes, of which the following is a full, clear, and exact description.

My invention relates to arc light electrodes containing materials for producing a flaming or luminous arc, and is more particularly adapted to those of a carbonaceous nature.

One object of my invention is to use materials in an arc lamp electrode of the flaming type that will increase the candle power, and at the same time reduce or eliminate slagging on the positive electrode which as a rule contains the flaming material.

Another object of my invention is to provide a material that can be used in the negative electrode to prevent slag formations thereon.

Another object of my invention is to provide the particles of the flaming material with a non-hygroscopic coating or incrustation to protect them from moisture.

Other objects will appear in the appended description.

Flaming arc electrodes consists of a body of carbon with flaming materials such as the fluorids of calcium, rare earths, etc., and arc supporting materials such as potassium and sodium salts. Most of the materials used with the carbon produce more or less slag.

My invention is particularly adapted for use in solid electrodes having such a flaming mixture though not necessarily limited thereto.

It is not new to use silica, silicates and such compounds of silicon as corborundum, etc., in lamp electrodes. However, the silica used is obtained from the natural crystalline product which has very objectionable features.

In flaming electrodes, the natural form of silica causes insulating buttons of slag to form on the ends of electrodes which obscure the light and untimately cause the arc to be extinguished. After having been extinguished, the lamp cannot restart as the insulating buttons prevent the conducting constitutents of the electrode from coming in contact.

I have found that chemically precipitated silica when used with flaming mixes in the place of the natural crystalline silica, silicon, carborundum, or the silicates of sodium potassium and calcium, increases the candle power very considerably and reduces the slagging tendencies to such an extent that they can be said to be practically eliminated. I cannot say beyond question exactly why the precipitated form produces such radically different results, but I believe it is on account of the extreme fineness of the particles and the increased chemical reaction that takes place in the arc.

Certain types of flaming electrodes give excellent results as far as light efficiency is concerned, but on account of containing certain calcium compounds and carbonates, the baking in the furnace results in the formation of calcium oxid. Calcium oxid or lime will absorb moisture from the air to produce calcium hydroxid and finally calcium carbonate, which frequently causes complete disintegration of the electrode. I have known electrodes strong and rigid in all respects to be reduced to powder in a short time after being stored where the moisture of the air could reach them. I have found that this disintegration can be practically eliminated by incorporating precipitated silica in the electrode containing carbonates and compounds of calcium.

Silica could be prepared in any of the ways well known to chemists such as precipitating it from a solution of a silicate with some acid such as nitric, sulfuric or hydrochloric. The silica may also be prepared by oxidizing silicon vapor by bringing it in contact with the oxygen of the air.

The electrode (in usual practice the positive electrode) may be made up of carbon and various kinds of flaming materials with which is incorporated the precipitated silica. The latter has its advantages when used in any kind of a carbonaceous flaming mixture, but as a typical example of the electrode composition, the following may be given: Coke or other carbonaceous material, 50% to 60%; precipitated silica 1% to 6%; and the remainder of flaming and arc sup-

porting materials such as rare earth fluorids, calcium fluorid or other alkaline fluorids with borates, carbonates, tungstic oxids, etc. These materials may be homogeneously mixed with carbon to form a solid electrode or they may be incorporated partly or entirely in the core of the electrode.

In forming the oxids of tungsten and silicon, I find it advantageous to precipitate both simultaneously from a mixture of soluble silicates and tungstates by the addition of an acid as previously described. This gives a very intimate mixture of the two oxids which is a desirable feature.

In direct current flaming lamps of the carbonaceous type, the flaming material is mostly in the positive electrode, the negative electrode containing little or no materials that enhance the flaming property of the arc except in that type of lamp in which the stub from the burned out positive electrode is placed in the negative holder to constitute the negative electrode. If an electrode is composed of various materials in such proportions as to reduce slagging when it acts as a positive electrode, it is liable to slag very badly when the stub is used as a negative electrode. In all cases, it is extremely difficult to prevent slag formations on a negative electrode, and as far as I am aware, there is no material or combination of materials so efficient in eliminating slag on the negative electrode as the precipitated silica constituting one of the objects of my invention. This material when put in a negative electrode causes it to burn with a clean point, and very little trouble in slagging is experienced. My invention, therefore, is especially useful in those types of flaming lamps in which the positive stub is used as the negative, since the precipitated silica contained therein acts also to eliminate slag when it is used as the negative. In other words, my improved combination of materials tends to make a universal electrode for direct current lamps.

Boric oxid, aluminum oxid and chromic oxid have somewhat the same effect as the silica when used in negative electrodes, but in a much less degree.

Tungsten compounds, one of which has been previously mentioned, have been found to be a valuable constituent of lamp electrodes as tungsten forms many complex compounds with numerous other elements and, inasmuch as the efficiency of the arc seems to depend upon the number of possible compounds that can be formed therein, it adds greatly to the efficiency. However, on account of the comparatively high cost of tungsten, I have experimented with other materials with the idea of decreasing the amount of tungsten necessary, or eliminating it altogether. I have found that the tungstic oxid can be replaced by phospho-boric compounds in combination with other materials such as the precipitated silica previously described. The substitute materials produce substantially as good a light as the tungstic oxid, and at the same time, eliminate the slag formations almost altogether.

I have obtained electrodes that burn with high candle power and substantially no slag by incorporating the phospho-boric compounds in combination with silica in a flaming mixture. The silica is preferably used in the form of a precipitate for the reasons previously given. After the silica is precipitated, it is placed in a solution of boric and phosphoric acids and evaporated to dryness. I also prefer to heat the residue to a low red heat. This process causes a phospho-boric incrustation to be formed on the small particles of the silica which protect them from moisture, since the phospho-boric compound is non-hygroscopic and insoluble. This is a very important feature as some substances produce an efficient light but are hygroscopic to such an extent as to cause disintegration of the electrode as previously explained.

The chemical composition of the coating on the silica particles has the formula $B_2O_3P_2O_5$ and in making the solution of the boric and phosphoric acids, it is preferable to mix them in the approximate proportions to unite in the above form. As an example of an electrode composition containing these last mentioned materials, the following may be given though the proportions can be changed without entirely eliminating the desirable features produced thereby. Coke or other carbon, 55 parts; calcium or rare earth fluorids, 32 parts; carbonates of sodium and potassium, five parts; silica and phospho-boric compound 6 parts. To this also may be added one part fused borax and one part barium sulfate.

The process can also be used to apply a coating or incrustation on materials other than silica. It is not new to use phospho-boric compounds in electrodes *per se* but I believe I am the first to use such material as a coat around the particles of another material to be incorporated in a lamp electrode. I also lay claim to the broad idea of applying an incrustation to such particles and instead of using phospho-boric compounds I may use other substances, sodium sulfate and potassium chlorid being given by way of example.

Having described my invention, what I claim is:

1. An arc lamp electrode containing carbon, flaming materials and precipitated silica.

2. An arc lamp electrode containing a carbonate, a salt of calcium and precipitated silica.

3. The method of forming the materials

for arc lamp electrodes which consists in precipitating simultaneously a plurality of oxids from a solution and mixing carbon therewith.

4. An arc lamp electrode containing a carbonate, precipitated silica, and an oxid of tungsten.

In testimony whereof I hereunto affix my signature.

WILLIAM R. MOTT.

Witnesses:
E. M. SPELMAN,
HOWARD L. BARKDULL.