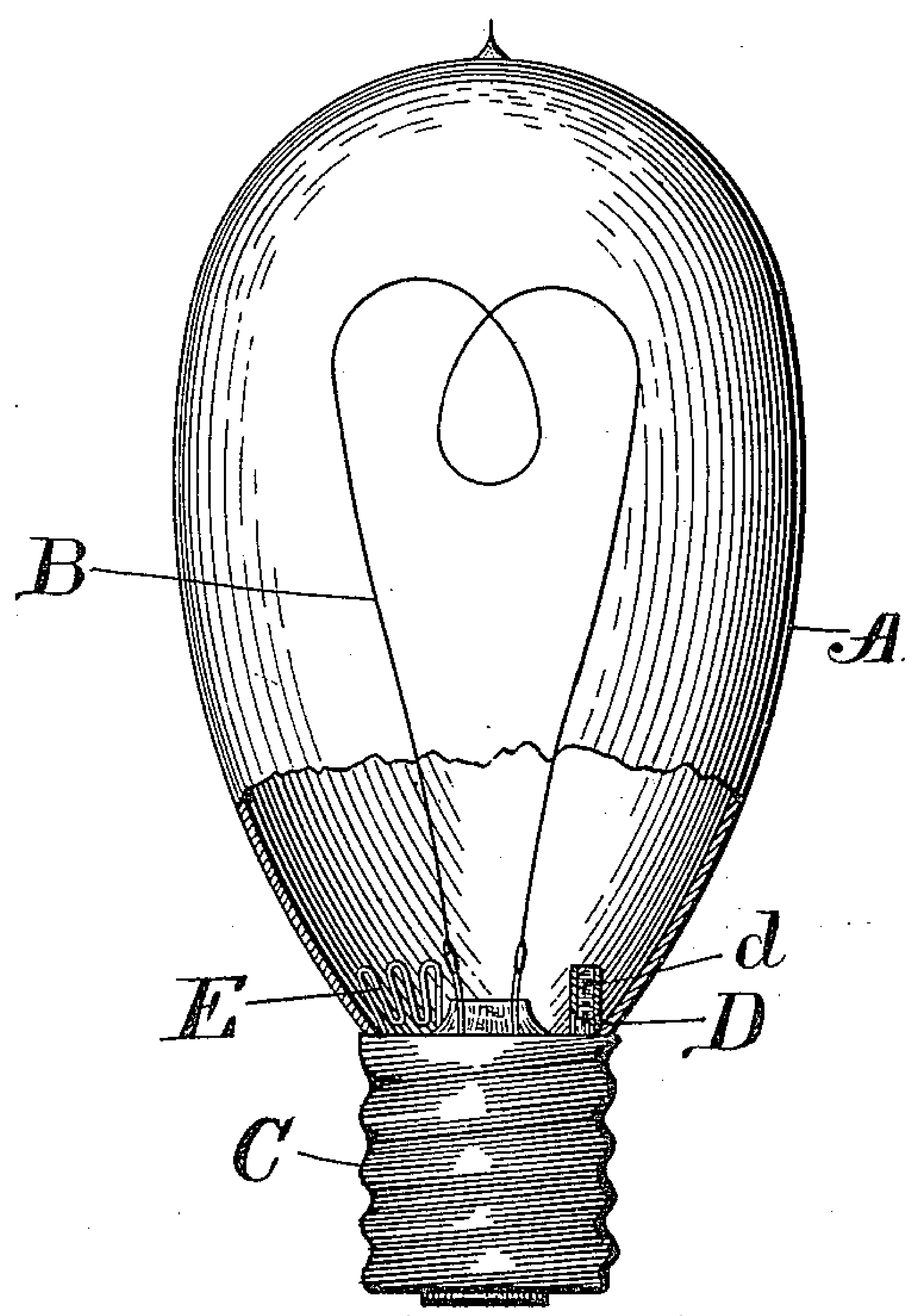
No. 674,754. Patented May 21, 1901.

F. BLAU.

MANUFACTURE OF ELECTRIC GLOW LAMPS.

(Application filed Jan. 2, 1901.)

(No Model.)



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UNITED STATES PATENT OFFICE.

FRITZ BLAU, OF VIENNA, AUSTRIA-HUNGARY.

MANUFACTURE OF ELECTRIC GLOW-LAMPS.

SPECIFICATION forming part of Letters Patent No. 674,754, dated May 21, 1901.

Application filed January 2, 1901. Serial No. 41,881. (No specimens.)

To all whom it may concern:

Be it known that I, FRITZ BLAU, private academical lecturer, a subject of the Emperor of Austria-Hungary, residing at I, Wallzeile 12, in the city of Vienna and Empire of Austria-Hungary, have invented certain new and useful Improvements in Processes of Making Incandescent Lamps; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to the manufacture of electric incandescent lamps containing a carbon filament.

The lamps produced by my invention, on account of properties peculiar to themselves, can be subjected to a much higher temperature than has hitherto been possible, and their durability is vastly increased.

It is well known that the carbon filament of an incandescent lamp, especially one of low watt-power, undergoes some damage, or, in other words, deteriorates, every moment that it burns; that the resistance gradually increases, owing to the loss of material which breaks off in the form of dust and owing to the fact that the specific resistance of the filament itself is increased; that the surface of the filament loses its luster and radiates a larger proportion of heat compared with the light given out than it did when new, and that the bulb becomes blackened. Various remedies have been proposed for these objections. For example, the blackening of the bulb is in a measure prevented by employing a larger bulb, and the gradual disintegration of the surface of the carbon filament has been retarded, although not entirely prevented, by charging the bulb with inert gases. I have succeeded in discovering means whereby all the objections mentioned may be obviated and whereby to a considerable extent the evil caused by these objectionable occurrences may be repaired. By my improved process incandescent lamps may be made whose life is considerably longer than that of the life of an ordinary incandescent lamp, and, indeed, if the preparation be carried on with care and the usage is kept within certain definite conditions the life of an incandescent lamp can be prolonged almost indefinitely.

The means for preventing the difficulties already mentioned consist, broadly, in precipitating fresh carbon on the filament while the lamp is burning, but in such extremely small quantities and so slowly that the increase of resistance due to the burning of the lamp is constantly compensated for, especially since the layer of carbon deposited upon the filament prevents the unavoidable roughening of the surface thereof, which would otherwise take place.

In the ordinary preparation of carbon filaments, as is well known, said filament is raised by an electric current to bright incandescence in a hydrocarbon atmosphere, so as to reduce the resistance to the desired amount by depositing carbon upon a filament and producing a smooth surface thereupon. This operation is a very short one—only a few seconds, in fact. My process, however, necessitates means whereby the deposit of carbon upon the filament during days and weeks while the lamp is burning and is inclosed in an air-tight bulb is much smaller than that deposited in a few seconds in the ordinary process of preparing filaments. I attain this object by providing means whereby a quantity of carbon containing gas or vapor, preferably vapor or gas obtained from hydrocarbons or derivatives thereof, may be produced in the air-tight bulb from time to time as its presence is required. In other words, if the lamp is not burning no gas will be produced. If the lamp is burning in a very cold atmosphere or out of doors in the winter, a different and smaller quantity of carbonaceous or carbon-containing gas will be produced than would be the case were the lamp used in a heated room or out of doors in the summertime. It will not do, however, to simply fill the globe with the carbonaceous or carbon-containing gas before actually using it for practical purposes, for this gas would in a short time become exhausted, and the result would be an ordinary incandescent lamp. By my process a small quantity of solid or liquid carbonaceous compounds is inclosed in the bulb during the process of making or repairing, and as the lamp is used small quantities of this carbonaceous compound are volatilized, forming a carbon-containing gas, which is decomposed by the glowing filament, thus automatically repairing the waste in such filament.

My invention will be understood by reference to the accompanying drawing, which represents an incandescent lamp constructed in accordance with my invention, a part of the bulb being broken away to better illustrate the special features of my improvement.

A designates the bulb, B the filament supported in the bulb in the usual manner, and C the metal supporting and contact cap, of an incandescent lamp constructed in accordance with my invention.

Within the bulb A is secured a tube D, which is open at its inner end, and this tube contains a small quantity of solid or liquid carbonaceous compound *d*, which will be volatilized very slowly through the open end of the tube. The compounds which I may use for this purpose may be divided into two classes—first, hydrocarbon compounds, which at ordinary temperatures have very small vapor-pressure, and which therefore under the temperature of the bulb vaporize very slowly—as, for example, the higher hydrocarbons, such as naphthalene, plenanthrene, and so on through the series up to chrysene and picene or halogen derivatives of hydrocarbons—for example, perchloro-benzol, perchloro-naphthalene, and compounds of nitrogen and hydrocarbons, such as acridin—and, second, compounds which under the influence of heat are decomposed, giving as one of the products of decomposition at least a gas or vapor containing carbon. A good example of this class is paracyanogen.

In carrying out my process I preferably fix in the bulb A a small tube D, which holds a few centigrams of anthracene or chrysene—for example, in lamps the bulbs of which it is expected will become rather hot in actual usage. The air is then exhausted from the bulb A in the usual way. When the lamp burns, the bulb A and the small tube D are heated and the carbonaceous compound *d* vaporizes very slowly in accordance with its vapor-pressure. Upon observing the resistance of such a lamp it will be noticed that it gradually decreases, and, indeed, the rate of decrease (or rather the rate of change) is a function of the temperature, but of course it depends upon many other functions. If the lamp is brought into a considerably-heated place, the resistance decreases much more rapidly. In a cool place, on the other hand, it decreases very slowly or not at all, and in some instances may even increase. Slight differences of temperature, like the variations in a room or in a house, have usually a very slight influence on the speed of vaporization, and consequently on the speed of the succeeding steps of the process. It is obvious that this speed of vaporization depends also upon the nature of the body to be vaporized. If such body has a low vapor-pressure, a lower temperature causes sufficient action. For instance, a lower temperature is necessary in vaporizing naphthalene or plenanthrene than is necessary when chrysene or picene is used. In order that the speed of vaporization may exactly suffice to compensate for the damage to which the filament is subject when the lamp is burning, certain special conditions must be observed; but these conditions vary largely and are dependent upon a great many different factors, such as the chemical and physical properties of the substances vaporized in the bulb, the speed of vaporization, the amount of use of the lamp as compared with its periods of rest, and many other conditions. I therefore find it desirable and even necessary in the production of certain types of lamps to determine these conditions by experimental trials—for instance, by letting lamps burn in spaces having known variations of temperature and by ascertaining in what direction and with what speed the resistance changes. If, for instance, it is found that on burning the lamp in a room kept at 50° centigrade carbon is sufficiently rapidly deposited from the carbon-containing gas on the filament to compensate for the waste that takes place in the same, care should be taken—for instance, by increasing the temperature of the filament—to accelerate the vaporization of the carbon-containing gas-evolving substance. The desired increase of the temperature within the bulb of the lamp may be obtained by diminishing the dimensions of the bulb or by frosting the same. In such lamps the bulbs of which are not completely exhausted, but contain some inert gas, this increase of temperature within the bulb may be obtained by properly selecting such inert gas and suitably determining the pressure of the same. Also the shape of the bulb and the position of the filament in the same are of some influence upon the temperature within the bulb. The effect that is produced by an elevation of temperature can also be obtained by the use of a more volatile carbonaceous substance in the tube. If the formation of the carbon-containing gas goes on too rapidly, the incandescence of the filament becomes stronger and stronger and at last so strong that the lamp may become permanently injured—that is to say, it may get into such a condition that it can be used only with currents of lower tension. As it is by no means easy to hit with absolute accuracy upon the quantity, position, and chemical constitution of the substance to be introduced into the globe, I prefer, if I cannot get the conditions so that the waste in the filament is exactly compensated for by the carbonaceous or carbon-containing gas, (a thing which rarely happens,) to so construct the lamp that the increase in carbon on the filament due to the decomposition of the carbon-containing vapor is slightly less than the damage done to the filament by the operation of burning. Then after long intervals of actual use—fifty hours, for example—a lamp is for a short time burned in a heated space while the tension and current are observed, the filament being thus energetically treated until the required degree of resistance is obtained. For street-lamps this mode of procedure or application of my invention is especially advantageous, as a lamp which is constant when exposed to the cold of winter would generate carbonaceous or carbon-containing gas too quickly in summer-time, although the influence of the external heat or cold can be greatly reduced by double glazing or by an exhausted outer globe.

In the second modification of my process—namely, the use of substances decomposed by heat to produce a carbon-containing gas—the manner of procedure is substantially the same. For example, near the filament is placed a small tube containing—for example, paracyanogen—a compound which by the heat of the glowing filament gives off cyanogen gas, which gas in contact with the glowing filament deposits carbon thereon, setting free nitrogen. This modification is really substantially the same as the modification first described, as in each case a carbon-containing gas is produced—in the first case by simple volatilization and in the second case by volatilization accompanied by decomposition, and in both modifications the decomposition of the carbon-containing gas by the incandescent filament is the same. It is difficult to exactly hit upon the proper position of the small tube relatively to the filament, and I therefore prefer to select a distance which is too great rather than one which is too small. In other words, if I cannot hit upon a distance and a compound by means of which the repair will be exactly equal to the waste I desire that the waste shall be greater than the repair. The lamp is from time to time regenerated by burning it in a heated atmosphere, observing the condition of the current, as previously set forth. As the carbon-containing vapors or gases are decomposed by the action of the incandescent filament, as before described, obviously new gases are formed and set free—for example, hydrogren from hydrocarbons, nitrogen from cyanogen, &c. These gases are conductors of heat, and of course they vary the pressure in the bulb. They therefore by their evolution alter the thermal conditions of the lamp. For these and other reasons, therefore, I consider it advisable (although not strictly necessary) to charge the bulb in the first instance with inert gases, such as nitrogen or argon, which have a tendency to keep the temperature of the lamp constant and the rate of vaporization uniform. Of course it is preferable, if it could be done, that the gas should contain nothing but carbon, so that after the decomposition thereof and deposit of carbon on the filament there should remain no residual gases, especially such as could attack the filament. This condition is not possible, at least as far as I know; but care must be taken in the selection of the hydrocarbon compounds to select those which contain no oxygen. Even with pure hydrocarbons the evolution of the hydrogen and from chlorin carbon compounds the evolution of the chlorin often acts injuriously. To avoid such injurious action, I introduce into the bulbs substances for absorbing such freed products of decomposition—as, for example, spongy palladium, in case pure hydrocarbons are used—or small pieces of metal with very large surfaces—such, for example, as silver foil, which may be formed with convolutions, as shown at E, and secured in the bulb A in any suitable manner—in cases where the halogen carbon compounds are used.

Lamps constructed in accordance with my process, where the conditions of waste and repair are substantially equivalent, will last almost indefinitely, and even should the first cost of said lamps be increased in the end they are very much cheaper and much more satisfactory, because their times of useful service are greatly prolonged and because the light given by them while in service is much more satisfactory.

Having thus described my invention, what I claim, and desire to secure by Letters Patent of the United States, is—

1. The process of manufacturing self-regenerating incandescent lamps, which consists in permanently placing in the bulbs of said lamps a compound, which will evolve a carbon-containing gas or vapor.

2. The process of manufacturing self-regenerating incandescent lamps, which consists in permanently placing in the bulbs of said lamps during the process of manufacture a compound, which under the influence of the heat generated by the burning of the lamp, will evolve a carbon-containing gas or vapor.

3. The process of manufacturing self-regenerating incandescent lamps, which consists in making an incandescent lamp in the usual way, but permanently placing in the bulbs of said lamps during the process of manufacture a compound, which under the influence of the heat generated by the burning of the lamp, will evolve a carbon-containing gas or vapor.

4. The process of manufacturing self-regenerating incandescent lamps, which consists in making said lamps in the usual way, but permanently placing in the bulbs thereof during the process of manufacture a carbon compound, which, under the influence of the heat generated by the burning of the lamp, will evolve a carbon-containing gas or vapor, and inserting another substance in said bulbs capable of mechanically or chemically absorbing the portions of said carbon-containing gas or vapor which are not deposited on the filament of the lamp.

5. The process of manufacturing self-regenerating incandescent lamps, which consists in making said lamps in the usual way, but introducing into the bulbs thereof during the process of manufacture, small tubes con-

taining a carbon compound or compounds, which, under the influence of the heat generated by the lamp while burning, will evolve a carbon-containing gas or vapor, which vapor is decomposed by the heated filament, thereby repairing the waste incident to the burning of the lamp.

6. The process of manufacturing self-regenerating incandescent lamps, which consists in making said lamps in the usual way, inserting in the bulbs thereof during the process of manufacture a carbon compound or compounds, which, under the influence of the heat caused by the burning of the lamp, will evolve a carbon-containing gas or vapor, which gas or vapor is decomposed by the incandescent filament, to repair the waste thereof due to the burning of the lamp, the character of the carbon compound and its position in the bulb being calculated so that the repair in said filament falls slightly short of the waste thereof.

In testimony whereof I affix my signature in presence of two witnesses.

FRITZ BLAU.

Witnesses:

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