CLASSIC INVENTIONS: Edison's Electric Lamp

Light

"Classic Inventions," as a supplement to "Classics of Science," will appear approximately once every four weeks. Its aim, like that of the "Classics of Science," is to reprint accounts of scientific discoveries which everyone has heard of but never seen. Neither series of "Classics" claims to settle any disputes as to priority. Neither claims to use the one, sole and original account of the subject. Nevertheless, as far as possible, the extract chosen gives the author's own account of his discovery, in the light of his vision and his enthusiasm.

Thomas A. Edison, of Menlo Park, New Jersey. ELECTRIC LAMP. Specification forming part of Letters Patent No. 223,898, dated January 27, 1880.

To all whom it may concern:

Be is known that I, THOMAS ALVA EDISON, of Menlo Park, in the State of New Jersey, United States of America, have invented an Improvement in Electric Lamps, and in the method of manufacturing the same, (Case No. 186,) of which the following is a specification.

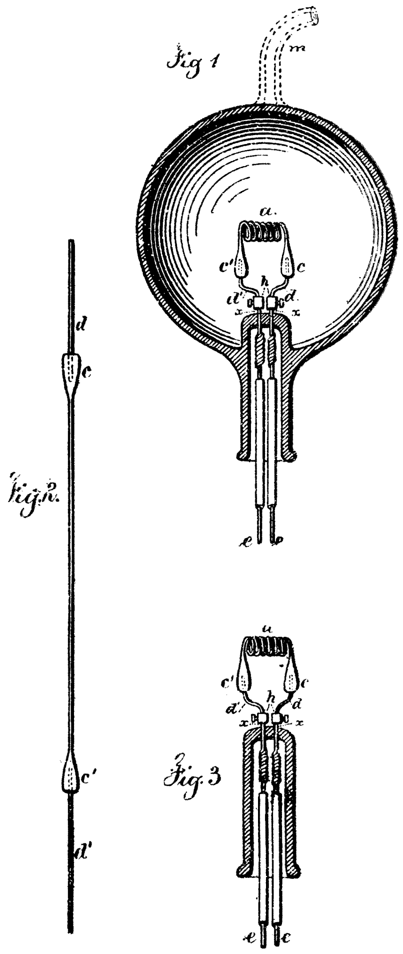
The object of this invention is to produce electric lamps giving light by incandescence, which lamps shall have high resistance, so as to allow of the practical subdivision of the electric light.

The invention consists in a light giving body of carbon wire or sheets coiled or arranged in such a manner as to offer great resistance to the passage of the electric current, and at the same time present but a slight surface from which radiation can take place.

The invention further consists in placing such burner of great resistance in a nearly perfect vacuum, to prevent oxidation and injury to the conductor by the atmosphere. The current is conducted into the vacuum bulb through platina wires sealed into the glass.

The invention further consists in the method of manufacturing carbon conductors of high resistance, so as to be suitable for giving light by incandescence, and in the manner of securing perfect contact between the metallic conductors or leading wires and the carbon conductor.

Heretofore, light by incandescence has been obtained from rods of carbon of one to four ohms resistance, placed in closed vessels, in which the atmospheric air has been replaced by gases that do not combine chemically with the carbon. The vessel holding the burner has been composed of glass cemented to a metallic base. The connection between the leading wires and the carbon has been obtained by clamping the carbon to the metal. The leading wires have always been large, so



THE FIRST ELECTRIC LAMP

that their resistance shall be many times less than the burner, and, in general, the attempts of previous persons have been to reduce the resistance of the carbon rod. The disadvantages of following this practice are, that a lamp having but one to four ohms resistance cannot be worked in great numbers in multiple arc without the employment of main conductors of enormous dimensions; that, owing to the low resistance of the lamp, the leading wires must be of large dimensions and good conductors, and a glass globe cannot be kept tight at the place where the wires pass in and are cemented; hence the carbon is consumed, because there must be almost a perfect vacuum to render the carbon stable, especially when such carbon is small in mass and high in electrical resistance.

The use of a gas in the receiver at the atmospheric pressure, although not attacking the carbon, serves to destroy it in time by "air-washing," or the attrition produced by the rapid passage of the air over the slightly coherent highly heated surface of the carbon. I have reversed this practice. I have discovered that even a cotton thread properly carbonized and placed in a sealed glass bulb exhausted to one millionth of an atmosphere offers from one hundred to five hundred ohms resistance to the passage of the current, and that it is absolutely stable at very high temperatures; that if the thread be coiled as a spiral and carbonized, or if any fibrous vegetable substance which will leave a carbon residue after heating in a closed chamber be so coiled, as much as two thousand ohms resistance may be obtained without presenting a radiating surface greater than three sixteenths of an inch; that if such fibrous material be rubbed with a plastic composed of lamp black and tar, its resistance may be made high or low, according to the amount of lamp-black placed upon it; that carbon filaments may be made by a combination of tar and lamp-black, the latter being previously ignited in a closed crucible for several hours and afterward moistened and kneaded until it assumes the consistency of thick putty. Small pieces of this material may be rolled out in the form of wire as small as seven one-thousandths of an inch in diameter and over a foot in length, and the same may be coated with a non-conducting non-carbonizing substance and wound on a bobbin, or as a spiral, and the tar carbonized in a closed chamber by subjecting it to high heat, the spiral after carbonization retaining its form.

All these forms are fragile and cannot be clamped to the leading wires with sufficient force to insure good contact and prevent heating. I have discovered that if platinum wires are used and the plastic lamp-black and tar material be molded around it in the act of carbonization there is an intimate union by combination and by pressure between the carbon and platina, and nearly perfect contact is obtained without the necessity of clamps; hence the burner and the leading wires are connected to the carbon ready to be placed in the vacuum bulb.

When fibrous material is used the plastic lamp-black and tar are used to secure it to the platina before carbonizing.

By using the carbon wire of such high resistance, I am enabled to use fine platinum wires for leading wires, as they will (*Turn to next page*)

The Future of Heating

Engineering

Ernest Greenwood, in *Prometheus, U. S. A.* (Harper's):

It is only yesterday that our mothers and grandmothers were toiling with the coal range in the kitchen, and the astonishing thing about it is that it took man so long to question its perfection and to say to himself: "There must be something better." The housewife of those days had to be a competent heating engineer if she was to be a good cook. Her knowledge of how to build and keep the fire played quite as important a part in the production of the good things which came on the table as her knowledge of how to prepare and mix the ingredients. Water had to be heated on this range, and the Saturday-night bath was taken in tin or wooden tubs in the kitchen beside it. The only artificial light came from candles or, at best, the kerosene lamp. Refrigerators, electric lights, running water, the gas range, and a host of other conveniences which are commonplace today were unknown.

Then came the gas company with its gas ranges to relieve the housewife from untold drudgery. Kitchens are thought of today in terms of gas ranges. Here was a device by means of which heat for cooking could be had at a moment's notice just when it was wanted, and turned off completely the moment it was no longer needed. No longer was it necessary for the housewife to be a heating engineer—the gas company had relieved her of that obligation. No longer did the kitchen resemble a Turkish bath in summer. This was followed by the gas hot-water heater to take the place of the old coal-range boiler, and coal in the kitchen as direct fuel was gone forever.

In the meantime man was busy with the creation of devices to take the place of the coal range in those districts where gas was not obtainable. Oil ranges and portable oil stoves for heating began to appear on the market, and their manufacture soon became a great industry. Even today this is a thriving industry and literally hundreds of thousands of oil ranges and portable oil heaters are manufactured and sold all over the world every year.

Then man began to turn his attention to house heating. With the constant improvement in coal-burning central plants in the cellar it seemed as though little more could be done. But he resented having thrust upon him continually the machinery by means of which he kept warm—the drudgery of the coal furnace made him say once more to himself: "There must be something" even better, and turned his thoughts to something which would relieve him of it. Experiments in oil-burning devices had been going on for a long time and the gas companies were searching for a type of burner which would enable them to heat the home at a cost which would be within range of the man of moderate means.

Science News-Letter, August 10, 1929

Edison's Lamp—*Continued*

have a small resistance compared to the burner, and hence will not heat and crack the sealed vacuum bulb. Platina can only be used, as its expansion is nearly the same as that of glass.

By using a considerable length of carbon wire and coiling it the exterior, which is only a small portion of its entire surface, will form the principal radiating surface; hence I am able to raise the specific heat of the whole of the carbon, and thus prevent the rapid reception and disappearance of the light, which on a plain wire is prejudicial, as it shows the least unsteadiness of the current by the flickering of the light; but if the current is steady the defect does not show.

I have carbonized and used cotton and linen thread, wood splints, papers coiled in various ways, also lampblack, plumbago, and carbon in various forms, mixed with tar and kneaded so that the same may be rolled out into wires of various lengths and diameters. Each wire, however, is to be uniform in size throughout.

If the carbon thread is liable to be distorted during carbonization it is to be coiled between a helix of copper wire. The ends of the carbon or filament are secured to the platina leading wires by plastic carbonizable material, and the whole placed in the carbonizing chamber. The copper, which has served to prevent distortion of the carbon thread, is afterward eaten away by nitric acid, and the spiral soaked in water, and then dried and placed on the glass holder, and a glass bulb blown over the whole, with a leading tube for exhaustion by a mercury pump. This tube, when a high vacuum has been reached, is hermetically sealed.

With substances which are not greatly distorted in carbonizing, they may be coated with a non-conducting non-carbonizable substance, which allows one coil or turn of the carbon to rest upon and be supported by the other.

In the drawings, Figure 1 shows the lamp sectionally. *a* is the carbon spiral or thread. *c c'* are the thickened ends of the spiral, formed of the plastic compound of lamp-black and tar. *d d'* are the platina wires. *h h* are the clamps, which serve to connect the platina wires, cemented in the carbon, with the leading-wires *x x*, sealed in the glass vacuum-bulb. *e e* are copper wires, connected just outside the bulb to the wires *x x*. *m* is the tube (shown by dotted lines) leading to the vacuum pump, which, after exhaustion, is hermetically sealed and the surplus removed.

Fig. 2 represents the plastic material before being wound into a spiral.

Fig. 3 shows the spiral after carbonization, ready to have a bulb blown over it.

I claim as my invention—

1. An electric lamp for giving light by incandescence, consisting of a filament of carbon of high resistance, made as described, and secured to metallic wires, as set forth.

2. The combination of carbon filaments with a receiver made entirely of glass and conductors passing through the glass, and from which receiver the air is exhausted, for the purposes set forth.

3. A carbon filament or strip coiled and connected to electric conductors so that only a portion of the surface of such carbon conductors shall be exposed for radiating light, as set forth.

4. The method herein described of securing the platina contact-wires to the carbon filament and carbonizing of the whole in a closed chamber, substantially as set forth.

Signed by me this 1st day of November, A. D. 1879.

THOMAS A. EDISON.

Witnesses:

S. L. Griffin,

John F. Randolph.

Science News-Letter, August 10, 1929