THE FRANKLIN INSTITUTE

COMMITTEE ON SCIENCE AND THE ARTS

No. 2710 *Subject* Sperry High Intensity Searchlight

Applicant Elmer Ambrose Sperry

Address Manhattan Bridge Plaza, Brooklyn, N. Y.

Date of Application November 10, 1917.

Inventor Above

Address

COMMITTEE:

Mr. W. C. L. Eglin, *Chairman*

Mr. Charles Wm. Masland,

Mr. Charles Penrose,

Mr. M. M. Price,

Mr. F. R. Wadleigh.

MEETINGS:

Tuesday, September 9, 1919, four P.

Report presented to General Committee:

Tabled, April, 1920.

Final Action:

Award

to

Report sent to Inventor

THE FRANKLIN INSTITUTE OF THE STATE OF PENNSYLVANIA

For the Promotion of the Mechanic Arts

Committee on Science and
the Arts Case No. 2710.

THE SPERRY HIGH-INTENSITY SEARCH-LIGHT.

Search by Science and Arts Assistant.

March 12, 1918.

An electric arc is set up between two conductors whenever they are placed in line touching each other, have an electric current sent through them and are then drawn apart.

The resistance at the point of contact, being greater than that of any other part of the circuit, having equal length, there results a local increase of heat at that point, which makes the conductors incandescent and which enables the arc to be established and maintained when the conductors are separated.

The maintenance of the arc requires a certain potential difference at the terminals, and the passage of the current causes a wearing away of the terminals of the conductors. The potential difference required to maintain an arc between carbon terminals, where a current of nine or ten amperes is used, is from 45 to 50 volts. This type of low voltage arc light is well known, having been in use for many years.

It is well adapted for use in projectors, since the intensity of the light is higher than that of any other known artificial source, and the source is of small area, being mainly confined to the crater in the end of the positive carbon.

While the light from such an arc is satisfactory for projecting lanterns and the like, it does not furnish a source of sufficient capacity for such projectors as are used on battleships, or for any purpose in which a great quantity of light is required. These requirements have formerly been met by increasing the cross sectional area of the light-giving crater. As the area of this crater increases, there is a corresponding increase in the difficulty of keeping the point of maximum light intensity in the same place in the crater.

The means employed by Mr. Elmer A. Sperry, for securing a fixed location for the principal source of light in his High Intensity Search-Light, is described in this report, and is disclosed in U. S. Patent No. 1,227,210, dated May 22, 1917, for which the application was filed on June 28, 1915.

Three citations were made--one to McLean's U. S. Patent No. 593,899, for an "Electric-Arc Lamp," using cored carbons, which contains the following claim: "The combination with an arc-inclosed alternating-current arc-lamp of cored carbons, the cores of which are one-sixteenth of an inch in diameter or less, substantially as set forth." A second to Beck's U. S. Patent No. 1,029,787, for an "Electric Arc Lamp for Search-Lights, Projectors, and the like." In this device, the location of the crater is controlled by a blast of air or other gas from an external source.

The third citation to Beck's U. S. Patent No. 1,086,311, which contains three claims, as follows:

1. "The method of operating arc lamps which consists in employing a high current density which produces a tongue in the negative flame and deflecting said tongue from the center of the positive electrode."

2. "The method of operating arc lamps which consists in employing a high current density which produces a tongue in the negative flame and blowing said tongue away from the center of the positive electrode."

3. "The method of operating arc lamps which consists in employing a high current density to produce a tongue in the negative flame and deflecting said tongue away from the center of the positive electrode by a jet of gas."

Plate I is taken from the afore mentioned patent and shows how the results claimed are obtained. In Fig. 1 of this plate, a represents the positive carbon, and b, the negative, c is the positive crater, f and f_1 are flames coming from the negative carbon. The positive electrode is of the "flame arc" type, while the negative is of the solid carbon type. In this figure the flame from the negative carbon is represented as surrounding the end of the positive carbon, thus shutting out the oxygen of the air and reducing the crater of the positive carbon to a slight depression.

The conditions that are desired are shown in Fig. 2.

These are a deep crater and a deflection of the flame from the negative carbon away from this crater. To produce the deep crater a heavy current rising to 120 amperes, or more, is used, while the diameter of the carbon is reduced to 20 mm., thus making the current density very high. This corresponds to a current density of 39 amperes per square centimeter or 250 amperes per square inch.

To keep the flame from the negative carbon from surrounding the positive crater, three suggestions are made; that of Fig. 3, in which both carbons are horizontal, but the negative slightly raised above the positive; that of Fig. 4, in which the positive carbon is horizontal but the negative is slightly inclined, so that the flame passing out from it will strike above the positive crater; and that of Fig. 5, in which a jet of air or other gas is directed toward the negative flame at a right angle to its direction.

The Sperry High-Intensity Search-Light, which is the subject of this report, is disclosed in British Patents Numbers 12,999 of 1915; 100,781 of 1916, and U. S. Patent No. 1,227,210 of May 22, 1917, for which the application was filed June 28, 1915.

The object of the invention is to provide a source of light for search-lights, projectors, and the like, which will emit a higher candle-power per unit area of light source than can be obtained from the ordinary carbon-arc.

To obtain this result the light from the incandescent crater of the positive carbon is used, and, in addition to this, a volume of brilliantly glowing vapor, which is confined to such a position in the arc that substantially the total amount of light that it emits is added to the light from the incandescent crater. A method of reducing the area of the light source is also used, which results in greatly increasing the intrinsic brilliancy of the source.

The characteristics of this arc are shown in Plate II. Fig. 1 represents an ordinary low-pressure arc, the positive crater being shallow,and the positive and negative flames striking against each other.

Fig. 6 shows the desired condition of burning, in which the positive crater is deep, and the positive flame is mainly confined within this crater.

Fig. 2 shows the result of increasing the current with the same carbons as in Fig. 1. The positive crater is deeper than in Fig. 1, but the flames from the two electrodes meet in a rising arc, the light from which is fluctuating, while the arc itself is unsteady, with a tendency to rise to the top of the negative carbon.

In order to control the direction of the negative flame, a cored carbon is used for the negative, as shown in Fig. 3. This core is of small diameter and is filled with a vapor-producing material that burns away faster than the shell. The use of this core confines the negative flame to a small crater at the tip of the carbon and gives to the flame coming from this crater a well defined direction. The negative carbon is small, thus forming but a slight obstacle in the path of the projected rays.

The positive carbon is also provided with a core, 2, (Fig. 2) the material of which produces a flaming arc when burned.

The heavy current used, from 90 to 150 amperes, produces a current density of 500 amperes per square inch, and by its rapid burning away of the core makes a deep crater in the positive carbon. The luminous flame from the positive carbon is retained within this crater by the controlling action of the flame from the negative carbon acting at high current intensities, as a blast projected from the negative terminal.

To use this directed negative blast so that it may confine the positive flame to the best advantage, it is necessary to cause a definite impinging contact between the two flames across the crater mouth in such a manner that a steady and somewhat upwardly inclined current is created at the contact of the two flames (Fig. 6). This kind of impingement permits a steady escape of a small portion of the spent vapor from the positive crater, thus preventing the flickering of the arc. This escape of spent vapor over the upper lip of the arc is shown in Fig. 6, which also shows a ball of condensed luminous vapor in the positive crater.

Fig. 7 indicates a method by which the desired direction of the projected flame from the negative carbon can be secured when that terminal is placed in such a position that it will not cast a shadow in the direction of the projected beam.

No 15 in this figure represents the cross section of a coil of conductor in the form of a ring. Whenever an electric current is sent through this ring its electro-magnetic effect can be used to give direction to the flame. To maintain the proper depth and symmetry of its crater, the positive carbon is rotated continuously in the direction indicated by the arrow, 20, in Fig. 6. This arrangement produces a steady, reliable and very concentrated arc having a fall of potential of from 70 to 75 volts.

Seven claims are mentioned in the Sperry patent, which may be briefly stated as follows: The method of operating flaming arc lamps for projectors so as to give a two-flame arc; to direct the negative flame past the positive at such an angle as to confine the positive flame mainly to the crater, allowing but a slight amount of the flame to escape from it; to rotate the positive carbon in order to secure a deep and symmetrical crater; to make use of a negative carbon having a core of more rapidly burning material than the shell, the flame from which deposits a protective layer of graphite on the outside of the positive carbon and to use so great current density that the foregoing results can be obtained.

The claim is made by the inventor that, for a given size of search-light and a given current consumption, the Sperry Light has increased the beam intensity from 500 per cent. to 800 per cent., and has more than doubled the useful range of the search-light.

The device is operated and controlled by an automatic mechanism in such a way as to give continuously a steady light of high intrinsic brilliancy.

This invention has been in use in several countries since the latter part of 1915.