H. AYRTON.

ARC LIGHT CARBON.

APPLICATION FILED MAR. 7, 1914.

1,115,480. Patented Nov. 3, 1914.

Fig. 1.

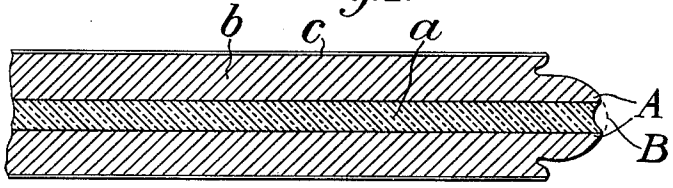


Fig. 2.

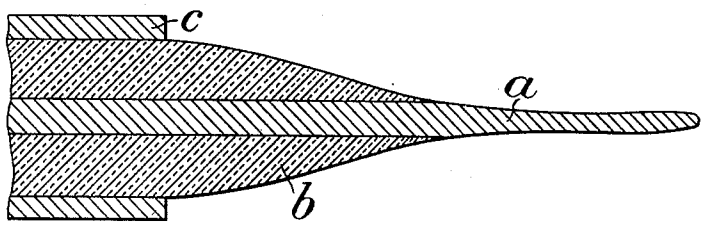
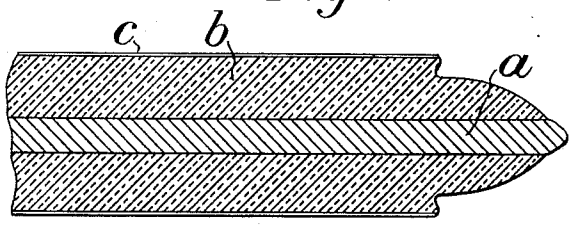


Fig. 3.



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UNITED STATES PATENT OFFICE.

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ARC-LIGHT CARBON.

1,115,480. Specification of Letters Patent. Patented Nov. 3, 1914.

Application filed March 7, 1914. Serial No. 823,123.

To all whom it may concern:

Be it known that I, HERTHA AYRTON, subject of the King of Great Britain, residing at 41 Norfolk Square, Hyde Park, in the county of London, England, have invented certain new and useful Improvements in Arc-Light Carbons, of which the following is a specification.

This invention relates to negative carbons for arc lights.

It has not yet been possible to produce a negative carbon which may be of any required thickness and which will maintain a perfectly steady arc with a suitable current and positive carbon under the varying conditions which exist in different lamp-houses or inclosures employed for arc lighting.

In the drawings accompanying this specification, Figures 1 and 2 are longitudinal sections of electric light carbons which have been heretofore used, and Fig. 3 is a longitudinal section of an electric light carbon made in accordance with my present invention.

It is the object of this invention to provide a negative carbon which will fulfil these conditions or which can be readily manufactured to suit any particular conditions.

It is well known that to secure a steady silent arc, giving constant illumination, it is necessary that the end surface of the burning tip of the negative carbon shall be so small that the arc cannot wander about on it. To overcome the various difficulties encountered with negative carbons it has hitherto been proposed to employ very slender carbons and to coat them with copper to increase the conductivity of the carbon and thereby prevent its becoming unduly heated by reason of its reduction in size. I have also previously proposed for the purpose of obtaining a slender carbon to employ a carbon consisting of a soft core surrounded by a shell of hard carbon covered with thin copper which by increasing the conductivity of the rod allowed of a much slenderer carbon with the same current than could otherwise be employed. Carbons so made give very good results for searchlights, where the inside of the lamp-house may be kept very hot, because the arc is always at a fair distance from the mirror of the lens. I found that under these conditions the carbons burnt away somewhat in the form indicated in Fig. 1 of the accompanying drawings, from which it will be seen that the soft core *a* burns away with a central depression in such a manner as to leave only a small ring A of hard carbon for the arc to rest upon. If, however, a carbon made as above described is used in a lamp-house which has to be kept comparatively cool, to avoid the cracking of the lens, I find that the burning away of the soft core cannot always be depended upon, and at times it may only burn away at about the same rate as the outer shell of hard carbon *b* with the result that the tip of the negative carbon has no depression in it, and presents a blunt point entailing a large end surface as indicated in the dotted lines B Fig. 1, which form is very undesirable and produces an unsteady and noisy arc. It will therefore be seen that in the case of ordinary carbons it has been proposed for the purpose of obtaining a slender carbon to employ in one case a substantial thickness of copper covering, and in another case to employ a thin copper covering upon a hard shell inclosing a soft core. Further it has also been proposed to employ a thin copper covering to prevent the disintegration of carbons made of luminiferous material which burn in a different way from ordinary carbons, but none of these proposals have been entirely successful in accomplish the object of this invention. It has also been proposed to make negative carbons without a copper covering and in which the core *a*, Fig. 2, was hard, or less easily combustible than the body of the carbon *b* so that a well tapered point may be secured, but such carbons have the disadvantage that the soft outer shell burns away too rapidly, and leaves a long narrow portion consisting mainly of a hard core (Fig. 2) which sometimes even breaks off at the holder *c* Fig. 2. It has also been proposed to employ a carbon made of a hard core, a more easily combustible shell and an outer coating of copper, the latter being employed for the purpose of increasing the conductivity of the carbon and therefore necessarily being of some substantial thickness. The copper covering employed by me is, however, a mere film serving only as a means for predetermining or adjusting the rate at which the outer shell will burn away.

I find that the desired results are obtained with a negative carbon consisting of the combination of the following: 1. A cen-

tral core of hard carbon. 2. An outer shell of carbon which is made to burn away more easily than the core either by being softer, or by being mixed with other substances or in any other way. 3. A thin film of copper adhering very tightly to the outside of the soft shell.

The thickness of the hard core and outer shell must of course depend upon the current that is required and I find that the thickness of the copper skin may also be varied with advantage within certain limits. The lower of these limits is determined by the thickness required to withstand the necessary handling and packing; the upper limit depends upon the thickness which will result in the outer shell not burning away sufficiently far to allow the core to protrude well beyond it. Within these limits quite a small variation in the thickness of the metallic skin makes a sufficient variation in the length of the carbon tip exposed to cause a considerable change in the rate of burning of the carbon. The thinner the copper all other things being equal the longer is the exposed tip and the faster therefore does the carbon burn. This leads to the following important result: I find that by choosing the right thickness of core, outer shell, and copper skin, it is always possible to obtain a negative carbon that will burn steadily at substantially the same rate as any positive carbon suitable for the current and pressure employed.

A negative carbon constructed according to this invention is shown in Fig. 3 of the accompanying drawings. There is a central core *a* of hard carbon, an outer shell *b* of carbon which is made to burn away more quickly than the core and a thin incasing film *c* of copper, or other metal.

The copper coating here employed is not used, as such coatings have hitherto been, to reduce the size of the carbon by increasing its conductivity. So long as the carbon burns with such a tip that the core protrudes well beyond the softer outer shell, its size elsewhere is unimportant. The sole object of the copper film is to form a tightly adhering incombustible skin over the carbon, which, while protecting the major portion of it from burning, shall always melt off and volatilize at such a distance from the tip as to allow the point to be well tapered, and to insure that none of the melted or volatilized metal shall enter the arc. A carbon with a hard core, a more combustible outer shell and a protective metallic skin, such as is described above, burns with perfect steadiness during the whole of its life. Also there is so little copper that most of it volatilizes as it melts and does not drop off or splash the lens or mirror as is the case where thick copper coverings are employed and the copper melts at such a distance along the carbon that none of the melted or volatilized metal enters the arc. Fig. 3 of the drawings shows an example of the shape assumed during burning of a negative carbon made in accordance with this invention.

The outer shell and the central hard core need not necessarily be in engagement since a film or skin of copper may be interposed between them.

I find that in a comparatively cool lamphouse with a current of 85 amperes, a 15 mm. negative carbon having a hard core 4 mm. in diameter, and a skin or coating of copper .02 mm. in thickness burns perfectly steadily with a cored positive carbon 25 mm. in diameter during the whole of both of their lives, and they both burn at substantially the same rate.

Other metals besides copper may be employed to form the incombustible coating, though copper has so far been found the most useful.

What I claim and desire to secure by Letters Patent is:—

1. A negative carbon for arc lights consisting of the combination of a hard core, a softer or more readily combustible shell and an outer film of copper or some other metal, the whole being such that the metal, while forming an adherent incombustible skin over the carbon, melts and volatilizes at such a distance from the tip that the melted and volatilized metal is too far from the arc to enter it, and that the bared carbon burns so that the core always protrudes well beyond the outer shell and the arc remains steadily on the protruding end without moving substantially as set forth.

2. A negative carbon for arc lights, consisting of the combination of a hard core, a softer or more readily combustible shell and an outer film of copper or some other metal, the whole being such that the metal, while forming an adherent incombustible skin over the carbon, melts and volatilizes at such a distance from the tip that the melted and volatilized metal is too far from the arc to enter it, and that the bared carbon burns so that the core always protrudes well beyond the outer shell and the arc remains steadily on the protruding end without moving, the parts of said carbon being so proportioned that it will burn away at the same rate as any positive carbon suitable for the current employed substantially as set forth.

3. A negative carbon for electric lights comprising a hard core, a softer or more readily combustible shell and a film of incombustible volatilizable metal disposed upon such shell.

4. A negative carbon for electric lights comprising a hard core, a softer or more readily combustible shell and a film of incombustible volatilizable metal disposed

upon such shell, the various parts of the structure being of such relative proportion that the same will burn away at the same rate of speed as any positive carbon suitable for the current employed, substantially as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

HERTHA AYRTON.

Witnesses:
G. V. SYMES,
ALFRED B. CAMPBELL.