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## CARBON ELECTRODE FOR PROJECTORS

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7 Claims. (Cl. 176—119)

The invention relates to carbon-electrodes for projectors.

In the projection of moving pictures in theatres, it is desirable to project a complete roll of film without interruption. At present, motion picture reels frequently contain as much as 2000 feet of film. When an arc lamp is used for projection, it has been customary to inspect the carbons before starting to run off a reel to ascertain whether there is sufficient of the carbon-electrode left to furnish illumination for the complete roll of film. It frequently requires, for example,  $4\frac{1}{2}$  or more inches of positive carbon-electrode to furnish illumination for an entire roll of film about 2000 feet in length and less of a negative carbon-electrode. In order to avoid interruption in the projection of the film by the loading of a carbon or the consumption of the carbon-electrode before the film reaches its end, the operator, if the unconsumed remainder of the electrode is so short, say about 4 inches, that it is not ample for projection of the entire roll of film, will remove the partially consumed carbon-stick and replace it with one of full length. This results in a very substantial loss or waste from the failure to utilize the unconsumed pieces which are removed from the lamp-house. This waste sometimes runs as high as 25 to 35% of the carbon-stick, and results in a correspondingly increased cost of providing illumination.

Carbon electrodes, for efficient illumination for projection, are composed of a soft core of neutral carbon, a hard carbon shell surrounding the soft core and a coating of carbon which acts as an electrical conductor. In practice, it has been found that such carbon sticks can not be connected together end-to-end for continuous or uninterrupted illumination unless contact or continuity of the core and the carbon shell is maintained in the sticks and provision is made for uninterrupted electrical conduction between the copper coating on the sticks. Any gap between the cores or shells of the sticks results in flickering and inefficient and unsatisfactory projection of the film. Any interruption of the flow of current through the copper coating results in an arcing or separation of the sticks at the joint and burning at the gap before it reaches the arc and causes an interruption of the light for projection. So far as I am aware, prior attempts by the end-to-end connection of carbon sticks for continuous or uninterrupted illumination have not been practical or successful because no provision was made for making the cores and shells continuous or without a gap at the joint,

or for continuous conduction between the coatings on the adjacent ends of the sticks.

One object of the invention is to provide carbon-electrodes in stick-form for use in electrical lamps for picture projection, which are adapted to be joined end-to-end for continuous and uninterrupted illumination, for connection of partially consumed and unconsumed joined carbon-sticks and in which the core and carbon shell of the joined sticks are continuous and there is no interruption of current conduction through the copper coating at the joints.

Primarily, these objects are attained by providing sticks which are adapted to be joined or telescoped together end-to-end by the operator in such a manner that there will be no gap between the cores and carbon shells at the joint and no interruption of conductivity in the coating of copper at the joint, with the result that while the carbon sticks adjacent the joint are being consumed, there is no interruption, flickering or substantial reduction in the efficiency or degree of illumination.

Other objects of the invention will appear from the detailed description.

The invention consists in the several novel features which are hereinafter set forth and are more particularly defined by claims at the conclusion hereof.

In the drawing:

Fig. 1 is a view, partly in section, of a lamp-house for a motion picture projector, illustrating the use of carbon-electrodes in accordance with the invention. Fig. 2 is a perspective, parts being shown in section, of one partially consumed, and one full length carbon-electrode embodying the invention before being connected end-to-end for successive consumption in the lamp-house. Fig. 3 is a perspective, partly in section, of partly consumed and full length carbon-sticks connected together end-to-end for complete consumption of the partly consumed stick. Fig. 4 is a perspective of the sleeve or band for electrically connecting the copper coatings of the strips and maintaining a continuous path for electric current between the coatings on connected sticks. Fig. 5 is a perspective of the sleeve applied to two sticks. Fig. 6 is a view illustrating the telescopic portions of two sticks being welded together at the arc before the sleeve begins to melt. Fig. 7 is a view illustrating the portion of the connecting sleeve melted with the short end of the female section of the telescopic joint held on the male section by the weld previously made.

The electrodes embodying the invention are designed for use in a lamp-house A which is associated with a picture projector. This lamp-house may be of any suitable or usual construction and contains a reciprocable carriage 10 provided with a clamp 11 for holding one end of a positive carbon electrode 12; a fixed bracket 13 having an open-sided slot in which the positive carbon-electrode is slidably supported adjacent the arc; a reciprocable carriage 14 which carries a clamp 15 for gripping one end of the negative electrode 16; and a fixed support 17 having a notch in its inner end in which the negative electrode is slidably supported adjacent the arc. The negative electrode extends through reflector 18. Automatic or power-driven mechanism is usually provided for feeding the carriages 11 and 14 toward each other to feed the electrodes at such a rate as to compensate for the consumption of carbon at the arc, as well understood in the art. These carriages are also manually operable to adjust the contiguous ends of the carbon-electrodes, for varying the arc length for efficient illumination. Initially, electrodes 12 and 16 have their outer ends secured in the clamps 11 and 15 respectively and the carriages are set to hold the electrodes so their inner ends are correctly spaced apart for the arc. The details of the feed mechanism for the electrodes form no part of the present invention and, therefore, it has not been illustrated and described in detail. The carbons embodying the invention are adapted for use, and the method of providing continuous illumination from electrodes connected together end-to-end can be carried out, in present lamp-house equipment.

Each carbon electrode, for efficient illumination for picture projection, comprises a body consisting of a partially soft core 20 of neutral carbon and a hard carbon shell 21 around the core and a conductive coating 22 of copper around the shell.

Each carbon stick is provided at one end with a longitudinally tapered socket 24 and at its other end with a tapered stem 25 which constitute, respectively, female and male members of a telescopic joint for end-to-end connection with similar sticks. The inner periphery of socket 24 and the outer periphery of male member 25 are formed in the hard carbon shell portion 21 of the stick. The inner end of socket 24 and the outer end of member 25 terminate in flat faces 24', 25', respectively. The inner and outer peripheries of the female and male members, respectively, are tapered to conform to each other and to provide a firm contact between the hard carbon shell portions of joined carbon sticks. The end faces 24', 25' of the male and female members are located so they will abut against each other when the sticks are telescopically joined. In these end-faces the soft core portions are flush with the portions of the shell. This results in providing continuity of the hard carbon in the shell portions of the sticks and in the soft cores of the sticks. This continuity is of great importance in preventing flickering or interruption of the light when the joint reaches the arc. This also provides continuous protection of hard shell carbon around the soft core in both of the joined sticks. In order to avoid a gap between the transverse end-faces 24', 25' when the two sticks are telescopically connected, it is necessary to provide a slight clearance, as at 25<sup>a</sup>, between the coatings and the outer circumferential portions of the carbon shells in the socket and the tapered stem.

This necessitates a slight gap between the copper coatings 22 on the sticks. When a pair of sticks are telescopically joined it is important, in order to maintain efficiency of the light, to provide continuity of the carbon in the core and continuity of carbon in the shell because any gap results in flickering or interruption of the light. For this reason, the tapered portions of the male and female members must firmly contact with each other to provide for continuity of the shell and the end members must firmly abut to provide continuity of the carbon in the core.

The tapered and telescopic connection, as thus described, serves to connect the sticks endwise, firmly and to maintain continuity of the carbon shell and the carbon core at the joint so no flickering or decrease of illumination will result when the connection reaches the arc.

For efficient illumination, it is necessary to provide a continuous path for electric current through the copper coatings from the support to the arc or throughout the length of the electrode. Any interruption or slight gap in the copper coating when the sticks are telescopically connected will result in arcing across, and burning away of the stick at, the gap, no matter where in the coating the gap is located. At the joint between two carbon sticks, a split or resilient sleeve of metal of high conductivity, such as copper, is provided to receive and resiliently grip the contiguous end portions of such sticks, as shown in Fig. 4, for the purpose of maintaining conductivity through the coatings of the connected sticks. The central portion of this sleeve is formed with a very slight bead 33 which fits in the slight clearance 25<sup>a</sup> between the sticks and positions it so that each end-half of the sleeve will clamp around one of the sticks. This sleeve is provided with circumferentially offset longitudinal slots 34, 35 which extend inwardly from the ends, respectively, to adapt each end portion of the sleeve to resiliently fit around and contact with one of the copper coatings of adjacent sticks and to form an efficient electrical path for the current flow through the copper coatings on the sticks to the arc. The slots are circumferentially offset so that each end-portion of the sleeve will resiliently and firmly grip one of the sticks notwithstanding slight variations in the outer diameters of the sticks. In addition to performing this conducting function, the sleeve reinforces the telescopic connection between the carbon sticks and secures them together until the sleeve is consumed at the arc.

In operation, the copper coating and sleeve of the electrode at the arc are burned and drip away in advance of the core and carbon shell, usually about a half inch, as indicated at a, (Fig. 6), and the portion b of the carbon shell and core beyond the coating or sleeve will glow to produce the desired light. The copper coatings and sleeve, as they reach the arc, will be melted and drip from the electrode, as indicated at c.

In practice, it is important to prevent a short trailing end of the nearly consumed stick from falling off its mating telescopic portion as it nears the arc, particularly after one-half of the sleeve has been consumed, for example, as shown in Fig. 7. To prevent this, the socket 24 and stem 25 are of sufficient length, approximately three-quarters of an inch, so that the abutting inside end faces 24', 25' of the male and female members will reach the arc in advance of the leading end of the sleeve, as shown in Fig. 6. With such length of said members the sleeve is usually one inch

in length so it will lap each stick approximately one-half inch. In this figure, the portion *b* of the carbon stick will be glowing and the portions of the male and female members in the glowing zone will be fused or welded together in advance of the sleeve and while the sleeve is still effective in holding the sticks together. As a result, the leading portions of the members will be progressively brought to a glow and heated so they will be fused together. When the copper coating and sleeve have been burned away to the point shown in Fig. 7, the fragment of the female portion of the consumed stick will be fused or welded to the male portion of the second stick, so that it cannot drop from the male member. This results from providing male and female members in the telescopic connection of such length that they will be welded or fused together before reaching the arc and so that short ends will not drop from the electrode and interrupt the efficient illumination desired.

The method of the present invention involves interconnecting a partially consumed carbon-stick and a full length carbon-stick end-to-end in the lamp-house for continuous illumination from, and for the cumulative period of, the connected carbon-sticks. In projection, the carriages 11 and 15 are gradually advanced toward each other as the carbons are consumed to maintain the arc for efficient illumination. When the operator commences to project a long roll of film and one or both carbons have been partially consumed and the remaining carbon is of such length as to leave it doubtful whether it will burn until the entire reel has been run off, he will leave the short end of the carbon in the clamp or holder, and insert the tapered end 25 of a full length stick into the socket 24 of the short or partly consumed stick and connect both sticks to a sleeve 32 and secure the outer end of the long stick in its carriage, thus providing an elongation of the electrode, as shown in Fig. 1.

The invention provides carbon electrodes consisting of carbon cores and shells and copper coatings and a method of elongating them, which makes it possible to keep the electrodes of sufficient length for projecting long reels of film without discarding or wasting short lengths of carbon and which provides for continuity in the core and shells at the joint and for continuity of conduction across the copper coatings at the joint and which prevents short pieces of the telescopically joined portions from falling from the electrode at the arc so that the illumination while the joined portions of the electrode are being consumed, will not be interrupted, flickering will be avoided, and illumination will be constantly efficient.

When the arc reaches the joint between the telescopically connected sticks, there will be continuity of the carbon core and shell at the arc and continuity of current conduction through the copper coating, and no short end of the consumed stick will separate from the succeeding stick to which it is connected, so that there will be no interruption in the efficient supply of light while the portions of the sticks forming the light are consumed.

The invention may be applied to positive and negative electrodes used for picture projection, but the greater saving is effected when applied to positive electrodes because of their more rapid consumption.

The present application is a substitute for an

application filed by me April 5, 1937, Serial No. 134,972.

The invention is not to be understood as restricted to the details set forth, since these may be modified within the scope of the appended claims, without departing from the spirit and scope of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is:

1. An electrode comprising a stick having a body of carbon and a metallic conductive coating around the body, and provided at its ends with means for telescopic end-to-end and contacting connection of the carbon body with the carbon bodies of other carbon-sticks, and means for electrically connecting the conductive coating to the conductive coating of said other carbon-sticks and extending across the joint between the sticks for maintaining a continuous electrical path to the arc and through the coatings of connected sticks.

2. An electrode comprising a stick having a core of carbon, a carbon shell around the core, and a metallic conductive coating around the shell and provided at its ends with means for telescopic end-to-end and contacting connection of the core and the shell with the carbon cores and shells of other sticks, and means for electrically connecting the conductive coating to the conductive coating of said other carbon sticks and extending across the joint between the sticks for maintaining a continuous electrical path to the arc through the coatings of the connected sticks.

3. An electrode comprising a stick having a body of carbon and a metallic conductive coating around the body and provided at its ends with means for telescopic end-to-end and contacting connection of the carbon body, with the carbon bodies of similar sticks, and a sleeve of conductive metal having portions for gripping the conductive coatings of telescopically connected carbon sticks and extending across the joint between the sticks and for maintaining a continuous electrical path through the coatings of the sticks to the arc, and holding the sticks together.

4. An electrode comprising a stick having a body of carbon and a metallic conductive coating around the body and provided at its ends with means for telescopic end-to-end and contacting connection of the carbon body with the carbon bodies of similar sticks, and a sleeve of conductive metal having portions for gripping the conductive coatings of telescopically connected carbon sticks and extending across the joint between the sticks and for maintaining a continuous electrical path to the arc and through the coatings of the sticks, and holding the sticks together, the sleeve portions being separately expandable to fit around sticks of slightly different outside diameters.

5. An electrode comprising a stick composed of a core of carbon, a carbon shell around the core, and a metallic conductive coating around the shell and provided at its end with tapered members for telescopic end-to-end contacting connection with other similar sticks, the members having their peripheries formed in the shell for wedging contact with the shell of said other sticks and end-faces intersecting the core and adapted to contact with the cores of said other sticks, for providing continuity of the cores and the shells, and means for electrically connecting

the conductive coating to the conductive coatings of said other sticks, extending across the joint between the sticks and, for maintaining a continuous electrical path to the arc through the coatings of the connected sticks.

- 5 6. An electrode comprising a plurality of sticks, each having a carbon core, a carbon shell around the core and a conductive outer coating, telescopic carbon male and female connecting members on  
10 the ends of the sticks for connecting one to another and fusible means fitting around the end portions of a pair of connected sticks for conductively connecting the coatings on the sticks and adapted to hold the sticks together, the tele-  
15 scopic members being of sufficient length to bring their leading ends into the arc so they will be fused together while they are held by the fusible means and so the short end will not drop from the electrode.

7. That improvement in illumination for picture projection which consists in telescopically connecting end-to-end a partially consumed stick, having a carbon core, a carbon shell and a metallic conductive coating, with a similar stick of normal length to form an elongated electrode, so as to maintain across the connection the continuity of the carbon in the cores and the shells of the connected sticks, electrically connecting the coatings across the joint between the sticks to maintain continuous conduction between the coatings and to the arc, feeding the elongated electrode to an arc and producing continuous illumination from the connected sticks without flickering or interruption during the consumption of the connected portions of the sticks.

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