

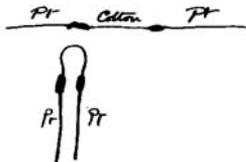
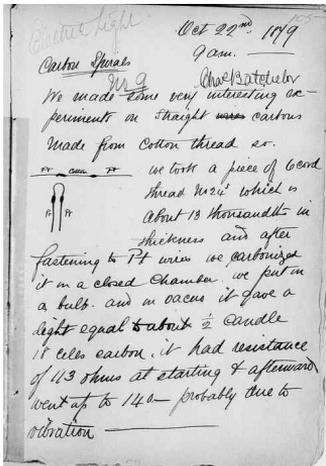
-1831-

[Menlo Park,] Oct 22nd 1879 9 A.M.^a

Notebook Entry:
Electric Lighting¹

Electric Light Carbon Spirals^b No 9^b

We made some very interesting experiments on straight wires carbons made from cotton thread so.²



we took a piece of 6 cord thread No 24s which is about 13 thousandths in thickness and after fastening to Pt wires we carbonized it in a closed chamber. we put in a bulb and in vacuo it gave a light equal to about 1/2 candle 18 cells carbon. it had resistance of 113 ohms at starting & afterward went up to 140— probably due to vibration^a

Electric Light Carbon lamps Carbonizing process^a

We made lamps in same manner

- 1 of— Vulcanized fibre³
- 2—^c Thread rubbed with tarred lampblack⁴
- 3—^c Soft paper—⁵
- 4—^c Fish line
- 5— Fine pthread plaited together 6 strands—
- 6— Soft paper saturated with tar
- 7— Tar'd Lampblack^{6d} with half its bulk of finely divided lime work down to .020— Straight one 1/2 inch
- 8—^c 200's 6 cord 8 strands—^e
- 9—^c 20s⁷ Coats⁸ 6 cord ~~not~~ no coating of any kind
- 10—^c Cardboard—
- 11 cotton soaked in tar (boiling) & put in^f

Electric Light

No. 2^{9b} lamp of page 107¹⁰ had on 18 cells and gave an elegant light equal to about 22 candles^a

No. 9^b ordinary thread Coats 6 cord #24s— Came up to ½ candle and was put on 18 cells battery permanently for at 1.30 AM— ~~¶~~ Page 105 & Page 115^{11a}

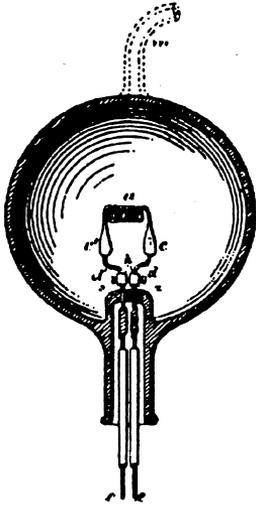
3 Came up to 1½ gas jet leading wire melted on account of conduction across mica (perhaps) See page 115^{12a} was put on machine with 3rd speed 6 cells in field— It had an enormous resistance^a

No 10^b Considerable resistance— equals 1 gas— jet had a small arc in—^a

No 9^b On from 1.30 AM till 3 pm 13½ hour and was then raised to 3 gas jets for 1 hour then cracked glass & busted^a

No 11^b A great many were made and boiled in tar before carbonizing but all so done broke in carbonizing^a

Chas Batchelor



The drawings for Edison's 1 November patent application (U.S. Patent 223,898) show the ends of the filaments c c' thickened with lampblack and tar. At this point Edison still preferred the spiral shape as a way of increasing resistance and reducing radiating surface.

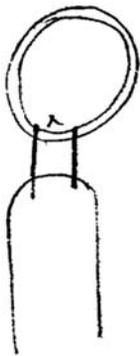
X, NjWOE, Lab., N-79-07-31:105 (*TAEM* 33:594; *TAED* No52:52). Written by Charles Batchelor; document multiply dated. ^aFollowed by dividing mark. ^bMultiply underlined. ^cPreceded by "X" in left margin. ^d"d Lampblack" interlined above. ^eItems 8 through 11 enclosed by vertical lines at right. ^fSentence enclosed in braces.

1. This entry is a continuation of Doc. 1830 and is continued in Doc. 1838.

2. In a notebook entry of the same date Francis Upton wrote: "Trying to make a lamp of a carbonized thread. 100 ohms can be made from an inch of .010 inch thread. A thread with 45 ohms resistance when cold was brought up in a high vacuum to 4 candles about. It remained constant for two or three hours and then the resistance seemed to concentrate in one spot. Resistance cold 800 Ohms." Upton's record of the results and calculations of lamps per horse power based on these results follow. He calculated that at 113 ohms per lamp they would get 114 per horse power but when the lamp went up to "140 Ohms after ½ hour" he recalculated that they would get "106 per H.P. light equal to about ½ candle." N-79-08-22:171-75, Lab. (*TAEM* 35:868-70; *TAED* No85:85-7).

3. It is not clear if Upton meant this filament, but writing about lamps made with "Fibre thread" he noted that "None of these carbon spirals blacken the glass." N-79-08-22:179, Lab. (*TAEM* 35:872; *TAED* No85:89).

4. In the carbon-filament patent application that he executed on 1 November (U.S. Patent 223,898) Edison stated that when a thread or other fibrous material was "rubbed with a plastic composed of lampblack and tar, its resistance may be made high or low, according to the amount of lamp-black placed upon it" and that "the plastic lamp-black and tar are used to secure it to the platina before carbonizing." The shape of the thread filaments listed here and in Doc. 1838 is unknown, although the drawing for the patent application showed a spiral and Edi-



Edison's 21 October drawing shows a filament made from a circle of carbonized, paper with X indicating the section to be removed.

son stated that when these filaments were coiled into a spiral “as much as two thousands ohms resistance may be obtained without presenting a radiating-surface greater than three-sixteenths of an inch.” Upton noted of one lamp with a thread coated with lampblack that it gave “very brilliant light all the cells on Broke.” Of another he wrote “Thread with lamp-black very fine light on several hours giving two or three candles and in hour giving a gas jet. No change two candles leading wires burnt. N-79-08-22:177, Lab. (*TAEM* 35:871; *TAED* No85:88).

5. This or filament No. 5 may be related to the drawing Edison made on 21 October showing a circle of carbonized paper with the bottom section between the lead-in wires broken out. N-79-07-31:92, Lab. (*TAEM* 33:588; *TAED* No52:46).

6. In U.S. Patent 223,898 Edison stated 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.”

7. Batchelor probably meant 24 as that number is given above and below in connection with this lamp.

8. J. & P. Coats was the dominant thread manufacturing enterprise in the United Kingdom during the nineteenth century. Charles Batchelor had worked for the company between 1865 and 1870, when it sent him to install machinery at its Clark thread mill in Newark. The six-cord spool cotton thread used in several lamps described in these notes had been developed at the Clark mill in 1864 for use in sewing machines. Cairncross 1987, Kim 1998.

9. Batchelor dated the document from here to the end as 21 October even though the text was clearly written on 22 October because it discusses the experiments that had begun the night before.

10. That is, the list immediately above.

11. That is, the discussion above and below of lamp No. 9.

12. Batchelor apparently wrote this as a page turn; the text that follows is on page 115.