The Benjamin Franklin American Inn of Court

is pleased to present

EDISON ELECTRIC LIGHT CO. v. UNITED STATES ELECTRIC LIGHTING CO.

with special guest participants

The Honorable Richard Linn

United States Court of Appeals for the Federal Circuit

The Honorable Berle M. Schiller

The Honorable Mitchell S. Goldberg

United States District Court for the Eastern District of Pennsylvania

Program Materials

Linn Inn Alliance

Edison, Knight of the Burning Lamp

Statement of Issues and Facts

Timeline

Brief of Defendant-Appellant

Brief of Plaintiff-Appellee

The *Edison Electric* Decision

U.S. Patent No. 223,898

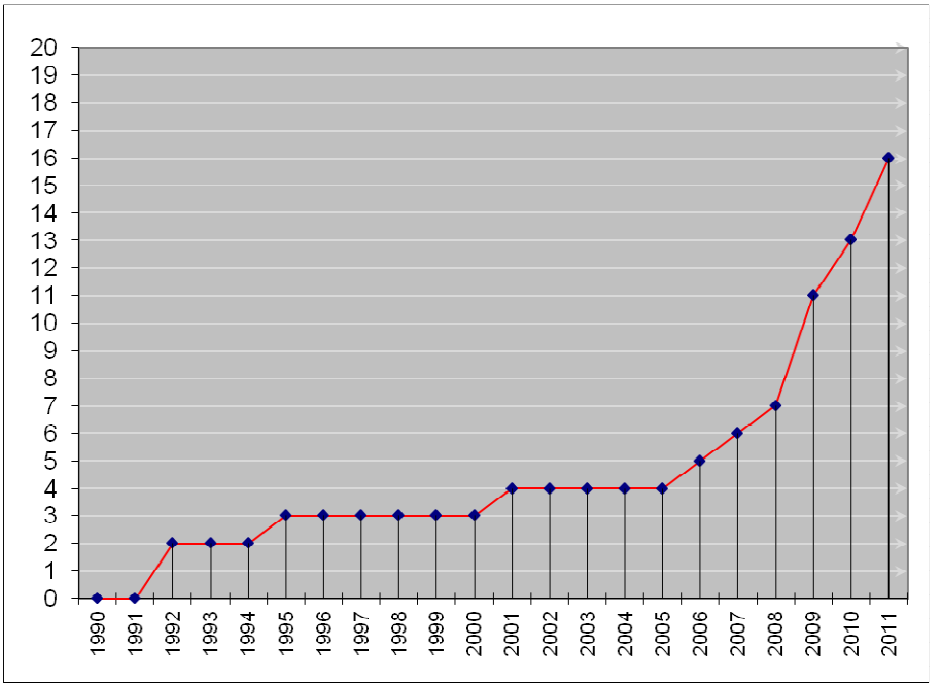
Federal Courthouse

Ceremonial Courtroom

601 Market Street

Philadelphia

Wednesday, January 18, 2012



~ LINN INN ALLIANCE ~

(http://www.linninn.org/innalliance.htm)

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(Author: *Thomas Edison's Patent Application for the Incandescent Light Bulb*)

EDISON, KNIGHT OF THE BURNING LAMP

William Shakespeare*

Anon comes one with light[1], but in his sphere,[2]
Which now shows all the beauty of the sun.[3]
But sun it is not, when you say it is not;[4]
Thou art the Knight of the Burning Lamp.[5]

Fair glass of light,[6] each one a perfect sun,[7]
Giving more light than heat[8] out of their spheres,[9]
Where you did give a fair and natural light[10]
Like to the glorious sun's transparent beams.[11]

How can my Muse want subject to invent,
When thou thyself dost give invention light?[12]
O, thou art a perpetual triumph;[13]
Dark needs no candles now, for dark is light.[14]

Witness, you ever-burning lights above,[15]
This is a man's invention and his hand,[16]
So clear, so shining and so evident[17]
Behind the globe, that lights the lower world.[18]

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* Edited by Stewart M. Wiener. Presented to the Benjamin Franklin American Inn of Court, Jan. 18, 2012, with apologies to the Bard of Avon and the Wizard of Menlo Park. Verses compiled using RhymeZone Shakespeare Search, available at www.rhymezone.com/shakespeare. Alterations (not shown) are limited to ellipsis, capitalization, and punctuation.

[1] William Shakespeare, ROMEO AND JULIET, Act V, sc. iii.
[2] William Shakespeare, HAMLET, Act IV, sc. vii.
[3] William Shakespeare, THE TWO GENTLEMEN OF VERONA, Act I, sc. iii.
[4] William Shakespeare, THE TAMING OF THE SHREW, Act IV, sc. v.
[5] William Shakespeare, KING HENRY IV, PART 1, Act III, sc. iii.
[6] William Shakespeare, PERICLES, PRINCE OF TYRE, Act I, sc. i.
[7] William Shakespeare, KING HENRY VI, PART 3, Act II, sc. i.
[8] William Shakespeare, HAMLET, Act I, sc. iii.
[9] William Shakespeare, SONNET CXIX.
[10] William Shakespeare, KING HENRY IV, PART 1, Act V, sc. i.
[11] William Shakespeare, KING HENRY VI, PART 2, Act III, sc. i.
[12] William Shakespeare, SONNET XXXVIII.
[13] William Shakespeare, KING HENRY IV, PART 1, Act III, sc. iii.
[14] William Shakespeare, LOVE'S LABOUR'S LOST, Act IV, sc. iii.
[15] William Shakespeare, OTHELLO, Act III, sc. iii.
[16] William Shakespeare, AS YOU LIKE IT, Act IV, sc. iii.
[17] William Shakespeare, KING HENRY VI, PART 1, Act II, sc. iv.
[18] William Shakespeare, KING RICHARD II, Act III, sc. ii.

No. 2012-0118

United States Court of Appeals
for the
Federal Circuit

UNITED STATES ELECTRIC LIGHTING CO.,

Defendant-Appellant,

v.

EDISON ELECTRIC LIGHT CO.,

Plaintiff-Appellee.

ON APPEAL FROM THE 1891 DECISION OF THE CIRCUIT COURT FOR THE SOUTHERN DISTRICT OF NEW YORK

STATEMENT OF ISSUES AND FACTS

January 18, 2012

STATEMENT OF ISSUES

ISSUE I: Did the district court, applying current law, err in granting summary judgment of non-obviousness of claim 2 of U.S. Patent No. 223,898 of Edison Electric Light Co. in view of one or more of U.S. Patent No. 204,144 (Sawyer and Man); British Patent No. 2402 (Edison); Canadian Patent No. 3738 (Woodward and Evans); and British Patent No. 4626 (Lane-Fox)?

ISSUE II: Did the district court err in holding that the disclosures of Joseph Swan do not qualify as prior art under the new definition of prior art in the AIA with respect to claim 2 of U.S. Patent No. 223,898 of Edison Electric Light Co.?

STATEMENT OF FACTS

1. Claim 2 of U.S. Patent No. 223,898 recites:

> 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.

2. Claim 2 had been construed to require:

> The combination of a high specific resistance carbon filament conductor having extreme tenuity and arranged in an exhausted bulb made wholly of glass, and sealed at all points, including those where leading platinum wires enter, by the fusion of the glass.

3. U.S. Patent No. 204,144 (Sawyer and Man), issued June 18, 1878, discloses:

> "At the present day it is not new to produce a light by causing the electric current to heat a carbon conductor to incandescence in a vacuum, or in nitrogen, or in other gas …."

In the lamp of Sawyer & Man the carbon burner was a low resistance carbon rod or pencil burner maintained in a globe charged with nitrogen gas, and the globe and its stopper (both of glass) were held together by a clamping device.

4. British Patent No. 2402 (Edison), issued June 17, 1879, discloses a vacuum chamber made wholly of glass, with the parts sealed together by fusion, the conducting wires leading to a burner through the glass being sealed by fusion of the glass, the burner being a platinum wire coiled upon a bobbin.

5. Canadian Patent No. 3738 (Woodward and Evans), granted August 3, 1874, discloses carbon within a glass globe and connected via electrodes, with the air being exhausted from the globe, the globe being hermetically sealed and filled with a gas.

6. British Patent No. 4626 (Lane-Fox), issued in October 1878, discloses platinum or iridium strips or wires in spiral forms and fastened on both ends to platinum wires which are sealed in glass, with carbon conductors also being disclosed.

7. On December 18, 1878, a lamp using a slender carbon rod was shown by Joseph Swan at a meeting of the Newcastle upon Tyne Chemical Society.

8. On January 17, 1879, Joseph Swan gave a working demonstration of his lamp to the Newcastle Chemical Society.

9. On February 3, 1879, Joseph Swan showed his lamp to 700 attendees of a meeting of the Literary and Philosophical Society of Newcastle upon Tyne.

10. The effective filing date of claim 2 of U.S. Patent No. 223,898 is November 4, 1879.

11. The lamp in public use at the three Swan events was an incandescent lamp having an evacuated glass chamber enclosing a filament consisting of carbonized thread wrapped around paper and connected to platinum lead wires which had been fused to the glass chamber.

12. On November 5, 1878, Edison held a closed meeting for 15 potential investors to fund his incandescent lamp research. At this meeting, Edison demonstrated the use of an incandescent lamp having a carbonized paper filament in a glass bulb under vacuum, the filament being attached to platinum lead wires fused into the glass bulb.

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TIMELINE

Issue I Facts	Date	Issue II Facts
Canadian Patent No. 3738 (Woodward and Evans) was granted, disclosing carbon within a glass globe and connected via electrodes, with the air being exhausted from the globe, the globe being hermetically sealed and filled with a gas.	**8/3/1874**	
U.S. Patent No. 204,144 (Sawyer and Man) issued disclosing: "At the present day it is not new to produce a light by causing the electric current to heat a carbon conductor to incandescence in a vacuum, or in nitrogen, or in other gas …." In the lamp of Sawyer & Man the carbon burner was a low resistance carbon rod or pencil burner maintained in a globe charged with nitrogen gas, and the globe and its stopper (both of glass) were held together by a clamping device.	**6/18/1878**	
British Patent No. 4626 (Lane-Fox) issued, disclosing platinum or iridium strips or wires in spiral forms and fastened on both ends to platinum wires which are sealed in glass, with carbon conductors also being disclosed.	**Oct-1878**	
	11/5/1878	Edison held a closed meeting for 15 potential investors to fund his incandescent lamp research. At this meeting, Edison demonstrated the use of an incandescent lamp having a carbonized paper filament in a glass bulb under vacuum, the filament being attached to platinum lead wires fused into the glass bulb.
	12/18/1878	A lamp using a slender carbon rod was shown by Joseph Swan at a meeting of the Newcastle upon Tyne Chemical Society.
	1/17/1879	Joseph Swan gave a working demonstration of his lamp to the Newcastle Chemical Society.
	2/3/1879	Joseph Swan showed his lamp to 700 attendees of a meeting of the Literary and Philosophical Society of Newcastle upon Tyne. The lamp in public use at the three Swan events was an incandescent lamp having an evacuated glass chamber enclosing a filament consisting of carbonized thread wrapped around paper and connected to platinum lead wires which had been fused to the glass chamber.
British Patent No. 2402 (Edison) issued, disclosing a vacuum chamber made wholly of glass, with the parts sealed together by fusion, the conducting wires leading to a burner through the glass being sealed by fusion of the glass, the burner being a platinum wire coiled upon a bobbin.	**6/17/1879**	
	11/4/1879	The effective filing date of claim 2 of U.S. Patent No. 223,898.

No. 2012-0118

United States Court of Appeals
for the
Federal Circuit

UNITED STATES ELECTRIC LIGHTING CO.,

Defendant-Appellant,

v.

EDISON ELECTRIC LIGHT CO.,

Plaintiff-Appellee.

ON APPEAL FROM THE 1891 DECISION OF THE CIRCUIT COURT FOR THE SOUTHERN DISTRICT OF NEW YORK

BRIEF OF DEFENDANT-APPELLANT UNITED STATES ELECTRIC LIGHTING CO.

January 18, 2012

ARGUMENT

I. Claim 2 is invalid as obvious under 35 U.S.C. § 103.

As a preliminary matter, the district court erred by importing limitations in its construction of Claim 2 of the '898 patent. The terms *"high specific resistance," "extreme tenuity," "leading platinum wires," and "sealed at all points ... by the fusion of the glass"* are not found in the claim itself. The claim states: *"The combination of [1] carbon filaments with [2] a receiver made entirely of glass and [3] conductors passing through the glass, and [4] from which receiver the air is exhausted, [5] for the purposes set forth."* These terms are unambiguous. It is unjust to the public, and inconsistent with law, to construe a claim differently from the plain import of its terms. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005).[1]

The lower court erred by applying an improper test for obviousness. *KSR Intern. Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 1734 (U.S. 2007) confirms the obviousness factors in *Graham v. John Deere Co.,* 86 S.Ct. 684 (U.S. 1966): *"Under § 103, [A] the scope and content of the prior art are to be determined; [B] differences between the prior art and the claims at issue are to be ascertained; and*

[1] Even if the improper construction were allowed, the result would be unenforceably vague. The terms *"high specific resistance"* and *"extreme tenuity"* are indefinite under 35 U.S.C. § 112, ¶ 2, even viewed in best light of the specification by a person of ordinary skill in the art ("POSA"). *See Orthokinetics v. Safety Travel Chairs,* 806 F.2d 1565, 1576 (Fed. Cir. 1986). No numerical limits are offered as to either term. Nor is any measure of *"tenuity"* available.

[C] the level of ordinary skill in the pertinent art resolved. Against this background the obviousness or nonobviousness of the subject matter is determined." (Emphasis added).

Sawyer '144 discloses that *"[a]t the present day it is not new to produce a light by causing the electric current to heat a carbon conductor to incandescence in a vacuum ...."* (Emphasis added). Woodward 3738 discloses carbon within a glass globe, connected via electrodes, with the air being exhausted from the globe, the globe being hermetically sealed and filled with a gas. Lane-Fox 4626 discloses platinum or iridium strips or wires in spiral forms and fastened on both ends to platinum wires which are sealed in glass, with carbon conductors also disclosed. A POSA knows spiral forms provide high tenuity and high resistance.

Edison 2402 discloses a vacuum chamber made wholly of glass, with the parts sealed together by fusion, the conducting wires leading to a burner through the glass being sealed by fusion of the glass, the burner being a platinum wire coiled upon a bobbin. The coiling of the long platinum wire results in a burner of high tenuity and high resistance. The use of glass for this purpose is also taught in Woodward and is readily apparent in Lane-Fox and Sawyer. Inherently, wherever glass is used, something must convey electricity into the chamber, as explicit in Edison 2402, Lane-Fox, and Woodward. The use of a chamber from which air is exhausted is taught in Edison 2402, Sawyer, and Woodward.

The bulb of Claim 2 differs from that in Edison 2402 only in the use of carbon. But the use of carbon is known in Sawyer, Woodward, and Lane-Fox. The latter teaches that platinum and carbon are equivalent for these purposes, thus suggesting that a filament may be changed from platinum to carbon. If one chose to make that known change, then the bulb of Edison 2402 becomes that of Claim 2.

The bulb of Claim 2 differs from those in Sawyer or Woodward in that in Sawyer and Woodward, some non-glass parts are used to seal the chamber. The POSA altering the chamber of either Woodward or Sawyer to that in Edison 2402, readily obtains a result identical to that of Claim 2.

The district court stated that *"[i]t seems almost preposterous to argue that the substitution of the carbon filament for the platinum burner of that lamp was an obvious thing to electricians."* This does not accord with current case law. A POSA for present purposes is an average electrical researcher employed in the development of electric lighting. Presumptively, a POSA is acquainted with the recent patents in the field including Lane-Fox which equates carbon and platinum wires for use as incandescent burner elements. Under *KSR*, when a claim simply arranges old elements, with each performing the same function it had been known to perform, and yields no more than one would expect from such an arrangement, the combination is obvious. *KSR* at 1740. Hence the permutation of substitutable parts – in the same manner and for the same purposes as taught – is obvious. This

same reasoning applies to substituting an all-glass enclosure for a mostly-glass enclosure. Thus, no matter how the differences between Claim 2 and the prior art are viewed, Claim 2 is obvious under *KSR*, and hence invalid.

Secondary considerations do not overcome *prima facie* obviousness based on strong prior art. *KSR* at 1745 (no secondary factors "dislodge" obviousness).

II. Swan's Public Disclosures Were Invalidating Prior Art

Additionally, the district court erred in holding that the disclosures of Joseph Swan do not qualify as prior art. Under the America Invents Act ("AIA"), 35 U.S.C. §102(a)(1), a claimed invention is not patentable if it "*was … in public use … or otherwise available to the public before the effective filing date of the claimed invention …"* However, *"[a] disclosure made 1 year or less before the effective filing date of a claimed invention shall not be prior art to the claimed invention under subsection (a)(I) if- … (B) the subject matter disclosed had, before such disclosure, been publicly disclosed by the inventor …"*. §102(b)(1)(B).

Claim 2 of the '898 patent has an effective filing date of 11/4/79. On three occasions before the filing date, Swan publicly demonstrated his lamp ("the Swan events"). The Swan events were undisputed "public use[s]" and/or *"otherwise available to the public before the effective filing date of the claimed invention …"* under AIA §102(a)(1). Thus, unless Edison ***publicly*** disclosed a lamp identical to Swan's before the Swan events, the Swan lamp is prior art. *See* AIA

§102(b)(1)(B). Edison made no such public disclosure. He did show his lamp to 15 potential investors in a 11/5/78 ***closed***, non-public meeting.

The AIA disposed of a "first-to-invent" regime in favor of a "first-inventor-to-file" regime. Unlike the "first-to-invent" regime, the AIA does not give credence to ***private*** reductions to practice or descriptions to antedate *prima facie* prior art. The AIA is explicit that only the inventor's ***public disclosures*** within a year of filing can be relied on to antedate *prima facie* intervening art. To invoke the safe harbor of AIA §102(b)(1)(B), the patentee must present evidence establishing the public nature of the prior disclosure. Appellee has not done so.

Under pre-AIA §102(b), the meanings of "public use" and "printed publication" were well established and are instructive here. A public use "*includes any use of the claimed invention by a person other than the inventor who is under no limitation, restriction or obligation of secrecy to the inventor*." *Bernhardt, L.L.C. v. Collezione Europa USA, Inc.*, 386 F.3d 1371, 1379 (Fed. Cir. 2004). Whether a use is "public" depends on "*the nature of the activity that occurred in public; the public access to and knowledge of the public use; [and] whether there was any confidentiality obligation imposed on persons who observed the use ...*". *Id*. Notably, a confidentiality obligation need not be express to prevent an invention's disclosure from being "public." *Bernhardt*, *supra*; *Cordis Corp. v. Boston Scientific Corp.*, 561 F.3d 1319, 1333-35 (Fed. Cir. 2009).

Edison's 11/5/78 meeting with 15 investors was "closed." His ***non-public*** meeting had the purpose of obtaining research funding -- a confidential undertaking -- which does not antedate the Swan events under AIA §102(b)(1)(B).

In addition, even if, *arguendo*, Edison's 11/5/78 lamp disclosure was "public," it would not antedate the Swan events because the lamp Edison disclosed was not identical to Swan's lamp. To qualify for the AIA §102(b)(1)(B) exception, "the subject matter [Swan] disclosed" had to have been "publicly disclosed by [Edison]." The statutory language plainly requires exact parallelism between "the subject matter" of the prior art and the inventor's public disclosure. The statute does not qualify the phrase "the subject matter" with language such as "essentially the same," "an obvious variant," or the like. This interpretation is supported by legislative history, which confirms that the AIA §102(b)(1)(B) safe harbor protects inventors only "against the disclosures of any of ***the same subject matter*** in disclosures made by others being prior art against the inventor's claimed invention." 157 Cong. Rec. 1496-97 (Mar. 9, 2011) (emphasis added).

Swan's lamp had a filament made of ***carbonized thread wrapped around paper*** while Edison's lamp had a ***carbonized paper*** filament without a thread. Since Swan's subject matter differed from Edison's disclosed subject matter, Edison cannot rely on AIA's §102(b)(1)(B) exception to antedate the Swan events.

No. 2012-0118

United States Court of Appeals
for the
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UNITED STATES ELECTRIC LIGHTING CO.,

Defendant-Appellant,

v.

EDISON ELECTRIC LIGHT CO.,

Plaintiff-Appellee.

ON APPEAL FROM THE 1891 DECISION OF THE CIRCUIT COURT FOR THE SOUTHERN DISTRICT OF NEW YORK

BRIEF OF PLAINTIFF-APPELLEE EDISON ELECTRIC LIGHT CO.

January 18, 2012

ARGUMENT

I. Introduction

This appeal by US Electric Lighting Co. seeks to reverse a legally proper determination by the district court that Edison's U.S. Patent 223,898 is not invalid under 35 U.S.C. § 103. The facts as to what the purported prior art references disclose and the general level of knowledge in the art are not in dispute. The district court's legal determination of non-obviousness was appropriately based on US Electric's failure to show either that the references or that the general knowledge in the art would have provided a reason to combine the disclosures of the references to produce an improved electric lamp as claimed by the 898 patent.

Further, the additional prior art that US Electric seeks to add to the analysis was properly disregarded by the district court because it's disclosures were negated under the safe harbor provision of the AIA. Nothing in the purported prior art had not already been properly antedated by Edison's own pre-filing disclosures.

II. Statement of the Facts

Claim 2 of the 898 patent has been construed to require "[t]he combination of a high specific resistance carbon filament conductor having extreme tenuity and arranged in an exhausted bulb made wholly of glass, and sealed at all points, including those where leading platinum wires enter, by the fusion of the glass." Neither party contests the district court's construction.

The asserted prior art does not disclose all of these elements, either individually or in combination. None of the references discloses a filament having extreme tenuity and high total resistance. The only references that disclose a carbon conductor are U.S. Patent No 204,144 (Sawyer and Man) and British Patent No. 4626 (Lane-Fox). The Sawyer and Man patent discloses a lamp made of an exhausted glass bulb; the bulb is not sealed by fusion, but rather has a stopper and clamping device for the lead wires. And while Canadian patent 3738 (Woodward and Evans) and British patent 2402 each discloses a glass bulb sealed by fusion, in the former the bulb is not evacuated (it is filled with a gas) and in the latter the lamp does not have a carbon filament.

Edison's U.S. Patent No. 223,898 was filed on November 4, 1879. On November 5, 1878, he demonstrated an incandescent lamp with a carbonized paper filament in an evacuated glass bulb, with the filament attached to platinum wires. The wires and the bulb were sealed by fusion of the glass. In two separate demonstrations in January and February of 1879, Swan demonstrated a similar lamp with a filament of carbonized thread wrapped around paper.

III. Claim 2 of U.S. Patent No. 223,898 Is Not Obvious

Despite years of research directed towards an efficient bulb for home use, nothing in the references or general knowledge in the art would have led to combining the references relied on by US Lighting to provide an efficient

incandescent bulb as now claimed. The bulb of claim 2 is a complex combination of specific components and elements that were selected to work efficiently together.

To have claim 2 declared invalid for obviousness, it was US Electric's burden to show that all elements of Claim 2 were known in the art and that there was something in the prior art or within the general level of skill to suggest combining them in the manner of the claim. *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1743 (2007). The prior art does not clearly suggest even the critical element of a carbon conductor of both extreme tenuity and high resistance. But even if this filament were itself known, the filament alone would not enable a satisfactory lamp unless the bulb in which it is set is completely exhausted and the seal, despite letting the lead wires pass through, remains completely intact. Though it was known that carbon could be used as the conductor-filament of an incandescent bulb, the combination with particular lead wires, an evacuated bulb, and the means of fusing and sealing them all so as to maintain the vacuum and provide a long-lasting bulb suitable for home use evaded the art for years, until Edison's invention.

Nor would it have been obvious simply to try different combinations of the various disclosures of the references, with the allegedly expected hope of arriving at the specific combination of claim 2. Even if all of the individual elements of

claim 2 were separately disclosed, KSR would permit an "obvious to try" analysis only where "there are a finite number of identified, predictable solutions." *KSR*, 127 S.Ct. at 1742. The situation here is much different. The claimed combination here is only one of myriad possibilities that might have been fashioned from the individual elements and teachings of the art, too many possibilities to say that any were predictable, particularly in view of the long history of failed attempts.

The non-obviousness of the invention is illustrated by the long-felt need for an incandescent bulb and Edison's commercial success upon providing a workable solution. Such secondary considerations "might be utilized to give light – [no pun intended] – into the circumstances surrounding the origin of the subject matter sought to be patented." *Graham v. Deere*, 86 S.Ct. 684 (1966). The incandescent bulb was first invented in 1802, but 77 years passed before Edison's perfection of it, in an invention that now provides lighting to thousands of customers. Finkelman & Lesh, Milestone Documents in American History at 980-984 (2008).

IV. Edison's Disclosure Predates the Swan Disclosure and Removes It as Prior Art under the AIA

Edison's prior disclosure invokes the safe harbor provision in 35 U.S.C. § 102(b)(1)(B), precluding any invalidating effect of Swan's demonstrations. This provision states "the subject matter disclosed had, before such disclosure, been publicly disclosed by the inventor . . . ." Swan's filament was carbonized cotton thread wrapped around paper; the filament of the Edison lamp displayed at the

investor meeting was carbonized paper, a filament within his later filed claims and the same as the subject matter of the Swan disclosure. Consequently, § 102(b)(1)(B) precludes any invalidating effect of Swan's disclosure.

Edison's demonstration to the group of 15 investors without any requirement of confidentiality, and without any control over the information disclosed was a "public disclosure." *See Beachcombers, Int'l, Inc. v. WildeWood Creative Products, Inc.,* 31 F.3d 1154 (Fed. Cir. 1994) (public use where a designer demonstrated a kaleidoscope invention to twenty or so guests during a private party at her home, because the inventor "did not retain control over the use of the device and the future dissemination of information about it."); *System Management Arts Inc. v. Avesta Technologies Inc.*, 87 F. Supp.2d 258, 268 (S.D. N.Y. 2000) ("the demonstration of an invention without obtaining assurances of confidentiality may well constitute 'public use' under Section 102(b)."). That Edison's disclosure was to a select group of investors does not make it any less "public" than the slect goup of guests at the private party in *Beachcombers*.

Further, inventor Edison demonstrated the same "subject matter" (within the meaning of § 102(b)(1)(B)) as the lamp demonstrated by Swan. Both lamps employ evacuated glass chambers and platinum lead wires fused into the glass. The only difference between the respective lamps – Swan's filament of carbonized thread wrapped around paper versus Edison's carbonized paper – is irrelevant. The

latter is the functional equivalent of Swan's filament and is an embodiment of the later-claimed filament.

Section § 102(b)(1)(B) does not require that the inventor's disclosure, to antedate the purported reference, be the *exact same* "subject matter." If Edison's disclosure varies from Swan's, it is at worst a very obvious variation, which the legislative history makes clear would be considered antedating "subject matter" under the statute. The House Committee Report on § 102(b)(1)(B) confirms that it is designed to provide protection to the inventor once the invention is disclosed:

> Once the U.S. inventor discloses his invention, no subsequent prior art can defeat the invention. . . . He can thus take full advantage of the grace period and disclose his invention in academic papers and at trade shows without worrying that such disclosures will lead to theft or fraudulent invalidation of his patent.

Congressional Record, September 6, 2011, S5320.

> Subparagraph 102(b)(1)(B) is designed to work in tandem with subparagraph 102(b)(1)(A) to make a *very strong grace period* for inventors that have made a public disclosure before seeking a patent.

157 Congressional Record 1496-97 (March 9, 2011) (emphasis added). This legislative history is consistent with protecting not only the exact embodiment disclosed by the inventor, but obvious variants of it. Since Edison's original disclosure and Swan's purported prior art are, if not identical, merely obvious variants of each other, under § 102(b)(1)(B), Swan's disclosures do not constitute prior art against Edison's U.S. Patent No. 223,898.

EDISON ELECTRIC LIGHT CO. v. UNITED STATES ELECTRIC LIGHTING CO.

Circuit Court, S.D. New York

47 F. 454*; *1891 U.S. App. LEXIS 1151

1891

COUNSEL: [**1] *Eaton & Lewis, (Clarence A. Seward, Grosvenor P. Lowrey,* and *Richard N. Dyer,* of counsel,) for complainant.

Kerr & Curtis, (Samuel A. Duncan, Edmund Wetmore, Frederic H. Betts, and *Leonard E. Curtis,* of counsel,) for defendant.

OPINION BY: WALLACE

OPINION

[*454] WALLACE, J. Two claims of letters patent No. 223,898, granted Thomas A. Edison, January 27, 1880, for an improvement in electric lamps, are in controversy in this suit. These are claims 1 and 2. It is not asserted for plaintiff that the defendant infringes the other claims of the patent, consequently they will require no attention further than to see whether their terms may assist in defining the meaning of the claims in litigation.

The plaintiff contends that these claims are for fundamental inventions of great merit, and are entitled to a construction by which every incandescent lamp for electric lighting, consisting essentially of a filamentary carbon burner, hermetically sealed in a glass vacuum chamber, is within their terms. The defendant contends that, unless the claims are limited to narrow inventions, not employed by the defendant, they are invalid for want of patentable novelty. The questions [**2] of the validity and scope of the patent have been adjudicated in the courts of England and Germany with a diversity of opinion by the judges who have considered them. The specification is a perplexing one. The difficulty lies in its shadowy demarkation of the line between the essential and non-essential features of the invention described. It catalogues a number of discoveries which Mr. Edison has made. It sets forth some of the essential features of the lamp, and then it leaves to be found by inference from generalities what the elements are of the combinations included in the extremely elastic terms of the two important claims. Nevertheless, when a sufficient knowledge of the prior state of the art of which it relates has been acquired, the new departures from old devices which it describes, and which, presumably, the inventor proposed to incorporate into the claims of his patent, are reasonably apparent. The specification states that the object of the 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 subdivision of the electric light is the concrete [**3] term of the division of the electric current [*455] into numerous small units and their conversion into luminous centers. By "practical subdivision" is meant a distribution and division of the current and its conversion into lights comparable with those of ordinary gas jets, on a scale and under conditions of convenience and economy adequate to a system of illumination for domestic purposes, in villages and cities, analogous to that of gas. Prior to 1879 there was no method known by which this could be done practically. The problem involved the perfection of devices for the proper distribution and regulation of the current as well as those for translating it into light. No reference to the pre-existing devices for generating electricity, conducting it to the translating devices, or regulating its pressure and quantity, is necessary, except to state that the principles governing the relation of the resistance of translating devices to the character of the circuit in which they are arranged, whether in series or in multiple arc, were well known to electricians, and had been applied in various forms of electrical apparatus. There were two well-known devices for converting the [**4] current into light, -- the arc lamp and the incandescent lamp. In the former the current is forced to leap an air gap separating two conductors, usually of carbon, and in overcoming the resistance of the air space heats the adjacent surfaces of the conductors and produces a light of great intensity. In the latter, light is produced by the incandescence of an electrical conductor, a conducting strip or burner, placed in a continuous circuit, through which the current passes, and which develops heat by its resistance to the flow. The are lamp was suitable for use in streets, open spaces, and large halls; but its light was too concentrated and powerful for the illumination of dwellings or rooms of small dimensions. It was the generally accepted opinion of electricians that the hope of progress in the subdivision of the electric light was to be found in modifying the features of the are lamp. The reasons for this conclusion need not be mentioned. It suffices to say that Mr. Lane-Fox in England, and Mr. Edison in this country, seem to have been the only notable dissidents, and each of them had expressed the conclusion that sub-

division might be accomplished by the incandescent lamp, [**5] when provided with a conductor of high resistance and small radiating surface, arranged in a system of multiple arc. Lane-Fox had set forth the advantages of such a lamp in three patents granted to him in England, -- two in October, 1878, and one in March, 1879, -- and in a letter to the London Times, published in December, 1878; and Mr. Edison had done so in a patent granted to him in France, May 28, 1879, for improvements in electric lighting.

By arrangement in multiple arc no greater electro-motive force is required for a large number of translating devices than for a single one, and the amount of current can graduated to the number employed; consequently, a lamp with a conductor of high resistance can be utilized as efficiently as one with a conductor of low resistance. Higher resistance in the conductor permits the use of a weaker current, and, consequently, of smaller and less expensive main conductors. With a small surface of conductor less energy is required to produce a candle-power, and the small incandescent mass will radiate a moderate light, like the [*456] domestic lamp. Electricians knew how to make conductors of high resistance, and how to make them with [**6] a small ratiating surface. They knew that with material of the same specific resistance the total resistance of the conductor could be varied by varying its length or cross-section, high resistance being imparted by length and small section. They knew what materials were preferable, and what processes of treatment, to make conductors of high or low resistance. If they had only known how to construct a lamp in which the conductor would have adequate mechanical strength and durability for practical commercial use, while having the small radiating surface and high resistance desirable, there would have been nothing wanting, and electric lighting by incandescence would soon have been an accomplished fact. Although Lane-Fox and Edison had contributed to the state of the art the recognition of the principle that the conductor must have high resistance and small ratiating surface, and each of them had embodied the principle in lamps for which they had severally obtained patents, neither of them had invented a lamp which satisfactorily met all the conditions of success, because a burner of the necessary materials, form, and complementary adjuncts was yet to be devised. As to materials, [**7] experiments had been tried with platinum, iridium, and alloys of these metals, and with carbon of various kinds. It was known that platinum, being a poor conductor, could be readily brought to incandescence by the electric current, but to do so it was necessary to raise it to a temperature very near the fusing point, and a minute increase would melt it. On the other hand, carbon was known to possess at an equal temperature much greater power of radiation than platinum, but the difficulty was that it would combine with oxygen at high temperature and rapidly disintegrate. It could only be used, therefore, in a vacuum from which the oxygen had been excluded, and a perfect vacuum was practically unattainable. From the earliest lamp, (disregarding the Geissler tube, because it has no burner in the true sense,) patented in England by King in 1845, to the latest examples, like those of Lane-Fox or Edison's platinum lmap, patented in 1878-79, the history of the art shows a variety of experiments to perfect a lamp in which a carbon burner, or a platinum burner, would have sufficiently long life for practical requirements. The result of these experiments may be succinctly shown by quoting [**8] two well-known electricians. Mr. Schwendler, in an article published in 1879, in the Telegraphic Journal, said:

"Unless we shall be fortunate enough to discover a conductor of electricity with a much higher melting point than platinum, and the specific weight and the specific heat of which conductor is also much lower than for platinum, and which at the same time does not combine at high temperatures with oxygen, we can scarcely expect that the principle of incandescence will be made use of for practical illumination."

Mr. Sawyer, in a patent to Sawyer & Man, granted in June, 1878, said:

"At the present day it is not new to produce a light by causing the electric current to heat a carbon conductor to incandescence in a vacuum, or in nitrogen, [*457] or in other gas; but no lamp has yet been devised which would be practically operative, and for these reasons: *First.* The methods which have been adopted for charging the lamp with the artificial atmosphere, such as a displacement of mercury, water, or air by the gas, or the combuston of phosphorous in the lamp, are imperfect. A perfect vacuum is unattainable. Some oxygen or other element or compound remains in the lamp, [**9] and slow consumption or disintegration takes place, for the remaining gas or vapor other than hydrogen or nitrogen attacks the carbon, which in turn is decomposed, with a result of depositing the carbon upon the globe, and setting free the oxygen to attack fresh carbon. *Second.* It has been found practically impossible, under the varying degrees of heat and pressure, to maintain perfect joints, and the result is that expansion of the artificial atmosphere by the heat from the luminous conductor expels a portion of the same, and the contraction of the atmosphere upon cooling causes a portion of the external air to penetrate the globe, thus supplying oxygen, which at the next lighting feeds upon the carbon. *Third.* The unequal expansion of the carbon and its holders has resulted in fractures of the former, so that, however perfect the atmosphere in the globe, the lamp has never been permanent."

The most advanced type of carbon-burner lamps in 1875 were the lamps of Lodyguine or of Konn, and until the spring of 1879 lamps like those of the Sawyer & Man patent, or the patent of Mr. Farmer. It was thought to be the merit of Lodyguine's lamp that it obviated the difficulty of [**10] the short life of the burner by using two burners, rods of diminished section at the luminous focus, in a glass receiver, hermetically sealed, and filled with nitrogen, electrically arranged so that the current could be passed to the second carbon when the first had been consumed. Mr. Konn provided his lamp with five carbon burners in the form of rods or pencils, and devices for bringing them successively into circuit. In the lamp of Sawyer & Man the carbon burner was a rod or pencil maintained in a globe charged with nitrogen gas, and the globe and its stopper (both of glass) were held together by a clamping device. In the lamp of the patent granted to Mr. Farmer in March, 1879, the burner was a carbon rod or pencil inclosed in a globe filled with nitrogen or other analogous gas, and the globe was closed by a rubber stopper. In none of the lamps, except the one described in Mr. Edison's prior French and English patents of 1879, had any attempt been made to make the vacuum chamber wholly of glass, with the parts sealed together by fusion, or to seal the conducting wires leading to the burner through the glass by fusion of the glass. The impracticability of maintaining a carbon [**11] burner under such conditions that it would be sufficiently durable had apparently so impressed those who were studying lighting by incandescence that we find that as late as in the early part of 1879 both Lane-Fox and Edison were trying to perfect a burner of other material. Edison's burner, in his French patent of May 28, 1879, and his English patent of June 17, 1879, was of platinum wire coiled upon a bobbin composed of an infusible oxide; and Lane-Fox's burner, in his patent of May 14, 1879, was of platinum-iridium alloy, or of spiral strips of metal surrounding a tube of glass, fire-clay, steatite, or lime, with the surface of the metal strips covered with asbestos or some vitreous material.

This cursory view of the prior state of the art is sufficient for an [*458] intelligent reading of the specification. The specification describes the general nature of the invention as follows:

"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 [**12] 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."

The specification then recites that previously light by incandescence had been obtained from rods of carbon of one to four ohms of resistance, placed in closed vessels, in which the atmospheric air had been replaced by gases that did not combine chemically with the carbon; that the vessels holding the burner had been composed of glass cemented to a metal base; that the connections between the leading wires and the carbon has been obtained by clamping the carbon with the metal; that the leading wires had always been large, so that their resistance should be many times less than the burner; and generally the attempts of previous persons had been to reduce the resistance of a carbon [**13] rod. It then points out the disadvantages of such a lamp, stating that it could not be worked in great numbers in multiple arc without the employment of main conductors of enormous dimensions; that, owing to the low resistance the leading wires have to 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, and consequently the carbon is consumed because there must be almost a perfect vacuum to render it stable, especially when it is small in mass and high in electrical resistance; and that the use of gas in the receiver at the atmospheric pressure serves to destroy the carbon by attrition. The specification then states in substance that the patentee proposes a new departure, and that he has discovered that even a cotton thread properly carbonized and placed in a sealed glass bulb exhausted to one-millionth of an atmosphere offers from 100 to 500 ohms resistance to the passage of the current, and that it is absolutely stable at very high temperature; 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 [**14] chamber be so coiled, as much as 2,000 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 afterwards moistened and kneaded until it assumes the consistency of thick putty; that small pieces of this material [*459] 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; that he has carbonized and used cotton and linen thread, wood splints, papers, coiled in various ways, also lamp-black, plumbago, and carbon in various forms, mixed with tar, and kneaded so that the same may be rolled [**15] out into wires of various lengths and diameters; that each wire should be uniform in size throughout; that all these forms are fragile, and cannot be clamped to the leading wires with sufficient force to insure good contact and prevent heating; that, if platinum wires are used, and the plastic lamp-black and tar material be moulded around it in the act of carbonization, there is an intimate union by combination and by pressure between the carbon and platinum, and nearly perfect contact is obtained without the necessity of clamps; that the burner and the leading wires should be connected to the carbon ready to be placed in the vacuum bulb, and, when fibrous material is used, the plastic lamp-black and tar should be used to secure it to the platina before carbonizing. The specification proceeds as follows:

"By using the carbon wire of such high resistance I am enabled to use fine platinum wires for leading wires, as they will 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, [**16] 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."

The specification then gives directions for carbonizing the carbon thread in a manner to prevent its distortion, for blowing a glass bulb over it after it is formed, for exhausting the glass bulb, and for hermetically sealing the bulb when a high vacuum has been reached.

The claims are as follows:

"(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 [**17] 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."

The specification is addressed to those who were skilled in the art to which it relates; who appreciated the advantages of arranging incandescent lamps in a system of multiple arc, and of providing the lamp with [*460] a burner of high resistance and small radiating surface; who knew how high resistance, both specific and total, is imparted to a conductor; who knew that the rods, pencils, or other forms of carbon burners previously used, had not been designed to embody the principle of high resistance; who knew how desirable it was to maintain the burner in a perfect vacuum, or in gases that would exclude the oxygen; who knew what had been attempted and had proved impracticable in that behalf; who knew that such materials as are mentioned in the specification (even the tar-putty compound seems to have been used in Gauduin's process) would compose a carbon of high resistance when subjected to a proper process of carbonization; and [**18] who knew how to practice proper processes for the carbonization of such materials. Read by those having this knowledge, the radically new discovery disclosed by the specification is that a carbon filament as attenuated before carbonization as a linen or cotton thread, or a wire seven one-thousandths of an inch in diameter, and still more attenuated after carbonization, can be made, which will have extremely high resistance, and be absolutely stable when maintained in a practically perfect vacuum. It informs them of everything necessary to utilize this discovery and incorporate it into a practical lamp. It describes, with the assistance of the recital in the second claim, as the vacuum in which the burner is to be maintained, a bulb made wholly of glass, exhausted of air, sealed at all points by the fusion of the glass, and in which platinum leading wires are sealed by the fusion of the glass. It describes the materials of which the burner is to be made, and instructs them that the materials are to be shaped into their ultimate form before carbonization. It describes the use of platinum for the leading wires, and a method of securing the leading wires and filaments, intended to [**19] dispense with clamping, which consists in moulding tar putty about the joints, and carbonizing the whole in a closed chamber. Besides stating that the resistance of the burner will be greatly increased and the radiating surface still be kept within moderate limits by coiling it in the form of a spiral, the specification states that, by increasing the length of the filament coiled, the exterior only will be the principal radiating surface, and greater steadiness of illumination will be promoted.

The first claim must be read with several limitations. The filament is to be made of carbon of high resistance;

that is, as the experts agree, of high specific resistance. The filament is to be made as described; that is, the materials are to be of some of the kinds described, and are to be shaped in filamentary form and then carbonized. The filament is to be secured to metallic wires according to the method of the patent, because the claim implies the elements of a globe and metallic conductor arranged in circuit with the burner; otherwise the combination would not be operative, and it would have been needless to specify the securing of the metallic wires to the filament unless it was [**20] intended to import into the claim the specific method of doing so emphasized in the specification. The defendant does not infringe this claim, if for no other reason, because the leading wires in its lamps are not secured to the filament [*461] according to the method of the patent; that is, by cement carbonized *in situ,* but by clamps such as the specification condemns.

The second claim is broad enough in its phraseology to secure the real invention described in the specification, and can be read consistently with its language, so as to import into it every essential limitation. It was a remarkable discovery that an attenuated thread of carbon would possess all the long-sought qualities of a practical burner when maintained in a perfect vacuum. The extreme fragility of such a structure was calculated to discourage experimentation with it, and it does not detract in the least from the originality of the conception that previous patents had suggested, that thin plates, or pencils, or small bridges could be used. The futility of hoping to maintain a burner in vacuo with any permanency had discouraged prior inventors, and Mr. Edison is entitled to the credit of obviating [**21] the mechanical difficulties which disheartened them; but what he did in this respect was a matter of only secondary merit, and was no longer new in the art, because he had already disclosed it in his French and English patents. What he actually accomplished was to unite the characteristics of high resistance, small radiating surface, and durability in a carbon conductor by making it in a form of extreme tenuity, out of any such materials as are mentioned in the specification, carbonizing it, and arranging it as he had previously arranged his platinum burner in an exhausted bulb made wholly of glass, and sealed at all points, including those where the leading wires entered, by the fusion of the glass. He was the first to make a carbon of materials and by a process which was especially designed to impart high specific resistance to it; the first to make a carbon in the special form for the special purpose of imparting to it high total resistance; and the first to combine such a burner with the necessary adjuncts of lamp construction to prevent its disintegration and give it sufficiently long life. By doing these things he made a lamp which was practically operative and successful, [**22] the embryo of the best lamps now in commercial use, and but for which the subdivision of the electric light by incandescence would still be nothing but the *ignis fatuus,* which it was proclaimed to be in 1879 by some of the learned experts who are now witnesses to belittle his achievement and show that it did not rise to the dignity of an invention.

The coiled form of the burner is only an alternative feature, and is not a constituent of the second claim. It is the subject of the third claim. Nor is the bent form or any form other than the filamentary. It may be that in the haste which has always seemed to characterize Mr. Edison's efforts to patent every improvement, real or imaginary, which he has made or hoped to make, he had not stopped to reflect when he framed his application for the patent that the filamentary burner would do its work just as well uncoiled as coiled, provided the same length and cross-section were used. It is true that it is said in the general statement of the nature of the invention that the burner is so "coiled or arranged" as to offer high resistance and present a small radiating surface; but this description is satisfied by any arrangement, whether [**23] by coiling [*462] a considerable length in a small globe, or using the same length uncoiled in a larger globe, by which sufficient total resistance is obtained from a filament of small diameter. It certainly would not involve invention to omit the coiling and elongate the globe; hence, it is manifest that the invention described is the same thing essentially whether the coiled form is used or not. The language is satisfied if the burner is filamentary and so arranged as to offer great resistance and slight radiation, without importing into it anything which is not of the essence of the invention. No precise limitation upon the maximum diameter of the filament can be defined from the specification or is required as an element of the claim. The specification mentions by way of illustration the threads of linen or cotton which become more attenuated after carbonization, and the carbon wire which after carbonization would be from four to five one-thousandths of an inch in diameter; while the smallest rods of carbon previously known were about a millimeter in diameter, thus having a cross-section fifty times as great as the carbon wire. It is to be implied from the suggestions [**24] in the specification that it is to have sufficiently high total resistance for efficient use when the lamps are arranged in multiple arc, and to be used with leading wires of fine platinum. The claim is not limited to a carbon filament made of non-fibrous material. The conductors of the claim are the platinum wires mentioned in the specification. The receiver is the vacuum described in the specification. The peculiar method of securing the conductors to the filament, made a constituent of the first claim, is not imported into the second claim. A more exact interpretation of the meaning of the claim than has thus been indicated is not necessary in the present case, because each of the three lamps representing the kinds used by the

defendant embodies the invention of the claim as thus interpreted.

It is of little import what Mr. Edison, or his patent solicitor, may have thought about the meaning of the claim during the pendency of the application for a subsequent patent, or that Mr. Edison may have supposed a resistance as high as 100 ohms in the burner would be required for use with the means of distribution which he expected to employ with his system of lighting. There are [**25] many adjudicated cases in which it appears that the inventor builded better than he knew; where a patent has been sustained for an invention the full significance of which was not appreciated by the inventor when it was made. In the case of the Bell telephone patent there was great room for doubt whether the speaking telephone had been thought of by Mr. Bell when he filed his application for a patent, but the court said: "It describes apparatus which was an articulating telephone, whether Bell knew it or not." *American Bell Tel. Co. v. People's Tel. Co., 22 Blatchf. 532, 22 Fed. Rep. 309*. The nearest approach in the prior art to the invention of the second claim is undoubtedly the lamp of Edison's French and English patents with a platinum burner. It seems almost preposterous to argue that the substitution of the carbon filament for the platinum burner of that lamp was an obvious thing to electricians. It would have been, probably, if there had been such a thing as a filamentary carbon [*463] in the prior art. But the nearest approximations to it were the ribbon-shaped carbon burner of low resistance of Mr. Adams, (which was not a part of the prior art, but an isolated [**26] example, known only to a select few,) and the low resistance carbon rod burners of the patent of Sawyer & Man. Undoubtedly the improvements that have been made in the art -- such, for instance, as the method of electrical carbonization of the filament -- since Mr. Edison's inventions have been of great value, and the perfected commercial lamp of to-day is far superior to the one which could be made by applying to the description of the patent all the the knowledge and skill then possessed by those to whom it was more particularly addressed; but as was said by BOWEN, L.J., in the court of appeal in England: "The evidence shows that lamps made solely on the patent will and do succeed, although subsequent improvements have been ingrafted on the original design." It is impossible to resist the conclusion that the invention of the slender thread of carbon as a substitute for the burners previously employed opened the path to the practical subdivision of the electric light.

The questions which have seemed the most meritorious of those argued at the bar have now been considered. Others, to which no reference has been made, have not been overlooked, and may be dismissed without discussion, [**27] and with the single remark that nothing which has been presented by the voluminous proofs and the exceedingly able and elaborate arguments of counsel seems to supply any valid reason for refusing to decree for the plaintiff. The usual decree for an injunction and accounting is accordingly ordered.

T. A. EDISON.

Electric-Lamp.

No. 223,898. Patented Jan. 27, 1880.

Fig 1.

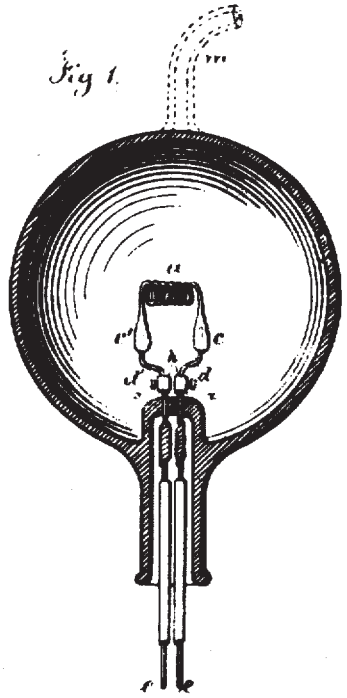


Fig. 2.

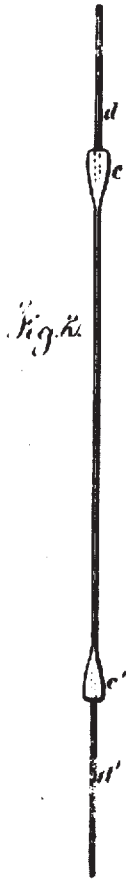
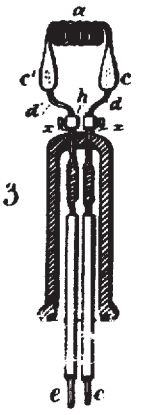


Fig. 3



Witnesses

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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY

ELECTRIC LAMP.

SPECIFICATION forming part of Letters Patent No. 223,898, dated January 27, 1880.

Application filed November 4, 1879.

To all whom it may concern:

Be it 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 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 a 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 beating. 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 com-

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 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 lamp-black, 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.

Order of Cancellation of Certificate of Correction of Letters Patent No. 223,898.

It is found that the following certificate has been attached to Letters Patent granted to Thomas A. Edison for improvement in "Electric Lamps," No. 223,898, dated January 27, 1880:

DEPARTMENT OF THE INTERIOR,

UNITED STATES PATENT OFFICE,

WASHINGTON, D. C., *December 18, 1883.*

In compliance with the request of the party in interest Letters Patent No. 223,898, granted January 27, 1880, to Thomas A. Edison, of Menlo Park, New Jersey, for an improvement in "Electric Lamps," is hereby limited so as to expire at the same time with the patent of the following-named, having the shortest time to run, viz.: British patent, dated November 10, 1879, No. 4,576; Canadian patent, dated November 17, 1879, No. 10,654; Belgian patent, dated November 29, 1879, No. 49,884; Italian patent, dated December 6, 1879, and French patent, dated January 20, 1880, No. 133,756.

It is hereby certified that the proper entries and corrections have been made in the files and records of the Patent Office.

This amendment is made that the United States patent may conform to the provisions of section 4887 of the Revised Statutes.

[SEAL.]

BENJ. BUTTERWORTH,
Commissioner of Patents.

Approved:
M. L. JOSLYN,
Acting Secretary of the Interior.

Now, in compliance with the request of the parties in interest, said certificate is hereby *canceled* and proper entries and corrections have been made in the files and records of the Patent Office.

In testimony whereof I have hereunto set my hand and caused the seal of the Patent Office to be affixed, this 15th day of March, 1893.

W. E. SIMONDS,
Commissioner of Patents.

Approved:
CYRUS BUSSEY,
Assistant Secretary of the Interior.

Correction in Letters Patent No. 223,898.

DEPARTMENT OF THE INTERIOR,

UNITED STATES PATENT OFFICE,

WASHINGTON, D. C., *December 18, 1883.*

In compliance with the request of the party in interest, Letters Patent No. 223,898, granted January 27, 1880, to Thomas A. Edison, of Menlo Park, New Jersey, for an improvement in "Electric-Lamps," is hereby limited so as to expire at the same time with the patent of the following named, having the shortest time to run, viz: British Patent dated November 10, 1879, No. 4,576; Canadian Patent dated November 17, 1879, No. 10,654; Belgian Patent dated November 29, 1879, No. 49,884; Italian Patent dated December 6, 1879; and French Patent dated January 20, 1880, No. 133,756;

It is hereby certified that the proper entries and corrections have been made in the files and records of the Patent Office.

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BENJ. BUTTERWORTH,
Commissioner of Patents.

Approved:
M. L. JOSLYN,
Acting Secretary of the Interior.