that the amount of invention involved in it is small. The patent, however, was prima facie evidence of its own validity, and the burden of proof was upon the defendant to establish its want of novelty." Smith v. Goodyear Co., 93 U. S. 486; Lehnbeuter v. Holthaus, 105 U. S. 94; Cantrell v. Wallick, 117 U. S. 690, 6 Sup. Ct. 970; 3 Rob. Pat. § 1016.

In National Cash-Register Co. v. American Cash-Register Co., 3 C. C. A. 559, 53 Fed. 371, the court of appeals (Third circuit) said:

"We have not overlooked the suggestion of appellee's counsel that Campbell's conception and arrangement were merely of an aggregation of known elements, not amounting to a true combination, and that, therefore, he was not entitled to a patent for anything. This suggestion is based upon the allegation that each of the elements associated by Campbell does not qualify every other of them; but this is true only in the sense that each does not modify or change the characteristic mode of action or method of operation of the others. In doing its appointed share towards effecting the single result achieved by the co-operation of all, each element acts, of course, according to the law of its own being; but, though of necessity so acting, it is still none the less combined with the others, and does 'qualify' each and all of them (not their distinctive methods of operation), in the sense that each is, by the co-operation of the others, capacitated to contribute, by acting in its own peculiar way, to the common end, which, without the co-operation of each and every other of the co-ordinated elements, it would be powerless to accomplish or advance."

In the light of the principles announced in the foregoing cases, we are not disposed to disturb the judgment in this case. The validity of the fourth claim may be conceded to be doubtful and close. But we cannot say, as matter of law, that it appears, from the face of the patent, that this claim is so plainly void for want of invention that it could not be aided by evidence. The court did not err in submitting the question to the jury. The judgment of the circuit court is affirmed, with costs.

LOWREY v. COWLES ELECTRIC SMELTING & ALUMINUM CO. et al.

(Circuit Court, N. D. Ohio, E. D. April 23, 1895.)

No. 4,982.

1. PATENTS—REDUCTION OF ORES—"ELECTROLYSIS."
"Electrolysis," as used in connection with metallurgical operations, takes place whenever a current of electricity of sufficient quantity and intensity is passed through a chemical compound in a fluid condition as to cause a chemical disruption thereof, the result being that one of the elements will go to the anode, or the place by which the current enters the fluid mass, and the other will go to the cathode, or place where the current leaves it. If the compound treated is metallic, the metal element will gather at the cathode, while the other will go to the anode.

2. SAME—"SMELTING."
The word "smelting," though by derivation synonymous with "melting," has come to have a more contracted meaning, when used in connection with metallurgical operations, and, in that connection, it usually means a melting of ores in the presence of some reagent which operates to separate the metallic element, by combining with the nonmetallic element.

3. ASSIGNMENT OF PATENTS—CONSTRUCTION.
A contract of assignment, by which the parties intend to convey a certain class of discoveries, applications, and patents, which class is described in general terms, will pass title to an application previously made

by the assignor if the same in fact falls within the class, although the pendency of such application was known to both parties, and was not specifically mentioned in the contract, and although neither party at that time believed that it fell within the class; but the fact that neither party thought it was in the class may be a pregnant circumstance to show in what sense the words describing the class were used, if those words are capable of more than one meaning.

4. SAME.

By a contract of assignment, certain inventors conveyed to their assignees "any and all discoveries and inventions relating to electric smelting processes and furnaces, and all patents they have obtained therefor, and all applications now pending, and caveats on file in the United States patent office relating to electric smelting processes and furnaces, which do or may interfere with any applications for patents made by [the assignors], now pending in the United States patent office." *Held*, that the words, "which do or may interfere with," qualify not only the phrase immediately preceding, namely, "caveats on file," etc., but also the words, "discoveries," "patents," and "applications," and that the interference referred to was either a declared interference in the patent office, or the total defeat or narrowing of any of the otherwise valid claims of the patents issued to the assignees.

5. SAME.

Eugene and Alfred H. Cowles, after long investigation, made certain discoveries and inventions relating to the reduction of the more refractory ores, especially aluminum ore. Their process consisted substantially in the use of granulated carbon distributed through the mass of the ore in the furnace to carry the electric current from one electrode to the other, whereby intense heat was produced which fused the ore, and enabled the carbon, by its chemical action upon the nonmetallic elements in the ore, to separate the metallic element therefrom. This process they designated as an "electric smelting process." In 1885, having applied for certain patents, and being about to apply for others, they learned that C. S. Bradley and Francis V. Crocker had made similar inventions, and that an application filed by them was about to be thrown into interference with the principal application of the Cowles brothers. They thereupon secured from Bradley and Crocker, for a large money consideration, a contract of assignment, which, after reciting that the Cowles brothers had made certain discoveries and inventions relating to "electric smelting processes and furnaces," and had applied for patents therefor, conveyed all the interest of said Bradley and Crocker in "any and all discoveries and inventions relating to electric smelting processes and furnaces, and all patents they have obtained therefor, and all applications now pending and caveats on file in the United States patent office, relating to electric smelting processes and furnaces, which do or may interfere with any applications for patents made by Eugene and Alfred H. Cowles, of Cleveland, Ohio, now pending in the United States patent office." At the date of the contract, Bradley, individually, had pending an application for a process of reducing ores by electrolysis, which application, after long delay, was divided, and three patents issued thereon, the main one (No. 468,148) being restricted to a combination of three steps, namely: (1) The initial fusion of the ore mass by the use of an electric arc; (2) maintenance of the fusion by the heat of resistance to the current in the fused ore, and the consequent progressive melting of the rest of the ore; (3) electrolysis by the current. The pendency of this application was known to the Cowles brothers, but it was not specifically referred to in the contract. *Held*, that this Bradley application did not pass by the assignment: First, because the phrase "electric smelting process," as used in the contract, meant a smelting process as ordinarily understood, including the use of a chemical reducing agent; and, second, because, even if these words were broad enough to include electrolysis, yet the Cowles inventions were not "interfered with" by the Bradley application for the reason that they did not effect initial fusion by means of an electric arc, which was an essential step in the Bradley process.

The bill in this case was filed by Grosvenor P. Lowrey, a citizen of New York. He has since died, and the case has been revived in the name of his executrix.

The bill averred that Lowrey was the owner by assignment of two patents issued to Charles S. Bradley for a process of separating metals from their ores by the use of the electric current both to fuse and to electrolyze the ore. The bill charged that the defendant the Cowles Electric Smelting & Aluminum Company, a corporation of Ohio, had executed and recorded in the patent office an assignment of the same patents, in which it purported to convey them to its codefendant, Alanson T. Osborn, a citizen of Ohio; that the Cowles Company asserted title to the patents, and the right to convey them by virtue of an assignment to it made by Bradley and one Crocker, on May 8, 1885; that the assignment relied on did not cover the patents in question at all; and that the assignment of the Cowles Company to Osborn was a cloud upon complainant's title. He prayed that the defendants might be enjoined from further asserting any claim to the patents in question, and be ordered to cancel the assignment already made and recorded.

The answer of the defendant asserted its ownership of the two patents by virtue of the assignment of May 8, 1885. By a cross bill, it prays for a decree enjoining complainant from claiming title to the patents by virtue of Bradley's assignment to him. In answer to the cross bill complainant sets up that he was a purchaser for value without notice of the patents, and that defendant's conduct in not claiming title to the Bradley inventions for 10 years estops it from now asserting it. The case was argued to the court, and decided on a plea to the bill. The plea was held insufficient, and leave given to answer. 56 Fed. 488. Evidence upon the issues presented by the pleadings has been taken, and the case is now before the court on its merits.

The main question in the case is whether the assignment of Bradley and Crocker to the Cowles Company, dated May 8, 1885, of certain patents, applications, and inventions, covered and included the patents title to which is here in controversy. The assignment was as follows:

"This agreement entered into this 8th day of May, 1885, between F. B. Crocker, of New York City, N. Y., and C. S. Bradley, of Yonkers, N. Y., constituting the first party, and the Cowles Electric Smelting and Aluminum Company, of Cleveland, Ohio, a corporation organized under the laws of the state of Ohio, constituting the second party, witnesseth that whereas, the first party have made certain discoveries and inventions relating to electric smelting processes and furnaces, and have made some applications for patents therefor in the United States patent office; and whereas, second party is desirous of becoming the owner of all such discoveries and inventions: It is therefore agreed between the parties as follows: (1) For the consideration hereinafter mentioned, the receipt of which, to our full satisfaction, is hereby acknowledged, the said party does hereby sell, assign, and set over to the said second party all interest in any and all discoveries and inventions relating to electric smelting processes and furnaces, and all patents they have obtained therefor, and all applications now pending, and caveats on file, in the United States patent office, relating to electric smelting processes and furnaces, which do or may interfere with any applications for patents made by Eugene H. and Alfred H. Cowles, of Cleveland, Ohio, now pending in the United States patent office. It is understood and agreed between the parties that this clause also includes the application of the first party, now pending in the United States patent office, and designated serial number 158,805, and filed March 14, 1885. (2) Said first party also sells, assigns, and sets over to said second party their entire interest in all inventions, patents, and applications for patents, in all foreign countries, for the discoveries and inventions mentioned in the preceding clause of this agreement. (3) Said first party hereby authorizes and requests the commissioner of patents to issue to the said second party patents for said discoveries and inventions mentioned in the first clause of this agreement. (4) Said first party, for said consideration, further agrees to sign and execute all papers necessary to perfecting applications for said inventions, and obtaining patents therefor. (5) In consideration

of the preceding, said second party hereby pays in hand to said first party the sum of five thousand dollars. In testimony whereof said parties have hereunto set their hands the day and year first above written.

"Francis B. Crocker.
"Charles S. Bradley."

This assignment was recorded in the patent office a short time after its execution. At the hearing of the plea, this court held that, from an examination of the Bradley patents and of the Cowles patents, referred to in the foregoing assignment, and their file wrappers and contents, it did not appear that the Bradley patents interfered with the Cowles patents, but that the introduction of expert evidence might show that they necessarily covered the same ground; that the issue thus raised was not an issue proper to be raised upon a plea, but should be raised in an answer, and heard upon full evidence, expert and otherwise. The evidence which has now been taken discloses quite fully the circumstances surrounding the execution of the assignment.

Eugene Cowles and Alfred H. Cowles, sons of Edwin Cowles, of Cleveland, Ohio, had given much time and study to the investigation of processes and apparatus for the winning of the rarer metals from their refractory ores by the use of electricity. They had experimented much in the Brush laboratory in Cleveland, and had made several important discoveries and inventions, for which they had applied, or were about to apply, for patents in the years 1884 and 1885. Early in 1885 they were informed by some means that their principal application for a patent for an electric furnace and smelting process was about to be declared in interference in the patent office with an application for a similar furnace and process of C. S. Bradley and Francis B. Crocker. Through Colgate Hoyt, a lawyer of New York City who acted for them, the Cowles brothers obtained the following option from Bradley, then living at Yonkers, N. Y.

"New York, April 8, 1885.

"By and between Charles S. Bradley and Colgate Hoyt, both of Yonkers, in the state of New York, it is agreed as follows: Said Bradley shall, upon demand of said Hoyt, made at any time within 90 days from the date hereof, assign to said Hoyt, or his order, for the consideration of ten thousand dollars cash, an undivided ¼ interest in all inventions which he had hitherto made in electric furnaces, and in the reduction of ores by electricity, and of all patents to be granted therefor, whether applications for such patents have already been filed, or shall hereafter be filed, in the patent office of the United States; and, in consideration of the option being granted, said Hoyt, or the party to whom he may have assigned the same, shall pay to said Bradley, at the date hereof, the sum of five hundred dollars. Charles S. Bradley."

During the life of the option thus secured, the Cowles brothers, with their father, Edwin Cowles, organized the defendant corporation under the laws of Ohio, and a correspondence was begun between the company and Bradley and Crocker, with reference to the purchase of the latter's application, which was then declared in interference with theirs. The result of the correspondence was that Bradley and Crocker visited Cleveland, and had a conference with the Cowleses, father and sons. The conference was upon Saturday afternoon and evening, and an adjournment was had until Monday morning for the drawing up of the contract. On Monday morning, Crocker and Bradley produced their application, which had been declared to be an interference with the Cowles applications. It contained the following reference to the application by Bradley alone, upon which the two patents which are here the subject of litigation were subsequently issued: "In an application for letters patent of the United States now pending (filed February 23, 1883, serial number 85,957), Charles S. Bradley, one of the present inventors, has described an electro metallurgical process in which an electric current is employed to perform two functions: First, to effect the electrolytic decomposition of the materials treated; and, second, to supply the heat necessary to maintain said materials in the fused state while they are being electrolyzed. The present invention resembles the above to a certain extent, but in the present invention the electric current which we employ performs no electrolytic action, the reaction which takes place being solely to develop the heat which is a necessary condition of the reaction. For this reason, our invention does

not require the use of a continuous current of electricity. An alternating current may be employed, if desired, which is an advantage, since large alternating current dynamos may be constructed more cheaply than the continuous current machines, and it is also less trouble and expense to run them."

This reference to the application of Bradley, of 1883, was brought to the attention of both Eugene and Alfred Cowles, and was the subject of discussion between them and Bradley and Crocker before the contract was finally drawn and signed. The option of April 8, 1885, was surrendered to Bradley. At the time the contract was signed, Bradley and Crocker had no other application than the one then declared to be in interference by the patent office authorities with the Cowles application. They owned no patent of the United States for any invention. They had no application pending in any European country, and owned no patent issued by any European government. Bradley at that time had pending only one application in addition to the Crocker and Bradley application in terms assigned by the contract, and that was the application for the patents here in controversy. Upon the execution of the contract, the question was submitted to Gen. M. D. Leggett, counselor in patent cases at Cleveland, who supervised and revised the contract as agreed upon between the parties, whether it would be better to have the patent for the entire process and discovery issued on the application of the Cowles brothers or upon the application of Bradley and Crocker. He decided, on the evidence adduced, that the stronger case was with the Cowles brothers, and that it was better for them to have Bradley and Crocker concede priority of invention, so that the patent might be issued upon the Cowles application. This was done, but the Cowles brothers proceeded with the Bradley and Crocker application, omitting the general claims which interfered with the Cowles application, and obtained a patent for the particular apparatus described by Bradley and Crocker in their application which might prove to be an improvement on or useful variation from, the Cowles patent. This patent was issued to the Cowles brothers as the assignors of Bradley and Crocker. No claim of title to the Bradley application of 1883 was ever made by the Cowles brothers nor did they ever attempt to prosecute it to a patent. As a matter of fact, although it was not then known to the Cowles brothers, at the time of the execution of the contract of assignment in May, 1885, the application of Bradley of 1883 stood rejected, as not involving a patentable process. The application lingered along in the patent office, retained there by the filing of amendments until 1891. It was divided into three applications. The main application was finally rejected by the examiner, and was then carried on appeal to the board of review in the patent office, which reversed the decision of the examiner, and allowed the issuance of a patent in 1892. After their issuance the patents were assigned by Bradley to Grosvenor P. Lowrey, the original complainant in this action.

To render the issues clear, it is necessary to describe at some length the various Cowles patents referred to in the assignment, the Bradley and Crocker application referred to therein, and the Bradley patents, which are the subject of this litigation.

The first and most important of the Cowles patents, the one between which and the Crocker and Bradley patent an interference was declared, was entitled "A Process for Smelting Ores by the Electric Current." The description taken from the specifications was as follows: "The present invention relates to the class of smelting furnaces which employ an electric current solely as a source of heat. Heretofore it has been attempted to reduce ores and perform metallurgical operations by means of an electric arc, the material to be treated being brought within the field of the arc or passed or fed through it; but numerous experiments have demonstrated that the arc system is not adapted for long and continuous operations on a scale of any considerable magnitude. The difficulties attending the regulation of the arc and the preservation of a constant resistance are very great, and the heat generated, though intense, is localized and difficult to control. The object of this invention is to provide a process by which electricity can be practically employed for metallurgical operations, and for this purpose to secure a distribution of the intense heat which it is well known electricity is capable of generating over a large area or through a large mass, in such manner that a high temperature can be sustained for a long time and controlled. To this end the in-

vention consists, essentially, in the use for metallurgical purposes of a body of granular material of high resistance or low conductivity, interposed within the circuit in such a manner as to form a continuous and unbroken part of the same, which granular body, by reason of its resistance, is made incandescent, and generates all the heat required. The ore or light material to be reduced—as, for example, the hydrated oxide of aluminium, alum, chloride of sodium, oxide of calcium, or sulphate of strontium—is usually mixed with the body of granular resistance material, and is thus brought directly in contact with the heat at the points of generation at the same time the heat is distributed through the mass of granular material, being generated by the resistance of all the granules, and is not localized at one point or along a single line. The material best adapted for this purpose is electric light carbon, as it possesses the necessary amount of electrical resistance, and is capable of enduring any known degree of heat when protected from oxygen, without disintegrating or fusing; but crystalline silicon or other equivalent of carbon can be employed for the same purpose. This is pulverized or granulated, the degree of granulation depending upon the size of the furnace. Coarse granulated carbon works better than finely pulverized carbon, and gives more even results. The electrical energy is more evenly distributed, and the current cannot so readily form a path of highest temperature, and consequently of least resistance, through the mass along which the entire current, or the bulk of the current, can pass. * * * The operation must necessarily be conducted within an airtight chamber, or in a nonoxidizing atmosphere, as otherwise the carbon will be consumed and act as fuel. The carbon acts as a deoxidizing agent for the ore or metalliferous material treated, and to this extent it is consumed, but otherwise than from this cause it remains unimpaired."

The patentees illustrate their process by describing a zinc furnace, which consists of a cylinder made of silica or other nonconducting material, imbedded in powdered charcoal, mineral wool, or some other nonconductor of heat. One end of the cylinder is closed by means of a carbon plate forming the positive electrode. The other end is closed by means of an inverted graphite crucible, forming the negative electrode, and, through a hole communicating with the furnace, forms a condensing chamber for the zinc fumes. The patent proceeds: "The circuit between the electrodes, so called, is continuous, being established by means of and through the body of broken carbon. * * * The zinc ore is mixed with the pulverized or granular carbon, and the retort charged nearly full through the front end with the mixture, the plug D being removed for this purpose. After the plug has been inserted, and the joint properly luted, the electric circuit is closed, and the current allowed to pass through the retort, traversing its entire length through the body of mixed ore and carbon. The carbon constituents of the mass become incandescent, generating a very high degree of heat, and, being in direct contact with the ore, the latter is rapidly and effectually reduced and distilled. The heat evolved distills the zinc, and the zinc fumes are condensed in the condensing chamber precisely as in the present method of zinc making, with this important exception: that, aside from the reaction produced by heating carbon in the presence of zinc oxide, the electric current, in passing through the zinc oxide, has a decomposing and disintegrating action upon it, not unlike the effect produced by an electric current in a solution. This action accelerates the distillation, and promotes economy in the process. * * * We have found in practice that a mixture of about one part of carbon with * * * one and a half parts of zinc ore, by weight, gives most satisfactory results with the particular ore which we have treated; but the proportions to be used will depend upon the character of the ore and the degree of heat required to reduce it, and the degree of heat evolved will be determined by the resistance or conductivity of the mass and the strength of the current employed. * * * In the reduction of an ore composed of a nonvolatile metal, or a metal which is not volatilized at the heat generated in the furnace, the metal remains in the furnace mixed with the carbon, filling the interstices between the grains, while the gases produced pass off. In the reduction of rare metals, where a pure product is desired, it is necessary to use a pure carbon, or a carbon free from iron or other foreign ingredient; otherwise the iron or other substance will go into the product."

The claims of the patentee are as follows: "(1) The method of generating heat for metallurgical operations herein described, which consists in passing an electric current through a body of broken or pulverized resistance material that forms a continuous part of the electric circuit, the ore to be treated by the process being brought into contact with the broken or pulverized resistance material, whereby the heat is generated by the resistance of the broken or pulverized body throughout its mass, and the operation can be performed solely by means of electrical energy. (2) The method of smelting or reducing ores or metalliferous compounds herein described, which consists in subjecting the ore, in the presence of carbon, to the action of heat generated by passing an electric current through a body of broken or pulverized resistance material that forms a continuous part of the electric circuit, the ore being in contact with the broken or pulverized resistance material, whereby the ore is reduced by the combined action of the carbon and of the heat generated solely by the resistance of the broken or pulverized body throughout its mass. (3) The method of smelting or reducing ores or metalliferous compounds herein described, which consists in pulverizing the ore, and mixing with it pulverized or broken carbon or like material, then introducing the mixed ore and carbon within an electric circuit, of which it forms a continuous part, the said circuit being established through the carbon constituents of the mass, whereby the heat is generated by the electrical resistance of the carbon throughout the mass, and the operation can be performed entirely by means of the carbon reagent and the electrical energy. (4) The method of smelting or reducing ores or metalliferous compounds herein described, which consists in subjecting the ore, in the presence of a reducing agent, to the action of heat generated by passing an electric current through a body of broken or pulverized resistance material that forms a continuous part of the electric circuit, the ore being in contact with the broken or pulverized resistance material, whereby the ore is reduced by the combined action of the reducing agent, and of the heat generated solely by the resistance of the broken or pulverized body throughout its mass." Patent No. 319,945, to the same patentees, dated June 9, 1885, is a patent for the apparatus by which the process just described was carried on. In the specifications it is said that "there is no deposit made on either plate of the decomposed constituents of the material reduced." The plates referred to are those which formed the anode and the cathode. Again it is said: "The reduced metal is found, at the close of the operation, filling the interstices between the particles of carbon mixed with it and plated, as it were, onto the same; and, when the carbon is very coarse, it works down through it, and collects in the bottom of the charge on the charcoal floor."

In patent No. 324,658, also issued to the Cowles brothers, a process is described of smelting ore for the production of alloys, bronzes, and metallic compounds. Patentees say: "In a prior application we have described an important process of smelting ores and reducing the salts of refractory metals by means of electricity, which consists, briefly, in the use of a body of broken or pulverized carbon made incandescent by the passage of an electric current through the same; and in carrying out our present invention we preferably use said process as being best adapted for the purpose. This invention consists in mixing or imbedding in the body of broken carbon pieces of the metal which is to constitute the base of the alloy, whereby it is melted by the incandescent carbon, and takes up the other metal, whatever it may be, that is being smelted or reduced. This produces an alloy rich in the rare metal, sometimes to the point of saturation, and the alloy is afterwards brought down to the proper percentage by the remelting of the alloy and the addition of the necessary amount of base metal, by any ordinary process."

The patentee describes the application of the invention to the Siemens electric arc thus: "For example, in that we would either mix the ores or metals to be reduced together or alloyed in the arc furnace or crucible, or we would use an electrode of copper, tin, nickel, iron, or other metal, as the case might be, depending on the heat and force of the current at the arc to smelt and carry over, to the mixture of ore, carbon, or metals, the metal of the electrode, and thus incorporating the same together into an alloy, carbide, silicide, or boride, as desired, the operation being performed entirely by electrical energy and the reducing effect of carbon; and we further assert that results in

alloying and compounding may be obtained that cannot be otherwise performed, on account of the intensity of the temperature attainable by this means, and above all by the intermixing, incorporating, and merging power of the current. * * * We are aware that alloys have been produced by electrolysis, the current being made to pass through plates of platinum and carbon placed in contact with a base metal and with the compound to be reduced, and therefore we do not claim the same broadly."

The claims of the patentee are as follows: "(1) The process of producing alloys, which consists in passing an electric current through a mixture of broken resistance material,—ore to be reduced and pieces of the base metal of the alloy,—so that said mixture is rendered incandescent, and the alloy formed, substantially as hereinbefore described and set forth. (2) The process of producing alloys, which consists in passing an electric current through a mixture of broken resistance material and ore to be reduced, into which wires or rods of the base metal of the alloy have been inserted transversely to the path of the current, substantially as and for the purpose set forth. (3) The process of producing alloys hereinbefore described, which consists in mixing together ore of one of the metals of the alloy, broken or pulverized carbon, inserting wires or rods of the other metal of the alloy into the said mixture, and then passing an electric current through the mixture in a transverse direction to the wires or rods, so that the said mixture is rendered incandescent, and an alloy formed, substantially as set forth."

Patent No. 335,058, to Alfred H. Cowles, is a patent for an electric furnace and method of operating the same. "This invention," says the patentee, "consists in the improved method of operating incandescent electric furnaces herein described, and in the combination, with a furnace containing a charge of electrical resistance material, of two movable electrodes situated at opposite ends of the furnace, and projecting into the body of the charge contained within it, so that the said electrodes may, when the resistance runs down, be drawn apart, thereby increasing the amount of the charge between the electrodes, and consequently increasing the resistance, and thus preserving a uniform resistance within the furnace. * * *"

After describing the furnace, the patentee goes on: "This invention relates to electrical smelting furnaces operating on the incandescent principle, in which metallurgical operations requiring an intense heat are carried on, with electricity as the heat-producing agent. D is the charge. This consists, ordinarily, of electrical resistance material, such as electric light carbon and the ore to be reduced. Both of these are previously pulverized and intimately mixed together before being placed in the furnace; but in some cases pulverized ore alone is used when it is a sufficient conductor of electricity. * * * The current of electricity flows from the sides and ends of the said electrodes through the charge, and causes the electrical resistance material in the charge to become incandescent. The intense heat of the said incandescent material reduces the ore. When the furnace is employed for the reduction of ore, the metal is found at the close of the operation filling the interstices between the particles of carbon, mixed with it, and at the bottom of the furnace, where it collects upon the charcoal floor after having worked down through the charge. When the furnace is started, the electrodes are near together in the positions indicated by dotted lines, the resistance at the start being very great. After the furnace has been running for a while, and this portion of the charge between the electrodes has become heated, the resistance falls, and the electrodes are then drawn out a little, increasing the length of the charge between them, and bringing into the active part of the electrical field additional parts of the charge. In this manner, by successive withdrawings of the electrodes, a uniform resistance is preserved until the entire charge is brought into action. * * * I am aware that it is not new to make the electrodes of an electric furnace automatically adjustable, so that, as the resistance diminishes, they are drawn apart, and I do not claim the same broadly; but all such attempts and experiments have relation to furnaces in which the electric arc is employed, and, the electrodes being subject to rapid wear, the loss must be compensated for. * * * A continuous body of material is preserved between the electrodes, and the distance between them varies, gradually widening from the beginning of the operation until the whole of the charge is brought into action."

The first and second claims of this patent are as follows: "The method of smelting ores and other substances by the incandescence of an electrical resistance material contained in said substances or mixed therewith, which consists in first bringing a limited quantity of the material to be treated between a pair of electrodes, and then gradually increasing the quantity of such material by causing the electrodes to recede from each other, substantially as herein set forth. (2) In the art of smelting ores and other substances by the direct heating action of the electric current, the method of obtaining a uniform action of said electric current upon the mass or charge to be treated, herein described, which consists in introducing into the charge electrodes which are normally in proximity to each other, and then gradually causing said electrodes to recede from each other, the contact with the charge still being preserved until the mass of the charge is contained between the said electrodes, substantially as set forth."

Patent No. 324,659, issued to Cowles, Mabery, and Cowles, is for a process of obtaining aluminium. In this patent the patentees refer to the fact that aluminium can be produced under the patents Nos. 319,945 and 317,795, already described, and continues: "Ores are reduced in said furnace by mixing them with broken or granular carbon, and passing an electric current through a charge of the mixed ore and carbon; but the product thereby obtained, when an ore of aluminium is reduced, contains a considerable percentage of carbon, which is taken up both chemically and mechanically by the aluminium; and the object of the present invention is to provide a process whereby the aluminium can be obtained free from carbon and in a pure metallic state. This we accomplish by reducing the ore of aluminium, in company with tin, copper, manganese, or other metal which will alloy with the aluminium, and then subsequently separating the alloying metal from the aluminium by amalgamation, lixiviation, or equivalent process, leaving the residue aluminium in the form of an amorphous powder or state, which can be melted down into an ingot. When aluminum is alloyed with either of the metals above named, it takes up very little, if any, of the carbon; whereas the pure aluminium will, as above stated, absorb a very considerable percentage of carbon, more even than iron or any of the other metals. * * * We are aware that it has been heretofore proposed to reduce aluminium ores by smelting them with zinc ores, and then separating the two metals, and that the alkaline earths have been reduced by electrolysis in contact with an alloying metal and plates of carbon or platinum, and the alloyed metals thus produced subsequently separated. We do not, therefore, claim the same broadly, but what we do claim as our invention, and desire to secure by letters patent, is: (1) The method of producing aluminium which consists in reducing an ore or compound of aluminium, in company with an amalgamating metal, by means of electricity and in the presence of carbon, substantially as described, and then separating the two metals of the alloy by amalgamation. (2) The method of producing aluminium which consists of mixing the aluminium ore with carbon and with a metal, reducing the said ore by means of electricity, so that the aluminium forms an alloy with the said metal, and finally separating the two metals of the alloy, substantially as set forth. (3) The method of producing aluminium which consists of mixing the aluminium ore with broken carbon and with a metal, reducing the said ore by means of electricity, so that the aluminium forms an alloy with the metal, and finally separating the aluminium from the alloy by amalgamating the said metal, substantially as set forth."

As already stated, three patents were issued to Bradley on his original application, No. 85,957, of February 23, 1883. One was for heating by a blow pipe, and has no relation to this controversy. The main patent was No. 468,148. His invention is described in his specifications as follows: "My invention relates to a process of effecting by the electric current the separation or disassociation of aluminium from its ores or compounds, or the decomposition in a similar manner of other like highly refractory metallic compounds, of which aluminium may be considered a type, and which have been classed together by reason of the great difficulty in their reduction. Hitherto this process has been carried on by subjecting the fused ore to the action of the current in a crucible or other refractory vessel placed in a heating furnace, where the temperature is sufficiently high to keep the ore in a melted con-

dition ; but the greatest difficulty is encountered in preventing the destruction of the crucible with this mode of working the process, for it has been found that, in the case of cryolite especially, which is a double fluoride of aluminium and sodium, the fused ore unites or fluxes with the crucible itself, and that the gas liberated in the process of reduction (fluorine gas) attacks the material of which the crucible is composed, and the consequence is that the crucible is quickly destroyed. This destructive fluxing action takes place to a greater or less extent in treating almost any material, and is greatly aggravated by the fact that the crucible is subjected to heat from without; but, even in the case of materials which do not exert a fluxing action, the mere mechanical action of the external heat is sufficient to make it almost impossible to prevent the cracking of the crucibles. The main object of my invention, therefore, is to dispense with the external application of heat to the ore in order to keep it fused. In order to accomplish this object, I employ an electric current of greater strength or intensity than what would be required to produce the electrolytic decomposition alone, and I maintain the ore or other substance in a state of fusion by the heat developed by the passage of the current through the melted mass, so that by my invention the electric current is employed to perform two distinct functions, one of these being to keep the ore melted by having a portion of its electrical energy converted into heat, by the electrical resistance offered by the fused ore, and the other being to effect the desired electrolytic decomposition, by which means the heat, being produced in the ore itself, is concentrated at exactly the point where it is required to keep the ore in a state of fusion. Another feature of my invention consists in dispensing with the crucible for holding the ore, and in employing a body or heap of the ore itself to constitute the vessel or cell in which the reduction takes place, which is not destroyed by the chemical action of the fused ore and the gas liberated, and which, therefore, admits of the process being perfectly continuous, nothing being required but the charging of fresh ore as fast as the reduction goes on, either from without or from the sides or walls of the heap itself."

The process he describes is as follows: "Upon a hearth of brick or other suitable material is piled a heap or body of the ore, more or less pulverized, in the shape of a truncated cone, and a cavity or basin is excavated in the top of the heap to contain the fused portion of the ore which is to be treated electrolytically. In order to fuse the ore at the start, I take two electrodes of a suitable material, such as already used in like processes where fusion has been effected by an external furnace, and connected, respectively, to the two poles of a dynamo-electric machine or other source of current, bring the said electrodes into contact, separate them sufficiently to produce an electric arc, and then thrust them into the ore lying at the bottom of the cavity or basin, where the ore soon fuses by the heat of the arc, and becomes a conducting electrolyte, through which the current from the electrodes continues to flow. The arc of course ceases to exist as soon as there is a conducting liquid—the fused ore—between the electrodes, and the passage of the current then takes place through the fused ore by conduction, and the heat is produced as it is in an incandescent lamp. The arc is merely used to melt the ore in the beginning, and the ore is kept melted by incandescence, so to speak; the metallic aluminium being gradually deposited at the cathode, and the fluorine gas being set free at the anode, so long as the ore is maintained in a state of fusion. As soon as the action is properly started, the electrodes should be moved a little further apart, in order that the metals set free at the cathode shall not form a short circuit between the electrodes, or be attacked by the fluorine set free at the anode. I have found that, by using an electric current twice as strong as would be employed to perform a given amount of electrolytic work in the ordinary way in externally heated crucibles, I am enabled to keep the ore fused according to my invention, without the application of any external heat whatever. * * * I have described my process as preferably carried on by employing a body of the ore itself to form the basin or receptacle in which the electrodes are situated, between which the current flows through the ore for heating and electrolyzing the same. That specific invention, however, is not claimed herein, since it forms the subject-matter of Patent No. 464,933, dated December 8, 1891. My present invention is not limited to the specific character of the receptacle nor the spe-

cific arrangements of the electrodes. What I claim as my invention is as follows: (1) The process of separating or dissociating metals from their highly refractory ores or compounds, nonconductors in an unfused state, of which the ores and compounds of aluminium are a type, which consists in fusing the refractory ore or compound progressively by a source of heat concentrated directly upon it, rather than by an external furnace, and as it becomes fused, effecting electrolysis by passing an electric current therethrough between terminals which are maintained in circuit with the fused bath, whereby the process is rendered continuous, substantially as set forth. (2) The continuous process of separating or dissociating metals from aluminous or like highly refractory ores or compounds, nonconductors in an unfused state, which consists in progressively fusing the refractory ore or compound, and as it becomes fused electrolyzing it by passing an electric current therethrough of sufficient volume to continue and maintain the fusion and effect electrolysis, and adding fresh metal from time to time to preserve the bath constant, as set forth. (3) The process of reducing metals from that class of highly refractory ores and compounds, nonconductors in an unfused state, of which the ores and compounds of aluminium are a type, which consists in fusing a portion of the refractory or compound to be treated, in establishing an electric current through said fused portion, and by such current producing simultaneously progressive fusion of such ore or compound, and continuous electrolysis of the same as fused. (4) The process of separating or dissociating aluminium from its ores or compounds, consisting in fusing and maintaining the fusion, and electrolytically decomposing the ore or compound by the passage of the electric current therethrough, substantially as set forth. (5) The continuous process of separating or dissociating aluminium from its ores or compounds, consisting in fusing and maintaining the fusion, and electrolytically decomposing the ore or compound by the passage of the electric current therethrough, and charging the bath as the reduction proceeds, substantially as set forth. (6) The process of separating or dissociating aluminium from its ores or compounds, consisting in fusing and maintaining the fusion, and electrolytically decomposing the ore or compound by the passage of the electric current therethrough, and regulating the strength of said current in accordance with the requirements of the fused mass, substantially as set forth."

A reference to the file wrapper and contents shows that from 1883 until 1890 the claims of the patent were a number of times rejected by the examiners of the patent office on the ground that the use of an electric current for the combined purpose of heating and electrolyzing a metallic compound was shown by the published reports of Sir Humphrey Davy's experiments in the electrolysis of soda and potash, as far back as 1807. Among the claims contained in the first application was this: (4) "In the electrolysis of materials, or other chemical compounds, in the fused state, the method of maintaining them in a fused state by the heating effect of the electrolytic current itself." The case was appealed to the board of examiners in chief at a time when, among the claims, were the following: (1) "The process of obtaining metals from their ores or compounds consisting in maintaining the ore or compound in a fused or molten condition by the direct passage of an electric current therethrough, simultaneously electrolytically decomposing the ore or compound, and regulating the strength of the said current in accordance with the requirements of the fused mass, substantially as set forth." (2) "The process of obtaining aluminium from its ore or compounds consisting in maintaining the aluminium ore or compound in a fused or molten condition by the direct passage of an electric current therethrough, simultaneously electrolytically decomposing the aluminium ore or compound, and regulating the strength of said current, in accordance with the requirements of the fused mass, substantially as set forth."

The result of the appeal and subsequent proceedings was the issuance of the patent and allowance of claims above stated. Patent No. 464,933, issued to Bradley, referred to in the specifications of his main patent, was, shortly stated, a patent for the method of fusing and electrolyzing ore by the use of a pile of the unfused ore as the basin or receptacle in which the fused ore was to be contained.

The application of Bradley and Crocker, declared to be an interference with that of the Cowles brothers, was for a useful process for reducing and heating ores by electricity. The invention is thus generally described: "In a large number of chemical and metallurgical processes, in which high temperatures are required, and in which it is impossible, on account of the nature of the operation, to heat the materials by the direct action of fire in a reverberatory or blast furnace, it is customary to treat such materials in closed, externally heated crucibles or retorts. For example, the reduction of sodium, potassium, and zinc, and the manufacture of aluminium chloride, are carried on in this way. That this method is very troublesome and expensive. The crucibles or retorts are rapidly destroyed, and, being necessarily small in order that it shall not require too long to heat them through, the labor of charging and managing a large number of small retorts becomes very great. The object of our invention is to overcome these and other difficulties, and to obtain the heat necessary to carry on such operations in a convenient and efficient manner, and to concentrate the heat exactly where it is needed; and, furthermore, our invention has for its object the attainment in commercial processes of temperatures very much higher than have ever been reached before. Primarily, our invention consists in carrying on chemical and metallurgical operations or processes in chambers or furnaces, preferably constructed of or inclosed in nonconductors of heat, in which furnaces the necessary heat is produced and maintained by passing a powerful electric current either through the materials themselves, or through separate conductors near or in contact with said materials, the energy of the electric current being converted into heat by the electrical resistance of the materials or conductors through which it passes. Our invention is applicable to a large number of chemical and metallurgical processes, but, in order to enable others to use the invention, we shall describe in detail two or three of its most typical applications." After describing one means of carrying the current along the sides of the furnace, and developing the heat by the resistance there, the patentee proceeds: "Another form of furnace which we have devised for carrying out our invention is shown in figures 1 and 2, in which A and B are plates of carbon set in refractory brickwork, and covered by an arch, D. This chamber is inclosed in an outer chamber, J, J, J, which may also be of brickwork, or of some porous nonconductor of heat, such as the material known as 'terra cotta lumber.' Between the inner and outer chambers there is a space, as shown, which is filled with asbestos, mineral wool, or other suitable nonconductor. S is a tap hole for withdrawing residue, slag, etc. G is a conduit for taking off the gases or vapors produced. The door, H, is so arranged that the whole of it may be removed in order to remove the carbon plates, etc., or only a plug may be taken out for charging the furnace. Electrical connection is made to the two carbon plates, A and B, by two heavy copper strips or bars, E and F. This furnace may be employed for the reduction of the same metals as we have described in the case of the first form of apparatus (that is potassium, sodium, and zinc), and the same materials may be used; but instead of the heat being produced by an electric current, in which conductors surround or are in contact with the materials undergoing treatment, the current is caused to pass through the materials themselves, and the heat is produced in said materials. For example, in employing this furnace for the reduction of zinc, we take the ordinary mixture of roasted zinc ore (zinc oxide and carbon, and charge the furnace, as indicated in the drawings. This material rests upon the carbon plates, A and B, as shown, and the copper strips E and F, being now connected, respectively, to the poles of a suitable dynamo-electric machine or other source of electrical energy, a current will pass from one carbon plate to the other, through the material resting upon and between them, it being conducted by the carbon contained in the mixture. * * * The zinc, as fast as it is reduced, distills over through the conduit, G, and is collected in the usual manner. Sodium and potassium may be reduced in a similar way. * * * We believe that the metal aluminium can be reduced by our process from its oxide (alumina) by mixing the oxide with carbon, and subjecting the mixture to an intense heat in our furnace. This reduction of alumina by carbon directly has often been attempted, but a high enough temperature cannot be attained in the ordinary way by combustion. By our proc-

ess, however, an almost unlimited temperature can be produced, and it is probable that in this way we can accomplish this important result. * * * In an application for letters patent of the United States now pending (filed February 23, 1883, serial number 85,957), Charles S. Bradley, one of the present inventors, has described an electro-metallurgical process in which an electric current is employed to perform two functions: First, to effect the electrolytic decomposition of the materials treated; and, second, to supply the heat necessary to maintain said materials in the fused state while they are being electrolyzed. The present invention resembles the above to a certain extent, but in the present invention the electric current which we employ performs no electrolytic actions, the reaction which takes place being purely chemical, and the function of the current being solely to develop the heat which is a necessary condition of the reaction. For this reason, our invention does not require the use of a continuous current of electricity. An alternating current may be employed if desired, which is an advantage, since large alternating current dynamos may be constructed more cheaply than the continuous current machines, and it is also less trouble and expense to run them."

Among the 10 claims made in the applications just before the interference was declared with the Cowles process were the following: "(2) The herein-described process, which consists in mixing together in a finely-divided state two or more materials at least one of which is a conductor of electricity, and in heating said materials or maintaining them at a high temperature by passing an electric current through them, in order to cause them to act or be acted upon chemically." "(9) The herein-described electrical heating process, in which the material to be treated is mixed with carbon, both being in a finely-divided state, and the mixture is heated or maintained at a high temperature by passing through it an electric current. (10) The herein-described process of obtaining aluminium from alumina, which consists in mixing the alumina with carbon, and in heating the mixture or maintaining it at a high temperature by means of an electric current."

The subject-matter of the interference in the patent office was as follows: "The process of reducing ores which consists in mixing the ore with carbon, and subjecting the charge to the action of heat generated by passing an electric current through the same, the ore being kept in contact with the carbon, which forms a continuous part of the electric circuit, substantially as set forth in applicant's 2d, 5th, 9th, and 10th claims, and in the four claims presented in the application of E. H. and A. H. Cowles, of Cleveland, Ohio, entitled 'Electric Furnaces.'"

After the assignment of May 18, 1885, the features of the Bradley and Crocker invention, to which reference has been made, were eliminated therefrom, including the claims declared to be in interference.

R. S. Taylor, for complainant.

Betts, Hyde & Betts, and Loren Prentiss, for respondents.

TAFT, Circuit Judge (after stating the facts). We have in this case to deal with the use of the electric current to perform two functions in metallurgical operations. Whenever a current of sufficient quantity and intensity is passed through a chemical compound in a fluid condition, it will cause a chemical disruption, and one of the elements will go to the anode, or the place at which the current enters the fluid mass, and the other will go to the cathode, or place where the current leaves it. This chemical dissolution by the current is called "electrolysis." If the compound to be treated is metallic, the metal element will gather at the cathode, while the other will go to the anode. If the other element is a gas, as it is when the ores are oxides, the oxygen or other gas will bubble out of the bath at the anode. The effort that the electric current has to make in order to pass through any body or matter produces heat. The greater the resistance, or, what is the same thing, the lower

the conductivity of a material, the more heat will be generated by forcing a current through it. Heat can thus be produced of great intensity. The highest heat known is that caused by the electric arc, where the current forces its way through the air and completes the circuit. The usual way of reducing metals from their ores has been to fuse the ores by the heat of combustion in the presence of what is called a reagent. The reagent is a substance with a stronger chemical affinity for the nonmetallic element of the ore when the ore is melted than the metal sought. The result of the melting and reaction is that the metal is left pure. Whenever the ore is an oxide, carbon will serve as a reagent, because the affinity of carbon for oxygen is very strong. Carbon is a conductor of electricity in which there is sufficient resistance to the passage of the current to generate a very great heat. The Cowles brothers conceived the idea of a furnace for reducing ores by the use of electricity in which granulated ore should be mixed with granulated carbon, so that the carbon should form a continuous conductor from anode to cathode. The passage of the current would generate heat in every particle of carbon throughout the furnace, and would soon fuse the ore, when the carbon, acting as a reagent, would take the oxygen from the fused compound, and leave the ore pure. Whether electrolysis necessarily took place in the furnace I shall discuss later.

Bradley's process of 1883 was a fusion of the ore, unmixed with carbon by the electric arc, an electrolysis of the fused ore, and a maintenance of the fusion from the heat generated by the passage of the current and the electrolytic action. There was no reagent in the Bradley process. The only agent of dissolution, except the fusion, was the current. In 1885, the Cowles brothers were convinced that they had made a great discovery,—one which would revolutionize the art of winning the rarer metals, like aluminium, from their usually refractory ores. As they were forming their company, they learned that some one else had made a similar discovery. They wished to buy peace, as their counsel says, and so they proposed to buy from Bradley and Crocker the invention which threatened to destroy the value of their own, and, to make themselves perfectly secure, they secured the assignment of all other inventions or discoveries of the assignors which would tend to interfere with the monopoly they hoped to enjoy from their own. They were seeking insurance from invasion by the assignors, and so the assignment was made to cover patents, applications, and discoveries which never were, and which the assignors, of course, knew had no existence. Bradley and Crocker were willing to make the language thus broad, because, as it could convey nothing, it did them no injury. The intention of the Cowles brothers was not only to secure the application which had interfered, but also to have a most sweeping guaranty from Bradley and Crocker that they had no other discovery which would interfere with the Cowles discoveries. This is the only explanation possible of the assignment of European patents and applications, and of the reference to inventions, applications, and patents all in the plural, in addition to

the application specifically assigned. It is not claimed that Bradley and Crocker represented that they had other inventions and discoveries which would satisfy the words of the assignment. It is manifest that the general and indefinite language was used only to secure the Cowles Company against possible and undisclosed inventions, and not for the purpose of including inventions known to both parties to be in existence.

With the general purpose of the parties in the framing of the contract well understood, we come to the question whether they intended to include in the assignment Bradley's electrolytic process of 1883. The evidence establishes beyond controversy that when the assignment was drawn and executed the Cowles brothers knew that Bradley had applied for a patent for a process of reducing metals by electrolysis in which the current also effected the necessary fusion. They knew this from the Bradley and Crocker application which they were buying, in which the Bradley process was not only described, but the patent office number was given. It was discussed by them. Had the Cowles Company then intended that it should pass by the assignment, it is not possible that it would not have been specifically mentioned therein. The Bradley and Crocker application was identified in the assignment by number and otherwise. Why not Bradley's? On its face, the assignment purported to convey Bradley and Crocker's applications, patents, and discoveries. This was the stronger reason, if an individual application of Bradley was to pass, to make the reference to it free from doubt. The Cowles Company was using general terms to describe patents and applications in the assignment for fear that the assignors might have others undisclosed. But here was one brought to its attention while the contract was being drafted. Surely the failure to mention it specifically is strong evidence that it did not intend or wish to acquire it. Otherwise, why did not the Cowles Company at once take steps to prosecute the application to a patent as it did in the case of the Bradley and Crocker application? For eight years it made no claim of title to the Bradley application. It is suggested that, at the time of the assignment, it stood rejected. But the Cowles Company did not know this, and, even if it had, rejections are not final in the patent office, as the many rejections of this very application abundantly show. It is fair also to infer that Bradley did not suppose he had included his application of 1883 in the assignment, because from 1885 until the issuance of the patent, in 1892, Bradley pressed for its allowance.

The circumstances present convincing evidence that neither of the parties to the assignment thought that the Bradley application of 1883 was within its terms. But this conclusion does not dispose of the case. It was the purpose of the parties to this assignment that a certain class of discoveries, applications, and patents, if owned by the assignors, should pass to the assignee. The description of them ex industria was made general, so that it might include individuals of the class whose existence was not known. If, now, it appears that there was an application which must be included within the general description to effect the purpose of the

assignment, can the court exclude it from the operation of the grant, because both parties at the time of the assignment knew of its existence, but were ignorant that it was within the description of the class to be conveyed? It does not seem so. The question of construction is, what did the assignors intend to convey? If a class, then all the individuals fairly within it must be included in the assignment. The very object in a class description is to avoid the necessity of mentioning individuals, and to include individuals which might otherwise be omitted. It follows that the mistake of the parties in thinking that a certain individual is not of the class conveyed will not exclude it from the grant. But the fact that both parties do not think the individual to be in the class described may be a pregnant circumstance to show in what sense the words describing the class are used, if those words are capable of several meanings. This, then, brings us to the question whether the Bradley application of 1883 is fairly included within the words of the grant. The important words are:

"Any and all discoveries and inventions relating to electric smelting processes and furnaces, and all patents they have obtained therefor, and all applications now pending and caveats on file in the United States patent office relating to electric smelting processes and furnaces, which do or may interfere with any applications for patents made by Eugene and Alfred H. Cowles, of Cleveland, Ohio, now pending in the United States patent office."

It is clear that Bradley's application of 1883 was not included in the grant, unless it related to electric smelting processes and furnaces, i. e. unless the process described therein was an "electric smelting process," as that term might reasonably have been understood by the parties when the assignment was executed. The meaning of terms often changes from time to time, and the words of a contract are to be construed as of the time when it was entered into. "Smelting," by its derivation, is synonymous with "melting," but in metallurgy and the commercial manufacture it has come to have a more contracted meaning. Thus Prof. Morton, the expert for the defendant, quotes, from a treatise on metallurgy by Frederick Overman, this distinction between "melting" and "smelting":

"When metallic ores are exposed to heat, and such reagents as develop the metal, we call it 'smelting,' in contradistinction from the mere application of heat, causing the ore to become fluid, which is called 'melting.'"

Prof. Morton, however, is of the opinion that "smelting" really means nothing more then "melting apart," and that any process in which the melting apart or separation of a metal from its ore is effected by the use of electricity is correctly described as electric smelting, and therefore that the Bradley process was electric smelting.

Prof. Langley, the expert for the complainant, thus defines "smelt":

"The word 'smelt' is customarily applied to that class of metallurgical operations in which a metal results, said metal being in a metallic condition, and obtained from an ore or mixture in which the metal originally existed in the form of a chemical compound. In all instances the operation of smelting results in producing something different from the body operated upon, and this change is brought about by the action of heat and chemical force. Usually the chemical action involved is between carbon, on the one hand, and

the oxygen of the ore, on the other; as, for example, in the smelting of iron, the ore, which in this case is always an oxide of iron, is introduced into a furnace where it comes in contact with hot carbon, which removes the carbon chemically by combining with it and setting the iron free. 'Smelting,' then, may be said generally to indicate the melting of something by heat, accompanied by a chemical change induced by the substances present in contact with the ore. The two exceptions just alluded to in this definition are—First, the case of bismuth, in which the bismuth exists in a metallic condition; and, secondly, the Lake Superior ores of copper, where the copper also exists in a metallic condition. In both of these instances it is sufficient merely to raise these ores to a temperature sufficient to melt the contained metal, and chemical action is not, therefore, necessarily present, but, even in these cases, chemical action is resorted to practically to render the earthy materials of the ore fusible, and thus render the separation of the metal more perfect. The substance added to bring about a chemical change in the earthy matters of the ore are called 'fluxes,' and they generally consist of limestone or of limestone and clay, so that, in the practical sense of the word, one may say the term 'smelting' always involves melting by heat and the concomitant presence of a chemical change."

On cross-examination, Prof. Morton was asked this question:

"Can you refer me to any instance of the use of the word 'smelt' or 'smelting' to signify the decomposition of a compound by the action of the electric current by any writer of recognized accuracy or authority? Ans. Not without the addition of the word 'electric.' As far as I am aware, the use of this compound word was first introduced into literature by the Messrs. Cowles in connection with their process, in which they described the operation which took place as electric smelting."

The first application of the Cowles brothers was filed December 24, 1884, and the patent was issued in June, 1885. This described the process, and was termed the "Process of Smelting Ore by the Current." On February 24, 1885, their second application was made for the apparatus by which this process might be successfully and commercially carried on. This was termed "An Electric Smelting Furnace." The most general claim describing the process in the first patent was as follows:

"The method of smelting or reducing ores or metalliferous compounds herein described, which consists in subjecting the ore in the presence of a reducing agent to the action of heat generated by passing an electric current through a body of broken or pulverized resistance material that forms a continuous part of the electric circuit, the ore being in contact with the broken or pulverized resistance material, whereby the ore is reduced by the combined action of the reducing agent and of the heat generated solely by the resistance of the broken or pulverized body through its mass."

It seems clear to me that the reason why the Cowles brothers called this an "electric smelting process" was because its main feature was like that of any smelting process as ordinarily understood, namely, the use of high heat and a chemical reducing agent, and because the heat was produced by electricity. The use of the carbon to attract the oxygen of the fused ore by chemical affinity most naturally suggested the smelting of iron and other metals by the same reagent. Before that time ores had been fused, and then subjected to electrolysis. If "smelting" meant only "melting apart," then this was smelting by means of electricity, but it was never so called. Even the Siemens arc furnace of 1877 was not described as an electric smelting furnace. It remained for the Cowles brothers to invent

the term to distinguish their discovery, and we may gain some idea of the sense in which they used it at the time of the assignment by reference to their idea of what their discovery was. Its important and main features, in their judgment, were the intense heat of the current made available by distributed carbon and the chemical reaction caused by the same agent. The many articles written by the Cowles brothers, and by disinterested scientists, together with the evidence of Alfred Cowles in an interference proceeding between the Cowles application and that of one Faure, are all quite convincing that, in 1885, they thought that, though electrolysis might play some part in the process, the main success of it was due to the smelting effect of the high heat, and the chemical reaction between the carbon and the nonmetallic element of the ores, and that a process which was purely and solely electrolytic was not embraced within the meaning of the term "electric smelting process" as they used it. This conclusion is still further borne out by the circumstance, already commented on, that though the parties to the contract of 1885 had before them and under discussion this very Bradley process, so described as to bring it clearly within the definition of "electric smelting" now contended for by the defendant and given by its witnesses, yet no specific words were used in the contract either to include the process in, or exclude it from, the operation of the assignment as would have been most natural, had the process been an electric smelting process, as it was then understood by the parties. There can be no doubt either of the distinction which the assignors in the assignment made between such a smelting process and one of electrolysis, for in the very application which the Cowles Company bought by this assignment of May 8, 1885, Bradley and Crocker distinguished the Bradley process of 1883 from the equivalent of the Cowles process, as follows:

"The present invention (i. e. their carbon smelting process) resembles the above (i. e. the Bradley process of 1883) to a certain extent; but in the present invention the electric current which we employ performs no electrolytic action, the reaction which takes place being purely chemical, and the function of the current being solely to develop the heat which is a necessary condition of the reaction. For this reason our invention does not require the use of a continuous current of electricity. An alternating current may be employed if desired, which is an advantage, since large alternating current dynamos may be constructed more cheaply than the continuous current machines, and it is also less trouble and expense to return them."

The Cowles Company took this application, and pressed it to a patent, which was issued to it as assignees, and, though the claim for the fundamental process was waived, that for an improvement thereon was retained, and the foregoing explicit declaration of a radical distinction between the carbon electric smelting process and the Bradley electrolytic process still appears in the specifications of the patent, and is, in effect, a formal admission by the Cowles Company, without which it may be presumed the patent would not have issued to it. From the whole record, I feel sure that the parties to the assignment of 1885 did not use the term "electric smelting processes" in the wide sense claimed on defendant's behalf, and that, in their minds, processes solely electrolytic were not embraced within

it. Therefore the Bradley process of 1883 was not conveyed to the Cowles Company by the assignment, and it never acquired title.

But suppose that I am wrong in thus limiting the meaning of the words "electric smelting process," and that even in 1885 it did include any process in which by the use of the current ores were melted and separated, even if there was no chemical reaction at all. The discoveries, patents, applications, and caveats relating to electric smelting processes and furnaces assigned by Bradley and Crocker are only those "which do or may interfere with" the Cowles patents. It has been pressed upon the court that these words modify only the phrase immediately preceding, namely, "caveats on file," etc., and do not qualify the terms "discoveries," "patents," and "applications." This is much too narrow a construction. The Cowles Company was buying peace, and the clause in question was expressive of the intention which pervaded the entire document, and should be given its effect in construing every sentence and clause in it. We have found that neither of the parties thought that the Bradley process of 1883 was included in the assignment. We are now considering the question whether the general language of the assignment describing a class carried the process in spite of this common view of the parties. Certainly the court will lean to the construction of the general language used which may be reconciled with the common thought of the parties as to the particular process, and if, therefore, as I shall attempt to show, the construction, by which the discoveries, patents, and applications assigned are limited to those which did or might interfere with the Cowles patents, excludes from the grant the Bradley process of 1883, then it is the court's duty to place that construction upon the assignment. Moreover, the reference of the clause, "which do or may interfere," to all preceding subjects of the assignment, is a reasonable and grammatical interpretation of the language, for the relative pronoun "which" often has more than one antecedent, and there would seem to be no reason for thus limiting the caveats assigned without also limiting the more important words, "discoveries, patents, and applications." The words, "do or may interfere," are plainly to be construed with reference to the atmosphere in which the parties then were. They were in the atmosphere of the patent office. They were considering the question of applications, caveats, and patents,—all technical terms to describe different steps in the securing of a monopoly by government grant. The word "interfere" has a technical meaning in that connection. It is used in the statutes of the United States. Strictly speaking, an interference is declared to exist by the patent office whenever it is decided by the properly constituted authority in that bureau that two pending applications, or that a patent and a pending application, in their claims or essence cover the same discovery or invention, so as to require an investigation into the question of the priority of invention between the two applications or the application and the patent.

In the strictest technical sense, therefore, the fact that the Bradley application of 1883 was not declared to be an interference with

any of the Cowles patents, and that the Cowles patents were issued, and as issued were not modified or affected, by the Bradley application of 1883, would exclude the Bradley application from the effect of the assignment. But it may be conceded that this is too strict an interpretation, and does not square with what appears to have been the manifest intention of the Cowles Company in securing this assignment. The interference referred to was either a declared interference in the patent office, or the total defeat or the narrowing of any of the otherwise valid claims of the Cowles patents, after issuance, in a court of competent jurisdiction, by the use of an application or invention of Bradley and Crocker or either of them. If, therefore, it appears that the otherwise valid claims of the Cowles patents are not narrowed or defeated by the specifications of the Bradley patents which are the subject of this litigation, then the Bradley patents did not pass by the assignment. The question is not to be determined by what the Cowles brothers may have claimed in any application, nor by what might have been claimed under their specifications and drawings, had Bradley never made his invention or application in 1883. It is whether the claims allowed to the Cowles brothers by the patent office are restricted or invalidated by the really new inventions of Bradley, as disclosed by his application of 1883.

If the patent office allowed Bradley any claims which the history of the art shows he should not have been allowed, then those claims can play no part in this discussion. If invalid, they are invalid because anticipated by some other patent, or by the discoveries in the prior art, and it certainly cannot be held that claims thus narrowed or defeated interfere, in the sense of the contract, with any of the otherwise valid claims of the Cowles patents. The questions remaining, therefore, for consideration, are: (1) What was the real invention of the Bradley patents? and (2) what are the valid claims of the Cowles patents, excluding consideration of the Bradley patent? and (3) are they interfered with by Bradley's discovery of 1883?

For eight years, from 1883 to 1891, the claims of the Bradley patent were rejected by the patent office, the examiners ruling that the use of a current of electricity to fuse a metallic compound, and to maintain the fusion, and to electrolyze the fused compound, was old in the art, because Sir Humphrey Davy had reported, as a contribution to science, his use of the electric current first to fuse, and then to electrolyze, potash and soda, securing a deposit at the cathode of the metal potassium and the metal sodium, respectively. In the collected works of Sir Humphrey Davy, reported in 1840, occurs this statement:

"I tried several experiments on the electrization of potash rendered fluid by heat, with the hopes of being able to collect the combustible matter, but without success; and I only attained my object by employing electricity as the common agent for fusion and decomposition. Though potash, perfectly dried by ignition, is a nonconductor, yet it is rendered a conductor by a very slight addition of moisture, which does not perceptibly destroy its aggregation, and in this state it readily fuses and decomposes by strong electrical powers."

Sir Humphrey Davy also tried the experiment with alumina or other refractory ores or oxides, and did not succeed in fusing them, because the current would not pass through them in their dry state. It was known that these ores, if fused, could be subjected to the electrolytic action of the current, but it seems never to have occurred to any one but Bradley how the current might be used to effect the fusion of the metal in its nonconducting state, as part of the electrolytic process. He secured it by putting the anode and cathode so close together that an electric arc was formed by the passage of the current through the air. This, as was well known, produced the highest possible heat, and quickly fused the ore between or near the anode and the cathode. The power of fused ore thus produced became at once a medium for the conduction of the current. Thereafter the resistance to the current in the fused ore caused heat, which could be easily increased to effect the progressive melting of the rest of the ore, by adding to the voltage or intensity of the current.

The history of the Bradley patent shows, as disclosed above, in the statement of facts, that Bradley attempted to secure the allowance by the patent office of one claim or more for the process of maintaining fusion and electrolysis by the electric current simultaneously in the treatment of metallic compounds. But it will be observed that even on appeal, and by the decision of the board of review in the patent office, his claims in this regard were very much narrowed. He was required by the board of appeal to make, as an essential part of the process described in his specifications and claims, the initial fusing of the metal as therein set forth, and, as the only initial fusing suggested was that described in the patent to be by the electric arc, it became an essential part of the process patented.

The acceptance by the patentee after he had made the claim for merely maintaining the fusion, and simultaneously electrolyzing the fused mass, and it had been rejected, estopped him from ever afterwards asserting monopoly to such a process, when the initial fusion described in his patent was not included in it, and showed with reasonable certainty that he was entitled to nothing more. Bradley's discovery, therefore, was of a combination of steps, each one of which was old. The steps were, first, the initial fusion by the electric arc between the carbon anode and cathode. The electric arc was certainly old. Second, the maintenance of the fusion by the heat of resistance to the current in the fused ore, and the consequent progressive melting of the rest of the ore. This step was plainly shown by Sir Humphrey Davy. And, third, electrolysis by the current, which was equally well known. Whether Bradley is really entitled to the monopoly of this combination or not may be questioned when the validity of his process is directly in issue. Both parties to this cause, in contending for the possession of it, have a motive not to diminish its scope more than is absolutely necessary to the establishment of his or its title, but sufficient appears in the record to justify the limitation of it as above. The other patent of

Bradley's involved here is for the use of a pile of ore as a containing vessel for the bath to be electrolyzed, in accordance with the directions of the main patent. It does not seem to me, except as it involves the process described in the main patent, to have any bearing on the question of interference with the Cowles patents. Having thus considered the scope and extent of the Bradley process of 1883, we come now to consider what is the real essence of the Cowles patents. The gist of the Cowles invention is the use of granular carbon or other equivalent resistance material distributed through the mass of granulated ore to carry the current from one electrode to the other, and by its low conductivity or resistance to produce intense heat, not at a single point or in a single line, but throughout the ore, and by the heat thus generated to fuse the ore, and to separate the metal element by the chemical action of the carbon upon the nonmetallic element of the ore, just as iron and other like ores are smelted in a furnace.

The claims of the first or main patent of the Cowles brothers relate, the first one to the fusion of the ore by the process described, the second to its smelting or reduction by the reagency of the same carbon used to generate the heat, and the third and fourth claims are but variations from the second. This Cowles patent was not intended to disrupt the metallic compounds by electrolysis. There is a suggestion in the patent that the current has a disrupting or disintegrating effect of assistance in the reduction and distillation of zinc ores in accordance with the specifications of the patent, like the disrupting effect of the current in the solution. Whether this obscure statement is a blind intimation that electrolysis takes place or not is somewhat difficult to determine. But, even if it is, certainly the main purpose of the Cowles brothers in their patent was to accomplish the reduction of the ores therein mentioned by the chemical reaction of the carbon, and not by the electrolytical disrupting of the ore. It is confidently claimed, however, on behalf of the defendant, and the claim is rested on elaborate expert evidence, that the main agent in reducing metals from their ores by the Cowles process is the electrolytic action of the current after the ore is fused by the heating contact of the incandescent carbon distributed through its pulverized mass. In my opinion, it is immaterial whether this theory be true or not, for, even if electrolysis is necessarily present in the Cowles process as the main and leading agent for its successful carrying on, the claims of the Cowles patents are not at all affected by anything disclosed in the Bradley process of 1883, either in the specifications or in the claims allowed by the department. The only valid claims of novelty in the Bradley process, as we have shown, are of a combination which must have, as part of it, the initial fusion of the dry ore by the electric arc. This was the difficulty which Sir Humphrey Davy seems not to have been able to overcome in the process of electrolysis with internal heating, and this difficulty, if the Cowles process is an electrolytic process, was overcome in it, not by the use of the electric arc, but by the establishment of a continuous current through granulated carbon placed between the anode

and the cathode. In other words, the Bradley process and the Cowles process, if they both involve electrolysis, and thus cover common ground, do not interfere with each other, because the common ground covered was well known in the history of the art, and was not subject to the monopoly of either.

But much has been said concerning the suggestion in one of the Cowles patents (the one to Alfred Cowles, No. 319,945) that in some cases pulverized ore might alone be used where it is a sufficient conductor of electricity without carbon. This is the only suggestion of the kind in all the five patents belonging to the Cowles Company. It is said that, in furnaces operated with the granulated ore alone without the carbon, we should necessarily have a reproduction of the Bradley process, and therefore that the Bradley process would interfere with the Alfred Cowles patent to that extent. The argument is untenable, first because the evidence shows that the suggestion of the Alfred Cowles patent is wholly impracticable. There is no ore disclosed in the record which in its dry state is a sufficient conductor to permit the passage of a current, and, unless the current can pass through the resistance material which is to generate the heat, the process must be a failure. Again, the suggestion of the patent was never embodied in any of the claims allowed. Therefore the Cowles Company, without regard to the Bradley process, would have no monopoly on it, and their patents could not be said to be interfered with in respect of the process which they did not own.

Finally, I do not think that it is by any means clear that electrolysis in the Cowles patents, as they are described in the specifications of the patents, plays any considerable part in the reduction of metals. In the first place, in one of the Cowles patents it is stated that there is no deposit of metal upon the carbon plate which makes the cathode. There has been no evidence introduced to show that this statement is a mistake. If there were any electrolysis between the electrodes, the metal must be deposited at the cathode. Prof. Morton, the chief expert for the defendants, on his examination in chief developed and illustrated a theory by which every two pieces of the granulated carbon lying next to each other in the fused ore constitute an electrolytic pair, and electrolysis goes on everywhere in the bath, wherever two such adjacent granules of carbon could be found. Out of the mouth of this same witness, by the cross-examination of counsel for the complainant, who proved himself both on examination and in the argument to be a learned expert himself, the elaborate and convincing theory developed by Prof. Morton was shown to have but limited application to the Cowles furnaces. His statement in chief gave the impression that the melted ore would find its way and form a film between every two adjacent grains of carbon in the furnace, and that between each two grains thus separated by the film an electric cell would form, and electrolysis would go on; but when counsel for the complainant brought out from the witness the fact that the counter electro motive force needed in each electrolytic cell for the work of electrolysis would require to produce electrolysis in the number of cells which must thus occur in a

Cowles furnace of ordinary dimensions a voltage three or four times that actually used in the Cowles furnaces, he was obliged to admit that the number of cells in the furnace would be much less than that which his answers in chief would have led a nonexpert to suppose. When his attention was called to the statement in the Alfred Cowles patent that there was no deposit on the cathode of metal, he immediately supposed an aggregation of carbon granules there, so closely united as to prevent the fused ore from finding its way to the cathode, departing thereby from the principal hypothesis of his theory, as originally stated, that the fused ore would necessarily thread its way in between all the loose particles of carbon in the furnace. The effect of his answers on cross-examination was to weaken much the probative force of his general statement that the chief agent in reducing metals under the Cowles patents was electrolysis. Prof. Morton did demonstrate that some electrolysis must go on in the Cowles furnace, and this, indeed, was not denied on behalf of the complainant. He demonstrated it by electrolyzing a solution of sulphate of copper with carbon, in which the result of electrolysis was seen in the particles of copper distributed all over the bottom of the glass disk in which the experiment was performed, and not confined to the cathode. While these show that electrolysis must go on to some extent in the Cowles furnaces, they do not show that the smelting effect of the high heat and the carbon reagent is not the important and principal means of reducing the metal in the Cowles process.

In one of the papers published in connection with the Cowles process, a Mr. Darrow reports an experiment by the Cowles Company for the purpose of determining whether electrolysis played any considerable part in the Cowles furnaces. His experiment consisted in the operation of the furnaces with a continuous current, and then with an alternating current. It was conceded, at that time, that electrolysis was impossible in an alternating current. Prof. Morton and others question this, but there is no substantial evidence that the theory is unsound. Mr. Darrow's announced result was that there was substantially no difference in the product of the Cowles furnace from an alternating current and from a continuous current. Prof. Morton, from the figures of Mr. Darrow, thinks that there is a wide difference demonstrated. If such a difference could be shown, it would go far to prove the claim now made on behalf of the Cowles Company that electrolysis played a great part in their furnaces, but no such experiment has been attempted since Darrow's, or, if attempted, has not been shown in evidence. On the whole, from the entire record, including the evidence of Prof. Langley and Prof. Haynes, and of Prof. Morton on cross-examination, I conclude that there is electrolysis present as an incidental feature in the Cowles furnaces, but that the presence of carbon, instead of aiding the electrolysis, interferes with it, and that it is by no means an important feature in the reduction of metals under the Cowles patent.

Evidence appears in the record of the operation of the Cowles furnaces at Lockport, N. Y., and these are used to show that electrolysis

must go on. One of the chief evidences is said to be the bubbling of the gas at the anode. But on cross-examination of the witnesses it was developed that the operation of the furnaces was a departure from the Cowles method, in that the carbon was only about 10 per cent. of the mixture, and would hardly form a continuous conductor; that the fusion was begun by the electric arc; and that in fact the process described in the Bradley patent was the one which was used.

For the reasons given I am satisfied that the Bradley patent was not intended to be conveyed by the assignment of May 8, 1885, and that it was not, in any view, included within the general terms of that assignment. The finding of the court will be that the valid title of United States patents Nos. 464,933 and 468,148, issued to Charles S. Bradley and mentioned in the bill, is now in the complainant by lawful assignment; that neither the defendant the Cowles Electric Smelting & Aluminum Company nor Alanson T. Osborn has any title to these patents; and that the assignment of them, executed by the Cowles Company to Osborn, and placed upon the record in the patent office, had no effect to carry title to them, and constitutes a cloud upon the title of the complainant. The decree of the court will be that the defendants shall cancel the record of the said assignment by the Cowles Company to Osborn in the patent office, and that the defendants, and each of them, shall be perpetually enjoined from asserting any title or claim of title to the patents described in the bill. The cross-bill of the defendant the Cowles Company will be dismissed, and the costs of the cause taxed to it.

CARTER-CRUME CO. v. ASHLEY et al.

(Circuit Court, N. D. New York. June 26, 1895.)

PATENTS—SALESMEN'S CHECK BOOKS—INJUNCTION PENDENTE LITE.

Injunction pendente lite against infringement of the Carter reissue patent (No. 10,359), for improvement in salesmen's check books, will be granted, the patent having but 3½ years to run, complainant having built up a large business employing many men and much capital, defendants being small users, the manufacturer who sold to them being a small and recently organized corporation; a decision sustaining the patent having been rendered six years ago, in a case in which substantially the same defenses now relied upon were presented, there having, since such time, been general acquiescence in complainant's rights, and there being little doubt that defendants' book is an infringement.

Suit by the Carter-Crume Company against John W. Ashley and others for infringement of patent. Complainant moves for preliminary injunction.

C. H. Duell, for complainant.
George B. Selden, for defendants.

COXE, District Judge. The complainant, as owner of reissued letters patent, No. 10,359, asks for an injunction restraining the defendants from infringing pendente lite. The patent was granted