MISCELLANEOUS.

THE ELECTRIC ARC.—II.

BY HERTHA AYRTON.

The following table gives the results of the actual measurements made of the diameters, for each current, with the 2mm. and 4mm. arcs, side by side with the diameters calculated from the formulæ

$$D = 3.2 + 0.163\ A, \text{ for the 2mm. arc,}$$
$$D = 3.2 + 0.172\ A, \text{ for the 4mm. arc,}$$

D being the diameter of the crater in millimetres, and A the current in amperes. The coefficients given here of A are somewhat higher than those stated in the last article; but those, I find, were a little too small to produce the best agreement between the formulæ and the results obtained experimentally.

Carbons: Positive, 13mm. cored. Negative, 11mm. solid. Length of arc, 2mm. silent.

Current in amperes.	Measured diameter of crater in mm.	Calculated diameter of crater in mm.
4	3.8	3.85
7	4.2	4.33
10	4.75	4.89
15	5.6	5.63
20	6.45	6.44
25	7.35	7.26

Length of arc, 4mm. silent.

Current in amperes.	Measured diameter of crater in mm.	Calculated diameter of crater in mm.
7	4.4	4.404
10	4.9	4.92
15	5.8	5.78
20	6.6	6.64
25	7.6	7.5

For all currents, therefore, between a comparatively small one and the largest that will give a silent arc the *diameter* of the crater may be expressed with surprising accuracy as a linear function of the current.

The curves in Figs. 4, 5 and 6 (pp. 142 and 143, THE ELECTRICAL ENGINEER Feb. 18), for the three pairs of carbons may be employed to ascertain what must be the resistance of the extra coil used with an arc lamp, and what is the potential difference necessary to be maintained between the mains, in order to produce a *silent* arc of given length with a given current.

From the curves in Fig. 5 we see that the resistance added to an arc lamp on a constant pressure circuit fulfills two objects. It not only prevents the current from becoming very large when the carbons are in contact before the arc is struck, but it fulfills another very important function in making it possible for a solenoid to regulate the length of the arc, and keep the current passing through the arc approximately constant, by causing the feeding mechanism to approach the carbons together when the current falls below the required value.

For if there were no added resistance coil, and the only resistance in the lamp, beyond that of the arc itself, were the very small resistance of the regulating solenoid, the potential difference between the carbons would be practically constant when the lamp was attached to constant-pressure mains. In that case we see from the curves in Fig. 5 that if the arc were, say, 3 mm. long, and the current were, say, 13 amperes, the burning of the carbons would *increase* the current, so that the regulating solenoid would have to start the feeding mechanism when the current became too *large*, and not when it became too small, as with the regulating solenoid of an ordinary arc lamp.

But even if the regulating solenoid were constructed so as to start the feeding mechanism when the current became too large, such a lamp could not be satisfactorily used with a constant potential difference between the carbons—that is, without an added resistance on a constant-pressure circuit. For a length of arc of about 1.8 mm. is not uncommon in arc lamps, and at about this length, a small increase in the length of the arc may cause either a great increase or a great diminution in the current for a constant potential difference between the carbons, depending on whether the length of the arc is greater than, or less than, the length corresponding with the point of intersection of the curves.

The addition of a resistance to an arc lamp on a constant-pressure circuit is necessary to make it possible for an electromagnetic mechanism to regulate the distance between the carbons. This explains the curious fact noticed by Prof. Ayrton when giving the lecture on "The Storage of Energy" at the London Institution on March 2, 1882. A Foucault-Duboseq arc lamp, which regulated perfectly well when supplied with current from Grove's cells without any interposed resistance, refused entirely to regulate when the Grove cells were replaced by a battery of Faure accumulators, although the number of accumulators was chosen to set up the same potential difference between the lamp terminals as was produced by the Grove's cells. He had, in fact, replaced a circuit of constant E. M. F. by one supplying constant pressure, and with the latter the distance between the carbons oscillated backwards and forwards between two wide limits, the regulating mechanism, which both approaches and recedes the carbons in a Foucault-Duboseq lamp, vainly trying to find a position of stability. The length of the excursion up and down of the carbons in such a case can be calculated from the curves which will accompany the next article.

CONTRIBUTORY INFRINGEMENT OF PATENTS.[1]

BY HUBERT HOWSON.

CONTRIBUTORY infringement of a patent right may be defined as the intentional aiding of one person by another in the unlawful making or selling or using of the patented invention. The doctrine or judicial law of "contributory infringement," considered as a settled doctrine, is comparatively modern; less than twenty-five years ago it was an unknown term. When Curtis published the third edition of his book on the law of Patents in 1867, he had nothing to say on "contributory infringement." When he published his fourth edition in 1873, he inserted in his book a new section of two pages devoted mainly to quotations from the first reported opinion, which may be said to have laid the foundation for the whole modern doctrine on this subject.

When this term "contributory infringement" is used, one naturally thinks at once of that form of it which consists in one person's supplying to another a part of a patented combination with the intent that that other may make up and sell or use the whole combination. It was in such form that the question first came before the Courts in 1871 and 1872.

In the fall of 1871, Judge Woodruff in Connecticut, had before him the now leading case of *Wallace & Sons v. Holmes, Booth & Haydens*,[2] involving the simple but then novel state of facts, which are sufficiently explained in the following quotations from the opinion of the Court:—

"The complainants having a patent for an improved burner in combination with a chimney, the defendants have manufactured and sold extensively the burner leaving the purchasers to supply the chimney without which such burner is useless. They have done this for the express purpose of assisting, and making profit by assisting, in a gross infringement of the complainants' patent. They have exhibited their burner furnished with a chimney, using it in their sales rooms to recommend it to customers and prove its superiority and therefore as a means of inducing the unlawful use of the complainants' invention, and now it is urged that, having made and used burners only, they are not infringers, even though they have distributed them throughout the country in competition with the complainants and have to their utmost ability, occupied the market, with a certain knowledge that they were to be used as they can only be used, by the addition of a chimney. * * * The defendants are therefore active parties to the whole infringement, consenting and acting to that end, manufacturing and selling for that purpose."

It will be quite clear from the foregoing quotation that although the question presented to Judge Woodruff was entirely new, he had no hesitancy in reaching the conclusion that the defendants were infringers, but when a similar question was presented to Judge McKennan in the Eastern District of Pennsylvania, in the spring of the following year (1872) in the case of *Keystone Bridge Co. v. Phœnix Iron Co.*,[3] it seems as if the Court reached the opposite conclusion from that arrived at by Judge Woodruff. It is not by any means clear however, that this Bridge case, as presented and argued, was "on all fours" with the lamp burner case.

The ruling in the case of *Wallace v. Holmes* was quickly recognized as authority. In the latter part of 1872, in the case of *Renwick v. Pond*,[4] a suit on a patent for a cartridge-extracting mechanism for firearms, Judge Blatchford approved the ruling of Judge Woodruff. In another case[5] in 1876, the patents in suit were for improvements in children's carriages, the distinguishing feature in both being the connection of the top of the carriages with movable and adjustable standards, so that the top could be adjusted and fastened in any required position. The defendants made only the standards for the carriages "but it is admitted that they are made and sold to carriage builders for the express use to which they are put, that is, to children's carriages, and it is not denied that this in law makes them infringers." In another case[6] on the patent for the well-known Holly system of waterworks, the defendants seem to have only supplied the pump for the system, but the Court said: "The effect of the whole (answer and evidence) clearly is that they participated in putting in the whole by furnishing the pumps for that purpose, and this is sufficient to make them liable as infringers."

The doctrine of "contributory infringement" is of course no exception to the general rule that a patent for a combination of elements is not infringed unless the whole combination be

1. Abstract of a paper read before the American Association of Inventors and Manufacturers, Washington, January 15, 1886.
2. 1 *Off. Gaz.* 117.
3. 1 *Off. Gaz.* 471.
4. 2 *O. G.* 302.
5. *Richardson v. Noyes*; 10 *O. G.*, 507.
6. *Holly v. Machine Co.*, 4 *Fed. Rep.* 74; 12 *O. G.* 1177.

employed. It is only when, and because, a defendant has supplied a material part with the knowledge or intention that it is to be used in making up the whole combination, that he becomes a contributory infringer.

It is generally recognized now that this doctrine of "contributory infringement" is founded upon a well-settled rule of law. The principle may be roughly stated that he who wilfully assists in a wrongful act, becomes answerable for all the consequences of that wrongful act,—is himself a wrong doer. An infringement of a patent right is a "tort," as it is termed, that is, (to express it generally), a wrongful act, for which an action will lie. Therefore any one who intentionally contributes to or assists in an infringement of a patent right, thereby makes himself answerable for that infringement—is himself an infringer.

The cases to which I have alluded are cases in which the patents were for combinations, but there are many reported cases of contributory infringement of patents for *processes*, by supplying the materials therefor. Thus, as early as 1876, Judge Nixon in the New Jersey District, in the case of *Rumford Chemical Works v. Hecker*[7], held that Hecker (of Buckwheat fame) in selling his self-raising flour, and advertising it as "an invaluable article for producing in a few minutes by addition of cold water only, without yeast or salt, the most nutritious and wholesome bread," was an infringer of a patent of Prof. Horsford for the use of phosphoric acid when combined with alkaline carbonates as a substitute for ferment or leaven in the preparation of a farinaceous food, and the ground for the decision was that this flour contained the ingredients mentioned, so that when the cook should make the flour into bread in the usual way, the process would necessarily be carried into effect. Again, where a dealer in photographic supplies, who was himself licensed to sell the materials to the licensees of the platinotype photographic process, sold the materials to other persons known not to be licensees, he was held to be an infringer.[8]

In still another case[9] the complainant owned the Cooley patent of September 1879 for "a new process of raising cream from milk." The defendant made and sold milk cans adapted to be used according to the Cooley process and they were sold with directions for such use. Defendant very naturally contended that as he only made a mechanical device, he could not be held to infringe a patent for a process. Nevertheless the Court held that as the defendant's cans were to be used only for the purpose of raising cream in the manner described by the Cooley process and were sold with directions for such use, the fact of infringement was established.

It is scarcely a matter of surprise to find that this doctrine of contributory infringement had hardly got well under way before patentees were anxious to carry it beyond the limits of the principle upon which it is founded. The principle requires an intention on the part of a defendant to participate in the act which constitutes the infringement. As early as 1874, in the case of *Coolidge v. McCone*[10] where the complainant sought to have defendant enjoined as an infringer of a patent for a combination of shoes and dies and bevelled bars in an amalgamating pan for silver ores, the Court held that as there was no evidence of any intention on the part of the defendant to supply the shoes and dies for the purpose of making up the complete combination by the addition of the "bevelled bars" by the users, he was not a contributory infringer.

This necessary element in contributory infringement of an *intention* to so contribute to the infringing act was expressed by Judge Shepley in the following lucid language as early as 1875:

"As the defendants only make one element of the patented invention, in order to hold them guilty, I must find proof connecting them with the infringement. Different parties may all infringe, by respectively making or selling, each of them, one of the elements of a patented combination, provided those separate elements are made for the purpose, and with the intent, of their being combined by a party having no right to combine them, but the mere manufacture of a separate element of a patented combination, unless such manufacture be proved to have been conducted for the purpose and with the intent of aiding infringement, is not, in and of itself, infringement."[11]

By this is not meant that the party must have known of the patent and intended to infringe it. If he intentionally contributed to the *act*, which the Court holds to be an infringement of the patent, he is an infringer, and his actual lack of knowledge of the existence of the patent will not excuse him. The publication of patents is assumed in law as to be sufficient notice to the public of their existence.

Bearing in mind the principle of law upon which this doctrine of contributory infringement is based, it will not be difficult to perceive that there may be other ways in which one can contribute to an infringement of a patent right. An interesting case[12] of contributory infringement was decided by Judge Blatchford in 1879. It consisted in the transportation by the Old Dominion Steamship Co. of cotton ties from New York to various southern ports, knowing that such ties were intended for sale and use in southern cotton ports and elsewhere. The Court said:—

"It would seem, on principle, that there ought to be no difficulty in restraining by injunction all persons, whether officers of the company or not, who are aiding in the promotion of the infringing sale and use, whether such persons would be liable for profits or damages or not."

When the term "contribution" is used in ordinary conversation, it suggests "passing around the hat," and in point of fact that is one way in which you may contribute towards an infringement. In a case of *Bate v. Gillett*[14] the Court had granted an injunction against the Gilletts enjoining them from infringing the plaintiff's patent. They immediately ceased to make use of the complainant's process for preserving meat, but afterwards they entered into an agreement with others, to contribute to a fund for a common defence against all infringement suits which should be thereafter instituted by the complainant against any one of the parties. Suit was brought against one of the parties and the expense of defending that suit was or was to be, paid out of the common fund, and it was shown that these defendants paid their proportional share of money to the fund.

"Such conduct is in disobedience of the injunction in its spirit, if not in the letter. They are doing, indirectly, what they have been commanded not to do either by themselves or through the agency of others * * * * *—Where it is proved that what a party does is done for the purpose and with the intent of aiding infringement, he is liable under the doctrine of contributory infringement."

Finally, contributory infringement may take on more of the nature of a conspiracy than is suggested in the cases to which reference has been made. In the comparatively recent case of *Waterman v. Shipman*[15], decided by the Circuit Court of Appeals in New York, the bill of complaint alleged a combination between the defendants to deprive the plaintiff of the benefits and advantages of his license. Waterman had the exclusive license to manufacture under the patent in suit. One of the defendants, Asa L. Shipman, afterwards acquired the legal title to the patent, and undertook to give his sons, the co-defendants, a license. The Court said:—

"If the licensee's rights have been infringed by the owner, and third parties confederating with the owner, there is no reason why all the infringers should not be joined as defendants." * * * * * * The evidence shows that the license granted by Asa L. Shipman to his sons, the other defendants, was granted by him, and procured by them, for the paramount purpose of preventing the complainant from enjoying the monopoly conferred by his license. The defendants, therefore, are joint infringers."

Many other reported cases might be cited to elucidate the subject, but what has been said will serve to make it clear to you that you may infringe a patent not only by directly making or selling or using the patented invention yourself without a license, but also by intentionally aiding any one else in any such unlawful act.

THE ELECTRIC LIGHT IN CONGRESS.

REPRESENTATIVE Linton from the Committee on Ventilation and Acoustics in the lower house of Congress has submitted the following report concerning the ventilation and lighting by electricity of the House of Representatives:

The Committee on Ventilation and Acoustics, to whom the matter of ventilation of the House of Representatives was referred, beg leave to report that the testimony of the experts from the Supervising Architect's Office and the Marine Hospital Service proves most conclusively that the present method of lighting the south wing of the United States Capitol is one of the principal causes for the existing impure condition of the air throughout that portion of the building referred to. Mr. Adams, heating and ventilating engineer of the Supervising Architect's Office, says:

"In addition to this it will be almost imperative to substitute electric light for gas light, especially for lighting the Hall; this will remove one of the dangerous sources of impurities in the air. If a suitable electric light plant is installed, the heating of the entire building can be so arranged that it will practically cost nothing, as the exhaust steam from the electric light and fan engines will be more than sufficient to heat the same."

Dr. J. J. Kinyoun, of the Marine Hospital Service, says:

"There are leaky gas pipes in the building, especially in the cellar. In one instance 0.7 part per 1,000 was detected, the quantity of gas present depending upon how long the building had been closed and the ventilating machinery stopped. The system of lighting the hall is open to a serious objection due to the escape of gas from the numerous gas jets over the ceiling. The electric light plant should be enlarged sufficiently to supply all parts of the building with electric lighting. This alone will add much to the sanitary condition of all parts of the building."

The committee further recommend that the Committee on Appropriations cause to be inserted in the Sundry Civil Bill or deficiency appropriation bill of this session an amount, not exceeding $70,000, for the purchase of an electric plant, and to place in operation facilities for carrying out the objects of this Congress to perfect the ventilation and acoustics of the House of Representatives.

BRISTOL, TENN.—It is now quite certain that Bristol will have a new telephone exchange company, as a rival of the East Tennessee Telephone company, which has an exchange there.

7. 2 *Banning & Arden*, 351.
8. *Willis v. McCollin*, 20 *Fed. Rep.* 641; 38 *O. G.* 1017.
9. *Boyd v. Cherry*, 50 *Fed. Rep.* 279
10. 5 *Off. Gaz.* 468.
11. *Sayre v. Hammond*, 7 *Off. Gaz.* 781.
12. *Am. Cotton Tie Co. v. McCready*, 17 *O. G.*, 565.
14. 20 *Fed. Rep.* 668. 15. 55 Fed. Rep. 983.