
1929
Mar. 12-21.
Sept. 10.

CANADIAN RADIO PATENTS LIMITED, ET AL ..... } PLAINTIFFS;

v.

THE HOBBS HARDWARE COMPANY, LIMITED ..... } DEFENDANT.

Patents—Infringement—Specification—Equivalents—New result—New Method of applying a new principle and a well known principle

Held, that in respect of subject matter inventions may be divided into two classes, first that kind of invention which consists of the discovery of a new method of application of a new principle, and second, that kind which is to be found in some particular new method of applying a well known principle. As to the first, upon the ground that the patentee is not bound to describe every method by which his invention could be put into effect; the Court will regard jealously any other method embodying the same principle. As to the second, the use of other methods is not contemplated by the patentee, and should not be included within the ambit of his claims.

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2. That it is important to ascertain what is the exact invention that is protected, and which is said to be infringed and if the invention belongs to the former class, then the doctrine of infringement by the substitution of equivalents applies. On the other hand if the invention belongs to the second class, and is only for an improved method of attaining an old object, the monopoly would be for that particular improved method only, and only by using that particular method would a person be held to have infringed.
3. Held further that when an invention consists in the production of a new result, the patentee is not tied down to the particular means, or the identical parts mentioned in his specification. In other words one cannot make use of the novel principle of an invention, the carrying of which into effect is the real substance of the patentee's invention, by substituting obvious equivalents for some of the parts mentioned in the patentee's specifications, and thus escape infringement.

ACTION for the infringement of Patent 174,690 Hartley, and 241,138 Rice.

The action was tried before the Honourable Mr. Justice Maclean, President of the Court, at Ottawa.

O. M. Biggar, K.C., and *R. S. Smart, K.C.*, for plaintiffs.

W. L. Scott, K.C, for defendant.

The facts are stated in the reasons for judgment

THE PRESIDENT, now (September 10, 1929), delivered judgment.

In this case, the plaintiffs claim infringement of two patents having to do with certain improvements in that type of radio receiving circuit in which the desired signal is progressively selected and amplified, in a succession of tuned circuits, coupled by means of vacuum tubes or audions. In this type of circuit, the input as well as the output circuit of each successive audion, is tuned to the frequency of the signal to be selected. It is this tuning which gives to the circuits the property of selectivity, or discrimination, in favour of a signal whose frequency corresponds to the frequency to which the circuit is tuned.

The audion acts as a relay, to generate in its output a signal identical in all respects to the signal impressed on its input terminals. Under favourable conditions of operation, the amplitude or strength of the signal so relayed may be considerably increased and the audion caused to act as an amplifier as well as a relay. The audion consists of an evacuated glass enclosure containing a cathode, an anode and a grid. The cathode usually takes the form of a metal-

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lic filament which may be heated by an electric current. The anode is generally in the form of a metal plate surrounding the filament, and the grid in the form of a spiral of wire placed between the anode and the cathode or filament. The input circuit is connected between the grid and the filament, and the output circuit which includes a battery is connected between the anode plate and the filament. The combination of tuned circuits and audion, which constitute the selective amplifier involved in this case, is represented diagramatically in fig. 1 of the Alexanderson patent, referred to in the reported case of *Canadian General Electric Company Ltd.* v. *Fada* (1).

It is conceded that an amplifier of this type, designed to operate at broadcast frequencies, is essentially unstable, that is to say, there is an inherent tendency in the amplifier to act as an oscillator or generator of oscillations. This tendency is due to the fact that the anode and the grid act as the two plates of a condenser. By reason of this condenser effect, or internal capacity of the vacuum tube, some of the high frequency energy in the output circuit is fed back into the input circuit. If this feedback or regenerative action is sufficient to compensate for the energy losses of the system, the oscillations are sustained even though no oscillations are impressed upon the system from outside, and the audion functions as an oscillator. When functioning as an oscillator, the audion or vacuum tube is incapable of functioning efficiently as an amplifier of the signals impressed upon the receiver, and reception becomes unsatisfactory. The oscillating condition of the tube gives rise to a whistling noise in the telephones or loud speaker which seriously impairs the quality of the received signals.

The object of the improvements described in the two patents in suit, owned by the plaintiffs, and which are said to be infringed, Hartley, Canadian patent no. 174,690, and Rice, Canadian patent no. 241,138, is to prevent the tube from functioning as an oscillator while at the same time taking full advantage of its amplifying properties. Hartley's method of attaining this result is described in his specifications. He says:—

> This invention relates in general to electrical circuits containing amplifiers, in particular to such circuits in which an electrical coupling exists

(1) (1927) Ex. C.R. 134, at p. 138.

which is capable of transferring power from the output terminals of an amplifier to its input terminals. * * * * *

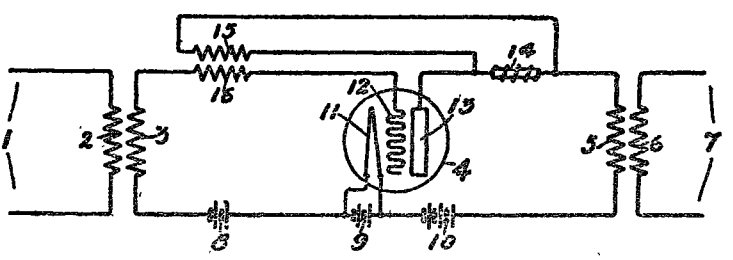
Now in the thermionic repeater it is impossible to eliminate this coupling, and the present invention contemplates introducing still another electromotive force into the input circuit and so adjusting it, as to amplitude and phase, that it shall annul the effect of elcctromotive force introduced by the first-mentioned unavoidable coupling inside of the repeater itself.

Then he proceeds to describe an arrangement by which this may be accomplished.

The application of this idea to amplifying networks containing some such unavoidable coupling is illustrated in the drawings, in which Fig. 1 shows a typical amplifying arrangement in which an inductive coupling of input and output circuits is secured by breaking the output circuit and closing this break through one winding of a transformer, whose other winding is included in the input circuit.

Below is Fig. 1 of Hartley, referred to in his specification.

Fig. 1



Hartley further proceeds to say:—

In the operation of this network, an electromotive force impressed upon the input circuit produces a current in the output circuit, which current, through the agency of the coupling inside the repeater, induces a further electromotive force in the input circuit. As has been stated the present invention consists in opposing to the last named electromotive force, another which is obtained in the typical cases illustrated, by the transformer coupling 15, 16.

Hartley's arrangement is briefly stated in claim 1

1. An electrical network containing a thermionic amplifier having an input and output circuit, said output circuit being adjustably coupled to said input circuit to oppose the effect upon said input circuit of currents in said output circuit.

The fundamental principle involved in Hartley is, that it seeks to counteract the effect of the parasitic or objectionable feedback which takes place through the internal capacity of the vacuum tube, by creating an external feedback, the direction or phase of which is such as to oppose and neutralize at every instant the internal feedback. And this is the basic principle of the so called "neutralization cir-

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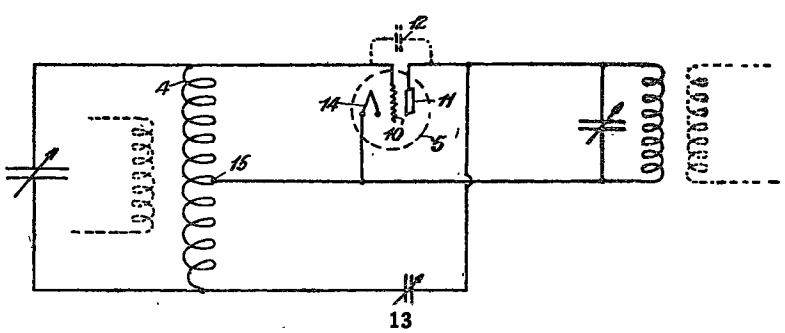
cuits." To secure neutralization, it is necessary to feed back a certain electromotive force by external means from the output circuit to the input circuit, equal and opposite in direction to that impressed on the input circuit by reason of the internal feedback. Hartley has disclosed one way of doing this. He does it entirely by electro-magnetic means, that is, by coupling two coils together and he suggests that it could be done in other ways.

Rice describes in his specifications, the object of his invention and how it is carried out. He says:—

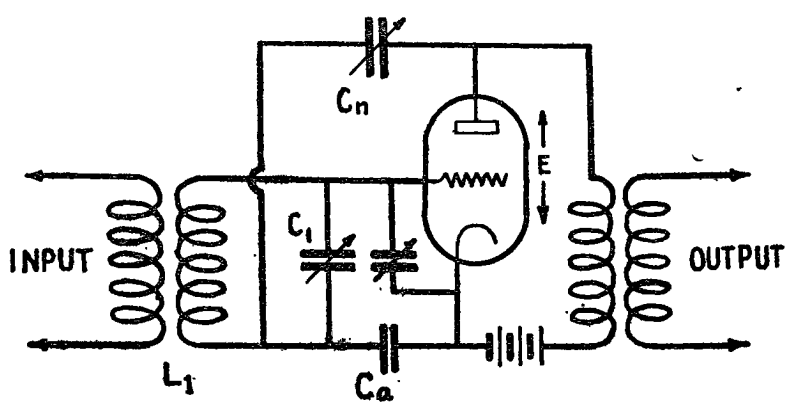
> The object of our invention is to avoid the undesired production of oscillatory currents when such a device is used either as an amplifier or detector, or to serve both functions. It has been ascertained that the production of oscillatory currents by such a device is due to the coupling which is always present between the grid and plate circuits.
>
> This coupling is of two kinds, electromagnetic and electrostatic. . . .
>
> In carrying our invention into effect we overcome the electromagnetic coupling between the circuits which is present when air core inductances are used by inclosing the inductances in separate metal boxes. We also overcome the effect of the electrostatic coupling by impressing upon the circuits electromotive forces equal to and opposite in direction to those impressed thereon by reason of the natural capacity coupling and thereby neutralize the effect of this coupling. When this compensation is once adjusted it is effective for all frequencies to which the circuits may be tuned.
>
> * * * * *
>
> The coupling between the inductances may also be avoided by employing closed iron cores for the inductances. In order to compensate for the coupling due to the natural capacity between the grid 10 and anode 11, which is represented by the dotted condenser 12, we apply to the grid circuit through the condenser 13 an electromotive force equal and opposite to that impressed upon the grid from the anode 11 across the capacity 12. In order to do this the cathode 14 is connected to the central point 15 of inductance 4, the grid is connected to one end of this inductance and condenser 13 is connected to the other end.

A drawing of Rice, shown in Exhibit No. 11, is as follows:—



In the case of Rice, the plaintiffs point out that a reversal of phase is obtained by connecting the cathode to the mid-point of the inductance 4. This mid-point 15 was described by the plaintiffs' expert witness, Waterman, as an "electrical pivot," and its action was explained by him. The reversal of phase in Rice, is obtained electro-magnetically by means of a coil tapped at some point, preferably the centre point, which is connected to the cathode. So far, Rice is essentially the same as Hartley in that the reversal of phase is obtained electro-magnetically. In Rice however, the energy is fed back from the plate or anode circuit by way of the condenser 13, that is, the feedback is obtained electrostatically. Therein lies the improvement of Rice over Hartley, for, whereas in Hartley the adjustment of magnetic coupling covers a very narrow band of frequencies, in Rice the condenser 13 once adjusted is correct over a wide band of frequencies.

Turning now to the defendant's receiver. One stage of the tuned radio frequency amplifier of this receiver is represented in fig. 1 of defendant's Exhibit B, which is identical with plaintiffs' Exhibit 9, except that the latter diagram omits the anode battery, and this battery is not essential to the point under discussion. Fig. 1 of the defendant's Exhibit B is as follows:—



The various elements of this circuit may be redrawn as in the plaintiffs' Exhibit no. 12, to show the relation between Rice and the defendant's receiver, and which drawing here follows:—

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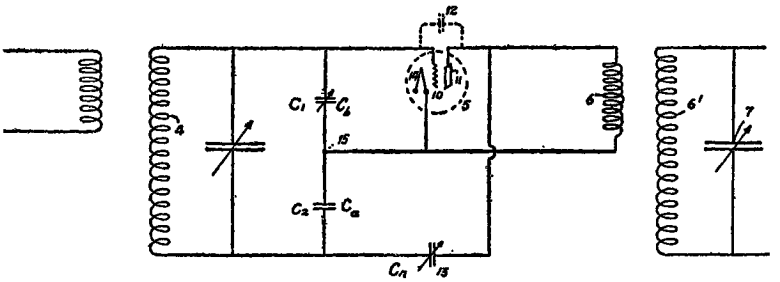
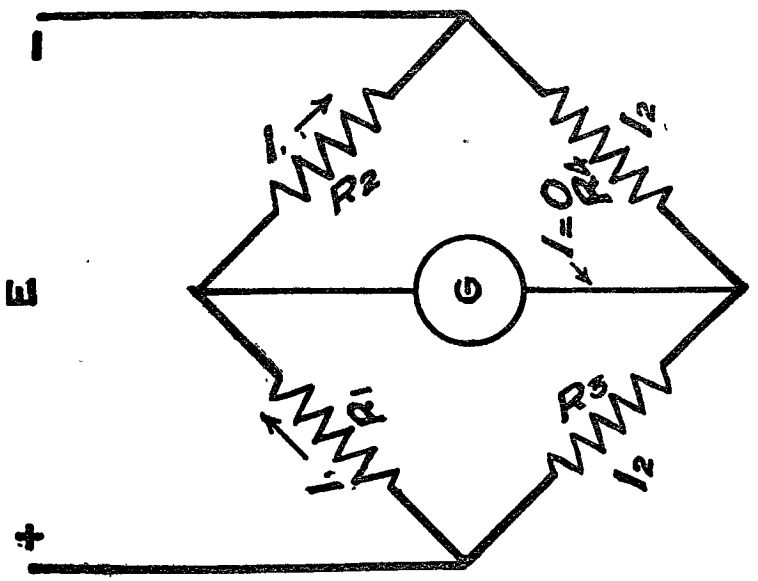


In the above figure, the various elements are designated by the symbols used by the plaintiffs and defendant respectively to identify the different elements.

It is the plaintiffs' contention, that in the defendant's receiver known as Sparton, energy is fed back from the output to the input circuit by the agency of the small variable condenser, designated by the symbol C_n in the defendant's diagram, and by fig. 13 in that of the plaintiffs', in a manner identical to that described in Rice, and for the same purpose. It is the plaintiffs' further contention that in Sparton an "electrical pivot" is to be found, and that this pivot which produces reversal of phase, is obtained by connecting the cathode to the mid-point of two small condensers C_b and C_a connected in series across the tuned input circuit. In other words, these two condensers connected in series with their mid-point connected to the cathode, constitute, when taken in conjunction with the tuned circuit, an exact electrical equivalent of a tapped coil as suggested by Rice. The defendant has not questioned directly the contention that such an arrangement is capable of producing phase reversal in the manner indicated by the plaintiffs, nor did it offer evidence upon this point. The defence is based chiefly on the contention that Sparton does not depend for its action on the principle of feedback in phase opposition, or, as it is sometimes called, feedback in counter-phase, but on an entirely different principle, namely, that of isolating the output from the input circuit by means of a balanced network of the Wheatstone bridge type.

It might be observed that a balanced network or bridge was originally used as a measuring device for measuring resistance and was later used to measure capacity and inductance. To measure these electrical values a balance is

obtained in the circuit, and it is this balancing effect that the defendant claims to use to secure isolation of the input from the output circuits and thus obtain stability of the audion. The defendant's Exhibit A illustrates the principle of the Wheatstone bridge. It is as follows:—



As explained by the defendant's expert witness, Prof. Glasgow, there are in a Wheatstone bridge, four arms arranged in the form of a square and marked in the above drawing R_1, R_2, R_3, and R_4 respectively. Across one diagonal of the square is connected a source of electromotive force E, and across the other diagonal a measuring instrument which may be a sensitive galvanometer. The arms may be composed of four resistances, and the source of electromotive force may be a battery. Or again, they may be made up of resistances, inductances or condensers, and the source of electromotive force may be a generator of alternating current, but so long as a certain relation obtains between the numerical values of the elements of the network, the bridge is said to be balanced, and no current will pass through the galvanometer, or to use the words of Glasgow, the galvanometer may be said to be isolated from the source of electromotive force. The circuit diagram of one stage of radio frequency amplification in Sparton, as represented in the defendant's Exhibit B, fig. 1, may be redrawn as in fig. 3 of the defendant's Exhibit B, and

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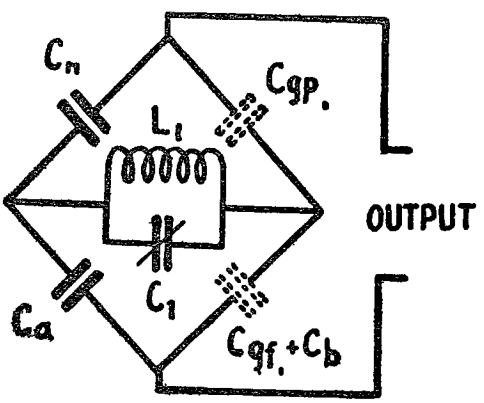
when so drawn it forms a network of the type just described, in which two of the arms of the bridge are formed by the condensers C_n and C_a, and the other two arms by the internal tube capacities between grid and plate, and between filament and grid respectively, the latter being also paralleled by the condenser C_b. Defendant's Exhibit B, fig. 3 is as follows:—



The input circuit L_1, C_1, is across one diagonal of the bridge and the output circuit across the other. When the network is balanced by adjusting the small variable condenser C_n, it is claimed by the defendant that the output circuit is then isolated from the input circuit, and no transfer of energy can take place between the tuned circuits by way of the internal grid-plate capacity of the vacuum tube. In such a condition the defendant claims that the grid-plate capacity is prevented from acting as an internal coupling so as to cause the tube to function as an oscillator. This constituted the main argument of the defences.

It will probably be as convenient here as elsewhere, to discuss any legal principles applicable to this case. In respect of subject matter, inventions may be divided roughly into two classes. First there is that kind of invention which consists of the discovery of a method of application of a new principle, and generally speaking the Court will regard jealously any other method embodying that principle, upon the ground that the patentee is not bound to describe every method by which his invention could be put into effect. In the next place, there is that kind of invention which is to be found in some particular new method of applying a well known principle; in this case the use of other methods

is not contemplated by the patentee, and of course should not be included within the ambit of his claims. It is therefore always important to ascertain what is the exact invention that is protected, and which is said to be infringed. If the invention belongs to the former class, then the doctrine of infringement by the substitution of equivalents applies, and the plaintiffs may say to the defendant "you cannot effect the same result by electrical equivalents." On the other hand if the invention belongs to the second class, and is only for an improved method of attaining an old object, the monopoly would be for that particular improved method only, and only by using that particular method would a person be held to have infringed. Further when an invention consists in the production of a new result the patentee is not tied down to the particular means, or the identical parts mentioned in his specification. In other words one cannot make use of the novel principle of an invention, the carrying of which into effect is the real substance of the patentee's invention, by substituting obvious equivalents for some of the parts mentioned in the patentee's specifications, and thus escape infringement. In *Automatic Weighing Machine Co.* v. *Knight* (1), Cotton L.J. said:—

> Where there is a principle first applied in a machine capable of carrying it into effect, the Court looks more narrowly at those who carry out the same principle, and say they do it by a different mode, and looks to see whether, in effect, although the mode is not exactly the same, it is only a colourable difference—a mechanical equivalent for a substantial part of the patentee's invention being looked upon as a mere colourable difference, and, therefore, he being entitled to an injunction against that mode of carrying out his principle, which is only the same in substance as that which he patented, though there are colourable differences.

I am of the opinion that Hartley and Rice possess subject matter for letters patent and belong to the first class mentioned. The real essence or substance of the invention claimed by Hartley and Rice, was a neutralizing circuit employing feedback in counterphase, to avoid the undesired production of oscillatory currents. These inventions were intended, or expected, to produce new results, I think,—at least upon the evidence presented in this case—that Hartley and Rice together showed how to attain new and useful results, or the method of application of new principles which they discovered, and the novelty of the result itself is part of the merit of the invention; at that

(1) (1889) 6 R.P.C. 297.

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time, I think, the step was a long one, and they appear to be the first to disclose how some principle which underlay the actual circuit described by them, might be utilized. By "principle" I do not mean any of those first principles or laws of nature which cannot be subject of a patent, but merely a practical application of those first principles by some device or other. Hartley and Rice are not, I think, to be construed as claims to monopoly for the precise mechanisms described, but for the attainment of the same results by any means equivalent to the precise mechanism described. The circuits which they disclosed were not in my opinion merely improved methods of attaining old objects or applying well known principles; if that were so the monopoly could only be for the particular or improved methods described by them.

Many prior patents were cited by the defendant to show that the principle of a balanced electrical network was old in the art. Of these, all the references to the telephone art may be dismissed as having no bearing upon this case. The telephone art deals with voice frequencies, and at these frequencies the effect of the internal grid-plate capacity of the audion is negligible and requires no balancing or neutralization. The defendant referred to a well known United States patent granted to Armstrong. This is not an anticipation of Hartley or Rice. Armstrong deals with a circuit which is essentially stable and discloses means of producing regenerative or positive feedback, and not feedback in counterphase. Armstrong did not address himself to the problem of neutralizing the effect of the internal capacity. The same remarks apply to the De Forest patents which were also cited. Another prior patent, Wright, was also cited. This patent had for its object the provision of a wireless telegraph receiver in which the noises due to atmospherics would be so reduced that they would not overpower the sounds due to the signals it was desired to read; obviously this could not be an anticipation of Rice. I am of the opinion that no anticipation of Hartley and Rice had been established.

There remains for consideration therefore the question whether Sparton is only colourably different from Hartley and Rice, and that any distinction is obtained by the substitution of equivalents.

Counsel for the defendant stressed the contention that Sparton was of the bridge type of circuit, and that it secured neutralization by isolating the input and output circuits and not by feedback and counterphase as claimed by the plaintiffs. If any importance is to be attached to the fact that a circuit is of the bridge type, then there is reason for saying that Rice is also of the same type. For instance, Prof. Glasgow described Rice as of the bridge type of circuits in a paper presented by him, before the American Institute of Electrical Engineers in March, 1928. In this paper he was discussing the question of stability, in the operation of tuned radio-frequency amplifiers, and the various methods practised to secure this stability; his reference to Rice is as follow:—

> These objections have lead to the development of a number of bridge types of circuits, so called because of their similarity to the a-c wheatstone bridge. The first of these, for which credit is due C. W. Rice, is shown in Fig. 14,—A being the actual circuit and B. the electrical equivalent omitting the tube electrodes. The filament terminal of the tube instead of being connected to the lower end of the input circuit is connected to an intermediate point which provides the inductance into two parts, L_a and L_b. The lower terminal $_n$ of the input circuit is connected to the plate through a small balancing condenser C_n. The terminals $_g$ and $_n$ of the input circuit and $_f$ and $_p$ of the output circuit constitute two pairs of opposite points of a bridge, as shown in B. An inspection of the latter figure indicates that no voltage can exist across the input terminals $_{g\ n}$, due to a voltage between $_{f\ p}$ if the arms are balanced. Hence the energy which is fed back through C_{gp} is opposed in phase by that which flows through C_n. The conditions for a balance are
>
> $$\frac{L_a}{L_b} = \frac{C_n}{C_{gp}} \qquad (17)$$

I think there is no doubt Rice may be drawn in the form of a bridge as in fig. 14 of defendant's Exhibit K, the Glasgow paper just referred to. The two halves of the input inductance form two of the four arms of the bridge, the internal grid plate capacity of the tube forms a third arm, and the neutralizing condenser forms the fourth. On the other hand some standard text books describe circuits similar to Rice, as circuits in which stability is attained by feedback in counterphase, or to use the exact words of Rice, by impressing on the circuits electromotive forces equal to and opposite in direction to those impressed thereon by reason of the natural capacity coupling. Further it is to be re-

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membered that Glasgow stated, that while Rice's circuit resembled a Wheatstone bridge yet if looked upon as a bridge it is out of balance with all except one frequency, whereas it is claimed that Sparton balanced for all frequencies, but in the Glasgow paper, it is stated that if the coupling between the coils L_a and L_b of Rice, be made substantially unity, then a balance for all frequencies would be secured; so far as I can see there is no reason why this condition could not be fulfilled, thus making Rice as satisfactory a bridge as Sparton.

I do not think it is of importance what names are given to the circuits in question, nor do I think that deductions one way or the other can be usefully made from the fact that Rice and Sparton, as neutralizing circuits, are variously named as of the bridge type or as feedback in counter phase. The important question is, what in fact is the precise nature of the circuits. Rice and Sparton may be drawn in the same way. The conventional manner of graphically representing the electrical connections between the component parts making up an electrical device, is by means of a diagram of connections. These components, which, in the case of a radio set, consist of vacuum tubes, condensers, inductances, resistances, etc., are graphically represented by standardized symbols, and the diagram is completed by means of lines indicating the wires whereby the components are connected together. A diagram need not be an exact plan or photograph of the wired device, it being the privilege of the draughtsman to locate the symbols representing the different component parts on the diagram wherever his fancy pleases; so long as the component parts are shown connected together, exactly as they are connected physically in the receiver itself, the diagram would be correct and perfectly intelligible to one skilled in the art. Thus in the case under discussion, if the draughtsman desires to show Rice or Sparton as a bridge, he arranges the component parts so as to appear in the conventional square shaped bridge arrangement, whereas if he elects to draw the diagram in the conventional manner adopted for receiving sets, he would present an entirely different picture; nevertheless, there would be present in each picture every one of the component parts of the device, and these component parts would be interconnected in precisely the same manner.

Repeating what I have already stated; in an ordinary vacuum tube circuit, such as the Alexanderson type which I have earlier mentioned, the output circuit impresses a voltage on the input circuit by virtue of the internal capacity of the tube, and by reason of this voltage energy is transferred from the output to the input circuit, and the tube will tend to oscillate. To neutralize this flow of energy it is necessary to impress upon the input circuit an equal voltage acting in the opposite direction, when a static, balanced, or neutralized condition is obtained, and the undesired transfer of energy ceases. That is a result or condition which both Rice and Sparton produce, and they each secure this result or condition by impressing upon the input circuit by external means an equal voltage acting in the opposite direction. The term "isolation" as used by Glasgow, in describing Sparton, is purely relative, and has reference to the absence of electrical reaction between the input and output circuits when balanced. Equally there is an absence of electrical reaction in Rice when the circuit is balanced, and in such a condition the term "isolation" can as appropriately be applied to Rice as to Sparton. It must be borne in mind that the component parts of these circuits are physically connected together by condensers and wires, and, I think, that in both Rice and Sparton these connections are identical in that the grid end of the input circuit is connected to the plate through the internal tube capacity, and the other end of the input circuit to the same plate by means of a neutralizing condenser; the only difference in the arrangement of the two circuits being that in the case of Rice, the filament is connected to the centre of the coil of the input circuit, whereas in the case of Sparton it is connected to the centre point of two small condensers connected in series across the same coil. When a circuit is balanced or neutralized a condition is obtained whereby no voltage can exist across the terminals of the input circuit due to a voltage across the terminals of the output circuit; in the electrical sense these two circuits may then, if one wishes, be described as being isolated from one another inasmuch as a voltage in one cannot create a voltage in the other, but that is as true of Rice as of Sparton. In both cases there is impressed upon the grid terminal of the input circuit a voltage to the filament through the internal tube capacity, which in turn is bal-

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anced or neutralized by an equal voltage impressed on the other end of the input circuit by virtue of a neutralizing condenser. The terms, "feedback in counterphase," "isolation," "balancing," or "neutralization," so far as this case is concerned, describe the same condition, namely, that no voltage exists across the input terminals by reason of a voltage across the output terminal.

Hartley and Rice disclosed a method of overcoming the tendency of the tuned radio-frequency amplifier to generate oscillations caused by the feeding of energy from the plate circuit to the grid circuit; that method I have fully described. Sparton I think obtains the same result by using the substance and principle of Hartley and Rice, and by practically the same means. I think in this case the doctrine of equivalents applies, and Rice and Hartley cannot be destroyed by the use of slightly different means for obtaining the same result. The only distinction I can observe between Rice and Sparton relates to the means employed in securing what has been called reversal in phase. Reversal of phase, in the circuits under discussion, can always be obtained by tapping the centre of the coil with a wire and connecting it to the cathode; that is what Hartley and Rice did. Waterman stated in his evidence that if one uses two condensers connected in series across this coil, and connect the mid-point to the cathode, you obtain the same pivoting action or reversal of phase just as if the mid-point of the coil was connected with the cathode. This statement of Waterman's was not I think contested by the defendant, and I do not see how it can be. That being so, then it is my conclusion that Sparton's means of securing reversal of phase is the equivalent of the means employed by Hartley and Rice.

I have not thought it necessary to distinguish between Hartley and Rice in my discussion of this case, but I have generally referred to them as one. These two patents being controlled by the plaintiffs, they were not here in any way in conflict. In one respect at least, I think Sparton infringes Rice alone; and that is in the use of the neutralizing condenser C_n in such a circuit. This I think was really the substance of Rice's invention, and without this condenser the Sparton circuit could not be balanced or neutralized. I therefore think that upon this ground alone, Spar-

ton must be held to infringe Rice, but I do not propose to discuss this point at greater length.

From what I have said, it follows that in my opinion infringement has been established, and the plaintiffs are entitled to the relief claimed; costs will follow the event.

Judgment accordingly.

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