1932
Nov. 2, 3 & 4.
1933
Jan. 30.

BETWEEN:

WESTERN ELECTRIC COMPANY INCORPORATED AND NORTHERN ELECTRIC COMPANY, LIMITED. } PLAINTIFFS;

AND

BALDWIN INTERNATIONAL RADIO OF CANADA, LIMITED..... } DEFENDANT.

(13632)

Patents—Patentability—Infringement—Invention—Claims—Equivalency.

The two patents in suit relate to electric signalling and particularly to signalling over ocean cables. The Court found that there was no infringement and

Held: That on a true construction of the patents, the monopoly claimed must be limited to the precise combination described, and if the claims purport to go beyond this, then such claims, if not the patents themselves, would be void.

2. These are not cases where the doctrine of equivalency applies.

ACTION by the plaintiffs to have it declared that their patents no. 169,472 and no. 213,999 for electric signalling over ocean cables are valid and were infringed by the defendant company.

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 the plaintiffs.

E. G. Gowling and *D. K. MacTavish* for the defendant.

The facts and questions of law raised at the trial are stated in the reasons for judgment.

THE PRESIDENT, now (January 30, 1933) delivered the following judgment:

This is an action for alleged infringement, by the defendant, of two patents owned by the plaintiffs. The first patent no. 169,472, was granted to E. H. Colpitts in May, 1916, on an application made in October, 1914. The specification states that the invention relates to electric signalling and particularly to signalling over ocean cables. One of its objects is to amplify efficiently very low frequency electric waves, and a special object is to provide an efficient amplifying system adapted without transformers for use at

the receiving end of a signalling circuit. The second patent, no. 213,999, issued in October, 1921, on an application made in January, 1921, by H. De F. Arnold, and is apparently a re-issue of a patent granted in January, 1915. This alleged invention relates to the use of repeaters generally and vacuum discharge repeaters more particularly, "as amplifiers without transformers", and still more particularly to thermionic repeaters for securing amplification of current in circuits of low impedance. Both patents deal with the amplification of feeble currents or signals, whereby weak signals fed into the terminals of a device are amplified or strengthened to the extent that they are enabled to operate a recording or sound reproducing device, or to repeat the strengthened signals into an outgoing line. In each case the devices are intended to repeat signals with a frequency as low as two periods per second from one low impedance line or circuit into another of like impedance, and the exclusion of transformers is particularly emphasized.

Apparently the problem which concerned Colpitts was to devise an amplifier which would take a weak signal from a low impedance line, such as a submarine cable, telegraph or wireless circuit, and to amplify it to a sufficient strength to operate a siphon recorder, a device in common use at that time for the recording of telegraph signals. He explains that in order to secure a maximum use of the small energy available at the terminals of a submarine cable, it is necessary that the impedances should be equalized, or, to employ the term used by Waterman, a witness for the plaintiff, in his explanation of this law of electrical circuits, "matched". All electrical circuits and devices in a signalling system have impedance or resistance. The simplest way to match impedances is by means of transformers. A transformer consists of an iron core on which are wound two coils of wire; it has the property of transferring the effect of impedance from one side to the other, that is to say, if one coil is wound with an impedance of 100,000 ohms and the other coil with 1,000 ohms it would effect the transfer of a signal from a 100,000 ohms line or device to a 1,000 ohms line or device, with maximum efficiency, which would not obtain if two lines or devices of such dissimilar impedance were directly connected together. Transformers were well known means of matching im-

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pedances. Both Colpitts and Arnold, however, state the undesirability of transformers in the particular amplifications they had in mind and they each sought to provide effective amplifying devices from which transformers were to be excluded. Colpitts accordingly devises an amplifier, the impedance of the input of which is low, to approximate that of the incoming line, and the output impedance of which is arranged to match that of the recording apparatus. His amplifier, shown in fig. 1 of the patent, consists of what he describes as an "ionized gas repeater" directly connected to a plurality of audions operating in parallel. The ionized gas repeater used by Colpitts is a mercury ionized gas repeater device. The input circuit consists of two electro magnets, which being connected to the incoming line have their magnetism affected in sympathy with the signal currents and in turn create a corresponding varying deflection in the stream of gaseous ions created by the mercury arc, thereby enabling the signal currents to be repeated in the output terminals of the device.

The input impedance of Colpitts' device is dependent on the electro magnets; these can be wound to a suitable impedance to correspond with that of the incoming line; the output of the device is said to be of high impedance. The audion, the second element used in the device is now so well known as not to require any detailed description; briefly, it consists of three elements in an evacuated enclosure, one element being the heated cathode which emits electrons, the second the anode or plate, and the third the control grid. A voltage applied to the control grid controls the current flowing between the cathode and the plate and signals impressed on the grid are reproduced in amplified or strengthened form in the output of the plate-cathode circuit. The amplifying power of an audion is largely dependent on the mechanical arrangement, the size and spacing of the three electrodes, but in all cases, where an audion is used for amplifying purposes, there is an amplification of energy. The input impedance of all types of audion is of a high order, while the impedance of their output varies according to the construction of the tube. If the output circuits of a number of like audions are connected in parallel, then the output impedance will be proportionately reduced.

Colpitts' arrangement, in operation, accordingly contemplates: (1) a low impedance line connected to the electro magnet of the ionized gas device, the coil of the magnet being wound to have an impedance corresponding to that of the line; (2) a direct connection consisting of a wire and a battery between the high impedance output of the gas device to the grids or control members of several audions; (3) the plate circuits or outputs of these several audions being connected together, thus reducing the impedance of the output to correspond with that of the recording device or of the outgoing line. There does not appear, so far as I can see, to be any direct reference in Colpitts to the transmission of speech, or music, as such. He seems to have been chiefly concerned with the amplification of very low frequency signals such as telegraph or cable signals, as low as two vibrations per second. Colpitts does not appear to have been used to any great extent commercially. Waterman stated it was used in connection with transcontinental telegraphy for a while, but has been obsolete for the past ten years having been replaced by audions.

Coming now to Arnold's patent. Arnold is intended to be an improvement on Colpitts; in his device he retains an audion as the output element, but he abandons the ionized gas repeater as the first or input element, substituting therefor one of the audion type. He introduces a third audion between the input and output and the device accordingly comprises three audions in cascade. He, like Colpitts, does not use transformers in the different circuits, and, he states that "while heretofore it has been necessary to employ transformers in circuit with the audion in order to secure efficient amplification", by the audion, and that "it has been discovered that audions of the usual type may be so constructed that without the use of transformers they will step up the input voltage of either direct current or alternating current of any frequency in one step, as much as 30 times its original value". This type of audion he calls a "high-voltage output audion". He then goes on to state that "it has furthermore been discovered that audions may be constructed which will step down the input voltage, for example, to one-third of its original value. This last mentioned type of audion has a

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high current and a low voltage output, and because of its low output impedance such an audion can be worked efficiently into a line of like impedance". This new type of audions he calls a "high current output audion" and states that these special audions form the subject matter of another patent. He abandons the principle of matching impedances in the case of the connection between the incoming low impedance line and the input audion, but retains it in the connection between the output of the last audion or audions and the low impedance outgoing line. The undistorted amplification of speech and music, where there is a wide range of frequencies, is claimed to be one of the properties of the device by reason of the exclusion of transformers from the circuits. He states that his device "will operate, without transformers, from a line of low impedance, for example 250 ohms, into a like line with a resultant current much greater—fifty or more times greater, than would flow in the second circuit if it were directly connected to the first circuit."

Arnold, operatively, therefore contemplates: (1) a low impedance line directly connected to the high impedance input of a "high voltage audion"; (2) a direct connection consisting of a wire and a battery between the high impedance output of the "high voltage" audion and the high impedance input of the "high current" audion; and (3) direct connection between the output of the high current audion (output of the device) and the outgoing low impedance line, these impedances being approximately the same or matched.

Now, as to the alleged infringing circuit made by the defendant, which, I shall when convenient, designate as Baldwin. This is a device comprising three audions, the first called variously 224 or A; the second 250 or B; and the third 250 or C. The first two audions are in cascade, while C, the third, has a complicated connection with B, its input being connected to the output of B, as in cascade, but at the same time its output is connected with the output of B in a sort of series or parallel connection. It is stated that the input line to the device is of a high impedance. It is also said that the output of the device has an impedance of 8,000 ohms. In actual construction and operation Baldwin presents the following combination:

(1) a low impedance microphone working into a transformer; (2) the output of the transformer connected to the high impedance input of the device; (3) a direct connection consisting of a wire between the high impedance output of the first audion A to the high impedance input of audion B; (4) a complicated connection between audions B and C; (5) a combined output of audions B and C, with an output impedance of 8,000 ohms; (6) an outgoing line into a transformer of a low impedance sound reproducing device.

Now, to compare the devices of Colpitts and Baldwin. Colpitts, as his first element, uses an ionized gas discharge device, and as his second, a number of audions in parallel, while Baldwin uses an audion as his first element and as his second a combination of audions, but not Colpitts' combination. Audions in parallel were known to the art, and Colpitts deliberately abandons the audion as his first or input element for the reason that "a direct connection between the output terminals of the gaseous repeater and a siphon recorder, or one between the input terminals of an audion, or even a bank of audions in multiple, and a cable circuit, would result in inefficient operation." He further states "it is extremely desirable to avoid the use of a transformer", and "the necessity of using the undesirable transformer to balance impedance is at once avoided in accordance with this invention". Colpitts accordingly abandoned the audion because of its high input impedance and substituted therefor an ionized gas discharge device thereby securing a device capable of giving a low impedance to correspond with the low impedance of the incoming cable.

There is, it seems to me, a fundamental difference between the audion and an ionized gas repeater, in that the latter depends, as its name implies, on ionization for its successful operation. Baldwin does not use an ionized gas repeater, nor does he use audions in the true parallel connection of Colpitts in the output. There is therefore, in my opinion, a clear distinction between Colpitts and Baldwin, and I do not think that the latter can be said to infringe the former.

It now remains to be determined whether Arnold is infringed by Baldwin. Here we find considerable similar-

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ity in that the amplifying elements of both devices consist of audions only. The terms "high" and "low" in respect of impedance, voltage, and current, are constantly used in both the patents here in suit, and was used by counsel in argument, but except in the case of Baldwin where the different values are known, complete information as to the meaning to be ascribed to those terms is lacking. What then did Arnold regard as a high impedance or a low impedance, what at that time was a high voltage or a low voltage, and what at that time was a high current and what was a low current? Arnold has to do with the amplification of signals in circuits of low impedance, and in his specification he stresses the fact that his device "will operate without transformers, from a line of low impedance for example, 250 ohms, into a like line with a resultant current much greater, fifty or more times greater, than would flow in the second circuit if it were directly connected to the first circuit". We may therefore assume that to Arnold 250 ohms was low, and he refers to 100,000 ohms as being very high. High voltage, as used in the expression "high voltage output" of Arnold, can, I think, be interpreted by reference to the patent where it is stated that a "high voltage output audion" is one which amplifies or steps up the voltage to as much as thirty times its original value without the use of transformers. The audion in the Arnold circuit is not, however so far as I can see, described as a part of the circuit in the specification of the patent. It would appear that what Arnold had in mind was not that "high voltage" is 100, or 1,000 or more volts, but rather the amplifying capacity of the audion. We have no evidence as to the amplifying qualities of audions known at that time and we cannot say how they compared with the figures mentioned by Arnold. We can only assume that he regarded an amplifying ability of thirty times, as classifying the audion as "high voltage". His (Arnold) output audion he calls a "high current output" audion but again he fails to define what is a "high current". We may assume the current was higher than that in the high voltage audion, but how much higher than this, or how much higher than in known types of audion, we have

no information. He does, however, give some details of the audion used in describing his device. He states:

> Audions may be constructed which will step down the input voltage, for example, to one-third of its original value. This last mentioned type of audion has a high current and a low voltage output. Because of its low impedance, i.e., the low impedance between its cathode and anode, such type of audion can be worked efficiently in a line of like impedance. This new type of audion will be referred to as the "high current output audion".

and

> The audion 2 (that is the high current audion) acts as an amplifier in which the current is increased and the voltage lowered in its output circuit.

and

> Because of the fact that the impedance between the cathode and anode 8 of the audion 2 is lowered, it can be worked efficiently into a line 16 of similarly low impedance.

and the device as a whole will, for example:

> Work from an incoming line of 250 ohms impedance into an outgoing line of like impedance with a resultant current of more than fifty times that which would flow into the outgoing line if the latter were directly connected to the incoming line.

This is quite specific and irrespective of what the current may be, and however measured, the voltage of the output of this audion is lower than the voltage of the input and may be as low as one-third of the same, while at the same time the output impedance is low and it is presumed that it approximates 250 ohms since it was intended to connect with a line of that impedance.

Let us now examine Baldwin in the light of what I have just said concerning Arnold. Audion 224 of Baldwin has high amplifying capacity, it being admitted that three-tenths of 1 volt applied to the input gives a resulting voltage of 50 in the output, or an amplification of 168 as compared with Arnold's 30. The 224 audion contains one additional element to the audion shown in Arnold. Cornell called it a "screen grid tube" and stated that "it is a development of late years, wherein a high rate of amplification is realized over what was had in the days of Colpitts and Arnold; by virtue of the introduction of this screen grid this tube steps up the voltage that is applied to the grid and in addition increases the current at the same time; in other words, it is an energy amplifier, which is the standard and common action of all conventional tubes". Hence, under the Arnold classification it might be called a high voltage output audion, but it is an audion of a type unknown to Arnold at that time.

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We may now consider the 250 B and C audions of Baldwin. Audions of this type, according to Cornell, have an amplifying ability of 3 times, and the two combined as in Baldwin produce a voltage amplification of 6 times, that is to say, the 50 volt output of the 224 audion impressed on the grid of B, results in a voltage of 300 at the output terminals of the Baldwin device. As for the output current, this is stated to be 37/1000 ampere, but having no information in regard to Arnold, one cannot say whether it is higher or lower than Arnold. In so far as impedance is concerned, the impedance of the output of Baldwin is stated to be 8,000 ohms, though that of a single 250 audion is stated to be 1,800 to 2,000 ohms. In any case it is materially higher than the 250 ohms mentioned by Arnold.

Coming now to the matter of transformers. In exhibit 10, it is agreed in regard to Baldwin that, "in all cases a matching transformer would be used to couple the other circuits to the main amplifier", an exception however being that when a phonograph pick-up is used the latter is connected directly to the input of the amplifier without a matching transformer. In other words, notwithstanding the statement of the defendant's counsel, there appears to be a definite effort to at least approximately match the impedance of the different portions of the circuits and of the device. Are transformers necessary for the efficient and satisfactory working of Baldwin? Waterman says you can feed directly from a modern microphone into the input of Baldwin without a transformer coupling between the microphone and the amplifier with entire success "but you might or might not desire to do it". In respect of feeding the output into the low impedance loud speaking device Waterman says it can be done, "but if taken in series it is in the order of 3,500 ohms and with a loud speaker of 16 ohms you would not get an entirely efficient operation without the function of a transformer taking place again in tubes B and C". On the other hand, Cornell stated definitely that it is not practical to dispense with transformers in public address systems, and, I think that transformers are necessary for the satisfactory operation of Baldwin as used.

There remains to consider the connection between the A and B tubes in Baldwin, and the corresponding connec-

tion in Arnold. Prior to Arnold, the usual way of connecting audions in cascade was to use transformers between the output of one audion and the input of the next. Arnold simply eliminates the transformers and his system is a direct connection between two audions, consisting of a wire and a battery. In Baldwin we have the same direct connection between the two audions but he simplifies it by leaving out Arnold's battery. I do not find any claim to invention in regard to this direct connection, and Waterman stated that direct coupling between circuits is often used and has been a generally accepted practice for the past twenty-five or thirty years.

So far as the principle of the matching of impedances is concerned that was well known before Arnold, and therefore was not subject matter for a patent. Arnold claims a combination of a high voltage audion connected to a high current audion. Audion A of Baldwin might be called a high voltage audion, according to Arnold's definition, but Arnold does not claim the audion itself, he claims the combination of elements constituting the circuit arrangement or system; audions B and C of Baldwin are not high current audions within the definition of Arnold. Arnold calls for high current and low or reduced voltage in the output, whereas the B and C audions of Baldwin separately give a three-fold increase in voltage, and when combined a six-fold increase in voltage, as well as a high current. The Arnold device is limited to repeating and amplifying a signal from one low impedance line to another of like character without the use of transformers; Baldwin is never used without transformers and, upon the evidence, I do not think it could function successfully without transformers. Baldwin, I think, seeks the amplification of energy in progressive stages in which the voltage is progressively amplified and the circuits are matched where necessary, with transformers, in order to secure the maximum of efficiency, whereas Arnold contemplates an amplification of voltage in his first element and a lowering of voltage and a higher current in his output element. The combination of Arnold, and Baldwin not only represent different combinations and circuit arrangements, but they produce results which vary. Arnold claims a simple combination of two audions of different characteristics and he defines those characteristics.

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Baldwin also employs two audions of different characteristics but not the same combination as Arnold; while the first audion of Baldwin might possibly be classed as a high voltage audion under Arnold's classification, the second audion cannot be classified as a high current audion, and therefore Baldwin does not use a combination of a high voltage audion, and a high current audion, as defined by Arnold. Therefore, in my opinion, Baldwin does not infringe Arnold.

A true construction of both patents in suit, in my opinion, limits the monopoly claimed to the precise combination described, and by that limitation Colpitts and Arnold are each bound. If the claims of these patents purport to go beyond this, then such claims, if not the patents themselves, would be void. These are not cases, I think, where the doctrine of equivalency applies.

Finding there is no infringement, it is not necessary to discuss any other phases of the case developed at the trial. The action is therefore dismissed and the defendant will have its costs.

Judgment accordingly.