

PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION.

Improvements in or relating to Thermionic Amplifying Circuits for Telephony.

I, PAUL GUSTAVUS ADOLPHUS HELMUTH VOIGT, of "Bowdon Mount", 121, Honor Oak Park, London, S.E. 23, British subject, do hereby declare the nature of this invention to be as follows:—

This invention relates to a method of improving the quality of the reproduction which can be obtained by means of loud speakers or other sound reproducers whose efficiency is not constant at all frequencies.

It is known that with ordinary telephone receivers the quality can be greatly improved by using a suitable rejector in series with them.

With good loud speakers it is much more difficult to make a suitable rejector. According to this invention the loud speaker or transformer to which it is connected is made part of one arm of a bridge. The other arm may contain an artificial load and a similar transformer or loud speaker, whose diaphragm is fixed or whose mouth is covered up so that it is not giving out sound energy. The bridge may be completed by resistances, chokes or transformers. The difference between the currents in the two arms of the bridge causes a difference in the voltage at the junction points, which by means of a transformer or other device can be passed back into the grid

or plate circuit of one of the amplifying valves in such a manner that frequencies on which the loud speaker is efficient are reduced, and frequencies on which it is inefficient are increased in amplitude.

Instead of connecting the back coupling transformer to the bridge itself, transformers may be used in the arms of the bridge and the back coupling voltage may be taken direct from their secondaries.

In a modification only one loud speaker is used with a telephone transformer, the other arm contains only an inductive resistance. By adjusting the feed back transformer and the relative resistances and inductances of the arms, the difference between the voltages at the junction points can be made to alter the relative amplitudes of the various frequencies so as to partly compensate for the unequal efficiency curve of the loud speaker.

Other modifications will be obvious to those skilled in the art, for example:— The bridge circuit may form part of an intervalve circuit and only the compensated current may be amplified by the last valve. In this case the loud speaker in the bridge circuit can sometimes be replaced by an inductive resistance.

Dated the 28th day of January, 1924.

P. G. A. H. VOIGT. 65

COMPLETE SPECIFICATION.

Improvements in or relating to Thermionic Amplifying Circuits for Telephony.

I, PAUL GUSTAVUS ADOLPHUS HELMUTH VOIGT, of "Bowdon Mount", 121, Honor Oak Park, London, S.E. 23,

British subject, do hereby declare the nature of this invention and in what manner the same is to be performed, to

be particularly described and ascertained in and by the following statement:—

This invention relates to circuits for the purpose of improving the quality of speech or music obtainable from loud speakers or the like.

According to this invention the plate circuit of a valve includes a modified form of Wheatstone bridge whose arms are so adjusted that the bridge is not balanced at all frequencies. The unbalanced voltages are fed back into the grid circuit to modify the original voltages.

By suitably adjusting the arms of the bridge and the feed back coupling, the original voltages can be modified in such a manner as to compensate to some extent for distortion produced in loud speakers or the like.

In order that this invention may be better understood, I describe by way of example and illustrate in the accompanying drawing one of the many ways in which it may be carried into effect. The plate current of the last amplifying valve V is passed through a Wheatstone bridge arrangement of which the loud speaker S or its telephone transformer T forms one of the arms. A special choke C (which may consist of an exactly similar loud speaker whose reed or diaphragm is prevented from moving) forms one of the other arms. While two resistances R R or chokes complete the bridge.

The junction points A B are connected to the primary of a feed back transformer F whose secondary is connected in the grid circuit. The currents to be amplified may be introduced by means of a transformer D, resistance coupling, or any other method.

The direction of connecting the feed back transformer is important. To test if the transformer is correctly connected, disconnect the choke C, or the lower resistance R, and the strength should decrease, the quality remaining good. If the loud speaker is disconnected the circuit should howl.

The action of this circuit when the choke consists of a similar loud speaker with a fixed diaphragm, and when the resistances are similar is as follows.

For frequencies away from the resonant frequencies the voltages of the points A and B vary together and no current flows through the feed back transformer.

At the resonant frequency however, impedance of the loud speaker S is less than that of the choke, therefore the balance or the bridge is upset, and consequently the voltage of the point A varies more than that of the point B. This difference in voltage causes a current through the

primary, which produces a voltage on the secondary in opposition to the original voltage.

I prefer generally to make the choke C different to the loud speaker, because a correction for the general faults of the loud speaker can then be obtained. By varying such factors as the thickness of the stampings, their air gap, the winding depth, number of turns, self capacity, resistance, or by adding parallel capacity and the like, and also by altering similar factors on the feed back transformers or other parts of the bridge, it is possible for the system to accentuate very high and very low frequencies simultaneously as well as correct for the resonance. I usually adjust the arrangement in such a way that it is near the point of whistling at a very high frequency, and buzzing at a very low one.

When extra high power is required, or more than one loudspeaker is to be used it is not always convenient to have the bridge in the plate circuit of the last valve. The bridge may then be in the plate circuit of an earlier valve, and the compensated voltage taken from the grid or plate may be passed into the last valve or valves. I have found that when this is done the correction for the loud speaker in the bridge will not be perfect for the main loud speaker. The loud speaker in the bridge may then sometimes be replaced by a suitable choke, which must be found by trial and should have about the same impedance-frequency characteristic as the loud speaker it replaces, and a very good correction can still be obtained. I have found a switch for changing the circuit over to a standard valve circuit very useful.

In another form, instead of resistances, transformer primaries are used.

The bridge is arranged with the speaker and choke at the top, and the transformers below, or *vice versa*. The secondaries are connected in series and the feed back voltage is taken from them. The transformer F then becomes unnecessary.

The circuit may be varied in countless ways without departing from the spirit of the invention, which expressed broadly consists of circuits whereby the change of impedance with change of frequency of the loud speaker or equivalent circuit is caused to alter the reaction into the grid circuit in such a manner as to compensate for the distortion of the said loud speaker.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is

to be performed, I declare that what I claim is:—

5 1. Circuits whereby the varying im-
pedance with varying frequency of a
part (such as a loud speaker), or parts
of the plate circuit is utilised to modify
the voltage being amplified in such a
manner as to compensate for the distor-
10 tion produced by a loud speaker or the
like or by some other part of the system.

15 2. A Wheatstone bridge arrangement
which causes the difference in voltage at
the terminals of a loud speaker or the
like, and of a choke to control the
reaction into the grid circuit so as to
compensate for the distortion of the

loud speaker, substantially as described
and illustrated.

3. A modification of the arrangement
claimed in Claim 2 in which the voltages 20
on the grid or plate are amplified by
another valve or valves, before being
supplied to the main loud speaker, the
loud speaker in the bridge circuit being
replaced if desired by some other device 25
such as a slightly resonant choke or the
like.

4. Tone quality connecting circuits
substantially as described.

Dated the 23rd day of October, 1924. 30

P. G. A. H. VOIGT.

2nd Edition

[This Drawing is a reproduction of the Original on a reduced scale.]

