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WAVE TRANSLATING SYSTEM

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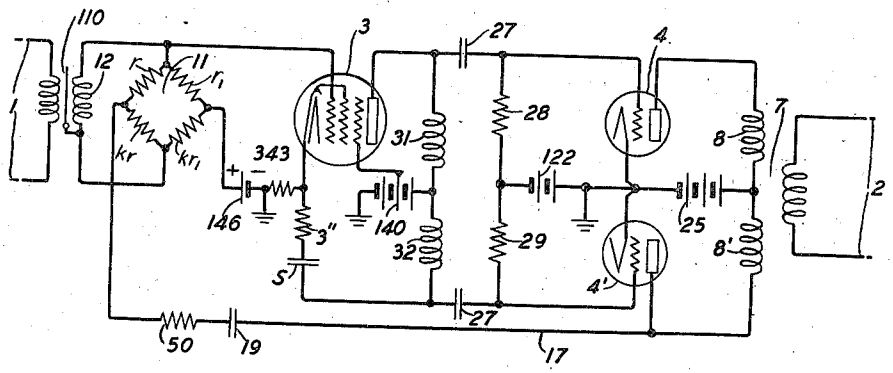

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WAVE TRANSLATING SYSTEM

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2 Claims. (Cl. 179—171)

This invention relates to wave translation and especially to retroaction or feedback in wave translating systems, as for example, in systems involving vacuum tubes or electric wave amplifying devices.

An object of the invention is to control transmission properties, as for example modulation or transmission efficiency, in such systems.

It is also an object of the invention to control feedback in such systems, or to facilitate application of feedback in such systems.

A further object is to reduce singing tendency in such systems, especially amplifiers or systems involving push-pull stages that feed back a portion of the output waves in gain-reducing phase and in amount sufficient to reduce distortion below the distortion level without feedback.

In one specific aspect the invention is embodied in a two-stage amplifier of such type comprising a single-tube stage driving a push-pull stage, with a feedback connection from the plate of a chosen one of the push-pull tubes to the input circuit of the single-tube stage for producing the distortion-reducing feedback. This choice between the two tubes of the pull stage is so made that for transmission propagated through the push-pull stage in the push-pull mode, this plate has its alternating current potential approximately opposite in phase to the potential of the driver-tube grid. However, for transmission propagated through the push-pull stage in the parallel mode, i. e., for parallel transmission, the plates of the push-pull stage unfortunately may have their potential in phase with that of the driver-tube grid; and since the feedback connection may feed this parallel transmission back to the driver-tube grid in this phase, overall singing may result. This singing may be called parallel singing, the oscillations being propagated through the push-pull stage in the parallel mode. Unfortunately, the parallel-singing tendency may be strong, since the feedback loop for the oscillations has an even number of amplifier stages and the driver tube, for example, may have a high amplification constant.

In accordance with the invention, the parallel-singing tendency is reduced by a local or auxiliary negative feedback around the driver tube, obtained by balancing the output circuit of the driver tube with passive impedance for example as described hereinafter, and deriving the auxiliary feedback voltage from an impedance in the balanced output circuit so formed that is traversed by the parallel transmission to the exclusion of normal transmission, as for instance a resistance or impedance in the mid-branch of the latter circuit.

Other objects and aspects of the invention will be apparent from the following description and claims.

The single figure of the drawing shows an amplifier embodying the specific form of the invention referred to above.

The two-stage amplifier amplifies waves received from circuit 1 and transmits the amplified waves to circuit 2. The waves may be, for example, speech waves or a broad band of carrier waves transmitting a number of speech messages by multiplex carrier telephony. The first stage of the amplifier may be a single-tube, high-gain stage substantially free from non-linear distortion, comprising a vacuum tube 3 shown by way of example as a pentode. The second stage may be a power stage. It comprises two tubes 4 and 4′ which are alike and which are shown, by way of example, as triodes.

The tubes 4 and 4′ are connected to the outgoing circuit 2 through output transformer 7 having closely coupled primary windings 8 and 8′, the close coupling reducing parallel-singing tendency.

The incoming circuit 1 is connected to the tube 3 through input transformer 10 and input bridge 11. The secondary winding 12 of the transformer forms one diagonal of the bridge. The four ratio arms of the bridge comprise resistances r_1, kr_1, kr and r, respectively.

Tube 3 drives the push-pull stage through a coupling circuit comprising an autotransformer or retard coil having closely coupled balanced windings 31 and 32, coupling condensers 27 and balanced resistors 28 and 29. The close coupling of coils 31 and 32 reduces parallel-singing tendency.

Overall negative feedback is obtained by a feedback path through connection 17 which gives the desired reverse phase of feedback voltage by connecting the plate of tube 4′ to the input bridge 11. The bridge renders the feedback path and the winding 12 conjugate at balance of the bridge. The feedback connection is shown as including a stopping condenser 19 and a feedback resistor 50 which may be used to control the amount of the feedback. The gain reduction effected by this feedback may be large, as for example, several times ten decibels.

A plate current supply source 25 and a grid bias potential source 122 are shown for tubes 4 and 4′. The source 122 may bias the tubes for so-called class B operation, in which the space current of

the tube is interrupted for the order of half the period of the waves to be amplified. Further, the source **122** may maintain the grids always negative during operation of the amplifier.

A plate current supply source **140** supplies direct space current for tube **3**.

To reduce parallel-singing tendency, a resistance **3''** equal to the internal plate resistance of tube **3** is connected across winding **32**, thus balancing the output circuit of tube **3** and creating an artificial mid-branch of the balanced output circuit so formed, and a feedback impedance, shown by way of example as a resistance **343**, is connected in this artificial mid-branch.

The resistance **343** in the balanced output circuit for tube **3** is included in the input circuit of the tube and produces local negative feedback around the tube of parallel transmission to the exclusion of normal transmission. This feedback reduces the gain of the driver stage for only parallel transmission, reducing overall parallel-singing tendency of the amplifier without materially reducing the overall gain of the amplifier.

If desired a stopping condenser may be connected in series with resistance **3''**, for example as shown at S, to reduce current drain on source **140**.

Since the direct current voltage drop across resistance **343** is applied to the driver grid as negative biasing voltage and ordinarily will be more than sufficient to properly bias the grid for class A operation of the tube, a grid biasing battery **146** which may be used to adjust the grid bias to the proper value is shown as supplying a positive biasing potential to the grid to counteract a portion of the negative biasing voltage derived from resistance **343**.

What is claimed is:

1. A wave translating system comprising two wave amplifying stages, of which one stage is a push-pull stage and the other is a driver stage therefor having but one amplifying element and having means cooperating with the output circuit of said amplifying element to form therewith a balanced output circuit of the stage including a mid-branch that contains a portion of the impedance of the input circuit of said amplifying element, and means producing negative feedback of waves from the output of said push-pull stage to the input of said amplifying element.

2. A wave translating system comprising two stages of vacuum tubes, of which one stage is a push-pull stage and the other is a driver stage therefor having but one amplifying element and having passive impedance cooperating with the output circuit of said amplifying element to form therewith a balanced output circuit of the stage including a mid-branch that contains a feedback impedance connected between the grid and the cathode of said amplifying element, and means feeding waves back from but one side of the output circuit of said push-pull stage to the grid of said driver stage in gain-reducing phase and in amount sufficient to reduce distortion below the distortion level without feedback.

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