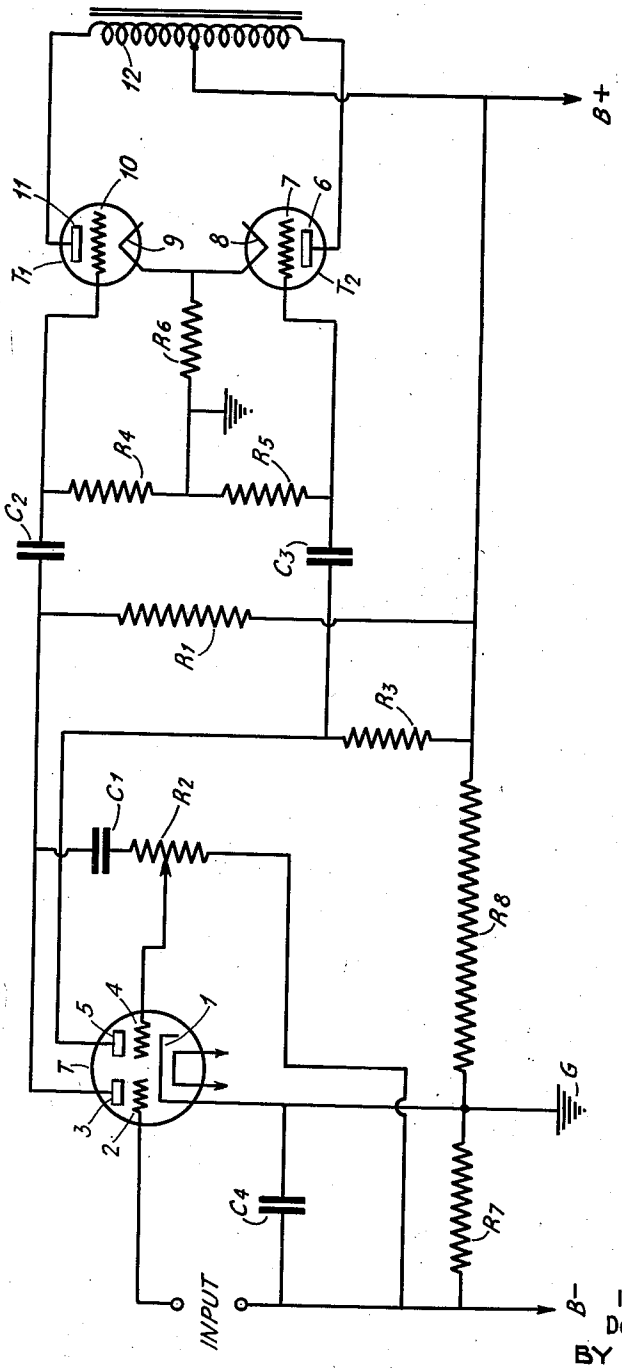
Sept. 14, 1937. D. G. BURNSIDE 2,092,874

AMPLIFIER

Filed Oct. 23, 1933




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Patented Sept. 14, 1937

2,092,874

# UNITED STATES PATENT OFFICE

2,092,874

## AMPLIFIER

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Application October 23, 1933, Serial No. 694,721

1 Claim. (Cl. 179—171)

The present invention relates broadly to amplifiers and more particularly to a novel circuit arrangement utilized as a driver and phase changer for supplying alternating current voltage to the grids of tubes connected resistance coupled push-pull.

It is known in the art that push-pull transformers are expensive and that a system which would eliminate the use thereof while still retaining the advantages of push-pull amplification is greatly to be desired.

With the above in mind, the present invention makes use of a driver circuit for the push-pull circuit which includes a tube having within a single enclosure a cathode, two grids and two anodes. These tubes are known in the art as type 79, type 19 and type 53 tubes and consist of two high-mu triodes in a single bulb. The two triode units are identical and except for a common cathode are distinct each from the other. The characteristics of these tubes are such that they may be readily adapted for use as phase inverters and it is an object of the present invention to devise a circuit arrangement by means of which the outputs of one of these tubes may be impressed upon a push-pull amplifier.

The single figure in the drawing shows a preferred embodiment of the invention.

In the drawing, a pair of tubes $T_1$ and $T_2$ are shown provided with a push-pull output circuit represented generally by primary 12 of an output transformer. Each tube comprises an anode, a cathode and a control grid, the space current for the tubes being furnished by a suitable source, not shown, having terminals B— and B+. Across the source is connected a voltage divider $R_7$, $R_8$. The cathodes 8 and 9 of tubes $T_2$ and $T_1$ have a common connection to ground through a bias resistance $R_6$ while the anodes 6 and 11 of these tubes are connected to the B+ side of the source by a connection from terminal B+ to the center point of winding 12. Tube $T_1$ is provided with a grid leak resistor $R_4$ connected between grid 10 and the grounded side of $R_6$ while tube $T_2$ is provided with a similar grid leak resistor $R_5$ which is connected between grid 7 and the grounded side of resistor $R_6$.

The driver circuit comprises a tube T provided with a cathode 1, two grids 2 and 4 and two anodes 3 and 5. Cathode 1, grid 2 and anode 3 form one unit of the tube while cathode 1, grid 4 and anode 5 form a second unit. The input circuit of the first unit comprises a connection between grid 2 and cathode 1 including the input terminals shown and a resistor $R_7$. This resistor which is, in fact, a section of the voltage divider provides the proper bias voltage. Cathode 1 is grounded at G in customary fashion and a usual signal by-pass condenser $C_4$ is shunted across resistor $R_7$. The output circuit for the first unit comprises a connection between anode 3 and the B+ side of the source and includes a plate load or plate resistor $R_1$. The anode end of resistor $R_1$ is connected to grid 10 of tube $T_1$ through a coupling condenser $C_2$ so that signals impressed on the grid 2 of tube T put amplified voltage on grid 10. At the same time, a voltage 180 degrees out of phase with voltage on grid 2 is applied to grid 4 of the second unit through a connection from anode 3 to cathode 1 including a condenser $C_1$ in series with a resistor $R_2$ and a connection from grid 4 of the second unit to a point of resistor $R_2$.

The output circuit of the second unit comprises a connection from anode 5 to the B+ side of the source and includes a plate resistor or load $R_3$. The anode side of resistor $R_3$ is connected to grid 7 of tube $T_2$ by means of a coupling condenser $C_3$. Resistor $R_2$ is arranged so as to act as a grid leak for the second unit. Audio voltage of proper amplitude for grid 4 is derived by means of a variable tap on the resistor $R_2$ as shown.

With the arrangement shown, the voltage developed across the plate load $R_1$ is 180 degrees out of phase with the voltage developed across plate load $R_3$, hence, the grids 10 and 7 of the two output tubes $T_1$ and $T_2$ can, therefore, be resistance coupled to the two resistors $R_1$ and $R_3$.

If the two tubes $T_1$ and $T_2$ are identical then the tap on resistor $R_2$ is adjusted to equalize the voltages on resistors $R_1$ and $R_3$ since under these circumstances the voltages impressed upon grids 10 and 7 must be of opposite phase and equal amplitude for the push-pull amplifier to operate properly.

It is obvious now that if the two tubes $T_1$ and $T_2$ are not identical the tap on resistor $R_2$ may be adjusted so that equal outputs from tubes $T_1$ and $T_2$ are obtained.

It is, of course, obvious to any one skilled in the art that tubes $T_1$ and $T_2$ may be replaced by a single tube like tube T and that tube T may be replaced by two separate tubes.

While only one embodiment has been shown for purposes of illustration, to those skilled in the art many variations of the system and details of the apparatus herein described are at once obvious and the fact that specific arrangements have been illustrated is not to be taken as in-

dicating any intention of limiting the invention thereto.

I claim:

In an amplifier, a pair of electronic tubes provided with anode, cathode and control grid electrodes, a push-pull output circuit therefor, a pair of resistance elements in series connecting the control grids of both tubes, a common cathode lead and a connection between the common cathode lead and a point intermediate the resistance elements, including a common grid bias resistor, a driving circuit comprising an electronic tube provided with at least a cathode, two control grids and two anodes, disposed with relation to each other so that the cathode, one grid and one anode thereof form a first amplifying unit while the cathode, the other grid and the other anode form a second amplifying unit, a single source of space current for all of said tubes, said source being provided with positive and negative terminals, connections between the anodes of said pair of electronic tubes and the positive terminal of the source, an input circuit for the first unit including means for connecting a source of energy to be amplified, an output circuit for the first unit comprising a connection between the anode thereof and the positive terminal of the source, including a plate resistor element, means comprising a coupling condenser for connecting a point of the last named circuit connection to the control grid of one of said pair of electronic tubes, a connection between the anode of the first unit and the negative terminal of the source of space current, including a condenser and a resistor in series, means comprising a variable tap device for connecting the grid of the second unit to any desired point of said resistor whereby signal energy is impressed upon the grid of the second unit in phase opposition to the signal energy impressed upon the grid of the first unit, an output circuit for the second unit comprising a connection between the anode thereof and the positive terminal of the source, said last-named output circuit including a load resistance means comprising a coupling condenser for connecting a point of the last-named output circuit to the grid of the other of said pair of electronic tubes, and a bias impedance device connected between the negative terminal of the source and the cathode of the driver circuit electronic tube, said bias impedance being included in both the input and output circuits of the two amplifying units whereby the same bias potential is impressed upon the control grids of the two amplifying units.

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