May 5, 1953

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BRIDGE AMPLIFIER CIRCUIT

Filed June 22, 1950

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1. This invention relates to improvements in a bridge amplifier circuit, wherein a very low-impedance balanced output is provided for a very high gain bridge amplifier. This makes possible the use of a simple bridge amplifier with the advantages of high stability and constant gain as well as absence of difficulties caused by circuit characteristics, vibration, thermal effects, etc.

These objects are attained by methods described in the accompanying drawing in which the figure shows a schematic electric diagram of one form of the invention.

Referring to the figure, numeral 10 is a source of filament supply voltage and high voltage D.C. for the bridge amplifier and low impedance balanced output circuit. Numerals 12 and 14 are terminals connected to the heaters X, X of the cathode follower tubes 70 and 30. Numerals 16 and 18 are terminals connected to the heaters Y, Y of the bridge amplifier tubes 40 and 50. High voltage terminal 22 is connected by lines 24 and 26 to points 75 and 85 of cathode follower tubes 70 and 30 respectively, and through ballast resistor 26 and line 28 to voltage regulator tube 34 and thence through lines 36, 38, and 50 to a second voltage regulator tube 92, and thence to the low voltage return 20 by line 66.

The source of regulated voltage at point 29 is connected by line 30 to the plate load resistors 47 and 51 respectively of bridge amplifier tubes 40 and 50 respectively, and the source of regulated voltage at point 29 is connected by line 30 through screen dropping resistors 43 and 55 to the screens 48 and 56 of bridge amplifier tube 40 and 50 respectively. Suppressors 48 and 58 are connected respectively to the cathodes 42 and 52 respectively and thence by common line 41 to cathode resistor 60 and to a balancing network consisting of potentiometer 61 and resistors 62 and 63 connected in parallel with potentiometer 61 and thence through lines 64, 66, and 98 to the low voltage return point 20.

The grid 54 of bridge tube 50 is connected by grid resistor 64 to the junction point between resistors 62 and 63. The grid 44 of tube 40 is connected through grid resistor 106 and line 103 to the slider 102 of potentiometer 61. The high side of the input to the amplifier is directly connected from terminal 104 to grid 44 and the low side of the input connects from terminal 105 to the slider 102 which may be used as a ground reference by strapping together points 100A and 103 by connecting link 107, or these may be left floating by removal of link 107.

The source of regulated voltage at point 29 is also connected through a bleeder biasing resistor 32 to the junction point of resistors 60, 61, and 62 to provide a small amount of fixed bias used in conjunction with the self-bias developed across resistor 60 and the biasing network consisting of resistors 61, 62 and 63. Plate 49 is connected by line 49A to grid 54 of cathode follower tube 80. Plate 59 is connected by line 59A to grid 49 of cathode follower tube 70. Cathode 12 of cathode follower tube 70 is connected to point 70A which will hereinafter be called output terminal A, and also through cathode load resistor 74 and line 76 to the voltage regulator tube 92, and thence to the B minus return through line 98. Cathode 62 is connected to terminal 80A which will hereinafter be called output terminal B and through cathode resistor 81 to voltage regulator tube 92.

An electro-mechanical device 110 is shown, this device representing any of the various types of indicators, recorders, relays, solenoids, etc., which can be used to advantage in the output of the circuit of the figure. Since it is the basic circuit which is here presented and not a specific application, it is not desired to be limited to the use of a relay, recorder, or indicator, but it is to be understood that the present circuit can be used to advantage with any electrical output device.

The operation of this circuit is as follows:

With no signal impressed at input 104, the slider 102 is moved up or down to vary the initial bias on the grid 44 of tube 40 either above or below that of grid 54, so as to effect a perfect balance between the voltages at the plates 49 and 59 of the bridge amplifier tubes, or if it is desired to initially offset the balance at the plates of these tubes to a predetermined amount of either polarity, this may be done. The voltages at the plates 49 and 59 are directly coupled to the grids 44 and 54 respectively of cathode follower tubes 80 and 70 which in themselves would provide an appreciably reduced impedance. That is, several megohms could be used for plate load resistors 47 and 57 and cathode resistors 74 and 81 could be made in the order of 10,000 ohms. However, by the novel addition of a voltage regulator tube between the cathode follower resistors 84 and 74 and 71 and the B minus return, it is possible to use resistors on the order of several hundred ohms in the cathodes of the cathode follower tubes. By this development it is possible to produce an extremely low output impedance from the output cathode follower stage and still maintain all of the advantages that a balanced bridge amplifier circuit can possess plus additional advantages arising from the much higher plate load resistors which can be used if the bridge amplifier tube does not have to drive the load directly.
Having thus described my invention and the advantages thereof, I do not wish to be limited to the details herein disclosed otherwise than as set forth in the claims, but what I claim is:

1. A bridge amplifier comprising a source of electrical energy, a pair of amplifier tubes each having at least a plate, a cathode, and a control grid, a pair of cathode follower output tubes each having at least a plate, a cathode, and a control grid, and a voltage regulator tube, the said amplifier tube plates being connected through separate plate resistors to the positive terminal of said source of electrical energy, the said amplifier tube cathodes being connected together through a common self-biasing network to the negative terminal of said source of electrical energy, the cathode follower tube plates being connected to the positive terminal of said source of electrical energy, the said cathode follower tube control grids being connected separately to the plates of the said amplifier tubes, the cathode follower tube cathodes being connected through separate cathode resistors to the anode of the said voltage regulator tube, and the cathode of the said voltage regulator tube being connected to the negative terminal of the said source of electrical energy, the amplifier output being taken between the cathodes of the said cathode follower tubes, the said voltage regulator tube and the said cathode resistors being effective in combination to provide the amplifier with very low impedance output.

2. The circuit of the preceding claim wherein the said self-biasing network comprises two resistance branches, the first said branch being tapped and the tap connected to the control grid of one of said amplifier tubes, and the second said branch comprising a potentiometer having its slider connected through the amplifier input circuit to the control grid of the other said amplifier tube, said network comprising means whereby the bias of one of said control grids may be adjusted selectively above, equal to, or below the bias of the other said control grid.

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