The present invention relates to amplifier circuits, and more particularly to diode biased transistor amplifier circuits.

Various transistor audio amplifier circuits have been devised requiring no output transformer between the transistors, usually connected in a push-pull fashion, and the load. A basic disadvantage of many of these circuits is the inability to obtain a stabilized temperature and voltage operating point because of the use of biasing resistors. To overcome this, diodes were substituted for the biasing resistors. Ideally, the voltage characteristics of the diode should be substantially similar to those of the emitter-base diode of the transistor. In particular, the matching of the voltage-current characteristics with shifts in temperature is highly desirable for temperature stabilization. Nevertheless, another disadvantage exists in the presently known resistor and diode amplifier circuits in that the output signals of the amplifier and the biasing path are in series. As a consequence of this there is degenerate feedback of the output signals to the input with a resulting loss of power gain. When diode biasing is used, it is essential that the diodes pass a substantial amount of current in order to forward bias the diode into the low impedance portion of its voltage-current characteristic. The impedance of the diode must be small at the input frequency as compared to the input impedance of the transistor or else distortion will result. Since the output signal of the transistor subtracts from the biasing potential, the output and biasing paths being in series, the available biasing current for the diode is limited. It therefore becomes difficult to maintain it in its low impedance region without drawing excessive diode current which greatly limits battery life and also limits the life of the diodes. To avert the latter problem electrolytic capacitances could be used to bypass the biasing diodes. However, such capacitors are large, expensive, and short lived. It is therefore an object of the present invention to provide a new and improved diode biased transistor amplifier circuit.

It is another object of the present invention to provide a new and improved amplifier circuit having separate and independent output and biasing paths.

Broadly, the present invention provides an amplifier circuit in which a pair of transistors operate in a push-pull manner having diode biasing circuits in which the diodes are maintained in their low impedance state independently of the output current, which drives a load without permitting output signals to appear at the input of the transistors to cause degenerate feedback.

These and other objects and advantages of the present invention will become more apparent when considered in view of the following specification and drawing, in which:

The single figure is a schematic diagram showing the amplifier circuit of the present invention.

Referring to the figure, a pair of transistors Q1 and Q2 are connected to operate in a push-pull fashion. An input transformer W1, having a core Fs, a primary winding L1, secondary windings L1 and L2, is utilized to drive the transistors Q1 and Q2. Input signals, which, for example, may be at an audio frequency, are applied to a pair of input terminals T1 and T2 of the primary winding L1 of the input transformer W1. By transformer action input signals appear at both of the secondary windings L1 and L2. The phase of the signals appearing at the secondary windings L1 and L2 is determined by the dot convention as shown. The dotted end of the secondary winding L1 is connected to the base electrode of the transistor Q2, while the undotted end of the secondary winding L1 is connected to the base of the transistor Q1. The dotted end of the primary winding L1 is shown at the terminal T1, so it may be assumed that the signals appearing at the secondary winding L1 will be in phase with the input signals at the primary winding L1, while the signals at the winding L2 will be 180° out of phase therewith.

Separate output circuits O1 and O2 as shown by the arrows, are provided to drive the load ZL in a push-pull fashion. The output circuit O1 includes a series connection of a battery Eb, the emitter-collector circuit of the transistor Q1, the load ZL, and the negative electrode of the battery being connected to the emitter electrode, and the load ZL and the collector electrode of the transistor Q1 being connected to a junction J1, at one end of the load ZL, and the negative electrode of the battery being connected to a junction J2, at the other end of the load ZL. The load ZL, for example, may comprise a resistor or other impedance elements. The other output circuit O2 of the transistor Q2 includes the emitter-collector circuit of the transistor Q2, which has its emitter electrode connected to the positive terminal of a battery Eb and its collector electrode connected to the junction J3 of the load ZL. The series output circuits O1 and O2 are completed through the load ZL, which has the junction J1 connected to the negative terminal of the battery Eb. The batteries Eb1 and Eb2 are shown to be separate physically. However, of course, they may form one battery having voltage taps thereon.

Separate and distinct from the output circuits O1 and O2 are biasing circuits B1 and B2, as shown by the arrows in the figure, associated respectively with the transistors Q1 and Q2. Biasing circuit B1 includes the battery Eb1, a diode D1, which has its anode connected at a junction J4 to the emitter electrode of the transistor Q1 and to the positive terminal of the battery Eb1, and its cathode connected to the undotted end of the secondary winding L2 and to one end of a resistor R9, which is connected to the negative terminal of the battery Eb1 at the junction J5. The biasing circuit B2 includes the battery Eb2, a diode D2 and a resistor R8. The diode D2 has its anode connected at a junction J6 to the emitter electrode of the transistor Q2 and to the positive terminal of the battery Eb2 and its cathode electrode connected to the dotted end of the secondary winding L2 at a resistor R8. The other end of the resistor R8 is connected to the negative terminal of the battery Eb2 at the junction J5.

By such circuit connections, it can be seen that the output circuit O1 and the biasing circuit B1 and the output circuit O2 and the biasing circuit B2 operate independently of each other without output signals in the output circuits interfering with the biasing levels of the respective transistors Q1 and Q2. Thus, incoming audio signals applied to the input terminals T1 and T2 are transformed and appear at the secondary winding L1 and L2 of the transformer W1. The transistors Q1 and Q2 operate in a push-pull fashion so that the transistor Q1 will supply output signals to the load ZL1 from the junction J1 when the input signals applied to the base of the transistor Q1 are of a positive polarity. Conversely, the transistor Q2 will supply output signals to the load ZL2 from the junction J2 to the junction J2 when a signal supplied to its base is of a negative polarity or, in other words, the negative of the input signal supplied.
words, when the input signals are of a positive polarity because of the dot convention as described previously.
The output signals appearing in the output circuits $O_1$ and $O_2$ do not appear at the input of the respective transistors $Q_1$ and $Q_2$ because the batteries $E_1$ and $E_2$ connected between the load $Z_L$ and the respective emitter electrodes isolate the output circuit from the input of the transistors.

Bias potential is applied to the emitter electrodes of the transistors $Q_1$ and $Q_2$ at the junctions $J_1$ and $J_4$, respectively. From the positive terminal of the batteries $E_1$ and $E_2$, a return path, however, for the biasing current passing through the diodes $D_1$ and $D_2$ is provided by the resistors $R_1$ and $R_2$, respectively, which are connected across the diode and battery series connection. Thus, the biasing circuits $B_1$ and $B_2$ may operate at a predetermined current level so that the diodes $D_1$ and $D_2$ will be in their low impedance regions irrespective of the output signals then appearing in the output circuits $O_1$ and $O_2$. The diodes $D_1$ and $D_2$ are selected to have similar voltage-current characteristics as the corresponding emitter-base diode characteristics of the transistors $Q_1$ and $Q_2$. By such a selection of diodes, the temperature and voltage operating points may be stabilized and thereby improve the overall operation of the amplifier circuit. Moreover, the biasing circuit operating independently of the input circuit limits distortion of incoming signals since the diodes remain throughout both the positive and negative excursion of the incoming signals in their low impedance state.

Although the present invention has been described with a certain degree of particularity, it should be understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the scope and the spirit of the present invention.

I claim as my invention:

1. An amplifier circuit operative with a common load comprising, a pair of transistors connected to function in a push-pull manner and each including base, collector and emitter electrodes, said pair of transistors being of the same conductivity type, input circuit means for applying input signals to the base electrodes of each of said transistors so that said transistors function in a push-pull manner, a biasing circuit connected respectively to each of said transistors, each biasing circuit including a source of direct potential, a diode and an impedance device operatively connected to forward bias said diode, said source being operatively connected to the emitter electrode of the respective transistor to supply bias potential thereto, and an output circuit respectively connected to each of said transistors to drive said common load, said collector electrodes of said pair of transistors directly connected respectively to opposite ends of said load, each output circuit including one of said separate sources of direct potential, the emitter-collector circuit of the respective transistor and said load and operative to function independently of said biasing circuits, with current being supplied through said load in opposite directions from each of said output circuits respectively.

2. An amplifier circuit operative with a common load comprising, a pair of transistors connected to function in a push-pull manner and each including base, collector and emitter electrodes, said pair of transistors being of the same conductivity type, input circuit means for applying input signals to the base electrodes of each of said transistors so that said transistors function in a push-pull manner, a biasing circuit connected respectively to each of said transistors, each biasing circuit including a source of direct potential, a diode and an impedance device operatively connected to forward bias said diode, said source being operatively connected to the emitter electrode of the respective transistor to supply bias potential thereto, and an output circuit connected respectively to each of said transistors to drive said common load, said collector electrodes of said pair of transistors directly connected respectively to opposite ends of said load, each output circuit including one of said separate sources of direct potential, the emitter-collector circuit of the respective transistor and said load and operative to function independently of said biasing circuits with output signals appearing in said output circuits not affecting the biasing levels of either of said transistors, with current being supplied through said load in opposite directions from each of said output circuits respectively.

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