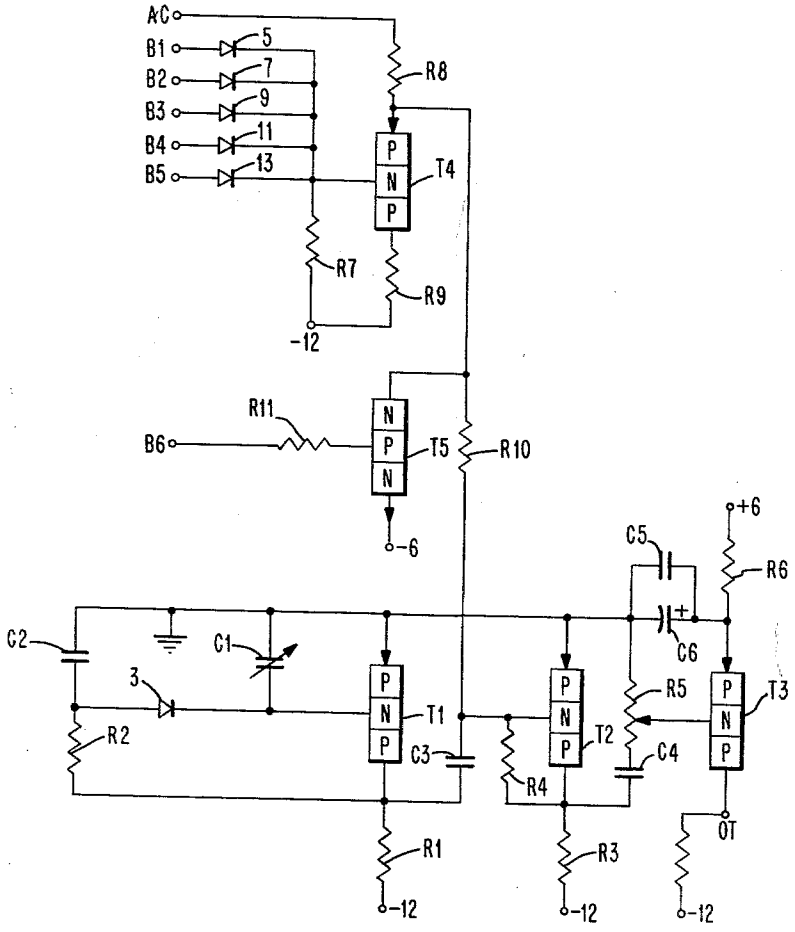
Jan. 12, 1965 G. L. CLAPPER 3,165,707

ZENER DIODE NOISE GENERATOR WITH FEEDBACK FOR THRESHOLD MAINTENANCE

Filed Dec. 27, 1960



INVENTOR

GENUNG L. CLAPPER

BY Paul M. Brennen

AGENT

United States Patent Office 3,165,707 Patented Jan. 12, 1965

3,165,707

ZENER DIODE NOISE GENERATOR WITH FEEDBACK FOR THRESHOLD MAINTENANCE

Genung L. Clapper, Vestal, N.Y., assignor to International Business Machines Corporation, New York, N.Y., a corporation of New York

Filed Dec. 27, 1960, Ser. No. 78,385
2 Claims. (Cl. 331—78)

The present invention relates to noise generating circuits, and particularly to an improved noise generating circuit for use in speech synthesis systems.

It is known in speech synthesis that noise in an appropriate frequency range must be utilized if the sibilant sounds are to be adequately synthesized. Although not limited thereto, the noise generating circuit according to the present invention is well suited for use as a noise generator in speech synthesis systems, being especially characterized by economy of parts and high stability.

Accordingly, an object of the present invention is to provide an improved noise generating circuit, particularly for use in speech synthesis systems.

Another object of the invention is to provide an improved noise generating circuit which utilizes relatively few components, yet is characterized by good stability in operation.

A further object of the invention is to provide an improved noise generating circuit of the type employing a non-linear asymmetric impedance, with voltage control feedback to provide improved stability.

Briefly described, the present invention contemplates the use of a non-linear asymmetric impedance, particularly a Zener type diode, arranged so that it is energized at its control or breakdown threshold. The noise energy produced by the minor breakdowns occurring at this point is amplified by an electron discharge device, more specifically a transistor, with a degenerative feedback path incorporating the noise diode, which feedback path serves to maintain the diode at its threshold point, despite variations in the other circuit parameters. The term "threshold," as used hereinafter, is to be understood as defining that point at which the inverse or back resistance of the diode suddenly decreases, so that a relatively small increase in voltage causes a relatively large inverse current. In other words, the threshold defines the point at which the Zener diode starts to conduct heavily in the reverse direction.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawing.

The single figure in the accompanying drawing is a diagrammatic illustration of a preferred embodiment of the invention, as utilized for a sibilant generator in a speech synthesis system.

Referring now to the drawing, the noise generator in accordance with the present invention comprises a Zener diode 3 connected in the forwardly conducting direction to the base of a PNP junction transistor, the emitter of which is connected to ground and the collector of which is connected to the negative terminal of a source of potential, designated as —12, through a load resistor R1. A degenerative feedbath path from the collector via resistor R2 sets the operating point of the Zener diode and the associated transistor T1 to the optimum value for production of high frequency noise. A variable capacitor C1 of relative low capacity range acts as a high frequency bypass to ground, and since it is variable, allows for a certain amount of adjustment of the frequency band. A much larger fixed capacitor C2 connected between the anode of diode 3 and ground stabilizes the direct current operating point.

The parts are proportioned and arranged so that the Zener diode is operating at its threshold or control point, where the Zener breakdown is pust commencing. It is these insufficient breakdowns which generate the noise energy. Amplification and reversal of phase of the noise energy are accomplished by the associated transistor, and the feedback connection via resistor R2 stabilizes the dynamic operation of the diode at its threshold point.

A conventional grounded emitter amplifier including a PNP transistor T2 amplifies the low-level energy provided by the noise generator. Transistor T2 has its emitter electrode grounded and its collector electrode connected to —12 via load resistor R3. Resistor R4 connects the collector to base to establish the operating point, and the low-level noise energy is supplied to the base of T2 via coupling capacitor C3. After amplification, the noise energy may be supplied to any desired load circuit. In the disclosed embodiment, the noise generator is shown and described in use in a speech synthesis system. The noise is to be selectively supplied to a portion of a mixing circuit where it is combined with the outputs of one or more oscillators.

In accordance with such use, the amplified noise energy is supplied through coupling capacitor C4 to an adjustable voltage divider R5, from where it is supplied to the base of a PNP transistor T3. Transistor T3 has its emitter connected to a positive terminal +6 via a resistor R6, and is bypassed to ground by a non-polarized capacitor C5 and a polarized capacitor C6. The collector of transistor T3 is connected to an output terminal OT, and thence through a mixing circuit, including a common resistor, to a negative potential. Transistor T3 is arranged to act as a variable current generator, and the noise frequency energy is impressed on the mixing circuit as a result of current changes in the collector circuit of this transistor.

The output of the noise generator is gated to the amplifier including transistor T2 and the amplitude of the noise output is governed by controlling the flow of base current in transistor T2. This control circuit in an exemplary form, includes an OR circuit comprising a plurality of conventional diodes 5, 7, 9, 11, and 13 connected to terminals B1 through B5, respectively, and having their cathodes commoned and connected to —12 via a common load resistor R7. The common connection of the diodes is connected to the base of a transistor T4, the emitter of which is connected to an amplitude control terminal AC via resistor R8, and the collector of which is connected to —12 via resistor R9.

The emitter of transistor T4 is connected to the base of transistor T2 via a resistor R10. The collector of an NPN transistor T5 is also connected through resistor R10 to transistor T2. The base of transistor T5 is connected to an input terminal B6 through a resistor R11, and the emitter of transistor T5 is connected to the negative terminal —6.

The gating circuit just described is arranged and proportioned so that with an input signal supplied to any one of inputs B1 through B5, and with no input supplied to terminal B6, the noise generator output is supplied to terminal OT, at an amplitude dependent upon the value of the signal supplied to terminal AC.

The amplifying output and gating circuits are exemplary only and many other types of circuits may be employed with the noise generator circuit.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A noise generator comprising in combination, an electron discharge device having an input and an output circuit, means for supplying direct current operating potentials to said electron discharge device, a Zener diode having a predetermined threshold voltage, means for supplying direct current potential to said diode to bias said diode, circuit means connecting said diode to the input of said electron discharge device, and a degenerative feedback circuit connected between said diode and said output circuit to vary the bias of said diode in response to fluctuations in said output circuit the variations in bias continuously maintaining the diode at said threshold voltage.

2. A noise generator comprising, in combination, a junction transistor having an emitter, a base and a collector electrode, means including a load resistor for supplying direct current operating potential to said transistor in an emitter-collector circuit, a Zener diode and a feedback resistor connected in series between the collector and the base electrodes of said transistor to provide a degenerative feedback to said diode, and an output circuit connected between the collector and the emitter electrodes of said transistor, said Zener diode being continuously maintained at its threshold potential by said feedback.

References Cited in the file of this patent

UNITED STATES PATENTS

2,974,424	Roberts	Mar. 14, 1961
2,981,898	St. John	Apr. 25, 1961
2,994,784	White et al.	Aug. 1, 1961
3,094,675	Ule	June 18, 1963