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Oberbury

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[54] **SINGLE SIDEBAND GENERATOR EMPLOYING A PLURALITY OF CYCLICALLY SWITCHED SHORTING DIODES CONTROLLING A TRANSMISSION LINE ELECTRICAL LENGTH**

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[52] **U.S. Cl.** **325/137,** 325/45

[51] **Int. Cl.** **H04b 1/68**

[58] **Field of Search** ..... 325/138, 49, 137, 325/50, 329–331, 136; 332/44, 45; 179/15 FS

[56] **References Cited**

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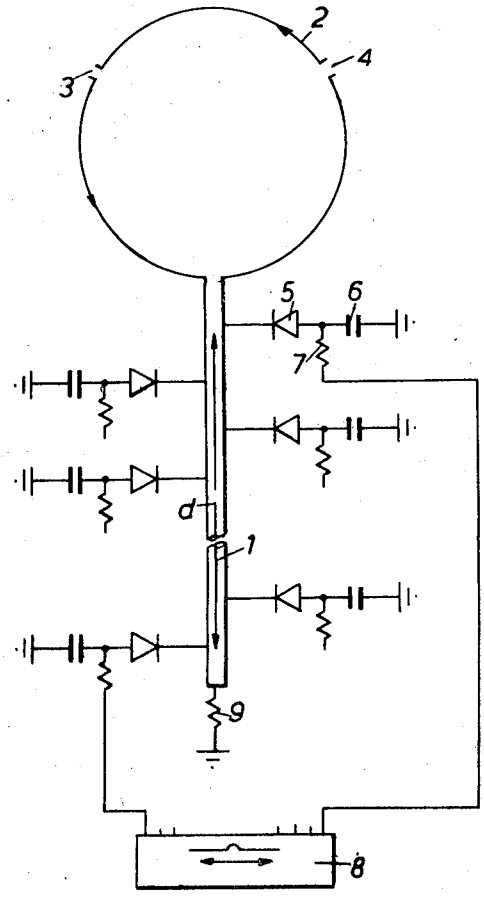
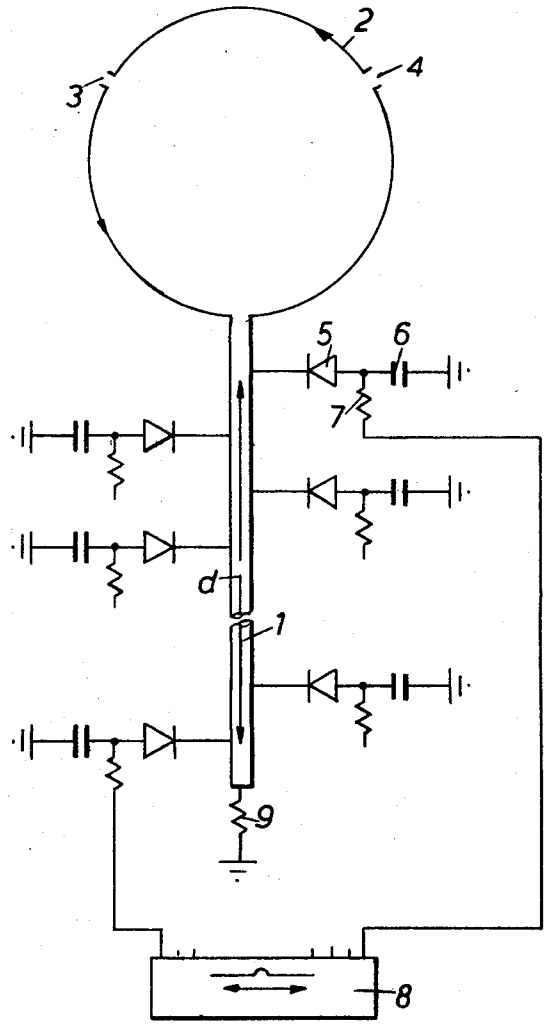
[57] **ABSTRACT**

A digital single sideband generator in which the carrier frequency is fed via a circulator to a (microstrip) transmission line which has a series of switchable short circuits (RF grounded diodes) along a length of the line equal to half the carrier wavelength. Successive cyclic switching of the diodes simulates a moving RF energy reflector advancing or retarding the phase of the reflected energy according to direction of switching and resulting in a frequency offset at the circulator output determined by the cyclic rate.

5 Claims, 1 Drawing Figure

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SINGLE SIDEBAND GENERATOR EMPLOYING A PLURALITY OF CYCLICALLY SWITCHED SHORTING DIODES CONTROLLING A TRANSMISSION LINE ELECTRICAL LENGTH

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates generally to radio frequency systems and, more particularly, to single sideband generation.

2. Description of the Prior Art

In the prior art there have been various methods of obtaining electrical sidebands, including single sidebands. These methods have been either wholly electrical or partially mechanical, however, many have been complex, lossy or suitable over only a relatively narrow range of frequencies.

SUMMARY OF THE INVENTION

It may be said to have been the general objective of the present invention to produce a single sideband generator which inherently generates only an upper or a lower sideband, basically substantially lossless, except for a relatively small circulator loss, and adaptable to instrumentation over a broad range of frequencies.

According to the invention, there is provided a single sideband generating device including a radio frequency transmission line having an electical length from one end thereof at least equal to half the carrier wavelength means for simulating cyclic unidirectional movement along said transmission line over a length thereof equal to said half wavelength of a radio frequency energy reflector in a direction and at a rate determining respectively the sense and the magnitude of frequency offset of the sideband frequency from the carrier frequency, and circulator means for coupling a source of carrier frequency when connected to the circulator input to said one end of the transmission line and for coupling the reflected energy from said one end of the transmission line to the circulator output.

BRIEF DESCRIPTION OF DRAWINGS

A single FIGURE is included, presenting a schematic diagram of a system in accordance with the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

A preferred embodiment of the invention will now be described with reference to the accompanying drawing which shows a single sideband generating device.

A radio frequency microstrip transmission line **1** is coupled at one end to an intermediate port of a circulator **2** having an input port **3** for connection to a carrier frequency source and an output port **4** for connection to a load.

Connected to the transmission line **1** along an electrical length d equal to half the wavelength of the carrier frequency are n diodes **5** with an electrical length spacing of d/n between adjacent diodes.

Each diode is connected to ground for radio frequency energy, via a suitable capacitance, shown as a capacitor **6**, on application to the diode of a positive switching pulse via each pulse input (typically **7**).

There is a pulse distributor **8** for applying the switching pulse cyclically in turn to each of the diodes **5** to enable the short circuit resulting from the respective diode being RF grounded.

The other end of the transmission line **1** is properly terminated in a matched load **9** to absorb any energy passing the short circuit.

In operation, the carrier frequency is fed to the input **3** of the circulator **2** and the radio frequency energy propagates along the transmission line. The pulse distributor operates at a cyclic rate and in a direction corresponding respectively to the desired frequency offset of the sideband and the sense of the offset from the carrier frequency.

The energy propagating along the transmission line is reflected at the instantaneous position of the short circuit to return along the length thereof, after having travelled a distance determined by the position of the short circuit and is thereafter routed from the circulator end of the line to the output **4** of the circulator, which prevents the reflected energy returning to the source.

Successive switching of the position of the short circuit on the line, typically by a series of **16** diodes (typically **5**), causes a corresponding advance or retard of the phase of the signal at the load, in digital steps, determined by the direction of the switching sequence, the shift in this signal frequency from that of the carrier being determined by the rate of simulated movement of the radio frequency energy reflecting short circuit. After a complete cycle of phase has been introduced (after a half wavelength due to the double path to be travelled), switching reverts to the start for the next cycle in the repetitive series.

The above described sideband generator is very suitable for frequencies between 50 MHZ and 3,000 MHZ. Only an upper or a lower sideband is fundamentally generated, and there is no basic loss other than that in the circulator.

Modifications and variations falling within the spirit of the invention will suggest themselves to those skilled in this art. Accordingly, it is not intended that the drawing or this description should be regarded as a limitation on the scope of the invention, these being typical and illustrative only.

What is claimed is

1. A single sideband generating device for a radio frequency system, comprising:

a radio frequency transmission line having an electrical length at least equal to one half wavelength at the carrier frequency;

a radio frequency circulator having input, output and intermediate ports, said intermediate port being connected to a first end of said transmission line and said input and output ports providing carrier input and output, respectively;

a plurality of electrically controllable shorting devices spaced along a half carrier wavelength of said transmission line;

and means for cyclically controlling said shorting devices to produce short circuits to ground at corresponding locations progressively along the length of said transmission line, thereby to provide a variable radio frequency reflection point for energy entering said line from said intermediate circulator port, said cyclical control being at a rate and in a sense corresponding to the desired magnitude of sideband frequency offset from said carrier and the sense of said sideband frequency offset, respectively.

2. Apparatus according to claim 1 in which said shorting devices comprise a plurality of normally open devices equally spaced along said half wavelength and said means for cyclically controlling comprises means for electrically sequencing said shorting devices to cause them to provide said short circuits to ground, one at a time, said sequencing proceeding in a direction along said line and at a rate corresponding, respectively, to the desired sense and magnitude of said sideband frequency offset.

3. Apparatus according to claim 2 in which said shorting devices include diodes responsive to said cyclical control, said means for cyclically controlling comprising an electrical pulse distributor to produce said electrical sequencing.

4. Apparatus according to claim 1 in which said transmission line is a microstrip transmission line.

5. Apparatus according to claim 4 including a matched load connected to the second end of said transmission line for terminating said line.

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