

[54] BEACON MARKER INTERRUPT DEVICE

[75] Inventor: **Norman A. Messinger**, Center Square, Pa.

[73] Assignee: **Narco Scientific Industries, Inc., Ft. Washington, Pa.**

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[58] **Field of Search**..... 179/1 SW, 1 VL;
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169, 172, 173

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Primary Examiner—Stanley D. Miller, Jr.

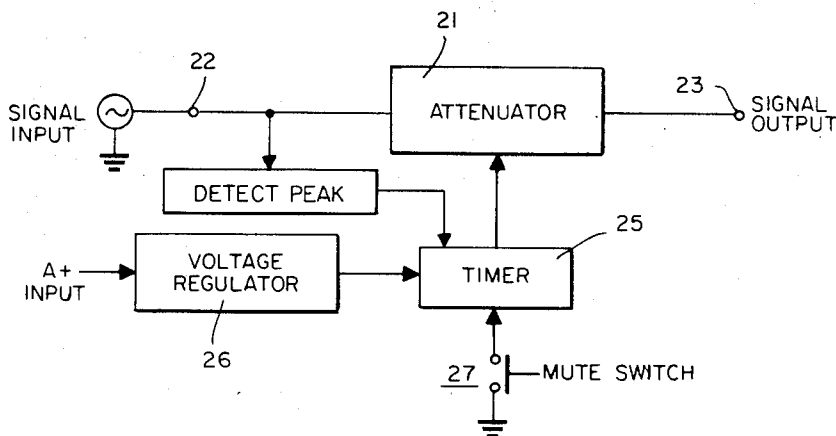
Attorney—Henry N. Paul, Jr., Albert W. Preston, Jr. et al.

[57]

ABSTRACT

Apparatus for providing adjustable time-limited attenuation of a marker beacon receiver audio signal, comprising a variable attenuator connected between the audio signal source and the audio signal output, and shunted by a normally closed timer switch. An adjustable RC timing circuit, actuated by an automatic or manually operable mute switch, drives a two state amplifier, the output of which is connected to and operates the timer switch.

7 Claims, 3 Drawing Figures



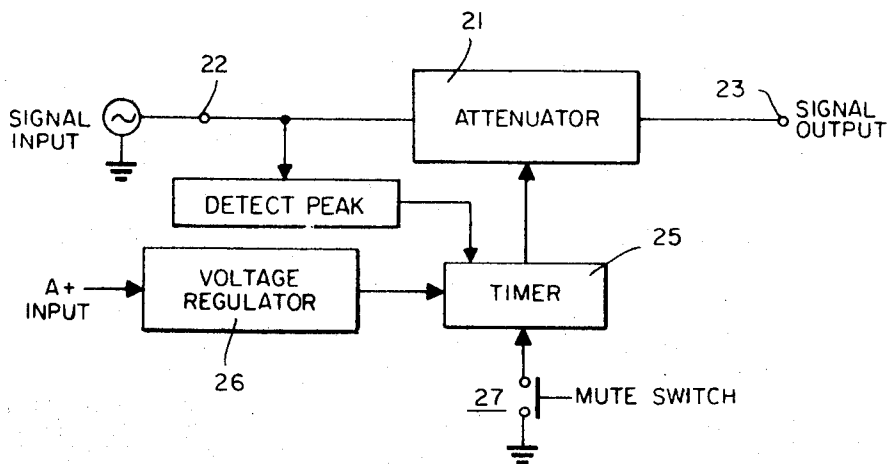


Fig. 1

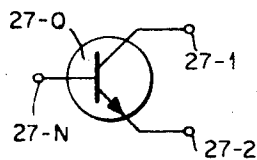


Fig. 3

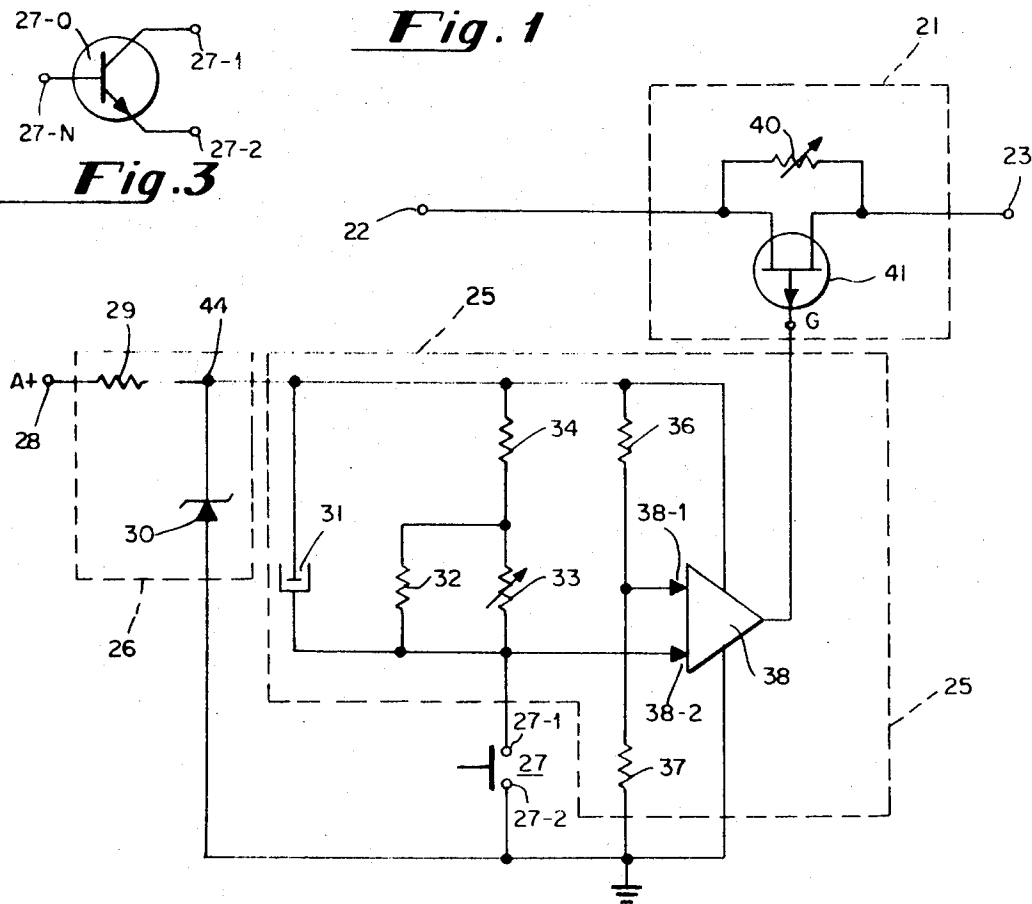


Fig. 2

BEACON MARKER INTERRUPT DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention lies in the field of audio muting devices and, more particularly, devices for providing adjustable time period muting of an aircraft marker beacon receiver audio output.

2. Description of the Prior Art

In an airport instrument landing system, commonly referred to as ILS, a pair of marker beacons are provided in line with the runway, the purpose of which beacons is to provide information to the pilot concerning the ground distance of the plane from the runway. The marker beacons consist of relatively thin fan-shaped radio beams directed generally vertically from the ground, with each beacon radiating approximately 2 watts at 75 megahertz. The "outer" marker, generally located 4 to 7 miles from the end of the runway, carries a 400 Hz modulation which is received and detected as an audio signal, generally two dashes per second. A "middle" marker is placed about 3,500 feet from the end of the runway, and is modulated at 1,300 Hz in the form of a dot and dash signal. Thus, as the pilot brings his aircraft in toward the runway along the localizer path, he first receives an audio signal from the outer marker beacon, which audio signal is maintained as long as the plane is passing through the pattern of the outer marker beacon. After passing through such outer marker beacon, at some subsequent point the plane enters the middle marker beacon, where the middle marker audio signal is detected and maintained while the plane passes through such middle beacon.

In practice, the aircraft receiver which produces the audio signal is without any volume control circuitry, such that as the plane enters a marker beacon pattern, the marker audio signal increases in intensity until the aircraft is approximately directly over the beacon transmitter, and then decreases until the plane is entirely out of the beacon pattern. For typical approach speeds, the beacon signal may be picked up 15 to 25 seconds before the audio peak, and will be maintained for a comparable amount of time after such peak. As is well known by those familiar with ILS flight operation, the beacon audio signal may be very bothersome, particularly when noted that for at least half of its duration it is not providing any information, since the aircraft operator has already noted his position. Consequently, there is a great desire among aircraft operators for the capability of attenuating the beacon audio signal after the pilot detects the audio peak. However, a simple audio-attenuator device, whereby the pilot would limit the audio volume, would not be feasible, since in many instances the pilot would not remember to turn the audio signal back on and would consequently miss the signal provided by the middle beacon. There thus exists a need for an efficient and reliable device for obtaining a timed attenuation of the marker beacon audio signal, such that the pilot can attenuate the signal when he so desires, and yet have the beacon circuit ready to provide the audio signal upon passage through the next marker.

Another application where there is a need for a marker beacon interrupt device is where a pilot is flying his plane over an airport, but without intention of entering the flight pattern at such airport. This commonly occurs during cross country flights, and particularly

where VOR stations are located at or near an airport. In such situations, the pilot desires to attenuate the beacon audio signal while in the vicinity of the airport. However, here again, if the pilot simply turned off the beacon audio volume, he quite likely would forget to turn it back after leaving the range of the beacon, and could well miss it when it was needed at a later time during the flight.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a block diagram of the primary components of the marker beacon interrupt device of this invention.

FIG. 2 is a schematic diagram of the electrical circuitry comprising the marker beacon interrupt device of this invention.

FIG. 3 shows an alternate form of muting switch used in this invention.

SUMMARY OF THE INVENTION

It is a primary object of this invention to provide a device for interrupting the marker beacon receiver audio signal in an airplane for an adjustable duration of time.

It is a further object of this invention to provide a device for attenuating the marker beacon audio signal received in an airplane for a duration of time, after which duration of time the marker beacon audio signal is received in the normal manner. The duration may be internally adjusted in accordance with the aircraft approach speed.

In accordance with the above objectives, there is provided an adjustable attenuator which is placed in series with the marker beacon audio output, which attenuator is shunted by a normal closed electronic gate, which gate is switchably operated by a two-state operational amplifier with an RC timing circuit connected to one of its inputs. Operation of a mute switch connected to the RC circuit holds the amplifier in a second state for appreciably the discharge time of the RC circuit, thus holding the gate in an open position, and placing the variable attenuator in the path of the marker beacon audio signal. Upon discharge of the timing circuit, the amplifier returns to its first state, and the attenuator is again shunted by the low impedance closed gate.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, the operation of the device of this invention is shown in block diagram form. The audio signal input, appearing at terminal 22, is connected to output terminal 23 through attenuator 21. The means of deriving the audio signal in the receiver, and transmitting it to terminal 22 with sufficient power, is well known in the art, and does not form a part of this invention. Attenuator 21 comprises a normally closed electrically actuated gate, or switch, having a gate input terminal which is connected to a timer 25. The normal output from timer 25 allows the switch to exist in its closed position. Timer 25 is powered by a voltage regulator 26, and is set in motion by momentary manual or automatic operation of mute switch 27. When switch 27 is closed, timer 25 produces a timed output signal which causes the switch to open, thereby placing an attenuator impedance directly in series between terminals 22 and 23, thus providing the desired attenuation. At the end of the preset time period, the output signal from timer 25 reverts to its prior state, such that the at-

tenuating impedance is again shunted, in which state attenuator 21 introduces minimal insertion loss.

Referring now to FIG. 2, attenuator 21 is shown to be preferably comprised of a variable resistance 40 (suitably a manually adjustable potentiometer) in parallel with an enhancement mode FET 41. FET 41 has its output terminals tied to terminals 22 and 23 respectively, and is in an "on" condition, and provides a substantially closed switch (very low impedance) shunting resistor 40 when its gate G is open or is driven by a low voltage signal. Consequently, under normal conditions resistor 40 provides no attenuation of the audio signal, with only minimal insertion loss due to the presence of FET 41 in the circuit.

DC power, designated A+, is connected to terminal 28 from any external voltage source. The A+ voltage is regulated through resistor 29 and zener diode 30, to provide a regulated DC voltage of about 10 volts between terminal 44 and ground. With this regulator, the line voltage supplied at terminal 28 may drop as low as 10 volts, and in practice may be as high as about 32 volts. The regulated voltage is supplied through two paths to the two input terminals 38-1 and 38-2 of comparator-amplifier unit 38. Unit 38 is a bi-stable IC device, such as is commercially available from National Semiconductor Corporation, Motorola, or Fairchild Camera. It has a characteristic of providing a low output (about 2 volts) when the voltage on terminal 38-2 is plus with respect to the voltage on terminal 38-1, and a high output (about 9 volts) when the voltage on terminal 38-2 is below, or less plus than that on terminal 38-1. The voltage on terminal 38-1 is provided by the voltage divider comprising resistors 36 and 37 connected between terminal 44 and ground, which divider provides a fixed fraction of the regulated voltage. The voltage on terminal 38-2 is provided by the RC circuit comprising capacitor 31 and the parallel combination of resistors 32 and 33 in series with current limiting resistor 34.

Capacitor 31 is connected between terminal 44, carrying the regulated voltage, and input terminal 38-2. Connected across capacitor 31 is a resistive path consisting of resistor 32 and variable resistor 33 in parallel, which parallel combination is in turn connected in series with resistor 34. Terminal 38-2 is also connected through muting switch 27 to ground. Switch 27 may be any manual or automatic momentary closed type switch which, when closed, provides a sufficiently low conductance path between terminal 38-2 and ground to permit capacitor 31 to substantially discharge. For example, as illustrated at FIG. 3, switch 27 may consist of a transistor switch, as shown at 27-Q, which is turned on for a short interval by a signal derived from the marker beacon audio, suitably processed, and connected to transistor input terminal 27-N. Suitably, the approximate peak of the audio signal is detected, corresponding to the point where the aircraft is substantially over the transmitter of the marker beacon and then transistor switch 27-Q is gated on.

In operation, with switch 27 open, the voltage on terminal 38-2 is appreciably the regulated voltage derived across the zener diode, and is more positive than the divided voltage on terminal 38-1. Consequently, the output of unit 38 is low, holding the switch 41 in a closed condition. When switch 27 is closed, terminal 38-2 is driven to ground, such that it is less positive than terminal 38-1, causing a high output signal from

unit 38, and causing switch 41 to open and place the attenuator resistor 40 in the audio circuit. During the brief moment that switch 27 is closed, capacitor 31 quickly charges to appreciably the regulated voltage, and after switch 27 is again opened, the capacitor 31 discharges through resistors 32, 33, and 34. Resistor 32 is suitably 500 K, and resistor 33 is suitably a 500 K potentiometer. Resistor 34 is a low value (suitably 2.2 K) current limiting resistor, to guard against excess currents in case resistor 33 is made close to a short circuit and switch 27 is closed. Thus, the time constant of the timing circuit is appreciably determined by capacitor 31 and the parallel combination of resistors 32 and 33. By varying resistor 33, the time constant can, of course, be varied. As soon as capacitor 31 has discharged to a point where the voltage on terminal 38-2 becomes equal to or greater than that on terminal 38-1, the output of unit 38 reverts to its low state, FET 41 becomes essentially a closed switch, and attenuator resistor 40 is effectively taken out of the circuit. Thus, the time period for attenuation, during which resistor 40 attenuates the audio signal, is determined both by the RC constant and the voltage divider 36, 37, since unit 38 switches when the compared signals on its two inputs reverse in relative magnitude.

From the above, it is seen that the apparatus of this invention provides a simple, efficient and reliable circuit for providing an aircraft with means for safe interruption of a marker beacon audio signal. The amount of audio attenuation provided during the timing cycle is adjustable by varying resistor 40. It has been found that by using a 500 K pot for resistor 40, audio attenuation can be adjusted between 2 db and 60 db, assuming a 600 ohm source and load impedance. FET 41 provides a minimal insertion loss of 2 db for a 600 ohm system. Further, the period of audio interrupt may be conveniently varied by adjusting pot 33, to provide the correct interrupt period according to approach speed and/or other factors. For applications where a timed interrupt might not be desirable, the marker beacon audio signal may be processed to first detect the peak, and then detect when the audio level has dropped back down to a pre-determined level. When the lower level is reached, a re-set signal is derived to re-set the attenuator switch.

The apparatus of this invention may be easily installed in an aircraft without disruption of the existing navigation electrical system. Both the audio input and output terminals may be maintained at ground reference. If the line voltage, A+, is removed or lost, the circuit reverts to the minimum attenuation state, due to the normal closed condition of FET 41. Muting control is effected by a single wire which is switched to ground, and operation of the muting switch does not introduce any pops, cracks or other transients into the audio signal.

I claim:

1. Apparatus for timed interruption of a marker beacon audio signal, comprising:

- a. attenuator means, connected in the path of said audio signal, and having switchable attenuating and non-attenuating states and an input for receiving a switching signal;
- b. switching signal means, for switching said attenuator means into one of said states, having an output connected to said input of said attenuator means, and having first and second input terminals, the

output of said switching signal means switching said attenuator means to a first low attenuation state when the signal connected to said first input terminal is greater than the signal connected to said second input terminal, and driving said attenuator means to a second high attenuation state when the signal connected to the second input terminal is greater than the signal connected to the first input terminal,

- c. timing means, connected to said first and second inputs, and adapted to provide a time varying signal to one of said inputs, and a constant signal to the other of said inputs said constant signal being such that said switching means normally maintains said attenuator means in its low attenuation state, and
- d. switch means, connected to said timing means for triggering said timing means through a timing cycle, whereby said switching circuit means switches said attenuator means into said attenuating state, causing attenuation of said audio signal during such timing cycle.

2. The apparatus as described in claim 1, wherein said attenuator means comprises a variable resistor shunted by a semiconductor switch.

3. The apparatus as described in claim 2, wherein said semiconductor switch is an enhancement mode

FET.

4. The apparatus as described in claim 1, wherein said switching signal means comprises a comparator amplifier.

5. The apparatus as described in claim 1, wherein said timing means comprises an RC circuit, with a variable resistor.

6. The apparatus as described in claim 1, wherein said timing means includes a divider circuit for determining the relative amplitudes of the signals connected to said first and second input terminals respectively.

7. A method for providing a timed interruption of a detected marker beacon audio signal in an aircraft, comprising:

- a. detecting the approximate peak of said audio signal, corresponding to the point where said aircraft is substantially over the transmitter of said marker beacon;
- b. attenuating said audio signal by switchably placing an attenuator in the electrical path of said detected audio signal;
- c. automatically maintaining said attenuator in said path for a predetermined time; and
- d. automatically removing said attenuator after said predetermined period is timed.

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