Nov. 28, 1967 G. M. HANUS 3,355,709

CODE RECEIVER RESPONSIVE TO PLURAL TONES IN SEQUENCE

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FIG. 2

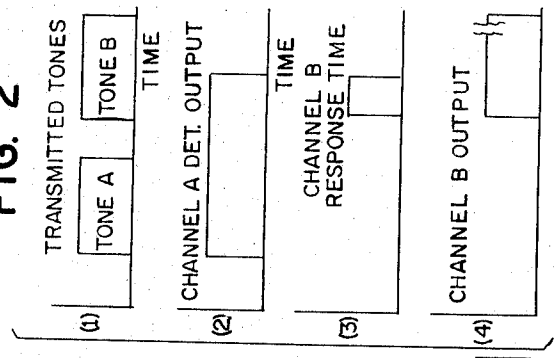
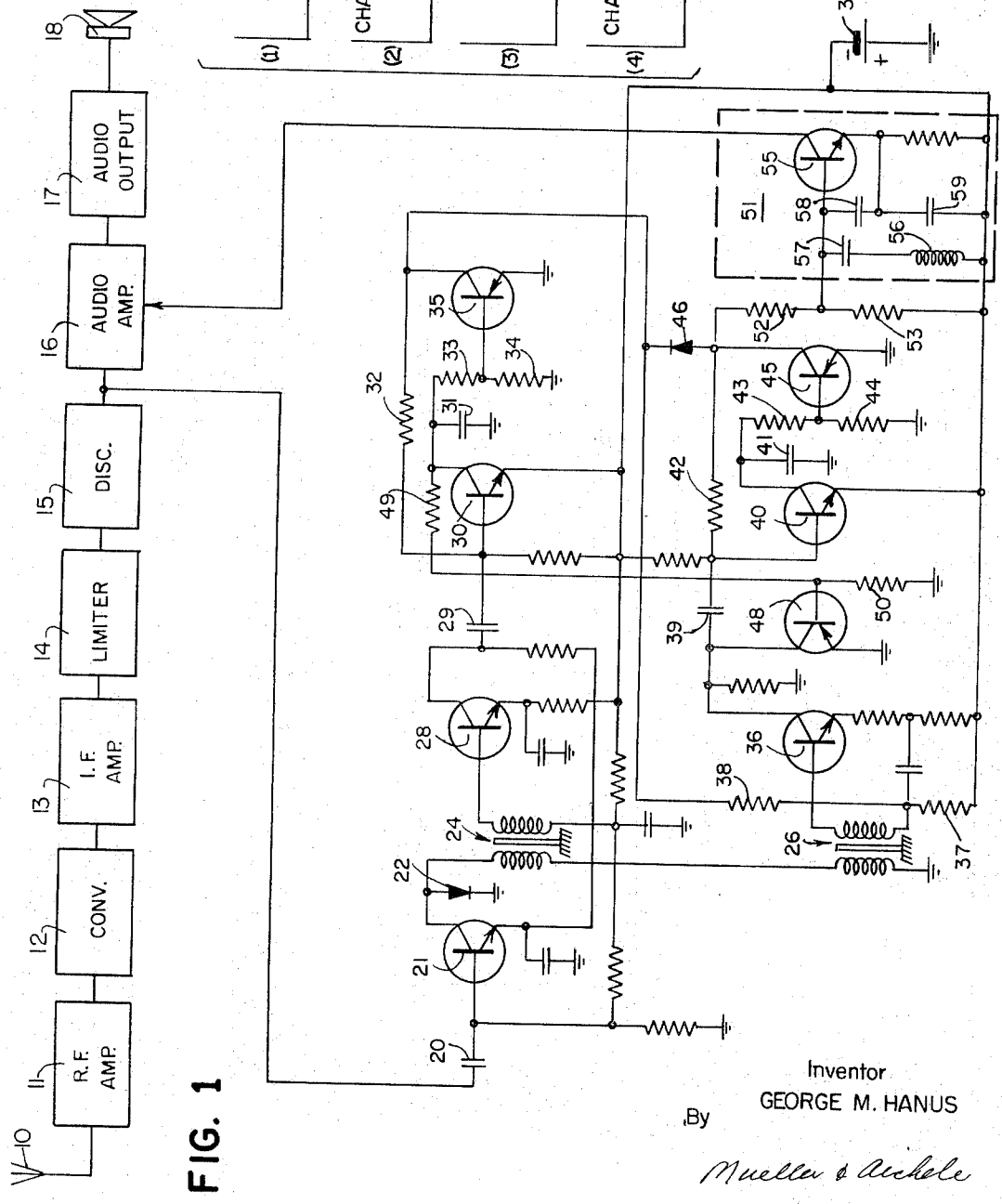


FIG. 1



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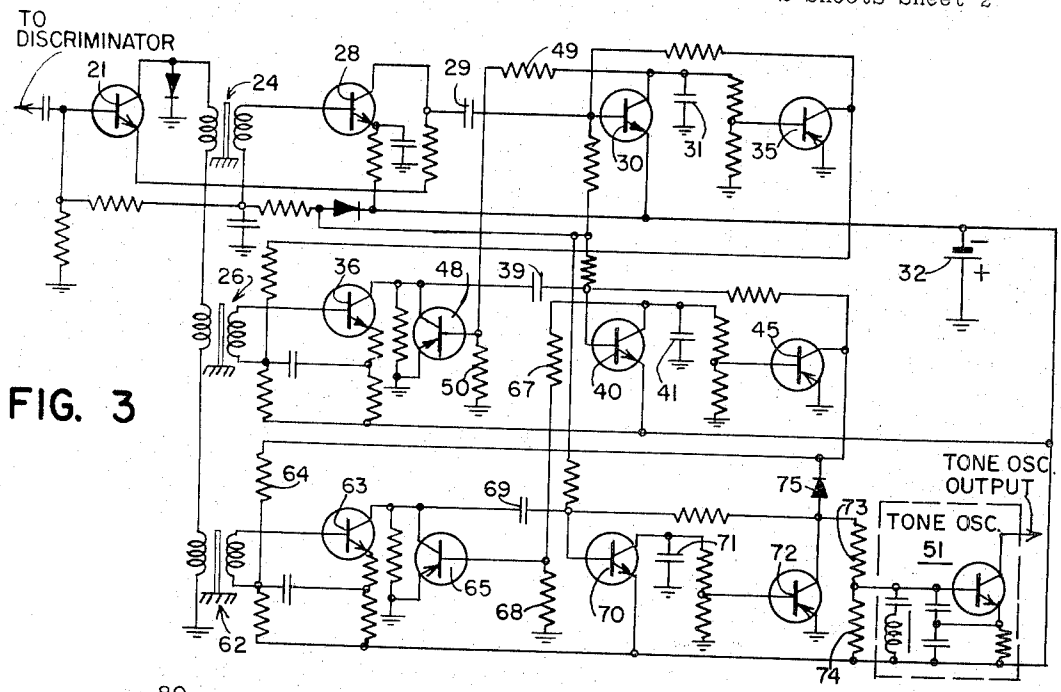

FIG. 3

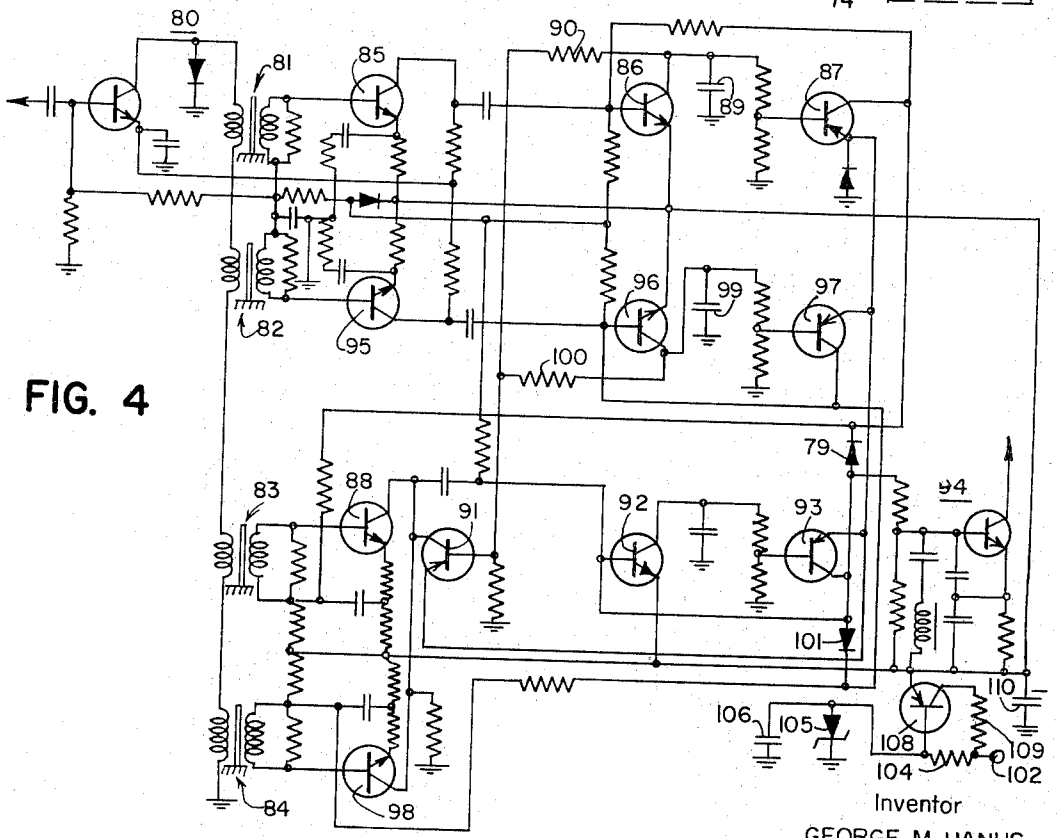

FIG. 4

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CODE RECEIVER RESPONSIVE TO PLURAL TONES IN SEQUENCE

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14 Claims. (Cl. 340—164)

This invention relates generally to tone decoder systems, and more particularly to a decoder system responsive to tones applied in a predetermined sequence and which prevents false operation.

In selective signalling equipment, it is desired in many cases to provide an alert signal of some type in response to reception of a plurality of tone signals. It has become quite common to use frequency selective reed devices in tone decoders, because such devices provide a very sharp response to select signals of one frequency from signals of closely adjacent frequencies. Miniature reed devices have been provided for small portable units, such as paging units, wherein selective alarms are provided. However, such portable units may be dropped or otherwise subjected to shock which can cause vibratory movement of the reeds to provide false alarm signals. Another problem is that the received signal may include simultaneously a large number of frequencies including the frequencies to which the tone selective devices respond to cause false operation. Although the tone signals used may generally be in the audio frequency range, the systems described will operate with tone signals of higher frequencies.

It is an object of the present invention to provide a tone decoder system for responding to a plurality of tone signals in a sequence, and which will not respond to simultaneous application of the tone signals.

Another object of the invention is to provide a tone decoder system including resonant reed devices for providing tone selection, wherein simultaneous vibration of the reed devices will not produce an alarm signal.

A further object of the invention is to provide a transistorized tone decoder circuit having resonant reed selective units, wherein the section responsive to the second tone signal is disabled except for a short period after reception and termination of the first tone signal.

A feature of the invention is the provision of a decoder circuit responsive to a plurality of tones of different frequencies applied in sequence, including a selective device for each tone, a detector for responding to each preselected tone with the detector for one tone acting to enable the detector for the next succeeding tone for a period of time, and a disabling circuit connected from the detector for the one tone to the detector for the succeeding tone to disable the same until after termination of the one tone. The circuit can respond to two tones in sequence, or to a greater number of tones applied in sequences.

Another feature of the invention is the provision of a tone decoder system including a plurality of resonant reed devices each coupled to a transistor detecting circuit, with the detecting circuit for the first tone applying a first potential to the detecting circuit of the second tone to enable the same when the first tone is received, and the detecting circuit for the first tone applying a second potential to the detecting circuit for the second tone for disabling the same until after termination of the first tone. The detecting circuit for the first tone includes two portions having different time constants coupled to the detecting circuit for the second tone so that the second disabling potential is removed from the second detecting circuit while this detecting circuit is enabled by the first potential, so that the detecting circuit can respond to the second tone when it is received after termination of the first tone.

A further feature of the invention is the provision of a decoder system which is responsive to either of two different pairs of tone signals applied in sequence, and which acts to disable the detector for the second tone of each pair during reception of the first tone of each pair and provides response to either pair only when the tones thereof are transmitted in sequence.

The invention is illustrated in the drawing wherein:

FIG. 1 is a schematic diagram of the decoder circuit of the invention coupled to a receiver, with the stages of the receiver being shown in block diagram;

FIG. 2 is a chart illustrating the operation of the decoder circuit of FIG. 1;

FIG. 3 is a circuit diagram of a decoder system responsive to three tones in sequence; and

FIG. 4 is a circuit diagram of a decoder system responding to either of two different tones applied in sequence.

In practicing the invention there is provided a transistorized decoder circuit which may be used in a radio receiver to provide an alert upon the reception of a plurality of tones in sequence. The decoder circuit is coupled to the output of the modulation detector of the receiver, and applies the signals therefrom simultaneously to a plurality of resonant selective devices. The selective devices may include resonant reeds to provide sharp selectivity at a particular frequency. Each selective device is coupled to an amplifier and a tone detector which provides an output voltage when the tone is received. The amplifier for the second tone is normally biased off and voltage is applied thereto from the output of the first detector to render it conducting. A clamping circuit is connected to the output of the tone amplifier for the second tone to disable the same, and this is rendered operative by a voltage from the detector for the first tone. The clamping action is removed, however, after the first tone ceases, whereas the voltage applied to the amplifier continues so that the second tone is applied to the detector therefor when it appears following the termination of the first tone. A number of detectors must be provided corresponding to the number of tones in the sequence, and each detector can enable the following one so that each detector will respond only to tones applied in the proper sequence. The detector for the last tone can actuate an alarm, or enable an audio amplifier so that the receiver audio output is translated. This action may be provided through operation of an oscillator rendered conducting when the last tone is received in its proper order.

A decoder system may be provided which is responsive to any one of a plurality of different tone pair combinations, with a single clamping transistor used to prevent false operation. In such case the clamping transistor is actuated by either of the detectors for the first tones of the pairs to disable the amplifier for the second tones of the pairs.

Referring now to the drawing, the decoder of the invention is illustrated in FIG. 1 for use with a frequency modulation receiver. Signals from antenna 10 are applied to radio frequency amplifier 11, wherein the level of the signals is increased. The amplified signals are applied to converter 12, which may include one or more stages of frequency conversion, and may also include separate oscillators for providing heterodyning signals. The reduced frequency signals from converter 12 are applied to intermediate frequency amplifier 13, and from the amplifier to limiter 14. The limited signals are applied to discriminator 15 wherein the modulation signals are derived from the frequency modulated wave. The modulation signals are applied through audio amplifier 16 and audio output circuit 17 to a loudspeaker 18. The audio amplifier 16 may be normally biased off, and rendered conducting when a

control signal is applied thereto. The portion of the receiver which has been described may be of standard well-known construction.

The modulation signals from the discriminator 15 are applied through capacitor 20 to the base of transistor 21, which together with diode 22 act to amplify and limit the signals. The output signals are applied to input windings of resonant reed devices 24 and 26. The devices 24 and 26 include a resonant magnetic reed with input and output windings coupled thereto. When the frequency to which the reeds are resonant is applied to the input windings, the reeds will vibrate to produce signals in the output windings thereof. When a tone signal is received which is of the frequency to which the device 24 responds, tone signals will be applied from the output winding thereof to the transistor 28 which is connected as a forward biased transistor amplifier. The amplified tone output is applied through capacitor 29 to transistor 30 which functions as a tone detector. When a signal of sufficient level is applied to the transistor 30, this transistor conducts to charge capacitor 31 from the voltage on battery 32. The voltage across capacitor 31 is applied to the voltage divider including resistors 33 and 34, the common terminal of which is connected to the base of transistor 35. When capacitor 31 charges to a predetermined value the voltage applied to transistor 35 causes this transistor to conduct and provide the output of the tone detector. Feedback is applied from the collector electrode of transistor 35 to the base electrode of transistor 30, through resistor 32.

The reed of device 26 will be selected to respond to the second tone in a sequence, and whenever this tone is present it will be applied from the output of resonant device 26 to the base of transistor 36. Transistor 36 is biased off by the potential applied from battery 32 through resistor 37 and the output winding of device 26 to the base electrode of transistor 36. However, when transistor 35 conducts, this acts to ground resistor 38 so that the bias voltage applied to the base of transistor 36 is reduced and this transistor is rendered conducting. The output of tone amplifier transistor 36 is applied through capacitor 39 to transistor 40 to render the same conducting to charge capacitor 41. Voltage across capacitor 41 is applied to the voltage divided including resistors 43 and 44, the common terminal of which is connected to the base of transistor 45. Feedback is provided from the collector electrode of transistor 45 to the base electrode of transistor 40 through resistor 42. It will be obvious that the circuits for amplifying and detecting the two tones are quite similar.

Transistor 48 is connected to clamp the output of tone amplifier 36, when the transistor 48 is conducting. The voltage across capacitor 31 is applied through resistor 49 and across resistor 50 to the base electrode of transistor 48 to render it conducting. Resistor 49 has a greater value than resistor 33, and resistors 34 and 50 have the same value, so that a larger portion of the voltage of capacitor 31 is applied to transistor 35 to hold the same conducting for a longer period than transistor 48 is held conducting.

Accordingly, transistor 36 is rendered conducting as soon as the first tone is detected and transistor 35 is rendered conducting. However, the second tone amplified by transistor 36 is shorted out by transistor 48 until after the first tone is terminated. Therefore, the output of the second tone detector (transistor 45) appears only after the first tone has been received to render transistor 36 conducting, and after the first tone has terminated so that transistor 48 is cut off to remove the clamp. Diode 46 connected from the collector electrode of transistor 45 to resistor 38, grounds this resistor as long as the second tone is received to hold transistor 36 conducting for the duration of the second tone.

The operation of the decoder system which has been described is illustrated in FIG. 2. Chart (1) illustrates the tones which may be transmitted, with tone A of a first frequency having a duration of about one second. The interval between tones A and B may be about 400 milliseconds, and tone B may have a duration of at least one second or longer. Chart (2) of FIG. 2 shows the output of the channel A detector, which is the output of transistor 35 in FIG. 1. The time constant provided by capacitor 31 and resistors 33 and 34 will hold the transistor 35 conducting for about one second after tone A is terminated. Chart (3) shows the period of time that channel B, which detects tone B, is responsive to the tone signal. This period is initiated by cut off of transistor 48, and terminated by termination of conduction of transistor 36. As previously stated, the voltage across capacitor 31 applied to transistor 48 is less than that applied to transistor 35, so that transistor 48 remains conducting for a shorter period than transistor 36. Transistor 48 may be conducting for about 600 milliseconds after tone A is terminated. This leaves the remainder of the one second period, or a period of about 400 milliseconds, during which channel B is responsive. If tone B is applied to the second channel during this period, this tone will be applied from amplifier 36 through capacitor 39 to transistor 40 to render the same conducting to charge capacitor 41. Feedback through diode 46 holds amplifier 36 conductive for the duration of the second tone. The time constant of capacitor 41 and resistors 43 and 44 controls the period of conduction of transistor 45 at the termination of tone B. As stated above, the B channel is responsive for a period of about 400 milliseconds, and the tone may be continued thereafter for a period of one second or longer, so that transistor 45 may be conducting for a period of more than one second.

The transistor 45 when conducting causes operation of an oscillator 51. Resistors 52 and 53 are connected from the collector of transistor 45 to the battery 32. When transistor 45 conducts, resistor 52 is grounded thereby so that resistors 52 and 53 form a voltage divider connected to the battery 32. This applies a bias to the base of transistor 55 causing this transistor to conduct. Inductor 56 and capacitors 57, 58 and 59 cooperate with transistor 55 to form a tone oscillator, so that oscillations are produced when transistor 55 conducts. The output of oscillator 51 is applied to audio amplifier 16 to render the audio amplifier conductive when the tone signals to which resonant reed devices 24 and 26 respond are received in their proper sequence.

FIG. 3 shows a decoder system for use with three tones applied in sequence. The circuit is generally similar to that of the decoder in FIG. 2 and corresponding parts have been given the same numbers. A third resonant reed frequency selective device 62 has its input winding connected in series with the input windings of frequency selective devices 24 and 26. This applies signals of a particular frequency to the base electrode of transistor 63, which is normally biased to a non-conducting condition. When transistor 45 of the detector for the second tone conducts, resistor 64 is grounded to reduce the bias on transistor 63 to render it conducting. The output of transistor 63 is clamped to ground by transistor 65 which performs the same function as transistor 48 in the circuit for detecting the second tone. This is controlled by the potential across capacitor 41 which is applied across resistors 67 and 68. This holds the circuit for the third tone clamped to ground until the second tone is terminated and the voltage across capacitor 41 falls to a value such that transistor 65 is cut off.

The tone output for the third tone is applied through capacitor 69 to the base of transistor 70. Transistor 70 when conducting charges capacitor 71 to render transistor 72 conducting. Transistor 72 grounds resistor 73 of the voltage divider 73, 74 to render the tone oscillator 51 operative. Transistor 72 acts through diode 75 to ground resistor 64 to hold transistor 63 conducting as long as the third tone is received. The tone oscillator may be used to render an audio amplifier conducting in a system as shown in FIG. 1, or may be used to provide an alarm

or any other control. The operation of the tone oscillator is the same as in the system of FIG. 1.

FIG. 4 shows a detector system which will respond to either of two pairs of tones applied in sequence. The drive amplifier 80 applies signals to resonant reed devices 81, 82, 83 and 84. Reed device 81 applies the first tone to amplifier 85 which in turn applies amplified signals to detector transistors 86 and 87. Resonant reed device 83 responds to the second tone of the first group and applies the tone to the amplifier including transistor 88, which is normally cut off. When transistor 86 conducts in response to the first tone, capacitor 89 charges to apply a potential to actuate transistor 87. When transistor 87 conducts, transistor 88 is rendered conductive to amplify the second tone. Capacitor 89 also applies potential through resistor 90 to clamping transistor 91 to short the output of transistor 88. When the first tone ceases, transistor 91 is cut off so that the tone output of transistor 88 is applied to detector transistors 92 and 93. This system operates in the manner described in connection with FIG. 1 so that when the two tones are received in sequence, transistor 93 is rendered conducting to cause operation of tone oscillator 94. Transistor 93 also acts through diode 79 to apply a bias to transistor 88 to hold the same operative as long as the second tone is received.

The system of FIG. 4 is also responsive to a second pair of tones, which have the frequencies selected by resonant reed devices 82 and 84. Devices 82 applies the signals selected thereby to transistor 95 which amplifies the signal and applies the same to detector transistors 96 and 97. These transistors operate in the manner previously described. Reed device 84 applies the selected tone to transistor 98 which is normally biased off. When transistor 97 conducts, a voltage is applied to render transistor 98 conducting. However, the voltage developed across capacitor 99 by conduction of transistor 96 is applied through resistor 100 to transistor 91. This clamps the output of transistor 98 as well as the output of transistor 88. When the first tone ceases and transistor 91 is cut off to remove the clamp, the output of transistor 98 is applied to detector transistors 92 and 93 to cause operation of the tone oscillator 94 in the manner previously described. The signal clamp transistor 91 prevents falsing by simultaneous operation of the two tones of either tone combination. Transistor 93 operates through diode 101 to hold transistor 98 operative as long as the second tone is received.

Simultaneous operation of tones to which any two of the selective devices 81, 82, 83 and 84 respond will not cause a detector output. The detector output will be produced only when the tone selected by device 81 is followed by the tone selected by device 83, or in response to the tone selected by device 82 followed by the tone selected by device 84. Inasmuch as both pairs of tones operate to provide the same control, the tone outputs of transistors 88 and 98 can be applied to a single detector circuit and for this reason a single clamp transistor is effective for both tone combinations.

In the circuit of FIG. 4 the battery 32 of FIGS. 1 and 3 has been replaced by a regulated power supply. The terminal 102 is connected to a minus potential which is applied through resistor 104 to the zener diode 105 in parallel with capacitor 106. The voltage across resistor 104 is applied between the base and collector for transistor 108 to control the conduction thereof, so that the source voltage is dropped by resistor 109 and the resistance between the emitter and collector electrodes of transistor 108 to provide a regulated voltage across capacitor 110.

The system of the invention has been found to be highly desirable for decoder systems used in portable equipment. Since the portable equipment is subjected to shock, the resonant reed devices may be mechanically excited by the shock to provide signals which produce an alarm. However, in such case the devices would be simultaneously excited and this would not cause operation of the decoder

system described. This is because the circuit responding to signals from the second resonant device cannot operate until the circuit coupled to the first resonant device removes the clamp therefrom. Since the clamp is not removed until after the first resonant device ceases to apply a signal to the first detector circuit, the second detector circuit cannot respond unless the second resonant device continues to apply a signal after the first device has stopped applying a signal. The circuit of the invention therefore, prevents false operation both in response to simultaneous application of two tones to the system which may be present in an electrical signal applied, and also in response to a mechanical excitation of the reed devices.

I claim:

1. A decoder circuit for responding to first and second tone signals of different frequencies applied in sequence including in combination, first and second tone frequency selecting and detecting circuits, means for applying tone signals to said circuits, said first tone circuit providing first and second output signals in response to a first tone signal selected thereby, said first and second output signals continuing after said first tone signal ceases with said first output signal continuing for a time period after said second output signal terminates, said second tone selecting and detecting circuit providing an output signal in response to a second tone signal selected thereby, said second circuit being coupled to said first circuit and being enabled by said first output signal and disabled by said second output signal, whereby said second tone circuit produces an output signal only in response to said second tone signal applied after said first tone signal and in the time period during which said first output signal continues after termination of said second output signal.

2. A decoder circuit for responding to first and second tone signals of different frequencies applied in sequence including in combination, first and second tone frequency selecting means, means for applying tone signals to said selecting means, first tone detecting means connected to said selecting means and providing first and second output signals in response to a first tone signal selected by said first selecting means with said first output signal continuing for a time period after said second output signal and said first tone signal terminate, second tone detecting means connected to said second selecting means for providing an output signal in response to a second tone signal selected by said second selecting means, said second tone detecting means including first and second portions coupled to said first detecting means, with said first portion being enabled by said first output signal and said second portion being disabled by said second output signal, whereby said second tone detecting means produces an output signal only in response to said second tone signal applied after said first tone signal and in the time period during which said first output signal continues after termination of said second output signal.

3. A decoder circuit for responding to first and second tone signals of different frequencies applied in sequence including in combination, first and second tone frequency selecting devices, means for applying tone signals to said selecting devices, first tone detecting means connected to said first selecting device and including means providing a voltage in response to a first tone signal selected by said first selecting device, second tone detecting means connected to said second selecting device for providing an output signal in response to a second tone signal selected by said second selecting device, said second tone detecting means including amplifier means normally biased to be non-conducting, first circuit means connecting said voltage providing means to said amplifier means to render the same conducting in response to said first tone signal, clamping means connected to said amplifier means to disable the output thereof, second circuit means connecting said voltage providing means to said clamping means for rendering the same operative, said first and second circuit means having time constants such that said amplifier

neans is held conducting after termniation of said first one signal for a longer time period than said clamping neans is held operative, whereby said second tone detect-ng means produces an output signal only in response to aid second tone signal applied after termination of said irst tone signal and in the time period during which said mplifier means is held conducting after said clamping neans is no longer held operative.

4. A decoder circuit for responding to first and second one signals of different frequencies applied in sequence ncluding in combination, first and second tone frequency electing devices, means for applying tone signals to said electing devices, first tone detecting means connected to aid first selecting device and including capacitor means cross which a predetermined voltage is developed in re-sponse to a first tone signal selected by said first selecting levice, second tone detecting means connected to said econd selecting device for providing an output signal in esponse to a second tone signal selected by said second electing device, said second tone detecting means in-cluding amplifier means normally biased to be non-con-ducting, first circuit means connecting said capacitor means to said amplifier means to render the same con-ducting in response to said first tone signal, clamping means connected to said amplifier means to disable the output thereof, second circuit means connecting said ca-pacitor means to said clamping means for rendering the same operative, said first and second circuit means hav-ing time constants such that said amplifier means is held conducting after termination of said first tone signal for a longer time period than said clamp means is held op-erative, whereby said second tone detecting means pro-duces an output signal only in response to said second tone signal applied after termination of said first tone signal and in the time period during which said amplifier means is held conducting after said clamping means is no longer held operative.

5. A decoder circuit for responding to first and second tone signals of different frequencies applied in sequence including in combination, first and second tone frequency selecting means including vibratory reed elements respon-sive respectively to said frequencies of said first and sec-ond tone signals, means for applying tone signals to said selecting means, first tone detecting means connected to said first selecting means and providing first and second output signals in response to the first tone signal selected by said first selecting means, with said output signals con-tinuing after termination of said first tone signal and said first output signal continuing for a time period after said second output signal terminates, second tone detecting means connected to said second selecting means for pro-viding an output signal in response to the second tone signal selected by said second selecting means, said sec-ond tone detecting means including a selectively disabled portion coupled to said first detecting means which is enabled by said first output signal and disabled by said second output signal, whereby said second tone detecting means produces an output signal only in response to said second tone signal applied after termination of said first tone signal and in the time period during which said first output signal continues after termination of said second output signal.

6. A decoder system for responding to first and second tone signals of different frequencies applied in sequence including in combination, first and second tone frequency selecting devices including vibratory reed elements re-sponsive respectively to said frequencies of said first and second tone signals, means for applying tone signals to said selecting devices, first tone detecting means con-nected to said first selecting device and including means providing a voltage in response to said first tone signal, second tone detecting means connected to said second selecting device for providing an output signal in response to said second tone signal, said second tone detecting means including amplifier means normally biased to be non-conducting, first circuit means connecting said volt-age providing means to said amplifier means to render the same conducting in response to said first tone signal, clamping means connected to said amplifier means to dis-able the output thereof, second circuit means connecting said voltage providing means to said clamping means for rendering the same operative, said first and second means having time constants such that said amplifier means is held conducting after termination of said first tone signal for a longer time period than said clamping means is held operative, whereby said second tone detecting means pro-duces an output signal only in response to said second tone signal applied after termination of said first tone signal and in the time period during which said amplifier means is held conducting after said clamping means is no longer held operative.

7. A decoder system for use with a radio receiver hav-ing a detector and an audio amplifier selectively rendered operative by a control signal, said decoder system re-sponding to first and second tone signals of different fre-quencies applied in sequence and including in combina-tion, first and second tone frequency selecting devices in-cluding vibratory reed elements responsive respectively to said frequencies of said first and second tone signals, means for applying tone signals from the detector of the receiver to said selecting devices, first tone detecting means connected to said first selecting device and includ-ing means providing a voltage in response to said first tone signal and output means, second tone detecting means connected to said second selecting device for pro-viding an output signal in response to said second tone signal, said second tone detecting means including tran-sistor amplifier means normally biased to be non-con-ducting, first circuit means connecting said output means to said amplifier means to render the same conducting in response to said first tone signal, transistor switch means connected to the output of said amplifier means to short such output when said switch means conducts, second cir-cuit means connecting said voltage providing means to said transistor switch means for rendering the same con-ductive, said first and second means being constructed to hold said amplifier means conducting after termination of said first tone signal for a longer time period than said switch means is held conductive, whereby said second tone detecting means produces an output signal only in response to said second tone signal applied after termina-tion of said first tone signal and in the time period dur-ing which said amplifier means is held conducting after said switch means is no longer held conductive, and con-trol means coupled to said second tone detecting means and responsive to said output signal thereof to apply a control signal to the audio amplifier of the radio receiver to render the same operative.

8. A decoder system for responding to a plurality of tone signals of different frequencies applied in sequence including in combination, a plurality of tone frequency selecting devices each including a vibratory reed element responsive to one of said tone signals, means for apply-ing tone signals to said selecting devices, a plurality of detecting means connected respectively to said selecting devices, said detecting means connected to said selecting devices responsive to all the tone signals in the sequence except the last tone providing first and second output sig-nals in response to the tone signal applied thereto, with said output signals continuing after the termination of the tone signal and said first output signal continuing for a time period after said second output signal terminates, said tone detecting means connected to said selecting de-vices responsive to all of the tone signals in the sequence except the first tone including a selectively disabled por-tion, said selectively disabled portion of each detecting means being coupled to said tone detecting means for the preceding tone and being enabled by said first output sig-nal therefrom and disabled by said second output signal therefrom, whereby said tone detecting means for all the

tones except the first tone produce an output signal only in response to said tone signal applied thereto after termination of the preceding tone signal and in the time period during which said first output signal from said tone detecting means for the preceding tone continues after termination of said second output signal therefrom.

9. A decoder system for responding to a plurality of tone signals of different frequencies applied in sequence including in combination, a plurality of tone frequency selecting devices each responsive to one of said tone signals, means for applying tone signals to said selecting devices, a plurality of detecting means connected respectively to said selecting devices, said detecting means connected to said selecting device responsive to all the tone signals in the sequence except the last tone signal providing first and second output signals in response to the tone signal applied thereto, with said output signals continuing after the termination of the tone signal and said first output signal continuing for a time period after said second output signal terminates, said tone detecting means connected to said selecting devices responsive to all of the tone signals in the sequence except the first tone including a selectively disabled portion, said selectively disabled portion of each detecting means being coupled to said tone detecting means for the preceding tone and being enabled by said first output signal therefrom and disabled by said second output signal therefrom, whereby said tone detecting means for all the tones except the first tone produce an output signal only in response to said tone signal applied thereto after termination of the preceding tone signal and in the time period during which said first output signal from said tone detecting means for the preceding tone continues after termination of said second output signal therefrom.

10. A decoder system for responding to a plurality of tone signals of different frequencies applied in sequence including in combination, a plurality of tone frequency selecting devices each responsive to one of said tone signals, means for applying tone signals to said selecting devices, a plurality of detecting means connected respectively to said selecting devices, said detecting means connected to said selecting devices responsive to all of the tone signals in the sequence except the last tone signal providing a control voltage and an output signal in response to the tone signal applied thereto, with said control voltage and said output signal continuing after the termination of the tone signal and said output signal continuing for a time period after said control voltage terminates, said detecting means connected to said selecting devices responsive to all of the tone signals in the sequence except the first tone signal including amplifier means normally biased to be non-conducting, first circuit means applying said output signal from the preceding detector means to said amplifier means to render the same conducting, clamping means connected to said output of said amplifier means and operative to disable said amplifier means, and second circuit means applying said control voltage from the preceding detector means to said clamping means for rendering the same operative, said first and second circuit means being constructed to hold said amplifier means of said detecting means for one tone signal conducting after termination of the preceding tone signal in the sequence for a longer time period than said clamping means is held operative, whereby said tone detecting means for all tone signals except the first produces an output signal only in response to said tone signal applied thereto after termination of the preceding tone signal and in the time period during which said amplifier means is held conducting and after said clamping means has been operative.

11. A decoder system for responding to a plurality of tone signals of different frequencies applied in sequence including in combination, a plurality of tone frequency selecting devices each including a vibratory reed element responsive to one of said tone signals, means for applying tone signals to said selecting devices, a plurality of detecting means connected respectively to said selecting devices, said detecting means connected to said selecting devices responsive to all of the tone signals in the sequence except the last tone signal providing a control voltage and an output signal in response to the tone signal applied thereto, with said control voltage and said output signal continuing after the termination of the tone signal and said output signal continuing for a time period after said control voltage terminates, said detecting means connected to said selecting devices responsive to all of the tone signals in the sequence except the first tone signal including transistor amplifier means normally biased to be non-conducting, first circuit means applying said output signal from the preceding detector means to said amplifier means to render the same conducting, transistor switch means connected to said output of said amplifier means to short such output when said switch means conducts, and second circuit means applying said control voltage from the preceding detector means to said transistor switch means for rendering the same conductive, said first and second circuit means being constructed to hold said amplifier means of said detecting means for one tone signal conducting after termination of the preceding tone signal in the sequence for a longer time period than said switch means thereof is held conductive, whereby said tone detecting means for all tone signals except the first produces an output signal only in response to said tone signal applied thereto after termination of the preceding tone signal and in the time period during which said amplifier means is held conducting and after said switch means has been conductive.

12. A decoder system for responding to either of two pairs of tone signals of different frequencies wherein the tone signals of each pair are applied in sequence, said system including in combinaton, first, second, third and fourth tone frequency selecting devices, with said first and second devices selecting the first pair of tones and the third and fourth devices selecting the second pair of tones, means for applying tone signals to said selecting devices, first tone detecting means connected to said first selecting device and including first impedance means across which a first voltage is developed in response to the tone signal selected by said first selecting device, first amplifier means connected to said second selecting device and being normally biased to be non-conducting, first circuit means connecting said first impedance means to said first amplifier means to render the same conducting in response to said first voltage, third tone detecting means connected to said third selecting device and including second impedance means across which a second voltage is developed in response to the tone signal selected by said third selecting device, second amplifier means connected to said fourth tone selecting means and being normally biased to be non-conducting, second circuit means connecting said second impedance means to said second amplifier means to render the same conducting in response to said second voltage, clamping means connected to said first and second amplifier means to disable the outputs thereof, third circuit means connected to said first and second impedance means and to said clamping means for rendering the same operative in response to one of said first and second voltages, said first, second and third circuit means having time constants such that each of said amplifier means is held conducting for a longer time period than said clamping means is held operative, whereby each of said amplifier means produces an output only when a tone signal is applied thereto in the time period during which said amplifier is held conducting and after said clamping means has been operative, and third tone detecting means connected to said outputs of said first and second amplifier means for producing an output signal.

13. A decoder system for responding to either of two pairs of tone signals of different frequencies wherein the tone signals of each pair are applied in sequence, said system including in combination, first, second, third and

fourth tone frequency selecting devices including vibratory reed elements responsive respectively to said frequencies of said tone signals of said first and second pairs, means for applying tone signals to said selecting devices, first tone detecting means connected to said first selecting device and including first impedance means across which a voltage is developed in response to a first tone signal selected by said first selecting device, first amplifier means connected to said second selecting device and being normally biased to be non-conducting, first circuit means connecting said first impedance means to said first amplifier means to render the same conducting in response to said first tone signal to amplify a second tone signal selected by said second selecting device, third tone detecting means connected to said third selecting device and including second impedance means across which a voltage is developed in response to a third tone signal selected by said third selecting device, second amplifier means connected to said fourth tone selecting means and being normally biased to be non-conducting, second circuit means connecting said second impedance means to said second amplifier means to render the same conducting in response to said third tone signal to amplify a fourth tone signal selected by said fourth selecting device, clamping means connected to said first and second amplifier means to disable the outputs thereof, third circuit means connecting said first and second impedance means to said clamping means for rendering the same operative, said first, second and third circuit means having time constants such that each of said amplifier means is held conducting for a longer time period than said clamping means is held operative, and third tone detecting means connected to said outputs of said first and second amplifier means for producing an output signal, said amplifier means applying a signal to said third tone detecting means only in response to one of said second and fourth tone signals applied after termination of said first and third tone signals respectively in the time period during which said amplifier means is held conducting after said clamping means becomes inoperative.

14. A decoder system for responding to either of two pairs of tone signals of different frequencies wherein the tone signals of each pair are applied in sequence, said system including in combination, first, second, third and fourth tone frequency selecting devices each including a vibratory reed element responsive to the frequency of one of said tone signals, means for applying tone signals to said selecting devices, first tone detecting means connected to said first selecting device and including first capacitor means across which a voltage is developed in response to a first tone signal selected by said first selecting device, first transistor amplifier means connected to said second selecting device and being normally biased to be non-conducting, first circuit means connecting said first impedance means to said first amplifier means to render the same conducting in response to said first tone signal to amplify a second tone signal selected by said second selecting device, third tone detecting means connected to said third selecting device and including second capacitor means across which a voltage is developed in response to a third tone signal selected by said third selecting device, second transistor amplifier means connected to said fourth tone selecting means and being normally biased to be non-conducting, second circuit means connecting said second impedance means to said second amplifier means to render the same conducting in response to said third tone signal to amplify a fourth tone signal selected by said fourth selecting device, transistor switch means connected to said first and second amplifier means to short the outputs thereof, third circuit means connecting said first and second capacitor means to said transistor switch means for rendering the same conductive, said first and second circuit means having a time constant longer than said third circuit means so that each of said amplifier means is held conducting for a longer time period than said switch means is held conductive, and third tone detecting means connected to said outputs of said first and second amplifier means for producing an output signal, said first amplifier means applying a signal to said third tone detecting means only in response to said second tone signal applied after termination of said first tone signal and said second amplifier means applying a signal to said third tone detecting means only in response to said fourth tone signal applied after termination of said third tone signal in the time period during which such amplifier means is held conducting after said transistor switch becomes non-conductive.

No references cited.

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