Dec. 11, 1962 J. L. FLETCHER ET AL 3,068,319

ACOUSTIC REFLEX EAR PROTECTIVE SYSTEM

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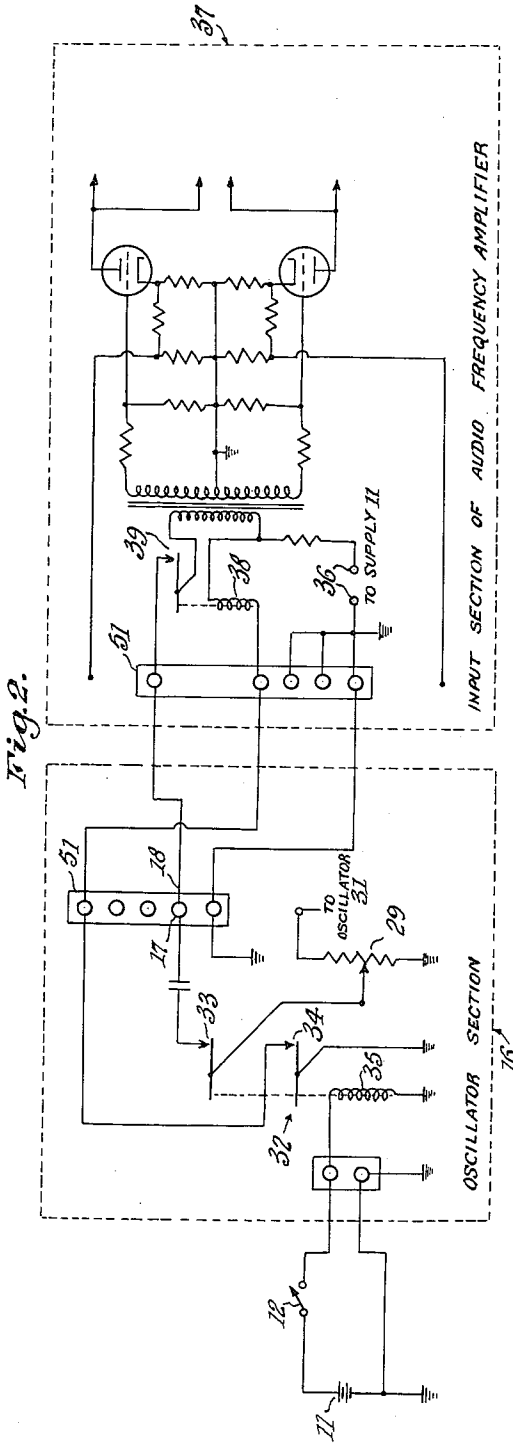


Fig. 2.

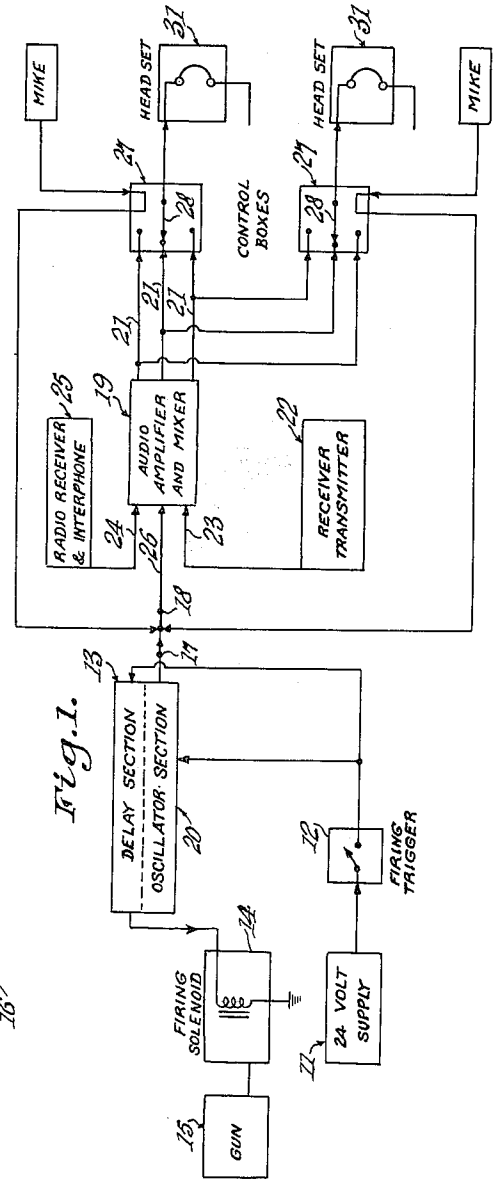


Fig. 1.

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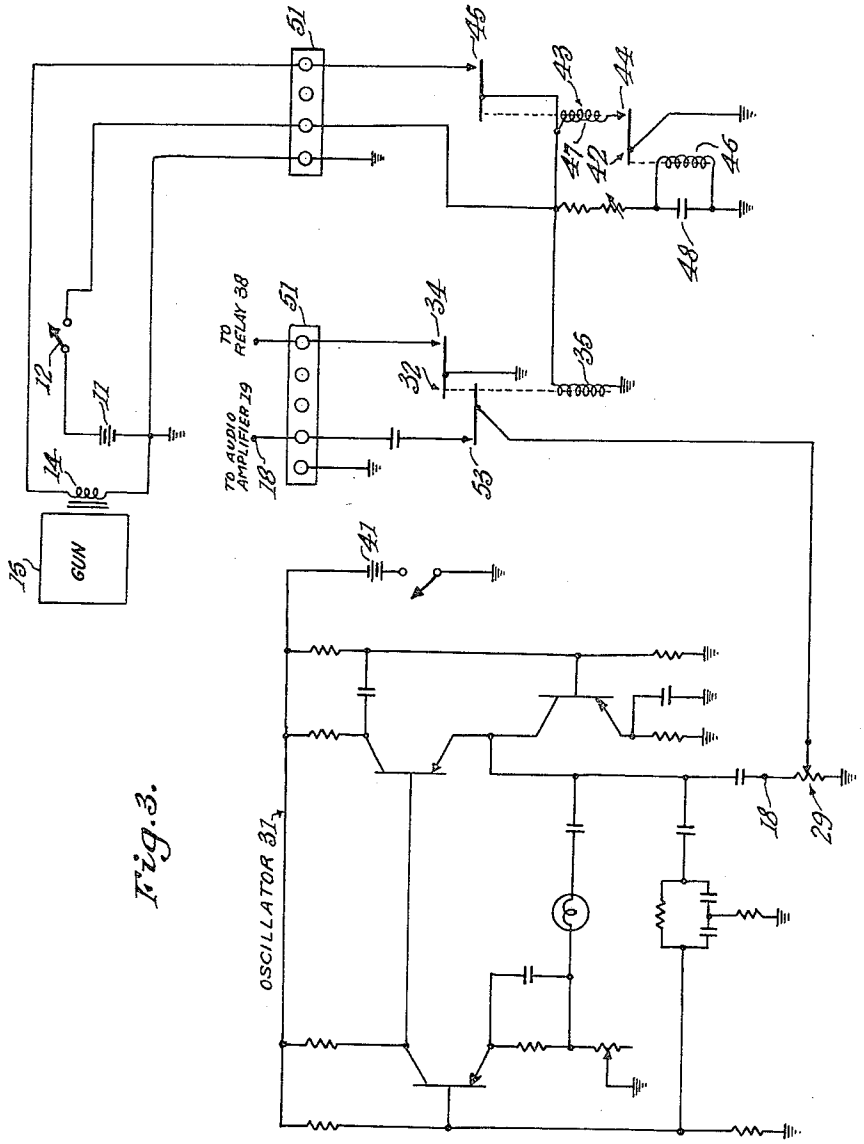


Fig. 3.

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ACOUSTIC REFLEX EAR PROTECTIVE SYSTEM

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The invention described herein may be manufactured and used by or for the Government for governmental purposes without the payment of any royalty thereon.

The present invention relates to an acoustic reflex ear protective system and more particularly to an acoustic reflex ear protective system for introduction of a sound to the ear anticipatory to the reception of a second sound to the ear such that the ear is protected from noise-induced hearing loss.

The introduction of a sound at the level of 80 to 110 decibels, for example, into the human ear causes a brief contracture of the stapedius and tensor tympani muscles of the middle ear and tightens the eardrum. The tightened eardrum is less free to vibrate and thus less able to transmit sound vibrations to the fluids of the inner ear. This contracture is termed the acoustic reflex.

A system exemplary of the present invention may include a source of energy, a pair of energy paths connected in parallel to the source, sonic generator means connected to each path and actuated by the energy source, and energy impeding means positioned in one path between the sonic generator means and the energy source such that actuation of one sonic generator means precedes actuation of the other sonic generator means by the energy source whereupon the sound produced by the first-actuated sonic generator means conditions by acoustic reflex the ear for reception of the sound produced by the last-actuated sonic generator means.

An object of the present invention is to provide a new and improved acoustic reflex ear protective system.

Another object is the provision of an ear protective system to induce a sound to the ear to actuate acoustic reflex in advance of the reception of sound which otherwise could cause noise-induced hearing loss.

Still another object of this invention is to provide a system including circuitry adapted for use with standard military equipment.

A further object is the provision of an ear protective system which causes delay of the production of a deafening noise until after the production of a sound capable of conditioning by acoustic reflex the ear for reception of the deafening noise.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing in which like reference numerals designate like parts throughout the figures thereof and wherein:

FIG. 1 is a block diagram of the general concept of the invention;

FIG. 2 illustrates in schematic circuitry a portion of a preferred embodiment of the system disconnected from an input section of an audio frequency amplifier; and

FIG. 3 is a view of the specific circuitry of the input section of an audio frequency amplifier connected with the output of an oscillator section of the system.

Referring to FIG. 1 there is shown a voltage supply 11 connected to a firing trigger or switch 12 which is in series with a delay section 13 of the protective system. The output of the delay section 13 is fed to a firing solenoid 14, which, when energized upon closing of the switch 12, actuates by mechanical linkage not shown, the firing mechanism of a gun 15, for example.

An oscillator section 20 illustrated in FIG. 1 is connected in parallel with the delay section 13 to the switch 12, as best shown in FIG. 3, with an output terminal 17 connected to the input point 18 of an audio frequency amplifier and mixer 19, FIG. 1. The amplifier and mixer 19 is identified as AM–65/GRC by the U.S. Army, and is described in detail in Technical Manual 11–5039, an Army Signal Corps publication available from the U.S. Army Publications Branch, Office of The Adjutant General, the Pentagon, Washington 25, D.C.

Basically, the audio frequency amplifier and electronic mixer 19 includes three channels 21 and is designed to provide interphone operation and radio monitoring in installations using one or two receiver-transmitters and one or more interphone control boxes. The installation shown in FIG. 1 includes, for example, a radio receiver-transmitter 22, designated by the U.S. Army as RT–70/GRC, which is used for radio and interphone operation. The radio receiver-transmitter output is fed to input 23 of the amplifier and mixer 19. Input 24 of the amplifier and mixer 19 is used for a radio receiver and interphone, generally designated as numeral 25. Input 26 is available for intercommunication only between local stations, and has a parallel connection which serves as the input point 18 from the oscillator section 16. Control boxes 27 are selectively connected by three-position switches 28 to output channels 21 of the amplifier and mixer 19 and are in turn serially connected to headsets 31. The control boxes 27 are identified as C–375/VRC by the U.S. Army in TM 11–5039, referred to hereinabove.

As shown best in FIG. 2, the oscillator section 16 of the ear protective system includes the output terminal 17 connected to an output volume control 29 of an oscillator 31, FIG. 3. A relay 32 with pairs of contacts 33 and 34 has its actuating coil 35 operatively connected to the voltage supply 11 at terminals 36 by the trigger or switch 12. The relay 32 is actuated to close contacts 33 to complete a circuit from the oscillator 31 to an input section 37 of the audio frequency amplifier 19. Also, actuation of the relay 32 closes the contacts 34 to complete a circuit from the supply 11 to ground through a relay 38 which in turn closes contacts 39 to complete the connection between the oscillator 31 and the audio amplifier 19.

The oscillator 31, FIG. 3, is a conventional R.C. coupled transistor oscillator, and, in the preferred embodiment of the invention, is designed with an output of approximately one volt at 1000 cycles per second. The oscillator 31 is powered by a 22.5 volt battery 41, for example, with the oscillator output appearing at terminal 17, which is connected through the output volume control 29 to the input point 18 of the amplifier 19.

A circuit for energizing the solenoid 14 is shown in FIG. 3 to include relays 42 and 43 in series arrangement having pairs of contacts 44 and 45 with coils 46 and 47, respectively. The relays 42 and 43 connect the solenoid 14 with the switch 12 and the voltage supply 11, and are in parallel with the relay 32. A charging capacitor 48 and a variable resistor 49 are provided for delaying the actuation of the solenoid 14 by the source 11.

Cannon sockets 51 are utilized in the schematic views of the system in FIGS. 2 and 3 as terminal blocks.

Operation

The firing trigger 12, which may be a hand gripped electrical switch, is closed by an operator whereupon 24 volts, for example, are applied from the voltage supply 11 to the charging capacitor 48 and the variable resistor 49. The current sensitive relay 42 has its coil 46 energized upon charging of the 100 microfarads, capacitor 48 for example, at which time the contacts 44 of the relay 42 complete the circuit for energizing the relay 43. Through

the closing of the contacts 45 of the relay 43, the 24-volt circuit is completed to the solenoid 14, causing a gun 15, for example, to fire.

Also, when the firing trigger 12 is closed, 24 volts from the supply 11 are applied to the relay 32, energizing the coil 35 and causing the two sets of contacts 33 and 34 to close. The closing of contacts 34 energizes the relay 38 in the input section 16 of the amplifier 19 to complete an input circuit, and the closing of contacts 33 completes the circuit from the output terminal 17 of the oscillator 31 to the input point 18 of the amplifier 19. The output of the amplifier 19 is distributed to one or more of the control boxes 27 and is then fed into earphones 31 worn by an operator to cause an acoustic reflex in his ears. The delay in the firing circuit caused by the charging capacitor 48 is sufficient to permit reception of the output signal from the amplifier 19 into the ear of an operator through headsets 31 prior to the energization of the solenoid 14 which causes a gun 15 to fire, for example. Accordingly, the ears of the operator are protected from the damaging effect of the gun noise by activation of the acoustic reflex by the output of amplifier 19 in advance of the firing of the gun.

Obviously, many modifications and variations of the present invention are possible in the light of the above teachings. For example, the relay 43 may be omitted if the contacts 44 of the relay 42 are capable of carrying the 6 ampere current, in the preferred embodiment, necessary to operate the firing solenoid 14. Similarly, the audio amplifier 19 may be omitted from the ear protective system should the output power of the oscillator 31 be sufficient to deliver the acoustic energy required to create acoustic reflex in the human ear. It is therefore to be understood, that within the scope of the teachings herein, the invention may be practiced otherwise than as specifically described.

We claim:

1. An acoustic reflex ear protective system for protection against a distressing sound the timing of which distressing sound is subject to control comprising an energy source, a plurality of energy paths connected in parallel to said energy source, control means for said energy source, means for generating said distressing sound and means for generating non-distressing sound stimuli, each of said sound generating means positioned in one of said energy paths and actuated by the energy source, and sound delay means connected serially between said distressing sound generating means and said energy source, whereby the energy source actuates said non-distressing sound generating means in advance to the actuation of said distressing sound generating means.

2. An acoustic reflex ear protective system comprising a source of electrical energy, a pair of sound generators connected in parallel to the source and actuated thereby, one of said sound generators being for production of distressing sound the other of said generators being for production of non-distressing sound stimuli, means for interrupting the connection between the source and the generators, and electrical delay means connected serially between the distressing sound generator and the source whereby said non-distressing generator is actuated in advance of the distressing sound generator upon connection with the source.

3. An acoustic reflex ear protective system which comprises a source of electrical energy; a first circuit connection to the source including an oscillator with an output of frequency within the audible range, transducer means connected to the output of the oscillator for converting the output signal to sound energy of an intensity to effect acoustic reflex in the human ear, and means for interrupting the connection between the oscillator and the transducer connected operatively to the source of electrical energy; and a second circuit connected to the source in parallel with the first circuit and including a source of sound energy, means for actuating the source of sound energy connected serially between the source of sound energy and the source of electrical energy and energized by the latter source, and an electrical delay means connected serially between the actuating means and the source of electrical energy; and means for interrupting the connection betwen the electrical source and the parallel circuits whereby upon completion of the connection the first circuit produces a sound to condition the ear by acoustic reflex prior to the production of sound by the source in the second circuit by a time period determined by the delay means in the second circuit.

4. An acoustic reflex ear protective system comprising an oscillator for generating an audio frequency signal, a transducer connected to the output of the oscillator for production of a sound of an intensity to cause acoustic reflex in the human ear, a first relay having contacts for interrupting the connection between the oscillator and the transducer, a voltage source operatively connected to the first relay for actuating the contacts, a delay relay connected in parallel with the first relay to the voltage source, a solenoid connected in series with contacts of the delay relay and actuated by the voltage source upon passage of the current from the voltage source through the contacts of the delay relay, sound producing means connected operatively to the solenoid and energized thereby for production of a sound of higher intensity and different frequency than that of the output signal of the transducer, and a switch for connecting the relays with the voltage supply whereby when the switch is closed the transducer output sound conditions the ear by acoustic reflex in advance of the production of the sound by actuation of the solenoid.

5. An acoustic reflex ear protective system comprising an oscillator for generating an audio frequency signal, a voltage supply for driving the oscillator, an audio amplifier connected to the output of the oscillator for amplifying the signal, an earphone connected to the output of the amplifier for converting the amplified signal to a sound of an intensity to effect acoustic reflex in the ears of a listener from the earphone, a first relay having contacts for interrupting the connection between the oscillator and the amplifier, a gun having a solenoid-actuated trigger mechanism, a trigger switch, a delay relay having contacts connecting the solenoid with the trigger switch, a switch, the first relay being connected to the switch in parallel with the delay relay, and a voltage source connected to the switch for energizing the delay relay, the solenoid, and the contacts of the first relay.

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