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SECONDARY ALARM SYSTEM

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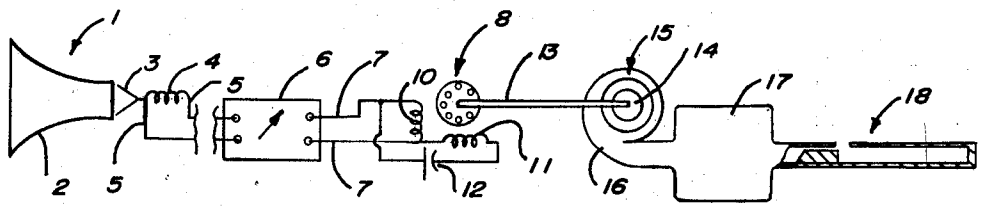


Fig. I

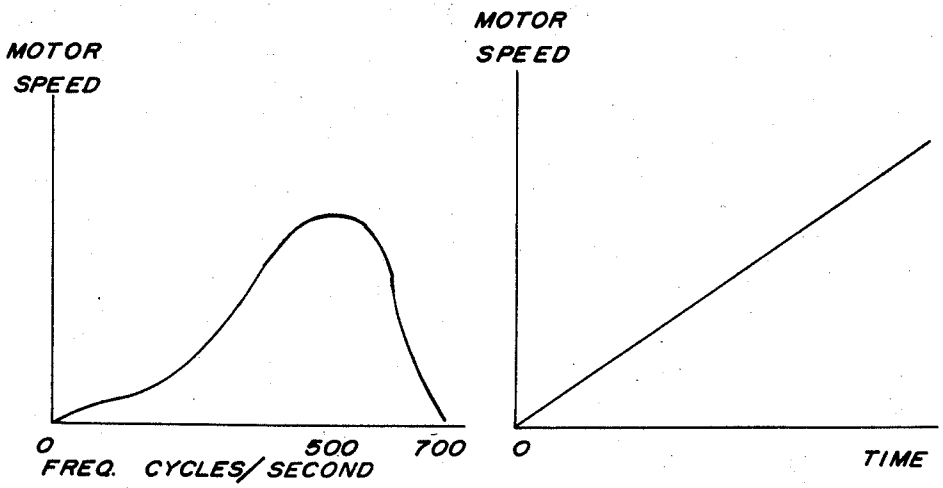


Fig. II

Fig. III

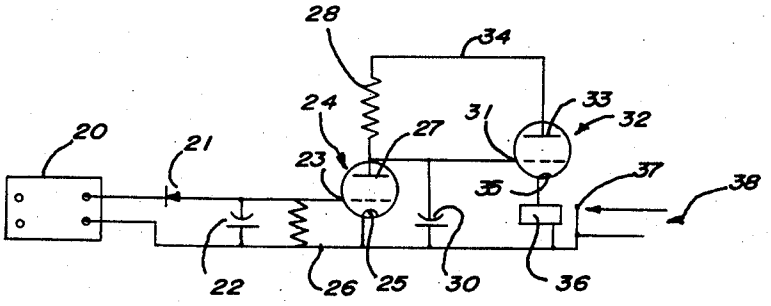


Fig. IV

INVENTOR.
THOMAS J. BENDER

BY

Marshall, Marshall & Hastings
ATTORNEYS

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SECONDARY ALARM SYSTEM

Thomas J. Bender, Toledo, Ohio

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This invention relates to alarm systems and in particular to equipment that may be installed in a residence of a volunteer fireman or a similar person and arranged to provide a signal inside the house in response to a fire alarm signal sounded by a fire station siren.

Many volunteer fire departments face the serious problem that during the winter months, when storm windows are in place, the sound or audible signal from a fire siren is not of sufficient intensity to be readily heard within a well constructed and well insulated home. It usually is too expensive to attempt to run individual wire circuits to each of the volunteer firemen's homes to actuate local alarms and it is too slow to rely upon ordinary telephone service.

The principal object of this invention is to provide inexpensive equipment which may be located in a volunteer fireman's home and which will respond to the audible signal of a fire siren and produce a similar distinctive signal within the home.

Another object of the invention is to provide a reproducing system that serves or acts like a filter to eliminate other sounds or undesired signals and respond only to the sustained note of a fire siren.

A still further object of the invention is to provide a signal filter system that distinguishes between wanted and unwanted signals on the basis of the continuity and pitch characteristic of the desired signal as compared to the relatively short and intermittent nature of other sounds in the same or similar frequency ranges.

These and other objects and advantages are provided by a secondary alarm system constructed according to the invention.

According to the invention, audible signals are picked up in a directional pick up system, amplified, and used to drive a small instrument type electrical motor. The motor in turn drives a centrifugal fan that operates an air whistle or similar audible signal. Alternatively an electronic or detecting time delay system may be employed in connection with a band pass amplifier to provide a signal in response to a continuous audible signal such as a fire siren.

A preferred embodiment of the invention is illustrated in the accompanying drawings.

In the drawings:

Figure I is a schematic or block diagram illustrating the arrangement and cooperation of the various elements of the invention.

Figure II is a diagram in the nature of a graph illustrating the motor speed versus frequency characteristic of the system shown in Figure I.

Figure III is another diagram in the nature of a graph showing the motor speed as a function of time after the start of a constant amplitude signal.

Figure IV is a schematic wiring diagram of a simplified electronic circuit for energizing an alarm circuit in the event that an incoming signal has sufficient amplitude and duration.

Referring now to Figure I, sound from a fire siren,

not shown, is picked up by a horn type audio pick up **1** that is mounted outside the residence and directed toward the fire siren to which it is to respond. The pick up **1** comprises preferably a horn **2** or other similar arrangement for collecting and directing sound waves to a diaphragm **3** carrying a coil **4** located in the field of a permanent magnet. Voltages are generated in the coil **4** according to the incoming sound waves and these voltages are transmitted over leads **5** to an amplifier **6**. The amplifier **6** is a conventional amplifier such as is used in small public address systems for amplifying the output of a microphone and delivering it to a speaker. As shown, the output of the amplifier **6**, at a maximum level of approximately 15 watts, is transmitted over leads **7** to a small electric motor **8**.

The motor **8** is preferably a small two-phase alternating current motor of the squirrel cage induction type designed for operation at 400 to 500 cycles per second. The motor stator includes a first winding **10** connected directly to the amplifier output leads **7** and a second winding **11** connected through a condenser **12** to the amplifier leads **7**. The condenser **12** is selected in accordance with the impedance of the winding **11** so that at a frequency of approximately 500 cycles per second the current flow through the winding **11** shall be approximately 90° out of phase with the current flow through the winding **10**. With this phase relation maximum torque is developed by the motor.

The motor **8** is mechanically coupled through shaft **13** to a rotor **14** of a small centrifugal fan **15**. The fan **15** includes an involute housing **16** through which air under pressure of the fan is delivered to a receiver **17** and from the receiver to a whistle **18**. While a conventional type of whistle is illustrated other types of whistles such as the parallel perforated disk type used in automatic tea kettles may be substituted without changing the effect or the result.

Referring to Figure II, the speed of the motor in driving the fan varies with the applied frequency of the current from the amplifier **6** so as to reach a maximum speed in the neighborhood of 500 cycles per second. As the frequency is raised the speed of the motor tends to drop slowly at first and then quite rapidly. The motor does not respond to low frequencies primarily because of the mismatch of the impedances between the amplifier and the motor resulting in a low power transfer and because the condenser **12** does not provide the sufficient phase shift between the current flow in the two windings to produce torque. Therefore the motor **8** responds primarily to currents in the frequency range from 450 cycles per second up to 650 or 700 cycles per second.

Since the motor **8** is loaded primarily by its own inertia and that of the rotor of the fan **15** its speed versus time curve for constant applied voltage is approximately a straight line as indicated in Figure III. The slope of the line varies according to the frequency and voltage of the applied energizing current. Since the motor must reach a speed of two to three thousand revolutions per minute to sound the whistle, this provides a substantial time delay in response of the motor to changes in supply voltage.

In the operation of this system illustrated in Figure I the sounds picked up by the horn **2** and amplified through the amplifier **6** may consist of background noise in addition to the desired sound from a siren or other continuous frequency source. The amplified signals delivered through the leads **7** cause the motor to rotate at speeds which vary according to the frequency and voltage of the applied signals and the duration of time that the signals persist. Thus a sudden burst of sound, while it may give the motor a sudden acceleration, does not result in a substantial change in speed or a sustained speed. Before the

whistle 18 will sound, however, it is necessary that sufficient air pressure be built up within the accumulator 17 and this requires that the fan 15 run at substantial speed for a certain length of time. This has the effect of still further increasing the time delay so as to distinguish between sounds of short duration and those of longer duration.

In one experimental model of an alarm system built according to the invention it was found that the whistle 18 would not sound unless the motor operated at speeds somewhere in the range 2,000 to 7,000 revolutions per minute and operated in that range long enough to build up air pressure in the accumulator 17. It was observed with this equipment that a howl of a dog somewhere near the pick up horn would produce a motor speed of approximately 1,000 r.p.m. Other devices such as a train whistle produced a speed of 900; a truck motor, 875 r.p.m.; a car motor approximately 850; a police siren 1,100 r.p.m.; an ambulance siren, 1,200 r.p.m.; whereas the motor ran at approximately 600 r.p.m. in response to background noise. By properly orienting the pick up horn 1 with respect to the location of the fire siren to which it is to respond it is possible to still further differentiate between the desired and undesired signals. The principal filtering action in this circuit results from the fact that the motor has considerable inertia and therefore does not respond quickly to changes in applied voltage and that the fan must operate above a minimum speed before it builds up sufficient air pressure to cause the whistle to break into vibration and give an audible output. Thus the motor, fan and whistle system provide a time and amplitude responsive filter to separate a desired signal from background and extraneous noises.

In a preferred form of the equipment a 400 cycle 120 volts A.C. instrument motor was employed. This motor is quite similar to the small instrument motors used in aircraft servomechanism applications.

A somewhat similar filtering action may be obtained from an all electronic circuit as shown in Figure IV. In this arrangement signals from an amplifier 20 corresponding to the amplifier 6 are passed through a diode rectifier 21 to charge a condenser 22 to a voltage corresponding to the output circuit of the amplifier 20. The voltage on the condenser 22 is transmitted to a control grid 23 of an amplifier tube 24. The amplifier 24 has its cathode 25 connected to a grounded lead 26 to which one terminal of the condenser 22 at the output of the amplifier 20 is also connected. The rectifier 21 is polarized in such direction that the output signals of the amplifier 20 cause a grid 23 to go negative with respect to the grounded lead 26. As the grid 23 goes negative it cuts off flow of current from a plate 27 of the amplifier tube 24 thus decreasing the current flow through the plate resistor 28 and allowing the plate voltage of the amplifier tube 24 to rise at a rate determined by a current flow into a fairly large condenser 30 connected between the plate 27 and ground. The voltage developed across the condenser 30 is applied to the grid 31 of a second amplifier stage 32. The amplifier stage 32 has its plate 33 connected directly to a B plus lead 34, to which the plate resistor 28 is also connected, and has its cathode 35 connected through a relay coil 36 to the grounded lead 26. The relay coil 36 operates contacts 37 arranged in a circuit 38 connected to an alarm device suitable for signalling the presence of an incoming signal.

In this arrangement, as the signal from the amplifier 20 produces current cutoff in the amplifier tube 24 the plate voltage slowly rises but it is immediately reduced at any time the input signal ceases even momentarily. If the voltage across the condenser 30 exceeds a predetermined amount, which in effect corresponds to the air pressure developed by the fan 15, sufficient current is allowed to pass through the relay coil 36 to close the relay contacts and operate the alarm. By adjusting the time constant of the resistor 28 and condenser 30 the selectivity of the circuit to signals of various durations may be adjusted and thus the circuit may distinguish between desired and undesired signals on the basis of their time duration.

Various modifications of the circuits and devices shown may be made without departing from the scope of the invention or losing the advantages of employing circuits and equipment having substantial time delays to distinguish between desired signals of substantial time duration and undesired signals having substantially shorter time durations.

Having described the invention, I claim:

1. In a device of the class described, in combination, sound pick-up means responsive to a desired audio signal and undesired noise of similar frequencies and dissimilar amplitude and time duration characteristics, an amplifier connected to said pick-up means for amplifying signals received from said pick-up means, an electrical motor connected to the amplifier and energized by the amplified audio signals, said motor being frequency responsive and having its maximum response in the range of frequencies of said desired audio signal, and speed responsive signal means connected to said motor, said motor and speed responsive signal means having a response slow compared to the time duration of the undesired signals, whereby said motor and speed responsive signal means are responsive only to sustained signals in the desired frequency range.

2. A device according to claim 1 in which the speed responsive signal means is a fan and whistle.

References Cited in the file of this patent

UNITED STATES PATENTS

1,368,736	Lavigne	Feb. 15, 1921
2,268,476	Duncan	Dec. 30, 1941
2,435,423	Clapp	Feb. 3, 1948
2,509,345	Howell	May 30, 1950
2,545,218	Weber, et al.	Mar. 13, 1951
2,595,524	Henneman	May 6, 1952
2,709,799	Norton	May 31, 1955

FOREIGN PATENTS

770,019	France	Sept. 6, 1934
1,047,370	France	Dec. 14, 1953