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ALARM SYSTEM

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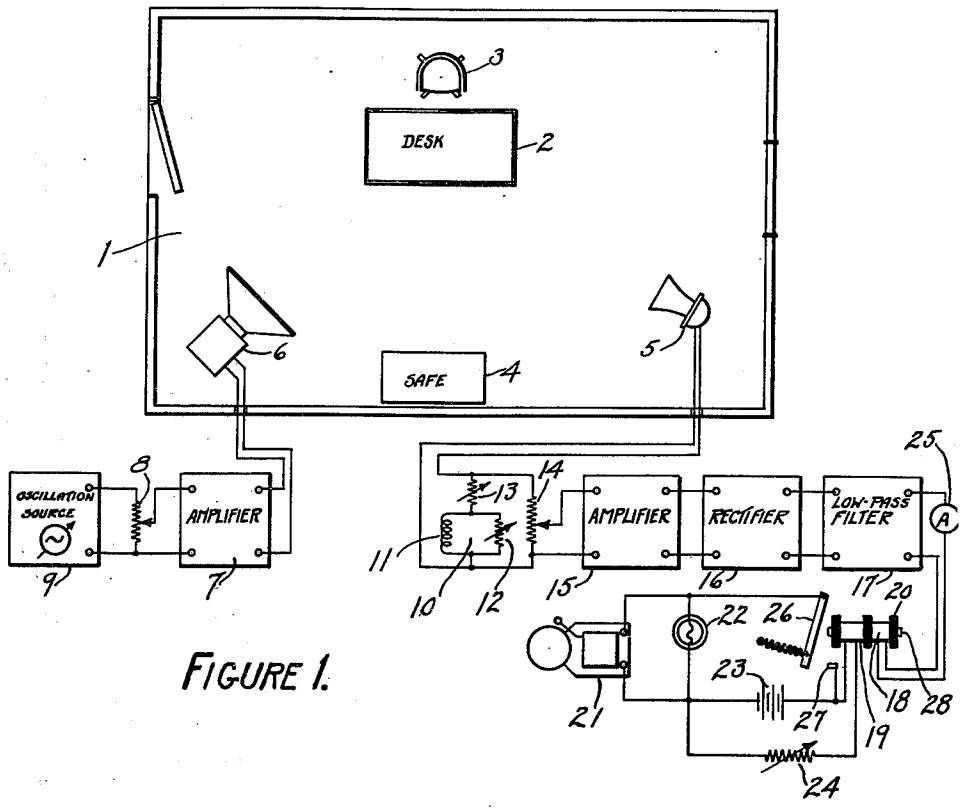

FIGURE 1.

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ALARM SYSTEM

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This invention relates to alarm systems and more particularly to methods and apparatus for making known the introduction of a new object into a given locality or the disturbance of existing objects therein. Thus for example my invention may simultaneously be employed as a very sensitive burglar alarm and an indicator of any event involving motion of the objects in such locality.

It is an object of my invention to provide an alarm system of the class described actuated by the disturbance of sound waves. It is a further object to provide such a system available in controllable degree for further actuation by sound per se. Other allied objects will more fully appear from the following description and the appended claims.

In the detailed description of my invention hereinafter set forth, reference is had to the accompanying drawing, containing a single Figure 1, showing the plan of a room protected by my invention and a schematic diagram of the apparatus I employ.

In the figure, 1 is a room or space to be protected, including such customary furnishings as, for example, a desk 2, chair 3 and safe 4. The room is shown provided with microphone 5 and also loudspeaker 6, which is actuated by oscillation source 9, preferably generating a single frequency upon any given adjustment thereof. The output of the source may be controlled as by potentiometer 8 and amplified as by amplifier 7 before actuation thereby of the loudspeaker. Microphone 5 may be connected to a filter 10 to reduce the intensity of sounds of other frequencies than that of source 9, such filter comprising for example inductance 11 and variable resistor 12, as well as a variable resistor 13 for controlling its effectiveness. The output of the microphone, which may be filtered as mentioned, may be controlled in amplitude as by potentiometer 14 and is amplified and rectified by amplifier 15 and rectifier 16, respectively. The output of the rectifier may be filtered to produce almost pure direct current by low-pass filter 17; and it is applied to coil 18 of relay 20, thereby tending to polarize the core 28 and cause the armature 26 to touch contact 27, closing the indicating circuit comprising battery or other current source 23 and the indicating devices, such as bell 21 and lamp 22. The relay is also provided with bucking coil 19, which may be excited by current adjusted as by variable resistor 24 and derived from any suitable source, such as the current source 23 of the indicating circuit. It is convenient to have merely the microphone and loudspeaker in the room or space 1; but other of the apparatus, as for example 7, 8 and 9, may also be placed therein if desired.

To place the alarm in actuable condition the transmitter, comprising in the figure current source 9, potentiometer 8, amplifier 7 and loudspeaker 6, is caused to sound continuously and thus to excite microphone 5; the amplifier 15 and rectifier 16 are rendered operative, so that by virtue of the output of the microphone there is applied to coil 18 a continuous current; and the current in the bucking coil 19 is adjusted so that its effect in polarizing the core 28 of the relay exactly neutralizes that of the current in coil 18, causing the indicating circuit to remain open.

When the transmitter is operating, the sound produced thereby distributes therefrom and is reflected by the surfaces of the walls and objects in the room with varying efficiency, depending on the absorbing qualities of such walls and objects, and there is thus produced an aggregation of direct and reflected waves. These various waves combine in some positions in the room in phase, producing large sound intensity; in some other positions out of phase, producing low intensity; and in other positions in various other phase and amplitude relationships, causing therein a great variety of intensities. These various sound intensities at different points may be considered to form a sound or interference pattern in the room, the precise form of which depends on the exact nature and placement of everything in and about the room. If now a door or window be opened, if any other object in the room be moved, or if a foreign object be introduced or enter into the room, the sound pattern will shift, or change in form, over the whole room; and hence the intensity of the sound in any given position, such as that of the microphone, will be changed as such door or window is opened or such object is moved or introduced. Such a change of sound intensity at the microphone will produce a change of its output and hence of the current in coil 18; and since the current in bucking coil 19 is adjusted for one value of current only in coil 18, the core 28 of the relay will be polarized, the armature 26 subjected to its attraction and the indicating circuit thereby closed, operating the indicating devices. It is desirable that the transmitter and microphone be so placed relative to each other that the sound picked up by the microphone is made up to as small an extent as possible of direct waves from the transmitter and to as large an extent as possible of waves reflected from various objects in the room; and to this end

the figure shows them materially separated and angled with respect to each other.

The microphone 5 and the succession of apparatus beginning with it and terminating in the indicating circuit may be employed to perform the function, in addition to that already set forth, of providing an alarm actuated by noise per se. In such event the filter 10 may be dispensed with or its effectiveness reduced by a high value of resistance in 13. Generally, however, it is not desired that noises occurring outside the protected room or space and which may be audible therein shall actuate the alarm; and in such cases a highly effective filter at 10 is desirable, resistance in 13 in the figure being preferably low or absent and a more elaborate filter being employed if preferred. In the latter case it is increasingly important that the oscillation source 9 be of very constant frequency for any given adjustment thereof in order that a slight change in frequency may not occur and change the voltage output from the filter 10. For the mere reduction of sensitivity of the system to noises or sounds other than those from the transmitter, the microphone or other pick-up device 5 may be tuned, inherently or otherwise, to the frequency of the transmitter.

At the same time it is convenient in some cases to have the frequency of the oscillation source adjustable, and I have so shown it in the figure. Thus at times it may be desired to have the frequency within the range of audibility so that the presence of sound in the protected space, besides functioning as an integral part of the alarm system, may also serve as a warning to prospective intruders that some form of protective system exists there. On other occasions it may be desired to be advised of the presence of an intruder in the protected space without his knowledge; under such circumstances the use of a superaudible frequency, say 20,000 cycles, is desirable. If variability of the frequency of the oscillation source be not desired, such source may take the form of a tuning-fork controlled oscillator; otherwise it may be a stable audio oscillator, synthetic tone source or any other of a variety of well-known devices for producing oscillations. While the transmitter has been illustrated in the figure as comprising source 9, control 8, amplifier 7 and speaker 6, it will be understood that any other form of sound generator, non-electric if desired, may be employed as the transmitter; and in any event that the transmitter may optionally be located entirely within the protected space or room 1.

The degree of amplification of amplifiers 7 and 15 and the amplitude adjustment of controls 8 and 14 may vary within wide limits, depending on the characteristics of the room and the nature and placement of objects therein, and being permissibly less the greater be the output of the oscillation source, the efficiency of the loudspeaker, the efficiency of the filter 10 if employed, and the sensitivity of the relay 20; also being preferably greater, the greater be the degree of responsivity desired in the system. Determination thereof is readily effected with particular apparatus in any given case by test, as will be understood. In the system as illustrated the apportionment of the total amplification between the two amplifiers 7 and 15 will depend in general on the type of service to be performed by the system, a relatively high degree of amplification at 7 and a relatively low degree at 15 being preferable if response to the source frequency alone be desired, and vice versa if appreciable response to other noise as well be intended. If the degree of amplification required for either amplifier in a particular case be negligible, that amplifier may of course be omitted. Likewise the potentiometer controls 8 and 14 may be omitted, their use being in the nature of a convenience in choice of degree amplification, as will be understood. Low pass filter 17 is not always necessary, but if frequently desirable in keeping in stable condition a very sensitive relay.

Having the apparatus set up one may readily set the alarm in actuable condition by placing the transmitter in operation at the desired frequency; and, with the windows and doors and other objects in and about the protected space in the positions in which they are to be left during the period of protection, adjusting the filter 10 for resonance to the transmitter frequency and adjusting the current in the bucking coil 19 to that value which frees the armature 26 from attraction by the core 28. To facilitate the adjustment of filter 10, ammeter or milliammeter 25 may be provided in series with the input to coil 18; the adjustment of filter 10 then being made for maximum deflection of the meter.

An alternative method of setting the alarm in actuable condition may be employed when a transmitter of variable frequency is used; and with this method of adjustment the bucking coil 19 on relay 20 and the control 24 may be omitted. The transmitter is placed in operation at an approximate frequency and the filter 10, if used, adjusted for resonance thereto. If the armature 26 of the relay is attracted by the core 28, the frequency of the transmitter and the tuning of the filter 10 are coincidentally varied until the armature is just released from attraction by the core. If with the frequency first employed the armature is not attracted by the core, the frequency of the transmitter and the tuning of filter 10 may be first varied until such attraction takes place; further adjustment then being made as last above set forth.

In this case the principle of operation is that with certain frequencies, and hence wavelengths, the position of the microphone will become one of low or zero intensity in the sound pattern of the room, with the objects therein in particular positions; and the output of the microphone and hence the current in coil 18 are therefore low or zero. To such a condition the method of adjustment last above outlined will lead. Almost any disturbance of the room will then increase the input to and output from the microphone and hence the current in coil 18. In the case of this method of adjustment it is especially desirable that a relatively weak current be sufficient to actuate the relay.

While I have shown my invention in certain form and have described its manner of functioning in different ways and with simplifications, it will be understood that various modifications may be made in the choice and disposition of the component parts of the apparatus without departing from the novel general method of alarm operation described or the spirit of my invention as hereinabove disclosed and in the appended claims defined. It will be further appreciated that my invention is not confined to the protection of a room or other totally enclosed space, but may also be employed to protect any space sufficiently enclosed to cause the formation of an appreciable sound or interference pattern. It will finally be understood that in the practice of my

invention I may employ sound waves of audible or ultra-audible frequency, or may alternatively employ radio or other forms of wave energy adapted to produce an interference pattern, of the type above described for sound waves and of a sufficiently non-minute nature to permit the detection of changes therein by a suitable receiving device.

I claim:—

1. The method of detecting the introduction of a new object into a given substantially enclosed space and the disturbance of objects therein, which consists in propagating in said space continuous waves of a wavelength substantially greater than that of light, which waves are reflected by the confines of said space and by objects therein to produce reflected waves, and which reflected waves form with each other and with said propagated waves a wave pattern substantially filling said space; in receiving the waves comprised in said pattern at a fixed region within said space; in adjusting the length of said propagated waves to render normally low the amplitude of said received waves; and in signalling increases in the amplitude of said received waves, whereby to detect changes in said pattern.

2. The method of detecting the introduction of a new object into a given substantially enclosed space and the disturbance of objects therein, which consists in propagating in said space continuous sound waves, which waves are reflected by the confines of said space and by objects therein to produce reflected waves, and which reflected waves form with each other and with said propagated waves a sound pattern substantially filling said space; in receiving the waves comprised in said pattern at a fixed region within said space; in adjusting the length of said propagated waves to render normally low the amplitude of said received waves; and in signalling increases in the amplitude of said received waves, whereby to detect changes in said pattern.

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