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(54) **Alarm system.**

(57) An alarm system in which a fire alarm is activated only when both movement and radiation having characteristics associated with fire emitted radiation are detected. Movement can be detected by a Doppler shift ultrasonic device, and fire emitted radiation by an infra red device. The system avoids false alarms as experienced with ultrasonic and infra red systems operating in isolation. The system may also incorporate an intruder alarm activated only when movement and infra red radiation associated with body movement are detected. The source of infra red radiation may be discriminated by monitoring the flicker frequency of that radiation, the flicker frequency of fire emitted radiation being greater than the flicker frequency of human body emitted radiation.

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ALARM SYSTEM

The present invention relates to an alarm system.

Alarm systems for detecting unauthorised entry into restricted areas and for detecting fires are now widely used. Increasing concern is however being expressed about the number of false alarms which occur due to activation of the known systems by environmental conditions occurring in normal circumstances.

In recent years many movement detecting alarm systems have been installed which are sensitive to the movements of any intruder within a limited space such as a room. Such systems may comprise an ultrasonic transmitter, an ultrasonic receiver, and a circuit for monitoring the received ultrasonic signal to detect changes of the type which occur when a person moves in the limited area. Generally such systems rely on Doppler shift techniques and have the advantage that they are difficult to neutralize. Unfortunately as they must be sensitive to even very small and/or slow movements to ensure that they will detect intruders moving very carefully they are also sensitive to for example wind-induced curtain or window movements, traffic-induced vibrations, and air currents resulting from heat given out by heating systems. Thus in many applications the known movement detecting systems are liable to an unacceptable number of false alarms.

Passive infra red detectors are also well known for use in both intruder and fire detection systems. In infra red intruder detectors short wavelength radiation may be filtered out optically to prevent spurious alarms caused by visible light sources such as flames and sunlight but such filtering obviously cannot be used in infra red fire detectors. Even in the case of infra red intruder detectors however spurious alarms can result from radiation emitted by for example heating systems. Thus infra red detector systems have also proved to be prone to numerous false alarms.

It is known from British Patent Specification No. 964 755 to monitor the outputs of an electromagnetic detector and an ultrasonic detector simultaneously to provide an alarm output only when both detectors indicate the presence of an intruder. This reduces the occurrence of spurious alarms and a variety of "two-detector" systems have been proposed over the period subsequent to the publication of British Patent No. 964 755. All of these proposals have relied upon selecting two detectors of as high a reliability as possible and monitoring their outputs simultaneously.

As mentioned above it is known that ultrasonic movement detectors can give spurious alarms as a result of the operation of heating systems. Extensive efforts have gone into looking for a solution to this

"problem" in the characteristics of ultrasonic detectors. It has now surprisingly been discovered that this "problem" can in fact be taken advantage of in fire detection systems.

According to the present invention, there is provided an alarm system comprising an ultrasonic movement detector, a passive radiation detector responsive to radiation having characteristics associated with radiation emitted by a fire, a fire alarm device, and means for activating the fire alarm device if and only if the detectors detect both movement and radiation having the said characteristics.

Preferably the ultrasonic movement detector comprises a Doppler shift responsive device and the radiation detector comprises a passive infra red detector.

The frequency of amplitude variation in the infra red radiation is a function of its source. Typically this frequency (hereinafter referred to as the flicker frequency) is greater than 10Hz for flames and less than 5Hz for a human body moving at normal speeds. Accordingly by filtering the output of the infra red detector "intruder" or "fire" alarm conditions can be established, and if and only if the ultrasonic detector detects movement an appropriate intruder or fire alarm can be sounded. An integrated fire and intruder alarm system can thus

be provided of simple design but high reliability.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which :

Fig. 1 is a circuit diagram of an ultrasonic transmitter;

Fig. 2 is a circuit diagram of an ultrasonic receiver and Doppler shift detector;

Fig. 3 is a circuit diagram of a passive infra red detector and filter network; and

Fig. 4 is a circuit diagram of an audible alarm device driven by the ultrasonic Doppler shift and infra red detectors of Figs. 2 and 3.

Referring to Figs. 1 and 2, an ultrasonic beam is emitted into the area to be protected by a transmitter XMTR (Fig. 1) driven by a conventional oscillator circuit comprising a crystal XTAL and gate circuits IC1a and IC1b. Reflected ultrasonic waves are picked up by the receiver RCVR of Fig. 2 and amplified by amplifier IC2a. Any movement in the field of the beam results in a shift in the frequency of the received ultrasonic waves.

The lower frequency components (e.g. 1 to 33Hz) resulting from these Doppler shifts are demodulated from the carrier frequency by a network formed by diode D1, capacitor C1 and resistor R1. They are then amplified by amplifiers IC2b and IC2c. The

resulting signal is then passed into a diode pump network defined by diodes D2, D3, capacitors C2, C3, and resistor R2.

A sufficiently large Doppler shift will result in switching of a comparator IC2d, latching of the comparator in the alarm condition being prevented by capacitor C4. Thus an alarm condition output appears at output OP1 whenever a Doppler shift is detected as a result of a movement occurring in the ultrasonic beam. When the movement ceases, the alarm condition output does not remain indefinitely.

Referring now to Fig. 3, a passive infra red detection system is shown which is used both to detect an intruder and to detect fire.

An infra red detector Z1 is provided which is sensitive to radiation in the wavelength range 1 to 15 microns. This range covers both infra red radiation emitted by the human body and that emitted by a typical flame. The detector Z1 is positioned to receive radiation emitted in the same area as that covered by the ultrasonic beam.

Any radiation of the selected wavelength range is detected by Z1 and amplified by amplifier IC3a. The resulting signal is then filtered in order to differentiate between human body emitted radiation with a flicker frequency typically less than 5Hz and flame emitted radiation with a flicker frequency

typically greater than 10Hz. A suitable low pass filter IC3b is used as the intruder detector, and a high pass filter IC4b as the fire detector.

The signal from IC3b is amplified and rectified by the full-wave rectifier network IC3c and IC3d. A sufficiently large intruder signal will switch a comparator IC4a resulting in an alarm condition signal appearing at output OP2.

The signal from high pass filter IC4b is amplified by amplifier IC4c and passed into a diode pump network formed by diodes D4, D5, capacitors C5, C6, and resistor R3. To ensure that momentary spurious signals at this point do not result in an alarm condition, a small delay is provided by the diode pump network. This ensures that a flame must be present for a specific period of time before a comparator IC4d switches and an alarm condition signal appears at output OP3.

Referring now to Fig. 4, the infra red intruder output (OP2, Fig. 3) and the ultrasonic output (OP1, Fig. 2) are applied with the output of an on/off control switch SW to a NAND gate IC5. The fire alarm condition output (OP3, Fig. 3) is applied to a NAND gate IC6. The output of gate IC5 is applied to a gate circuit IC7a, and the output of gate IC6 is applied via gates IC8b and c to a gate IC8d.

When the ultrasonic detector detects movement, and the infra red intruder output OP2 is high, the

gate IC8d turns on an oscillator made up of components IC7c and IC7d. In addition, a modulator made up of IC7a and IC7b is turned on. The result is an oscillator output which sweeps up and down in frequency, driving speaker SPKR.

When the ultrasonic detector detects movement, and the infra red detector flame output OP3 is high, the gate IC8d again turns on the oscillator but the modulator remains off. Thus the oscillator delivers a continuous tone. The fire and intruder alarm signals are thus clearly distinguished.

Reference is made above to the flicker frequency of the infra red detector. In the case of flames, the flicker frequency is inherent in the condition being monitored. In the case of an intruder, who may be moving slowly, as is well known it is necessary to view the infra red signal in a manner which breaks up the incoming signal. This is done conventionally by viewing the infra red signal via a suitably faceted mirror or a faceted lens which is transparent to the infra red frequency of interest.

Thus the above described system is not only largely immune to false intruder and fire alarms but also gives distinguishable fire and intruder alarm indications.

It will be appreciated that the detectors may incorporate any appropriate additional circuitry to improve their discrimination.

Circuit details of the described device will be apparent from the drawings, and may be implemented using a variety of conventional circuit devices. For example, the infra red detector Z1 may be a Mullard type RPY87, circuits IC1, IC7 and IC9 may be type 4011, circuits IC2, IC3 and IC4 may be type TL084, circuits IC5 and IC6 may be type 4023, and circuits IC7 may be type 4093.

CLAIMS:

1. An alarm system comprising an ultrasonic movement detector, a passive radiation detector responsive to radiation having characteristics associated with radiation emitted by a fire, a fire alarm device, and means for activating the fire alarm device if and only if the detectors detect both movement and radiation having the said characteristics.

2. An alarm system according to claim 1, wherein the movement detector comprises a Doppler shift responsive device.

3. An alarm system according to claim 1 or 2, wherein the radiation detector comprises a passive infra red detector.

4. An alarm system according to claim 3, wherein the infra red detector is responsive to radiation having characteristics associated both with human body emitted radiation and fire, the infra red detector further comprising filters providing a first output when radiation having a flicker frequency within a first frequency range associated with flames is detected and a second output when radiation having a second lower flicker frequency is detected, the first output causing the activation of the fire alarm device and the second output causing the activation of an intruder alarm device if and only if movement has been detected by

the movement detector.

5. An alarm device according to claim 4, wherein the fire alarm and intruder alarm devices are formed as a single circuit which is switchable between intruder and fire alarm modes depending upon the inputs to it from the detectors.

6. An alarm device according to claim 4, wherein the first freqyency range is above 10Hz and the second frequency range is below 5Hz.

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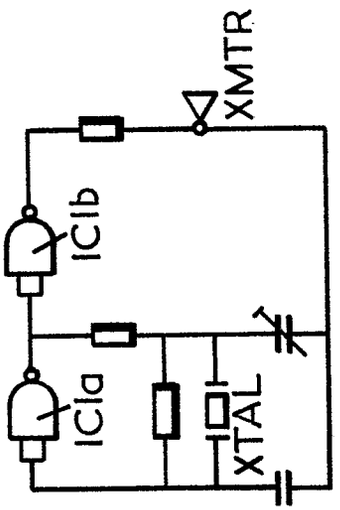

FIG. 1

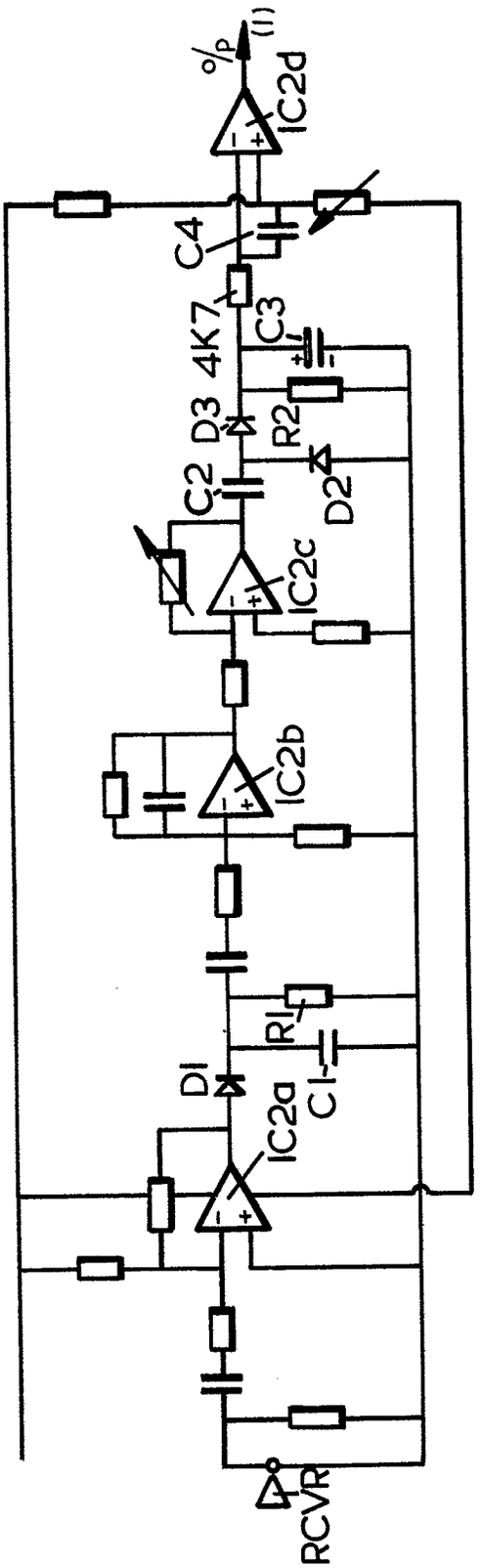

FIG. 2

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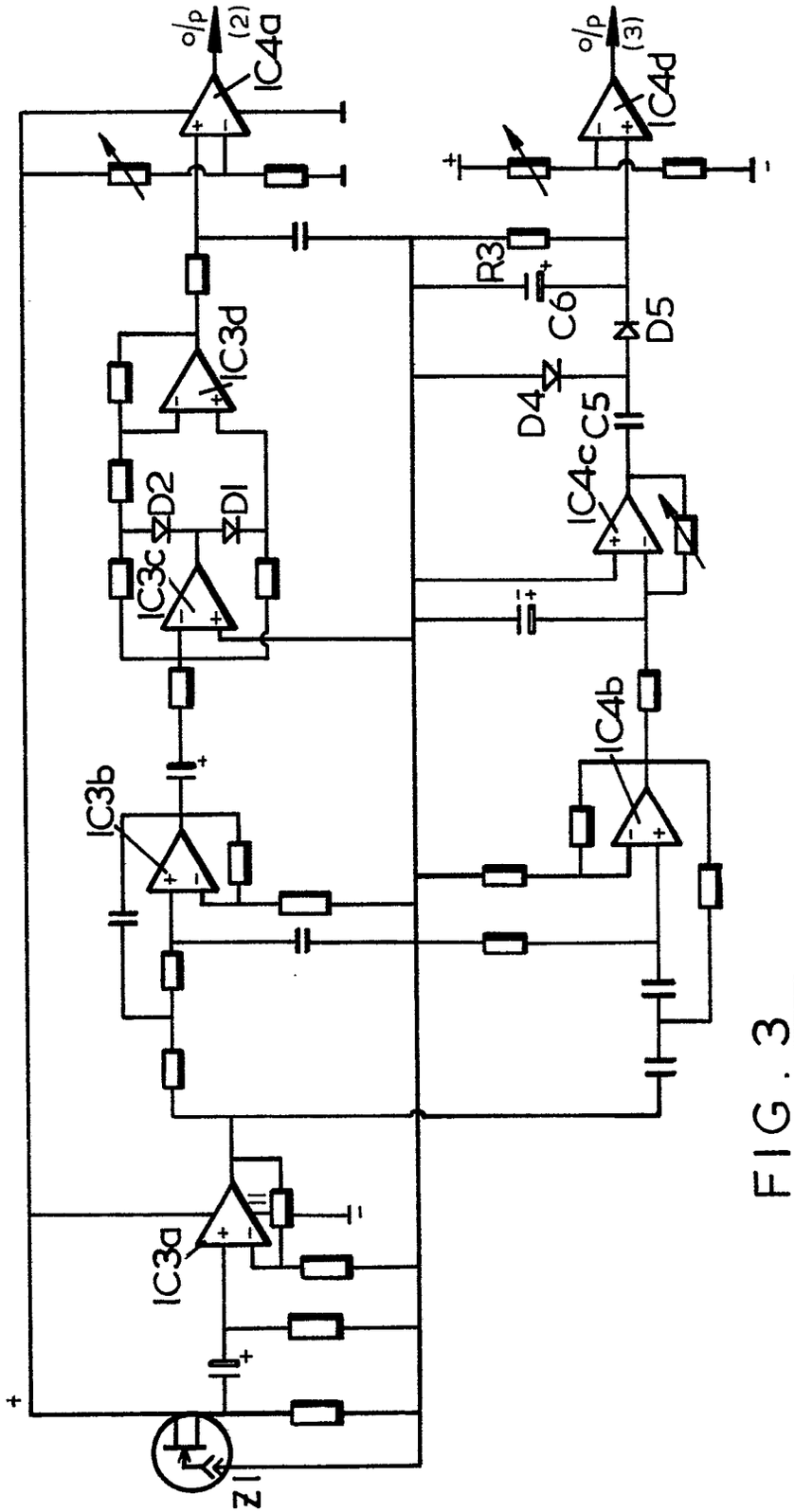

FIG. 3

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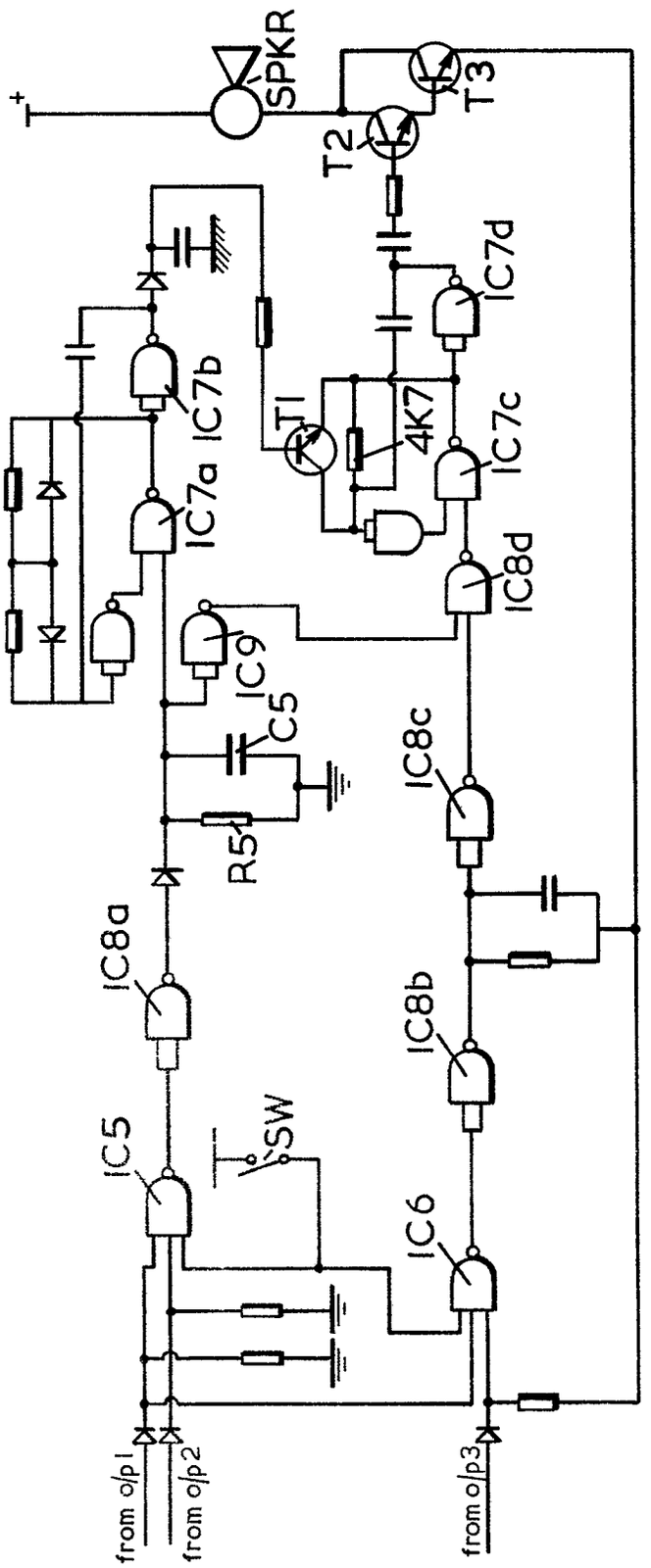

FIG. 4

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Application number

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EUROPEAN SEARCH REPORT

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
A	US-A-4 100 543 (R. STOCKDALE et al.) * Figure; abstract *	1	G 08 B 19/00
A	DE-A-2 820 343 (CERBERUS AG) * Claims 18, 19 *	1,4	
A	DE-C-1 078 016 (W. KIDDE & CO.) * Claims *	1,2	
A	US-A-3 745 550 (M.P. ANTHONY et al.)		
A	US-A-4 052 716 (T.A. MORTENSEN)		TECHNICAL FIELDS SEARCHED (Int. Cl. ³)
A	US-A-4 321 591 (T. VIEWEG)		G 08 B 19/00 G 08 B 13/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	28-10-1983	BEYER F

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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