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FIRE ALARM WITH INFRA-RED SCANNER

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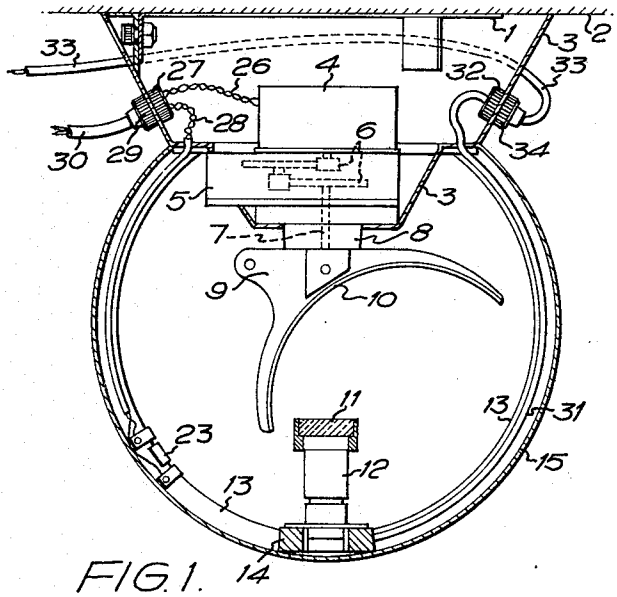


FIG. 1.

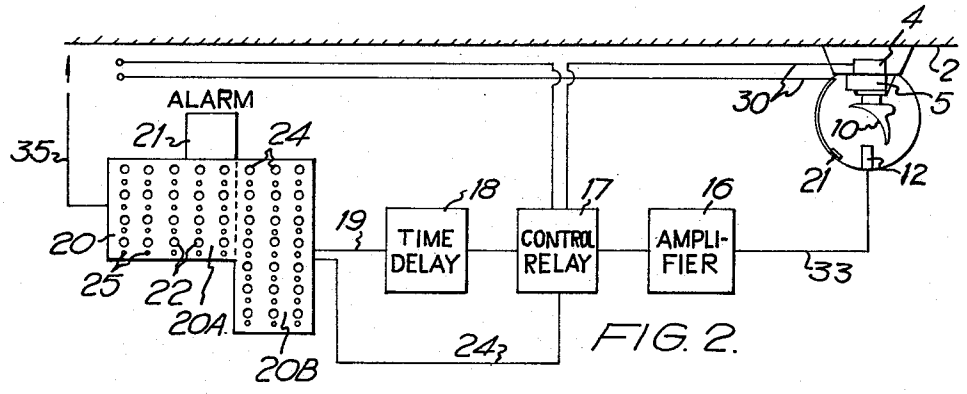


FIG. 2.

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FIRE ALARM WITH INFRA-RED SCANNER

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U.S. Cl. 340—228 4 Claims

ABSTRACT OF THE DISCLOSURE

Fire detection apparatus having a detection unit with a radiation sensitive device and a motor driven rotary scanner, together with an alarm actuated by the detection unit, has its sensitive device responsive to infra-red radiation only, and its scanner in the form of a curved mirror scanner to receive radiation from anywhere below and around the unit in the vertical plane that is being scanned at any instant, a motor-switching device that is controlled by an amplifier fed by the sensitive device to stop the scanning rotation on receipt of radiation, and a time delay device under the control of the switching device to delay the operation of the alarm for a period sufficient for checking whether persistent flickering radiation is being received by the stationary scanner, so that, if this is not the case, the scanning rotation is resumed. For checking that the unit is functioning correctly, a constant infra-red source is included in the unit, so that a brief monitoring signal is given automatically at each revolution of the scanner, of a duration insufficient to allow the time delay device to operate the alarm.

This invention relates to fire detection and alarm apparatus, also capable of being used to control fire-fighting apparatus.

In applicant's U.S. patent application Ser. No. 429,057 filed Jan. 21, 1965 now abandoned, fire detection apparatus is described as comprising a detector unit containing a sensitive device capable of reacting to infra-red radiation, i.e., in the region of 2 to 7 microns, but insensitive to visible radiation, and including rotary scanning means that serve to direct onto the sensitive device an invisible beam from any location in the space scanned around the detector. Such a detector unit, containing a sensitive device and including rotary scanning means, hereinafter described as "of the type referred to," is used in the present invention; but, whereas according to the aforesaid patent application Ser. No. 429,057 the scanning rotation was at a frequency of several times per second, thus producing amplifiable current impulses at that frequency in the event of detection of an invisible beam from a fire source in the space scanned, the scanning rate according to the invention is much slower, and is not itself used to produce any such amplifiable impulses. Instead, the detection unit makes use of the flickering of the flames of an actual fire to produce current impulses capable of being amplified to operate an alarm and/or to bring fire-fighting equipment into operation, and, in this way, distinguishes between an actual fire hazard and the presence of a constant source of infra-red radiation (e.g., an electric fire or an infra-red heater) located in the space scanned.

According to the present invention, a fire detection apparatus comprises a detection unit of the type referred to, with an electric motor for rotating the scanning device of the unit at a relatively slow speed, e.g., one revolution in 30 seconds, an amplifier fed by the sensitive device of the unit and responsive to a frequency of 1 to 30 cycles per second, a switching device controlled by the amplifier to open the motor circuit on receipt by the amplifier

of a signal within that frequency, and to connect the circuit on the cessation of any such signal, a time delay device also controlled by the switching device and incorporating a relay to give a fire alarm signal only after a predetermined delay period has elapsed from initial activation of the time delay device by the switching device.

If a fire occurs in the space scanned, the flickering flame activates the amplifier, the motor is stopped so that the fire continues to be scanned, and the continuous activation of the amplifier causes the time delay device to run its pre-set course and thus to cause its relay to transmit a fire alarm signal.

If, however, a constant infra-red source, e.g., an electric fire, becomes active in the space scanned, the brief activation of the amplifier once per revolution of the scanning device again stops the motor, but the steady radiation from that moment brings the amplifier operation to rest, so that the motor re-starts before the time delay period has run, and, consequently, no alarm signal is transmitted.

A constant source of infra-red radiation may be deliberately provided, e.g., in the detecting unit itself, as a means for providing a brief stoppage of the motor once per revolution, as in the preceding paragraph, with communication of a signal to a monitoring station, where the regular reception of such brief signals would show that the detection unit was functioning correctly.

The invention will now be further described with reference to the accompanying drawings, in which:

FIGURE 1 is a sectional view of a detection unit intended for ceiling mounting; and

FIGURE 2 is a diagram showing the connection of one such detection unit, and devices activated thereby, to an alarm station capable of receiving signals from a plurality of such units.

In FIGURE 1, a mounting plate **1** to be secured to a ceiling **2** carries a housing **3** for a motor **4** surmounting a reduction gearbox **5**, the gears **6** of which are indicated by broken lines, for the rotation of a shaft **7** that passes through a bearing block **8**. The shaft **7** carries a backing member **9** for a curved mirror strip **10** of a width somewhat in excess of the diameter of an infra-red filter **11** on a photoelectric cell **12** mounted co-axially with the shaft **7**. Circular ribs **13** depend from the housing **3** and carry a mounting **14** for the cell **12**, as well as supporting a globe **15** of infra-red transparent material. By appropriate selection of the reduction ratio of the gearbox **5** in relation to the speed of the motor **4**, the mirror **10** is rotated slowly about a vertical axis, say at 1 revolution per 30 seconds. Because of the curvature of the mirror **10**, and because of its rotation, radiation from an infra-red source anywhere in the space below the ceiling **2**, and centred on the vertical axis of the unit, is directed onto the cell **12** once in each revolution of the mirror. It will be understood that, instead of the photocell **17**, any other infra-red sensitive device, such as a thermistor or a bolometer, may be used. The filter **11** can serve to bring the actual wave band for detection into a suitable range, e.g., 2 to 7 microns.

Assuming for the moment that, in the space being scanned, there is no constant source of infra-red radiation, the mirror **10** rotates continuously so long as there is no outbreak of fire, because the level of radiation directed to the cell **12** is nearly constant, so that the cell emits no activating impulses. The cell **12** is connected to an amplifier **16** (FIGURE 2), responsive to impulses in the range 1 to 30 cycles per second, and therefore, of course, unresponsive both to absence of output from the cell and to steady output from the cell.

However, the amplifier **16** is activated and the apparatus serves to transmit a fire alarm signal, e.g., to a bell or

or hooter, and if desired, to a visual indicator, if an actual fire occurs in the space. When such a fire occurs in the space, the slow rotation of the device **10** brings the mirror into a position directed towards the fire and directs infra-red radiation from the fire onto the cell **12**, which thus receives radiation that fluctuates with the flickering of the fire and with a frequency of several times per second to which the amplifier, of course, responds. The resultant response of the amplifier **16** causes a switching device **17**, in the form of a control relay, immediately to switch off the motor **4** and to activate a time delay device **18**. The stopping of the motor **4** brings the mirror **10** to rest in a position still directed at the fire, so that the cell **12** continues to receive the fluctuating radiation and to forward corresponding impulses to the amplifier **16**, which thus maintains the control relay **17** in condition for the time delay device **18** to run through its pre-set delay period. At the end of that period, a signal is given by the relay incorporated in the time delay device **18**, and transmitted by a live **19** to a monitoring station.

Such a station is indicated in FIGURE 2 as comprising an indicator board **20** and an alarm **21**, which can be visual and/or audiable. The board **20** contains visual indicia **22**, e.g., lamps arranged in mimic order corresponding to the disposition of a plurality of the detection units as in FIGURE 1 over the whole space to be protected, or over a plurality of rooms in a building to be protected, such as indicated in the board **20** by **20A** and **20B**. It will be understood that each detection unit as in FIGURE 1 has its own assembly of devices **16**, **17**, **18**, providing for its individual activating connection by a line **19** to the corresponding lamp **22** in the event of a fire. When a lamp **22** is lit, this enables suitable fire-fighting equipment to be brought to the scene of the fire, since the location of the particular detection unit that has produced the alarm is known at the monitoring station from the position of the lamp **22** on the board **20**. It could be that two or more of the detection units were near enough the fire for their mirrors **10**, scanning overlapping territories, to cause several lamps to be lit at the board **20**, so that the seat of the fire would be known with considerable precision.

It is possible that the space scanned contains a constant source of infra-red radiation, such as an electric fire or an infra-red heater, liable to be switched on, possibly at unpredictable times. When so switched on, the source gives off infra-red radiation, which is picked up by the mirror **10** and directed on to the cell **12** once in each revolution of the mirror. When this occurs, the sudden increase in the radiation directed onto the cell **12** causes a signal to be passed to the amplifier **16** to sufficient for the latter to cause the control relay **17** to start the time delay device **18** and stop the motor **4** and the rotation of the mirror **10**. The stationary mirror now receives the increased radiation at constant level from the infra-red source at which it remains directed, so that the level of the signal fed to the amplifier becomes steady. This causes the motor **4** and the mirror **10** to be re-started and the time delay device **18** to be stopped and re-set, well before it could have completed its pre-set delay period. It could happen that, as soon as the mirror **10** resumed rotation, it still found itself beamed on the constant source, when the same short cycle would be repeated, and perhaps repeated several times, with a mirror movement of the mirror at each instance, until the mirror no longer finds itself beamed on the constant source when it is re-started. During each short cycle of stopping and restarting of the mirror movement, the time delay device **18** would never be permitted to run through its full delay period, and no alarm signal could be given to the board **20**. Therefore, although the presence of such a constant source as an electric fire or an infra-red heater may subject the mirror to one or more brief arrests during each scanning cycle, this has no effect on the alarm system.

The ability of the detector unit to detect a constant source of infra-red radiation may also be utilized to ensure that the detection unit is operating satisfactorily by the incorporation in the unit of a small constant source **23** of infra-red radiation, sufficient in intensity to cause an arrest of the scanning device at each revolution. Such source **23** could be a dimly glowing filament lamp or a heated resistor. The periodic arrest, arising as the mirror **10** becomes directed on the source **23**, is then communicated to the monitoring station by transmitting the brief signal sent from the amplifier **16** to the control relay **17** by another line **24**. Thus, in addition to the fire-alarm lamps **22** (say red) on the board **20**, there could be associated with each a lamp **25** (preferably smaller, and of different colour, say green), so that the correct functioning of the detection unit associated with one particular alarm lamp **22** would be shown by the periodic lighting of the other lamp **25**.

The lamp **25** would also show at the board **20** the presence in any space scanned of some other constant infra-red source than the source **23** built into the detection unit, and could therefore show at the monitoring station the existence of something in a particular space that made imspection or remedial action desirable.

Each detection unit, as in FIGURE 1, can be connected to the assembly of devices **16**, **17**, **18** with the latter located at any convenient position. Thus, all the assemblies for all the units could be located at the monitoring station, near the board **20**. Each unit has its motor **4** supplied and controlled by leads **26** from a socket **27** on the housing **3**. From the same socket, leads **28** supply the infra-red source **23**. A plug **29** on a supply and control cable **30** provides the connections to the socket **27**. The cell **12** has a co-axial cable **31** leading to a socket **32** on the housing **3**, to which connection is made to the amplifier **16** by a co-axial cable **33** with a plug **34**.

The board **20** may be connected to a line **35** to a fire station, the line **35** being activated whenever one of the alarm signals **22** is operated.

It is possible for a fire to occur at such height in the space containing the detection unit, say in the ceiling **2**, that radiation could fall directly onto the cell **12** possibly without any reflection of it to the cell by the mirror **10**. In such case, the directly received fluctuating radiation actuates the amplifier **16**, which in turn activates the time delay devices **18**, so that an alarm is given, even though the mirror **10** in the position at which it has been stopped may not be directed towards the source of the fire.

What I claim is:

1. Fire detection apparatus of the type including at least one detection unit containing a radiation-sensitive device, motor-driven rotary scanning means to direct radiation emanating from a fire to the sensitive device and means energized by the sensitive device to operate an alarm on detection of radiation from around the unit in the space scanned, the apparatus comprising in combination:

(a) the sensitive device being provided with an infra-red filter and being, therefore, insensitive to visible radiation;

(b) the rotary scanning means being a curved mirror strip rotatable about a vertical axis and capable of directing to the sensitive device infra-red radiation arising anywhere below and around the at least one detection unit in the particular vertical plane that includes the direction of scanning at any instant during the rotation;

(c) an amplifier fed by the sensitive device and responsive to a frequency of 1 to 30 cycles per second;

(d) a switching device controlled by the amplifier to open the motor circuit on receipt by the amplifier from the sensitive device of a signal within the said

frequency, and to connect the circuit on the absence, and likewise on the cessation, of any such signal; and

(e) a time delay device controlled by the switching device and having a predetermined delay period only at the end of which it is operative to transmit a fire alarm signal, the time delay device being stopped and re-set on the cessation, within the period, of any merely brief signal that has been sent to the amplifier by the sensitive device.

2. Fire detection apparatus as in claim 1, wherein there is provided in the detection unit itself a constant infra-red source, mounted outside the circle of rotation of the curved scanning mirror, so as to be scanned once in each revolution of the mirror, thereby to provide a brief stopping and re-starting of the motor and the mirror and communication of a brief signal to indicate correct functioning of the detection unit, the running of the time delay device being correspondingly brief until it re-sets itself, so that only the correct functioning signal is communicated.

3. Fire detection apparatus as in claim 1, further comprising a monitoring station at which is located an indicator board having indicators, each of which is connected to the time delay device associated with a rotary scanning detection unit, together with a fire alarm.

4. Fire detection apparatus as in claim 3, wherein the indicator board contains further indicators, one for each

detection unit, to indicate the correct functioning of that unit, there being provided in each unit itself a constant infra-red source, mounted outside the circle of rotation of the curved scanning mirror, so as to be scanned once in each revolution of the mirror, thereby to provide a brief stopping and re-starting of the motor and the mirror and communication of a brief signal to indicate correct functioning of the detection unit, the running of the time delay device being correspondingly brief until it re-sets itself, so that only the correct functioning signal is communicated from that unit.

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