AUTOMATIC PERSONNEL INTRUSION ALARM

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Field of Search ................... 340/258 D, 228 R, 340/228 S; 250/83.3 H; 178/DIG. 33, DIG. 38

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Primary Examiner—David L. Traiton
Attorney—Harry M. Saragovitz et al.

ABSTRACT

The invention is concerned with infrared viewing systems, particularly those operating in the spectral wavelength regions between 3 to 5 and 8 to 14 microns. An alarm is provided for these systems to draw particular attention to subtle or drastic changes in the scene being viewed, thereby reducing operator fatigue or relieving the operator to perform other tasks simultaneously.

6 Claims, 3 Drawing Figures
FIG. 1

AUTOMATIC PERSONNEL INTRUSION ALARM (APIA)

AUDIO WARNING DEVICE OR VISIBLE INDICATOR

ALARM DETECTOR AMPLIFIER

HIGH PASS AMPLIFIER

AUTOMATIC GAIN CONTROL AMPLIFIER
AUTOMATIC PERSONNEL INTRUSION ALARM

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

RELATED APPLICATIONS

Ser. No. 231,545 entitled "Universal Viewer for Far Infrared" filed Mar. 3, 1972 by Patrick J. Daly et al. (Also assigned to the U. S. Government).

BACKGROUND

In the military and in many civilian situations it is desirable to protect strategic or monetarily valuable establishments from sneak attack utilizing only a single observer. To achieve this the observer must have some technological assist to overcome the elements of surprise, greater numbers, and probable greater prowess of infiltrators. Contact alarm systems are fairly useful to such an observer, but these can be bypassed or deactivated without the observers knowledge. They also are not suited to all types of terrain particularly where large bodies of water are involved. Sonar devices are useful in water, but can be defeated by carefully designed countermeasures. Likewise listening devices can be used above water, but these also can be defeated.

Perhaps the most difficult system to defeat is a passive IR viewer operating in the far infrared region from 3 to 5 and 8 to 14 microns. The intruder is detected by his body temperature, which is normally much higher than the background terrain, particularly at night when visibility is poorest. Far infrared light penetrates fog, dust and smoke and is not effected by most optical camouflage.

There are difficulties associated with current systems, however, in that they require two much of the operator. The presentation is much different than a simple visual display or an image intensifier output. Familiar details of a scene are omitted while normally invisible heat images are prevalent. The operator must be continuously observing and interpreting the scene to provide proper security. It is preferred and is sometimes necessary that the operator be free to perform other tasks. At worst, the operator should be able to man a number of viewers pointed in different directions.

SUMMARY OF THE INVENTION

The above difficulties are overcome in the present invention by providing an alarm which warns the operator of changes in radiation from the area under surveillance, which might signify the presence of an intruder. A typical infrared (IR) viewing system with which the present invention may be used is shown in application Ser. No. 231,545, a Universal Viewer for Far Infrared filed Mar. 3, 1972 by Patrick J. Daly et al. The IR viewers type AN/PAS-7 and AN/PAS-10 can also employ the alarm system of the invention. To be effective the alarm must sort out variations in the video signal from the viewer that are attributable to the operation of the viewer or to gradual changes in the scene due to ambient temperature variations. The alarm is thus provided with a combination of signal processing devices which enable a visible or audible device. The operator can be stationed at a considerable distance from one or more of these units, and is free to perform other duties such as maintenance, inspection or reporting.

BRIEF DESCRIPTION OF DRAWINGS

The invention is best understood with reference to the accompanying drawings wherein:

FIG. 1 shows a block diagram of the alarm system connected to an infrared viewer;

FIG. 2 shows a complete circuit diagram of the alarm system; and

FIG. 3 shows a pictorial view of the alarm unit mounted on a remote viewing station.

DESCRIPTION OF PREFERRED EMBODIMENT

Referring to FIG. 1, the dashed box 11 separates a scanning type infrared (IR) viewer from the alarm system of the present invention in dashed block 12. An IR scene 13 is viewed through a window 14. This implies both that the frequency is selected to match a natural atmospheric window, e.g. 3 to 5 or 8 to 12 microns, and that transparent elements intervening between the scene and mirror 15 are formed of special materials such as germanium which transmit IR with little attenuation. Objective lens 16 formed from one of the above special materials, forms an image of the scene reflected from mirror 15 on the surface of detector 17.

Ideally the detector would be formed of a two dimensional array of diodes in sufficient members, e.g. 40 to 200 to provide the desired resolution in the final visible display. As a matter of economy a one dimensional array on even a single diode may be used by providing a scan mechanism for the mirror to periodically sweep all parts of the image over a diode. In doing the scan mechanism introduces low frequency components in the video output 18 of the diodes (or diode). When the video signal is amplified by signal processing circuits 19 and applied to a display device, these components are cancelled by the scanning mechanism employed. Ambient temperature changes add very low frequency components which can be removed by the operator with a manual gain control included in block 19, while watching the display device.

The very low frequency components act as a bias that can result in distortion of high frequency components. This is due to operation in the non-linear region of amplifiers used in the alarm circuit. To prevent such distortion, the first stage 21 of the alarm circuit is an automatic gain controlled (AGC) amplifier with a long time constant feedback. Sustained variations of periods greater than three seconds are removed by this stage.

To remove the major signal components introduced by the scanning mechanism, the video output is next processed by a high-pass amplifier 22 which effectively removes all frequencies below two kilohertz. The output of all amplifiers not preceded by detectors is flat to approximately 40 kh.

The output from the high-pass amplifier contains only responses to radiation from the scene. This is fed to the alarm detector amplifier 23 which has a response time constant of 0.15 seconds. A short constant was selected to permit line to line verification of a level change with sweep rates as low as 15 cps. The alarm circuit utilizes a threshold breakdown to produce substantial output energy at a bias level that can be preset by the operator. The energy can be channelled into either an audible or a visible alerting device 24.
3,766,539

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FIG. 2 shows the complete circuit diagram of the alarm which includes blocks 21 to 24 from FIG. 1. All transistors are type 2N2222 except CK1, which is a Rajyistor type CK1116 and Q9 which is a silicon controlled rectifier (SCR) type 2N2323. The resistors all have quarter watt ratings and the capacitors are rated at 15 volts. Individual values of these elements are given in Table 1 which follows.

TABLE 1

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<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>R1</td>
<td>20,000</td>
<td>R14</td>
</tr>
<tr>
<td>R2</td>
<td>100,000</td>
<td>R15</td>
</tr>
<tr>
<td>R3</td>
<td>150,000</td>
<td>C3</td>
</tr>
<tr>
<td>R4</td>
<td>56</td>
<td>R16</td>
</tr>
<tr>
<td>R5</td>
<td>10,000</td>
<td>C4</td>
</tr>
<tr>
<td>R6</td>
<td>100,000</td>
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<td>R8</td>
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<td>C11</td>
</tr>
<tr>
<td>R14</td>
<td>1,000,000</td>
<td>C12</td>
</tr>
</tbody>
</table>

For remote operation of the alarm it is only necessary to bring out the potentiometer R8 and the elements S1, B1, and L1 in block 24 as shown in FIG. 2. To protect the low level signals the gain control and high-pass amplifiers are provided with Faraday cages and the leads from potentiometer R8 include a shielding conductor 30 when brought out of their cages. The switch S1 connects either a light bulb or sound generator such as sonalert unit type SCG28. If desired S1 can be replaced with an AND/OR logic switch arrangement to permit both the light and sound alarms to be operated simultaneously.

The 3 second time constant of the AGC amplifier is provided by RC time integration of the video signals pass from stage to stage. A conventional diode detector furnishes the dc feedback signal for AGC action. Gain is stabilized by the variable shunt resistance of the Rajyistor CK1. The stabilized signal is tapped off the emitter of the first amplifier stage to avoid the smoothing effect of the feedback circuit. The input capacitor C1 of the high-pass amplifier forms part of an RC filter to provide the 2 kh low frequency cutoff. The signal is integrated by RC interstage coupling and rectified as in the AGC amplifier but with a much smaller time constant (0.15 sec) to detect subtle changes in the scene and to ignore a single line anomaly such as a voltage spike or defective detector diode. The integrated current signal is applied to a threshold device such as a silicon controlled rectifier which furnishes a strong current pulse when the signal exceeds its threshold. Adjustment of potentiometer R4 lowers the signal to a level just below threshold when a quiescent scene is presented to the viewing device and must be adjusted whenever the scene is changed or an intolerable false alarm rate is encountered.

FIG. 3 shows a remote viewing cathode ray tube unit 40 with a video display 41 at the bottom and the alarm unit 44 of the present invention mounted on its top. The entire alarm system can be mounted in such a unit if desired. Control 42 sets the threshold level for the detector circuit to trigger the alarm 43 indicator which plugs into the face of the unit. This unit differs from Universal Viewer mentioned earlier, which does not employ a cathode ray tube. For that viewer a remote alarm is best provided by transferring elements R8 and 24 from FIG. 2 as discussed earlier.

Many obvious variations of the specific embodiments described above will occur to those skilled in the art, but the current invention is limited only as construed in the light of the claims which follow.

We claim:

1. In combination with a far infrared viewer wherein an infrared image is scanned by a detector diode to produce a video output signal:
   a bandpass AGC amplifier having its input coupled to said viewer to monitor said video signal;
   a highpass amplifier with a low frequency cutoff at approximately two kilocycles serially coupled to said bandpass amplifier;
   a signal detector with a time constant less than three seconds serially coupled to said highpass amplifier;
   and an alarm means coupled to said detector to emit an alarm signal when significant changes occur in the video signal amplitude.

2. The combination according to claim 1 wherein said AGC amplifier includes a feedback circuit for automatic gain control with a 3 second time constant.

3. The combination according to claim 1 wherein said signal detector has a time constant of 0.15 second.

4. The combination according to claim 1 wherein said AGC and high-pass amplifiers have a band pass of approximately 40 kilohertz.

5. The combination according to claim 1 wherein said alarm means emits an audible alarm signal.

6. The combination according to claim 1 wherein said alarm means emits a visible signal.

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