

①

United States Patent 3,812,483

Graves

[11] 3,812,483

[45] May 21, 1974

[54] POINT SOURCE DISCRIMINATOR THERMAL ALARM

[75] Inventor: Howard T. Graves, Alexandria, Va.

[73] Assignee: The United States of America as
represented by the Secretary of the
Army, Washington, D.C.

[22] Filed: May 26, 1972

[21] Appl. No.: 257,222

[52] U.S. Cl. 340/258 R, 178/DIG. 38,
178/DIG. 8, 340/258 D

[51] Int. Cl. G08b 13/18

[58] Field of Search 340/258 D, 258 R;
178/DIG. 38, DIG. 33, DIG. 8

[56] References Cited

UNITED STATES PATENTS

3,610,822 10/1971 Ingham et al. 178/DIG. 33

3,507,992	4/1970	Foote.....	178/DIG. 33
3,641,266	2/1972	Stults et al.....	178/DIG. 38
3,718,757	2/1973	Gulitz et al.....	178/DIG. 8

Primary Examiner—John W. Caldwell

Assistant Examiner—Glen R. Swann, III

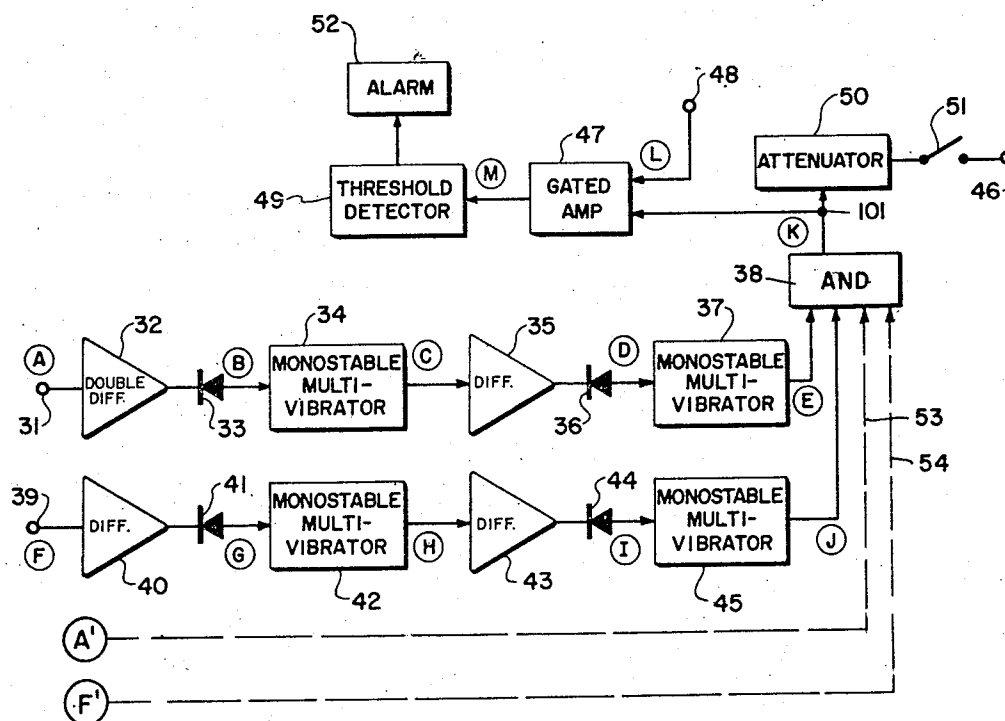
Attorney, Agent, or Firm—Edward J. Kelly; Herbert
Berl; John E. Holford

[57]

ABSTRACT

An alarm system is provided for a scanning type far infrared system. The video signal is processed by a gated pulse blanking system which permits automatic surveillance of one or more windows within the scene displayed. Any significant change within the selected window triggers an audible or visible alarm.

10 Claims, 8 Drawing Figures



SHEET 1 OF 4

FIG. 1

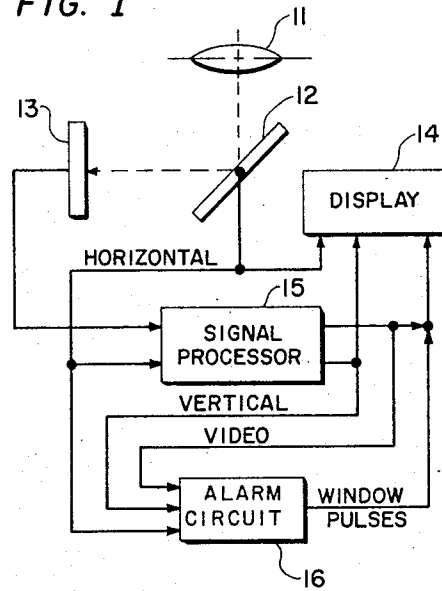


FIG. 2

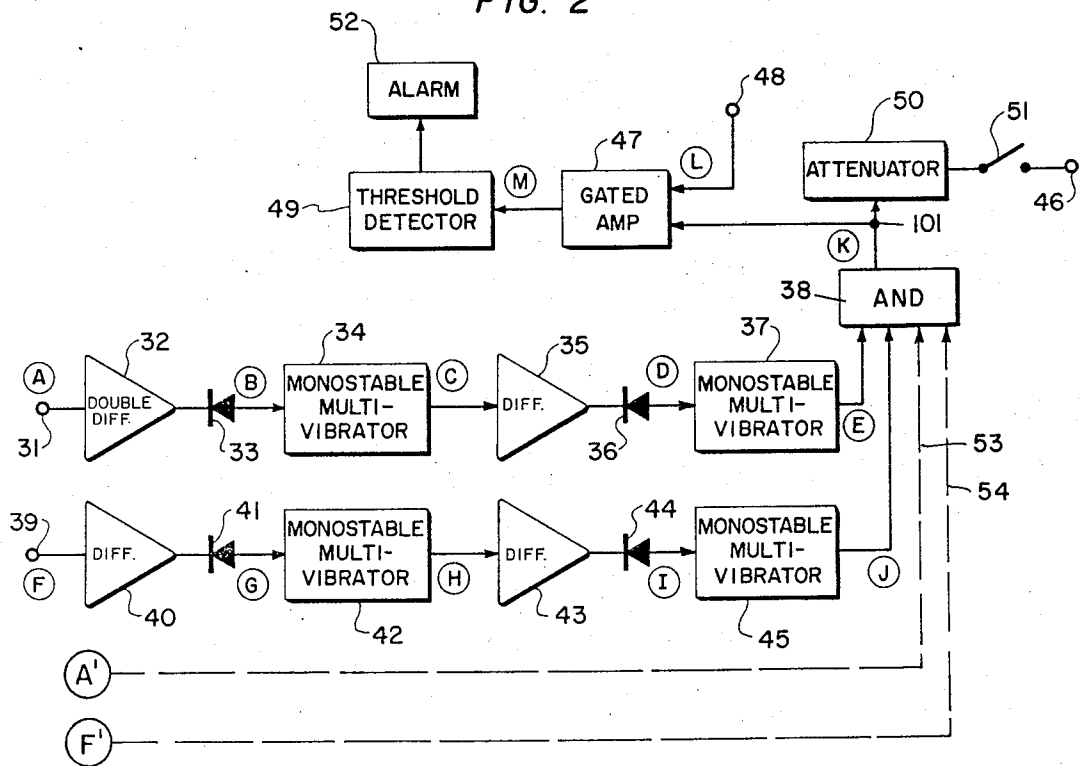


FIG. 3

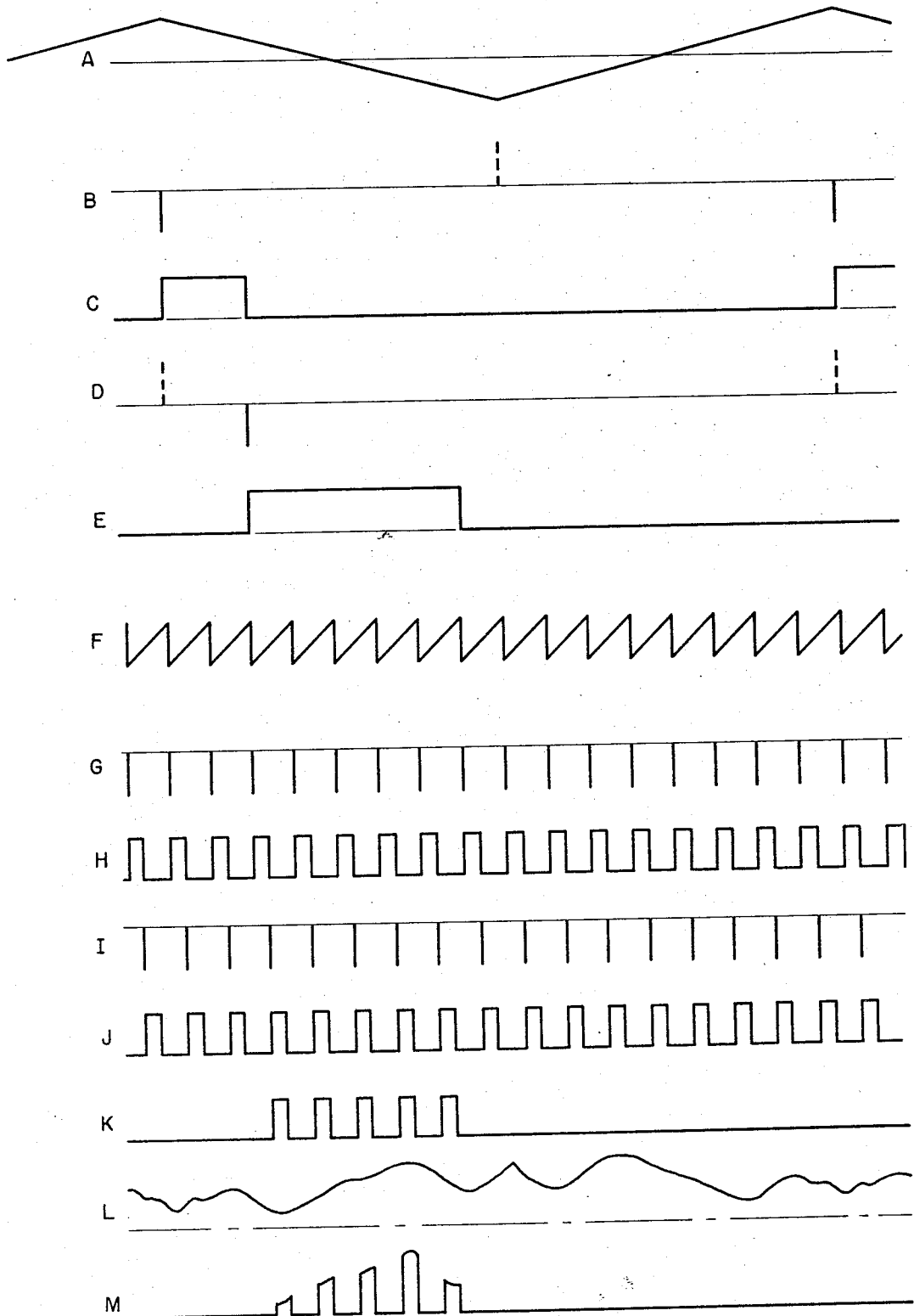
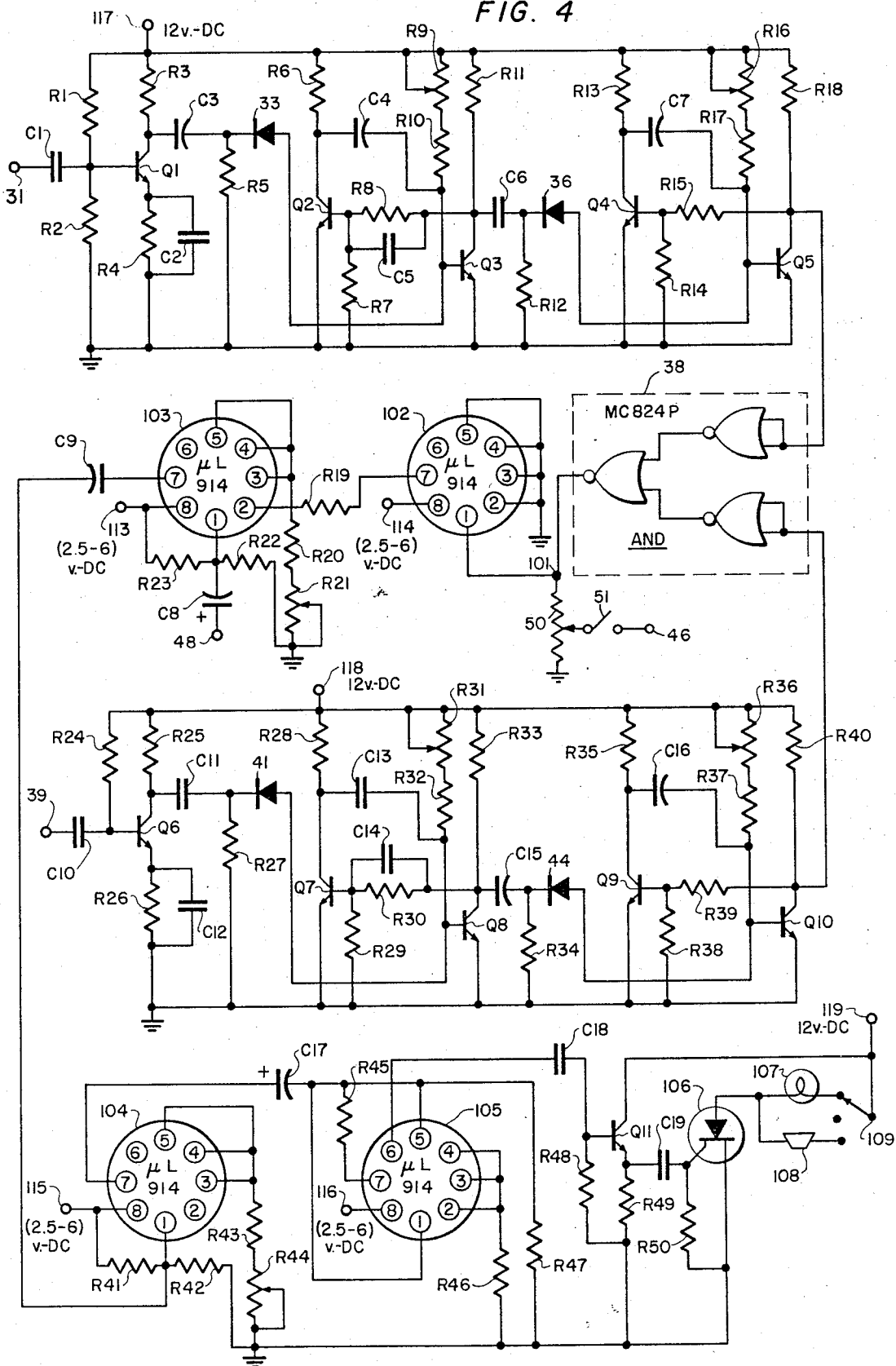


FIG. 4



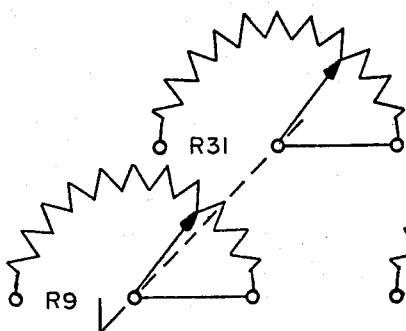


FIG. 5

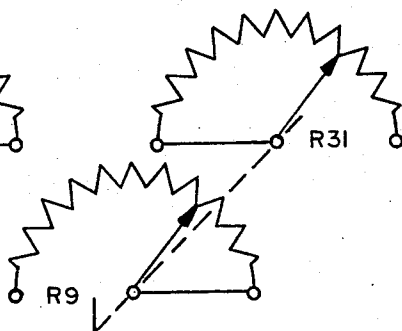


FIG. 6

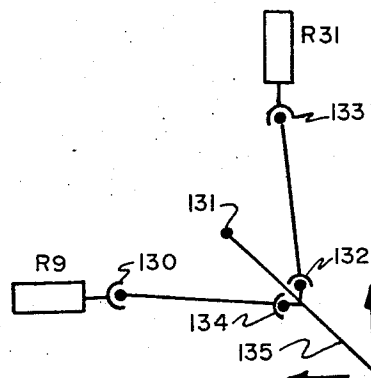


FIG. 7

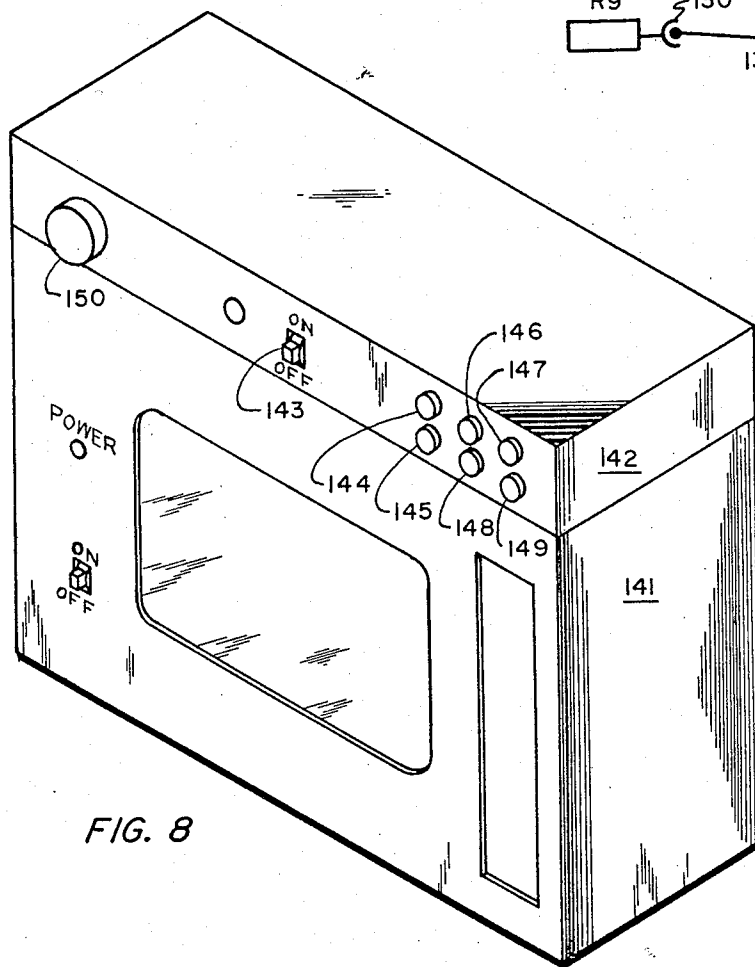


FIG. 8

POINT SOURCE DISCRIMINATOR THERMAL ALARM

GOVERNMENT INTEREST

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

BACKGROUND

Far infrared systems have proved to be extremely effective detectors for infiltrations of men and motorized equipment. The temperature of natural backgrounds such as vegetation or large bodies of water is usually much lower than a human body or a truck motor and its exhaust system. To reduce operator fatigue an automatic alarm system has been devised which gives an audible or visible signal when changes in the video signal exceed a preset threshold. This system, the Automatic Personnel Intrusion Alarm (APIA) Application Ser. No. 249,256 by Bradshaw and Graves, filed May 1, 1972 works well against a uniform background. Situations frequently arise, however, where the total scene under surveillance is penetrated by a number of non-critical sources of infrared such as friendly troops, guns, power sources and vehicles. These are generally randomly dispersed in time, but geographically limited by the operations they are performing. Such a scene imposes an unacceptable false alarm rate on the APIA. One approach might be to optically restrict the field of view to certain areas of the scene but his is not always possible and it denies the operator a chance to assess the whole situation.

SUMMARY OF THE INVENTION

The present invention is intended for use with infrared viewers where an electrical analog signal is derived from one or more infrared detector diodes. Usually this signal is processed for display on a cathode ray tube (CRT) display. This requires the generation of horizontal and vertical sweep signals usually with some degree of blanking and a serial video signal which may require multiplex sampling when more than one diode is scanned simultaneously. Horizontal signals are usually generated by an electro-mechanical scanning mirror in the infrared portion of the viewer, while the vertical sweep signals result from the multiplex processing.

It is the purpose of this invention to provide an electrical switching and timing circuit which samples the various signals in the viewer and selects certain portions of the video analog signal to control an alarm circuit. This circuit in turn generates its own signals which are fed back and added to the video signal to inform the operator of the portions thereof which have been selected. The latter function is accomplished with a minimum of distortion in the CRT display.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects of the invention will be best understood with reference to the accompanying drawings wherein:

FIG. 1 shows an infrared viewer with an alarm added;

FIG. 2 shows a block diagram of the alarm system;

FIG. 3 shows the waveforms generated at each point on FIG. 2;

FIG. 4 shows a circuit diagram of the alarm system, component values of which appear at Table 1 of the specification;

FIG. 5 shows a physical arrangement of variable resistors from the circuit of FIG. 4;

FIG. 6 shows an alternate physical arrangement of the same resistors from FIG. 4;

FIG. 7 shows a preferred arrangement of the same resistors for FIG. 4; and

FIG. 8 shows a pictorial view of a remote CRT display and alarm system.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. 1 an infrared viewing system such as the current military models AN/PAS-7 and AN/PAS-10 can be broken down into a few basic components. A special refractive optical system 11 projects an infrared image via an oscillating mirror 12 to a detector 13 comprising an array of diodes. The oscillating drive system for the mirror provides a horizontal sweep signal which can be used to control a cathode ray display tube 14. Since there normally is no vertical scan (the array consists of a vertical line of diodes), a vertical sweep is introduced by a signal processing circuit 15. This circuit is synchronized by the horizontal drive from the mirror and includes a multiplexing unit which combines the many continuous parallel signals from the diode to a sequential vertically scanned video signal for the display unit. This process is also controlled by a vertical oscillator in the signal processor 15 which provides the vertical sweep and vertical blanking pulses. The video signal, horizontal sweep signal and vertical sweep or blanking pulses are used to control an alarm circuit 16 in a manner to be described. The alarm circuit supplies positioning pulses to the display which are superimposed on the video signals for reasons which will become apparent.

FIG. 2 shows a block diagram of the alarm circuit. The horizontal sweep signal is applied to terminal 31. The circled letter shown on this and other junctions in the circuit are keyed to the waveforms shown in FIG. 3. The horizontal sweep signals are double differentiated by amplifier 32 to form narrow control pulses. Diode 33 passes only the negative control pulses to trigger a horizontal delay monostable multivibrator 34. The pulse width of this multivibrator is adjustable so that its trailing edge will occur a predetermined delay time after a negative control pulse, i.e., the beginning of a horizontal sweep. The delay pulse is differentiated and the resulting negative pulse from its trailing edge passes through diode 36 to trigger a horizontal window monostable multivibrator 37. This vibrator also has an adjustment for pulse width which defines the width of a sampling window. The window can be centered at any point on the horizontal sweep by adjusting the pulse width of the multivibrator 34.

The vertical height of the window is provided by an almost identical circuit triggered either by the blanking pulses or the sawtooth waves associated with the vertical sweep signal from the viewer. Since these pulses have a steep trailing edge they require only a single differentiation. In some viewers noise spikes appear in the vertical sweep signal which can be removed by a band pass filter having a center frequency at 2.35 khz. Elements 41-45 are essentially the same as equivalent elements 33-37 but the time width of the pulses will be

quite different due to the difference in horizontal and vertical scan rates. Passing both signals through an AND gate produces a composite series of window forming pulses covering the time portion of each line in the video display that falls within the sampling window. Using an AND gate with one or more additional pair of inputs, additional sampling windows can be generated. This is done by adding additional pulse generators such as circuits 32-37 and 40-45 having input signals A' & F' derived from the same terminals as A & F. These generators are represented by the dashed lines 53 and 54.

By applying these pulses at low amplitude through an adjustable attenuator 50 to the intensity modulation (VIDEO) input of the display cathode ray tube, the sampling window will have a slightly different contrast than the remainder of the scene. Normally this will not disturb the operator, but it can be fully attenuated once the window size and position is adjusted without compromising the operation of the alarm circuit. The window forming pulses are also used in combination with the video signal entering terminal 48 from the viewer to enable the gated amplifier 47. The output level of this amplifier follows the intensity of the video signal within the sampling window as seen on the display. The threshold detector integrates this signal each time the display is scanned and triggers an alarm when a preset threshold is exceeded. Long term variations and scan information contained in the video signal may be removed using a preprocessing feedback amplifier as shown in patent application Ser. No. 249,256, entitled, "Automatic Personnel Intrusion Alarm," filed May 1, 1972 by B. G. Bradshaw and Howard Graves.

FIG. 3 as mentioned earlier shows the waveforms at various lettered points within the circuit of FIG. 2. The shape and timing of the pulses is fairly critical in obtaining an alarm that will remain stable and not have an unduly large false alarm rate. The shape of the waveforms are idealized and not to scale. The vertical sweep waveform F would normally contain many more cycles per horizontal sweep cycle. The video waveform would probably be far more complex and this would be reflected in the shape of the tops in waveform M.

FIG. 4 shows the complete circuit diagram of the alarm circuit. The diodes are all type 1N270 and the transistors are all type 2N2222. AND gate 38 and blocks 47, 49 and 52 from FIG. 2 are fabricated using an integrated circuit type MC824P, and four Fairchild Logic 914 circuits 102-105 and a silicon controlled rectifier (SCR) 106 type 2323A. The values for all resistors and capacitors are given in Table 1. In the integrated circuit MC824P a four input NOR gate has been connected to perform the AND logic required in block 38 of FIG. 2. The first two Micro Logic circuits act as a signal inverter and gated amplifier to satisfy block 47 in FIG. 2 and the last two provide a threshold amplifier and a Schmitt Trigger for the threshold detector 49 in FIG. 2. Variable resistor R₄₄ adjusts the threshold level. After passing through the buffer amplifier Q11 the trigger signal fires SCR 106 to operate lamp unit 107 or a Sonalert unit 108 depending on the position of switch 109. Separate switches or a ganged switch may be used, if the option to operate both units at once is desired.

The horizontal and vertical signals are applied to the terminal 31 and 39, respectively, and the video signal to terminal 48.

The horizontal window pulse forming circuit includes all components from terminal 31 to integrated circuit 38. The vertical window pulse circuit includes all components from terminal 39 up to circuit 38. If more than one window is desired additional pairs of horizontal and vertical circuits of this type may be added between these same terminals 31, 39, and 38 to parallel the circuits shown, as previously described in FIG. 2. The resistors R₉, R₁₆, R₃₁ and R₃₆ control the dimensions and position of the sampling window. For convenience the operation of R₉ can be ganged to R₃₁ and R₁₆ can be ganged with R₃₆ as shown in FIG. 5. Using rotatable potentiometers their resistance can vary directly or inversely as shown in FIG. 6 with various proportionality functions depending on the resistance taper built into the potentiometer. The preferred arrangement is to use pairs of push-pull potentiometers orthogonally mounted and universally linked, as shown in FIG. 7 e.g., using ball and socket joints, 130, 132, 133, and 134 to the central portion of a joy stick which has one end fixed by a similar universal coupling 131. Moving the free end of the lever permits independent, direct coupled, or inverse adjustments of the resistors and, if the potentiometers are chosen and arranged, logically movement of the lever will directly correlate with movement of the window boundaries. The unit requires two direct current sources one supplying 2.5-6 volts connected to terminals 113, 114, 115, 116 and Pin No. 8 of the Micro-Logic circuits. The second source supplies 12 volts to terminals 117, 118 and 119. Element 50 can be a simple potentiometer between terminal 101 and ground. Switch 51 can be attached thereto in the conventional manner or even omitted entirely without affecting the present invention. The value of the potentiometer is not critical except that like R22 and R42, it must be large enough not to ground the input of the MICRO-LOGIC circuit 102.

FIG. 8 shows a typical application to a remote monitoring unit. The lower portion 141 contains a CRT display and portions of the signal processing circuit from FIG. 1. The required inputs for the alarm must of course be present to drive the CRT. The alarm 142 is mounted over the CRT with its controls mounted on the front face. An on-off switch 143 connects the dc sources to the alarm. A first pair of vertical controls 144 and 145 vary the video gain and the threshold setting of R₄₄ in FIG. 4. The remaining four controls 146-149 vary resistors R₉, R₁₆, R₃₁ and R₃₆. Ganging as mentioned earlier will substantially reduce the number of controls required. The alarm indicator 150 is plug-in unit, in this case the Sonalert device. The lamp device when used is a similar plug-in unit, and when both are present two sockets are provided with a switch as previously described.

Obviously the circuits can be fabricated using other basic components or filters and wave shapers may be used to further refine any of the signals being processed, but the invention is to be limited only as indicated by the scope of the claims which follow.

TABLE 1

All Resistors are 1/4 Watt

All Capacitors are rated at least 12"

65	R ₁	750,000	R ₂₆	120	C ₁	2 mfd
	R ₂	120,000	R ₂₇	10,000	C ₂	10 mfd
	R ₃	10,000	R ₂₈	1,000	C ₃	0.1 mfd
	R ₄	1,000	R ₂₉	100,000	C ₄	5 mfd
	R ₅	10,000	R ₃₀	20,000	C ₅	0.0012 mfd

R ₆	1,000	R ₃₁	20,000
R ₇	100,000	R ₃₂	2,000
R ₈	20,000	R ₃₃	1,000
R ₉	50,000	R ₃₄	10,000
R ₁₀	2,200	R ₃₅	1,500
R ₁₁	1,000	R ₃₆	20,000
R ₁₂	10,000	R ₃₇	2,200
R ₁₃	1,500	R ₃₈	100,000
R ₁₄	100,000	R ₃₉	22,000
R ₁₅	2,200	R ₄₀	2,200
R ₁₆	20,000	R ₄₁	10,000
R ₁₇	2,200	R ₄₂	12,000
R ₁₈	1,500	R ₄₃	25
R ₁₉	1,000	R ₄₄	200
R ₂₀	200	R ₄₅	1,000
R ₂₁	200	R ₄₆	56
R ₂₂	12,000	R ₄₇	1,200
R ₂₃	10,000	R ₄₈	750,000
R ₂₄	330,000	R ₄₉	1,000
R ₂₅	10,000	R ₅₀	2,200

I claim:

1. An alarm circuit for an infrared viewer utilizing a cathode ray tube (CRT) display with first and second terminals, respectively, for periodic linear horizontal and vertical sweep signals and a third terminal for an intensity modulation or video signal derived from an infrared detector comprising,

at least one horizontal window pulse forming circuit means having an input coupled to said first terminal to generate a pulse of controlled width and having a controlled delay relative to the beginning of each of said periodic horizontal sweep signals,

at least one vertical window pulse forming circuit means having an input coupled to said second terminal to generate a pulse of controlled width and having a controlled delay relative to the beginning of each of said periodic vertical sweep signals,

an AND gate having at least first and second inputs respectively coupled to the outputs of each of said horizontal and vertical window pulse forming means,

a gated amplifier having a first gate signal input coupled to the output of said AND gate and a second amplifier input coupled to said third terminal on the CRT display and

a detector means coupled to the output of said gated amplifier to actuate an alarm device when the average signal output from said gated amplifier exceeds a preset threshold.

2. An alarm circuit according to claim 1 wherein at least one tandem control means is connected between

C ₆	0.15 mfd
C ₇	4.8 mfd
C ₈	1.0 mfd
C ₉	1.0 mfd
C ₁₀	1.0 mfd
C ₁₁	0.0039 mfd
C ₁₂	20 mfd
C ₁₃	0.007 mfd
C ₁₄	0.001 mfd
C ₁₅	0.003 mfd
C ₁₆	0.002 mfd
C ₁₇	1.0 mfd
C ₁₈	1.0 mfd
C ₁₉	1.0 mfd

a horizontal and a vertical window pulse forming circuit to vary said delay in each circuit simultaneously.

3. An alarm circuit according to claim 1 wherein a sound generating alarm is connected to the output of said detector means.

4. An alarm circuit according to claim 1 wherein a light source alarm is connected to the output of said detector means.

5. An alarm circuit according to claim 1 wherein said horizontal and vertical window pulse forming means each comprise:

a first differentiating network;

a first half wave rectifier;

15 a first monostable multivibrator;

a second differentiating network;

a second half wave rectifier; and

a second monostable multivibrator, the above being serially connected in the order named.

6. An alarm circuit according to claim 5 wherein said first and second monostable multivibrators include a variable resistance to control the pulse width generated.

7. An alarm circuit according to claim 6 wherein said variable resistance means are two rotatable potentiometers ganged to directly track one another.

8. An alarm circuit according to claim 6 wherein said variable resistance means are two rotatable potentiometers ganged to track one another in an inverse relationship.

9. An alarm circuit according to claim 6 wherein said variable resistance means are two push-pull potentiometers coupled to a joy stick control whereby the potentiometers may be varied in direct, inverse or independent relationships.

10. An alarm circuit according to claim 1 wherein: said AND gate includes a plurality of pairs of inputs;

a like plurality of said horizontal window pulse forming circuits all having a common input; and

a like plurality of said vertical window pulse forming circuits all having a common input, the output of each of said window pulse forming circuits being connected to a different one of said inputs to said AND gate.

* * * * *

50

55

60

65