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Takahashi

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[54] **PATTERN DISCRIMINATION SYSTEM USING TELEVISION**

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[52] **U.S. Cl.** **178/6.8,** 178/DIG. 33, 178/DIG. 38

[51] **Int. Cl.** **H04n 7/18**

[58] **Field of Search** ..... 178/6.8, DIG. 33, DIG. 38, 178/DIG. 1, DIG. 37

[56] **References Cited**

UNITED STATES PATENTS

2,244,826	10/1941	Cox	178/DIG. 1
3,562,423	2/1971	Murphy	178/DIG. 38
3,603,729	9/1971	Sperber	178/DIG. 38
3,732,366	5/1973	Bolie	178/DIG. 33
3,743,768	7/1973	Copland	178/DIG. 38
3,781,468	12/1973	Chomet	178/6.8

Primary Examiner—Howard W. Britton

Attorney, Agent, or Firm—Stevens, Davis, Miller & Mosher

[57] **ABSTRACT**

A pattern discrimination system for automatic and rapid detection of occurrences of an abnormal condition in a pattern under surveillance comprising the means and steps of producing at least one horizontal gate pulse and vertical gate pulse of any required width and position by utilizing the television art, sampling a video signal with the horizontal and vertical gate pulses to form at least one sample surface variable in position, size or shape thereof in the field of view of a monitor, producing an integrated value of voltage of a video signal corresponding to the sample surface of the pattern under surveillance, digitally storing the integrated value of voltage of the video signal in a digital memory, and producing another integrated value of voltage of the video signal corresponding to said sample surface of the pattern under surveillance after a lapse of a predetermined time interval and comparing the second integrated value of voltage with the integrated value of voltage stored previously.

2 Claims, 8 Drawing Figures

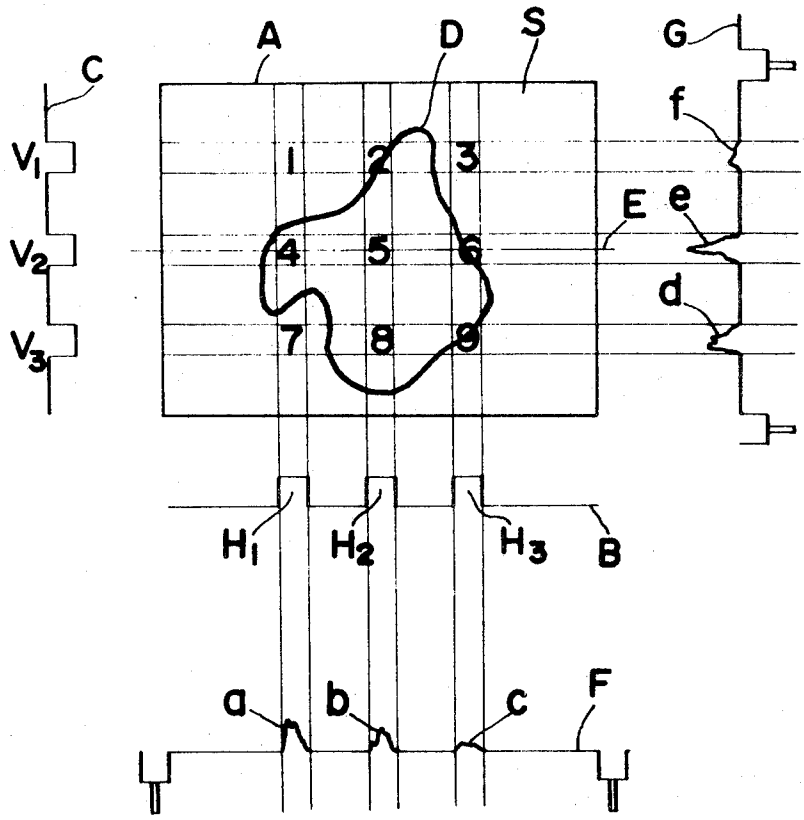
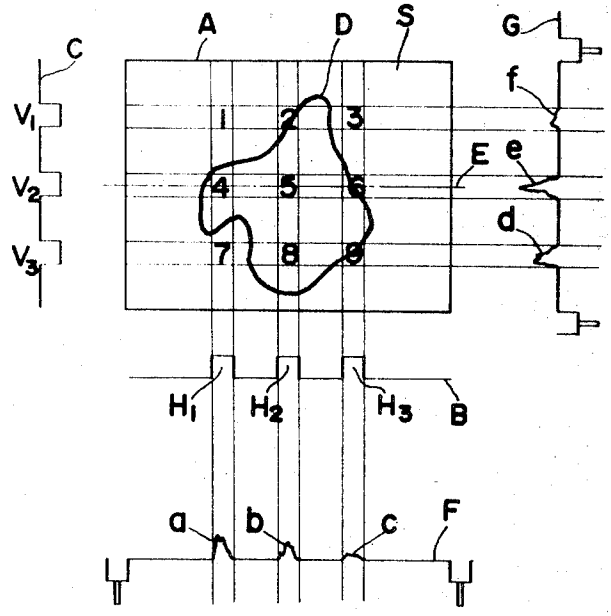


FIG. 1



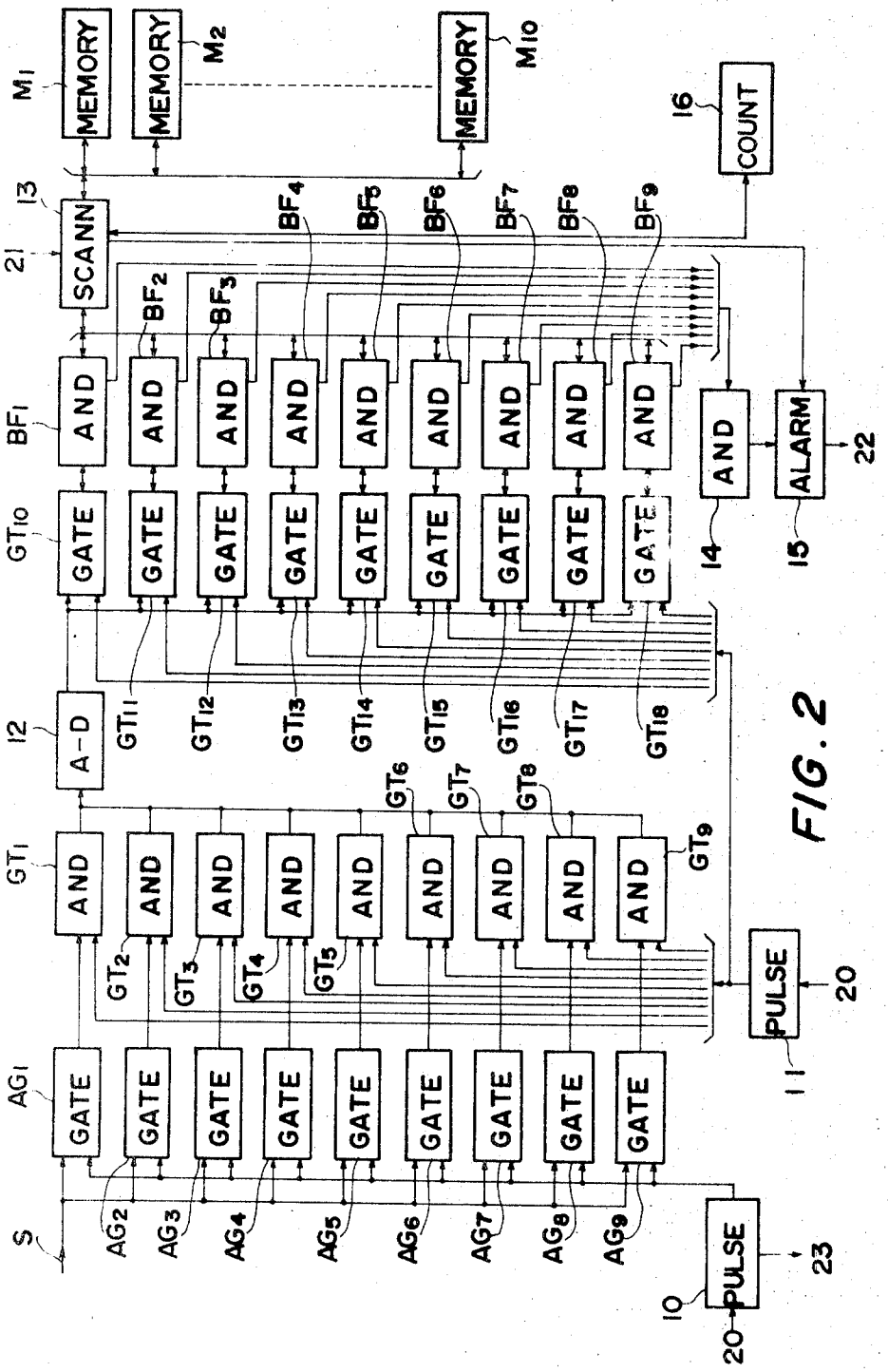

MEMORY
M1
M2
M10
16
COUNT
13
SCANN
21
BF1
BF2
BF3
BF4
BF5
BF6
BF7
BF8
BF9
AND
GATE
GT10
GT11
GT12
GT13
GT14
GT15
GT16
GT17
GT18
14
15
ALARM
22
12
A-D
GT1
GT2
GT3
GT4
GT5
GT6
GT7
GT8
GT9
PULSE
20
11
AG1
AG2
AG3
AG4
AG5
AG6
AG7
AG8
AG9
S
10
23

FIG. 2

FIG. 3A

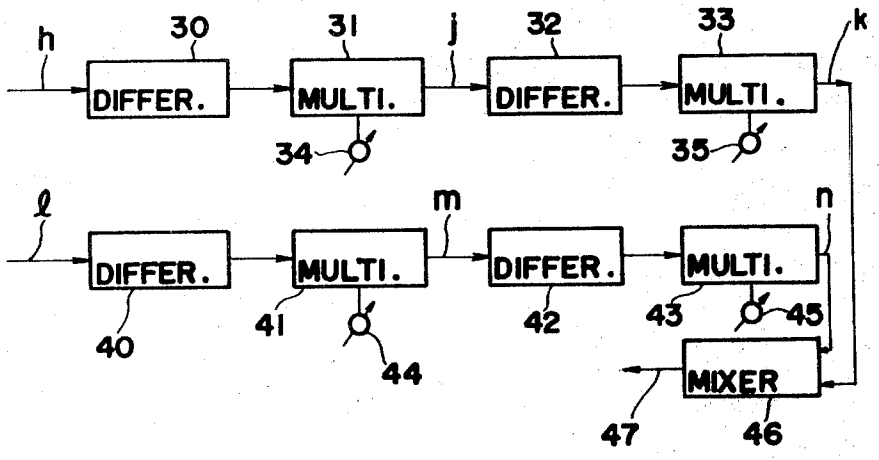

h
30
DIFFER.
31
MULTI.
34
j
32
DIFFER.
33
MULTI.
35
k
ℓ
DIFFER.
40
MULTI.
41
44
m
DIFFER.
42
MULTI.
43
45
n
MIXER
47
46

FIG. 3B

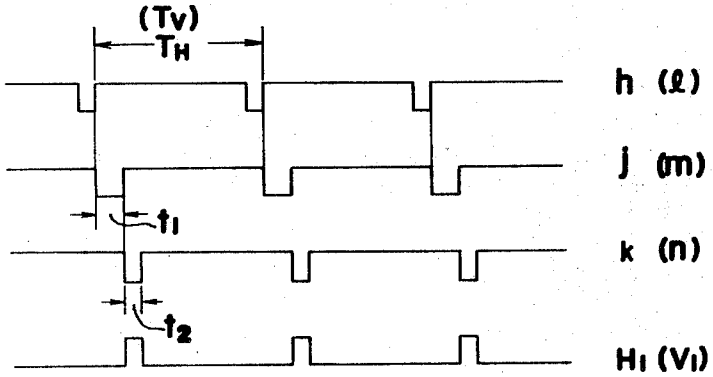

(Tv)
TH
h (ℓ)
j (m)
t1
k (n)
t2
H1 (V1)

FIG. 4

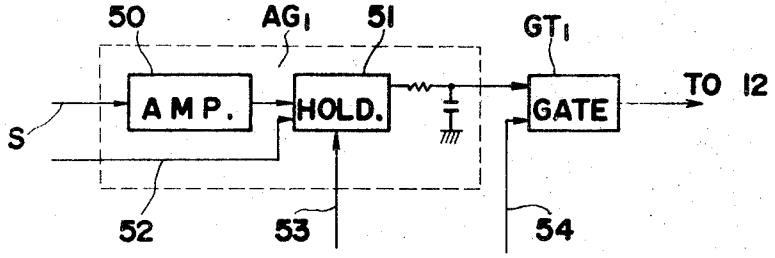


FIG. 5

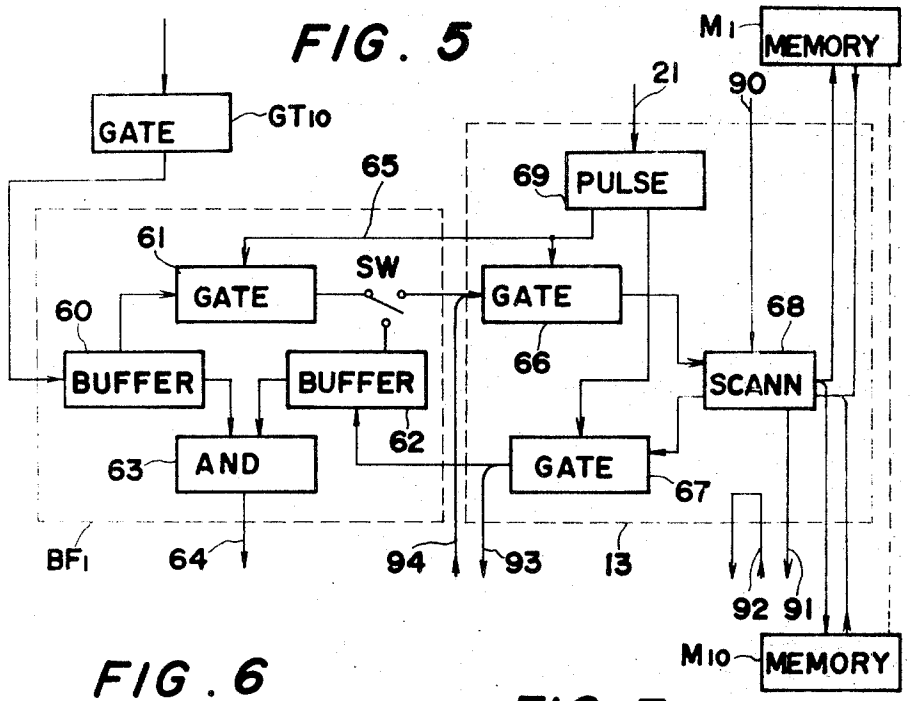


FIG. 6

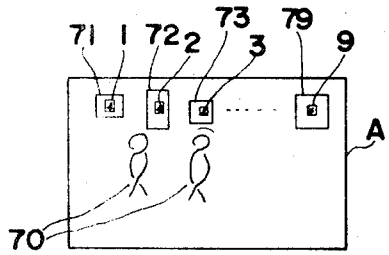
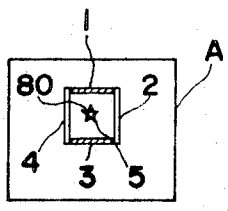


FIG. 7



PATTERN DISCRIMINATION SYSTEM USING TELEVISION

This invention relates to improvements in pattern discrimination systems using the television art.

The practice of using a television system comprising at least one television camera and at least one minitor for keeping watch on various conditions (for protecting safes, detecting unwarranted intruders, keeping vigil against burglars, detecting fires and effecting control of traffic conditions, for example) has in recent years become very popular. However, this system has the disadvantage that an operator is required to watch one or more monitors at all times. It is a strain on the operator to constantly watch, particularly at night, a plurality of minitors and this entails an increase in the number of operators required for this task and hence a rise in personal expenses.

To solve this problem, proposals have been made to employ a surveillance apparatus which uses a television system and produces an alarm only when an abnormal condition is detected. By this arrangement, it is possible to save labor because the operator has to look at a minitor only when an alarm is given for an accident or to take a picture or keep a record on a video tape recorder of the abnormal condition upon production of a signal indicating the trouble without requiring the operator.

Generally, the use of a digital system for discrimination of information on a pattern under surveillance entails the use of an enormous number of bits for covering every nook and corner of the pattern. At the present status of art, the surveillance apparatus of the type described uses very expensive video discs, memories and other components. Thus, full realization of advantages from use of the surveillance apparatus of the type described has been hampered by inability to produce an apparatus which is low in cost and reliable in performance. In addition to being uneconomincal, the use of a digital system designed to compare video signals for the whole pattern has an additional disadvantage in that fatal trouble occurs when comparison of information on the pattern is effected with respect to the entire field of view of the monitor as subsequently to be described.

The present invention obviates the aforementioned disadvantages of the prior art. Accordingly, the invention has as its object the provision of a pattern discrimination system using a television system wherein a number of horizontal gate pulses and vertical gate pulses corresponding to portions of a pattern to be sampled are produced. A video signal of the pattern produced by a television camera is sampled by the horizontal and vertical gate pulses in order to produce a signal or signals representing a sample portion or portions of the pattern, voltage or voltages of an integrated value of said signal or integrated values of said signals for one field being supplied to a digital memory as a piece of information for the pattern under surveillance, and such piece of information for the one pattern under surveillance being compared with the information of the pattern stored in the digital memory, so that pattern discrimination can be effected rapidly and automatically.

One feature of the invention lies in the fact that comparison of information is made not between video signals for the whole pattern under surveillance but between components of the video signals for discrete portions of the pattern under surveillance of any size, shape, position and number obtained by sampling. The integrated value of the voltage for one field period for each of these discrete portions or sample surfaces is compared with the corresponding integrated value of the voltage for one field which is obtained earlier at a predetermined time interval and stored in the digital memory.

The reasons why the aforementioned specific portion or portions of the field of view of the television camera which may be of any number, size, shape and position are used as sample surfaces are as follows: If the pattern discrimination system used as a burglar-proof device for the paintings shown in FIG. 6, for example, is designed to cover the entire field of view of the television camera or the minitor, the movement of a person in the field of view would be detected by the system as an abnormal condition even if the paintings are not involved in an accident. If a sample surface or surfaces of suitable number, shape, size and position are selected which consists of relevant portions of the paintings, the aforementioned disadvantage could be obviated and the accident involving the paintings could only be detected as an abnormal condition. The gate pulses produced correspond in position, size, shape and number to the sample surfaces on the field of view of the monitor.

When optical images of a pattern illuminated by a light source are converted into electric signals by a television camera, the intensity of illumination may undergo a gradual change caused by a change in weather or the light source and such change may be detected as an abnormal condition in the pattern discrimination system according to this invention. However, this can be obviated by replacing at regular intervals the information stored in the memory by new information. Replacements of the stored information also have the effect of preventing the system from passing the judgement of the existence of an abnormal condition by error due to drift which may be encountered in the television circuit.

The pattern discrimination system according to this invention also permits the number of objects passing through the field of view of the monitor to be determined by counting the number of occurrences of the abnormal conditions in the sample surfaces obtained in comparison with the normal conditions stored in the digital memory.

Additional and other objects, as well as features and advantages of the invention, will become evident from the description set forth hereinafter when considered in conjunction with the accompanying drawings, in which:

FIG. 1 shows the basic concept of the present invention, showing a pattern and sample surfaces thereof, and vertical and horizontal gate pulses in relation to a video signal;

FIG. 2 is a block diagram of an apparatus used for carrying out the system according to this invention into practice;

FIG. 3A is a diagrammatic representation of one form of the vertical and horizontal gate pulse producing circuit used in the system according to this invention;

FIG. 3B shows the vertical and horizontal gate pulses;

FIG. 4 shows one form of the video signal amplifying, integrating and gating circuit used in the system according to this invention;

FIG. 5 shows one form of the buffer and AND circuit and the scanner used in the system according to this invention; and

FIGS. 6 and 7 show examples of the system according to this invention.

The basic concept of the present invention will be described with reference to FIG. 1. When optical images of a pattern D are converted into electric signals by means of a television camera, the pattern D appears in a field of view A of a monitor. B designates horizontal gate pulses and C, vertical gate pulses. If a video signal S which corresponds to the monitor field of view A is sampled by the horizontal gate pulses and vertical gate pulses, a signal or signals corresponding in number to the sample surfaces of pattern D can be produced. Each of the signals representing the sample surfaces of pattern D may, for example, be integrated for one field period.

The sample surfaces, **1, 2, . . . 9** appearing in the monitor field of view A shown in FIG. 1 correspond to the signals produced by sampling the video signal of the pattern D by the horizontal gate pulses and vertical gate pulses B and C. In actual practice, outputs of a gate pulse generator **10** shown in FIG. 2, adapted to produce horizontal gate pulses with vertical gate pulses, are taken out through a line **23** and mixed with the video signal S, so that the sample surfaces **1, 2, . . 9** are superimposed on the pattern D in the monitor field of view A and can be seen as shown in FIG. 1 with respect to their position, size, shape and number. This facilitates setting of the position, size, shape and number of the sample surfaces.

The image actually seen in the monitor field of view A as shown in FIG. 1 consists of the sample surfaces **1, 2, . . . 9** and the pattern D. Other portions shown in FIG. 1 are inserted in FIG. 1 merely for the sake of convenience to enable the invention to be clearly understood and are not actually visible in the monitor field of view A.

Production of gate pulses will be described with reference to FIGS. 3A and 3B. In FIG. 3A, *h* designates horizontal drive pulses. **30** designates a differentiation circuit which differentiates each of the pulses *h* and triggers a one-shot multivibrator **31** by a differentiated pulse corresponding to the trailing edge of the pulse *h* as shown in FIG. 3B to cause the latter to produce a pulse *j*. The pulse width t_1 may be varied by a variable resistor **34.**

The pulse j is differentiated by differentiation circuit **32,** and a one-shot multivibrator **33** is triggered by a differentiated pulse corresponding to the trailing edge of pulse *j* and caused to produce a pulse *k*. The pulse width t_2 may be varied by a variable resistor **35.**

Gate pulses H_1 are reversed in form with respect to pulses *k* and correspond to the horizontal gate pulses H_1 shown in FIG. **1.** The horizontal drive pulses *h* shown in FIG. 3B have a horizontal scanning period of T_H corresponding to the width of the monitor field of view A.

It will be seen that the horizontal position of gate pulses H_1 can be changed by varying pulse width t_1 by means of variable resistor **34** and that the width of gate pulses H_1 can be changed by varying pulse width t_2 by means of variable resistor **35.** This also applies to the vertical gate pulses. In FIG. 3A, **40** and **42** are differentiation circuits, **41** and **43** are one-shot multivibrators, and **44** and **45** are variable resistors capable of adjusting the width of vertical gate pulses. I designates vertical drive pulses. The gate pulses V_1 shown in FIG. **1** can be produced by inverting pulses *n* shown in FIG. **3B.** Pulses *m* shown in FIG. 3B are produced by one-shot multivibrator **41.**

Gate pulses *k* and *n* are of reversed polarity and are mixed by a polarity reversing and mixer circuit **46** to produce gate pulses H_1 and V_1 shown in FIG. 1 which are taken out through a terminal **47.** The sample surface **1** shown in FIG. **1** is formed by a pair of one horizontal gate pulse and one vertical gate pulse H_1 and V_1. Thus, it will be appreciated that the sample surface **1** may be disposed in any position and may have any shape and size as desired in the monitor field of view A.

The gate pulse generator **10** shown in FIG. **2** comprises circuits for producing the abovementioned gate pulses which may be in any number as required. In the embodiment shown and described, there are provided six gate pulse producing circuits for H_1, H_2, H_3 and V_1, V_2, V_3 which are combined with one another for V_1H_1, V_1H_2, V_1H_3, V_2H_1, V_2H_2, V_2H_3, V_3H_1, V_3H_2 and V_3H_3 which correspond to nine sample surfaces **1, 2, . . . 9.** Gate pulse V_1, for example, is concerned with the simultaneous formation of sample surfaces **1, 2** and **3,** so that a variation in the position and width of gate pulse V_1 simultaneously affects sample surfaces **1, 2** and **3.** Thus, if it is desired to cause a variation to occur in each of the sample surfaces independently of one another, it would be necessary to provide eighteen gate pulse producing circuits.

There are a number of gate pulse producing systems which can be used in this invention. The gate pulse producing system used in this embodiment is one which uses one-shot multivibrators to produce nine sample surfaces.

A video signal corresponding to a line E in the monitor field of view A is indicated by F in FIG. **1.** Signals on sample surfaces **4, 5** and **6** have wave forms *a, b* and *c* in video signal F respectively. In a video signal G, *d* is a composite signal for sample surfaces **7, 8** and **9,** *e* is a composite signal for sample surfaces **4, 5** and **6** and *f* is a composite signal for sample surfaces **1, 2** and **3.** Thus, it is possible to take out the component of a video signal corresponding to the sample surface **1** by using gate pulses V_1, H_1, the component of the video signal corresponding to the sample surface **2** by using gate pulses V_1, H_2, and so on so that the components of the video signal corresponding to sample surfaces **3** to **9** can be taken out by using gate pulses V_1, H_3 to V_3, H_3.

FIG. **2** shows one form of the apparatus used for carrying out the system according to this invention into practice. The video signal S is supplied to video signal amplifying, integrating and gating circuits AG_1 to AG_9. On the other hand, gate pulses V_1H_1, V_1H_2, V_1H_3, V_2H_1, V_2H_2, V_2H_3, V_3H_1, V_3H_2 and V_3H_3 are taken out from the gate pulse generator **10** described with reference to FIG. **3A** and supplied to circuits AG_1 to AG_9.

FIG. **4** shows one of the video signal amplifying, integrating and gating circuits shown in FIG. **2.** Video signal S is supplied to a video signal amplifier circuit **50** and amplified thereby. The amplified video signal is introduced into a sampling and holding circuit **51** per-

forming the operation of integration to which the aforementioned gate pulses H_1, V_1 are supplied through a line **52**, so that the portion of the video signal S corresponding to the sample surface **1** is sampled. More specifically, the integrated value of the voltage for one field period corresponding to the sample surface **1** is produced and stored as a signal for the sample surface **1**. At the same time, circuit **51** is reset after a lapse of one field period by a reset pulse produced by a blanking signal supplied through a line **53**. Thus, circuit **51** is ready for integrating the next following input thereto.

In this way, the video signal S supplied to video signal amplifying, integrating and gating circuits AG_1 to AG_9 is amplified and sampled so that the integrated values of the voltages for one field period corresponding to sample surfaces **1** to **9** are produced and stored while the gating circuits are reset by reset pulses after the lapse of one field period. This cycle of operation is repeated. GT_1 in FIG. **4** is the same gate GT_1 shown in FIG. **2**, and **54** designates a line through which a clock pulse is supplied to the gate GT_1.

Thus, the integrated value of the voltage for one field period corresponding to the video signal for the sample surface **1** shown in FIG. **1** is stored in the video signal amplifying, integrating and gating circuit AG_1 shown in FIG. **2**. In like manner, the integrated values of the voltages for one field period corresponding to the video signal for sample surfaces **2** to **9** shown in FIG. **1** are stored in the video signal amplifying, integrating and gating circuits AG_2 to AG_9 respectively. Gate pulse generator **10** is connected through a line **20** to a synchronizing signal generator (not shown) so that the gate pulses may be produced in synchronism with the video signal S.

The output signal voltages of circuits AG_1 to AG_9 are supplied to gates GT_1 to GT_9 respectively. Gates GT_1 to GT_9 successively effect gating upon receiving a supply of clock pulses from a clock pulse generator **11**, and the outputs of gates GT_1 to GT_9 are successively converted into digital values by an analogue-to-digital converter **12**. At the same time, gates GT_{10} to GT_{18} are successively made to effect gating by clock pulses supplied from clock pulse generator **11** to transmit the output of gate GT_{10} to a buffer and AND circuit BF_1. It will be appreciated that the outputs of integrating and gating circuits AG_2 to AG_9 are successively transmitted through gates GT_2 to GT_9, A–D converter **12** and gates GT_{11} to GT_{18} to buffer and AND circuits BF_2 to BF_9, respectively.

Clock pulse generator **11** shown in FIG. **2** is connected through line **20** to the synchronizing signal generator (not shown) so that the transmission of the outputs of gates GT_1 to GT_9 may be in synchronism with the video signal S. The nine output signal voltages of integrating and gating circuits AG_1 to AG_9 are successively converted into digital quantities within about **1** millisecond in each vertical blanking period by the analogue-to-digital converter **12**.

In this embodiment, the output of analogue-to-digital converter **12** is set at a digital quantity represented by three bits by considering economy and also because this arrangement suits the purpose for which the invention is intended. It is to be understood that the invention is not limited to this digital quantity and that a digital quantity represented by a greater number of bits may be used in this invention. The analogue-to-digital converter **12** used in this embodiment is of the successive operation type. It is also to be understood that the invention is not limited to this type and that nine analogue-to-digital converters may be used and arranged in parallel with one another.

The operation of buffer and AND circuits BF_1 to BF_9 will be described with reference to circuit BF_1 shown in FIG. **5** which comprises a first buffer **60** and a second buffer **62** (which are buffers of three bits as aforementioned), an AND circuit **63** for checking on the digital quantity stored in the two buffers, and a gate circuit **61**.

The digital quantity obtained from the output of circuit AG_1 by analogue-to-digital converter **12** is invariably stored in the first buffer **60** initially. As aforementioned, new digital quantities are stored one after another in the first buffer **60** each for one field period. For example, if a memory command signal **21** is supplied from outside to a scanner **13**, then the digital quantity stored in the first buffer **60** is transferred by the gating action of gate **61** which is operated by a pulse producing circuit **69** through a line **65** to the second buffer **62**. At this time the movable contact of a switch SW is in contact with the lower fixed contact shown. The digital quantity stored in the second buffer **62** shows no change unless the memory command signal **21** is supplied thereto. Thus, the buffer and AND circuit BF_1 is, in the absence of the memory command signal **21**, in a collation mode in which a fresh digital quantity introduced into the first buffer **60** is examined and compared with the digital quantity stored in the second buffer **62** by the AND circuit **63** whose output is taken out through a line **64**.

Other buffer and AND circuits BF_2 to BF_9 function in the same manner as described with reference to circuit BF_1. The outputs of the buffer and AND circuit BF_1 to BF_9 are supplied to an AND circuit **14** as shown in FIG. **2**.

One example of examining and comparing a new digital quantity with the digital quantity stored in the second buffer **62** will be described with reference to FIG. **6**. This example is an application of the invention in a burglar-proof device adapted for use with paintings exhibited in a gallery. In the figure, A designates a field of view of the monitor as shown at A in FIG. **1**. Paintings **71** to **79** and men **70**, **70** correspond to the pattern D shown in FIG. **1**. The paintings **71** to **79** and men **70**, **70** are used as nine sample surfaces corresponding to the nine sample surfaces shown in FIG. **1**. This device is intended to detect the theft of any one of the paintings concerned without detecting the movement of men in the gallery.

When there is no abnormal condition involving any one of the nine paintings, the components of a video signal of normal value corresponding to the nine sample surfaces are supplied to video signal amplifying, integrating and gating circuits AG_1 to AG_9, passed successively through gates GT_1 to GT_9 respectively by clock pulses supplied successively from clock pulse generator **11**, and converted into digital quantities by analogue-to-digital converter **12** which are stored in the first buffers **60** in buffer and AND circuits BF_1 to BF_9 respectively.

If a memory command signal is supplied to the scanner **13**, each gate **61** of each buffer and AND circuit performs a gating operation so as to transfer the digital

quantity stored in the first buffer **60** of each buffer and AND circuit to the second buffer **62** thereof.

If no other memory command signal is supplied to the scanner **13** after one digital quantity transfer operation is performed, then a new digital quantity supplied as an input to each of the first buffers **60** is examined and compared with the digital quantity stored previously in each of the corresponding second buffers **62,** and the results are transferred from all the circuits BF_1 to BF_9 to the AND circuit **14.** The outputs of the AND circuits of the buffer and AND circuits BF_1 to BF_9 will indicate agreement of the compared digital quantities and the output of the AND circuit **14** will also indicate agreement of the compared digital quantities, so that an alarm circuit **15** is not actuated.

Assuming that the painting **71** shown in FIG. **6** is stolen, a change will occur in the component of the video signal corresponding to the sample surface **1.** Thus, the digital quantity supplied to the first buffer **60** in the buffer and AND circuit BF_1 after the theft has taken place will vary from the digital quantity stored in the second buffer **62** therein. As a result, a disagreement signal will be produced by the AND circuit **63** and the AND circuit **14** will also produce a disagreement signal, so that the alarm circuit **15** is actuated to give warning of the theft.

An alarm signal produced by the alarm circuit **15** and taken out through a line **22** shown in FIG. **2** to the outside may be supplied to a photographic camera or a video tape recorder to keep a record of the scene of the crime. Alternatively, the line **22** for taking out the alarm signal to the outside may be connected to an apparatus to transmit the alarm signal through communication lines to a remote place.

It is possible to obtain the number of objects that have moved in the field of view of the monitor by counting the number of alarm signals produced by the alarm circuit. Also, it is possible to obtain the number of alarms given for each sample surface by counting the outputs of each AND circuit of buffer and AND circuits BF_1 to BF_9.

Another example of application of this invention is shown in FIG. **7.** As shown, the invention is directed to a burglar-proof device for a jewel **80** placed in a showcase. A designates the showcase which corresponds to the field of view of the monitor, **1, 2, 3, 4** and **5** designate sample surfaces, the sample surfaces **1,2, 3** and **4** surrounding the jewel **80** while the sample surface **5** is set on the jewel **80.**

In case the pattern under surveillance is illuminated by a light, such as one supplied through a household power supply outlet, whose intensity of illumination remains constant at all times, only one memory command signal **21** may be supplied at the beginning of the operation to store initial digital quantities in the second buffers **62** in buffer and AND circuits BF_1 to BF_5 and digital quantities successively produced thereafter may be compared with the initially stored digital quantities. If, however, the pattern under surveillance is disposed out of doors and subjected to illumination which gradually varies in intensity, or if the circuits of the television camera used are not stable in performance and the signal voltages produced vary gradually with time, false alarms will be produced by changes in the signal voltages of sample surfaces due to changes in the intensity of illumination to which the pattern is subjected or to the instability of the television camera circuits, even if no abnormal condition is produced in the pattern. This problem is obviated in the present invention by using a timer, for example, which is operative to produce a plurality of memory command signals at intervals of, say, 5 minutes and to supply the same to the scanner **13.** By this arrangement, the digital quantities stored in the second buffers **62** in all the buffer and AND circuits each can be replaced by a new digital quantity at intervals of 5 minutes.

If there is no appreciable change in the intensity of illumination in 5 minutes, there will be no change between the stored information on the pattern and the information on the pattern obtained five minutes later; therefore, no alarm is produced. Thus, it is possible to eliminate the likelihood of false alarms which might otherwise be produced by changes in the digital quantities of the sample surfaces of the pattern caused not by the abnormal conditions occurring in the pattern but by changes in extraneous conditions not involving the pattern.

The embodiment shown and described above concerns the application of the invention in cases where one pattern is placed under surveillance at a time in an effort to detect the occurrence of abnormal conditions in it. The invention is not limited to this embodiment and can have application in cases where a plurality of patterns are placed under surveillance at a time to detect the occurrences of the abnormal condition in them by storing the reference information in a plurality of memories.

In these cases, one television camera with a pantilt head may be used or a plurality of television cameras may be utilized for converting the optical image of a plurality of different patterns into electric signals. This application will be described with reference to FIG. **5.** The movable contact of the switch SW shown in the figure is brought into contact with an upper fixed contact to connect gate **61** to a gate **66.** If a signal is supplied through a line **90** to a scanner circuit **68** in scanner **13,** then the scanner circuit **68** selects any one of memories M_1 to M_{10}.

Assuming that an optical image of a first image is converted into an electric signal and memory M_1 is selected, a gate pulse will be produced by pulse generator **69** and transmitted through line **65** to gates **61** and **66** if a memory command signal **21** is supplied to scanner **13.** This permits the digital quantities of the sample surfaces to be passed on from the first buffer to the memory M_1 through the scanner circuit **68** to be stored therein. The outputs of buffer and AND circuits BF_2 to BF_9 are taken out through a line **94.**

The digital quantity corresponding to each sample surface is represented by three bits, so that it is possible to store in a memory the digital quantity corresponding to one pattern by using 27 bits altogether since one pattern comprises nine sample surfaces. This is conducive to reducing the cost of production of the memories.

When the information on a second pattern is stored in a memory, a signal is supplied through line **90** to the scanner circuit **68** to connect the same to memory M_2, so that the information on the second pattern is stored in memory M_2 in like manner. The information on the next following patterns is stored successively in the same manner till the information on a tenth pattern is stored in memory M_{10}.

Upon completion of storing of the information on the tenth pattern in memory M_{10}, the apparatus is placed

in a collation mode till another memory command signal **21** is supplied to scanner **13.** Now, if the optical image of the first pattern is converted into an electric signal again and memory M_1 is selected by the scanner circuit **68** in scanner **13,** the information in memory M_1 will be returned through a gate **67** in the scanner **13** to the second buffer **62** in the first buffer and AND circuit BF_1. Gate **67** is open in the absence of a memory command signal **21** to permit the information stored in a memory M_1 to be returned to the second buffer **62** in a buffer and AND circuit. A line **93** from the gate **67** in the scanner **13** is one through which information is transferred to the second buffers **62** in buffer and AND circuits BF_2 to BF_9.

All the information represented by twenty-seven bits in memory M_1 is transferred to the second buffers **62** in buffer and AND circuits BF_1 to BF_9 in this way and compared with the information stored in the first buffers **60** therein.

Then, if the optical image of the second pattern is converted into an electric signal again and memory M_2 is selected by the scanner circuit **68,** the information stored in the second buffers **62** in the buffer and AND circuits BF_1 to BF_9 is replaced by the information stored in memory M_2 and compared with the new information supplied to the first buffers **60** therein.

The optical images of the third to tenth patterns are successively converted into electric signals which are processed in the same manner as aforementioned so as to compare the patterns with one another at regular intervals. The AND circuit **14** is actuated in the same manner when ten patterns are placed under surveillance as when one pattern is placed under surveillance.

Another application of the invention presently to be described also involves a sort of pattern discrimination. In this application, the information on 10 different patterns may, for example, be stored in 10 memories M_1 to M_{10} respectively, and the information on the pattern D shown in FIG. **1** may be stored in memory M_1, for example. A television camera may selectively convert the optical image of any one of a plurality of patterns including the pattern D as desired into an electric signal to compare the information on the selected pattern with the information stored in any one of the memories M_1 to M_{10}.

If scanner **13** is made to scan memories M_1 to M_{10} at high speed and the information stored therein is compared with the information on the pattern D while the television camera is converting the optical image of the pattern D into an electric signal, a coincidence signal should be produced when memory M_1 is scanned. The coincidence signal is produced by the alarm circuit **15** shown in FIG. **2** and indication is given at the same time that the memory whose information coincides with the information on the pattern being surveyed is memory M_1. A line **91** shown in FIG. **5** is one through which an output signal of the scanner **13** is transmitted to a counter **16** to cause the latter to indicate that the memory sought is memory M_1. A line **92** shown in FIG. **5** is one through which an output signal of counter **16** is transmitted to the alarm circuit **15** to give an alarm that the memory sought is memory M_1.

All the embodiments of the invention shown and described hereinabove involve the use of the monochrome television camera or cameras and the processing of the video signal S produced by converting the optical image of the pattern D into electric signals. It is to be understood, however, that the invention is not limited to these embodiments and that the invention can have application in cases where the pattern D is in color and a color television camera is used to effect pattern discrimination based on colors. If the optical image of the pattern D is converted into an electric signal by using a color television camera when the pattern D is colored, three video signals for red, green and blue colors respectively will be produced in place of one video signal which is the case when a monochrome television camera is used. It will thus be necessary to use three sets of the apparatus shown in FIG. **2** and to supply each of the red, green and blue video signals to the input terminal of one of these three apparatus, and it will be possible to effect pattern discrimination in color.

Discrimination of a pattern represented in one or more colors may be effected by using the apparatus shown in FIG. **2** which may agree in number with the number of color or colors of the pattern.

Discrimination of a color pattern can be effected based on a color characteristic of the pattern by using a monochrome television camera. In this case, various types of color filters are inserted in the television camera and the color of the pattern which is characteristic thereof is only converted into an electric signal for processing.

What is claimed is:

1. A pattern discrimination method for automatic and rapid detection of occurrences of an abnormal condition in a plurality of patterns under surveillance comprising the steps of producing a number of horizontal gate pulses and vertical gate pulses of any width and position as required by utilizing the television art, forming in the field of view of a monitor one or more sample surfaces variable in position, size and shape thereof by sampling by using said horizontal gate pulses and vertical gate pulses, converting optical images of the patterns under surveillance into electric signals by means of at least one television camera, producing and storing separately in a plurality of memories a plurality of sets of integrated values of voltages of video signal components corresponding to said one or more sample surfaces of the patterns under surveillance, and producing further plurality of sets of integrated values of voltages of video signal components corresponding to said one or more sample surfaces of the patterns under surveillance and comparing said further plurality of sets of integrated values of voltages with the plurality of sets of integrated values of voltages stored separately in the memories.

2. A pattern discriminating apparatus for automatic detection of occurrences of an abnormal condition in a pattern under surveillance, comprising:

generating means for generating horizontal and vertical gate pulses;

sampling means for sequentially sampling first and second portions of a video signal corresponding to a predetermined portion of the field of view of a television camera with said horizontal and vertical gate pulses;

integrating means for integrating the sampled video signal portions;

converting means for converting the integrated video signal portions into first and second series of corresponding digital pulses;

digital memory means for storing said first series of digital pulses therein;

comparing means for comparing said stored digital pulses with said second series of digital pulses;

indicator signal means for producing a signal when said stored series of pulses and said second series of pulses compared in said comparing means differ by a predetermined amount;

a plurality of AND gates, each having one input connected to an output of said sampling means;

a gate pulse generator connected to a second input of each of said AND gates, said gate pulse generator generating a plurality of pairs of vertical and horizontal gate pulses, one pair of gate pulses being supplied to a corresponding one of said AND gates through said second input thereof;

means applying outputs of said AND gates sequentially to said integrating means;

means applying outputs of said integrating means in a corresponding sequence to a corresponding plurality of digital memory means and comparing means; and

means applying outputs of said plurality of comparing means to said indicator signal means.

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