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(54) **SIZE DISCRIMINATING DUAL ELEMENT PIR DETECTOR**

GRÖSSENUNTERSCHEIDENDER DOPPELELEMENT-PIR-DETEKTOR

DETECTEUR INFRAROUGE PASSIF COMPORTANT DEUX ELEMENTS ET ETABLISSANT UNE DISTINCTION DE TAILLE

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to detectors for alarm systems, and in particular relates to detectors useful in discriminating between small pets and intruders.

BACKGROUND OF THE INVENTION

[0002] There are a host of different intruder alarm detection systems now on the market and many of these alarm systems are remotely monitored. In such systems, the detection of an alarm condition typically results in the alarm being reported to the police. Unfortunately, false alarms are a nuisance to the police forces and take them away from other important matters. One source of false alarms is caused by pets, and in particular small domestic pets. Screening of the lower ground level of the area being monitored is a common practice to reduce false alarms from pets, however, this approach is not effective for some small pets that have a tendency to climb. Domestic cats can cause problems for security systems.

[0003] United States Patent 4,849,635 uses a specialized lens to try to distinguish between a small pet and an intruder, using a single sensor. This is difficult to achieve over a large monitored area.

[0004] United States Patent 4,752,769 discloses an infrared motion alarm using a lens arrangement in combination with a mirror arrangement. The mirror arrangement is designed to detect radiation from an intruder attempting to crawl through the monitored area.

[0005] European application 624857A1 discloses an infrared passive type object detection system which seeks to distinguish between humans and pets. The system uses a first detector having a lens for monitoring regions with a limited height characteristic appropriate for pets. A second detector having a lens monitoring regions with a height characteristic appropriate for humans. The signals from the sensors are processed to make an assessment of whether a human or pet have been detected. In some embodiments the monitored regions overlap.

[0006] This system seeks to size the responsive regions, such that a human intruder, due to the larger size, will produce a much larger signal which can be distinguished from the signal produced by a pet. Responses from the sensors are added and subtracted to improve the distinction between intruder types. This is necessary as the distance from the sensor greatly influences the signal response.

[0007] The present invention seeks to overcome the problems of false alarms caused by small, domestic pets in a simple cost effective manner.

SUMMARY OF THE INVENTION

[0008] An infrared intrusion detector, according to the present invention, comprises a housing having two PIR receiver arrangements with each PIR receiver arrangement including a lens arrangement which focuses IR radiation from predetermined zones within a space to be monitored onto a IR sensor. The IR sensor produces a signal based on received IR radiation. The intrusion detector has a signal processing means connected to the sensors which processes the signals and evaluates the signals. The signal processing means produces an alarm signal when necessary based on the evaluation of the signals. The lens arrangements defining two sets of alternating active zones where one set of active zones is associated with one PIR arrangement and the second set of active zones is associated with the other PIR arrangement. The adjacent active zones are spearated by a nonresponsive zone which reduces the response from a ground level region associated with infrared radiation from radiation sources of the size of a small domestic pet.

[0009] According to an aspect of the invention, the zones alternate in a vertical direction.

[0010] According to a further aspect of the invention, the first and second sets of active zones alternate in a verticaldirection and additionally alternate horizontally producing nonresponsive zones therebetween at ground level within about forty feet of the detector.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Preferred embodiments of the invention are shown in the drawings, wherein:

Figure 1 is a schematic of an infrared intrusion detector;

Figure 2 is a schematic showing the beams of the detector;

Figure 3 is a top view showing various beams of the bottom passive infrared receiver arrangement of the detector;

Figure 4 is a side view showing various beams associated with the bottom passive infrared receiver arrangement; and

Figure 5 is a front view of a flexible lens arrangement.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0012] A dual element passive infrared detector 2 is shown in Figure 1. The detector 2 has a housing 3 containing an upper PIR receiver arrangement 4 and a low-

er PIR receiver arrangement 6. The upper PIR receiver arrangement has a lens 8 which focuses selective infrared radiation from an area to be monitored 51 onto a sensor 10. The lower PIR receiver arrangement 6 also has a lens 14 which selectively focuses infrared radiation onto the sensor 16. An example of the combined lenses 8 and 10 is shown in Figure 5.

[0013] The housing 3 has a back wall 5 for mounting to a wall of a premise at a raised position. Each of the sensors 10 and 16 are tilted forwardly approximately 6° to look downwardly. The signals from the sensors 10 and 16 are evaluated by the processor 12. An alarm signal is produced at 24 if the evaluation indicates an alarm condition.

[0014] Figure 2 shows how the upper lens 8 and the lower lens 14 cooperate for monitoring of the area 51. The passive infrared detector 2 is shown mounted on a wall or similar structure at an elevation of approximately 7½ feet from the floor. The lens arrangement is looking forward and monitors the space 51. The distance grid along ground level is shown and it can be seen that two series of active zones 30 and 32 which alternate and are separated by a series of nonactive zones 34. The nonactive zones progressively narrow between active zones in a direction back towards the sensor. Zone 30 defines a response region where infrared radiation within the region is focused by the lens arrangement onto sensor 16. Infrared radiation within beams 32 is focused onto sensor 10. Infrared radiation in the nonactive zone is not focused on a sensor. The area from about five to forty feet from the base of the detector at ground level, is covered by the alternating series of zones 30 and 32. It can also be seen that the zones within about twenty-five feet of the sensor are relatively narrow and the nonactive zones define a considerable region, particularly within about two feet of ground level. With this spacing of the beams, a small pet, such as a domestic cat, is of a size less than approximately two feet in height and cannot cause sufficient infrared radiation to be received by both of the sensors 10 and 16 to produce an alarm. For example, a cat at twenty feet could be exposed to the beam 32 of the upper sensor 10, but the cat at ground level is not of sufficient size to also cause a high response in the active zone positioned at about fifteen feet where radiation will be focused on the sensor 16. It can also be seen that the active zones tend to diverge, however, there is still considerable spacing of the beams between two and three feet above ground level. The spacing between the active zones above the two foot level narrows, rendering this region more responsive to infrared radiation sources. In this way, the detector provides vertical discrimination.

[0015] The alternating zones 30 and 32 separated by the progressively narrowing nonactive zones produce vertical discrimination where the sensor within about twenty-five feet of the sensor is able to distinguish small domestic pets at ground level from larger and taller human intruders. Basically, the region within two feet of ground level and within twenty-five feet of the sensor is less responsive than a corresponding area above this two foot level. Small domestic pets have a large percentage of their volume normally in this lower region and false alarms from small domestic pets is reduced.

[0016] It can be seen that beyond approximately twenty-five feet, due to the divergence of the beams, the dead zone 34 between adjacent beams is becoming smaller. Fortunately, the amount of radiation received from a small domestic cat at these distances also decreases as a function of the distance. For this reason, the detector is not responsive to such a small infrared body, but would be responsive in a distance from six to approximately twenty feet if the upwardly narrowing nonactive zones were not present.

[0017] Figure 3 also illustrates how a pattern of zones is used to cover the space 51 being monitored. As shown in the sectional view of Figure 4, there is a distant set of zones, generally indicated as 53, two intermediate sets of zones, indicated as 55 and 57, and a close series of zones 59. The exact position of these zones is determined by the Fresnel lens shown in Figure 5. The lens 40 of Figure 5 has an upper section 42 and a lower section 44. Each of the sections 42 and 44 are divided horizontally and vertically to cover different areas of the region, and thus, define the alternating active zones separated by the narrowing nonactive zones.

[0018] A review of Figures 2 and 4 show how the response area of each zone 30 or 32 narrows as the distance from the detector decreases. This takes into account the higher levels of IR radiation received as the distance from the detector decreases.

[0019] The passive infrared detector has been described with respect to the benefits in discriminating small, domestic pets from human intruders. Cats have previously posed considerable problems, as they can climb and even though they are relatively small, they can enter an area substantially above ground level, resulting in the detector receiving a relatively high level of infrared radiation and resulting in an alarm condition. With the present invention, the area immediately adjacent the detector should be kept free of chairs or other objects which would allow a cat to establish itself at a high point in front of the detector. If the cat is at a low level, such as ground level or below about 2½ feet, it will cause considerable radiation to be received by one sensor, but the cat is not of sufficient size to cause a similar result in the other sensor. In contrast, a human intruder, due to the much greater size and height, will cause a high response in each sensor, causing an alarm to be produced.

[0020] The signals from the sensors 10 and 16 can be evaluated in a number of different ways. In the preferred form, each signal is evaluated at different amplitude levels and processed as described in U.S. Patent 5,444,432. In this case, each signal is evaluated separately and an alarm signal is produced when both signals exceed a standard. Basically, the lens arrangement

has rendered the area below two feet and within twenty-five feet of the detector less sensitive than a corresponding area above the two foot level. Other systems have tried to identify infrared radiation from pets and in contrast, the present invention reduces the possibility of receiving sufficient radiation from pets to cause an alarm.

[0021] A simple approach for evaluating the signals from the two sensors is to merely add the two results and then compare this result with a predetermined threshold. A small domestic animal, such as a cat, does not produce a response of sufficient magnitude in each sensor to cause it to exceed the alarm threshold. In contrast, an intruder, due to its size and normal vertical orientation, produces sufficient IR radiation to be immediately detected. This arrangement provides a simple approach for discriminating between different sizes of radiation sources. It has also been found that pets, such as dogs, of average size can also be discriminated in this way. It can be appreciated that the detector can also easily be adjusted for a particular application, if desired, by providing a variable threshold. In this case, depending upon the particular animals, thresholds can be set such that the animal does not cause an alarm while still being sensitive to a human intruder. A person can easily check this merely by setting the detector for the particular pet and then testing the system by entering the space himself and noting when a detection is made or using other test specimens, such as children. This arrangement provides a very efficient manner for size discrimination of moving IR radiation sources while still providing effective coverage of the space being monitored from unwanted intruders.

Claims

1. An infrared intrusion detector (2) comprising a housing having two PIR receiver arrangements (4, 6), each PIR receiver arrangement including a lens arrangement (8, 14) which focuses IR radiation from predetermined active zones (53, 55, 57, 59) within a space to be monitored onto a IR sensor (10, 16) which produces a signal based on received IR radiation, said intrusion detector having a signal processing means (12) connected to said sensors (10, 16) which processes the signals and evaluates the signals and produces an alarm signal (24) when necessary based on the evaluation of the signals, said lens arrangements (8, 14) defining two sets of alternating active zones where one set of active zones (30) is associated with one PIR arrangement and the second set of active zones (32) is associated with the other PIR arrangement and wherein adjacent active zones (30, 32) are separated by a nonresponsive zone (34) which reduces the response from a ground level region associated with infrared radiation from radiation sources of the size of a small domestic pet.

2. A detector (2) as claimed in claim 1 wherein said zones alternate in a vertical direction.

3. A detector (2) as claimed in claim 2 wherein said first and second sets of active zones (30, 32) additionally alternate horizontally and have nonresponsive zones (34) therebetween at ground level within about forty feet of the detector.

4. A detector (2) as claimed in claim 1 wherein within about twenty feet of said detector (2) said sets of active zones (30, 32) are separated by nonresponsive zones (34) and beyond about twenty-five feet and at a height of about four feet said sets of active zones (30, 32) overlap.

5. A detector (2) as claimed in claim 2 wherein said sets of active zones (30, 32) also alternate in a horizontal direction.

6. A detector (2) as claimed in claim 1 wherein said nonresponsive zones (34) between ground level and two feet and within twenty-five feet of the detector (2) are large relative to a corresponding nonresponsive zone (34) above the two foot level.

7. An infrared intrusion detector (2) as claimed in claim 1 wherein said active zones (53, 55, 57, 59) are vertically separated with nonresponsive zones (34) therebetween, said vertically separated active zones and said nonresponsive zones (34) being arranged such that at ground level a domestic cat located anywhere between six and twenty feet from the detector (2) has insufficient effect on adjacent active zones (53, 55, 57, 59) to have IR radiation therefrom and received by said two PIR receiver arrangements (4, 6) to satisfy a minimum value indicating an intruder is present.

8. A passive IR detector (2) as claimed in claim 7 wherein said active and nonresponsive zones are sized such that a cat at ground level and within twenty-five feet of the detector has insufficient overlap between two adjacent active zones such that said PIR receiver arrangements (4, 6) receive IR radiation from the cat at a level which is insufficient to produce an alarm signal (24).

Patentansprüche

1. Ein Infrarot-Eindringlingsdetektor (2), der aus einem Gehäuse, das zwei PIR-Empfängermontagen (4, 6) enthält, besteht, wobei jede PIR-Empfängermontage eine Linsenmontage enthält (8, 14), die die IR-Strahlung aus vorbestimmten aktiven Zonen (53, 55, 57, 59) in einem zu überwachenden Raum in einem IR-Sensor (10, 16) bündelt, wodurch ein

der empfangenen IR-Strahlung entsprechendes Signal erzeugt wird, wobei der o. g. Eindringlingsdetektor ein mit den o. g. Sensoren (10, 16) assoziiertes Signalverarbeitungsmittel (12) hat, das die Signale bearbeitet und auswertet und nach Bedarf ein der Signalauswertung entsprechendes Alarmsignal (24) erzeugt, wobei die o. g. Linsenmontagen (8, 14) zwei Sätze von alternierenden aktiven Zonen definieren, von denen ein Satz aktiver Zonen (30) mit einer PIR-Montage assoziiert ist, aber der zweite Satz alternierender Zonen (32) mit der anderen PIR-Montage assoziiert ist und benachbarte aktive Zonen durch eine nicht-ansprechende Zone (34) getrennt sind, wodurch die Ansprechung auf bodennahe Infrarotstrahlung von Strahlungsquellen in der Größe von kleinen Haustieren verringert wird.

2. Ein Detektor (2), wie in Anspruch 1 beansprucht, wobei die Zonen senkrecht alternieren.

3. Ein Detektor (2), wie in Anspruch 2 beansprucht, wobei die ersten und zweiten aktiven Zonensätze (30, 32) waagrecht alternieren und nicht-ansprechende Zonen in Bodennähe innerhalb von 12 m Abstand vom Detektor sich dazwischen befinden.

4. Ein Detektor (2), wie in Anspruch 1 beansprucht, wobei innerhalb von 7,5 m Abstand von diesem Detektor (2) die o. g. aktiven Zonensätze (30, 32) von nicht-ansprechenden Zonen (34) getrennt sind und nach ungefähr 7,5 m und einer Höhe von 1,25 m diese aktiven Zonensätze (30, 32) sich gegenseitig überschneiden.

5. Ein Detektor (2), wie in Anspruch 2 beansprucht, wobei die o. g. aktiven Zonensätze (30, 32) auch in waagrechter Richtung alternieren.

6. Ein Detektor (2), wie in Anspruch 1 beansprucht, wobei die o. g. nicht-ansprechenden Zonen (34) zwischen dem Boden und 60 cm Höhe innerhalb von 7,5 m vom Detektor (2) im Verhältnis zu den entsprechenden nicht-ansprechenden Zonen (14) über dem 60 cm Niveau größer sind.

7. Ein Infrarot-Eindringlingsdetektor (2), wie in Anspruch 1 beansprucht, wobei die o. g. aktiven Zonen (53, 55, 57, 59) durch nicht-ansprechende Zonen (34) voneinander senkrecht getrennt sind und diese senkrechten aktiven Zonen sowie die.nicht-ansprechende Zonen (34) so angeordnet sind, daß eine Hauskatze, die sich irgendwo zwischen 1,8 m und 7,5 m vom Detektor (2) entfernt befindet, nicht ausreichende Einwirkung auf die naheliegenden aktiven Zonen (53, 55, 57, 59) hat und daß ihre IR-Strahlung, wie sie von den beiden PIR-Empfängermontagen (4, 5) aufgenommen wird, dem Mindestwert nicht genügt, der die Anwesenheit eines Eindringlings anzeigt.

8. Ein passiver IR-Detektor (2), wie in Anspruch 7 beansprucht, wobei aktive und nicht-ansprechende Zonen so groß sind, daß eine bodennahe Katze innerhalb von 7,5 m vom Detektor zwei nebeneinander liegende aktive Zonen unzureichend unterbricht und daß die o. g. PIR-Empfängermontagen (4, 6) von der Katze nur IR-Strahlung empfangen, die nicht ausreicht, um ein Alarmsignal zu erzeugen (24).

Revendications

1. Un détecteur d'intrusion infrarouge (2), comportant un bâti avec deux récepteurs PIR (4, 6), où chaque récepteur PIR comprend un objectif (8, 14) qui fait converger le rayonnement IR de zones actives prédéterminées (53, 55, 57, 59) à l'intérieur d'un espace surveillé sur un capteur IR (10, 16), qui produit un signal en fonction du rayonnement IR reçu, ledit détecteur d'intrusion étant muni d'un dispositif de traitement de signal (12) raccordé aux capteurs (10, 16) qui traite et évalue les signaux et produit un signal d'alarme (24) au besoin selon l'évaluation des signaux, lesdits objectifs (8, 14) définissant deux jeux de zones actives alternantes, où un jeu de zones actives (30) est associé à un récepteur PIR et l'autre jeu de zones actives (32) est associé à l'autre récepteur PIR et où les zones actives adjacentes (30, 32) sont séparées par une zone non sensible (34) qui réduit la réponse d'un secteur au niveau du sol associée au rayonnement infrarouge de sources de rayonnement de la taille d'un petit animal.

2. Un détecteur (2) selon la revendication 1, **caractérisé en ce que** lesdites zones alternent dans une direction verticale.

3. Un détecteur (2) selon la revendication 2, **caractérisé en ce que** lesdits premier et deuxième jeux de zones actives (30, 32) alternent en plus horizontalement, ayant des zones non sensibles (34) entre elles au niveau du sol à moins d'environ quarante pieds du détecteur.

4. Un détecteur (2) selon la revendication 1, **caractérisé en ce que** lesdits jeux de zones actives (30, 32), à moins d'environ vingt pieds dudit détecteur (2), sont séparés par des zones non sensibles (34), et qu'au-delà d'environ vingt-cinq pieds et à une hauteur d'environ quatre pieds, lesdits jeux de zones actives (30, 32) se chevauchent.

5. Un détecteur (2) selon la revendication 2, **caractérisé en ce que** lesdits jeux de zones actives (30, 32) alternent en plus horizontalement.

6. Un détecteur (2) selon la revendication 1, **caractérisé en ce que** lesdites zones non sensibles (34) entre le niveau du sol et deux pieds et à moins de vingt-cinq pieds du détecteur (2) sont grandes relativement à une zone non sensible correspondante (34) au-dessus du niveau de deux pieds.

7. Un détecteur d'intrusion infrarouge (2) selon la revendication 1, **caractérisé en ce que** lesdites zones actives (53, 55, 57, 59) sont séparées verticalement par des zones non sensibles (34), lesdites zones actives séparées verticalement et lesdites zones non sensibles (34) étant agencées de manière qu'au niveau du sol un chat situé à n'importe quel point entre six et vingt pieds du détecteur (2) ait un effet insuffisant sur les zones actives adjacentes (53, 55, 57, 59) pour entraîner la réception du rayonnement IR par lesdits récepteurs PIR (4, 6) et satisfaire une valeur minimale indiquant la présence d'un intrus.

8. Un détecteur IR passif (2) selon la revendication 7, **caractérisé en ce que** lesdites zones actives et non sensibles sont dimensionnées de manière qu'un chat au niveau du sol et à moins de vingt-cinq pieds du détecteur produise un chevauchement insuffisant entre deux zones actives adjacentes de manière que lesdits récepteurs PIR (4, 6) reçoivent un rayonnement IR du chat à un niveau qui ne suffit pas à produire un signal d'alarme (24).

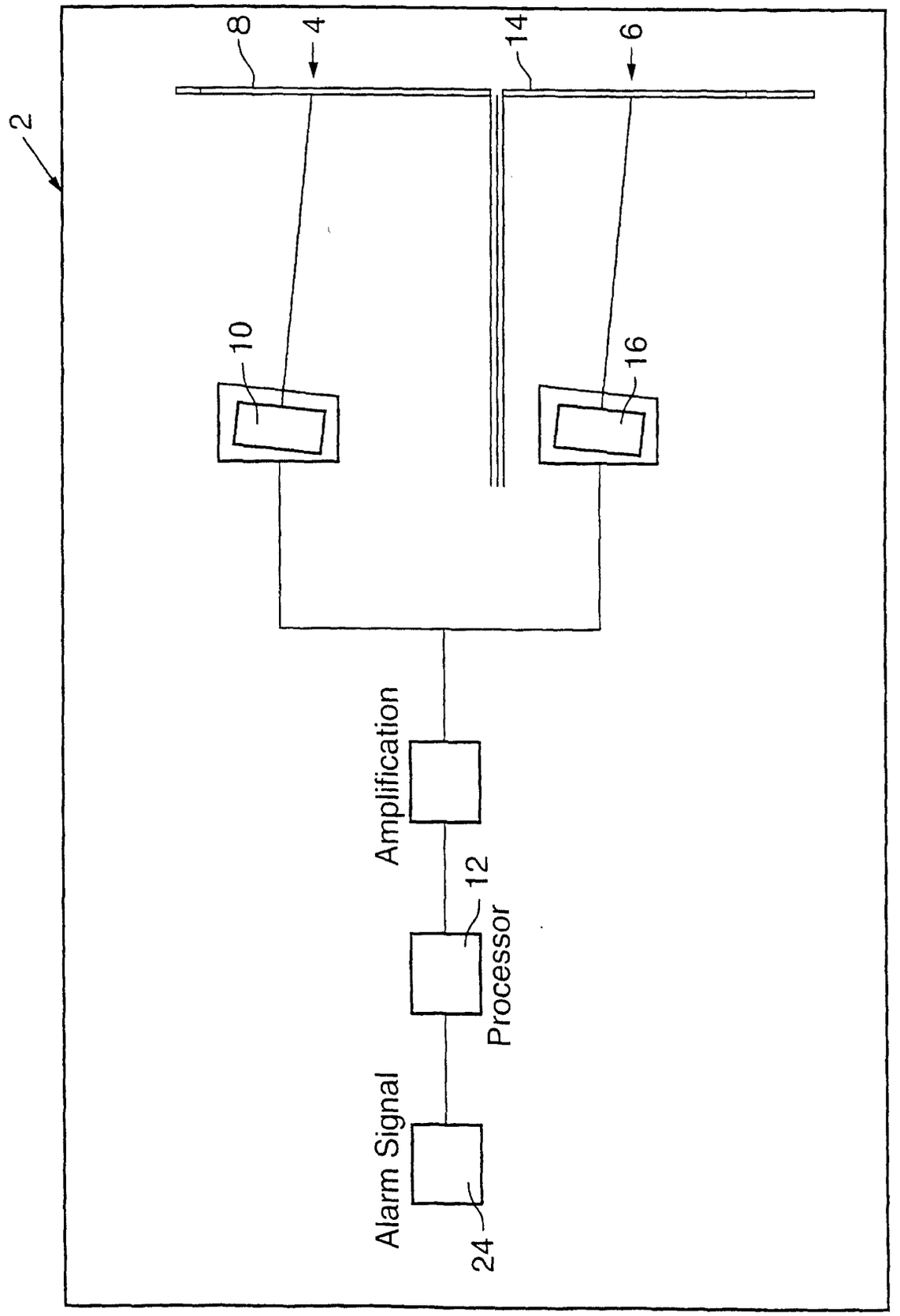


FIG.1

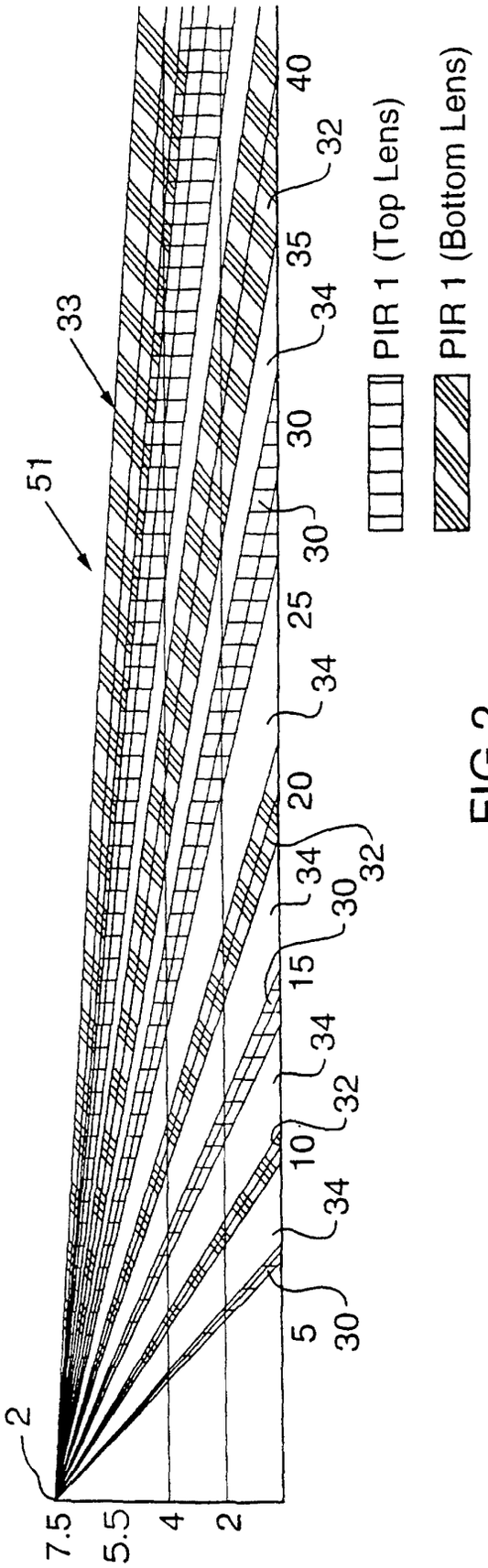

PIR 1 (Top Lens)
PIR 1 (Bottom Lens)
2
7.5
5.5
4
2
5
10
15
20
25
30
35
40
30
30
30
32
32
32
34
34
34
34
34
51
33

FIG.2

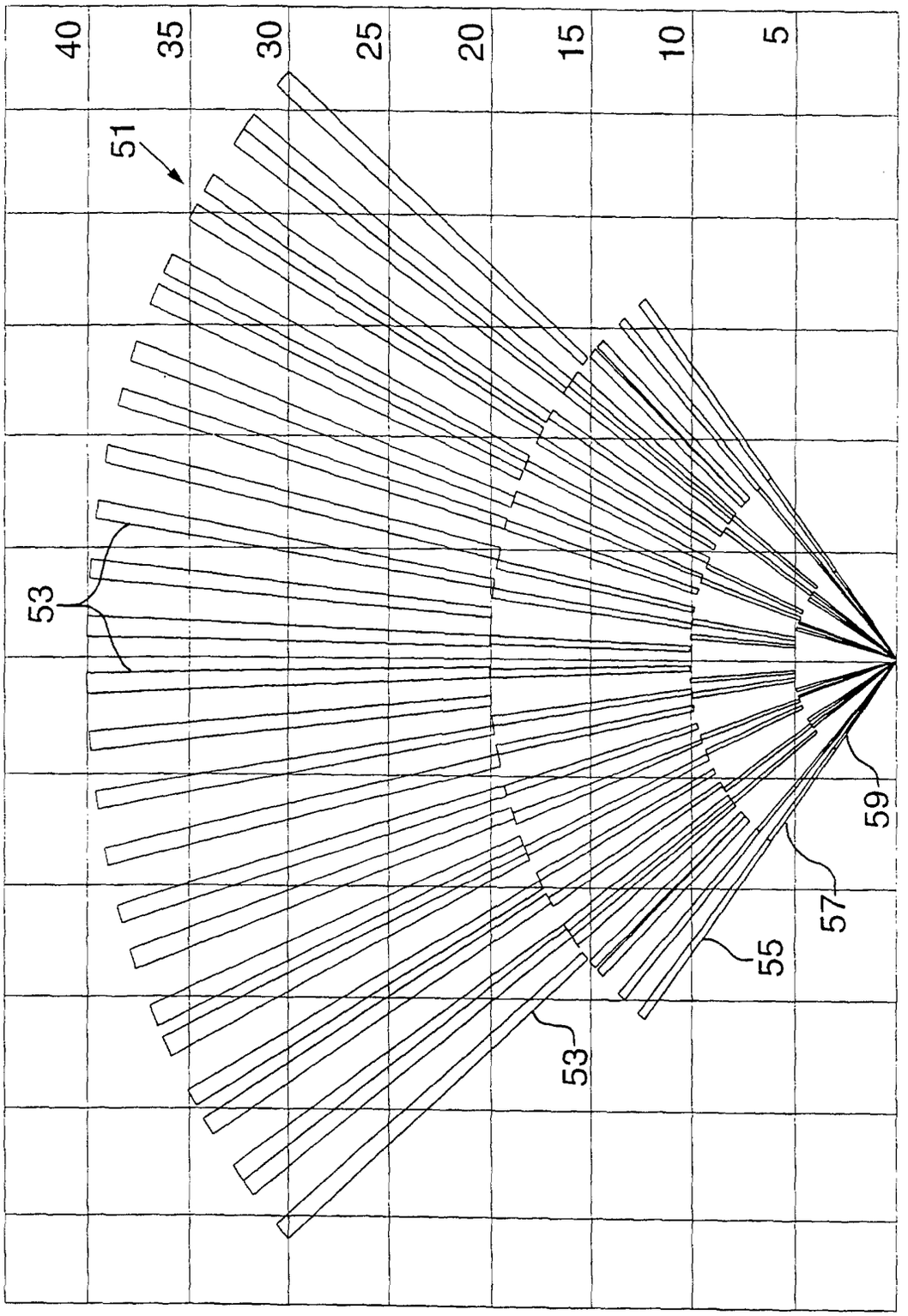


FIG.3

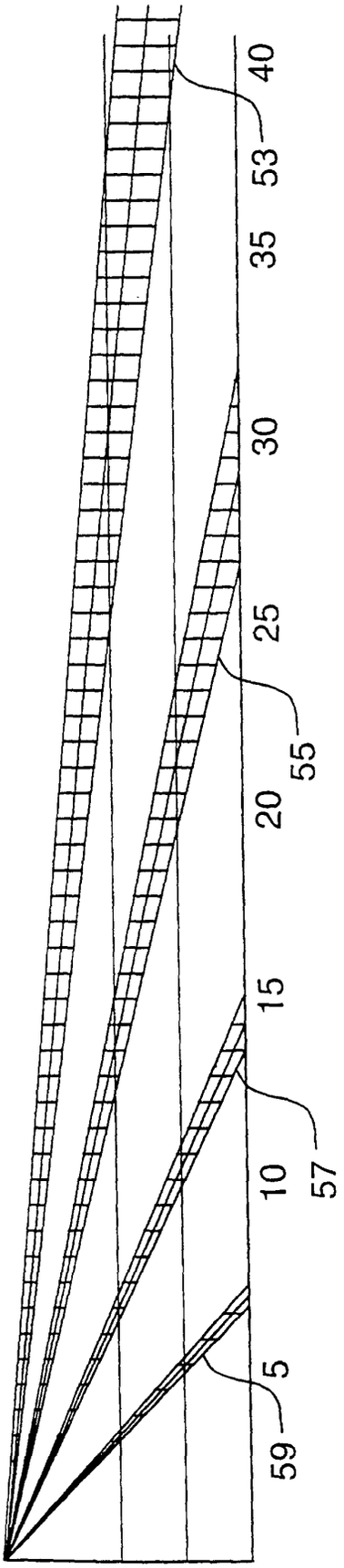


FIG.4

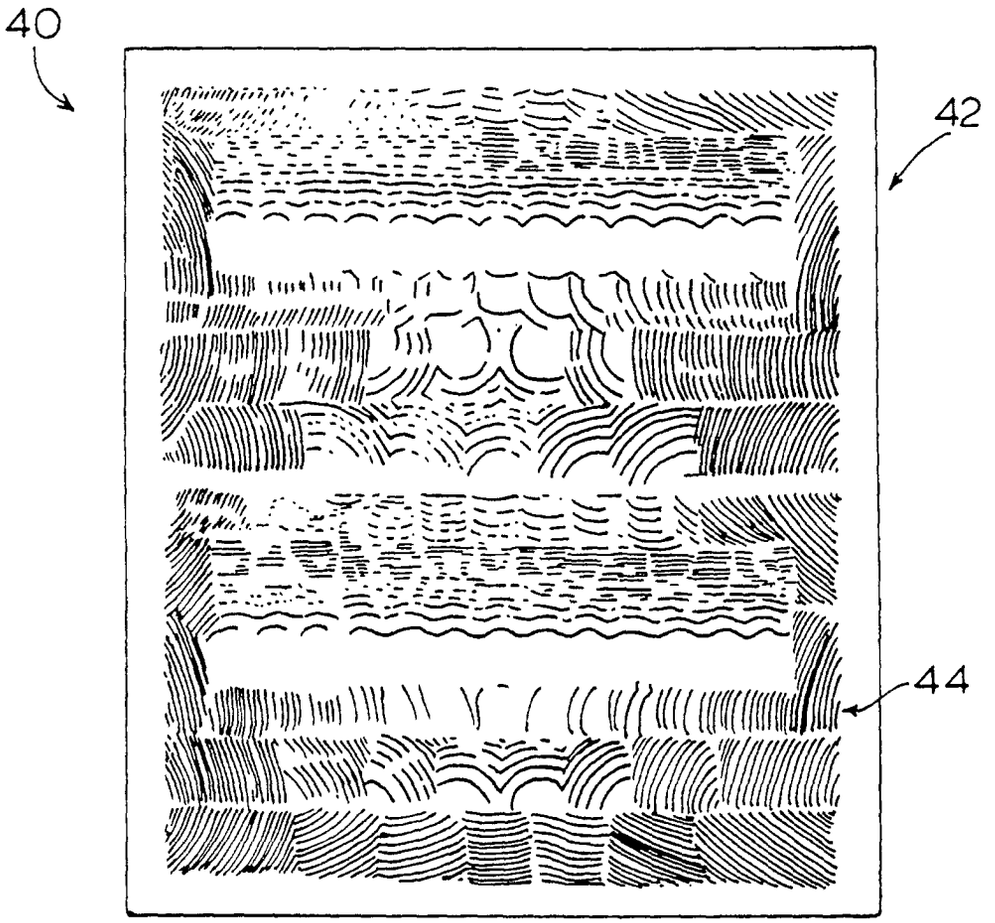


FIG.5