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(54) **COMPOSITE SENSOR FOR DOOR AND AUTOMATIC DOOR SYSTEM**

(75) Inventors: **Shigeaki Sasaki**, Kobe (JP); **Kenji Nishigaki**, Kobe (JP); **Yasutaka Kanda**, Kobe (JP)

(73) Assignee: **Nabtesco Corporation**, Kobe, Hyogo-ken (JP)

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H02P 1/00 (2006.01)

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(58) **Field of Classification Search** 318/282, 318/286, 466, 468, 467; 49/26, 28; 340/545.1, 340/545.2, 545.3
See application file for complete search history.

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Primary Examiner—Rina I Duda
(74) *Attorney, Agent, or Firm*—Duane Morris LLP

(57) **ABSTRACT**

A first area (**16**) for detecting an object is formed by a radio wave or an ultrasonic wave, and a second area (**18**) for detecting an object by means of light is formed near the first area (**16**). When an object is detected in the first area (**16**) approaching the second area (**18**), the second area (**18**) is enabled. When an object is detected in the first area (**16**) moving in the direction away from the second area (**18**), the second area (**18**) is disabled.

7 Claims, 7 Drawing Sheets

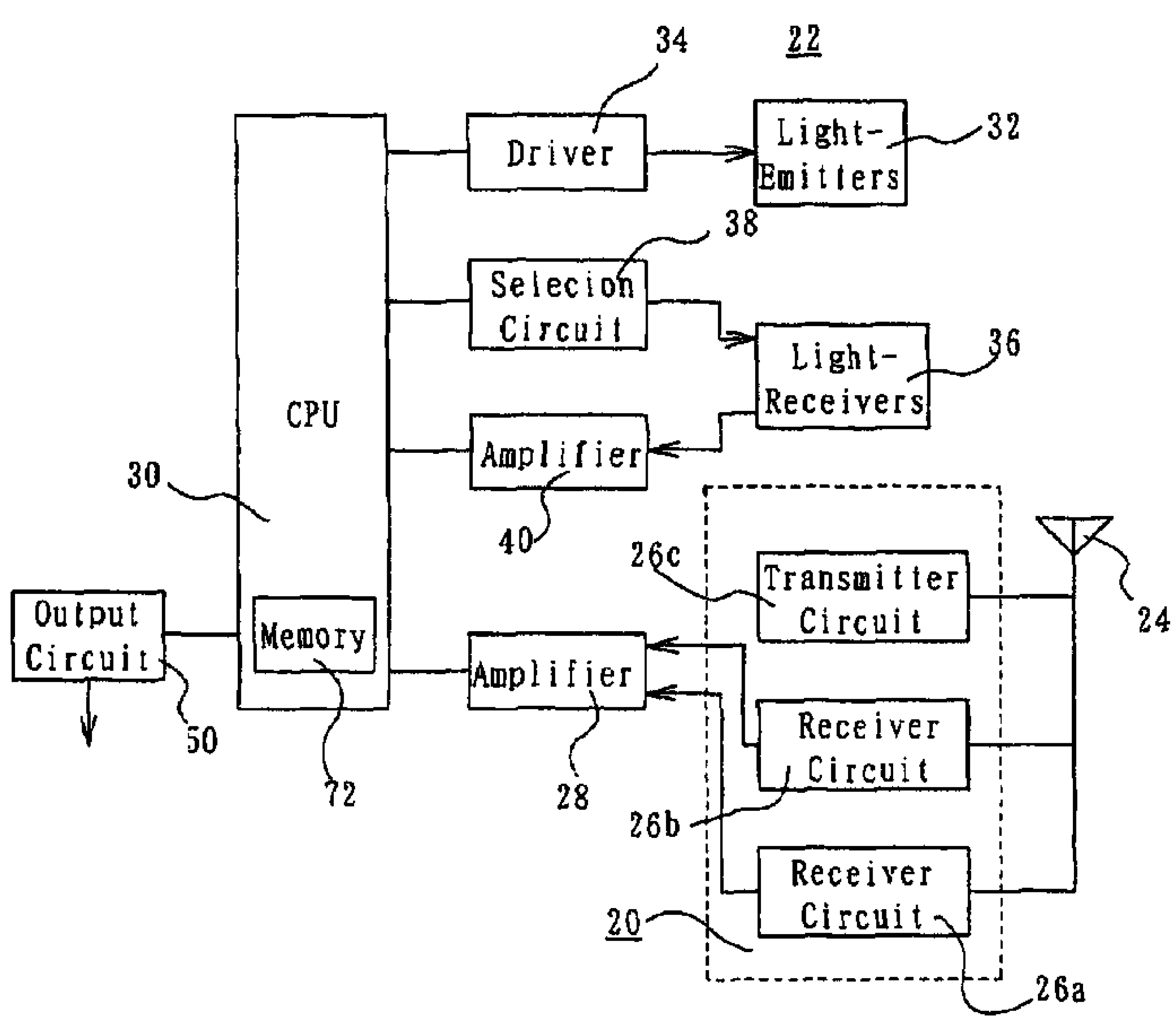


Fig. 1

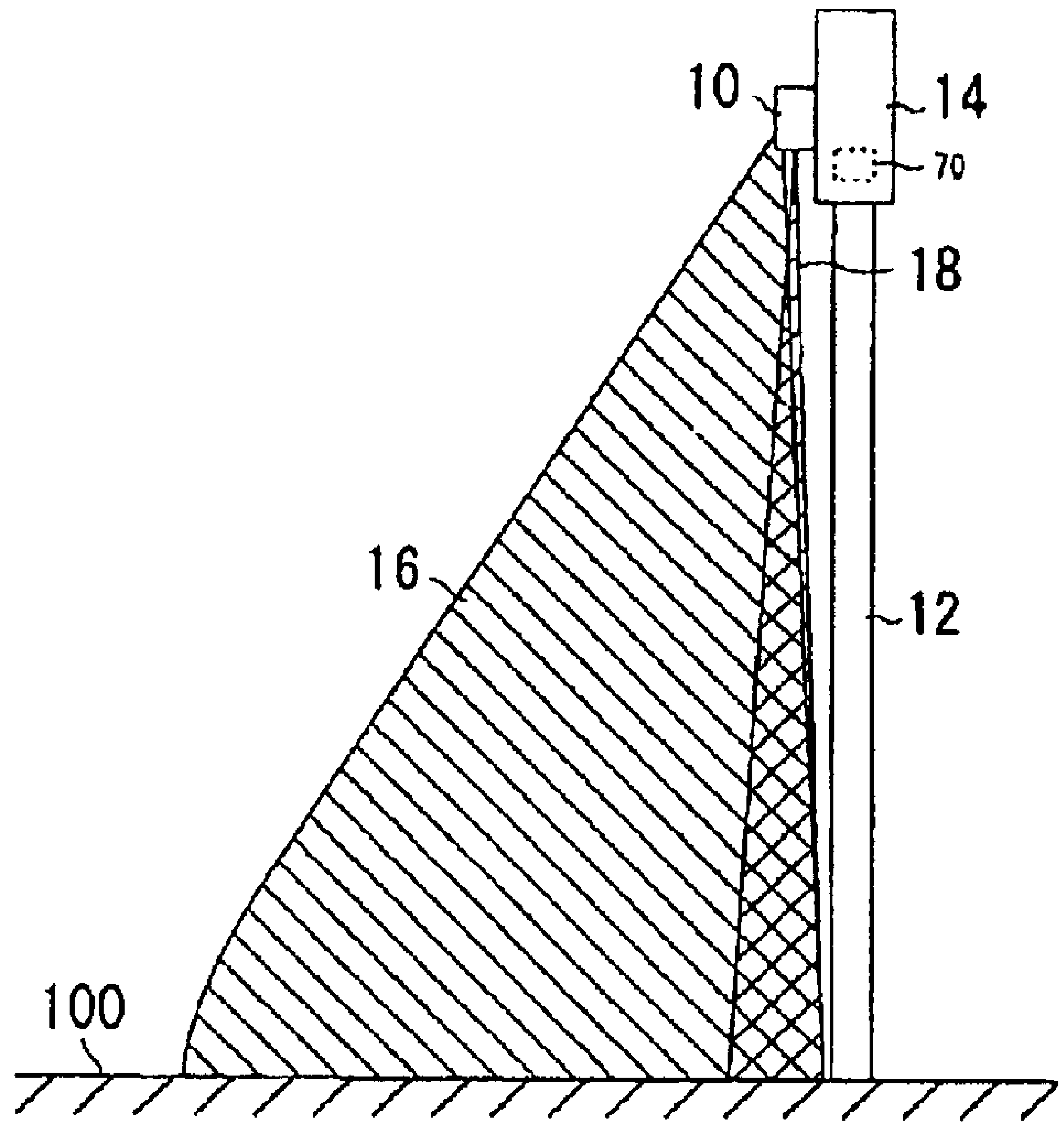
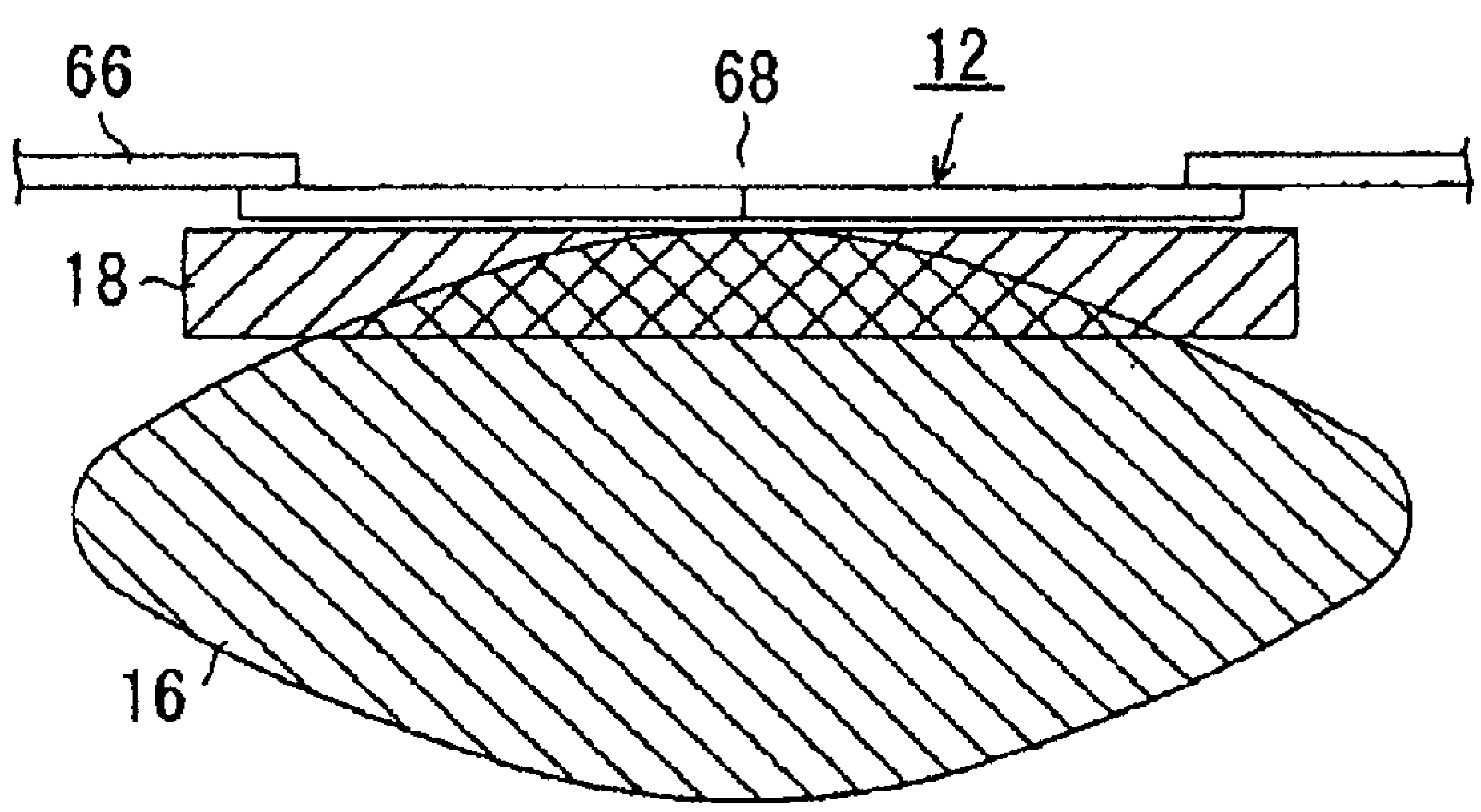


Fig. 2



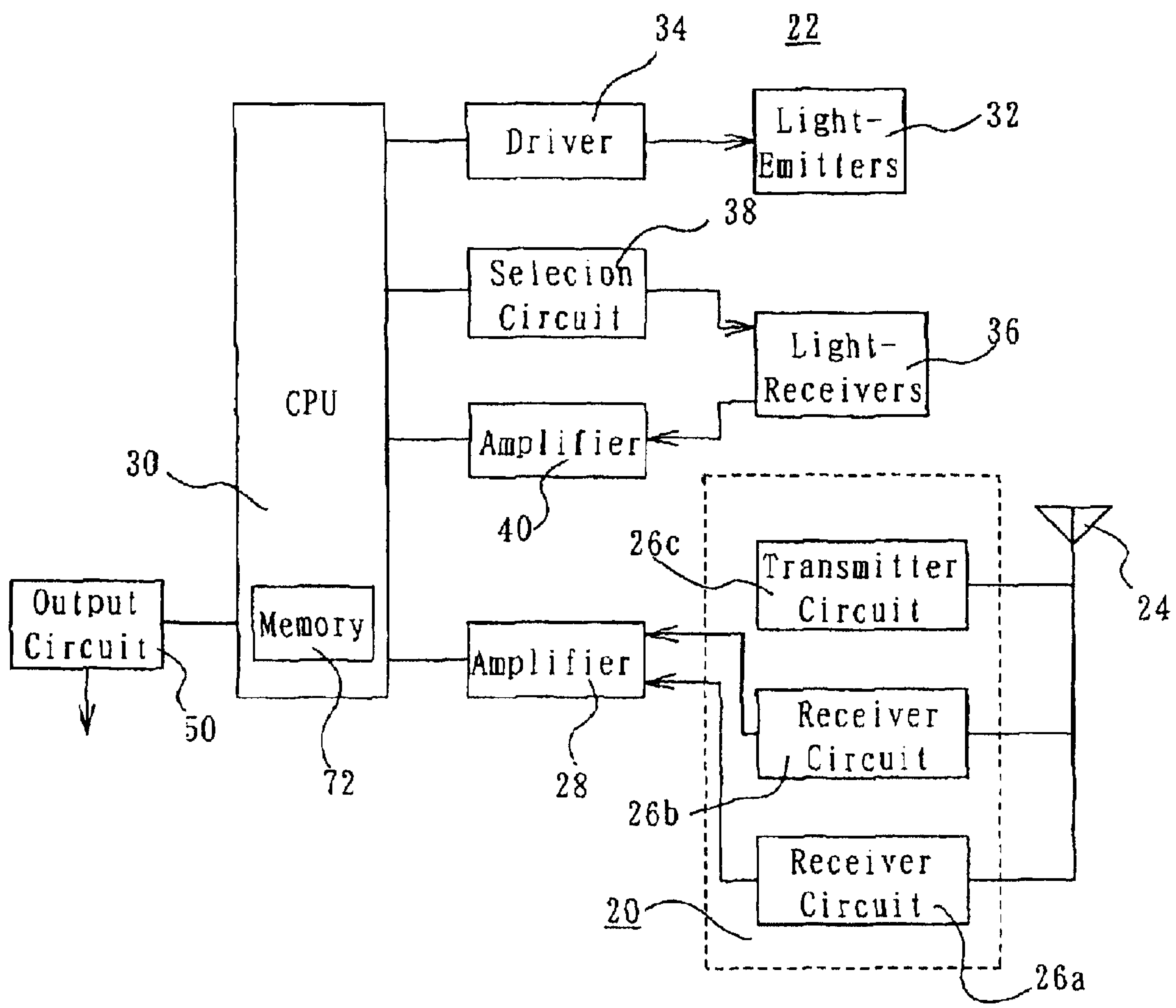

34
22
Driver
Light-
Emitters
32
38
Selecion
Circuit
Light-
Receivers
36
CPU
Amplifier
30
40
26c
Transmitter
Circuit
24
Output
Circuit
Memory
Amplifier
Receiver
Circuit
50
72
28
26b
Receiver
Circuit
20
26a

Fig. 3

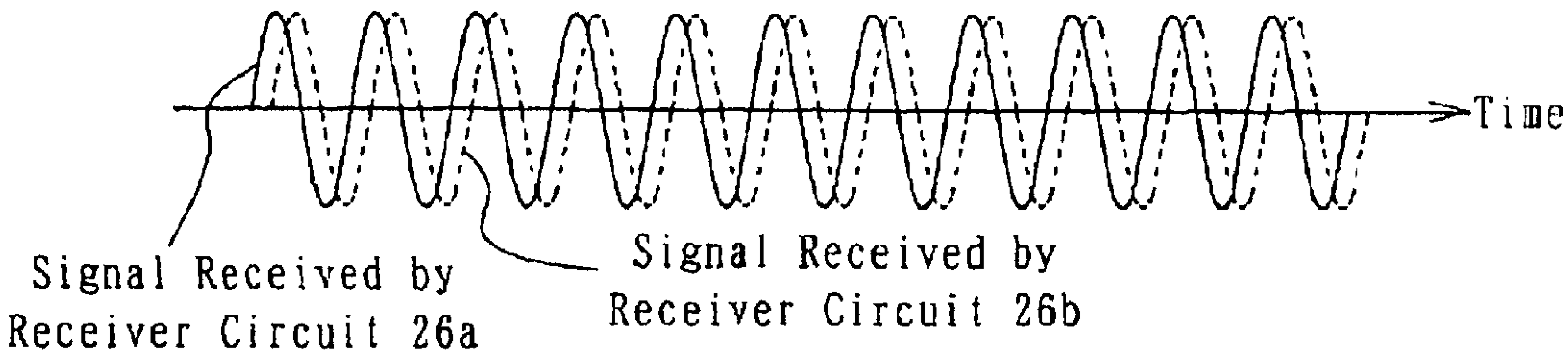


Fig. 4A

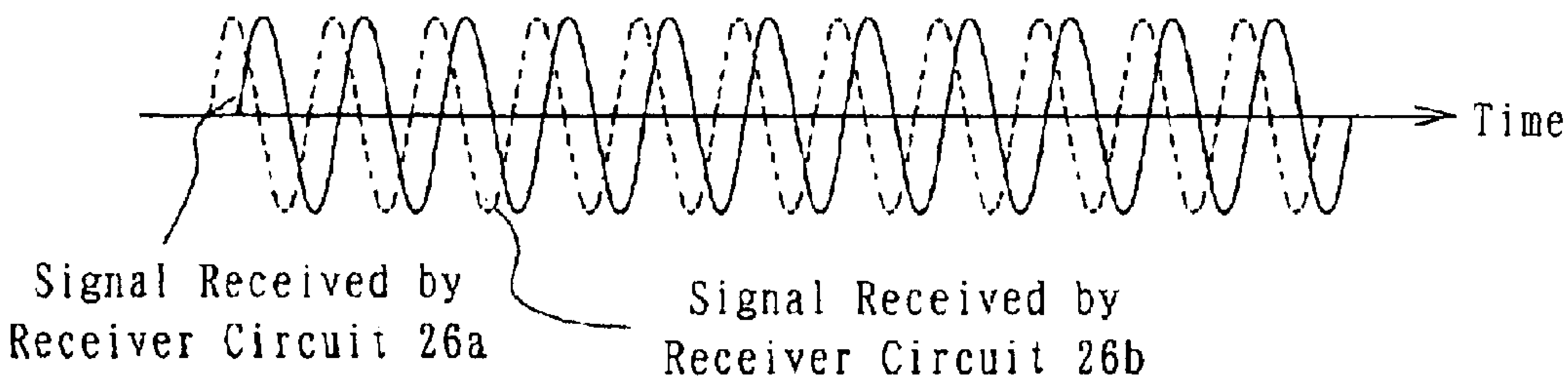


Fig. 4B

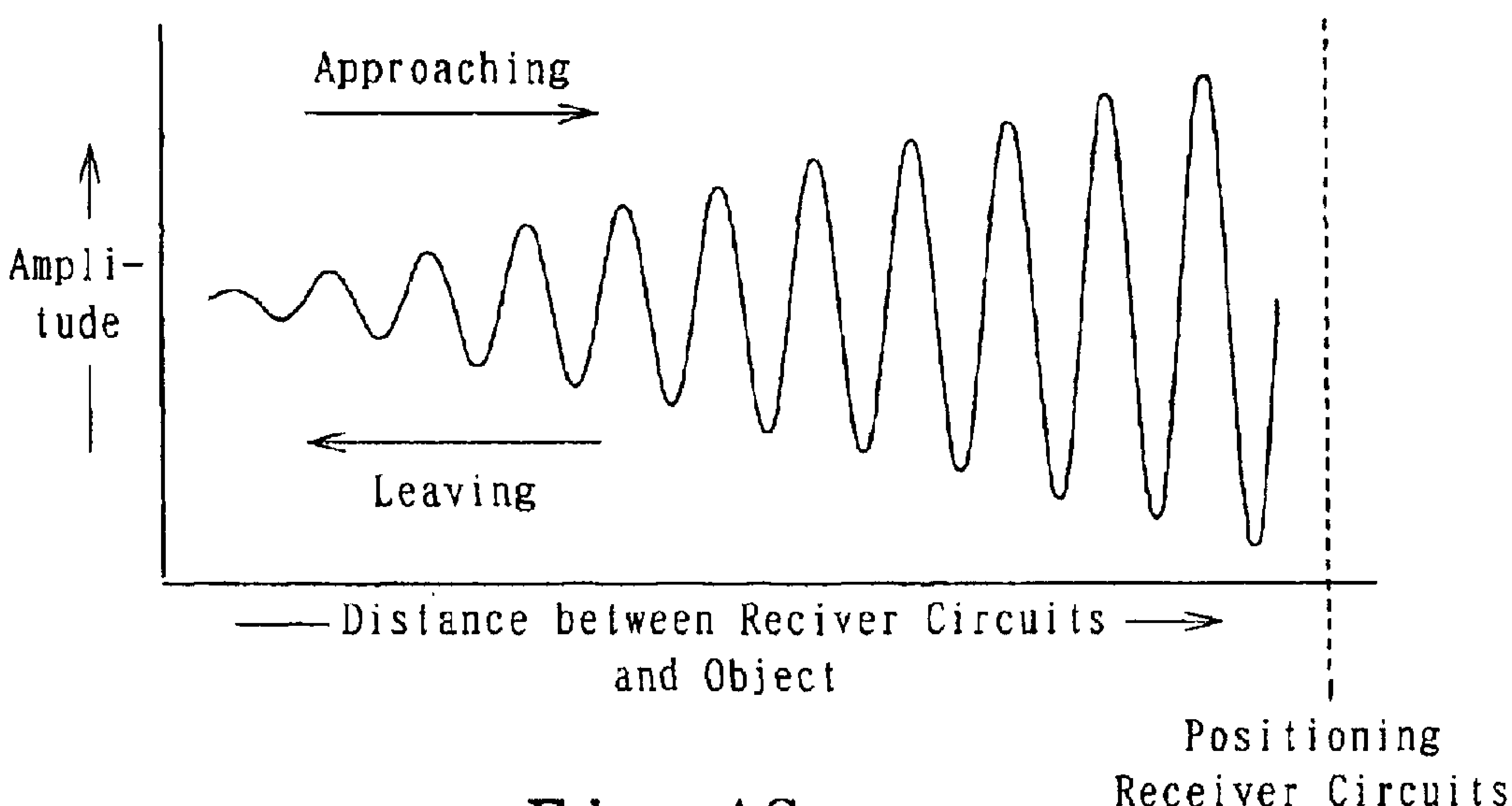


Fig. 4C

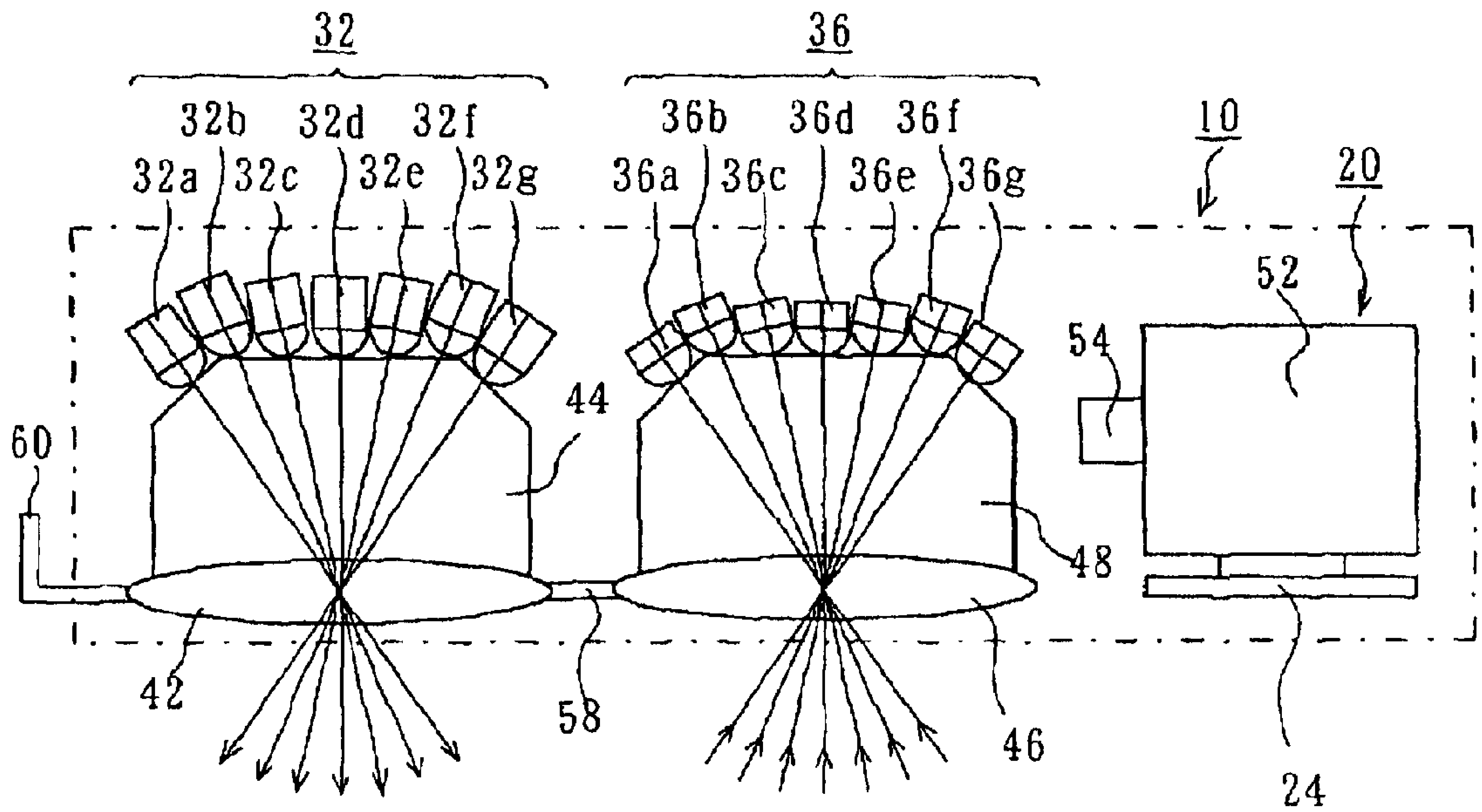

32
32b
32d
32f
32a
32c
32e
32g
36
36b
36d
36f
36a
36c
36e
36g
10
20
52
54
44
60
48
42
58
46
24

Fig. 5

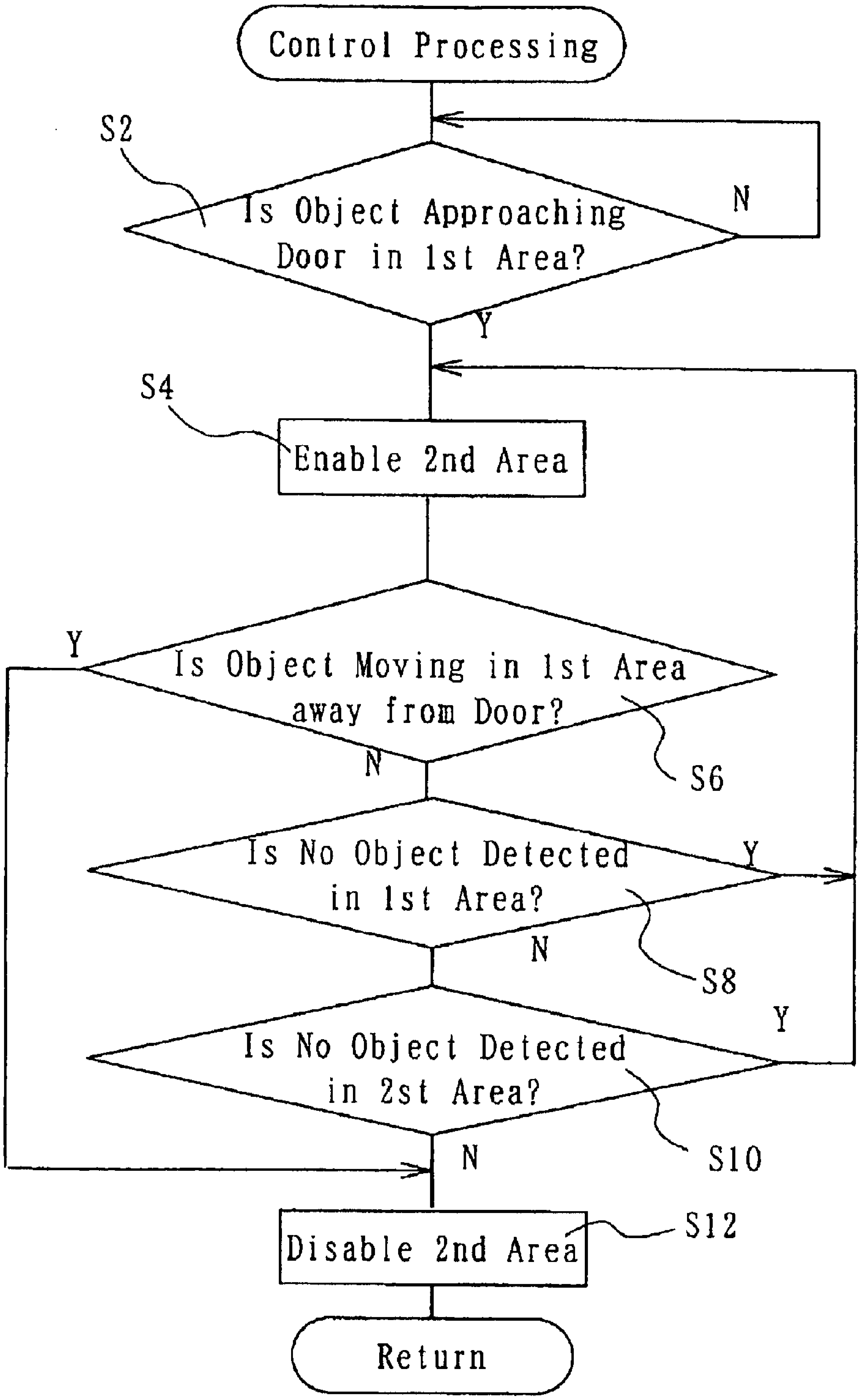

Control Processing
S2
Is Object Approaching Door in 1st Area?
N
Y
S4
Enable 2nd Area
Y
Is Object Moving in 1st Area away from Door?
N
S6
Is No Object Detected in 1st Area?
Y
N
S8
Y
Is No Object Detected in 2st Area?
S10
N
S12
Disable 2nd Area
Return

Fig. 6

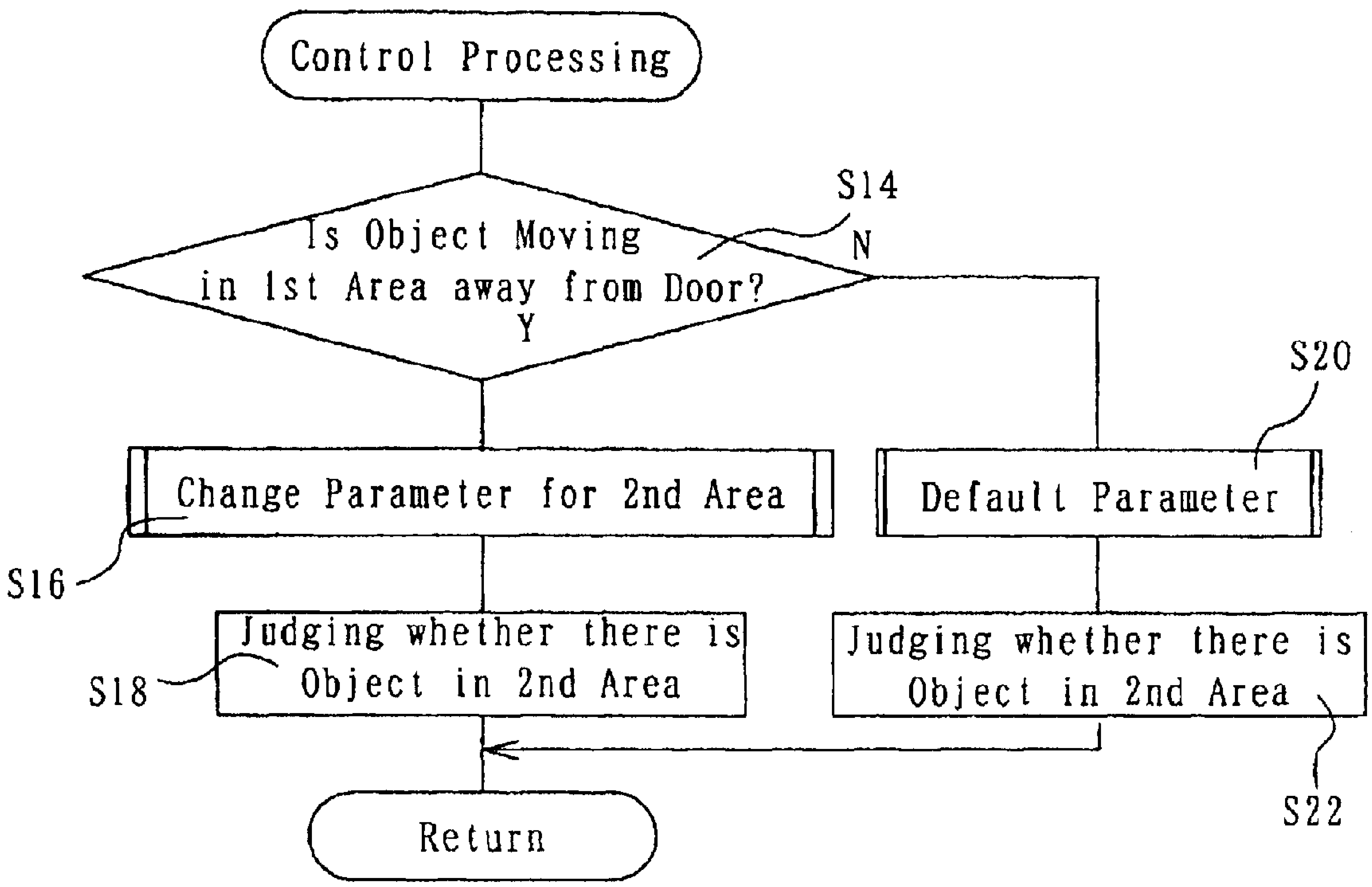

Control Processing
S14
Is Object Moving in 1st Area away from Door?
N
Y
S20
Change Parameter for 2nd Area
Default Parameter
S16
Judging whether there is Object in 2nd Area
S18
Judging whether there is Object in 2nd Area
S22
Return

Fig. 7

Fig. 8A

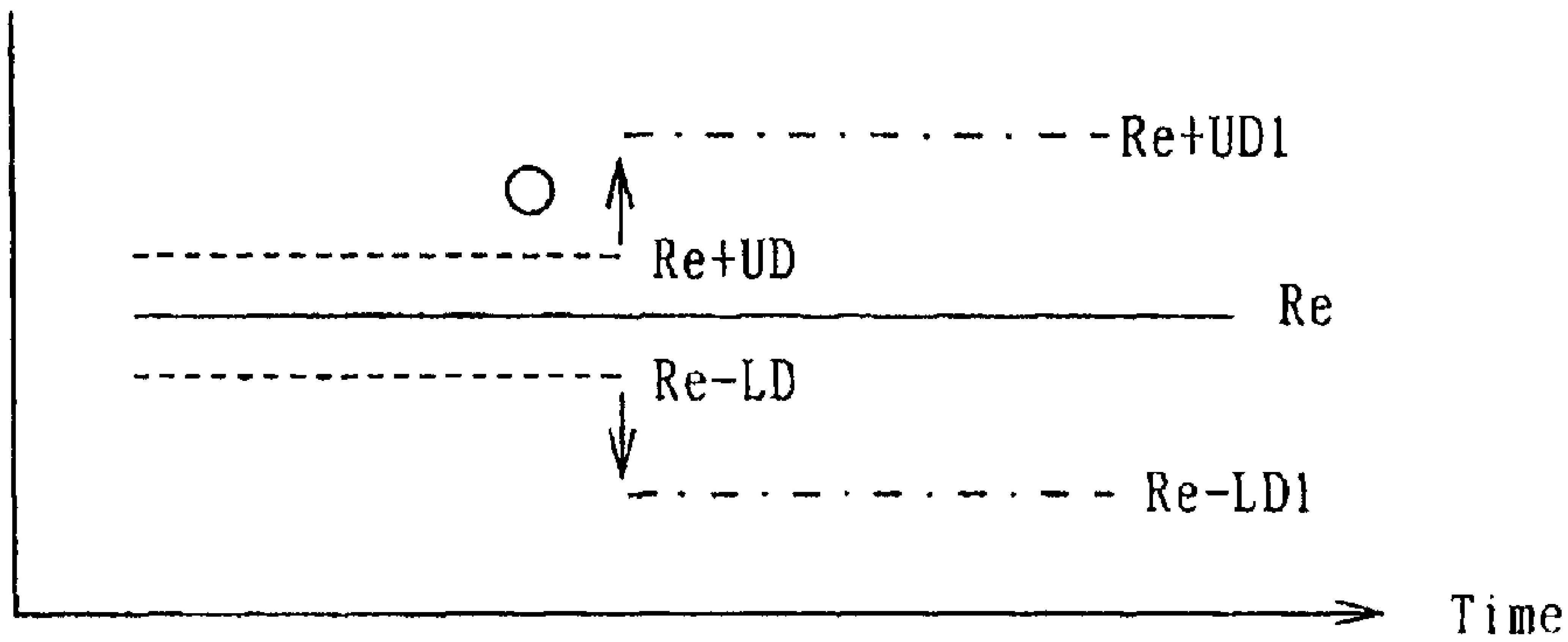


Fig. 8B

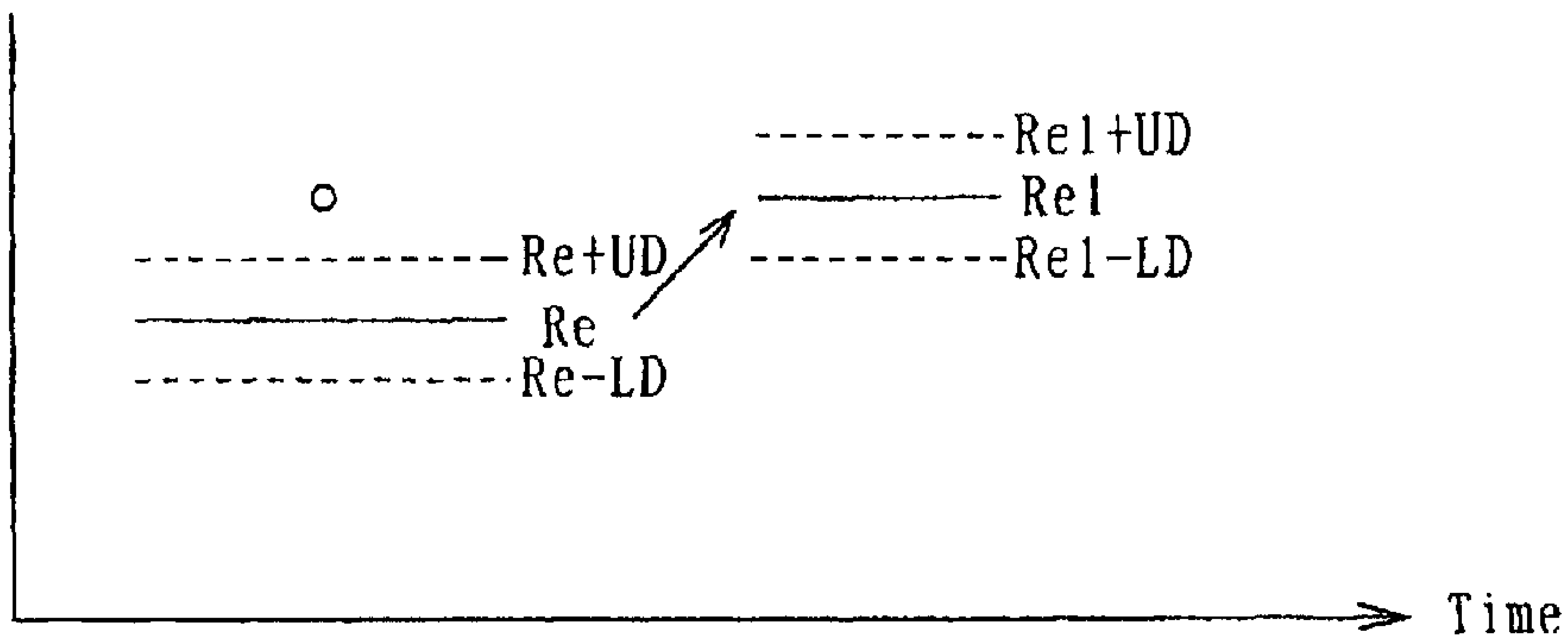
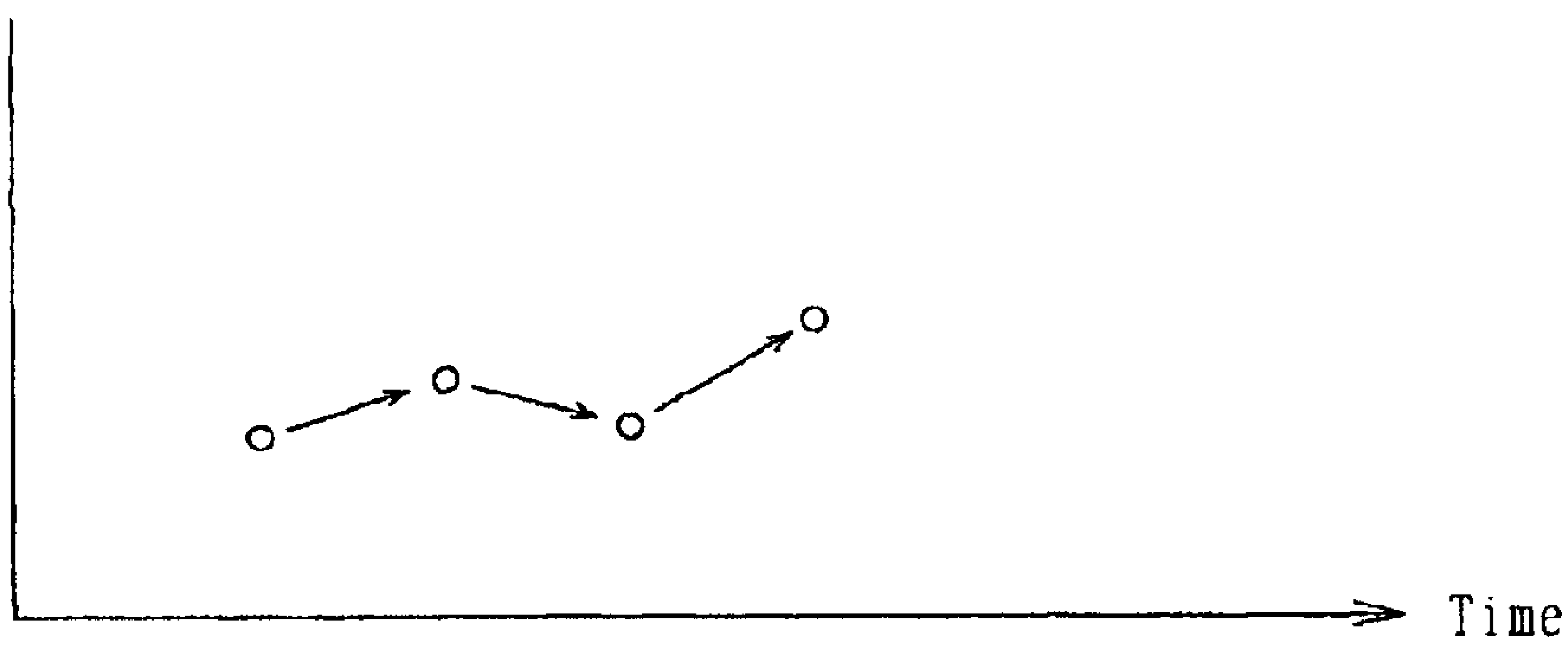


Fig. 8C



COMPOSITE SENSOR FOR DOOR AND AUTOMATIC DOOR SYSTEM

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This invention relates to a composite sensor for use with a door, for sensing an object by the use of, for example, a radio wave and light in combination.

BACKGROUND OF THE INVENTION

An example of such composite sensor for use with a door (hereinafter referred to as composite door sensor) is disclosed in a catalogue of composite sensors available from B.E.A. Inc., entitled "ACTIV8.3". The composite door sensor disclosed in the catalogue includes a microwave transmitter-receiver unit and an infrared emitter-receiver unit in a single casing. A microwave is used to detect an object, e.g. a moving object or pedestrian moving toward a door. When a moving object is detected by the microwave, the door is opened. Infrared light is used to detect a moving object standing stationary in the vicinity of the door. As long as the object is being detected by the infrared light, the door is kept open. Thus, an accident of a moving object being caught in the door can be avoided, and the safety of the moving object can be secured.

Infrared light used in such composite sensor for a door system tends to be adversely affected by disturbances, such as rain and snow. Infrared light is reflected not only by human bodies but also by rain and snow. Therefore a prior art composite door sensor like the one described before would erroneously detect rainfall, snowfall, puddle after the rain, or snow on the ground as an object to be detected by the sensor (hereinafter sometimes referred to as relevant object), such as a pedestrian. This causes an erroneous operation of an automatic door to open the door in spite of absence of any relevant object.

An object of the present invention is to provide a composite sensor for a door system with reduced possibility of erroneous operation of the automatic door which would be caused by disturbances, such as rain and snow.

SUMMARY OF THE INVENTION

A composite door sensor according to a first aspect of the present invention forms a first area for detecting an object therein by means of a radio wave, for example, and a second area close to the first area for detecting an object therein by means of light. The composite door sensor includes a radio wave transmitter and receiver for forming the first area, and a light emitter and receiver for forming the second area. The light emitter and receiver may be an infrared-light emitter and receiver. The light emitter and receiver may be of reflection type, in which the light emitter emits infrared light and the light receiver receives a reflected version of the infrared light emitted by the light emitter. The first area may be formed at a location spaced from a door and detect an object moving toward the door, with the second area formed closer to the door to detect a stationary object standing still near the door. When an object is detected moving in the first area toward the second area, the second area is enabled, and when an object is detected moving in the first area in a direction away from the second area, the second area is disabled.

This composite door sensor is arranged such that the second area is enabled at a time when an object is detected moving in the first area toward the second area. Accordingly, since, even if snow or rain disturbing the light is present in the second area, the second area is kept disabled until an object in the first area begins to move toward the second area, no erroneous operation of the door is caused by rain or snow. Also, the second area is disabled when an object which has come through the second area into the first area is detected moving in the first area in the direction away from the second area, and, therefore, it is prevented that the second area is erroneously operated due to disturbances thereafter.

A composite door sensor according to a second aspect of the present invention forms a first area for detecting an object therein by means of a radio wave, for example, and a second area close to the first area for detecting an object therein by means of light. The composite door sensor includes a radio wave transmitter and receiver for forming the first area, and a light emitter and receiver for forming the second area. The light emitter and receiver may be an infrared light emitter and receiver. The light emitter and receiver may be of reflection type, in which the light emitter emits infrared light and the light receiver receives a reflected version of the infrared light emitted by the light emitter. The first area may be formed at a location spaced from a door and detect an object moving toward the door, with the second area formed closer to the door to detect a stationary object standing still near the door. When an object is detected in the first area moving in the direction away from the second area when an object is being detected in the second area, a parameter relating to the second area is changed. The parameter is one for use in detecting an object in the second area, for example.

Specifically, the parameter change may be a change of sensitivity of detection in the second area, or a change of a reference value for the second area to a value corresponding to an amount of received light, or a change of the second area to an area for detection of a moving object.

When an object is detected moving in the first area away from the second area, with an object being also detected in the second area, it is highly possible that erroneous detection is occurring in the second area. In such case, a parameter for the second area is changed to remove the erroneous operating condition, so that entering of an object into the second area occurring thereafter can be detected without fail.

An automatic door system is provided, which can respond to a sensor signal from any one of the above-described composite door sensor by opening and closing the door.

In any of the above-described composite door sensor, the detection in the first area may be based on a detection method other than using a radio wave. For example, another detecting technique for detecting presence of an object and a direction of movement of the object, such as an ultrasonic Doppler technique and a millimeter wave radar technique may be used.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a side view of a composite sensor according to a first embodiment of the present invention used in an automatic door.

FIG. **2** illustrates detection areas provided by the composite sensor of FIG. **1**.

FIG. **3** is a block diagram of the composite sensor of FIG. **1**.

FIGS. **4**A, **4**B and **4**C show signals as received by a radio wave transmitter-receiver module of the composite sensor of FIG. **1**.

FIG. **5** illustrates how a light-emitting device set, light-receiving device set, and radio wave transmitter-receiver module of the composite sensor of FIG. **1** are disposed relative to each other.

FIG. **6** is a flow chart of operation of the composite sensor of FIG. **1**.

FIG. **7** is a flow chart of operation of a composite sensor according to a second embodiment of the present invention.

FIG. **8** exemplifies manners in which an infrared parameter of the composite sensor of FIG. **7** is changed.

DESCRIPTION OF EMBODIMENTS

A composite sensor for use with a door according to a first embodiment of the invention is now described with reference to FIGS. **1** through **6**. As shown in FIG. **1**, the composite sensor **10** according to the first embodiment is mounted on a lintel **14** located above a door **12** of an automatic door system. The door **12** is a double sliding door, for example, as shown in FIG. **2**.

The composite sensor **10** forms a first area **16** and a second area **18**, as shown in FIGS. **1** and **2**. The first area **16** is located at a location spaced from the front surface, for example, of the door **12**, e.g. a location spaced in front of the door **12**, i.e. leftward of the door **12** in FIG. **1** or downward of the door **12** in FIG. **2**. The first area **16** is an area for detecting an object (not shown) moving toward the door **12**, e.g. a pedestrian going to pass through the door **12**. When an object is detected in the first area **16**, a controller (not shown) causes the door **12** to be opened. Thus, the first area **16** functions as an activation area for initiating the opening operation of the door **12** by the controller.

The second area **18** is formed at a location nearer to and in front of the door **12**, for example. The second area **18** is for detecting an object standing still in the vicinity of the door **12**. When an object is detected in the second area while the door **12** is open, the controller causes the door **12** to be kept open. This prevents the object from being caught in the door **12**. Thus, the second area **18** functions as a safety area for securing the safety of an object.

In order to form the first and second areas **16** and **18**, the composite sensor **10** includes a radio-wave transmitter-receiver module **20** and an infrared light emitter-receiver module **22**, as shown in FIG. **3**.

The radio-wave transmitter-receiver module **20** is for forming the first area **16**, and includes an antenna **24**, receiver circuits **24**a and **24**b, a transmitter circuit **26**c and an amplifier circuit **28**. The antenna **24** transmits a radio wave, e.g. a microwave having a frequency of 24.15 GHz, corresponding to a transmission signal from the transmitter circuit **26**c, toward a floor **100**. The transmitted radio wave is reflected by the floor or an object, if there, and the reflected radio wave is received by the antenna **24**. The received signal is applied to the receiver circuits **26**a and **26**b, which are disposed, being spaced by a distance equal to a quarter of the wavelength of transmission signal in the direction perpendicular to the door **12**. In other words, there is a difference in length, which is equal to a quarter wavelength, between transmission lines from the antenna **24** to the respective receiver circuits **26**a and **26**b.

When an object enters into the first area **16**, the transmitted microwave or radio wave is reflected by the object, and the reflected wave is received by the antenna **24**. A received wave representative signal from the antenna **24** is applied to the respective receiver circuits **26**a and **26**b. The receiver circuits **26**a and **26**b process the received wave representative signals in a predetermined manner, including demodulation of the signal. The signals from the receiver circuits **26**a and **26**b are amplified in the amplifier circuit **28** and, then, applied to a CPU **30**.

The phase relationship between the demodulated signals from the receiver circuits **26**a and **26**b when an objected is moving in the first area **16** toward the second area **18**, or, in other words, moving toward the door **12**, and the phase relationship between the demodulated signals when the object is moving in the first area **16** in the direction away from the second area **18**, or the door **12**, is different. For example, as shown in FIG. **4**A, if the object is approaching the door **12**, the phase of the signal from the receiver circuit **26**b is delayed relative to the phase of the signal from the receiver circuit **26**a. If the object is moving in the first area **16** leaving the door **12** behind, the phase of the signal from the receiver circuit **26**b advances relative to the phase of signal from the receiver circuit **26**a. In addition, the amplitudes of the signals from the receiver circuits **26**a and **26**b are small when the object is remote from the receiver circuits **26**a and **26**b and become larger as the object approaches the receiver circuits **26**a and **26**b, as shown in FIG. **4**C.

Taking advantage of these phenomena, it can be judged that the object is approaching the door **12** when the phase of the signal from the receiver circuit **26**a advances relative to that of the signal from the receiver circuit **26**b and the amplitudes of the signals from the receiver circuits **26**a and **26**b are becoming larger. On the other hand, if the phase of the signal from the receiver circuit **26**a delays relative to that of the signal from the receiver circuit **26**b and the amplitudes of the signals from the receiver circuits **26**a and **26**b are becoming smaller, it can be judged that the object is moving, leaving the door **12** behind.

The infrared light emitter-receiver module **22** is for forming the second area **18** functioning as a safety area, and includes a set of light-emitting devices **32**, a driver circuit **34**, a set of light-receiving devices **36**, a selection circuit **38** and an amplifier circuit **40**.

The set of light-emitting devices **32** includes plural, e.g. seven, light emitting devices **32**a through **32**g, as shown in FIG. **5**. FIG. **5** is a view of part of the composite sensor **10** seen from a location confronting the front surface of the door **12**, i.e. from the left side in FIG. **1**. The light-emitting devices **32**a-**32**g are disposed in a plane extending in parallel with the front surface of the door **12** with the fronts thereof (i.e. the light-emitting centers) facing toward a point in a converging lens **42** disposed below the respective light-emitting devices **32**a-**32**g. The light-emitting devices **32**a-**32**g are respectively responsive to a driving signal supplied thereto from the driver circuit **34** to successively emit light one by one. The light may be infrared light within the near-infrared band. The infrared light is directed to the floor **100** through the converging lens **42**. This results in the formation of the safety or second area **18** at a location near and along the door **12**.

Reflecting means, e.g. a planar mirror **44**, is fixed to the edge of the converging lens **42** on its side nearer to the door **12**. The mirror **44** extends from the edge of the converging lens **42** toward the light-emitting devices **32**a-**32**g. Part of the infrared light emitted from each of the light-emitting devices **32**a-**32**g is reflected by the mirror and, then, passes through the converging lens **42** toward the floor **100**. The part of the infrared light projected through the mirror **44** also contributes to the formation of the safety area **18**.

When an object enters into the safety area **18**, the infrared light is reflected by the object, and the reflected light is received by the light-receiving device set **36**. More specifically, the light-receiving device set **36** is disposed by the light-emitting device set **32** (on its right hand side in FIG. **5**), and includes seven light-receiving devices **36**a through **36**g, respectively corresponding to ones of the light-emitting devices **32**a-**32**g of the light-emitting device set **32**. Like the light-emitting devices **32**a-**32**g, the light-receiving devices **36**a-**36**g are disposed in a plane extending in parallel with the front surface of the door **12** with the fronts thereof facing toward a point in a converging lens **46** disposed below the respective light-receiving devices **36**a-**36**g. The light-receiving devices **36**a-**36**g are successively enabled one by one in synchronization with the light-emitting timing of the counterpart ones of the light-emitting devices **32**a-**32**g, in response to a selection signal supplied thereto from the selection circuit **38**. Thus, the infrared light emitted from the respective ones of the light-emitting devices **32**a-**32**g and directed toward the floor **100** is reflected by an object, passes through the converging lens **46**, and is received by the respective corresponding ones of the light-receiving devices **36**a-**36**g.

A mirror **48** similar to the mirror **44** is secured to the edge of the converging lens **46** on its side nearer to the door **12**. The mirror **48** directs reflected light from the portion of the safety area **18** expanded by the mirror **44**, to the light-receiving devices **36**a-**36**g.

The light-receiving devices **36**a-**36**g convert reflected infrared light which they receive to electrical signals. The resulting electrical signals are amplified in the amplifier circuit **40** and, then, applied to the CPU **30**. The light-receiving devices **36**a-**36**g to which no selection signal is applied from the selection circuit **38** are disabled, and, therefore, even when they receive reflected light corresponding to the infrared light emitted from the corresponding ones of the light-emitting devices **32**a-**32**g, they develop no output signals. The disablement of the light-receiving devices is effectuated in response to a signal supplied by the CPU **30**.

The CPU **30** converts two demodulated signals supplied thereto from the amplifier circuit **28** of the radio-wave transmitter-receiver module **20**, to digital signals, and judges the situation in the activation area **16**, or, in other words, judges whether there is any object in the activation area **16**, based on the resulting digital signals. The CPU **30** also converts the signals supplied thereto from the amplifier **40** of the infrared light emitter-receiver module **22** to digital signals, and judges the situation in the safety area **18** based on the resulting digital signals. When the CPU **30** judges that there is an object in at least one of the activation and safety areas **16** and **18**, the CPU **30** outputs the judgment as the output signal (i.e. the sensor output) of the composite sensor **10** through the output circuit **50**. The output signal is then applied to the previously mentioned controller, which opens the door **12** in accordance with the output signal. When the CPU **30** judges that there is no object in either of the activation and safety areas **16** and **18** after the door **12** is opened, the CPU **30** causes the sensor output to disappear and makes the controller operate to close the door **12**.

The radio-wave transmitter-receiver module **20** is disposed beside the light-receiving device set **36**, as shown in FIG. **5**, with the antenna **24** facing toward the floor **100**. An antenna angle adjusting knob **54** is on one side of a module case **52** for use in adjusting the direction in which the antenna **24** is directed.

The converging lenses **42** and **46** associated with the light-emitting device set **32** and the light-receiving set **36**, respectively, are coupled together by means of a connecting rod **58**. At one end of the connecting rod **58**, an L-shaped lever **60** is attached. By handling the lever **60**, the converging lenses **42** and **46** rotate about the connecting rod **58** functioning as a rotation axis. At the same time, the respective mirrors **44** and **48** also rotate about the connecting rod **58**. As a result, the direction in which the infrared light projected via the mirrors **44** and **48** is directed changes to and fro with respect to the door **12**, i.e. perpendicularly to the door **12**.

As stated previously, infrared light in the near-infrared band is liable to be affected by disturbances such as rain and snow. If, therefore, rain or snow enters into the second or safety area **18**, such rain or snow is sometimes detected as a relevant object. If such erroneous detection were reflected in the sensor output, the automatic door system would operate erroneously. For example, the door **12** would be opened despite the absence of any relevant object in the second area **18**. In other case, the door **12** would be kept open even after a relevant object has passed through the door **12**, due to the detection of rain or snow as a relevant object. In order to eliminate such erroneous operation, according to the first embodiment, the infrared light emitter-receiver module **22** is normally disabled, and is enabled when it is judged, from the properties of the previously described two demodulated signals, that an object is moving in the first area **16** toward the door **12**.

A sequential operation of the CPU **30** to enable and disable the infrared light emitter-receiver module **22** is carried out in the following manner in accordance with a control program stored in a memory **72** of the CPU **30**.

Referring to FIG. **6**, whether any object is moving in the first area **16** toward the door **12** is judged (Step S**2**). If the answer to this query is NO, the processing of Step S**2** is repeated until the answer becomes YES. When the answer to the query in Step S**2** is YES, the second area **18** is enabled (Step S**4**). For example, the supply of the control signal from the selection circuit **38** is enabled. After that, a judgment is made as to whether the object is moving in the first area **16** away from the door **12** (Step S**6**). In other words, a judgment is made as to if the object has come through the open door **12** and the second area **18** into the first area **16** and is going out of the first area **16** away from the second area **18**, or if the object which has been moving in the first area **16** toward the door **12** has turned its direction and is going away from the door **12**. The answer of YES to this query means that the object is moving away from the door **12**, and, then, the second area **18** is disabled (Step S**12**). When the answer to this query made in Step S**6** is NO, a judgment is made as to whether no object is being detected in the first and second areas **16** and **18** (Step S**8** and Step S**10**). The processing in Steps S**4**, S**6**, S**8** and S**10** is repeated and the second area **18** is kept enabled until the queries in both Step S**8** and S**10** become NO, or, in other words, no object is detected either in the first area **16** or in the second area **18**. A predetermined time period after this, the second area **18** is disabled (Step S**12**), and the processing is ended.

By selectively enabling and disabling the second area **18**, even when there is a layer of snow, for example, in the second area **18** near the door **12** and there is no relevant object in the second area **18**, it never occurs that the layer of snow is detected by the infrared light emitter-receiver module **22**, and, therefore, the door **12** is not opened. However, under such situation, if any object moves in the first area **16** toward the door **12**, the infrared light emitter-receiver module **22** is enabled. Thus, it never happens that the door **12** is unnecessarily kept open.

Although not shown, another composite sensor similar to the composite sensor **10** may be installed on the opposite side of the door **12** to form activation and safety areas similar to the areas **16** and **18**. In such a case, the both composite sensors may be controlled by a single CPU or may be connected together in such a manner as to communicate with each other, so that, when an object is moving in either one of the activation areas **16** toward the door **12**, both infrared light emitter-receiver modules **22** can be enabled and that, when an object is detected moving in the activation area **16** away from the door **12**, both infrared light emitter-receiver modules **22** can be disabled together, whereby the safety areas **18** are selectively enabled and disabled.

A composite sensor according to a second embodiment is the same in structure as the composite sensor **10** according to the first embodiment. Accordingly, the same reference numerals as used in the description of the composite sensor **10** according to the first embodiment are used in the following description of the composite sensor according to the second embodiment. According to the second embodiment, if the door **12** is kept open although an object which has moved through the second area **18** has entered into the first area **16** and is moving in the direction away from the door **12**, which means that the infrared light emitter-receiver module **22** is making erroneous detection due to disturbance such as the presence of a rain puddle or a snow layer, a parameter of the infrared light emitter-receiver module **22** is changed. For example, a parameter used by the infrared light emitter-receiver module **22** in making a judgment as to whether there is a relevant object, is adjusted to release the infrared light emitter-receiver module **22** from the situation of erroneous detection.

To achieve this, the CPU **30** performs processing as shown in FIG. **7**. Now, let it be assumed that an object is coming toward the door **12** from the opposite or rear side of the door **12** and the door **12** is open. Under this circumstance, whether or not the object is moving in the first area **16** in the direction away from the door **12** is judged (Step S**14**). If the answer to this query is NO, a default parameter is used to judge whether the object is in tire second area **18** (Step S**22**). On the other hand, if the answer to the query in Step S**14** is YES, it is highly probable that the object has passed the second area **18** and is moving in the first area **16** in the direction away from the door **12**. There is a possibility that snow stuck on the soles of shoes may be left on a mat on the floor **100** and that such snow may be erroneously detected as a relevant object. Then, an infrared parameter relating to the infrared light emitter-receiver module **22** for the second area **18** is altered (Step S**16**) so that the infrared light emitter-receiver parameter **22** can correctly detect a relevant object in the second area **18** regardless of the presence of snow and the like. Whether there is an object in the second area **18** is judged (Step S**18**), using the altered parameter, and an output signal based on the result of the judgment is supplied through the output circuit **50** to the controller.

An example of the parameter alteration is alteration of the sensitivity of the sensor, as shown in FIG. **8**A. A reference value Re, an allowable upper limit deviation UD and an allowable lower limit deviation LD are determined beforehand. When a received light amount representative signal from a light-receiving device is outside a dead zone defined between the reference value Re plus the allowable upper limit deviation UD and the reference value Re minus the allowable lower limit deviation LD, it is judged that an object has been detected. If the received light amount representative signal is outside this dead zone, indicating that an object moving in the first area **16** in the direction away from the door is detected, in spite of the absence of the relevant object, which would be caused by, for example, the presence of a layer of snow, the allowable upper and lower limit deviations UD and LD are changed to UD**1** and LD**1**, as shown, to widen the dead zone. This makes the received light amount representative signal influenced by the presence of snow enter into the dead zone, i.e. lowers the sensitivity of the infrared light emitter-receiver module **22**, whereby erroneous detection is prevented.

Another example of the parameter alteration is to alter a reference value as shown in FIG. **8**B. In this case, too, a reference value Re, an allowable upper limit deviation UD, and an allowable lower limit deviation LD are determined previously. When a received light amount representative signal from a light receiving device falls outside a dead zone defined between the reference value Re plus the allowable upper limit deviation UD and the reference value Re minus the allowable lower limit deviation LD, it is judged that an object has been detected. In the absence of a relevant object, if the received light amount representative signal is outside the dead zone for a time longer than a predetermined time due to the presence of a layer of snow or the like, the value of the received light amount representative signal is used as a new reference value Re**1**. In this case, however, the allowable upper and lower limit deviations UD and LD are not changed. It should be noted, however, that, if the reason why the state in which the received light amount representative signal is outside the dead zone has continued for more than the predetermined time, is that the relevant object has stood still there, the object, which has started moving again, cannot be detected, because the reference value has been altered from Re to Re**1**. To cope with this problem, the previous reference value Re is stored after it has been changed to Re**1** until it can be confirmed that the received light amount representative signals are stable for a predetermined time. If the value of the received light amount representative signal varies after the alteration of the reference value to Re**1**, the original reference value Re is used.

A third example of infrared light parameter change is to limit the detection in the second area **18** to the detection of only a moving object, as shown in FIG. **8**C. When, an object passes through the second area **18** and moves in the first area in the direction away from the door **12**, the detection in the second area **18** is performed by detecting a movement of the object. For example, it is judged that, when the amount of variations of the received light amount representative signal is more than a predetermined value, an object is present in the second area **18**.

According to the first embodiment, the disablement of the infrared module **22** is done by interrupting the supply of a control signal from the selection circuit **38** to the set of light-receiving devices **36**, but it may be done by making the light-emitting device set **32** stop emitting light. Furthermore, according to the first embodiment, whether an object is approaching the door **12** or leaving the door **12** in the first area **16** is judged based on both a phase difference between the two radio-frequency signals and changes in the amplitudes of the two signals, but it can be made based only on either the phase difference or the amplitude changes.

What is claimed is:

1. A composite sensor for use with a door, comprising:

radio wave or ultrasonic-wave detecting means for detecting the presence of an object and the direction of movement of the object in a first area along said door;

light detecting means for detecting a stationary object in a second area along and near said door;

enabling means for enabling, when said radio-wave or ultrasonic-wave detecting means detects an object approaching said door in said first area, said light detecting means to thereby make object detection in said second area possible; and

disabling means for disabling, when said radio-wave or ultrasonic-wave detecting means detects the movement of the object in said first area away from said door with the object detection in said second area made possible, said light detecting means so as to disable object detection in said second area.

2. An automatic door system for selectively opening and closing a door in response to a signal representative of the result of detection by said composite sensor according to claim **1**.

3. A composite sensor for use with a door, comprising:

radio wave or ultrasonic-wave detecting means for detecting the presence of an object and the direction of movement of the object in a first area along said door;

light detecting means for detecting a stationary object in a second area along and near said door; and

a parameter adjusting means for changing a parameter relating to object detection by said light detecting means in such a manner that said light detecting means does not detect a stationary object when said radio-wave or ultrasonic-wave detecting means detects an object moving in said first area away from said door, when said door is open.

4. The composite sensor according to claim **3**, wherein said parameter adjusting means lowers a sensitivity of said light detecting means.

5. The composite sensor according to claim **3**, wherein said light detecting means judges that no object is present when a received light amount representative signal from said light detecting means is outside an allowable range determined for a predetermined reference signal, and said parameter adjusting means changes said reference signal to said received light amount representative signal.

[6. The composite sensor according to claim **3**, wherein said light detecting means judges that no object is present when a received light amount representative signal from said light detecting means is outside an allowable range determined for a predetermined reference signal, and said parameter adjusting means changes said reference signal to said received light amount representative signal.**]**

7. An automatic door system for selectively opening and closing a door in response to a signal representative of the result of detection by said composite sensor according to claim **3**.

8. The composite sensor according to claim 3, wherein said parameter adjusting means changes detection control provided by said light detecting means to moving object detection, in which it is judged that an object is present when the amount of variations of said received light amount representative signal is more than a predetermined value.

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