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(71) Applicant:
Daikin Industries, Ltd.
Osaka-shi Osaka 530-8323 (JP)

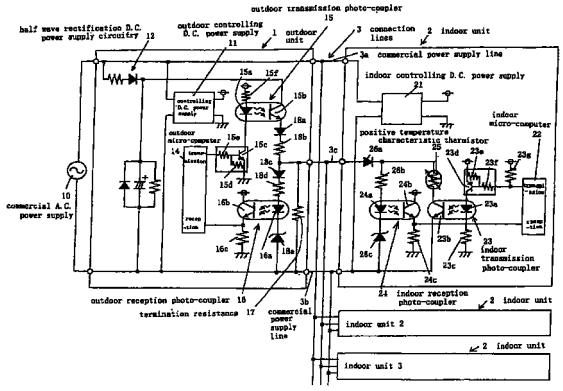
(72) Inventors:
- **NISHIMURA, Masaya,**
  Daikin Industries Ltd.
  Kusatsu-shi, Shiga 525-0044 (JP)
- **HISAOKA, Kunitoshi,**
  Daikin Industries Ltd.
  Kusatsu-shi, Shiga 525-0044 (JP)
- **YAMAMOTO, Mitsuhiko,**
  Daikin Industries Ltd.
  Sakai-shi, Osaka 591-8022 (JP)
- **MURAI, Akira,**
  Daikin Industries, Ltd.
  Sakai-shi, Osaka 591-8022 (JP)

(74) Representative:
Prüfer, Lutz H., Dipl.-Phys. et al
PRÜFER & PARTNER,
Patentanwälte,
Harthauser Strasse 25d
81545 München (DE)

(54) INDOOR-OUTDOOR COMMUNICATION DEVICE IN AIR CONDITIONER

(57) An air conditioner comprising one outdoor unit (1) and a plurality of indoor units (2) connected to the outdoor unit (1) via three connection lines (3) including commercial power supply lines (3a)(3b) in parallel with each other, wherein the outdoor unit (1) includes an outdoor micro-computer (14), an outdoor D.C. power supply (11), an outdoor transmission photo-coupler (15), an outdoor reception photo-coupler (16), and a termination resistance (17)connected in parallel with the outdoor reception photo-coupler (16), and each indoor unit (2) includes an indoor D.C. power supply (21), an indoor micro-computer (22), an indoor reception photo-coupler (24), an indoor transmission photo-coupler (23), and a positive temperature characteristic thermister (25) connected in series with the indoor transmission photo-coupler (23), so that components having nothing to do with ordinary indoor-outdoor communication operation are not required, and a disadvantage such that transmission and reception circuit components are destroyed or snapped is prevented from occurrence even when miswiring is realized.

Fig. 1



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Description

Technical Field

[0001] The present invention relates to an indoor-outdoor communication device in air conditioner. More particularly, the present invention relates to an indoor-outdoor communication device in air conditioner which comprises an outdoor unit and indoor units connected to the outdoor unit via three connection lines including commercial power supply lines.

Background Art

[0002] From the past, an air conditioner comprising an outdoor unit and an indoor unit connected to the outdoor unit via three indoor-outdoor connection lines including commercial power supply lines, is proposed.

[0003] In such air conditioner, installation of the outdoor unit, installation of the indoor unit, and wiring of the three indoor-outdoor connection lines should be performed at the actual spots, therefore mis-wiring may be realized. When mis-wiring is realized, signal transmission between the outdoor unit and the indoor unit is not normally performed, and circuitry elements may be destroyed occasionally. Therefore, detection of mis-wiring is necessary prior to the usual operation of the air conditioner.

[0004] To satisfy such demands, an arrangement to turn off a power switch means using a timer means when indoor-outdoor communication is not realized for a predetermined time period (refer to Japanese Patent Laid-Open Gazette No. Tokukaihei 6-147616), and an arrangement to stop operation of a transmission switch section of a transmission-reception circuitry section by providing an abnormal voltage detection protection section (refer to Japanese Patent Laid-Open Gazette No. Tokukaihei 8-271022) are proposed from the past.

[0005] When those arrangement are employed, a disadvantage is prevented from occurrence such that an air conditioner is operated with mis-wiring when mis-wiring is realized.

[0006] When the arrangement disclosed in Tokukaihei 6-147616 gazette is employed, the power switch means is optionally required. The power switch means should have sufficient voltage-resistance for commercial power voltage, and the power switch means have nothing to do with normal indoor-outdoor communication operation. Therefore, it is difficult to suppress the cost of communication circuitry section. Of course, installation space for installing the power switch means is necessary. Therefore, it is difficult to suppress the installation space of the communication circuitry section.

[0007] When the arrangement disclosed in Tokuganhei 8-271022 gazette is employed, the abnormal voltage detection protection section is optionally required. The abnormal voltage detection protection section should have sufficient voltage-resistance for commercial power voltage, and the abnormal voltage detection protection section have nothing to do with normal indoor-outdoor communication operation. Therefore, it is difficult to suppress the cost of communication circuitry section. Of course, installation space for installing the abnormal voltage detection protection section is necessary. Therefore, it is difficult to suppress the installation space of the communication circuitry section.

[0008] Further, those disadvantages arise in a multiple type air conditioner comprising one outdoor unit and a plurality of indoor units connected to the outdoor unit via three connection lines including commercial power supply lines in parallel with each other.

[0009] The present invention was made in view of the above problems.

[0010] It is an object of the present invention to offer an indoor-outdoor communication device in air conditioner which device does not require circuitry arrangement having nothing to do with normal indoor-outdoor communication operation such as power switch means, abnormal voltage detection protection section, which device prevents the elements of the transmission reception circuitry from destroyment and snapping even when mis-wiring is realized.

Disclosure of the Invention

[0011] An indoor-outdoor communication device in air conditioner of claim 1 which air conditioner comprises an outdoor unit and indoor unit connected to the outdoor unit via three connection lines including commercial power supply lines,

wherein one of the outdoor unit and the indoor unit includes first control means, first power supply means for supplying power to the first control means, first transmission photo-coupler and first reception photo-coupler for transmitting and receiving signal between the first control means which photo-couplers are connected between terminals of the commercial A.C. power supply via a D.C. power supply means in series with each other, and first resistance means connected in parallel with the first reception photo-coupler, and

the other of the outdoor unit and the indoor unit includes second control means, second reception photo-coupler and second transmission photo-coupler for transmitting and receiving signal between the second control means which photo-couplers are connected in parallel with the first reception photo-coupler via two connection lines among the three connection lines, and second resistance means for suppressing over current due to mis-wiring which resistance means is connected in series with the second transmission photo-coupler.

[0012] An indoor-outdoor communication device in air conditioner of claim 2 which air conditioner com-

prises one outdoor unit and a plurality of indoor units connected to the outdoor unit via three connection lines including commercial power supply lines in parallel with each other,
wherein the outdoor unit includes outdoor control means, outdoor controlling power supply means for supplying power to the outdoor control means, outdoor transmission photo-coupler and outdoor reception photo-coupler for transmitting and receiving signal between the outdoor control means which photo-couplers are connected between terminals of the commercial A.C. power supply via D.C. power supply means in series with each other, and first resistance means connected in parallel with the outdoor reception photo-coupler, and

each indoor unit includes indoor controlling power supply means connected between terminals of the commercial A.C. power supply via commercial power supply lines, indoor control means which is supplied power from the indoor controlling power supply means, indoor reception photo-coupler and indoor transmission photo-coupler for transmitting and receiving signal between the indoor control means which photo-couplers are connected with the outdoor reception photo-coupler in parallel via two connection lines among the three connection lines, and second resistance means for suppressing over current due to mis-wiring which resistance means is connected to the indoor transmission photo-coupler.

[0013] An indoor-outdoor communication device in air conditioner of claim 3 employs a positive temperature characteristic thermistor as the second resistance means.

[0014] An indoor-outdoor communication device in air conditioner of claim 4 which air conditioner comprises an outdoor unit and indoor unit connected to the outdoor unit via three connection lines including commercial power supply lines,
wherein one of the outdoor unit and the indoor unit includes outdoor control means, outdoor controlling power supply means for supplying power to the outdoor control means, outdoor transmission photo-coupler and outdoor reception photo-coupler for transmitting and receiving signal between the outdoor control means which photo-couplers are connected between terminals of the commercial A.C. power supply via a D.C. power supply means in series with each other, and first resistance means connected in parallel with the outdoor reception photo-coupler, and

the other of the outdoor unit and the indoor unit includes a transformer connected to terminals of the commercial A.C. power supply via the commercial power supply lines, rectification means for transforming the output voltage from the transformer to a D. C. voltage, abnormal voltage detection means which operates based upon the transformed D.C. voltage, second power supply means connected between output terminals of the rectification means, indoor control means to which the transformed D.C. voltage is supplied, indoor reception photo-coupler and indoor transmission photo-coupler for transmitting and receiving signal between the indoor control means which photo-couplers are connected in parallel with the outdoor reception photo-coupler via two connection lines among the three connection lines, and second resistance means which is connected in series with the indoor transmission photo-coupler.

[0015] An indoor-outdoor communication device in air conditioner of claim 5 which air conditioner comprises one outdoor unit and a plurality of indoor units connected to the outdoor unit via three connection lines including commercial power supply lines in parallel with each other,
wherein the outdoor unit includes outdoor control means, outdoor controlling power supply means, outdoor transmission photo-coupler and outdoor reception photo-coupler for transmitting and receiving signal between the outdoor control means which photo-couplers are connected between terminals of the commercial A.C. power supply via D.C. power supply means in series with each other, and first resistance means connected in parallel with the outdoor reception photo-coupler, and

each indoor unit includes a transformer connected to terminals of the commercial A. C. power supply via the commercial power supply lines, rectification means for transforming the output voltage from the transformer to a D.C. voltage, abnormal voltage detection means which operates based upon the transformed D.C. voltage, indoor controlling power supply means connected between output terminals of the rectification means, indoor control means to which the transformed D.C. voltage is supplied, indoor reception photo-coupler and indoor transmission photo-coupler for transmitting and receiving signal between the indoor control means which photo-couplers are connected in parallel with the outdoor reception photo-coupler via two connection lines among the three connection lines, and second resistance means which is connected in series with the indoor transmission photo-coupler.

[0016] When the indoor-outdoor communication device in air conditioner of claim 1 is employed, and when the air conditioner is operated with transmitting and receiving signal between the outdoor unit and indoor unit by connecting the outdoor unit and indoor unit via three connection lines including commercial power supply lines, A.C. power is supplied to one of the

outdoor unit and indoor unit from the commercial A.C. power supply and A.C. power is supplied to the other of the outdoor unit and indoor unit from the commercial A.C. power supply via the commercial power supply lines. Communication signal from the first control means is received by the second reception photo-coupler via the first transmission photo-coupler, reception signal of the second reception photo-coupler is supplied to the second control means so as to control the other of the outdoor unit and indoor unit. Further, communication signal from the second control means is received by the first reception photo-coupler via the second transmission photo-coupler, the reception signal of the first reception photo-coupler is supplied to the first control means so as to perform monitoring or the like of the other of the outdoor unit and indoor unit.

[0017] Further, when the outdoor unit and indoor unit are disposed and each control means is operated for performing signal transmission and signal reception between the outdoor unit and indoor unit just after the connection of the outdoor unit and indoor unit using the three connection lines, normal signal transmission and signal reception are performed under a condition that the three connection lines are connected normally, while normal signal transmission and signal reception are not performed under a condition that the three connection lines are not connected normally. Therefore, it is judged whether or not the three connection lines are connected normally.

[0018] Consequently, destroying and snapping or the like of transmission and reception circuitry components due to mis-wiring are prevented from occurrence by forcibly determining the operation condition of the second transmission photo-coupler and by limiting the current using the second resistance means which suppresses over current due to mis-wiring. Communication speed is improved by determining the power supply for communication to be D.C. power. Increase in cost and increase in installation space are prevented because circuitry components having nothing to do with normal indoor-outdoor communication operation such as power switch means, abnormal voltage detection protection section are not required at all.

[0019] When the indoor-outdoor communication device in air conditioner of claim 2 is employed, and when the air conditioner is operated with transmitting and receiving signal between the outdoor unit and indoor units by connecting the indoor units to the outdoor unit via three connection lines including commercial power supply lines in parallel with each other, A.C. power is supplied to the outdoor unit from the commercial A.C. power supply and A.C. power is supplied to the indoor controlling power supply means of each indoor unit from the commercial A.C. power supply via the commercial power supply lines. Communication signal from the outdoor control means is received by the indoor reception photo-coupler via the outdoor transmission photo-coupler, reception signal of the indoor reception photo-coupler is supplied to the indoor control means so as to control the indoor unit. Further, communication signal from the indoor control means is received by the outdoor reception photo-coupler via the indoor transmission photo-coupler, the reception signal of the outdoor reception photo-coupler is supplied to the outdoor control means so as to perform monitoring or the like of the indoor unit.

[0020] Further, when the outdoor unit and a plurality of indoor units are disposed and each control means is operated for performing signal transmission and signal reception between the outdoor unit and indoor units just after the connection of the outdoor unit and indoor units using the three connection lines, normal signal transmission and signal reception are performed under a condition that the three connection lines are connected normally, while normal signal transmission and signal reception are not performed under a condition that the three connection lines are not connected normally. Therefore, it is judged whether or not the three connection lines are connected normally.

[0021] Consequently, destroying and snapping or the like of transmission and reception circuitry components due to mis-wiring are prevented from occurrence by forcibly determining the operation condition of the second transmission photo-coupler and by limiting the current using the second resistance means which suppresses over current due to mis-wiring. Communication speed is improved by determining the power supply for communication to be D.C. power. Increase in cost and increase in installation space are prevented because circuitry components having nothing to do with normal indoor-outdoor communication operation such as power switch means, abnormal voltage detection protection section are not required at all.

[0022] When the indoor-outdoor communication device in air conditioner of claim 3 is employed, current suppressing effect under mis-wiring condition is improved and the operation and effect which are similar to those of claim 1 or claim 2 are realized because the device employs a positive temperature characteristic thermistor as the second resistance means.

[0023] When the indoor-outdoor communication device in air conditioner of claim 4 is employed, and when the air conditioner is operated with transmitting and receiving signal between the outdoor unit and indoor unit by connecting one of the outdoor unit and indoor unit and the other of the outdoor unit and indoor unit via three connection lines including commercial power supply lines, A.C. power is supplied to one of the outdoor unit and indoor unit from the commercial A.C. power supply and A.C. power is supplied to the second power supply means of the other of the outdoor unit and indoor unit from the commercial A.C. power supply via the commercial power supply lines and the transformer. Communication signal from the first control means is received by the second reception photo-coupler of the other of the outdoor unit and indoor unit via the first

transmission photo-coupler, reception signal of the second reception photo-coupler is supplied to the second control means so as to control the other of the outdoor unit and indoor unit. Further, communication signal from the second control means is received by the first reception photo-coupler of the one of the outdoor unit and indoor unit via the second transmission photo-coupler, the reception signal of the first reception photo-coupler is supplied to the first control means so as to perform monitoring or the like of the other of the outdoor unit and indoor unit.

[0024] Further, when the outdoor unit and indoor unit are disposed and each control means is operated for performing signal transmission and signal reception between the outdoor unit and indoor unit just after the connection of the outdoor unit and indoor unit using the three connection lines, normal signal transmission and signal reception are performed under a condition that the three connection lines are connected normally, while normal signal transmission and signal reception are not performed under a condition that the three connection lines are not connected normally. Therefore, it is judged whether or not the three connection lines are connected normally. Furthermore, when mis-wiring is realized, a normal voltage is not generated in the output side of the transformer due to generation of a current loop passing through the first resistance means. Therefore, species of mis-wiring is recognized by detecting the above condition using the abnormal voltage detection means.

[0025] Consequently, destroying and snapping or the like of transmission and reception circuitry components due to mis-wiring are prevented from occurrence by forcibly determining the operation condition of the second transmission photo-coupler and by limiting the current using the second resistance means which suppresses over current due to mis-wiring. Communication speed is improved by determining the power supply for communication to be D.C. power. Increase in cost and increase in installation space are prevented because circuitry components having nothing to do with normal indoor-outdoor communication operation such as power switch means, abnormal voltage detection protection section are not required at all.

[0026] When the indoor-outdoor communication device in air conditioner of claim 5 is employed, and when the air conditioner is operated with transmitting and receiving signal between the outdoor unit and indoor units by connecting the indoor units to the outdoor unit via three connection lines including commercial power supply lines in parallel with each other, A.C. power is supplied to the outdoor unit from the commercial A.C. power supply and A.C. power is supplied to the indoor controlling power supply means of each indoor unit from the commercial A.C. power supply via the commercial power supply lines. Communication signal from the outdoor control means is received by the indoor reception photo-coupler via the outdoor transmission photo-coupler, reception signal of the indoor reception photo-coupler is supplied to the indoor control means so as to control the indoor unit. Further, communication signal from the indoor control means is received by the outdoor reception photo-coupler via the indoor transmission photo-coupler, the reception signal of the outdoor reception photo-coupler is supplied to the outdoor control means so as to perform monitoring or the like of the indoor unit.

[0027] Further, when the outdoor unit and a plurality of indoor units are disposed and each control means is operated for performing signal transmission and signal reception between the outdoor unit and indoor units just after the connection of the outdoor unit and indoor units using the three connection lines, normal signal transmission and signal reception are performed under a condition that the three connection lines are connected normally, while normal signal transmission and signal reception are not performed under a condition that the three connection lines are not connected normally. Therefore, it is judged whether or not the three connection lines are connected normally.

[0028] Consequently, destroying and snapping or the like of transmission and reception circuitry components due to mis-wiring are prevented from occurrence by forcibly determining the operation condition of the second transmission photo-coupler and by limiting the current using the second resistance means which suppresses over current due to mis-wiring. Communication speed is improved by determining the power supply for communication to be D.C. power. Increase in cost and increase in installation space are prevented because circuitry components having nothing to do with normal indoor-outdoor communication operation such as power switch means, abnormal voltage detection protection section are not required at all.

Brief Description of the Drawings

[0029]

Figure 1 is an electric diagram illustrating an indoor-outdoor communication device in air conditioner of an embodiment;

Figure 2 is a flowchart useful in understanding mis-wiring judgment operation of an indoor unit;

Figure 3 is a flowchart useful in understanding mis-wiring judgment operation of an outdoor unit;

Figures 4(A) through 4(F) are signal waveform diagrams useful in understanding a mis-wiring judgment timing when the power is turned ON;

Figures 5(A) through 5(F) are waveform diagrams useful in understanding communication from the outdoor unit to the indoor unit when mis-wiring is not realized;

Figures 6(A) through 6(F) are waveform diagrams useful in understanding communication from the indoor unit 1 to the outdoor unit and indoor unit 2

when mis-wiring is not realized;

Figures 7(A) through 7(E) are waveform diagrams useful in understanding communication data between the outdoor unit and indoor unit and communication signal line operation;

Figures 8(A) through 8(E) are diagrams useful in understanding mis-wiring patterns when the outdoor unit and one indoor unit exist;

Figures 9(AA) through 9(AE) are diagrams useful in understanding mis-wiring patterns when the outdoor unit and two indoor units exist;

Figure 10 is a diagram representing a condition that the commercial power supply line 3a and the signal line 3c are mis-wired;

Figure 11 is a diagram representing a condition that the commercial power supply line 3b and the signal line 3c are mis-wired;

Figure 12 is a diagram representing a condition that the commercial power supply lines 3a and 3b are mis-wired;

Figure 13 is a diagram representing a condition that the commercial power supply lines 3a is mis-wired with the signal line 3c, signal line 3c is mis-wired with the commercial power supply line 3b, and the commercial power supply line 3b is mis-wired with the commercial power supply line 3a;

Figure 14 is a diagram representing a condition that the commercial power supply lines 3a is mis-wired with the commercial power supply line 3b, signal line 3c is mis-wired with the commercial power supply line 3a, and the commercial power supply line 3b is mis-wired with the signal line 3c;

Figure 15 is an electric diagram illustrating an indoor-outdoor communication device in air conditioner of another embodiment; and

Figure 16 is a flowchart useful in understanding mis-wiring judgment operation of an indoor unit.

Best Mode for Carrying Out the Invention

[0030] Hereinafter, referring to the attached drawings, we explain the indoor-outdoor communication device in air conditioner of embodiments according to the present invention in detail.

[0031] Fig. 1 is an electric diagram illustrating an indoor-outdoor communication device in air conditioner of an embodiment according to the present invention.

[0032] This air conditioner includes one outdoor unit 1 and a plurality of indoor units 2. The plurality of indoor units 2 are connected to the outdoor unit 1 via three connection lines 3 in parallel with each other.

[0033] The outdoor unit 1 includes a half-wave rectification D.C. power supply circuitry (D.C. power supply means) 12 connected between terminals of a commercial A.C. power supply 10, an outdoor controlling D.C. power supply 11 as an outdoor controlling power supply means connected between terminals of the commercial A.C. power supply 10, an outdoor micro-computer 14 as a outdoor control means, an outdoor transmission photo-coupler 15 connected to a transmission port of the outdoor micro-computer 14, an outdoor reception photo-coupler 16 connected to a reception port of the outdoor micro-computer 14, and a termination resistance 17 as a first resistance means connected in parallel with the outdoor reception photo-coupler 16. The termination resistance 17 is a resistance for determining an impedance of a communication line to be a constant impedance and for devising a countermove to mis-operation due to floating capacity of wiring cables (communication lines) for connecting the indoor unit and outdoor unit. The termination resistance 17 is a resistance which is necessary for usual communication.

[0034] And, a light reception element 15b of the outdoor transmission photo-coupler 15, a first diode 18a, a third resistance 18b (a resistance having a resistance value for performing sufficient current limitation for the light reception element 15b of the outdoor transmission photo-coupler 15 when mis-wiring is realized and for performing communication using the light reception element 15b of the outdoor transmission photo-coupler 15), a second diode 18c, a fourth resistance 18d (a resistance having a resistance value for limiting a current so as to prevent destroyment of a light emitting element 16a of the outdoor reception photo-coupler 16 when mis-wiring is realized and for performing communication using the light reception element 16a of the outdoor reception photo-coupler 16), the light emitting element 16a of the outdoor reception photo-coupler 16, and a Zener diode 18e are connected in series, and this series connection circuitry is connected in parallel with a rectification circuitry section of the half-wave rectification D.C. power supply circuitry 12. A collector terminal of a transistor 15c is connected in series to a light emitting element 15a of the outdoor transmission photo-coupler 15. An emitter terminal of the transistor 15c is connected to the ground. A resistance 15d is connected between a base terminal and the emitter terminal of the transistor 15c. A resistor 15e is connected between the base terminal of the transistor 15c and the transmission port of the outdoor micro-computer 14. Further, a reference numeral 15f represents a resistance connected between the output terminal of the output controlling D.C. power supply 11 and the light emitting element 15a of the outdoor transmission photo-coupler 15. An emitter terminal of a light receiving element 16a of the outdoor reception photo-coupler 16 is connected to the ground via a resistance 16c, and a connection point of an emitter terminal of the light receiving element 16b and the resistance 16c is connected to the reception port of the outdoor micro-computer 14.

[0035] Further, a digital transistor can be employed instead the electric circuitry consisting of the transistor 15c, and the resistances 15d and 15e, and the porality can be determined to suit a signal which is intended to be output.

[0036] The three indoor-outdoor connection lines 3

consist a pair of commercial power supply lines 3a and 3b and one communication signal line 3c. The pair of commercial power supply lines 3a and 3b are connected to both terminals of the commercial A.C. power supply 10, and the communication signal line 3c is connected to a connection point of the third resistance 18b and second diode 18c.

[0037] The indoor unit 2 includes a control D.C. power supply 21 as a indoor controlling power supply means connected between the pair of commercial power supply lines 3a and 3b, an indoor micro-computer 22 as an indoor control means, an indoor transmission photo-coupler 23 connected to a transmission port of the indoor micro-computer 22, an indoor reception photo-coupler 24 connected to a reception port of the indoor micro-computer 22, and a positive temperature characteristic thermister 25 for protecting against over current as a second resistance having a positive temperature coefficient which thermister 25 is connected in series with a collector terminal of a photo-transistor 23b of the indoor transmission photo-coupler 23.

[0038] A third diode 26a, a fifth resistance 26b (a resistance having a resistance value for limiting a current so as to prevent destroyment of a light emitting element 24a of the indoor reception photo-coupler 24 when mis-wiring is realized and for performing communication using the light emitting element 24a of the indoor reception photo-coupler 24), the light emitting element 24a of the indoor reception photo-coupler 24 and a zener diode 26c are connected in series, and this series connection circuitry is connected in parallel with the termination resistance 17 via the commercial power supply line 3b and the communication signal line 3c.

[0039] Further, the series connection circuitry consisting of the positive temperature characteristic thermister 25 and the light receiving element 23b of the indoor transmission photo-coupler 23 is connected in parallel with the series connection circuitry consisting of the fifth resistance 26b, the light emitting element 24a of the indoor reception photo-coupler 24 and the zener diode 26c. Furthermore, a cathode terminal of the light emitting element 23a of the indoor transmission photo-coupler 23 is connected to the ground via a resistance 23c, an anode terminal of the light emitting element 23a is connected to a collector terminal of a transistor 23d, a resistance 23e is connected between the emitter terminal and a base terminal of the transistor 23d, and the base terminal of the transistor 23d is connected to a transmission port of the indoor micro-computer 22 via a resistance 23f. A reference numeral 23g represents a pull-up resistance connected to the transmission port of the indoor micro-computer 22.

[0040] An emitter terminal of a light reception element 24b of the indoor reception photo-coupler 24 is connected to the ground via a resistance 24c, and a connection point of the emitter terminal of the light reception element 24b and the resistance 24c is connected to the reception port of the indoor micro-computer 22.

[0041] A digital transistor can be employed instead the electric circuitry consisting of the transistor 23c, and the resistances 23d and 23e, and the porality can be determined to suit a signal which is intended to be output. Further, the positive temperature characteristic thermister 25 has function and operation which protect a switching over current of the light reception element 23b of the indoor transmission photo-coupler 23 when normal communication is carried out.

[0042] Fig. 2 is a flowchart useful in understanding mis-wiring judgment operation of the indoor unit.

[0043] In step SP1, the transmission port of the indoor micro-computer 22 is turned ON (the light receiving element 23b of the indoor transmission photo-coupler 23 is turned OFF). In step SP2, it is judged whether or not a commercial power frequency interruption exists. When it is judged that the commercial power frequency interruption exists, in step SP3, it is recognized that the connection of the indoor-outdoor connection lines 3 is abnormal. In step SP4, the transmission port of the indoor micro-computer 22 is turned OFF (the light receiving element 23b of the indoor transmission photo-coupler 23 is turned ON). Then, the series of operation is finished.

[0044] On the contrary, when it is judged in step SP2 that the commercial power frequency interruption does not exist, in step SP5, it is recognized that the connection of the indoor-outdoor connection lines 3 is normal. In step SP6, an operation based upon the normal sequence is carried out.

[0045] Fig. 3 is a flowchart useful in understanding mis-wiring judgment operation of the outdoor unit.

[0046] In step SP1, the transmission port of the outdoor micro-computer 14 is turned OFF (the light receiving element 15b of the outdoor transmission photo-coupler 15 is turned OFF). In step SP2, it is judged whether or not a reception data interruption exists. When it is judged that the reception data interruption exists, in step 8, it is recognized that the connection of the indoor-outdoor connection lines 3 is abnormal. Then, the operation in step SP1 is carried out again. On the contrary, when it is judged that the reception data interruption does not exist in step SP2, in step SP3, waiting operation is carried out till a mis-wiring judgment time period of the indoor unit 2 has passed. In step SP4, the transmission port of the outdoor micro-computer 14 is turned ON (the light receiving element 15b of the outdoor transmission photo-coupler 15 is turned ON). In step SP5, it is judged whether or not a transmission output and a reception input are equal to one another. When it is judged that the transmission output and the reception input are not equal to one another, the operation in step SP8 is carried out. On the contrary, when it is judged that the transmission output and the reception input are not equal to one another in step SP5, in step SP6, it is recognized that the connection of the indoor-outdoor connection lines 3 is normal. In step 7, an oper-

ation based upon the normal sequence is carried out.

[0047] Figs. 4(A) through 4(F) are signal waveform diagrams useful in understanding a mis-wiring judgment timing when the power is turned ON.

[0048] When the power is turned ON as is illustrated in Fig. 4(A) and when the reset operation is carried out as is illustrated in Fig. 4(B), the outdoor transmission output and outdoor reception input turn to low level as are illustrated in Figs. 4(C) and 4(D), and the indoor transmission output turns to high level while the indoor reception input turns to low level as are illustrated in Figs. 4(E) and 4(F).

[0049] And, during a first time period after the reset operation {interruption judgment time period in Fig. 4(C)}, the judgment for the reception data interruption in step SP2 of the flowchart illustrated in Fig. 3 is carried out. During following second time period {indoor unit judgment time period Wait in Fig. 4(C)}, the waiting operation in step SP3 of the flowchart illustrated in Fig. 3 is carried out. During following third time period {input-output coincidence judgment time period in Fig. 4(C)}, the input-output coincidence judgment operation in step SP5 of the flowchart illustrated in Fig. 3 is carried out so that it is judged whether or not the connection of the indoor-outdoor connection lines 3 is normal.

[0050] Further, during a fourth time period after the reset operation {a time period longer than the first time period and shorter than a sum time period of the first time period and the second time period: commercial power frequency interruption judgment time period in Fig. 4(F)}, the commercial power frequency interruption judgment operation is carried out.

[0051] Description is made in more detail.

[0052] After the power is turned ON, the light receiving element 15b of the outdoor transmission photo-coupler 15 managing the generation of the outdoor unit transmission signal is turned OFF. When the outdoor unit reception circuitry receives some pulse signal despite of that the power supply for communication of the outdoor unit is not carried out, it is judged that the outdoor unit is mis-wired and the light receiving element 15b of the outdoor transmission photo-coupler 15 is maintained to be in OFF condition, so that communication circuitry elements are protected when mis-wired condition is realized.

[0053] When the reception circuitry of the indoor unit detects pulses having a commercial power frequency based upon the input of the reception circuitry, the light receiving element 23b of the indoor transmission photo-coupler 23 is turned ON which operation is reverse to the operation of the light receiving element 15b of the outdoor transmission photo-coupler 15 so as to make short circuit of the communication signal line 3c and one of the commercial power supply lines. Therefore, the light receiving element 23b of the indoor transmission photo-coupler 23 is protected so as not to applied a voltage which is over the resistance voltage of the photo-coupler even when the outdoor unit does not know the mis-wiring and when the outdoor unit transmits data. Further, the commercial power supply lines become short circuit condition when this operation is carried out in some mis-wired pattern. In view of this problem, the positive temperature characteristic thermister 25 for protecting against over current is connected in series to the light receiving element 23b of the indoor transmission photo-coupler 23 for the purpose of communication current limitation and damping so that the transmission and reception circuitry of the indoor unit suffers no damage even when the commercial power supply lines become short circuit condition. Therefore, the resistance value of the positive temperature characteristic thermister 25 rapidly increases due to the self-heating thereof when the commercial power supply lines become short circuit condition. As a result, the short circuit current is suppressed so as to protect the light receiving element 23b of the indoor transmission photo-coupler 23.

[0054] Further, the automatic reset is possible so that the communication circuitry is protected prior to destroyment by employing the arrangement in which the micro-computer can be self-reset using a watch-dog-timer even when the micro-computer runs away due to mis-wiring.

[0055] Figs. 5(A) through 5(F) are waveform diagrams useful in understanding communication from the outdoor unit to the indoor unit when mis-wiring is not realized. Figs. 5(A), 5(B), 5(C), 5(D), 5(E) and 5(F) represent an outdoor transmission waveform, outdoor reception waveform, indoor 1 transmission waveform, indoor 1 reception waveform, indoor 2 transmission waveform and indoor 2 reception waveform, respectively. But, actual communication waveforms are determined based upon the communication rule between outdoor unit and indoor unit, therefore the waveforms illustrated in Figs. 5(A) through 5(F) are not always realized.

[0056] In this case, turning OFF-ON operation following the transmission signal is carried out after the outdoor transmission waveform turning ON and maintaining ON condition for a predetermined time period from the OFF condition. The light emitting element 15a of the outdoor transmission photo-coupler 15 is controlled by the electric circuitry consisting of the transistor 15c, and resistances 15d and 15e, and a reception signal outputting terminal from the light receiving element 16b of the outdoor reception photo-coupler 16 and a reception signal outputting terminal from the light receiving element 24b of the indoor reception photo-coupler 24 are determined to have the arrangements which are illustrated in Fig. 1. Therefore, the outdoor reception waveform becomes a waveform which is coincident to the outdoor transmission waveform, and the indoor 1 reception waveform and indoor 2 reception waveform become waveforms each is coincident to the outdoor transmission waveform. And, the indoor unit 1 and indoor unit 2 do not transmit signals, therefore the

indoor 1 transmission waveform and indoor 2 transmission waveform are maintained to be ON condition.

[0057] Figs. 6(A) through 6(F) are waveform diagrams of an example useful in understanding communication from the indoor unit 1 to the outdoor unit and indoor unit 2 when mis-wiring is not realized. Figs. 6(A), 6(B), 6(C), 6(D), 6(E) and 6(F) represent an outdoor transmission waveform, outdoor reception waveform, indoor 1 transmission waveform, indoor 1 reception waveform, indoor 2 transmission waveform and indoor 2 reception waveform, respectively. But, actual communication waveforms are determined based upon the communication rule between outdoor unit and indoor unit, therefore the waveforms illustrated in Figs. 6(A) through 6(F) are not always realized.

[0058] In this case, turning OFF-ON operation following the transmission signal is carried out after the indoor 1 transmission waveform maintaining ON condition for a predetermined time period. The light emitting element 23a of the indoor transmission photo-coupler 23 is controlled by the electric circuitry consisting of the transistor 23c, and resistances 23d and 23e, and a reception signal outputting terminal from the light receiving element 16b of the outdoor reception photo-coupler 16 and a reception signal outputting terminal from the light receiving element 24b of the indoor reception photo-coupler 24 are determined to have the arrangements which are illustrated in Fig. 1. Therefore, the indoor 1 reception waveform becomes a waveform which is coincident to the indoor 1 transmission waveform, and the outdoor reception waveform and indoor 2 reception waveform become waveforms each is coincident to the indoor 1 transmission waveform. And, the outdoor unit and indoor unit 2 do not transmit signals, therefore the outdoor transmission waveform and indoor 2 transmission waveform are maintained to be ON condition.

[0059] Figs. 7(A) through 7(E) are waveform diagrams of an example useful in understanding communication data between the outdoor unit and indoor unit and communication signal line operation. Figs. 7(A), 7(B), 7(C), 7(D) and 7(E) represent an outdoor transmission waveform, outdoor reception waveform, communication line waveform, indoor 1 transmission waveform and indoor 1 reception waveform, respectively. But, actual communication waveforms are determined based upon the communication rule between outdoor unit and indoor unit, therefore the waveforms illustrated in Figs. 7(A) through 7(E) are not always realized.

[0060] In this case, turning OFF-ON operation following the transmission signal is carried out so as to transmit data after the outdoor transmission waveform turning ON and maintaining ON condition for a predetermined time period from the OFF condition. The light emitting element 23a of the indoor transmission photo-coupler 23 is controlled by the electric circuitry consisting of the transistor 23c, and resistances 23d and 23e, and a reception signal outputting terminal from the light receiving element 16b of the outdoor reception photo-coupler 16 is determined to have the arrangements which is illustrated in Fig. 1. Therefore, the outdoor reception waveform becomes a waveform which is coincident to the outdoor transmission waveform, consequently the transmission data can be monitored. Of course, this data is supplied to the indoor unit 1 via the signal line 3c, and the reception signal outputting terminal from the light receiving element 24b of the indoor reception photo-coupler 24 is determined to have the arrangements which is illustrated in Fig. 1. Therefore, the communication line waveform and indoor 1 reception waveform become waveforms each is coincident to the outdoor transmission waveform. And, the indoor unit 1 does not transmit signals, therefore the indoor 1 transmission waveform is maintained to be ON condition.

[0061] After the data transmission from the outdoor unit to the indoor unit 1 has carried out in the above manner, data is transmitted by carrying out turning OFF-ON of the indoor 1 transmission waveform following the transmission signal. The light emitting element 23a of the indoor transmission photo-coupler 23 is controlled by the electric circuitry consisting of the transistor 23c, and resistances 23d and 23e, and a reception signal outputting terminal from the light receiving element 24b of the outdoor reception photo-coupler 24 is determined to have the arrangements which is illustrated in Fig. 1. Therefore, the indoor 1 reception waveform becomes a waveform which is coincident to the indoor 1 transmission waveform, consequently the transmission data can be monitored. Of course, this data is supplied to the outdoor unit via the signal line 3c, and the reception signal outputting terminal from the light receiving element 16b of the indoor reception photo-coupler 16 is determined to have the arrangements which is illustrated in Fig. 1. Therefore, the communication line waveform and outdoor reception waveform become waveforms each is coincident to the indoor 1 transmission waveform. And, the outdoor unit does not transmit signals, therefore the outdoor transmission waveform is maintained to be ON condition.

[0062] Mis-wired patterns are illustrated in Figs. 8(A) through 8(E) and in Figs. 9(AA) through 9(AE). Figs. 8(A) through 8(E) represent cases in which an outdoor unit and one indoor unit exist, while Figs. 9(AA) through 9(AE) represent cases in which an outdoor unit and two indoor units exist.

[0063] Figs. 9(AA) through 9(AE) represent cases in which mis-wired pattern illustrated in Fig. 8(A) is realized between the outdoor unit and the first indoor unit, and mis-wired patterns illustrated in Figs. 8(A) through 8(E) are realized between the first indoor unit and the second indoor unit, respectively. That is, Figs. 9(AA) through 9(AE) represent cases in which the above mis-wired patterns are combined. Therefore, mis-wired patterns illustrated in Figs. 9(AA) through 9(AE) are principally same to the mis-wired patterns illustrated in Figs.

8(A) through 8(E). Even when a number of mis-wired indoor units is increased, mis-wired patterns are principally same to the mis-wired patterns illustrated in Figs. 8(A) through 8(E).

[0064] Next, operations for cases are described in detail by referring to Figs. 10 through 14, the cases corresponding to the mis-wired patterns illustrated in Figs. 8(A) through 8(E), respectively.

[0065] Fig. 10 is a diagram representing a condition that the commercial power supply line 3a and the signal line 3c are mis-wired.

[0066] In Fig. 10, the third diode 26a, the fifth resistance 26b, the light emitting element 24a of the indoor reception photo-coupler 24 and the zener diode 26c are connected in series between the output terminals of the commercial A.C. power supply 10. Therefore, a current flows at every half cycle of the commercial A.C. power supply 10 as is illustrated with an arrow A1 in Fig. 10. In this case, the indoor controlling D.C. power supply 21 is shut off from the commercial A.C. power supply 10 so that the operation power is not supplied to the indoor micro-computer 22. Consequently, the indoor micro-computer 22 does not operate. In this case, the current directly flows the light emitting element 24a of the indoor reception photo-coupler 24. But, the fifth resistance 26b is connected in series so that destroyment of the light emitting element 24a is prevented from occurrence.

[0067] Further in this case, signal from the indoor unit 2 is not supplied to the outdoor unit 1 at all so that mis-wiring is detected in the outdoor unit 1 based upon the time-out after the signal transmission.

[0068] Fig. 11 is a diagram representing a condition that the commercial power supply line 3b and the signal line 3c are mis-wired.

[0069] In Fig. 11, currents flow the series connection circuitry consisting of the second diode 18c, the fourth resistance 18d, the light emitting element 16a of the outdoor reception photo-coupler 16 and the zener diode 18e and the termination resistance 17 which is connected in parallel with the series connection circuitry through the controlling D.C. power supply 21 of the indoor unit 2 as is illustrated by an arrow A1 during a half cycle of the commercial A.C. power supply 10 so that the reception data interruption is generated for the outdoor micro-computer 14. Further, during the other half cycle of the commercial A.C. power supply 10, currents flow the series connection circuitry consisting of the third diode 26a, the fifth resistance 26b, the light emitting element 24a of the indoor reception photo-coupler 24 and the zener diode 26c and the termination resistance 17 which is connected in parallel with the series connection circuitry, and further flow the controlling D.C. power supply 21 of the indoor unit 2. Consequently, the controlling D.C. power supply 21 of the indoor unit 2 rises, therefore the indoor micro-computer 22 rises so that commercial power frequency interruption for the indoor micro-computer 22 is detected. Consequently, it is detected that mis-wiring is generated by the operation of the flowchart illustrated in Fig. 2 and by the operation of the flowchart illustrated in Fig. 3. In this case, the fifth resistance 26b is connected in series to the light emitting element 24a of the indoor reception photo-coupler 24 and the commercial power is supplied to this series connection circuitry through the controlling D.C. power supply 21, therefore a disadvantage is prevented from occurrence such that the light emitting element 24a is destroyed. Further, the fourth resistance 18d is connected in series to the light emitting element 16a of the outdoor reception photo-coupler 16, the termination resistance 17 is connected in parallel with the light emitting element 16a of the outdoor reception photo-coupler 16, and the commercial power is supplied to those circuits through the controlling D.C. power supply 21, therefore a disadvantage is prevented from occurrence such that the light emitting element 16a is destroyed.

[0070] Fig. 12 is a diagram representing a condition that the commercial power supply lines 3a and 3b are mis-wired.

[0071] In Fig. 12, a current flows only the controlling D.C. power supply 21 of the indoor unit 2 as is illustrated by an arrow A1 during a half cycle of the commercial A.C. power supply 10. Further, currents flow the termination diode 17 and the series connection circuitry consisting of the third diode 26a, the fifth resistance 26b, the light emitting element 24a of the indoor reception photo-coupler 24 and the zener diode 26c, then flow the controlling D.C. power supply 21 of the indoor unit 2 as is illustrated by an arrow A2 during the other half cycle of the commercial A.C. power supply 10. In this case, both terminals of the commercial A.C. power supply 10 are connected to the controlling D.C. power supply 21 of the indoor unit 2 in an exchanged condition so that the controlling D.C. power supply 21 operates normally and the indoor micro-computer 22 operates normally. As a result, electricity passes through the light emitting element 24a of the in door reception photo-coupler 24 so that the commercial power frequency interruption for the indoor micro-computer 22 is generated. Therefore, it is detected that mis-wiring is generated by the operation of the flowchart illustrated in Fig. 2 and by the operation of the flowchart illustrated in Fig. 3. That is, existing or non-existing of mis-wiring is judged as consequence by judging the input and the output whether they are coincident or not to one another. In this case, the fifth resistance 26b is connected in series to the light emitting diode 24a of the indoor reception photo-coupler 24, and electricity passes through the termination resistance 17 and this series connection circuitry, therefore a disadvantage is prevented from occurrence such that the light emitting element 24a of the indoor reception photo-coupler 24 is destroyed.

[0072] Fig. 13 is a diagram representing a condition that the commercial power supply lines 3a is mis-wired with the signal line 3c, signal line 3c is mis-wired with the commercial power supply line 3b, and the commer-

cial power supply line 3b is mis-wired with the commercial power supply line 3a.

[0073] In Fig. 13, currents flow the series connection circuitry consisting of the third diode 26a, the fifth resistance 26b, the light emitting element 24a of the indoor reception photo-diode 24 and the zener diode 26c, then flow the series connection circuitry consisting of the second diode 18c, the fourth resistance 18d, the light emitting element 16a of the outdoor reception photo-coupler 16 and the zener diode 18e and the termination resistance 17 connected in parallel with this series connection circuitry as is illustrated by an arrow A1 during a half cycle of the commercial A.C. power supply 10. In this case, the controlling D.C. power supply 21 of the indoor unit 2 does not rise, then the indoor micro-computer 22 does not rise, so that the commercial power frequency interruption is not generated. But, the reception data interruption is generated for the outdoor micro-computer 14. Therefore, it is detected that mis-wiring is generated by the operation of the flowchart illustrated in Fig. 3. In this case, the fifth resistance 26b and the termination resistance 17 are connected in series to the light emitting element 24a of the indoor reception photo-coupler 24, the fifth resistance 26b, the fourth resistance 18d and the light emitting element 16a of the outdoor reception photo-coupler 16 are connected in series to the light emitting element 24a of the indoor reception photo-coupler 24, therefore disadvantages are prevented from occurrence such that the light emitting element 24a of the indoor reception photo-coupler 24 is destroyed and that the light emitting element 16a of the outdoor reception photo-coupler 16 is destroyed.

[0074] In this case, the signal from the indoor unit 2 is not supplied to the outdoor unit 1 so that it is detected that mis-wiring is realized by the outdoor unit 1 based upon the time-out after the signal transmission.

[0075] Fig. 14 is a diagram representing a condition that the commercial power supply lines 3a is mis-wired with the commercial power supply line 3b, signal line 3c is mis-wired with the commercial power supply line 3a, and the commercial power supply line 3b is mis-wired with the signal line 3c.

[0076] In Fig. 14, currents flow the controlling D.C. power supply 21 of the indoor unit 2, then flow the series connection circuitry consisting of the second diode 18c, the fourth resistance 18d, the light emitting element 16a of the outdoor reception photo-coupler 16 and the termination resistance 17 connected in parallel with this series connection circuitry so that the reception data interruption is generated for the outdoor micro-computer 14 as is illustrated by an arrow A1 during a half cycle of the commercial A.C. power supply 10. Further, a current flows the termination resistance 17 and the controlling D.C. power supply 21 of the indoor unit 2, and a current flows the third diode 26a, the fifth resistance 26b, the light emitting element 24a of the indoor reception photo-coupler 24 and the zener diode 26c as is illustrated by an arrow A2 during the other half cycle of the commercial A.C. power supply 10, so that the controlling D.C. power supply 21 of the indoor unit 2 rises, the commercial power frequency interruption is generated for the indoor micro-computer 22, accordingly. Therefore, it is detected that mis-wiring is generated by the operation of the flowchart illustrated in Fig. 2 and by the operation of the flowchart illustrated in Fig. 2. In this case, the commercial A.C. power is directly applied to the series connection circuitry consisting of the light emitting element 24a of the indoor reception photo-coupler 24 and the fifth resistance 26b. But, a disadvantage is prevented from occurrence such that the light emitting element 24a of the indoor reception photo-coupler 24 is destroyed because the fifth resistance 26b is connected in series to the light emitting element 24a of the indoor reception photo-coupler 24. Further, the fourth resistance 18d is connected in series to the light emitting element 16a of the outdoor reception photo-coupler 16, and the termination resistance 17 is connected in parallel with the light emitting element 16a of the outdoor reception photo-coupler 16, so that a disadvantage is prevented from occurrence such that the light emitting element 16a is destroyed.

[0077] Of course in any one of Figs. 10 through 14, the positive temperature characteristic thermister 25 for protecting against over current is connected in series to the light receiving element 23b of the indoor reception photo-coupler 23. Therefore, a disadvantage is prevented from occurrence such that the light receiving element 23b of the indoor reception photo-coupler 23 is destroyed even when the commercial A.C. power voltage is directly applied to the series connection circuitry and when the light receiving element 23b of the indoor transmission photo-coupler 23 is turned ON.

[0078] As is apparent from the foregoing, judgment whether or not mis-wiring is realized is carried out by judging whether or not the commercial power frequency interruption exists, by judging whether or not the reception data interruption exists, and by judging whether or not the transmission output and the reception input coincident to one another after turning ON of the transmission port of the outdoor micro-computer 14.

[0079] Further, mis-wiring protection circuitry or the like which is necessary only when mis-wiring is realized and which has nothing to do with the operation when normal operation is carried out, so that the transmission control circuitry having a low cost and a saved space can be offered. Furthermore, the apparatus operates safely without giving damage to the transmission and reception circuitry elements even when mis-wiring is realized so that the system can be offered which is not required exchanging of a base-board and which is superior in maintaining.

[0080] As to the indoor-outdoor transmission and reception data patterns, the transmission data appears on the reception port as it is, so that communication operation programs of the outdoor unit and the indoor

unit are in common to one another, and the transmission and reception can be carried out from any one of the outdoor unit and indoor unit in the initial communication condition. Further, data transmitted from one unit is received by each unit simultaneously so that the system having high transmission efficiency and high development efficiency can be offered.

[0081] In the above embodiment, the positive temperature characteristic thermister for protecting against over current is employed as the second resistance means having a positive temperature coefficient, but a resistance element made by combining conductive carbon and polymer such as polyolefine, fluororesin or the like can be employed instead the positive temperature characteristic thermister for protecting against over current.

[0082] Fig. 15 is an electric diagram illustrating an indoor-outdoor communication device in air conditioner of another embodiment according to the present invention.

[0083] This air conditioner is different from the air conditioner illustrated in Fig. 1 in that a damping resistance 25' is employed instead the positive temperature characteristic thermister 25, that a power supply including a transformer 12a which is connected its primary winding between the output terminals of the commercial A.C. power supply 10, a rectification circuitry 21b connected between the terminals of the secondary winding of the transformer 21a, and an indoor controlling D.C. power supply circuitry 21c for receiving the rectification output from the rectification circuitry 21b and for carrying out smoothing operation and voltage stabilizing operation or the like is employed as the power supply 21, and that a circuitry, device or the like for inputting an input for detecting abnormal condition from the abnormal voltage detection circuitry is employed as the abnormal voltage detection circuitry and the indoor micro-computer 22.

[0084] Description is made in more detail.

[0085] A resistance 21d is connected between the output terminal of the indoor controlling D.C. power supply circuitry 21c and an abnormal detection input of the indoor micro-computer 22, and the abnormal detection input is connected to the ground via the collector-emitter terminals of a transistor 21e. A resistance 21f is connected between the base terminal and the emitter terminal of the transistor 21e, and a zener diode (abnormal voltage detection means) 21g and a resistance 21h are connected in series and in this order between the input terminal of the input terminal of the indoor controlling D.C. power supply circuitry 21 and the base terminal of the transistor 21e. Therefore, the transistor 21e, resistances 21d, 21f, 21h and the zener diode 21g consist the abnormal voltage detection means (circuitry). Further, a digital transistor can be employed instead the electric circuitry consisting of the transistor 21e and resistances 21f and 21h, and the polarity can be determined so as to match the signal which is to be output.

[0086] Fig. 16 is a flowchart useful in understanding mis-wiring judgment operation of an indoor unit.

[0087] In step SP1, the transmission port of the indoor micro-computer 22 is turned ON (the light receiving element 23b of the indoor transmission photo-coupler 23 is turned OFF). In step SP2, it is judged whether or not the commercial power frequency interruption exists. When it is judged that the commercial power frequency interruption exists, in step SP3, it is recognized that the connection of the indoor-outdoor connection lines 3 is abnormal. In step SP4, it is judged whether or not the abnormal voltage is detected. When the abnormal voltage is detected, in step SP5, it is recognized that the mis-wiring is a mis-wiring (mis-wiring illustrated in Fig. 11 or Fig. 14) other than reversing in polarity. In step SP6, the transmission port of the indoor micro-computer 22 is turned ON (the light receiving element 23b of the indoor transmission photo-coupler 23 is turned OFF). Then, the series of operation is finished.

[0088] When it is judged in step SP4 that the abnormal voltage is not detected, in step SP7, it is judged that the mis-wiring is a mis-wiring which is reversed in polarity (mis-wiring illustrated in Fig. 12). In step SP8, the transmission port of the indoor micro-computer 22 is turned OFF (the light receiving element 23b of the indoor transmission photo-coupler 23 is turned ON). Then, the series of operation is finished.

[0089] When it is judged in step SP2 that the commercial power frequency interruption does not exist, in step SP9, it is recognized that the connection of the indoor-outdoor connection lines 3 is normal. In step SP10, the operation based upon the ordinary sequence is carried out.

[0090] Description is made in more detail.

[0091] When mis-wiring is generated, a current-loop is realized which certainly passes through the termination resistance 17. Therefore, a normal voltage is not generated in the secondary side of the transformer 21a when the resistance value of the termination resistance 17 is determined to be greater than the impedance of the transformer 21a. When the mis-wiring is realized and when the power supply (indoor controlling D.C. power supply circuitry 21c) of the indoor micro-computer 22 is risen, the voltage in the secondary side of the transformer 21a can be monitored. Further, the species of mis-wiring can be detected based upon the existence/non-existence of a pulse having the commercial power frequency and the voltage in the secondary side of the transformer 21a, and the most proper protection operation corresponding to the species of mis-wiring is carried out so as to protect the communication circuitry elements, because the pulse having the commercial power frequency is input to the reception port of the indoor micro-computer 22 when the mis-wiring is realized. Furthermore, operability for dissolving the mis-wiring is improved and the safe connection is accelerated by transmitting information representing the species of the mis-wiring to an installment operator via a display

device or the like. When the mis-wiring (mis-wiring illustrated in Fig. 10 or Fig. 13) is realized other than the mis-wiring which can be detected by the operation of the flowchart illustrated in Fig. 16, the indoor controlling D.C. power supply circuitry 21c of the indoor unit 2 does not rise so that the communication circuitry elements are not destroyed at all.

[0092] Further, when the power supply for the communication is performed by a D.C. power supply, the communication speed is greatly improved in comparison with the conventional system (the system including a communication circuitry which can communicate in synchronism with a communication speed up to twice baud-rate of the communication power frequency) so that the system can be realized which does not give sense of incompatibility in operation such that the system operates with scarce delay following the input from a remote controller (not illustrated). This operation and effect cab be realized in all of the rest embodiments.

[0093] When the arrangement is employed in each embodiment which arrangement provides one indoor unit 2 for one outdoor unit 1, the circuitry arrangement of the outdoor unit 1 and the circuitry arrangement of the indoor unit 2 can be exchanged with one another.

Industrial Applicability

[0094] The indoor-outdoor communication device in air conditioner according to the present invention does not require circuitry arrangements having nothing to do with ordinary indoor-outdoor communication operation such as power switch means, abnormal voltage detection protection section or the like, and prevents a disadvantage from occurrence even when mis-wiring is realized such that the transmission and reception circuitry components are destroyed, snapped or the like, by applying the indoor-outdoor communication device to an air conditioner in which an indoor unit is connected to an outdoor unit via three connection lines including the commercial power supply lines.

Claims

1. An indoor-outdoor communication device in air conditioner which comprises an outdoor unit (1) and an indoor unit (2) connected to the outdoor unit via three connection lines (3) including commercial power supply lines (3a)(3b);
   wherein one of the outdoor unit (1) and the indoor unit (2) includes first control means (14), first power supply means (11) for supplying power to the first control means (14), first transmission photo-coupler (15) and first reception photo-coupler (16) for transmitting and receiving signal between the first control means (14) which photo-couplers are connected between terminals of the commercial A.C. power supply (10) via a D.C. power supply means (12) in series with each other, and first resistance means (17) connected in parallel with the first reception photo-coupler (16), and

   the other of the outdoor unit (1) and the indoor unit (2) includes second control means (22), second reception photo-coupler (24) and second transmission photo-coupler (23) for transmitting and receiving signal between the second control means (22) which photo-couplers are connected in parallel with the first reception photo-coupler(16) via two connection lines among the three connection lines (3), and second resistance means (25) for suppressing over current due to mis-wiring which resistance means (25) is connected in series with the second transmission photo-coupler (23).

2. An indoor-outdoor communication device in air conditioner which comprises one outdoor unit (1) and a plurality of indoor units (2) connected to the outdoor unit (1) via three connection lines (3) including commercial power supply lines (3a)(3b) in parallel with each other,
   wherein the outdoor unit (1) includes outdoor control means (14), outdoor controlling power supply means (11) for supplying power to the outdoor control means (14), outdoor transmission photo-coupler (15) and outdoor reception photo-coupler (16) for transmitting and receiving signal between the outdoor control means (14) which photo-couplers are connected between terminals of the commercial A.C. power supply (10) via D.C. power supply means (12) in series with each other, and first resistance means (17) connected in parallel with the outdoor reception photo-coupler (16), and

   each indoor unit (2) includes indoor controlling power supply means (21) connected between terminals of the commercial A.C. power supply (10) via commercial power supply lines (3a)(3b), indoor control means (22) which is supplied power from the indoor controlling power supply means (21), indoor reception photo-coupler (24) and indoor transmission photo-coupler (23) for transmitting and receiving signal between the indoor control means (22) which photo-couplers are connected to the outdoor reception photo-coupler (16) in parallel via two connection lines among the three connection lines (3), and second resistance means (25) for suppressing over current due to mis-wiring which resistance means (25) is connected to the indoor transmission photo-coupler (23).

3. An indoor-outdoor communication device in air conditioner as set forth in claim 1 or claim 2, wherein a positive temperature characteristic thermister (25)

is employed as the second resistance means (25).

4. An indoor-outdoor communication device in air conditioner which comprises an outdoor unit (1) and an indoor unit (2) connected to the outdoor unit (1) via three connection lines (3) including commercial power supply lines (3a)(3b),
wherein one of the outdoor unit (1) and the indoor unit (2) includes first control means (14), first controlling power supply means (11) for supplying power to the first control means (14), first transmission photo-coupler (15) and first reception photo-coupler (16) for transmitting and receiving signal between the first control means (14) which photo-couplers are connected between terminals of the commercial A.C. power supply (10) via a D.C. power supply means (12) in series with each other, and first resistance means (17) connected in parallel with the first reception photo-coupler (16), and

the other of the outdoor unit (1) and the indoor unit (2) includes a transformer (21a) connected to terminals of the commercial A.C. power supply (10) via the commercial power supply lines (3a)(3b), rectification means (21b) for transforming the output voltage from the transformer (21a) to a D.C. voltage, abnormal voltage detection means (21g) which operates based upon the transformed D.C. voltage, second power supply means (21c) connected between output terminals of the rectification means (21b), second control means (22) to which the transformed D.C. voltage is supplied, second reception photo-coupler (24) and second transmission photo-coupler (23) for transmitting and receiving signal between the second control means (22) which photo-couplers are connected in parallel with the first reception photo-coupler (16) via two connection lines among the three connection lines (3), and second resistance means (25') which is connected in series with the second transmission photo-coupler (23).

5. An indoor-outdoor communication device in air conditioner which comprises one outdoor unit (1) and a plurality of indoor units (2) connected to the outdoor unit (1) via three connection lines (3) including commercial power supply lines (3a)(3b) in parallel with each other,
wherein the outdoor unit (1) includes outdoor control means (14), outdoor controlling power supply means (11) for supplying power to the outdoor control means (14), outdoor transmission photo-coupler (15) and outdoor reception photo-coupler (16) for transmitting and receiving signal between the outdoor control means (14) which photo-couplers are connected between terminals of the commercial A.C. power supply (10) via D.C. power supply means (12) in series with each other, and first resistance means (17) connected in parallel with the outdoor reception photo-coupler (16), and

each indoor unit (2) includes a transformer (21a) connected to terminals of the commercial A.C. power supply (10) via the commercial power supply lines (3a)(3b), rectification means (21b) for transforming the output voltage from the transformer (21a) to a D.C. voltage, abnormal voltage detection means (21g) which operates based upon the transformed D.C. voltage, indoor controlling power supply means (21c) connected between output terminals of the rectification means (21b), indoor control means (22) to which the transformed D.C. voltage is supplied, indoor reception photo-coupler (24) and indoor transmission photo-coupler (23) for transmitting and receiving signal between the indoor control means (22) which photo-couplers are connected in parallel with the outdoor reception photo-coupler (16) via two connection lines among the three connection lines (3), and second resistance means (25') which is connected in series with the indoor transmission photo-coupler (23).

Fig. 1

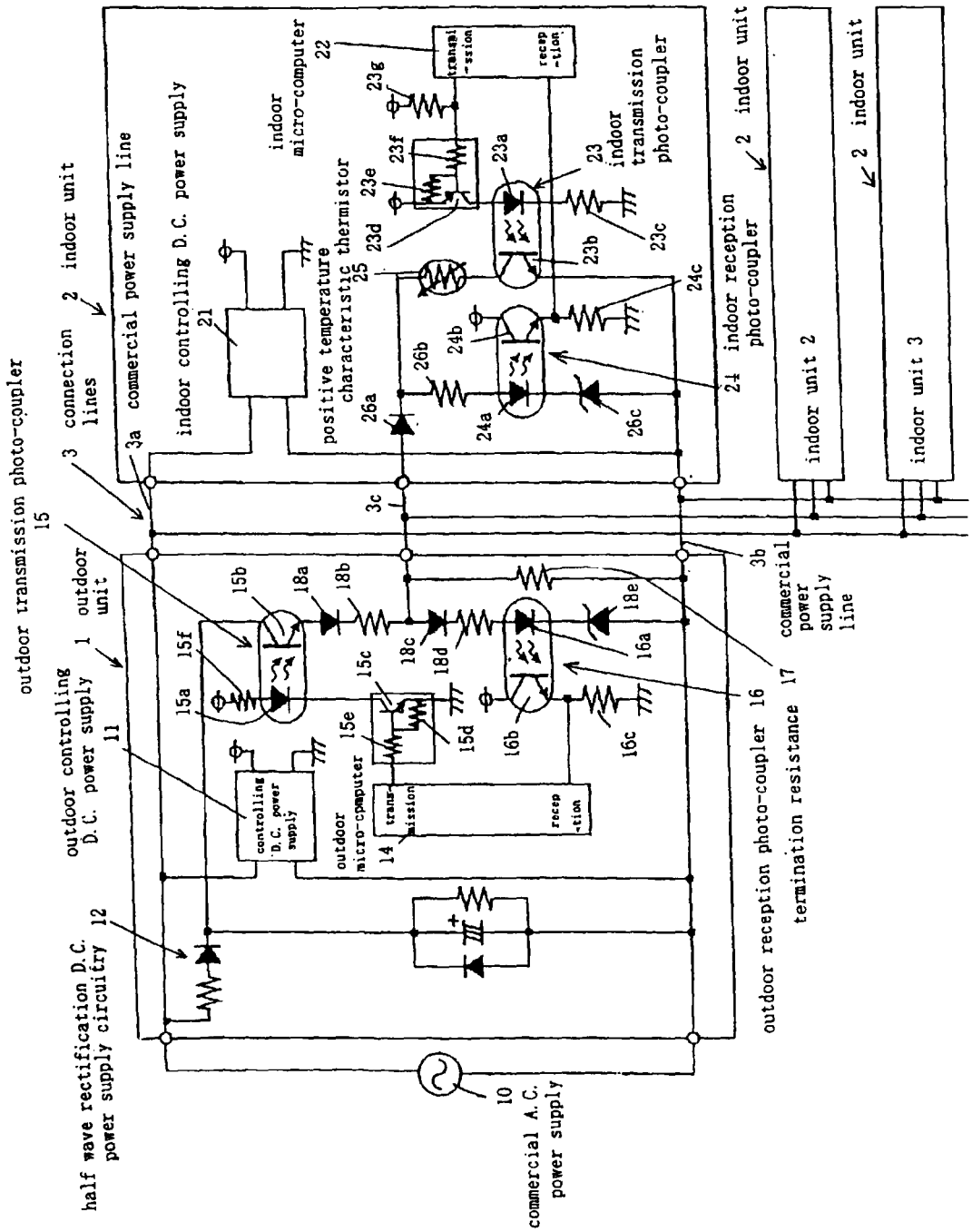

outdoor transmission photo-coupler 15
half wave rectification D.C. power supply circuitry 12
outdoor controlling D.C. power supply 11
1 outdoor unit
3 connection lines
2 indoor unit
3a commercial power supply line
indoor controlling D.C. power supply 21
indoor micro-computer 22
positive temperature characteristic thermistor 25
23 indoor transmission photo-coupler
24 indoor reception photo-coupler
2 indoor unit
indoor unit 2
indoor unit 3
outdoor micro-computer 14
outdoor reception photo-coupler 16
termination resistance 17
commercial power supply line
3b
3c
commercial A.C. power supply 10
controlling D.C. power supply
transmission
reception

Fig. 2

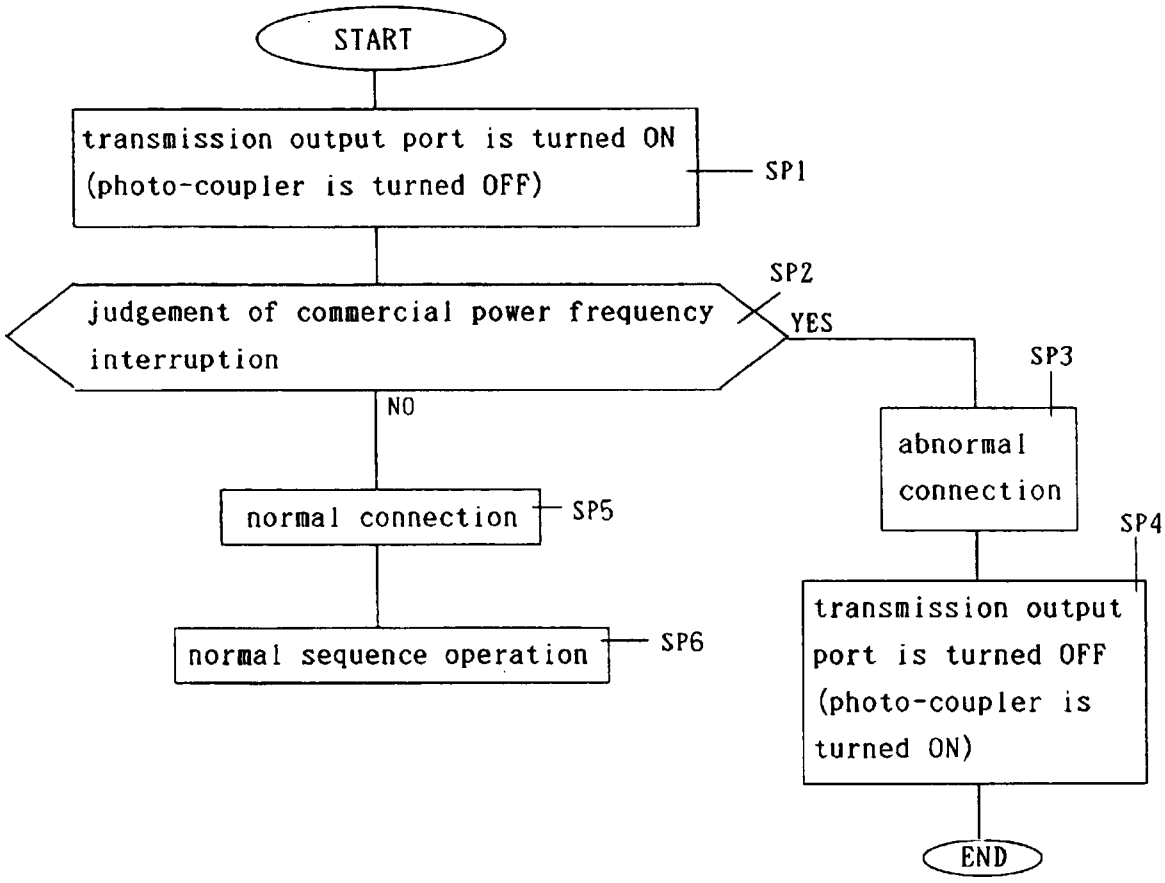

START
transmission output port is turned ON
(photo-coupler is turned OFF)
SP1
judgement of commercial power frequency interruption
SP2
YES
NO
SP3
abnormal connection
SP4
transmission output port is turned OFF (photo-coupler is turned ON)
END
normal connection
SP5
normal sequence operation
SP6

Fig. 3

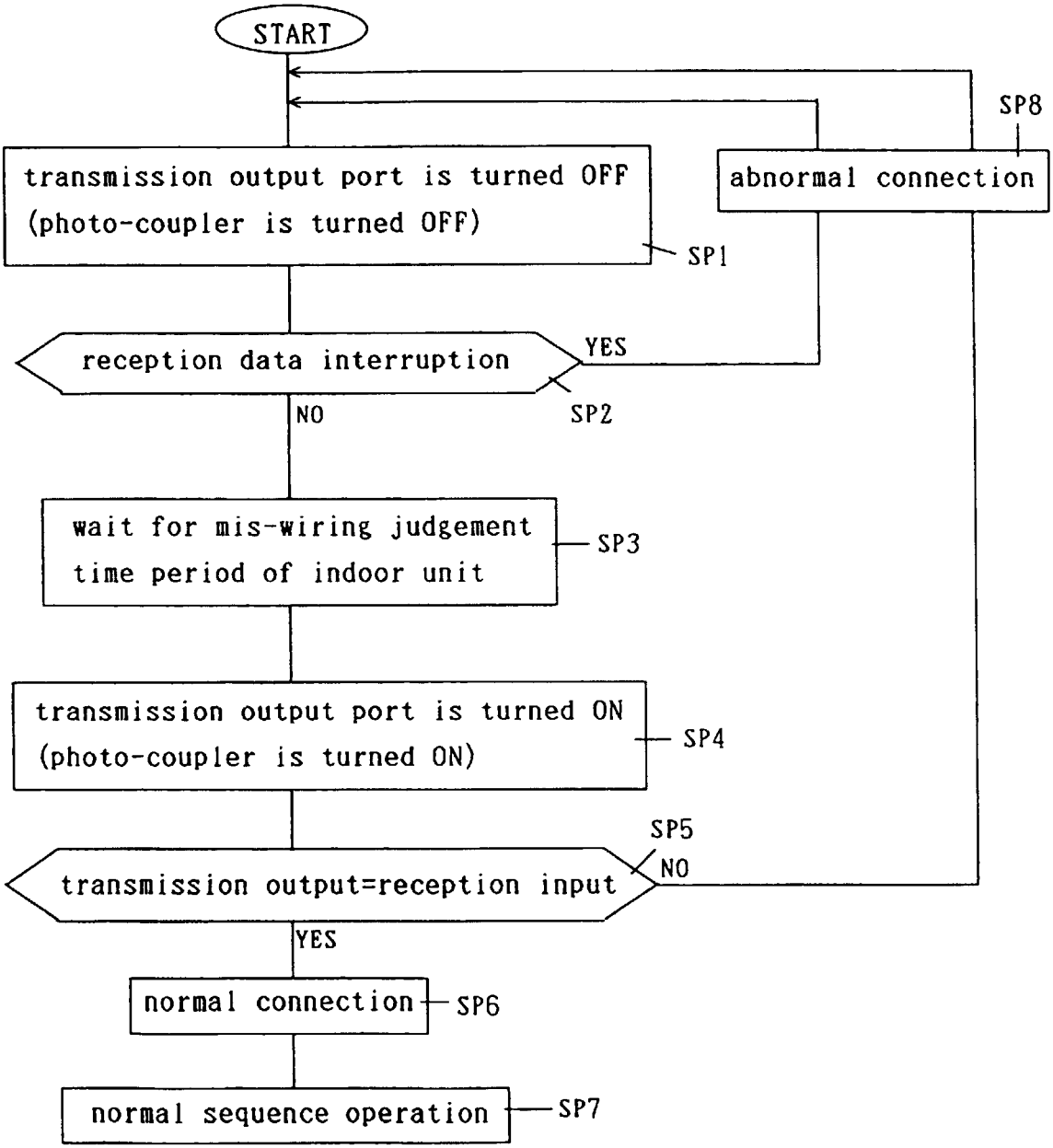

START
transmission output port is turned OFF
(photo-coupler is turned OFF)
SP1
reception data interruption
YES
SP2
NO
wait for mis-wiring judgement
time period of indoor unit
SP3
transmission output port is turned ON
(photo-coupler is turned ON)
SP4
SP5
transmission output=reception input
NO
YES
normal connection
SP6
normal sequence operation
SP7
abnormal connection
SP8

Fig. 4

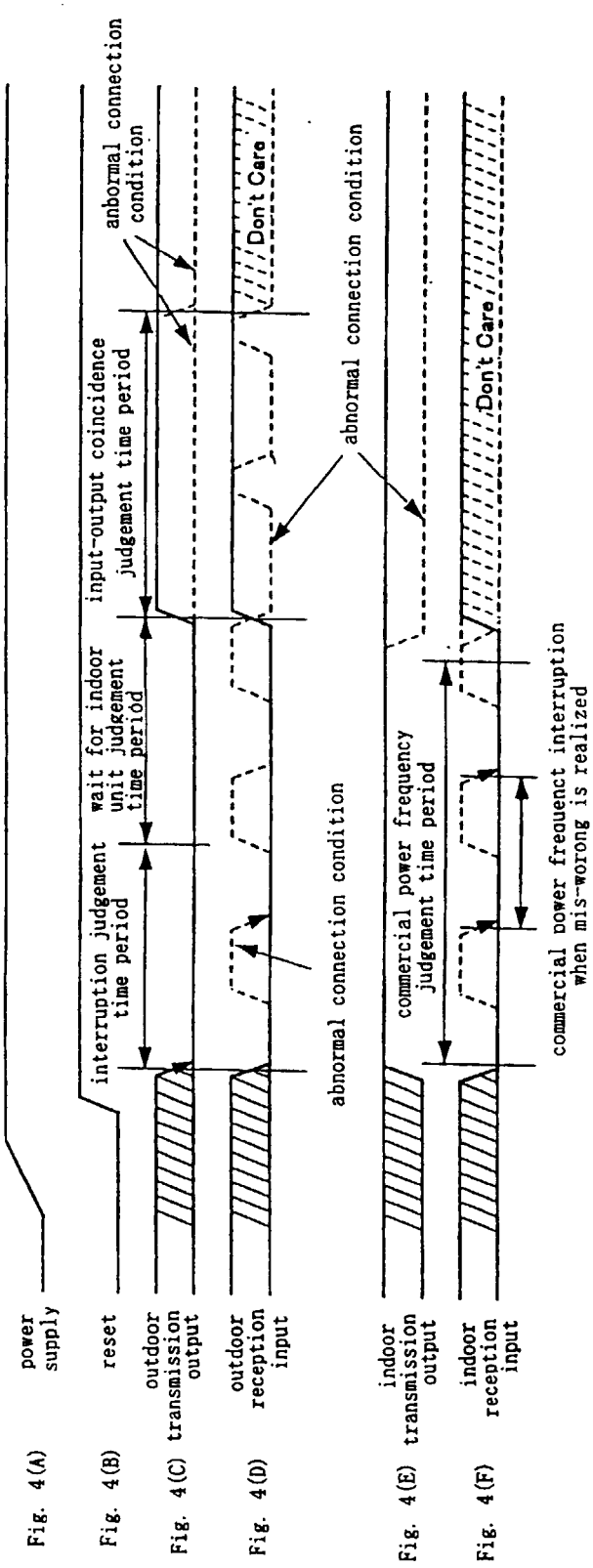


Fig. 4(A)
power supply
Fig. 4(B)
reset
interruption judgement time period
wait for indoor unit judgement time period
input-output coincidence judgement time period
anbormal connection condition
Fig. 4(C)
outdoor transmission output
Don't Care
Fig. 4(D)
outdoor reception input
abnormal connection condition
abnormal connection condition
Fig. 4(E)
indoor transmission output
commercial power frequency judgement time period
Fig. 4(F)
indoor reception input
Don't Care
commercial power frequenct interruption when mis-worong is realized

Fig. 5

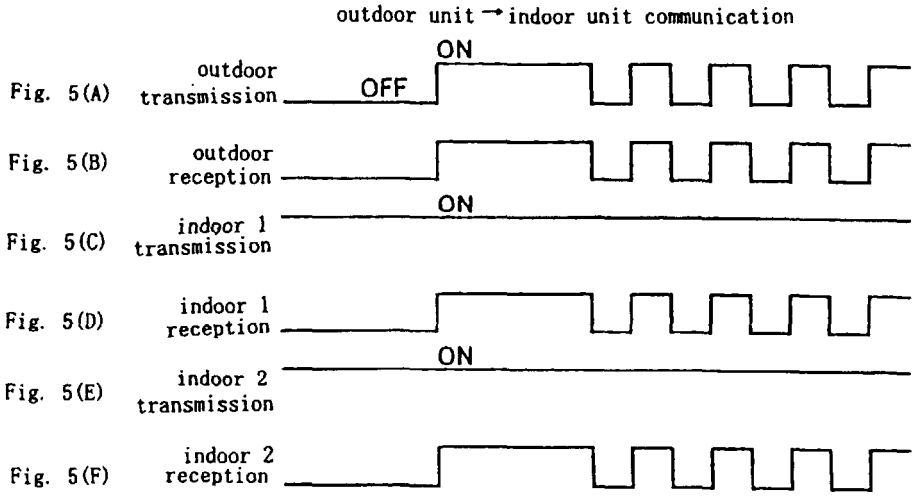

outdoor unit → indoor unit communication
Fig. 5(A)
outdoor transmission
ON
OFF
Fig. 5(B)
outdoor reception
Fig. 5(C)
indoor 1 transmission
ON
Fig. 5(D)
indoor 1 reception
Fig. 5(E)
indoor 2 transmission
ON
Fig. 5(F)
indoor 2 reception

Fig. 6

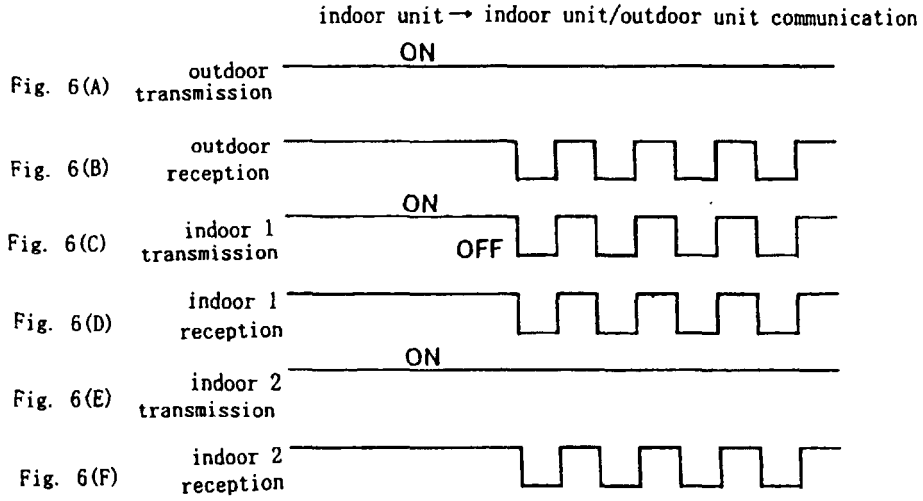

indoor unit → indoor unit/outdoor unit communication
Fig. 6(A)
outdoor transmission
ON
Fig. 6(B)
outdoor reception
Fig. 6(C)
indoor 1 transmission
ON
OFF
Fig. 6(D)
indoor 1 reception
Fig. 6(E)
indoor 2 transmission
ON
Fig. 6(F)
indoor 2 reception

Fig. 7

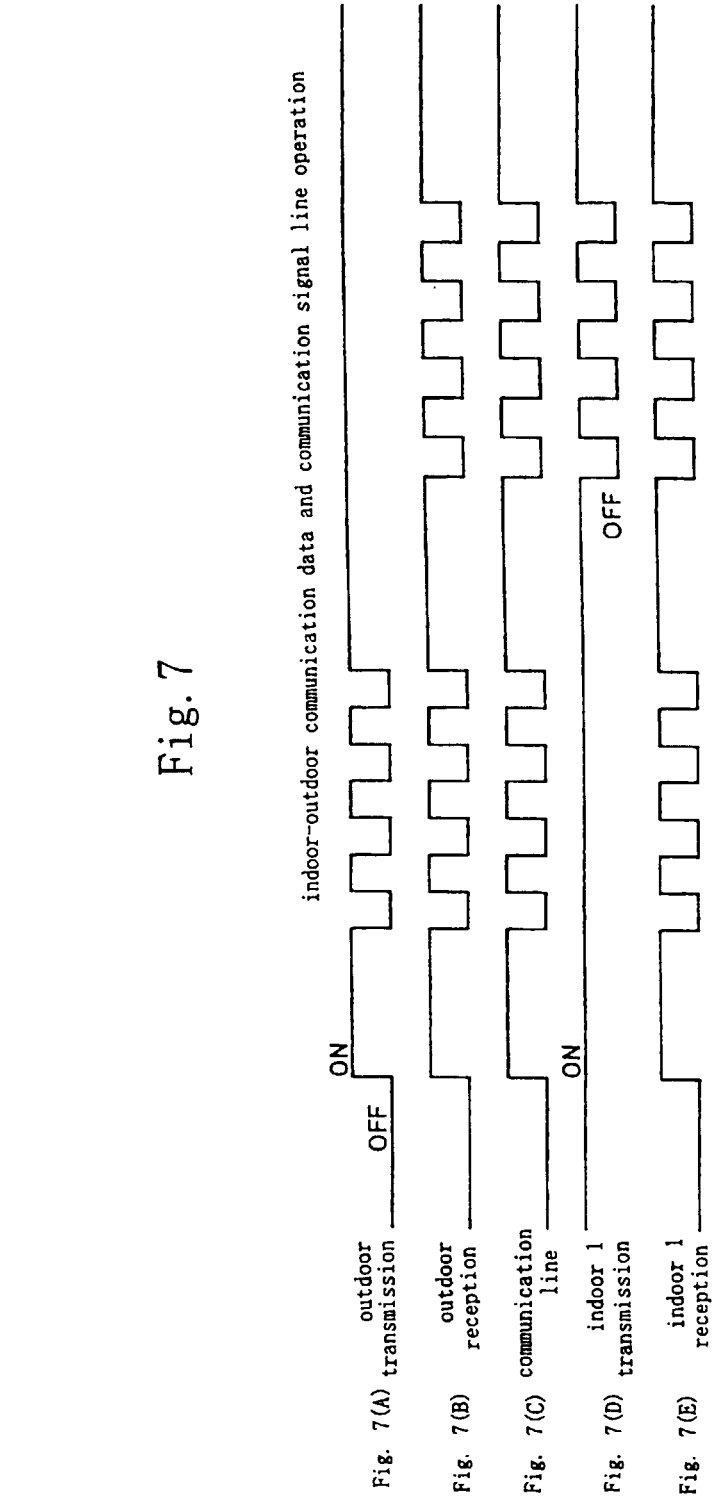

indoor-outdoor communication data and communication signal line operation
ON
OFF
outdoor transmission
Fig. 7(A)
outdoor reception
Fig. 7(B)
communication line
Fig. 7(C)
ON
OFF
indoor 1 transmission
Fig. 7(D)
indoor 1 reception
Fig. 7(E)

Fig. 8

Fig. 8(A)

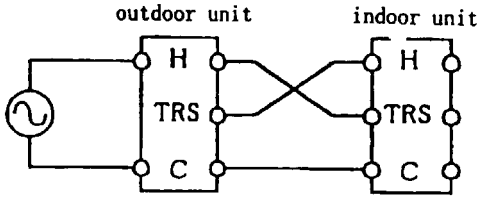


Fig. 8(B)

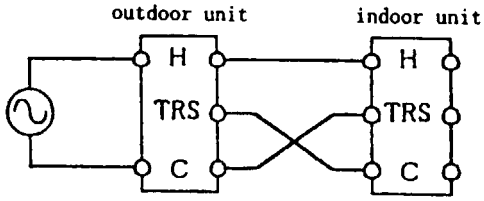


Fig. 8(C)

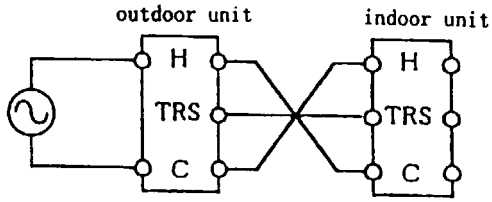


Fig. 8(D)

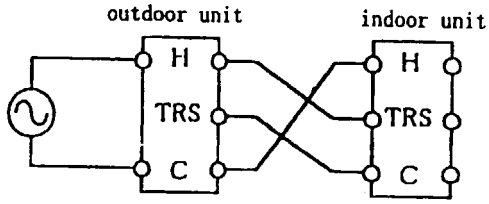


Fig. 8(E)

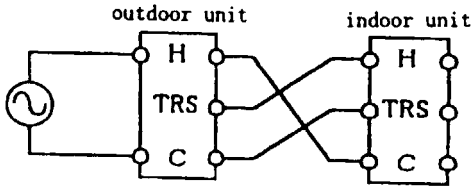


Fig. 9

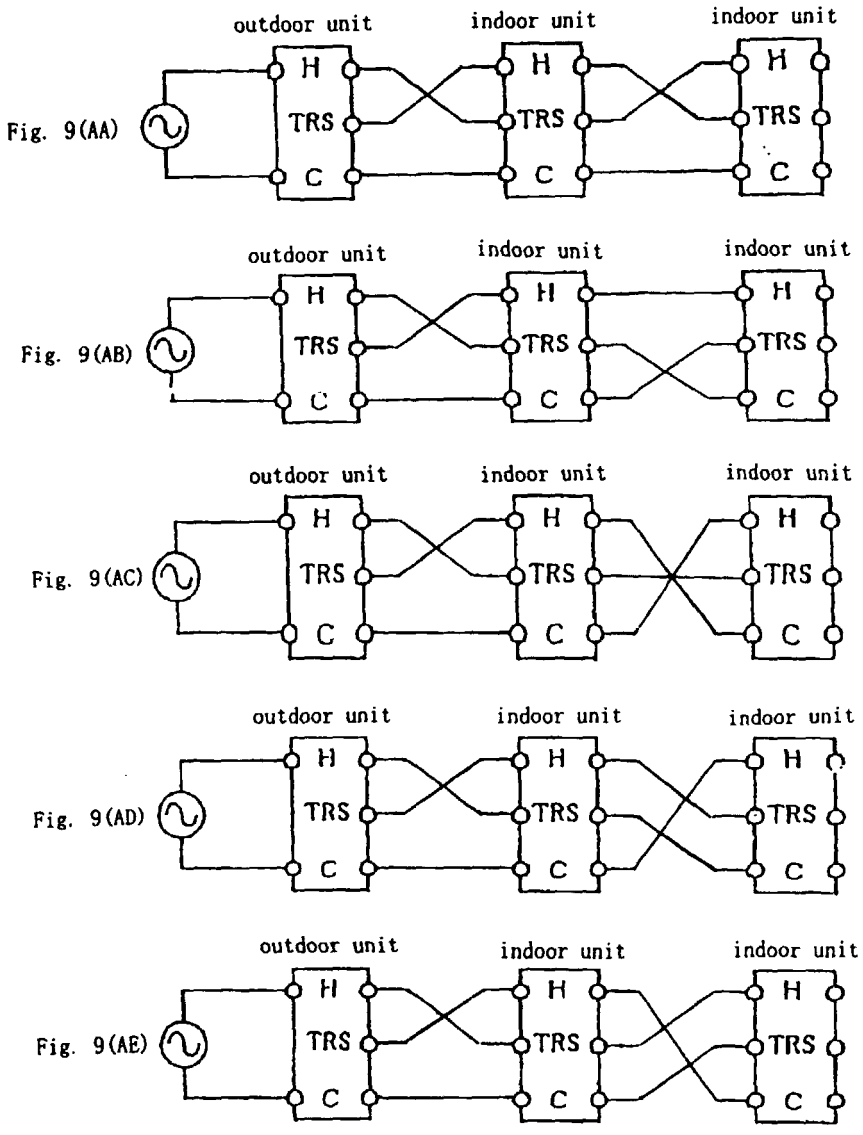

outdoor unit
indoor unit
indoor unit
H
TRS
C
Fig. 9(AA)
Fig. 9(AB)
Fig. 9(AC)
Fig. 9(AD)
Fig. 9(AE)

Fig. 10

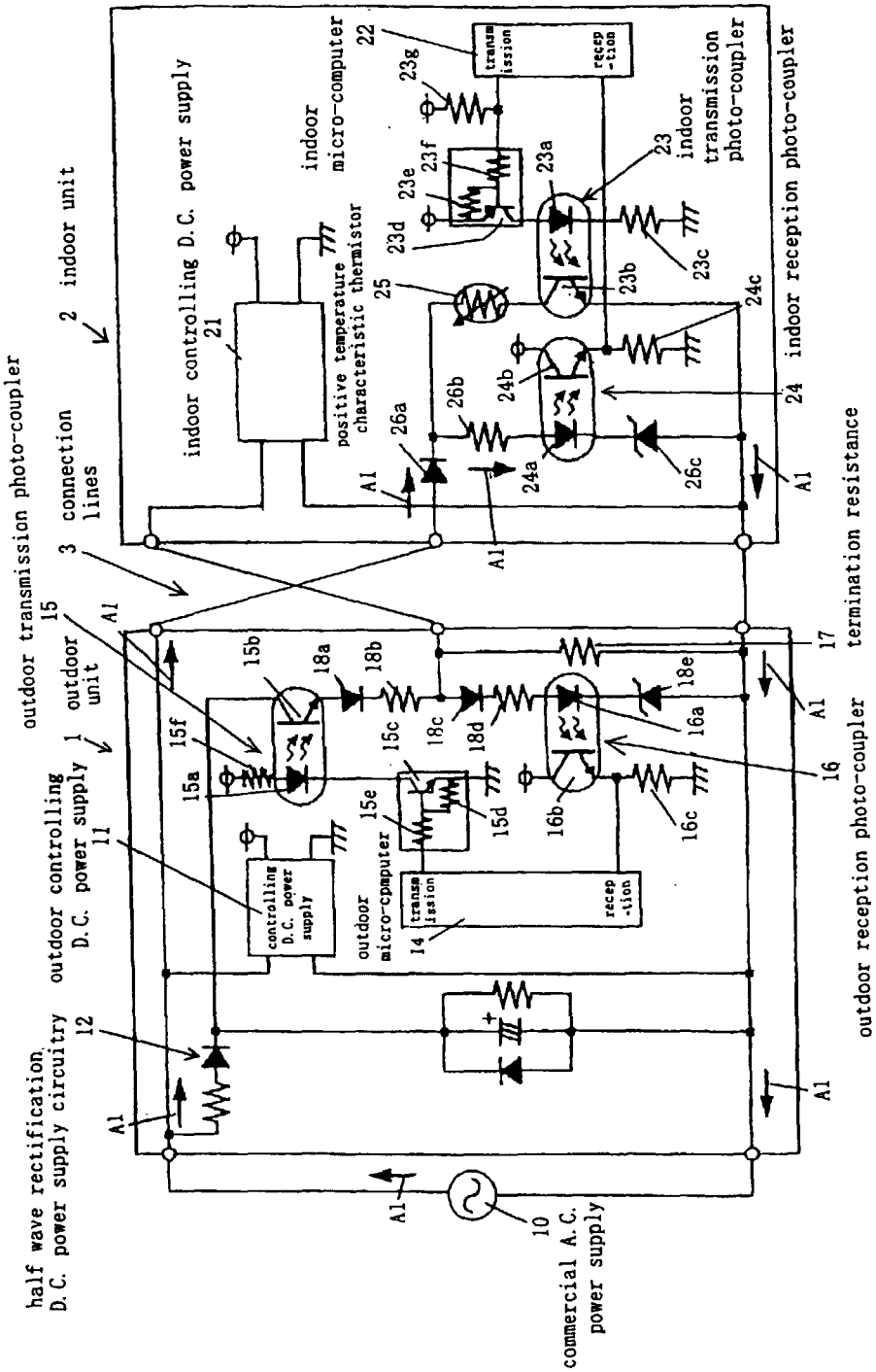

half wave rectification D.C. power supply circuitry
12
outdoor controlling D.C. power supply
11
controlling D.C. power supply
outdoor unit
1
outdoor transmission photo-coupler
15
15a
15b
15c
15d
15e
15f
18a
18b
18c
18d
18e
16a
16b
16c
16
outdoor reception photo-coupler
outdoor micro-computer
14
transmission
reception
termination resistance
17
A1
commercial A.C. power supply
10
connection lines
3
indoor unit
2
indoor controlling D.C. power supply
21
indoor micro-computer
22
positive temperature characteristic thermistor
25
23
indoor transmission photo-coupler
23a
23b
23c
23d
23e
23f
23g
24
indoor reception photo-coupler
24a
24b
24c
26a
26b
26c

Fig. 11

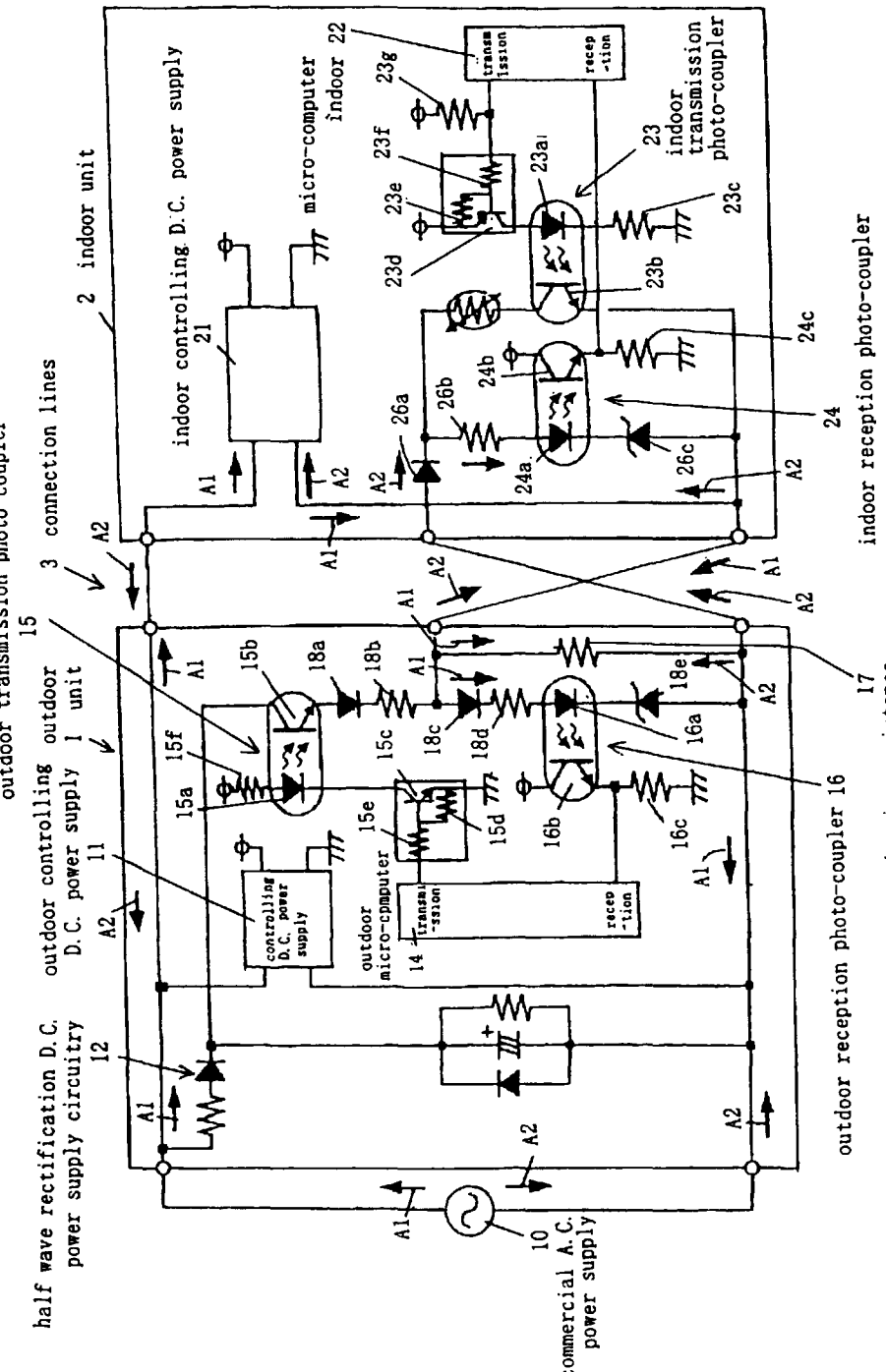

outdoor transmission photo-coupler 15
half wave rectification D.C. power supply circuitry 12
outdoor controlling D.C. power supply 11
outdoor unit 1
3 connection lines
2 indoor unit
indoor controlling D.C. power supply 21
micro-computer indoor 22
indoor transmission photo-coupler 23
indoor reception photo-coupler 24
outdoor micro-computer 14
outdoor reception photo-coupler 16
termination resistance 17
commercial A.C. power supply 10
controlling D.C. power supply
transmission
reception
A1
A2

Fig. 12

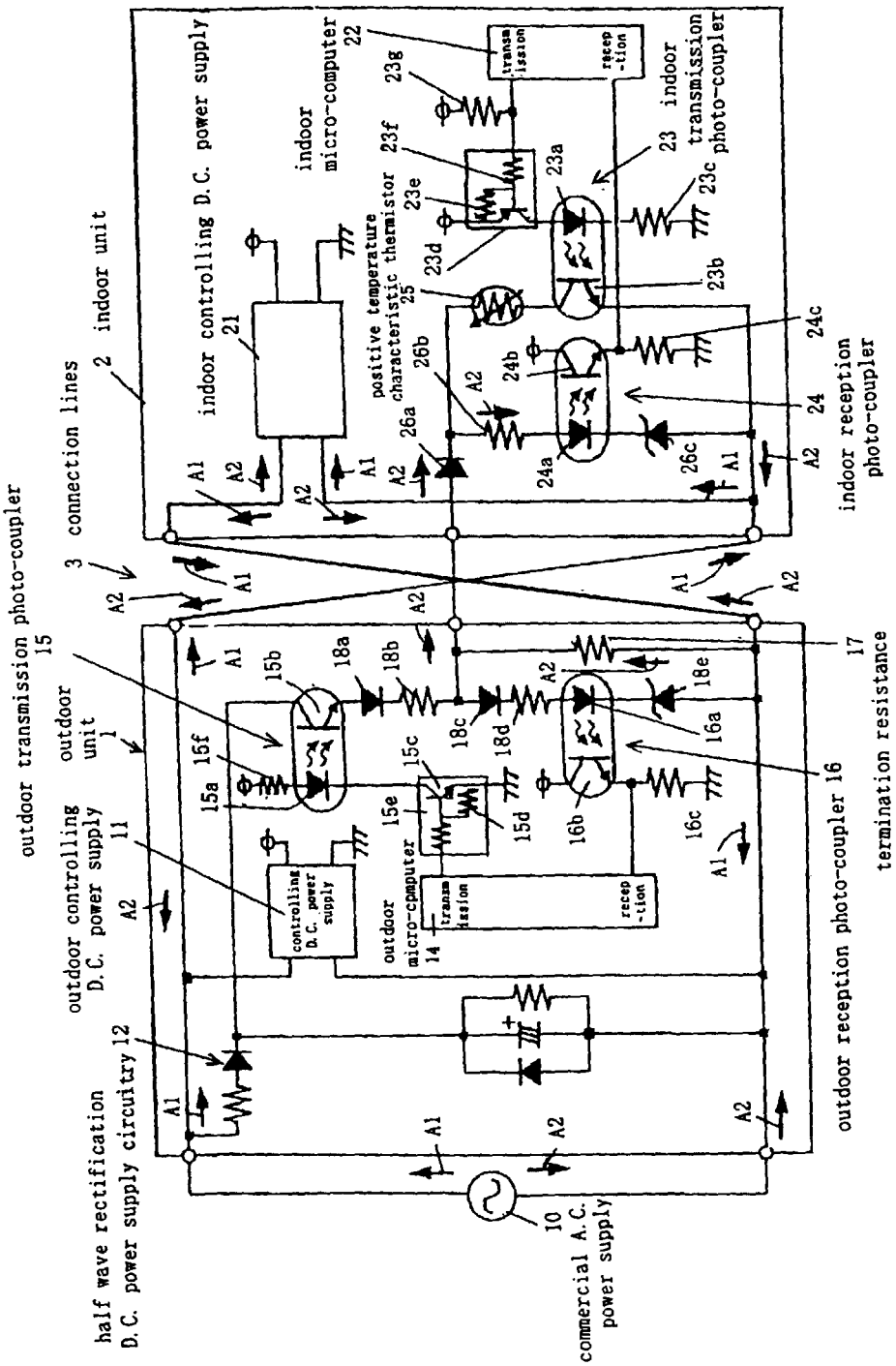

outdoor transmission photo-coupler
15
outdoor unit
1
outdoor controlling D.C. power supply
11
half wave rectification D.C. power supply circuitry
12
commercial A.C. power supply
10
3 connection lines
2 indoor unit
indoor controlling D.C. power supply
21
indoor micro-computer
22
positive temperature characteristic thermistor
25
23 indoor transmission photo-coupler
indoor reception photo-coupler
24
outdoor reception photo-coupler
16
termination resistance
17
outdoor micro-computer
14
controlling D.C. power supply
transmission
reception
A1
A2

Fig. 13

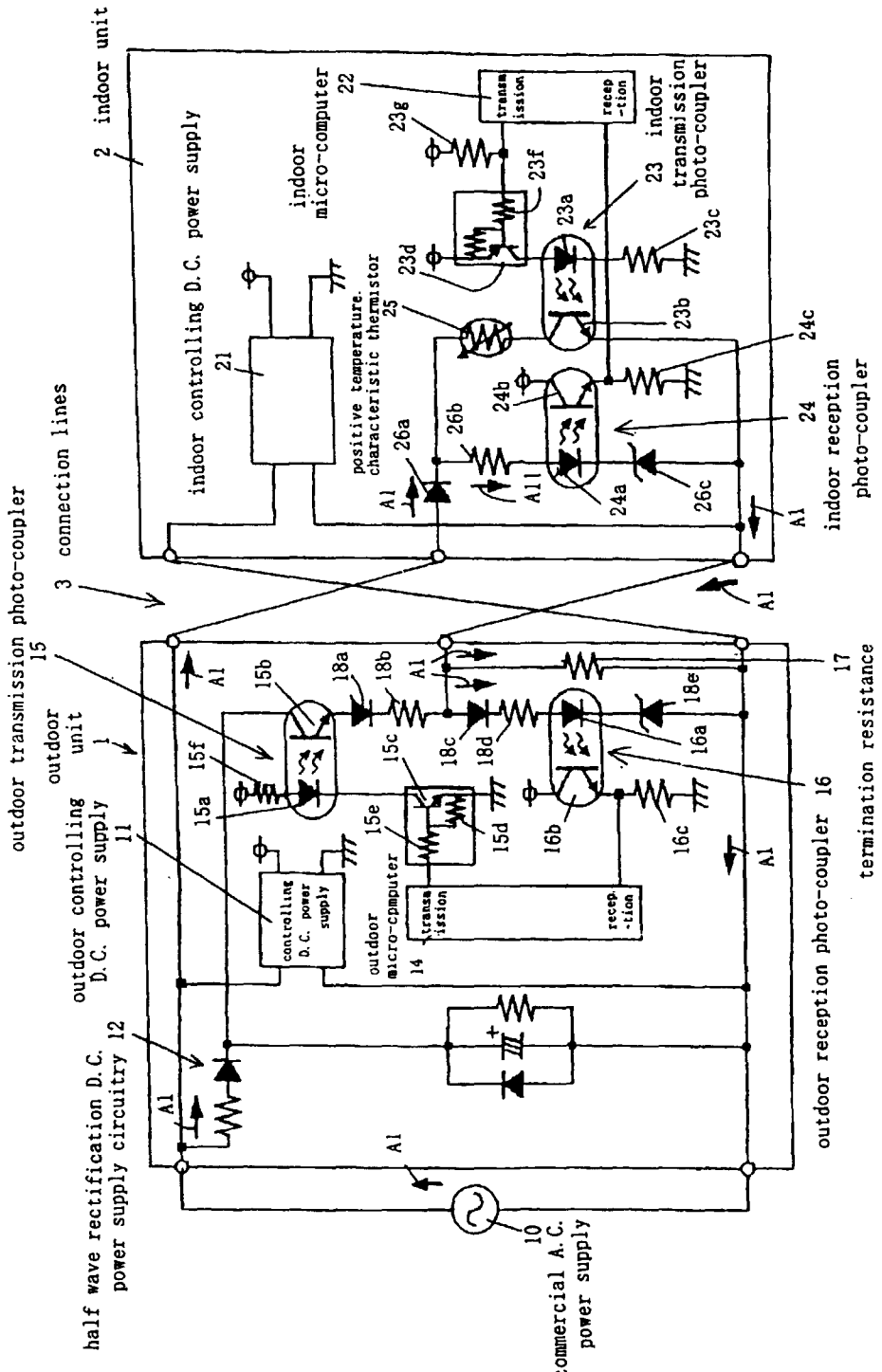

2 indoor unit
indoor controlling D.C. power supply
indoor micro-computer
22
transmission
recep-tion
23g
23f
23 indoor transmission photo-coupler
23a
23c
23d
23b
positive temperature characteristic thermistor
25
21
24c
24b
24
indoor reception photo-coupler
26b
26a
24a
26c
A1
3 connection lines
outdoor transmission photo-coupler
15
outdoor unit
1
outdoor controlling D.C. power supply
11
controlling D.C. power supply
outdoor micro-computer
14
15b
18a
18b
15f
15a
15c
18c
18d
18e
16a
15e
15d
16b
16c
17
termination resistance
outdoor reception photo-coupler 16
half wave rectification D.C. power supply circuitry 12
commercial A.C. power supply
10

Fig. 14

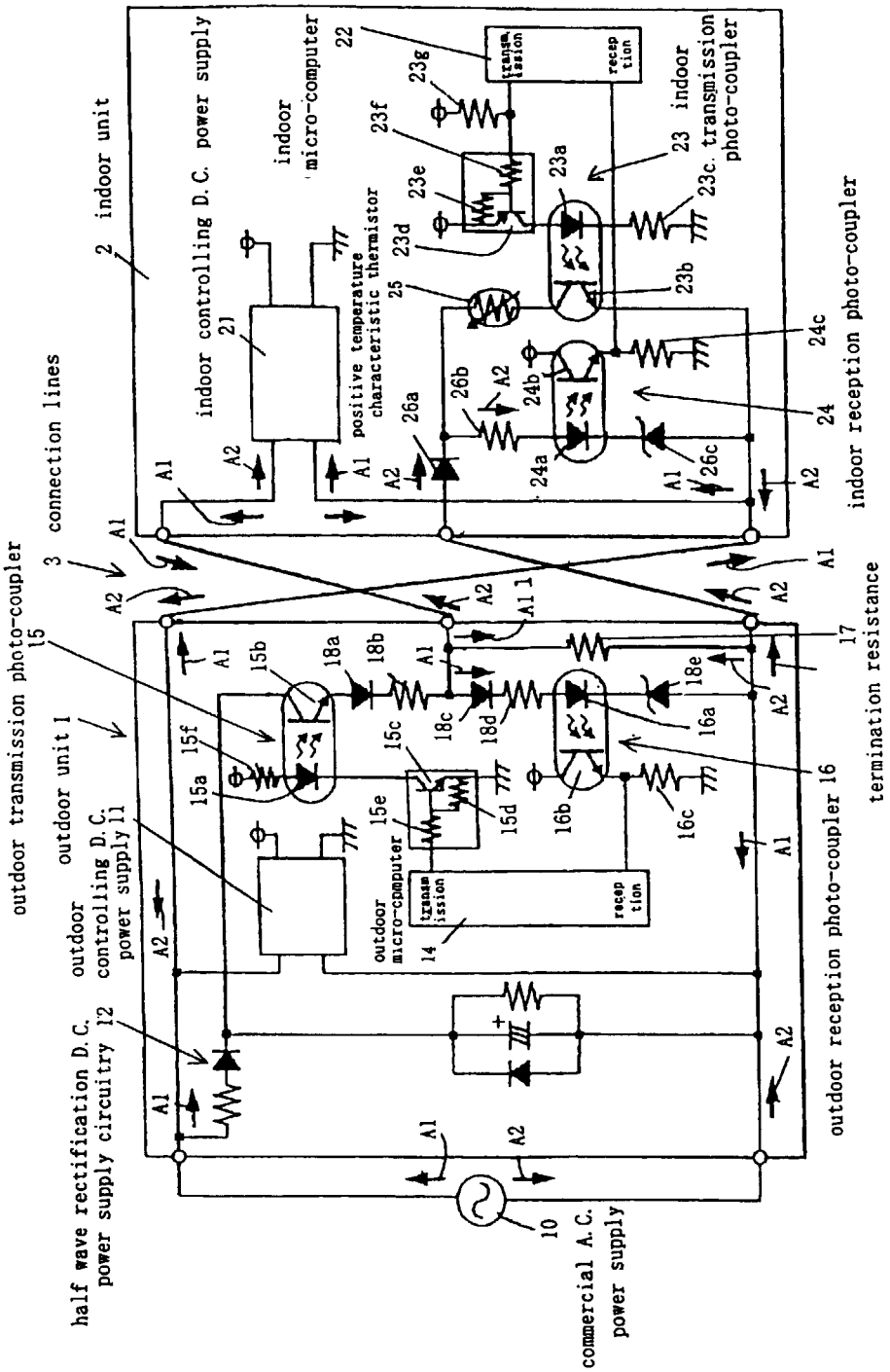

outdoor transmission photo-coupler 15
3 connection lines
2 indoor unit
indoor controlling D.C. power supply 21
indoor micro-computer 22
positive temperature characteristic thermistor 25
23 indoor transmission photo-coupler
23c. transmission photo-coupler
indoor reception photo-coupler 24
outdoor unit 1
outdoor controlling D.C. power supply 11
half wave rectification D.C. power supply circuitry 12
outdoor micro-computer 14
outdoor reception photo-coupler 16
termination resistance 17
commercial A.C. power supply 10
transmission
reception
A1
A2

Fig. 15

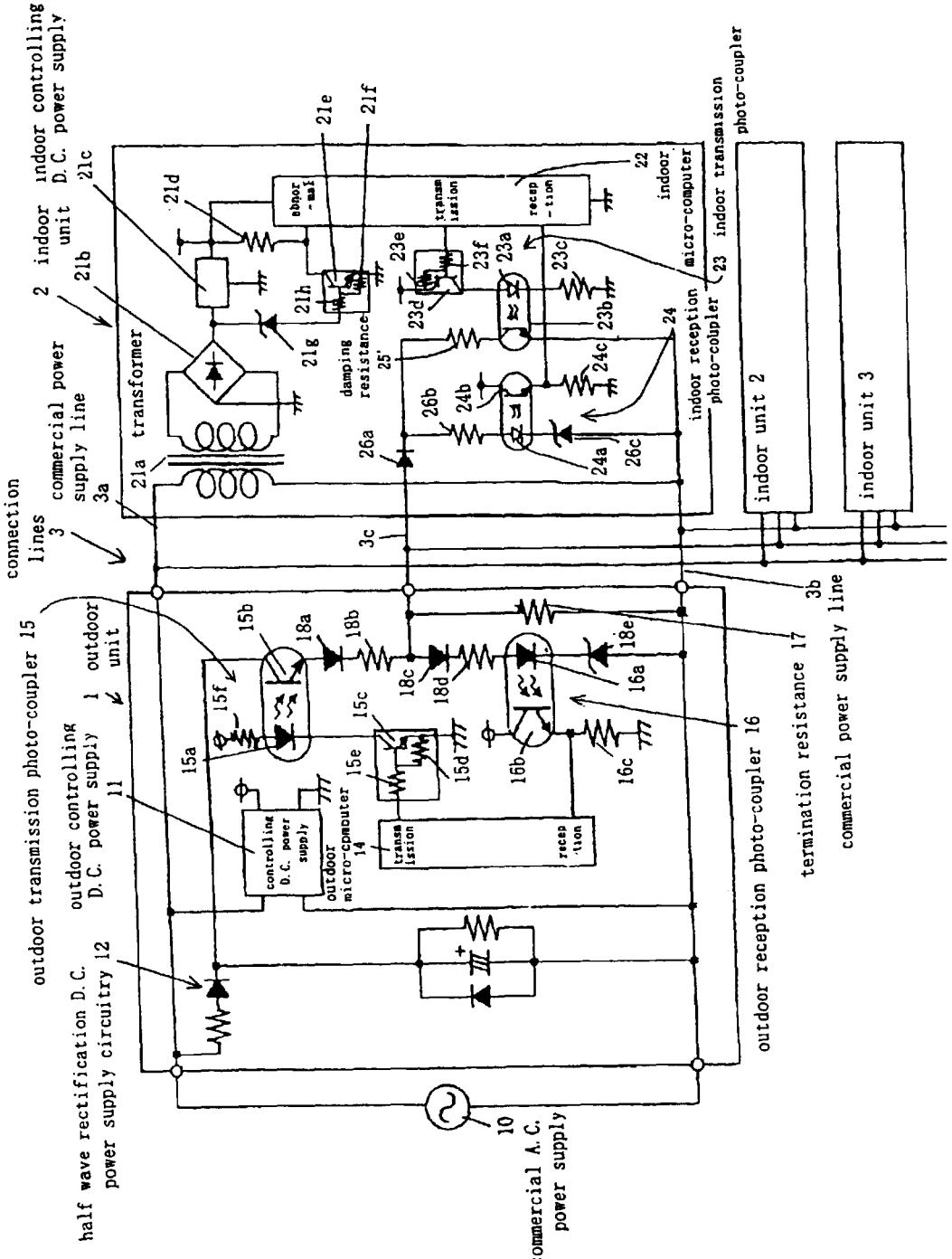
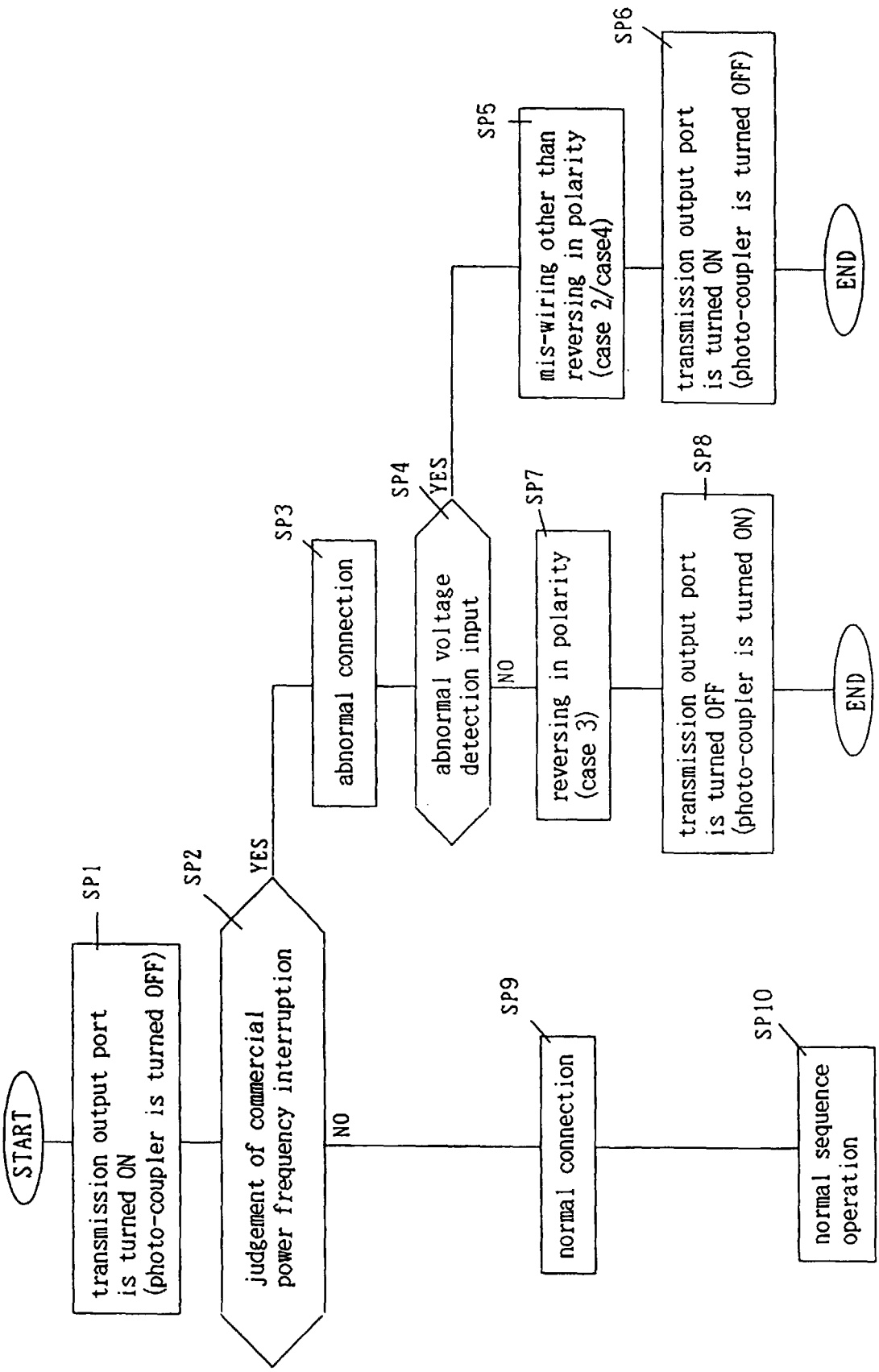

connection lines 3
commercial power supply line 3a
2 indoor unit
indoor controlling D.C. power supply 21c
21b
21a transformer
21d
21e
21f
21g
21h
damping resistance 25'
23e
23f
23a
23c
23b
23d
24
24c
24b
24a
26a
26b
26c
indoor reception photo-coupler
22 indoor micro-computer
23 indoor transmission photo-coupler
indoor unit 2
indoor unit 3
3c
3b
outdoor transmission photo-coupler 15
1 outdoor unit
outdoor controlling D.C. power supply 11
half wave rectification D.C. power supply circuitry 12
15b
18a
18b
18c
18d
18e
16a
15f
15c
15e
15d
15a
16b
16c
controlling D.C. power supply
outdoor micro-computer 14
outdoor reception photo-coupler 16
termination resistance 17
commercial power supply line
10 commercial A.C. power supply

Fig. 16


START
transmission output port is turned ON (photo-coupler is turned OFF)
SP1
judgement of commercial power frequency interruption
SP2
YES
NO
abnormal connection
SP3
abnormal voltage detection input
SP4
YES
NO
mis-wiring other than reversing in polarity (case 2/case4)
SP5
transmission output port is turned ON (photo-coupler is turned OFF)
SP6
END
reversing in polarity (case 3)
SP7
transmission output port is turned OFF (photo-coupler is turned ON)
SP8
END
normal connection
SP9
normal sequence operation
SP10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/00002

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[6] F24F11/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[6] F24F11/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1999 Toroku Jitsuyo Shinan Koho 1994-1999
Kokai Jitsuyo Shinan Koho 1971-1999

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 8-35715, A (Mitsubishi Electric Corp.), 6 February, 1996 (06. 02. 96) (Family: none)	1-5
A	JP, 7-133950, A (Sharp Corp.), 23 May, 1995 (23. 05. 95) (Family: none)	1-5
A	JP, 6-123479, A (Sharp Corp.), 6 May, 1994 (06. 05. 94) (Family: none)	1-5
A	JP, 4-110556, A (Toshiba Corp.), 13 April, 1992 (13. 04. 92) (Family: none)	1-5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 March, 1999 (30. 03. 99)	13 April, 1999 (13. 04. 99)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)