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(54) **REDUCED POWER CONSUMPTION IN AIR CONDITIONERS**

(57) The present invention relates to air conditioners with reduced power consumption in standby mode. The Outdoor unit of the air conditioner is provided with a zero crossing circuit connected to a power source from one end and connected to the relay circuit from the other end. The power source of the zero crossing circuit 130 is cut-off by deactivating the RY-AC and RY-PWR during standby mode to reduce power consumption. The air conditioner 100 includes another microprocessor-con-

trolled relay (RY-C) at the outdoor unit 120 connected between a terminal (T1') and a compressor, which is kept "OFF" during standby mode to reduce the power consumption. The air conditioner 100 further includes a low power, high impedance switching transformer connected between a terminal (T2') and the terminal (T1') for reducing a standby current by increasing resistance of the switching transformer that in turn results in reduced power consumption.

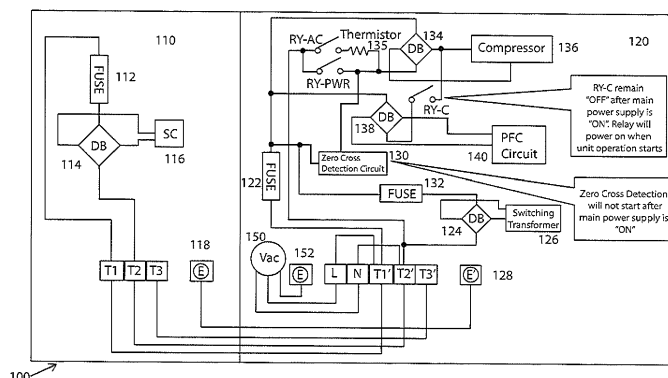


FIG. 1

Description

FIELD OF INVENTION

[0001] The present invention relates to air conditioners. More particularly, the invention relates to reducing power consumption in air conditioners.

BACKGROUND OF THE INVENTION

[0002] Air conditioners have evolved over the years by leaps and bounds. Initially, the window type air conditioners were developed, which are still in use at certain residential and commercial locations. However, in recent past the split-type air conditioners have gained popularity because of its low sound and better cooling efficiency.

[0003] Generally, a split-type air conditioner comprises an indoor unit and an outdoor unit with both requiring electrical power supply. The power connections, for the split-type air conditioners, are made through terminal board of either the indoor unit or the outdoor unit.

[0004] The split-type air conditioners consume higher standby power, which may be due to constant interaction between the indoor unit and the outdoor unit. Standby power is electrical power used by electrical appliances and equipment while switched off or while they are waiting for external power supplies, or for purposes of use of remote control receivers; or for energizing text or light displays circuits, when the device is plugged in although switched off. This occurs because some devices are claimed to be "switched off" on the electronic interface, but are in a different state from switching off at the plug, or at the power point.

[0005] In view of the above, there is a continuing need for improved air conditioning equipments and methods that result in low or reduced power consumption.

SUMMARY OF THE INVENTION

[0006] Accordingly, the present invention provides an air conditioner with reduced power consumption in standby mode. The air conditioner comprising an indoor unit having an indoor terminal board with at least three terminal slots (T1, T2, T3), an outdoor unit (120) having an outdoor terminal board with at least three terminal slots (T1', T2', T3') wherein the terminal slots of indoor units are connected to outdoor unit terminal slots, a relay circuit at outdoor unit with RY-AC parallel to RY-PWR operating to switch ON or OFF the air conditioner and a zero crossing circuit 130 connected to a power source from one end and connected to the control/switching circuit 135 from the other end; wherein power source of the zero crossing circuit 130 is cut-off by deactivating the RY-AC and RY-PWR during standby mode to reduce power consumption.

[0007] In an embodiment, the air conditioner includes another RY-C relay at the outdoor unit connected between terminal (T1') and a compressor wherein said RY-

C relay is controlled by a microprocessor to be off during standby mode to reduce the power consumption.

[0008] In an embodiment, the air conditioner further includes a low power, high impedance switching transformer connected between terminal (T2') and terminal (T1') for reducing a standby current by increasing resistance of the switching transformer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Reference will be made to embodiments of the invention, examples of which may be illustrated in the accompanying figures. These figures are intended to be illustrative, not limiting. Although the invention is generally described in the context of these embodiments, it should be understood that it is not intended to limit the scope of the invention to these particular embodiments.

Fig. 1 shows an air conditioner in standby mode in accordance with an embodiment of the present invention.

Fig. 1a shows an outdoor unit of the air conditioner in standby mode in accordance with an embodiment of the present invention.

Fig. 2a shows a comparative chart of the operational parameters with respect to the software at 50/60HZ judgement of the air conditioner system before and after connection of the zero crossing circuit in accordance with an embodiment of the present invention.

Fig. 2b shows a comparative chart of the operational parameters of the air conditioning system before and after connection of the zero crossing circuit in accordance with an embodiment of the present invention.

DESCRIPTION OF THE INVENTION

[0010] Various embodiments of the present invention provide an air conditioner with reduced power consumption in stand by mode.

[0011] The invention described herein is explained using specific exemplary details for better understanding. However, the invention disclosed can be worked on by a person skilled in the art without the use of these specific details. Components and devices shown in block diagram are illustrative of exemplary embodiments of the invention and are meant to avoid obscuring the invention. Also, the connections between various elements may not necessarily be direct and the data transfer in between can be subjected to modifications.

[0012] References in the specification to "one embodiment" or "an embodiment" means that a particular feature, structure, characteristic, or function described in connection with the embodiment is included in at least

one embodiment of the invention. The appearances of these phrases "one embodiment" or "an embodiment" in various places in the specification are not necessarily all referring to the same embodiment.

[0013] Referring to Fig. 1, an air conditioner 100 capable of reducing standby power consumption is shown in accordance with an embodiment of the invention. The air conditioner 100 includes an indoor unit 110 and an outdoor unit 120. The indoor unit (110) having an indoor terminal board with at least three terminal slots (T1, T2, T3). The outdoor unit (120) having an outdoor terminal board with terminal slots (T1', T2', T3') wherein the terminal slots (T1, T2, T3) of the indoor unit 110 are connected to outdoor unit terminal slots (T1', T2', T3'). The air conditioner 100 includes a control/switching circuit 135 at outdoor unit 120 with RY-AC parallel to RY-PWR operating to switch ON or OFF the air conditioner 100. The zero crossing circuit 130 is connected to a power source 150 from one end and connected to the control/switching circuit 135 from the other end. The power source of the zero crossing circuit 130 is cut-off by deactivating the RY-AC and RY-PWR during standby mode to reduce power consumption.

[0014] The indoor unit 110 includes fuse 112 connected between terminal slot T1 and rectifier circuit 114. The rectifier circuit 114 connected to SC 116.

[0015] In an embodiment, the air conditioner 100 further comprises a power supply means 150 adapted for powering the outdoor unit 120 via terminal slots (L, N) arranged on the outdoor terminal board (T1', T2', T3').

[0016] In an embodiment, the air conditioner further includes a low power, high impedance switching transformer 126 is connected between terminal (T2') and terminal (T1') for reducing a standby current by increasing resistance of the switching transformer 126.

[0017] In an embodiment, the air conditioner 100 further includes another RY-C relay at the outdoor unit 120 is connected between terminal (T1') and a compressor 136 through DB wherein the RY-C relay connected to rectifier circuit 138 is controlled by a microprocessor to be off during standby mode to reduce the power consumption.

[0018] In one embodiment, the RY-C relay remains "OFF" after the main power supply 150 is "ON" and RY-C relay will power on when outdoor unit 120 operations starts.

[0019] In an embodiment, indoor unit 110 earth terminal (E) 118 and outdoor unit 120 earth terminal (E') 128 are connected to each other using a connecting wire.

[0020] In an embodiment, the zero crossing circuit 130 will not start after main power supply is "ON".

[0021] In one embodiment, the zero cross circuit 130 will start function after RY-PWR is ON during operation MODE (Cooling/Heating).

[0022] In an embodiment, the indoor unit 110 and outdoor unit 120 of the air conditioner 100 being provided with at least one fuse each (112, 122) for cutting off connection upon incorrect wiring arrangement.

[0023] In an embodiment, the control/switching circuit 135 with RY-AC is provided at the outdoor unit 120 with a thermistor to provide inrush-current protection before connection to the terminal slot (T2').

5 **[0024]** In an embodiment, air conditioner 100 has a current fuse 112 connected from the terminal slot (T1) to a rectifier circuit 114 and provided therein as over-current protection of the rectifier circuit 114 of the air conditioner 100 indoor unit 110.

10 **[0025]** In an embodiment, air conditioner 100 has a current fuse 122 connected from said terminal slot (T1') to a rectifier circuit 134 and provided therein as over-current protection of the rectifier circuit 134 of said air conditioner 100 outdoor unit 120.

15 **[0026]** In an embodiment, air conditioner 100 has a current fuse 132 is connected from said zero crossing circuit 130 to a rectifier circuit 124 and provided therein as over-current protection of the rectifier circuit 124 of the air conditioner 100 outdoor unit 120.

20 **[0027]** Referring to Fig. 1a, the outdoor unit 120 of the air conditioner 100 is shown in accordance with an embodiment of the present invention. Besides being used for running the outdoor unit 120 for normal operation, the control/switching circuit 135 is also use to periodically determine the status of the outdoor unit 120 throughout the operation. Further, earth line (E') is provided for the purpose of grounding or earthing of the air conditioner 100. The outdoor unit 120 may also include a microprocessor to control the devices in the outdoor unit 120, outdoor unit temperature sensor to detect the temperature around the outdoor unit 120.

25 **[0028]** In an embodiment the outdoor unit 120 of the air conditioner 100 further includes PFC circuit protected by the fuse 122 which protects rectifier circuits 134, 138 from over current, a compressor 136, a fuse 132 which protects rectifier circuit 124 from over current and a switching transformer 126.

30 **[0029]** In this system when air conditioner is operated to exercise its function, according to the operation indoor unit is closed and power source is supplied to the outdoor unit and outdoor microprocessor (not shown) controls every devices such as fan, compressor 136 and so on.

35 **[0030]** Referring to Fig. 2a, a comparative chart 200a of the operational parameter with respect to the software at 50/60HZ judgement of the air conditioner system before and after connection of the zero crossing circuit in accordance with an embodiment of the present invention.

40 **[0031]** Fig. 2b shows a comparative chart 200b of the operational parameters of the air conditioning system before and after connection of the zero crossing circuit in accordance with an embodiment of the present invention. The operational chart of the outdoor unit components such as AC power supply 150, RY-C relay, RY-AC relay and RY-PWR relay shows the reduced power consumption in stand by mode of the air conditioner 100.

45 **[0032]** In operation mode, when the air conditioner 100 is out of standby mode, the zero crossing circuit 130 is operational along with RY-AC and the relay RY-C oper-

ates after a time delay T3 from the time when the power supply is switched ON, RY-PWR operates after a time interval of T1 from the time when RY-C operates. RY-AC is cut off after a time interval of T2 from the time RY-PWR operates. After time interval of T4 from the time the power supply is switched off, the relay RY-AC, the zero crossing circuit 130 and the relay RY-PWR is cut-off.

[0033] Apart from the above, the relay (RY-AC, RY-C, RY-PWR) in the outdoor terminal board as described above would provide a highly dependable component for minimizing standby power consumption of an air conditioner and would be conveniently used to connect the air conditioner to outdoor supply system. In use, it is desirable to have such air conditioner that is convenient to use and able to reduce standby power consumption thereby minimizing electricity and cost. In addition, utilization of such relay and indoor terminal boards are applicable not only to the split system air conditioners, but are also applicable to the window system air conditioners, window split system air conditioner and air to water conditioner having hot/cold water producing system.

[0034] While the preferred embodiments of the present invention have been described, it should be understood that various changes, adaptations and modifications may be made thereto. It should be understood, therefore, that the invention is not limited to details of the illustrated invention shown in the figures and that variations in such minor details will be apparent to one skilled in the art.

Claims

1. An air conditioner comprising:

an indoor unit having an indoor terminal board with at least three terminal slots (T1, T2, T3); and an outdoor unit (120) having an outdoor terminal board with at least three terminal slots (T1', T2', T3') wherein the terminal slots of indoor units are connected to outdoor unit terminal slots; a control/switching circuit 135 at outdoor unit 120 with RY-AC parallel to RY-PWR operating to switch ON or OFF the air conditioner; and a zero crossing circuit 130 connected to a power source from one end and connected to the control/switching circuit 135 from the other end; wherein power source of the zero crossing circuit 130 is cut-off by deactivating the RY-AC and RY-PWR during standby mode to reduce power consumption.

2. An air conditioner as claimed in claim 1, further **characterized in that** another RY-C at the outdoor unit is connected between terminal (T1') and a compressor wherein said RY-C is controlled by a microprocessor to be off during standby mode to reduce the power consumption.

3. An air conditioner as claimed in claim 2, wherein RY-C remains "OFF" after main power supply is "ON" and RY-C will power on when outdoor unit operation starts.

4. An air conditioner as claimed in claim 1, further **characterized in that** a low power, high impedance switching transformer is connected between terminal (T2') and terminal (T1') for reducing a standby current by increasing resistance of the switching transformer.

5. An air conditioner as claimed in claim 1 or 2, further **characterized in that** said outdoor terminal board having earth terminal (E') 128 for connection to earth terminal (E) 118 of said indoor terminal board.

6. The air conditioner according to claim 1, further comprising a power supply means adapted for powering said outdoor unit via terminal slots (L, N) arranged on said, outdoor terminal board.

7. An air conditioner as claimed in claim 6, wherein zero crossing circuit will not start after main power supply is "ON".

8. An air conditioner as claimed in claim 1, wherein zero cross circuit will start function after RY-PWR is ON during operation MODE (Cooling / Heating).

9. An air conditioner as claimed in claim 6, wherein the indoor and outdoor unit of the air conditioner power supply being provided with fuses for cutting off connection upon incorrect wiring arrangement.

10. An air conditioner as claimed in Claim 1, further **characterized in that** said relay circuit with RY-AC being provided with a thermistor to provide inrush-current protection before connection to said terminal slot (T2').

11. An air conditioner as claimed in Claim 1, further **characterized in that** a current fuse 112 is connected from the terminal slot (T1) to a rectifier circuit 114 and provided therein as over-current protection of the rectifier circuit 114 of the air conditioner 100 indoor unit 110.

12. An air conditioner as claimed in Claim 1, further **characterized in that** a current fuse 122 connected from said terminal slot (T1') to a rectifier circuit 134 and provided therein as over-current protection of the rectifier circuit 134 of the air conditioner 100 outdoor unit 120.

13. An air conditioner as claimed in Claim 1, further **characterized in that** a current fuse 132 is connected from said zero crossing circuit 130 to a rectifier circuit

124 and provided therein as over-current protection of the rectifier circuit 124 of the air conditioner 100 outdoor unit 120.

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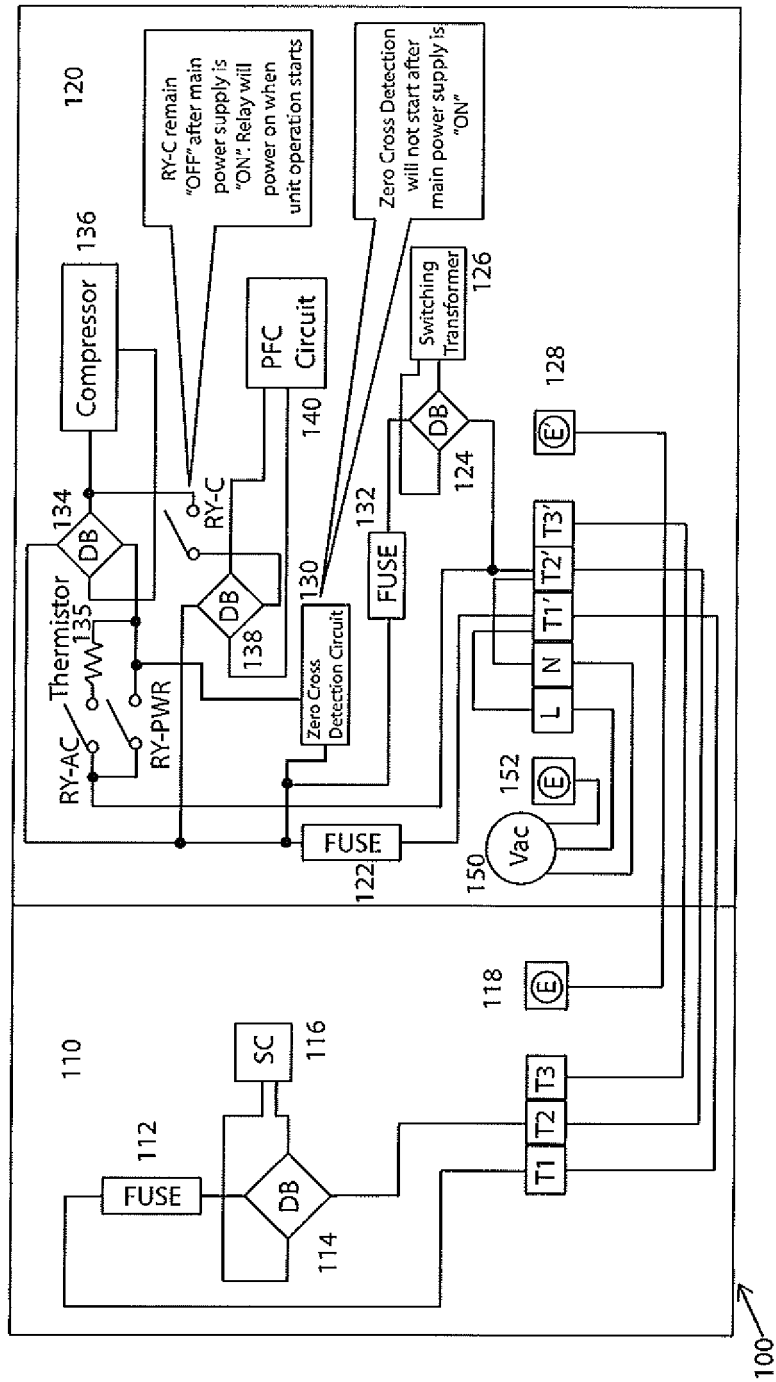


FIG. 1

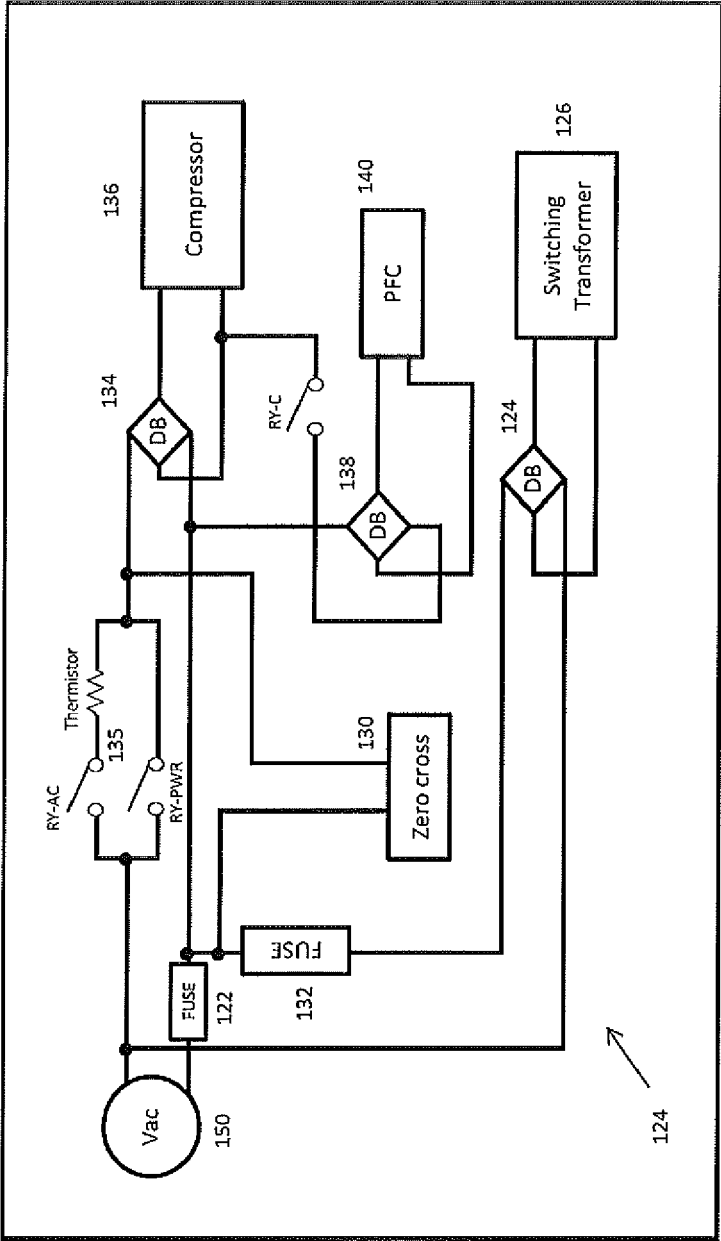


FIG. 1a

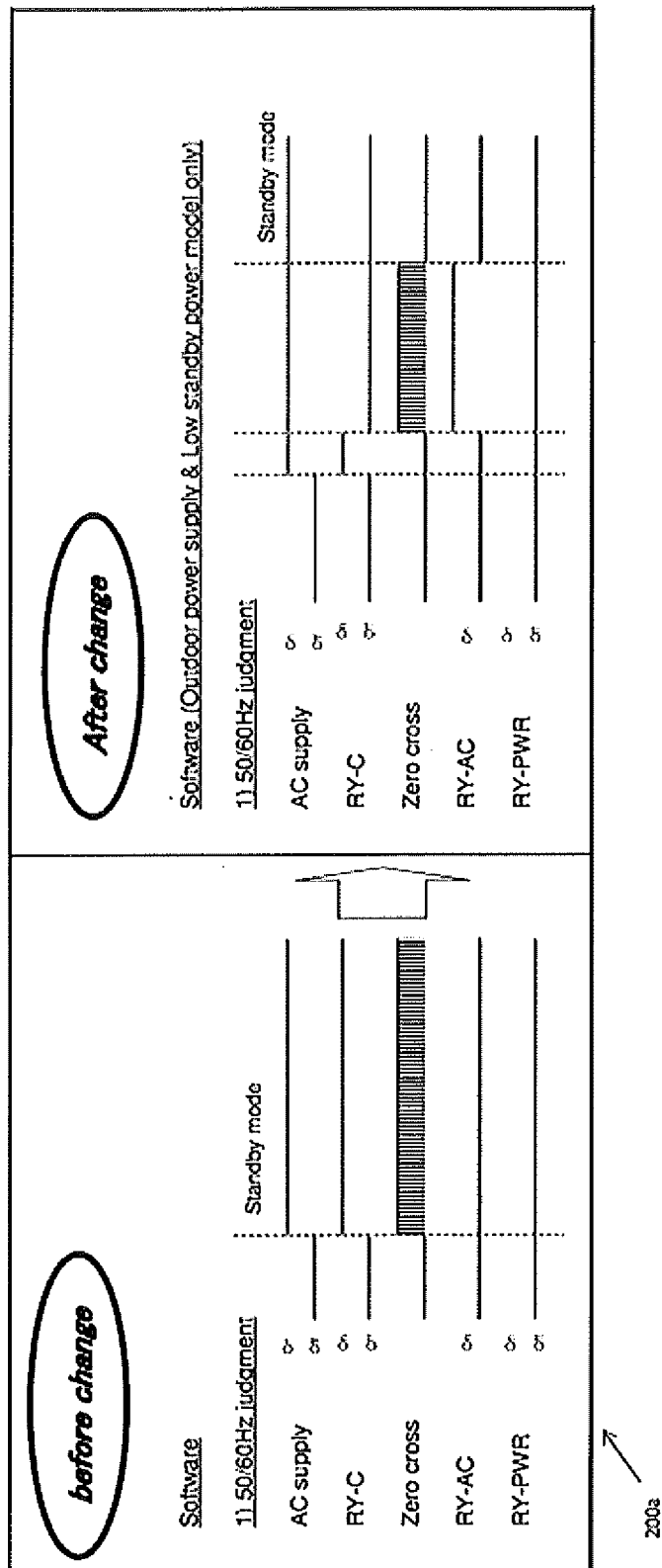


FIG. 2a

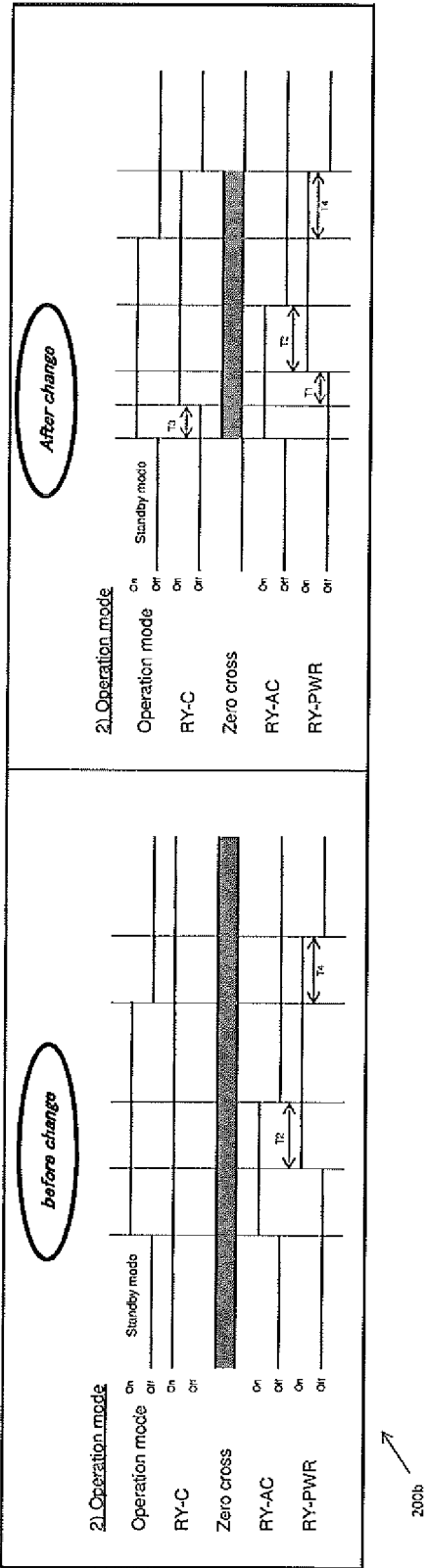


FIG. 2b



EUROPEAN SEARCH REPORT

Application Number
EP 15 46 5552

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Place of search Munich		Date of completion of the search 1 July 2016	Examiner Vuc, Arianda
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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