(12) UK Patent Application (19) GB (11) 2 081 879 A

(21) Application No **8113001**
(22) Date of filing **28 Apr 1981**
(30) Priority data
(31) **55/055524**
(32) **28 Apr 1980**
(33) **Japan (JP)**
(43) Application published **24 Feb 1982**
(51) **INT CL³ B60H 1/00**
(52) Domestic classification **F4V** B1D B3E
(56) Documents cited
GB 1379040
GB 1377502
GB 1033175
GB 942535
(58) Field of search
F4V
H2J
(71) Applicants
Nissan Motor Company Limited,
No. 2, Takara-cho,
Kanagawa-ku,
Yokohama City,
Japan.

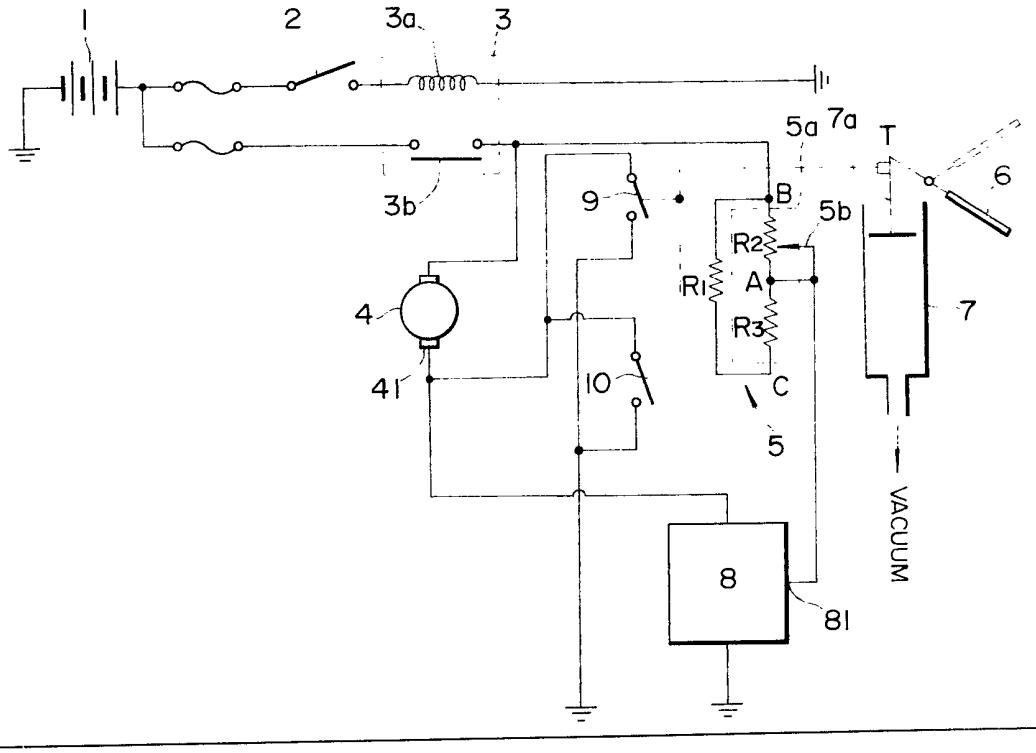
(72) Inventors
Toshio Ohashi,
Toyotoshi Katoh,
Masaru Takasaki.

(74) Agents
Marks & Clerk,
57 - 60 Lincoln's Inn Fields,
London, WC2A 3LS.

(54) **Automatic blower speed control system of an air conditioner**

(57) In an automatic blower speed control system of an air conditioner, a control amplifier (8) controls a driving current applied to a blower fan motor (4) in response to the position of an air mix door (6). Bypass switch means (9, 10) is operable when the door (6) attains its fully open or closed position for bypassing a current directly to the blower fan motor (4) from an electric power source.

FIG. 4



GB 2 081 879 A

FIG. 1 PRIOR ART

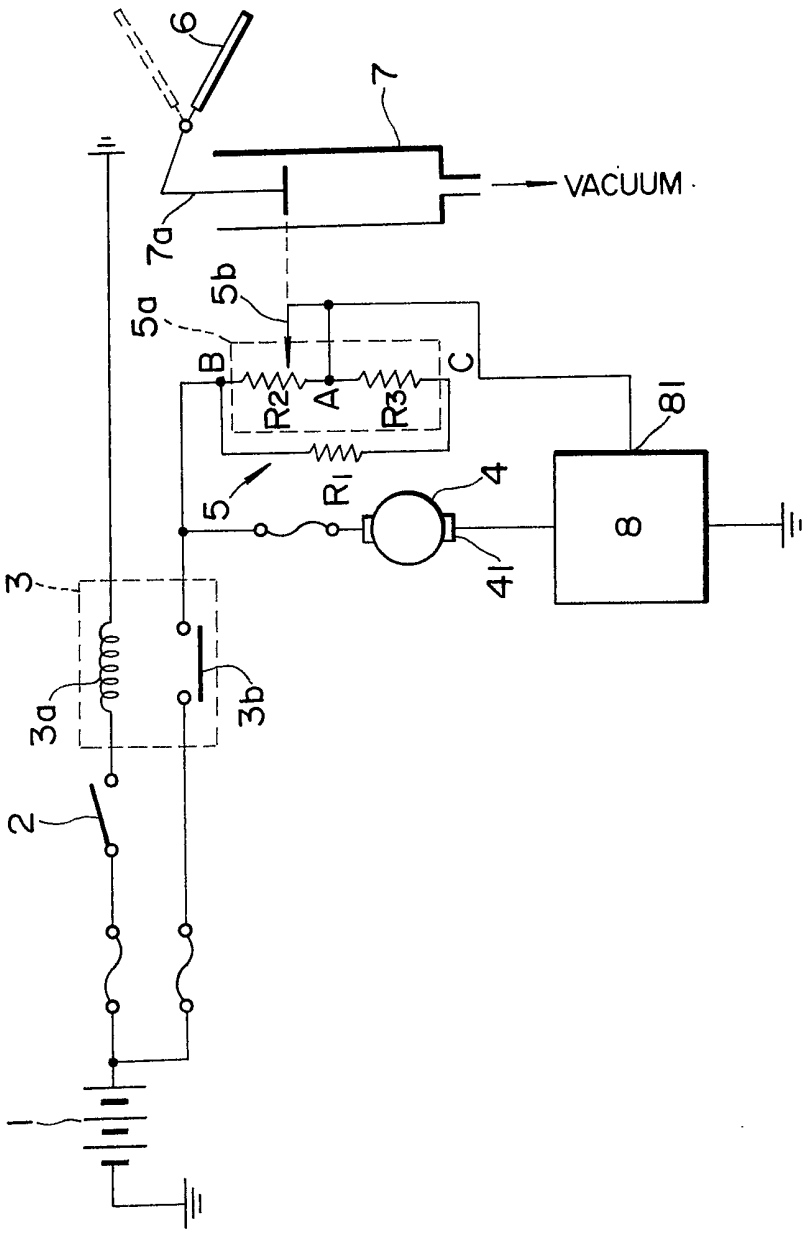


FIG. 2

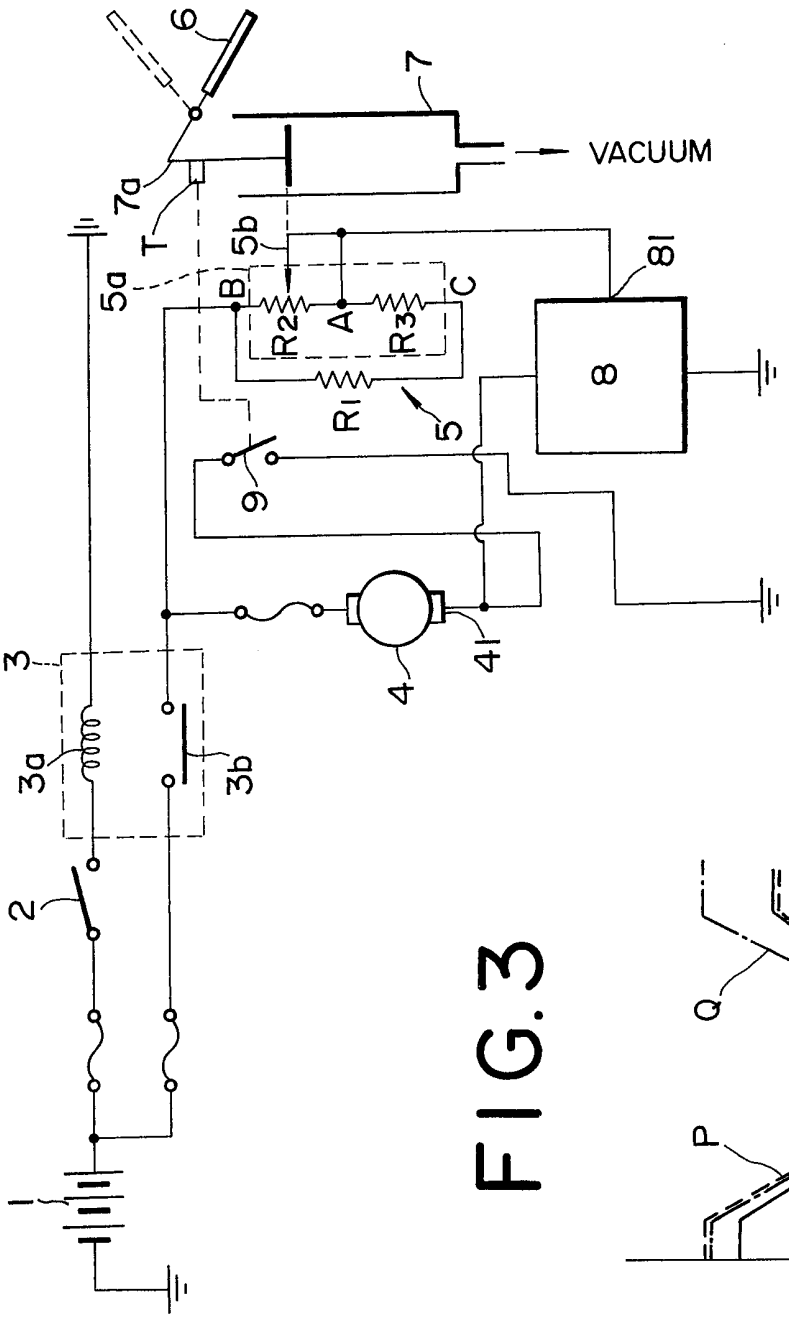


FIG. 3

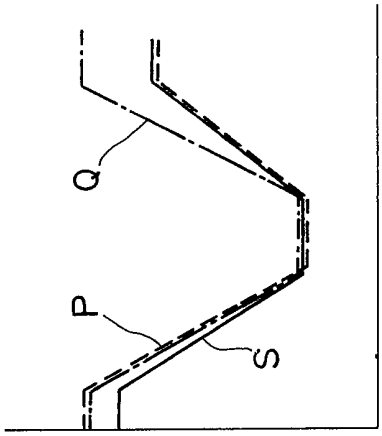


FIG. 4

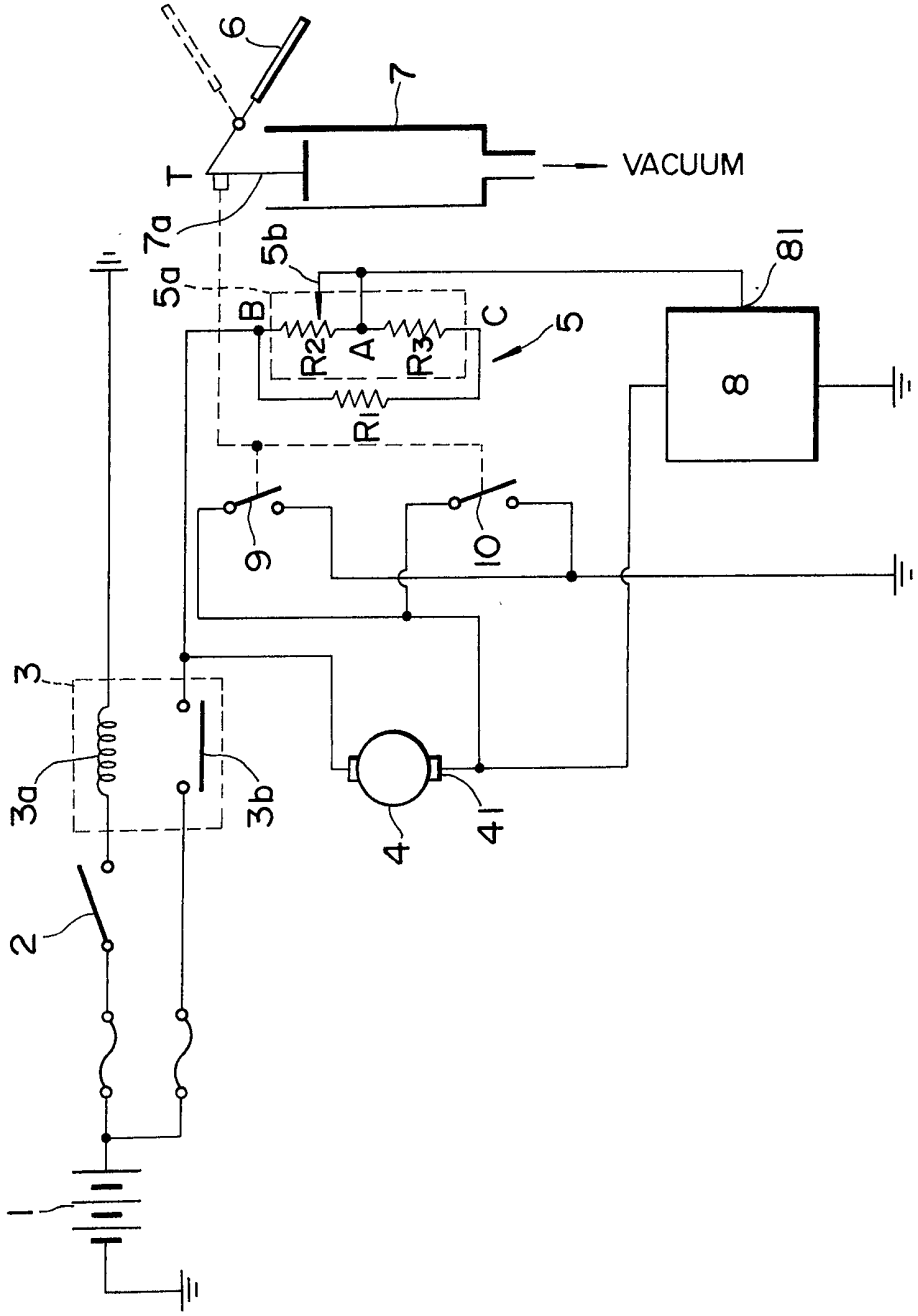
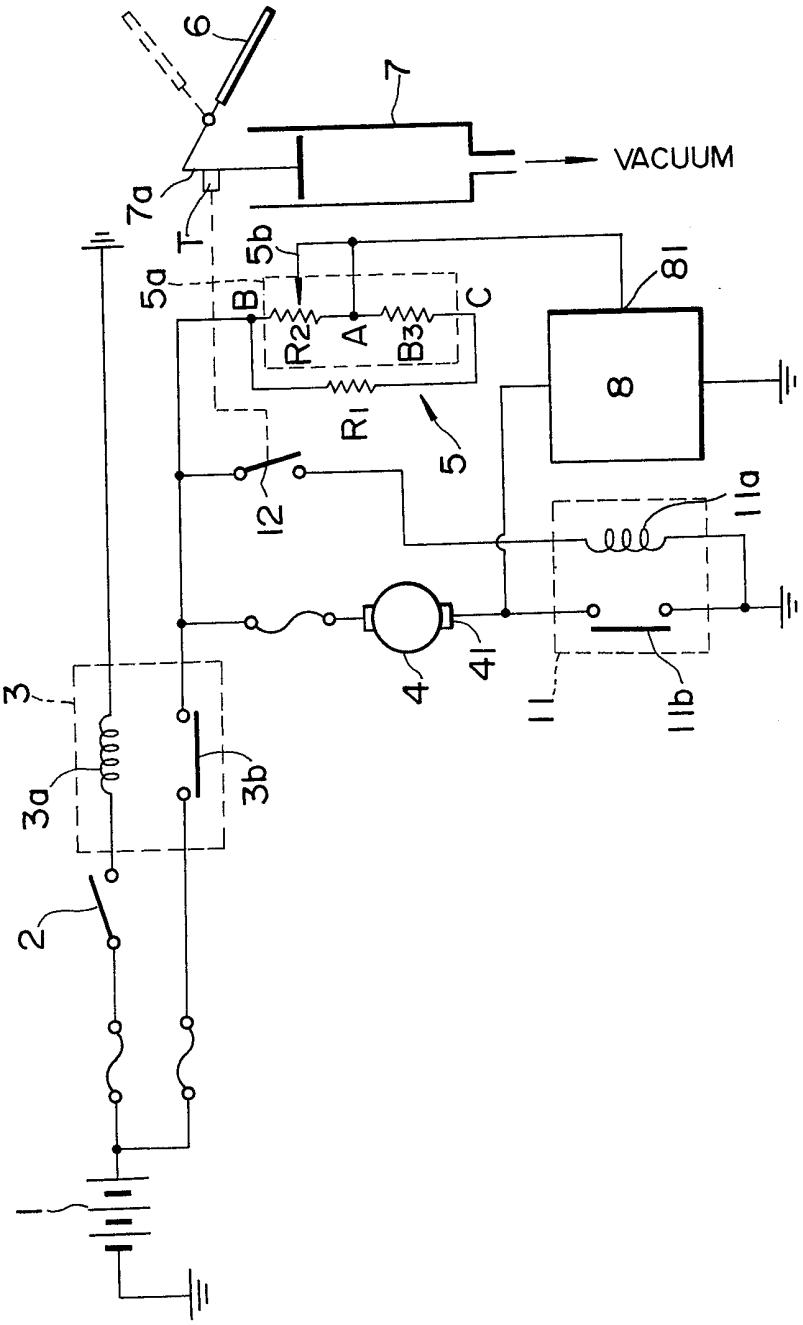


FIG.5



SPECIFICATION

Automatic blower speed control system of an air conditioner

Background of the invention

1. Field of the invention

The present invention relates to an automatic blower speed control system of an air conditioner wherein the efficiency of a blower is improved by utilizing a simple construction of the blower for motor circuit.

2. Description of the prior art

In the case of an automotive air conditioner having an automatic blower control system, an amount of output air is controlled by varying the speed of the blower fan motor in response to the position of an air mix door disposed within an air flow passageway of the air conditioner.

An ordinary automatic blower control system comprises a control amplifier for varying the blower fan motor driving current including a regulator transistor connected in series to the blower fan motor, and a rheostat responsive to the position of the air mix door. In this sort of blower speed control system, the inner resistance of the regulator transistor varies with a control voltage fed thereto from the rheostat.

Specifically, the control amplifier is constructed so that a medium driving current is supplied to the blower fan motor when the position of the air mix door is a partially closed position for admitting the air into either of heater core or a bypass passageway, thus producing a moderate temperature output air.

Then, in response to the movement of the air mix door, the fan motor driving current is gradually increased until the air mix door is moved to a fully closed or fully opened position for permitting the air solely into the bypass passageway or into the heater core. In this state, the maximum driving current is supplied to the blower fan motor.

Thus, the amount of output air is maximized, causing the air conditioner system to operate at its maximum cooling or heating capacity.

However, in the case of the automatic blower control system constructed as above, the internal resistence of the regulator transistor causes a considerable voltage drop across the control amplifier terminals, especially when the blower fan motor is supplied with a high driving current. In other words, a part of the electric power for driving the blower fan motor is always consumed by the regulator transistor of the control amplifier. This energy consumption results in a drop in the blower efficiency when the blower is operated at its maximum capacity, for example, in the midsummer or midwinter season.

Summary of the invention

According to the present invention, an automatic blower speed control system of an air conditioner comprises an actuator for shifting the position of an air mix door utilized for varying the mixing ratio of the hot and cool air, a blower fan motor, an electric power source for supplying a driving current to said blower fan motor, control amplifier means connected to a terminal of said blower fan motor for varing the current flowing therethrough, rheostat means responsive to a position of said air mix door for producing a control voltage of said control amplifier, and bypass switch means for bypassing said control amplifier means to supply said driving current directly to the blower fan motor when the air mix door is shifted to a fully closed and/or fully opened position so that the blower fan performs its maximum operation.

An object of the invention is therefore to provide an automatic blower speed control system of an air conditioner wherein the efficiency of the blower is improved.

Brief description of the drawings

Figure 1 is a circuit diagram of a conventional automatic blower speed control system of an air conditioner;

Figure 2 is a circuit diagram of a first embodiment of the automatic blower speed control system according to the present invention;

Figure 3 shows the relationship between the driving voltage applied to the blower fan motor and the position of the air mix door;

Figure 4 is a circuit diagram of a second embodiment according to the present invention; and

Figure 5 is a circuit diagram of a third embodiment according to the present invention.

Detailed description of the preferred embodiments

Before entering into the explanation of the embodiment according to the present invention, a conventional automatic blower speed control system is explained with reference to Figure 1.

As shown in Figure 1, the conventional automatic blower speed control system includes a control amplifier 8 connected in series to the blower fan motor 4, and a rheostat circuit 5 interlocked with a power servo actuator 7 for driving an air mix door 6. A wiper 5b of the rheostat circuit 5 is located at a position B when the air mix door is fully closed so as to direct the air from an evaporator of a cooling unit into air conditioner outlets. In this state, the rheostat circuit 5 has the minimum resistance value and the bettery voltage applied to the terminal B of the rheostat 5a is picked out by the wiper 5b and this voltage is applied to the control amplifier 8.

The control amplifier 8 varies its internal resistance in accordance with the voltage applied at the terminal 81 thereof from the wiper 5b. In this state, the internal resistance of the control amplifier 8 is reduced to the minimum value by applying the highest voltage, and the maximum driving current flows through the blower fan motor 4 so that the air conditioner system performs the cooling operation at its maximum capacity.

Similarly, when the air mix door 6 is fully opened to direct the air from the evaporator into a heater core, the wiper 5a is located at the position C of the rheostat 5a. Also in this state, the rheostat circuit has almost the minimum resistance value and the voltage substantially equal to the battery voltage is

applied to the control amplifier 8. As a result, the maximum driving current flows through the blower fan motor 4.

The relationship between the air mix door position and the voltage applied to the blower fan motor 4 is illustrated by a solid line S in Figure 3.

However, in the case of the automatic blower speed control system described as above, there is a drawback that the maximum blower efficiency is not obtained since the voltage drop across the control amplifier terminals is not negligible due to the inner resistance thereof.

Referring to Figure 2, a first embodiment according to the present invention is explained. In Figure 2, the corresponding or equivalent elements in Figure 1 are designated by the same reference numerals.

As shown in Figure 2, the automatic blower control system according to the present invention comprises an electric power source, a blower fan motor 4, a control amplifier 8 connected in series to the blower fan motor 4, a rheostat circuit 5 responsive to the position of a power servo actuator 7 of an air mix door 6, and a bypass switch 9 interlocked with the position of the air mix door 6.

The electric power source includes a storage battery 1, an ignition switch 2, and an ignition relay 3 having a relay coil 3a and a relay contacts 3b.

The power servo actuator 7 has a lever 7a which moves reciprocally for driving the air mix door 6 in accordance with a vacuum produced in proportion to a temperature level determined by an operator of the air conditioner.

The control amplifier 8 preferably comprises a Darlington connected circuit of two power transistors, and it is interposed between the ground and the ground side terminal 41 of the blower fan motor 4, the internal resistance of the control amplifier varies with the control voltage applied to an input terminal 81 thereof.

The rheostat circuit 5 is made up of a parallel circuit of a resistor R_1 and a rheostat 5a having a series circuit of resistors R_2 and R_3, and one of the junctions of the resistor R_3 and the rheostat 5a is connected to a relay contact 3b of the ignition relay 3.

The rheostat circuit 5 further includes a movable wiper 5b interlocked with a lever 7a of the power servo actuator 7 for driving the air mix door 6 of the air conditioner. The movable wiper 5b is slidably mounted on the resistors R_2 and R_3.

The bypass switch 9 is interposed between the ground side terminal 41 of the blower fan motor 4 and the ground, and it is closed when the air mix door is fully closed to direct the air into the bypass passageway, causing the air conditioner system to perform its cooling operation.

In order to actuate the bypass switch 9, it is preferable to provide a protrusion T on the lever 7a of the power servo actuator 7, at a suitable position for closing the bypass switch 9 when the lever 7a is fully extended to close the air mix door 6.

The operation of this automatic blower speed control system is explained hereinafter.

The operation of the control amplifier 8 and the rheostat circuit 5 are substantially the same as that of the conventional blower speed control system as described above.

Specifically, when an ignition switch 2 (or an accessory switch) is turned on, a relay coil 3a of an ignition relay 3 is energized to close its relay contacts 3b, thereby supplying a driving voltage from the storage battery 1 to the blower fan motor 4.

When the air conditioner system is operated at its maximum cooling capacity (full cool operation mode), the air mix door 6 is fully closed by the lever 7a of the power servo actuator 7 and consequently, the wiper 5b of the rheostat 5a is located at a position B.

Conversely, when the air conditioner system is operated at its maximum heating capacity (full hot operation mode), the air mix door 6 is fully opened to direct the air into the heater core, and the wiper 5b is located at a position C. When the air mix door 6 is located between the fully opened and fully closed positions, the wiper 5b moves between the positions B and C in response to the movement of the lever 7a of the power servo actuator 7. The resistance of the rheostat circuit 5 varies with the movement of the wiper 5b and it is determined by a combined resistance of a resistance between the wiper 5b and the terminal B and a resistance between the wiper 5b and the terminal C plus the resistance of the resistor R_1. The rheostat circuit 5 has the maximum resistance value when the air mix door is located at the partially closed position and the wiper 5b is positioned at the junction of the resistors R_2 and R_3 and the rheostat 5a.

Thus the control amplifier 8 is supplied with the control voltage through the wiper 5b, and the speed of the blower fan motor 4 is controlled in conjunction with the opening degree of the air mix door 6 except when the air mix door 6 is fully closed at the full cool operation of the air conditioner system.

When the air mix door 6 is fully opened, that is, when the power servo 7 assumes at its maximum stroke position, the protrusion T on the lever 7a actuates the bypass switch 9 to close its contacts. Closing of the bypass switch 9 allows the ground side terminal of the blower fan motor 4 to directly connect to the ground by bypassing the control amplifier 8. The bypass path thus established has eliminated a drop in voltage owing to energy consumption of the control amplifier 8. As the result, the driving current passign through the blower fan motor 4 is allowed to increase, causing the blower fan motor 4 to rotate at the highest speed. Thus, the blower efficiency during the full cool operation mode of the air conditioner system is improved. The voltage applied to the blower fan motor in this embodiment is illustrated by a broken line P in Figure 3.

A second embodiment according to the present invention is explained with reference to Figure 4.

This embodiment features that the control amplifier 8 is bypassed during either of the full cool operation mode or full hot operation mode of the air conditioner in contrast with the case of the first embodiment where the blower efficiency is improved only during full cool operation mode.

In order to realize the above operation, an addi-

tional bypass switch 10 is provided which is responsive to the full hot operation mode of the air conditioner. This bypass switch 10 is positioned near the lever 7a of the power servo actuator 7 and it is closed with the movement of the lever 7a when the air mix door 6 is fully opened.

By the above construction, the fan control amplifier 8 is bypassed when the air conditioner is operated at full hot or full cool operation, thereby increasing the power current through the blower fan motor 4, thereby causing an increase in the blower fan motor speed.

The voltage applied to the blower fan motor 4 in the case of this embodiment is shown by a dotted line Q in Figure 3.

A third embodiment according to the present invention is explained with reference to Figure 5.

In this embodiment, a relay 11 is provided in parallel to the control amplifier 8, the relay coil 11a of the relay 11 is connected to a terminal of a bypass switch 12, and the other terminal of the bypass switch 12 is connected to the ground. The relay contacts 11b of the relay 11 is connected between the ground side terminal 41 of the blower fan motor 4 and the ground. The bypass switch 12 is interlocked with the lever 7a of the power servo actuator 7 and it is closed when the lever 7a is at the positions respectively for opening and closing the air mix door 6.

In the above circuit construction, the relay coil 11a of the relay 11 is energized when the bypass switch 12 is closed, thus the realy contacts 11b is closed for supplying the power voltage directly to the blower fan motor 4. Thus, the blower fan motor speed is increased as compared with the conventional blower speed control system.

As is appreciated from the foregoing, in the case of the present invention, a bypass switch which is closed at the full hot and/or full cool position of the power servo actuator, and the fan control amplifier is bypassed when the bypass switch is closed. Thus, the power voltage is directly supplied to the blower fan motor without causing the voltage drop accross the fan control amplifier terminals, during the full hot and/or full cool operation of the air conditioner system, thereby raising the blower fan motor speed, so that the air conditioner system performs the maximum heating or cooling operation.

In addition, when the present invention is adapted to the conventional stepwise speed control system of the blower fan motor with stationary contacts and a movable contact, a fine control of the blower fan motor speed during the full hot operation mode and full cool operation mode is also expected.

CLAIMS

1. An automatic blower speed control system of an air conditioner comprising:

an actuator for shifting the position of an air mix door utilized for varying the mixing ratio of the hot and cool air;

a blower fan motor;

an electric power source for supplying a driving current to said blower fan motor;

control amplifier means connected to a terminal of said blower fan motor for varying the current flowing therethrough in response to a control voltage applied thereto, said control amplifier and said blower fan motor being connected to said electric power source in series relation with each other.

rheostat means (5) responsive to the position of said air mix door for producing said control voltage applied to said control amplifier; and

bypass switch means for bypassing said control amplifier means to supply said driving current directly to the blower fan motor when the air mix door is shifted to a fully closed and/or fully opened position so that the blower fan performs its maximum operation.

2. An automatic blower speed control system as claimed in claim 1, in which said bypass switch means comprises a first switch and a second switch connected in parallel with terminals of said control amplifier, said first switch being closed when the air mix door is fully closed, and said second switch being closed when the air mix door is fully opened.

3. An automatic blower fan speed control system as claimed in claim 1, in which said bypass switch means comprises a relay having a relay coil and a relay contacts connected to terminals of said control amplifier, and a control switch for controlling the driving current of said relay coil.

4. An automatic blower speed control system as claimed in any one of claim 1 to 3, in which said actuator has a lever means for driving said air mix door and a protrusion is provided on said lever means for actuating said bypass switch means.

5. An automatic blower speed control system substantially as hereinbefore described with reference to Figures 2 to 5 of the accompanying drawings.

Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1982.
Published by The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.