US006383071B1

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Takeuchi et al.

(10) **Patent No.: US 6,383,071 B1**
(45) **Date of Patent: May 7, 2002**

(54) **VEHICULAR AIR-CONDITIONING APPARATUS**

(75) Inventors: **Tokuhisa Takeuchi**, Chita-gun; **So Hibino**, Anjo; **Teruhiko Kameoka**, Okazaki; **Koichi Ito**, Kariya, all of (JP)

(73) Assignee: **Denso Corporation**, Kariya (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/693,469**

(22) Filed: **Oct. 20, 2000**

(30) **Foreign Application Priority Data**

Oct. 21, 1999 (JP) 11-300210
Jul. 27, 2000 (JP) 2000-227500
Aug. 21, 2000 (JP) 2000-250121

(51) **Int. Cl.**[7] **B60S 1/54**
(52) **U.S. Cl.** **454/121**; 454/333
(58) **Field of Search** 454/121, 256, 454/258, 333

(56) **References Cited**

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3,641,915 A * 2/1972 Jardinier et al. 454/333
4,874,127 A * 10/1989 Collier 165/205
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Primary Examiner—Harold Joyce
Assistant Examiner—Derek S. Boles
(74) *Attorney, Agent, or Firm*—Harness, Dickey & Pierce, PLC

(57) **ABSTRACT**

A differential mechanism is provided between first output shaft, to which the rotation of the drive motor is transmitted, and second output shaft, to which the rotation of first output shaft is transmitted, for adjusting the relative positions of these two output shafts. An air-mix door is connected to first output shaft, and a blowout mode door is connected to second output shaft. The rotation of the drive motor is used to operate the air-mix door and the blowout mode door in linkage, and the blowout mode door is designed to be able to be independently operated by the operation of movable lever of differential gear mechanism.

27 Claims, 48 Drawing Sheets

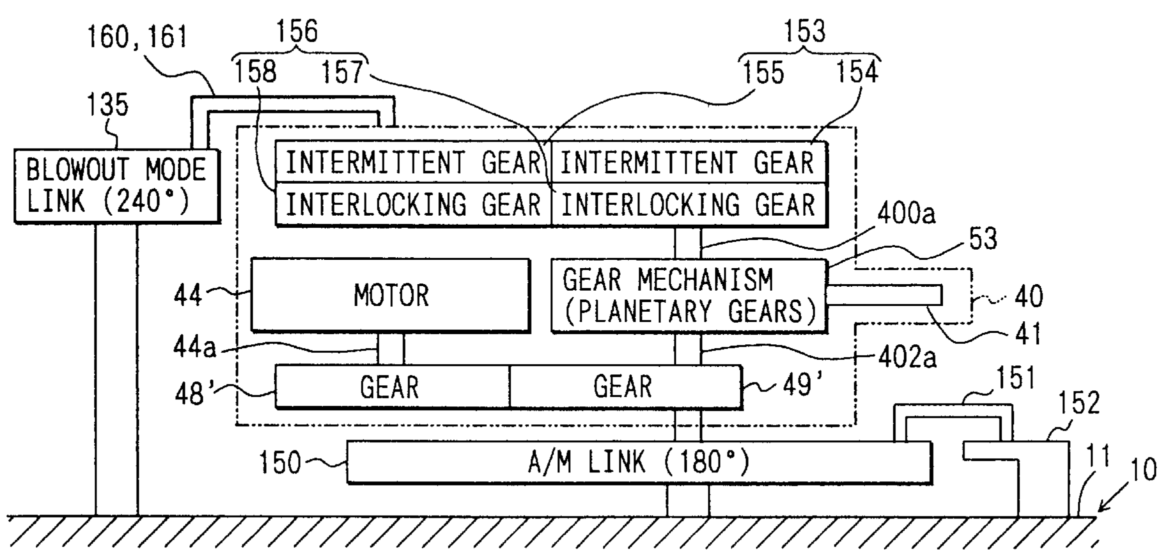


FIG. 1

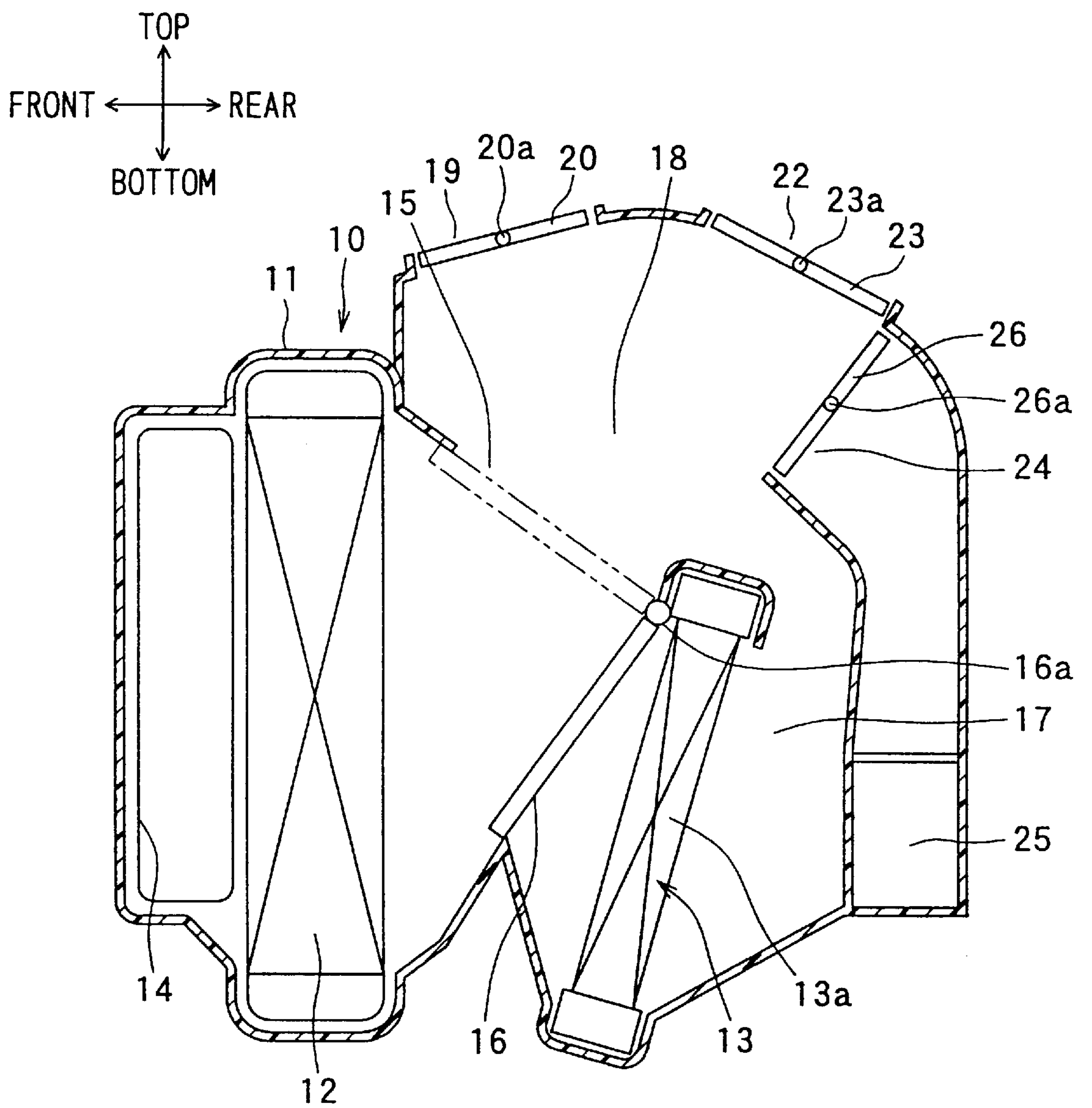

TOP
FRONT
REAR
BOTTOM
10
11
12
13
13a
14
15
16
16a
17
18
19
20
20a
22
23
23a
24
25
26
26a

FIG. 2A

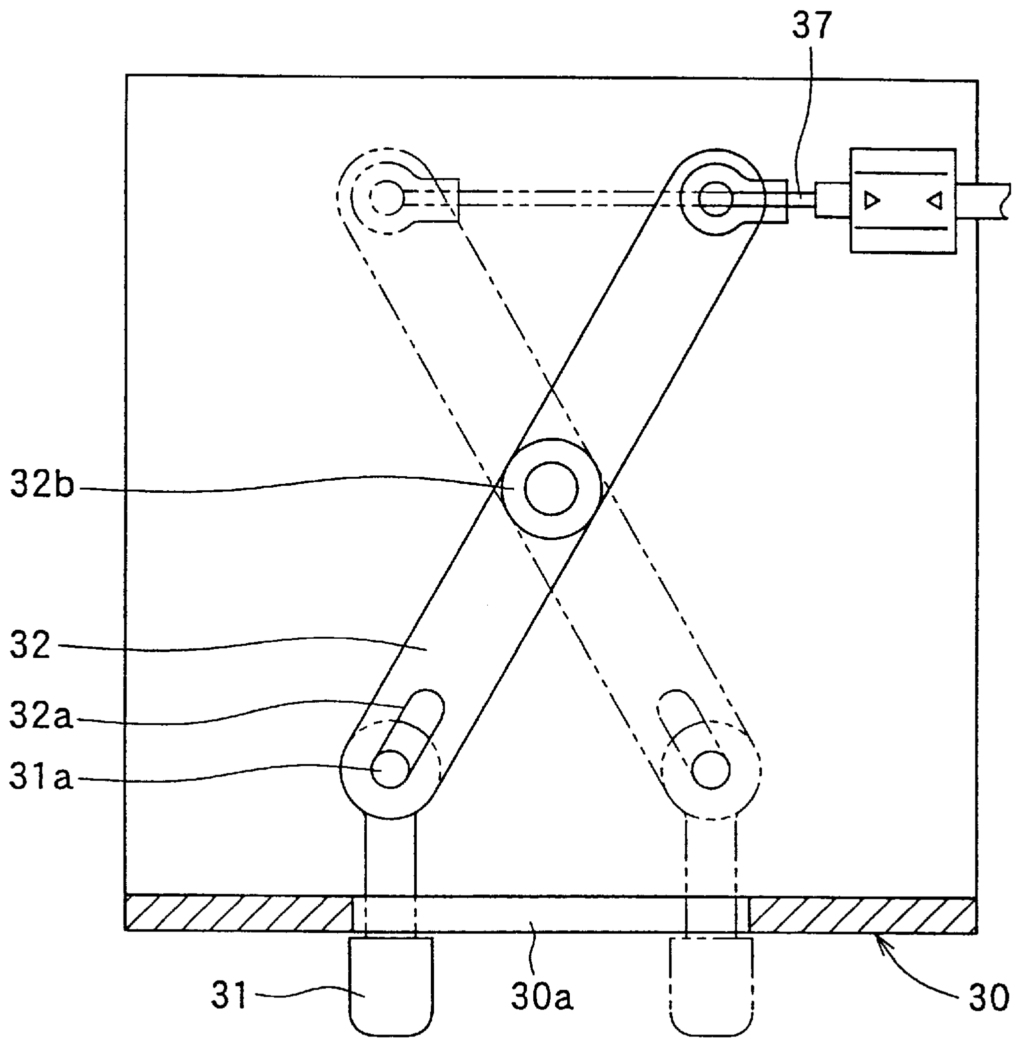

37
32b
32
32a
31a
31
30a
30

FIG. 2B

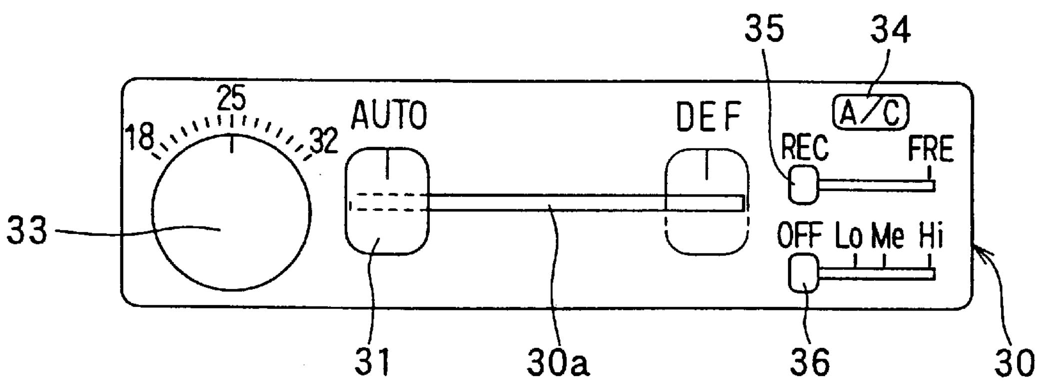
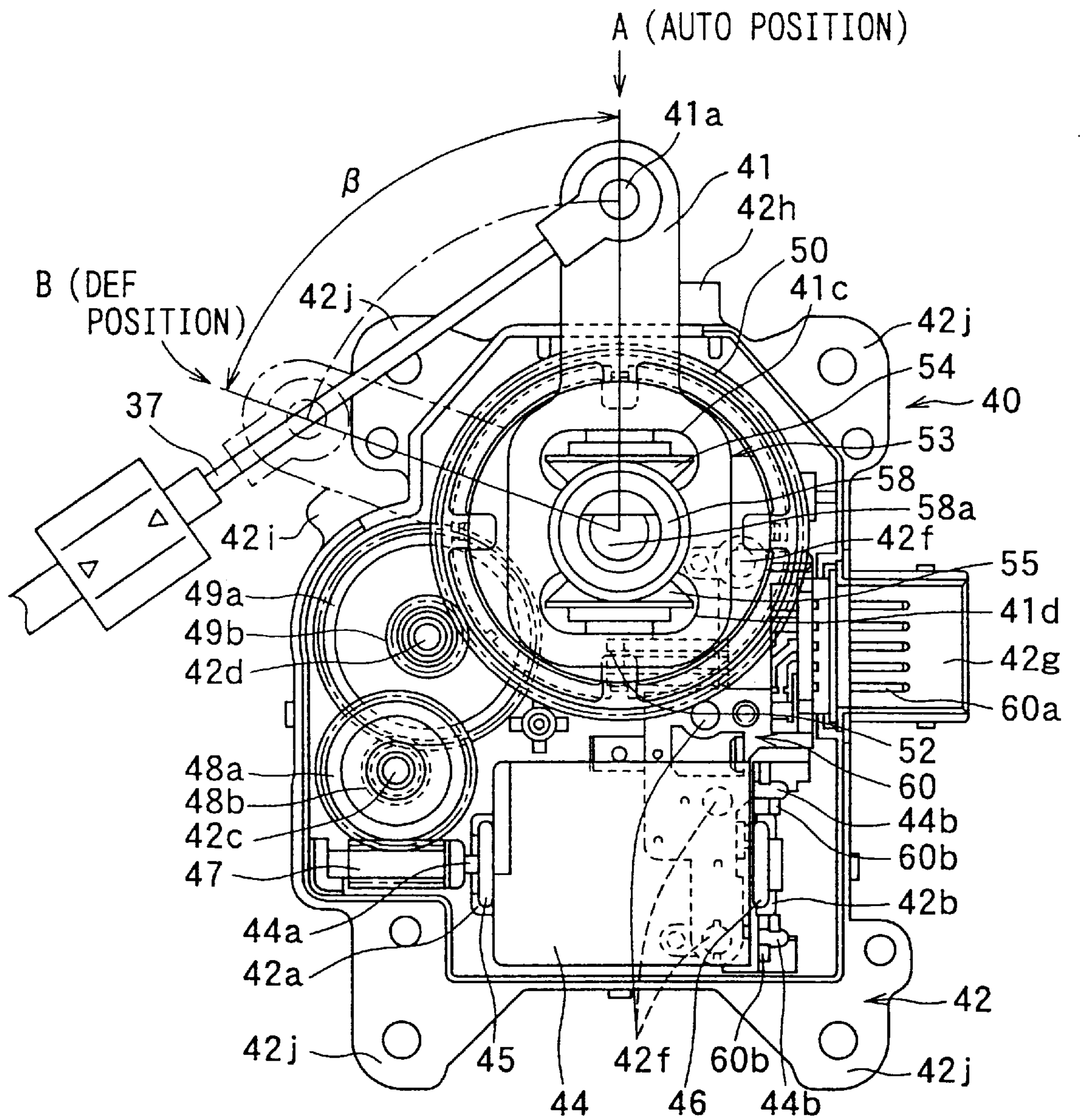
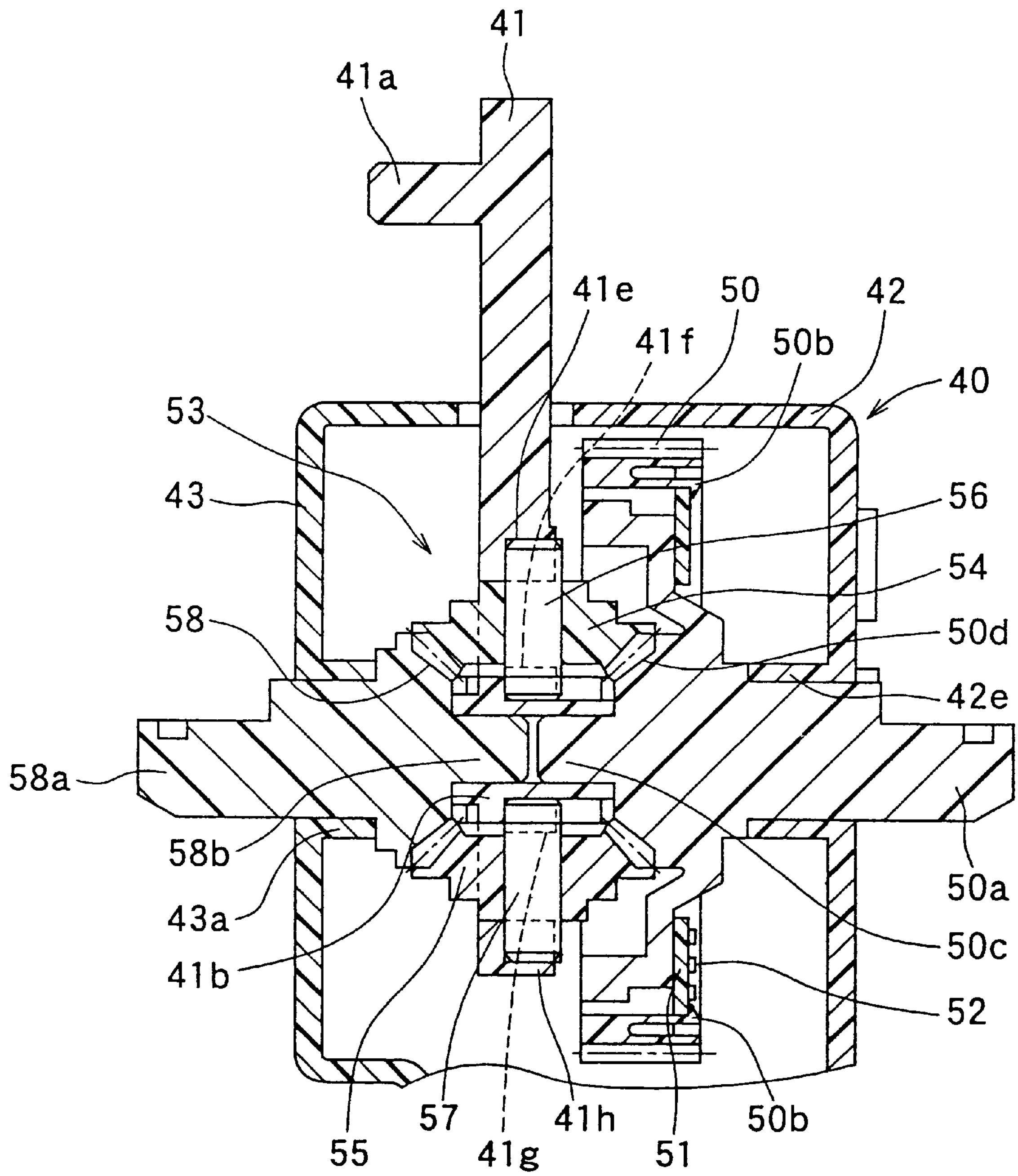

35
34
A/C
18
25
32
AUTO
DEF
REC
FRE
OFF
Lo
Me
Hi
33
31
30a
36
30

FIG. 3



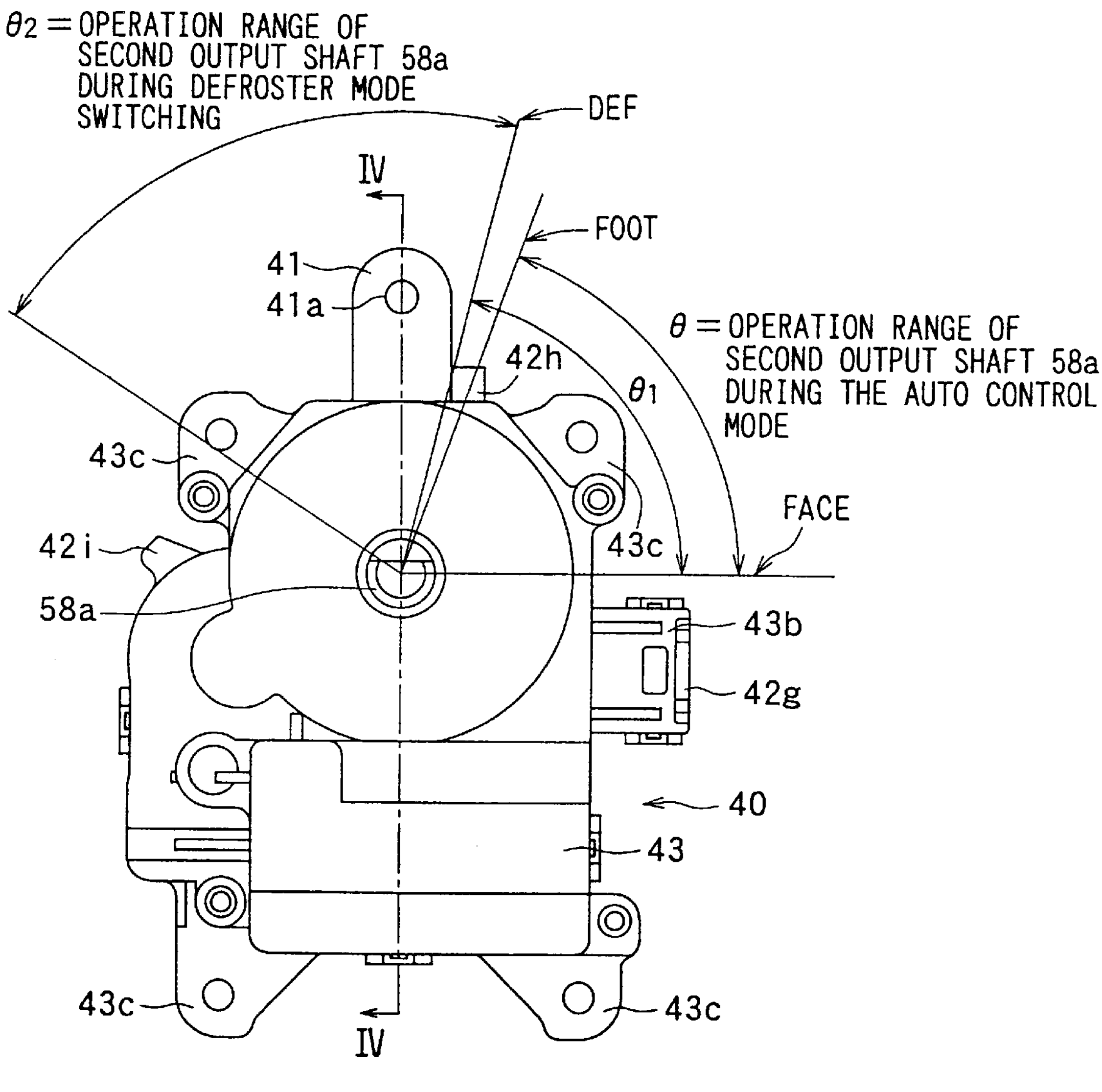
A (AUTO POSITION)
41a
41
42h
50
41c
42j
54
40
53
58
58a
42f
55
41d
42g
60a
52
60
44b
60b
42b
42
42j
B (DEF POSITION)
β
42j
37
42i
49a
49b
42d
48a
48b
42c
47
44a
42a
42j
45
44
42f
46
60b
44b

FIG. 4



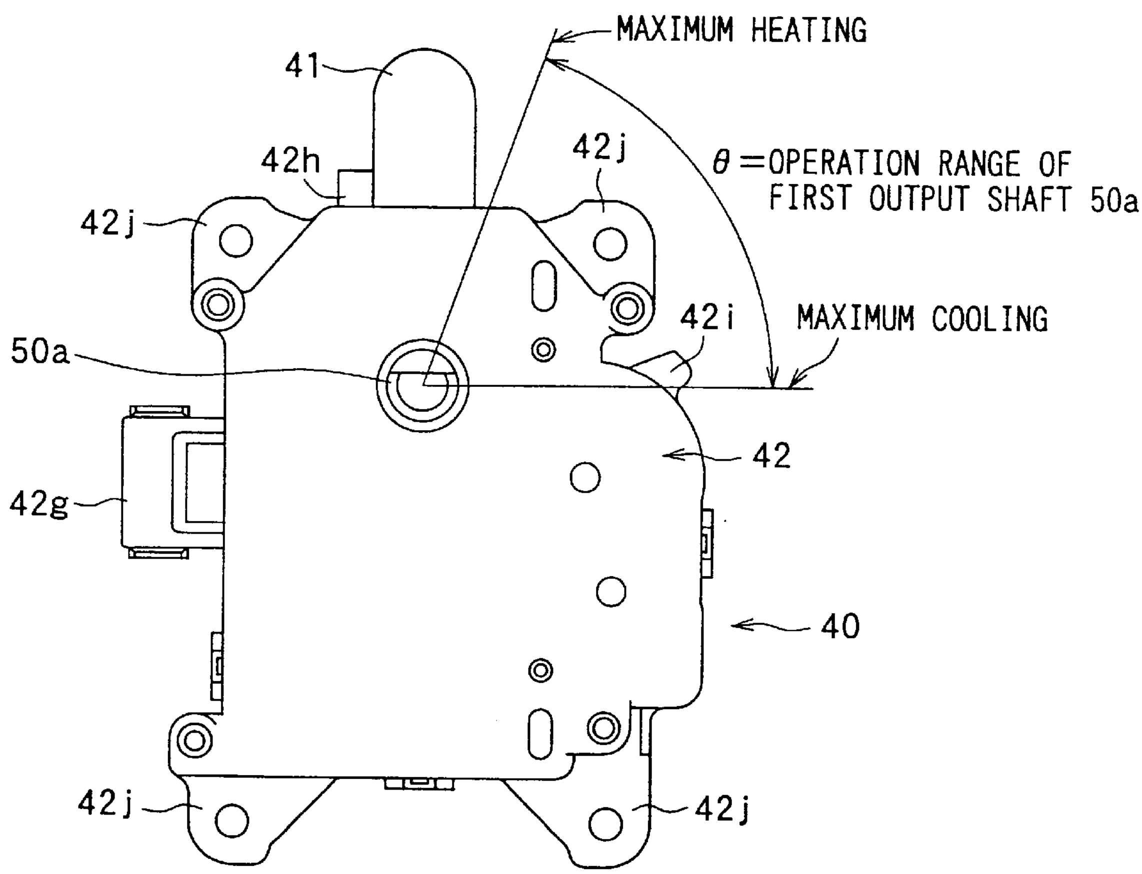
41
41a
41e
50
42
41f
50b
40
53
43
56
54
58
50d
42e
58a
58b
50a
43a
50c
41b
52
50b
57
41h
55
41g
51

FIG. 5



θ2 = OPERATION RANGE OF SECOND OUTPUT SHAFT 58a DURING DEFROSTER MODE SWITCHING
DEF
IV
FOOT
41
41a
42h
θ1
θ = OPERATION RANGE OF SECOND OUTPUT SHAFT 58a DURING THE AUTO CONTROL MODE
43c
43c
FACE
42i
58a
43b
42g
40
43
43c
43c
IV

FIG. 6



MAXIMUM HEATING
41
42h
42j
θ =OPERATION RANGE OF FIRST OUTPUT SHAFT 50a
42j
42i
MAXIMUM COOLING
50a
42
42g
40
42j
42j

FIG. 7

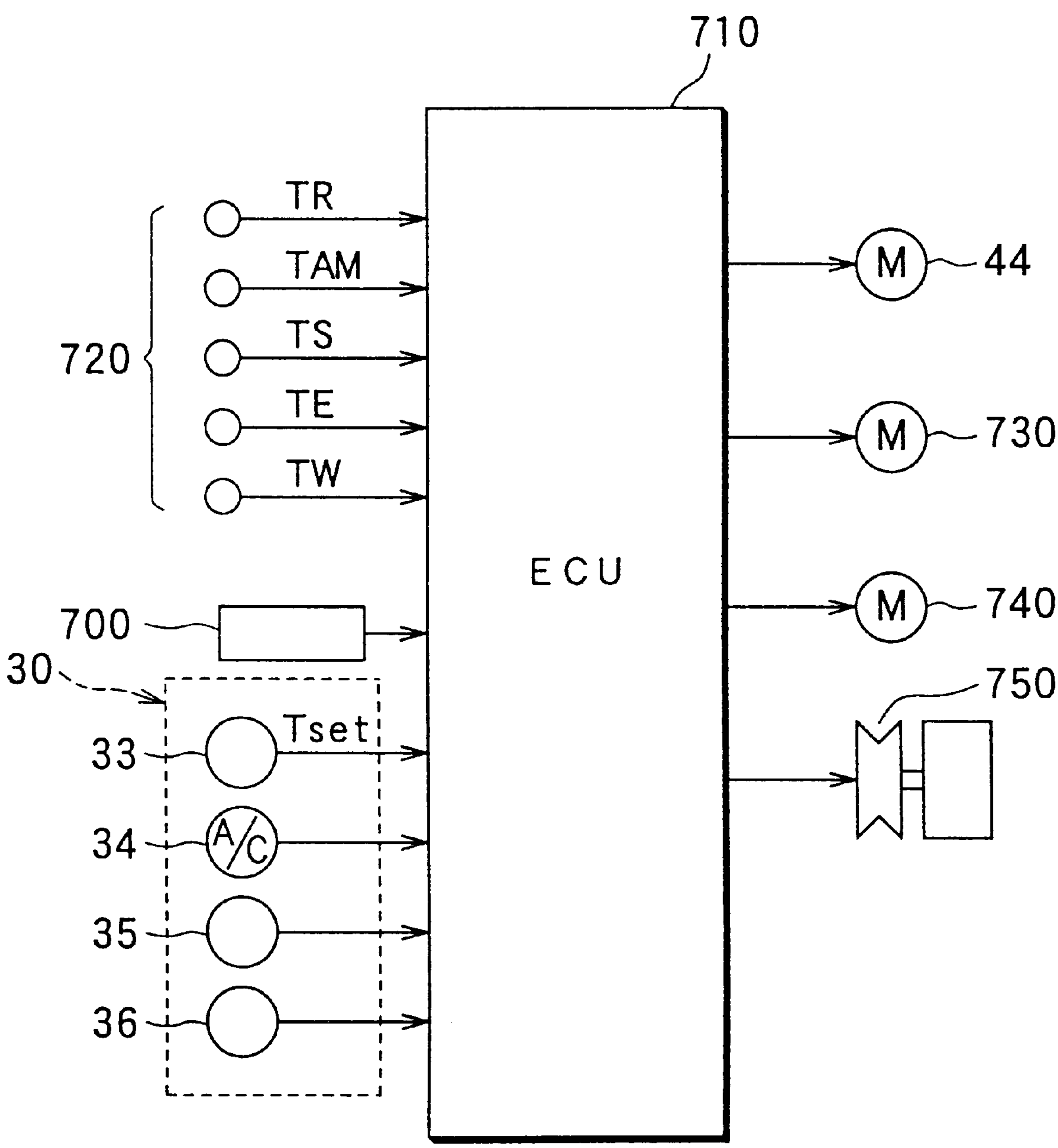

710
TR
TAM
TS
TE
TW
720
ECU
700
30
Tset
33
34
A/C
35
36
M
44
M
730
M
740
750

FIG. 8

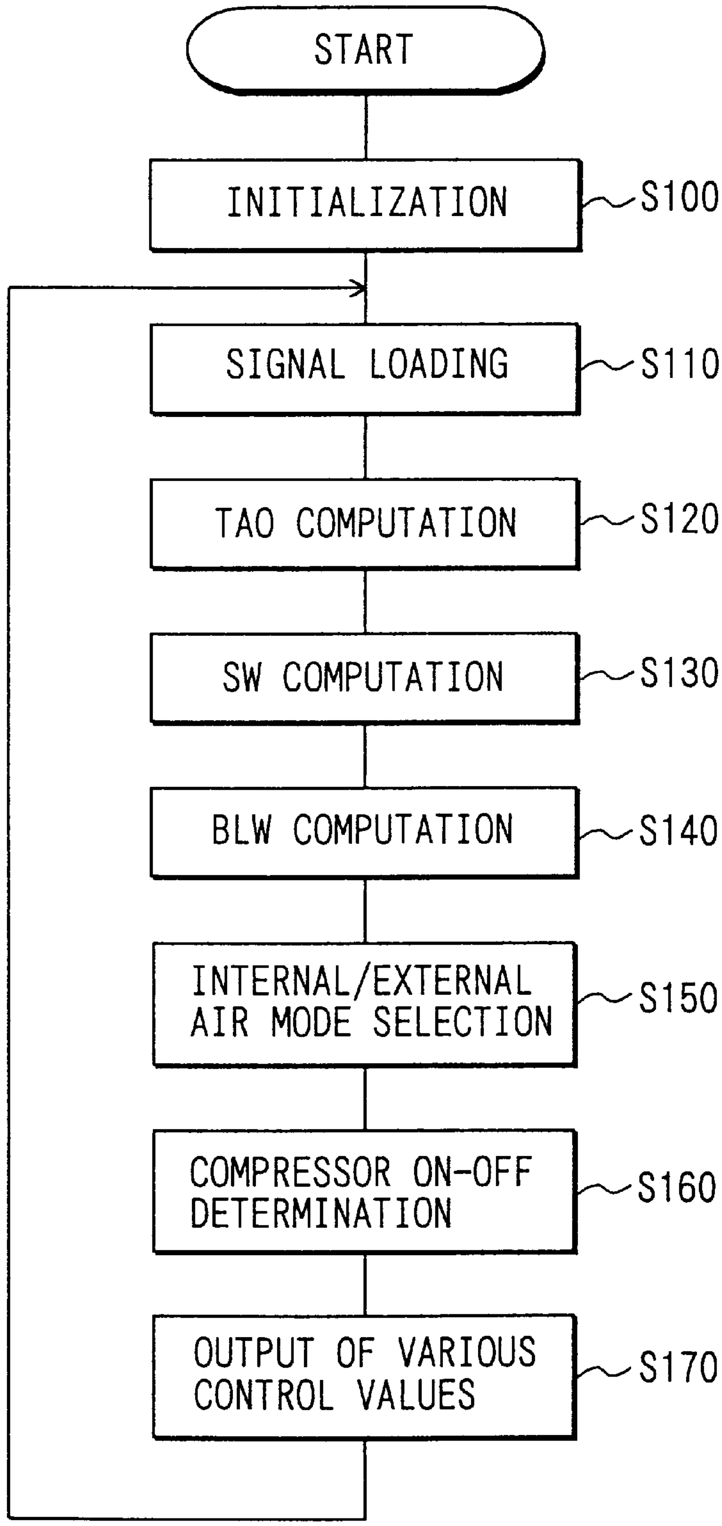
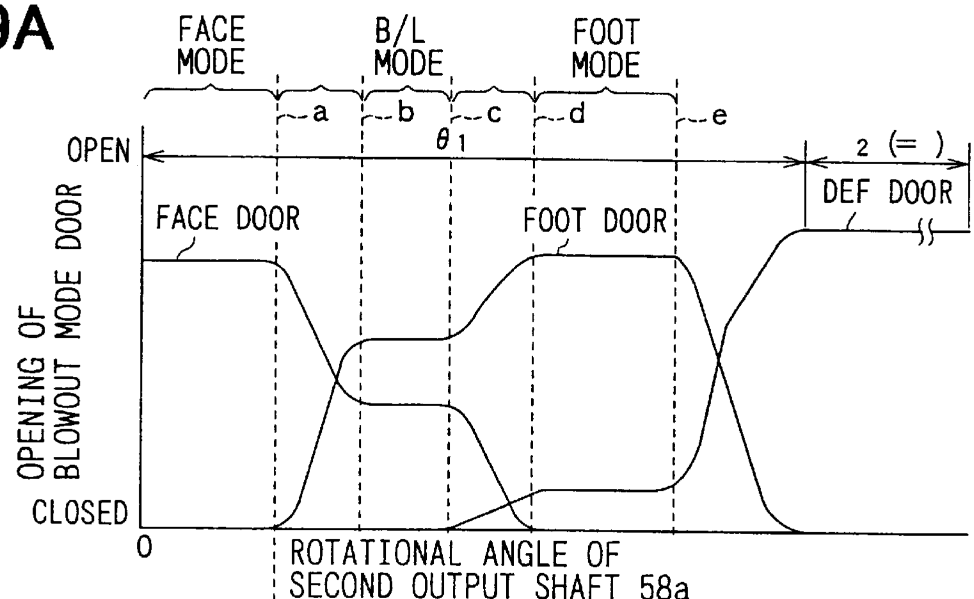
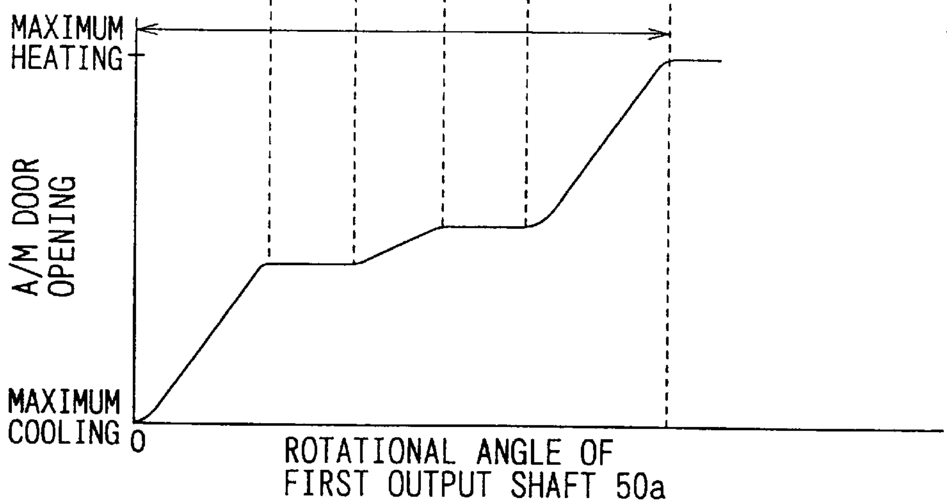

START
INITIALIZATION
S100
SIGNAL LOADING
S110
TAO COMPUTATION
S120
SW COMPUTATION
S130
BLW COMPUTATION
S140
INTERNAL/EXTERNAL AIR MODE SELECTION
S150
COMPRESSOR ON-OFF DETERMINATION
S160
OUTPUT OF VARIOUS CONTROL VALUES
S170

FIG. 9A



FACE MODE
B/L MODE
FOOT MODE
a
b
c
d
e
θ1
2 (=)
OPEN
DEF DOOR
FACE DOOR
FOOT DOOR
OPENING OF BLOWOUT MODE DOOR
CLOSED
0
ROTATIONAL ANGLE OF SECOND OUTPUT SHAFT 58a

FIG. 9B



MAXIMUM HEATING
A/M DOOR OPENING
MAXIMUM COOLING
0
ROTATIONAL ANGLE OF FIRST OUTPUT SHAFT 50a

FIG. 10

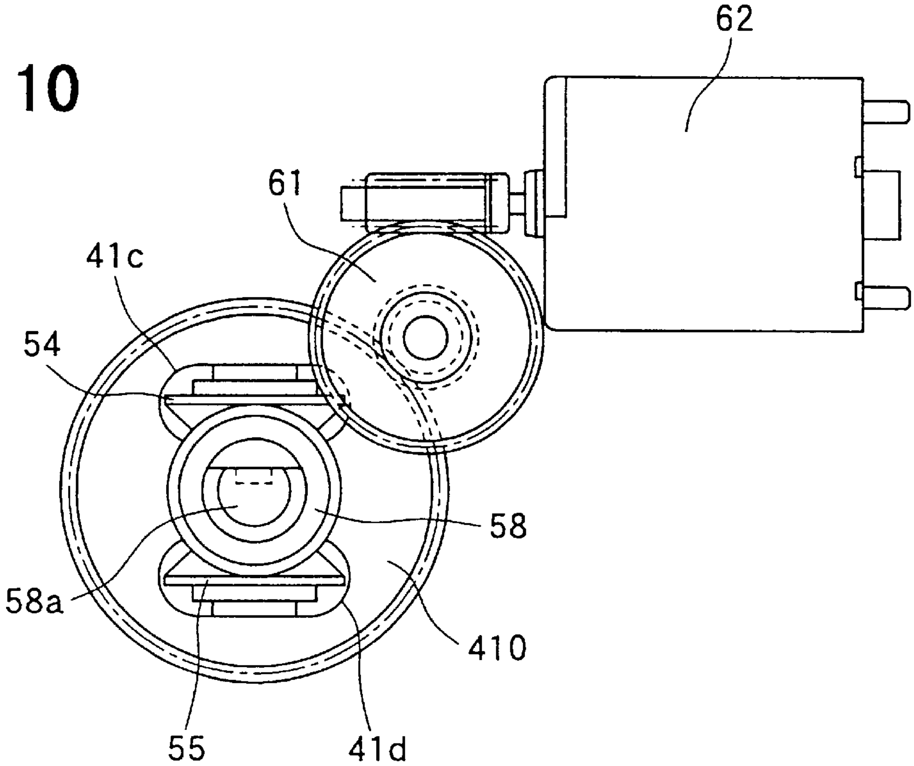


FIG. 11

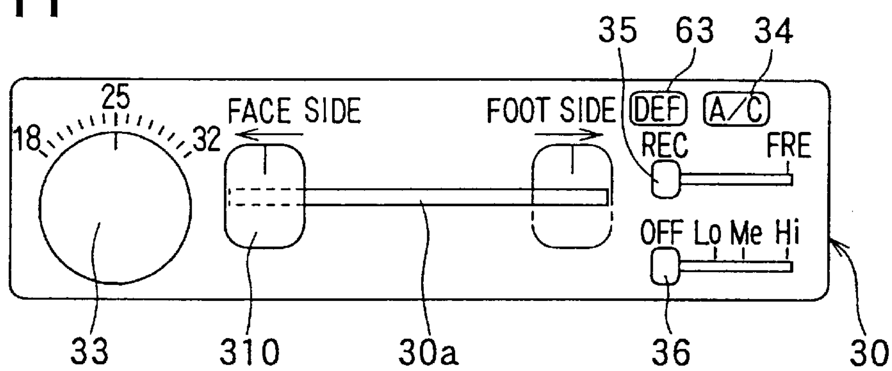


FIG. 12

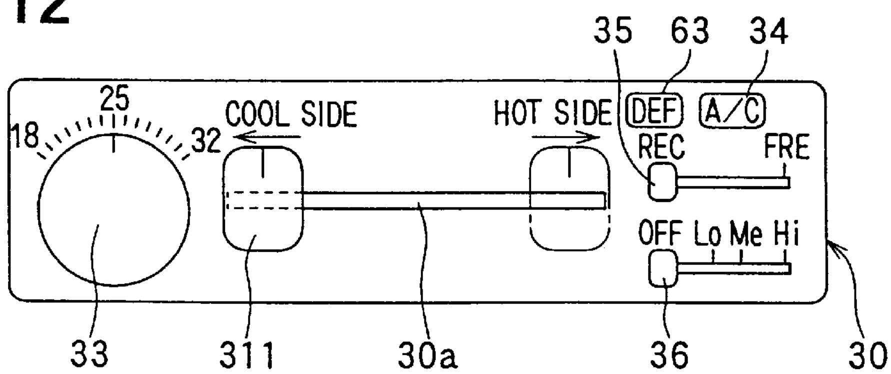


FIG. 13

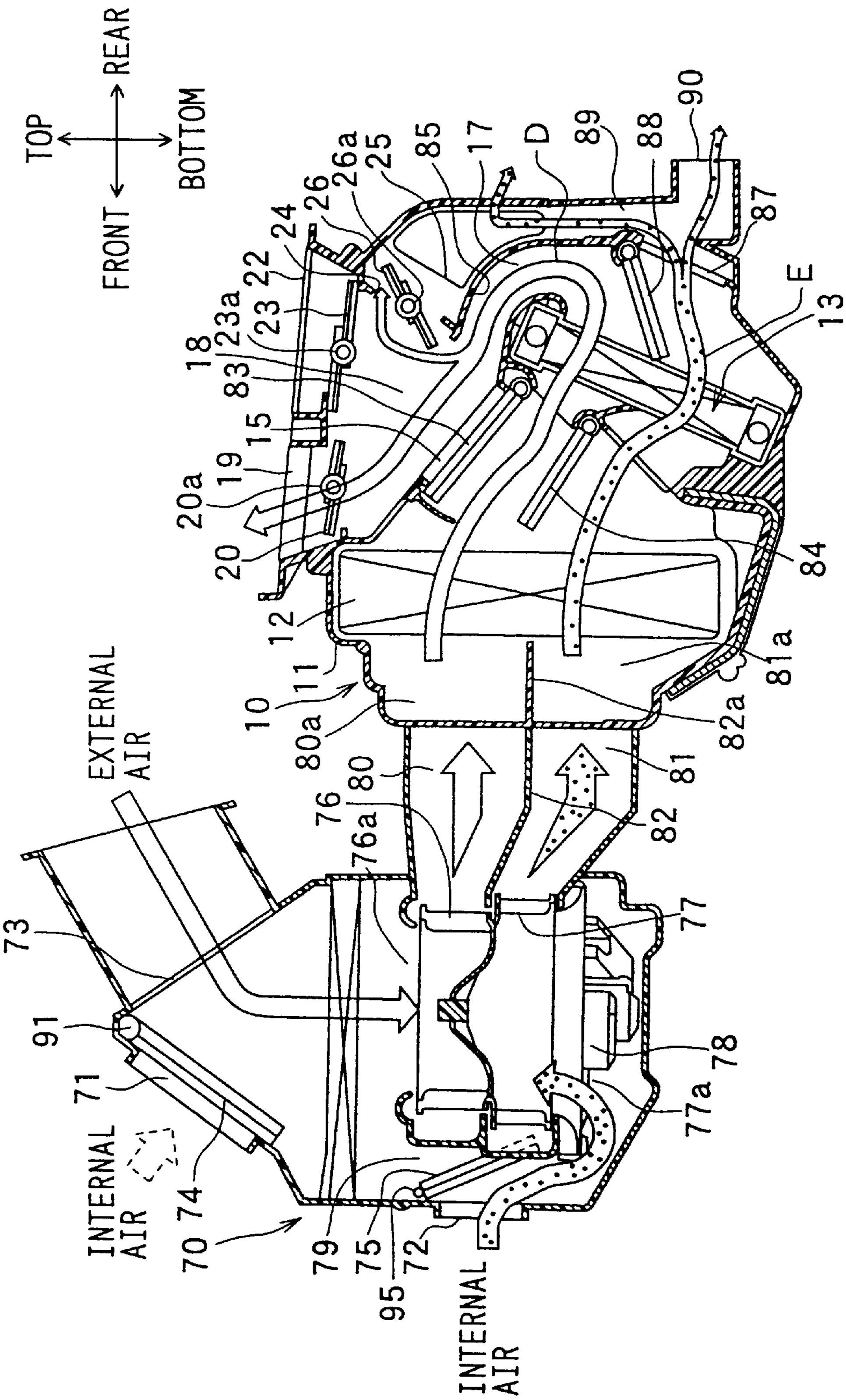
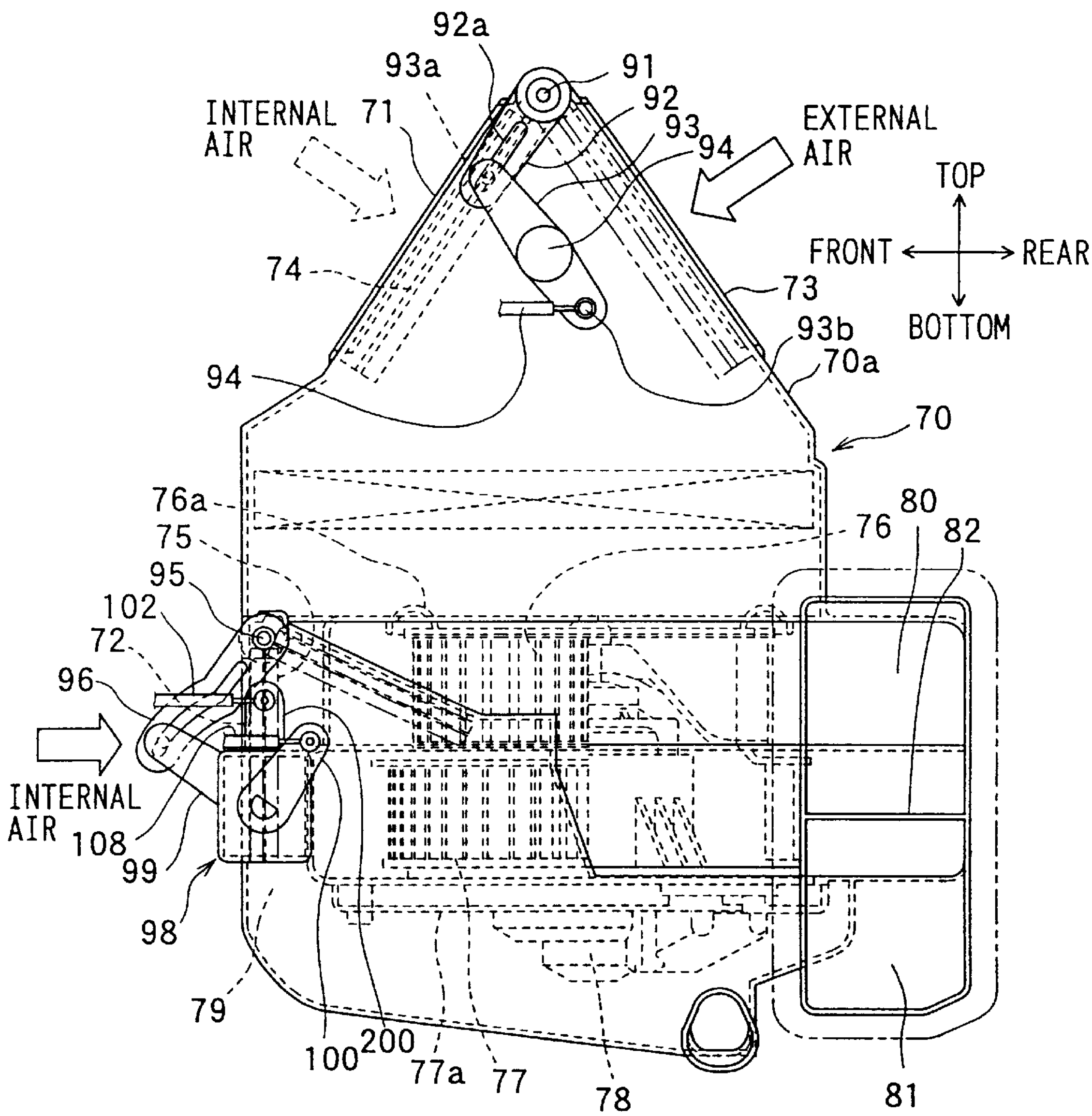

TOP
REAR
FRONT
BOTTOM
EXTERNAL AIR
INTERNAL AIR
INTERNAL AIR
10
11
12
13
15
17
18
19
20
20a
22
23
23a
24
25
26
26a
70
71
72
73
74
75
76
76a
77
77a
78
79
80
80a
81
81a
82
82a
83
84
85
87
88
89
90
91
95
D
E

FIG. 14



92a
91
93a
92
INTERNAL AIR
71
93
94
EXTERNAL AIR
TOP
FRONT
REAR
BOTTOM
74
73
93b
94
70a
70
76a
80
75
76
82
95
102
72
96
INTERNAL AIR
108
99
98
79
100
200
77a
77
78
81

FIG. 15

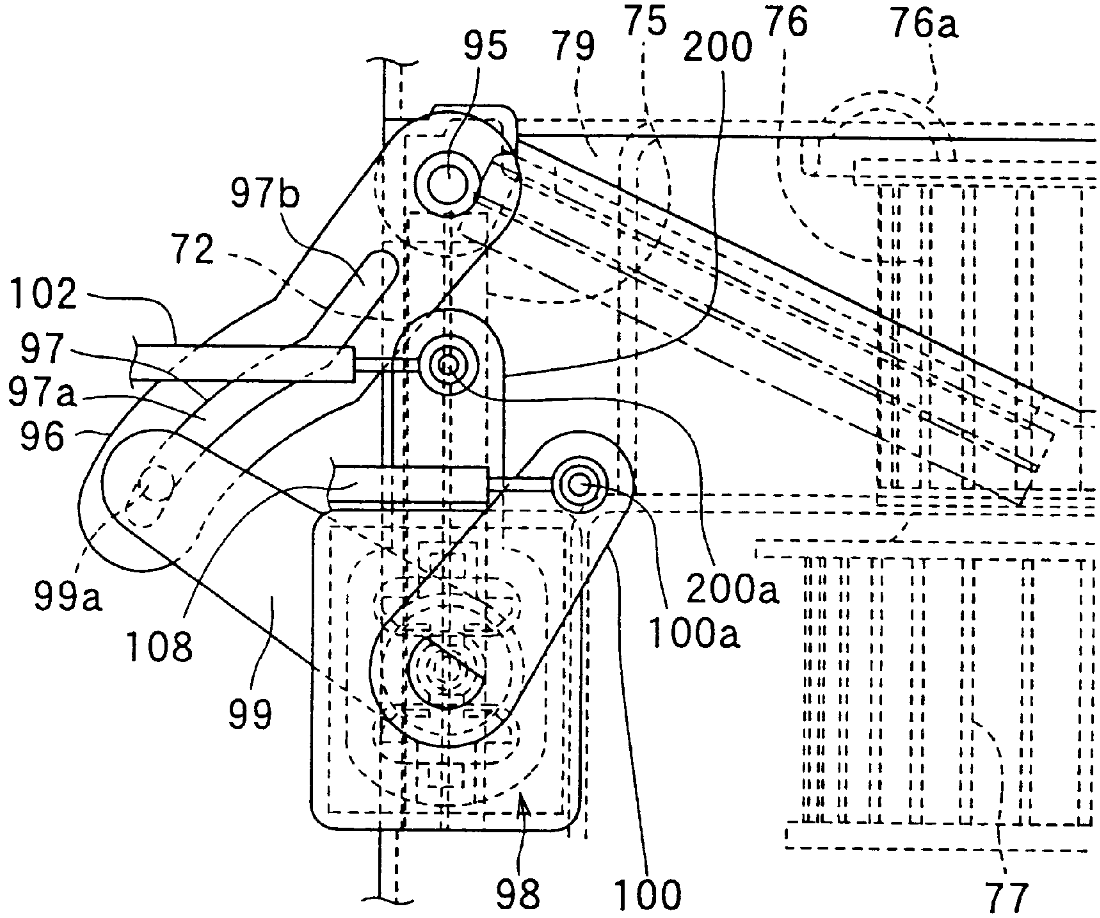
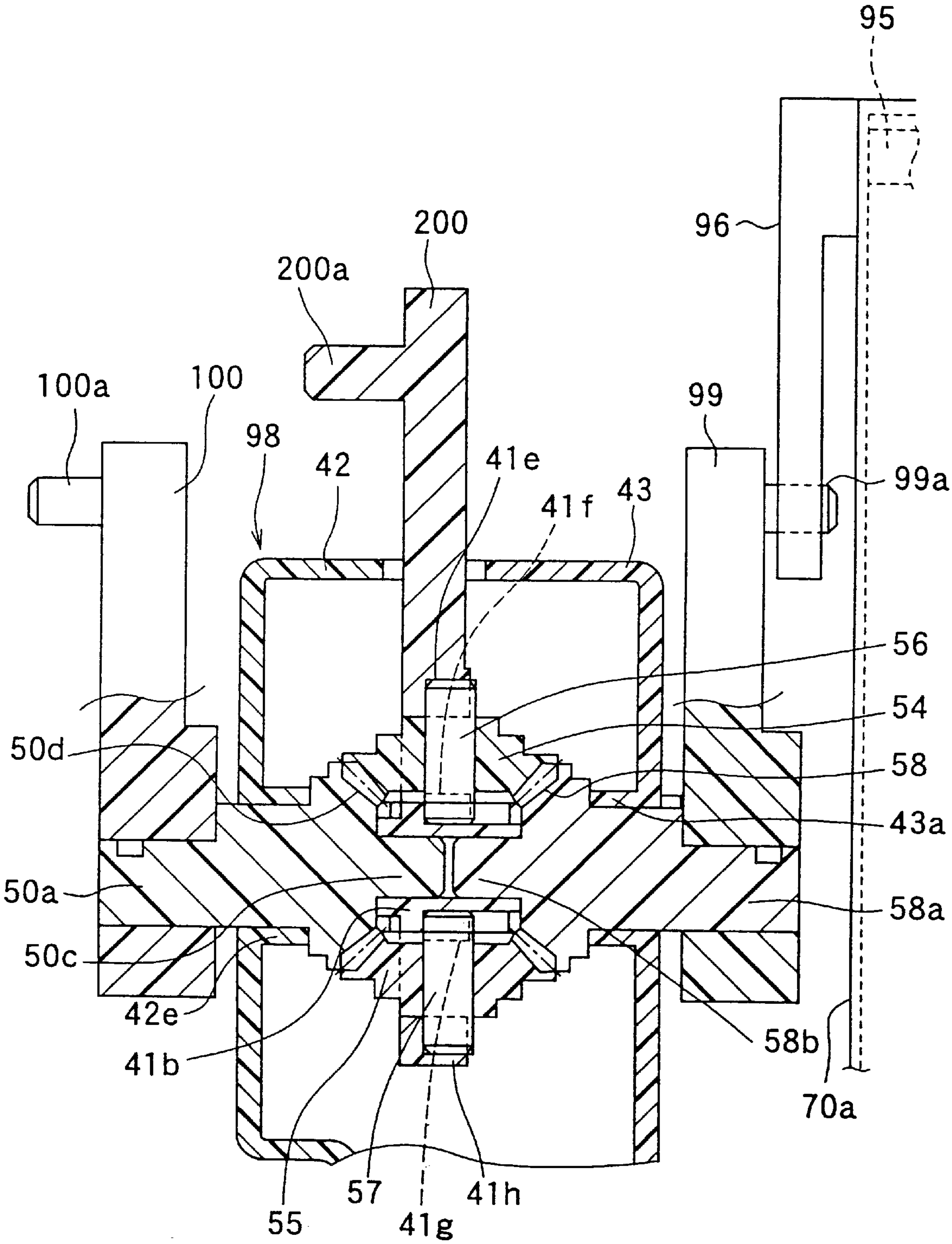

95
79
75
200
76
76a
97b
72
102
97
97a
96
99a
108
99
98
100
200a
100a
77

FIG. 16



95
96
200
200a
100a
100
98
42
41e
41f
43
99
99a
56
54
50d
58
43a
50a
58a
50c
42e
41b
58b
70a
55
57
41g
41h

FIG. 17

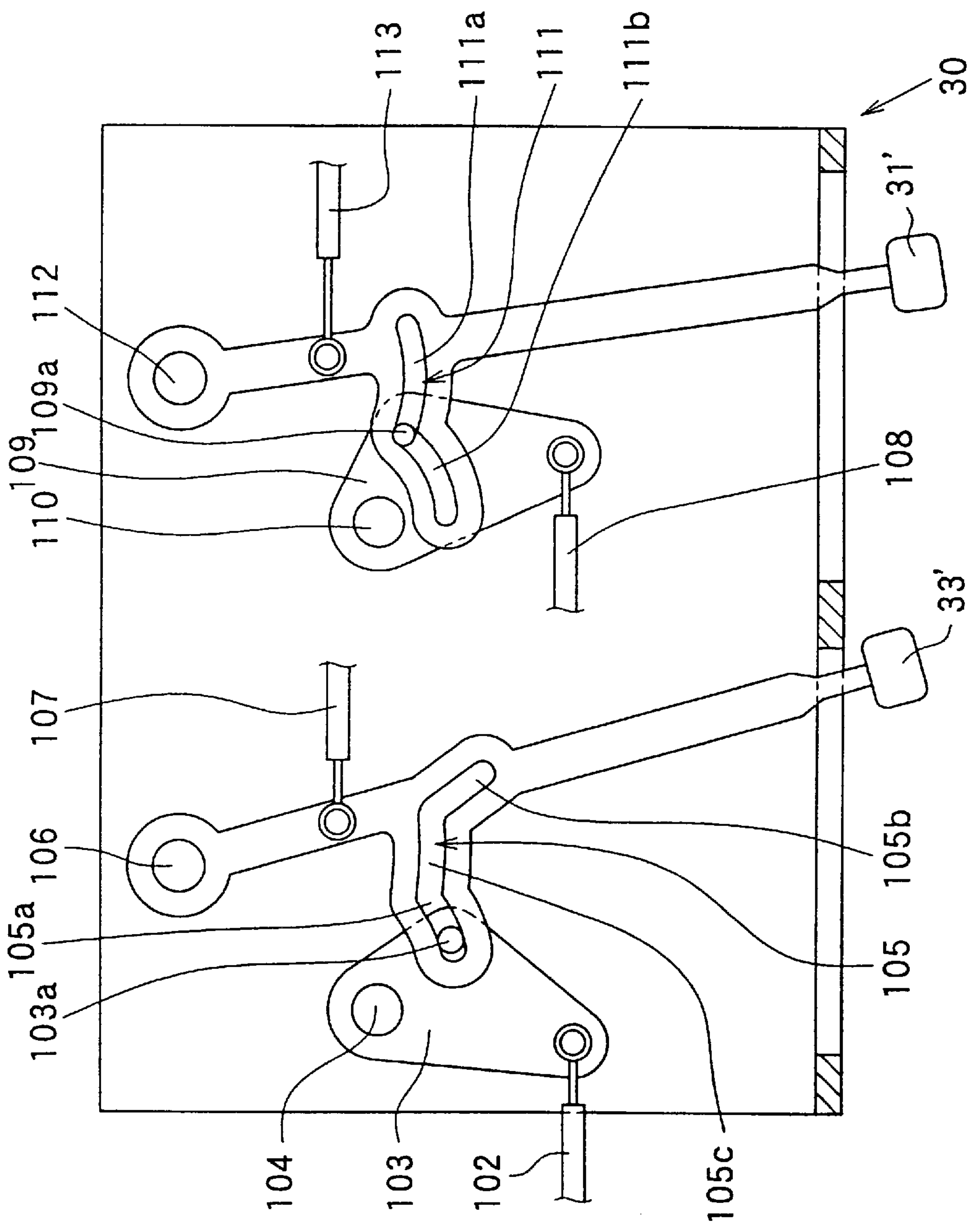

30
31'
33'
102
103
103a
104
105
105a
105b
105c
106
107
108
109
109a
110
111
111a
111b
112
113

FIG. 18

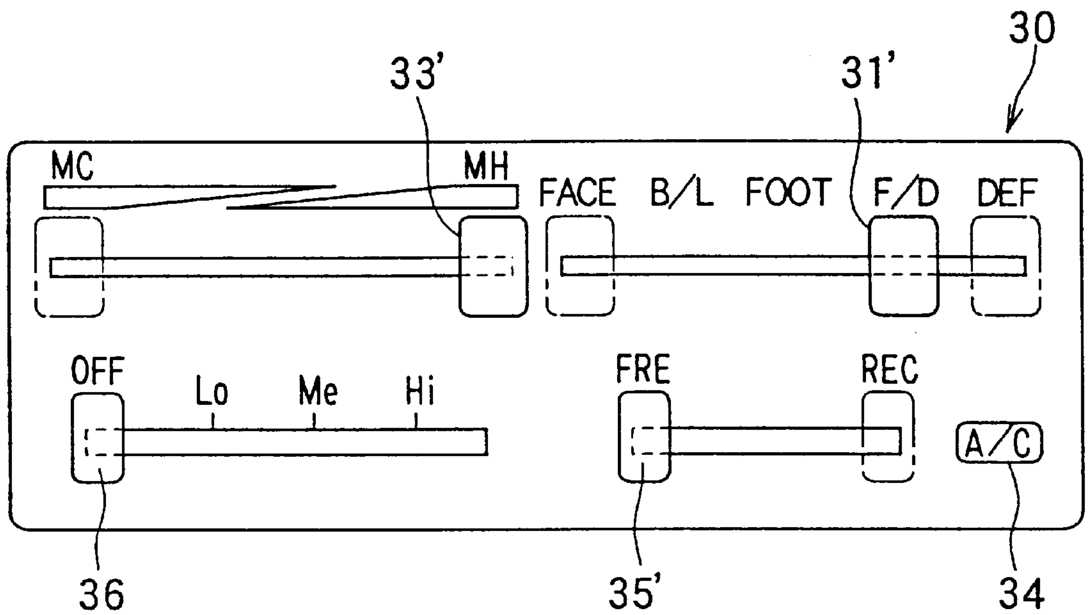


FIG. 19

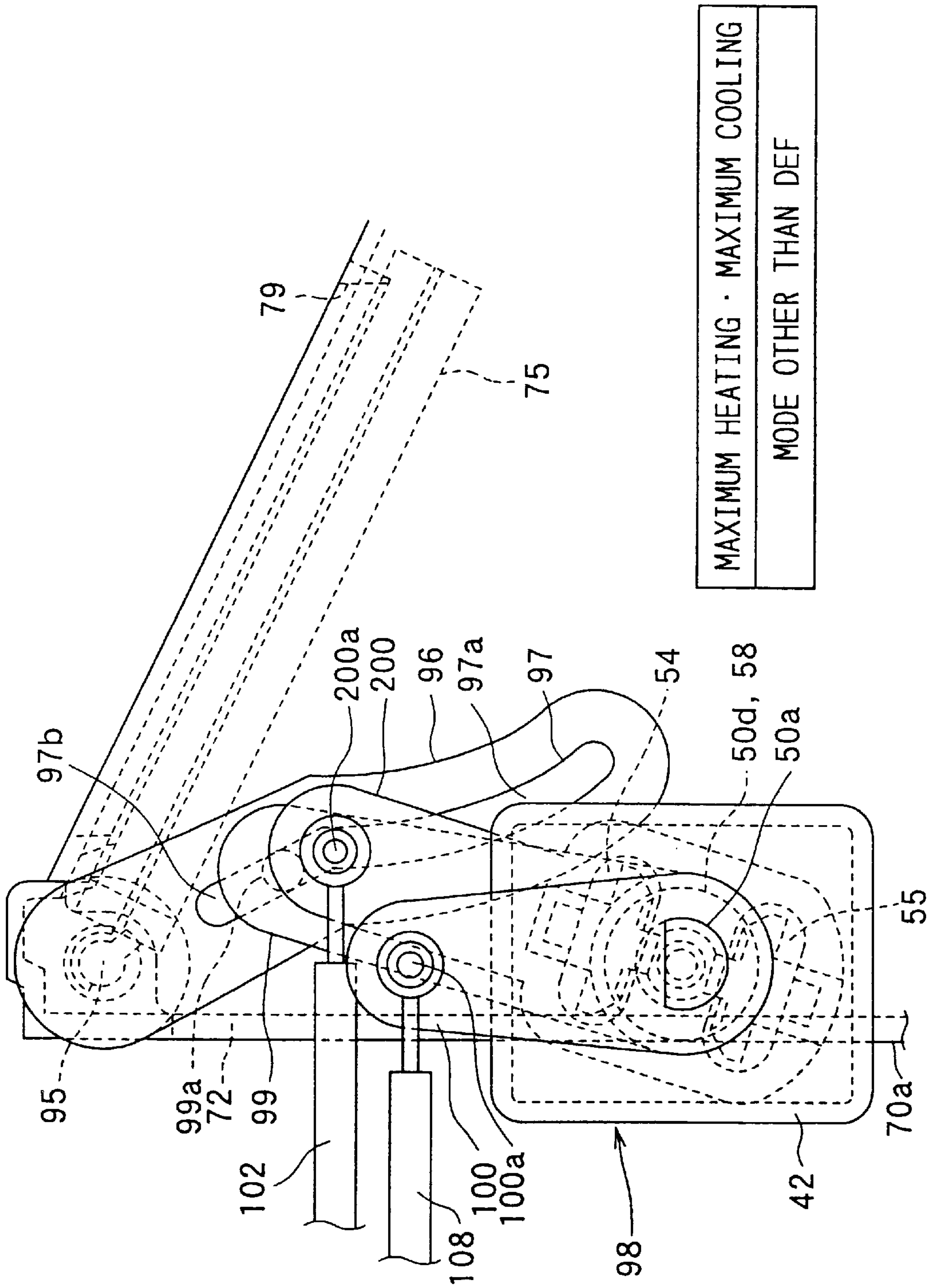

MAXIMUM HEATING · MAXIMUM COOLING
MODE OTHER THAN DEF
79
75
97b
200a
200
96
97a
97
54
50d, 58
50a
55
95
99a
72
99
102
108
100
100a
98
42
70a

FIG. 20

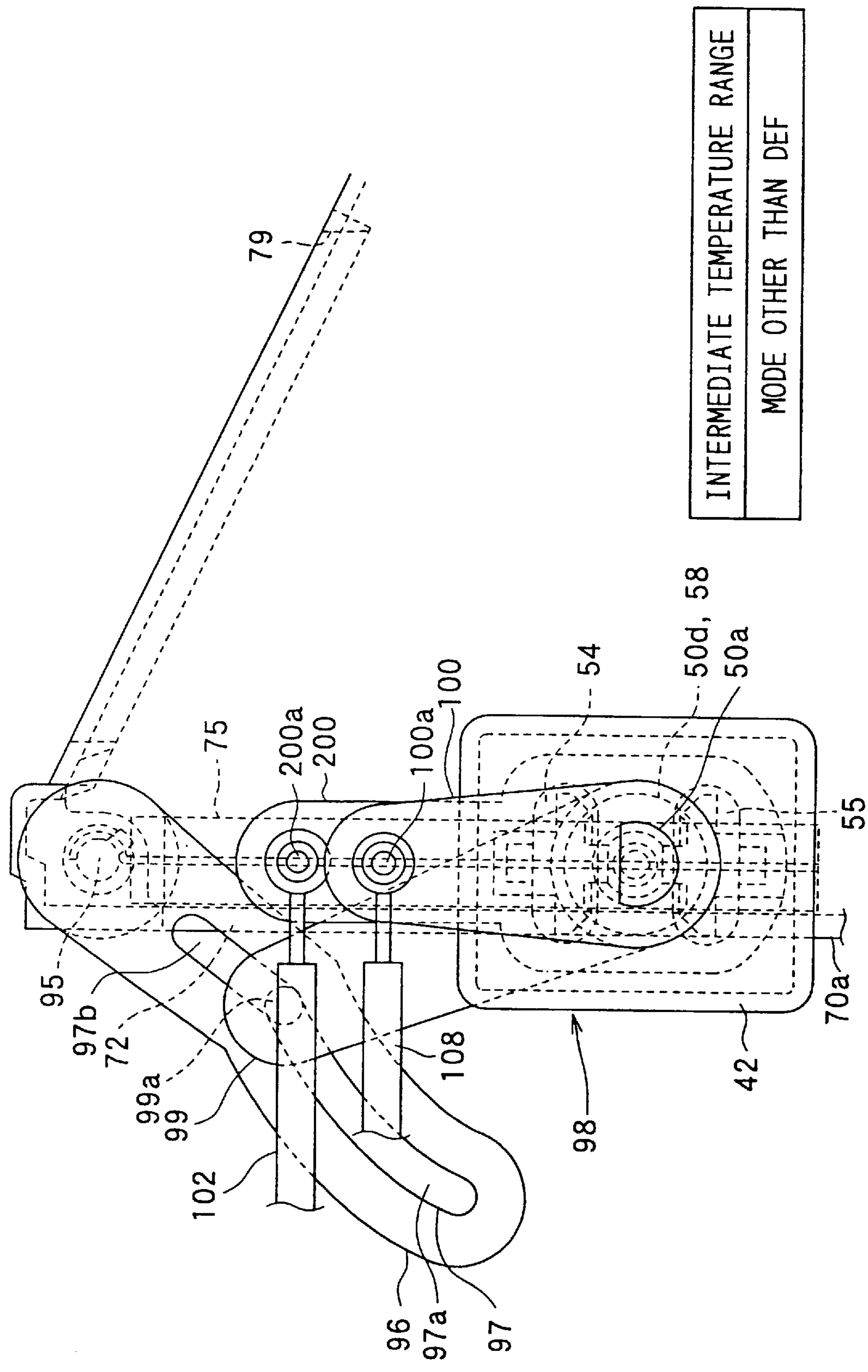

INTERMEDIATE TEMPERATURE RANGE
MODE OTHER THAN DEF
79
75
200a
200
100a
100
54
50d, 58
50a
55
70a
42
98
108
95
97b
72
99a
99
102
96
97a
97

FIG. 21

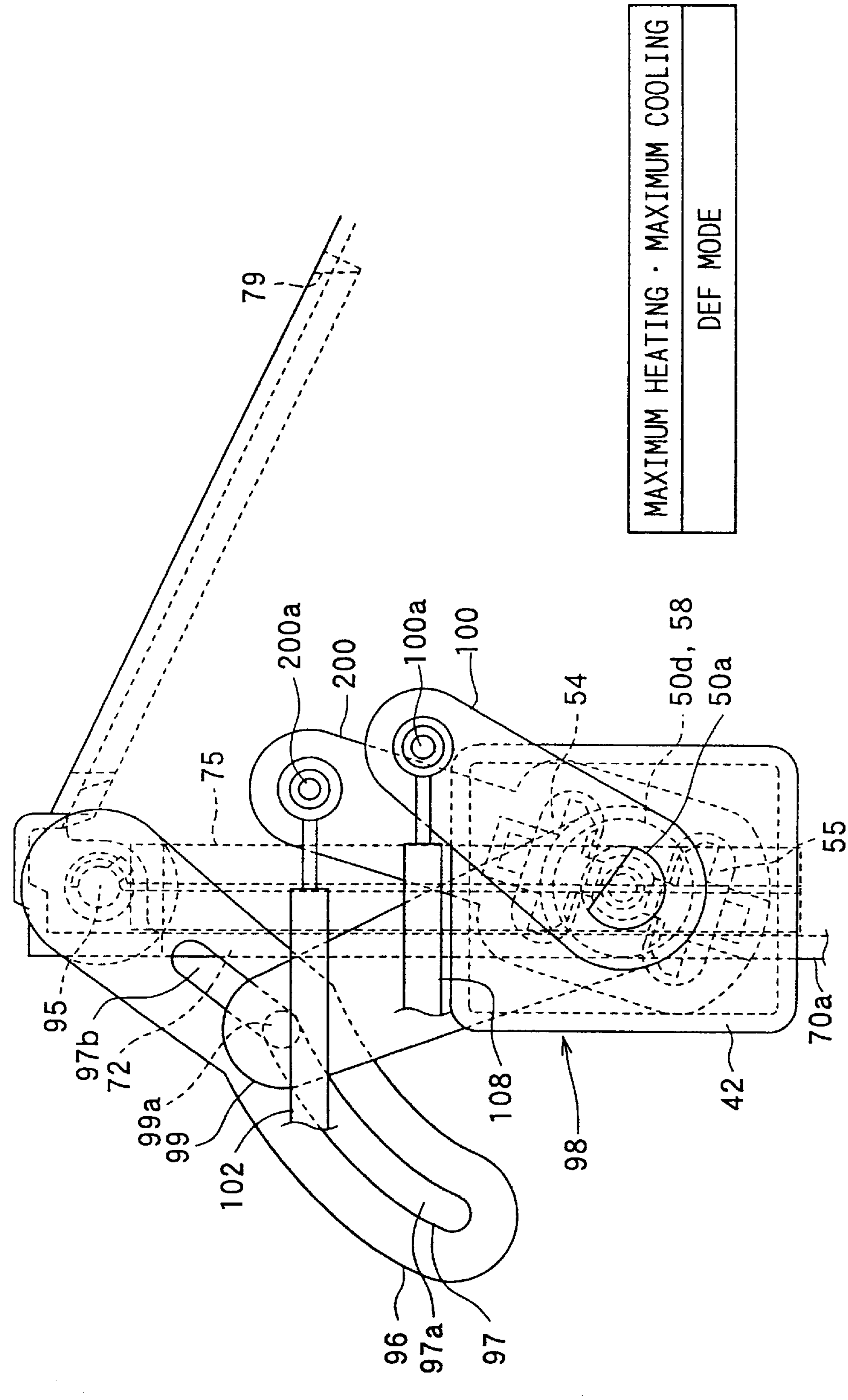

MAXIMUM HEATING · MAXIMUM COOLING
DEF MODE
79
75
200a
200
100a
100
54
50d, 58
50a
55
95
97b
72
99a
99
102
108
98
42
70a
96
97a
97

FIG. 22

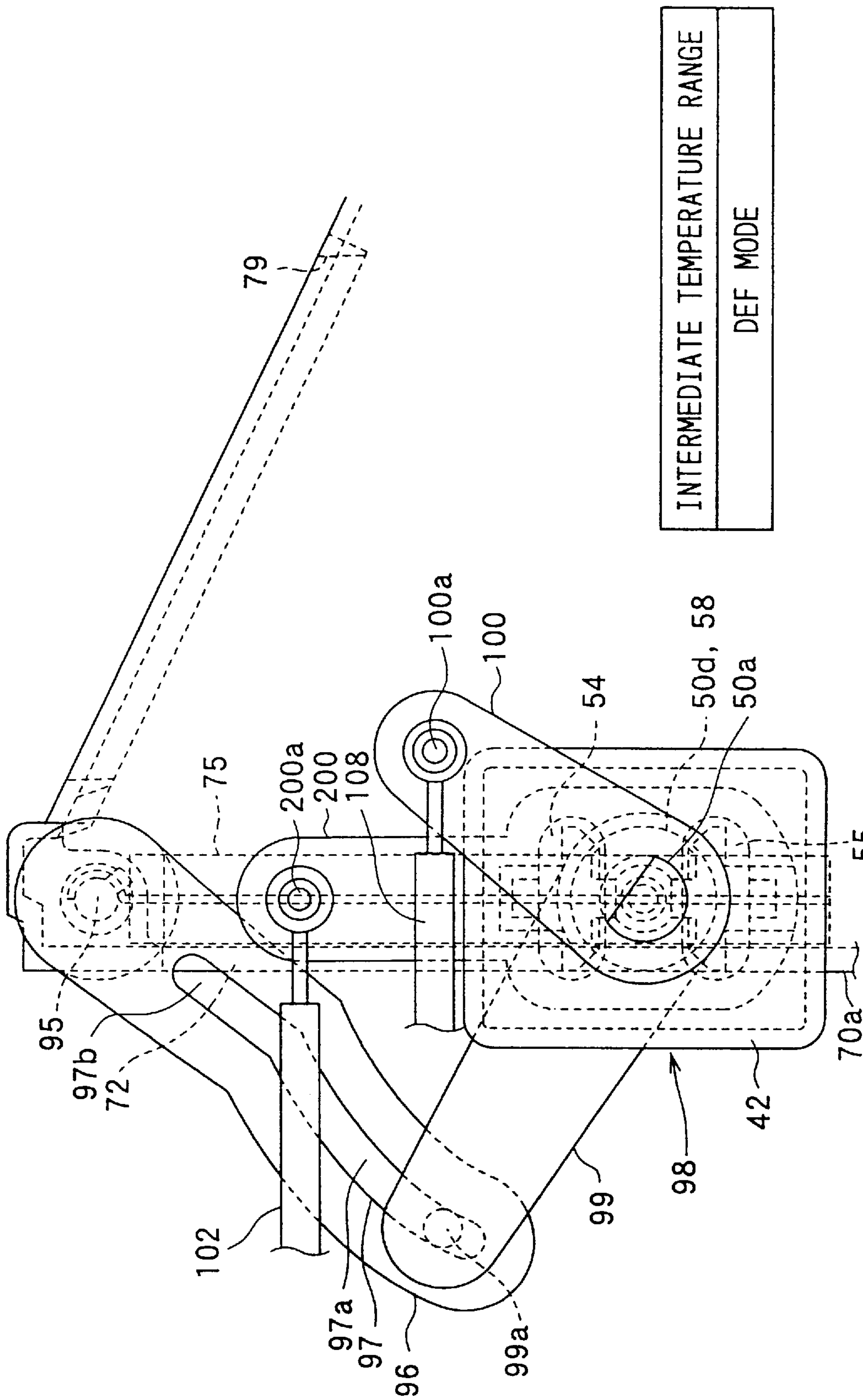

INTERMEDIATE TEMPERATURE RANGE
DEF MODE
79
75
95
97b
72
102
97a
97
96
99a
99
98
42
70a
55
50a
50d, 58
54
100
100a
108
200
200a

FIG. 23

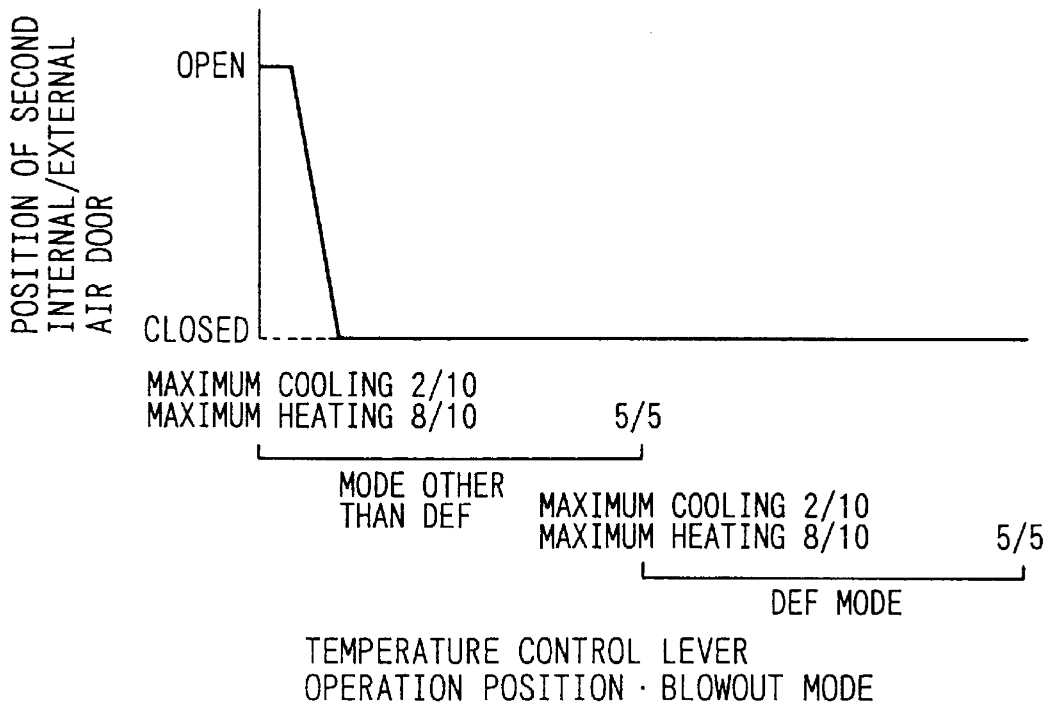


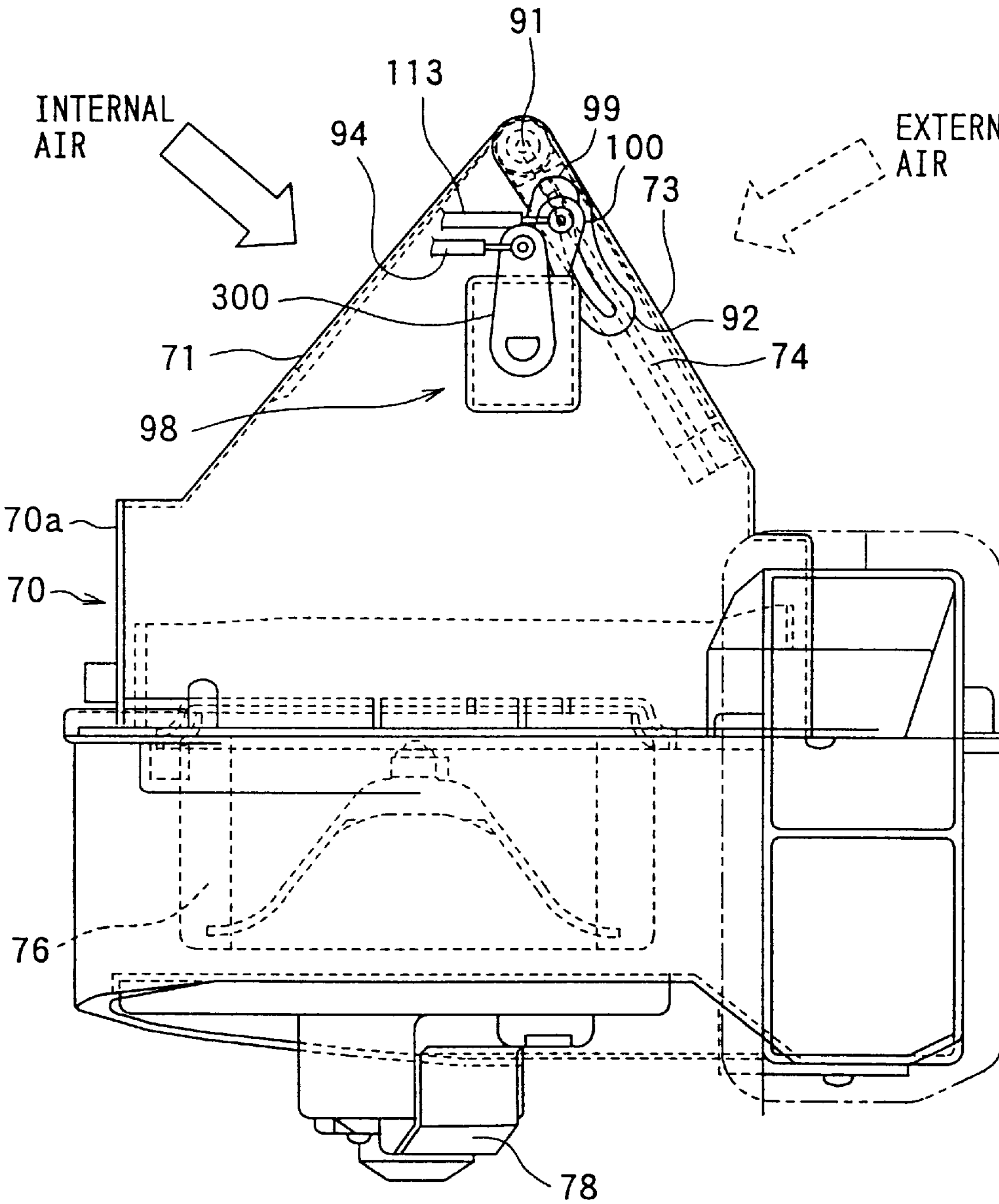
FIG. 24

	BLOWOUT MODE				
TEMPERATURE CONTROL LEVER	FACE	B/L	FOOT	F/D	DEF
MAXIMUM COOLING (M, C)	OPEN	OPEN	OPEN	OPEN	CLOSED
↑ INTERMEDIATE ↓	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED
MAXIMUM HEATING (M, H)	OPEN	OPEN	OPEN	OPEN	CLOSED

FIG. 25

TEMPERATURE CONTROL LEVER	BLOWOUT MODE				
	FACE	B/L	FOOT	F/D	DEF
MAXIMUM COOLING (M, C) ↑ INTERMEDIATE ↓	CLOSED	CLOSED	CLOSED	CLOSED	CLOSED
MAXIMUM HEATING (M, H)	OPEN				

FIG. 26



91
113
99
INTERNAL AIR
94
100
EXTERNAL AIR
73
300
92
71
74
98
70a
70
76
78

FIG. 27

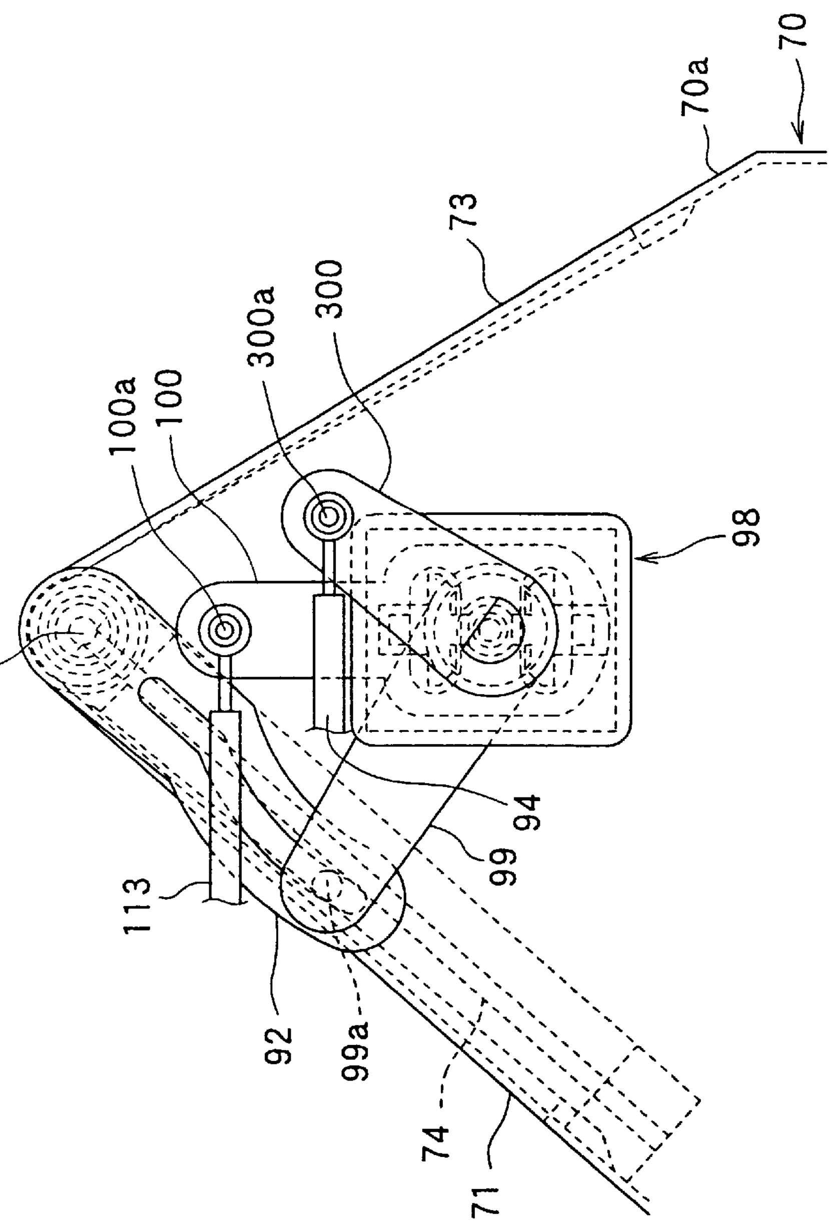


FIG. 28

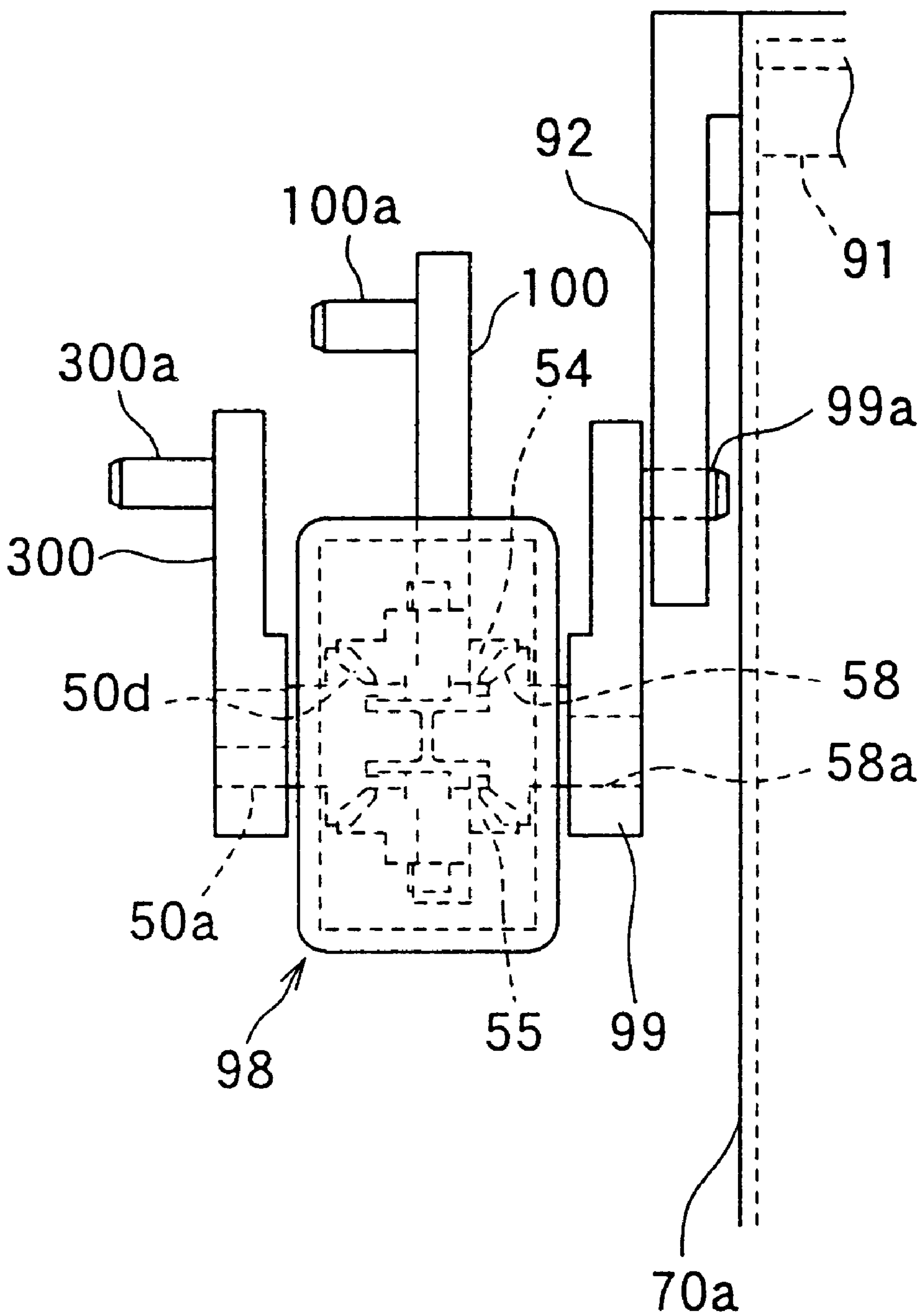


FIG. 29

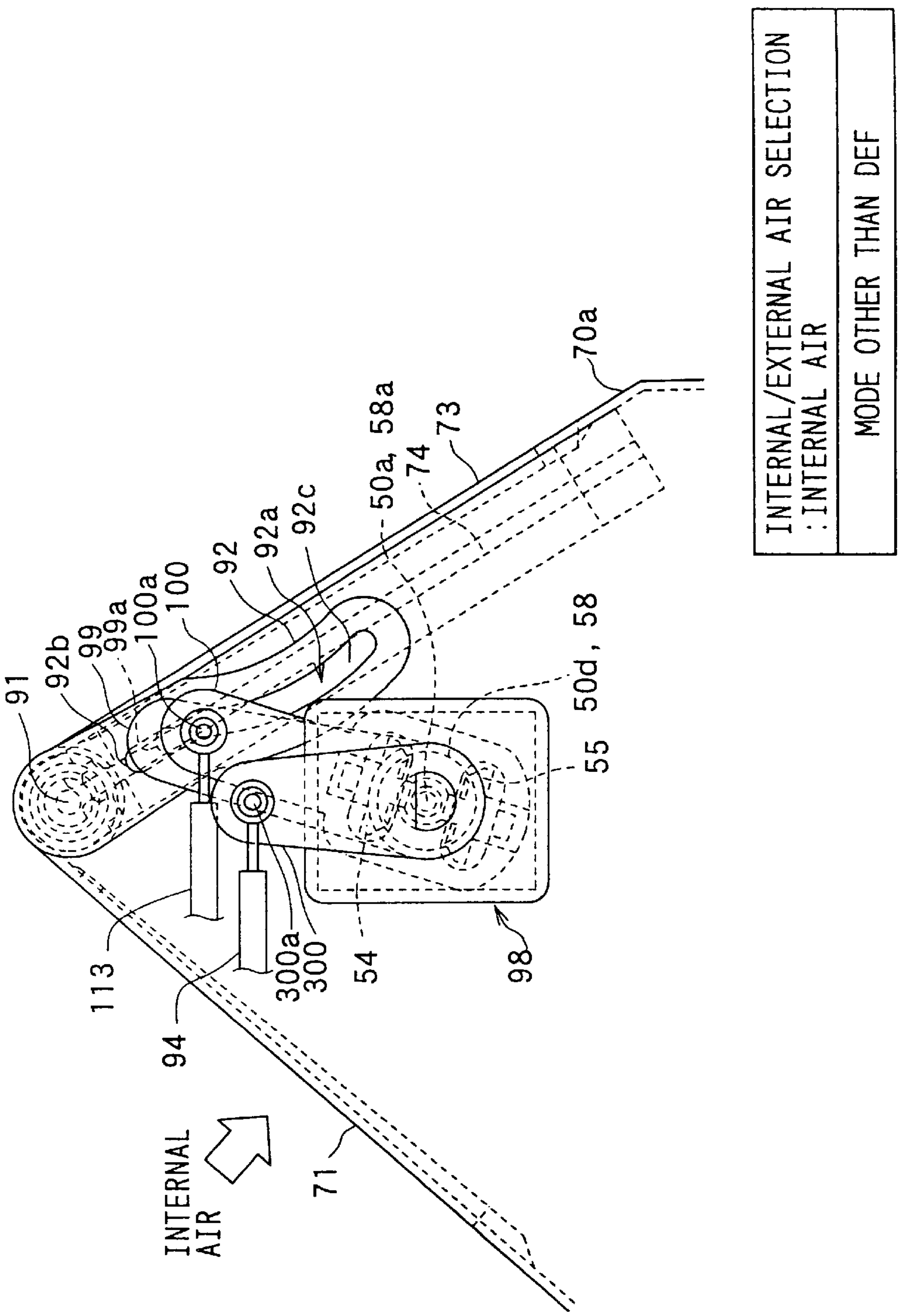
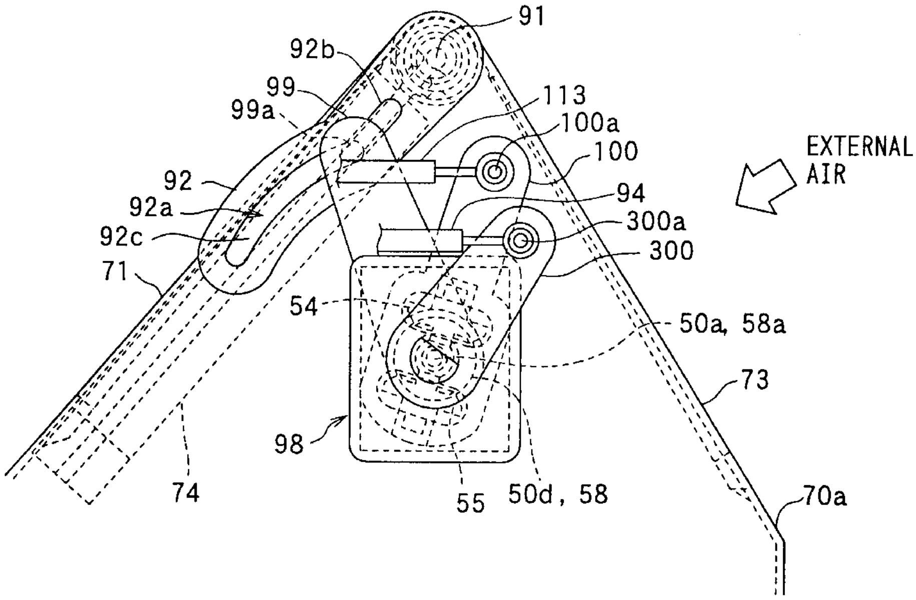

INTERNAL/EXTERNAL AIR SELECTION
:INTERNAL AIR
MODE OTHER THAN DEF
70a
50a, 58a
74
73
92c
92a
92
100
100a
99a
99
92b
91
50d, 58
55
54
98
300
300a
113
94
71
INTERNAL
AIR

FIG. 30



INTERNAL/EXTERNAL AIR SELECTION :EXTERNAL AIR
MODE OTHER THAN DEF

FIG. 31

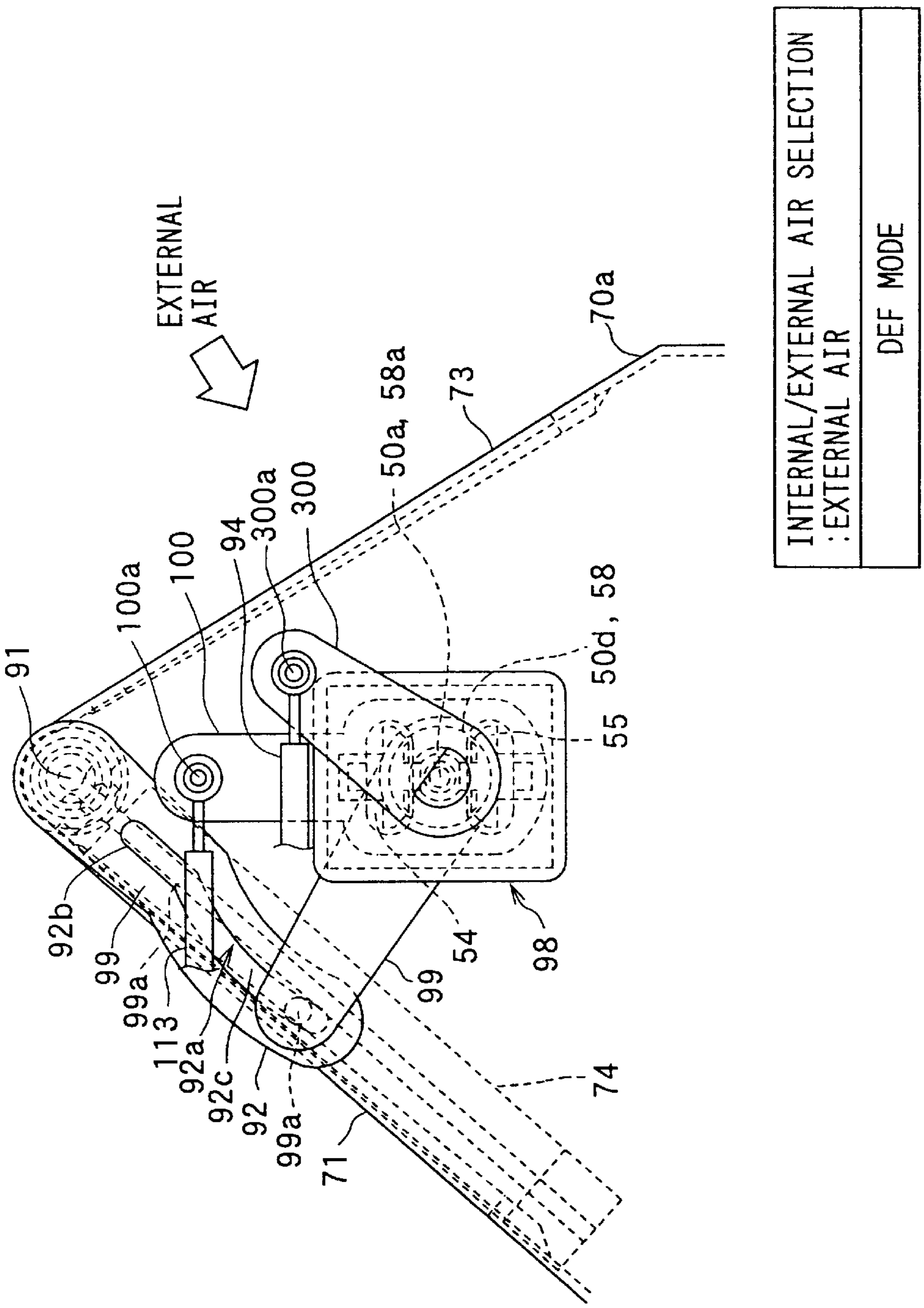

EXTERNAL AIR
70a
73
50a, 58a
300
300a
94
100
100a
91
50d, 58
55
54
98
99
92b
99
99a
113
92a
92c
92
99a
71
74
INTERNAL/EXTERNAL AIR SELECTION
:EXTERNAL AIR
DEF MODE

FIG. 32

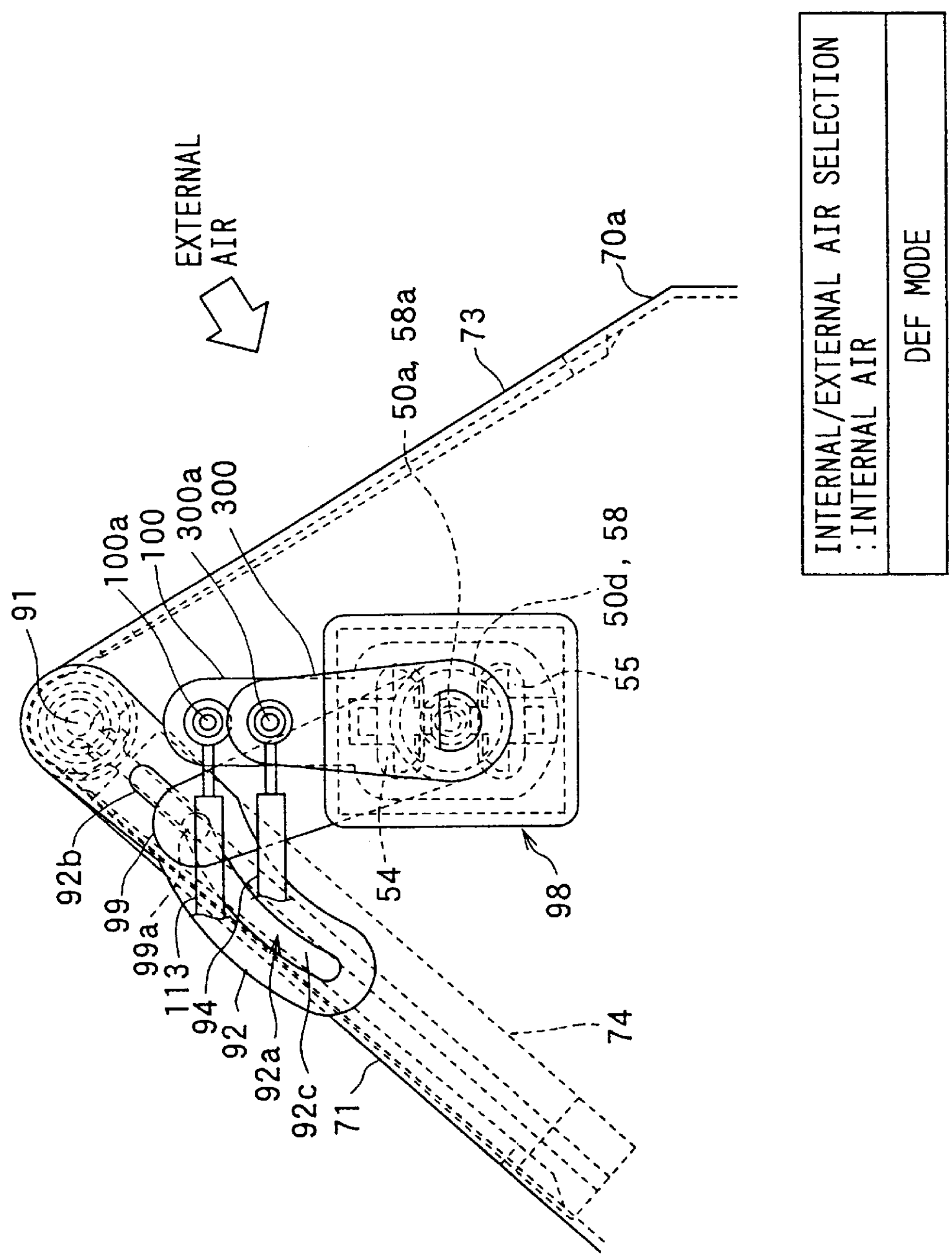

EXTERNAL AIR
70a
73
50a, 58a
300
300a
100
100a
91
50d, 58
55
54
98
92b
99
99a
113
94
92
92a
92c
71
74
INTERNAL/EXTERNAL AIR SELECTION
:INTERNAL AIR
DEF MODE

FIG. 33

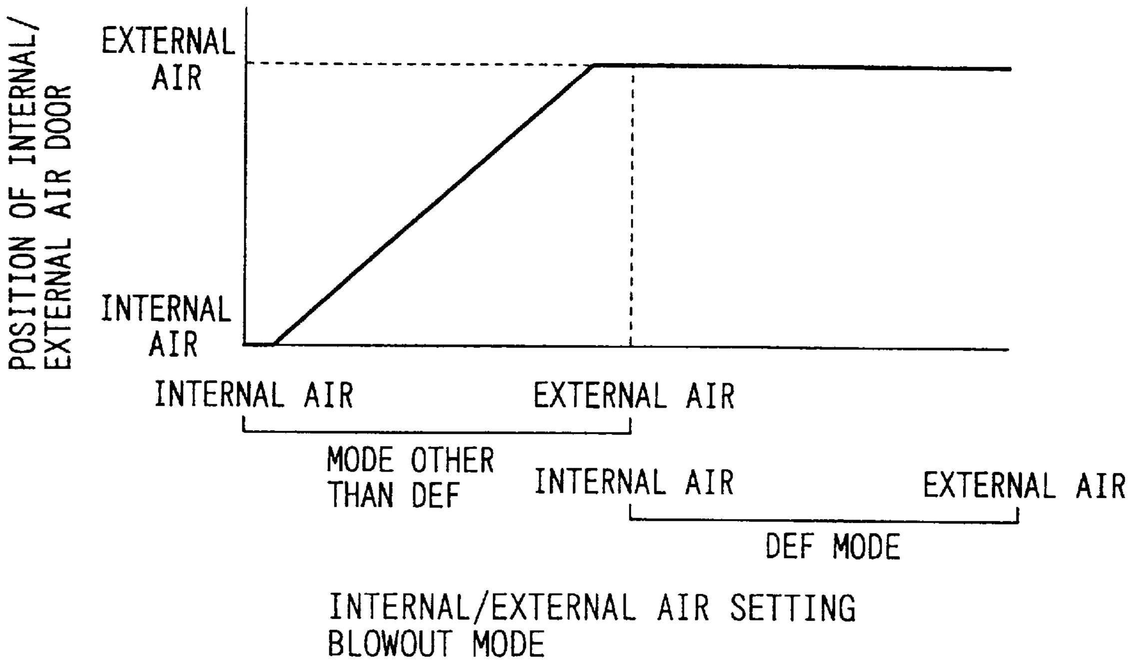

POSITION OF INTERNAL/
EXTERNAL AIR DOOR
EXTERNAL
AIR
INTERNAL
AIR
INTERNAL AIR
EXTERNAL AIR
MODE OTHER
THAN DEF
INTERNAL AIR
EXTERNAL AIR
DEF MODE
INTERNAL/EXTERNAL AIR SETTING
BLOWOUT MODE

FIG. 34

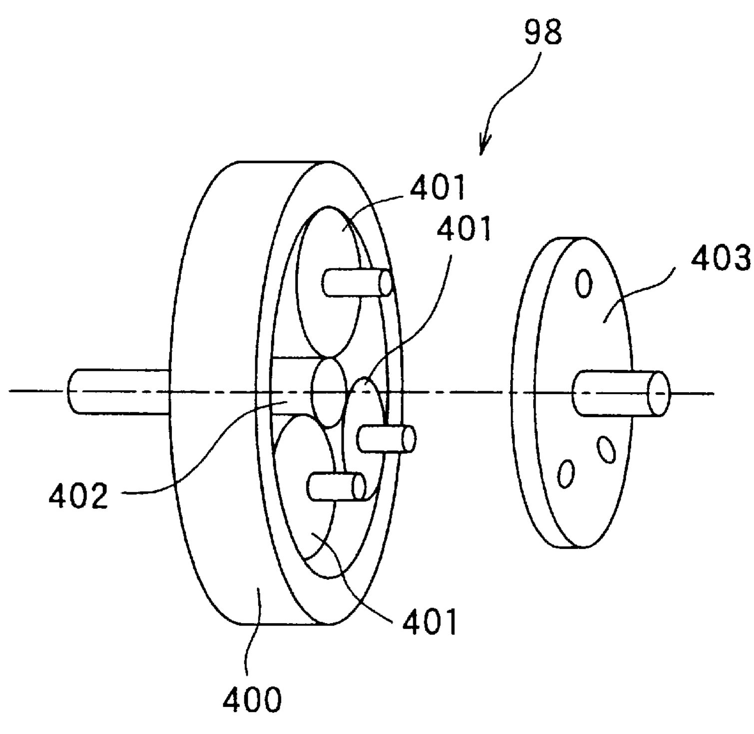

98
401
401
403
402
401
400

FIG. 35

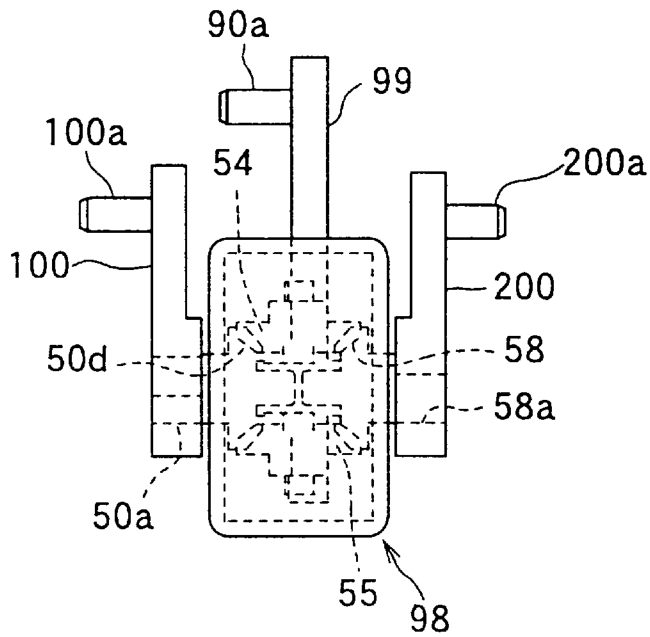
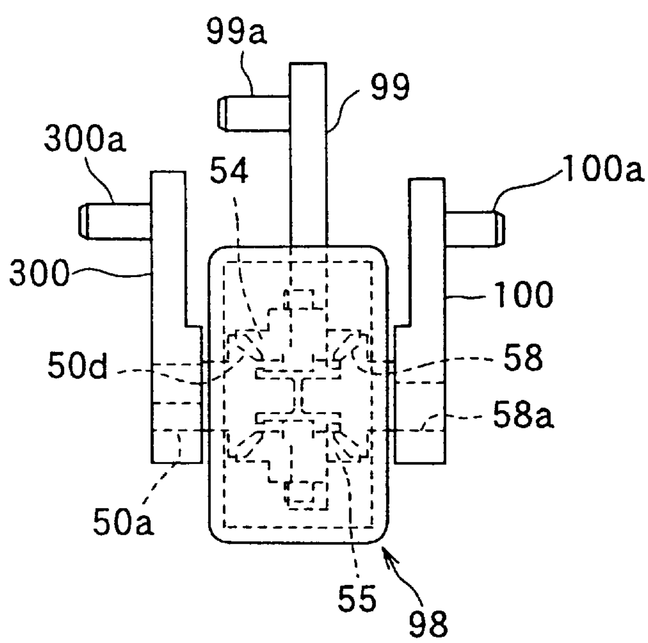

90a
99
100a
54
200a
100
200
50d
58
58a
50a
55
98

FIG. 36


99a
99
300a
54
100a
300
100
50d
58
58a
50a
55
98

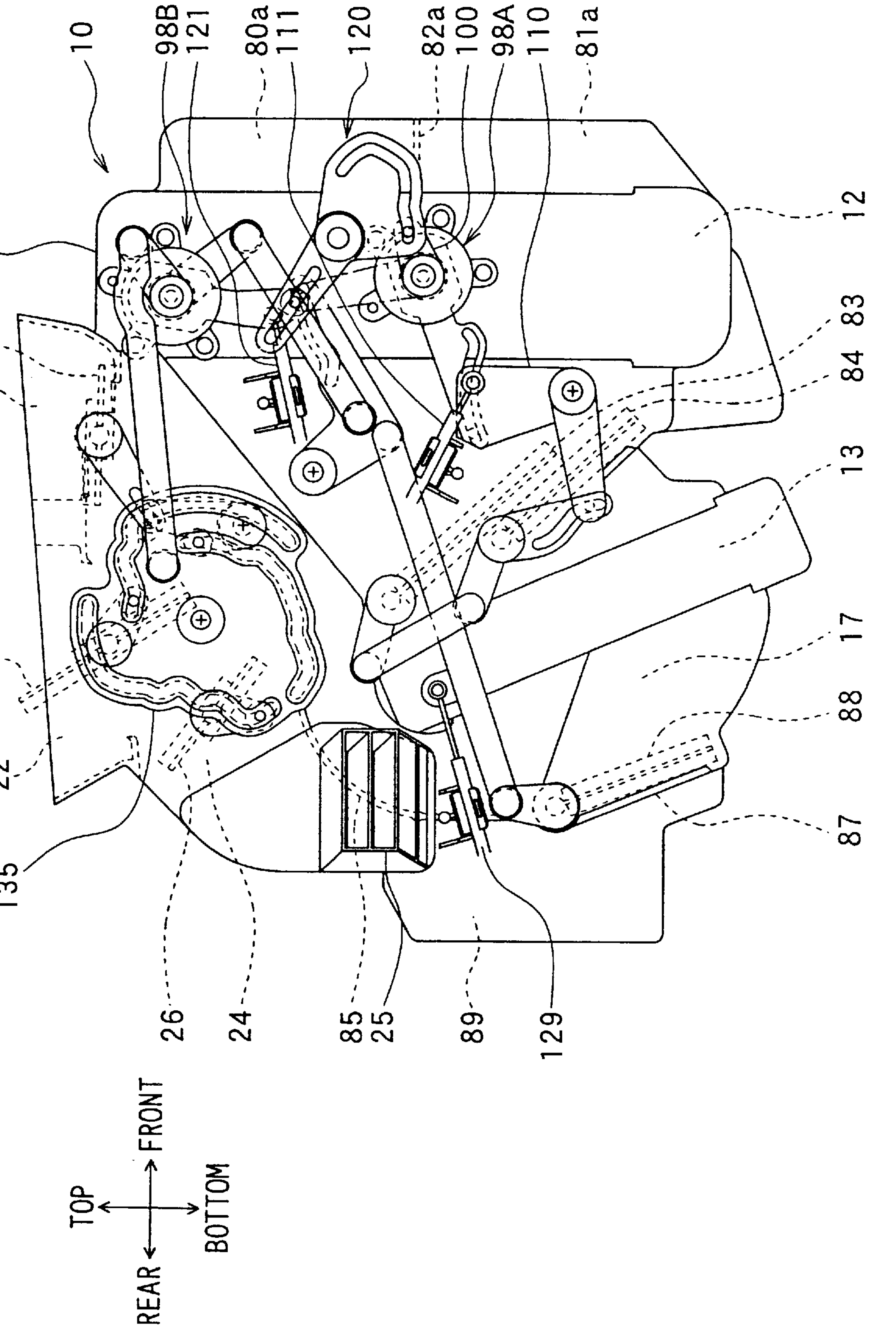
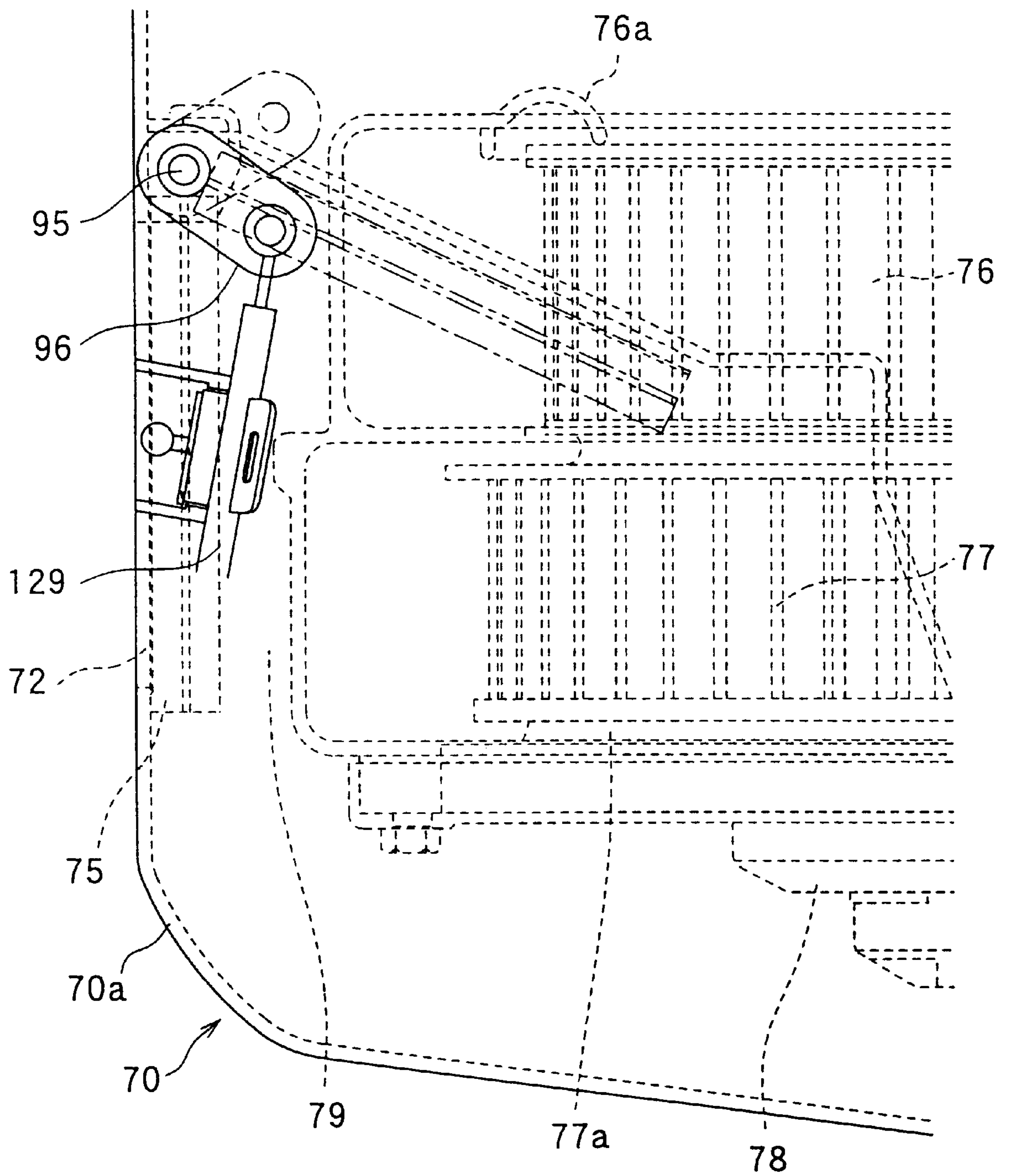

10
98B
121
80a
111
120
82a
100
98A
110
81a
11
20
19
12
83
84
13
17
88
87
23
22
135
26
24
85
25
89
129
TOP
FRONT
REAR
BOTTOM

FIG. 37

FIG. 38



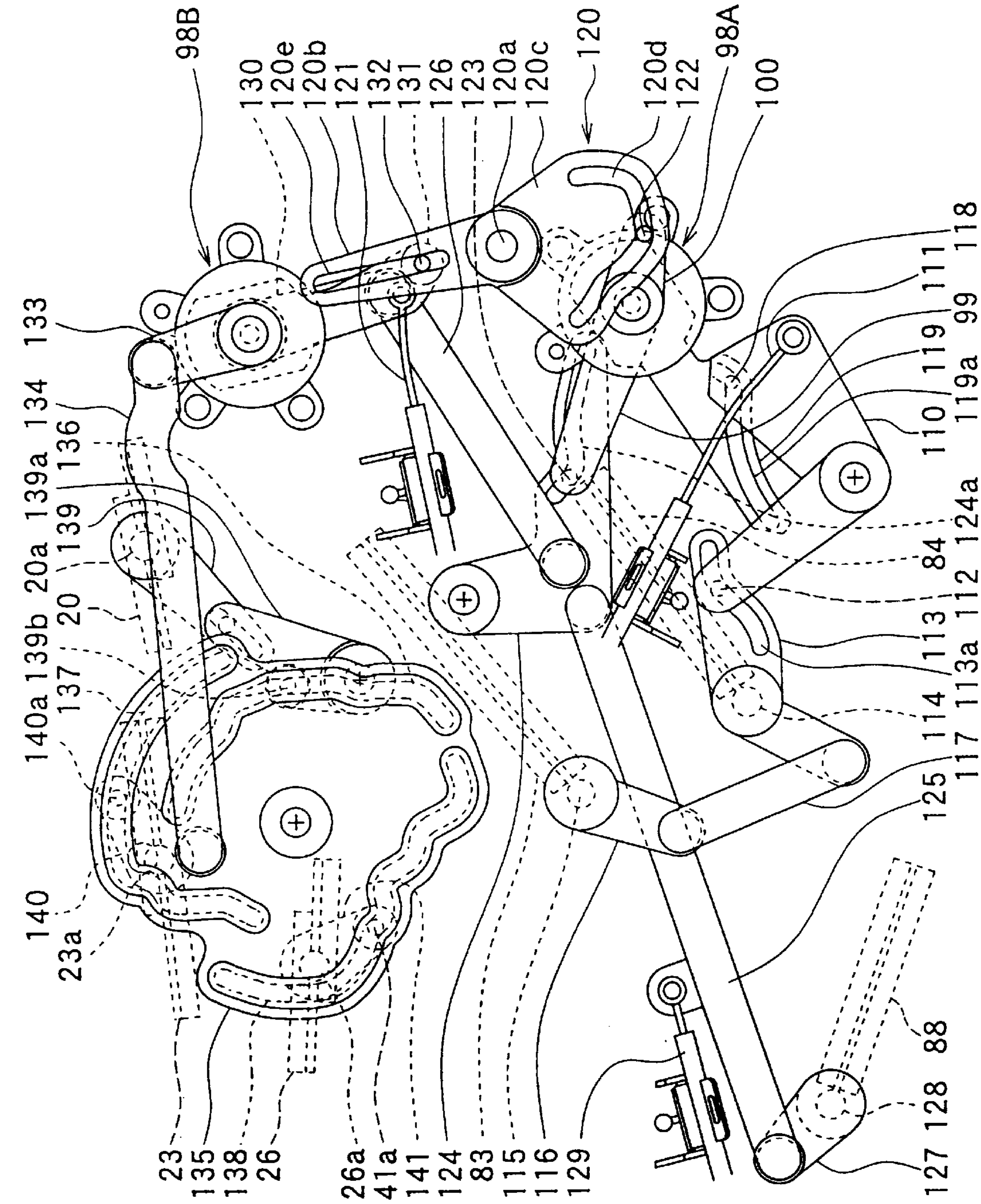


FIG. 39

FOOT MODE
MAXIMUM HEATING

FIG. 40

FOOT MODE
MAXIMUM COOLING

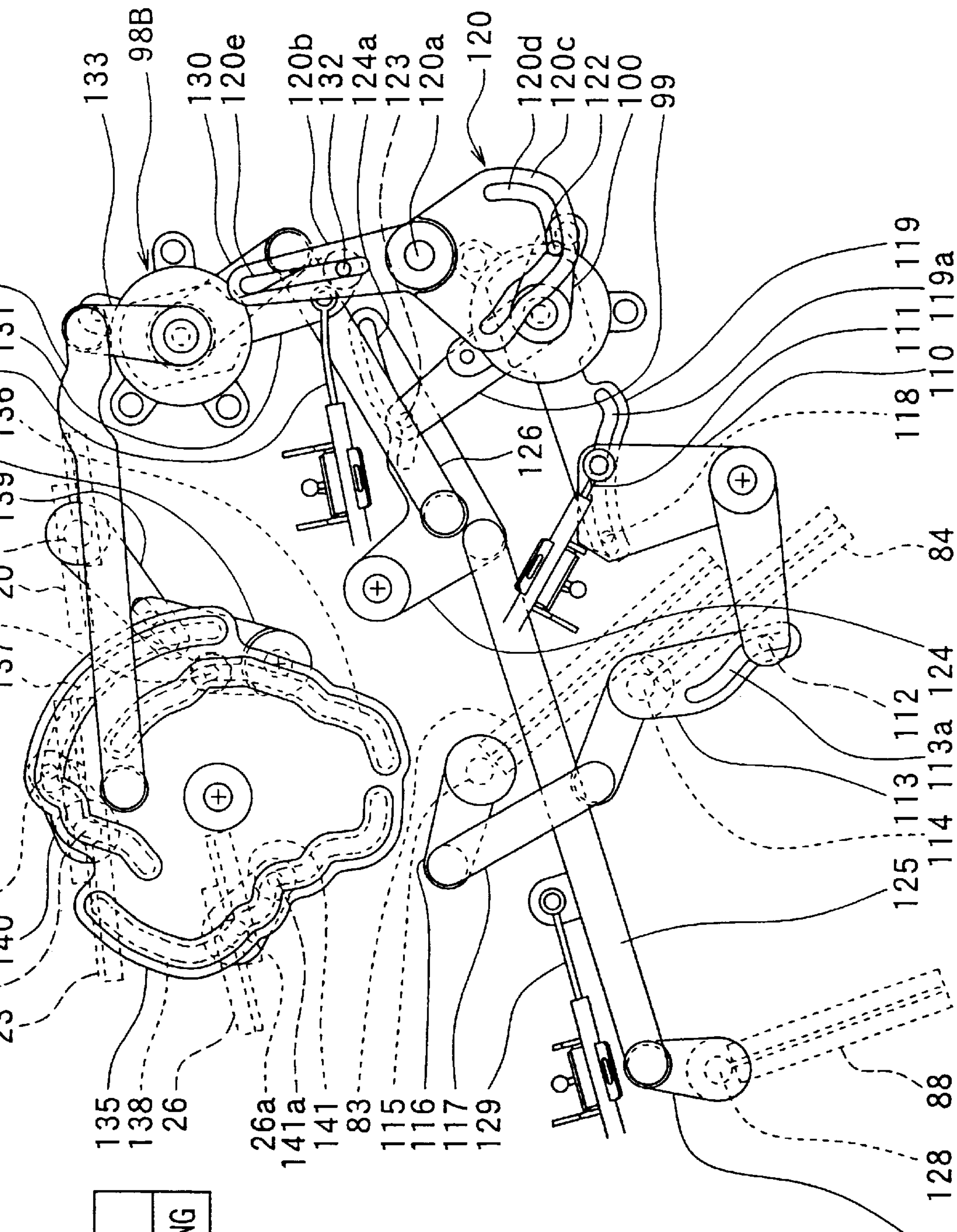


FIG. 41

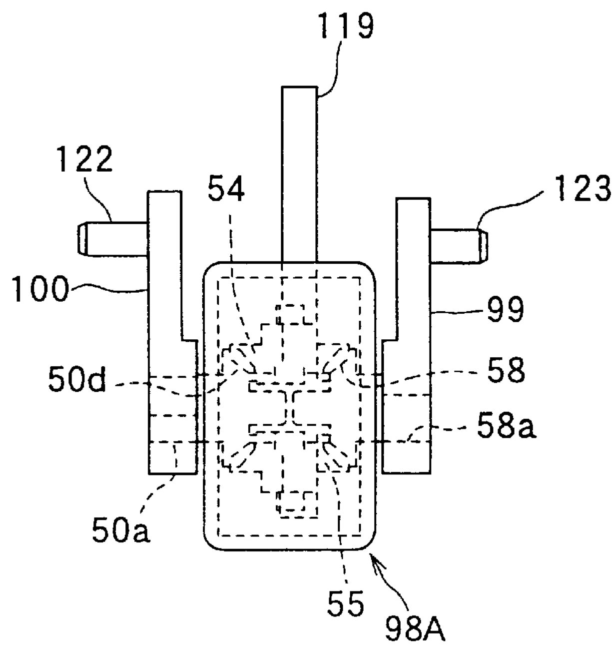

119
122
54
123
100
99
50d
58
58a
50a
55
98A

FIG. 42

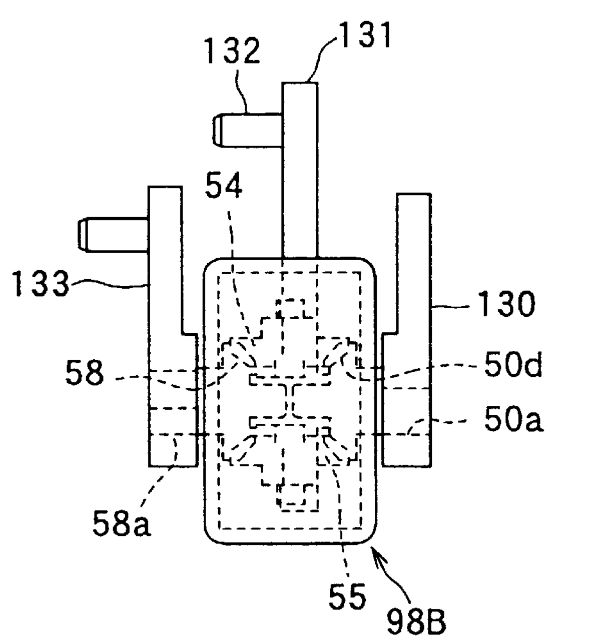
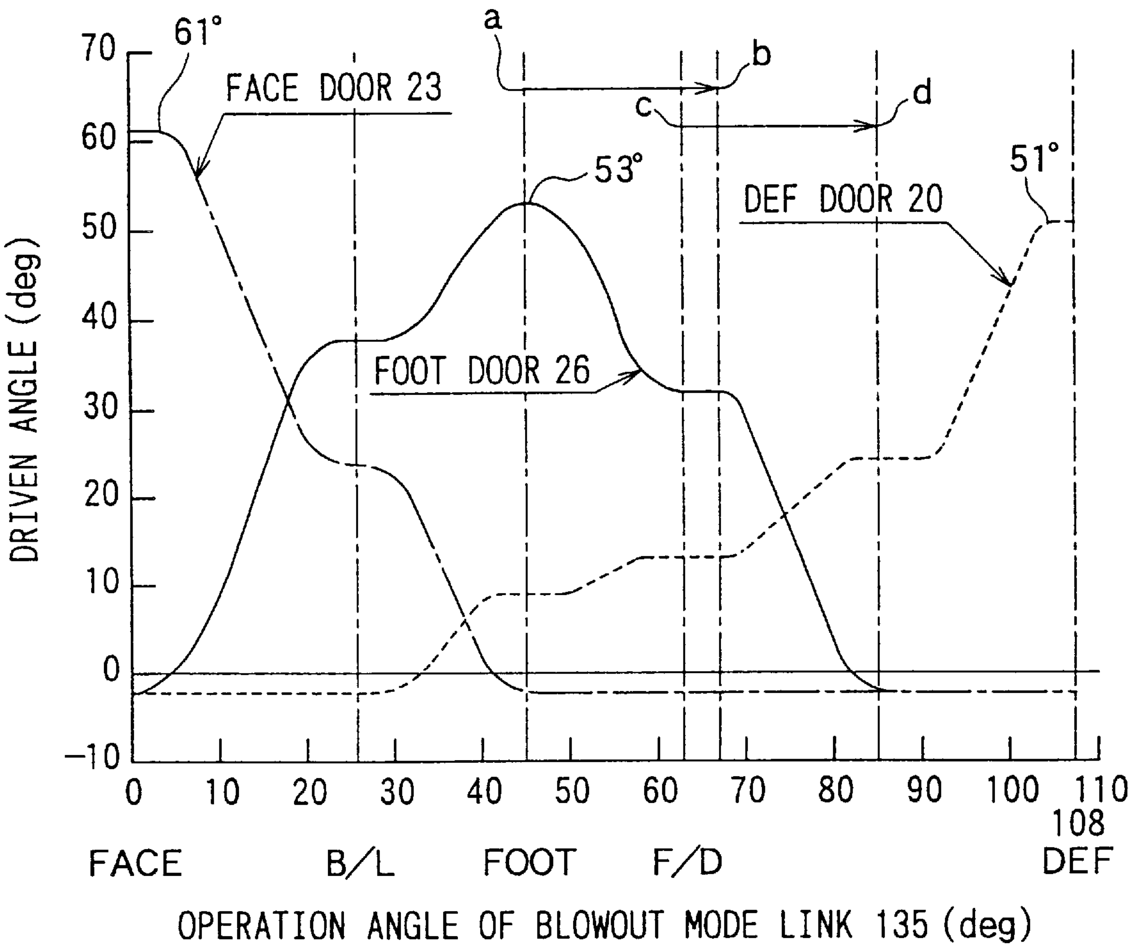

132
131
54
133
130
58
50d
50a
58a
55
98B

FIG. 43



61°
FACE DOOR 23
a
b
c
d
53°
51°
DEF DOOR 20
FOOT DOOR 26
70
60
50
40
30
20
10
0
−10
DRIVEN ANGLE (deg)
0
10
20
30
40
50
60
70
80
90
100
110
108
FACE
B/L
FOOT
F/D
DEF
OPERATION ANGLE OF BLOWOUT MODE LINK 135 (deg)

FIG. 44

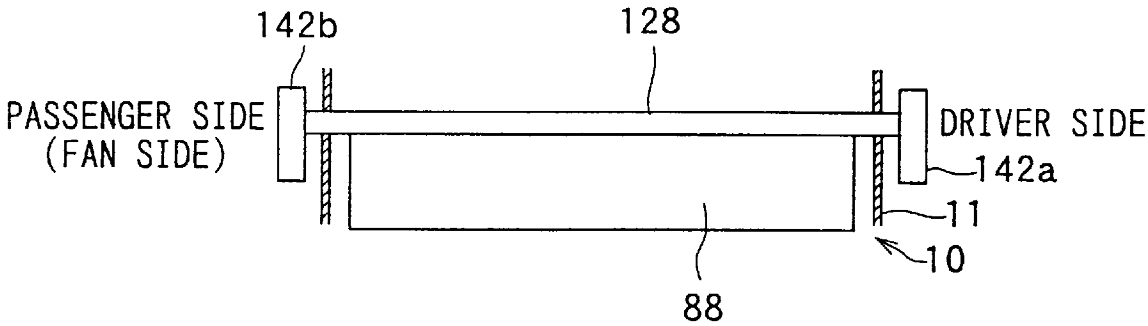
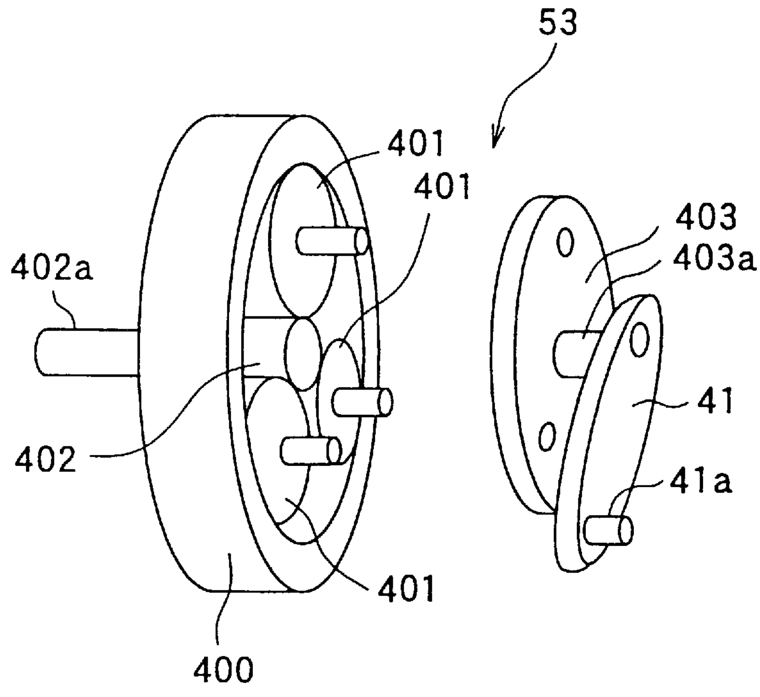

142b
128
PASSENGER SIDE
(FAN SIDE)
DRIVER SIDE
142a
11
10
88

FIG. 46


53
401
401
403
403a
402a
41
402
41a
401
400

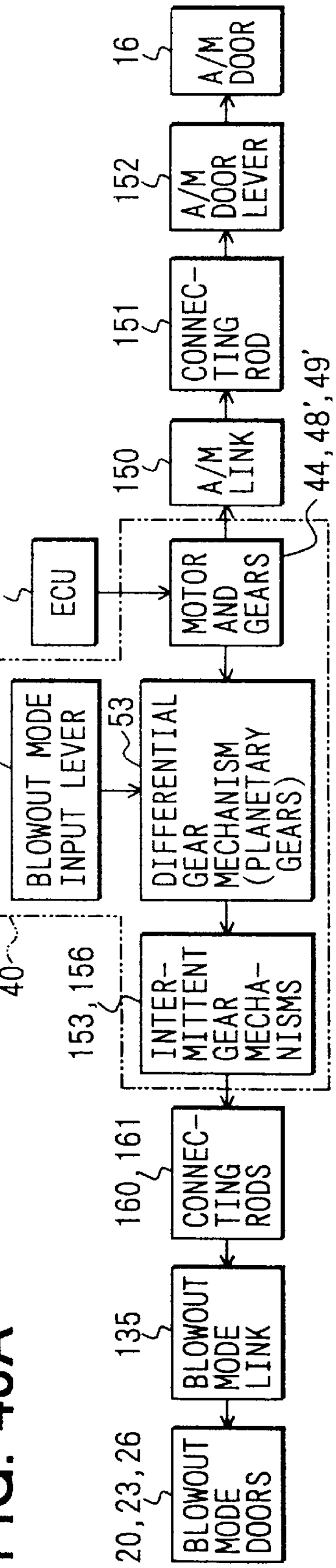


FIG. 45A

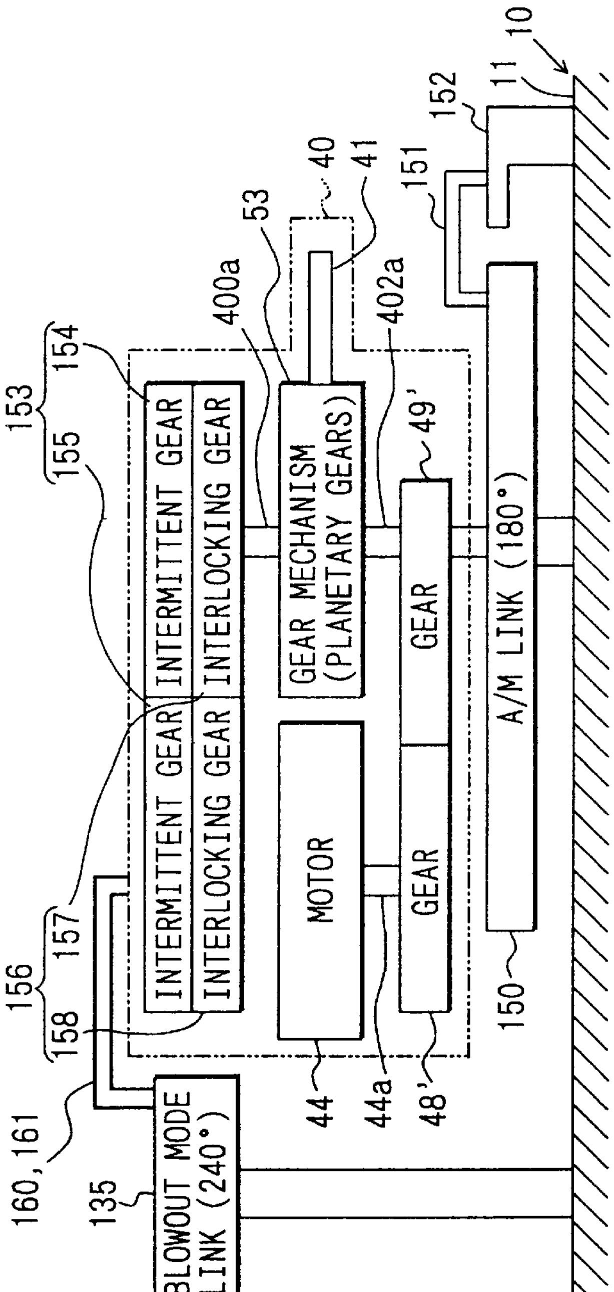


FIG. 45B

FIG. 47

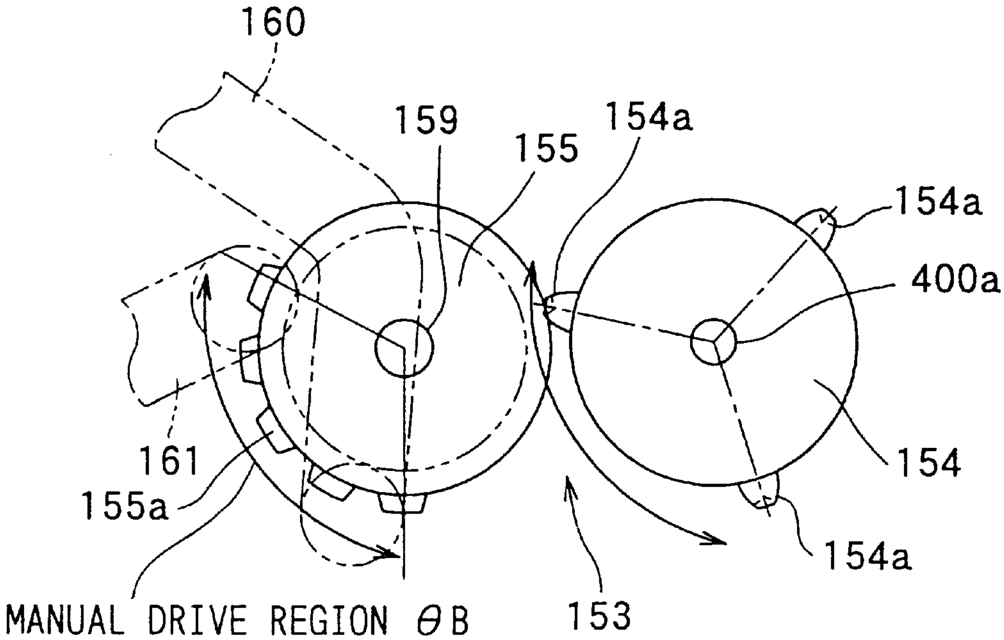

160
159
155
154a
154a
400a
161
155a
154
154a
MANUAL DRIVE REGION θB
153

FIG. 48

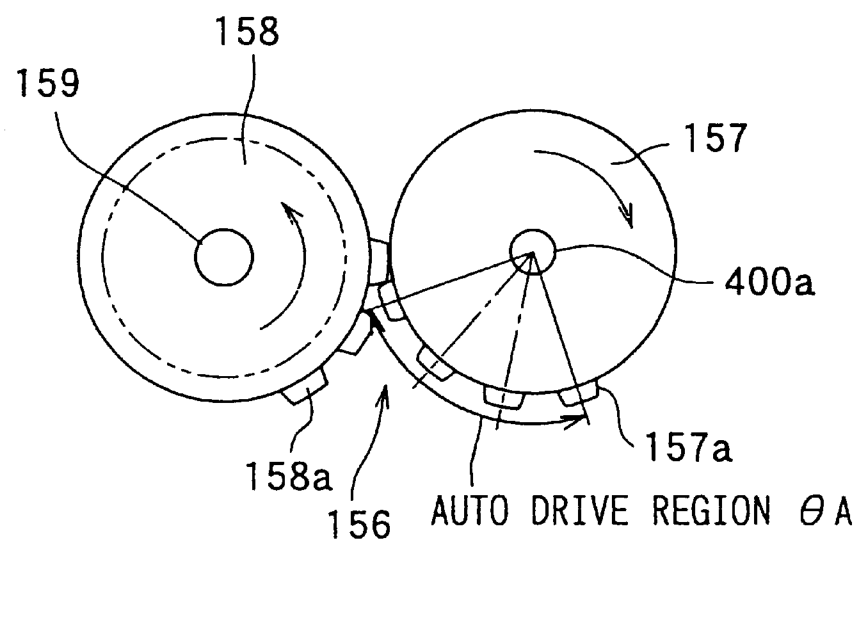

158
159
157
400a
158a
157a
156
AUTO DRIVE REGION θA

FIG. 49

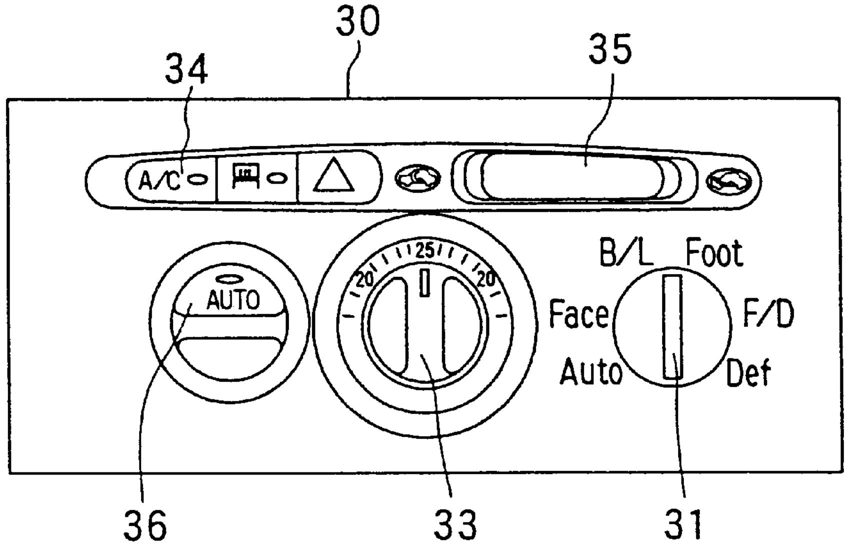

30
34
35
A/C
AUTO
25
20
20
B/L
Foot
Face
F/D
Auto
Def
36
33
31

FIG. 50

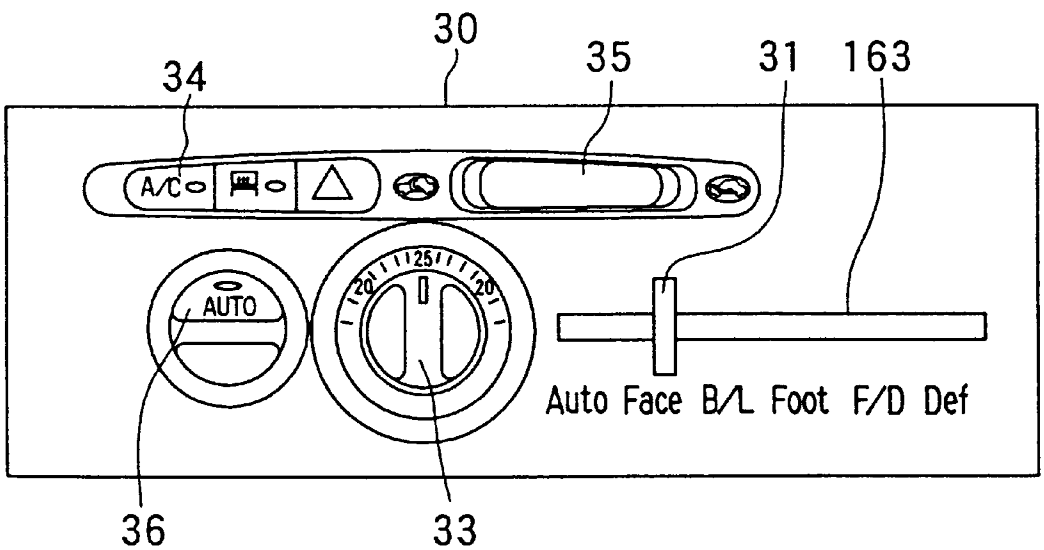

30
34
35
31
163
A/C
AUTO
25
20
20
Auto Face B/L Foot F/D Def
36
33

FIG. 51

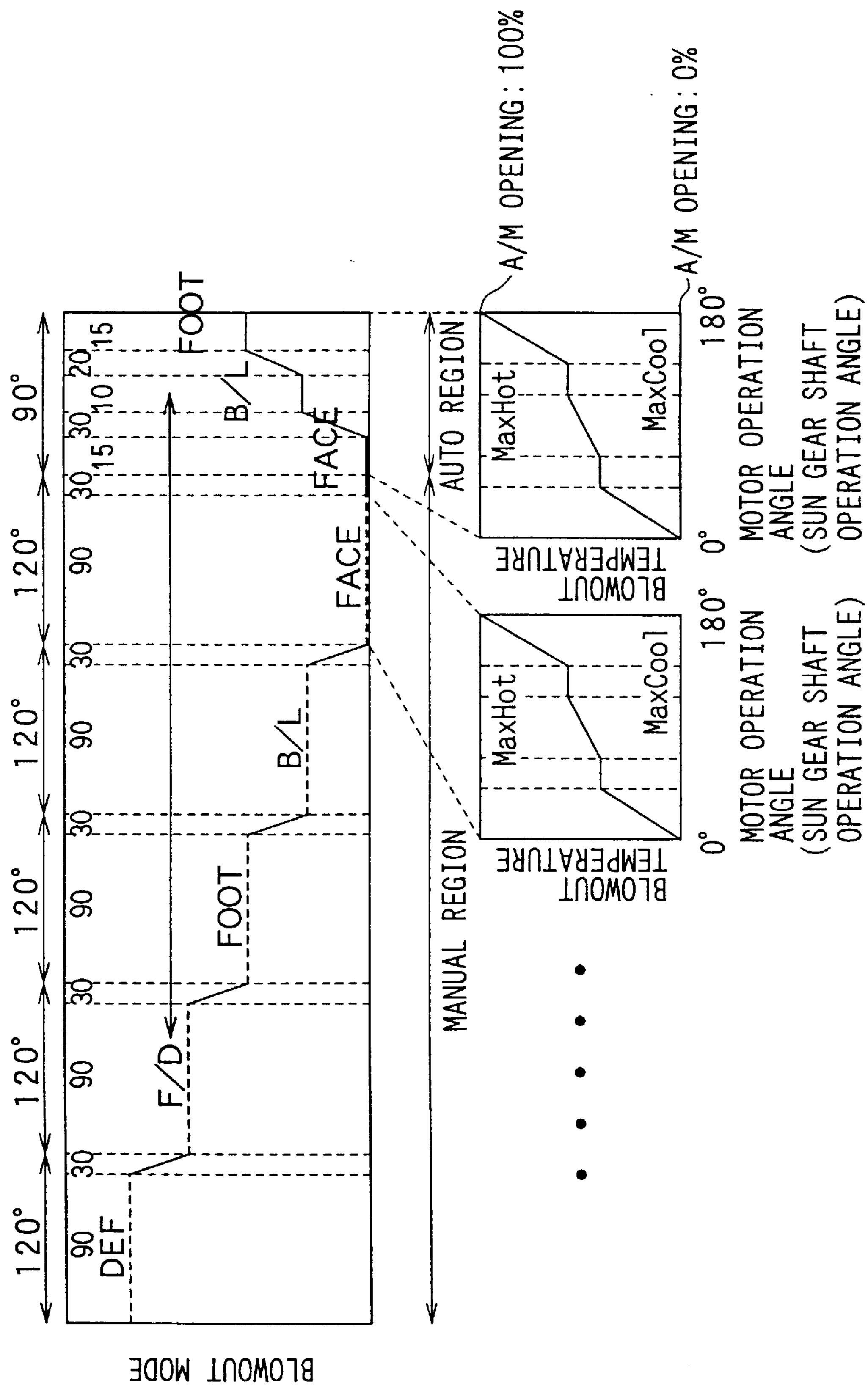

BLOWOUT MODE
DEF
F/D
FOOT
B/L
FACE
90°
120°
90
30
15
20
10
MANUAL REGION
AUTO REGION
BLOWOUT TEMPERATURE
MaxHot
MaxCool
0°
180°
MOTOR OPERATION ANGLE (SUN GEAR SHAFT OPERATION ANGLE)
A/M OPENING : 100%
A/M OPENING : 0%

FIG. 52

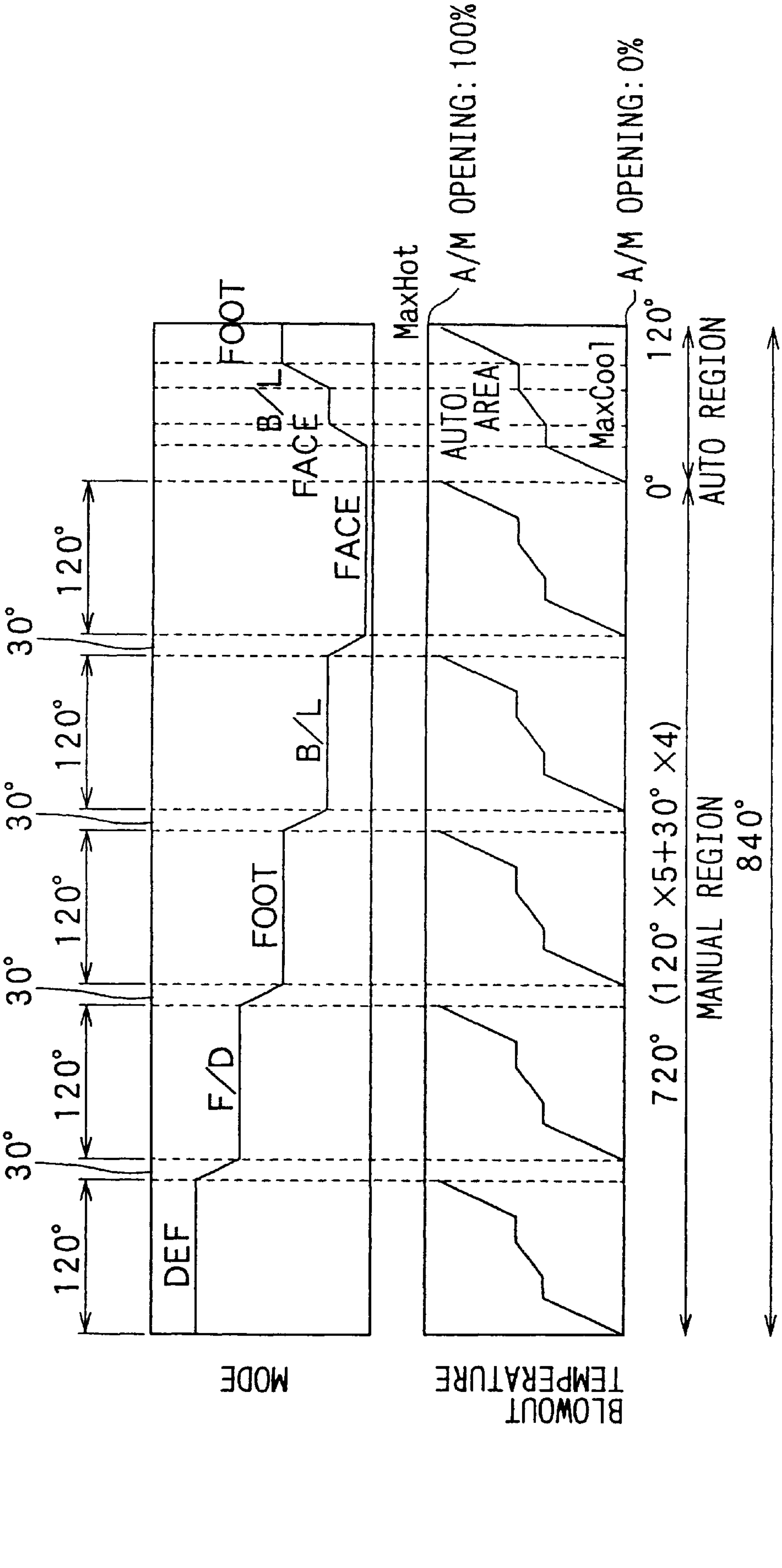

MODE
BLOWOUT TEMPERATURE
DEF
F/D
FOOT
B/L
FACE
FACE
B/L
FOOT
MaxHot
A/M OPENING: 100%
A/M OPENING: 0%
AUTO AREA
MaxCool
120°
30°
120°
30°
120°
30°
120°
30°
120°
0°
120°
AUTO REGION
720° (120° ×5+30° ×4)
MANUAL REGION
840°

FIG. 53

	GEAR	MODULE	DIAMETER	OPERATION ANGLE DURING AUTO SETTING	OPERATION ANGLE DURING MANUAL SETTING (MAX VALUE)
SUN GEAR (A/M)	40	0.5	20	180°	STATIONARY (MOTOR STOPPED)
INTERNAL GEAR (BLOWOUT MODE OUTPUT SIDE)	80	0.5	40	90°	600° ※1
PLANETARY GEAR (BLOWOUT MODE INPUT SIDE)	20	0.5	10	STATIONARY	400° ※2

FIG. 54A

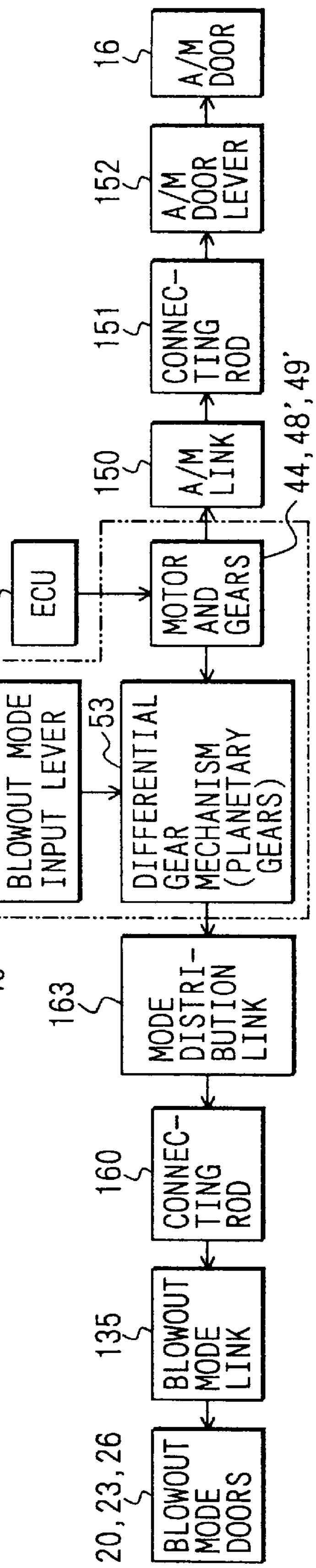
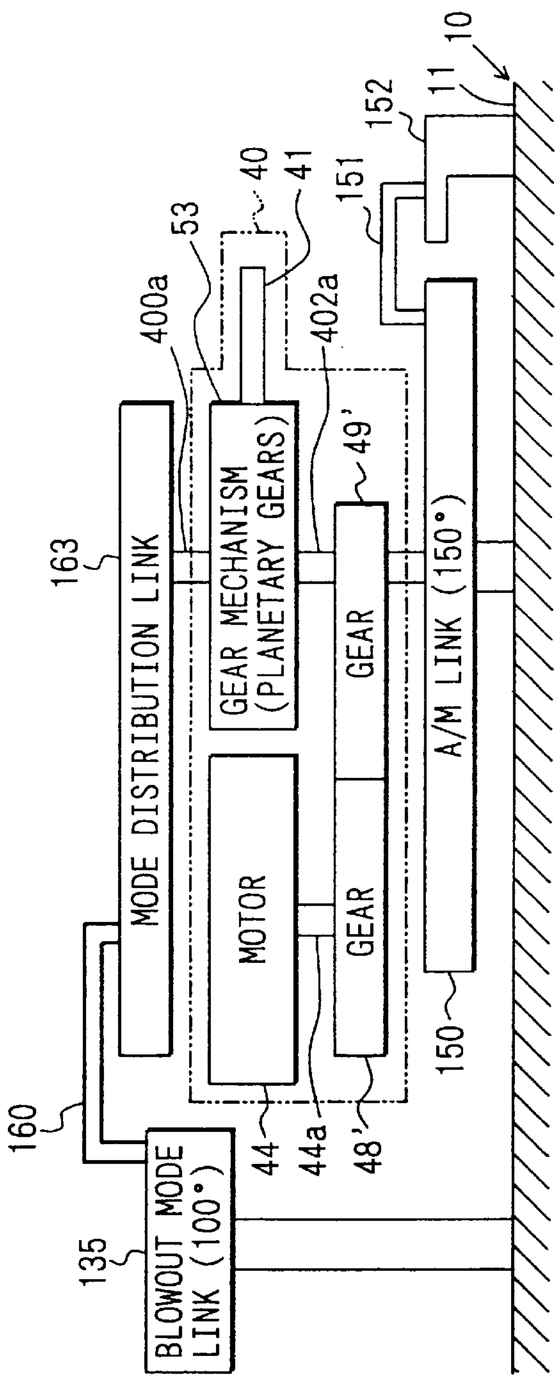


FIG. 54B



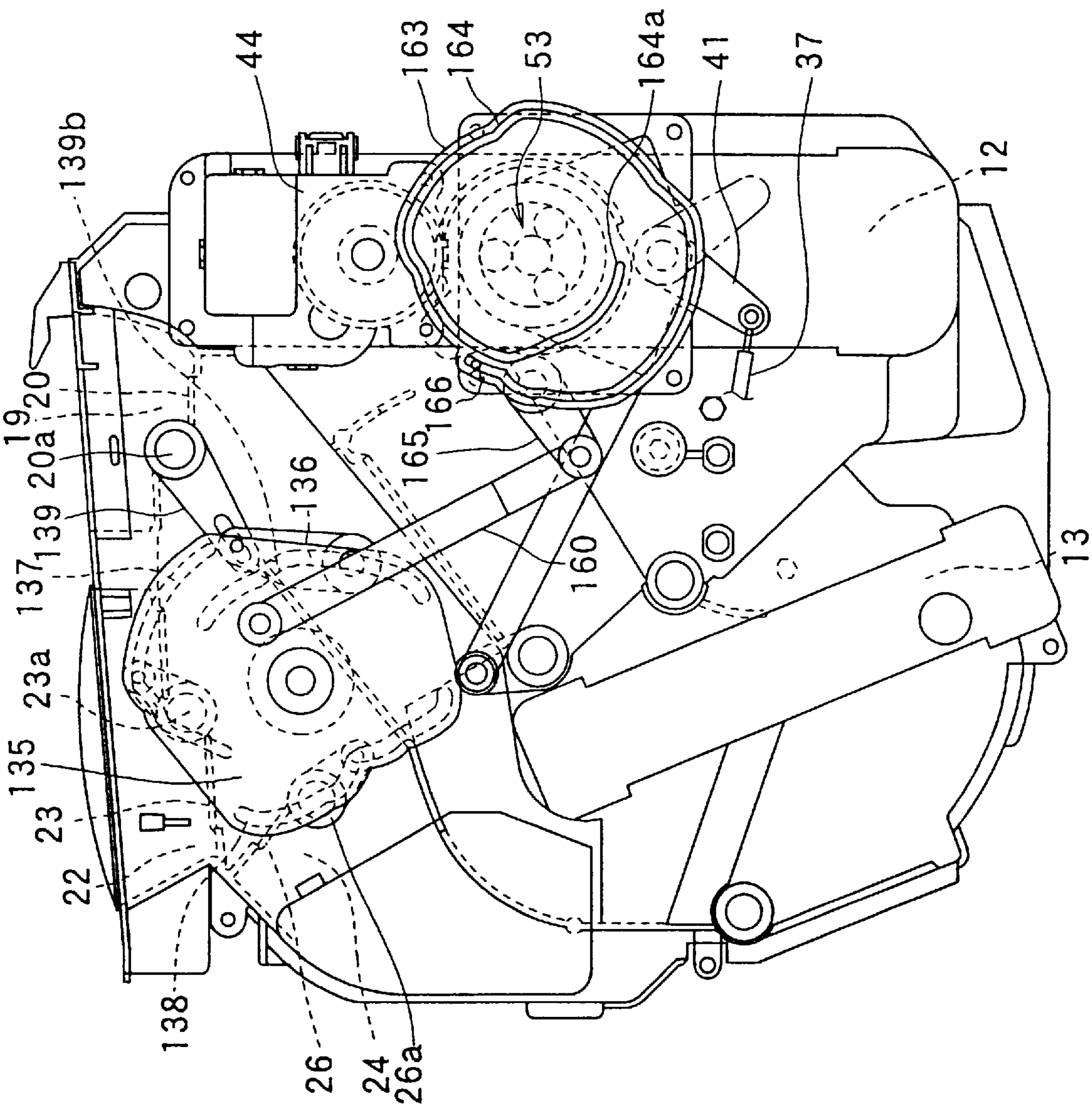

44
163
164
53
164a
41
37
12
13
139b
20
19
20a
139
137
23a
135
23
22
138
26
24
26a
136
165
166
160

FIG. 55

FIG. 56

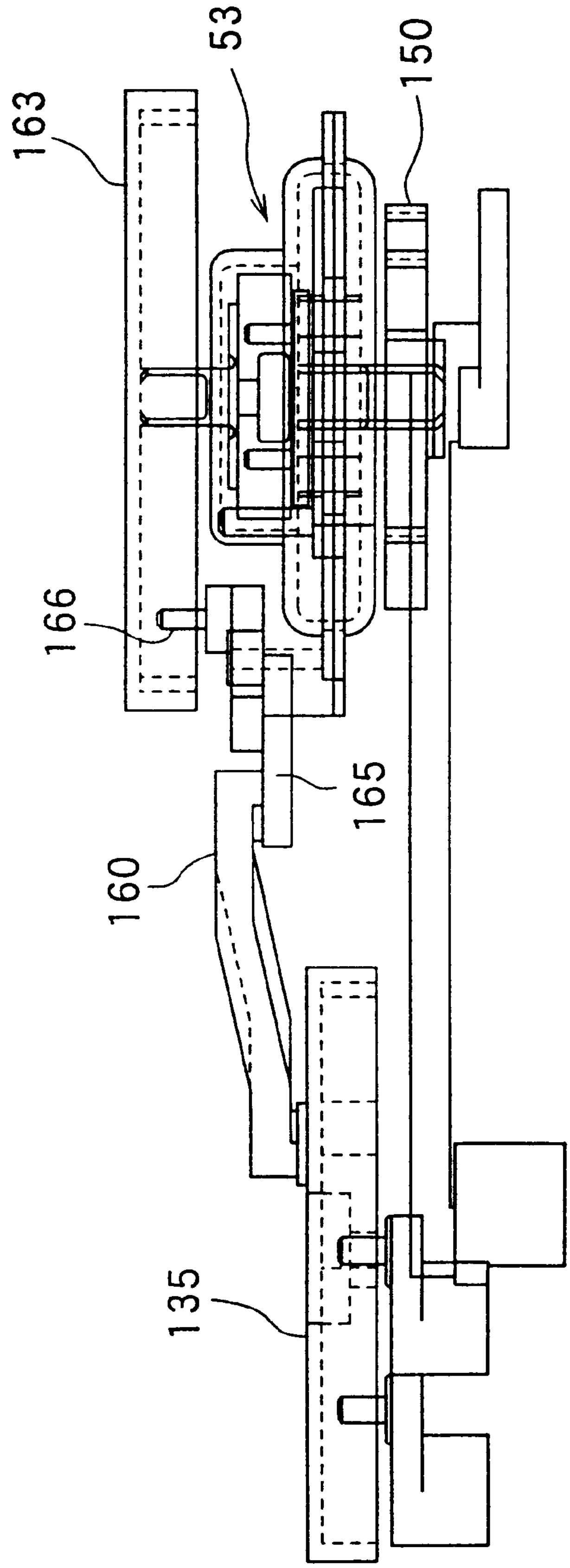
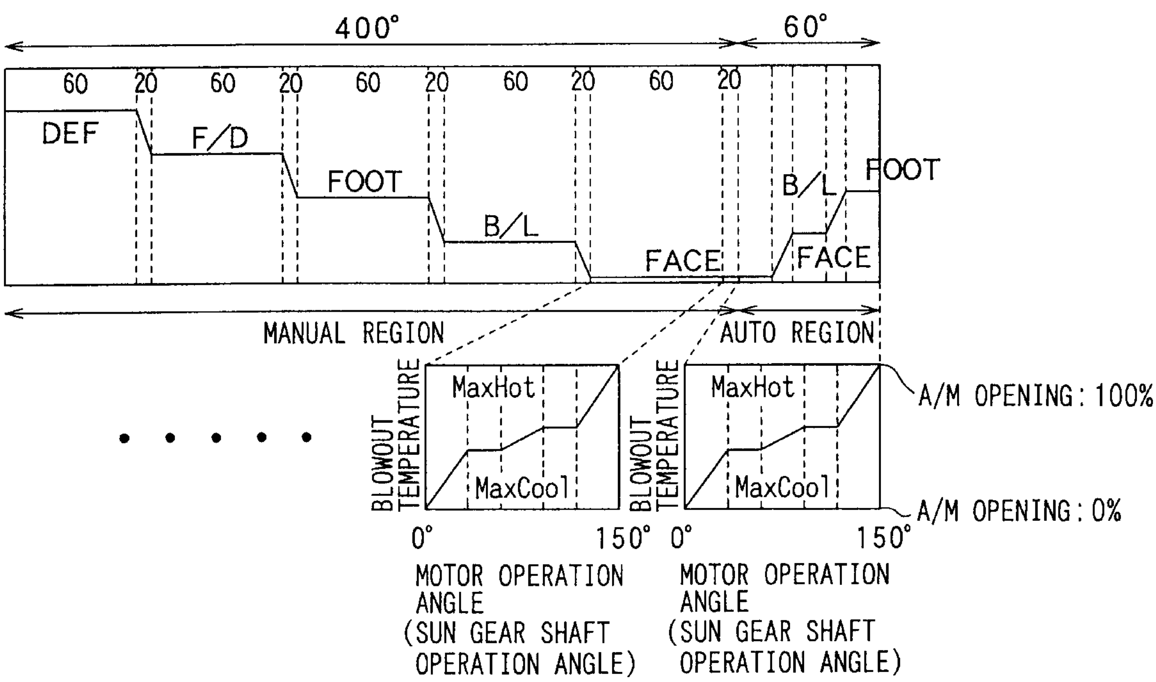


FIG. 57


400°
60°
60
20
60
20
60
20
60
20
60
20
DEF
F/D
FOOT
B/L
FACE
B/L
FOOT
FACE
MANUAL REGION
AUTO REGION
BLOWOUT TEMPERATURE
MaxHot
MaxCool
0°
150°
MOTOR OPERATION ANGLE (SUN GEAR SHAFT OPERATION ANGLE)
BLOWOUT TEMPERATURE
MaxHot
MaxCool
0°
150°
MOTOR OPERATION ANGLE (SUN GEAR SHAFT OPERATION ANGLE)
A/M OPENING: 100%
A/M OPENING: 0%

VEHICULAR AIR-CONDITIONING APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

The present invention is related to Japanese patent application No. Hei. 11-300210, filed Oct. 21, 1999; No. 2000-227500, filed Jul. 27, 2000; and No. 2000-250121, filed Aug. 21, 2000, the contents of which are incorporated herein by reference.

FIELD OF THE INVENTION

The present invention relates to a vehicular air-conditioning apparatus, and more particularly, to a motor actuator and the operational force transmission device used for a vehicular air-conditioning apparatus.

BACKGROUND OF THE INVENTION

Conventional vehicular air-conditioning apparatus is provided with an internal/external air selection door, a temperature control means (air mix door, hot water valve, etc.), as well as a blowout mode door, whereby these instruments are independently operated by means of manual operation mechanisms or motor actuators.

More recently, an increasing number of vehicular air-conditioning apparatuses are beginning to allow the driver to use switch operations for activating motor actuators to easily operate the aforementioned instruments. This type of apparatus requires dedicated motor actuators for internal/external air selection, temperature control, and blowout mode door switching, resulting in higher costs.

Therefore, the inventors evaluated the possibility of using a single motor actuator for temperature control and blowout mode switching, in order to reduce the number of motor actuators. That is, by focusing on the fact that correlation exists between the switching of the blowout mode and the operation position of the temperature control means, and by sequentially shifting the blowout mode from the face mode, to the bi-level mode, and then to lo the foot mode as the operation position of the temperature control means shifts from the low-temperature side to the high-temperature side, the inventors evaluated the possibility of using a single motor actuator for temperature control and blowout mode switching.

However, when temperature control and blowout mode switching are simply performed using a single motor actuator, the operating position of the temperature control means and the switching of the blowout mode are always fixed to a 1-to-1 relationship. Consequently, a problem arises, i.e., when the window is fogged up, it will not be possible to set the defroster mode regardless of the operating position of the temperature control means.

Note that Japanese patent application No. H4-131657 describes a vehicular air-conditioning apparatus that can drive multiple doors by means of a single motor actuator by providing electromagnetic clutches between a single drive shaft and multiple door shafts and using the interrupting action of this electromagnetic clutch for transmitting or shutting off the drive force of the single motor to individual doors.

However, with this conventional technology, it is necessary to provide electromagnetic clutches in the drive force transmission routes to the multiple doors. Consequently, even though the number of motor actuators can be reduced, multiple electromagnetic clutches must be added instead, making it impossible to avoid cost increases.

Moreover, it has been known that some conventional vehicular air-conditioning apparatuses use an internal/external air 2-layer flow mode, in which recirculated internal high-temperature air is blown out from the foot opening while warm low-moisture external air is blown out from the defroster opening. This both improves the heating performance in the area near the vehicle occupant's feet and maintains the window glass fog-free when heating is used in winter.

However, vehicular air-conditioning apparatuses in which this internal/external air 2-layer flow mode can be set have the problem described below. Specifically, this internal/external air 2-layer flow mode is set when the maximum heating capacity is required (i.e., when the temperature control means, such as an air-mix door, is at the maximum heating position) in the blowout mode that opens both the foot and defroster openings. In the internal/external air 2-layer flow mode, the air passage is partitioned into an internal passage leading to the foot openings and an external passage leading to the defroster openings. At the same time, an internal/external air selection box introduces internal air into the internal passage by opening the internal air introduction port located on the internal passage side and introduces external air into the external passage by opening the external air introduction port located on the external passage side.

As explained above, the aforementioned internal/external air 2-layer flow mode must be set in linkage with the setting of the blowout mode for opening both the foot and defroster openings as well as the operation of the temperature control means to the maximum heating setting. Therefore, conventionally, the setting condition for the internal/external air 2-layer flow mode is determined by an air-conditioning control device based on the blowout mode and the operating position of the temperature control means. The output of this air-conditioning control device is added to the drive motor for the internal/external air door, thereby moving the internal/external air door to the 2-layer flow mode.

As described above, a method that sets the 2-layer flow mode through automatic control requires an electrical control area for determining the setting condition for the 2-layer flow mode as well as an electrically controlled door drive motor, thus leading to cost increases.

SUMMARY OF THE INVENTION

The present invention includes a drive motor, a first output shaft to which the rotation of drive motor is transmitted, a second output shaft to which the rotation of first output shaft is transmitted, a differential mechanism located between the first output shaft and second output shaft that adjusts the relative positions of the two output shafts, and an operation component that operates differential mechanism.

A temperature control means, which controls air temperature blown into the interior of the vehicle, is connected to first output shaft. Blowout mode doors are connected to second output shaft. When operation component is set to the auto blowout mode, the rotation of drive motor rotates first output shaft and second output shaft via differential mechanism at the same time. The rotation of first output shaft controls temperature control means. The rotation of second output shaft drives blowout mode doors, thereby switching between the face mode and the foot mode. When operation component is set to the defroster blowout mode while drive motor is stationary, differential mechanism is activated while first output shaft is stationary, thereby setting the defroster mode by rotating second output shaft and shifting the relative positions of the two output shafts.

Accordingly, switching between the blowout temperature control and blowout mode in a vehicular air-conditioning apparatus can be accomplished using a single motor actuator. Moreover, by shifting the relative positions of the two output shafts using differential mechanism, the defroster mode can be set while first output shaft is stationary. Therefore, no electromagnetic clutch is required in the drive force transmission route, as is the case in a conventional technology. Also, the defroster mode can be set any time when the windshield is fogged up, using a simple configuration.

In another aspect of the invention, the defroster mode is maintained even when a second output shaft rotates within a predetermined angle (θ^2) during the defroster mode.

Consequently, the rotation of the drive motor rotates the first output shaft, thereby controlling the position of the temperature control means and controlling the blowout temperature, while maintaining the defroster mode.

In another aspect of the invention, the first output shaft is positioned on one side of the axial direction of differential mechanism while a second output shaft is positioned on the other side of the axial direction of differential mechanism.

In another aspect of the invention, stopper means are provided, which restrict the rotation angle of second output shaft to a predetermined range (θ^1) when second output shaft is rotated by moving operation component to the defroster blowout mode.

In another aspect of the invention, the rotation angle (θ^1) of the second output shaft, rotated when an operation component is moved from the auto blowout mode to the defroster mode, is set larger than the rotation angle (θ) of second output shaft, which is rotated by the rotation of drive motor, when operation component is set to the auto blowout mode.

Consequently, regardless of the rotational position of the second output shaft during automatic control of the blowout mode, the defroster mode is set with the rotation of second output shaft. In another aspect of the invention, operation component is installed in an air-conditioning operation panel in a manually operable manner, and a differential mechanism is provided with a movable component that is activated by receiving the manual operation force from operation component.

In another aspect of the invention, the differential mechanism component is configured using a differential mechanism that uses bevel gears. In another aspect of the invention includes a drive motor, a first output shaft to which the rotation of drive motor is transmitted, a second output shaft to which the rotation of first output shaft is transmitted, a differential mechanism located between first output shaft and second output shaft and that can adjust the relative positions of the two output shafts (**50***a* and **58***a*), and a movable component installed in a differential mechanism. A first slave component is connected to first output shaft while second slave components (**20**, **23**, and **26**) are connected to second output shaft. When the movable component is being set to the first operation position, the rotation of drive motor rotates the first output shaft and the second output shaft at the same time, via differential mechanism within a predetermined operation angle range. A First slave component and second slave components are activated in linkage through the rotation of first output shaft and the second output shaft. When movable component is set to the second operation position while drive motor is stopped, a differential mechanism is activated while the first output shaft is stationary, thereby rotating the second output shaft outside the afore-mentioned predetermined operation angle range by shifting the relative positions of the two output shafts (**50***a* and **58***a*).

Consequently, first slave component and second slave components (**20**, **23**, and **26**) can be simultaneously activated in linkage based on the rotation of drive motor. Also, moving the second slave components (**20**, **23**, and **26**) to positions different from those when the drive motor is. active is accomplished by shifting the relative positions of the two output shafts by means of differential mechanism.

In another aspect, the rotation angle (θ^1) of the second output shaft, which is rotated when the movable component is moved from the first operation position to the second operation position, is set larger than the rotation angle (θ) of second output shaft, which is rotated by the rotation of drive motor, when the movable component is set to the first operation position.

In another aspect, the motor actuator described is used as a motor actuator for vehicular air-conditioning by using a temperature control means for controlling the air temperature blown into the cabin as first slave component and using blowout mode doors (**20**, **23**, and **26**) for switching blowout modes for the cabin, as second slave components.

In another aspect, a vehicular air-conditioning apparatus is provided with defroster openings for blowing air toward the vehicular window glass, foot openings for blowing air toward the foot area of the vehicle occupant, a first air passages (**80** and **80***a*) for sending air to the defroster openings, a second air passages (**81** and **81***a*) for sending air to foot openings, a first internal/external air selection door for switching the air introduced into first air passages between the internal and external air, a second internal/external air selection door for switching the air introduced into second air passages, a blowout mode operation component that is manually operated for selecting the blowout mode for the cabin, a blowout mode input component which rotates in linkage with the operation of blowout mode operation component, a temperature control operation component manually operated for controlling air temperature blown into the cabin, temperature control input components (**200** and **119**) which rotate in linkage with the operation of temperature control operation component, and with differential mechanisms which rotate output component using the rotational shift in all input components. An output component is connected to the operation area of second internal/external air selection door, and the mode for blowing out air from both the defroster opening and the foot opening is set by blowout mode operation component. At the same time, when temperature control operation component is set to the maximum heating setting, differential mechanisms rotate the output component to the predetermined position based on the rotational shifts of all input components. This sets the second internal/external air selection door to the position for introducing the internal air into the second air passages.

In another aspect of the invention, when the defroster mode for blowing out air from the defroster opening is set by the blowout mode operation component, differential mechanisms (**98** and **98**A) rotate the output component to the predetermined position based on the rotational shifts of blowout mode input component. Accordingly, the second internal/external air selection door is set to stop internal air from entering the second air passages. In another aspect, the shift adjustment mechanisms are installed between the output component and the second internal/external air selection door to adjust the shifts between the two components, and when the defroster mode is set, even if the rotational shifts of temperature control input components change the rotational position of output component, second internal/external air selection door can be maintained in the external air introduction position by means of shift adjustment mechanisms.

In another aspect, when a blowout mode other than the defroster mode is set by the blowout mode operation component and the temperature control operation component is set to the maximum cooling position, differential mechanisms rotate the output component to the predetermined position based on the rotational shifts of all input components, thereby setting the second internal/external air selection door for introducing internal air into second air passages.

In another aspect of the invention, the differential mechanisms use bevel gears. The rotational shifts of temperature control input components are input into the bevel gears.

In another aspect of the invention, shift adjustment mechanisms that adjust the shifts between two components are installed between the blowout mode operation component and the blowout mode input component, and between the temperature control operation component and the temperature control input components.

Another aspect of the invention provides defroster openings for blowing air toward the vehicular window glass, foot openings for blowing out air to the foot area of the vehicle occupant, an internal/external air selection door for switching the air sent to the cabin between internal and external air, an internal/external air operation component manually operated to switch between internal and external air introduction, a blowout mode operation component manually operated for selecting the blowout mode for the cabin, a blowout mode input component which rotates in linkage with the operation of blowout mode operation component, an internal/external air selection input component which rotates in linkage with the operation of internal/external air operation component, and with a differential mechanism which rotates output component using the rotational shift of both input components as inputs. The output component is connected to the operation area of internal/external air selection door. When the mode for blowing air from the defroster openings is set by the blowout mode operation component, differential mechanism rotates output component to predetermined position based on the rotational shifts of blowout mode input component, thereby maintaining internal/external air selection door in the external air introduction position. When a blowout mode other than the defroster-dominant mode is being set by blowout mode operation component, the differential mechanism rotates output component to the position that corresponds to the rotational shift of internal/external air selection input component. This sets the internal/external air selection door to the internal/external air mode set by blowout mode operation component.

In another aspect, shift adjustment mechanisms are installed between the output component and the internal/external air selection door to adjust the shifts between these two components. When the defroster-dominant mode is being set, even if the rotational shifts of temperature control input components cause the rotational position of output component, internal/external air selection door can be maintained in the external air introduction position by means of shift adjustment mechanisms.

Another aspect of the invention includes a temperature control means for controlling the air temperature blown into the cabin, blowout mode doors for switching the mode for blowing air into the cabin, a first transmission means for transmitting the operation of the temperature control operation component to the operation area of temperature control means, and a second transmission means for transmitting the operation of blowout mode operation component to the operation areas of blowout mode doors. Temperature control input components of differential mechanisms are rotated based on the shift transmitted from first transmission means. The blowout mode input component of the differential mechanisms is rotated based on the shift transmitted from second transmission means.

In another aspect of the invention, a vehicular air-conditioning apparatus has a temperature control means for controlling the air temperature blown into the cabin, face openings for blowing out air toward the head of the vehicle occupant in the cabin, foot openings for blowing out air toward the feet of the vehicle occupant in the cabin, defroster openings for blowing out air to the vehicular window glass, and blowout mode doors for opening/closing the individual openings, and that switches at least among the face mode for blowing out air from face opening, the foot mode for blowing out air from foot opening, and the defroster mode for blowing out air from defroster opening. There is further provided a drive motor, a first rotation shaft to which the rotation of drive motor is transmitted, a second rotation shaft to which the rotation of first rotation shaft is transmitted, a differential mechanism that is positioned between first rotation shaft and second rotation shaft for adjusting the relative positions of the two rotation shafts, and an operation component for operating differential mechanism. The temperature control means is connected to first rotation shaft, blowout mode doors are connected to second rotation shaft. When operation component is set to the auto blowout mode, the rotation of drive motor rotates first rotation shaft, and at the same time, rotates second rotation shaft via differential mechanism. Also, at the same time, the rotation of first rotation shaft controls temperature control means and the rotation of second rotation shaft drives blowout mode doors (**20**, **23**, and **26**), thereby switching between the face mode and the foot mode. When operation component is set to the face mode position, the foot mode position, or the defroster position of the blowout mode while drive motor is stopped, differential mechanism is activated while first rotation shaft is stationary, thereby setting the face mode, the foot mode, or the defroster mode by rotating second rotation shaft and changing the operation angle of second rotation shaft corresponding to the operation position of operation component.

In another aspect of the invention, an intermittent operation mechanism is provided between the second rotation shaft and the operation mechanism on the side of the blowout mode doors. The rotation of second rotation shaft is intermittently transmitted to the operation mechanism only within part of the operation angle of second rotation shaft.

In another aspect of the invention, a planetary gear mechanism is used for the differential mechanism, and the first rotation shaft is a sun gear shaft while the second rotation shaft is an internal gear shaft. A planetary gear is revolved by operating operation component.

Another aspect of the invention provides an operational force transmission device, provided with a first input component that rotates in linkage with the operation of first operation component, second input components that rotate in linkage with the second operation components, a differential mechanism that rotates output component using the rotational shift of all input components, and with slave components that are driven by the rotational shift of output component.

The differential mechanism rotates the output component to the first output position when all input components have rotated to their predetermined positions. The differential mechanism rotates the output component to the second output position when any of the input components rotates to a position different from the predetermined position. Also, shift adjustment mechanisms can be provided that are installed between output component and slave components for adjusting the shifts among these components. Here, a differential mechanism rotates output component within the predetermined range between first and second positions corresponding to the rotational shift of the first input component within the predetermined range, and moreover, output component is designed to rotate to a third position that is outside of the predetermined range based on the rotational shift of second input components. When output component rotates to the third position, the rotational shift of output component is not transmitted to slave components by shift adjustment mechanisms.

Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating preferred embodiments of the invention, are intended for purposes of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will become more fully understood from the detailed description and the accompanying drawings, wherein:

FIG. **1** is a schematic cross-sectional diagram of the major areas of the vehicular air-conditioning apparatus in a first embodiment of the present invention;

FIG. **2**A is a top view of a partial cross-sectional diagram of the air-conditioning operation panel in a first embodiment of the present invention;

FIG. **2**B shows the top view of a partial cross-sectional diagram of the air-conditioning operation panel in a first embodiment of the present invention;

FIG. **3** is an exploded front view of the motor actuator in a first embodiment of the present invention;

FIG. **4** is a cross-section along IV—IV of FIG. **5**;

FIG. **5** is a front view of the motor actuator in a first embodiment of the present invention;

FIG. **6** is a rear view of the motor actuator in a first embodiment of the present invention;

FIG. **7** is an electrical control block diagram of a first embodiment of the present invention;

FIG. **8** is a flowchart of the air-conditioning control in a first embodiment of the present invention;

FIG. **9** is an operation diagram of a first embodiment of the present invention;

FIG. **10** is a diagram explaining the motor actuator of a vehicle air conditioning apparatus according to the present invention;

FIG. **11** is a front view of the air-conditioning operation panel in a vehicle air conditioning apparatus according to the present invention;

FIG. **12** is a front view of the air-conditioning operation panel in a vehicle air conditioning apparatus according to the present invention;

FIG. **13** is a schematic cross-sectional diagram of the vehicular air-conditioning apparatus in a vehicle air conditioning apparatus according to the present invention;

FIG. **14** is a front view of the fan unit in a vehicle air conditioning apparatus according to the present invention;

FIG. **15** is an exploded view of the major area of FIG. **14** of a vehicle air conditioning apparatus according to the present invention;

FIG. **16** is a cross-sectional diagram of the differential gear mechanism in FIG. **15** of a vehicle air conditioning apparatus according to the present invention;

FIG. **17** is a partial cross-sectional diagram of the air-conditioning operation panel in Embodiment 5 of a vehicle air conditioning apparatus according to the present invention;

FIG. **18** is a front view of the air-conditioning operation panel of a vehicle air conditioning apparatus according to the present invention;

FIG. **19** is a diagram explaining the operation of the differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. **20** is a diagram explaining the operation of the differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. **21** is a diagram explaining the operation of the differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. **22** is a diagram explaining the operation of the differential gear mechanism in of a vehicle air conditioning apparatus according to the present invention;

FIG. **23** is a diagram explaining the operation of the second internal/external air door of a vehicle air conditioning apparatus according to the present invention;

FIG. **24** is a table showing the operational characteristics of the second internal/external air door of a vehicle air conditioning apparatus according to the present invention;

FIG. **25** is a table showing the operational characteristics of the second internal/external-air door in a modified example of a vehicle air conditioning apparatus according to the present invention;

FIG. **26** is a front view of the fan unit of a vehicle air conditioning apparatus according to the present invention;

FIG. **27** is an exploded view of the major area of a vehicle air conditioning apparatus according to the present invention;

FIG. **28** is a side view of the differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. **29** is a diagram explaining the operation of the differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. **30** is a diagram explaining the operation of the differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. **31** is a diagram explaining the operation of the differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. **32** is a diagram explaining the operation of the differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. **33** is an operational characteristics diagram of the internal/external air door of a vehicle air conditioning apparatus according to the present invention;

FIG. **34** is an exploded perspective diagram of the planetary gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 35 is a side view of the differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 36 is a side view of the differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 37 is a front view of the air-conditioning unit of a vehicle air conditioning apparatus according to the present invention;

FIG. 38 is a front view of the major areas of the fan unit of vehicle air conditioning apparatus according to the present invention;

FIG. 39 is a configuration diagram of the door operation mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 40 is a configuration diagram of the door operation mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 41 is a side view of the first differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 42 is a side view of the second differential gear mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 43 is a diagram explaining the operation of a vehicle air conditioning apparatus according to the present invention;

FIG. 44 is a diagram explaining a modified example of a vehicle air conditioning apparatus according to the present invention;

FIG. 45A is a diagram explaining the interlocked flow of the door operation mechanism of Embodiment 11 of a vehicle air conditioning apparatus according to the present invention;

FIG. 45B is a schematic diagram of the door operation is mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 46 is a perspective diagram of the planetary gear mechanism used in the door operation mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 47 is a front view of the intermittent gear mechanism used in the door operation mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 48 is a front view of the interlocking gear mechanism used in the door operation mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 49 is a front view of the air-conditioning operation panel of a vehicle air conditioning apparatus according to the present invention;

FIG. 50 is a front view showing another example of the air-conditioning operation panel of a vehicle air conditioning apparatus according to the present invention;

FIG. 51 is an operational characteristics diagram of a vehicle air conditioning apparatus according to the present invention;

FIG. 52 is an operational characteristics diagram of the comparison example for Embodiment 11 of a vehicle air conditioning apparatus according to the present invention;

FIG. 53 is a table showing examples of specific specifications of the planetary gear mechanism used in the door operation mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 54A is a diagram explaining the interlocked flow of the door operation mechanism of Embodiment 12 of a vehicle air conditioning apparatus according to the present invention;

FIG. 54B is a schematic diagram of the door operation mechanism of a vehicle air conditioning apparatus according to the present invention;

FIG. 55 is a front view of the air-conditioning unit in which the door operation mechanism according to Embodiment 12 is installed for a vehicle air conditioning apparatus according to the present invention;

FIG. 56 is a side view of major areas in FIG. 55 for a vehicle air conditioning apparatus according to the present invention; and

FIG. 57 is an operational characteristics diagram for a vehicle air conditioning apparatus according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 is a cross-sectional diagram of the air-conditioning unit of a vehicular air-conditioning apparatus according to a first embodiment of the present invention. The air-conditioning apparatus in this embodiment has a so-called semi-center placement layout, in which air-conditioning unit **10** is positioned in the approximate center in the left-right direction of the vehicle inside the instrument panel located in the front portion of the cabin. The arrows in the figure indicate the installation orientation of air-conditioning unit **10** relative to the up-down and front-back directions.

A fan unit (not shown in the figure) for sending conditioned air to this air-conditioning unit **10** is positioned while being offset to one side (the passenger side) of air-conditioning unit **10**. As is well known, this fan unit is provided with an internal/external air selection box for selectively introducing the internal or external air and with a centrifugal electric fan for sending the air (the internal or external air) sucked into this internal/external air selection box toward air-conditioning unit **10**. Air-conditioning unit **10** has an air-conditioning case **11** made of resin, and an air passage, through which the supplied air flows from the front of the vehicle toward the back of the vehicle via heat exchangers **12** and **13**, is formed inside this air-conditioning case **11**.

Inside the air passage of air-conditioning case **11**, evaporator **12** is positioned toward the front of the vehicle and heater core **13** is positioned toward the back of the vehicle. As is well known, evaporator **12** is a heat exchanger for cooling, which cools air by absorbing latent heat of vaporization of the coolant in a cooling cycle. Heater core **13** is a heat exchanger for heating, that heats the air using hot water (cooling water) from the vehicle engine as the heat source. An air intake port **14** (not shown in the figure) into which air supplied from the fan unit flows, is formed on the front-most side of air-conditioning case **11** in the vehicle (in front of evaporator **12**) and on the side of the passenger seat.

A cool air bypass passage **15** is formed above heater core **13**, and a plate-shaped air-mix door **16** is rotatably installed with rotation shaft **16***a* at its center, immediately downstream of evaporator **12** (toward the back of the vehicle). This air-mix door **16** adjusts the temperature of air blown out to the desired level by controlling the ratio between the cool air passing through cool air bypass passage **15** and the warm air passing through core area **13***a* of heater core **13**.

An upward-facing warm air passage **17** is formed immediately behind heater core **13**, and the warm air from this warm air passage **17** and the cold air from cool air bypass passage **15** are mixed in air-mixing area **18**. Multiple blowout openings are formed on the downstream side of the air passages of air-conditioning case **11**. Of these blowout openings, defroster openings **19** open into air-conditioning case **11** on its top surface at the approximate center in the front-back direction of the vehicle. Furthermore, these defroster openings **19** blow conditioned air out toward the interior surfaces of vehicle window glass via defroster ducts (not shown in the figure). Defroster openings **19** are opened and closed by a plate-shaped defroster door **20** that rotates around a rotating shaft **20***a*.

Next, face openings **22** open into air-conditioning case **11** on its top surface, behind defroster openings **19** in terms of the vehicle direction. These face openings **22** blow air out toward the head of the vehicle occupants inside the cabin via face ducts (not shown in the figure). Face openings **22** are opened and closed by a plate-shaped face door **23** that rotates around a rotating shaft **23***a*.

Next, foot openings **24** open into air-conditioning case **11** below face openings **22**. The downstream side of foot openings **24** are connected to foot blowout openings **25** positioned on both the right and left sides of air-conditioning case **11**. These foot blowout openings **25** blow air out toward the feet of the vehicle occupants. Foot openings **24** are opened and closed by a plate-shaped foot door **26** that rotates around a rotating shaft **26***a*.

Note that, in the example in FIG. **1**, the aforementioned openings **19**, **22**, and **24** are configured to open and close by three dedicated doors **20**, **23**, and **26**, respectively. However, as is well known, it is also possible to open and close defroster openings **19** and face openings **22** using a single shared door, and to open and close face openings **22** and foot openings **24** using a single shared door.

In air-conditioning unit **10**, one end of rotation shaft **16***a* of air-mix door **16**, one end of rotation shaft **20***a* of defroster door **20**, one end of rotation shaft **23***a* of face door **23**, and one end of rotation shaft **26***a* of foot door **26** protrude outside air-conditioning case **11** and connects to the single motor actuator **40** described below (FIGS. **3** through **6**). As such, air-mix door **16** for controlling temperature as well as blowout mode selection doors **20**, **23**, and **26** are opened and closed by this single motor actuator **40**.

Next, the motor actuator, which is a unique feature of the present invention, will be explained. FIG. **2** shows air-conditioning operation panel **30** which is positioned near the instrument panel in the front portion inside the vehicle, and blowout mode knob **31** is manually operated to the Auto position and the defroster position of the blowout mode by sliding inside groove **30***a* on the front of panel **30**. When this blowout mode knob **31** is set to the Auto position, motor actuator **40** automatically sets the face, bi-level, or foot blowout mode in linkage with the blowout temperature control inside the cabin. On the other hand, when blowout mode knob **31** is set to the defroster position, the defroster mode gets set.

A pin **31***a* is provided on one end of blowout mode knob **31**, which is slidably inserted into groove **32***a* on one end of lever **32**. Since lever **32** is installed on air-conditioning operation panel **30** and rotatably supported by rotation shaft **32**b, lever **32** is operated by sliding blowout mode knob **31** inside groove **30***a* on the front of panel **30**. Note that, in this example, other operation components besides blowout mode knob **31**, that are manually operated by the vehicle occupant, are provided on the front of air-conditioning operation panel **30**. These other operation components are described below. A temperature setter **33** having a rotating knob generates a signal for setting the temperature inside the cabin. A push-button air-conditioning switch **34** generates the activation signal for the compressor (not shown in the figure) for the air-conditioning cooling cycle. An internal/external switch **35** having a lever-type knob generates the signal for switching between the internal and external air for the internal/external air selection box of the fan unit. A fan switch **36** having a lever-type knob generates the air volume selection signal for the electric fan of the fan unit.

One end of cable **37** is connected to the other end of the aforementioned lever **32**, and the other end of this cable **37** is connected to a shaft **41***a* of a movable lever (input component) **41** of motor actuator **40** as shown in FIG. **3**.

As shown in FIGS. **3** through **6**, motor actuator **40** is provided with a resin case **42** and a resin cover **43** for closing the open end of this case **42**. The space formed by this case **42** and cover **43** houses a drive motor **44** consisting of a direct current (DC) motor as well as gear mechanisms, etc. that are connected to this drive motor **44**. Concave support components **42***a* and **42***b* are integrally formed on case **42** corresponding to the two ends in the axial direction of drive motor **44**, and the two ends of drive motor **44** are held under slight pressure by these support components **42***a* and **42***b* via O-ring-shaped rubber elastic components.

A resin worm gear **47** is pressure-fitted onto output shaft **44***a* of drive motor **44**. The rotation of this worm gear **47** is transmitted to output gear **50** via reduction gears **48***a*, **48***b*, **49***a*, and **49***b*. Reduction gears **48***a* and **48***b* are rotatably supported by support shaft **42***c* which is integrally formed with case **42**, and reduction gears **49***a* and **49***b* are rotatably supported by support shaft **42***d* which is integrally formed with case **42**.

Output gear **50** is a spur gear made of resin, and a first output shaft **50***a* is integrally formed in the central area of the spur gear as shown in FIG. **4**. This first output shaft **50***a* is rotatably supported by bearing **42***e* of case **42** and at the same time protrudes outside case **42**. Rotation shaft **16***a* of air-mix door **16** is connected to this protruding end via a linking mechanism (not shown in the figure). Therefore, the rotation of first output shaft **50***a* rotates air-mix door **16** (the first slave component).

Furthermore, multiple latches **50***b* which can elastically deform, are integrally formed on the inside perimeter of the teeth area of output gear **50**. These latches **50***b* securely hold a rotating circuit board **51** onto the side of output gear **50**. This rotating circuit board **51** consists of a printed circuit board provided with an electrical resistor, and rotates while sliding over a brush **52** held by case **42**. This rotating circuit board **51** and brush **52** form a potentiometer **700** (see FIG. **7**) for detecting the rotational position of air-mix door **16**.

A shaft **50***c* is also integrally formed on output gear **50** on the same shaft as output shaft **50***a*. Shaft **50***c* is slidably inserted into bearing **41**b on the internal perimeter of movable lever **41**. Furthermore, a bevel gear **50***d* of differential gear mechanism **53** is formed in output gear **50** on the outer perimeter of shaft **50***c*.

Movable lever **41** is provided with two holes **41**c and **41**d (see FIG. **3**) in 180° symmetrical positions corresponding to the outer perimeter of bearing **41***b*. Bevel gears **54** and **55** of differential gear mechanism **53** are rotatably positioned inside these two holes **41***c* and **41***d*, respectively. Bevel gears **54** and **55** are equivalent to the planetary gears in a planetary gear mechanism, are made of resin, and are rotatably supported by support shafts **56** and **57** (see FIG. **4**). Support shafts **56** and **57** are made of metal (steel), and are securely held by concave areas **41***e*, **41***f*, **41***g*, and **41***h* formed in movable lever **41**.

Moreover, a resin bevel gear **58** is positioned to mesh with bevel gears **54** and **55**, and a second output shaft **58***a* is integrally formed in the central area of this bevel gear **58**. This second output shaft **58***a* is positioned on the same shaft as first output shaft **50***a*, and is rotatably supported by bearing **43***a* of cover **43**.

Second output shaft **58***a* protrudes outside cover **43**, and rotation shafts **20***a*, **23***a*, and **26***a* of blowout mode doors **20**, **23**, and **26** are connected to this protruding end via linking mechanisms (not shown in the figure). Therefore, the rotation of second output shaft **58***a* rotates blowout mode doors **20**, **23**, and **26** (the second slave components).

Furthermore, a shaft **58***b*, which corresponds to shaft **50***c* of first output shaft **50***a*, is integrally formed on second output shaft **58***a*. This shaft **58***b* is also slidably inserted into bearing **41***b* on the internal perimeter of movable lever **41**. Therefore, movable lever **41** is rotatably supported by shafts **50***c* and **58***b*.

In this embodiment, differential gear mechanism **53** comprises bevel gear **50***d* of output gear **50**, bevel gears **54** and **55**, bevel gear **58**, and movable lever **41** which rotatably supports bevel gears **54** and **55**.

Next, feeding plate **60** shown in FIG. **3** integrally forms an electric circuit on a substrate made of resin. Multiple (four in the example in FIG. **3**) protrusions **42**f are integrally formed on the bottom of case **43**, and feeding plate **60** is secured to the bottom of case **42** by interfitting the installation holes of the resin substrate of feeding plate **60** onto these protrusions **42***f*, and by thermally crimping protrusions **42***f*.

Connector terminals **60***a* for electrically connecting external lead wires, feeding area **60***b* for feeding power to terminal **44***b* of drive motor **44**, and the aforementioned brush **52** are integrally provided on feeding plate **60** by inserting these components into the resin substrate.

Note that, in addition to the aforementioned components (**42***a* through **42***f*), connector housing **42***g* for housing connector terminals **60***a*, stoppers **42***h* and **42***i* for restricting the operation range of movable lever **41** to the predetermined angle β, and installation areas **42***j* for installing case **42** in air-conditioning case **11** are formed in case **42**. These installation areas **42***j* are provided on four corners of case **42** and have screw throughholes. Stoppers **42***h* and **42***i* restrict the rotational angle of second output shaft **58***a* to the predetermined range θ^1 by restricting the operation range of movable lever **41**.

Meanwhile, connector housing **43***b* which, along with connector housing **42***g* of case **42**, houses connector terminal **60***a*, as well as installation areas **43***c* [for installing cover **43**] in air-conditioning case **11** are formed on cover **43**, in addition to the aforementioned bearing **43***a*. These installation areas **43***c* are provided on four corners of cover **43** and are provided with screw throughholes. Installation areas **42***j* of case **42** and installation areas **43***c* of cover **43** are together secured to air-conditioning case **11** using common screws.

Next, an overview of the electrical control area in this embodiment will be explained with reference to FIG. **7**. Detection signals are input into an air-conditioning electronic control device **710** for air-conditioning control, from a known sensor group **720** that detects internal air temperature TR, external air temperature TAM, sun light volume TS, evaporator blowout temperature (evaporator cooling performance) TE, warm water temperature TW, etc.

Temperature setting signal Tset inside the cabin from temperature setter **33** of air-conditioning operation panel **30**, compressor activation signals (ON and OFF signals) in the air-conditioning cooling cycle from air-conditioner switch **34**, an internal/external selection signal from internal/external switch **35**, and a fan air volume selection signal from fan switch **36** are also input. An air-mix door opening signal is also input from potentiometer **700** of motor actuator **40**.

Air-conditioning electronic control device **710** consists of a known microcomputer comprising a CPU, ROM, and RAM, and peripheral circuits; and performs predetermined computation according to a preset program to control power supplied to drive motor **44** of motor actuator **40**, drive motor **73** of the internal/external air selection door (not shown in the figure), drive motor **740** of the fan (not shown in the figure), and electromagnetic clutch **750** for activating and shutting off the compressor, etc.

Next, the operation of this embodiment will be explained based on the aforementioned configuration. The flowchart in FIG. **8** shows the control process executed by the microcomputer of air-conditioning electronic control device **710**. The control routine in FIG. **8** starts when fan switch **36** of air-conditioning operation panel **30** is turned on while power is supplied to control device **710** after the vehicle engine ignition switch has been turned on. First, in Step **S100**, flags, timers, etc. are initialized, and in the next Step **S110**, detection signals from sensor group **720**, the operation signal from air-conditioning operation panel **30**, etc. are loaded.

Then, in Step S**120**, the target blowout temperature (TAO) of air blown into the cabin is computed based on Mathematical expression 1 shown below. This target blowout temperature (TAO) is the blowout temperature necessary for maintaining the temperature inside the cabin at the temperature setting Tset of temperature setter **33**.

Mathematical expression 1

$$TAO=Kset\times Tset-Kr\times TR-Kam\times TAM-Ks\times TS+C$$

where Kset, Kr, Kam, and Ks: Control gains

C: Correction coefficient

Next, the process proceeds to Step **130**, in which the target opening SW of air-mix door **16** is computed based on Mathematical expression 2.

Mathematical Expression 2

$$SW=\{(TAO-TE)/(TW-TE)\}\times 100(\%)$$

According to Mathematical expression 2, target opening SW is computed as a percentage, and is set to 0% when air-mix door **16** is at the maximum cooling position (the position indicated by solid lines in FIG. **1**) which completely closes the air passage of heater core **13**, and to 100% when air-mix door **16** is at the maximum heating position (the position indicated by dotted lines in FIG. **1**) which completely closes cool air bypass passage **15**.

Next, in Step **S140**, the target air feed volume BLW of air sent by the fan of the fan unit is computed based on the aforementioned TAO. The method of computing this target air feed volume BLW is well known, and the target air volume is increased on the high-temperature side (maximum heating side) and the low-temperature side (maximum cooling side) of the aforementioned TAO. Also, the target air volume is decreased in the mid-temperature range of the aforementioned TAO.

Next, in Step **S150**, an internal/external air mode is determined according to the aforementioned TAO. As is well known, this internal/external air mode can be set so that it switches from the internal air mode to the external air mode, or from the all internal air mode to the internal/external mixed mode, and then to the all external air mode, as TAO shifts from the low-temperature side to the high-temperature side.

Next, in Step **S160**, ON-OFF of the compressor is determined. Specifically, the target evaporator blowout temperature TEO is computed based on the aforementioned TAO and external air temperature TAM. The actual evaporator blowout temperature TE is compared with the target evaporator blowout temperature TEO. If TE>TEO, the compressor is turned ON. If TE≦TEO, the compressor is turned OFF.

Next, in Step **S170**, the various control values computed in the aforementioned various steps S**130** through **S160** are output to motors **44**, **730**, and **740**, and to electromagnetic clutch **750**, to control air-conditioning. That is, motor **44** of motor actuator **40** controls the opening of air-mix door **16** so that the actual opening of the air-mix door detected by potentiometer **700** matches the target opening SW from Step **S130**.

The rotational frequency of fan drive motor **740** is controlled by controlling its supply voltage so that the target air volume BLW from Step **S140** can be achieved. Internal/external air motor **730** controls the operation position of the internal/external air door (not shown in the figure) so that the internal/external air mode from Step **S150** can be achieved. Electromagnetic clutch **750** controls the ON-OFF operation of the compressor so that the actual evaporator blowout temperature TE matches the target evaporator blowout temperature TEO.

Next, the operation of motor actuator **40**, will be described in detail. In motor actuator **40**, air-mix door **16** is connected to first output shaft **50***a*. Therefore, by providing first output shaft **50***a* with rotating circuit board **51** of potentiometer **700** and by sliding and rotating this rotating circuit board **51** on brush **52** of case **42**, the electrical resistance of rotating circuit board **51** can be varied and the rotation positional signal of air-mix door **16**, i.e., a door opening signal, can be extracted from brush **52**. This door opening signal is input into control device **710** via connector terminal **60***a*.

Then, if the actual opening of air-mix door **16** matches the target opening SW, control device **710** stops the supply of power to motor **44**, thus stopping motor **44**. In contrast, if the actual opening of air-mix door **16** does not match the target opening SW, control device **710** supplies power to motor **44**, thus activating motor **44**. Here, by switching between the positive and negative lo polarities of the power supplied to motor **44**, motor **44** rotates in either the positive or negative direction depending on whether the opening of air-mix door **16** is increased or decreased.

If power is supplied to motor **44** and motor **44** is activated, its rotational output is transmitted to output gear **50** via worm gear **47** and reduction gears **48***a*, **48***b*, **49***a*, and **49***b*. Then, first output shaft **50***a* and bevel gear **50***d* for the differential gear mechanism rotate with output gear **50**.

Here, if blowout mode knob **31** is set to the Auto blowout mode in air-conditioning operation panel **30**, movable lever **41** is set to point A in FIG. **3** via lever **32** and cable **37**, and movable lever **41** is securely held at point A of FIG. **3** by the friction, etc. of cable **37**.

Therefore, when bevel gear **50***d* rotates, its rotational output is transmitted to bevel gear **58** via bevel gears **54** and **55**, thus rotating second output shaft **58***a*. Here, second output shaft **58***a* rotates in the direction opposite from first output shaft **50***a* because of bevel gears **54** and **55**.

That is, when blowout mode knob **31** is being set to the auto blowout mode, first output shaft **50***a* and second output shaft **58***a* rotate in linkage based on the rotational output of motor **44**. Therefore, the rotation of first output shaft **50***a* increases/decreases the opening of air-mix door **16**, and at the same time, the rotation of second output shaft **58***a* automatically switches the blowout mode. FIG. **9** explains the operation of automatically switching blowout modes in linkage with the change in the opening of air-mix door **16**. The horizontal axis in FIG. **9**A indicates the rotational angle of second output shaft **58***a*. The horizontal axis in FIG. **9**B indicates the rotational angle of first output shaft **50***a*, and first output shaft **50***a* rotates within the range of predetermined angle θ based on motor **44**.

The rotation of this first output shaft **50***a* continuously changes the opening of air-mix door **16** between the maximum cooling position (opening=0%) and the maximum heating position (opening =100%) indicated by the horizontal axis in FIG. **9**B. Note that the maximum cooling position and the maximum heating position of air-mix door **16** are indicated by the solid line position and the two-dot chain line position in FIG. **1**, respectively.

FIG. **9**A shows the changes in the opening of blowout mode doors **20**, **23**, and **26** corresponding to the rotational angle of second output shaft **58***a*. When the rotational angle of second output shaft **58***a* is within the range **0** to a, face door **23** fully opens face openings **22**, activating the face mode. When the rotational angle of second output shaft **58***a* is within the range b to c, both face door **23** and foot door **26** fully open both face openings **22** and foot openings **24**, activating the bi-level mode.

Then, when the rotational angle of second output shaft **58***a* is within the range d to e, foot door **26** fully opens foot openings **24**, and at the same time, defroster door **20** slightly opens defroster openings **19**, activating the foot mode.

In this way, when blowout mode knob **31** of air-conditioning operation panel **30** is set to the Auto position, the operational angle of first output shaft **50***a* increases according to increases in the drive angle of motor **44**, thus increasing the opening of air-mix door **16**. As the opening of the air-mix door increases, the blowout mode can be sequentially and automatically switched from the face mode to the bi-level mode, and to the foot mode.

Note that angle ranges a to b and c to d in FIG. **9**A are the regions used for switching the position of the blowout mode door, and therefore, the opening of air-mix door **16** is maintained constant in these regions. On the other hand, to set the defroster mode in order to remove the fogging from the vehicle window glass, blowout mode knob **31** of air-conditioning operation panel **30** is set to the defroster position. Then, movable lever **41** rotates from point A to point B via lever **32** and cable **37**. Here, the movement of movable lever **41** is restricted to point B by stopper **42***i*.

When this movable lever **41** rotates, output gear **50** does not move because it is restrained in the engagement area between worm gear **47** and reduction gear **48***a*. Therefore, first output shaft **50***a* does not move, and consequently air-mix door **16** does not move, either.

Since output gear **50** does not move, bevel gears **54** and **55**, which are rotatably supported on movable lever **41**, rotate (revolution and autorotation) on bevel gear **50***d* which is on the output gear **50** side as movable lever **41** rotates. The rotation of these bevel gears **54** and **55** causes bevel gear **58** to rotate, thus rotating second output shaft **58***a*.

While movable lever **41** rotates from point A to point B of FIG. **3** within the operation range of β°, second output shaft **58***a* rotates by angle el (FIGS. **5** and **9**). Therefore, second output shaft **58***a* becomes relatively offset by angle θ^1 from first output shaft **50***a*. Here, rotational angle θ^1 of second output shaft **58***a* is set to a value that is greater by a predetermined value than the rotational angle θ of second output shaft **58***a* when the aforementioned auto control mode is set.

Consequently, even if blowout mode knob **31** of air-conditioning operation panel **30** is moved to the defroster position while the blowout mode is set to the face mode (when air-mix door **16** is on the maximum cooling position side), second output shaft **58***a* rotates to a position that is past the foot mode position, as shown in FIGS. **5** and **9**. In this way, the defroster mode can be set as the blowout mode.

Likewise, if blowout mode knob **31** is moved to the defroster position when the blowout mode is set to the bi-level or foot mode, the defroster mode can be set as the blowout mode since second output shaft **58***a* rotates by angle θ.

Note that second output shaft **58***a* rotates within the range of angle θ^2 while the defroster mode is set by moving blowout mode knob **31** to the defroster position. That is, the link mechanisms (not shown in the figure) that exist between second output shaft **58***a* and blowout mode doors **20**, **23**, and **26** are provided with an idling mechanism that maintains blowout mode doors **20**, **23**, and **26** in the defroster mode position even when second output shaft **58***a* rotates within the range of angle θ^2.

Therefore, motor **44** can be used to rotate second output shaft **58***a* along with first output shaft **50***a* while blowout mode doors **20**, **23**, and **26** are maintaining the defroster mode position. As a result, the blowout temperature in the defroster mode can be controlled by changing the opening of air-mix door **16**, in the same way as in other modes.

Note that since operation angle θ^2 of second output shaft **58***a* during defroster mode switching is the operation range for controlling the blowout temperature in the defroster mode, it can be the same as operation angle θ of first output shaft **50***a* and second output shaft **58***a* during the auto control mode.

As can be understood from the above explanation, according to the present embodiment, a single dual-shaft-type motor actuator **40**, in which first and second output shafts **50***a* and **58***a* are positioned on both side in the axial direction, can be used to control the opening of air-mix door **16** for temperature control, to automatically switch the blowout modes (face, bi-level, and foot) by means of blowout mode doors **20**, **23**, and **26**, and to set the defroster mode whenever the vehicle window glass needs to be defogged, regardless of the opening of air-mix door **16**. Furthermore, the blowout temperature can be controlled even while the defroster mode is set, as in other modes.

Note that since the rotational position of second output shaft **58***a* is determined by the rotation of first output shaft **50***a* and the rotation of movable lever **41**, both first output shaft **50***a* and movable lever **41** can be considered input components in relation to second output shaft **58***a*.

In the first embodiment, to set the defroster mode, movable lever **41** is rotated by manually operating blowout mode knob **31** of air-conditioning operation panel **30**, thereby rotating bevel gears **54** and **55** of differential gear mechanism **53**. In contrast, as shown in FIG. **10**, in the second embodiment, a platter **410** having a gear area on the outer perimeter is used instead of movable lever **41**, and bevel gears **54** and **55** are rotatably supported in holes **41***c* and **41***d* of this platter **410** as in Embodiment 1.

The gear area of platter **410** is connected to the output shaft of drive motor **62** via a reduction gear **61**. Meanwhile, the defroster switch is designed to go ON to supply electrical power to drive motor **62** when blowout mode knob **31** of air-conditioning operation panel **30** is moved to the defroster position. In this way, in Embodiment 2, the blowout mode can be set to the defroster mode by simply performing a switching operation using switch blowout mode knob **31**, thus improving the operational ease for the vehicle occupant.

FIG. **11** shows a third embodiment, in which a blowout mode fine-tuning knob **310** is provided in air-conditioning operation panel **30** instead of blowout mode knob **31**. Also, movable lever **41** is rotated by manually operating this knob **310**, thereby causing a shift between the relative positions of first and second output shafts **50***a* and **58***a*. Therefore, the rotational angle of first output shaft **50***a*, i.e., the mode switching positions (points a, b, c, and d in FIG. **9**) corresponding to the opening of air-mix door **16**, can be fine-tuned.

Furthermore, in this embodiment, by adding a defroster switch **63** to air-conditioning operation panel **30** and turning ON this defroster switch **63**, drive motor **44** is activated to rotate first and second output shafts **50***a* and **58***a* by an angle equivalent to θ^1 in FIG. **9**, to set the defroster mode. Therefore, according to Embodiment 3, the defroster mode is always at the maximum heating state. FIG. **12** shows a fourth embodiment, in which a blowout temperature fine-tuning knob **311** is provided in air-conditioning operation panel **30** instead of blowout mode knob **31**. Movable lever **41** is rotated by manually operating this knob **311**, thereby causing a shift between the relative positions of first and second output shafts **50***a* and **58***a*.

Furthermore, in Embodiment **4**, blowout mode doors **20**, **23**, and **26** are connected to first output shaft **50***a* via linking mechanisms and air-mix door **16** is connected to second output shaft **58***a* via a linking mechanism.

Therefore, blowout modes (face, bi-level, and foot) are automatically switched corresponding to the rotational angle of drive motor **44**, and the opening of air-mix door **16** is adjusted according to this automatic switching of blowout modes. Furthermore, by rotating movable lever **41** by manually operating blowout temperature fine-tuning knob **311**, a shift between the relative positions of first output shaft **50***a* and second output shaft **58***a* can be generated. As a result, the temperature of the air blown into the cabin can be fine-tuned by fine-tuning the opening of air-mix door **16**.

Note that in Embodiment 4, the method of setting the defroster mode is the same as in Embodiment 3. That is, it is necessary to rotate first and second output shafts **50***a* and **58***a* by an angle equivalent to θ^1 in FIG. **9** by activating drive motor **44** by turning ON defroster switch **63** of air-conditioning operation panel **30**.

In a fifth embodiment, the vehicle occupant can set the internal/external air 2-layer flow mode through a manual operation in a vehicular air-conditioning apparatus in which the internal/external air 2-layer flow mode can be set. First, an overview of the vehicular air-conditioning apparatus to which Embodiment is applied will be provided with reference to FIG. **13**. In FIG. **13**, those areas that are identical or equivalent to those in FIG. **1** are assigned the same symbols and their explanations are omitted.

Note that although FIG. **13** shows fan unit **70** on the front side of air-conditioning unit **10** (toward the front of the vehicle), for convenience, fan unit is actually positioned on the passenger side of air-conditioning unit **10**. Fan unit **70** is provided with first and second internal air introduction ports **71** and **72** for introducing the internal air (air inside the cabin) and an external air introduction port **73** for introducing the external air (air outside the cabin). These introduction ports **71** through **73** can be opened and closed by first and second internal/external air selection doors **74** and **75**.

First fan **76** (on the external air side) and second fan **77** (on the internal air side), for sending the air introduced from the aforementioned introduction ports **71** through **73**, are positioned on top of each other inside fan unit **70**. These fans **76** and **77** are known centrifugal, multiple-blade fans, and are simultaneously driven and rotated by a single common electric motor **78**.

FIG. **13** shows the state of the 2-layer flow mode described below, and first internal/external air selection door **74** has closed first internal air introduction port **71** and opened external air introduction port **73**. Second internal/external air selection door **75** has opened second internal air introduction port **72** and closed linking passage **79**. Consequently, the external air is introduced from external air introduction port **73** into suction port **76***a* of first fan **76** (on the external air side) and is sent to first passage **80** (on the external air side). Meanwhile, the internal air is introduced from internal air introduction port **72** into suction port **77***a* of second fan **77** (on the internal air side) and is sent to second passage **81** (on the internal air side). First passage **80** and second passage **81** are separated by partitioning plate **82**.

Next, the differences in air-conditioning unit **10** from that in FIG. **1** will be described. Inside air-conditioning case **11**, the upstream part of evaporator **12** is divided into first and second air passages **80***a* and **81***a* by partitioning plate **82***a*. The air supplied from first and second air passages **80** and **81** of fan unit **70** flows into these first and second air passages **80***a* and **81***a*.

Also inside air-conditioning case **11**, cool air bypass passage **35**, through which air (cool air) flows by bypassing heater core **13**, is formed in the upper part of heater core **13**. Inside air-conditioning case **11**, flat plate-shaped main air-mix door **83** and auxiliary air-mix door **84**, which adjust the ratio between the warm air heated by heater core **13** and the cool air (i.e., the cool air that flows through cool air bypass passage **35**) that bypasses heater core **13**, are rotatably installed between heater core **13** and evaporator **12** as air-mix doors.

At the maximum cooling setting, both air-mix doors **83** and **84** are rotated to overlapping positions, thus completely closing the air inflow passages to heater core **13**. On the other hand, at maximum heating setting, both air-mix doors **83** and **84** are rotated to the positions indicated by the solid lines in FIG. **13**. As a result, main air-mix door **83** completely closes cool air bypass passage **15**, and at the same time, the tip of auxiliary air-mix door **84** becomes positioned near the approximate center in the vertical direction immediately behind evaporator **12**, and thus auxiliary air-mix door **84** acts as a movable partitioning component for partitioning the air passage between evaporator **12** and heater core **13** into first air passage **80***a* and second air passage **81***a*.

Also inside air-conditioning case **11**, partitioning wall **85** positioned on the downstream side of heater core **13** (toward the rear of the vehicle) forms warm air passage **17**, which faces upward immediately behind heater core **13**. The warm air from this warm air passage **17** and the cool air from cool air bypass passage **15** are mixed in air mixing area **18** above heater core **13**.

Additionally, warm air bypass opening **87** is provided on the bottom edge of partitioning wall **85**. This warm air bypass opening **87** is opened and closed by plate-shaped 2-layer partitioning door **88**. When the maximum heating state is set in the foot blowout mode and foot defroster blowout mode (i.e., 2-layer flow mode) described below, this 2-layer partitioning door **88** is moved to the position indicated by solid lines in FIG. **1** (approximate center in the vertical direction of heater core. **13**) to open warm air bypass opening **87**. At the same time, this door acts as a movable partitioning component for partitioning warm air passage **17** immediately behind heater core **13** into first air passage **80***a* and second air passage **81***a*.

Inside air-conditioning case **11**, foot blowout openings **25** for the front seats are provided on both sides toward the rear of the vehicle. Conditioned air that has been temperature-controlled, through mixing of cool and warm air, flows from the top of heater core **13** via foot opening **24** into these front-seat foot blowout openings **25**. At the same time, during maximum heating, warm air also flows in from warm air bypass opening **87** via warm air passage **89**.

Also, inside air-conditioning case **11**, rear-seat foot opening **90** is provided immediately behind warm air bypass opening **87** on the bottom edge toward the rear of the vehicle (closer to the vehicle occupant). Warm air from warm air bypass opening **87** and warm air passage **89** flows into this rear-seat foot opening **90**. This warm air is blown out to the foot area of the rear-seat passengers via a foot duct not shown in the figure.

Next, FIG. **14** is a magnified and detailed diagram of fan unit **70** in FIG. **13**, and plate-shaped first internal/external air selection door **74**, which opens and closes first internal air introduction port **71** and external air introduction port **73**, rotates around rotation shaft **91**. First internal/external air door lever **92** is connected to this rotation shaft **91**, such that it rotates on the exterior surface of case **70***a* of fan unit **70**. Pin **93***a* on one end of intermediate lever **93** is slidably fitted into groove **92***a* of this lever **92**.

Intermediate lever **93** rotates around rotation shaft **94** on the exterior surface of case **70***a*, and internal/external air selection cable **94** is connected to pin **93***b* on the other end of this intermediate lever **93**. The movement of cable **94** in the left-right direction in FIG. **14** causes, via intermediate lever **93**, first internal/external air door lever **92** and first internal/external air selection door **74** to rotate around rotation shaft **91** in the left-right direction in FIG. **2**. Note that the positions of levers **92** and **93** and the dotted line position (in FIG. **14**) of first internal/external air selection door **74** indicate the external air introduction position, and the two-dot chain position (in FIG. **14**) of first internal/external air selection door **74** indicates the internal air introduction position.

Next, the operation mechanism of second internal/external air selection door **75**, which opens and closes second internal air introduction port **72** and linking passage **79**, will be explained with reference to FIG. **15**. Second internal/external air selection door **75** is plate-shaped and rotates around rotation shaft **95**. Second internal/external air door lever **96** is connected to rotation shaft **95**, such that it rotates on the exterior surface of case **70***a*.

A long engagement groove (cam groove) **97**, which extends in the longitudinal direction of the lever, is formed on this second internal/external air door lever **96**. Pin **99***a* of output lever **99** of differential gear mechanism **98** engagement is slidably fitted into this groove **97**. Engagement groove **97** is also provided with an idling groove **97***a*, which prevents second internal/external air door lever **96** from rotating even when output lever **99** (pin **99***a*) rotates, and with a drive groove **97***b*, which rotates second internal/external air door lever **96** based on the rotational shift of output lever **99** (pin **99***a*). The aforementioned pin **99***a* and engagement groove **97** comprise a mechanism for adjusting the shift between output lever **99** and second internal/external air door lever **96**.

Next, differential gear mechanism **98** will be specifically explained with reference to FIG. **16**. Since the basic configuration of differential gear mechanism **98** is the same as that of differential gear mechanism **53** shown in FIGS. **3** through **6** for Embodiment 1, those areas in FIG. **16** that are identical or equivalent to differential gear mechanism **53** are assigned the same symbols and their explanations are omitted.

Differential gear mechanism **98** constitutes a "2-input, 1-output" type differential mechanism that has blowout mode input lever **100** as the first input component, temperature control input lever **200** as the second input component, and the aforementioned output lever (output component) **99**.

One end of blowout mode input lever **100** is integrally connected to input shaft **50***a* while the other end is provided with pin **100***a*. Pin **100***a* is connected to blowout mode setting lever **31**' of air-conditioning operation panel **30** (FIGS. **17** and **18**) via cable **108** and intermediate lever **109**. Intermediate lever **109** rotates around rotation shaft **110**, and pin **109***a* of intermediate lever **109** is slidably fitted into engagement groove **111** of blowout mode setting lever **31**'.

Blowout mode setting lever **31**' rotates around rotation shaft **112**, and the drive linking mechanism (not shown in the figure) of blowout mode doors **20** **23**, and **26** is connected to blowout mode setting lever **31**' via separate cable **113**. Therefore, by manually operating blowout mode setting lever **31**' in the left-right direction of FIGS. **17** and **18**, blowout mode doors **20**, **23**, and **26** can be opened and closed to set the various blowout modes described below. At the same time, blowout mode input lever **100** of differential gear mechanism **98** can be rotated together with input shaft **50***a*.

Note that, in the example in FIG. **18**, various blowout modes, i.e., face (FACE), bi-level (B/L), foot (FOOT), foot defroster (F/D), and defroster (DEF) modes, are switched by lever **31**'.

Meanwhile, temperature control input lever **200** is equivalent to movable lever **41** in Embodiment **1**, and slidably supports bevel gears **54** and **55**. Pin **200***a* on the tip of temperature control input lever **200** is connected to temperature control lever **33**' of air-conditioning operation panel **30** via cable **102** and intermediate lever **103**.

Intermediate lever **103** rotates around rotation shaft **104**, and pin **103***a* of intermediate lever **103** is slidably fitted into engagement groove **105** of temperature control lever **33**'. Temperature control lever **33**' rotates around rotation shaft **106**, and the drive linking mechanism (not shown in the figure) of both air-mix doors **83** and **84** is connected to temperature control lever **33**' via separate cable **107**. Therefore, by manually operating temperature control lever **33**' in the left-right direction of FIGS. **17** and **18**, the opening of air-mix doors **83** and **84** can be controlled. At the same time, temperature control input lever **200** of differential gear mechanism **98** can be rotated to cause bevel gears **54** and **55** to rotate (revolve) around bevel gear **50***d* of input shaft **50***a*.

In Embodiment 5, bevel gear **50***d* of input shaft **50***a* and bevel gear **58** of output shaft **58***a* are symmetrically positioned in differential gear mechanism **98**, and the gear ratio between these bevel gears **50***d* and **58** is set to 1:1. Therefore, if input shaft **50***a* rotates by a predetermined amount when temperature control input lever **200** is stopped, the rotation of bevel gear **50***d* causes bevel gears **54** and **55** to autorotate, thereby causing bevel gear **58** of output shaft **58***a* to rotate by the same amount in the opposite direction.

The aforementioned internal/external air selection cable **94** is connected to internal/external air selection lever **35**' (in FIG. **18**) which constitutes an internal/external operation component. Therefore, by manually operating this internal/external air selection lever **35**' in the left-right direction of FIG. **18**, first internal/external air selection door **74** can be set to the external air introduction position or the internal air introduction position via cable **94** and lever **93**.

Since differential gear mechanism **98** in Embodiment 5 uses the rotational shifts of the aforementioned blowout mode input lever **100** and temperature control input lever **200** as inputs, it is not equipped with output gear **50** for transmitting the output of motor **44** as in Embodiment 1.

Also, a shift adjustment mechanism is formed by pin **109***a* of intermediate lever **109** and engagement groove **111** of blowout mode setting lever **31**' between blowout mode input lever **100** (the first input component) and blowout mode setting lever **31**' of air-conditioning operation panel **30**. This shift adjustment mechanism adjusts the shift (operation angle) of blowout mode input lever **100** relative to the shift of blowout mode setting lever **31**'. In this example, the operation angle of blowout mode input lever **100** is divided into two states depending on the operation position of blowout mode setting lever **31**'.

That is, (1) when blowout mode setting lever **31**' is being set to a mode position (face (FACE), bi-level (B/L), foot (FOOT), or foot defroster (F/D) mode) other than the defroster (DEF) mode, blowout mode input lever **100** becomes approximately parallel to the opening face of second internal air introduction port **72** as shown in FIGS. **19** and **20** described below. This state is designated to be the first operation angle.

(2) when blowout mode setting lever **31**' is being set to the defroster (DEF) mode, blowout mode input lever **100** rotates from the position shown in FIGS. **19** and **20** by a predetermined angle in the clockwise direction, reaching the position shown in FIGS. **21** and **22**. This state is designated to be the second operation angle.

These operation angle characteristics of blowout mode input lever **100** can be obtained by making the shape of engagement groove **111** of blowout mode setting lever **31**' a double-arc shape connected in a mountain shape. Of engagement groove **111**, the right-side arc-shaped groove **111***a* is an idling groove that is used to move blowout mode input lever **100** to the first operation angle position in FIGS. **19** and **20** and to maintain this first operation angle position when a mode other than the defroster mode is set. Therefore, even when the blowout mode changes between the face mode and the foot defroster mode, blowout mode input lever **100** is maintained in the first operation angle position in FIGS. **19** and **20**. Of engagement groove **111**, the left-side arc-shaped groove **111***b* is a drive groove that is used to rotate blowout mode input lever **100** to the second operation angle position in FIGS. **21** and **22** when setting the defroster mode.

A shift adjustment mechanism is also formed by pin **103***a* of intermediate lever **103** and engagement groove **105** of temperature control lever **33**' between temperature control input lever **200** (the second input component) and temperature control lever **33**' of air-conditioning operation panel **30**. This shift adjustment mechanism adjusts the shift (operation angle) of temperature control input lever **200** relative to the shift of temperature control lever **33**', and in this example, the operation angle of temperature control input lever **200** is varied as explained below.

That is, when temperature control lever **33**' is at the maximum heating (MH) position on the right edge in FIGS. **17** and **18**, temperature control input lever **200** reaches the position that is rotated by a predetermined angle in the clockwise direction from the opening face of second internal air introduction port **72** as shown in FIGS. **19** and **20**. This state is designated as the first operation angle.

Then, when temperature control lever **33**' moves to an intermediate position (intermediate temperature region) between the left and right edges in FIGS. **17** and **18**, temperature control input lever **200** rotates from the position shown in FIGS. **19** and **21** by a predetermined angle in the counterclockwise direction, reaching the position that is approximately parallel to the opening face of second internal air introduction port **72**, as shown in FIGS. **20** and **22**. This state is designated as the second operation angle.

Furthermore, when temperature control lever **33'** moves to the maximum cooling (MC) position on the left edge in FIGS. **17** and **18**, temperature control input lever **200** is designed to return to the position of the first operation angle again.

These operation angle characteristics of temperature control input lever **200** can be obtained by making the shape of engagement groove **105** trapezoidal. Of engagement groove **105**, the right- and left-side grooves **105***a* and **105***b* on the two sides of the trapezoid are used to move temperature control input lever **200** to the first operation angle in FIGS. **19** and **20**. Of engagement groove **105**, groove **105***c* on top of the trapezoid is used to move temperature control input lever **200** to the second operation angle in FIGS. **20** and **22**, and to hold it there.

Next, the operation of Embodiment 5 in the aforementioned configuration will be explained with references to FIGS. **19** through **22**. FIGS. **19** and **20** show cases in which blowout mode setting lever **31'** is set to a mode position other than the defroster (DEF) mode. In this case, intermediate lever **109**, which is driven by lever **31'**, is located in the position shown in FIG. **17** and blowout mode input lever **100** is in a position (the first operation angle) that is approximately parallel to the opening face of second internal air introduction port **72**. This state is maintained by friction, etc. of cable **108** as long as lever **31'** is not moved again.

From this state, if temperature control lever **33'** of air-conditioning operation panel **30** is being set to the maximum heating (MH) position, pin **103***a* of intermediate lever **103** fits into the left-side groove **105***a* of engagement groove **105** of lever **33'**, setting intermediate lever **103** to the position shown in FIG. **17**.

As a result, when maximum heating (MH) is being set, temperature control input lever **200** reaches the position (the first operation angle) that is rotated by a predetermined angle in the clockwise direction from the opening face of second internal air introduction port **72** as shown in FIG. **19**, and bevel gears **54** and **55** revolve to the position corresponding this first operation angle of temperature control input lever **200**.

Therefore, in differential gear mechanism **98**, blowout mode input lever **100**, i.e., bevel gear **50***d* of input shaft **50***a*, rotates to the first operation angle position, and additionally, bevel gears **54** and **55** of temperature control input lever **200** further revolve to the first operation angle position of lever **200**.

In this way, the operation of both blowout mode input lever **100** and temperature control input lever **200** to the first operation angle position causes output shaft **58***a* and output lever **99** to rotate to the position corresponding to the first operation angle position of both levers **100** and **200**, via the engagement of bevel gear **50***d*, bevel gears **54** and **55**, and bevel gear **58**. As a result, output lever **99** rotates to the position shown in FIG. **19**, and pin **99***a* enters drive groove **97***b* of engagement groove **97** of second internal/external air door lever **96**, thus causing both second internal/external air door lever **96** and second internal/external air selection door **75** to the positions shown in FIG. **19**.

As a result, second internal/external air selection door **75** opens second internal air introduction port **72** and closes linking passage **79**. During this process, moving internal/external air selection lever **35'** to the external air (FRE) position causes first internal/external air selection door **74** to close first internal air introduction port **71** and open external air introduction port **73**. Therefore, the external air is sucked into suction port **76***a* of first fan **76** (on the external air side) from external air introduction port **73**, and the external air is supplied to first passages **80** and **80***a*. Meanwhile, the internal air is sucked into suction port **77***a* of second fan **77** from second internal air introduction port **72**, and the internal air is supplied to second passages **81** and **81***a*.

Also, auxiliary air-mix door **84** is moved to the maximum heating position and partitions the air passage between evaporator **12** and heater core **13** into first air passage **80***a* and second air passage **81***a*. Furthermore, if maximum heating is set in the foot blowout mode or the foot defroster blowout mode, both of which are different from the defroster (DEF) mode, 2-layer partitioning door **88** opens warm air bypass opening **87**, and at the same time, partitions warm air passage **17** immediately behind heater core **13** into first air passage **80***a* and second air passage **81***a*.

Consequently, when maximum heating is set in the foot blowout mode or the foot defroster blowout mode, the internal/external air 2-layer flow mode shown in FIG. **13** can be set, thereby achieving both window glass fogging prevention and improved heating in the foot area of the vehicle occupant.

Note that, pin **103***a* of intermediate lever **103** also fits into the right-side groove **105***b* of engagement groove **105** of lever **33'** when temperature control lever **33'** is being set to the maximum cooling (MC) position, setting intermediate lever **103** to the position shown in FIG. **17**. Consequently, again, when maximum cooling (MC) is being set, temperature control input lever **200** reaches the position (the first operation angle) that is rotated by a predetermined angle in the clockwise direction from the opening face of second internal air introduction port **72** as shown in FIGS. **19** and **21**.

Consequently, when maximum cooling (MC) is being set in the foot blowout mode or the foot defroster blowout mode, and when maximum heating (MH) or maximum cooling (MC) is being set in the face blowout mode or the bi-level blowout mode, second internal/external air selection door **75** is moved to the position shown in FIG. **19**, in the same manner as explained above, thus opening second internal air introduction port **72** and closing linking passage **79**. Therefore, the air volume can be increased by introducing the internal air, thereby improving the air-conditioning performance.

On the other hand, when temperature control lever **33'** of air-conditioning operation panel **30** is being set to a position between the maximum heating (MH) position and the maximum cooling (MC) position in a blowout mode other than the defroster mode, the rotational shift of lever **33'** causes pin **103***a* of intermediate lever **103** to fit into the top groove **105***c* of engagement groove **105**.

As a result, intermediate lever **103** rotates in the counter-clockwise direction in FIG. **17**, applying a force to pull cable **102** toward the right side of FIG. **17**. Therefore, temperature control input lever **200** rotates from the first operation angle position in FIG. **19** to the second operation angle position in FIG. **20**, and bevel gears **54** and **55** revolve on bevel gear **50***d* of input shaft **50***a* up to the position corresponding to the operation angle change of this input lever **200**.

The revolution of bevel gears **54** and **55** is transmitted to output shaft **58***a* and output lever **99**, and output lever **99** rotates from the first operation angle position in FIG. **19** to the second operation angle position in FIG. **20**. As a result, pin **99***a* of output lever **99** rotates second internal/external air door lever **96** and second internal/external air selection door **75** to the positions shown in FIG. **20**, causing second internal/external air selection door **75** to close second internal air introduction port **72** and open linking passage **79**.

Note that, likewise, when temperature control lever **33**' is set to the maximum cooling (MC) position, pin **103***a* again fits into the right-side groove **105***a* [sic. Should be **105***b*?] of engagement groove **105** of lever **33**', and intermediate lever **103** is at the position shown in FIG. **17**. Even when the blowout mode changes between the face mode and the foot defroster mode, the shift adjustment mechanism consisting of pin **109***a* and engagement groove **111** in FIG. **17** always maintains blowout mode input lever **100** in the first operation angle position as shown in FIGS. **19** and **20**, and therefore, the open state of second internal air introduction port **72** in FIG. **19** and the closed state of second internal air introduction port **72** in FIG. **20** are maintained.

Next, when blowout mode setting lever **31**' is moved to the defroster mode position, arc-shaped groove **111***b* on the left side of engagement groove **111** of blowout mode setting lever **31**' (see FIG. **17**) engages with pin **109***a* of intermediate lever **109**. Here, arc-shaped groove **111***b* rotates in the counterclockwise direction of FIG. **17** as lever **31**' is moved to the defroster mode position. However, since the groove shape is designed such that the walls of arc-shaped groove **111***b* apply a force that presses pin **109***a*toward the left side of FIG. **17** in this case, intermediate lever **109** rotates in the clockwise direction from the position in FIG. **17**, thus generating a force that presses cable **108** toward the left side of FIG. **17**.

Consequently, a rotational force in the clockwise direction is applied to blowout mode input lever **100**, which is in the first operation angle position in FIGS. **19** and **20**, via cable **108**, thus moving blowout mode input lever **100** to the second operation angle position in FIGS. **21** and **22**.

Then, in this state, if temperature control lever **33**' of air-conditioning operation panel **30** is moved to the maximum heating (MH) position or the maximum cooling (MC) position, pin **103***a* of intermediate lever **103** becomes positioned in groove **105***a* or **105***b* on either side of engagement groove **105** of temperature control lever **33**', setting intermediate lever **103** in the position in FIG. **17**. As a result, temperature control input lever **200** reaches the first operation angle position that is rotated by a predetermined angle in the clockwise direction from the opening face of second internal air introduction port **72** as shown in FIG. **21**, and bevel gears **54** and **55** revolve to the position corresponding to the first operation angle position of lever **200**.

When the first operation angle position (position in FIG. **21**) of temperature control input lever **200** is combined with the second operation angle position (position in FIGS. **21** and **22**) of blowout mode input lever **100** in this way, output shaft **58***a* and output lever **99** rotate to the second operation angle position in FIG. **21**. As a result, pin **99***a* of output lever **99** rotates second internal/external air door lever **96** and second internal/external air selection door **75** to the positions shown in FIG. **21**, causing second internal/external air selection door **75** to close second internal air introduction port **72** and open linking passage **79**.

During this process, internal/external air selection lever **35**' of air-conditioning operation panel **30** is moved to the external air introduction (FRE) position, causing first internal/external air selection door **74** to close first internal air introduction port **71** and open external air introduction port **73**. Therefore, the external air is sucked into suction port **76***a* of first fan **76** (on the external air side) from external air introduction port **73**, and the external air is also sucked into suction port **77***a* of second fan **77** via linking passage **79**.

On the other hand, if temperature control lever **33**' of air-conditioning operation panel **30** is moved to an intermediate temperature region between the maximum heating (MH) position and the maximum cooling (MC) position in the defroster mode, pin **103***a* of intermediate lever **103** engages with top groove **105***c* of engagement groove **105**.

As a result, intermediate lever **103** rotates in the counterclockwise direction of FIG. **17**, applying a rightward suction force to cable **102** in FIG. **17**. Therefore, temperature control input lever **200** rotates from the first operation angle position in FIG. **21** to the second operation angle position in FIG. **22**, causing bevel gears **54** and **55** to revolve on bevel gear **50***d* of input shaft **50***a* up to the position corresponding to the change in the operation angle of this input lever **200**.

The revolution of bevel gears **54** and **55** is transmitted to output shaft **58***a* and output lever **99**, and output lever **99** rotates from the second operation angle position in FIG. **21** to the third operation angle position in FIG. **22**. However, pin **99***a* of output lever **99** only slides inside idling groove **97***a* of engagement groove **97** of second internal/external air door lever **96**, and thus the position of second internal/external air door lever **96** is not changed. In other words, even when temperature control lever **33**' of air-conditioning operation panel **30** is being set to an intermediate temperature region from the maximum heating (MH) position or the maximum cooling (MC) position, second internal/external air selection door **75** can be maintained in the state that closes second internal air introduction port **72** and opens linking passage **79**, if the defroster mode is set.

As a result, second internal/external air selection door **75** can always be maintained in the state that closes second internal air introduction port **72** (and opens linking passage **79**) regardless of the operating position of temperature control lever **33**', if the defroster mode is set. Therefore, when the defroster mode is set, the all-external air mode, which supplies the external air to first passages **80** and **80***a* and second passages **81** and **81***a* can be set, thereby improving the fogging-prevention performance during the defroster mode.

FIG. **23** summarily shows the opening and closing operations of second internal/external air selection door **75** in Embodiment 5. "Open" on the vertical axis in FIG. **23** indicates that second internal air introduction port **72** is open while "Closed" indicates that second internal air introduction port **72** is closed. The horizontal axis in FIG. **23** indicates the operation position of temperature control lever **33**' and blowout modes. More specifically, the operation position of temperature control lever **33**' when the blowout mode is set to a mode other than the defroster mode is shown on the left side of the horizontal axis in FIG. **23** while the operation position of temperature control lever **33**' when the blowout mode is set to the defroster mode is shown on the right side of the horizontal axis in FIG. **23**.

"5/10", on the horizontal axis in FIG. **23** indicates a temperature position that is between the maximum cooling position and the maximum heating position. Since the maximum cooling position is indicated by 0/10 and the maximum heating position is indicated by 10/10, 2/10 indicates a position closer to maximum cooling while 8/10, a position closer to maximum heating.

As shown in FIG. **23**, when the defroster mode is set, second internal/external air selection door **75** is always maintained in the state that closes second internal air introduction port **72** regardless of the operating position of temperature control lever **33**'. In contrast, when the blowout mode is set to a mode other than the defroster mode, second internal/external air selection door **75** is maintained in the state that opens second internal air introduction port **72** both when temperature control lever **33**' is near the maximum cooling position or the maximum heating position, and second internal/external air selection door **75** is maintained in the state that closes second internal air introduction port **72** when temperature control lever **33'** is in a temperature range that is between maximum cooling and maximum heating. FIG. **24** summarizes the opening and closing states of second internal air introduction port **72** by second internal/external air selection door **75** (same as those shown in FIG. **23**) in a single table.

In the example in FIG. **23**, second internal/external air selection door **75** is designed to shift the state of second internal air introduction port **72** from CLOSED to OPEN, from the position (2/10) near maximum cooling or the position (8/10) near maximum heating. Therefore, it is necessary to have second internal/external air selection door **75** shift the state of second internal air introduction port **72** from CLOSED to OPEN based on a slight change (e.g., an operation position change that is 1/10 the full operation range) in the operation position of temperature control lever **33'**.

Embodiment 5 takes this point into consideration, and temperature control input lever **200**, whose rotational position is changed based on the operation position of temperature control lever **33'**, is used as the input component that revolves bevel gears **54** and **55**, in particular, out of the two input components of differential gear mechanism **98**. Here, in differential gear mechanism **98**, the revolution of bevel gears **54** and **55** is transmitted to the output side after being increased, and thus output lever **99** can be rotated to the desired position even if the rotational shift of temperature control input lever **200** is small. Therefore, second internal/external air selection door **75** can be opened and closed based on slight operations of temperature control lever **33'**.

Note that in Embodiment 5, second internal/external air selection door **75** is operated to open second internal air introduction port **72** during both maximum cooling and maximum heating, when a blowout mode other than the defroster mode is set, as shown in FIGS. **23** and **24**. However, it is also possible to operate second internal/external air selection door **75** such that it opens second internal air introduction port **72** only during maximum heating and such that it closes second internal air introduction port **72** during maximum cooling, when a blowout mode other than the defroster mode is set, as shown in FIG. **25**.

Also in Embodiment 5, manually operating internal/external air selection lever **35'** moves first internal/external air selection door **74** to the external or internal air introduction position via cable **94** and levers **93** and **92**. However, it is also possible to install a motor whose rotational position is controlled by the manual operation position of internal/external air selection lever **35'**, and to have this motor open and close first internal/external air selection door **74**.

Also in Embodiment 5, second internal/external air selection door **75** is used to open and close second internal air introduction port **72** and linking passage **79**. However, it is also possible to provide a second external air introduction port instead of linking passage **79**, and to have second internal/external air selection door **75** open and close this second external air introduction port and second internal air introduction port **72**.

In the aforementioned Embodiment 5, an operational force transmission device utilizing differential gear mechanism **98** is used to open and close second internal/external air selection door **75**. In contrast, in Embodiment 6, an operational force transmission device utilizing differential gear mechanism **98** is used to open and close first internal/external air selection door **74**. Note that fan unit **70** according to Embodiment 6 is an ordinary type that is not equipped with second internal/external air selection door **75** and that opens and closes internal air introduction port **71** and external air introduction port **73** using a single first internal/external air selection door **74**. Therefore, only a single fan **76** and a single air passage are provided, and the air passage is not partitioned into first and second passages.

FIGS. **26** through **32** show Embodiment 6. Although the configuration of differential gear mechanism **98** is the same as that in the aforementioned Embodiment 5, input/output configuration of differential gear mechanism **98** is changed from that of the aforementioned Embodiment 5 as follows. That is, as shown in FIG. **28**, one end of internal/external air selection input lever **300** is integrally connected as the first input component to input shaft **50*a*** of differential gear mechanism **98**. One end of cable **94** is connected to pin **300*a*** on the other end of this input lever **300**, and the other end of this cable **94** is connected to internal/external air selection lever **35'** of air-conditioning operation panel **30** in FIG. **18**.

Therefore, internal/external air selection input lever **300** rotates together with input shaft **50*a*** and bevel gear **50*d*** in linkage with the internal/external air selection operation of lever **35'**. Note that no shift adjustment mechanism is provided between cable **94** and internal/external air selection lever **35'** of air-conditioning operation panel **30**, as was the case above, and the operational shift of lever **35'** is directly transmitted to internal/external air selection input lever **300**.

Blowout mode input lever **100** is used as the second input component of differential gear mechanism **98**, and at the same time, this blowout mode input lever **100** is designed to rotatably support bevel gears **54** and **55**, such that blowout mode input lever **100** supplies revolution input into bevel gears **54** and **55**.

Here, blowout mode input lever **100** is connected to cable **113**, and cable **113** is connected to blowout mode setting lever **31'** of air-conditioning operation panel **30** via a shift adjustment mechanism (a combination of intermediate lever **109** having pin **109*a*** and engagement groove **111**) similar to that shown in FIG. **17**. Consequently, when blowout mode setting lever **31'** is being set to a position other than the defroster mode, blowout mode input lever **100** rotates to the first operation angle position in FIGS. **29** and **30** described below; and when blowout mode setting lever **31'** is being set to the defroster mode, blowout mode input lever **100** rotates to the second operation angle position in FIGS. **31** and **32** described below.

Then, one end of output lever **99** is integrally connected to output shaft **58*a*** of differential gear mechanism **98**, and pin **99*a*** at the other end of output lever **99** is slidably fitted into engagement groove **92*a*** of internal/external air door lever **92**. Here, engagement groove **92*a*** is provided with a drive groove **92*b*** which rotates internal/external air door lever **92** around rotation shaft **91** based on the shift in pin **99*a*** and with an idling groove **92*c*** which does not rotate blowout mode input lever **100** even when pin **99*a*** is shifted. The engagement structure between this engagement groove **92*a*** and pin **99*a*** forms a shift adjustment mechanism between output lever **99** and internal/external air door lever **92**.

Next, the operation of Embodiment 6 will be explained. FIG. **29** shows a case in which internal/external air selection lever **35'** of air-conditioning operation panel **30** is set to the internal air (REC) position and blowout mode setting lever **31'** is at a mode position other than the defroster mode. In this case, blowout mode input lever **100** rotates from the upright position to the right-leaning position, i.e., the first operation angle position, based on the operation position of blowout mode setting lever **31'**. Furthermore, internal/external air selection input lever **300** rotates to the upright position, i.e. the first operation angle position, based on the operation of internal/external air selection lever **35'** to the internal air position.

In this way, the rotation of two input levers **100** and **300** to the first operation angle position shown in FIG. **29** causes output lever **99**, which is integrated with output shaft **58***a* of differential gear mechanism **98**, rotate from the upright position to the right-leaning position, i.e., the first operation angle position. Consequently, pin **99***a* of output lever **99** enters drive groove **92***b* of engagement groove **92***a* of internal/external air door lever **92**, causing internal/external air door lever **92** and internal/external air door **74** to the positions in FIG. **29**. As a result, internal/external air door **74** opens internal air introduction port **71** and closes external air introduction port **73**.

Next, FIG. **30** shows a case in which internal/external air selection lever **35'** is set to the external air (FRE) position and blowout mode setting lever **31'** is set to a mode other than the defroster mode. In this case, setting internal/external air selection lever **35'** to the external air position causes internal/external air selection input lever **300** to rotate from the upright position to the right-leaning position, i.e., the second operation angle position.

This rotation is transmitted from bevel gear **50***d* of input shaft **50***a* to bevel gear **58**, output shaft **58***a*, and output lever **99** via bevel gears **54** and **55**, causing output lever **99** to rotate from the upright position to the left-leaning position, i.e., the second operation angle position. Consequently, pin **99***a* of output lever **99** engages with drive groove **92***b* of engagement groove **92***a* of internal/external air door lever **92**, causing internal/external air door lever **92** and internal/external air door **74** to the positions in FIG. **30**. As a result, internal/external air door **74** closes internal air introduction port **71** and opens external air introduction port **73**.

As explained above, when blowout mode setting lever **31'** is set to a mode position other than the defroster mode, internal/external air door **74** can be operated such that the internal/external mode selected by internal/external air selection lever **35'** will be set.

FIG. **31** shows a case in which internal/external air selection lever **35'** is set to the external (FRE) position and blowout mode setting lever **31'** is set to the defroster mode position. In this case, setting blowout mode setting lever **31'** to the defroster mode position causes blowout mode input lever **100** to rotate to the upright position, i.e., the second operation angle position.

Since this rotation causes bevel gears **54** and **55** to revolve on bevel gear **50***d* of input shaft **50***a*, the rotation associated with lo this revolution is transmitted to output shaft **58***a* and output lever **99** via bevel gear **58**, causing output lever **99** to rotate to the third operation angle position which is leaning further to the left than the aforementioned second operation angle position (FIG. **30**). However, even when the rotation of this output lever **99** occurs, pin **99***a* of output lever **99** only slides inside idling groove **92***c* of engagement groove **92***a* of internal/external air door lever **92**, and thus internal/external air door lever **92** and internal/external air door **74** maintain the state in which internal air introduction port **71** is closed and external air introduction port **73** is open.

FIG. **32** shows a case in which internal/external air selection lever **35'** is being set to the internal (REC) position when blowout mode setting lever **31'** is set to the defroster mode position. In this case, setting internal/external air selection lever **35'** to the internal air position causes internal/external air selection input lever **300** to rotate to the upright position, i.e., the first operation angle position.

Consequently, output lever **99** returns from the third operation angle position to the second operation angle position. However, during this return from the third operation angle position to the second operation angle position, pin **99***a* of output lever **99** only slides inside idling groove **92***c*, and thus internal/external air door lever **92** and internal/external air door **74** maintain the state in which internal air introduction port **71** is closed and external air introduction port **73** is open.

During the defroster mode, the external air, which has a lower absolute humidity than the internal air, should be introduced. However, the vehicle occupant sometimes makes a mistake and manually sets internal/external air selection lever **35'** of air-conditioning operation panel **30** to the internal air position. Even in such a case, according to Embodiment 6, internal/external air selection input lever **300** connected to internal/external air selection cable **94** rotates, rotating only output lever **99**, and internal/external air door lever **92** and internal/external air door **74** can be maintained in the external air introduction positions. Therefore, excellent fogging-prevention performance can be achieved during the defroster mode by nullifying the occupant's mistake.

FIG. **33** shows the internal/external air selection characteristics according to Embodiment 6. When the defroster mode is set, internal/external air selection door **74** is maintained at the external air introduction position, regardless of whether the internal/external air setting of air-conditioning operation panel **30** is internal air or external air. On the other hand, when a blowout mode other than the defroster mode is set, the internal air mode or the external air mode can be set according to the internal/external air setting of air-conditioning operation panel **30**.

Note that in Embodiment 6, the external air introduction mode is set regardless of internal/external air setting of air-conditioning operation panel **30**, only when the defroster mode is set, as shown in FIG. **33**. However, fogging-prevention might be strongly required in the foot defroster mode as well, in some cases. Therefore, it is possible to have the external air introduction mode set regardless of internal/external air setting of air-conditioning operation panel **30**, in both the defroster mode and the foot defroster mode.

In Embodiment 6, an explanation was provided for a differential gear mechanism for switching between the internal and external air, applied to an ordinary vehicular air-conditioning apparatus in which no internal/external air 2-layer flow mode is set. However, as in Embodiment 5, it is possible to apply Embodiment 6 to the driving of first internal/external air selection door **74** in a vehicular air-conditioning apparatus in which the internal/external air 2-layer flow mode can be set.

In the aforementioned Embodiments 5 and 6, bevel gears **50***d*, **54**, **55**, and **58** are used to configure differential gear mechanism **98**. However, in Embodiment 7, differential gear mechanism **98** is comprised of a known planetary gear mechanism as shown in FIG. **34**.

In FIG. **34**, the planetary gear mechanism (differential gear mechanism **98**) is comprised of a ring-shaped internal gear **400**, multiple planetary gears **401**, a sun gear **402**, and a carrier component **403** which supports the rotation shafts of multiple planetary gears **401** and which causes planetary gears **401** to revolve.

In applying a configuration example of input/output in differential gear mechanism **98** that uses this planetary gear mechanism to application to Embodiment 5, it is possible to supply the rotational shift of temperature control input lever **200** to internal gear **400** as the first input, to supply the rotational shift of blowout mode input lever **100** to carrier component **403** (planetary gears **401**) as the second input (revolution input), and to extract the rotational shift of sun gear **402** from output lever **99** as an output, for example.

In application to Embodiment 6, it is possible to supply the rotational shift of internal/external air selection input lever **300** to internal gear **300**[sic] as the first input, to supply the rotational shift of blowout mode input lever **100** to carrier component **403** (planetary gears **401**) as the second input (revolution input), and to extract the rotational shift of sun gear **402** from output lever **99** as an output, for example.

Note that it is of course possible to configure differential gear mechanism **53** in Embodiment 1 using a planetary gear mechanism in the same manner.

Input/output configuration examples of differential gear mechanism **98** are not limited to those in the aforementioned Embodiments 5 and 6, and various modifications are possible. In Embodiment 8, two rotation shafts **50***a* and **58***a*, that are positioned on the same shaft, are used as input shafts in differential gear mechanism **98** shown in FIG. **35**. In application to Embodiment 5, blowout mode input lever **100** is linked to input shaft **50***a* and temperature control input lever **200** is linked to the other input shaft **58***a*, for example. Then, it is possible to extract the revolution shifts of bevel gears **54** and **55** as outputs from output lever **99**, by rotatably supporting bevel gears **54** and **55** with output lever **99**.

In Embodiment 9, the concept of the aforementioned Embodiment 8 is applied to Embodiment 6. As an input/output configuration example of differential gear mechanism **98**, internal/external air selection input lever **300** is linked to input shaft **50***a* and blowout mode input lever **100** is linked to the other input shaft **58***a*. Then, it is possible to extract the revolution shifts of bevel gears **54** and **55** as outputs from output lever **99**, by rotatably supporting bevel gears **54** and **55** with output lever **99**.

Therefore, Embodiment 9 can be considered an example in which the positions of output lever **99** and blowout mode input lever **100** are reversed from those in the input/output configuration example in Embodiment 6 in FIG. **28**.

In Embodiment 10, the internal/external air 2-layer flow mode can be manually set in the vehicular air-conditioning apparatus by the vehicle occupant as in Embodiment 5 (FIGS. **13** through **24**), and the overall configuration of the vehicular air-conditioning apparatus can be the same as that shown in FIG. **13**.

First, the issues involved in Embodiment 10 will be explained based on Embodiment 5. According to Embodiment 5, as shown in FIGS. **14** through **18**, differential gear mechanism **98** is installed in fan unit **70**, and this differential gear mechanism **98** is provided with blowout mode input lever **100** (the first input component) and temperature control input lever **200** (the second input component); and the operational shift of blowout mode setting lever **31**' of air-conditioning operation panel **30** is transmitted to blowout mode input lever **100** via cable **108**. Also, the operational shift of temperature control lever **33**' of air-conditioning operation panel **30** is transmitted to temperature control input lever **200** via cable **102**.

Therefore, in Embodiment 5, two cables **102** and **108** are needed for linking the two input levers **100** and **200** of differential gear mechanism **98** with the two operation levers **31**' and **33**' of air-conditioning operation panel **30**, respectively. Here, air-conditioning operation panel **30** is a component that is mounted on the vehicle instrument panel (not shown in the figure) in the front interior of the vehicle. Therefore, after air-conditioning unit **10** and fan unit **70** are first installed on the inside of the instrument panel and air-conditioning operation panel **30** is mounted on the instrument panel, the aforementioned two cables **102** and **108** are connected.

Consequently, cable connection work must be performed within a tight space on the inside of the instrument panel, resulting in poor work efficiency.

In view of the aforementioned problem, Embodiment 10 is intended to provide a vehicular air-conditioning apparatus in which the operation components of air-conditioning operation panel **30** need not be connected to cables. FIG. **37** shows the state in which the operation link mechanism for various doors according to Embodiment 10 is mounted on the driver-side side surface of case **11** of air-conditioning unit **10**, and FIG. **38** shows the main area of fan unit **70** according to Embodiment 10. FIGS. **39** and **40** shows this operation link mechanism only.

Temperature control (air mix) input lever **110** is V-shaped, and one of its ends is connected to cable **111**, and input lever **110** is connected via this-cable **11** to temperature control lever **33**' of air-conditioning operation panel **30**. Consequently, the operation of temperature control lever **33**' rotates input lever **110**. The other end of this input lever **110** is connected to air-mix door lever **113** via the engagement area between pin **112** and engagement groove **113***a*. This air-mix door lever **113** is integrally connected to rotation shaft **114** of auxiliary air-mix door **84** and rotates auxiliary air-mix door **84**.

Door lever **116** is integrally connected to rotation shaft **115** of main air-mix door **83**, and air-mix door lever **113** is also connected to this door lever **116** via connecting rod **117**. Therefore, when air-mix door lever **113** is rotated, both air-mix doors **83** and **84** also rotate in linkage. Furthermore, temperature control (air mix) input lever **110** is connected to maximum heating input lever **119** via the engagement area between pin **118** and engagement groove **119***a*.

In Embodiment 10, two (first and second) differential gear mechanisms **98**A and **98**B are secured on the side surface of case **11**. Of these, first differential gear mechanism **98**A opens and closes second internal/external air selection door **75** (FIG. **38**) according to the temperature control (air mix) input condition and the blowout mode input condition, for manually setting the internal/external air 2-layer flow mode. Therefore, first differential gear mechanism **98**A performs the same function as differential gear mechanism **98** in Embodiment 5, and maximum heating input lever **119** acts as a revolution input component (the second input component) for causing bevel gears **54** and **55** to revolve in first differential gear mechanism **98**A, as shown in FIG. **41**.

Meanwhile, blowout mode input lever **120** rotates around rotation shaft **120***a*, and has a long lever **120***b* and a fan-shaped lever **120**. The shift in cable **121** is transmitted to long lever **120***b* via blowout mode input lever **131** of second differential gear mechanism **98**B described below. Since this cable **121** is connected to blowout mode setting lever **31**' of air-conditioning operation panel **30**, blowout mode input lever **120** rotates based on the operation of blowout mode setting lever **31**'.

This fan-shaped lever **120***c* of blowout mode input lever **120** is connected to blowout mode input lever **100** (the first input component) of first differential gear mechanism **98**A via the engagement area between engagement groove **120***d* and pin **122**. As shown in FIG. **41**, this input lever **100** is integrally coupled with input shaft **50***a* which has bevel gear **50***d*. This input lever **100** rotates to the positions shown in FIGS. **39** and **40** in the foot and foot defroster mode, and in other modes, is maintained in a position (the position in FIG. **37**) that is rotated by a predetermined angle in the counterclockwise direction from the positions in FIGS. **39** and **40** because of the shape of engagement groove **120***d* of fan-shaped lever **120***c*.

Also, in first differential gear mechanism **98**A, output lever **99** which is coupled to output shaft **58***a* is connected to internal/external air 2-layer lever **124** via the engagement area between pin **123** and engagement groove **124***a*. Note that, in first differential gear mechanism **98**A, input lever **100** is located on the top side in the direction perpendicular to the page in FIGS. **39** and **40**, maximum heating input lever **119** is located in the middle of the same direction, and output lever **99** is located on the bottom side of the same direction.

Two connecting rods **125** and **126** are connected to the aforementioned internal/external air 2-layer lever **124**, and lever **124** is connected to door lever **127** of 2-layer partitioning door **88** via one of the connecting rods, **125**. Door lever **127** is integrally coupled with rotation shaft **128** of door **88**. Connecting rod **125** is also connected to door lever **96** of second internal/external air selection door **75** via cable **129**.

The other connecting rod **126** is connected to internal/external air 2-layer input lever **130** if second differential gear mechanism **98**B. This internal/external air 2-layer input lever **130** is integrally coupled with input shaft **50***a* which has bevel gear **50***d*, as shown in FIG. **42**, and constitutes the first input component. Blowout mode input lever **131** of second differential gear mechanism **98**B is the second input component (revolution input component) which causes bevel gears **54** and **55** to revolve, and is connected to the aforementioned blowout mode cable **121**. This blowout mode input lever **131** is connected to long lever **120***b* of blowout mode input lever **120** of first differential gear mechanism **98**A via the engagement area between pin **132** and engagement groove **120***e*.

Output lever **133**, which is integrally coupled with output shaft **58***a* of second differential gear mechanism **98**B, is connected to a platter-shaped blowout mode link **135** via connecting rod **134**. Note that, in second differential gear mechanism **98**B, internal/external air 2-layer input lever **130** is located on the bottom side in the direction perpendicular to the page in FIGS. **39** and **40**, blowout mode input lever **131** is located in the middle of the same direction, and output lever **133** is located on the top side of the same direction.

The aforementioned blowout mode link **135** is a main link component for switching blowout modes, and has defroster engagement groove **136**, face engagement groove **137**, and foot engagement groove **138**. Door levers **139**, **140**, and **141** are integrated into rotation shaft **20***a* of defroster door **20**, rotation shaft **23***a* of face door **23**, and rotation shaft **26***a* of foot door **26**, respectively. Second door lever **139***a* is connected to defroster door **139**; and pins **139***b*, **140***a*, and **141***a* of door levers **139***a*, **140**, and **141** are slidably fitted into engagement grooves **136**, **137**, and **138**, respectively, such that doors **20**, **23**, and **26** can be opened and closed by the rotation of blowout mode link **135**.

Next, the operation of Embodiment 10 in the aforementioned configuration will be explained. FIG. **40** shows the maximum cooling position of temperature control lever **110**, and when temperature control lever **33**' of air-conditioning operation panel **30** is manually moved from the maximum cooling position to the maximum heating position, input lever **110** rotates in the clockwise direction from the position in FIG. **40** toward the position in FIG. **39**. Consequently, maximum heating input lever **119** rotates in the counterclockwise direction by a predetermined angle near the maximum heating position.

The rotation of this maximum heating input lever **119** causes bevel gears **54** and **55** to revolve in first differential gear mechanism **98**A. During this step, since input-side bevel gear **50***d*of first differential gear mechanism **98**A is restricted by blowout mode input lever **100** (the first input component) to the stopped position, the revolution of bevel gears **54** and **55** causes only bevel gear **58** on the output side to rotate. Here, since the revolution of bevel gears **54** and **55** is transmitted to bevel gear **58** after being increased, output lever **99** rotates in the same direction as input lever **119** and by an angle that is greater than (e.g., twice the rotation angle of) the rotation angle of input lever **119**.

In first differential gear mechanism **98**A, blowout mode input lever **100** (the first input component) rotates corresponding to the rotational position of blowout mode input lever **120**, which responds to the operation position of blowout mode setting lever **31**' of air-conditioning operation panel **30**. When setting lever **31**' is set to the face, bi-level, or defroster blowout mode, input lever **100** is held in the position in FIG. **37**. However, when setting lever **31**' is moved to the foot or foot defroster blowout mode, the clockwise rotation of blowout mode input lever **120** causes input lever **100** to rotate in the clockwise direction from the position in FIG. **37** to the position in FIGS. **39** and **40**.

In the face, bi-level, or defroster blowout mode, blowout mode input lever **100** of first differential gear mechanism **98**A is held in the position in FIG. **37**, and as a result, pin **123** of output lever **99** of first differential gear mechanism **98**A only moves inside the idling groove of engagement groove **124***a* of internal/external air 2-layer lever **124**, regardless of the position of maximum heating input lever **119**.

Consequently, in the face, bi-level, or defroster blowout mode, output lever **99** only moves inside the idling groove of engagement groove **124***a* regardless of where between the maximum cooling position and the maximum heating position temperature control input lever **110** is positioned, and thus internal/external air 2-layer lever **124** is always maintained in the position in FIGS. **37** and **40**.

As a result, 2-layer partitioning door **88** connected to internal/external air 2-layer lever **124** is moved to the position that closes warm air bypass opening **87**, and does not partition warm air passage **17**. Second internal/external air selection door **75** is connected to internal/external air 2-layer lever **124** via cable **129**, etc., and second internal/external air selection door **75** is moved to the position that closes second internal air introduction port **72**, in linkage with 2-layer partitioning door **88**.

However, when the blowout mode is set to the foot or defroster mode, the clockwise rotation of blowout mode input lever **120** causes blowout mode input lever **100** to rotate in the clockwise direction from the position in FIG. **37** to the position in FIGS. **39** and **40**. In response to this rotation of blowout mode input lever **100**, output lever **99** rotates in the opposite direction, i.e., in the counterclockwise direction, by the same angle.

During this process, if temperature control input lever **110** is located in a position between the maximum cooling position and the temperature control region, maximum heating input lever **119** is held in the position in FIG. **40**. Therefore, pin **123** of output lever **99** only moves inside the idling groove of engagement groove **124***a* of internal/external air 2-layer lever **124**, and consequently, internal/external air 2-layer lever **124**, and 2-layer partitioning door **88** and second internal/external air selection door **75** as well as a result, maintain the aforementioned positions.

In contrast, when temperature control input lever **110** is moved to the maximum heating position (FIG. **39**), maximum heating input lever **119** rotates in the counterclockwise direction from the position in FIG. **40** to the position in FIG. **39**. In response to this counterclockwise rotation of maximum heating input lever **119**, output lever **99** rotates further in the counterclockwise direction.

As a result, pin **123** of output lever **99** goes outside the idling groove of engagement groove **124***a* of internal/external air 2-layer lever **124**, causing internal/external air 2-layer lever **124** to rotate in the clockwise direction from the position in FIG. **40** to the position in FIG. **39**. Consequently, 2-layer partitioning door **88** rotates in the counterclockwise direction, opening warm air bypass opening **87**, and at the same time, partitioning warm air passage **17** into first air passage **80***a*(FIG. **13**) on the external air side and second air passage **81***a*(FIG. **13**) on the internal air side. Moreover, second internal/external air selection door **75** is moved to the position that opens second internal air introduction port **72** (the position indicated by the two-dot chain lines in FIG. **38**) in linkage with 2-layer partitioning door **88**. Therefore, the air-conditioning apparatus is set in the internal/external air 2-layer flow mode shown in FIG. **13**.

As explained above, only when both conditions for the internal/external air 2-layer flow (i.e., (1) the blowout mode is set to the foot or defroster mode, and (2) temperature control is at the maximum heating position) are satisfied, pin **123** of output lever **99** goes outside the idling groove of engagement groove **124***a* of internal/external air 2-layer lever **124**, setting internal/external air 2-layer lever **124** to the internal/external air 2-layer position in FIG. **39**.

In Embodiment 10, since connecting rod **125** is an accessory to air-conditioning unit **10** and door lever **96** is an accessory to fan unit **70**, the work of connecting cable **129** can be easily performed during the assembly process for integrating air-conditioning unit **10** with fan unit **70** (i.e., before installing units **10** and **70** in the vehicle).

By the way, as shown in FIG. **13**, in the internal/external air 2-layer flow mode, 2-layer partitioning door **88** opens warm air bypass opening **87**, thus reducing the air flow resistance to foot openings **24** and **90** for the front and rear seats. As a result, the air volume for the foot side increases compared to the volume that occurs when the mode is not set to the internal/external air 2-layer flow mode (i.e., during the normal mode), making this air volume inappropriate relative to the air volume on the defroster side.

Therefore, Embodiment 10 is designed such that second differential gear mechanism **98**B can be used to maintain the ratio between the foot-side air volume and the defroster-side air volume at an appropriate level during the internal/external air 2-layer flow mode.

In second differential gear mechanism **98**B, internal/external air 2-layer input lever **130** is fixed to the position in FIG. **40** when a mode other than the internal/external air 2-layer flow mode is set. The rotation of blowout mode input lever **131** of second differential gear mechanism **98**B according to the blowout mode causes bevel gears **54** and **55** in FIG. **42** to revolve. This revolution causes bevel gear **58** on the output side and output lever **133**, thereby causing blowout mode link **135** to rotate via connecting rod **134**.

Defroster mode door **20**, face door **23**, and foot door **26** are opened or closed at the predetermined rotational angle positions of this blowout mode link **135**, thus setting each blowout mode.

In contrast, when the internal/external air 2-layer flow mode is set as described above, internal/external air 2-layer input lever **130** rotates in the clockwise direction from the position in FIG. **40** to the position in FIG. **39**, in linkage with the rotation of internal/external air 2-layer lever **124**. During this process, since blowout mode input lever **131** on the revolution input side is stopped, the rotation of bevel gear **50***d* of input shaft **50***a* causes bevel gear **58** of output shaft **58***a* to rotate in the opposite direction (counterclockwise direction).

Consequently, output lever **133** of second differential gear mechanism **98**B rotates in the counterclockwise direction from the position in FIG. **40** to the position in FIG. **39** by the same angle as internal/external air 2-layer input lever **130**. Based on this rotation of output lever **133**, the operation angles (opening) of defroster door **20** and foot door **26** are corrected as explained below.

That is, the driven angles on the vertical axis in FIG. **43** are the operation angles of defroster door **20**, face door **23**, and foot door **26**, and the driving angles on the horizontal axis in FIG. **43** is the operation angle of blowout mode link **135**.

The example in FIG. **43** is configured such that the foot mode gets set in the vicinity of the operation angle of blowout mode link 135=45°, and the foot defroster mode gets set in the vicinity of the operation angle of blowout mode link 135=63°. If the internal/external air 2-layer flow mode gets set during the foot mode, the rotation of internal/external air 2-layer input lever **130** of second differential gear mechanism **98**B increases the drive angle of blowout mode link **135** from point a to point b by a predetermined angle (e.g., around 20°), thus increasing the operation angle (opening) of defroster door **20**, and at the same time, decreasing the operation angle (opening) of foot door **26**, thereby shifting the mode to the foot defroster mode.

If the internal/external air 2-layer flow mode gets set during the foot defroster mode, the drive angle of blowout mode link **135** increases from point c to point d by a predetermined angle (e.g., around 20°), thus increasing the operation angle (opening) of defroster door **20**, and at the same time, setting the operation angle (opening) of foot door **26** to 0, thereby shifting foot door **26** to the position that completely closes foot opening **24**. In other words, the mode is shifted from the foot defroster mode to the defroster mode.

Therefore, even if 2-layer partitioning door **88** opens warm air bypass opening **87** during the internal/external air 2-layer flow mode, reducing the air flow resistance to foot openings **24** and **90** for the front and rear seats, the opening of foot opening **24** is reduced in linkage with the setting of the 2-layer flow mode, and therefore the foot-side air volume can be prevented from increasing. As a result, even in the internal/external air 2-layer flow mode, the ratio between the foot-side air volume and the defroster-side air volume can be maintained at an appropriate level.

Note that in Embodiment 10, the increase in the foot-side air volume is prevented by correcting the operation angle (opening) of defroster door **20** and foot door **26** itself during the internal/external air 2-layer flow mode. However, if a dedicated air volume adjustment door for suppressing the increase in the foot-side air volume during the internal/external air 2-layer flow mode is added, second differential gear mechanism **98**B can be abolished.

In Embodiment 10, connecting rod **125** connected to 2-layer partitioning door **88** is connected to second internal/external air selection door **75** via cable **129**. However, it is also possible to position first and second differential gear mechanisms **98**A and **98**B as well as the linking mechanisms connected to them on the side surface on the passenger side inside case **11** of air-conditioning unit **10**, and to use a different link to directly connect second internal/external air selection door **75** to the linking area (connecting rod **125**, etc.) for opening and closing 2-layer partitioning door **88**. In this way, cable **129** can be eliminated.

As another modified example, it is also possible to use rotation shaft **128** of 2-layer partitioning door **88** simplify the operation mechanism of second internal/external air selection door **75**, as shown in FIG. **44**. In the example in FIG. **44**, the tips of rotation shaft **128** are protruded to both sides (the driver side and the passenger side) inside case **11** of air-conditioning unit **10**, and door lever **142***a* for driving 2-layer partitioning door **88** is provided on the driver-side tip of rotation shaft **128**.

In contrast, door lever **142***b* for driving second internal/external air selection door **75** is provided on the passenger-side tip of rotation shaft **128**, and this door lever **142***b* is connected to door lever **96** (FIG. **38**) of second internal/external air selection door **75** via an appropriate link (not shown in the figure).

With this configuration, it is possible to install door lever **142***b* for driving second internal/external air selection door **75** on the passenger-side (the fan side) of case **11**, using the length of rotation shaft **128** in the axial direction, and therefore second internal/external air selection door **75** can be opened and closed in linkage with 2-layer partitioning door **88**, using a simple link and without using cable **129**.

Also, in Embodiment 10, both first and second differential gear mechanisms **98**A and **98**B are concentrated on the side surface on the driver side inside case **11** of air-conditioning unit **10**. However, it is also possible to adopt a distributed layout, in which the mechanism (differential gear mechanism) for opening and closing second internal/external air selection door **75** is positioned in fan unit **70**, as in Embodiment 5, for example, and the drive mechanism for 2-layer partitioning door **88** and the blowout mode door opening control mechanism for controlling the air volume ratio are positioned on the side surface on driver side inside case **11** of air-conditioning unit **10**.

In this distributed layout, it is possible to supply the blowout mode input and temperature control (air mix) input to the opening/closing mechanism of second internal/external air selection door **75** from the air-conditioning unit **10** side. However, it is also possible to transmit the operational shift of blowout mode setting lever **31**' of air-conditioning operation panel **30** and the operational shift of temperature control lever **33**' to the opening/closing mechanism of second internal/external air selection door **75** via cables **102** and **108**, as in Embodiment 5.

Embodiment 11 relates to an improvement to Embodiment 1. In Embodiment 1, as shown in FIG. **9**, when blowout mode knob **31** of air-conditioning operation panel **30** is set to the Auto position, the opening of air-mix door **16** is increased as the drive angle of motor **44** increases, and at the same time, the blowout mode is sequentially and automatically switched from the face mode, to the bi-level mode, and then to the foot mode.

In contrast, when blowout mode knob **31** of air-conditioning operation panel **30** is set to the defroster position, movable lever **41** is used to cause bevel gears **54** and **55** of differential gear mechanism **53** to rotate (revolution and autorotation), thereby rotating bevel gear **58** and second output shaft **58***a* by angle θ^1 (θ^1 is greater than angle θ in the Auto mode), and in this way, the defroster mode can be manually set when desired.

Consequently, according to Embodiment 1, the only blowout mode that can be manually set is the defroster mode, and other blowout mode cannot be manually set.

Therefore, the objectives of Embodiment 11 are to secure an auto control function that achieves both the opening control of the air-mix door (temperature control means) and the blowout mode auto switching function according to Embodiment 1 in linkage, using a single motor actuator, and additionally to allow the manual setting of modes other than the defroster mode as desired, as in ordinary vehicular air-conditioning apparatuses.

FIG. **45**A shows the flow in which air-mix door **16** (temperature control means) and the entire operation mechanism of blowout mode doors **20**, **23**, and **26** operate in linkage, and FIG. **45**B shows a configuration overview of said operation mechanism.

Motor actuator **40** has drive motor **44**, and the rotation of output shaft **44***a* of motor **44** is input into differential gear mechanism **53** via gears **48**' and **49**'. In this example, the reduction ratio between gears **48**' and **49**' is set to 0, and thus the rotation of motor **44** is input into differential gear mechanism **53** without any reduction in speed. However, it is of course possible to reduce the rotation of motor **44** using gears **48**' and **49**'.

Differential gear mechanism **53** is comprised of the planetary gear mechanism shown in FIG. **46**. This differential (planetary) gear mechanism **53** has the same configuration as that in FIG. **34**, and like symbols indicate like components. Gear **49**' and air-mix link **150** are integrally provided on rotation shaft **402***a* of sun gear **402** of differential (planetary) gear mechanism **53**, and the rotation of gear **49**' rotates rotation shaft **402***a* and air-mix link **150** together. The rotation of air-mix link **150** is transmitted to rotation shaft **16***a* of air-mix door **16** inside case **11** via connecting rod **151** and air-mix door lever **152**.

In differential (planetary) gear mechanism **53**, rotation shaft **403***a* is provided on platter-shaped carrier component **403** which rotatably supports planetary gears **401** and causes planetary gears **401** to revolve. This rotation shaft **403***a* is integrally connected to one end of blowout mode input lever **41**, and this blowout mode input lever **41** is used to rotate carrier component **403**, thereby causing planetary gears **401** to revolve.

Here, blowout mode input lever **41** is equivalent to movable lever **41** in Embodiment 1, and pin **41***a* on the other end of blowout mode input lever **41** is connected to blowout mode knob **31** of air-conditioning operation panel **30** (see FIGS. **49** and **50** described below) via a cable, etc. (not shown in the figure but equivalent to cable **37** in FIG. **3**).

FIG. **47** shows intermittent gear mechanism **153**. Input-side gear **154** has three teeth **154***a* which are provided at a spacing of **1200**; and every time input-side gear **154** rotates by 120°, it rotates output-side gear **155** by 30°. On the outside perimeter of output-side gear **155**, five teeth **155***a* are provided only within the range of operation angle θ^B in the manual drive region.

FIG. **48** shows interlocking gear mechanism **156**. Input-side gear **157** is provided with four teeth **157***a* only within the auto drive region θ^A which is set within a predetermined angle (90° in this example); and input-side gear **157** rotates output-side gear **158** only within this auto drive region θ^A. Therefore, only three teeth **158***a* are provided on the outside perimeter of output-side gear **158**.

Here, input-side gears **154** and **157** of both gear mechanisms **153** and **156** are stacked in the axial direction and are integrally connected to rotation shaft **400***a* of internal gear **400** of differential (planetary) gear mechanism **53**, and rotate together with the rotation of internal gear **400**. Output-side gears **155** and **158** of both gear mechanisms **153** and **156** are also stacked in the axial direction and are integrally connected to a common rotation shaft **159**. Two connecting rods **160** and **161** are connected to either output-side gear **155** or **158** (to output-side gear **155** in this example), and output-side gear **155** is connected to blowout mode link **135** via these connecting rods **160** and **161**.

This blowout mode link **135** is the same as that shown in FIGS. **39** and **40**, has three engagement grooves (linking grooves) for rotating blowout mode doors **20**, **23**, and **26**, and the pin lever mechanisms of blowout mode doors **20**, **23**, and **26** engage with these engagement grooves. Therefore, the rotation of blowout mode link **135** can be used to rotate blowout mode doors **20**, **23**, and **26** inside case **11**.

FIG. **49** shows a specific example of air-conditioning operation panel **30**. Blowout mode knob **31** is a rotatable operation component, and, in linkage to the change in the opening of air-mix door **16**, can be rotated to set the blowout mode to the Auto mode position, the face mode position, the bi-level mode position, the foot mode position, the foot defroster mode position, or the defroster mode position.

As in FIG. **2**, air-conditioning operation panel **30** is provided with blowout mode knob **31**, as well as temperature setter **33** having a rotatable knob, push-button type air-conditioner switch **34**, push-button type internal/external air selection switch **35**, and fan switch **36** having a rotatable knob, etc. Note that blowout mode knob **31** is not limited to the rotatable operation component, and can be a lever operation component that can be slid along guiding groove **163** as shown in FIG. **50**.

Next, the operation of Embodiment 11 will be explained. First, a case will be explained, in which blowout mode knob **31** is set to the Auto position on air-conditioning operation panel **30**. In this case, as blowout mode knob **31** is moved to the Auto position, carrier component **403** of differential (planetary) gear mechanism **53** rotates. Since sun gear **402** is stopped if motor **44** is stopped, planetary gears **401** autorotate while revolving around sun gear **402**.

Internal gear **400** and both input-side gears **154** and **157** then together rotate to the positions that correspond to this revolution of planetary gears **401**. FIGS. **47** and **48** show the rotational positions of both input-side gears **154** and **157** when blowout mode knob **31** is set to the Auto position.

In the aforementioned state, by controlling the rotational angle of sun gear **402** by controlling the rotational angle of motor **44**, the blowout mode is automatically switched as described below, in linkage with the change in the opening of air-mix door **16**. In Embodiment 11, as in Embodiment 1, the operation (rotational) angle of motor **44** is determined according to the target air-mix door opening SW computed by air-conditioning electronic control device **710**.

More specifically speaking, in this example, sun gear **402**, i.e., air-mix link **150**, is designed to rotate by 180° between SW=0% (the maximum cooling position) and 100% (the maximum heating position), and the 180° rotation of sun gear **402** is designed to be extracted from internal gear **400** as rotation having an operation angle=90° (operation angle θ^A in the auto drive region in FIG. **48**), through reduction in the planetary gear mechanism.

When input-side gear **157** (FIG. **48**) which is integrated with internal gear **400** rotates within the range of "operation angle of internal gear 400=90°," output-side gear **158** rotates in response to the rotation of input-side gear **157**. This rotation of output-side gear **158** is transmitted to blowout mode link **135** via connecting rods **160** and **161**, and the rotation of this blowout mode link **135** drives blowout mode doors **20**, **23**, and **26**, thus sequentially switching the blowout mode from Face, to B/L, and to Foot as the opening of air-mix door **16** changes from 0% to 100%. This blowout mode switching is shown in the Auto region on the right edge of FIG. **51**.

Meanwhile, the rotation of air-mix link **150**, which rotates together with sun gear **402**, is transmitted to air-mix door **16** via connecting rod **151** and door lever **152**, and the opening of air-mix door **16** changes between 0% and 100% as shown on the bottom of the right edge of FIG. **51**.

Furthermore, since air-mix link **150** rotates within the range of operation angle=180° (twice the operation angle of internal gear **400**), this operation angle=180° can be utilized to fine-tune the opening of air-mix door **16**. Therefore, the resolution of blowout temperature control becomes fine, making it possible to control the blowout temperature well without causing hunting.

Note that, as is clear from the top and bottom diagrams on the right edge of FIG. **51**, blowout switching by means of blowout mode doors **20**, **23**, and **26** and the adjustment of the opening of air-mix door **16** are alternately performed. This alternate drive can be realized by alternately forming the idling groove in the engagement groove of blowout mode link **135** and the idling groove in the engagement groove of air-mix link **150** (or air-mix door lever **152**).

Next, the manual setting of blowout modes will be explained. When blowout mode knob **31** is moved from the Auto position to one of the blowout mode in air-conditioning operation panel **30**, carrier component **403** of differential (planetary) gear mechanism **53** rotates to the position that corresponds to the operation position of this blowout mode knob **31**. In this case, since sun gear **402** is stopped if motor **44** is stopped, planetary gears **401** autorotate while revolving around sun gear **402**, and as a result, internal gear **400** and both input-side gears **154** and **157** together rotate to the positions that correspond to the revolution of planetary gears **401**.

Here, if blowout mode knob **31** is set to a blowout mode other than the Auto position, teeth **157*a*** of input-side gear **157** of interlocking gear mechanism **157**[sic, should be **156**] rotate to positions that do not engage with teeth **158*a*** of output-side gear **158**, and thus the rotation of input-side gear **157** is not transmitted to output-side gear **158**.

On the other hand, if blowout mode knob **31** is moved from the Auto position to a position between the Face mode and the Defroster mode in air-conditioning operation panel **30**, interlocking gear mechanism **157**[sic, should be **156**] causes teeth **155*a*** of output-side gear **155** of intermittent gear mechanism **153** to rotated to positions that engage with teeth **154*a*** of input-side gear **154**. Therefore, if input-side gear **154** of intermittent gear mechanism **153** is rotated by a predetermined angle (120° in this example) by moving blowout mode knob **31** to a different mode position, output-side gear **155** rotates by a predetermined angle (30° in this example) every time input-side gear **154** rotates by **1200**.

The rotation of this output-side gear **155** is transmitted to blowout mode link **135** via connecting rods **160** and **161**, and the rotation of this blowout mode link **135** drives blowout mode doors **20**, **23**, and **26**, thereby switch the blowout mode.

Operation angle OB in the manual drive region of output-side gear **155** shown in FIG. **47** is 30°×5=150° in this example.

By the way, the aforementioned manual switching of blowout modes can be performed while sun gear **402** is held stationary. This means that the blowout mode can be switched while keeping the opening of air-mix door **16** constant to keep the blowout temperature constant. Therefore, the need for resetting temperature setter **33** every time the blowout mode is manually set, is eliminated.

To adjust the blowout temperature after manually setting a blowout mode, temperature setter **33** can be used to change the value of the target air-mix door opening SW to change the operation (rotation) angle of motor **44**. This change in the operation angle of motor **44** causes air-mix link **150** to rotate, adjusting the opening of air-mix door **16**, and thus the blowout temperature.

In this case, sun gear **402** rotates together with air-mix link **150**. Although the maximum operation angle of sun gear **402** is 180°, the operation angle of internal gear **400** is reduced by ½ to 90°, and input-side gear **154** of intermittent gear mechanism **153** rotates within this 90-degree operation angle. However, since input-side gear **154** is provided with idling angles (120°−30°=90°), in which teeth **154***a* of input-side gear **154** do not drive output-side gear **155**, output-side gear **155** does not rotate even when input-side gear **154** rotates by the aforementioned **90**o operation angle. Therefore, the opening of air-mix door **16** can be adjusted to adjust the blowout temperature, while keeping the blowout mode constant.

In the manual region in FIG. **51**, the characteristics of blowout temperature control below the Face mode show the characteristics for adjusting the opening of air-mix door **16** while keeping the blowout mode constant as described above. Note that, in the manual region in FIG. **51**, the dotted-line area of each blowout mode indicates that the blowout mode is held constant by the idling angle (=90°) of input-side gear **154**.

Furthermore, Embodiment 11 offers an advantage in that the blowout mode switching linking mechanism can be made compact as explained below by combining differential (planetary) gear mechanism **53** and intermittent gear mechanism **153**. That is, even when the operation angle of air-mix link **150** (sun gear **402**) is set to a large value of 180° for adjusting the blowout temperature in each mode, the operation angle of internal gear **400** (input-side gears **154** and **157**) can be reduced through speed reduction by differential (planetary) gear mechanism **53**. Therefore, the operation angle of output-side gear **155** in the Auto region can be held down to 90°.

Moreover, in the dotted-lined 90° area in each mode in the manual region, output-side gear **155** can be maintained in a stopped state by means of the idling angle of intermittent gear mechanism **153**. Consequently, the total operation angle of output-side gear **155** in the manual region is 30°×5=150°. Therefore, the total operation angle of output-side gear **155** in the Auto region and the manual region can be set to 90°+150°=240°. As a result, the operation mechanism for blowout mode doors **20**, **23**, and **26** can be made compact.

In contrast, FIG. **52** shows a comparison example, in which (1) no speed reduction is performed by differential (planetary) gear mechanism **53**, and (2) no idling angles are set in intermittent gear mechanism **153**. Consequently, in this comparison example, if the required operation angle in the Auto region is set to 120°, the angle in the manual region becomes 120°×5°+30°×4=720°, and the total required operation angle for the Auto region and the manual region becomes 840°. As a result, it becomes difficult to create an operation mechanism for blowout mode doors **20**, **23**, and **26**.

FIG. **53** shows a specific design example of differential (planetary) gear mechanism **53** according to Embodiment 11. In *__1__ in FIG. **53**, the operation angle of output-side gear **155** becomes 30°×5°=150° because idling angles are set in intermittent gear mechanism **153**. *__2__ indicates the autorotation angle of planetary gears **401**, and in response to this autorotation angle (400°), the operation angle of blowout mode input lever **41** can be 80°, resulting in 5X acceleration.

Embodiment 12 is a modified case of Embodiment 11. As shown in FIG. **54**, shaft **400***a* of internal gear **400** of differential (planetary) gear mechanism **53** is connected to a single blowout mode distribution link **163**, such that the rotation of internal gear **400** directly rotates blowout mode distribution link **163**.

FIGS. **55** and **56** show specific examples in which Embodiment 12 has been applied to air-conditioning unit **10**. Blowout mode distribution link **163** has an approximate platter shape, has engagement groove **164** formed along its external edge, and at the same time, has one end **164***a* of engagement groove **164** formed in a spiral manner reaching toward the center.

Pin **166** on one end of intermediate lever **165** is slidably fitted into this engagement groove **164**, and the other end of intermediate lever **165** is connected to blowout mode link **135** via connecting rod **160**. Blowout mode link **135** is the same as those in FIGS. **39** and **40**, has three engagement grooves **136**, **137**, and **138** which correspond to three blowout mode doors **20**, **23**, and **26**; and blowout mode doors **20**, **23**, and **26** are opened and closed via pin lever mechanisms that individual fit in these three engagement grooves **136**, **137**, and **138**.

To alternately drive air-mix door **16** and blowout mode doors **20**, **23**, and **26**, multiple idling grooves and drive grooves are alternately formed in engagement groove **164** of blowout mode distribution link **163**. In this way, the idling functions for stopping the drive of the blowout mode doors can be concentrated on the side of distribution link **163**. As a result, there is no need to provide idling functions for alternately driving on the side of blowout mode link **135**, blowout mode link **135** can be made compact by shortening engagement grooves **136**, **137**, and **138**, and at the same time, the operation angle of blowout mode link **135** can be made small. In this example, the operation angle of blowout mode link **135** is set to 100°.

In FIG. **55**, cable **37** connects blowout mode knob **31** of air-conditioning operation panel **30** (FIGS. **49** and **50**) to blowout mode input lever **41** of differential (planetary) gear mechanism **53**.

Embodiment 12 has a configuration in which blowout mode distribution link **163** is directly connected to rotation shaft **400***a*of internal gear **400**, without using intermittent gear mechanism **153** and interlocking gear mechanism **156** used in Embodiment 11, and thus the overall configuration can be simplified. On the other hand, the effect of operation angle reduction of output-side gear **155** by the idling angle of intermittent gear mechanism **153** cannot be obtained.

Therefore, in Embodiment 12, as shown in FIG. **57**, the motor operation angle for adjusting the opening of air-mix door **16**, i.e., the operation angle of sun gear **402** (air-mix link **150**) is reduced from 180° used in Embodiment 11 to 150°, and based on this, the operation angle of internal gear **400** (distribution link **164**[sic. should be **163**]) in the Auto region is reduced from 90° used in Embodiment 11 to 60°.

Based on the above, the total operation angle of distribution link **163** is set to 460°=60° in the Auto region +400° in the manual region.

(1) In Embodiment 1, stoppers **42***h* and **42***i* are provided in actuator case **42** as stopper means for restricting the operation range (β) of movable lever **41**. However, it is also possible to install these stopper means on the side of air-conditioning operation panel **30**.

(2) In each of the aforementioned embodiment, air-mix door **16** (**83** or **84**), which adjusts the ratio between the air passing through cool air bypass passage **15** and the air passing through heater core **13**, is used as a means of adjusting the temperature [of the air] blown into the cabin. However, it is also possible to use a warm water valve, etc., which adjusts the volume of the warm water passing through heater core **13**, as the temperature control means.

(3) In each of the aforementioned embodiment, differential gear mechanisms **53** or **98** is used to create a relative positional shift between first and second output shafts **50***a* and **58***a*. However, it is also possible to use a differential friction mechanism, which can transmit force based on a frictional force, instead of a differential gear mechanism, to create a relative positional shift between first and second output shafts **50***a* and **58***a*.

(5[sic]) The application of the motor actuator according to the present invention is not limited to the vehicular air-conditioning apparatuses according to the aforementioned embodiments, and can be applied to the driving of slave components in a wide variety of fields.

(6) A case in which two revolving bevel gears **54** and **55** are installed in differential gear mechanisms **53** and **98** was explained. However, it is also of course possible to provide three or more revolving bevel gears **54** and **55**. In differential gear mechanism **98** in Embodiments 5 and 6, an example was explained in which the gear ratio between bevel gears **50***d* and **58** on the two shafts **50***a* and **58***a* is set to 1:1. However, it is also possible to set this gear ratio to a value other than 1:1.

(7) In Embodiments 5 and 6, it is also possible to form part of cases **42** and **43** of differential gear mechanism **98** integrally with resin case **70***a* of fan unit **70**.

(8) In Embodiments 5 and 6, a case in which internal/external air selection doors **74** and **75** are comprised of rotatable plate-shaped doors was explained. However, it is also possible to configure internal/external air selection doors **74** and **75** using known rotary doors, sliding doors, film-type doors, etc.

(9) Two-layer partitioning door **88** explained in Embodiment 5 is designed to get set to the 2-layer flow partitioning position (the position that opens warm air bypass opening **87**) shown in FIG. **13** when the following two conditions are satisfied: (1) the blowout mode is set to the foot mode or the defroster mode, and (2) the temperature control means, such as air-mix doors **16**, **83**, or **84**, is at the maximum heating position. Therefore, it is also possible to open and close 2-layer partitioning door **88**, using differential gear mechanism **98** which uses both blowout mode input lever **100** and temperature control input lever **200** for inputs in the same way as second internal/external air selection door **75** does.

(10) In each embodiment, a case in which blowout mode doors **20**, **23**, and **26** are comprised of rotatable doors, was explained. However, it is also possible to configure the blowout mode doors as a single door using a known rotary door, a film-type door, etc.

While the above-described embodiments refer to examples of usage of the present invention, it is understood that the present invention may be applied to other usage, modifications and variations of the same, and is not limited to the disclosure provided herein.

What is claimed is:

1. A vehicular air-conditioning apparatus for a vehicle, comprising:

- a temperature control means for controlling air temperature of air blown to an interior of a vehicle;
- a face opening for blowing out air toward a head of a vehicle occupant in a cabin of the vehicle;
- a foot opening for blowing air toward feet of the vehicle occupant in the cabin;
- defroster openings for blowing out air to vehicular window glass of the vehicle;
- blowout mode doors for opening/closing the face opening, foot opening and defroster openings;
- wherein at least a face mode for blowing out air from the face opening, a foot mode for blowing out air from the foot opening, and a defroster mode for blowing out air from the defrosters openings can be selected and switched;
- a drive motor,
- a first output shaft which receives rotation from the drive motor;
- a second output shaft which receives the rotation from the first output shaft; and
- a differential mechanism positioned between the first output shaft and second output shaft that adjusts relative positions of the first output shaft and second output shaft;
- an operation component that operates the differential mechanism;
- wherein the temperature control means is connected to the first output shaft, the blowout mode doors are connected to the second output shaft, when the operation component is being set to the Auto blowout mode, the rotation of the drive motor rotates the first output shaft and the second output shaft at the same time, the rotation of the drive motor being transmitted to the first output shaft and the second output shaft through the differential mechanism;
- wherein the rotation of the first output shaft controls the temperature control means, and the rotation of the second output shaft drives the blowout mode doors to switch between a face mode and a foot mode; and
- wherein the differential mechanism is activated while the first output shaft is stationary when the operation component is being set to the defroster blowout mode while the drive motor is stopped to set the defroster mode by rotating the second output shaft and shift the relative positions of the first and second output shaft.

2. A vehicular air-conditioning apparatus as claimed in claim **1**, wherein the defroster mode is maintained even when the second output shaft rotates within a predetermined angle during the defroster mode.

3. A vehicular air-conditioning apparatus as claimed in claim **1**, wherein the first output shaft is positioned on one side of an axial direction of the differential mechanism and the second output shaft is positioned on an opposite side of the differential mechanism along the axial direction.

4. A vehicular air-conditioning apparatus as claimed in claim **1**, further comprising a stopper means that restricts the rotation angle of the second output shaft to a predetermined range when the second output shaft is rotated by moving the operation component to the defroster blowout mode.

5. A vehicular air-conditioning apparatus as claimed in claim **1**, wherein a rotation angle of the second output shaft, which is rotated when the operation component is moved from the auto blowout mode to the defroster mode, is set larger than the rotation angle of the second output shaft, which is rotated by the rotation of the drive motor, when operation component is set to the auto blowout mode.

6. A vehicular air-conditioning apparatus as claimed in claim **1**, wherein:

- the operation component is installed in an air-conditioning operation panel operable by the vehicle occupant; and
- the differential mechanism includes a movable component, said differential mechanism responsive to manual operation force from the operation component to be actuated.

7. A vehicular air-conditioning apparatus as claimed in claim 1, wherein the differential mechanism component is a differential mechanism includes bevel gears for transmitting rotational movement.

8. A motor actuator comprising:

a drive motor,

a first output shaft which receives rotation from the drive motor;

a second output shaft which receives the rotation from the first output shaft; and

a differential mechanism positioned between the first output shaft and second output shaft that adjusts relative positions of the first output shaft and second output shaft;

an operation component that operates the differential mechanism;

wherein a first slave component is connected to the first output shaft and a second slave components is connected to the second output shaft, and

wherein the rotation of the drive motor rotates the first output shaft and the second output shaft at the same time when the movable component is being set to a first operating position, the rotation of the drive motor being transmitted to the first output shaft and the second output shaft through a differential mechanism within a predetermined operation angle range; and

wherein the first slave component and the second slave component are activated in linkage through the rotation of the first output shaft and the second output shaft, and

wherein the differential mechanism is activated while the first output shaft is stationary when the movable component is being set to the second operation position while the drive motor is stopped to rotate the second output shaft outside the predetermined operation angle range by shifting the relative positions of the first output shaft and the second output shaft.

9. The motor actuator as claimed in claim 8, wherein the second output shaft is rotated when the movable component is moved from the first operating position to the second operating position, a rotation angle of the second output shaft is set larger than a rotation angle of the second output shaft when the movable component is set to the first operation position, said second output shaft being rotated by the drive motor.

10. A motor actuator as claimed in claim 8, wherein the first slave component is a temperature control means for controlling the temperature of air blown into the cabin, the second slave component being blowout mode doors for switching the blowout mode for the cabin.

11. A vehicular air-conditioning apparatus comprising:

defroster openings for blowing out air to a vehicular window glass;

foot openings blowing out air to a foot area of a vehicle occupant;

first air passages sending air to the defroster openings;

second air passages sending air to the foot openings,

a first internal/external air selection door that switches air introduced into the first air passages between internal and external air;

a second internal/external air selection door that switches air introduced into the second air passages between internal and external air;

a blowout mode operation component that is manually operated for selecting the blowout mode for a cabin;

a blowout mode input component that rotates in linkage with the operation of the blowout mode operation component;

a temperature control operation component that is manually operated for controlling the temperature of air blown into the cabin;

temperature control input components that rotate in linkage with the operation of the temperature control operation component;

differential mechanisms that rotate the output component using the rotational shift in all of the input components;

wherein the output component is connected to the operation area of the second internal/external air selection door, the mode for blowing out air from both the defroster opening and the foot opening is set by the blowout mode operation component, the differential mechanisms rotate the output component to the predetermined position at the same time based on the rotational shifts of all of the input components when the temperature control operation component is set to the maximum heating setting to set the second internal/external air selection door to introduce internal air into the second air passages.

12. A vehicular air-conditioning apparatus as claimed in claim 11, wherein the differential mechanisms rotate the output component to the predetermined position based on the rotational shifts of the blowout mode input component when the defroster mode for blowing air from the defroster opening is set by the blowout mode operation component to set the second internal/external air selection door to stop internal air flow into the second air passages.

13. A vehicular air-conditioning apparatus as claimed in claim 12, wherein shift adjustment mechanisms are installed between the output component and the second internal/external air selection door to adjust the shifts therebetween; and

the second internal/external air selection door remaining in the external air introduction position by a shift adjustment mechanisms even if the rotational shifts of the temperature control input components change the rotational position of the output component when the defroster mode is being set.

14. A vehicular air-conditioning apparatus as claimed in claim 11, wherein when a blowout mode other than the defroster mode is set by the blowout mode operation component and the temperature control operation component is set to the maximum cooling position, the differential mechanisms rotate the output component to the predetermined position based on the rotational shifts of all of the input components, whereby the second internal/external air selection door is set to introduce internal air into the second air passages.

15. A vehicular air-conditioning apparatus as claimed in claims 11, wherein the differential mechanisms include bevel gears, the rotational shifts of the temperature control input components are input into the bevel gears at the same time.

16. A vehicular air-conditioning apparatus as claimed in claim 11, wherein shift adjustment mechanisms for adjusting the shifts between two components are installed between the blowout mode operation component and the blowout mode input component, shift adjustment mechanisms being installed between the temperature control operation component and the temperature control input components.

17. A vehicular air-conditioning apparatus comprising:

defroster openings that blow air into the vehicular window glass;

foot openings that blow air into the foot area of the vehicle occupant;

an internal/external air selection door that switches air sent to the cabin between internal and external air;

an internal/external air operation component that is manually operated to switch between internal and external air introduction;

a blowout mode operation component that is manually operated to select a blowout mode for the cabin,

a blowout mode input component which rotates in linkage with the operation of the blowout mode operation component;

an internal/external air selection input component that rotates in linkage with the operation of the internal/external air operation component;

wherein a differential mechanism that rotates the output component using the rotational shift of both of the input components as inputs;

wherein the output component is connected to the operation area of the internal/external air selection door;

wherein when the mode for blowing out air mainly from defroster openings is being set by the blowout mode operation component, the differential mechanism rotates the output component to the predetermined position based on the rotational shifts of the blowout mode input component, whereby the internal/external air selection door is maintained in the external air introduction position; and

wherein when a blowout mode other than the defroster-dominant mode is being set by the blowout mode operation component, the differential mechanism rotates the output component to the position that corresponds to the rotational shift of the internal/external air selection input component, whereby the internal/external air selection door is set to the internal/external air mode set by the blowout mode operation component.

18. A vehicular air-conditioning apparatus as claimed in claim **17**, wherein shift adjustment mechanisms are installed between the output component and the second internal/external air selection door to adjust the shifts therebetween; and

the second internal/external air selection door remaining in the external air introduction position by a shift adjustment mechanisms even if the rotational shifts of the temperature control input components change the rotational position of the output component when the defroster mode is being set.

19. A vehicular air-conditioning apparatus as claimed in claim **17**, wherein the differential mechanism uses bevel gears, the rotational shift of the blowout mode input component is input into the bevel gears at the same time.

20. A vehicular air-conditioning apparatus as claimed in claim **11**, further comprising:

a temperature control means for controlling a temperature of air blown into the cabin;

blowout mode doors that switch a mode for blowing air into the cabin;

a first transmission means that transmits the operation of the temperature control operation component to the operation area of the temperature control means;

a second transmission means for transmitting the operation of the blowout mode operation component to the operation areas of the blowout mode doors,

the control input components (**200** and **119**) of the differential mechanisms (**98** and **98**A) are rotated based on the shift transmitted from the first transmission means, and

the blowout mode input component of the differential mechanisms is rotated based on the shift transmitted from the second transmission means.

21. A vehicular air-conditioning apparatus as claimed in claim **20**, wherein the differential mechanisms are positioned closer to the temperature control means and the blowout mode doors than to the second internal/external air selection door, and a third transmission means is provided that transmits the rotational shift of the output component of the differential mechanisms to the second internal/external air selection door.

22. A vehicular air-conditioning apparatus as claimed in claim **21**, further comprising a 2-layer partitioning door for separating the first air passages from the second air passages on the upstream side of the defroster opening and the foot opening;

wherein the second internal/external air selection door and the 2-layer partitioning door are operated in linkage based on the rotational shift of the output component.

23. A vehicular air-conditioning apparatus comprising:

a temperature control means for controlling the temperature of air blown into the cabin;

face openings that blow air toward a head of a vehicle occupant in a cabin;

foot openings that blow air toward feet of the vehicle occupant in the cabin;

defroster openings that blow air toward the vehicular window glass;

blowout mode doors that open and close individual openings and switches including a face mode for blowing out air from the face openings, a foot mode for blowing out air from the foot openings, and a defroster mode for blowing out air from the defroster openings;

a drive motor;

a first rotation shaft that receives rotation from the drive motor;

a second rotation shaft that receives rotation from the first rotation shaft;

a differential mechanism positioned between the first rotation shaft and the second rotation shaft for adjusting the relative positions theirbetween;

an operation component that operates a differential mechanism; wherein

the temperature control means is connected to the first rotation shaft;

the blowout mode doors are connected to the second rotation shaft; and

when the operation component is set to the auto blowout mode, the rotation of the drive motor rotates the first rotation shaft and the second rotation shaft at the same time, the differential mechanism transmitting rotation from the drive motor to the first rotation shaft and the second rotation shaft; and

wherein the rotation of the first rotation shaft controls the temperature control means, the rotation of the second rotation shaft drives the blowout mode doors; and

wherein when the operation component is being set to the face mode position, the foot mode position, or the defroster position of the blowout mode while the drive motor is stopped, the differential mechanism is activated while the first rotation shaft is stationary, whereby the face mode, foot mode, or defroster mode is set by rotating the second rotation shaft and changing the operation angle of the second rotation shaft corresponding to the operation position of the operation component.

24. A vehicular air-conditioning apparatus described in claim **23**, wherein:

an intermittent operation mechanism is provided between the second rotation shaft and the operation mechanism on the side of the blowout mode doors; and

the rotation of the second rotation shaft is intermittently transmitted to the operation mechanism only within part of the operation angle of the second rotation shaft.

25. A vehicular air-conditioning apparatus as claimed in claim **23**, wherein the differential mechanism is a planetary gear mechanism, the first rotation shaft being a sun gear shaft of the planetary gear mechanism and the second rotation shaft being an internal gear shaft of the planetary gear shaft, and

a planetary gear is revolved by operating the operation component.

26. An operational force transmission device comprising:

a first input component that rotates in linkage with the operation of a first operation component;

a second input components that rotate in linkage with the operation of second operation components;

a differential mechanism that rotates an output component using the rotational shift of the first input component and the second input components;

slave components driven by rotational shift of the output component;

wherein the differential mechanism rotates the output component to the first output position when all of the input components have rotated to predetermined positions, the differential mechanism rotating the output component to the second output position when any of input components rotates to a position different from the predetermined position.

27. An operational force transmission device comprising:

a first input component that rotates in linkage with operation of a first operation component;

second input components that rotate in linkage with the operation of second operation components;

a differential mechanism that rotates an output component using rotational shift of the first input component and the second input components;

slave components driven by rotational shift of the output component;

wherein shift adjustment mechanisms are installed between the output component and the slave components for adjusting shifts theirbetween;

wherein the differential mechanism rotates the output component within a predetermined range between first and second positions corresponding to the rotational shift of the first input component within the predetermined range, the output component rotates to a third position that is outside of the predetermined range based on the rotational shift of the second input components; and

when the output component rotates to the third position, the rotational shift of the output component is designed not to be transmitted to the slave components by the shift adjustment mechanisms.

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