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(54) **Bell-mouth structure of air blower**

(57) A bell-mouth structure of an air blower provided around a blade wheel of an axial-flow air blower for guiding air from an air suction side of the blade wheel to an air blow-out side including an air blow-out wall portion that intercommunicates with an air blow-out opening and extends substantially along an axial direction of the blade wheel, and a slope wall portion that intercommunicates with the air blow-out wall portion and slopes to an air suction opening so as to expand in diameter. When the overall height of the bell-mouth is represented by H, the height of the slope wall portion is represented by h and a slope angle of the slope wall portion is represented by β, the bell mouth structure is configured so as to satisfy 0.33≤h/H≤0.42 and 60°≤β≤70°.

FIG.3A

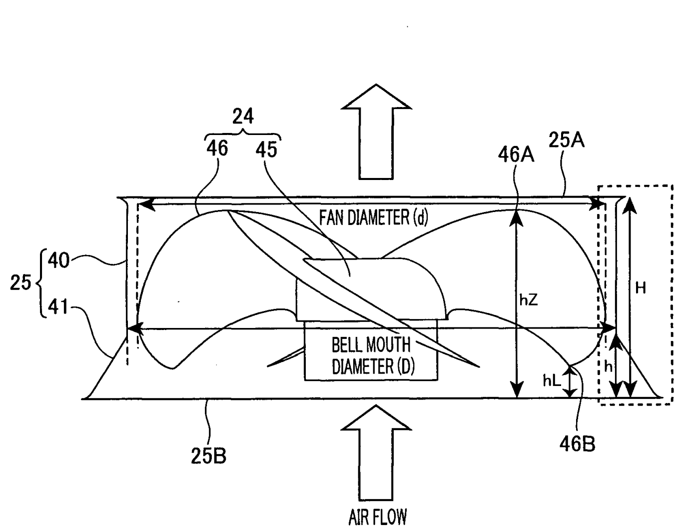

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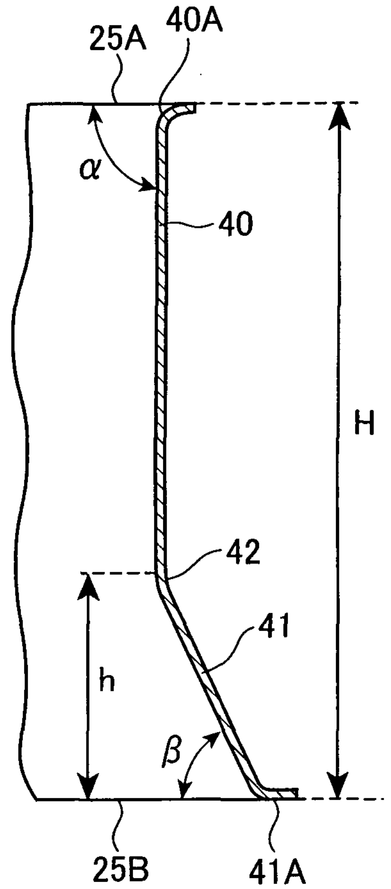
FIG.3B



Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] The present invention relates to a bell-mouth structure of an air blower used in an air conditioner or the like.

2. Description of the Related Art

[0002] An axial-flow air blower such as a propeller fan or the like has been widely used as an air blower for an air conditioner or the like, and a bell-mouth for smoothly guiding air from an air suction side to an air blow-out side and reducing a leakage amount of air is provided around a blade wheel for blowing air. With respect to this type of air blower, it has been recently more strongly required to enhance the performance and reduce the noise, and a performance enhancing method based on an improvement of the bell-mouth shape has been proposed (for example, see JP-A-2004-211971).

[0003] Furthermore, it has been recently required to enhance the air flow amount of the air blower and reduce the driving force of the air blower (motor load) from the viewpoint of energy saving.

SUMMARY OF THE INVENTION

[0004] Therefore, an obj ect of the present invention is to provide a bell-mouth structure of an air blower that can solve the problem of the technique described above, and also satisfy reduction of both of the rotational number and the driving force of the air blower at the same time with keeping the air flow amount equal.

[0005] In order to attain the above object, according to a first aspect of the present invention, a bell-mouth structure of an air blower that is provided around a blade wheel of an axial-flow air blower and guides air from an air suction side of the blade wheel to an air blow-out side of the blade wheel has an air blow-out wall portion that intercommunicates with an air blow-out opening and extends substantially along an axial direction of the blade wheel, and a slope wall portion that intercommunicates with the air blow-out wall portion and slopes to an air suction opening so as to expand in diameter, wherein when the overall height of the bell-mouth is represented by H, the height of the slope wall portion is represented by h and a slope angle of the slope wall portion is represented by β, $0.33 \leq h/H \leq 0.42$ and $60° \leq \beta \leq 70°$ are satisfied.

[0006] In this construction, when the diameter of an opening of a connecting portion between the air blow-out wall portion and the slope wall portion is represented by D and the diameter of the blade wheel is represented by d, $1.02 < D/d < 1.03$ maybe satisfied. When the height from the air suction opening to the position of a blade out of blades of the blade wheel which is nearest to the air suction opening is represented by hL, $0.24 \leq hL/h \leq 0.4$ may be satisfied.

[0007] Furthermore, when the height from the air suction opening to the position of a blade out of blades of the blade wheel which is nearest to the air blow-out opening is represented by hZ, $0.875 \leq hZ/H \leq 0.925$ may be satisfied. The axial-flow air blower may be a propeller fan. The blade wheel of the propeller fan may be disposed so as to be perfectly overlapped with the bell mouth in side view.

[0008] According to a second aspect of the present invention, an air conditioner includes an axial-flow air blower having a blade wheel for blowing air to a heat exchanger and a bell mouth that is provided around the blade wheel of the air blower and guides air from an air suction side of the blade wheel to an air blow-out side of the blade wheel, wherein the bell mouth has an air blow-out wall portion that intercommunicates with an air blow-out opening and extends substantially along an axial direction of the blade wheel, and a slope wall portion that intercommunicates with the air blow-out wall portion and slopes to an air suction opening so as to expand in diameter, and when the overall height of the bell-mouth is represented by H, the height of the slope wall portion is represented by h and a slope angle of the slope wall portion is represented by β, $0.33 \leq h/H \leq 0.42$ and $60° \leq \beta \leq 70°$ are satisfied.

[0009] According to the present invention, the bell mouth is configured so as to satisfy $0.33 \leq h/H \leq 0.42$ and $60° \leq \beta \leq 70°$, whereby the reduction of the rotational number and the reduction of the driving force of the air blower can be satisfied at the same time with keeping the air flow amount equal.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a side cross-sectional view of an outdoor unit of an air conditioner according to a first embodiment of the present invention;

Fig. 2 is a top view showing the internal construction of the outdoor unit;

Fig. 3A is a side view showing the arrangement relationship between a bell mouth and a propeller fan, and Fig. 3B is a partially cross-sectional view of the bell mouth;

Fig. 4 is a diagram showing the relationship of a height ratio of a slope wall portion of the bell mouth at the same operating point, a slope angle of the slope wall portion, the rotational number of the propeller fan and a motor load;

Fig. 5 is a diagram showing the relationship of the diameter ratio between the bell mouth and the propeller fan, the rotational number of the propeller fan and the motor load;

Fig. 6 is a diagram showing the height ratio of the height from an air suction opening till the lower end point of the propeller fan to the height of the slope wall portion; and

Fig. 7 is a diagram showing the relationship of the height ratio of the height from the air suction opening till the upper end point of the propeller fan to the height of the bell mouth, the rotational number of the propeller fan and the motor load.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0011] A preferred embodiment according to the present invention will be described with reference to the accompanying drawings.

[0012] An air conditioner according to an embodiment comprises an outdoor unit 10 and an indoor unit (not shown), and makes refrigerant flow through a refrigerant circuit connected through a refrigerant pipe to perform cooling operation or heating operation. The outdoor unit 10 is disposed outdoors to heat-exchange with outdoor air so that refrigerant is condensed and heat is radiated to the outdoor air under cooling operation and also refrigerant is vaporized and take in heat from the outdoor air under heating operation. UP-and-down and right-and-left directions described below correspond to directions when the outdoor unit 10 is viewed from the front side thereof under the state that the outdoor unit 10 is installed.

[0013] Fig. 1 is a side cross-sectional view of the outdoor unit 10, and Fig. 2 is a top view showing the internal construction of the outdoor unit 10. The outdoor unit 10 has a substantially rectangular parallelepiped box-shaped unit case (housing) 11, and the unit case 11 has a bottom plate 12, support poles 14 extending from the four corners of the bottom plate 12 in the vertical direction, and a front panel 15 (Fig. 2).

[0014] As shown in Fig. 2, a heat exchanger 21 which is formed so as to be bent in a substantially U-shape in top view is disposed on the bottom plate 12, and an air blower (axial-flow air blower) 22 is disposed at the upper side of the heat exchanger 21. The heat exchanger 21 constitutes side surface portions of the unit case 11, and it is disposed so as to extend from the left side surface of the unit case 11 along the back surface and the right side surface thereof.

[0015] As shown in Fig. 1, the air blower 22 comprises a fan motor 23 disposed above the heat exchanger 21, and a propeller fan (blade wheel) 24 secured to the shaft of the fan motor 23. Joint members 16 for joining the neighboring support poles 14 at the position corresponding to the upper end of the heat exchanger 21 are provided between the neighboring support poles 14, and a pair of support frames 17 bridged between the joint members 16 are fixed to the fan motor 23.

[0016] A bell mouth 25 for guiding air at the air suction side of the propeller fan 24 to the air blow-out side of the propeller fan 24 is provided around the propeller fan 24, and the air blow-out opening 25A of the bell mouth 25 is covered by a fan guard (not shown) for preventing a human body or the like from coming into contact with the propeller fan 24. A face panel (not shown) is provided around the bell mouth 25 through a heat insulating member 26 such as foamed polystyrene.

[0017] When the propeller fan 24 is rotated by the fan motor 23, outdoor air is sucked into the unit case 11 from the surrounding of the outdoor unit 10, specifically, from the left, back and right sides of the unit case 11 excluding the front side of the unit case 11 as indicated by arrows X in Fig. 1, and discharged to the outside through an air blow-out opening 25A of the bell mouth 25 which is provided to the top surface portion of the unit case 11. That is, the outdoor unit 10 is configured as a top blow-out type for blowing out heat-exchanged air from the top surface.

[0018] A compressor (not shown), an accumulator 31, an oil separator 32 and a receiver tank 33 which constitute a part of the refrigerant circuit are provided on the bottom plate 12 in the unit case 11, and refrigerant circuit constituting parts such as valve members such as a four-way valve (not shown) , an expansion valve (not shown), etc. are mounted in the unit case 11 so as to be connected to one another through pipes. One end sides of the pipes for the refrigerant circuit constituting parts are connected to the indoor unit through the heat exchanger 21, and the other end sides of the pipes for the refrigerant circuit constituting parts are connected to the indoor unit, thereby constructing the refrigerant circuit in which refrigerant is circulated.

[0019] In this construction, the compressor is disposed at the front side of the unit case 11, and an electrical component box 34 in which various kinds of electrical component units such as a control board, etc. for controlling the air conditioner are arranged is disposed at the upper space of the compressor. Therefore, by detaching the front panel 15, a worker can easily perform a maintenance work for parts in the unit case 11. Reference numeral 35 represents a cover plate which is provided at the upper side of the compressor and prevents rain drops from directly impinging against the compressor.

[0020] Next, the construction of the bell mouth will be described.

[0021] The bell mouth 25 is formed by resin molding and thus it can be configured to be light in weight and have a desired shape. As shown in Fig. 3A, the bell mouth 25 is configured in a cylindrical shape so as to have an air low-out opening 25A and an air suction opening 25B which is larger in diameter than the air blow-out opening 25A, and also has an air blow-out wall portion 40 which intercommunicates with the air blow-out opening 25A and extends substantially along the axial direction of the propeller fan 24, and a slope wall portion 41 which intercommunicates with the air blow-out wall portion 40 and slopes toward the air suction opening 25B so as to gradually increase in diameter.

[0022] The air blow-out wall portion 40 guides air blown out by the propeller fan 24 to the air blow-out opening

25A, and an angle α with respect to the plane of the air blow-out opening 25A is set to a right angle or an angle which is slightly smaller than the right angle (in this embodiment, the angle α = 89°). Furthermore, the upper endportion of the air blow-out wall portion 40 (the end portion at the air blow-out opening side) is outwardly and annually bent to have a predetermined radius of curvature, and suppresses resistance to air flow when air is blown out.

[0023] Furthermore, the slope wall portion 41 smoothly feed air in the unit case 11 into the bell mouth 25 when the propeller fan 24 is operated, and it is integrally joined to the air blow-out wall portion 40 by a joint portion 42 as shown in Fig. 3B. The slope wall portion 41 expands outwardly toward the air suction opening 25B, and it is formed so as to be bent annularly at a slope angle β with respect to the plane of the air suction opening 25B. Furthermore, the lower end portion (the end portion at the air suction opening side) 41A of the slope wall portion 41 is bent outwardly along the plane of the air suction opening 25B.

[0024] The propeller fan 24 has a hub 45 fixed to the motor shaft of a fanmotor 23 (Fig. 1), and plural blades 46 which are integrally formed on the outer periphery of the hub 45 so as to have a predetermined blade angle and be spaced from one another at predetermined intervals. As shown in Fig. 3A, the propeller fan 24 is disposed so as to be perfectly overlapped with the bell mouth 25 in side view. According to this construction, since the bell mouth 2 5 covers an area where the propeller fan 2 4 operates, all the air blown out by the propeller fan 24 can be guided by the bell mouth 25, so that the air blowing amount of the propeller fan 24 can be enhanced.

[0025] The inventors of this application has performed a simulation to derive shape factors for the bell mouth 25 which can simultaneously satisfy both reduction of the rotational number of the propeller fan 24 and reduction of the load of the fan motor 23 at the same operating point of the air blower 22. Here, the same operating point of the air blower 22 means an operating condition that the air flow amount Q (m^3/min) and the static pressure (mmAq) are equal. In Figs. 3A and 3B, when the height H of the bell mouth 25, the height h of the slope wall portion 41, the slope angle β of the slope wall portion 41, the diameter D of the bell mouth 25 at the joint portion 42, the diameter d of the propeller fan 24, the height hZ from the air suction opening 25B to the upper end point (the position nearest to the air blow-out opening 25A) 46A of the blade 46 of the propeller fan 24, and the height hL from the air suction opening 25B to the lower end point (the position nearest to the air suction opening 25B) of the blade of the propeller fan 24 are introduced as parameters, the inventors have found how the variation of these shape values act on the reduction of the rotational number of the propeller 24 and the reduction of the load of the fan motor 23.

[0026] In Fig. 4, the abscissa axis represents an air suction port angle, that is, the slope angle β of the slope wall portion 41 of the bell mouth 25, the ordinate axis at the left side represents a motor load (W) and the ordinate axis at the right side represents the rotational number (rpm) of the propeller fan 24. When the air blower 22 is operated under the same condition that the air flow amount Q is set to (200m^3/min) and the static pressure is set to (6mmA), it is simulated how the rotational number of the propeller fan 24 and the load of the fan motor 23 vary while each of the height ratio h/H of the slope wall portion 41 of the bell mouth 25 and the slope angle β of the slope wall portion 41 is changed.

[0027] According to this simulation, it has been found that a bell mouth 25 designed in the neighborhood of the condition that h/H = 0.33 (filled circles, filled rectangles) and the slope angle β = 60° has the minimum rotational number of the propeller fan 24 and the minimum load of the fan motor 23 and thus has highest performance.

[0028] In a range where the slope angle β is larger than 70°, with respect to all bell mouths satisfying 0.20≤h/H≤0.67, the motor load and the rotational number of the propeller fan 24 trend to increase as the slope angle increases. On the other hand, in a range where the slope angle β is not more than 70°, with respect to a bell mouth satisfying h/H = 0.67, the motor load and the rotational number are extremely high values.

[0029] When considered from the viewpoint of the motor load, with respect to bell mouths satisfying h/H - 0.20, 0.33, the motor load has a local minimum point in the neighborhood of the slope angle β of 60°, and the motor load increases even when the slope angle is smaller and larger than 60°. Here, the bell mouth satisfying h/H=0.20 has the remarkably largest value at the slope angle β=70. With respect to bell mouths satisfying h/H=0.42, 0.50, the motor load decreases when the slope angle β ranges from 50° to 60°, and it is equal to a substantially fixed value when the slope angle β ranges from 60° to 70°.

[0030] Furthermore, when considered from the viewpoint of the rotational number, with respect to a bell mouth satisfying h/H=0.50, it trends to decrease when the slope angle β ranges from 50° to 70°. With respect to a bell mouth satisfying h/H=0.42, it decreases when the slope angle β ranges from 50° to 60°, and it is equal to a substantially fixed value when the slope angle β ranges from 60° to 70°. With respect to a bell mouth satisfying h/H=0.3, the rotational number has a local minimum point in the neighborhood of the slope angle β of 60°, and the rotational number increases even when the slope angle β is smaller and larger than 60°. With respect to a bell mouth satisfying h/H = 0.20, it trends to be substantially constant when the slope angle β ranges from 50° to 60°, but increase when the slope angle β ranges from 60° to 70°.

[0031] In order to reduce the rotational number of the propeller fan 24 and the load of the fan motor 23, it is found from this simulation that it is desirable to set 0.33≤h/H≤0.42 and 60°≤β≤70°.

[0032] As described above, when the bell mouth of this embodiment is configured to satisfy 0.33≤h/H≤0.42 and

60°≤β≤70°, it has been found that the bell mouth of this embodiment can satisfy both the reduction of the rotational number of the propeller fan 24 and the reduction of the motor load at the same time with keeping the same air flow amount.

[0033] Fig. 5 is a diagram showing the relationship of the diameter ratio (D/d) between the bell mouth 25 and the propeller fan, the rotational number of the propeller fan and the motor load when the bell mouth 25 is designed to satisfy h/H=0.33 and the slope angle β=60°.

[0034] As shown in Fig. 5, the motor load and the rotational number trend to increase as the diameter ratio D/d increases. Therefore, in order to reduce the motor load and the rotational number, it is desirable that the value of the diameter ratio D/d is set to be as small as possible. On the other hand, when the value of the diameter ratio D/d is reduced, there occurs a risk that the blades 46 of the propeller fan 24 come into contact with the inner surface of the bell mouth 25. Therefore, from the viewpoint of reducing the motor load and the rotational number and suppressing the contact between the propeller fan 24 and the bell mouth 25, it is desirable from the simulation result that the bell mouth and the propeller fan are configured in the range of 1.02<D/d<1.03, and further it is more desirable that the bell mouth and the propeller fan are configured in the range of 1.0225≤D/d≤1.0285.

[0035] Fig. 6 is a diagram showing the relationship of the rate hL/h of the height hL from the air suction opening 25B to the lower end point of the propeller fan 24 to the height h of the slope wall portion 41, the rotational number of the propeller fan and the motor load. It has been found from the simulation result that the motor load trends to increase as hL/h increases, however, the rotational number has a local minimum value in the neighborhood of hL/h=0.24 or hL/h = 0.3.

[0036] Accordingly, it is desirable from the simulation result that the propeller fan 24 is disposed so as to satisfy the range of 0.24≤hL/h≤0.40, whereby the rotational number of the propeller fan 24 and the motor load can be further reduced.

[0037] Fig. 7 is a diagram showing the relationship of the rate of the height hZ from the air suction opening 25B to the upper end point 46A of the propeller fan 24 to the height H of the bell mouth 25, the rotational number of the propeller fan and the motor load. It has been found from this simulation result that the motor load trends to increase as hZ/H increases and the rotational number has a local minimum value in the neighborhood of hZ/H = 0.9.

[0038] Accordingly, it is desirable from this simulation result that the propeller fan 24 is disposed so as to satisfy the range of 0.866≤hZ/H≤0.933, and further the propeller fan 24 is disposed so as to satisfy the range of 0.875≤hZ/H≤0.925. Accordingly, the rotational number of the propeller fan 24 and the motor load can be further reduced.

[0039] As described above, the bell mouth of this embodiment is configured so as to satisfy 0.33≤h/H≤0.42 and 60°≤β≤70°, the diameter D of the opening of the joint portion 42 of the bell mouth 25 is set to satisfy 1.02<D/d<1.03, and the propeller fan 24 is disposed in the bell mouth so as to satisfy 0.24≤hL/h≤0.40 and 0.866≤hZ/H≤0.933, whereby both the reduction of the rotational number of the propeller fan 24 and the reduction of the motor load can be satisfied at the same time with keeping the same air flow amount.

[0040] According to this embodiment, the propeller fan 24 is disposed so as to be perfectly overlapped with the bell mouth 25 in side view. Therefore, the area where the propeller fan 24 operates is covered by the bell mouth 25, whereby all the air blown by the propeller fan 24 can be guided by the bell mouth 25, and the air flow amount of the propeller fan 24 can be enhanced.

Claims

1. Abell-mouth structure of an air blower that is provided around a blade wheel of an axial-flow air blower and guides air from an air suction side of the blade wheel to an air blow-out side of the blade wheel, comprising:

   an air blow-out wall portion that intercommunicates with an air blow-out opening and extends substantially along an axial direction of the blade wheel; and
   a slope wall portion that intercommunicates with the air blow-out wall portion and slopes to an air suction opening so as to expand in diameter, wherein when the overall height of the bell-mouth is represented by H, the height of the slope wall portion is represented by h and a slope angle of the slope wall portion is represented by β, the bell mouth structure is configured so as to satisfy 0.33≤h/H≤0.42 and 60°≤β≤70°.

2. The bell mouth structure according to claim 1, wherein when the diameter of an opening of a connecting portion between the air blow-out wall portion and the slope wall portion is represented by D and the diameter of the blade wheel is represented by d, 1.02<D/d<1.03 is satisfied.

3. The bell mouth structure according to anyone of claims 1 and 2, wherein when the height from the air suction opening to the position of a blade out of blades of the blade wheel which is nearest to the air suction opening is represented by hL, 0.24≤hL/h≤0.4 is satisfied.

4. The bell mouth structure according to any one of claims 1 to 3, wherein when the height from the air suction opening to a position of a blade out of blades of the blade wheel which is nearest to the air blow-

out opening is represented by hZ, $0.875 \leq hZ/H \leq 0.925$ is satisfied.

5. The bell mouth structure according to any one of claims 1 to 4, wherein the axial-flow air blower is a propeller fan.

6. The bell mouth structure according to claim 5, wherein the blade wheel of the propeller fan is disposed so as to be perfectly overlapped with the bell mouth in side view.

7. An air conditioner comprising:

a heat exchanger;
an axial-flow air blower having a blade wheel for blowing air to the heat exchanger; and
a bell mouth that is provided around the blade wheel of the air blower and guides air from an air suction side of the blade wheel to an air blow-out side, wherein the bell mouth has an air blow-out wall portion that intercommunicates with an air blow-out opening and extends substantially along an axial direction of the blade wheel, and a slope wall portion that intercommunicates with the air blow-out wall portion and slopes to an air suction opening so as to expand in diameter, and when the overall height of the bell-mouth is represented by H, the height of the slope wall portion is represented by h and a slope angle of the slope wall portion is represented by β, the bell mouth is configured so as to satisfy $0.33 \leq h/H \leq 0.42$ and $60° \leq \beta \leq 70°$.

FIG.1

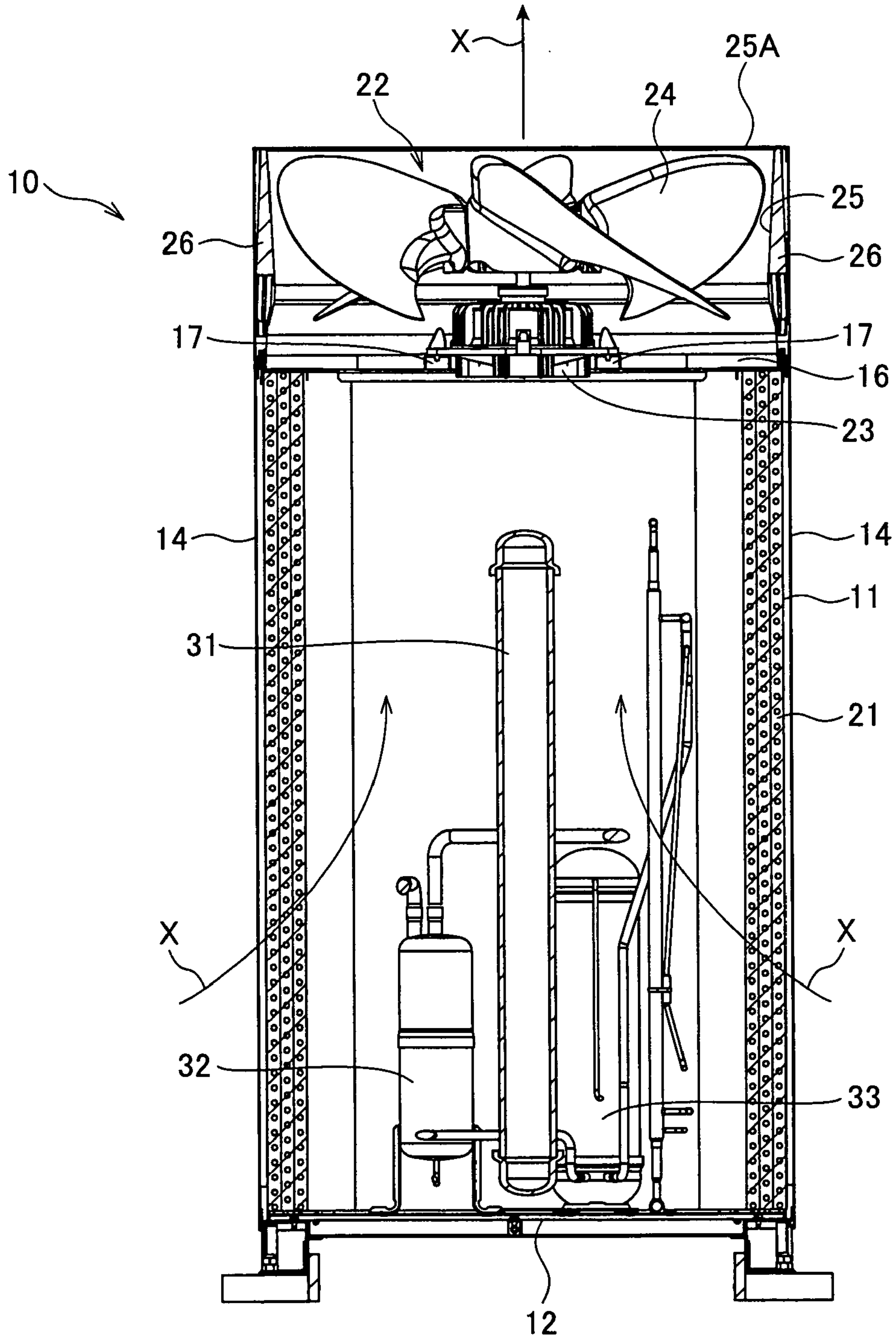


FIG.2

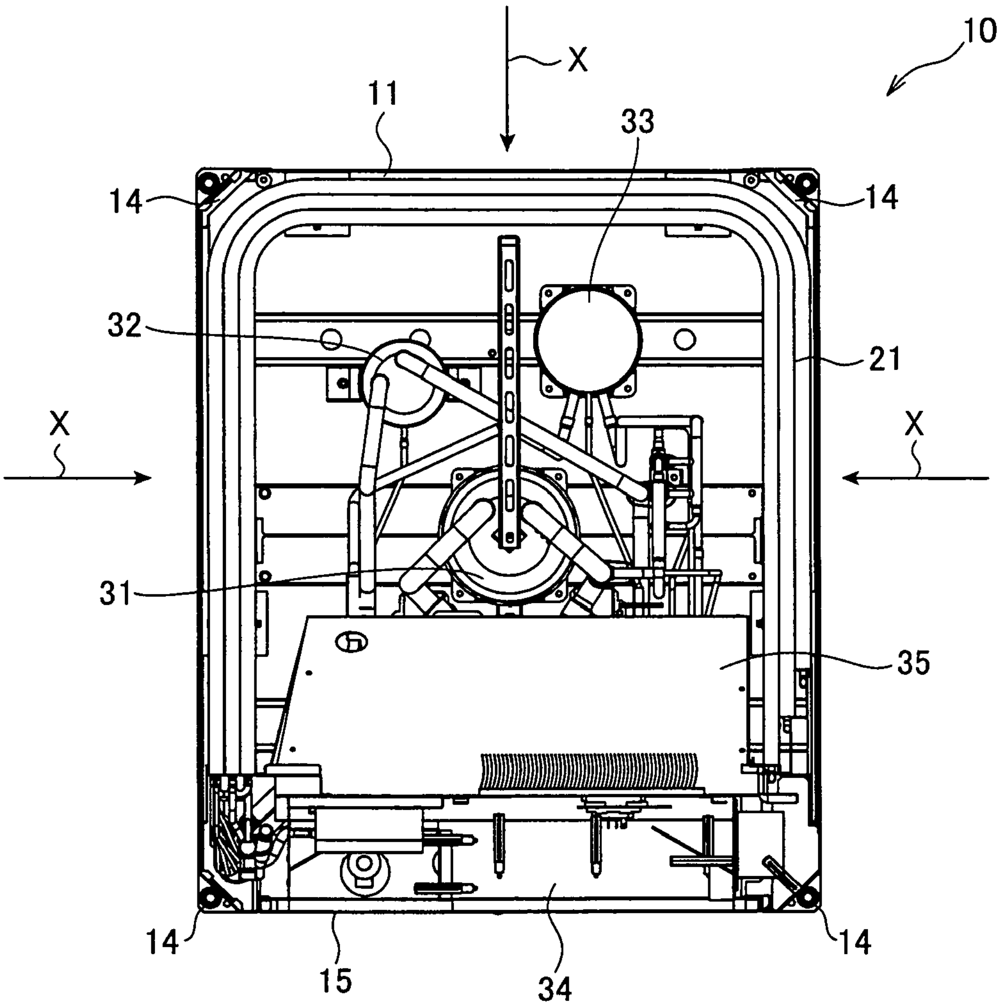


FIG.3B

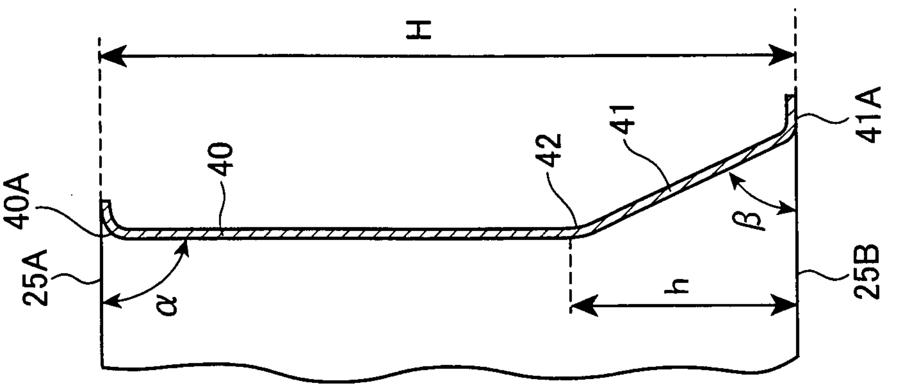

H
25A
40A
40
42
41
41A
α
β
h
25B

FIG.3A

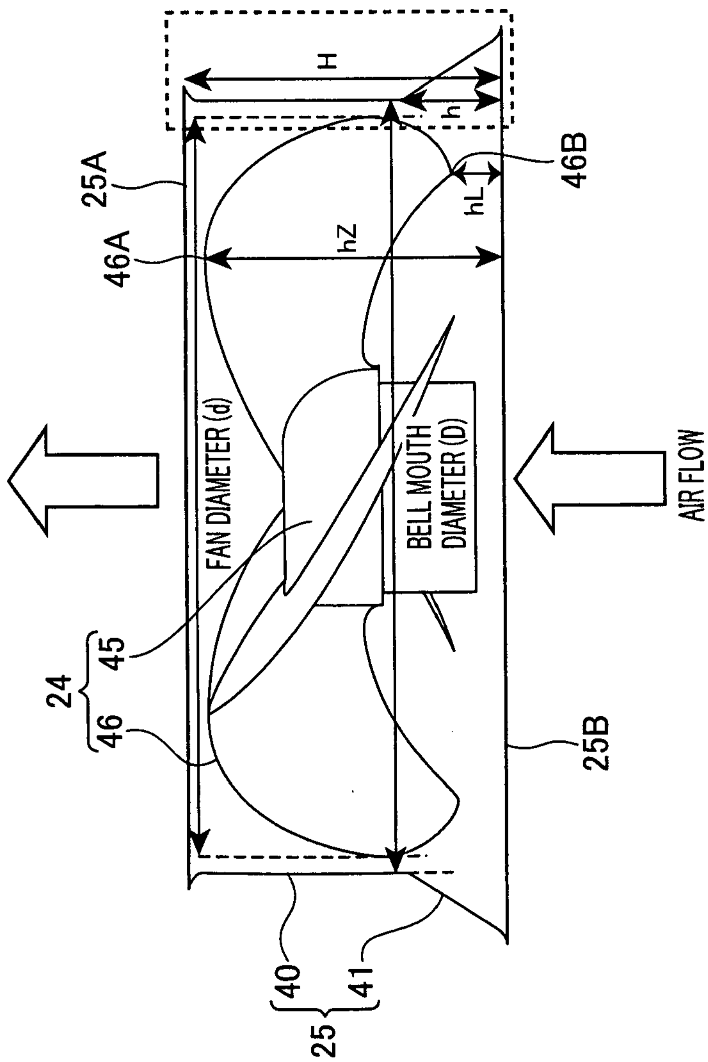

H
h
25A
46B
hL
46A
hZ
FAN DIAMETER (d)
BELL MOUTH
DIAMETER (D)
AIR FLOW
24
45
46
25B
40
41
25

FIG.4

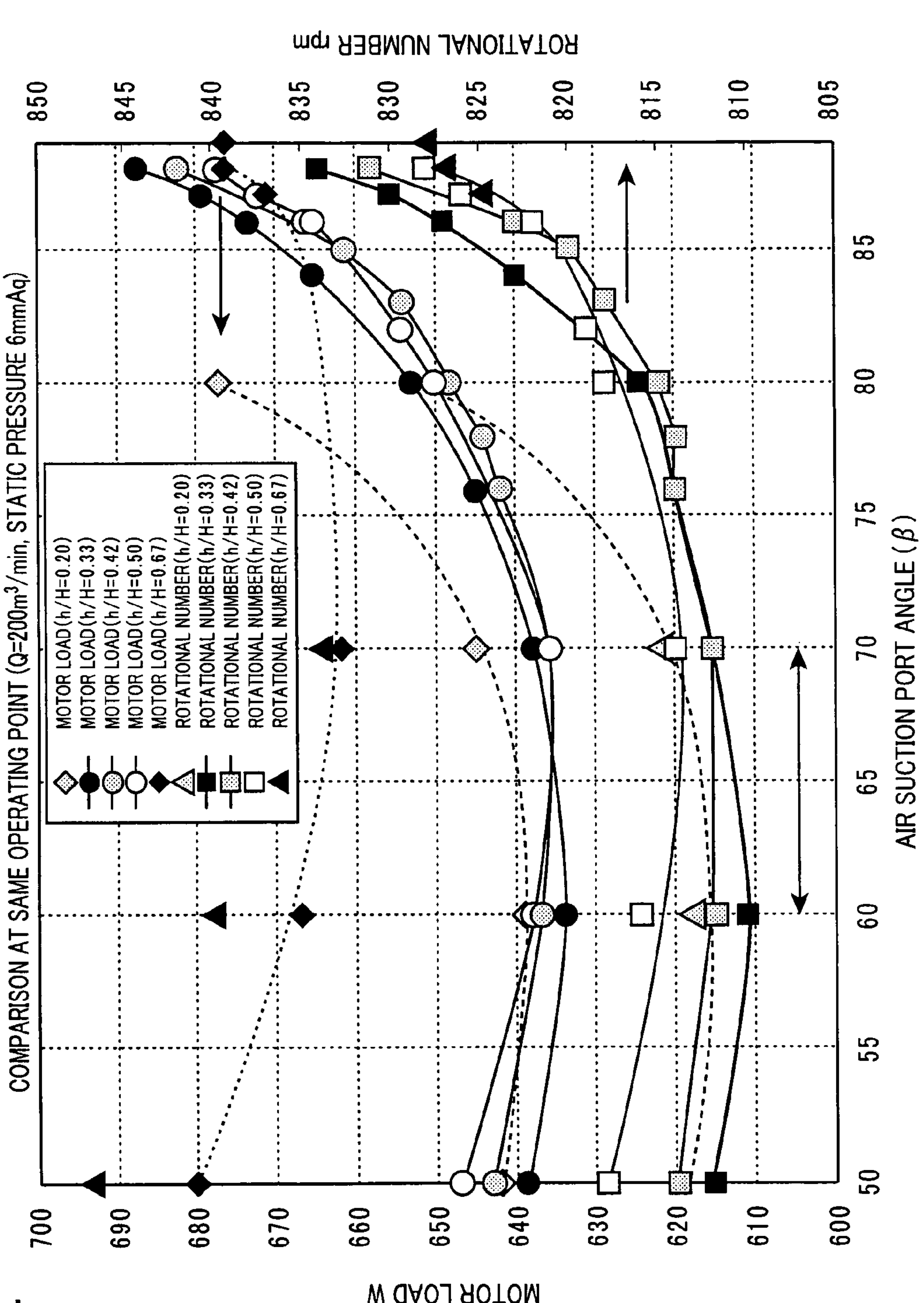
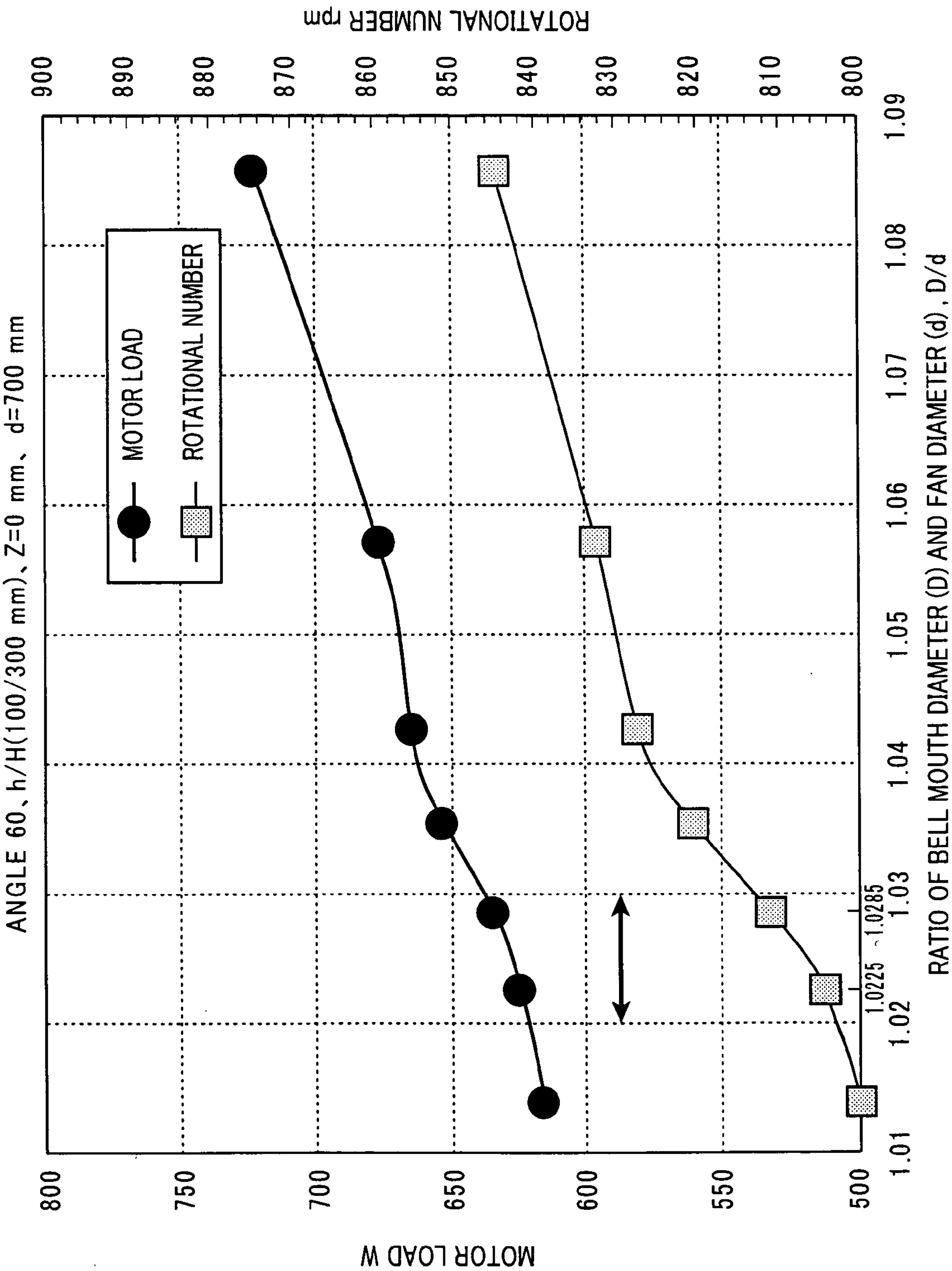

COMPARISON AT SAME OPERATING POINT (Q=200m³/min, STATIC PRESSURE 6mmAq)
MOTOR LOAD(h/H=0.20)
MOTOR LOAD(h/H=0.33)
MOTOR LOAD(h/H=0.42)
MOTOR LOAD(h/H=0.50)
MOTOR LOAD(h/H=0.67)
ROTATIONAL NUMBER(h/H=0.20)
ROTATIONAL NUMBER(h/H=0.33)
ROTATIONAL NUMBER(h/H=0.42)
ROTATIONAL NUMBER(h/H=0.50)
ROTATIONAL NUMBER(h/H=0.67)
MOTOR LOAD W
700
690
680
670
660
650
640
630
620
610
600
ROTATIONAL NUMBER rpm
850
845
840
835
830
825
820
815
810
805
AIR SUCTION PORT ANGLE (β)
50
55
60
65
70
75
80
85

FIG.5


ANGLE 60, h/H(100/300 mm), Z=0 mm, d=700 mm
MOTOR LOAD
ROTATIONAL NUMBER
MOTOR LOAD W
ROTATIONAL NUMBER rpm
RATIO OF BELL MOUTH DIAMETER (D) AND FAN DIAMETER (d), D/d
1.0225 ~1.0285
800
750
700
650
600
550
500
900
890
880
870
860
850
840
830
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1.07
1.08
1.09

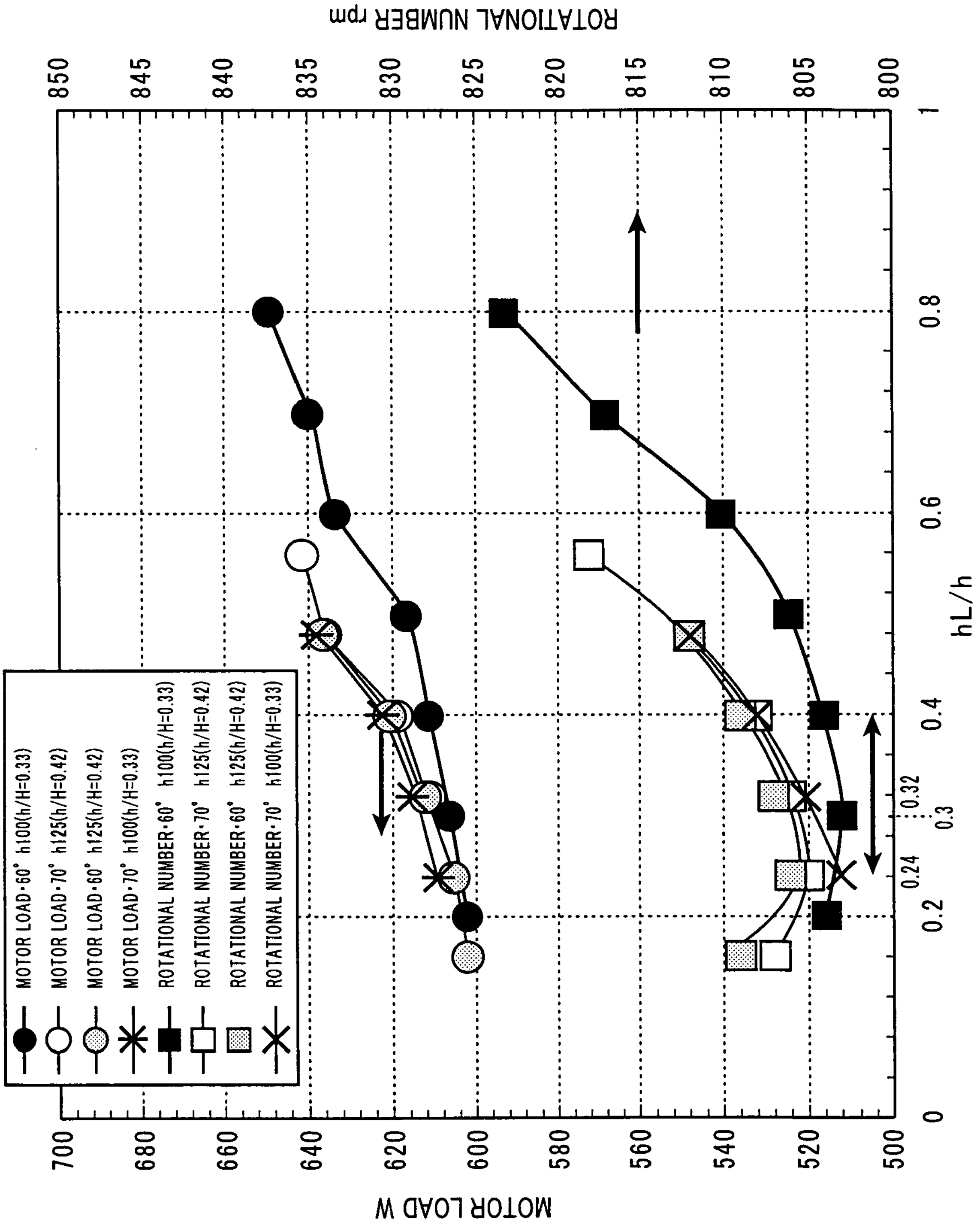
ROTATIONAL NUMBER rpm
850
845
840
835
830
825
820
815
810
805
800
MOTOR LOAD W
700
680
660
640
620
600
580
560
540
520
500
hL/h
0
0.2
0.24
0.3
0.32
0.4
0.6
0.8
1
MOTOR LOAD·60° h100(h/H=0.33)
MOTOR LOAD·70° h125(h/H=0.42)
MOTOR LOAD·60° h125(h/H=0.42)
MOTOR LOAD·70° h100(h/H=0.33)
ROTATIONAL NUMBER·60° h100(h/H=0.33)
ROTATIONAL NUMBER·70° h125(h/H=0.42)
ROTATIONAL NUMBER·60° h125(h/H=0.42)
ROTATIONAL NUMBER·70° h100(h/H=0.33)

FIG.6

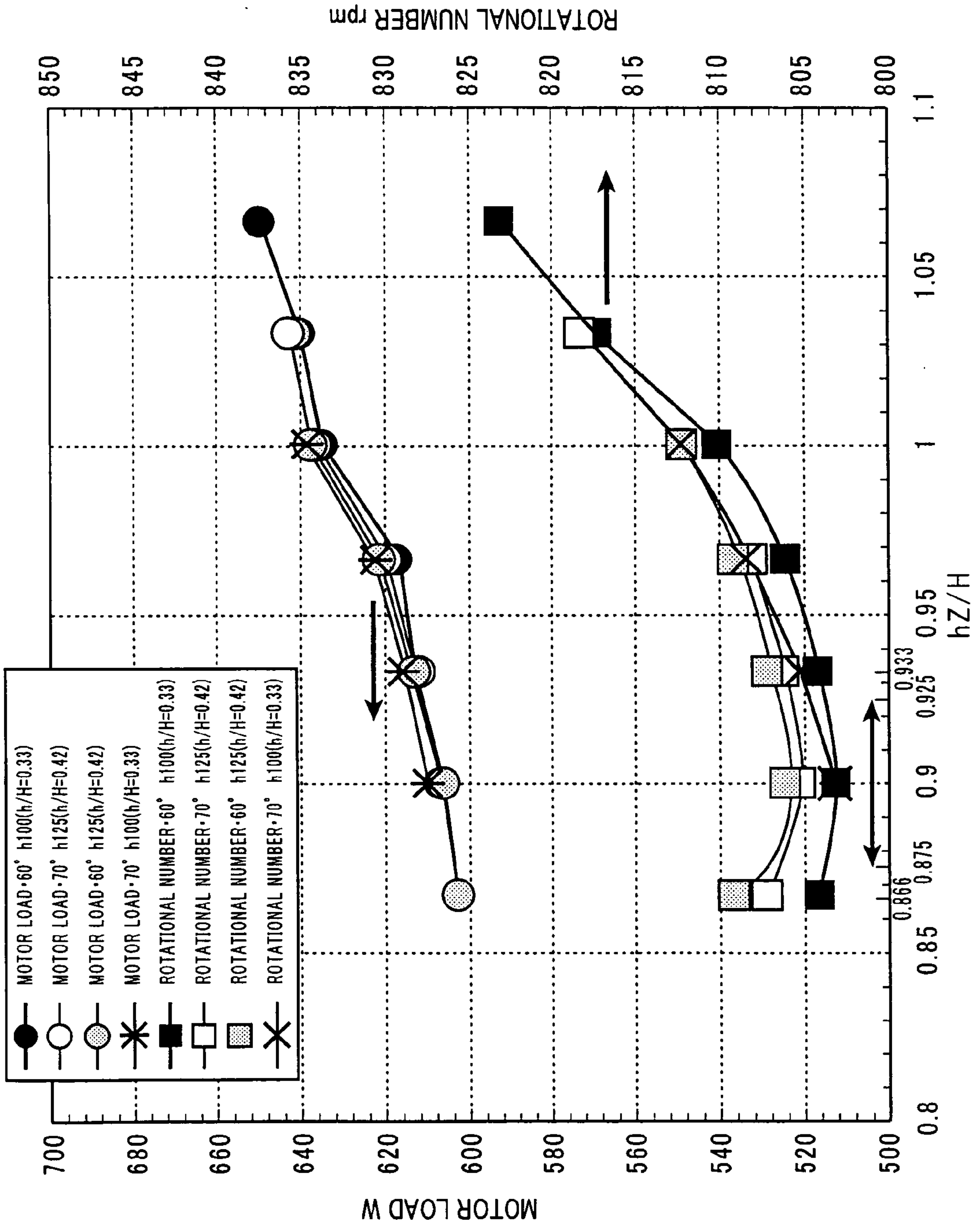
MOTOR LOAD·60° h100(h/H=0.33)
MOTOR LOAD·70° h125(h/H=0.42)
MOTOR LOAD·60° h125(h/H=0.42)
MOTOR LOAD·70° h100(h/H=0.33)
ROTATIONAL NUMBER·60° h100(h/H=0.33)
ROTATIONAL NUMBER·70° h125(h/H=0.42)
ROTATIONAL NUMBER·60° h125(h/H=0.42)
ROTATIONAL NUMBER·70° h100(h/H=0.33)
MOTOR LOAD W
700
680
660
640
620
600
580
560
540
520
500
ROTATIONAL NUMBER rpm
850
845
840
835
830
825
820
815
810
805
800
hZ/H
0.8
0.85
0.866
0.875
0.9
0.925
0.933
0.95
1
1.05
1.1

FIG.7

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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