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CA 2815746 C 2018/06/26

(11)(21) 2 815 746

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 2010/11/16
(87) Date publication PCT/PCT Publication Date: 2012/05/24
(45) Date de délivrance/Issue Date: 2018/06/26
(85) Entrée phase nationale/National Entry: 2013/04/24
(86) N° demande PCT/PCT Application No.: NL 2010/050762
(87) N° publication PCT/PCT Publication No.: 2012/067494

(51) Cl.Int./Int.Cl. *A61G 11/00* (2006.01)

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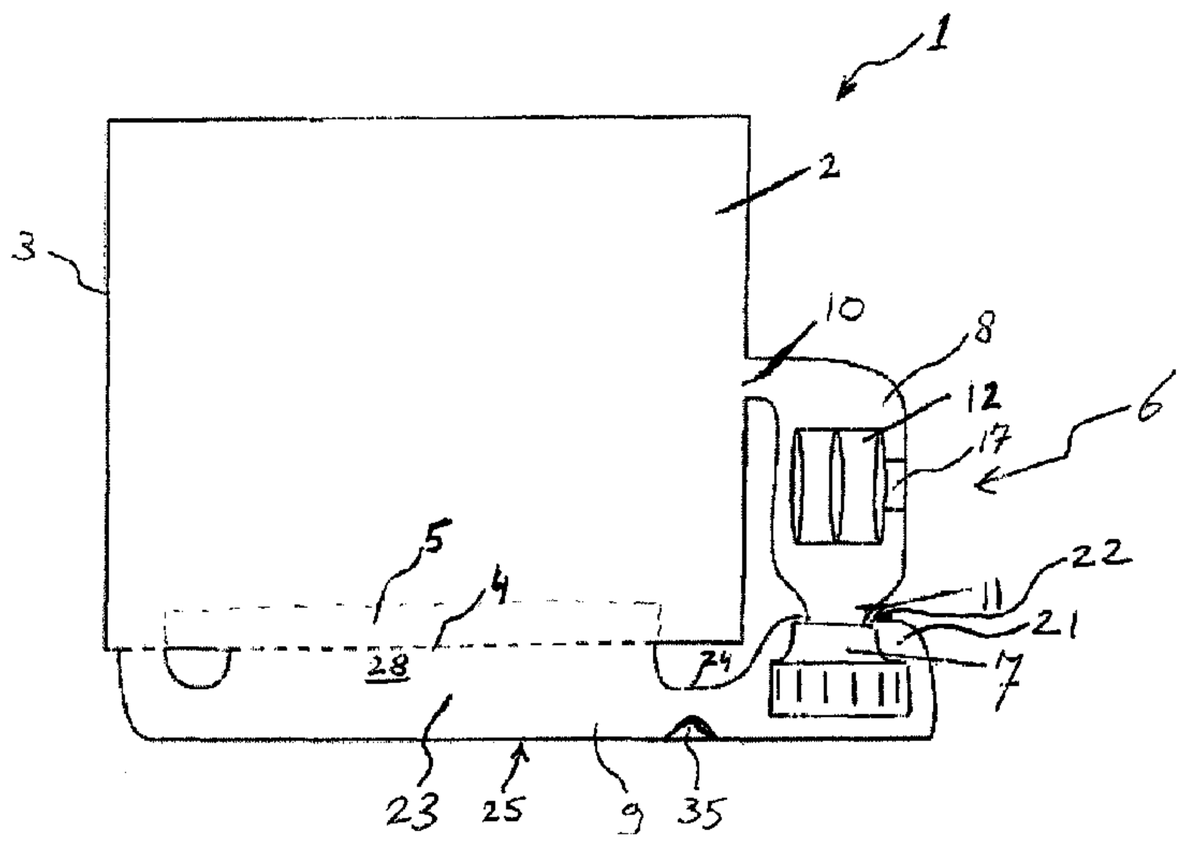
(54) Titre : INCUBATEUR UTILISE EN NEONATALOGIE POUR LES SOINS INTENSIFS AUX NOUVEAU-NES
(54) Title: INCUBATOR USED IN NEONATOLOGY FOR INTENSIVE CARE OF NEWBORNS



(57) Abrégé/Abstract:
An incubator, used in neonatology, comprises an incubator chamber defined by a bottom part and a top casing covering a bed area of the bottom part. The incubator comprises an air treatment and circulation device for treating air and circulating it through the chamber, said air treatment and circulation device including a ventilator. The air treatment and circulation device is connected to chamber inlet openings which are arranged along one or more sides of said bed area, allowing treated air to flow from the treatment and circulation device into the chamber. The air treatment and circulation device furthermore is connected to at least one chamber outlet opening allowing air to flow out from the chamber to the treatment and circulation device. The air flows in the incubator are routed such that noise is reduced and no high air flow speeds occur near the infant in the incubator.

ABSTRACT

An incubator, used in neonatology, comprises an incubator chamber defined by a bottom part and a top casing covering a bed area of the bottom part. The incubator comprises an air treatment and circulation device for treating air and circulating it through the chamber, said air treatment and circulation device including a ventilator. The air treatment and circulation device is connected to chamber inlet openings which are arranged along one or more sides of said bed area, allowing treated air to flow from the treatment and circulation device into the chamber. The air treatment and circulation device furthermore is connected to at least one chamber outlet opening allowing air to flow out from the chamber to the treatment and circulation device. The air flows in the incubator are routed such that noise is reduced and no high air flow speeds occur near the infant in the incubator.

INCUBATOR USED IN NEONATOLOGY FOR INTENSIVE CARE OF NEWBORNS

Field of the invention:

The present invention belongs to the field of incubators, in particular incubators used in neonatology for intensive care of newborns, possibly prematurely born.

Background:

Such incubators are used in neonatology for intensive care of newborns, possibly prematurely born. Such an incubator is for example known from EP 0162375 A1.

A problem with known incubators is the noise that the ventilator of the air treatment and circulation device makes, which disturbs the infant and which may cause stress and other negative effects on the infants well being and development.

Summary of the invention:

A first aspect of the present invention has for an object to provide an improved incubator in which the noise generated by the ventilator is reduced.

This object is achieved by an incubator an incubator comprising an incubator chamber defined by a bottom part and a top casing covering a bed area of the bottom part, and comprising an air treatment and circulation device for treating air and circulating it through the chamber, said air treatment and circulation device including a ventilator, wherein the air treatment and circulation device is connected to chamber inlet openings which are arranged along one or more sides of said bed area, allowing treated air to flow from the treatment and circulation device into the chamber, and the air treatment and circulation device furthermore is connected to at least one chamber outlet opening allowing air to flow out from the chamber to the treatment and circulation device.

The treatment and circulation device has an inlet air duct located between the chamber outlet opening and the ventilator, wherein a baffle unit is arranged in said inlet air duct.

The baffle unit inside the inlet duct, through which air is fed to the ventilator, generates a more homogeneous flow with less turbulence compared to the situation where no baffle unit is present. The low turbulence homogeneous feed flow towards the ventilator causes the ventilator to generate less noise.

In a preferred embodiment a constriction is arranged in the inlet air duct. The constriction removes turbulences from the air flow and increases the flow speed.

More preferably the constriction is arranged between the baffle unit and the ventilator. The constriction which is thus arranged just upstream from the ventilator, results in the air having a favourable angle of attack on the ventilator blades, which reduces air separation on the blades and thereby reduces the noise generated by the ventilator.

In a preferred embodiment the baffle unit comprises a tubular portion which is concentrically arranged in the inlet air duct, such that air can flow along the inner surface as well as the outer surface of the tubular portion. This baffle unit shape generates a particular advantageous homogeneous channel flow with less turbulence.

The baffle unit may advantageously include radial air guiding vanes that extend inwardly from the tubular portion towards the centre axis of the tubular portion and which are preferably are interconnected in the centre of the baffle unit by a centre piece.

The baffle unit and constriction as described here works particularly well with a ventilator of the centrifugal type. However, it must be noted that within the scope of the invention also a baffle unit is conceivable that cooperates with an axial ventilator.

In a particularly preferred embodiment the baffle unit comprises heating elements for heating the air flowing along its surface, wherein the heating elements are preferably incorporated in the tubular portion and/or the air guiding vanes of the baffle unit. The heating elements heat up the baffle unit and thereby allow the air guided along the surfaces of the baffle unit to be heated. The different parts of the baffle unit preferably have a low mass, whereby they are heated in a short time span. Thereby a fast temperature response can be achieved. The location of the baffle unit in the centre of the inlet duct and thus central in the air flow ensures a high heat

exchange between the baffle unit and the air flowing along. This results in a short cooling down time span. In all, the structure of the combined baffle and heating unit results in a heating system with a fast system response.

A second aspect of the invention relates to an incubator as defined at the outset, wherein the ventilator of the air treatment and circulation device is arranged in a ventilator chamber and wherein the air treatment and circulation device furthermore has a distribution chamber which is in communication with the ventilator chamber and with the chamber inlet openings. The distribution chamber distributes the air flowing out of the ventilator to the chamber inlet openings and is designed to reduce the air speed.

In a possible embodiment, the distribution chamber is defined by a housing having a substantially flat upper wall and a flat bottom wall extending parallel thereto. This particular of the upper wall and bottom wall prevents that the air flow runs into obstructions during its travel from the ventilator to the chamber inlets.

Preferably, the upper wall and bottom wall have on their longitudinal sides and at least one of their transversal sides an upwardly extending edge portion, wherein the associated edge portions between them define outlet ducts, wherein the free end of the outlet ducts is at least partly open, thereby defining the chamber inlet openings. Preferably, the upwardly extending edge portions are curved. The particular shape of the housing prevents obstacles and tight turns which could create additional pressure losses.

The outlet ducts are closed at their side ends by edge walls interconnecting the upper wall and bottom wall.

In a particularly advantageous embodiment a Venturi hump is arranged at the transition between the ventilator chamber and the distribution chamber. This Venturi hump creates a narrow gap through which the airflow locally accelerates. The created pressure differential over this hump balances the volume flow over the entire width of the Venturi hump such that all chamber inlet openings towards the chamber receive a certain amount of air. This effect is analogue to a water dam in a river which damps out dynamic effects.

Preferably the Venturi hump extends in a curved manner over the bottom wall, preferably in circular manner, thus with a constant radius of curvature. Thereby the air flow over the hump is equally distributed in the directions of the respective outlet ducts and the associated chamber inlets.

In a possible embodiment the ventilator chamber and the distribution chamber and the outlet ducts are defined by one integral casing. In this way a compact and low complex ducting construction can be achieved. No couplings and transition parts are necessary between the different chambers and ducts and therefore a ducting system with a smooth inner surface is provided in which the air flow is disturbed as little as possible.

A third aspect of the invention relates to the routing of the air flows in the incubator chamber. For the comfort of the infant lying in the incubator chamber it is important that the air speeds near the infant are low.

This aspect of the invention has for an object to provide an incubator that is improved or at least provides an alternative with respect to the air flow routing through the incubator chamber.

This object is achieved by an incubator as described at the outset, in which said bed area has a head end and a foot end, two longitudinal sides extending between the head end and the foot end and a transverse side on the head end and a transverse side on the foot end, as well as a centre defined by the intersection of the longitudinal an transversal centre lines, wherein on each of said longitudinal sides one or more of the chamber inlet openings are arranged, wherein the chamber inlet opening(s) on said longitudinal sides are positioned asymmetrically with respect to the centre. The asymmetric arrangement of the chamber inlet openings on the opposing longitudinal ends results in an asymmetric routing of the respective air flows exiting from these inlet openings.

The airflows exiting from the chamber inlet openings at the longitudinal sides, flow along the longitudinal side walls of the casing and along the top. The asymmetric routing prevents collision of the flow in the centre of the chamber top, which has the advantage for keeping both the temperature stability and the required low airspeeds near the infant.

Preferably, the chamber inlet opening(s) on one of the longitudinal sides is/are on the head end half of said longitudinal side and the chamber inlet opening(s) on the opposite longitudinal side is/are on the foot end half of said opposite longitudinal side.

Preferably only on one transversal side one or more chamber inlet openings are arranged, preferably on the foot end. The flow exiting from this inlet at the foot

end is relatively weak in order not to disturb the flows originating from the inlets at the longitudinal sides.

In a possible embodiment only one chamber inlet opening is arranged on each of the respective sides, said respective outlet openings preferably having an elongate shape, more preferably being slot shaped. By the slot shaped inlets a wide flow curtain along the walls of the casing is achieved, which shields the interior of the incubator chamber from the temperature influence of the walls.

In a possible embodiment the chamber outlet opening is arranged on the head end.

Preferably, the chamber outlet opening is arranged on a level above the bed area, preferably at least 200 mm above the bed area, more preferably at the half of the height of the chamber. This placement of the outlet opening prevents that the air speeds near the infant lying in the incubator will become too high.

The invention is also directed to incubator comprising an incubator chamber defined by a bottom part and a top casing covering a bed area of the bottom part, and comprising an air treatment and circulation device for treating air and circulating air through the chamber, said air treatment and circulation device including a ventilator;

wherein:

the air treatment and circulation device is connected to chamber inlet openings which are arranged along one or more sides of said bed area, allowing treated air to flow from the treatment and circulation device into the incubator chamber;

the air treatment and circulation device is furthermore connected to at least one chamber outlet opening allowing air to flow out from the incubator chamber to the treatment and circulation device;

said bed area has a head end and a foot end, two longitudinal sides extending between the head end and the foot end and a transverse side on the head end and a transverse side on the foot end, as well as a centre defined by the intersection of the longitudinal and transversal centre lines;

on each of said longitudinal sides one or more of the chamber inlet openings are arranged;

the chamber inlet opening(s) on said longitudinal sides are positioned asymmetrically with respect to the longitudinal centre line and with respect to the transversal centre line; and

the chamber inlet opening(s) on one of the longitudinal sides is/are on the head end half of said longitudinal side and the chamber inlet opening(s) on the opposite longitudinal side is/are on the foot end half of said opposite longitudinal side.

It is noted that the mentioned aspects of the invention can be combined with each other.

Brief description of the drawings:

The invention will be further elucidated in the following detailed description with reference to the drawings, in which:

Fig.1 shows a schematic sectional view of an embodiment of an incubator according to the invention,

Fig. 2 shows a view in perspective of a baffle unit for the incubator of Fig. 1,

Fig. 3 shows a schematic view in perspective of the incubator chamber of the incubator of Fig. 1, in which the air flows are indicated, and

Fig. 4 shows a view in perspective of a housing for the air treatment and circulation device and associated ducting system of the incubator of Fig. 1.

Description of preferred embodiments:

In Fig. 1 is shown an incubator 1 for neonatology. The incubator 1 has an incubator chamber 2 which is defined by a casing 3 and a bottom part 4. The bottom part 4 supports a bed portion 5 on which the infant lies.

The incubator 1 furthermore has an air treatment and circulation device 6. The air treatment and circulation device includes a ventilator unit 7, an inlet duct 8 and an outlet ducting assembly 9. The inlet duct may be of tubular shape with for example a substantially circular cross section. The inlet duct 8 is in fluid communication with the incubator chamber 2 through a chamber air outlet 10. The inlet duct 8 is connected

at its other end connected with the ventilator unit 7. At this end the inlet duct 8 has an end portion which forms a constriction 11, which means that said end portion of the inlet duct 8 narrows towards the ventilator unit 7.

The ventilator unit 7 comprises a centrifugal ventilator. The air flows towards the centrifugal ventilator in axial direction and exits in a radial direction.

In the inlet duct 8 between the constriction 11 and the chamber outlet opening 10 is arranged a baffle unit 12. The baffle unit 12 is shown in more detail in Fig. 2. The baffle unit 12 has a tubular portion 13. Furthermore the baffling unit 12 has air guiding vanes 14, in this specific embodiment shown, it has four vanes 14 which are attached to the inner side of the tubular portion 13 and extend therefrom radially inwards towards a centre part 15. The vanes 14 are connected to the centre part 15. The centre part 15 has on its end facing the chamber outlet an inlet cone 16.

The tubular portion 13 has on its outer side a support 17. The support 17 is in the mounted state (see Fig. 1) attached to the wall of the inlet duct 8.

Preferably, heater elements (not shown) are provided in the tubular portion 13 and the radial vanes 14 of the baffle unit 12. The heater elements are connected with external heating components through the connections 18 in the support 17. The baffle unit 12 is attached to the wall of the inlet duct 8 by means of screws that are inserted in the screw holes 19. The support 17 has a sort of vane shape and has only a small contact area with the wall of the inlet duct 8. Thereby heat loss through the support 17 to the wall of inlet duct 8 is reduced. This reduces in use the response time of the heating system. The baffle unit 12 inside the inlet duct 8, through which air is fed to the ventilator unit 7, generates a more homogeneous flow with less turbulence compared to the situation where no baffle unit is present.

The baffle unit 12 and the constriction 11 downstream thereof both condition the air flow in such a way that they both improve each others functionality. A combination of a baffle unit 12 with a constriction 11 is therefore advantageous and it provides a low turbulence homogeneous feed flow towards the ventilator 7, which causes the ventilator 7 to generate less noise. This effect is with the specific configuration of the baffle unit 12 shown in the figures in particular achieved with a centrifugal ventilator.

In Fig. 4 is shown a housing 20 for the air treatment and circulation device including its associated ducting system.

The housing 20 defines a ventilator chamber 21 where the ventilator unit 7 is located. The ventilator chamber 21 has an inlet opening 22 through which the ventilator chamber 21 is in fluid communication with the inlet duct 8.

The housing 22 furthermore defines a distribution chamber 23. The housing 20 has a substantially flat upper wall 24 and a flat bottom wall 25 extending parallel thereto which define the upper and bottom wall of the distribution chamber 23. The upper wall 24 and bottom wall 25 respectively have on their longitudinal sides an upwardly extending curved edge portion 26 and 27 respectively. The associated edge portions 26, 27 between them define outlet ducts 28 as can be seen in the sectional view in Fig 1. The outlet ducts 28are closed at their side ends by edge walls 29 interconnecting the upper wall 24 and bottom wall 25. The free end of the outlet ducts 28 is partly closed by a wall portion 30a and 30b. The remaining open portion of the free end of the outlet ducts 28 define chamber inlet openings 31a, 31b through which air can flow from the ducting system 9 to the incubator chamber 2.

The ventilator is arranged on the head end side of the incubator. On the transverse side opposite where the ventilator chamber is located the upper wall 24 and bottom wall 25, respectively, have an upwardly extending curved edge portion 32 and 33 respectively. At the free end of these curved wall portions 32, 33 a chamber inlet opening 34 is defined.

At the transition between the ventilator chamber 21 and the distribution chamber 23 a Venturi hump 35 is provided on the bottom wall 25. The Venturi hump 35 extends in a curved, preferably circular arch, shape as is clearly visible in Fig. 4. This Venturi hump 35 creates a narrow gap between the bottom and the top wall through which the airflow locally accelerates. The created pressure differential over this hump 35 balances the volume flow over the entire width of the Venturi hump 35 such that all inlet openings 31a, 31b, 34 towards the incubator chamber 2 receive a certain amount of air. This effect is analogue to a water dam in a river which damps out dynamic effects. Without this measure the dynamics added to the flow by the ventilator 7 will cause most air exiting through opening 34, and almost none through openings 31a, 31b.

In Fig. 3 is shown how the air flows are directed through the incubator chamber 2. The inlets 31a, 31b and 34 and the outlet 10 are schematically indicated.

The airflows exiting from the chamber inlet openings 31a and 31b at the longitudinal sides, flow upwardly along the longitudinal side walls 3a and 3b of the

casing 3 and along the top 3c. The asymmetric routing prevents collision of the flow in the centre of the chamber top 3c, which is an advantage for keeping both the temperature stability and the required low airspeeds near the infant. The flow exiting from the inlet 34 is relatively weak in order not to disturb the flows originating from the inlets 31a, 31b at the longitudinal sides.

CLAIMS:

1. An incubator comprising an incubator chamber defined by a bottom part and a top casing covering a bed area of the bottom part, and comprising an air treatment and circulation device for treating air and circulating air through the incubator chamber, said air treatment and circulation device including a ventilator;

wherein:

the air treatment and circulation device is connected to at least one chamber inlet opening which are arranged along one or more sides of said bed area, allowing treated air to flow from the treatment and circulation device into the incubator chamber;

the air treatment and circulation device is furthermore connected to at least one chamber outlet opening allowing air to flow out from the incubator chamber to the treatment and circulation device;

said bed area has a head end and a foot end, two longitudinal sides extending between the head end and the foot end and a transverse side on the head end and a transverse side on the foot end, as well as a centre defined by the intersection of the longitudinal and transversal centre lines;

on each of said longitudinal sides at least one said chamber inlet opening is arranged;

said at least one chamber inlet opening on said longitudinal sides is positioned asymmetrically with respect to the longitudinal centre line and with respect to the transversal centre line; and

said at least one chamber inlet opening on one of the longitudinal sides is on a head end half of said longitudinal side and said at least one chamber inlet opening on the opposite longitudinal side is on a foot end half of said opposite longitudinal side.

2. The incubator according to claim 1, wherein additionally only one of the transversal sides is provided with said at least one chamber inlet opening.

3. The incubator according to claim 2, wherein said at least one chamber inlet opening is provided on the foot end.

4. The incubator according to claim 1 or 2, wherein said at least one chamber outlet opening is arranged on the head end.

5. The incubator according to any one of claims 1 to 4, wherein only one said chamber inlet opening is arranged on each of the respective sides.

6. The incubator according to claim 5, wherein said respective at least one chamber inlet opening have an elongate shape.

7. The incubator according to claim 6, wherein said respective at least one chamber inlet opening have a slot shape.

8. The incubator according to any one of claims 1 to 7, wherein said at least one chamber outlet opening is arranged on a level above the bed area.

9. The incubator according to any one of claims 1 to 8, wherein said at least one chamber outlet opening is arranged on a level above the bed area at least at the half of the height of the incubator chamber.

10. The incubator according to any one of claims 1 to 9, wherein the ventilator of the air treatment and circulation device is arranged in a ventilator chamber and wherein the air treatment and circulation device furthermore has a distribution chamber which is in communication with the ventilator chamber and with said at least one chamber inlet opening.

11. The incubator according to claim 10, wherein the distribution chamber is defined by a housing having a substantially flat upper wall and a substantially flat bottom wall extending parallel of said substantially flat upper wall.

12. The incubator according to claim 11, wherein the upper wall and bottom wall have on their longitudinal sides and at least one of their transversal sides an upwardly extending edge portion, wherein at least one outlet duct is defined between said at least one upwardly extending edge portion.

13. The incubator according to claim 12, having one or more of the following features:

- the free end of said at least one outlet duct is at least partly open, thereby defining said at least one chamber inlet opening;

- said at least one outlet duct is closed at its side end by edge walls interconnecting the upper wall and the bottom wall; and

- said at least one upwardly extending edge portion is curved.

14. The incubator according to claim 10, wherein a Venturi hump is arranged at a transition between a ventilator chamber and a distribution chamber.

15. The incubator according to claim 14, wherein the Venturi hump extends in a curved manner over the bottom wall.

16. The incubator according to claim 15, wherein the Venturi hump extends in the curved manner over the bottom wall with a constant radius of curvature.

17. The incubator according to any one of claims 6 to 16, wherein the ventilator chamber, the distribution chamber and said at least one outlet duct is defined by one integral casing.

18. The incubator according to any one of claims 1 to 17, wherein the treatment and circulation device has an inlet air duct located between the chamber outlet opening and the ventilator, wherein a baffle unit is arranged in said inlet air duct.

19. The incubator according to claim 18, wherein a constriction is arranged in the inlet air duct.

20. The incubator according to claim 19, wherein the constriction is arranged in the inlet air duct between the baffle unit and the ventilator.

21. The incubator according to claim 19 or 20, wherein the baffle unit comprises a tubular portion which is concentrically arranged in the inlet air duct, such that air flows along the inner surface as well as the outer surface of the tubular portion.

22. The incubator according to claim 21, wherein the baffle unit includes at least one radial air guiding vane that extend inwardly from the tubular portion towards a centre axis of the tubular portion.

23. The incubator according to claim 22, wherein said at least one radial air guiding vane is interconnected in the centre of the baffle unit by a centre piece.

24. The incubator according to claim 23, wherein the baffle unit comprises at least one heating element for heating the air flowing along the surface of the baffle unit.

25. The incubator according to claim 24, wherein said heating element is incorporated in the tubular portion.

26. The incubator according to claim 24, wherein said at least one heating element is incorporated in said at least one radial air guiding vane of the baffle unit.

27. The incubator according to claim 24, wherein at least one heating element is incorporated in the tubular portion and in said at least one radial air guiding vane of the baffle unit.

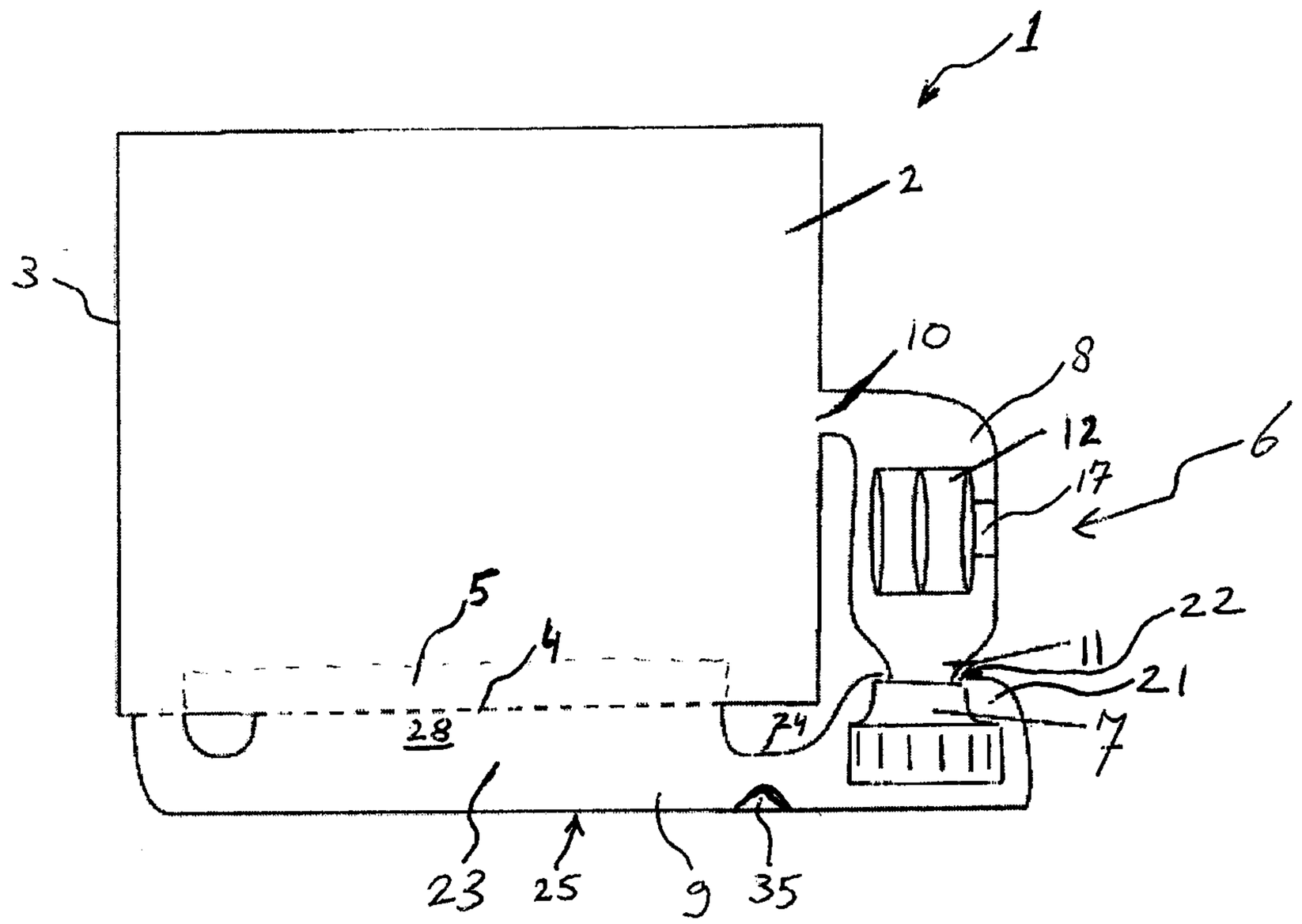

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Fig. 1

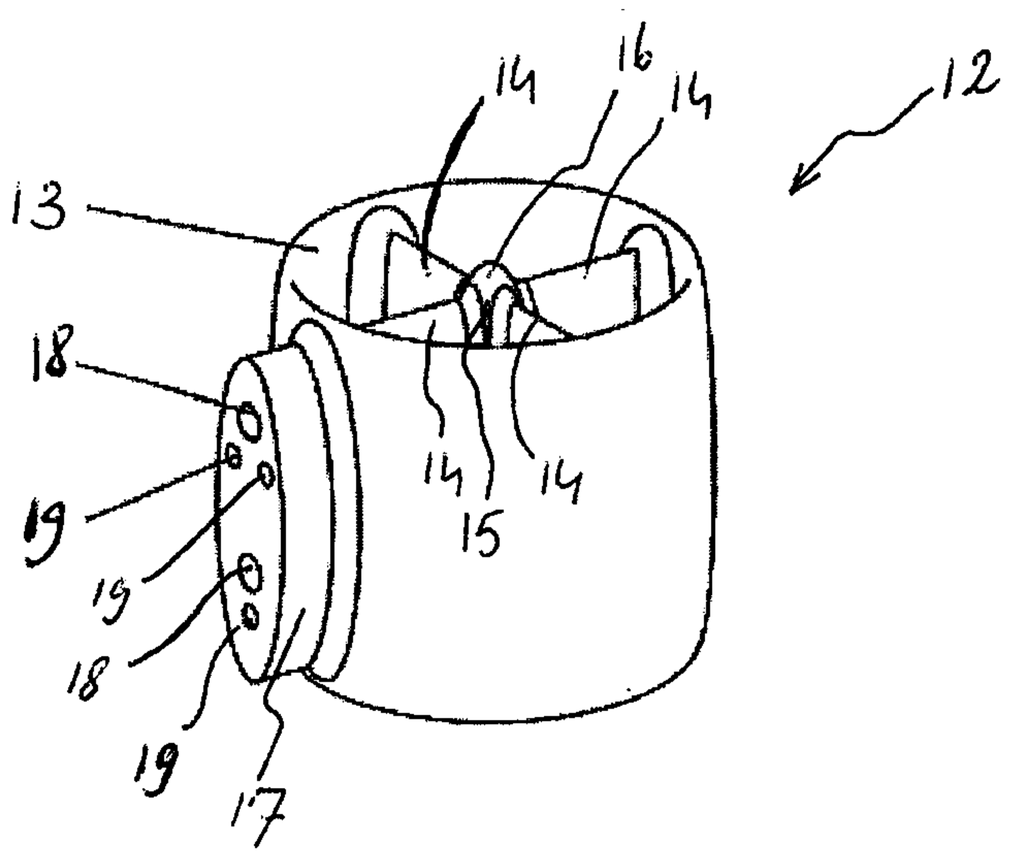
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Fig. 2

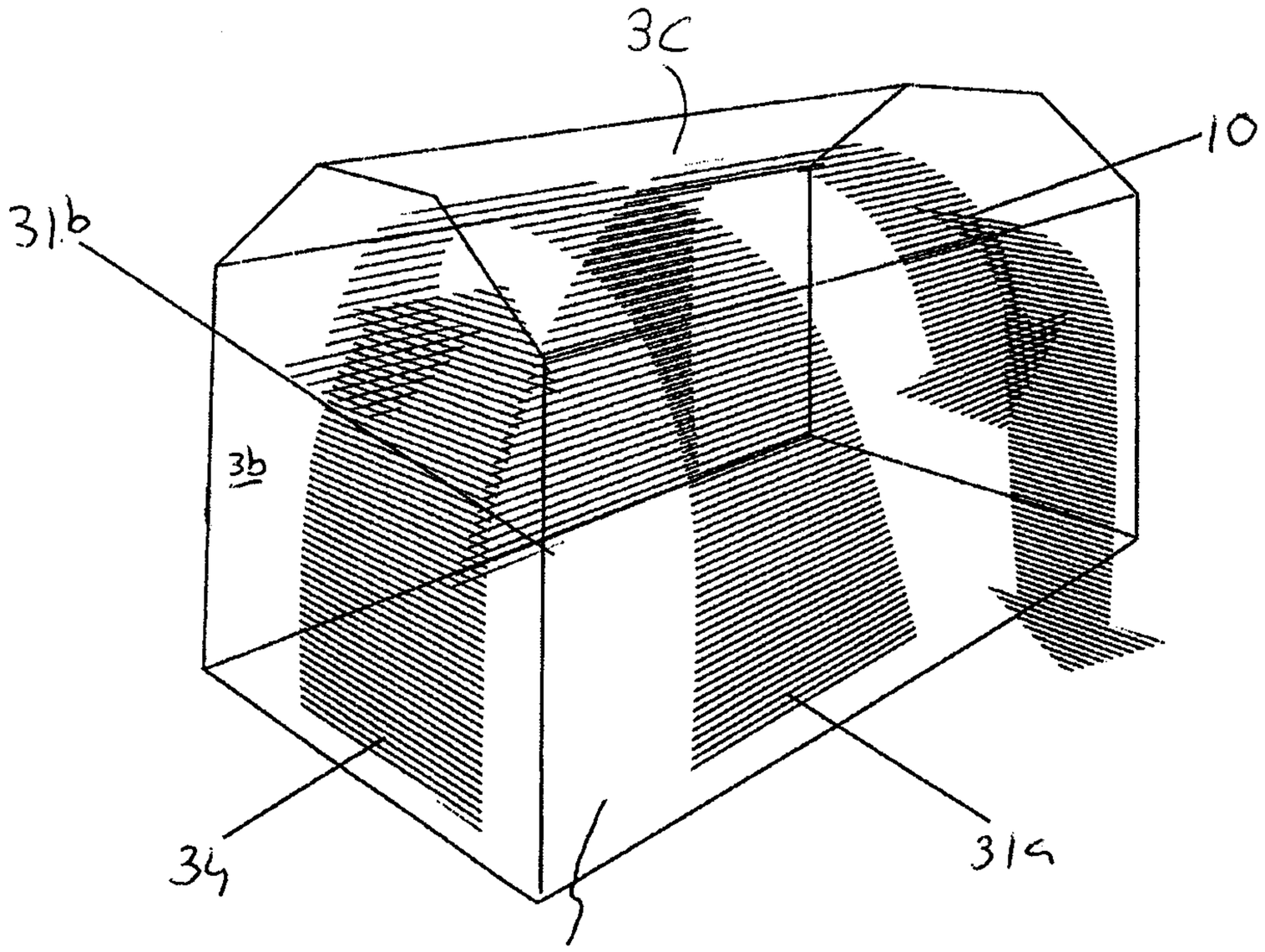
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Fig. 3

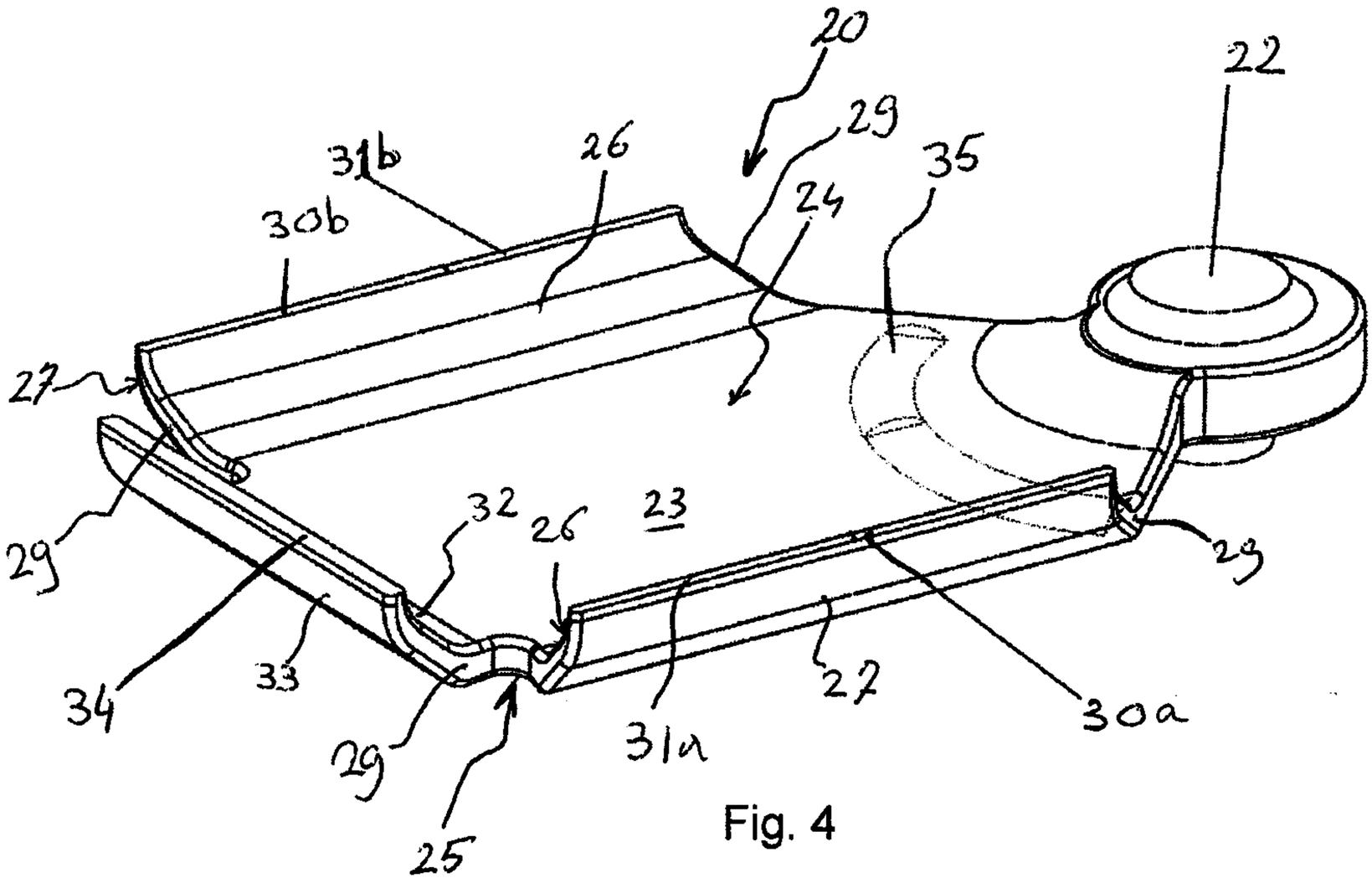
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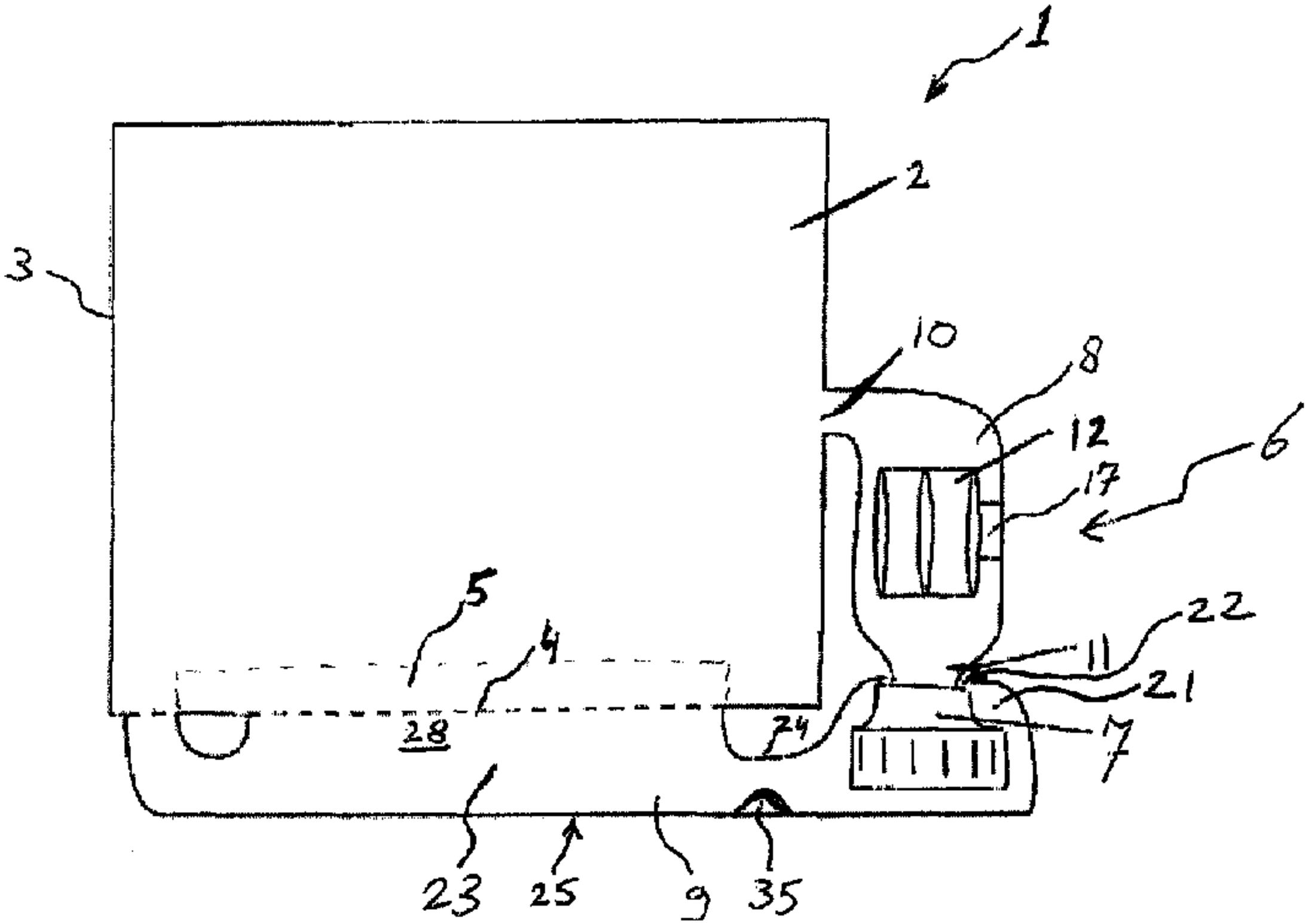
Fig. 4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