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CONTAINER PREFORM HEATING PLANT

Field of the invention

The present invention relates to a heating plant for container preforms, utilised in particular before the blow moulding stage of containers made of plastic material.

5 Background of the invention

Heating plants for container preforms made of plastic material are known to the prior art. The heating of preforms generally takes place before the blow moulding or stretch-blow stage so as to bring the preform material to an appropriate temperature for obtaining a better quality moulded container.

10 The thermal energy source for the heating of the preforms generally consists of infrared radiation (IR) lamps. The preforms, moved along a transfer chain provided with backing pads to support the preforms themselves, cross a tunnel-shaped furnace along which are arranged various sets of IR lamps.

Disadvantageously in the heating plants of the prior art there is a considerable
15 dispersion of infrared radiation, directly emitted by the lamps, which cannot be directed towards the zone through which the preform passes. Furthermore, the infrared radiation reflected by the wall of the tunnel through which the preform passes is also not adequately optimised. These drawbacks determine an increased energy consumption and/or an unacceptable decrease in the production
20 rate in order to achieve an optimal heating of the preforms.

A further disadvantage is represented in that often there is achieved a low penetration of heat in the preform thickness, which determines an overheating of the external surface of the preform with consequent crystallisation of the PET, which compromises the subsequent blowing.

25 There is therefore a need to create a preform heating plant that allows the aforementioned drawbacks to be overcome.

Summary of the invention

The main aim of the present invention is that of creating a preform heating plant which allows the optimisation of the focusing of the infrared radiation towards the
30 preform, thus reducing the energy costs while maintaining an extremely high production rate.

A further aim of the invention is that of providing a preform heating plant that

allows the optimisation of the penetration of heat throughout the preform thickness so as to make the temperature along said thickness as uniform as possible.

The present invention therefore proposes to achieve the above discussed aims by creating a heating plant for container preforms which, according to claim 1, comprises at least one heating module configured so as to define at least one tunnel, laterally arranged with respect to a longitudinal plane X, for the passage of the preforms to be heated, said at least one heating module comprising one first portion provided with forced ventilation means, at least one first lateral portion, arranged at a first side of said first portion, provided with a plurality of infrared radiation lamps for heating the preforms, wherein said first portion and said at least one first lateral portion are configured so as to define at least one tunnel part, delimited on a first side of said infrared radiation lamps; on a second side, opposite to the first side, by at least one plate; on a third side, transversal to said first and second side, by at least a second plate; said tunnel part being open at a fourth side, opposite to the third side, to allow preforms to pass; wherein the at least one first plate closes the lateral ends of the first portion and is provided with a plurality of slots for the passage of air, moved by said forced ventilation means, from the first portion to the tunnel part; and wherein said infrared radiation lamps are placed in respective longitudinal housings of a reflector of the lamps, each longitudinal housing having a substantially C-shaped cross-section profile, along a vertical plane.

The particular shape of the lamp housings, the gold coating of at least one of the reflective surfaces (lamp housings, first plates and second plates), the configuration of the slots for the passage of air synergically contribute to the maximising and making the most of the thermal energy of the lamps, determining an energy saving for the heating of each individual preform and a high moulding quality even at extremely high production rates. Considering that the heating plant of the invention, arranged upstream of the blow moulding plant, allows operation at a production rate of even 80.000 containers/hour, the energy saving is considerable.

A further advantage is represented in that the preform heating plant, object of the present invention, is provided with a channelling system for the air flows within IR

whereby there is obtained a uniform distribution of air to the compartments of the furnace thus taking advantage of the structure's symmetries.

The dependent claims describe preferred embodiments of the invention.

Brief description of the drawings

5 Further characteristics and advantages of the invention will become clearer in the light of the detailed description of one preferred, but non-exclusive, embodiment of a preform heating plant, illustrated by way of a non-limiting example, with the assistance of the accompanying drawings, wherein:

Figure 1 shows a perspective view of a heating plant according to the invention;

10 Figure 2 shows a schematic, cross-sectional view of the heating plant according to the invention;

Figure 3 shows a magnification of part of the view of Figure 2;

Figure 4 shows an exploded view of a first part of the plant of Figure 1;

Figure 5 shows a side view of a component of the plant of the invention;

15 Figure 6 shows an perspective view of a second part of the plant of Figure 1;

Figure 7 shows a magnification of part of the view of Figure 6.

The same reference numbers in the drawings identify the same elements or components.

Detailed description of a preferred embodiment of the invention

20 With reference to Figures 1 to 7 there is represented an embodiment of a heating plant for container preforms, globally indicated with the numerical reference 1 (Figure 1). The preforms to be heated are generally made of plastic material, for example PET, PP, PLA, PVC, but the plant of the invention can also be utilised to heat moulded preforms or containers made of other plastic material, or of a
25 combination of some of these materials.

With reference to Figures 1 and 2, in this embodiment the heating plant 1, is substantially symmetrical with respect to the longitudinal plane X, and comprises one or more modules 1', arranged sequentially one to the other.

There are possible, without departing from the object of the invention,
30 embodiments wherein the heating plant comprises just one symmetrical module or one or more modules having asymmetrical shapes, i.e. with heating only applied by one side or combinations of asymmetrical modules with symmetrical modules.

These alternative possibilities are not illustrated but can be easily understood by a person skilled in the art from that which is illustrated hereafter for the preferred embodiment.

The modules 1' are configured so as to define two tunnels 2, 2', symmetrically arranged with respect to plane X for the passage of the preforms 40 to be heated, which are transported by a transfer chain equipped with backing pads (not illustrated). The passage of the preforms 40 from the tunnel 2 to tunnel 2', or vice versa, takes place by means of curved stretch 31, connecting the ends of said tunnels, through which the transfer chain passes. Some collectors 30 are advantageously envisaged for the heating liquid to keep at a lower temperature the preform neck area, which must not be heated by the furnace in the course of the heating process to which the preforms are subjected.

Each module 1' comprises a central portion 16 and two lateral portions 17. Each central portion 16, hollow on the inside, in turn comprises:

- at least one air suction filter 3, arranged on the lower wall of the central portion 16, said air originating from the environment external to the plant, at room temperature;
- at least one ventilator 4 attached to the upper wall of the central portion 16 and provided with a impeller 5, placed in the hollow part 18 of the central portion 16 and substantially at the centre of the module 1' between the respective portions of tunnel 2, 2' of the module itself;
- two lateral ends 15, respectively closed by a first metal plate or sheet 7, provided with slots 14.

Each lateral portion 17 comprises at least one IR lamp 6 set for each length stretch of tunnel 2, 2' and a relative lamp support structure, in the form of p plates 25.

Each length stretch of tunnel 2, 2' is delimited on a first side by said at least one IR lamp 6 set; on a second side, opposite to the first side, by said first metal plate 7, preferably made of aluminium; on a third side, transversal to said first and second side, by a second metal plate or sheet 8, preferably made of aluminium. A fourth side of the tunnel, opposite to the third side, is on the other hand open to allow the passage of the preforms 40 by means of the transfer chain.

Each IR lamp set 6, supported by a support structure 39, is positioned in a respective housing provided in the structure of the reflector 9, preferably made of aluminium. This reflector is provided with a number of housings 10, 10' at least equal to the number of lamps 6. Each housing has a longitudinal extension or length suitable for fully housing each lamp 6 along its longitudinal extension or length.

Advantageously, within each length stretch of tunnel 2, 2', at least one of the surface of the housings 10, 10', the surface of the first plate 7 and surface of the second plate 8, is completely coated in gold to optimise the reflection of the infrared radiation. In one variant, both the surface of the housings 10, 10' and the surface of the first plate 7 and the surface of the second plate 8 are completely coated in gold.

In particular, the use of aluminium to create the reflector 9, the first plates 7 and the second plates 8, combine with the gold coating of the relative inward-facing surfaces of the tunnels 2, 2', has allowed optimal reflection of the infrared radiation to be achieved.

The layer of gold coating, preferably having a thickness of between $0.01\mu\text{m}$ e $0.1\mu\text{m}$, and even more preferably equal to $0.05\mu\text{m}$, can be created by spraying or by applying a film or by electroplating.

Each housing 10, 10' has a surface consisting, in part, of a lateral, semi-cylindrical surface 12 and in part of flat surfaces 11, which extend said lateral surface 12 at each end. Advantageously said flat surfaces 11 allow the lamps 6 to be entirely or almost entirely housed in each housing, allowing that part of infrared radiation that is generally dispersed to be recovered, while being optimally focused towards the area of passage of the preforms 40.

A further advantage is represented in that each housing 10 is configured so that the radius R of the lateral, semi-cylindrical surface 12 is of between 6 and 8 mm and the width L of said flat surfaces 11 is of between 2 and 3 mm whereby, one the lamp 6 has been placed in the housing, the front ends 13 of the flat surfaces 11 are positioned so as to cover at least the longitudinal, vertical centre-line of the lamp 6 by at least 1 mm. In the example of Figure 3 the IR lamps 6 are entirely arranged within the corresponding housing.

The distance between centres D of one housing and the next is advantageously of between 14 and 24 mm.

The IR lamps 6 preferably used are of the short wave type with temperature of 2400 K. Alternatively, quartz lamps at a temperature of 1800 K, of the low thermal inertia type, known as medium wave IR lamps can be used, or NIR lamps, with temperatures of up to 3400°K. The IR lamps 6 preferably have a diameter of 10÷12 mm, even more preferably of 11 mm.

The reflector 9 cooperates at the level of the two lateral ends 29 with respective perforated plates 25, wherein perforations 26 are envisaged at the level of the housings 10 for insertion of the ends of the IR lamps 6. In at least some of these perforations 26 there are envisaged removable shims 24. The removal or the addition of one of these shims 24 makes IR possible to adjust the distance of the IR lamps from the advancement direction of the preforms.

A further advantage is represented in that at least the lower housing 10' of the reflector 9 is arranged staggered with respect to the other housings 10 of the same structure. In particular, the lower housing 10' is positioned further forwards, i.e. more internally in the respective length stretch of tunnel and therefore closer to the advancement direction of the preforms 40, with respect to the other housings 10, by a distance equal to around 4÷6 mm. This entails that the flat, lower surface 11' of the housing 10, adjacent to the lower housing 10', has a length L' of between 6 and 10 mm, greater than the length L of all the other flat surfaces 11. This technical workaround allows optimisation of the infrared radiation required to heat the portion of preform 40 adjacent to the preform neck itself, which passes in proximity of said lower housing 10'. It is possible to prepare another housing having the same configuration as the lower housing 10' just described in another, higher or intermediate position of the reflector 9.

A further contribution to improved focusing of the infrared radiation and to energy saving is given by the presence and by the shape of the second plate 8. The presence of this further plate allows an additional side of the stretch length of the tunnels to be closed compared to the plants of the prior art. With reference to Figures 3, 6 and 7, in one preferred variant the plate 8 has a broken line profile and is attached to one end of the upper wall of the central portion 16 of the module

1' by means of appropriate fastening means. The profile of the plate 8 is configured so that IR minimises infrared radiation losses, and therefore heat losses, within each length stretch of tunnel. In another variant, each second plate 8 can be attached to a first end of the upper wall of the central portion 16 and to a second end of the upper wall of a lateral portion 17 of the module 1'.

Advantageously, the slots 14 of the first metal plates 7 allow the passage of air from the hollow part 18 of the central portion 16 to the respective portions of tunnel 2, 2'. The air is suctioned through the filter 3 longitudinally along the axis of the impeller 5 to then be expelled by the same impeller with a 90° in respect of said axis. First lateral air flows 19 thus generated cross the hollow part 18 until they reach the lateral ends 15 for which air blades exit from the slots 14 directed towards the area crossed by the preforms 40. On the other hand, second lateral air flows 19', after having crossed the hollow part 18, exit from the central portion 16 through slits 32 (Figure 7), configured so that the said second flows 19' are directed towards the passage area of the preform neck 40.

These lateral air flows 19, 19', having crossed the passage area of the preforms 40, are channelled in at least one internal channel 33 envisaged in the lateral portions 17 and exit from the modules 1' through the grills 34.

The slots 14 are preferably obtained on at least three rows along the plates 7. The slots of one row are staggered with respect to the slots of the adjacent row so that the air blades are distributed as homogeneously as possibly in the respective stretch length of tunnel. In the example of Figure 6, the slots of the central row are staggered with respect to the reciprocally aligned slots of the lateral rows and 22.

Advantageously, the presence of these slots 14, alongside the staggered distribution thereof on the plates 7, allows the penetration of heat throughout the thickness of the preforms to be significantly improved. Cooling by means of this air also allows the duration of the IR lamps, and of other components of the heating plant of the invention, to be increased.

CLAIMS

1. A heating plant (1) for heating preforms made of plastic material comprising at least one heating module (1') configured so as to define at least one tunnel (2, 2'), laterally arranged with respect to a longitudinal plane (X), for the passage of the preforms (40) to be heated,
- 5 said at least one heating module (1') comprising
- a first portion (16) provided with forced ventilation means (4, 5),
 - at least one first lateral portion (17), arranged at a first side of said first portion (16), provided with a plurality of infrared radiation lamps (6) to heat the preforms,
- 10 wherein said first portion (16) and said at least one first lateral portion (17) are configured so as to define at least one stretch of tunnel (2), delimited on a first side by said infrared radiation lamps (6); on a second side, opposite to the first side, by at least one first plate (7); on a third side, transversal to said first and second sides, by at least one second plate (8); said tunnel part being open at a fourth side,
- 15 opposite to the third side, to allow the preforms (40) to pass;
- wherein the at least one first plate (7) closes lateral ends (15) of the first portion (16) and is provided with a plurality of slots (14) for the air to pass, moved by said forced ventilation means (4, 5), from the first portion (16) to the stretch of tunnel (2);
- 20 and wherein said infrared radiation lamps (6) are placed in respective longitudinal housings (10, 10') of a reflector (9) of the lamps, each longitudinal housing having a substantially C-shaped cross-section profile, along a vertical plane.
2. A plant according to claim 1 wherein, within each length stretch of tunnel (2, 2'), at least one of the surface of the housings (10, 10'), the surface of the at least one
- 25 first plate (7) and the surface of the at least one second plate (8) is gold coated.
3. A plant according to claim 2, wherein the gold coating layer has a thickness between 0,01 and 0,1 μm .
4. A plant according to any one of the preceding claims, comprising two or more heating modules (1').
- 30 5. A plant according to any of the preceding claims, wherein each heating module (1') comprises a second lateral portion (17) equal to the first lateral portion (17) arranged on a second side of the first portion (16) opposite to the first side with

respect to the longitudinal plane (X), whereby further stretches of tunnel (2') are defined.

6. A plant according to any one of the preceding claims, wherein each longitudinal housing (10, 10') has a surface consisting, in part, of a semi-cylindrical lateral surface (12) and, in part, of longitudinal flat surfaces (11), parallel to one another, which are an extension of said semi-cylindrical lateral surface (12).

7. A plant according to claim 6, wherein the radius (R) of the semi-cylindrical lateral surface (12) is between 6 and 8 mm, and the length (L) of said flat surfaces (11) is between 1 and 3 mm.

8. A plant according to claim 7, wherein the front ends (13) of the flat surfaces (11) are positioned so as to cover at least the vertical centre-line plane of the lamps (6) by at least about 1 mm.

9. A plant according to claim 7 or 8, wherein the distance between centres (D) from one housing to the next housing is between 14 and 25 mm.

10. A plant according to any one of the preceding claims, wherein at least one end housing (10') is arranged staggered with respect to the other housings (10) of the same reflector (9), whereby it is more internally positioned in the respective length stretch of the tunnel and in proximity of the passing area of the portion of preform (40) adjacent to the neck of the preform itself.

11. A plant according to claim 10, wherein said end housing (10') is more internally positioned with respect to the other housings (10) by a distance of about 4÷6 mm.

12. A plant according to claim 11, wherein the lower flat surface (11') of the housing (10) adjacent to said end housing (10') has a width (L') which is greater than the width (L) of all the flat surfaces (11) of the other housings.

13. A plant according to claim 12, wherein the width (L') of said lower flat surface (11') is between 6 and 10 mm.

14. A plant according to any one of the preceding claims, wherein the slots (14) are obtained on at least three rows along the first plates (7) and the slots of a row are staggered with respect to the slots of the adjacent row, so that first air blades are homogeneously distributed in the respective length stretch of tunnel (2, 2').

15. A plant according to claim 14, wherein the slots (14) of a central row (20) are staggered with respect to the reciprocally aligned slots (14) of two lateral rows (21,

22).

16. A plant according to claim 14, wherein the first central portion (16) is also provided, at the lateral ends (15), with slits (32) configured so as to direct second air blades towards the passing area of the neck of the preforms (40).

- 5 17. A plant according to any one of the preceding claims, wherein respective pierced plates (25) are arranged at the lateral ends (29) of the reflector (9), said pierced plates having holes (26) placed at the housings (10) for inserting the ends of the lamps (6), at least some of said holes (26) being provided with removable shims (24).

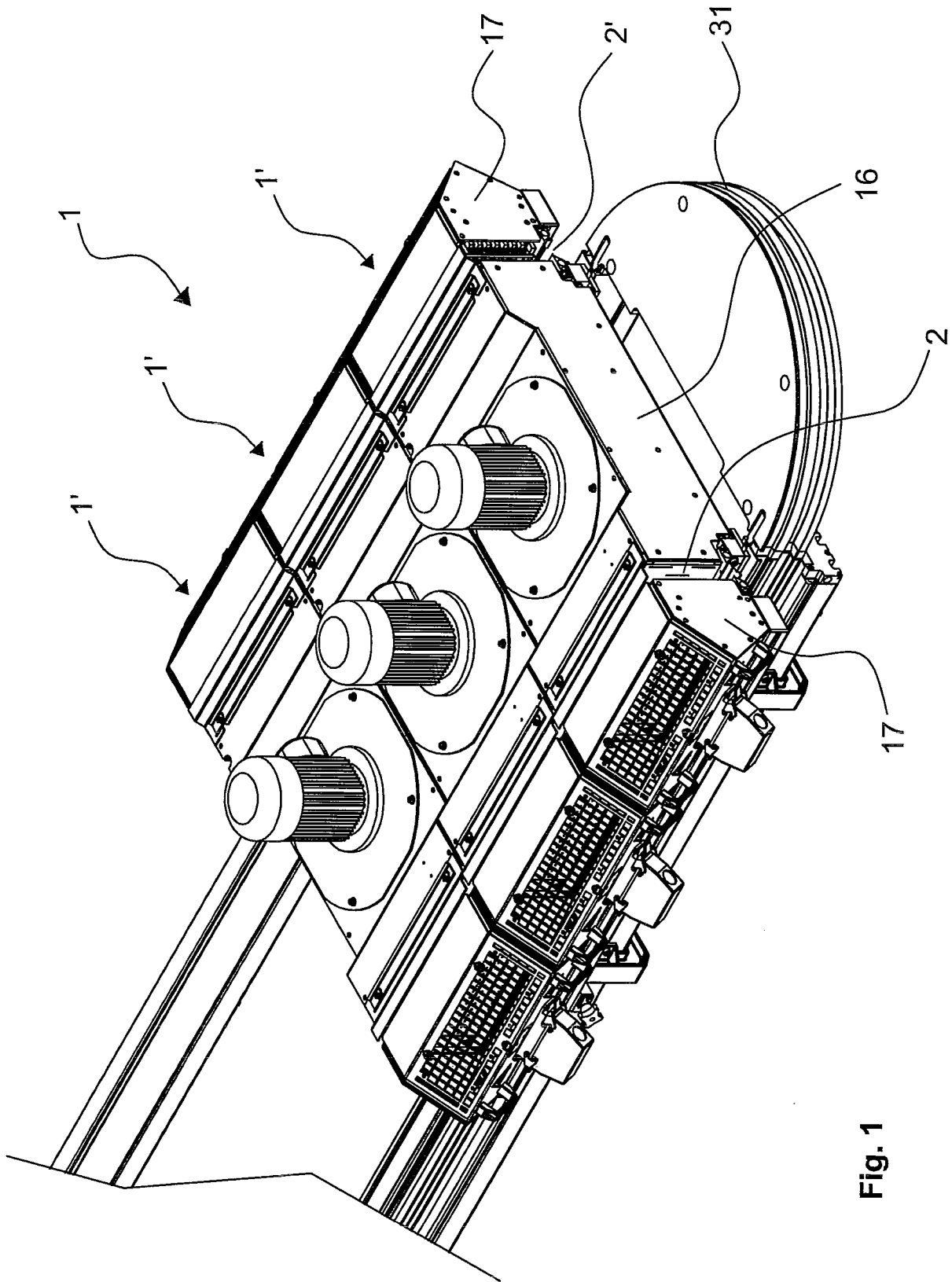


Fig. 1

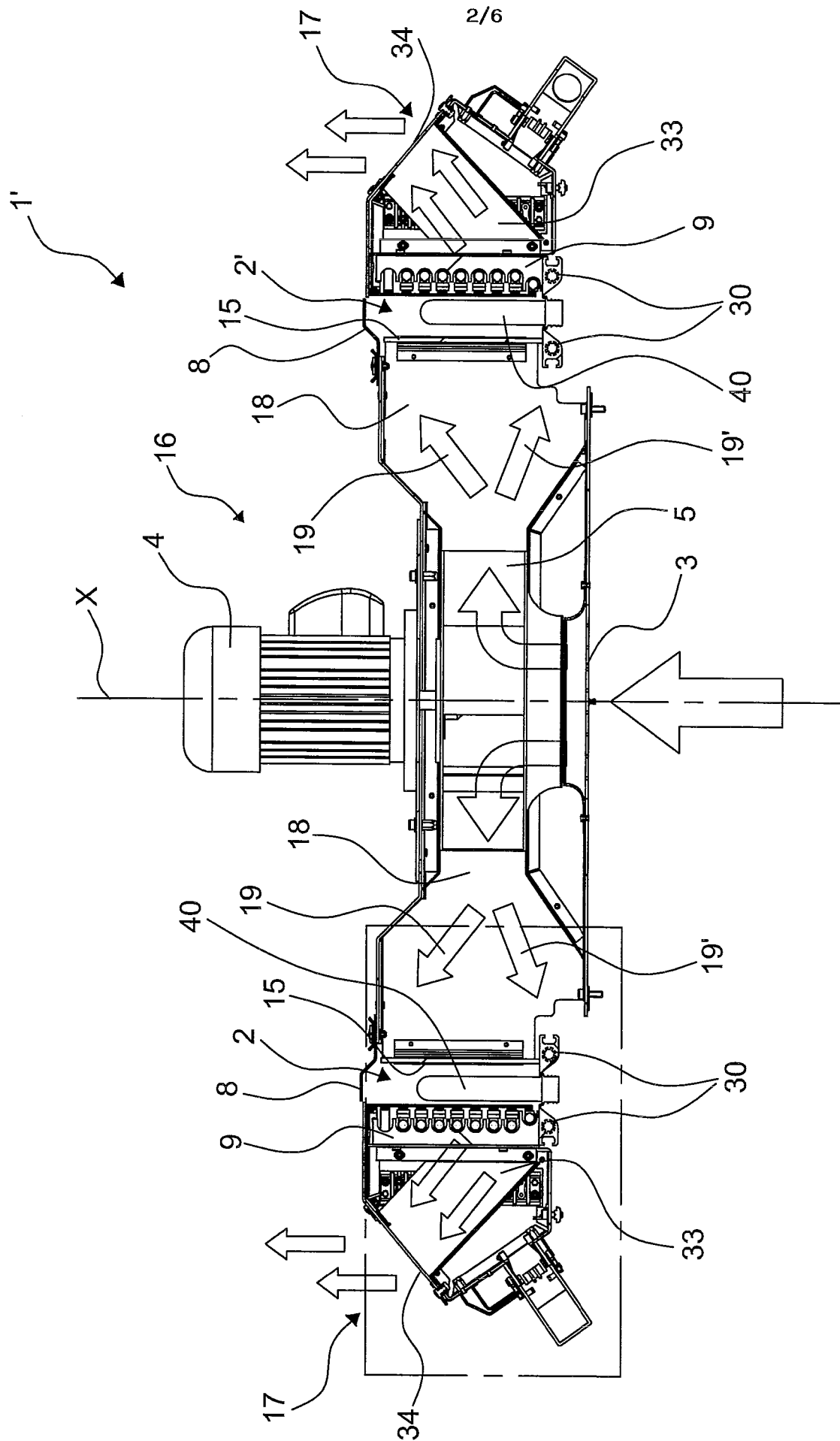


Fig. 2

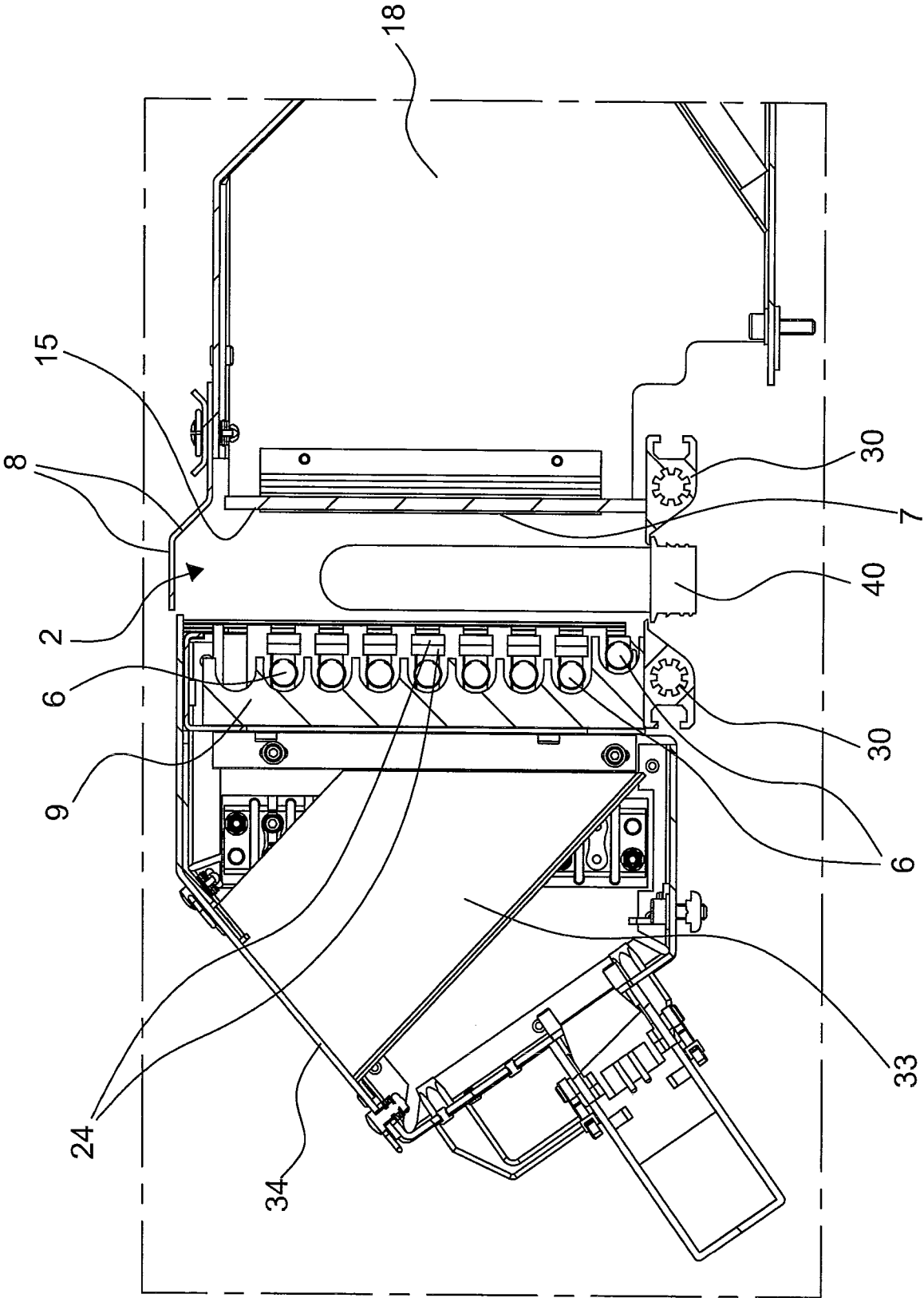


Fig. 3

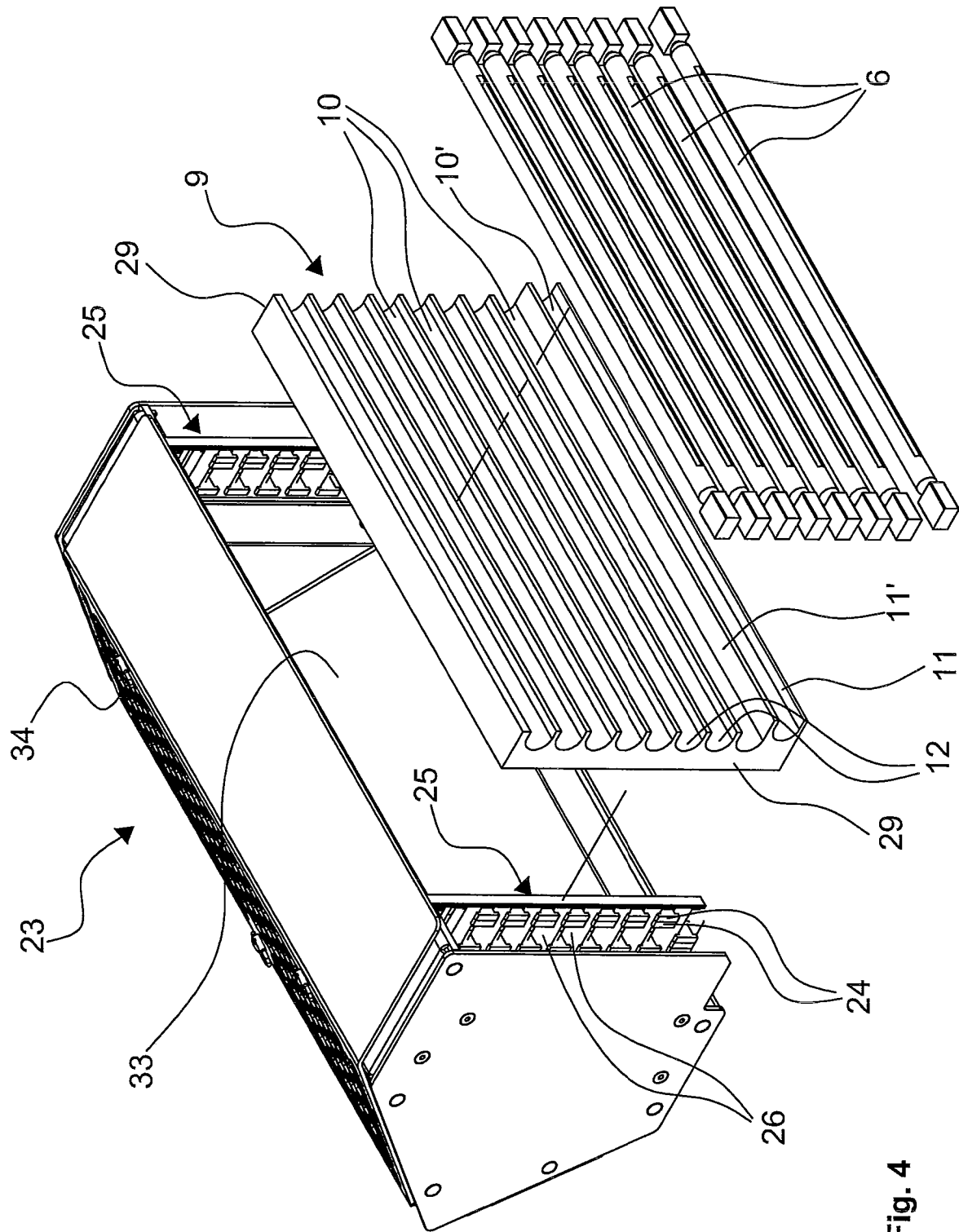


Fig. 4

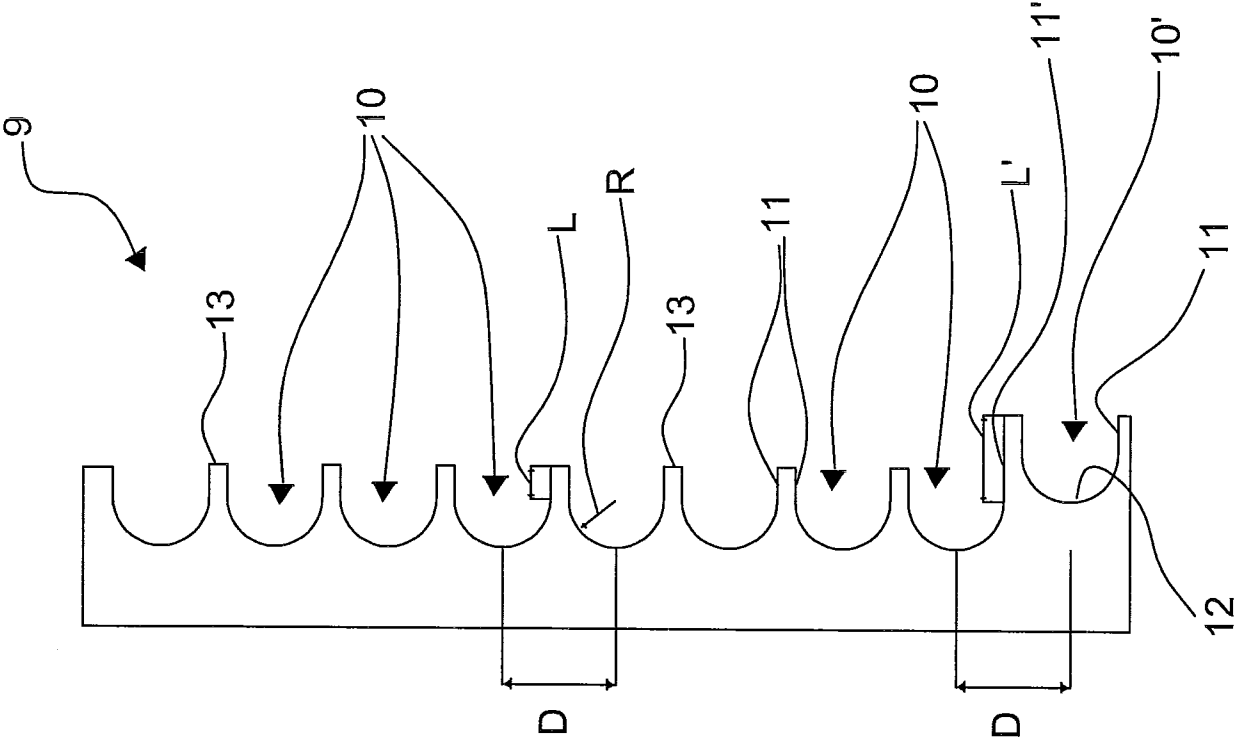


Fig. 5

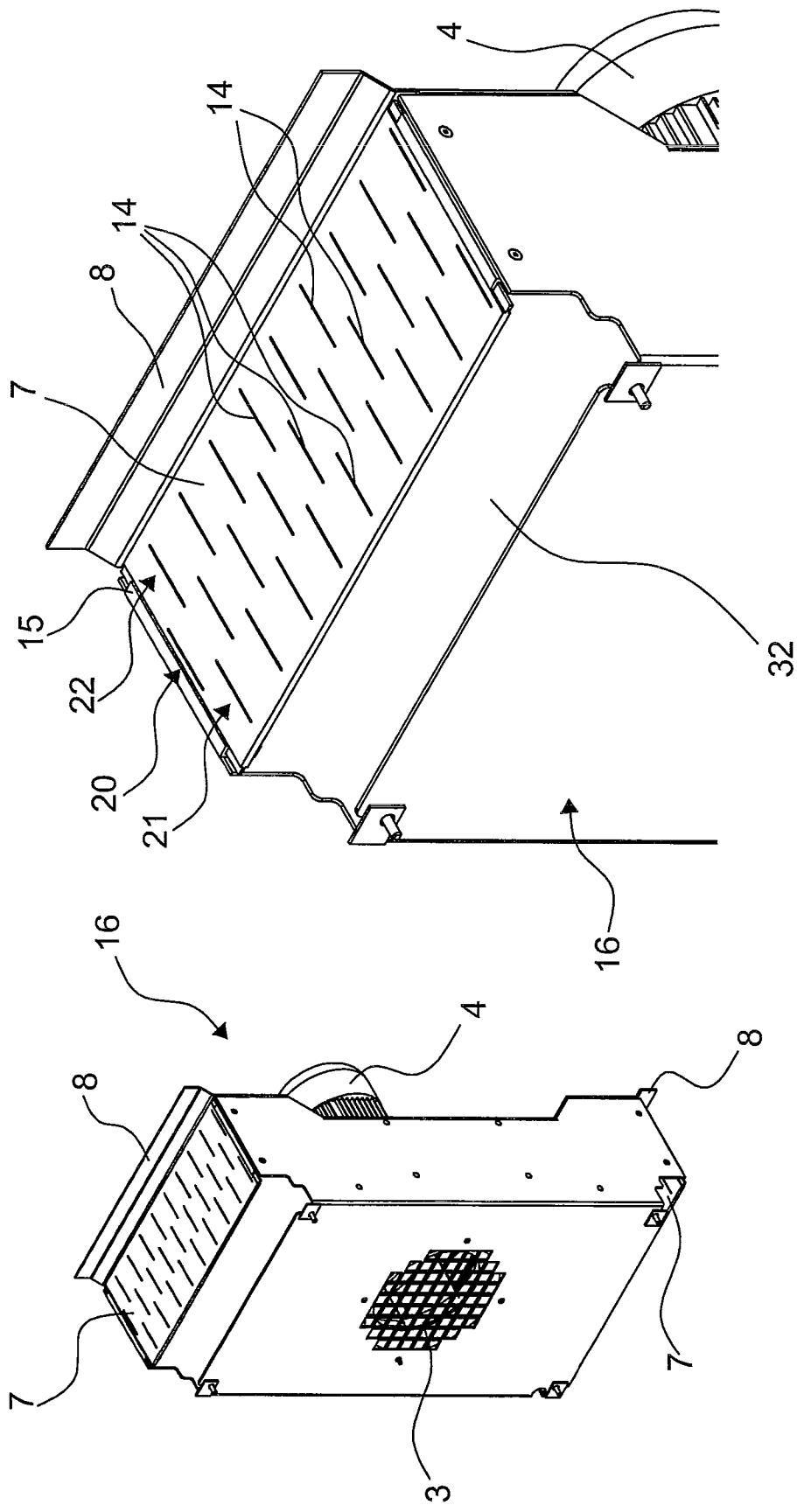


Fig. 7

Fig. 6