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(72) Inventor: **Yalçın, Levent**

45200 Manisa (TR)

(74) Representative: **Iskender, Ibrahim**

Destek Patent Inc.

Tophane Ortapazar Cad. No. 7

Zindankapi Sk. No :10

16040 Bursa (TR)

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(71) Applicant: **Yalçın, Levent**

45200 Manisa (TR)

(54) **Firing and drying system**

(57) The invention relates to a firing and drying system (8), which is developed for both reducing moisture of the product and during drying reducing the amount of micro organisms found in the product via its very special air speeds, very high air flows, and equal temperatures in order to obtain semi-dried products from fresh fruits

and vegetables in the food sector, and which comprising a computer (10); a steam boiler; and a drying room (1) which comprises fans (2), fan motors (2.1), fan cabinets (3), product trays (4), tray carts (5), serpentine (6), chimneys (7), chimney motors (9), suspended ceiling (11), humidity and temperature sensors.

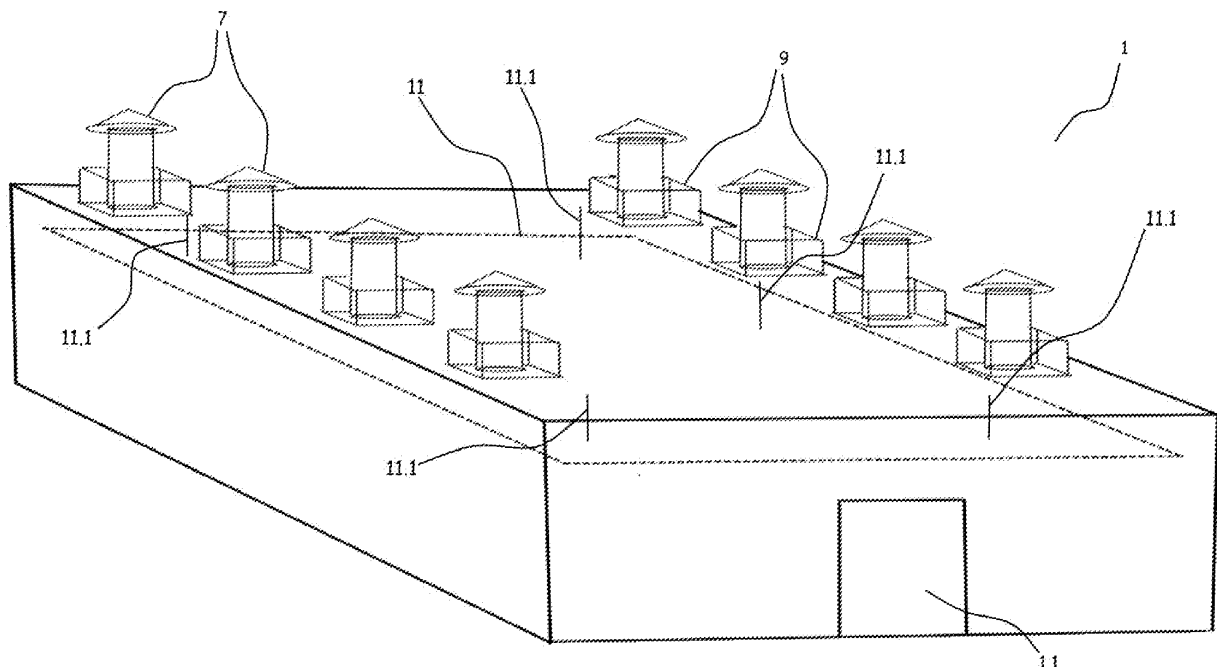


Figure 1

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Description

The Related Art

[0001] The invention relates to drying machines used for drying fresh fruits and vegetables.

[0002] The present invention relates to a firing and drying system reducing both the moisture of the product and the amount of micro organisms found in the product via its very special air speeds, very high air flows, and equal temperatures in order to obtain semi-dried products from fresh fruits and vegetables in the food sector.

Background of the Invention

[0003] Nowadays, hygiene of the products produced according to the obligatory HACCP rules in food enterprises and hygiene of production areas of these have great importance. Therefore, especially methods of food sterilization, food protection and thus extension of shelf life have improved.

[0004] Drying of fruits and vegetables is amongst the oldest methods of food protection. The process is generally based on removing the water content of fruits and vegetables slowly. In this way, moisture content of the dried product is reduced below a certain level.

[0005] In general terms, purpose of the drying process is to;

- Minimize the spoilage possibility of the product by reducing the moisture content of the food below a certain level in order to prevent growth of micro organisms.
- Reduce the costs of packaging, storage and transportation operations due to decrease of volume and increase of dry matter ratio because of decreasing the moisture content.
- Increase the shelf life by minimizing the micro organism activity.
- Provide consumption of the food in all seasons with this drying operation and thus provide increase in the profit margin.

[0006] The main purpose in drying is to extend the shelf life of the food by decreasing its water activity. In this way, microbial growth and enzyme activity is prevented. However, drying operation decreases nutrition value and it has negative impacts on the quality of eating. Therefore, design and mode of operation of drying equipments are made and adjusted in a way that would minimize these types of negativities, and specifications characteristic to food are applied.

[0007] There are two types of drying ovens used in the market and produced up to today. These are; tunnel type drying ovens with belt conveyor and cabin type drying ovens. In tunnel type drying ovens, it is difficult to decrease the moisture of a product like tomatoes to 60%, which is normally 94%. Furthermore, while this operation

continues, formation of yeast, mold and fungus in the product can not be prevented and these can not be disinfected at the end of the operation. As a result, total amount of organisms (yeast, mold, fungus etc.) are found to be much above the limits. Since the cabin type ovens are designed to completely dry the products placed in them, all parts, all pieces and all particles of the product would not have the same moisture ratio.

[0008] One of the applications made with the above said purposes in order to provide drying in the desired quality and production qualities is disclosed in the utility model no 2004/03679. This invention, having the title of drying oven with three systems, relates to drying of fruits and vegetables via an oven, obtaining the required energy from a stove, in which various fuels can be used, and a solar collector for obtaining hot air, and by air circulation channel and panel radiators, transmission of this heat to the section where drying will be made.

[0009] Another application is the patent application with no 2006/01704, which has the title of novelty in ovens. The invention particularly relates to drying ovens which provide drying of vegetables, fruits, cereals etc. food products and wood products by removing their moisture content in order to process and store them in a healthy way. The said drying oven comprises a shelf on which the product to be dried is placed, a heater battery which is used for heating of drying oven, a cooler oven which provides condensation of the moisture of air and the moisture of product to be dried, a thermostat which provides controlling the temperature, a moisture control component which provides controlling the moisture ratio, and control panel and air circulation fans which determine the direction of air flow.

[0010] The utility model with no 2004/01011 relates to ovens which make drying and roasting operations. The invention is intended for the sector of dried fruits, fresh fruits and vegetables, and it comprises the operations of drying and roasting of these products. The invention particularly relates to roasting of the products with gradually increasing heat and the moisture ratios and heat settings of roasting and resting areas being independently adjustable.

[0011] Another utility model with application no 2002/02363 relates to a granule drying machine with movable drum carrier. The invention is a drying machine, which is developed for drying seeds, pulses etc. granular products, has lateral surfaces which are formed as perforated in a way that they would form sieves, is formed by at least two tanks fitting into each other, where these tanks have reducing widths such that they would fit into each other, and it comprises a product channel formed of the region left between the internal tank outer surface and the external tank inner surface, at least one air channel formed by the internal tank inner surface, at least one drum which makes rotational motion by an actuating component, and at least one air circulation fan which transmits air to the said air channel by being connected to it.

[0012] However, the ovens used in none of these known systems can not dry fruits and vegetables in a uniform manner. The main reasons for this can be inadequate drying temperature, lack of air circulation, the drying time being short due to drying cost, the energy source used being expensive etc. Moreover another problem occurs about drying being made with how hygienic materials and in how healthy mediums. In the products which could not be dried sufficiently uniform and hygienic, the total amount of organisms increase during storage and these also spread over other granules which had been adequately dried. The product, which is spoiled in store means both loss of prestige and money.

[0013] As a result, the need for a firing and drying system, which eliminates the drawbacks found in the prior art, increases the temperature of the fruits and vegetables placed in it to 65 °C in 30 minutes with its very high air flows and uniform temperature properties which are different from the prior applications, makes them semi-dried in total of 4 hours and thus at the same time reduces the total amount of organisms found in the product while drying the product, and comprises fans, fan motors, fan cabinets, tray carts, serpentines, chimneys, chimney motor, suspended ceiling, a drying room having humidity and temperature sensors, a PLC computer, and a steam boiler; and the inadequacy of the present solutions have necessitated an improvement in the related technical field.

Purpose of the Invention

[0014] From the known status of the art, the purpose of the invention is to; develop a drying room which increases the temperature of the fruits and vegetables placed in it to 65 °C in 30 minutes with its very high air flows and uniform temperature properties which are different from the above said negative situations, and which makes them semi-dried in total of 4 hours.

[0015] Another purpose of the invention is to develop a drying room which at the same time reduces the total amount of organisms found in the product while drying the fruits and vegetables placed in it.

[0016] Another purpose of the invention is to develop a drying room which dries the fruits or vegetables placed in it uniformly by applying uniform heat on them and thus which provides obtaining standard products having the same moisture ratio.

[0017] Another purpose of the invention is to develop a drying room which minimizes time and labour losses which would occur during application.

[0018] Another purpose of the invention is to develop a drying room which provides energy saving by efficient moisture reducing operation.

[0019] In order to achieve the above said purposes, a firing and drying system is developed, which is developed in order to obtain semi-dried fruits and vegetables in the food industry, and which comprises fans, fan motors, fan cabinets, tray carts, serpentines, chimneys, chimney mo-

tor, suspended ceiling, a drying room having humidity and temperature sensors, a PLC computer, and a steam boiler,

[0020] The structural and characteristics features of the invention and all advantages will be understood better in detailed descriptions with the figures given below and with reference to the figures, and therefore, the assessment should be made taking into account the said figures and detailed explanations.

Description of the Figures of the Invention

[0021]

Figure-1; is the top perspective view of a preferred embodiment of the drying room of the firing and drying system, which is the subject of invention.

Figure-2a; is the front perspective view of the fan cabinet of the firing and drying system, which is the subject of invention.

Figure-2b; is the rear perspective view of the fan cabinet of the firing and drying system, which is the subject of invention.

Figure-3; is the front perspective view of the serpentine of the firing and drying system, which is the subject of invention.

Figure-4; is the rear perspective view of the computer of the firing and drying system, which is the subject of invention.

Figure-5a; is the top perspective view of the tray of the firing and drying system, which is the subject of invention.

Figure-5b; is the front perspective view of the tray cart of the firing and drying system, which is the subject of invention.

Figure-6; is the side section view of the drying room of the firing and drying system, which is the subject of invention.

Reference Numbers

[0022]

- 1- Drying room
- 1.1- Door
- 2- Fan
- 2.1- Fan motor
- 3- Fan cabinet
- 4- Tray
- 5- Tray cart
- 5.1- Shelf
- 5.2- Support part
- 5.3- Wheel
- 5.4- Handling arm
- 6- Serpentine
- 6.1- Opening
- 6.2- Pipe
- 7- Chimney

- 8- Firing and Drying System
- 9- Chimney Motor
- 10- PLC Computer
- 11- Suspended ceiling
- 11.1- Connection shaft

Detailed Description of the Invention

[0023] In this detailed description, the firing and drying system (8), which is the subject of the invention, will only be disclosed as an example for better understanding of the subject, and will not form any limiting effect.

[0024] In Figure-1, the top perspective view of a preferred embodiment of the drying room (1) of the firing and drying system (8), which is the subject of invention, is given. The said firing and drying system (1); comprises a drying room (1) which provides the required medium for drying the products, a steam boiler which provides energy to the required medium for drying the products, and a PLC computer (10) which actuates and controls all of the system. The perspective front view of the said PLC computer (10) is given in Figure-4.

[0025] Here the said drying room (1) is in the form of a closed room, and it comprises a door (1.1) for entrance and exit of the products to be dried, chimneys (7) and chimney motors (9) placed at its above part for circulation of the air found in it, and a suspended ceiling (11) which is connected to the ceiling surface via connection shafts (11.1) in order to form an air circulation space between the room (1) ceiling and the products.

[0026] The said drying room (1) also comprises at least two serpentine (6) which transfer the steam heat arising from the said boiler (8) into the room (1), fans (2) which blow the heat provided from the serpentine (6) to the tray carts (5), fan motors (2.1) which activate these fans (2), fan cabinets (3) which comprise at least two fans (2), trays (4) in which product is placed, tray carts (5) to which these trays (4) are placed, and humidity and temperature sensors.

[0027] In Figure-2a, the front perspective view of the fan cabinet (3) of the firing and drying system (8), which is the subject of invention, is given. When looked from the front side, fans (2) can be seen inside the fan cabinet (3). Dimensions of the said fan cabinet (3) are the same with the dimensions of the tray cabinet (5). In this way, the hot and drying air blown by the fans (2) can be provided to reach to all of the products placed inside the trays (4). Therefore, the front part of the fan cabinet (3) has to be open.

[0028] In Figure-2b, the rear perspective view of the fan cabinet (3) of the firing and drying system (8), which is the subject of invention, is given. When looked from the rear part, fan motors (2.1) connected just behind the fans (2) can be seen. These motors (2.1), by actuating the fans (2), transfer the hot air coming from their back to the tray carts (5) found in front of them. Therefore, the rear part of the fan cabinet (3) also has to be open in order to be able to provide this air circulation.

[0029] In Figure-3, the front perspective view of the serpentine (6) of the firing and drying system (8), which is the subject of invention, is given. Serpentine (6) consists of an opening (6.1) for entrance of hot steam coming from the steam boiler found outside the room (1), and pipes (6.2) along the room (1) in order to transfer the heat of the steam inside the room, and it looks like a heater core. And also its working principle is the same.

[0030] Figure-5a is the top perspective view of the tray (4) of the firing and drying system (8), which is the subject of invention. Edges of the said trays (4) prevent spillage of the product found inside it, and also it provides uniform drying of product by having a perforated structure.

[0031] Figure-5b is the front perspective view of the tray cart (5) of the firing and drying system (8), which is the subject of invention. The front and rear sides of the said tray cart (5) is open for providing air circulation, it comprises shelves (5.1) placed at its two sides at the inner walls in order to be able to arrange the trays (4) on top of each other, a support part (5.2) in band form placed at the front side of the cart (5) in order to prevent its natural flexibility, wheels (5.3) placed under the tray cart (5) in order to provide its mobility, and holding arms (5.4) which are again placed at its two sides.

[0032] In Figure-6, the side section view of the drying room (1) of the firing and drying system (8), which is the subject of invention, is given. In this figure also the sections of the chimney (7), chimney motor (9), suspended ceiling (13), serpentine (6), fans (2), fan cabinet (3), and the tray cart (5) are shown. Fan cabinets (3) and tray carts (5) are arranged in two sides of the said drying room (1) in lines of two, and although it can not be understood from the figure, their numbers are very high. This number can change according to the capacity (volume) of the drying room (1). However, their being arranged opposite and symmetrical to each other is important and required for providing balanced and uniform drying.

[0033] In the figure given here, there are also arrows which show air circulation. According to this, the fans (2), which are found inside the fan cabinet (3) which can be seen at the left side of the drawing, and which take the hot air coming from the serpentine (6), transmit this hot air to the tray carts (5) which are found just before the fan cabinet (3) in a way that they would have contact with the fan cabinet (3). This air reaches to the tray carts (5) found in the second row at the right side of the drawing. Meanwhile they reach to the second row fans (2) which operate in the opposite direction. The air moving upwards from the right side of the drawing advances towards the space found between the suspended ceiling (11) and the ceiling, and via the fans (2) placed here, the same air circulation continues for 30 minutes in this way and as a result the product in the trays (4) are dried. While this period can be changed arbitrarily, generally after 30 minutes, the same operation continues at the other direction by changing the circulation direction of the fans (2). Meanwhile the chimneys (7) and their motors (9) placed at the ceiling are kept in closed position. The said product

is increased to 65 °C temperature in 30 minutes by very high air flows and uniform temperature obtained in this way. Again this temperature can be changed according to the product and preference.

[0034] While the above disclosed air, direction of which changes in every 30 minutes, dries the product, it retains the moisture of the product inside itself and therefore its moisture content increases in time. Moisture of the air inside the drying room is controlled by being measured via moisture sensors. When high moisture value reaches the PLC computer (10), the computer (10) reorganizes the mode of operation of the system (8) in order to decrease the moisture of the air inside the drying room. In order to provide this, the chimneys (7) placed above the room (1) are opened and chimney motors (9) are actuated. Great number of chimneys (7) is placed just above the tray carts (5) and fan cabinets (3) which are found in two rows inside the room (1) and the chimneys (7) are placed in parallel with them. While the inner air circulation continues as described above, one of the rows of these chimneys (7) take fresh air from outside and the other chimney (7) row discharges the inner moist air to outside. In other words, fresh air and moisture discharge chimneys (7) are actuated according to the scenario loaded to the PLC computer. The temperature sensors measuring the temperature inside the room (1) and the PLC computer (10) controlling these sensors check the temperature inside the room (1) via the thermal valve connected to the steam boiler and keep it within the desired limits. This period takes 4 hours average. The product found inside the room (1) is taken out after its temperature being automatically decreased to the medium temperature.

Claims

1. The invention is a firing and drying system (8), which is developed for reducing both the moisture of the product and the amount of micro organisms found in the product during drying via its very special air speeds, very high air flows, and equal temperatures in order to obtain semi-dried products from fresh fruits and vegetables in the food sector, comprising a computer (10); a steam boiler; and a drying room (1) which comprises fans (2), fan motors (2.1), fan cabinets (3), product trays (4), tray carts (5), serpentine (6), chimneys (7), chimney motors (9), suspended ceiling (11), humidity and temperature sensors.
2. A firing and drying system (8) according to claim 1, and it is **characterized in that**; it comprises fan cabinets (3) inside the said drying room (1), which are placed in two longitudinal rows symmetrical with each other.
3. A firing and drying system (8) according to claim 1, and it is **characterized in that**; the said fan cabinets

(3) comprise at least one fan (2) and at least one fan motor (2.1).

4. A firing and drying system (8) according to claim 1, and it is **characterized in that**; the said drying room (1) comprises fans (2) and fan motors (2.1), operation directions of which change in order to increase drying efficiency by changing the air circulation direction in the room (1).
5. A firing and drying system (8) according to claim 1, and it is **characterized in that**; the said drying room (1) comprises tray carts (5) which are placed in two longitudinal rows symmetrical with each other and which are placed in front of the fan cabinets (3) in a way that they would have contact with the fan cabinets (3).
6. A firing and drying system (8) according to claim 5, and it is **characterized in that**; the said tray carts (5) comprise trays (4) in which the product is placed, shelves (5.1) placed at its two sides at the inner walls in order to be able to arrange the trays (4) on top of each other, a support part (5.2) in band form placed at the front side of the cart (5) in order to prevent its natural flexibility, wheels (5.3) placed under the tray cart (5) in order to provide its mobility, and holding arms (5.4).
7. A firing and drying system (8) according to claim 1, and it is **characterized in that**; the said drying room (1) comprises serpentine (6) which are longitudinally placed between the fan cabinets (3) and the room (1) walls.
8. A firing and drying system (8) according to claim 7, and it is **characterized in that**; the said serpentine (6) comprises an opening (6.1) for entrance of hot steam coming from the steam boiler placed outside the room (1) and pipes (6.2) in which the steam is circulated in order to transfer the heat of the steam inside the room.
9. A firing and drying system (8) according to claim 1, and it is **characterized in that**; the said drying room (1) comprises chimneys (7) and chimney motors (9) placed at the ceiling of the room in two rows symmetrical with each other in order to discharge the inner moist air to outside or to intake fresh air from outside to inside.
10. A firing and drying system (8) according to claim 1, and it is **characterized in that**; the said drying room (1) comprises a suspended ceiling (11) which is connected to the ceiling surface via connection shafts (11.1) in order to form an air circulation space between the room (1) ceiling and the products

11. A firing and drying system (8) according to claim 1, and it is **characterized in that**; the said drying room (1) comprises a computer (10), which controls the room (1) medium via the moisture and temperature sensors placed in the room (1), and which controls the chimneys (7) and chimney motors (9), thermal valve connected to the steam boiler, the fans (2) and fan motors (2.1) placed inside the room with the data obtained from these sensors.
12. A firing and drying system (8) according to claim 10, and it is **characterized in that**; the said drying room (1) comprises a PLC computer (10).

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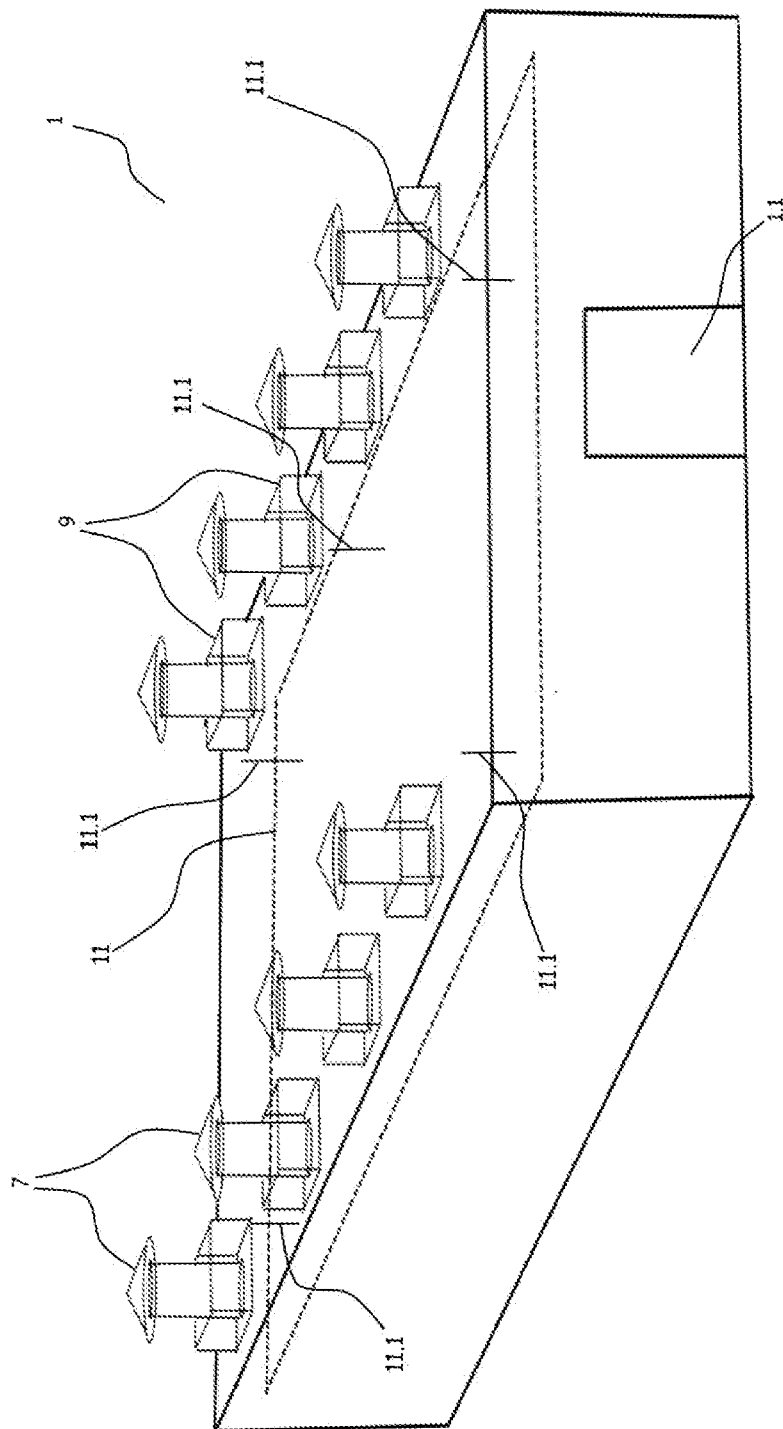


Figure 1

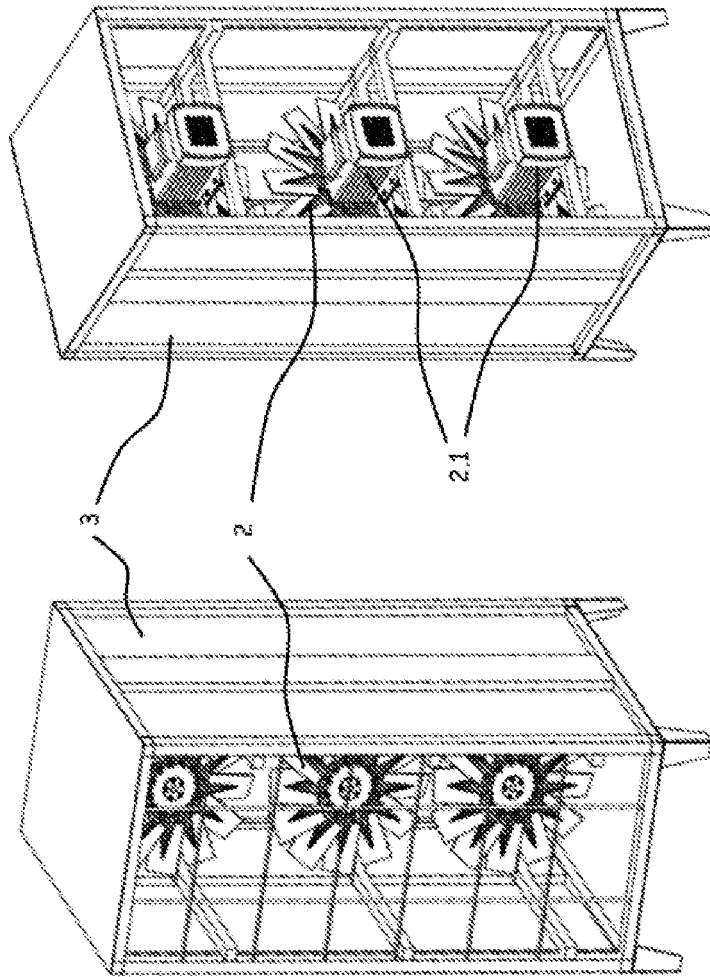


Figure 2b

Figure 2a

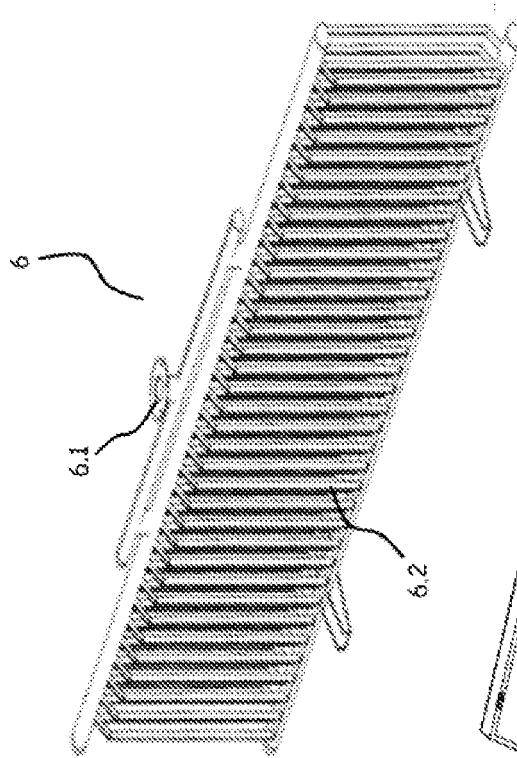


Figure 3

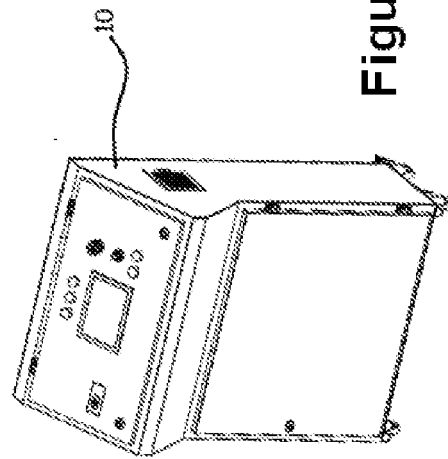


Figure 4

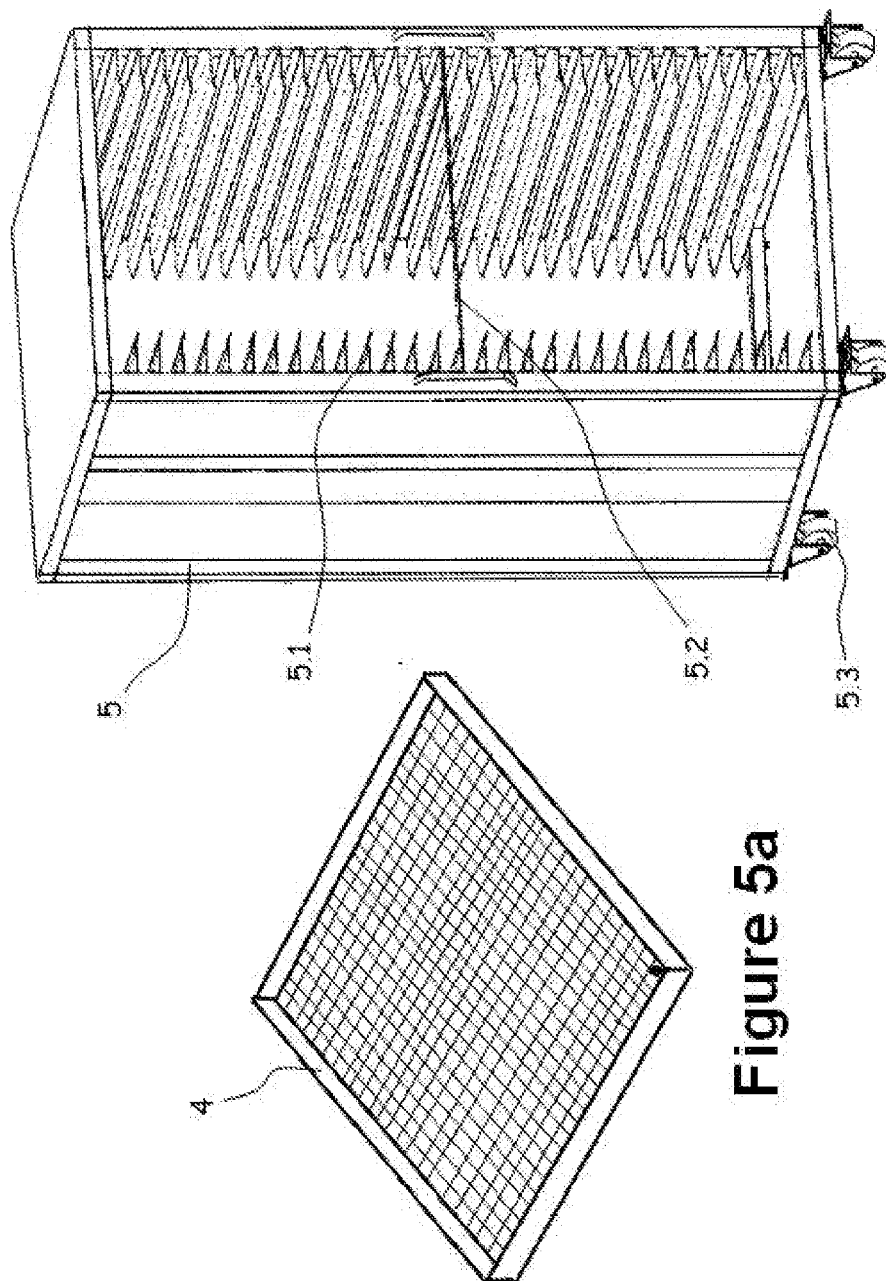


Figure 5b

Figure 5a

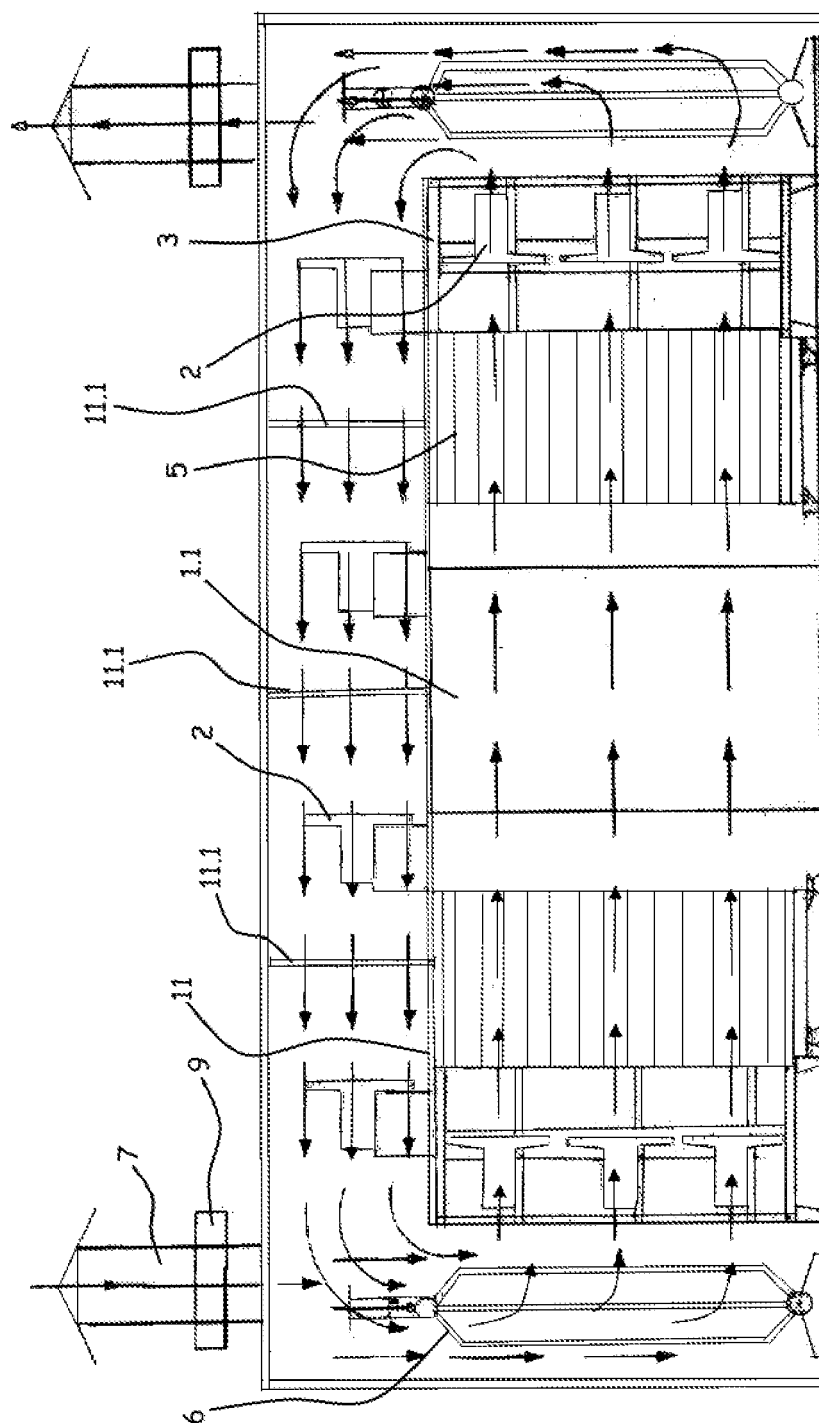


Figure 6

REFERENCES CITED IN THE DESCRIPTION

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