(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
21 February 2008 (21.02.2008)

PCT

(10) International Publication Number
WO 2008/021243 A2

(51) International Patent Classification:
F24F 7/00 (2006.01)

(21) International Application Number:
PCT/US2007/017807

(22) International Filing Date: 10 August 2007 (10.08.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/837,866 15 August 2006 (15.08.2006) US

(71) Applicant *(for all designated States except US)*: **LINCOLN FOODSERVICE PRODUCTS LLC** [US/US]; 1111 North Hadley Road, Fort Wayne, IN 46804 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **HUANG, Ming, Lung** [US/US]; 7323 Thoroughbred Dr., 1c, Fort Wayne, IN 46804 (US).

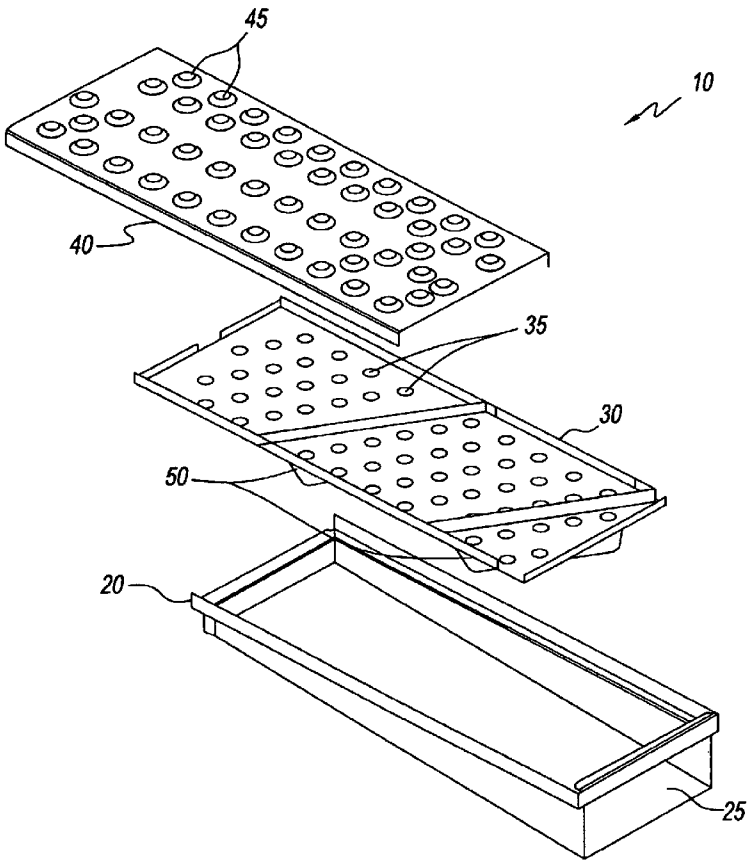
(74) Agent: **GREELEY, Paul, D.**; Ohlandt, Greeley, Ruggiero & Perle, L.L.P., One Landmark Square, 10th Floor, Stamford, CT 06901-2682 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: MULTIPLE AIR DAM DEVICE



(57) Abstract: An impinging air duct comprising a columnating plate and a plurality of orifices disposed thereon. A plurality of air dams direct air entering the impinging air duct through the orifices, to ensure that the flow of air out of the duct is substantially even along the length of the duct.

WO 2008/021243 A2

Published:

— *without international search report and to be republished upon receipt of that report*

MULTIPLE AIR DAM DEVICE

BACKGROUND OF THE DISCLOSURE

1. Field of the Disclosure

The present disclosure relates to a device for improving airflow inside an impinging air duct. More particularly, the present disclosure relates to an air dam that balances the air pressure along the length of the duct.

2. Description of the Related Art

In the field of impinging air ovens and other devices, an air duct is often a tapered, horizontal air delivery device disposed above and/or below the cooking surface. As heated air enters the air duct, the duct becomes pressurized and directs the airflow toward jet-forming or columnating orifices disposed in a columniating plate. These orifices then direct the airflow toward a cover plate with a second pattern of orifices or dispensing ducts. When the ducts are used in ovens, a food product can be passed above or below the duct for heating and/or cooking. Such tapered ducts are well known in the field.

The size and shape of the ducts will have to conform to the general shape of the oven. In situations where an oven with a lower dimensional profile or reduced height is preferred, this presents a problem because it is more difficult to acquire a uniform velocity and/or mass flow of air along the length of the duct. For example, in shorter air dispensing ducts, the air has a tendency to gravitate to the front or end of the duct. This phenomenon can adversely affect uniformity of cooking and efficiency of the oven, as well as increase the energy costs of operating the oven. Additionally, this problem can add to the engineering costs associated with designing such an oven, because the airflow characteristics of the air entering the dispensing duct and the characteristics of the duct itself will have to be adjusted according to the particular dimensions of the oven.

Accordingly, there is a need for an impingement air duct and airflow pattern inside the duct that overcomes the disadvantages of currently available systems.

SUMMARY OF THE DISCLOSURE

The present disclosure serves these and other purposes with a multiple air dam device disposed within an impinging air duct. The air dams help to direct the airflow out of the orifices of the dispensing duct in a balanced manner. Air entering the dispensing duct fills up the area behind the first dam, with the rest of the air passing over the dam and moving on to other areas of the dispensing duct and other air dams that may be located further downstream. This build up of air helps to ensure a balanced airflow pressure along the length of the dispensing duct, and also helps to ensure that the air exiting the dispensing duct does so in a flow that is substantially normal to the dispensing duct surface.

Thus, the present disclosure provides an impinging air duct. The air duct comprises an opening at one end of the air duct, wherein an air flow enters the air duct through the opening, a columnating plate having a face with a plurality of orifices disposed thereon and a plurality of side walls, wherein the air flow passes over the columnating plate, and at least one air dam disposed along the face of the columnating plate, wherein the air dam directs the air flow through the orifices.

The present disclosure also provides a method of directing air flow through an impinging air duct. The method comprising the steps of supplying the air flow through an opening of the impinging air duct, and directing the air flow through a plurality of columnating orifices disposed on a columnating plate disposed within the impinging air duct.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded view of an impinging air duct of the present disclosure;

Fig. 2 is a top cross-sectional view of an impinging air duct of the present disclosure;

Fig. 3 is a side cross-sectional view of the impinging air duct of Fig. 2;

Fig. 4 is an additional top cross-sectional view of the impinging air duct of Fig. 2; and

Fig. 5 is an additional side cross-sectional view of the impinging air duct of Fig. 2.

DETAILED DESCRIPTION OF THE DISCLOSURE

The air dams of the present disclosure are inserted into air dispensing ducts to help evenly distribute the flow of air out of the duct. Several air dams can be utilized in each dispensing duct, depending on the size of the duct. The air dam is a generally linear device that is connected to the columniating plate at an angle to that plate. This helps the air entering the duct make the transition from a generally horizontal flow to a generally vertical flow out of the dispensing orifices. Air entering the duct is captured by the first air dam, and directed out of the duct through the columnating orifices. When the space behind the air dam is filled up, the remaining air entering the duct passes over the first air dam, and passes onto the next air dam or air cavity within the duct. Thus, the air dams of the present disclosure help to ensure an even flow of air along the length of the dispensing duct, which substantially saves on the heating and energy costs associated with currently available models that have uneven air flow profiles.

Referring to Figs. 1 through 3, an air dispensing duct 10 including a plurality of air dams 50 according to the present disclosure is shown. Air dispensing duct 10 has housing 20, columniating plate 30, and cover plate 40. Columniating plate 30 has a plurality of columniating orifices 35, and cover plate 40 has a plurality of cover orifices 45. Air enters the dispensing duct 10 through opening 25, where it is partially intercepted by air dams 50 and directed out of the duct through columniating orifices 35 and cover orifices 45.

In the shown embodiment, air dams 50 are plates of aluminized steel that are connected to the columniating plate 30 by spot welding. The present disclosure, however, contemplates the use of other materials for the air dams 50, such as stainless steel or any other material capable of withstanding the environment inside the oven. The air dams may also be connected to the columniating plate 30 with other methods, such as with fasteners. The air dams 50 and the columniating plate 30 can also be stamped from the same sheet of metal so that they are formed as one piece. Finally, although in the shown embodiment there are two air dams 50 per dispensing duct 10, the present disclosure contemplates the use of one or more air dams 50 within the dispensing duct 10.

Referring to Figs 4 and 5, a first air dam 52 and a second air dam 54 within the dispensing duct 10 are shown. As is shown in Fig. 4, air dams 52 and 54 are mounted at distances I and L from opening 25, respectively, and at angles A and B to the sides of the columniating plate 30. As is shown in Fig. 5, air dams 52 and 54 are also mounted to columniating plate 30 at angles a and b, respectively, and have heights h and H as measured from the face of columniating plate 30.

The variables I, L, A, B, a, b, h, and H will all vary depending on the dimensional characteristics of the oven and the type of flow of air entering the dispensing duct 10. For example, with a deeper oven cavity, it may be advantageous to have more air dams spaced at long distances I and L from opening 25. If the flow entering dispensing duct 10 is substantially laminar, a larger value for angles a and b, and heights h and H, may be required. The air dams of the present disclosure are thus advantageous in that they can be adjusted to accommodate for a variety of airflow types entering the dispensing duct. This saves on the engineering costs associated with selecting and optimizing the proper air flow entering the duct. In another embodiment of the present disclosure, all of the above discussed variables can be adjusted with knobs or other manual controls.

The present disclosure having been thus described with particular reference to the preferred forms thereof, it will be obvious that various changes and modifications may be made therein without departing from the spirit and scope of the present disclosure as defined in the appended claims.

What is claimed is:

1. An impinging air duct, comprising:

an opening at one end of the air duct, wherein an air flow enters the air duct through said opening;

a columnating plate having a face with a plurality of orifices disposed thereon and a plurality of side walls, wherein said air flow passes over said columnating plate; and

at least one air dam disposed along said face of said columnating plate, wherein said dam directs said air flow through said orifices.

2. The impinging air duct of claim 1, wherein a distance between said air dam and said opening is adjustable.

3. The impinging air duct of claim 1, wherein a height of said air dam is adjustable.

4. The impinging air duct of claim 1, wherein said air dam is connected to said side walls of said columnating plate, and an angle of connection between said air dam and said side wall of said columnating plate is adjustable.

5. The impinging air duct of claim 1, wherein an angle between said air dam and said face of said columnating plate is adjustable.

6. A method of directing air flow through an impinging air duct, said method comprising the steps of:

supplying the air flow through an opening of the impinging air duct;

directing the air flow through a plurality of columnating orifices disposed on a columnating plate disposed within the impinging air duct.

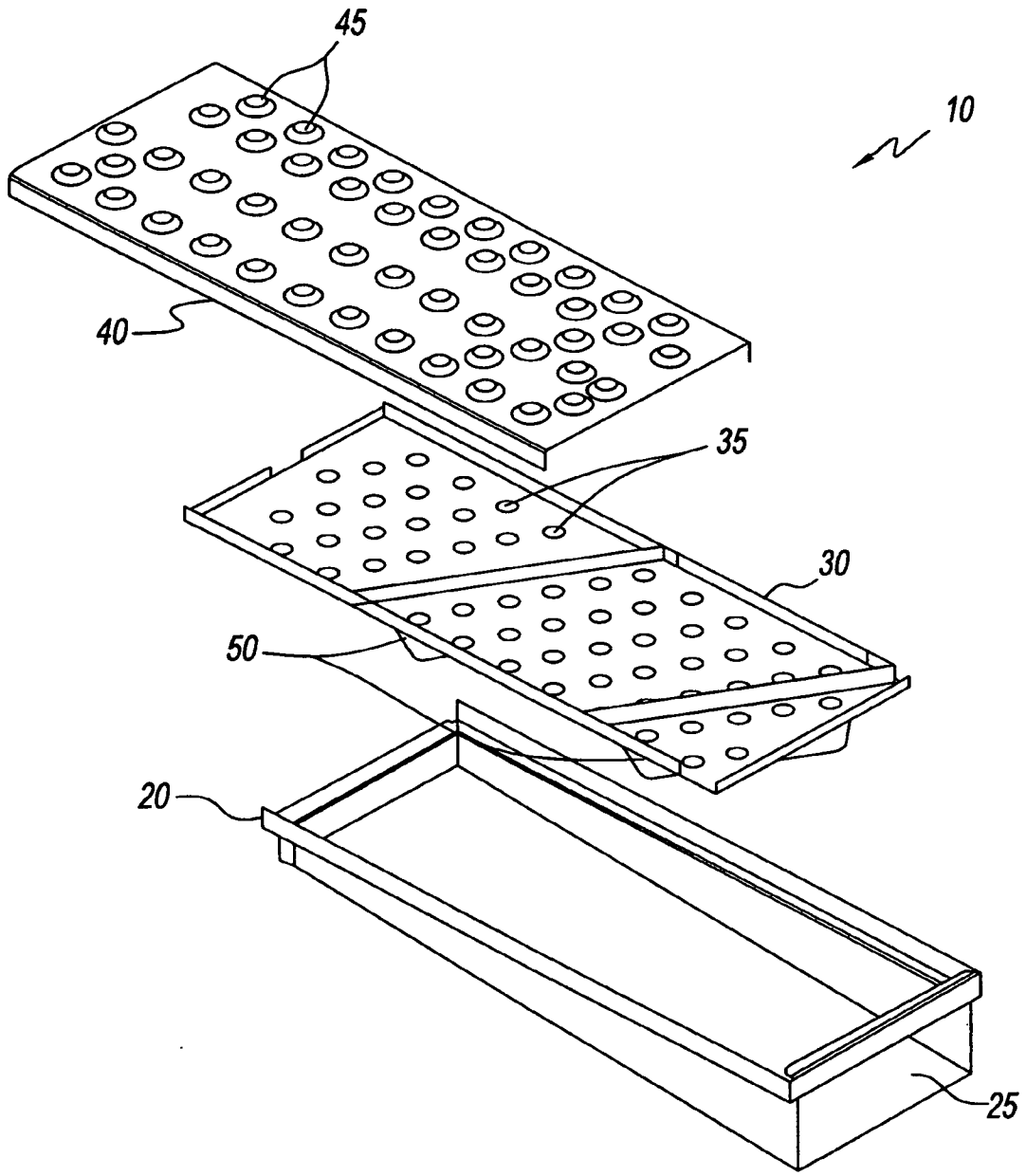


Fig. 1

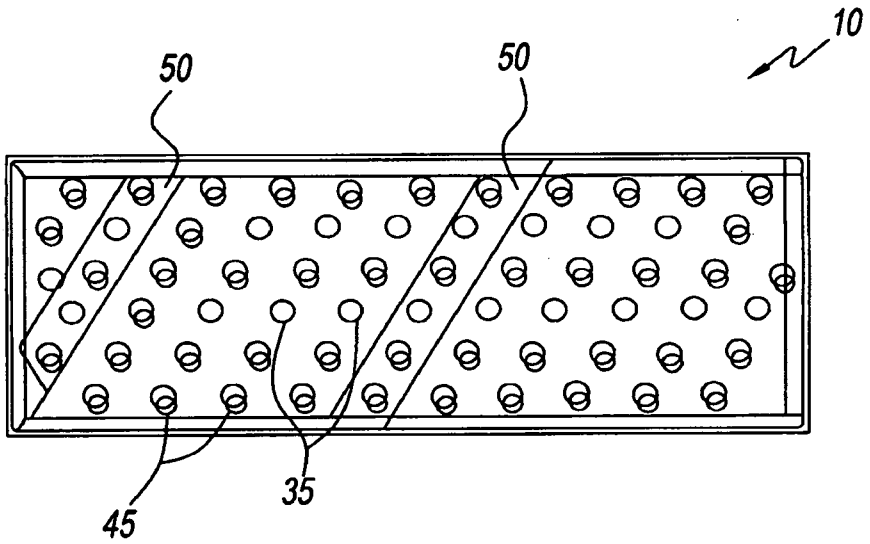


Fig. 2

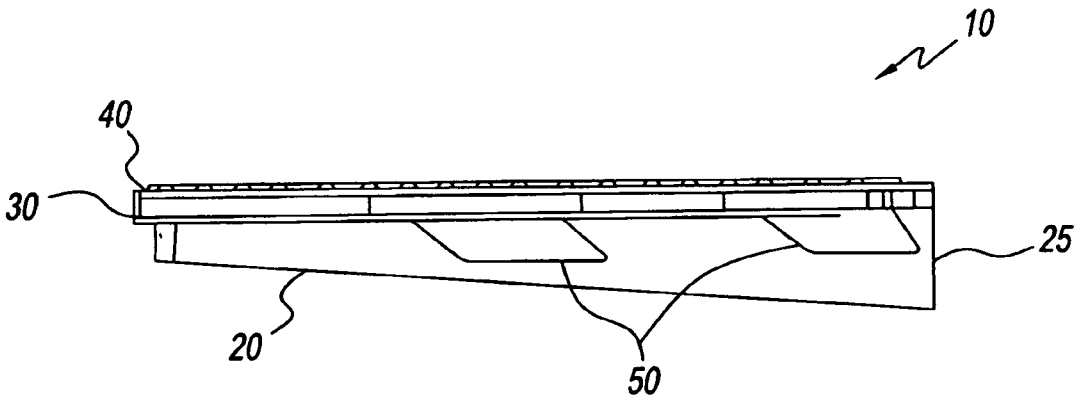


Fig. 3

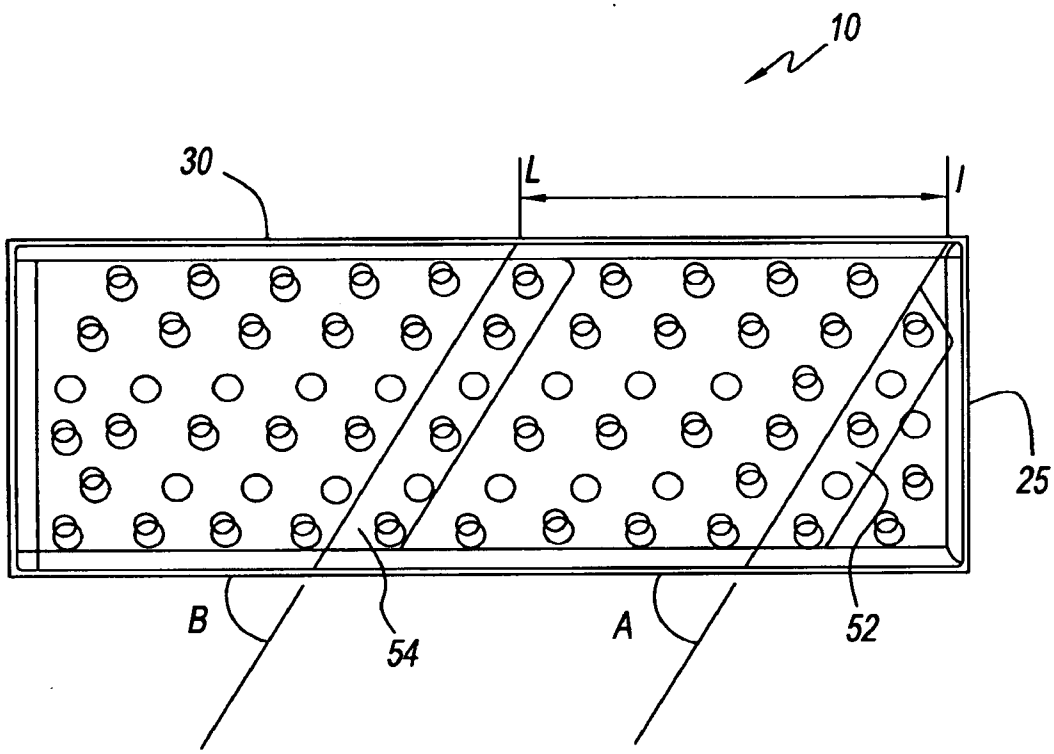


Fig. 4

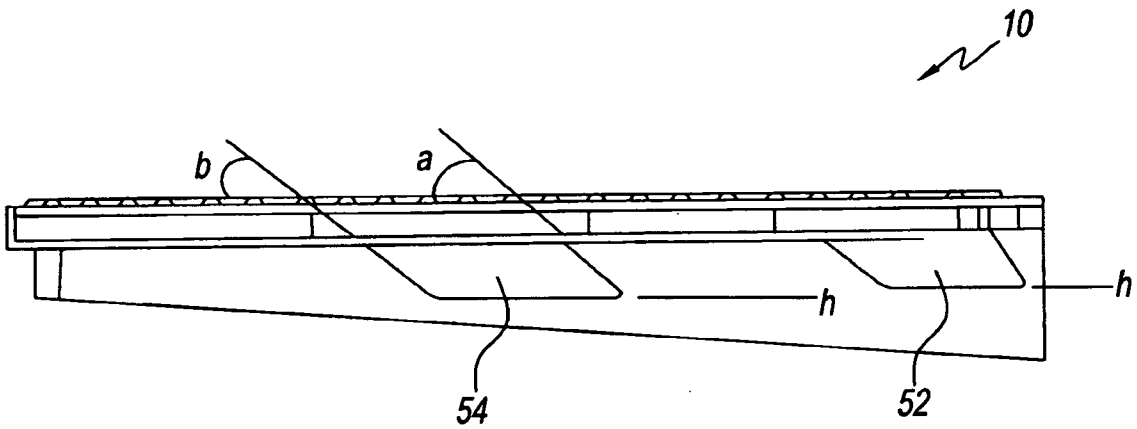


Fig. 5