

Dec. 7, 1965

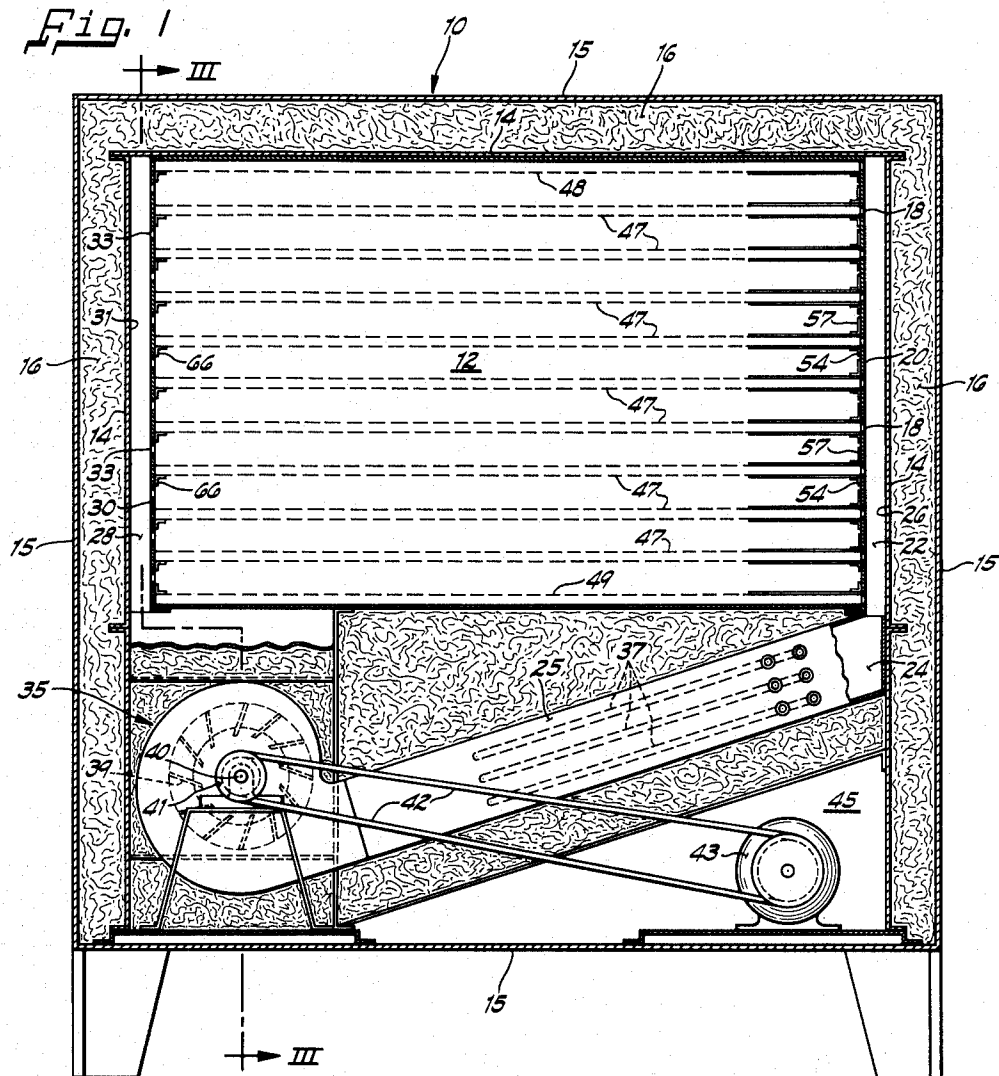
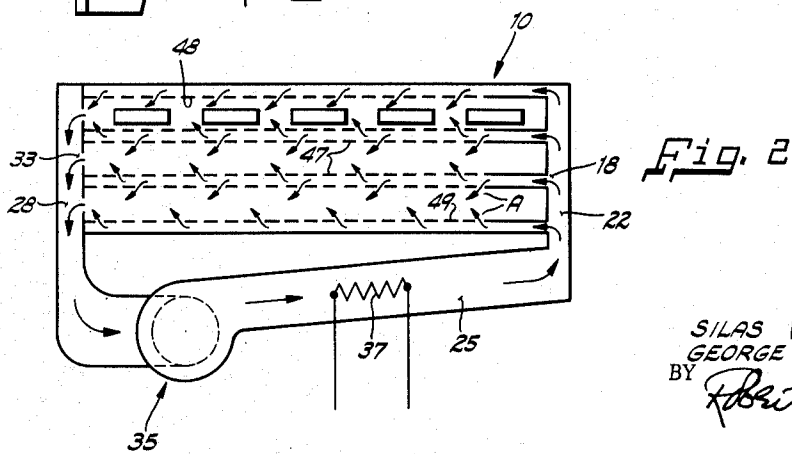
S. V. BEASLEY ETAL

3,221,729

OVEN SUPPLIED WITH HOT AIR THROUGH FORAMINOUS DUCT-SHELVES

Filed Oct. 22, 1962

4 Sheets-Sheet 1



INVENTORS.
 SILAS V. BEASLEY
 GEORGE K. HARDING, JR.
 BY *Robert W. Kallitman*
 ATTORNEY

Dec. 7, 1965

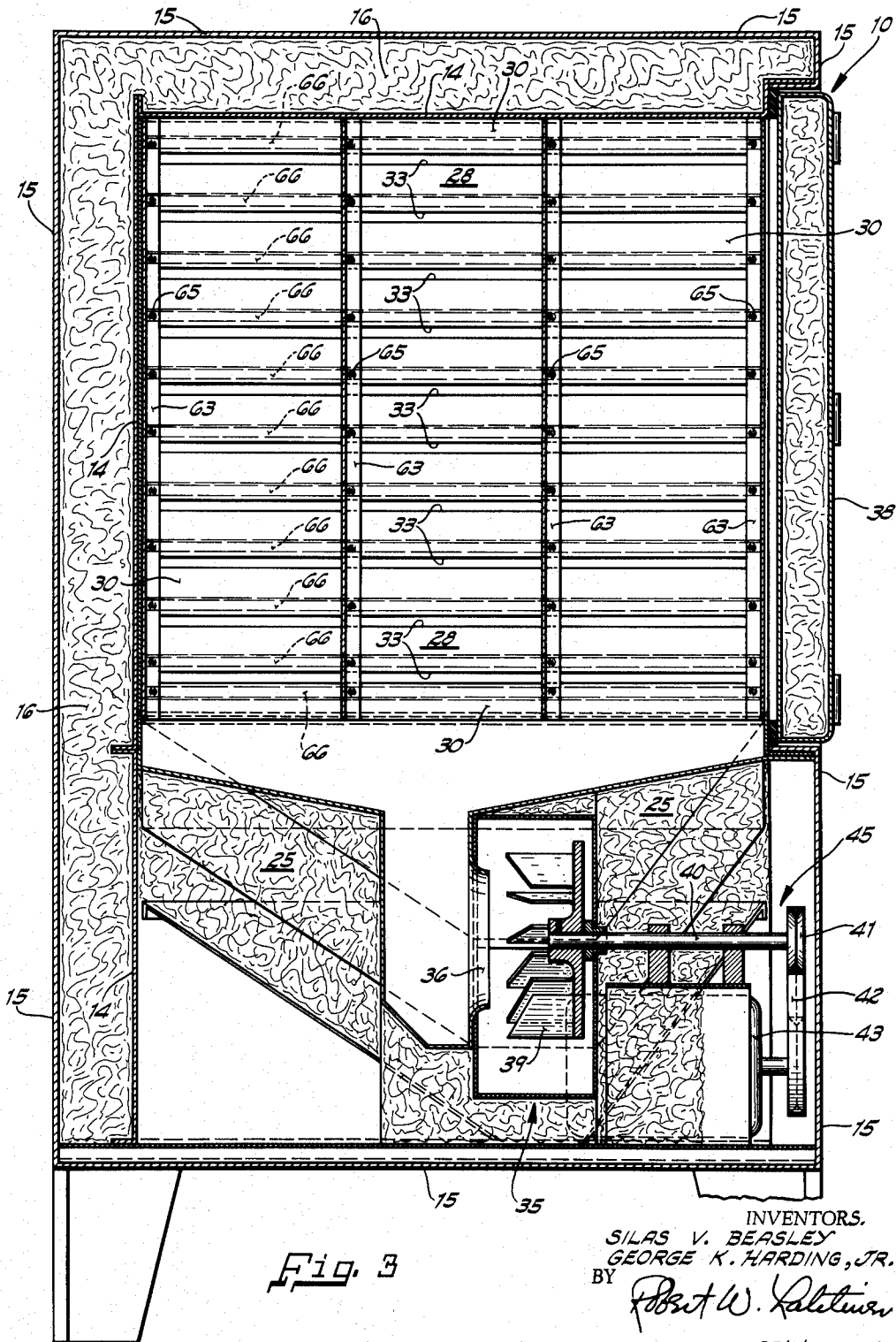
S. V. BEASLEY ET AL

3,221,729

OVEN SUPPLIED WITH HOT AIR THROUGH FORAMINOUS DUCT-SHELVES

Filed Oct. 22, 1962

4 Sheets-Sheet 2



Dec. 7, 1965

S. V. BEASLEY ETAL

3,221,729

OVEN SUPPLIED WITH HOT AIR THROUGH FORAMINOUS DUCT-SHELVES

Filed Oct. 22, 1962

4 Sheets-Sheet 3

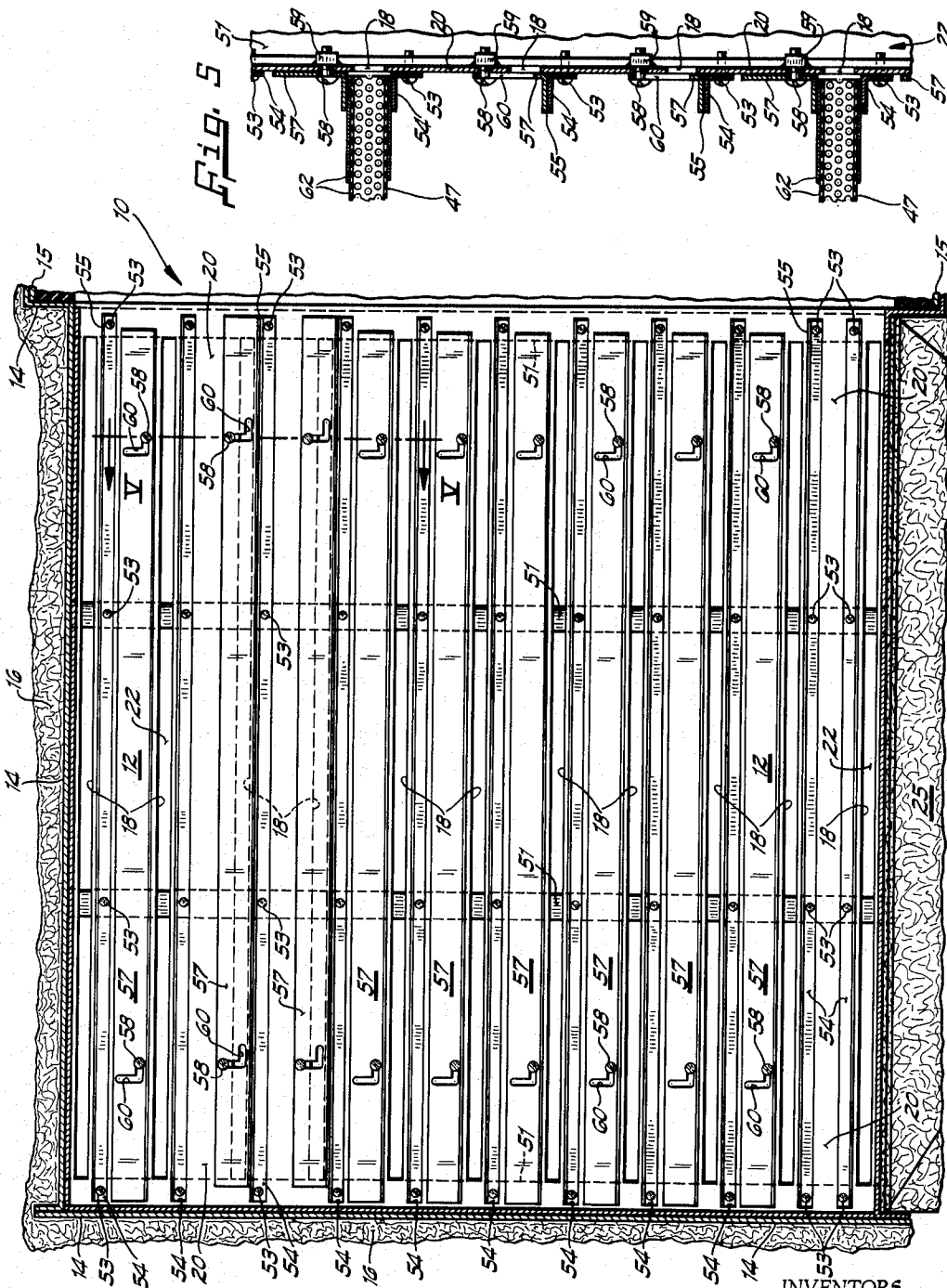


Fig. 4

Fig. 5

INVENTORS.
SILAS V. BEASLEY
GEORGE K. HARDING, JR.
BY *Robert W. Lattin*
ATTORNEY

Dec. 7, 1965

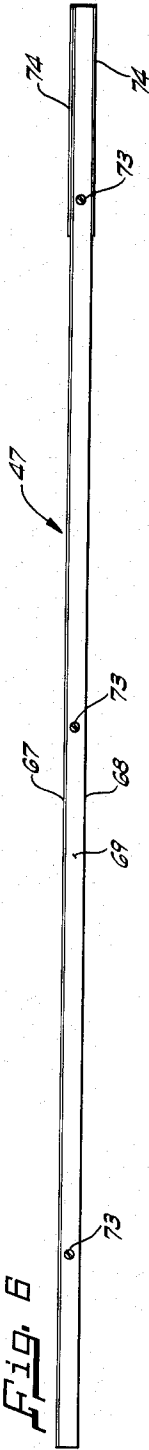
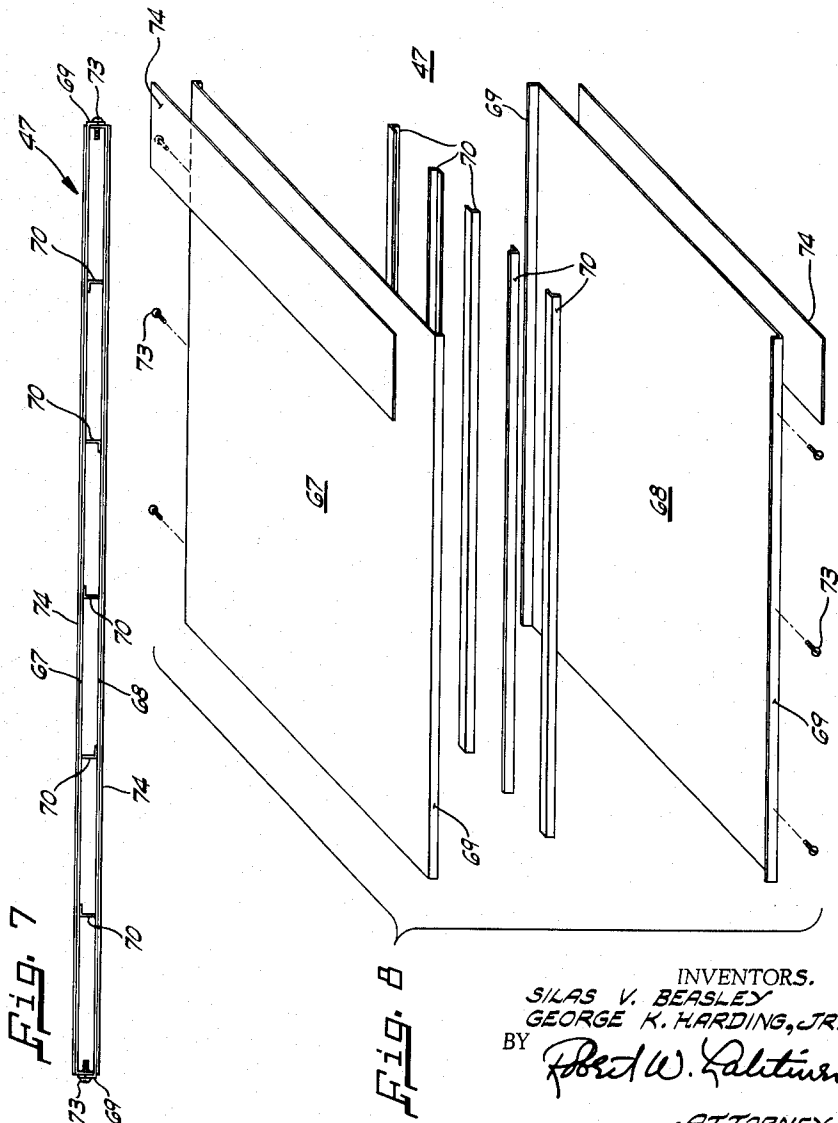
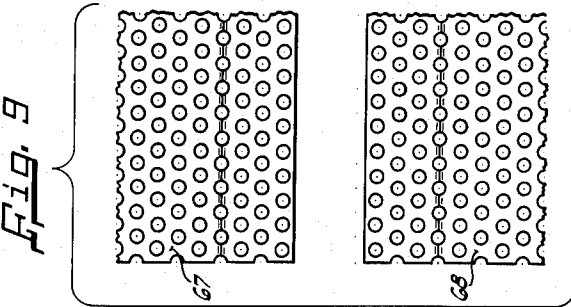
S. V. BEASLEY ET AL

3,221,729

OVEN SUPPLIED WITH HOT AIR THROUGH FORAMINOUS DUCT-SHELVES

Filed Oct. 22, 1962

4 Sheets-Sheet 4



INVENTORS.
SILAS V. BEASLEY
GEORGE K. HARDING, JR.
BY *Robert W. Lattin*
ATTORNEY

1

3,221,729

OVEN SUPPLIED WITH HOT AIR THROUGH FORAMINOUS DUCT-SHELVES

Silas V. Beasley, East Dundee, and George K. Harding, Jr., Carpentersville, Ill., assignors to McGraw-Edison Company, Milwaukee, Wis., a corporation of Delaware
Filed Oct. 22, 1962, Ser. No. 231,978
3 Claims. (Cl. 126—21)

This invention relates to ovens, and more particularly, to ovens for preparing foods and reconstituting and preparing frozen foods.

Conventional forced air circulating ovens deliver heated air at one side and withdraw the air from the oven at the opposite side. Although this method of circulation is adequate for numerous uses, it is less than satisfactory when the oven is used for defrosting and heating frozen foods. Under such conditions the incoming air is cooled to the extent that the food may be burned near the inlet while it is still raw near the outlet.

The practice used to overcome this difficulty in most current commercial units designed for such use is to make the oven very narrow so that the drop in air temperature during travel across the oven is not great enough to cause a material impairment of the operation. This approach does not solve the problem, but rather limits the severity of the disability to a condition that is tolerable and results in an oven poorly adapted to quantity cooking. Such an oven does not possess a sufficient flexibility for use in preparing food items of common size or conventional quantity due to the restriction imposed by the narrow configuration.

The present invention provides an oven wherein heated air is circulated into the processing portion of the chamber continuously across the width to accomplish a more equalized delivery of heat throughout the width traversed. By so doing the dimensions of the food processing enclosure may be selected on the basis of greatest utility and the enclosure located at the most convenient height rather than being limited to a tall unit of narrow width.

This method of air circulation that makes possible a truly effective frozen reconstituting oven also measurably improves the results obtained when the unit is utilized as a conventional oven. Ordinarily, a commercial type oven takes the form of a relatively static chamber with the heating elements disposed within the chamber at locations calculated to yield the most even heating. To overcome irregularities that occur in oven temperatures at various locations, blowers have been frequently added to create turbulence within the chamber and distribute heated air more uniformly throughout.

Units incorporating the preferred embodiment of this invention, described hereafter, have been found to bake faster and more evenly. For example, sheet cakes that required 25 minutes of baking time in a regular commercial oven were done in 15 minutes, and similarly bread normally requiring 40 minutes was baked in 25 minutes in oven incorporating the subject invention. In both instances the completed baked product was done evenly throughout. With respect to the bread, there was no identifiable difference in the browning of the loaves baked in any location within the oven. It has also been found that in most instances the initial baking period at a higher temperature may be eliminated when the present invention is used.

It is an object of this invention to provide an improved oven for food preparation and reconstituting frozen foods.

It is a further object of this invention to provide for delivery of heated air above, below and around the food articles in the amount necessary to provide even heating in all areas of the oven.

2

It is also an object of this invention to provide an oven that may effectively defrost and heat frozen foods in an oven of conventional dimensions that can readily be converted to use as a conventional oven.

It is also an object of this invention to provide an oven wherein it is possible to readily increase or decrease the size of the food preparing areas to accommodate smaller or larger articles.

It is also an object of this invention to provide an improved forced air circulating oven having means for controlling the volume rate of air flow through the food preparing compartment.

It is also an object of this invention to control the humidity of the air in an air recirculating system by effectively sealing such system from the atmosphere.

It is a further object of this invention to provide an oven that will bake goods evenly irrespective of location within the oven in a shorter time.

These and other objects and advantages of this invention will become apparent from the following description when taken in connection with the accompanying drawings, wherein:

FIG. 1 is a front elevation of the oven of this invention with portions broken away;

FIG. 2 is a schematic representation illustrating the path of air circulation of the oven of FIG. 1;

FIG. 3 is a section view taken along line III—III of FIG. 1;

FIG. 4 is a view of the oven side wall at the inlet side as viewed from the interior of the oven;

FIG. 5 is a section view of a portion of the side wall taken along line V—V of FIG. 4 and including two shelf inlet end portions;

FIG. 6 is a front elevation of one of the article supporting ducts;

FIG. 7 is a side elevation of the article supporting duct of FIG. 6;

FIG. 8 is an exploded view of the article supporting duct of FIG. 6; and

FIG. 9 is a fragmentary view of the porous sheet material used to form the duct surfaces with the fold lines for the overlapping flange portion indicated thereon.

Referring to FIGS. 1—3, the forced air recirculating oven 10 is shown with the food processing enclosure or oven chamber 12, and the associated air circulating assembly which is associated therewith included within a liner 14 that is thermally insulated from the exterior shell 15 by insulating material 16. The oven chamber 12 has a series of vertically spaced horizontal slotted openings 18 in the side or end wall 20 through which air is received from the air inlet duct 22. Duct 22 extends from the outlet end 24 of the heating chamber 25 upwardly between the side wall 20 and the inner shell surface 26 and extends from the front to the rear of the oven chamber 12. An outlet duct 28 adjoins the opposite side or end wall 30 of the oven chamber 12 and is similarly formed between the side wall 30 and the liner wall surface 31 extending over the full depth of the wall in air receiving communication with the oven chamber through the vertically spaced series of horizontal slots 33. The outlet duct 28 has a lower terminal portion that communicates with the blower 35. The blower 35 receives air at the suction side 36 from the outlet duct 28 and delivers air to the heater chamber 25.

Within the heater chamber are a series of sheath electrical resistance heating elements 37. These elements are controlled by a conventional thermostatically operated switch (not shown) for maintaining a predetermined temperature within the oven chamber, which control circuit forms no part of this invention and will not be further described.

With the oven closure door 38 in the closed position, the oven chamber 12, outlet duct 28, blower 35, heater chamber 25 and inlet duct 22 provide a substantially sealed recirculating path for continuously circulating heated air through the food processing oven chamber as schematically shown in FIG. 2. These portions of the total oven structure are thermally insulated from the exterior shell 15. The blower rotor 39 is mounted at one end of shaft 40 and is driven by a pulley 41 secured to the opposite end of the shaft that is in turn connected by the V-belt 42 to the motor 43 which is disposed in the machinery compartment 45 and thermally insulated from the heated portion of oven 10.

Within the oven chamber are a series of intermediate shelves 47 which are removable and upper and lower ducts 48 and 49 respectively which are not readily removable in use. The intermediate shelves 47 and the lower duct 49 are, in fact, article supporting ducts, serving the dual purpose of delivering air to the chamber 12 and supporting articles placed in the oven. At the inlet side wall 20 the slots 18 communicate with the interior of the shelves 47 which have perforate horizontal surfaces as will be more fully described below. At the outlet side wall 30 the slots 33 which allow the air to be withdrawn from the oven chamber 12 are intermediate the shelves 47.

FIGS. 4 and 5 illustrate the oven side wall 20 adjoining the inlet duct 22 having the vertically spaced horizontal openings 18 formed therein. A series of vertical angle members 51 extend through the inlet duct 22 to provide support for the oven wall 20 and an anchorage for the screws 53 which secure the shelf supporting angles 54 within the oven chamber 12. The angles are oriented to present a shelf supporting horizontal surface 55 immediately below the respective inlet 18 so that a shelf supported thereon will be aligned with the associated opening.

Overlying each shelf supporting angle is a baffle 57 formed by an angle member having one surface adjoining the side wall and another surface adapted to overlie the inlet end of the article supporting duct. The baffle is vertically adjustable and affords a selectively operable restriction for the associated opening 18 when the shelf 47 is removed. Each baffle 57 is loosely secured to the oven wall 20 by a pair of baffle pins 58 secured to the oven side wall 20 and extending through the L-shaped slots 60 in the respectively associated baffle. The baffle pins are secured to the oven wall by means of a series of associated weld nuts 59 mounted on the oven side wall 20 within the duct 22. When the shelf 47 is installed, as in the uppermost location shown in FIG. 5, the baffle 57 rests on the upper shelf surface 62 and serves to restrict the flow of air between the upper shelf surface and the oven wall 20. When the shelf 47 is withdrawn the baffle 57 can either be lowered by allowing it to lower vertically in the forwardmost position to restrict the opening 18 or can allow the opening 18 to remain unrestricted by lifting to the uppermost position and moving the baffle rearward to have the pin engage the horizontal portion of the L-shaped slot 60 remote from the vertical portion of the slot 60.

In FIG. 3 the outlet side wall 30 of the oven is seen from the outlet duct 28. The series of four vertically disposed angle members 63 provide support for the horizontally slotted wall 30 and also supply an anchorage for the screws 65 that secure the shelf supporting angle members 66 (FIG. 1) to the interior surface of the oven wall. It will be noted that the horizontal slots 33 are located between the shelf supports 66 to afford alignment intermediate the supported shelves 47.

The details of the shelves 47 are best shown in FIGS. 6-9, wherein the upper and lower duct portions 67 and 68 respectively are formed of sheets of perforate material as illustrated in FIG. 9. In practice a metal sheet having $\frac{1}{8}$ " circular openings on $\frac{3}{16}$ " centers has proved to afford the proper porosity in an oven of the standard 54" width.

The upper and lower duct walls in the illustrated embodiment are foraminous with a free opening area of approximately 35 percent uniformly distributed over the foraminous portions, which portions are interrupted only by the supporting angle members 70 and the marginally overlying sheet 74 which are described below. The upper and lower surfaces are fabricated with downwardly and upwardly extending marginal flanges 69 respectively along the edges extending between the side walls 20 and 30 of the oven. A series of angle members 70, which are spot-welded along the horizontal surface confronting the adjacent perforated sheet, are equidistantly spaced from front to rear between the confronting interior duct surfaces and serve to space the perforate sheets and add rigidity to the shelf structure intermediate the supported ends thereof. With the upper and lower duct portions 67 and 68 assembled as shown in FIG. 7, a series of sheet metal screws 73 secured through the overlapping flanges retain the portion together as a unitary structure.

Overlying the perforate structure at the inlet end of the duct are sheets 74 of imperforate sheet metal which are spot-welded to the upper and lower duct surfaces and extend over the entire depth of the shelf. The same structure may be achieved by using sheets of metal that have not been perforated over that portion of the surface area that would otherwise underlie the sheets 74. Particularly with respect to the upper horizontal shelf surface, by using such a structure a uniform surface, free of irregularities can be achieved that is only duplicated with sheets 74 when the latter are recessed into the article supporting surface of the shelf.

The operation of the oven is illustrated schematically in FIG. 2, wherein the blower 35 delivers air to the heating chamber 25 where heat is supplied by the heating elements 37. The air then passes through the inlet duct 22 and is delivered through the openings 18 to the perforate ducts 47, 48 and 49. The imperforate initial portion of the duct establishes a horizontal flow of air lengthwise across the duct 47 which, in concert with an adequate static pressure generated by the blower 35, serves to equalize the air delivery to the oven chamber throughout the perforate surface of the duct. The air enters the food processing portion of the oven throughout the length of the perforate portions of the ducts as indicated by the small arrows A, with some air entering along the inlet edges of the duct which are purposely not secured to the inlet slots 18 in gas tight relation. The air delivery is proportioned through the free opening of the duct surface to effect a uniform heat delivery throughout the width of the oven chamber 12. The air is withdrawn, or in the case of a non-recirculating oven would be allowed to vent, at the outlet side of the oven through the openings 33 and returned through the outlet duct 28 to the blower 35 to be recirculated.

By utilizing the structure shelf the high temperature air enters the food processing portion of the oven across the entire width thereof, eliminating the problem of excessively hot air at the inlet and unduly cool air at the outlet. Consequently, the width need not be restricted since heated air of a like temperature is delivered about the articles being processed at any location within the oven chamber. This even heat delivery is vital to reconstituting and preparing frozen foods and very markedly improves the results obtained when used for conventional baking.

This oven may also be effectively used for roasting large items such as turkeys or roasts by removing all or a portion of the intermediate shelves 47. It can be used as a single compartment by removing all the shelves, or divided into two compartments by utilizing a single intermediate shelf. Under those conditions a portion of the baffles 57 are adjusted to open the inlet slots to achieve adequate air circulation. Using the closed circuit substantially sealed recirculating air path of this oven for roasting, air in a saturated condition is recirculated during

5

the roasting process which substantially reduces shrinkage and yields a more tender, higher quality roasted food.

Although but one embodiment has been shown and described, it will be apparent to those skilled in the art that various changes and modifications may be made therein without departing from the spirit of the invention or from the scope of the appended claims.

We claim:

1. A food processing oven comprising an enclosure having first and second parallel vertical side walls and a front opening; a closure door mounted on said enclosure for selectively closing said front opening; a plurality of vertically spaced horizontal ducts extending between and removably supported on said first and second side walls, said ducts each presenting a foraminous horizontal upper supporting wall portion and a lower foraminous wall portion and defining vertically spaced food processing spaces therebetween wherein the sole horizontal support surfaces for articles to be processed in said oven is provided by the upper surfaces of ducts having foraminous air delivering surface portions; a plurality of elongated horizontally extending inlet openings in said first side wall respectively communicating with said plurality of ducts; a plurality of elongated, horizontally extending outlet openings in said second side wall respectively communicating with said food processing spaces intermediate said ducts and respectively vertically offset from said inlet openings; said ducts having imperforate upper and lower wall portions extending a predetermined distance from said first side wall; a plurality of closure members slidably mounted on said first side wall respectively adjacent said plurality of inlet openings and selectively operable to restrict said inlet openings when the duct associated with said inlet opening has been removed; enclosed air passage means exterior of said enclosure interconnecting said inlet openings and said outlet openings whereby a continuous recirculating air path is established; air circulating means disposed in said passage means for delivering air through said first side wall inlet openings and withdrawing air through said second side wall outlet openings; heating means disposed in said passage and thermal insulating means disposed about said enclosure and said air passage means.

2. A food processing oven comprising an enclosure having first and second side walls and a front wall with an access opening therein; a closure door for selectively closing said access opening; a plurality of vertically spaced inlet openings in said first side wall; a plurality of article supporting ducts horizontally supported within said enclosure respectively in air receiving alignment with

6

said inlet openings, each of said ducts having upper and lower horizontal walls extending between said first and second side walls, each said horizontal wall including an imperforate marginal portion adjoining said first side wall with the remaining area thereof being foraminous with a substantially uniform distribution of openings throughout said foraminous area, said ducts being of shallow construction of the vertical height of any such duct being substantially smaller than the height of the space intermediate any two adjoining ducts; outlet opening means in said second wall communicating with said enclosure exterior of said ducts; and means for circulating heated air into said enclosure through said inlet openings and withdrawing air from said enclosure through said air outlet opening means.

3. A food processing oven comprising an enclosure including first and second parallel side walls; a plurality of vertically spaced horizontally extending article supporting ducts mounted within said enclosure having foraminous upper and lower horizontal wall portions and defining vertically spaced food processing spaces therebetween; a plurality of air inlet openings through said first side wall respectively communicating with said ducts; said ducts having imperforate upper and lower wall portions extending a predetermined distance from said inlet opening, whereby a generally horizontal flow of air is established through the portion of each of said ducts adjoining said air inlet openings; a plurality of air outlet openings in said second side wall respectively communicating with said food processing spaces; and means for circulating heated air into said enclosure through said inlet openings and withdrawing air from said enclosure through said air outlet openings.

References Cited by the Examiner

UNITED STATES PATENTS

1,107,294	8/1914	Grau	34—195
1,149,948	8/1915	Rand	34—233
2,561,517	7/1951	Ladge	99—447
2,795,054	6/1957	Bowen	126—21
3,115,019	12/1963	Rutishauser	34—195 X

FOREIGN PATENTS

505,607	8/1930	Germany.
658,558	10/1951	Great Britain.

FREDERICK L. MATTESON, Jr., *Primary Examiner.*

JAMES W. WESTHAVER, *Examiner.*