United States Patent [19]

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[11] **3,713,401**

[45] **Jan. 30, 1973**

[54] **AIR-FLOW OVEN**

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[22] Filed: **March 23, 1971**

[21] Appl. No.: **127,205**

[52] **U.S. Cl.** ..... **107/57 B**
[51] **Int. Cl.** **A21b 3/06**
[58] **Field of Search** ..... 107/57 D, 57 R, 57 B

[56] **References Cited**

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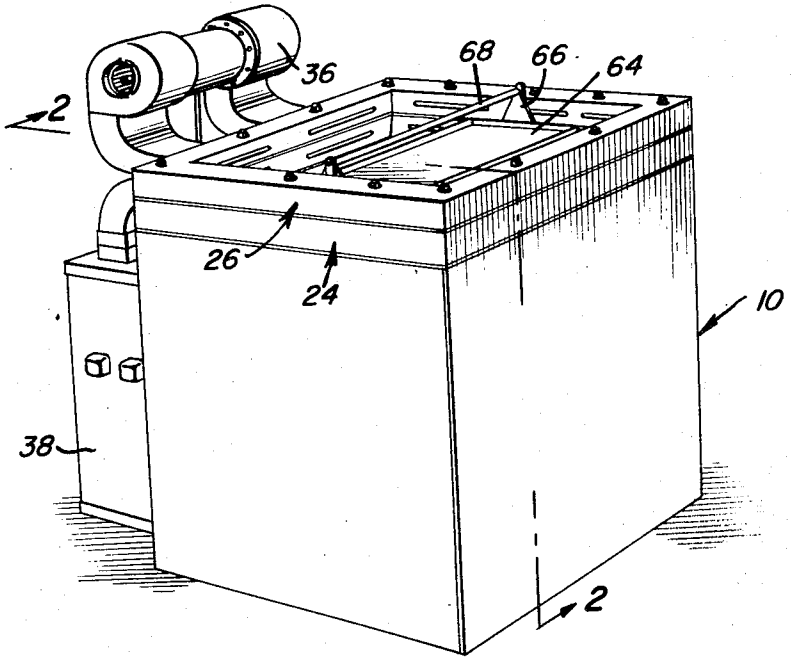
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[57] **ABSTRACT**

An oven for heating and maintaining heated food stuff wherein free access to the interior thereof is provided through an open port, either at the top or bottom thereof. A dual air curtain is provided about the access port or opening and includes an inwardly directed curtain defined by circulating oven heated air and a second overlying outer curtain defined by a blowing of the ambient air thereacross. THe food is maintained on a vertically traveling rack, the individual pans of which are removable for a selective removing of the food stuff.

18 Claims, 8 Drawing Figures



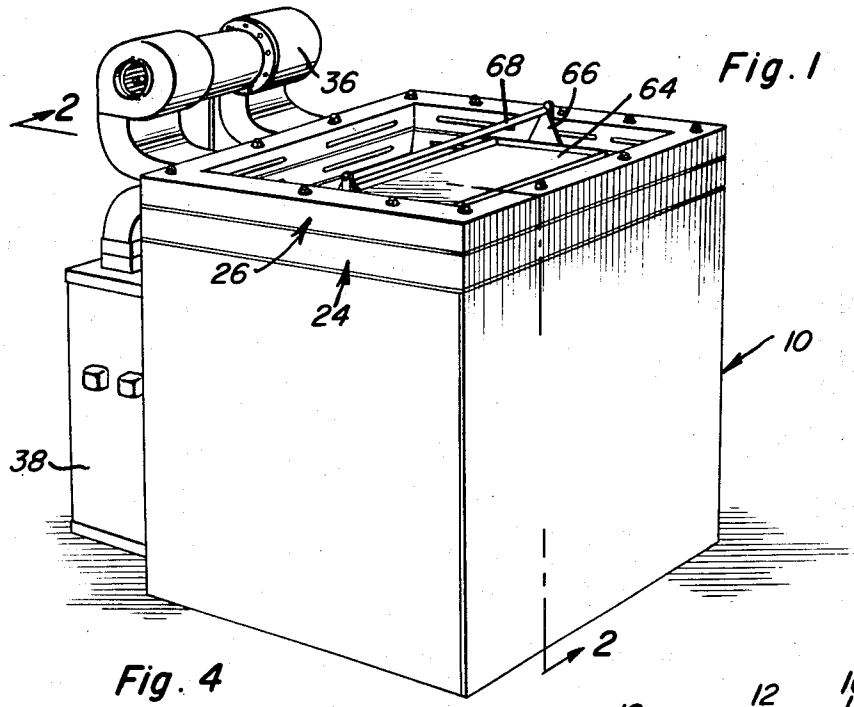


Fig. 1

Fig. 4

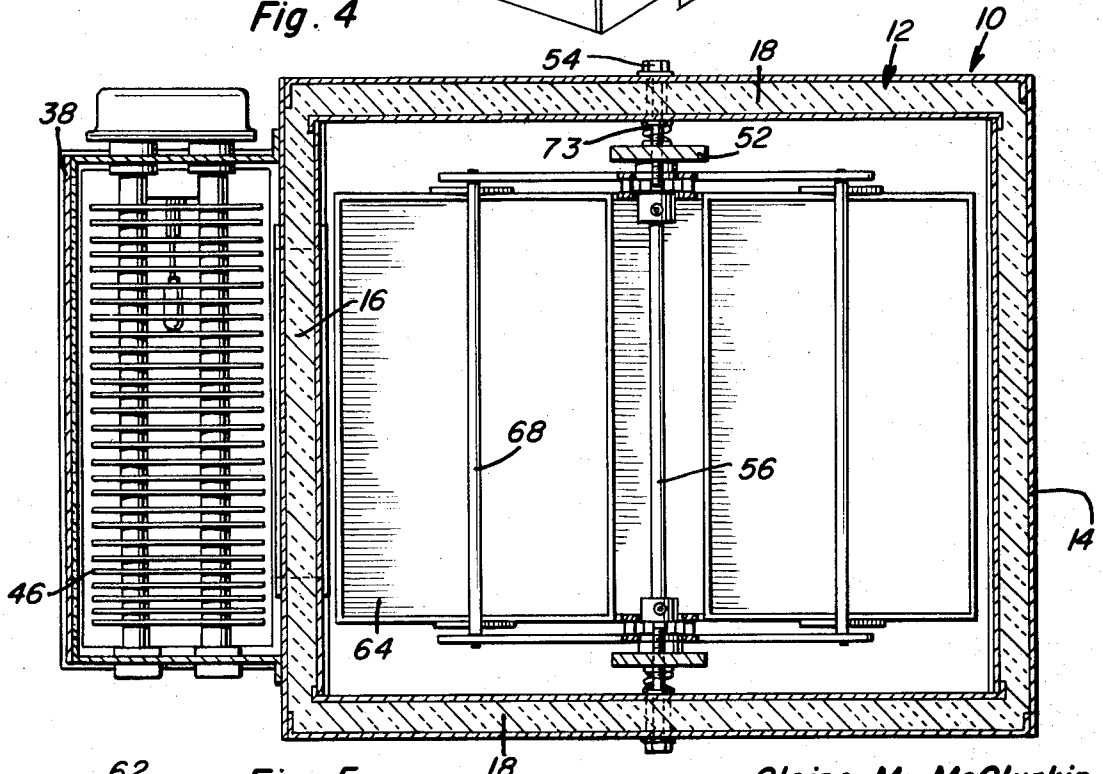
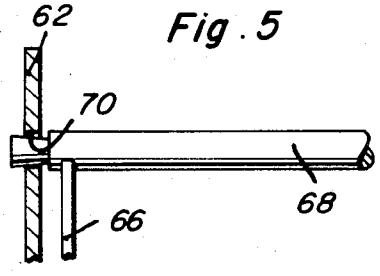


Fig. 5

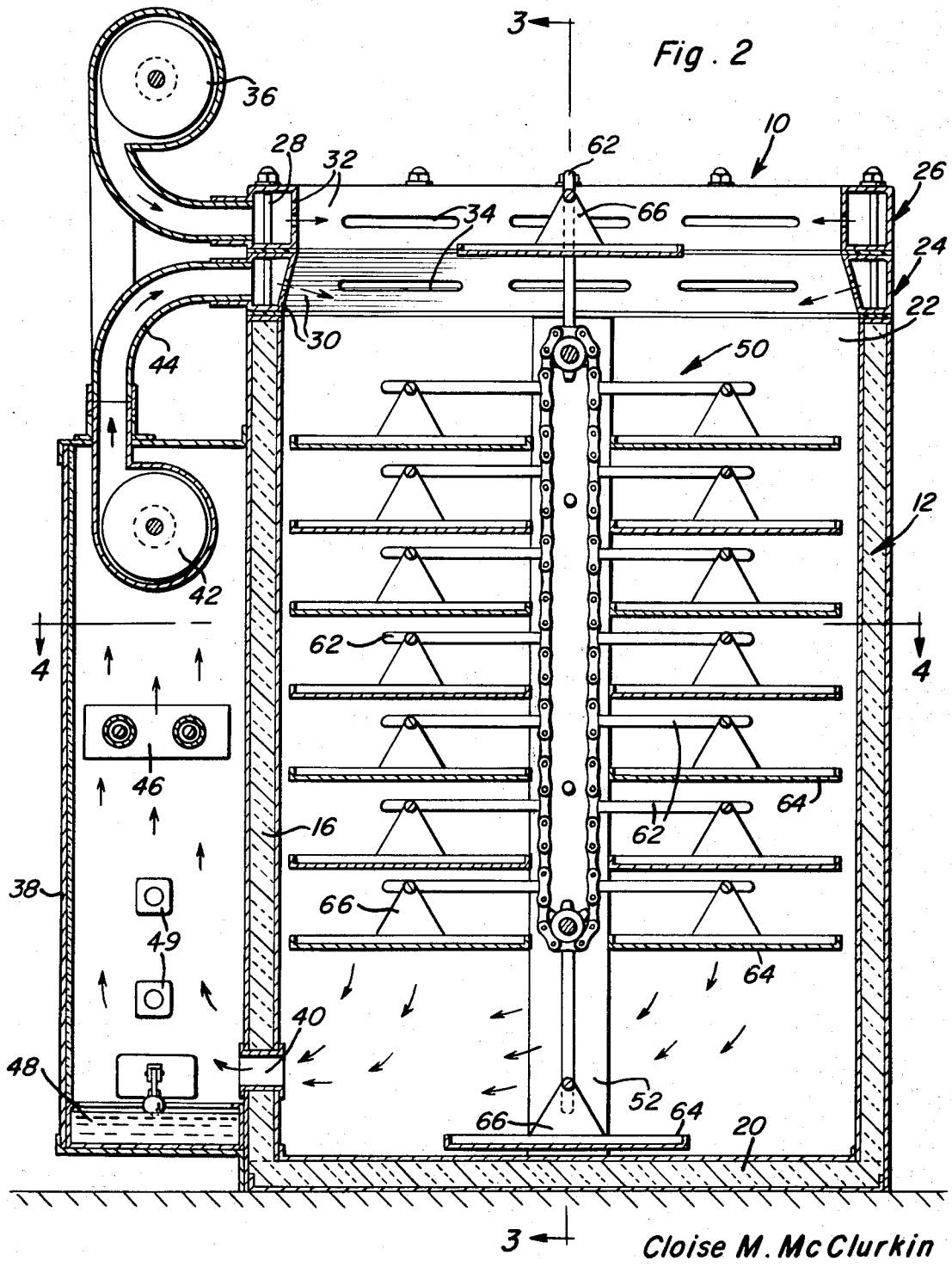


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Fig. 2

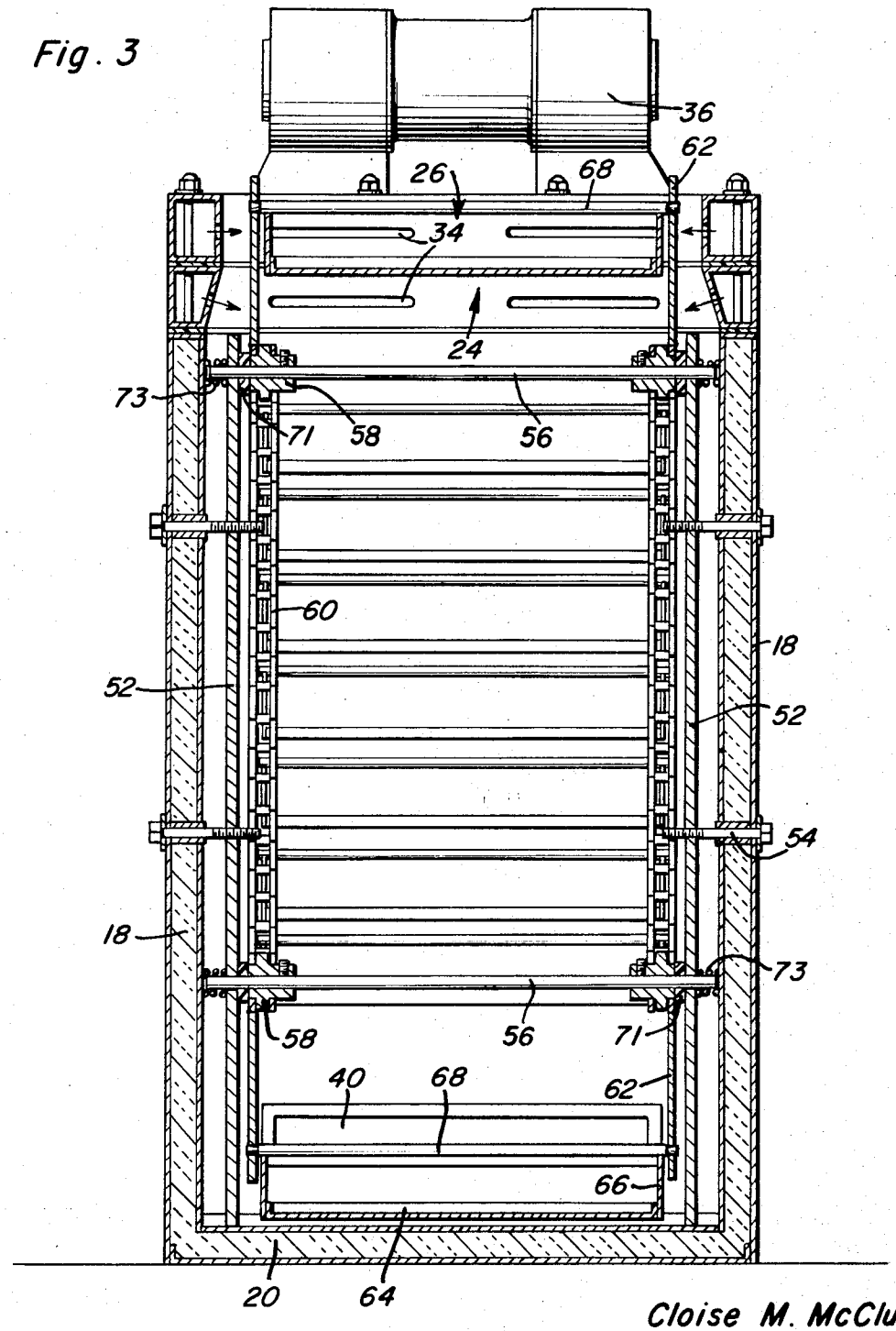


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Fig. 3



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Fig. 6

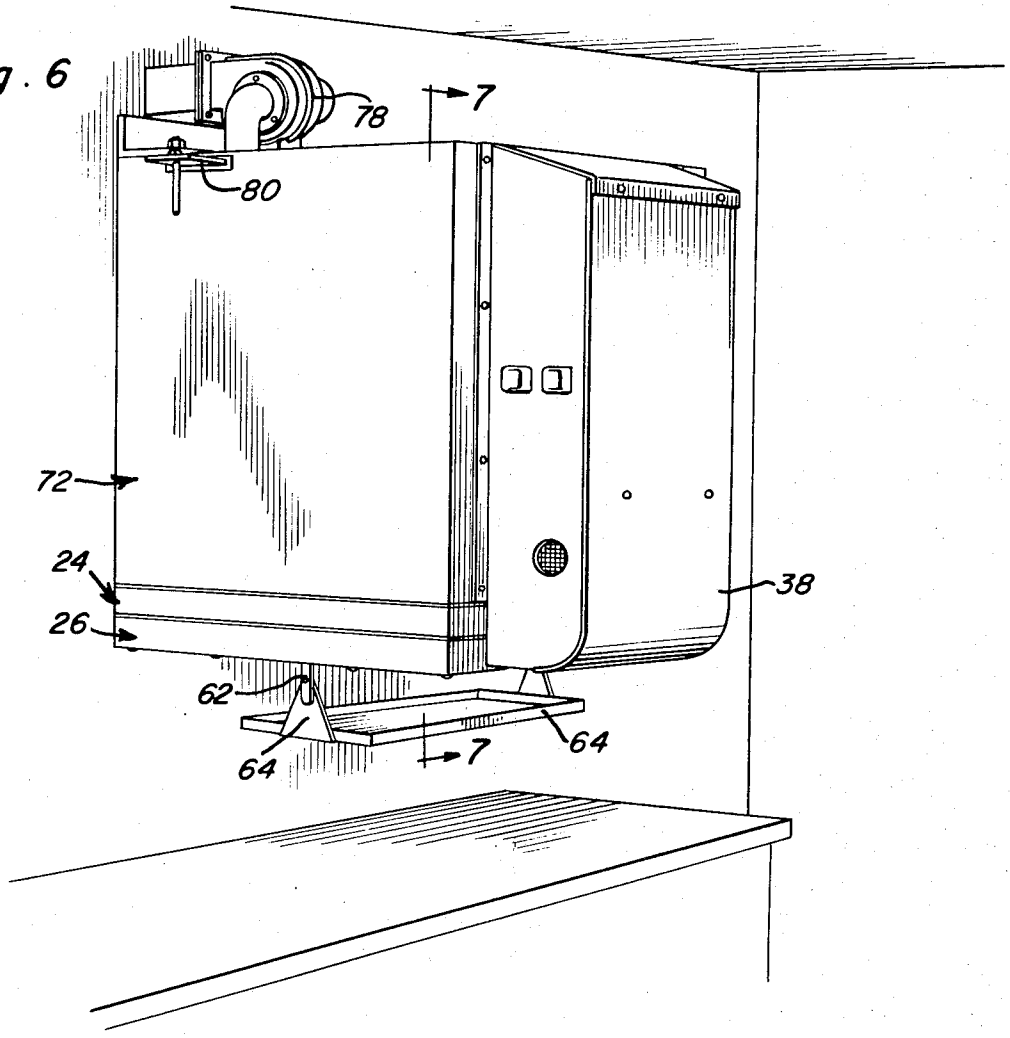
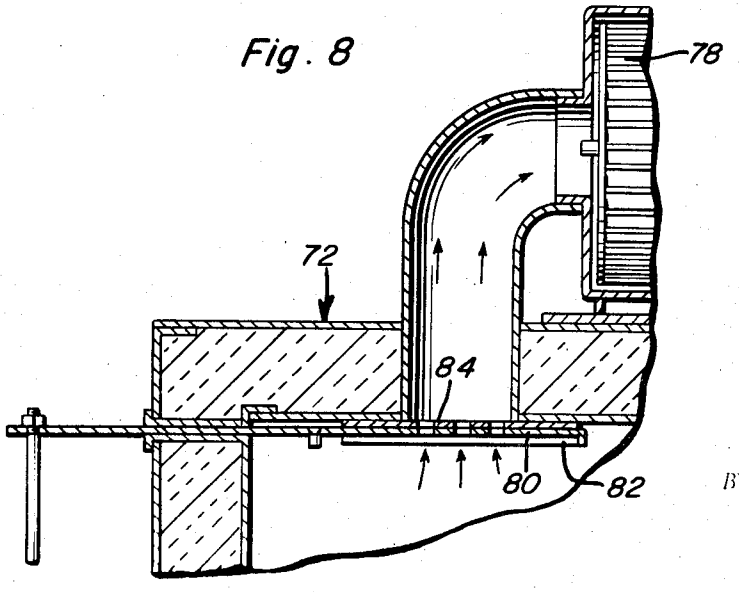


Fig. 8



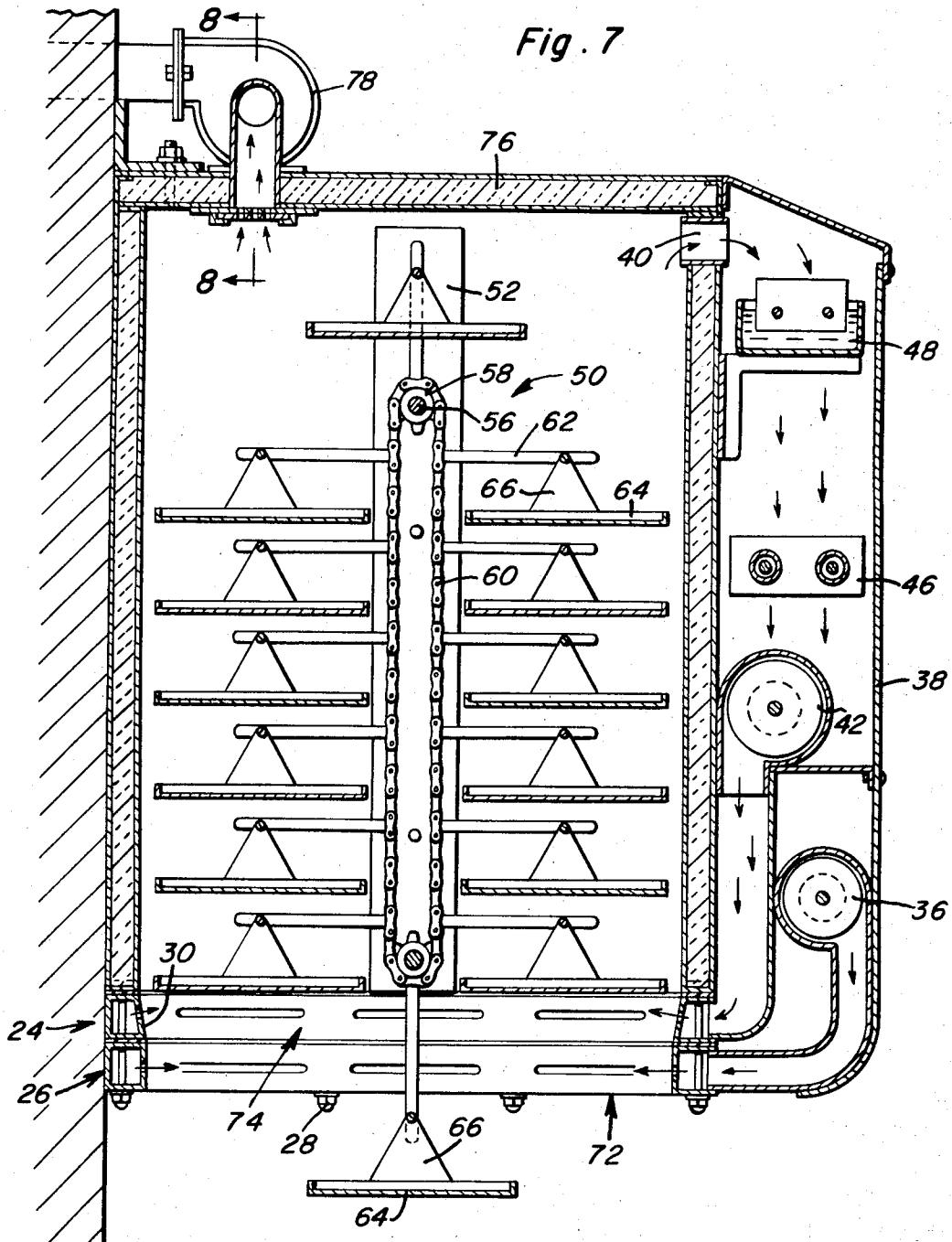
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Fig. 7



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AIR-FLOW OVEN

The instant invention generally relates to warming ovens whereby foods can be maintained in a ready to serve condition, such being particularly useful in ready-to-eat quick service restaurant operations.

More particularly, the invention herein is directed to an oven which can effectively maintain desired moisture and temperature levels so as to provide a satisfactory food product, and which at the same time enables free access to the interior of the oven for the introduction and removal of the food.

It is a primary object of the instant invention to provide an oven incorporating unique air circulating system whereby an effective controlled heating of the contents of the oven, is provided in conjunction with an open air curtain protected access port through which the food can be freely introduced and removed.

In addition to the above object, it is also a highly significant object of the instant invention to provide an open oven wherein necessary moisture and temperature levels can be properly maintained.

Other objects of the invention include the provision of a food handling rack whereby the food is so oriented as to be retrieved from the oven in the sequence in which it is introduced to insure a proper heating of each article of food stuff. This sequential handling of the food is effected by the utilization of traveling rack incorporating individual pans which can be removed from the rack as desired.

Basically, the objects of the instant invention are achieved through the provision of an oven cabinet incorporating either an open top port or an open bottom port. The port is surrounded by a pair of ducts, the inner one of which is communicated with a close system including the interior of the oven for circulation of heated air cross the port and back through the oven. The other duct is communicated with the ambient air which, through appropriate blower means, is driven across the port in outwardly spaced relation to the inner duct discharge whereby appropriate heat and moisture retained spaced curtains are provided. A vertically orientated traveling rack is provided within the oven and includes a plurality of arm supported pans which travel vertically down one side of the oven and up the other. Each pan is selectively removable from the rack in the vicinity of the port for removal of the entire pan should such be desired.

These together with other objects and advantages which become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIG. 1 is a perspective view of an oven incorporating the features of the instant invention;

FIG. 2 is an enlarged cross-sectional view taken substantially on a plane passing along line 2—2 in FIG. 1;

FIG. 3 is a cross-sectional view taken substantially on a plane passing along line 3—3 in FIG. 2;

FIG. 4 is a cross-sectional view taken substantially on a plane passing along line 4—4 in FIG. 2;

FIG. 5 is a detailed view of the manner in which the panel mounting support rod is releasably secured to one of the rack arms;

FIG. 6 is a perspective view of a modified form of oven,

FIG. 7 is an enlarged cross-sectional view taken substantially on a plane passing along line 7—7 in FIG. 6; and

FIG. 8 is a cross-sectional detail taken substantially on a plane passing along line 8-8 in FIG. 7.

Referring now more specifically to the drawings, reference numeral **10** is used to generally designate an oven constructed in accordance with the instant invention. The oven **10** includes an enlarged rectangular body **12** preferably formed of inner and outer panels with appropriate insulation sealed therebetween. The oven body **12** includes a front wall **14** a rear wall **16**, opposed side walls **18**, a closed bottom **20** and an open top **22** which defines an access port to the interior of the oven **10**.

Affixed peripherally about the access **22** of the oven **10** is a continuous inner duct **24** and continuous outer duct **26**, both of which are generally rectangular in cross section and bolted directly to the upper edges of the oven wall **14**, **16** and **18** by elongated bolts **28**.

The inner duct **24** is provided with an inner wall **30** orientated at an inward and downwardly inclined angle of approximately 15° from the vertical. The inner wall **32** of the outer duct **26** is perpendicularly orientated. Both of these duct walls **30** and **32** are provided with a series of elongated slots completely thereabout, each slot being approximately one-fourth inch high, 6 inches in length, and spaced approximately 1 inch from the adjoining slots. Such slots are designated by reference numeral **34** and, as will be readily apparent, extend along all four sides of the access port and port surrounding ducts.

The outer duct **26** is to receive pressurized ambient air and discharge this air horizontally across the open end of the oven inwardly from the four sides thereof. Accordingly an appropriate blower **36** is mounted in communication with the portion of the outer duct **26** corresponding with the rear of the oven **10**, this blower **36** including a housing enclosure which communicates directly with the interior of the duct **26** whereby air from outside the oven will be forcibly drawn into the blower **36** and discharged into the duct **26** for pressurized horizontal distribution across the open end of the oven **10** through the duct slots **34** thereby providing a moisture and temperature retaining air curtain.

The inner duct **24** is specifically utilized so as to continuously circulate heated air throughout the interior of the oven **10** and at the same time provide an second inner air curtain which cooperates the outer air curtain and effectively precluding the undesirable exhausting of moisture or heat from the oven.

The heated air to be circulated through the oven **10** originates in an enlarged chamber **38** mounted on the rear wall **16** of the oven body **12**. The closed chamber **38** is communicated with the lower portion of the oven **10** by one or more air passages **40** provided through the rear wall **16**, and is communicated with the inner duct **24** by an air pressurizing blower **42** mounted within the chamber **38** and incorporating an air flow directing duct portion **44** extending from the chamber **38** into communication with the lower duct **24**.

The chamber **38** incorporates an appropriate air heater **46**, a humidifier **48**, preferably a steam humidifi-

er, and appropriate temperature and humidity controls **49** whereby pre-selected levels can be maintained. For automatic operation, it will be appreciated that the humidifier will be connected to an appropriate source of water with the water level automatically maintained by a float control or the like.

With such a system, the heated and humidified air is continuously discharged inward and downward under pressure along all four sides of the open end of the oven **10** while at the same time being forcibly drawn downward through the lower portion of the oven and into the chamber **38** by way of the lower air passage or passages **40**. It will be appreciated that the flow path through the oven, due to the peripheral discharge about the open end of the oven, encompasses substantially the entire interior of the oven, thereby providing for a proper heating of oven received food. Utilizing this arrangement, it has been found that the temperature can be maintained at a substantially constant level throughout the full height of the oven while at the same time maintaining a relative humidity of approximately 40 to 60 per cent with no loss of heat or humidity when food stuffs are introduced or removed from the oven.

In order to accommodate the food or food stuff within the oven and provide for a selective travel thereof through the oven, a food supporting rack **50** is utilized. The rack **50** includes a pair of vertically elongated support bars **52** generally centrally of and inwardly spaced relative to the opposed side walls **18**. Each of the support bars is mounted by upper and lower bolts **54** rotatably received through the corresponding side wall **18** and threaded through the bar **52** whereby a variation in the inward spacing of the support bar **52** relative to the adjacent side wall **18** can be effected through a rotational adjusting of the bolts **54**. The bars **52** rotatably mount upper and lower rods **56**, each of which has a pair of chain sprockets **58** locked thereto toward the opposite ends thereof just inward of the support bars **52**. The sprockets **58** mounted a pair of endless vertically extending chains **60**. The two chains **60** in turn mount equally spaced transversely aligned pairs of support arms **62** therealong, each pair of support arms **62** supporting a food pan or tray **64**. The support of each pan **64** is effected by providing each pan **64** with a pair of upwardly extending side members **66** mounted at the opposed ends of the pan **64**. These sides members are in turn fixed to an overlying rod **68** which has the opposite ends thereof rotatably received within a pair of aligned openings **70** in the associated pair of arms **62**. With reference to FIG. **5** in particular, it will be noted that the opposed ends of each pan supporting rod **68** are of a generally dove-tailed or inwardly tapered configuration. This particular configuration is deemed significant in that while enabling an easy slipping of the rod ends from the arm holes **70** upon a physical grasping of the rod **68** and a movement thereof first in one direction to free one end and then in the second direction to free the second end, it acts so as to effectively rotatably retain the rod ends during the travel of the rack and until an intentional removal thereof is desired.

With reference to FIG. **2**, it will be noted that the pan supporting arms **62** project slightly beyond the point of engagement of the pan rods therewith so as to introduce a degree of lateral stability to the pans, particularly as they traverse the extreme upper and lower areas of travel wherein a swinging of the pan is required. However, as will also be readily appreciated, the length of the arms **62** in no way interfers with a movement of the pans **64** from one side of the rack to the other. It will also be noted that the pans are relatively wide whereby any tendency for a substantial degree of tipping of any pan will result in the pan engaging an adjacent pan, thereby avoiding an excess spilling of the food therefrom.

It is contemplated that the rack be manually manipulated, such as by extending one of the rods **56** and providing a handle thereon with the food introduced to the oven being placed on the uppermost tray toward the rear of the oven and the food being removed from the oven being removed from the uppermost forward tray. The rack will normally be made to travel down along the rear portions of the oven and up along the front portion of the oven, thereby moving each loaded pan completely through the interior of the oven so as to provide for a sufficient warming period therefor and at the same time making the ready to serve food easily accessible at the front of the oven. Should one desire to remove the entire pan, as previously indicated, this can be easily affected by grasping the pan support rod **68** and first shifting it laterally to disengage one rod end and then back to disengage the second rod end, the chain mounting arms flexing sufficiently so as to easily disengage the rod.

In order to maintain the rack in any manually adjusted position thereof, a braking system is provided which consists of the utilization of a brake shoe type element **71** about each end portion of each rod **56** between the vertical support bar **52** and the adjacent chain sprocket **58**. In addition, a compression spring **73** is coiled about each end of each of the sprocket rods **56** between the support bar **52** and the adjoining housing side wall **18**. The degree of brakeing action can be easily adjusted through a manipulation of the bar mounting bolts **54**. It will be of course appreciated that appropriate means can be provided for automatically driving the rack should such be desired.

Attention is now directed to the variation illustrated in FIGS. **6**, **7** and **8**, such comprising basically the same oven construction modified so as to incorporate the access port in the bottom rather than the top thereof. The primary purpose for such a variation of the basic oven construction is to facilitate a retention of the necessary humidity in connection with those foods which require a high relative humidity, such as bread. It has been found that, under conditions of extremely high humidity, the pressure build-up within the oven tends, as the steam or water vapor in the oven physically rises, to push through the air curtains. However, by in effect inverting the oven, the rising moisture laden air is trapped within the closed top of the oven and can be easily confined within the lower portion of the oven by the cooperating two air curtains, thus allowing an effective utilization of the basic oven regardless of the relative humidity required therein. Noting FIG. **6** is particular, it will be appreciated that another advantage of this variation of the oven is to provide additional floor or work space therebelow, the oven conveniently being positionable over a counter worktop.

The open bottom variation of the oven has been designated by reference numeral **72**. The oven **72** similar to the oven **10** incorporates an insulated housing, a housing body mounted chamber incorporating the heating and humidifying components in conjunction with an air circulating blower, a second ambient air circulating blower and a pan carrying traveling rack. For ease of comparison, those features and components of the oven **72** which directly relate to those of the oven **10** have been given the same reference numerals.

The basic difference in the oven **72** is the provision of the open access port **74** through the bottom thereof, the top **76** of the oven **72** being closed. The opening of the bottom of the oven **72** and the closing of the top **76** thereof of course requires a positioning of the air curtain forming inner and outer ducts **24** and **26** about the open lower end of the oven, the inner duct **24** having the inner face **30** thereof angled inwardly and upwardly at approximately 15° to the vertical so as to cause an upward directing of the pressurized air through the oven for discharge to the now upwardly located air passage **40**.

It will be appreciated that slight modifications may be necessary in the rack construction **50** which will enable a swinging of the pans beneath the closed in top **76** of the oven and in a manner so as to project below the open bottom of the oven for access thereto as the rack is rotated. Both the rotation of the rack and the removal of food therefrom otherwise function generally in the manner previously described.

One additional feature incorporated into the bottom opening oven **72** is the provision of a small exhaust fan **78** communicated with the interior of the oven **72** through the closed top **76** thereof at a point remote from the air passage **40** and circulating flow path within the oven. This exhaust fan or blower **78** exhausts through a perforated sliding panel **80** located across the intake end thereof within the oven, panel **80** being exteriorly controlled. The panel **80** guides with in appropriate track means **82** and selectively alignes the apertures therein with similarly shaped apertures in a fixed plate **84** immediately thereover. In this manner, the amount of air exhausted can be conveniently and simply regulated. The purpose of this small exhaust blower is to provide a further control over the relative humidity within the oven, the blower **78** helping to exhaust excess water vapor which may tend to collect at the upper portion of the oven, it being contemplated that with the use of such a blower **78**, a temperature of 150° and a 60 percent relative humidity can be maintained within the oven.

While not discussed in any substantial detail with regard to the oven **72**, it will be appreciated that the dual air curtains formed in conjunction therewith operate in the same manner as previously described in conjunction with the oven **10** and form an effective barrier to the escape of heat and moisture, notwithstanding the fact that the access port is completely open.

Incidentally, as a means for facilitating the cleaning of the ovens, one or more of the walls thereof can incorporate selectively removable doors or panels.

From the forgoing, it will be appreciated that a unique oven construction has been defined wherein provision is made for unlimited free access to the interior of the oven while at the same time effectively retaining and maintaining the moisture and temperature levels therein.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

What is claimed as new is as follows:

1. An air flow oven comprising a vertical oven body, a continuously open access port into said body, inner and outer air ducts surrounding said access port, discharge vents in said ducts, the vents in the inner duct being directed inwardly toward the interior of said oven body, means for introducing pressurized ambient air into said outer duct for discharge through the vents thereof, and means for receiving heated air from said oven body and introducing said heated air into the inner duct for discharge through the vents thereof back to said oven body.

2. The oven of claim **1** wherein said access port opens vertically through said oven body.

3. The oven of claim **2** wherein said outer duct vents discharge approximately horizontally across the access port.

4. The oven of claim **3** wherein the vents in each duct are located peripherally thereabout so as to discharge inwardly completely about said access port.

5. The oven of claim **4** including air heating and humidifying means in the flow path of the heated air circulated through the inner duct and oven body.

6. The oven of claim **2** wherein said access port opens through the top of said oven body.

7. The oven of claim **5** wherein said access port opens through the bottom of said body.

8. The oven of claim **2** wherein said access port opens through the top of said oven body, the air discharging through the vents of the inner and outer ducts defining a pair of spaced port covering air curtains precluding the exiting of moisture and heat from the oven body.

9. The oven of claim **2** wherein said access port opens through the bottom of said body, the air discharging through the vents of the inner and outer ducts defining a pair of spaced port covering air curtains precluding the exiting of moisture and heat from the oven body.

10. The oven of claim **5** including a vertically traveling food rack mounted within said oven, said rack comprising a series of separate food receiving pans and means mounting said pans for a selective moving of each pan vertically in a first direction through said oven body from the access port to the remote end of said body and then back again to said access port.

11. The oven of claim **10** wherein said means for moving said food receiving pans comprise a pair of spaced endless chains, upper and lower sprocket mounting rods, means mounting said rods for rotation, said chains being engaged over upper and lower pairs of rod mounted sprockets, and a plurality of pairs of arms afixed to and projecting outwardly from said chains at spaced points thereabout, each pair of arms

suspending a food pan therebetween for a carrying of the food pan along therewith upon a movement of said chains.

12. The oven of claim 11 wherein each pan is engaged with the corresponding pair of arms through a pan mounted rod, the opposite ends of which are releasably retained within apertures defined in the associated pair of arms.

13. The oven of claim 1 including a vertically traveling food rack mounted within said oven, said rack comprising a series of separate food receiving pans and means mounting said pans for a selective moving of each pan vertically in a first direction through said oven body from the access port to the remote end of said body and then back again to said access port.

14. The oven of claim 1 including controlled exhaust means through said oven body remote from said access port, and means associated with said exhaust means to effect a forced discharged therethrough from the interior of the body to the atmosphere to assist in maintaining desired internal humidity and temperature conditions.

15. The oven of claim 1 wherein the vents in the inner duct are located peripherally thereabout so as to discharge inwardly completely about said access port, said means for receiving heated air from said oven body and introducing the air into the inner duct including at least one air passage exiting through said body from the interior thereof at a point remote from said access port, a closed chamber provided exteriorly of said body and communicating said air passage with said inner duct, said closed chamber incorporated air heating and air humidifying means in the air flow path therethrough from the air passage to the inner duct.

16. An air flow oven comprising a vertical oven body, an access port into the interior of said body through one end thereof, an air duct surrounding said access port, discharge ducts in said duct located peripherally thereabout and being inwardly directed toward the interior of said oven body completely about said access port, at least one air passage existing through said body from the interior thereof at the opposite end of the body from the access port, a closed chamber exteriorly of said body communicating said air passage with said duct for a continuous flow of air from the oven body through the air passage and closed chamber back into the duct for subsequent discharge into the interior of the oven, and air heating and air humidifying means provided in the closed chamber in the flow path of the air for a continuing heating and humidifying of the moving air, and means for effecting a forced movement of the air through the oven and communicated closed chamber.

17. The oven of claim 16 including controlled exhaust means through said oven body remote from said access port, and means associated with said exhaust means to effect a forced discharge therethrough from the interior of the body to the atmosphere to assist in maintaining desired internal humidity and temperature conditions.

18. The oven of claim 16 wherein said access port opens vertically through one of the vertical ends of said oven body and a vertically traveling food rack mounted within said oven, said rack comprising a series of separate food receiving pans and means mounting said pans for a selective moving of each pan vertically in a first direction through said oven body from the access port to the opposite end of the body and then back again to said access port.

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